https://doi.org/10.24199/j.mmv.1980.41.02 13 October 1980

SILURO-DEVONIAN NOTANOPLIIDAE (BRACHIOPODA)

By Michael J. Garratt
Department of Minerals and Energy, Victoria.

Abstract

The Notanopliidae is reviewed and its systematic position is discussed. The family is divided into two subfamilies: Notanopliinae Gill, and Costanopliinae subfam. nov. Representatives of the family placed in the genera *Notoparmella, Notanoplia* and *Boucotia* from the Siluro-Devonian sequence of the Melbourne Trough are described. They are: *Notoparmella plentiensis* sp. nov., *Notanoplia panifica* sp. nov., *N. philipi* sp. nov., *N. pherista* Gill, *Boucotia janaea* sp. nov., *B. australis* (Gill), *B. withersi* (Gill), and *B. loyolensis* (Gill).

Introduction

Since Gill's (1969) work on the Notanopliidae, knowledge and number of constituent genera of the family have increased, from the two genera known then to some eleven genera. During a study of the brachiopod fauna of the Siluro-Devonian of the Melbourne Trough it became apparent that numerous representatives of the family are present, many of which are new. These are referred to the genera *Notoparmella, Notanoplia* and *Boucotia*. Further, the occurrence of previously described species is revised and consideration given to the phylogeny of the group.

The Siluro-Devonian stratigraphic succession of the Melbourne Trough has recently been reviewed by VandenBerg, Garratt and Spencer-Jones (1976). The lithostratigraphy and biostratigraphy of the Siluro-Devonian strata of the Melbourne Trough are described more fully elsewhere (Garratt, 1980, in prep.), and the stratigraphic sequence is not reviewed further here.

Collections

Registered number prefixes refer to the following institution:

NMVP— National Museum of Victoria.
MUGD—University of Melbourne Geology Department.

Terminology

The terminology described for the Notanopliidae follows that of Moore (1965) and Gill (1969)

Abbreviations

The following abbreviations used in the text are listed:

Hw	= Hinge width.
Mw	= Maximum width.
Lvv	= Length of the ventral valve measured from umbo to anterior commissure.
Ldv	= Length of the dorsal valve, measured from the cardinal process to the anterior commissure.
Lms	= Length of the median septum.
$<$ls	= angle between lateral septa.
$<as_1$	= angle between inner accessory septa.
$<as_2$	= angle between out accessory septa.
Wd	= Width of delthyrium.
Hd	= Height of delthyrium.

Suborder Chonetidina Muir-Wood 1955

Superfamily PLICANOPLITACEA superfam. nov.

(= *Plicanopliacea* Xu Hankui 1977, p. 59).

Diagnosis: Small strophic impunctate shells with thin visceral cavity; ventral valve with pedicle tube but lacking a foramen, muscle scars indistinct; cardinal process recurved and rectangular with long axis transverse, socket ridges nearly parallel to the hingeline, brachidium possibly of ptycholophous lophophore. (New diagnosis)

Discussion: The superfamily Plicanopliacea and the family Plicanoplidae (sic.) were erected by Xu Hankui in March 1977, unfortunately based on *Plicanoplia* Havlicek (*non* Boucot and Harper, 1968). These familial names are invalid (I.C.Z.N., Article 39. a (i)). The group of brachiopods encompassed by Xu Hankui's Plicanopliacea, warrants (at least) superfamilial status; hence the familial name Plicanoplitidae and superfamilial name Plicanoplitacea are proposed as replacement names based on the nominal genus *Plicanoplites* Havlicek, 1974.

Examination of Xu Hankui's excellent illustrations leaves no doubt as to the distinctive characters of *Paraplicanoplia* when compared with *Plicanoplites* (Havlicek, 1974) in such details as strength of external ribs and arrangement of the internal dorsal septa; (see Xu Hankui, table p. 64 and pl. 2, figs. 1-10, and pl. 3, figs. 14-20; cf. Havlicek 1973, pl. 1, figs. 1-9). The type species of *Paraplicanoplia* is *P. nana* Xu Hankui, 1977.

The generic name *Plicanoplia* was proposed by Boucot and Harper (1968, p. 169) for "coarsely costate anopliids with prominent accessory septa and andcridia in the brachial valve". The type species of *Plicanoplia,* Boucot and Harper is *Chonetes fornacula* Dunbar (1920, p. 130). The type species is well illustrated by Boucot and Harper (1968, p. 29, figs. 21-27; pl. 30, figs. 1-5). The genus clearly belongs to the chonetidine family Anopliidae, Muir-Wood (1962; *nom. trans.* Boucot and Harper 1968, p. 167 *ex* Anopliinae Muir-Wood 1962, p. 53).

Plicanoplia was again proposed as the name of a new genus by Havlicek (1973, p. 337) with *Plicanoplia peculiaris* Havlicek (1973) as type species. The genus was assigned to the Notanopliidae Gill, 1969. The diagnosis reads as follows: "Shell minute, subquadrate in outline, low, slightly convexo-concave in sagittal profile. Each valve bears two or more plicae of inconspicuous relief extending from the beak but dying out before reaching the front margin of the valve. Ventral interarea flat, apsacline medianly with an open delthyrium; dorsal interarea almost linear, anacline. Internal morphology of both valves same as that of *Notanoplia* Gill except for a sub-marginal rim well developed in the adult valves of the Bohemian genus" (Havlicek, 1973, p. 337-338).

As noted by Havlicek (1974, p. 170), *Plicanoplia* Boucot and Harper, and *Plicanoplia* Havlicek are homonyms (I.C.Z.N. Section 12, p. 51). *Plicanoplia* Boucot and Harper had priority; hence Havlicek's junior homonym was replaced by the generic name *Plicanoplites* with *Plicanoplia peculiaris* Havlicek as type species.

It is noted that the genus *Imatrypa* (Havlicek, 1977, p. 300) published in September 1977, is probably a junior synonym of *Paraplicanoplia* Xu Hankui published in March 1977.

Two families are recognised: Plicanoplitidae fam. nov. and the Notanopliidae. The following genera are assigned to the Plicanoplitidae: *Paraplicanoplia* Xu Hankui, 1977 (= *Imatrypa* Havlicek, 1977); *Tangxiangia* Xu Hankui, 1977; and *Plicanoplites* Havlicek, 1974.

The generic assignments to the *Notanopliidae* are discussed under each of the two subfamilies.

Range: Late Silurian (?Ludlovian) to Middle Devonian.

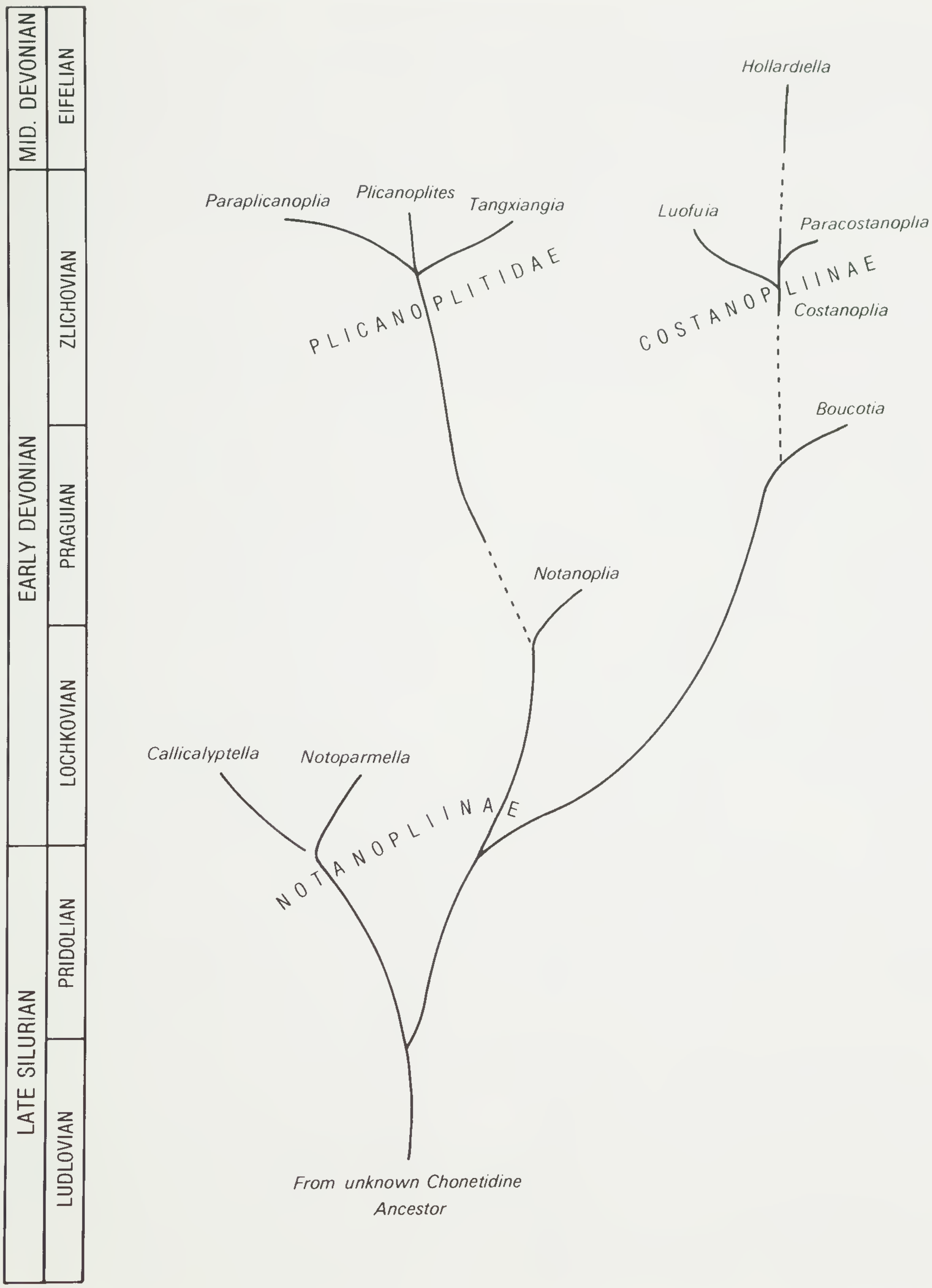
Phylogeny Diagram: The applicability of the stage names for the Late Silurian-Early Devonian discussed elsewhere (Garratt, in prep.). Stages are shown as being of varying duration and reflect their number of graptolite and conodont zones rather than radioactive decay dates. These durations may well require alteration if and when radioactive decay dates become available.

The diagrams (Figs) are dendritic in style and the branchlets do not necessarily indicate closeness of similarity time.

The proposed phylogeny and age ranges of the genera belonging to the Plicanoplitacea are shown in Fig. 1. The detailed morphology of the Notanopliidae is reviewed below. It is considered that the Plicanoplitacea includes two basic stocks here defined as families Notanopliidae and the Plicanoplitidae. One is characterised by a submarginal rim connecting the septa in the interior of the shell (Plicanoplitidae) the other lacks this structure (Notanopliidae).

The notanopliid stock arose, probably in the Late Silurian of south east Australia. Again two basic stocks are recognised separated from each other in space and time. These stocks are herein defined as subfamilies, one being essen-

Figure 1. Inferred phylogeny for the Plicanoplitacea.


MID. DEVONIAN
EIFELIAN
EARLY DEVONIAN
ZLICHOVIAN
PRAGUIAN
LOCHKOVIAN
LATE SILURIAN
PRIDOLIAN
LUDLOVIAN
Hollardiella
Paraplicanoplia
Plicanoplites
Tangxiangia
Luofuia
Paracostanoplia
PLICANOPLITIDAE
COSTANOPLIINAE
Costanoplia
Boucotia
Notanoplia
Callicalyptella
Notoparmella
NOTANOPLIINAE
From unknown Chonetidine
Ancestor

tially characterised by smooth or finely costellate shells, the other by essentially costate shells. Variation in the number of lateral septa, from genus to genus, (noted also by Johnson, 1973, p. 1024), may be related to environmental factors and consequently similar gross internal morphologies developed in both stocks at different times. Examples of such convergent internal morphologies are: a distinct median septum in *Notoparmella*, a smooth or weakly costellate Late Silurian form, and in *Hollardiella*, a costate shell from the Late Eifelian; and a pair of divergent lateral septa and median septum in *Notanoplia*, a smooth or very weakly costate Early Devonian form and in *Costanoplia* a markedly costate, Middle Devonian genus.

The convergence of costation in the Notanopliidae is not so marked. Only the very rare genus *Callicalyptella* is markedly costate. Costate notanopliids are otherwise confined to the Middle Devonian.

Notanoplia arose from *Notoparmella* probably in the Late Silurian by development of a pair of smooth lateral septa. *Boucotia* arose from *Notanoplia* by further modification of the septa into crested speta. The basic Plicanoplitid stock represented by *Plicanoplites* probably arose from either *Notanoplia* or *Boucotia* during the Praguian. The presence of *Notanoplia* in Siegenian strata of Germany (Langenstrassen, 1972, p. 49) and its close temporal proximity to the first occurrence of *Plicanoplites* from the Dvorce Limestones (Zlichovian) of Bohemia (Havlicek, 1973) supports an origin of the Plicanoplitidae via *Notanoplia*. I am unaware of any record of *Boucotia* from the Early Devonian of central Europe.

Family Notanopliidae Gill, 1969
(emend. Boucot and Johnson, 1972, p. 299, and Savage, 1974, p. 20, emend. herein).

Diagnosis: Small plano-convex or convabo-convex brachiopods with a straight hingeline and variably developed ventral interarea; shell surface smooth or costate; interiors with inequal or equal number of lateral septa or completely lacking lateral septa; ventral teeth are large, simple and deltiodont (new diagnosis).

Discussion: The Notanopliidae have been variously classified as chonetids (Gill, 1942, 1945a, 1950), leptestiids (Philip, 1962; Langenstrassen, 1972; Savage, 1974), atrypaceans (Johnson, 1973; Havlicek, 1973, 1974, 1977; Gratsianova and Schisckina, 1977) or incerta cedis (Gill, 1969; Boucot and Johnson, 1972).

