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A LATE MIDDLE CAMBRIAN FAUNA
FROM THE QUE RIVER BEDS, WESTERN TASMANIA

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(with one table and three plates)

ABSTRACT

A late Middle Cambrian (*Ptychagnostus punctuosus* or *P. nathorsti* Zone) fauna occurs in the Que River Beds, Western Tasmania. Hydroids, dendroids and a possible aglaspid have been described previously. The remaining fauna of ten species of agnostid trilobites, one species of acrotretid brachiopod, various sponge spicules and one bradoriid specimen is described herein. The fauna is unusual in that no polymerid trilobites are known and that there is a very high percentage of complete agnostid specimens. One new agnostid species *Ptychagnostus* (?) *murchisoni* is described. One probable new agnostid genus and one probable new species of *Diplagnostus* are left in open nomenclature, because of their poor preservation.

INTRODUCTION

The late Middle Cambrian fauna, described below, from the Que River Beds of Western Tasmania (lat. 41°34.7'S, long 145°41.0'E) is important both from a biostratigraphic and palaeoecologic view point. It is significant biostratigraphically because it is one of only two faunas found within the economically important Mt Read Volcanics. Gee *et al.* (1970) gave details of the location and stratigraphic relationships of the Mt Read Volcanics and the Que River Beds. The Que River fauna consists of hydroids and dendroids (Quilty 1971), a species of inarticulate brachiopod (*Linnarssonina* (?) sp.), sponge spicules and agnostid trilobites (table 1) in reasonable abundance. A single specimen of a possible aglaspid was described by Quilty (1972); one bradoriid specimen is described below. No polymerid trilobites are known from the Que River Beds. Jago (1973) discussed some palaeoecological aspects of the Que River fauna. As noted previously, a striking feature of this fauna is the very high proportion of complete agnostid specimens (table 1).

The agnostids listed in table 1 indicate a late Middle Cambrian age. In Sweden *Ptychagnostus stenorrhachis* occurs in both the *P. punctuosus* and *P. nathorsti* Zones (Westergård 1946). In Newfoundland, Hutchinson (1962) described *stenorrhachis* from the upper part of the *Paradoxides davidis* Zone, which is of similar age to the *P. punctuosus* Zone of Sweden. Although none of the other agnostids give precise ages, the overall assemblage indicates agreement with an age of either *P. punctuosus* Zone or the *P. nathorsti* Zone for the Que River Beds.

The Que River fauna, like all Tasmanian Cambrian faunas has undergone tectonic distortion. The terminology of distorted bilaterally symmetrical fossils (e.g., trilobites and brachiopods) was discussed by Henningsmoen (1960); the same terminology is used in this paper as in Jago (1976). All trilobites and brachiopods from the Que River Beds are preserved as internal and external moulds in weathered siltstone. Some of the sponge spicules retain their original siliceous material. Silicone rubber casts were made of external and internal moulds of the various fossil groups. These casts were then photographed after being whitened with magnesium oxide. The inarticulate brachiopod, bradoriid and agnostid classifications used below are those of Rowell (1965), Öpik (1968) and Öpik (1967), respectively. All catalogue numbers refer to the collection of the Geology Department, University of Tasmania.

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SYSTEMATIC DESCRIPTIONS

Phylum PORIFERA Grant 1872

Numerous sponge spicules occur in the Que River Beds. Three main types of spicules are present:

- (1) Very long monaxons up to 60 mm long (Pl. 3, fig. 5).
These have longitudinal striations.
- (2) Tetraxons in which the four rays have a tetrahedral relationship with one ray being considerably longer than the other three (Pl. 3, fig. 3). There is a suggestion of longitudinal striations on the longest ray.

TABLE 1

ANALYSIS OF AGNOSTID TRILOBITES FROM QUE RIVER BEDS AT QUE RIVER BRIDGE

(lat. $41^{\circ}34.7'S$, long. $145^{\circ}41.0'E$)

In this table each individual cephalon or pygidium is counted as one unit; a complete agnostid has two units.

	<u>Complete Specimens</u>	<u>Separate Cephalo</u>	<u>Separate Pygidia</u>	<u>Total No. Specimens</u>	<u>Total Cephalo & Pygidia</u>
<i>Hypagnostus</i> sp. aff.					
<i>H. parvifrons</i> (Linnarsson)	2	-	-	2	4
<i>Grandagnostus</i> (?) sp.	2	-	-	2	4
cf. <i>Valenagnostus</i> sp.	1	-	-	1	2
<i>Ptychagnostus</i> <i>stenorrhachis</i> (Grönwall)	4	5	8	17	21
<i>Ptychagnostus</i> sp.	2	-	-	2	4
<i>Ptychagnostus</i> (?) <i>murchisoni</i> sp. nov.	14	12	16	42	56
<i>Diplagnostus</i> sp.	3	2	5	10	13
cf. <i>Kormagnostus</i> sp.	2	1	-	3	5
Agnostid, gen. et sp. indet. no. 1	-	-	1	1	1
Agnostid, gen. et sp. indet. no. 2	-	-	1	1	1
Very poorly preserved unidentifiable specimens, 5 complete specimens, 5 individual cephalo or pygidia				10	<u>15</u>
Total number of cephalo and pygidia			126		<u>126</u>
Number of cephalo and pygidia in complete specimens			70		
Percentage of cephalo and pygidia in complete specimens			55.6%		

