

# SILURO-DEVONIAN BRACHIOPODS FROM MARBLE CREEK, THOMSON RIVER, VICTORIA

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## Abstract

Seven new species of brachiopods are described from two small crinoidal limestone deposits on the Thomson River, Victoria. The age is considered to be probably late Upper Silurian. A brief discussion of the paleoecology is included.

## Relationships of the Brachiopod Fauna

Thomas (1942) has discussed the sequence in the Walhalla synclinorium and regards the Walhalla Group as Devonian, the underlying *Panenka* beds being regarded as probably equivalent to Upper Ludlow in age. The characteristic basal conglomerates and lenticular limestones of the Walhalla Group outcrop in an approximately meridional belt running through Cooper's Creek, and are repeated by folding at Deep Creek some miles further east. The Marble Creek limestone lenses occur about five miles south of the Deep Creek limestone along the general strike and are consequently considered to be of approximately equivalent age. The two crinoidal limestone deposits have been described by Kitson (1925), but no brachiopods have been previously recorded from either deposit. The brachiopod faunas described are as follows:

### Upper Quarry

<i>Dicaelosia biloba</i> (Linnaeus)	<i>Atrypa</i> sp.
<i>Leptaena thomsonensis</i> n.sp.	<i>Howellella lirata</i> n.sp.
<i>Pugnax brevicostatus</i> n.sp.	<i>Howellella latisulcata</i> n.sp.
<i>Uncinulus globosus</i> n.sp.	<i>Howellella</i> cf. <i>gibbosa</i> (Barrande)
<i>Rhynchotrete</i> sp.	<i>Ambocoelia minuta</i> n.sp.
<i>Atrypa thomsonensis</i> n.sp.	

### Lower Quarry

<i>Orthostrophia</i> sp.	<i>Atrypa thomsonensis</i> n.sp.
<i>Leptaena thomsonensis</i> n.sp.	<i>Atrypa</i> sp.
<i>Gypidula pelagica</i> (Barrande)	<i>Howellella</i> sp.

Practically no extended correlative value can be attached to the occurrences of species of *Atrypa* and *Leptaena*. Except for Barrande's *Orthis dimera* there appears to be no attested case of a post-Gedinnian occurrence of species of *Dicaelosia*. *Uncinulus globosus* is closest to the Gedinnian *U. nucleolatus* (Hall) from the New Scotland of North America. *Rhynchotrete* is generally regarded as exclusively Silurian and *Pugnax* as post-Silurian. The pentamerid has been referred to *Gypidula pelagica* (Barrande) from the e2 (Ludlow) of Bohemia. *Ambocoelia minuta* is more closely comparable with *A. praecox* Kozłowski from the Middle Borszczow (uppermost Ludlow) of Poland than with later species of *Ambocoelia*. *Howellella* cf. *gibbosa* (Barrande) occurs in the e2 of Bohemia, but the determination is pro-



visional and future material will probably result in the erection of a new species. *Howellella lirata* is comparable to Upper Silurian and Gedinnian species of *Howellella* from other parts of the world.

No close comparison can be drawn between these two small faunas and any previously described Australian Siluro-Devonian brachiopod fauna. However, the overall aspect is Upper Silurian or Lower Devonian with a definite bias towards Silurian (Ludlow) rather than Lower Devonian (Gedinnian). It appears unlikely that a post- Gedinnian age can be assigned to the faunas.

### Paleoecology

Although crinoid plates and stems occur to the virtual exclusion of all other forms, associates that do occur cover a wide variety of invertebrate classes. The following table shows the approximate number of genera and frequency of occurrence of each group in the two limestone lenses:

	Total Genera	Lower Quarry		Upper Quarry	
		Genera	Frequency	Genera	Frequency
Coelenterata					
Stromatoporoidea .. ..	2+	2+	r	2+	c
Tetracoralla .. ..	4+	3+	o	2	r
Tabulata .. ..	4	3	o	2	o
Pelmatozoa					
Cystoid cups .. ..	1	1	r	—	—
Crinoid cups .. ..	6+	5+	r	1+	r
Bryozoa .. ..	1	1	o	1	o
Brachiopoda					
Pentameracea .. ..	1	1	r	—	—
Strophomenacea .. ..	2	1	r	2	o
Dalmanellacea .. ..	2	1	r	1	r
Rhynchonellacea .. ..	4	1	r	3	r
Atrypacea .. ..	1	1	r	1	r
Spiriferacea .. ..	2	1	r	2	c
Gastropoda .. ..	7	6	o	4	o
Pelecypoda .. ..	5	—	—	5	o
Cephalopoda .. ..	2	1	r	1	r
Trilobita .. ..	4	2	r	2	r
Ostracoda .. ..	2	—	—	2	o

r = rare; o = occasional; c = fairly common.