Gill (1950) argued for a close affinity of *Notanoplia* with *Anoplia* Hall & Clarke of the chonetidine family, Anopliidae, on the basis of similarity of shell shape, internal septa and the isochronous development with *Anoplia*.

Philip (1962, p. 206) proposed a leptestiid assignment for *Notanoplia*. This assignment was based on the absence of spines and spine bases along the edge of the ventral interarea of *Notanoplia*, the presence of strong divergent socket ridges and a suggestion of a trilobed cardinal process in *Notanoplia*. This plectambonitacean assignment was accepted by Langenstrassen (1972, p. 49) and tentatively by Savage (1974, p. 27).

Gill (1969) placed the family Notanopliidae under incerta cedis. His reasons (p. 1230) were based on internal structures—the lateral and median septa of both valves and the unique scroll-like cardinal process of the Notanopliidae. he noted the similarity of outline of the Notanopliidae to the Chonetidina but stated that anderidea (Sadlick, 1965) and hinge spines are lacking.

However, Johnson (1973), Havlicek (1973, 1974, 1977) and Gratsianova and Schisckina (1977) attributed the Notanopliidae to the Atrypacea, arising from either the Anoplitheeidae (Havlicek, 1973, p. 337) or the Carinatininae (Johnson, 1973, p. 1026). Johnson's reasons for an atrypacean assignment were based on:

(i) similar impunctate shell structure of Notanopliidae and Atrypacea;

(ii) the carinatinid genus *Gracianella* Boucot and Johnson and the notanopliid *Hollardiella* Drot, both have simple socket plates, solid transverse cardinal process and a short thick dorsal median septum.

(iii) the similarity of shape, smooth shells and presence of a median rib in the dorsal valve of *Notoparmella* Johnson and *Gracianella* (Johnson, 1973, p. 1025).

Havlicek (1973, p. 337) suggested that "the peculiar cardinal process of the notanopliid genera may represent a composite structure originated by the fusing of the hinge plates and cardinal process into one body and to some extent recalling the hinge morphology of some brachiopods of the family Anoplitheeidae".

The dichotomy of opinion concerning an adequate superfamily assignment for the Notanopliidae, prompted Xu Hankui (1977) to raise them to superfamily status. This status is accepted but the problem of their ordinal affinities and origin remain.

I consider that the strophic shell of Notanopliidae (and the Plicanoplitidae) and the possession of lateral septa reflect an affinity and origin with the Chonetidina (with loss of hinge spines and pseudopunctae) rather than the Atrypidina for the following reasons:

(i) All genera belonging to the Plicanoplitacea have strophic shells, with either a low or linear ventral interarea (i.e. they have a straight hingeline). Not one Late Silurian atrypide genus has a straight hingeline, all are curved albeit if some are gently so, and are therefore, non-strophic shells. It should be noted that only the late Early Devonian carinatininid genera *Biconostrophia* Havlicek, 1956, *Prodavidsonia* Havlicek, 1956, *Davidsoniatrypa* Lenz 1968, *Carinatinella* Gratsianova 1967, and *Carinatina* Nalivkin, 1930, have a straight hingeline, but this is a modification which is only attained in the adult or gerontic stages as typified by *Biconostrophia* (Johnson and Boucot, 1972, p. 35).

They are essentially non-strophic shells. Further, non-strophic shells are diagnostic of the Rhynchonellida. Copper (1967a, 1967b,) argued that the atrypide stock arose from the Rhychonellida because both groups had basic similar umbonal ventral and dorsal structures. It seems plausible that the similarity in the internal organisation of those structures can also be inferred by their common form; i.e. their non-strophic outline.

Johnson and Boucot's (1972) concept of the Carinatininae includes *Dnestrina* Nikiforora and Modzalevskaya 1968. Their illustrations of the internals (pl. 3, figs. 38, 39) of *D. gutta* Nikiforora and Modzalevskaya, the type species of *Dnestrina*, show cardinalia unlike those of other carinatinids. They recall the Notanopliidae except for a further modification of the cardinal process. *Dnestrina* is a non strophic form which may not reside in the Carinatininae because all other genera assigned to the Carinatininae, including *Gracianella* Johnson and Boucot, have cardinalia unlike those of the Notanopliidae. Copper (1973a, p. 486, 1973b, p. 121) regards *Dnestrina* as a dayiacean athridid.

Johnson (1973, text fig. 2, p. 1023) further emphasized an atrypide affinity through *Gracianella*. Again few of the species of *Gracianella* have internal umbonal features of the shell which are similar to the Notanopliidae. Certainly Johnson's (1973) illustrations of *Notoparmella* (pl. 4, fig. 2, 7) compare with Johnson and Boucot's (1967, pl. 109, figs. 22, 23, 39, 40) illustration of *Gracianella Lissumbra* Johnson and Boucot; but see illustrations of *Gracianella plicumbra* Johnson and Boucot (1972, pl. 3, figs. 24-6). Nevertheless all species of *Gracianella* have a curved hingeline. *Gracianella* lacks the solid transverse structure of *Notoparmella* as illustrated by Johnson (1973, pl. 14, figs. 2, 12). Rather, the variation of cardinalia of *N. gilli* may perhaps be the result of incomplete silicification.

(ii) Similarities in shell structure between atrypides and plicanoplitaceans may be fortuitous. Johnson, (1973, p. 1025) laid great emphasis on the absence of punctae and pseudo punctae in the silicified material of *Notoparmella gilli*, the nonsilicified shells of *Hollardiella*, and the absence of pits in well preserved internal moulds of *Notanoplia*, *Boucotia* and *Callicalptyella*; drawing the conclusion that all the members of the Plicanoplitacea are impunctate. He may well be correct, but silicification normally destroys shell structure and internal moulds of Notanopliidae are smooth. *Notanoplia philipi* sp. nov. has perforations in the lateral septa which may be pseudopunctae (pl. 7, fig. 1). One specimen of *Notoparmella plentiensis* sp. nov. has perforations in the anterior portion of the median septum. Their regular spacing and outline preclude these perforations from being produced from borers. These perforations are considered remnants of pseudopunctae.

(iii) The arrangement of the lateral, accessory and median septa of the (Para) Plicanoplitacea are similar to those characterising the Chonetidina. Gill (1945, 1950) accepted chonetide affinity of the Notanopliidae but later (1969, p. 1223) drew a distinction between lateral septa (Muir-Wood, 1962) = anderidia (Sadlick 1965, p. 157-9), accessory septa and median septa of the Chonetacea and the septal configuration of the Notanopliidae. In terms of their functional morphology, Gill (1969, p. 1228) suggested that the lateral septa of notanopliids functioned as controllers of exhalant and inhalant currents and for placement of organs. Grant (1976, p. 65 Text Fig. 11) postulated that the chonetacean lateral septa served as a seat for a ptycholophous (or complex schizolophe) lophophore. It seems plausible that the lateral septa of plicanopliaceans also functioned in the same way. No other structures are preserved or hinted at in the dorsal valve which could have supported the lophophore. I suggest that the septa of the plicanopliaceans functioned as lophophore supports and that they are homologous with those of the Chonestacea.

In deriving the Plicanoplitacea from the Chonetacea the latter have to lose pseudopunctae hinge spines, denticulate hinge, a chilidium and pseudodeltidium.

Finally a plectambonitacean origin for the Plicanoplitacea cannot be entirely discounted, but they too have to lose a denticulate hinge, pseudodeltidium, chilidium and pseudopunctae.

Subfamily Costanopliinae subfam. nov.

Diagnosis: Notanopliids with a costate shell or rarely smooth.

Discussion: Genera assigned include: *Costanoplia* Xu Hankui; *Paracostanoplia* Xu Hankui; *Hollardiella* Drot; and *Luofuia* Xu Hankui.

The Costanopliinae first appear in Late Zlichovian to Early Eifelian of southwest China. There are no known costanopliinids known from older strata but it is suggested herein that the subfamily probably arose from *Boucotia*, a widely distributed genus, rather than from the plicanopliid genus *Plicanoplites*. This is because the distinctive raised rim in the internal dorsal and ventral valve of the Plicanoplitidae is absent in the Notanopliinae.

Range: Late Zlichovian to Late Eifelian (Devonian).

Occurrence: The Costanopliinae are found in the late Eifelian of Morocco (Drot, 1967) and the late Zlichovian-Early Eifelian of southwest China.

Subfamily Notanopliinae Gill, 1969
(nom. trans. ex. Notanopliidae Gill (1969, p. 1223))

Diagnosis: Notanopliids with a smooth exterior or fine costellae rearely costate.

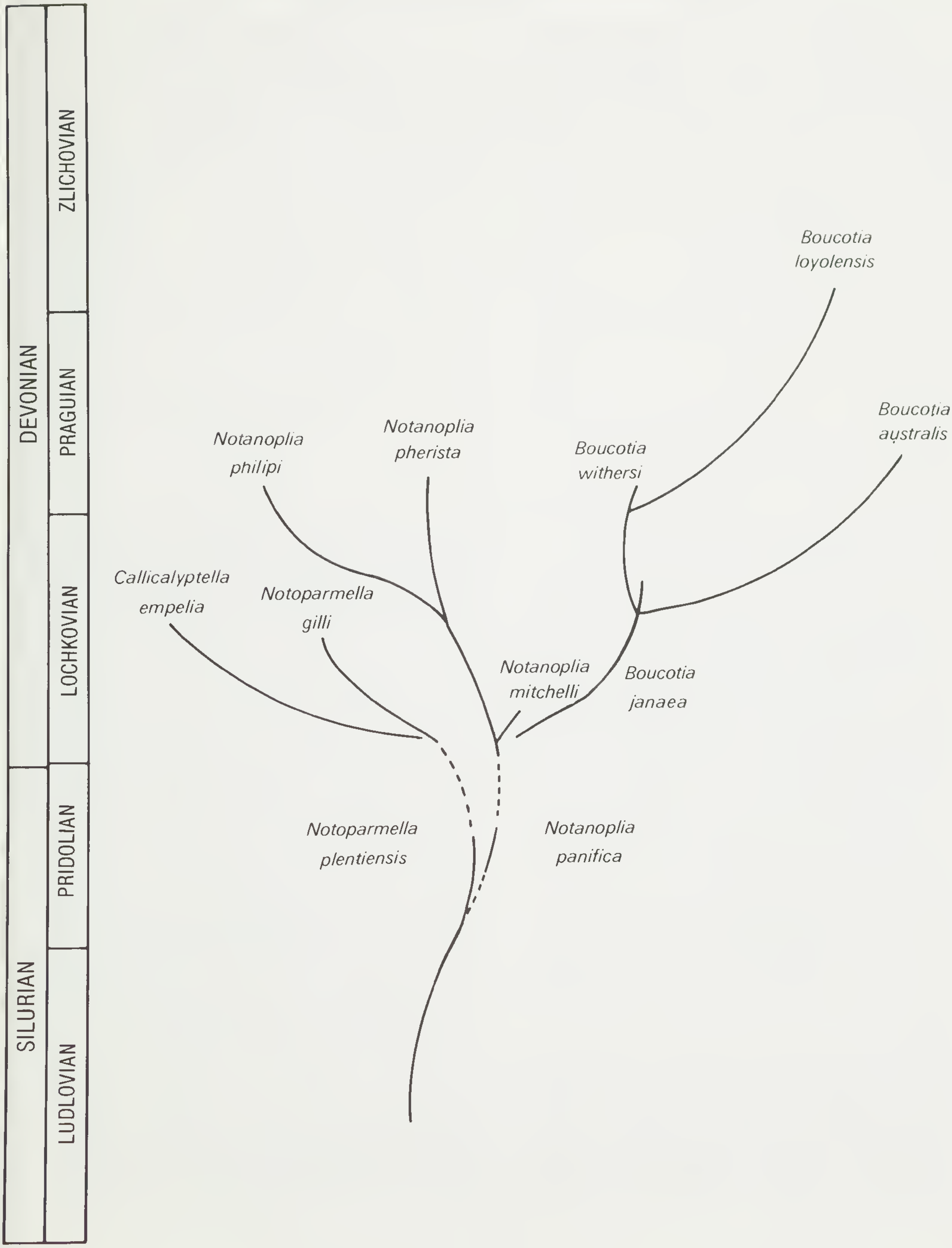
Discussion: The Late Silurian to Early Devonian notanopliids are smooth (*Boucotia*) or have very fine ill-developed costellae (*Notanoplia, Notoparmella*) or are costate (*Callicalpytella*). *Callicalyptella,* although costate appears to be more closely related to *Notoparmella* because of its close juxtaposition in space and time and similar outline. (Fig. 2).

Genus **Notoparmella** Johnson, 1973

Type species: Notoparmella gilli Johnson, 1973, p. 1026-7, p1. 4, figs. 1-17, p1. 5, figs. 4, 5.

Diagnosis: A small thin shelled, shield shaped, concavo-convex or plano-convex notanopliid, with variably developed fine costellae or apparently smooth, except for a ventral median fold. Interiors with impressed ventral diductors and simple discrete socket plates, variably strengthened by deposit of shell material into a

Figure 2. Inferred lineage for Notanopliidae.