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- (3) Cruciform stauracts (Pl. 3, figs. 1, 2 and 4) are by far the most common type of spicule. Individual stauracts have a cross-like arrangement of rays, with the centre of the cross being markedly elevated above the plane of the gently curved rays (Pl. 3, fig. 4). However, there is no evidence of a polar ray as seen in *Protospongia?* sp. of Henningsmoen (1958, Pl. 7, figs. 4-6) and in *Pleodioria tomacis* Öpik (1961, P. 49, fig. 16). There are at least two orders of stauracts (Pl. 3, figs. 1 & 2) with the first order spicules overlying the second order spicules. Within the first order spicules there is some variation, with some spicules having long thin rays, while others have shorter, thicker rays (Pl. 3, figs. 1 & 2). The Que River stauracts belong in *Protospongia*, the best described species of which is *P. hicksi*, which has been well illustrated from the Middle Cambrian of Utah (Rigby 1966) and from possible Middle Cambrian rocks in Ireland (Rushton and Phillips 1973). However, until larger and better preserved specimens are found, no species designation should be given to the Que River form of *Protospongia*.

Phylum BRACHIOPODA Dumeril 1806
 Class INARTICULATA Huxley 1869
 Order ACROTRETIDA Kuhn 1949
 Suborder ACROTRETIDINA Kuhn 1949
 Superfamily ACROTRETACEA Schuchert 1893
 Family ACROTRETIDAE Schuchert 1893
 Subfamily LINNARSSONIINAE Rowell 1965
 Genus *LINNARSSONIA* Walcott 1885
Linnarssonia (?) sp.
 Plate 3, figs. 7-15

Remarks: All the poorly preserved inarticulate brachiopod specimens from the Que River Beds appear to belong to a single species, probably of *Linnarssonia*. In all specimens the valves are decorticated.

On the brachial valve interior, there is a prominent median ridge extending from the posterior to about the centre of the valve. The ridge widens towards the centre of the valve. The only muscle scars seen on any specimens are those on the counterparts UT95164 and UT95165 (Pl. 3, figs. 9, 10). Here, almost half-way along the median ridge, there is a pair of small, kidney-shaped anterior muscle scars. All known pedicle valves are very poorly preserved and no features of the interior of the valve can be seen.

Phylum ARTHROPODA Siebold and Stannius 1845
 Class TRILOBITA Walch 1771
 Order MIOMERA Jaekel 1909
 Suborder AGNOSTINA Salter 1864
 Superfamily AGNOSTACEA M'Coy 1849
 Family AGNOSTIDAE M'Coy 1849
 Subfamily QUADRAGNOSTINAE Howell 1935
 Genus *HYPAGNOSTUS* Jaekel 1909

Synonymy: See Jago 1976, p. 140.

Type Species: *Agnostus parvifrons* Linnarsson, 1869, p. 82, pl. 2, figs. 56, 57.

Diagnosis: See Robison 1964, p. 529.

Hypagnostus sp. aff. *H. parvifrons* (Linnarsson)
 Plate 1, figs. 1, 2

Westergård (1946, p. 45) and Robison (1964, p. 529) gave the synonymy of *H. parvifrons*.

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Material: Two small, almost complete specimens are available.

Description: Cephalon about as wide as is long. Moderately wide rim only slightly elevated above narrow, shallow marginal furrow. Single-lobed glabella has a gently arched, almost truncated front. Glabella outlined by shallow wide furrows; it has a length just over 0.4 that of cephalon. Very small basal lobes. Distinct node on glabella of UT95148 but not on UT92496 where there is a prominent high area in the posterior and central parts of the glabella. This difference is probably due to distortion. Broadly rounded glabellar rear.

Pygidium about as wide as is long. Wide border with a wide rim and narrow, shallow marginal furrow. Pygidial axis extends just over 0.7 the length of the pygidium. Axis stands well above the smooth pleural fields, which are separated behind the posterior end of axis by a depressed area. Width of axis at anterior is just under half that of pygidium. Axis is slightly constricted at join of first and second axial lobes; it is widest at about its midpoint. Sharply rounded almost pointed axial posterior. Anterior transverse axial furrow is best developed laterally and can be traced faintly across axis. Second transverse furrow seen only at lateral extremities. Length of posterior axial lobe is about two-thirds that of axis. Pygidial axis shows no distinct node on second axial lobe (possibly due to distortion). There may be a prominent node at the posterior tip of axis. The apparent node seen in both specimens (Pl. 1, figs. 1 and 2) may be due to distortion, but the fact that the node has a similar shape in both specimens probably indicates a genuine feature.