The most common non-pelmatozoan forms are the platyceratid gastropods. This crinoid-platyceratid association is probably a significant indication of a suprophagous association such as examples described by Keyes (1889) of platyceratids living around and attached to the anal region of crinoids.

In spite of a first appearance of jumbling, a close examination shows that there is very little evidence of post-mortem transportation of the fossil components of the two deposits. Pelecypods and brachiopods are more commonly articulated than disarticulated. The preservation of thin-shelled brachiopods and molluscs, delicate bryozoans, crinoid cups, and pelmatozoan columns up to 8 inches or more in length indicates a lack of strong wave or current action causing disarticulation or smashing of delicate structures. However, some water movement is inferred because crinoids depend on circulating water for their food supply.



The proportion of crinoid debris is so high that the sea floor at both localities is interpreted as having been composed almost exclusively of crinoid columns, with only occasional crinoid cups and non-pelmatozoan shells. Non-organic sediment is less than 1 per cent. Surrounding mudstones are virtually unfossiliferous, so the two limestone lenses can be pictured as resulting from the accumulation of debris from two crinoid meadows surrounded by a comparatively uninhabited muddy bottom.

The presence of corals, crinoids, and rare cystoids indicates a minimum of turbidity, and the large number of classes represented suggests an approximately normal salinity. No definite information is available on depth or temperature because of the lack of close relationship of the brachiopods, crinoids and corals with living forms.

### Systematic Descriptions

#### Superfamily ORTHACEA

#### Family PLECTORTHIDAE Schuchert and Cooper, 1931

#### Genus *Orthostrophia* Hall, 1883

#### *Orthostrophia* sp.

(Pl. IX, fig. 9)

A single convex, wider than long, orthoid brachial valve (M.U.G.D. 2080) from the lower Toongabbie quarry is tentatively referred to *Orthostrophia*. Median sinus commencing near the beak and extending to the anterior margin. Ornament of subangular, radial costellae, increasing by intercalation and bifurcation to at least 70 at the commissure. Length 12 mm., width 16.5 mm. Shell structure apparently impunctate.

#### Superfamily DALMANELLACEA

#### Family DICAELOSIIDAE Schuchert and Cooper, 1931

#### Genus *Dicaelosia* King, 1850 (equals *Bilobites* of many authors)

#### *Dicaelosia biloba* (Linnaeus), 1767

*External morphology.* Shell small, strongly bilobed, unequally biconvex, cardi-form, wider than long, the maximum width being in the anterior half. Hinge line short, less than half the maximum shell width. Lateral margins almost straight, diverging anteriorly at about 120° to each other. Anterior margin bilobed.

*Pedicle valve* regularly convex from beak to anterior margin and approximately twice as deep as the brachial valve. Pedicle palintrope apsacline and higher than brachial palintrope. Median sinus deep, extending from near the beak to the anterior margin. *Brachial valve* feebly convex with a low palintrope and median sinus corresponding to, but less accentuated than, the sinus in the pedicle valve. *Ornamentation* of very fine radial costellae crossed by growth lines of almost equal size.

*Internal structure.* Unknown.

*Measurements.* Only two specimens have been found, one of which (the smaller) is complete, the other being a single valve. Both specimens are from the upper quarry.

	(1)	(2)
Maximum length (mm.)	4.1	—
Length along median line (mm.)	3.3	—
Maximum width (mm.)	5.0	approx. 8



*Discussion.* Described forms of *Dicaelosia* range from Upper Ordovician to basal Devonian (Lower Helderberg) after which there is only one solitary case of of a form *D. dimera* which Barrande obtained from the Middle Devonian (g<sub>1</sub>) of Bohemia. Otherwise there appears to be no attested case of a post-Gedinnian find of *Dicaelosia*.