DEVONIAN
SILURIAN
ZLICHOVIAN
PRAGUIAN
LOCHKOVIAN
PRIDOLIAN
LUDLOVIAN
Boucotia loyolensis
Boucotia australis
Notanoplia philipi
Notanoplia pherista
Boucotia withersi
Callicalyptella empelia
Notoparmella gilli
Notanoplia mitchelli
Boucotia janaea
Notoparmella plentiensis
Notanoplia panifica

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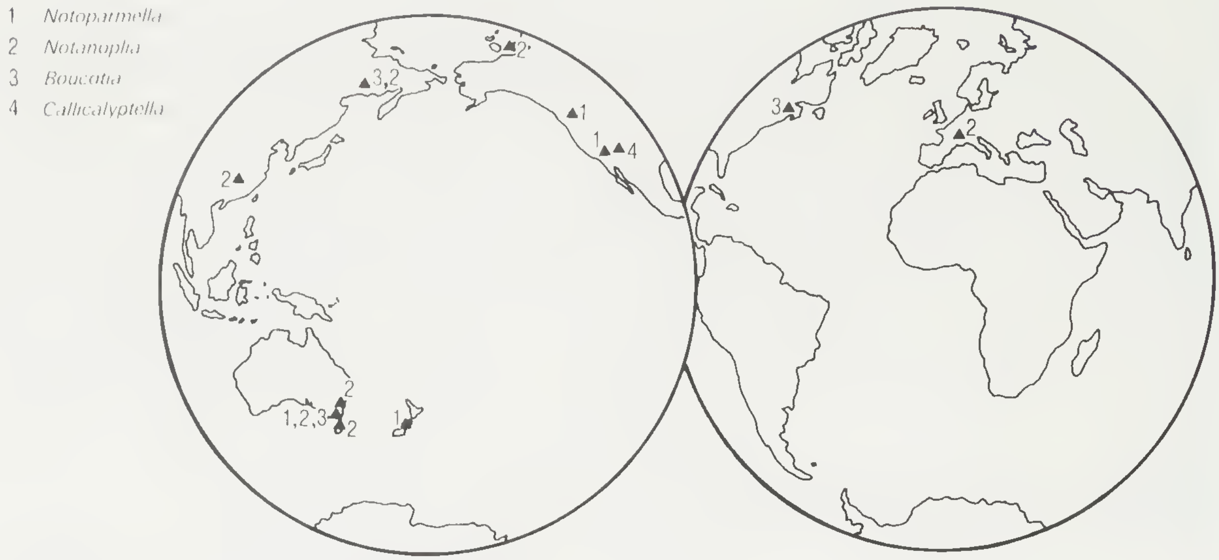

Figure 3. Distribution of the Notanopliidae.

single transverse bar. Ventral median septum varyingly developed (new diagnosis).

Discussion: Johnson's (1973, p. 1026) diagnosis is emended to include reference to costellae. *Notoparmella plentiensis* sp. nov. is invariably costellate but has identical internal characters to *N. gilli* from Windmill Limestone of Coal Canyon, Nevada (Lochkovian). Absence of lateral septa in the ventral and dorsal interiors of *Notoparmella,* distinguished it from *Notanoplia, Boucotia,* and the rare genus *Callicalyptella.*

Range: Late Silurian (?Ludlovian) to Early Devonian (Lochkovian).

Notoparmella plentiensis sp. nov.
(Plate 5, figs. 1-27; plate 6, figs. 1-3)

Derivation of name: After the hamlet of Plenty.

Holotype: Specimen NMVP 49695 which is an internal mould of an articulated specimen, and is illustrated pl. 5, figs. 1, 2 herein.

Paratypes: NMV P49601, NMV P49603-4,NMV P49607-8, NMV P49610, NMV P49613-14, NMV P49616, NVM P49625, NMV P49628, NMV P49637, NMV P49641-2, NMV P49644, NMV P49647, NMV P49652, NMV P49664, NMV P49666, NMV P49674, NMV P49697, NMV P49699.

Figured Specimens: NMV P496750 & b, NMV P49751.

Type locality: Locality A17, a small road cutting on the west side of the Whittlesea-Plenty Road. Coords. 104800 Kinglake 1:50,000 Military map.

Type strata: Humevale Formation.

Material: A total of 121 specimens comprising 25 external and 51 internal moulds of the ventral valve and 21 external and 24 internal moulds of the dorsal valve from the type locality. The high ratio of dorsal to ventral valves suggests sorting prior to deposition.

Description: Exterior: The valves are small, not exceeding 7.2 mm in width and 5.5 mm in length. They are semicircular in outline and plano-convex, more rarely concavo-convex in lateral profile. The hingeline is straight and is usually equal to the maximum width of the

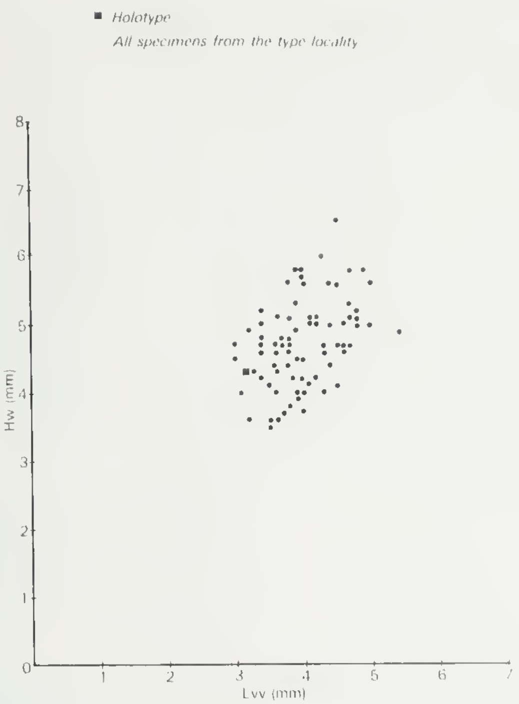

Figure 4. Scatter diagram of Hw:Lvv *Notoparmella plentiensis* sp. nov.

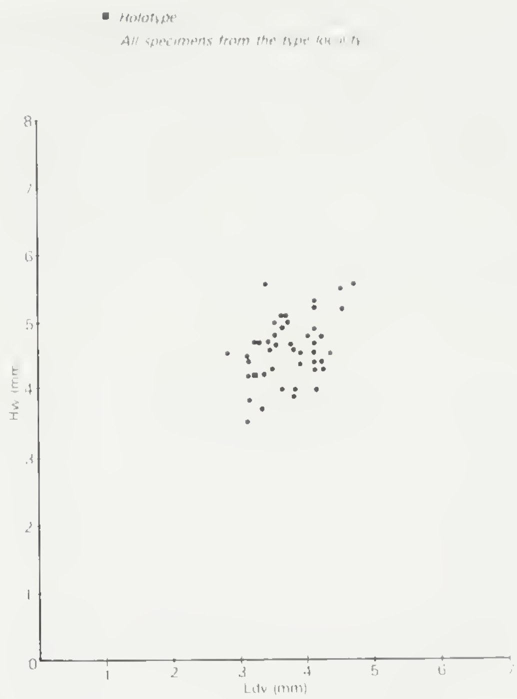

Figure 5. Scatter diagram of Hw:Ldv *Notoparmella plentiensis* sp. nov.

shell. A low apsacline area is developed in the ventral valve which is interpreted as a ventral interarea. It either extends to the cardinal extremities of the shell as a low ridge or terminates two thirds of the distance to the cardinal extremities of the valve. The dorsal posterior margin is linear. The ventral valve is gently to highly convex, the median portion being modified by the development of a median furrow. The dorsal valves bear a broad ill-defined sulcus which fades laterally into the flanks of the valve. The dorsal valve bears a median narrow costella, originating anterior to the umbo and extending to the anterior commissure.

The exterior of the shell if finely costellate (pl. 5, figs. 5, 8, 11) with the costellae increasing anteriorly by intercalation.

Interior of the ventral valve: The hinge teeth are relatively large and formed without any development of ventral adminicula. They are widely divergent and project beyond the hingeline. The delthyrium is triangular and wide. The posterior portion of the floor of the cavity is sculptured by a triangular diductor muscle field (pl. 5, figs. 16, 19). In larger specimens the muscle scar is deeply impressed and extends anterolaterally for one third of the distance to the commissure, where its width is equal to two thirds of the width of the valve at this position. The posterior angle of the postero-lateral borders of the muscle field is approximately 90°. The interior is smooth apart from a median septa which originates a short distance from the ventral diductor field and bifurcates at approximately three-quarters of the length of the valve. The anterior rim of the valve is sculptured by grooves which probably reflect the position of setae in life.

Interior of the dorsal valve: The sockets are shallow and widely divergent. They are defined by short divergent socket ridges originating from the apex of the notothyrium. The socket plates fuse posteriorly to form a transverse structure that curves around posteriorly duplicating the scroll-like cardinal structure of *Notanoplia, Boucotia* and *Callicalyptella.*

A well-defined, low dorsal median septum originates anterior to the scroll-like cardinalia (the cardinal plate of Boucot and Johnson, 1972, p. 392) and bifurcates three-quarters of the distance to the anterior commissure. The interior is smooth except for the faint impressions formed by costellae adjacent to the anterior commissure.

Discussion: The high convex ventral valve well developed ventral median septum and the costation of the shell serve to distinguish *Notoparmella plentiensis* sp. nov. from the type species *N. gilli. N. plentiensis* is the oldest notanopliid found to date. It is associated with *Gracianella* and *Plectodonta bipartita* and occurs in rocks overly strata containing *Bohemograptus bohemicus* by 100 m at Plenty. Accordingly probably Ludlovian in age.

Occurrence: Localities A15 and A17 coords. 095812 and 103,803 Kinglake 1:50,000 Military map, near Plenty, and loc. W78 coords. 507865 Glenburn 1:50,000 Military map, Glenburn, Victoria of the Humevale Formation, which may be Pridolian or Lochkovian in age. Also occasionally at Pl. 260 in the Upper Dargile beds of Christmas Hills, coords 325562 Yan Yean 1:63360 Military map, which are probably Pridolian.

Range: Late Silurian (Ludlovian to ? Pridolian) to ? Early Devonian (Lochkovian).

Genus **Notanoplia** Gill, 1951a
Type species: Notanoplia pherista Gill, 1951a, p. 250-252, pl. 1, figs. 29-32.

Diagnosis: Notanopliinids lacking crested septa, i.e. with smooth septa. Exterior smooth or rarely ornamented with fine costellae.

Discussion: Gill (1969, p. 1226) clarified the generic diagnosis of *Notanoplia.* He recognised that the morphology of the septa in the ventral and dorsal valves of *Notanoplia* contrasted with those of *Boucotia australis* (Gill), *B. withersi* (Gill) and *B. loyolensis* (Gill), which he had earlier assigned to *Notanoplia,* by these latter species having crested septa. This distinction was well illustrated by him. [See illustrations of *N. pherista* (Gill, 1969, pl. 143, figs. 1, 2, 5, 6) with those of *Boucotia australis* (pl. 143, figs. 9, pl. 143, figs. 8, 10) and *B. loyolensis* (pl. 144, figs. 19, 21)]. Illustrations of *B. withersi* do not show the crested septa but examination of Gill's hypotypes confirms their presence.

The generic distinction of *Notanoplia* from *Boucotia* is supported herein, even though considerable variation in the arrangement and morphology of the median and lateral septa occur in both genera. Smooth specimens of *Notanoplia* and *Boucotia* are homoeomorphic.

Notanoplia is almost entirely restricted to the Early Devonian of south eastern Australia. Only *N. panifica* sp. nov. is known from pre-Devonian deposits.

Three species are recognised: (1) *N. panifica* sp. nov. from the upper Dargile Formation of Christmas Hills, Victoria (? Late Ludlovian-Pridolian) is the only Silurian species known; (2) *N. pherista* from widely scattered localities of the Lochkovian to Praguian of south eastern Australia; and (3) *N. philipi* sp. nov. from Lilydale and Tyers, Victoria (late Lochkovian).

Species rejected from Notanoplia

Gratsianova (1967, p. 18, 52-54, pl. 3, figs. 17-19) described a form as *Notanoplia ganiensis* Gratsianova from the lower Devonian of the Horn Mountains near Kamishenko, Siberia, U.S.S.R. However, her illustrations show that it has well developed ears, a smooth exterior, high convex ventral valve and very short lateral and median septa. This assignment to *Notanoplia* is not accepted; the species probably merits erection of a new genus of the Anopliidae.

Species questionably assigned to Notanoplia

Langenstrassen (1972, p. 52, pl. 3 fig. 11) described *Notanoplia* sp. from the Rhenish lower Devonian of Germany (Siegenian). Externals of this species are unknown but it probably belongs to *Notanoplia.*

Xu (1979, p. 379) recorded *Notanoplia* from the lower Devonian (Siegenian) of north east

Dimensions of some specimens in mm

Specimen Number	Hw	Mw	Lvv	Ldv	(v) Lms	(d) Lms	(v) <ls	(d) <ls	Wd	Hd	costellae per mm
NMV P14827	11.1	11.1	7.1		5.8		105°		3.1	1.0	
NMV P14828	8.0	8.0		9.7		6.0		90°			
NMV P25557	6.6	9.6	8.1		5.8		90°				
NMV P25559	7.8	8.6	7.4		6.2		90°				
NMV P25561	6.0	6.0	8.4		7.4		80°				6
NMV P25562	9.4	10.1	8.2		8.0		90°				
NMV P25563	7.6	9.8	6.1		4.6		100°				
NMV P25564	5.7	7.7		7.9							
NMV P49721	3.1	4.4	2.8		2.1		90°				
NMV P49722a & b	6.5	7.2	5.0		5.0		90°				
NMV P14790	5.8	6.1	5.3								7-8

China, but no illustration or description of this species is known.

Notanoplia pherista Gill, 1951a

(Plate 6, figs. 1-18)

Synonymy:

1945 *Notanoplia australis* (Gill) – Gill, p1. V111, fig. 4.
1951a *Notanoplia pherista* Gill, p. 250-252 pl. 1, figs. 29-32.
1969 *Notanoplia pherista* Gill – Gill, p. 1226-7 pl. 143, figs. 8 (*non* figs. 1-7), pl. 144, figs. 22-23.
1974 *Notanoplia pherista* Gill – Savage, p. 27-28 pl. 6, figs. 1-20, Text figs. 10A, B.

Holotype: Specimen NMV P14827, which is an internal mould of the ventral valve; described and illustrated by Gill (1951a, p. 250-1, p1. 1, figs. 29, 30).

Paratype: Specimen NMV P14828a, which is an internal mould of the dorsal valve, described and illustrated by Gill (1951a, p. 251, p1. 1, fig. 31).

Figured Specimens: ~~NMV P14790~~, NMV P14827b, NMV P5557, NMV P25559, NMV P25561-4, NMV P49721 and NMV P49722a & b.

Diagnosis: Notanopliinids lacking crested septa in both valves; external ornament fine costellate or smooth.

Type locality: Right bank of the Little Henty River, 1.5 km south east of Zeehan, Tasmania; loc. 16 of Gill (1951a, p. 250).