Discussion: The species from the Que River Beds is similar to *H. parvifrons* in that it has a short, rather truncated cephalon, and a strongly convex pygidial axis which does not extend as far to the posterior as do the pleural fields. It is also similar to *parvifrons* in that the transverse axial furrows are poorly developed. The profile of the pygidial axis is similar to that of *H. parvifrons mammillatus* (Brögger) illustrated by Westergård (1946, pl. 5, figs. 3b, 4b). There is no distinct node on the second pygidial axial lobe in the Que River specimens; this feature may have been obliterated by distortion. The basal lobes of the Que River species appear to be even smaller than the small basal lobes of *H. parvifrons* from Sweden and Utah as illustrated by Westergård (1946) and Robison (1964). The cephalon of *H. parvifrons* from both Sweden and Utah have a distinct connecting band between the basal lobes; the presence or absence of this feature cannot be determined in the Que River specimens. There may be a prominent terminal pygidial axial node on the Que River forms; such a feature is not seen on *H. parvifrons*.

Genus *GRANDAGNOSTUS* Howell 1935

Synonymy: See Jago 1976, p. 141.

Type Species: *Grandagnostus vermontensis* Howell, 1935, p. 221, pl. 22, figs. 8-11.

Diagnosis See Jago 1976, p. 141.

Grandagnostus (?) sp.
Plate 1, figs. 3, 4

Material: Two poorly preserved enrolled specimens of a large agnostid are available: UT 92654 shows the pygidium and UT 92653 exhibits the cephalon.

Description: The cephalon of UT 92653 is subquadrate (about 5.5mm long and 6.0mm wide) with apparently entirely effaced surface. Moderately wide border area with shallow marginal furrow and elevated rim. Pygidium probably has a subquadrate outline. Moderately wide marginal furrow; rim not preserved. Axis well outlined at anterior by deep dorsal furrows which fade posteriorly. At anterior margin, width of axis is about half that of pygidium. Axis narrows posteriorly until it is narrowest about 0.25 of distance to posterior margin. To posterior of narrowest part, axis widens slightly and fades out. Smooth pleural fields.

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Discussion: The size and high degree of effacement of this species suggests affiliation with *Grandagnostus*, but until better specimens are found no definite generic assignment can be made.

Genus *VALENAGNOSTUS* Jago 1976*Valenagnostus* Jago 1976, p. 142.Type species: *Aagnostus nudus* Beyrich var. *marginata* Brögger, 1878, p. 773, pl. 6, fig. 3.

Diagnosis: See Jago 1976, p. 142.

cf. *Valenagnostus* sp.
Plate 1, figs. 5, 6

Material: One specimen, UT 92499, is available. It is an external mould in which the cephalon and pygidium are present but with no sign of the thorax, which was probably pushed under the pygidium during distortion. The cephalon and pygidium are both 2.0mm long and 2.2mm wide and have maximum heights of 0.6mm and 0.3mm respectively.

Description: Moderately convex cephalon with semicircular outline and straight posterior margin. No evidence of border, except possibly in left posterolateral corner, but this feature could be due to distortion. Surface of cephalon almost entirely effaced; faint axial furrows outline the rounded posterior end of a narrow glabella. Faint traces of small, separate basal lobes.

Pygidium has "subtriangular" outline; it is much flatter than cephalon (Pl. 1, fig. 6). Wide posterior border with wide, shallow marginal furrow and wide flatly convex rim; border narrows markedly anteriorly. Narrow shallow shoulder furrows; narrow convex shoulders. Length of the unconstricted acrolobe about five-sixths that of pygidium. Acrolobe may be entirely effaced, but there is a suggestion of a wide axis at extreme anterior end of pygidium.

Discussion: This specimen is similar to *Valenagnostus* in that both the cephalon and pygidium are almost entirely effaced, and there is a wide posterior pygidial border which narrows considerably to the anterior. If a cephalic border exists on cf. *Valenagnostus* sp., then it must be very narrow. The anterior axial trace on the pygidium of cf. *Valenagnostus* sp. is wider than the anterior part of the axis on any known species of *Valenagnostus*. There is no sign of a terminal axial node on cf. *Valenagnostus* sp., a feature which is seen in *Valenagnostus*. The difference in convexity of the acrollobes of the cephalon and pygidium of cf. *Valenagnostus* sp. is markedly greater than in any known species of *Valenagnostus*.

Subfamily PTYCHAGNOSTINAE Kobayashi 1939

Genus *PTYCHAGNOSTUS* Jaekel 1909

Synonymy: See Robison 1964, p. 522 and Jago 1976, p. 150.

Diagnosis: See Robison 1964, p. 522.

Type Species: *Aagnostus punctuosus* Angelin 1851, p. 8, pl. 6, fig. 11.*Ptychagnostus (Ptychagnostus) stenorrhachis* (Grönwall)

Plate 1, figs. 7-12

Synonymy: See Hutchinson 1962, p. 80.

Diagnosis: Cephalon with slightly scrobiculate cheeks and complete preglabellar median furrow. On the cheeks, there is a pair of short, faint furrows opposite the front of the anterior glabellar lobe, which curve obliquely forward parallel to the dorsal furrow, and join the preglabellar furrow. Transverse glabellar furrow bent slightly forward near centre. Small basal lobes.