The two specimens from the upper quarry bear no close resemblance to Barrande's species, but are far more closely comparable to the Silurian *D. biloba* which ranges at least to the top of the Silurian. The material available was not sufficient to show significant differences from *D. biloba* and so the reference is somewhat tentative.

Superfamily PENTAMERACEA

Family PENTAMERIDAE McCoy, 1844

Sub-family GYPIDULINAE Schuchert, 1929

Genus *Gypidula* Hall, 1867

*Gypidula pelagica* (Barrande), 1879

(Pl. VIII, figs. 5-7)

*External morphology.* Galeatiform with hinge line much less than the maximum width of the shell. Cardinal extremities well rounded. Lateral profile biconvex with pedicle valve having the greatest convexity. Anterior commissure sulcate. *Pedicle valve* with unequally bilobed median fold, not well defined posteriorly. Beak strongly incurved, concealing the delthyrium. Umbo strongly inflated. *Brachial valve* with rounded median sinus corresponding to the fold in the opposite valve.

*Internal structure.* Interior of *pedicle valve* with narrow spondylium supported at first by a very short median septum. Interior of *brachial valve* virtually unknown, but etching of beak shows a close double track indicating discrete brachial supports.

*Measurements.* M.U.G.D. 2078 has a length of 23 mm., width 25 mm., thickness 16 mm.

*Distribution.* Found only in the lower quarry.

*Discussion.* The closest comparable described species is *G. pelagica* Barrande from the Silurian e2 of Bohemia. Although Barrande's plates of *G. pelagica* cover more than one species, most of the illustrations could well be compared to the above species. The specimen illustrated by Barrande (1879) in Plate XXII, figs. 3a, b, d, and g is very close to the described specimen from Toongabbie. In the absence of detailed knowledge of the interior, and the close external similarity, no attempt has been made to erect a new species.

Superfamily STROPHOMENACEA

Family STROPHOMENIDAE King, 1850

Sub-family RAFINESQUININAE Schuchert, 1893

Genus *Leptaena* Dalman, 1828

*Leptaena thomsonensis* n.sp.

(Pl. VIII, fig. 8; Pl. IX, fig. 5)

*External morphology.* Shell moderately large, sub-rectangular to sub-semi-circular in outline, with auriculate cardinal extremities. Hinge line nearly straight. *Pedicle valve* with slightly convex visceral disc bearing about twelve irregular



sub-concentric rugae increasing in size away from the beak, the last one being abruptly deflected to form the trail. *Brachial valve* with almost flat visceral disc bearing about twelve sub-concentric rugae similar to those on the opposite valve. *Ornamentation* of fine, rounded, radiating costellae superimposed on the concentric rugae. Costellae averaging six per mm., increasing to ten or more costellae in the space of 1 mm. near the beak, and having as few as four costellae per mm. near the geniculation.

*Internal structure.* Unknown.

*Measurements.* The principal paratype (M.U.G.D. 2079) is 30 mm. wide and measures 11.5 mm. from beak to point of geniculation.

*Types.* Holotype M.U.G.D. 2058; principal paratype M.U.G.D. 2079; other paratypes M.U.G.D. 2059, 2060.

*Distribution.* Found in both quarries and in other limestones of the Walhalla Group.

*Discussion.* *Leptaena thomsonensis* differs from *L. rhomboidalis* (Wilckens) in having a much shorter trail, being less quadrate in outline, and having weaker rugae. *L. thomsonensis* differs from the two Victorian species referred to *Noto-leptaena* by Gill (1951) in that it is without a dorsally deflected tongue.

#### Superfamily RHYNCHONELLACEA

Family CAMAROTOECHIIDAE Schuchert and Le Vene, 1929

Genus *Pugnax* Hall and Clarke, 1893

*Pugnax brevicostatus* n.sp.

(Pl. IX, figs. 1-4; Fig. 1)

*External morphology.* Shell small, unequally biconvex, subpentagonal in outline, wider than long, with maximum width anterior to midlength; posterolateral margins curved and meeting in an angular beak. Anterior commissure fairly strongly sinuous. *Pedicle valve* convex umbonally, the surface sloping with moderate rapidity to the posterolateral margins and gently to the anterolateral margins. Sinus broad, extremely shallow, originating near midlength, and poorly defined except near the anterior margin. Sinus occupied by two angular plications and three equally angular grooves, there being no trace of the plications posterior of midlength. Lateral slopes marked by three or four incipient plications decreasing in size away from the sinus. Beak strong, sharply pointed, and projecting beyond that of the brachial valve. *Brachial valve* strongly convex, regularly arched transversely and longitudinally. Fold broad, low, originating just posterior of midlength, and poorly defined by furrows deepening towards the anterior margin. Fold occupied by three angular plications separated by equally angular grooves, the plications extending further than those in the sinus of the pedicle valve. Lateral slopes marked by three or four very short, feeble plications.