Type Strata: Bell Shale (Early Devonian).

Material: A total of 16 individuals are known from the type locality, including 9 internal moulds of the ventral valve, 5 internal and 2 ex-

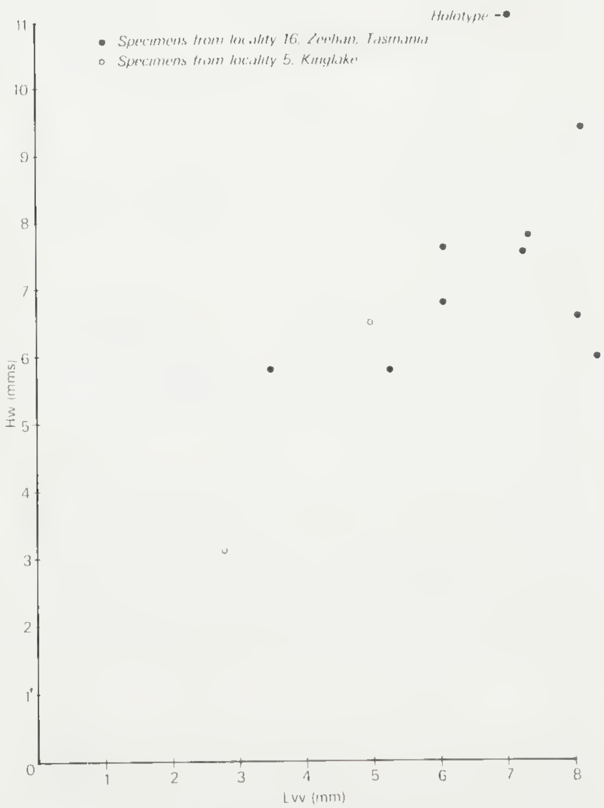

Figure 6. Scatter diagram of Hw:Lvv for *Notanoplia pherista* Gill.

Figure 7. Scatter diagram of Hw:Ldv for *Notanoplia pherista* Gill.

ternal moulds of the dorsal valve. This description is augmented by 4 specimens from Kinglake, including two internal moulds and one external mould of the ventral valve and one internal mould of an articulated specimen.

Occurrence: N. pherista is an occasional species of the benthos of the Bell Shale of Tasmania. It is rare in the Humevale Formation of the Kinglake district and occasional in the Maradana Shale of New South Wales.

Description: Savage (1974, p. 27, 28) fully described *N. pherista* from the Maradana Shale, Manildra, N.S.W. Examination of all known topotypes from loc. 16, Bell Shale of Zeehan, Tasmania shows that the species is variable in outline and in external ornamentation.

Exterior: Some of the topotype material is smooth, with concentric growth lines as in NMV P14790 (pl. 6, fig. 6) or faintly costellate as in NMV P25561. The outline is more transverse in the holotype NMV P14827 with maximum width of 11.1 mm at the hingeline and 7.1 mm in length. The Manildra material is commonly shield shaped.

Interior of the ventral valve: No bifurcation of the median septum occurs in the type material but two specimens NMV P25559 and NMV P25563 show incipient development of accessory septa in the anterior portion of the valve between the median and lateral septa (pl. 6, figs. 10, 17).

Interior of the dorsal valve: Dorsal valves of the material from Manildra and Zeehan are identical.

Discussion: N. pherista has a variable external ornament but is never costate as in *N. philipi* sp. nov. *N. pherista* differs from *N. panifica* sp. nov. by its larger size and the latter has indistinct lateral septa, and is markedly costellate. *N. pherista* is easily distinguished from its external homeomorph *Boucotia australis* by lacking pitted lateral septa.

Range: Early Devonian (Lochkovian).

Notanoplia panifica sp. nov.
(Plate 6, figs. 19-26)

Holotype: NMV P49746 which is an internal mould of the ventral valve and illustrated on pl. 6, fig. 19 herein.

Paratypes: NMV P49475, NMV P49747a & b, NMV P49748a & b, NMV P49753, NMV P49754.

Type locality: P1. 260 east side of wall of Sugarloaf Reservoir, Christmas Hills, Victoria.

Type strata: Top of the Dargile Formation (? Late Ludlovian or Pridolian).

Derivation of name: From the latin *panifica* meaning loaf, after the name of the type locality.

Material: Six specimens including two internal moulds of the ventral valve and two internal and external moulds of the dorsal valve.

Dimensions of some specimens of *N. panifica* sp. nov.

Registered Number	Hw	Mw	Lvv	Ldv	(v) Lms	(v) <ms	(d) Lms	(d) <ms	costellae per mm
NMVP 49745	5.4	6.3	5.4		3.7	90°			6
NMVP 49746	4.6	5.8	4.9		3.6	90°			6
NMVP 49747A	5.5	7.0		4.6			2.5	105°	6
NMVP 49747B	5.5	7.0		4.6					
NMVP 49753	5.4	7.0	6.0		5.0	80°			
NMVP 49754	5.1	5.6		4.3					6

Diagnosis: Notanoplia with incipient lateral septa with a costellate external ornament.

Description: Shells are small, subquadrate in outline and plano-convex in lateral profile. The hingeline is straight with maximum width anterior to it. The exterior of the shell is costellate with six costellae per mm as measured at the anterior commissure.

Interior of the ventral valve: Hinge teeth are of average size for the genus and widely divergent. The delthyrial cavity is bounded by incipient lateral septa. These septa diverge anterolaterally between 80 and 90°. A strong median septum arises anterior to the apex of the delthyrial cavity and extends almost to the anterior commissure.

Interior of the dorsal valve: This is based on two dorsal valves, paratypes NMV P49747b and NMV P49748a. The median septum and faintly developed lateral septa originate anterior to the position occupied by the cardinal process—not preserved, and terminate abruptly about 1 mm from the anterior commissure. No pits are present on the septa.

Discussion: The earliest known *Notanoplia, N. panifica* is distinguished from *N. phillipi,* and *N. pherista* by its finer costellae and faint lateral septa.

Occurrence: N. panifica sp. nov. is presently known only from the type locality.

Notanoplia philipi sp. nov.
(Plate 6, figs. 27-32, plate 7, figs. 1-10, 17, 33)

Synonymy:

1962 *Notanoplia* sp.—Philip, p. 208-9, pl. 31, figs. 11-17, Text fig. 13b, c.
1969 *Boucotia* sp.—Gill, p. 1227.

Diagnosis: Notanoplia with well developed costae on the surface of the shell, and no accessory septa.

Derivation of name: In honour of Professor Graeme Philip.

Holotype: Specimen MUGD 3441a which is an internal mould of the ventral valve and illustrated by Philip (1962, pl. XXXI, fig.).

Paratypes: MUGD 3441b, MUGD 3443, MUGD 3444.

Figured specimens: MUGD 3440, NMV - P49718A, NMV P49718B, NMV P49720, NMV P25489, NMV P49723, NMV P49724, NMV P25493-4, NMV P25535, NMV P25539 and NMV P25542.

Type locality: Locality 43, Parish of Boola, near Tyers, Gippsland, of Philip (1962).

Type strata: Boola Formation.

Material: A total of 10 specimens comprising 1 external and 7 internal moulds of the ventral valve and 2 internal moulds of the dorsal valve from the type locality. Specimens are known from Lilydale including 9 external moulds and

Dimensions of some specimens of *Notanoplia philipi* sp. nov.

Registered Number	Hw	Mw	Lvv	Ldv	(v) Lms	(v) < Ls	(d) Lms	(d) < Ls	costellae per mm
MUGD 3440	5.4	5.8		4.4			4.1	100°	5
MUGD 3441a	7.2	8.1	5.8		5.5	90°			4
MUGD 3441b	5.8	6.1	5.3		5.0	80°			5
MUGD 3444	6.4	7.5	6.1		5.7	100°			5
MNVP 49718a	5.0	5.4			4.1	95°			5
MNVP 49718b	5.0	5.4	4.4						5
NMVP 49720	5.8	6.0	5.2						5
NMVP 49723	1.5	1.8	2.1	2.1					4
NMVP 49724	4.5	4.6		4.0					4
NMVP 25489	4.3	4.3		3.7					5

The latter 4 specimens are from loc. 87 Lilydale, Victoria.

one internal mould of the dorsal valve and one external mould of an articulated specimen.

Description: Exterior: The shells are small subequal in length and width, not exceeding 9 mm in width. They are subquadrate to shield-shaped in outline, and concavo-convex in lateral profile. The hingeline is straight with the maximum width anterior to the hingeline, situated about midlength of the shell and exceeding length. A low apsacline ventral interarea occurs on either side of the delthyrium and abruptly terminates half the distance to the cardinal extremities of the valve. The dorsal

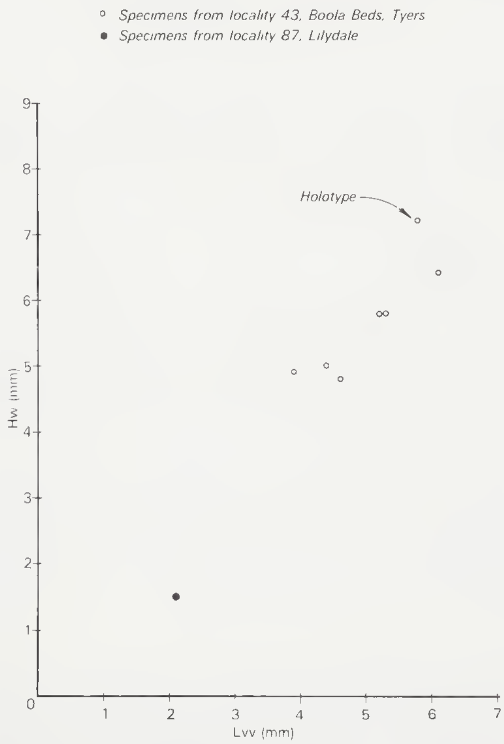

Figure 8. Scatter diagram of Hw:Lvv for *Notanoplia philipi* sp. nov.

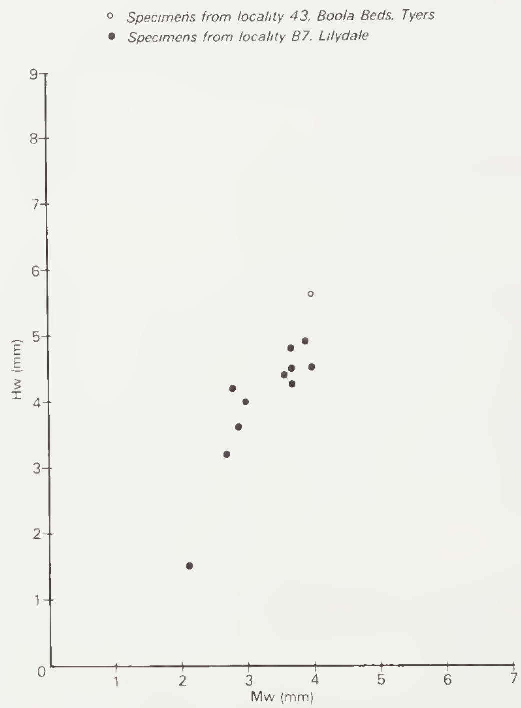

Figure 9. Scatter diagram of Hw:Ldv for *Notanoplia philipi* sp. nov.

posterior margin is linear. The ventral valve is moderately convex whilst the dorsal valve is planar to slightly concave.

The exterior of the shell is costate (pl. 6, fig 32, pl. 7, figs 2, 4-10) with the costae increasing anteriorly by intercalation. The costae originate from the umbones of the valves and the hingeline, and number 4 to 5 per mm measured at the anterior commissure.

Interior of the ventral valve: The hinge teeth are relatively large and formed without the development of ventral adminicula. They are widely divergent and project anteriorly beyond the hingeline. The delthyrium is open, triangular and wide. A narrow triangular ventral muscle field is situated in the posterior portion of the delthyrial cavity where it is flanked by the lateral septa. The lateral septa originate anterolaterally to the muscle field; they are smooth and diverge from each other at angles of 80° to 100°. A moderately deeply impressed median septum originates anterior to the ventral muscle field and bifurcates one-sixth to one-quarter of the distance to the anterior commissure. The two portions of the septum remain subparallel. The anterior rim of the valve is sculptured by grooves which probably reflect the position of setae in life.

Interior of the dorsal valve: The sockets are shallow and widely divergent. They are defined by short plate-like socket ridges originating from the apex of the notothyrium. The socket plates fuse posteriorly to form a scroll-like cardinal structure which is raised above the level of the floor of the valve and projects slightly beyond the hingeline, as illustrated by Philip (1962, pl. 31, fig. 14). A pair of divergent, smooth impressed lateral septa originate anterolaterally to the cardinalia at about the same distance as the median septum. The septum is deeply impressed and bifurcates almost immediately. The interior is sculptured with a mosaic of fine pits in MUGD 3440 (pl. 7, fig. 1) and they appear to represent the impressions of the individual shell fibres. The anterior rim of the valve is sculptured with fine grooves which correspond to the costae on the external surface; they may have borne the setae during life. Some of the grooves are punctured by larger circular depressions than the cell mosaic, and are linearly arranged. I believe these depressions to represent the position of pseudopunctae in the shell. This is supported by Dr G. A. Thomas (1978, oral comm.).

Discussion: The absence of "crested" lateral septa in both valves supports the generic placement of this species in *Notanoplia* as originally proposed by Philip (1962) rather than *Boucotia* as suggested by Gill (1969).

N. philipi is distinguished from *N. pherista* by the well developed costae on the external surface of the shell. Savage (1974, p. 28) noted that *N. pherista* is smooth to very faintly costate.

The report of pits in setal grooves has not been described elsewhere in Notanopliidae. The closeness in form, linear spacing and position recalls the linearly arranged pits of the pseudopunctae of strophomenides particularly among the Chonetidina.

Occurrence: N. philipi sp. nov. is confined to the Melbourne Trough where it is known from four localities. Loc. 43 and 54/60 in the Boola Formation 4 km west of W. 3 and Tyers Rd Junction along W 3. It is also known from loc. 87 (Gill, 1969, p. 1227) from the Humevale Formation at Lilydale.

Range: Early Devonian (Late Lochkovian).

