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Early Carboniferous Gastropoda from the Tamworth Belt, New South Wales, Australia

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ABSTRACT. Rich faunas of minute, Early Carboniferous gastropods, elegantly preserved as chloritic replacements, are documented from the Rangari Limestone Member of the Tulcumba Sandstone (early to middle Tournaisian), the Namoi Formation (middle to late Tournaisian), the Dangarfield Formation (late Tournaisian) and the uppermost part of the Kyndalyn Mudstone Member of the Merlewood Formation (middle or late Viséan) of eastern New South Wales. Seven new genera *Campbellospira*, *Globobulimorpha*, *Microcochlis*, *Kyndalynia*, *Palaeoalvania*, *Kimina* and *Pseudoaclisina* are proposed. Of the 79 gastropod species (referable to 47 genera and subgenera), 40 are described as new: *Euphemites pustula*, *Cymbularia carinata*, *Bellerophon* (*Bellerophon*) *kyndalynensis*, *Bellerophon* (*B.*) *swainsensis*, *Knightites* (*Retispira*) *multilirata*, *Knightites* (*R.*) *triangularis*, *Straparollus brevis*, *Serpulospira scalariformis*, *Platyschisma lingua*, *Platyschisma vitrea*, *Angyomphalus radianodosa*, *Eotomaria umbilicata*, *Campbellospira conica*, *Glabrocingulum pustulum*, *Hesperiella elongata*, *Hesperiella planorbis*, *Agnesia reticulata*, *Worthenia crenilunula*, *Gyronema nacreformis*, *Rhabdotocochlis turgida*, *Naticopsis* (*Naticopsis*) *minuta*, *Palaeozygopleura obesa*, *Pseudozygopleura gracilis*, *Leptozyga costata*, *Ceraunocochlis australis*, *Ceraunocochlis tenuis*, *Strobeus ovalis*, *Girtyspira inflata*, *Globobulimorpha costata*, *Microcochlis parva*, *Eucochlis depressa*, *Eucochlis umbiliparva*, *Kyndalynia inflata*, *Kimina australis*, *Kimina minor*, *Kimina globosa*, *Pseudoaclisina microspirulata*, *Palaeoalvania talenti*, *Donaldina minutissima*, *Streptacis gundyensis*. Seventeen additional forms are discriminated but because of bad preservation or dearth of material they are not named. *Campbellospira*, characterised by a planktotrophic protoconch with a selenizone and long slit is assigned to Pleurotomarioidea. *Globobulimorpha*, an unusual globular fusiform shell with a columellar fold and deviated protoconch is tentatively assigned to Subulitoidea. *Kimina* and *Palaeoalvania* are placed in Order Heterogastropoda. *Aclisina turgida* Yoo is made the basis of a new genus *Pseudoaclisina* and transferred from Murchisonioidea to Order Heterogastropoda. *Stegocoelia* is transferred from Murchisonioidea to Loxonematoidea. It is not possible at present to place three genera, *Microcochlis*, *Kyndalynia* and *Eucochlis* in any existing Order.

Aims and Scope of Present Study

Early Carboniferous brachiopods and conodonts of the Tamworth Belt have been the subject of a number of exhaustive studies in recent years (Campbell, 1957, 1961; Campbell & McKellar, 1969; Roberts, 1963, 1965, 1975; Jenkins, 1974; Crane, 1975 unpublished; Mory, 1980 unpublished; Mory & Crane, 1982). Gastropods from the same horizons have received relatively little attention, largely because they were thought to be poorly preserved, had evolved slowly and, accordingly, had little value for stratigraphic correlation. Literature of interest on other invertebrate groups includes ammonites (Delepine, 1941; Campbell *et al.*, 1983), crinoids (Campbell & Bein, 1971; Pickett, 1960), corals (Pickett, 1966), bryozoans (Engel, 1975; Campbell & Engel, 1963), and trilobites (Engel & Morris, 1983, 1984, 1985).

Carboniferous molluscs have been known in New South Wales since the work on a fauna from the Port Stephens District (Etheridge, 1890a,b) and other areas (Etheridge, 1890c, 1891, 1896, 1898, 1902, 1907). Occasional descriptions of molluscs (de Koninck, 1876; Dun & Benson, 1920; Campbell, 1962) and faunal lists (Benson, 1921) have appeared. New species of molluscs have been described in papers devoted to faunas from the Werrie and Belvue Synclines (Campbell & Engel, 1963), from Barrington (Campbell & McKelvey, 1971), from Old Cannindah, Queensland (Maxwell, 1961), and from the Dangarfield Formation near Gundy, Hunter Valley (Yoo, 1988).