*Internal structure.* *Pedicle valve* with teeth supported by well developed dental lamellae. *Brachial valve* with two long, strong crura curving ventrally. Median septum absent. No trace of muscular impressions or cardinal process observable.



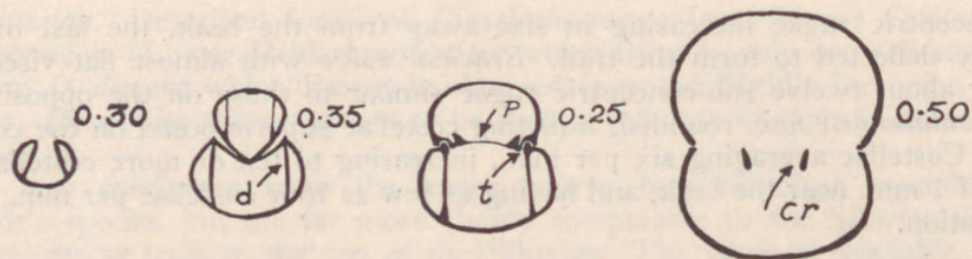


FIG. 1.—Series of four successive sections  $\times 2$  approximately through the beak of *Pugnax brevicostatus*. Distances shown are in mm. between each section. Specimen from Upper Quarry, Toongabbie Limestone. (cr. crura; d. dental lamellae; p. dental plate; t. teeth.)

*Measurements* (mm.).

	Holotype (M.U.G.D. 2073)	Sectioned Specimen
Length	7.8	8.7
Width	8.7	10.2
Thickness	5.8	6.9

Only two specimens, both from the upper Toongabbie quarry, were available for measurement. Both displayed the same number of plications on fold, sinus and flanks. The sectioned specimen was somewhat higher in the fold than the holotype.

**Genus *Uncinulus* Bayle, 1878**

***Uncinulus globosus* n.sp.**

(Pl. VIII, figs. 1-4)

*External morphology.* Shell small, unequally biconvex, subcuboidal in shape, subpentagonal in outline, slightly higher and wider than long. Posterolateral margins slightly concave and meeting in an acutely angular beak. Anterolateral margins well rounded. Anterior margin almost straight. *Pedicle valve* very strongly convex in lateral profile. Sinus broad, very shallow, originating slightly posterior of midlength. Lingual extension long, subrectangular and occupied by three strong medium-angular plications. Lateral slopes marked by about six plications decreasing in size away from the sinus. Beak strong, sharply pointed, and only slightly incurved. *Brachial valve* very strongly arched towards the anterolateral margin, moderately convex longitudinally, truncated at the front by the lingual extension of the opposite valve. Fold subrectangular in section, originating at about midlength, and occupied by four plications. Lateral slopes marked by six plications.

*Internal structure.* Unknown.

*Measurements.* The holotype has a length of 6.3 mm., width 7.1 mm., thickness 6.8 mm.

*Type.* Holotype M.U.G.D. 2074.

*Discussion.* Sufficient material was not available to investigate the interior. *Uncinulus globosus* is smaller than most species referred to *Uncinulus*. Externally, the closest resemblance is to the North American *U. nucleolatus* (Hall) from the New Scotland.



Sub-family RHYNCHOTREMATINAE Schuchert, 1913

Genus *Rhynchotreta* Hall, 1879

*Rhynchotreta* sp.indet.

(Pl. IX, fig. 6)

*External morphology.* Small, subtriangular shell with maximum width anterior of midlength, acutely angular at the beak. Anterolateral margins well rounded. Anterior commissure gently sinuous. Surface coarsely costate, bearing about eight costae on each valve. *Pedicle valve* weakly convex longitudinally, more strongly convex in lateral profile. Beak strong, nearly straight, with margins forming an angle of about 80°. Sinus narrow, being delineated by the two coarse central costae. *Brachial valve* slightly more convex than the pedicle valve.