Genus **Boucotia** Gill, 1969

Type species: Anoplia australis Gill, 1942, p. 38-9 pl. IV, fig. 8.

Diagnosis: Notanopliids with crested septa in both dorsal and ventral valves or in the ventral valve only.

Discussion: See also under discussion of *Notanoplia. Boucotia* was erected by Gill (1969, p. 1227) on the basis that all species of *Boucotia* possess crested septa in both valves. In his diagnosis and description or the type species *B. australis* he failed to include a description of illustration of the holotype

MUGD 1720. Re-examination of the holotype, has revealed that the septa in the dorsal valve lack the crested septal condition. The ventral valve does have crested septa as described by Gill (1969, p. 1228) for the species. Furthermore all specimens that Gill assigned to *B. australis* from locality 87, likewise have smooth, uncrested septa in the dorsal valve. They conform to the morphology of the holotype; as Gill noted (1969, p. 1228) it "is difficult to demonstrate the crestal furrows on the crest septa". His illustrations (pl. 143, figs. 13-18) apparently show well developed crestal furrows (see particularly his pl. 143, figs. 14, 16 and 18). However, detailed examination of his dorsal valve latex cast and the specimen P25497 does not reveal any trace of crestal furrows on the septa. Specimen P25551 illustrated by Gill (1969, pl. 144, fig. 11) from locality 23, which is in the lower part of the Humevale Formation does have crested septa in both valves. This condition occurs in all specimens examined from the lower part of the Humevale formation at Lilydale. It is the ancestral condition of the genus. It is here described as *Boucotia janaea* sp. nov. Other species of *Boucotia, B. withersi* (Gill) and *B. loyolensis* (Gill) have crested septa in both valves.

Species assigned to Boucotia: B. australis, B. withersi, B. janaea sp. nov. and *B. loyolensis*; all from the Lower Devonian of the Tasman Subprovince. *B.* aff. *australis* from the Guguro-Chumikansk Region of far eastern U.S.S.R. (Gratsianova and Schisckina, 1977, p. 2) belongs to *Boucotia,* but its specific affinities remain doubtful until dorsal valves of the species are described.

Species rejected from Boucotia: B. incognita Langenstrassen, 1972, from the Middle Devonian of Germany. This species belongs to *Plicanoplites* Havlicek, 1974.

Range: Early Devonian (Lochkovian to ? Zlichovian).

Boucotia australis (Gill, 1942)
(Plate 7, figs. 11-16, 18-31)

Synonymy:

1940 *Anoplia* sp. nov.,—Gill, pp. 251, 255–6 (name only).
1941 *Anoplia* sp. nov.—Gill, p. 157 (name only).
1942 *Anoplia australis* Gill, p. 38-39, pl. 1V, fig. 8.
1945a *Anoplia australis* Gill—Gill, p. 144.
1945b *Anoplia australis* Gill—Gill, p. 123 (name only).
1948 *Anoplia australis* Gill—Gill, p. 13 (name only).
1949 *Anoplia australis* Gill—Singleton, p. 251.
1950a *Anoplia australis* Gill, p. 85 (name only).
1950b *Anoplia yeringae* Gill (nom. nud.) p. 52 fig. 2c.
1950b *Anoplia australis* Gill—Gill, p. 52-53 (name only).
1951a *Notanoplia australis* (Gill)—Gill p. 251 (name only).
1951b *Notanoplia australis* (Gill)—Gill p. 64.

Dimensions of some specimens of *Boucotia* australis (Gill)

Registered Number	Hw	Mw	Lvv	Ldv	(v) Lms	(v) <ls	(d) Lms	(d) <ls	setae per mm
MUGD 1720 (Holotype)	5.0	5.8	4.3	4.3	3.2	90°	2.4	90°	
NMV P25475	3.9	4.4	3.4		2.8	85°			
NMV P25483	5.3	5.3	4.7	4.7	?	?	4.1	?	4
NMV P25496	4.4	5.0		4.6			3.5	70°	5
NMV P25497	4.6	4.6		3.7			2.5	75°4	
NMV P25505	4.8	4.8	3.9		1.7	90°			
NMV P25506	3.4	3.7	3.3		2.8	65°			
NMV P25507	3.6	4.0	3.0	3.0	2.1	75°	?	90°	
NMV P25508	3.5	3.8	3.1		?				
NMV P25511	2.3	2.5	2.2		1.8	80°			
NMV P25526	3.4	3.4	2.8		2.2	80°			
NMV P25503	5.5	5.5	4.6		3.8	?			
NMV P25514	5.3	5.1	3.6	3.6	3.1	80°	3.2		

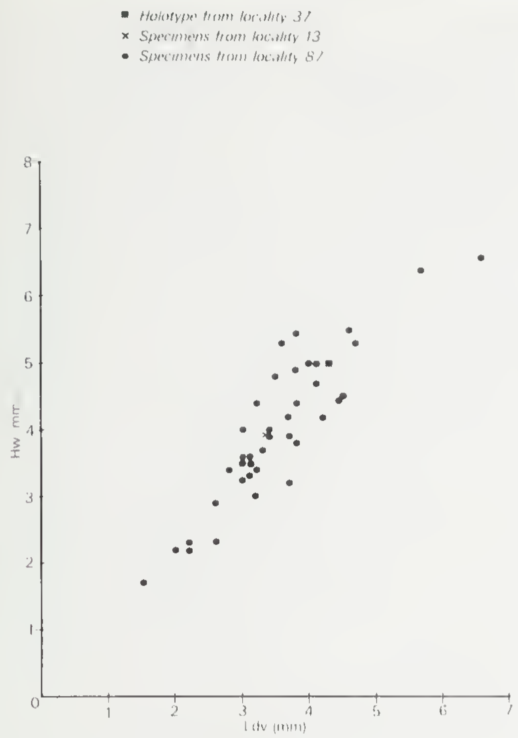

Figure 10. Scatter diagram of Hw:Lvv for *Boucotia australis* (Gill)

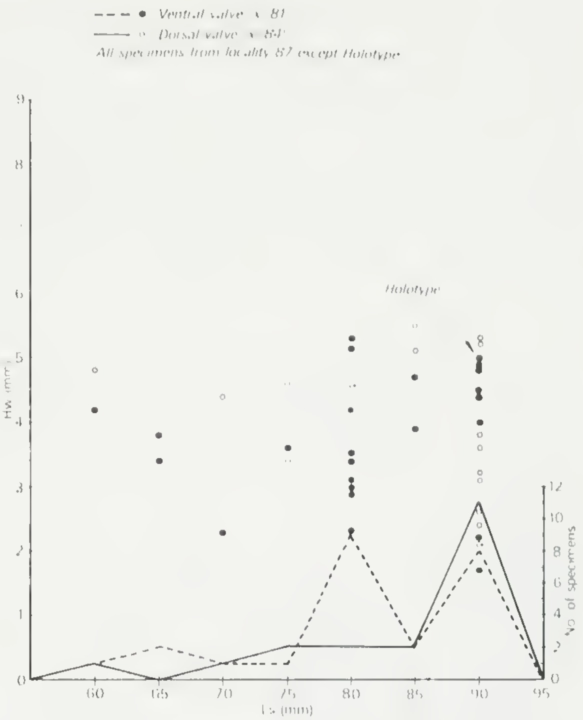

Figure 11. Diagram of Hw:<ls for *Boucotia australis* (Gill), frequency plotted as a curve.

1960 *Notanoplia australis* (Gill)—Philip p. 147, 150 (name only).
1962 *Notanoplia australis* (Gill)—Philip p. 206-7, pl. XXXI, figs. 9, 10, Fig. 13a.
1965 *Notanoplia australis* (Gill)—Gill p. 120 (name only).
1969 "*Notanoplia*" *australis* (Gill)—Boucot, Johnson, Talent, p. 89, pl. 10, figs. 7, 9.
1969 *Boucotia australis* (Gill)—Gill, p. 1227-9, text figs. 3, 4, pl. 143, figs. 9-21, pl. 144, figs. 1-10, 13, 14.
1972 *Boucotia australis* (Gill)—Strusz, p. 432-3 (name only).
1974 *Boucotia australis* (Gill)—Savage, p. 29 (name only.)
?1977 *Boucotia* aff. *australis* (Gill)—Gratsianova and Schisckina, p. 27, 28, pl. XXII, figs. 6, 7.

Diagnosis: Boucotia with crested septa in the ventral valve.

Holotype: MUGD 1720 which is an internal mould of an articulated specimen described by Gill (1942, p. 38, 39, pl. IV, fig. 8).

Figured specimens: NMVP 25475, NMVP 25497, NMVP 25503, NMVP 25505-8,

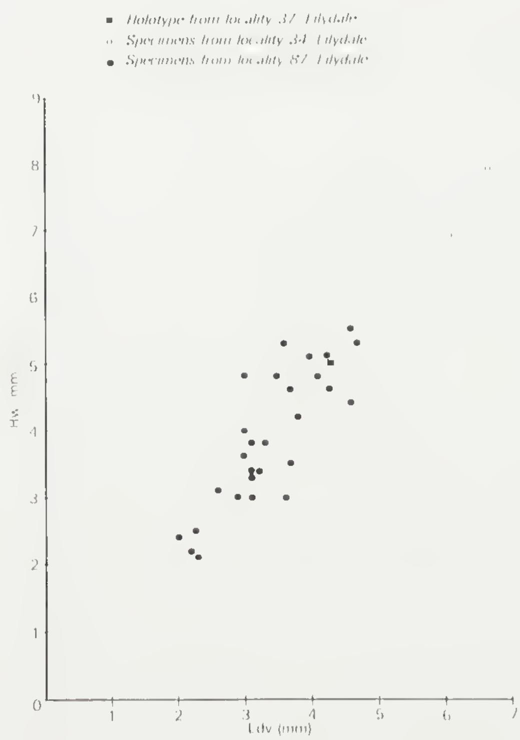

Figure 12. Scatter diagram of Hw:Ldv for *Boucotia australis* (Gill).

NMVP 25514, NMVP 25501, NMVP 25483, NMVP 25496, MUGD 3439a & b, MUGD 3442.

Type locality: Seville Quarry on Warburton Highway, approx. 2 km east of Seville. Coords. Ringwood 1:63360, 497413; it is locality 37 of Gill (1945a, p. 184).

Type strata: Humevale Formation.

Material: Description is based on 33 ventral and 23 dorsal valves and 6 internal moulds of conjoined valves from loc. 87 (Gill, 1969), 1 ventral valve from loc. 13 (Gill, 1942) and 1 internal mould of articulated specimen from loc. 37.

Description: The holotype MUGD 1720 which is an articulated specimen from locality 37, Seville Quarry, Seville, Victoria has not been adequately described or illustrated. This is rectified and comparisons are made with collections from other localities where variation in morphology are apparent.

Despite a detailed search at the type locality and in collections stored at the National Museum of Victoria and the Melbourne University Geology Department, no topotype material has been found.

Exterior: The shells are small, with a variable outline ranging from shield shaped to quadrate. The width exceeds the length of the shell. They are concavo-convex to plano-convex in lateral profile. The hingeline is straight with a maximum width usually anterior to the hingeline, but in NMV P25512, P25526 (pl. 7, fig. 31) and P25454 for example the maximum width is at the hingeline. A low apsacline ventral interarea occurs on either side of the delthyrium and terminates about half the distance to the cardinal extremities of the valve. The ventral valve is moderately convex whilst the dorsal valve is planar to slightly concave.

The surface of the shell is usually smooth but in NMV P25547 and P25548 concentric growth lines are located near the anterior commissure.

Interior of the ventral valve: The hinge teeth are relatively large lacking ventral adminicula. The delthyrium is open, triangular and wide. A narrow pedicle tube (Gill, 1969, p. 1227) lies on the floor of the delthyrial cavity, posterior to the median septum. It is well preserved in NMV P25475 and NMV P25506 (pl. 7 figs. 15, 24, 25). The lateral septa originate anterolaterally to the muscle field and diverge from each other at an angle of 60° to 90° (mean 81° (Fig. 11) in specimens from loc. 87). The lateral septa are narrow but in the holotype MUGD 1720, they broaden out towards the lateral edges of the valve. The crests of the lateral septa are grooved. A low narrow median septum arises anterior to the pedicle tube and terminates abruptly approximately 1 mm from the anterior commissure. In the holotype MUGD 1720 it is broad low and triangular in shape. It occasionally bifurcates as in NMV P25507 (pl. 7, figs. 26, 27). In NMV P25505 (pl. 7, fig. 23) the septum originates in mid length. The crestal furrows give a beaded appearance to the septum, in internal moulds.

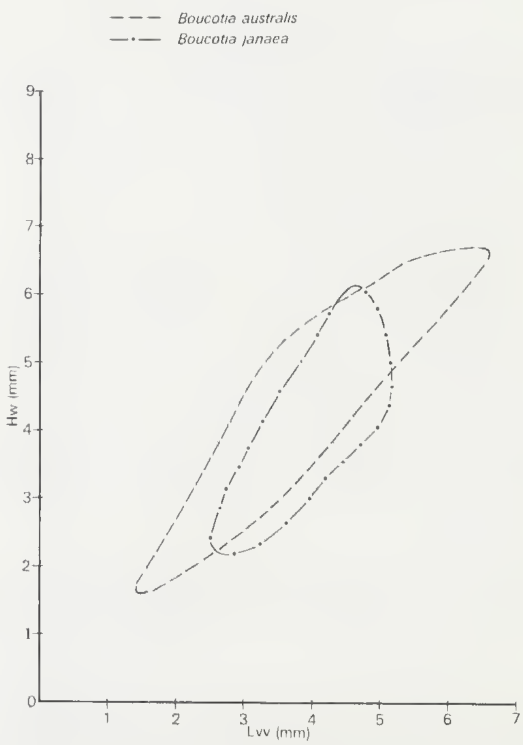

Figure 13. Envelopes surrounding points in graphs of Hw:Lvv in Figures 10 & 14.