The aim of this study is to make an extensive search for additional similarly well preserved material that might contribute to better understanding of the evolution of the Late Palaeozoic Gastropoda, especially of minute taxa which, because of poor preservation, are rarely investigated. Samples from 13 localities out of 42 localities examined in the Mandowa Formation, Luton Formation, Tulcumba Sandstone, Namoi Formation, Caroda Formation, Merlewood Formation, Dangarfield Formation and Woolooma Formation, yielded some 3,000 well preserved gastropods. The specimens were classified to the species level, where possible, and for systematic arrangement, the Treatise on Invertebrate of Paleontology Part I, Mollusca 1 (Knight *et al.*, 1960) was generally followed. However, the placement of many groups remains uncertain. Many species discussed here belong to existing genera which until recently have been placed in the Order 'Archaeogastropoda'. Recent phylogenetic studies based on anatomical features (Haszprunar, 1988) have shown that this order is an unnatural grouping. The name 'Archaeogastropoda' is retained here until we have a better idea of their phylogeny.

Preservation and Deposition of Material

Replacement of the mollusc shells by chlorite, sulfate and silicate was discussed by Ladd (1959), Tasch (1973), Bandel (1988), Yoo (1988) and others. Chlorite is one

of the most common secondary minerals occurring in the Early Carboniferous sediments of the Tamworth Belt. During the process of low-grade metamorphism, less stable minerals such as calcite, aragonite and clay minerals were partly replaced. This replacement has made the isolation of complete shells even those with thin and delicate ornamentation possible. All photographs illustrated in the plates were obtained using a JEOL JSM 840 stereoscan electron microscope, at Macquarie University.

All type specimens are given the Australian Museum Register Numbers unless stated otherwise, and are housed in the Australian Museum, Sydney. Plates are listed in the Appendix.

Abbreviations

DA – maximum diameter of aperture; GR – grid reference; H – height; MD – maximum diameter of whorl; NL – number of lirae; NW – number of whorl; PA – pleural angle; TS – thickness of spire; W – width.

Regional Geological Setting

The area investigated in this study is a long (280 km), narrow (13 km) belt stretching from Gravesend southwards to the Glenbawn Dam in the Upper Hunter Valley (Fig. 1) which is part of the Tamworth Belt.

The Tamworth Belt forms the western and southern margin of the New England Fold Belt, and lies between the Hunter-Mooki Thrust on the west and the Peel Fault to the east, parallel to it (Leitch, 1974; Korsch, 1977). West and south of the Hunter-Mooki Thrust, the belt is bordered by the Permian sediments of the Sydney-Gunnedah Basin. The Tamworth Belt extends for about 410 km, emerging from below Mesozoic sediments of the Surat Basin near Gravesend in the north, trending south-south-east, and swinging south-easterly at the Liverpool Range towards the eastern coast between Newcastle and Taree (Fig. 1) (Mory, 1980). It is 50 km wide with a stratigraphic thickness of approximately 10 km (Mory, 1980) comprising Late Palaeozoic rocks, principally Devonian marine sediments overlain by the marine to non-marine Carboniferous sediments outcropping parallel in the west; the tract of Carboniferous sediments is generally about 10 to 20 km in width. The sediments within the belt are faulted and folded. North of the Liverpool Range, structures are generally parallel or subparallel to the axis of the Belt with the Rocky Creek and Belvue-Werrie Synclines being the most prominent.

Stratigraphy

Selected stratigraphic nomenclature of Early Carboniferous units in the northern Tamworth Belt and