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Pygidium characterised by narrow axis constricted at second axial lobe. Prominent backwards directed spine on second axial lobe. There is a faint post-axial median furrow. Smooth pleural areas. Border spines absent.

Discussion: In discussing *P. stenorrhachis* from Newfoundland, Hutchinson (1962, P. 81) noted, "a pair of short, indistinct furrows opposite the front of the anterior glabellar lobe, which curve obliquely forward parallel to the dorsal furrow, and join the preglabellar furrow." Similar furrows occur in the cephalon figured by Westergård (1946, pl. 10, fig. 3), in the Que River specimens (Pl. 1, figs. 7, 8, 10), and appear to be a specific character (Hutchinson 1962). An inspection of photographs and rubber casts of many other species of *Ptychagnostus* failed to produce similar furrows, thus supporting Hutchinson's view. Some Que River specimens (e.g. UT 92504, Pl. 1, fig. 8 and UT 92506, Pl. 1, fig. 7) show a little more cephalic scrobiculation than on the specimen figured by Westergård.

The post-axial median furrow is only faintly outlined in the pygidium figured by Westergård (1946, Pl. 10, fig. 4). However, in a rubber cast of this specimen, which is available to the writer, this furrow, although faint, is quite distinct and is strongest at the anterior. The least distorted of the Que River specimens (Pl. 1, fig. 11) shows a similar furrow. The fulcra of *stenorrhachis* in both the Swedish and Newfoundland forms are in a similar position to those in the Que River specimens. A characteristic feature of *stenorrhachis* is the marked backward arching of the central part of the second axial lobe; this feature is present in the Que River specimens. A further feature indicating that the Que River specimens belong in *stenorrhachis* is the long, thin nature of the pygidial axis. A similar feature is seen in *P. hybridus* (Brögger), but the cephalon of this species is not scrobiculate.

Cobbold and Pocock (1934, pl. 44, fig. 22) figure a pygidium from Rushton, England as *Agnostus stenorrhachis* Grönwall. However, their figure is inadequate for comparative purposes, and the specific designation must remain open at present.

Ptychagnostus sp.

There are two unfigured, very poorly preserved, specimens of *Ptychagnostus* which do not appear to belong in *P. stenorrhachis*.

Ptychagnostus (?) *murchisoni* sp. nov.

Plate 1, figs. 13-15; plate 2, figs. 1-6

Diagnosis: Large agnostid in which both the cephalon and pygidium are moderately convex and slightly wider than long. Almost entirely effaced cephalon with faint node just to posterior of its midpoint. Narrow cephalic border is a little narrower than pygidial border. Basic articulating device; fulcral points close to axis. Trilobed pygidial axis is outlined by shallow axial furrows which fade posteriorly. Axis constricted at second lobe which bears a low node. No post-axial median furrow; border spines absent.

Material: Fourteen complete or almost complete specimens, plus several individual cephalae and pygidia are available. UT 92508 (Pl. 2, fig. 2) is selected as holotype.

Description: Moderately convex, almost entirely effaced cephalon is slightly wider than long. Low, small node occurs a little to posterior of cephalic centre. Narrow border, with narrow shallow marginal furrow and narrow convex rim. Short posterolateral spines. Vestigial traces of basal lobes in some specimens (e.g. UT 92508, Pl. 2 fig. 2.). There appear to be traces of axial furrows in UT 92510 (Pl. 1, fig. 15) although these could be due to distortion.

Moderately convex pygidium slightly wider than long. Narrow border with narrow, slightly convex rim and narrow marginal furrow. Narrow, moderately shallow shoulder furrows; narrow shoulders; fulcral points close to axis. Basic articulating device has a narrow, moderately deep, articulating furrow; low, convex articulating half-ring. Axial furrows faintly but clearly developed and are accentuated by distortion;

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they shallow posteriorly. Trilobed axis extends about 0.75 length of pygidium. Posterior lobe is longer than the two anterior lobes combined. Axis is constricted at second lobe. At its widest, axis is just under half the width of pygidium. Second lobe bears a distinct, elongated node. Border spines absent.

Discussion: *Ptychagnostus* (?) *murchisoni* sp. nov. is of a similar type to both *P. cicerooides* (Matthew) and *P. convexus* Westergård. In both these large species, the cephalon and pygidium are highly convex; the cephalon is partly effaced; the transverse pygidial axial furrows are somewhat effaced, and there are no border spines or post-axial median furrow on the pygidium.

Some cephalata of *P. convexus* show faint scrobiculation (Westergård, 1946, p. 73). It is difficult to determine from the photographs of *P. cicerooides*, given by Hutchinson (1962, pl. 10, figs. 1, 2, 8), whether this species has a faintly scrobiculate cephalon. However, *P. cicerooides* from Greenland, as figured by Poulsen (1969, p. 5, fig. 5), shows no sign of scrobiculation. The cephalon of *P. (?) murchisoni* is not scrobiculate. *P. convexus* and *P. cicerooides* are probably more convex than *P. (?) murchisoni* even allowing for the distortion of the latter. *P. (?) murchisoni* is much more effaced than *P. convexus*. *P. (?) murchisoni* is closer to *P. cicerooides* than *P. convexus*. It is a little more effaced than *cicerooides*, and the posterior end of the pygidial axis in *murchisoni* is usually almost obliterated whereas in *cicerooides* it is distinctly visible except in the specimen figured by Hutchinson (1962) as pl. 10, fig. 7.