Interior of the dorsal valve: The sockets are widely divergent. They are defined by short plate-like socket ridges originating laterally to the scroll-like cardinal process. The cardinal process is raised above the floor of the valve and recurves posteriorly to project beyond the hingline (pl. 7, fig. 20). The lateral septa are smooth and linear but in NMV P25495 and NMV P25497 they are slightly curved and project anteriorly (pl. 7, fig. 20). Divergence of the lateral septa from the cardinalia is between 60° and 90° (mean 84° in specimens from loc. 87). Dorsal median septum is narrow, linear arises anterior to the cardinalia and terminates abruptly between 1 mm and .5 mm from the anterior commissure. The anterior margin is sculptured by fine grooves 4 to 5 per mm which are probably setal grooves. These were termed capillae by Gill (1969, p. 1228). Otherwise the surface is smooth.

Discussion: The absence of septa (i.e. smooth septa) in the dorsal valve of *Boucotia australis* distinguishes it from *B. janaea* sp. nov. which has pitted crested septa in the dorsal valve. *B. withersi* and *B. loyolensis* are distinguished from *B. janea* by having 5 and 7 crested septa respectively in the dorsal and ventral valves. Gill (1951a, p. 64) stated that "there is a smaller variety of this species (his concept of *B. australis*) present at Ruddock's Quarry and many other Lower Yeringian localities, while in the Upper Yeringian this species is represented by a larger variety". This claim has not been verified in the present study. Scatter diagrams of *B. australis* and *B. janaea* show similar size ranges of populations separated by thousands of feet of strata (see Fig. 13). Gill (op. cit.) also stated that "there are small differences in structure". An assessment of the angle between the lateral septa of *B. australis* and *B. janaea* both show that the angle between the lateral septa of the dorsal valve is larger than that of the ventral valve. Mean for angle in ventral valve 80.4° and 81°, and dorsal valve, 86.4° and 84° for *B. janaea* and *B. australis* respectively. These differences are not considered significant.

The persistent difference in the angles of the lateral septa of the ventral and dorsal valve of both species allows the septa to overlap as illustrated by Gill (1969, text fig. 4, p. 1228), with one significant modification, the lateral septa of the ventral valve lie *inside* those of the dorsal valve. His drawing of P25483 has the dorsal and ventral valves reversed!

The lateral and median septa of the shell are thought to have functioned as lophophore supports in a similar manner to those of the Chonetacea as postulated by Grant (1976, p. 65, text fig. 11) for *Chonetina.*

Occurrence: B. australis is known from Gill's loc. 1, 3, 13, and 87 of the Lilydale district. It is known from Kinglake (w5) and Heathcote districts (loc. 54, Parish of Redcastle Talent, 1965).

Range: Early Devonian (Late Lochkovian to Early Praguian).

Boucotia janaea sp. nov.
(Plate 7, fig. 32, Plate 8, figs. 1-7, 9-25)

Synonymy: 1969 *Boucotia australis* (Gill)—Gill, pl. 144, fig. 10.

Diagnosis: Boucotia with three crested septa in both valves.

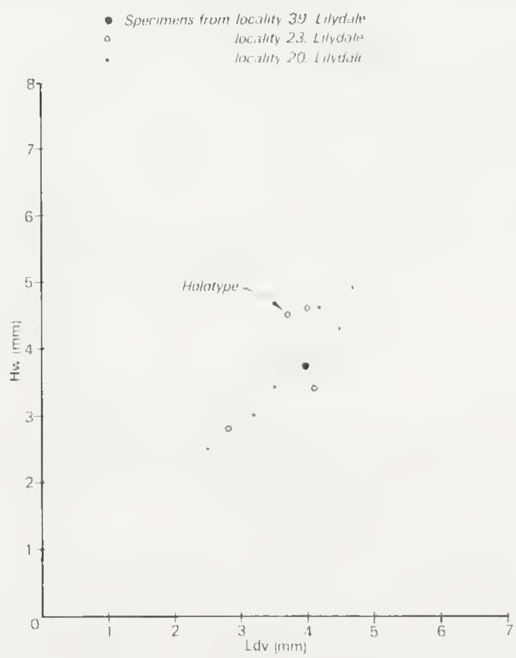

Figure 14. Scatter diagram of Hw:Lvv for *Boucotia janaea* sp. nov.

Dimensions of some specimens of *Boucotia janaea* sp. nov.

Registered Number	Hw	Mw	Lvv	Ldv	(v) Lms	(d) Lms	(v) <ls	(d) <ls	Setae per mm
NMVP 25471	4.9	6.1		4.7					3
NMVP 49728	3.4	4.1		3.5		2.3	90°		
NMVP 49729	3.0	4.6		3.2		2.5	90°		
NMVP 49730	3.8	4.8	4.5		2.9		80°		
NMVP 49731	5.0	5.4	5.0		4.0		80°		
NMVP 25465	3.4	4.2	4.1	4.1	3.3	3.3	80°	90°	
NMVP 25478	4.6	4.6	4.0	4.0	3.0	3.0	70°	85°	

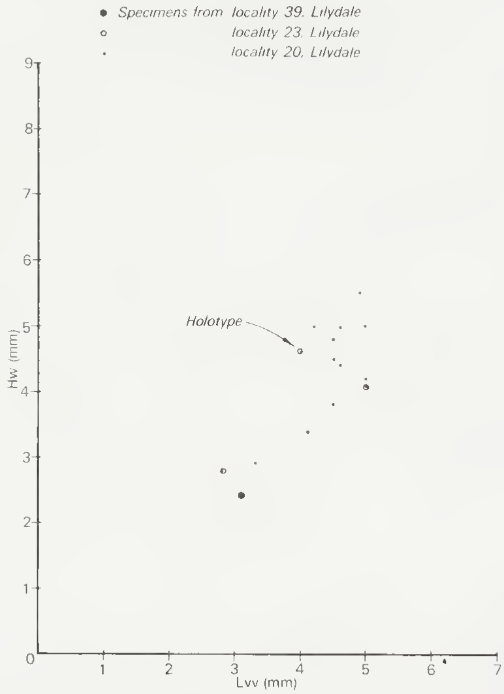

Figure 15. Scatter diagram of Hw:Ldv for *Boucotia janaea* sp. nov.

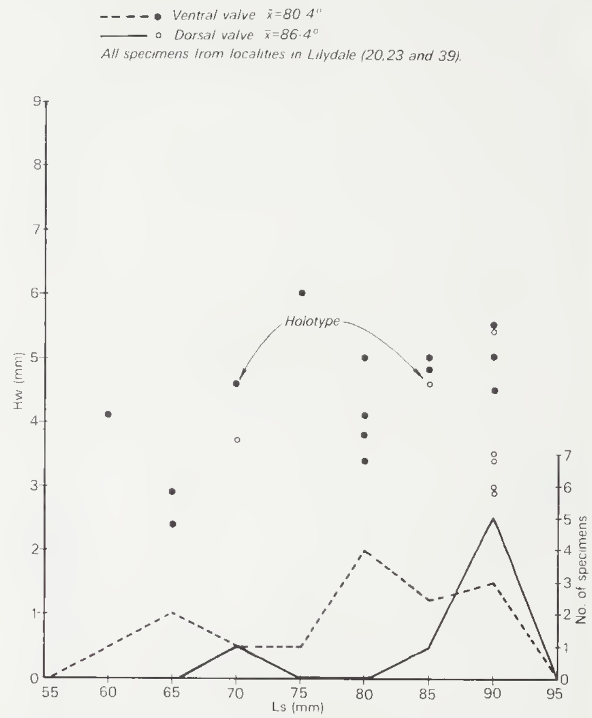

Figure 16. Diagram of Hw: ls for *Boucotia janaea* p. nov. with frequency plotted as curve. All specimens are from locs. 20, 23 and 39, Lilydale Victoria.

Derivation of name: After Jan, whose help and support in this paper is gratefully acknowledged.

Holotype: NMV P25478, which is an internal mould of an articulated specimen, figured herein, pl. 8, figs. 3-5.

Paratypes: NMV P25465, NMV P25551.

Figured Specimens: NMV P25471, NMV P49730, NMV P49731.

Type locality: Loc. 23, north of Ruddock's Quarry, Lilydale (Gill, 1940, p. 260).

Type strata: Humevale Formation.

Material: Description based on a total of 26 specimens of which two articulated specimens, two dorsal and 3 ventral valves are known from the type locality.

Description: The outline, range in size and shape replicates that of *B. australis* (text figs. 13, 14, 15).

Exterior: Shells are smooth.

Interior of ventral valve: Similar to the interiors of the ventral valve of *B. australis.*

Interior of dorsal valve: Lateral and median septa are smooth and show no pitting as in *B. australis.* Grooves interpreted as setal grooves are preserved near the anterior margin of the valve in two specimens from 2 to 3 per mm. Otherwise the interiors are similar to *B. australis.*

Discussion: See under *B. australis.*

Occurrence: Uncommon representative of the benthos in the lower part of the Humevale Formation at Gill's localities 20, 23, 3. Rare at localities P120, P98 and A4 north west of Whittlesea (Williams, 1964).

Range: Early Devonian (Lochkovian).

Boucotia loyolensis (Gill, 1951b)
(Plate 8, figs. 34-41)

Synonymy:

1913 *Leptaena rhomboidalis*, (Wilkins)—Chapman, p. 103-4, pl. X, figs. 6, 7.
1951b *Notanoplia loyolensis* Gill, p. 63-64, pl. 3, figs. 1-4.
1962 *Notanoplia loyolensis* Gill—Muir-Wood, pl. 5, figs. 8a, 8b.
1965 *Notanoplia loyolensis* Gill—Couper, p. 7.
1965 *Notanoplia loyolensis* Gill—Muir-Wood, p. 11426, Fig. 284.
1969 *Boucotia loyolensis* (Gill)—Gill, p. 1230, pl. 155, figs. 19-21.
1972 *Boucotia loyolensis* (Gill)—Strusz, p. 441 (name only).
1974 *Boucotia loyolensis* (Gill)—Savage, p. 29 (name only).

Holotype: NMV P12403 which is an internal mould of the ventral valve, originally illustrated by Chapman (1913, pl. X, Figs. 6, 7) and later by Gill (1951, pl. 111, figs, 1-4) and Muir-Wood, 1965, p. H426, Fig. 284, 3b, c; it was discovered by Mr. George Sweet.

Figured specimens: NMV P25542, NMV P28003, NMV P28035, NMV P49720, NMV P49740-2.

Type locality: Near Loyola, Quarry south west of Mansfield.

Type strata: Norton Gully Sandstone.

Material: A rare species at every locality where it has been found. Description is based on a total of 5 internal moulds of the ventral valve and 3 internal moulds of the dorsal valve. Dimensions of figured specimens of *Boucotia loyolensis* are shown overleaf.

Description: A full description of *B. loyolensis* is given because until now the interior of the dorsal valve was unknown.

Exterior: Shells average size for the genus, subquadrate in outline with a straight hingeline. The maximum width is usually anterior to the hingeline at about mid-length of the shell. A low apsacline ventral interarea flanks the open delthyrium extending two-thirds of the distance to the cardinal extremities of the shell. The ventral valve is convex whilst the dorsal is slightly concave. Exterior of the shell unknown.

Dimensions of figured specimens of *Boucotia loyolensis*

Registered Number	Hw	Mw	Lvv	Ldv	(v) Lms	(d) Lms	(v) $<as_1$	(v) $<ls$	(v) $<as_2$	(d) $<as_1$	(d) $<ls$	(d) $<as_2$	Costae per mm	Hd	Wd
NMV 25542	2.5	2.5		2.5									3		
NMV 49720	3.0	3.0		2.3		2.3				20°	75°	120°			
NMV 12403	6.8	7.2	5.7		3.8		40°	90°	140°					1.2	1.7
NMV 28003	6.0	6.6	5.8		5.6		30°	90°	130°						
NMV 28035	4.7	5.2	4.2		3.8		30°	90°	140°						
NMV 49740	4.7	5.7	4.6		3.7		30°	90°	130°						
NMV 49741	4.0	5.0		3.8		3.2				35°	95°	150°			
NMV 49742	5.6	6.0	5.5		4.4		45°	90°	130°						

Interior of the ventral valve: The hinge teeth project anteriorly beyond the hingeline in holotype NMV P12403, are divergent and formed without any development of ventral adminicula. In NMV P28003 (pl. 8, fig. 34) a narrow ventral muscle field is situated posterior to the median septum and flanked by the second pair of lateral septa. Three pairs of lateral septa are present, the inner and outermost pairs originating mid way to the anterior commissure whilst the middle pair originate close to the ventral umbo. In NMV P28003 the outer pair are smooth, pits only being developed on the middle, inner pairs of lateral septa and the median septum. In the holotype only the inner pair of laterals are smooth. The inner pair of lateral septa diverge at an angle of 30° to 45°, middle pair at 90°, and the outer pair between 130° and 140°. All three pairs of lateral septa and the median septum broaden anteriorly.

Interior of the dorsal valve: The sockets are shallow and widely divergent. The cardinal process is not preserved. The arrangement, development and form of the lateral septa replicates those of the ventral valve. Angle of divergence of the inner pair of lateral septa is between 20° and 35°, middle pair 75° to 95°and the outer pair 120° to 150°. The outer pair are smooth, whilst the inner and middle pairs of lateral septa are pitted.

Occurrence: Most of the specimens of *B. loyolensis* have been found in the Eildon district in the Norton Gully Sandstone, at Loloya Quarry near Mansfield, Jerusalem Creek, near Eildon, and 12 chains southwest of low saddle at the head of the right branch of Cales Creek, a tributary of the Big River near Enoch's Pt. Two other occurrences should be noted, locality 10 of Harris and Thomas (1942) at Yea in the Flowerdale Conglomerate Member (Couper, 1965) and locality 87, Lilydale in the upper beds of the Humevale Formation (Gill, 1969) (pl. 8, fig. 36).

Range: Early Devonian (Late Lochkovian to Praguian).