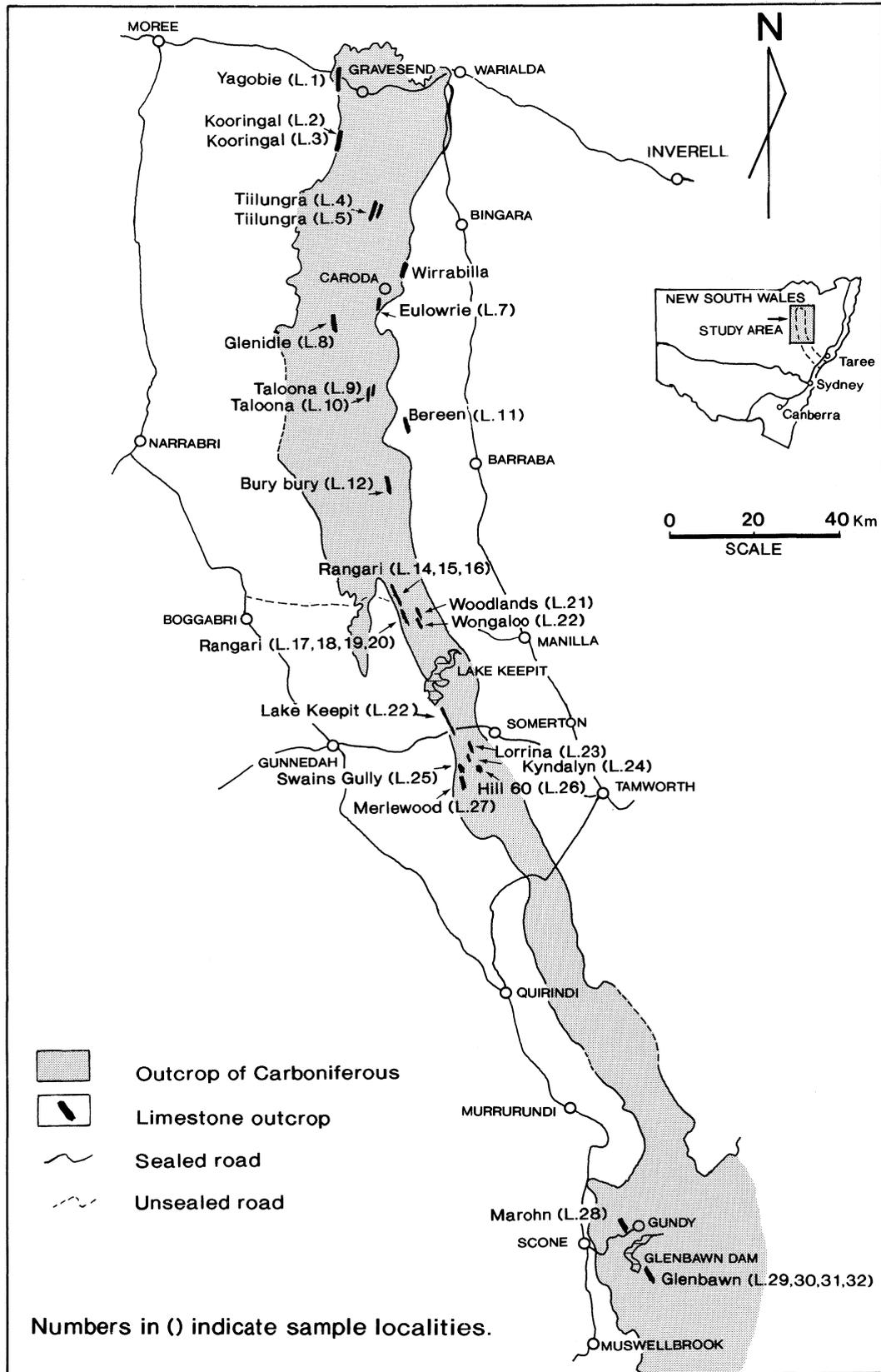


Fig. 1. Distribution of Carboniferous outcrop and examined localities.

in the Glenbawn Dam area is shown in Figure 2. The base of the Early Carboniferous has been taken to approximate the base of the Luton Formation in the Rocky Creek Syncline, the Tulcumba Sandstone in the Belvue-Werrie Syncline, and the upper part of the Kingsfield Formation in the Glenbawn Dam area. The upper boundary approximates the top of the Caroda Formation in the Rocky Creek Syncline, the top of the Merlewood Formation in the Belvue-Werrie Syncline, and the top of the Isismurra Formation in the Glenbawn Dam area (McKelvey & White, 1964; Voisey & Williams, 1964; White, 1964; Roberts & Oversby, 1974; Moore & Roberts, 1976; Mory, 1978, 1980, 1982).

Examined Localities

The examined localities are shown in Figure 1. The detail of the localities are as follows:

Locality 1 (Yagobie) - Gravesend 1:50,000, GR 365 278. Skeletal limestone interbedded in mudstone of the Namoi Formation. There are 5 bands of limestone ranging in thickness from 0.1 to 0.2 m. No gastropods were recovered.