*Internal structure.* Unknown.

*Measurements.* The only available specimen (M.U.G.D. 2075) has a length of 8 mm. approx., width 9 mm. approx., thickness 3.5 mm.

Superfamily ATRYPACEA

Family ATRYPIDAE Gill, 1871

Genus *Atrypa* Dalman, 1828

*Atrypa thomsonensis* n.sp.

(Pl. X, figs. 1-3)

*External morphology.* Shell subequally biconvex, subrounded in outline, slightly longer than wide. Hinge line obtuse. Anterior margin gently sinuous. *Pedicle valve* convex throughout and fairly regularly arched from the beak to the anterior margin. Sinus short, gently concave, poorly defined. Beak small, acute. *Brachial valve* more strongly convex transversely and longitudinally than the pedicle valve. Beak short, concealed by the opposite valve. *Ornamentation* of regular, rounded, radiating costae, separated by furrows of almost equal width. Costae averaging 18 in the space of 5 mm. and increasing mainly by bifurcation with occasional intercalation. Growth lines irregularly spaced and lamellose.

*Internal structure.* Unknown.

*Measurements.* Paratype (M.U.G.D. 2057) from the lower Toongabbie quarry has a length of 20 mm., width 19 mm., thickness 9 mm. A large exfoliated specimen from the upper quarry at Toongabbie (M.U.G.D. 2077) is 26 mm. wide.

*Types.* Holotype M.U.G.D. 2076; paratypes M.U.G.D. 2057, 2061 (immature), 2062 (immature).

*Distribution.* Poorly preserved specimens have been obtained from both of the Toongabbie quarries.

*Discussion.* *Atrypa thomsonensis* cannot be referred to *A. reticularis* (Linnaeus) to which so many Australian species of *Atrypa* have been erroneously referred in the past. Alexander's (1949) revision of *Atrypa reticularis* shows that this form has seven costae in the space of 5 mm. whereas *A. thomsonensis* bears eighteen costae in an equal space. *A. reticularis* is wider than long, and has a less convex pedicle valve than *A. thomsonensis*.



*Atrypa erectirostris* Mitchell and Dunn from the Middle Devonian of New South Wales appears to have about thirteen costae in the space of 5 mm., as well as having a more accentuated pedicle beak. *A. pulchra* Mitchell and Dunn from the Silurian of New South Wales is smaller and proportionally thicker than the new species, and has a reticulate surface ornament.

***Atrypa* spp. indet.**

At least two species of *Atrypa* are represented among material collected from both quarries. Both species have coarser costae than *A. thomsonensis* but were unsatisfactory for description or figuring.

Superfamily SPIRIFERACEA

Family SPIRIFERIDAE King, 1846

Sub-family DELTHYRINAE Waagen, 1883

Genus **Howellella** Kozłowski, 1946 (equals **Crispella** Kozłowski, 1929)

***Howellella* *lirata* n.sp.**

(Pl. X, figs. 4-7; Fig. 2)

*External morphology.* Small, subequally biconvex, spiriferoid-shaped shell with non-plicated sinus, and plicated slopes bearing five or six strong, subangular, simple plications separated by more rounded grooves, the size of the plications decreasing towards the rounded cardinal extremities. *Pedicle valve* moderately convex and arched regularly from the beak to the anterior and lateral margins. Sinus shallow, well rounded, approximately one-third the width of the shell, and extending from the beak to the anterior margin. Beak incurved over a moderately arched, well delineated, apsacline palintrope. Delthyrium wider than high and open to the apex. *Brachial valve* moderately arched transversely and longitudinally. Fold well defined, rounded, extending from the beak to the anterior margin, and bearing a faint median depression. Beak small and incurved over a very low palintrope. *Ornamentation* seen only on very well preserved material. Concentric growth lines spaced at about 15 lines per mm., crossed by fine radial threads spaced at 10 to 15 threads per mm., giving a reticulate appearance to the surface. Best preserved material showing fine spines developed at the intersection of radial and concentric ornament. Pedicle palintrope coarsely striated parallel to the cardinal margin and occasionally very finely striated longitudinally.