Boucotia withersi (Gill, 1942)
(Plate 8, figs. 26-33)

Synonymy:

1942 *Anoplia withersi*Gill— Gill, p. 39, pl. IV, fig. 7.
1945a *Anoplia withersi* Gill, p. 144-5.
1947 *Anoplia withersi* Gill—Gill, p. 13 (name only).
1949 *Anoplia withersi* Gill—Singleton, p. 251 (name only).
1950a *Anoplia withersi* Gill—Gill, p. 85 (name only).
1950b *Anoplia withersi* Gill—Gill, p. 52, 53 (name only).
1951 *Notanoplia withersi* (Gill)—Gill, p. 251 (name only).
1960 *Notanoplia withersi* (Gill)—Philip, p. 150 (name only).
1964 *Notanoplia withersi* (Gill)—Williams, p. 282 (name only).
1969 *"Notanoplia" c.f. withersi* (Gill)—Boucot, Johnson & Talent, p. 89, pl. 10, fig. 8.
1969 *Boucotia withersi* (Gill)—Gill, p. 1229, pl. 143, Figs. 21, pl. 144, figs. 1, 12, 15-18.
1972 *Boucotia withersi* (Gill)—Strusz, p. 432 (name only).
1974 *Boucotia withersi* (Gill)—Savage, p. 29 (name only).

Holotype: MUGD 1721, which is an internal mould of the ventral valve and described by Gill (1942, p. 39, pl. IV, fig. 7).

Figured specimens: NMV P25446, NMV P25447, NMV P25456, NMV P25458, NMV P25459.

Type locality: Symes Tunnel, Killara; loc. 34 of Gill (1945a, p. 184).

Type strata: Humevale Formation.

Diagnosis: Boucotia with two pairs of lateral septa in each valve.

Material: 3 internal moulds of the ventral valve and one internal and external mould of the dorsal valve.

Description: Exterior: Only dorsal exterior is known, which bears faint costae. The outline, convexity of valves and size correspond to *B. janaea* sp. nov.

Interior of the ventral valve: The open delthyrium, teeth and pedicle tube of *B. withersi,* are identical to those of *B. australis.* The

Dimensions of figured specimens of *B. withersi*

Registered Number	Hw	Mw	Lvv	Ldv	(v) Lms	(d) Lms	(v) $<as_1$	(v) $<ls$	(d) $<as_1$	(d) $<ls$
MUGD 1721	3.8	4.7		4.0						
NMV P25446	4.5	4.8		4.1		2.6			30°	90°
NMV P25447	4.2	4.4	3.9		3.3		75°	75°		
NMV P25456	5.4	7.0	5.6		5.0		90°	90°		
NMV P25458	4.6	5.3	4.2		4.0		40°	90°		
NMV P25459	5.3	6.5	6.5		3.6		30°	90°		

muscle field is not preserved. The lateral septa are crested and diverge at an angle 75° to 90°. They are usually narrow but in NMV 25459 they are deeply incised and broader anteriorly. The median septum originates anterior to the pedicle tube and terminates abruptly close to the anterior commissure. The accessory lateral septa originate between the lateral and median septa in two ways, as described by Gill (1969, p. 1229). They either (1) originate close to the lateral septa in the posterior portion of the valve as in NMV 25459 (pl. 8, fig. 33) diverging at an angle of 30° to 40°, or (2) arise from the median septum at its mid length diverging parallel to the lateral septa as in NMV 25456 (pl. 8, fig. 31) NMV 25447 (pl. 4, figs. 29, 30). The accessory septa are smooth.

Interior of the dorsal valve: Socket ridges and cardinal process are similar to those of *B. australis*. The lateral septa are thin, linear and crested, diverging from the cardinalia at 90°. Accessory septa are thin, linear and originate between the lateral and median septa in mid length of the valve and curve slightly anteriorly. The median septum is crested and terminates abruptly 1 mm from the anterior commissure.

Discussion: The holotype MUGD 1721 was originally described by Gill (1942, p. 39, pl. 4, fig. 7) as an internal mould of the ventral valve. This has since been destroyed leaving the external mould of the dorsal valve. Gill's description leaves no doubt that the specimen is *B. withersi*.

Gill (1969, p. 1229) noted that taxonomic significance of the variable development of the accessory septa could not be clarified because of lack of material. This still stands, *B. withersi* is a rare species at each of the localities where it occurs.

Occurrence: B. withersi occurs at loc. 33, 34, 41 and 87 at Lilydale (Gill, 1969, p. 1229) and Tommy's Hut, Kinglake. All specimens referred to *B. withersi* by Gill (1969, p. 1229) from loc. 20, 21, 26 and 39 Lilydale, and west of Yankee Jim Creek, undoubtedly belong to *B. janaea* sp. nov.

Range: Early Devonian (Late Lochkovian to Early Praguian).

Acknowledgements

I wish to thank Dr P. Jell, Curator of Invertebrate Fossils, National Museum of Victoria, and Dr O. P. Singleton, Geology Department, Melbourne University for providing material in their care. Sincere appreciation is expressed to Mr N. W. Archbold for helpful discussions during the early phases of this study. Dr A. J. Wright critically read and suggested improvements to the manuscript. Ms J. Daley drafted the figures and Mrs C. Healy assisted in the printing and make up of plates. This paper is published with permission of the Director of the Geological Survey of Victoria.

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Explanation of Plates

PLATE 5

Notoparmella plentiensis sp. nov.
All figures × 5 and from loc. A 17, Plenty, Victoria.

Figs. 1. NMV P49695a Holotype, internal mould of articulated specimen.
2. NMV P49695b Holotype, external mould of same.
3. NMV P49601 Paratype, internal mould of ventral valve, note development of muscle scars.
4. NMV P49603 Paratype, internal mould of dorsal valve.
5. NMV P49607 Paratype, external mould of ventral valve, note fine costellae.
6. NMV P49604 Paratype, internal mould of ventral valve.
7. NMV P49610 Paratype, internal mould of ventral valve.
8. NMV P49614 Paratype, external mould of dorsal valve.
9. NMV P49613 Paratype, internal mould of ventral valve.
10. NMV P49608 Paratype, external cast of ventral valve, note the bifurcation of the median septum.
11. NMV P49616a Paratype, external mould of dorsal valve.
12. NMV P49616b Paratype, internal mould of dorsal valve, a wide form.
13. NMV P49625 Paratype, internal mould of ventral valve.
14. NMV P49628 Paratype, internal mould of ventral valve.
15. NMV P49637 Paratype, internal mould of dorsal valve.
16. NMV P49641 Paratype, internal mould of ventral valve.
17. NMV P49642 Paratype, internal mould of ventral valve.
18. NMV P49644 Paratype, internal mould of dorsal valve.
19. NMV P49647 Paratype, internal mould of ventral valve.
20. NMV P49652 Paratype, external mould of dorsal valve.
21. NMV P49666 Paratype, internal mould of dorsal valve.
22. NMV P49664 Paratype, internal mould of ventral valve, a narrow form.
23. NMV P49674 Paratype, internal mould of ventral valve.
24. NMV P49697a Paratype, internal mould of dorsal valve.
25. NMV P49697b Paratype, external mould of dorsal valve.
26. NMV P49699a Paratype, internal mould of dorsal valve, note form of cardinal process.
27. NMV P49699b Paratype, external mould of dorsal valve.

PLATE 6

All figures × 4

Figs. 1-3 *Notoparmella plentiensis* sp. nov., from Sugarloaf Dam Christmas Hills, Victoria.
1. NMV P49750a internal mould of ventral valve.
2. NMV P49750b external mould of ventral valve.
3. NMV P49751 internal mould of ventral valve.

Figs. 4-18 *Notanoplia pherista* Gill.
4-15 from loc. 16, Zeehan Tasmania.
16-18 from loc. W5, Kinglake, Victoria.
4. NMV P14827 Holotype, latex cast of ventral valve, note smooth lateral septa.
5. NMV P14827 Holotype, internal mould of ventral valve.
6. NMV P14790 Hypotype, external mould of dorsal valve, note very fine costellae.
7. NMV P14827a Paratype, internal mould of dorsal valve.
8. NMV P14827b Paratype, internal mould of dorsal valve.
9. NMV P25557 Hypotype, internal mould of ventral valve.
10. NMV P25559 Hypotype, internal mould of ventral valve, note development of pedicle tube.
11. NMV P25561 Hypotype, internal mould of ventral valve.
12. NMV P25561 Latex cast of ventral valve.
13. NMV P25562 Hypotype, internal mould of ventral valve.
14. NMV P25563 Hypotype, internal mould of ventral valve.
15. NMV P25564 Hypotype, external mould of dorsal valve, note concentric lamellae and incipient costellae.
16. NMV P49721 internal mould of ventral valve, note incipient lateral and median septa.
17. NMV P49722a internal mould of ventral valve.
18. NMV P49722b external mould of ventral valve.

Figs. 19-26 *Notanoplia panifica* sp. nov., from Sugarloaf Dam Christmas Hills, Victoria.
19. NMV P49746 Holotype, internal mould of ventral valve, note incipient development of lateral septa.
20. NMV P49745 Paratype, internal mould of ventral valve.
21. NMV P49747a Paratype, external mould of dorsal valve, note development of fine incipient costellae.
22. NMV P49747b Paratype, internal mould of dorsal valve, note incipient lateral septa.
23. NMV P49748a Paratype, internal mould of dorsal valve, note incipient accessory septum.

24. NMV P49748b Paratype, external mould of dorsal valve.
25. NMV P49753 Paratype, internal mould of ventral valve, note well developed pedicle tube.
26. NMV P49754 Paratype, external mould of dorsal valve.

Figs. 27-32 *Notanoplia philipi* sp. nov.
27-30 from loc. 43, Parish of Boola, Tyers, Victoria.
31-32 from loc. 54/60 Parish of Boola, Tyers, Victoria.
27. MUGD 3441a Holotype, internal mould of ventral valve, note development of costae anteriorly.
28. MUGD 3441b Paratype, internal mould of ventral valve.
29. MUGD 3443 Paratype, internal mould of dorsal valve.
30. MUGD 3444 Paratype, internal mould of ventral valve.
31. NMVP 49718a, internal mould of ventral valve.
32. NMVP 49781b, external mould of ventral valve.

PLATE 7

Figure 1 × 14; Figures 2-33 × 4

Figs. 1-10 *Notanoplia philipi* sp. nov.
1. From loc. 36, Parish of Boola, Tyers, Victoria.
2-10 from loc. 87, Lilydale, Victoria.
1. MUGD 3440 internal mould of dorsal valve, note small cardinal process, large pits in the lateral septa and grooves between costae, and ovate muscle scars.
2. NMV P49720, external mould of dorsal valve.
3. NMV P25487 internal mould of ventral valve.
4. NMV P25488 external mould of dorsal valve, note costae.
5. NMV P25489, external mould of dorsal valve.
6. NMV P25494, external mould of dorsal valve.
7. NMV P25542, external mould of dorsal valve.
8. NMV P25535, external mould of dorsal valve.
9. NMV P49723 external mould of articulated specimen.
10. NMV P49724 external mould of dorsal valve.

Figs. 11-16 *Boucotia australis* (Gill)
11. MUGD 3442 internal mould of ventral valve from loc. 43, Parish of Boola, Tyers, Victoria.
12. MUGD 3439a, internal mould of ventral valve from loc. 47, Parish of Boola, Tyers, Victoria.
13. MUGD 1720 Holotype, internal mould of articulated specimen, note pitted crest septa in ventral valve only, from loc. 33, Seville, Victoria.
14. MUGD 3439b, internal mould of ventral valve from loc. 47, Parish of Boola, Tyers, Victoria.
15. NMV P25475 internal mould of ventral valve, from loc. 13, Hull Road, Mooroolbark, Victoria.
16. NMV P25483 internal mould of dorsal valve from loc. 87, Lilydale, Victoria.
17. *Notanoplia philipi* sp. nov., NMV 25493 internal mould of dorsal valve, from loc. 87, Lilydale, Victoria.

Figs. 18-31 *Boucotia australis* (Gill) from loc. 87, Lilydale, Victoria.
18. NMV P25496 internal mould of dorsal valve.
19. NMV P25497 internal mould of dorsal valve.
20. NMV P25497 latex cast of dorsal valve, note smooth septa.
21. NMV P25501 internal mould of articulated specimen.
22. NMV P25503 internal mould of ventral valve.
23. NMV P25505 internal mould of ventral valve.
24. NMV P25506 internal mould of ventral valve.
25. NMV P25506 latex cast of ventral valve, note pitted septa and pedicle tube.
26. NMV P25507 internal mould of articulated specimen.
27. NMV P25507 latex cast of articulated specimen.
28. NMV P25508 latex cast of ventral valve, note smooth exterior.
29. NMV P25514 posterior view of internal mould of articulated specimen.
30. NMV P25514 ventral view, note pitted septa on ventral valve only.
31. NMV P25526 internal mould of ventral valve.

Fig. 32 *Boucotia janaea* sp. nov., NMVP 33089 Paratype external mould of ventral valve from loc. 23, Lilydale, Victoria.

Fig. 33 *Notanoplia philipi* sp. nov., NMV P25539 external mould of dorsal valve from loc. 87, Lilydale, Victoria.

PLATE 8

All figures × 4

Figs. 1-7 *Boucotia janaea* sp. nov.
1-5 from loc. 23, Lilydale, Victoria.
6-7 from loc. 39, Lilydale, Victoria.
1. NMV P25551 Paratype, internal mould of dorsal valve.
2. NMV P25551 Paratype, latex cast of dorsal valve, note pitted crest septa.
3. NMV P25478 Holotype, internal mould of articulated specimen.
4. NMV P25478 Holotype, ventral view.
5. NMV P25478 Holotype, dorsal view, note smooth septa.
6. NMV P25444 internal mould of dorsal valve.
7. NMV P25444 latex cast of dorsal valve, note pitted septa.

Fig. 8 *Boucotia australis* (Gill) NMV 25445 external mould of dorsal valve, note concentric lamellae, from loc. 87, Lilydale, Victoria.