Locality 2 (Koorungal) - Gravesend 1:50,000, GR 361 107. Oolitic skeletal limestone containing bryozoans, crinoids, calcareous algae, echinoderm plates, and shell fragments in the Namoi Formation, 100 m south of 'Koorungal' homestead. Only internal molds of gastropods were recovered.

Locality 3 (Koorungal) - Gravesend 1:50,000, GR 360 108. Oolitic limestone interbedded in mudstone of the Namoi Formation, about 75 m stratigraphically higher than Locality 2. No gastropods were recovered.

Localities 4 & 5 (Tiilungra) - Terry Hie Hie 1:50,000,

GR 443 962. Oolitic and bioclastic limestone lenses in the Luton Formation, on the disused roadsides, 1.8 and 1.1 km west of 'Tiilungra' homestead respectively. No gastropods were recovered.

Locality 7 (Eulowrie) - Eulowrie 1:25,000, GR 472 732. Oolitic limestone in the Luton Formation, 3 m thick in a small gully, 0.5 km north-west of 'Kingsland' homestead. No gastropods were recovered.

Locality 8 (Glenidle) - Eulowrie 1:25,000, GR 375 652. Oolitic limestone in the Caroda Formation, up to 8 m thick behind a woolshed, on the eastern side of the Back Creek road near 'Glenidle'. No gastropods were recovered.

Locality 9 (Taloona) - Horton 1:25,000, GR 460 521. Oolitic-skeletal limestone in the Namoi Formation, containing fragments of bryozoans, crinoids, echinoderm spines. No gastropods were recovered.

Locality 10 (Taloona) - Horton 1:25,000, GR 463 518. Crinoidal limestone in the Namoi Formation, 5 m thick, 300 m stratigraphically higher than Locality 9. No gastropods were recovered.

Locality 11 (Bereen) - Horton 1:25,000, GR 508 519. Fine-grained limestone bands in the Namoi Formation, 0.8 km south of 'Bereen' homestead. The limestones are not fossiliferous.

Locality 12 (Burybury) - Horton 1:25,000, GR 504 314. Crinoidal limestone in the Namoi Formation, 1.5 km south of 'Pembury' homestead. No gastropods were recovered.

Locality 14 (Rangari) - Willuri 1:25,000, GR 506 044. Grey crystalline bioclastic limestone in the Rangari Limestone Member of the Tulcumba Sandstone, 1.7 km north of 'Rangari' homestead.

Locality 15 (Rangari) - Willuri 1:25,000, GR 513 037. Grey crinoidal bioclastic limestone in the Rangari Limestone Member of the Tulcumba Sandstone, 1.5 km

EUROPEAN		ROCKY CREEK SYNCLINE		WERRIE-BELVUE SYNCLINE		GLENBAWN DAM	
STAGES		McKelvey & White 1964	Mory 1980	Moore & Roberts 1976	Roberts & Oversby 1974		
Visean	V3	Caroda Fm 500m	Caroda Fm Merlewood Fm	Kyndalyn Ms Mb Merlewood Fm	Isismurra Fm 700m		
	V2	Namoi Fm	Namoi Fm	Namoi Fm	Dangarfield Fm 1020m		
	V1	750m					
Tournaisian	Tn3	Luton Fm >1200m	Luton Fm		Brush Hill Ls Mb 2m		
	Tn2		Tulcumba Ss	Rangari Ls Mb Tulcumba Ss	Kingsfield Fm		
	Tn1b						
	Tn1a						
Famennian		Mandowa Mudstone	Mandowa Mudstone				

Fig. 2. Stratigraphic nomenclature.

north-east of 'Rangari' homestead.

Locality 16 (Rangari) - Willuri 1:25,000, GR 507 043. 0.8 km north-west of Locality 15, on the same limestone band.

Locality 17 (Rangari) - Willuri 1:25,000, GR 525 999. The lower limestone band (oolitic limestone, 2 m thick) of the Rangari Limestone Member, 4 km south-east of 'Rangari' homestead.

Locality 18 (Rangari) - Willuri 1:25,000, GR 527 998. The middle band (bioclastic limestone) of the Rangari Limestone Member, approximately 150 m north-east of Locality 17.