The species from Que River is referred to *Ptychagnostus* with a query due to the effaced nature of the cephalon. The pygidium is similar to those of *Ptychagnostus* (*Ptychagnostus*). If *murchisoni* and *cicerooides* are to be included in *Ptychagnostus*, then the diagnoses of the genus given by Robison (1964, p. 522) and Palmer (1968, p.28) will have to be revised and the generic character based largely on the pygidium. The writer agrees with Hutchinson (1962, p. 85) and regards such species as *cicerooides* and *murchisoni* as being in an evolutionary line in the process of effacement. The writer also agrees with both Hutchinson (1962, p. 88) and Poulsen (1969, p. 6) that the erection of a new genus is unnecessary at this stage.

Family DIPLAGNOSTIDAE Whitehouse 1936

Subfamily DIPLAGNOSTINAE Whitehouse 1936

Genus *DIPLAGNOSTUS* Jaekel 1909

Synonymy: See Jago 1976, p. 158.

Type species: *Agnostus planicauda* Tullberg 1880 (non Angelin 1851)

Diagnosis: See Öpik 1961, p. 69.

Diplagnostus sp.

Plate 2, figs. 7-12

Material: Three more or less complete specimens and several isolated cephalata and pygidia are available. All are poorly preserved.

Description: Cephalon a little wider than is long. Wide, moderately deep marginal furrow at posterior, which becomes shallow and very wide at anterior. Narrow, elevated rim. Short, triangular, upturned posterolateral spines. Convex cheeks may be pitted to some extent although the distortion makes such a determination doubtful. Glabella is about two-thirds as long as cephalon and about one-third the width. Narrow, moderately deep axial furrows; shallow, straight transverse glabellar furrow. Moderate sized basal lobes. Preglabellar median furrow appears to be absent in UT 95154 (Pl. 2, fig. 7), but in UT 92617 (Pl. 2, fig. 11) and UT 89198a (Pl. 2, fig. 8) a short furrow appears to be there. Anterior glabellar lobe contains a median sulcus which extends about one-third the length of the lobe. Glabella widens slightly anteriorly; it is widest just posterior of transverse glabellar furrow. Length of anterior glabellar lobe about .25 that of glabella. Details of posterior glabellar lobe obscured by

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distortion. Glabellar rear angular.

Pygidium probably slightly wider than is long. Wide marginal furrow becomes very wide near posterolateral corners; convex narrow rim. Zonate posterior border with collar reaching rim at either end. Collar arched gently to posterior except at either extremity where it is arched very slightly to anterior. It meets the rim just to anterior of short border spines. Narrow, moderately deep shoulder furrows; narrow shoulders; fulcra close to axis. Smooth pleural areas. Axis outlined by moderately deep furrows; axis does not reach collar; bluntly pointed axial rear; well-defined post-axial median furrow. Axis consists of three lobes. Axis slightly constricted at second lobe. Anterior pair of lobes make up a little less than half the length of axis. This pair of lobes is outlined by poorly developed transverse furrows which are directed inwards and slightly forwards from the axial furrows. Well defined axial keel extends from anterior of axis along the first two lobes and just onto the third. About one-third of the distance along the posterior axial lobe from the anterior there is a suggestion of a pit on either side of the centre of the axis.

Discussion: This species differs from all other described species of *Diplagnostus* by the presence of very wide marginal furrows. However, the poor quality of the available material precludes the erection of a new species.

Subfamily AMMAGNOSTINAE Öpik 1967

Genus *KORMAGNOSTUS* Resser 1938

Synonymy: See Palmer 1954, p. 59. In addition see Hupé, 1953, p. 65 and Howell 1959, p. 185.

Diagnosis: See Palmer 1954, p. 59.

Type species: *Kormagnostus simplex* Resser, 1938, p. 49, pl. 9, figs. 11-13.

cf. *KORMAGNOSTUS* sp.

Plate 2, figs. 13, 14.

Material: Two badly distorted complete internal moulds, UT 92629 and UT 92630, are available, plus a poorly preserved external mould of a cephalon (UT 89198).

Description: Cephalon about as wide as is long. Narrow, weakly convex rim; moderately wide marginal furrow. Unconstricted acrolobe. Single lobed glabella outlined by moderately deep and wide axial furrows. Glabella has an elongated oval shape with a bluntly rounded anterior. Small basal lobes. Smooth cheeks.

Pygidium about as wide as is long. Wide marginal furrow and moderately wide rim; both features narrow anteriorly. Moderately deep shoulder furrows; well rounded shoulders; adaxially placed fulcra. Acrolobes appear slightly constricted. Very wide axis outlined by narrow axial furrows. Axis is slightly constricted towards anterior; from this constriction it expands posteriorly; the axial furrows meet the marginal furrows about two-thirds of the distance from the pygidial anterior to well-rounded pygidial posterior. May be a small node on central anterior part of axis. Small smooth pleural areas.