Figs. 9-25 *Boucotia janaea* sp. nov.
9-14,
16, 17 from loc. 20 Lilydale, Victoria.
9. NMV P25463 internal mould of ventral valve.
10. NMV P25464a, internal mould of ventral valve, note pedicle tube.
11. NMV P49725 internal mould of ventral valve, note ovate muscle scars.
12. NMV P25465 internal mould of articulated specimen.
13. NMV P25466 internal mould of ventral valve.
14. NMV P25467 internal mould of ventral valve.
15. NMV P25468 Paratype, internal mould of ventral valve, from loc. 23, Lilydale, Victoria.
16. NMV P25469 external mould of dorsal valve.
17. NMV P25470 internal mould of ventral valve.
18. NMV P25474 internal mould of ventral valve from loc. 39, Lilydale, Victoria.
19. NMV P25471 external mould of dorsal valve from loc. 20, Lilydale, Victoria.
20. NMV P25477 Paratype, external mould of dorsal valve from loc. 23, Lilydale, Victoria.
Figs. 21-25 from loc. 20, Lilydale, Victoria.
21. NMV P25480 external mould of dorsal valve.
22. NMV P49728 internal mould of dorsal valve.
23. NMV P49729 internal mould of dorsal valve.
24. NMV P49730 internal mould of ventral valve.
25. NMV P49731 internal mould of ventral valve.

Figs. 26-33 *Boucotia withersi* (Gill)
26. MUGD 1721 Holotype external mould of dorsal valve from loc. 34, Killara, Victoria.
27. NMV P25446, internal mould of dorsal valve, note attitude of accessory septa, from loc. 87, Lilydale, Victoria.
28. NMV P25446 latex cast of dorsal valve.
29. NMV P25447 internal mould of ventral valve, from loc. 87, Lilydale, Victoria.
30. NMV P25477 latex cast of ventral valve.
31. NMV P25456 internal mould of ventral valve from loc. 87, Lilydale, Victoria.
32. NMV P25458 internal mould of ventral valve from loc. 33, Killara, Victoria.
33. NMV P25459 internal mould of ventral valve from loc. 33, Killara, Victoria.

Figs. 34-41 *Boucotia loyolensis* (Gill)
34. NMV 28003 internal mould of ventral valve, note small muscle scan near umbo, from 1 ml SE of junction of Jerusalem Creek and Barnwell Creek, Eildon, Victoria.
35. NMV 28035 internal mould of ventral valve, from 12 chains SW of low saddle at head of right branch of Cables Creek Eildon, Victoria.
36. NMV 49720 internal mould of dorsal valve, from loc. 87, Lilydale, Victoria.
37. NMV 12403 Holotype, internal mould of ventral valve, from Loyola Quarry, Loyola, Victoria.
38. NMV 12403 Holotype, latex cast of ventral valve.
39. NMV 49740 internal mould of ventral valve, from Big River, Eildon, Victoria.
40. NMV 49741 internal mould of dorsal valve, from Enochs Point near Eildon, Victoria.
41. NMV 49742 internal mould of ventral valve from Enochs Point near Eildon, Victoria.


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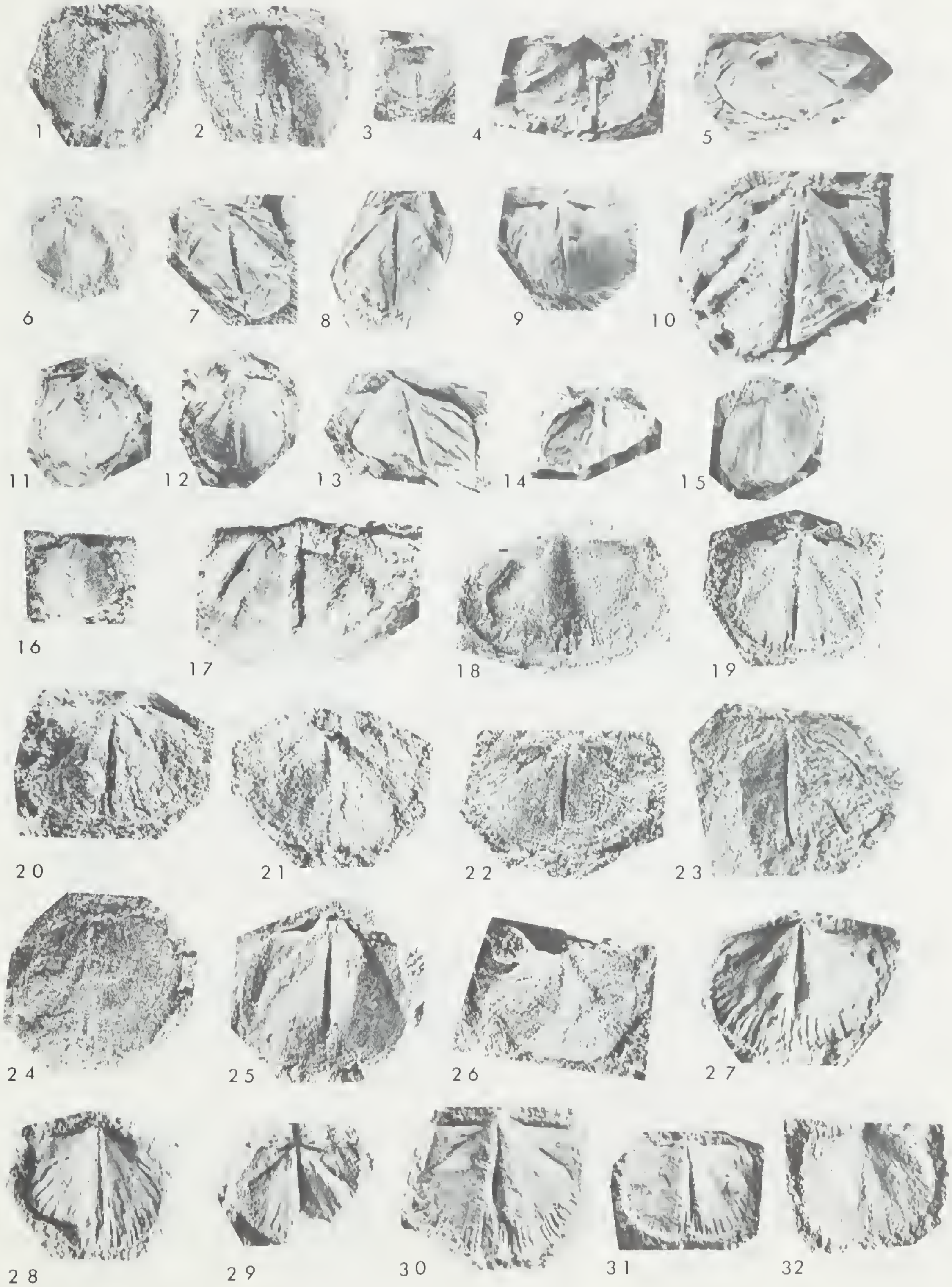

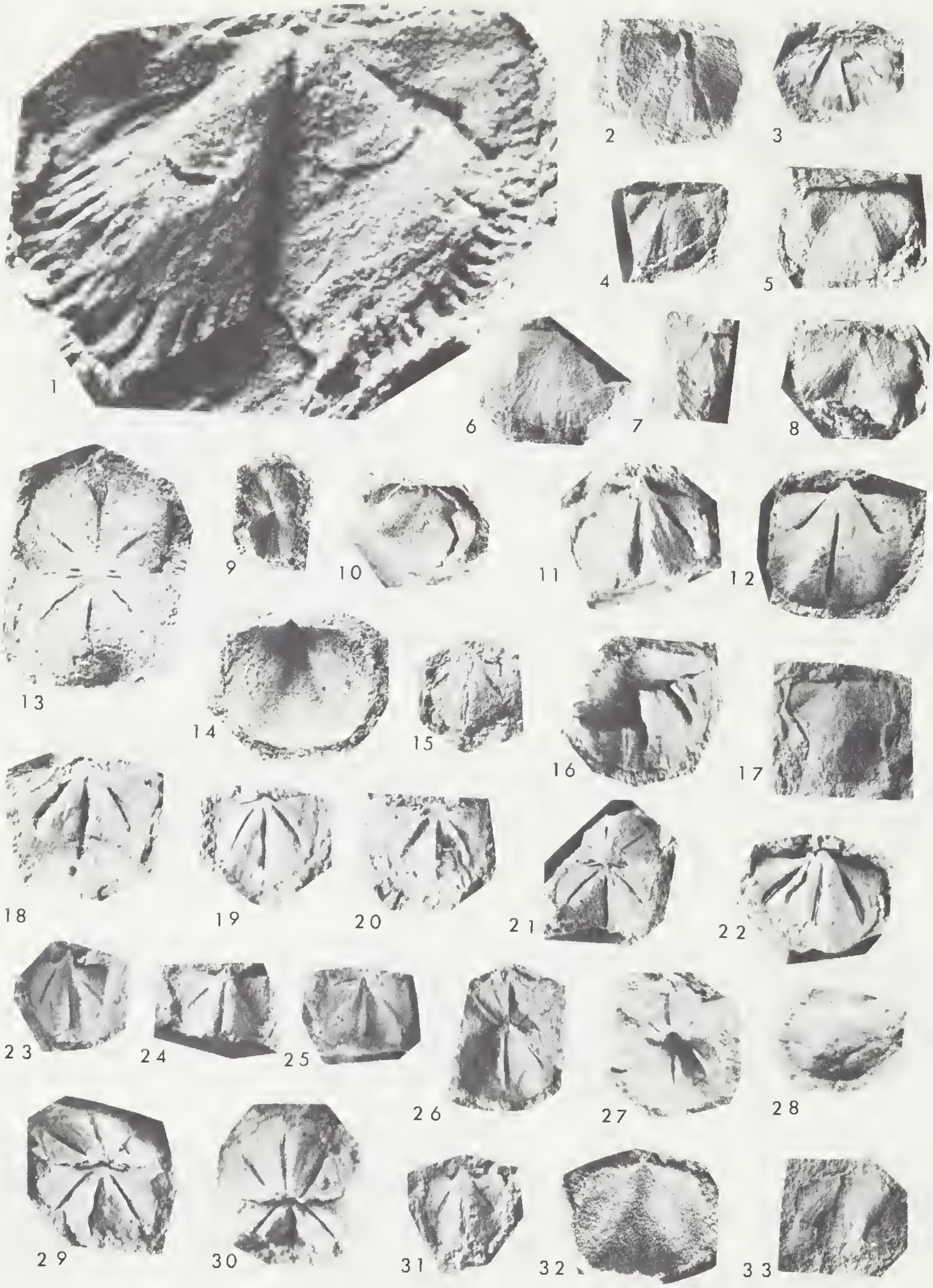
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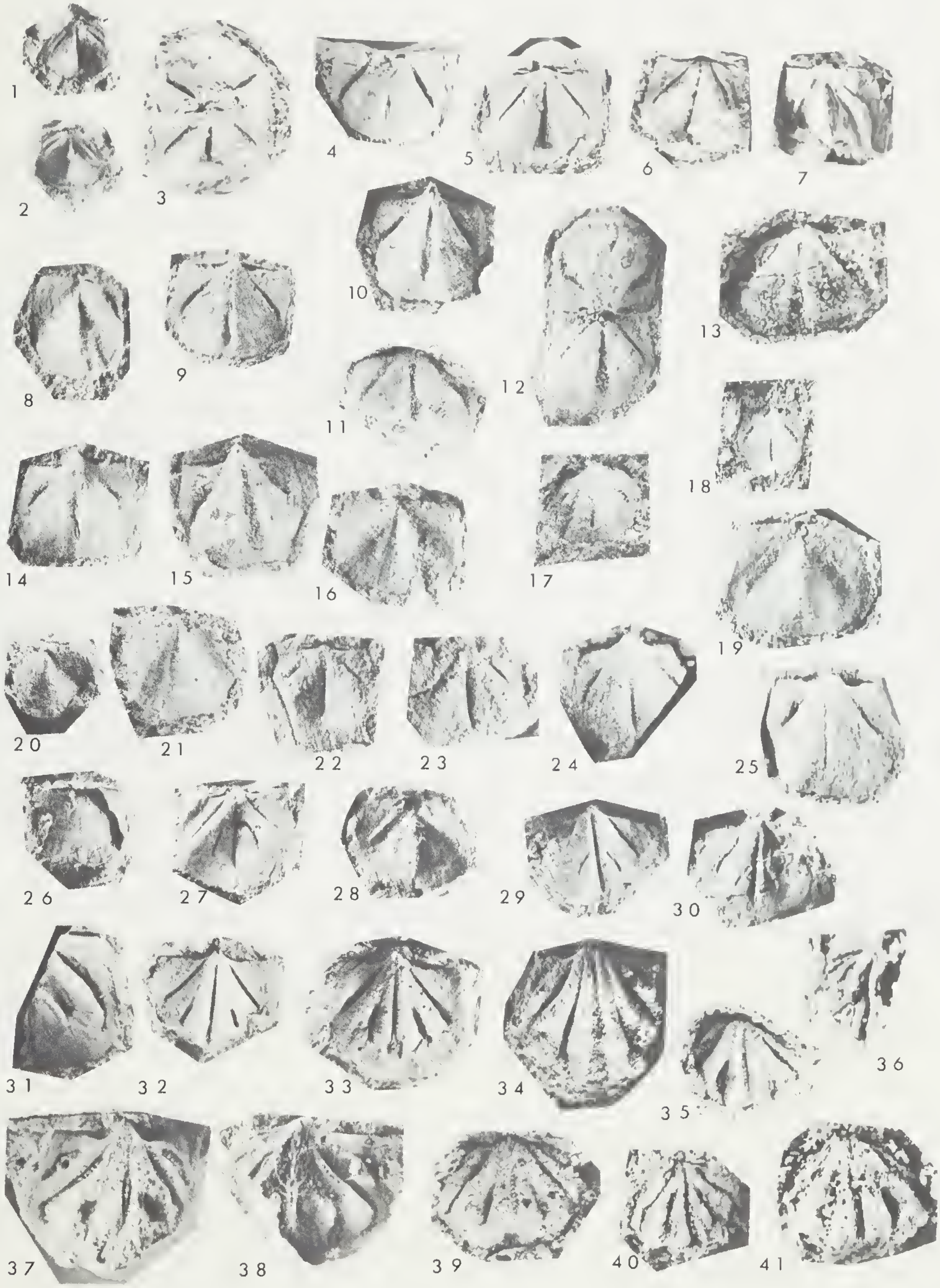
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