*Internal structure.* *Pedicle valve* with strong hinge teeth supported by dental lamellae diverging rather strongly from the delthyrial margins and extending a short distance along the floor of the valve. Median septum absent and muscle scars not preserved in any of the material available for study. *Brachial valve* with long, well developed dental sockets. Crura supported by strong crural bases converging towards the beak and uniting to form a median block supporting the cardinal process. Cardinal process with surface in the form of a comb. Spiralia consisting of about ten turns in a specimen 13.5 mm. wide. Muscular impressions not seen in any of the material available for study. Shell fairly thin and finely fibrous.

*Measurements.* Most of the available material broke out as single valves which did not lend themselves to measurement. However, three complete specimens were measureable.



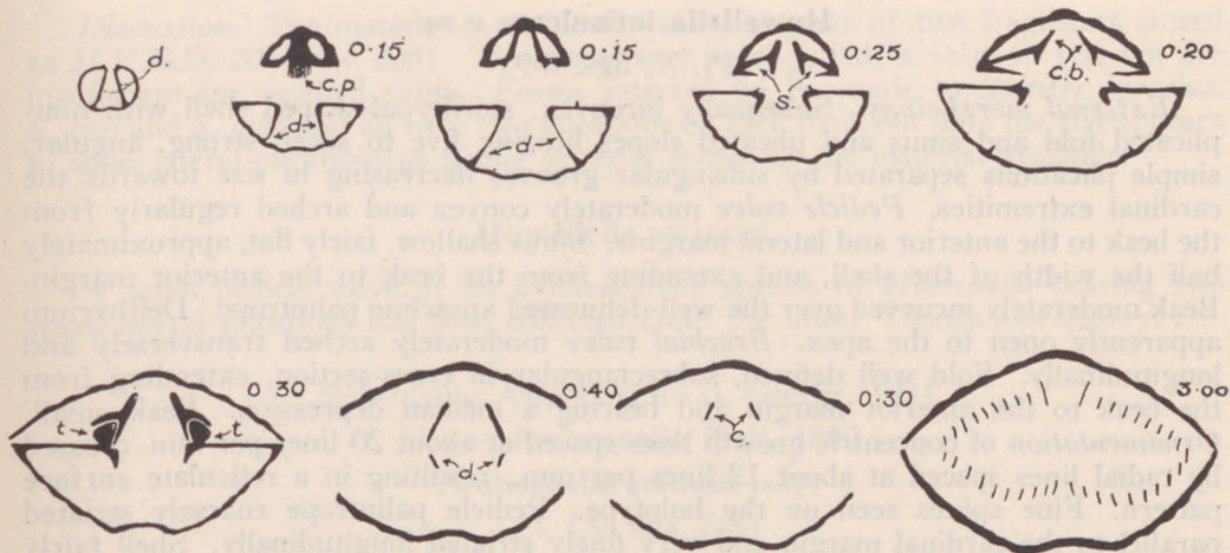


FIG. 2.—Series of nine successive sections  $\times 2.5$  through the beak of *Howellella lirata* at right angles to the plane of the commissure. Distances shown are in mm. from the preceding section. Specimen from the Upper Quarry, Toongabbie Limestone. (c. crura; c.b. crural bases; c.p. cardinal process; d. dental lamellae; s. dental sockets; t. teeth.)

	Length of Pedicel valve	Width	Thickness	Width of fold
Holotype	9.7 mm.	16.8 mm.	7.0 mm.	5.5 mm.
Paratype	9.5 mm.	14.0 mm.	6.8 mm.	5.6 mm.
Sectioned specimen	11.5 mm.	13.5 mm.	7.2 mm.	6.0 mm.

*Types.* Holotype M.U.G.D. 2066; principal paratype M.U.G.D. 2067; additional paratypes M.U.G.D. 2068, 2077, 2228, 2229.

*Distribution.* *Howellella lirata* is generally fairly rare throughout the limestone of the upper quarry, but is common in small patches. Only one small specimen has been found in the lower quarry.