Discussion: The species described above probably represents a new genus. However, the specimens are so poorly preserved that the erection of a new genus must be deferred until better material is available.

This species is related to *Kormagnostus* by virtue of its very wide pygidial axis, the probable constriction of the pygidial acrolobe combined with the non-constriction of the cephalic acrolobe, and the wide pygidial border. However, where the transverse glabellar furrow of *Kormagnostus* is straight, the glabellar front of cf. *Kormagnostus* sp. is well rounded. Whether in fact the transverse glabellar furrow of cf. *Kormagnostus* sp. is effaced or represented by the apparent glabellar front cannot be determined from the available material. *Kormagnostus* also differs from cf. *Kormagnostus* sp. in that the latter has a much wider pygidial axis. As with *Kormagnostus*, cf. *Kormagnostus* sp. belongs in the Ammagnostinae, and since it belongs in either the *Ptychagnostus*

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punctuosus or the *P. nathorsti* Zone, it is the oldest known member of the subfamily.

Family and Subfamily Unknown

Agnostid, gen. et sp. indet.no. 1

Plate 2, fig. 15

Material: One poorly preserved pygidium, UT 95156

Remarks: This specimen may belong in *Hypagnostus* or *Peronopsis*, although the border area seems too wide for either genus.

Agnostid, gen. et sp. indet.no. 2

Plate 2, fig. 16

Material: One small pygidium, UT 95157

Description: Small pygidium. Wide border narrows anteriorly. Narrow shallow marginal furrow and wide convex rim. Moderately wide axis is faintly outlined by shallow dorsal furrows which disappear posteriorly. Lateral furrows only faintly outlined; axis is markedly constricted at second axial lobe. Third axial lobe appears to be greatly expanded. Axial posterior not visible. Smooth pleural areas.

Discussion: This pygidium, with an expanded third axial lobe (?pseudolobe) does not fit into any known late Middle Cambrian agnostid genus. Until more specimens are found its relationships must remain unknown.

Class CRUSTACEA Pennant 1777

Order BRADORIIDA Raymond 1935

Gen. et sp. indet.

Plate 3, fig. 6

Remarks: One very poorly preserved valve is available as an internal mould. It may be a left valve but this cannot be determined with certainty. The surface of the test is finely pustulose. The rim is moderately wide; the hinge appears to be straight. The very poor preservation precludes an accurate generic or species determination.

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PLATE 1

All figures, except Figs. 10 & 15 are rubber casts of external moulds, which have been whitened with magnesium oxide prior to photography. Figs. 10 & 15 are internal moulds.

- Figs. 1-2 *Hypagnostus* sp. aff. *H. parvifrons* (Linnarsson).
1 UT92496, complete specimens, W form, X13.7. 2 UT95148, complete specimen, L form, X10.
- Figs. 3-4 *Grandagnostus*(?) sp. 3, UT92653, enrolled specimen with cephalon visible, intermediate distortion, X6, 4, UT92654, enrolled specimen with pygidium visible, W form, X5.5.
- Figs. 5-6 cf. *Valenagnostus* sp. Both figures are of UT 92499.5, top view, W form, X10.5. 6, side view showing cephalon has much greater convexity than pygidium, X10.5.
- Figs. 7-12 *Ptychagnostus* (*Ptychagnostus*) *stenorrhachis* (Grönwall).
7, UT92506, partially broken up, almost complete specimen, W form, X6.8. 8, UT92504, cephalon, W form, X5.5.
9, UT95149, pygidium, W form, X8.5. 10, UT92503, cephalon, L form, X8.3. 11, UT92505, pygidium, L Form, X6. 12, UT95150, pygidium, W form, X4.5.
- Figs. 13-15 *Ptychagnostus*(?) *murchisoni* sp. nov. 13, UT95151, pygidium, W form, X7. 14, UT89205, pygidium and two thoracic segments, W form, X6. 15, UT92510, cephalon, L form, X8.3.