Locality 19 (Rangari) - Willuri 1:25,000, GR 528 998. The upper band (sandy bioclastic limestone) of the Rangari Limestone Member, 130 m north-east of Locality 18.

Locality 20 (Rangari) - Willuri 1:25,000. GR 539 024. Crystalline limestone in the Namoi Formation, 1.3 km south-west of the cross road between Gunnedah-Barraba and Manilla-Boggabri roads.

Locality 21 (Woodlands) - Willuri 1:25,000, GR 567 014. Well sorted, fine-grained sandy limestone in the Tulcumba Sandstone. It is not fossiliferous.

Locality 22 (Lake Keepit) - Somerton 1:25,000, GR 642 728. Crinoidal limestone in the Tulcumba Sandstone, 100 m north of the junction of Oxley Highway and Lake Keepit road.

Locality 23 (Lorrina) - Somerton 1:25,000, GR 708 697. Bioclastic limestone in the upper part of the Namoi Formation, containing fragments of corals, crinoids, bryozoans and gastropods.

Locality 24 (Kyndalyn) - Somerton 1:25,000, GR 694 679. Oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation, up to 5 m thick, behind 'Kyndalyn' homestead, 10 km south-west of Somerton.

Locality 25 (Swains Gully) - Winton 1:25,000, GR 673 638. Fossiliferous limestone in the Namoi Formation in Swains Gully, approximately 250 m west of the Babbinboon Lane. This is one of the localities which have produced rich gastropod faunas.

Locality 26 (Hill 60) - Winton 1:25,000, GR 693 641. Bioclastic and oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation, up to 30 m thick, 1.9 km upstream in Swains Gully from the Babbinboon Lane.

Locality 27 (Merlewood) - Winton 1:25,000, GR 674 621. Merlewood Formation, 100 m east of Babbinboon Lane, 0.8 km north of 'Merlewood'.

Locality 28 (Marohn) - Scone 1:25,000, GR 084 544. Bioclastic limestone in the upper part of the Dangarfield Formation, 150 m west of 'Marohn' homestead, 4 km south-west of Gundy.

Locality 29 (Glenbawn) - Woolooma 1:25,000, GR 132 453. The uppermost limestone band in the Dangarfield Formation, 1.7 km east of Glenbawn Dam.

Locality 30 (Glenbawn) - Woolooma 1:25,000, GR 131 452. A coarse grained crystalline limestone 0.2 m thick, 11 m lower than Locality 29.

Locality 31 (Glenbawn) - Woolooma 1:25,000, GR 130 452. Muddy limestone and calcareous sandstone

ranging from 0.14 m to 0.2 m in a 3m interval, approximately 25 m lower than Locality 30.

Locality 32 (Glenbawn) - Woolooma 1:25,000, GR 129 453. Muddy limestone 0.12 m thick, 6 m lower than Locality 31.

Occurrence of Gastropod Faunas and Comparison with other Faunas

In three areas, (1) 'Rangari', (2) Swains Gully-'Kyndalyn' and (3) 'Marohn'-Glenbawn Dam, a large number of identifiable gastropod specimens was recovered from four different time units; early to middle Tournaisian, middle Tournaisian, late Tournaisian, and middle or late Viséan. Figure 3 shows the occurrences and ranges of the faunas.

Five brachiopod zones (Roberts, 1975) and seven conodont zones (Jenkins, 1974; Mory, 1980) have been discriminated in the Early Carboniferous of the study area. The stratigraphic positions of gastropod localities in relation to the pattern of brachiopod and conodont zones are shown in Figure 4.

'Rangari' area. Rangari Limestone Member of Tulcumba Sandstone. The bioclastic limestone of the Rangari Limestone Member yielded a large number of gastropods, particularly from the middle band in the Rangari area (Localities 14, 15 and 18). The lowest of the brachiopod zones, that of *Tulcumbella tenuistriata* (early Tournaisian) has been identified at 80 m below the top of the Tulcumba Sandstone in Swains Gully by Roberts (1975). The Rangari Limestone Member at 'Rangari' is the oldest unit from which gastropods are recovered in this study. Brachiopod faunas from the top of the Tulcumba Sandstone (L76 University of New England) and the base of the Namoi Formation (L77 University of New England), both at 'Rangari', are indicative of the *Spirifer sol* Zone, indicating a middle Tournaisian age (Roberts, 1975). Conodonts of the lower *crenulata* Zone from 7 m above the base of the Tulcumba Sandstone indicate that the formation is late Kinderhookian (middle Tournaisian) in age (Mory, 1980).