*Discussion.* *Howellella lirata* is assigned to *Howellella* Kozłowski (1946) on the basis of external morphology and internal structure. *Delthyris* Dalman (1828) and *Mauispirifer* Allan (1947) both have a median septum in the pedicel valve, although this structure is small in the case of *Mauispirifer*. *Hysterolites mercuri* and *Hysterolites hystericus* both have a median septum in the brachial valve. Consequently *Howellella lirata*, which lacks a median septum in both valves, can be readily distinguished from these forms. *Mauispirifer hectori* and *Hysterolites hystericus* both bear more lateral plications than *Howellella lirata*. *Hysterolites mercuri* shows a combination of concentric and radial ornament vaguely like *Howellella lirata* whereas *Mauispirifer hectori* is ornamented by radial threads which do not appear from Allan's description and illustration (1947, pp. 445-446 and Pl. 62, fig. 6) to be regularly crossed by almost concentric growth lines with development of spines at the intersections.

Comparison of Fig. 2 with illustrations of the structure of *Howellella crispa* and *Howellella angustiplicatus* given by Kozłowski (1929, pp. 191 and 193) allow ready separation of *Howellella lirata*. *Howellella henryhousensis* Amsden and *Howellella vanuxemi* (Hall) have less lateral plications than the new species.



*Howellella latisulcata* n.sp.

(Pl. X, figs. 8-9)

*External morphology.* Subequally biconvex, spiriferoid-shaped shell with non-plicated fold and sinus and plicated slopes bearing five to seven strong, angular, simple plications separated by subangular grooves decreasing in size towards the cardinal extremities. *Pedicle valve* moderately convex and arched regularly from the beak to the anterior and lateral margins. Sinus shallow, fairly flat, approximately half the width of the shell, and extending from the beak to the anterior margin. Beak moderately incurved over the well-delineated apsacline palintrope. Delthyrium apparently open to the apex. *Brachial valve* moderately arched transversely and longitudinally. Fold well defined, subrectangular in cross-section, extending from the beak to the anterior margin and bearing a median depression. Beak small. *Ornamentation* of concentric growth lines spaced at about 20 lines per mm. crossed by radial lines spaced at about 12 lines per mm., resulting in a reticulate surface pattern. Fine spines seen on the holotype. *Pedicle palintrope* coarsely striated parallel to the cardinal margin and very finely striated longitudinally. Shell fairly thin and finely fibrous.

*Internal structure.* The pedicle valve contains two moderately strong dental lamellae and is without a median septum. Insufficient material was available to investigate the interior of the brachial valve.

*Measurements* (mm.). All the available material consisted of disarticulated valves.

	Length of brachial valve	Length of pedicle valve	Width	Width of fold or sinus
Holotype	11.2	—	14.4	7.8
Paratype	—	12.9	17.3	9.3

*Types.* The holotype M.U.G.D. 2069a is a brachial valve; part of its counterpart is stored as M.U.G.D. 2069b. Paratype is a pedicle valve, M.U.G.D. 2070.

*Distribution.* *Howellella latisulcata* has so far been found only in the upper quarry.

*Discussion.* *Howellella latisulcata* differs morphologically from *Howellella lirata*. *H. latisulcata* is larger, has a wider median fold and sinus, and more angular lateral plications than *H. lirata*. None of the forms assigned to *Howellella* (or *Crispella*) in the literature has such a wide sinus as is seen in *H. latisulcata*.

*Howellella* cf. *H.* (?) *gibbosa* (Barrande, 1879)

*External morphology.* Small, biconvex, spiriferoid-shaped shell with non-plicated fold and sinus and plicated slopes bearing two very strong simple plications separated by deep rounded grooves. Sinus deep, well-rounded; fold correspondingly high, well-rounded, without any median depression. Ornamentation not visible on any of the material available. Shell finely fibrous.

*Internal structure.* Not deducible from the fragmentary material available.

*Measurements.* A complete specimen would have the following very approximate dimensions: Length 8 mm., width 10 mm.

*Distribution.* *Howellella* cf. *H.* (?) *gibbosa* has been found only in the upper quarry.



*Discussion.* The material available for study consists of two fragments stored as M.U.G.D. 2071 and 2081. The pieces each average half a valve in size but are insufficient for detailed study. Forms referred by Barrande to *Spirifer insocius*, *S. tiro* and *S. gibbosus* all have two plications on each flank but only the last appears to show lateral plications as strong as those shown by the material available.

***Howellella* sp.indet.**

A small pedicle valve of an indeterminate species of *Howellella* bearing two weak lateral plications has been collected from the lower Toongabbie quarry.