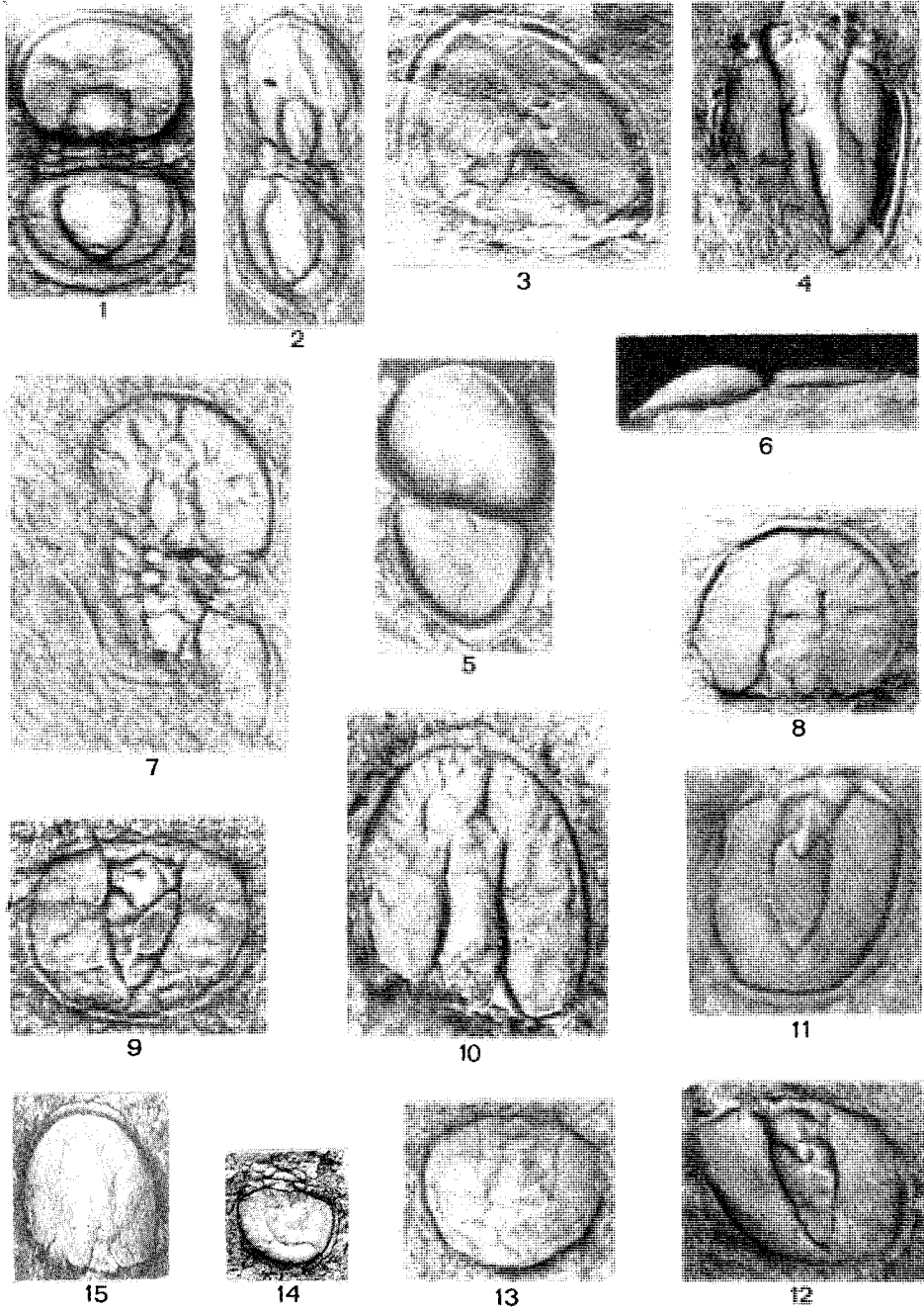
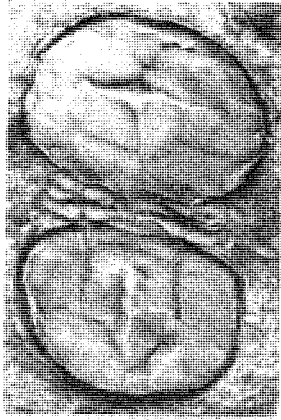


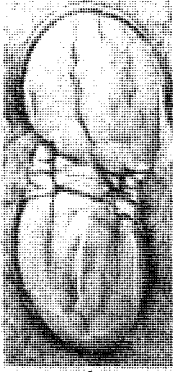
PLATE 2

Unless otherwise stated all figures are rubber casts of external moulds, which have been whitened with magnesium oxide prior to photography.

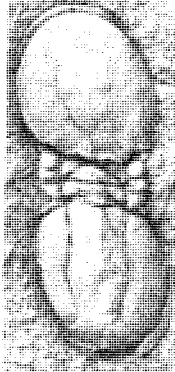
- Figs. 1-6 *Ptychagnostus(?) murchisoni* sp. nov. 1, UT92509, complete specimen, W form, X6.5. 2, UT92508, holotype, complete specimen, L. form, X10. 3, UT92507, complete specimen, L. form, X4.2. 4, UT95152, cephalon, W form, X6.5. 5, UT89211, internal mould of pygidium, W form, X8, 6, UT95153, pygidium, intermediate distortion, X4.5.
- Figs. 7-12 *Diplagnostus* sp. 7, UT95154, cephalon, intermediate distortion, X9.5. 8, UT89198a, complete specimen, L. form, X6. 9, UT95155, internal mould and pygidium, intermediate distortion, X9.3. 10, UT89207, pygidium, intermediate distortion, X6.2. 11, UT92617, almost complete specimen, L. form, X4.5. 12, UT92616, internal mould of pygidium, intermediate distortion, X11.5.
- Figs. 13-14 cf. *Kormagnostus* sp. 13, UT92630, complete internal mould, L form, X12. 14, UT92629, complete internal mould, W form X13.3.
- Fig. 15 Agnostid, gen. et sp. indet.No. 1, UT95156, pygidium, L form, X5.
- Fig. 16 Agnostid, gen. et sp. indet.No. 2, UT95157, pygidium, W form, X8.5.