Sub-family AMBOCOELIINAE George, 1931

Genus ***Ambocoelia*** Hall, 1860

***Ambocoelia minuta* n.sp.**

(Pl. IX, figs. 7-8)

*External morphology.* Very small, oval, smooth shell with very unequally biconvex valves, the pedicle valve being much deeper and longer than the brachial valve. Hinge short. *Pedicle valve* very deep and arched regularly from beak to anterior and lateral margins. Beak strong and incurved over a wider than high open delthyrium. *Brachial valve* feebly convex, subpentagonal in outline, but always wider than long. Beak very small. Palintrope very low but definite. Ornamentation unknown.

*Internal structure.* Two strong teeth in the pedicle valve are prolongations of the internal margin of the delthyrium. Dental sockets fairly strong. Spiralia composed of four or five turns. Muscular impressions unknown.

*Measurements* (mm.). Holotype (M.U.G.D. 2072)—

Length of pedicle valve	8.2
Length of brachial valve	7.5
Width	8.5
Thickness	4.8

*Distribution.* Only two specimens of *Ambocoelia minuta* were available. Both were from the upper Toongabbie quarry. The smaller of the two, being badly broken, was sectioned to give data on internal structure.

*Discussion.* *Ambocoelia minuta* is nearer *A. praecox* Kozłowski from equivalents of the uppermost Ludlow (middle Borszczow) than with later forms such as *A. umbonata* (Conrad), *A. pentagonalis* Termier and Termier, *A. planoconvexa* (Shumard), or *A. nana* Kindle, from all of which it can be distinguished by outline and the relative convexity of the brachial valve. *A. praecox* is smaller and proportionately thicker than *A. minuta*.

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### Explanation of Plates

#### PLATE VIII

- Figs. 1-4.—*Uncinulus globosus* n.sp. Pedicle, lateral, brachial, and anterior views of holotype (M.U.G.D. 2074),  $\times 6$ . Upper Quarry, Toongabbie Limestone, Victoria.
- Figs. 5-7.—*Gypidula* cf. *pelagica* (Barrande). Pedicle, lateral and brachial views of M.U.G.D. 2078,  $\times 2$ . Lower Quarry, Toongabbie Limestone, Victoria.
- Fig. 8.—*Leptaena thomsonensis* n.sp. Paratype (M.U.G.D. 2060),  $\times 2.5$ , showing concentric and radial ornament. Upper Quarry, Toongabbie Limestone, Victoria.

#### PLATE IX

- Figs. 1-4.—*Pugnax brevicostatus* n.sp. Brachial, pedicle, lateral and anterior views of holotype M.U.G.D. 2073,  $\times 4$ . Upper Quarry, Toongabbie Limestone, Victoria.
- Fig. 5.—*Leptaena thomsonensis*, n.sp. Brachial view of principal paratype M.U.G.D. 2079,  $\times 2$ . Upper Quarry, Toongabbie Limestone, Victoria.
- Fig. 6.—*Rhynchotrete* sp.indet. Brachial view of M.U.G.D. 2075. Upper Quarry, Toongabbie Limestone, Victoria.
- Figs. 7, 8.—*Ambocoelia minuta* n.sp. Pedicle and posterior views of holotype M.U.G.D. 2072,  $\times 5$ . Upper Quarry, Toongabbie Limestone, Victoria.
- Fig. 9.—*Orthostrophia* sp. Cast of pedicle valve M.U.G.D. 2080,  $\times 2$ . Lower Quarry, Toongabbie Limestone, Victoria.

#### PLATE X

- Figs. 1-3.—*Atrypa thomsonensis* n.sp. 1.—Paratype M.U.G.D. 2057,  $\times 2$ , pedicle view. 2, 3.—Pedicle and posterior views of holotype M.U.G.D. 2076,  $\times 2.3$ . Both specimens from the Lower Quarry, Toongabbie Limestone, Victoria.
- Figs. 4-7.—*Howellella lirata* n.sp. Pedicle, brachial, anterior, and posterior views of holotype M.U.G.D. 2066,  $\times 3.5$ . Upper Quarry, Toongabbie Limestone, Victoria.
- Figs. 8-9.—*Howellella latisulcata* n.sp. 8.—Brachial valve holotype M.U.G.D. 2069,  $\times 3$ . 9.—Pedicle valve paratype M.U.G.D. 2070,  $\times 3$ . Both specimens from the Upper Quarry, Toongabbie Limestone, Victoria.





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