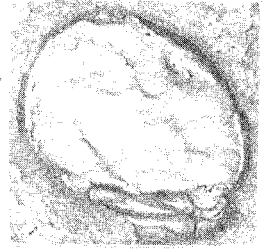
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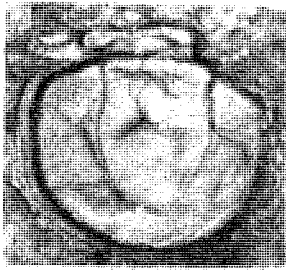
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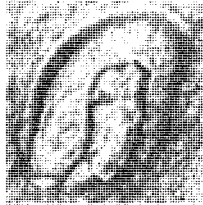
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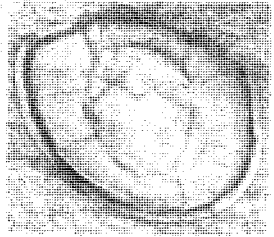
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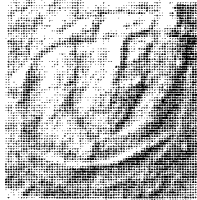
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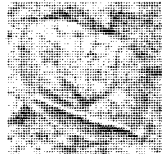
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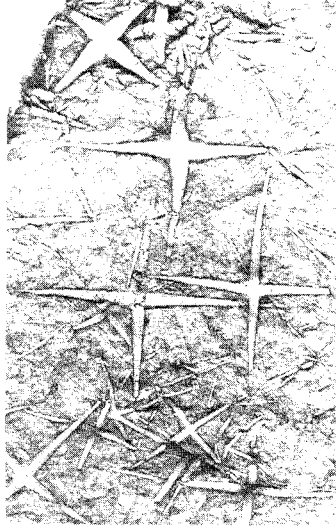
PLATE 3

All figures are whitened with magnesium oxide.

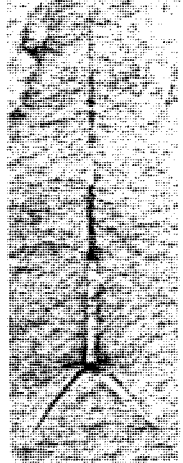
- Figs. 1, 2, 4. *Protospongia* sp. 1, UT 95158, accumulation of spicules, X3. 2, UT95158, close up of spicules in bottom left hand corner of Fig. 1, X6.5. 4, UT95158, side view of a cruciform stauract spicule which shows the umbrella-like appearance, X10.
- Figs. 3, 5. Sponge spicules. 3, UT95159, tetraxon, X4. 5, UT95160, very long monaxon, X2.
- Fig. 6. Bradoriid, UT95161, internal mould of (?) left valve, X7.
- Figs. 7-15 *Linnarssonina*(?) sp. 7, UT95162, internal mould of brachial valve, W form, X7.5. 8 UT95163, external mould of brachial valve, L form, X10. 9, UT95164, internal mould of brachial valve, W form, X9. 10, UT95165, internal mould of brachial valve (counterpart of Fig. 9), W form, X9. 11, UT95166, external mould of pedicle valve, W form, X8. 12, UT95167, external mould of pedicle valve, W form, X11. 13, UT95168, internal mould of pedicle valve, W form, X10. 14, UT95169, internal mould of pedicle valve (counterpart of UT95163, Fig. 9,)L form, X7.5. 15, UT95170, external mould of brachial valve, L form, X11.5.



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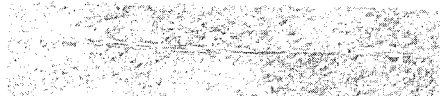
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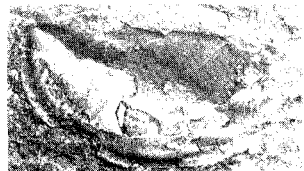
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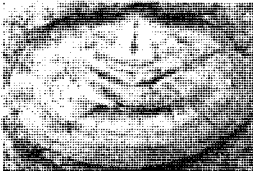
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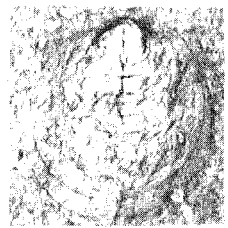
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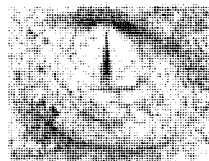
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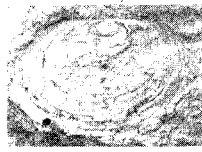
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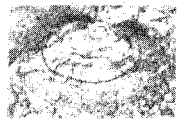
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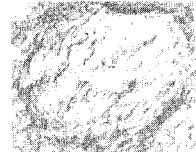
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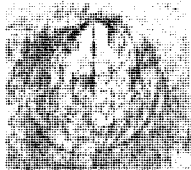
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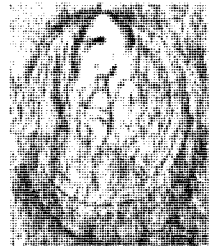
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