Swains Gully-'Kyndalyn' area. Namoi Formation. Major parts of the fauna for this study are recovered from a bioclastic limestone, 130 m above the base of the Namoi Formation in Swains Gully (Locality 25). This horizon is referred to the *Spirifer sol* Zone (middle Tournaisian); the remainder of the Namoi Formation is referred to the *Schellwienella cf. burlingtonensis* Zone (late Tournaisian) by Roberts (1975). Conodonts of the *isosticha*-upper *crenulata* Zone are recovered 2.5 m above the base of the Namoi Formation at 'Rangari', indicating lower part of the formation to be still middle Tournaisian in age (Mory, 1980). Conodonts indicative of the *Scaliognathus anchoralis* Zone (late Tournaisian) have been recovered from the upper limestone band of the formation in Swains Gully (Jenkins, 1974; Mory, 1980). A small number of gastropods recovered at 'Lorrina' (Locality 23), is thought

EUROPEAN STAGES	Tournaisian											M/L Viséan
	Early to Mid			Mid	Late					Lorina L.23	Kyndalyn L.24	
	Oakey Hwy L.22-2	Rangari		Swains Gully L.25	Glenbawn							
SAMPLE LOCALITIES												
GASTROPOD FAUNAS												
Order Uncertain												
SF Bellerophontoidea												
<i>Sinuitina portulacoides</i> Campbell & Engel												
<i>Euphemites labrosa</i> Campbell & Engel												
<i>Euphemites pustula</i> n. sp.												
<i>Cymbularia carinata</i> n. sp.												
<i>Straparollus brevis</i> n. sp.												
<i>Bellerophon (B.) kyndalynensis</i> n. sp.												
<i>Bellerophon (B.) swainsensis</i> n. sp.												
<i>Knightites (R.) culleni</i> Campbell & Engel												
<i>Knightites (R.) multilirata</i> n. sp.												
<i>Knightites (R.) triangularis</i> n. sp.												
Order 'Archaeogastropoda'												
SF Euomphaloidea												
<i>Onychochilus minutissimus</i> Yoo												
<i>Straparollus brevis</i> n. sp.												
<i>Straparollus davidi</i> Dun & Benson												
' <i>Serpulospira</i> ' <i>scalariformis</i> n. sp.												
SF Pleurotomarioidea												
<i>Platyschisma lingua</i> n. sp.												
<i>Platyschisma vitrea</i> n. sp.												
<i>Angyomphalus radianodosa</i> n. sp.												
<i>Eotomaria umbilicata</i> n. sp.												
<i>Glabrocingulum obesum</i> Yoo												
<i>Glabrocingulum pustulum</i> n. sp.												
<i>Glabrocingulum</i> sp.												
<i>Campbellospira conica</i> n. gen & n. sp.												
<i>Campbellospira</i> sp. A												
<i>Campbellospira</i> sp. B												
<i>Campbellospira</i> sp. C												
<i>Hesperiella elongata</i> n. sp.												
<i>Hesperiella planorbis</i> n. sp.												
<i>Hesperiella robertsi</i> Yoo												
<i>Agnesia reticulata</i> n. sp.												
<i>Peruviaspira gundyensis</i> Yoo												
<i>Worthenia crenilunula</i> n. sp.												
<i>Worthenia</i> sp.												
<i>Ruedemannia</i> sp.												
<i>Borestus costatus</i> Yoo												
SF Patelloidea												
' <i>Lepetopsis</i> ' sp.												
SF Trochoidea												
<i>Araconema microspirulata</i> Yoo												
<i>Rhabdocochlis turgida</i> n. sp.												
<i>Gyronema nacreiformis</i> n. sp.												
<i>Microdoma angulata</i> Yoo												
SF Neritoidea												
<i>Naticopsis (N.) minuta</i> n. sp.												
<i>Naticopsis (N.) osbornei</i> Yoo												
<i>Turbonitella</i> sp.												
Order Uncertain												
SF Murchisonioidea												
<i>Murchisonia</i> sp.												
Order Caenogastropoda												
SF Loxonematoidea												
<i>Stegocoelia (S.) nodosa</i> Yoo												
<i>Stegocoelia (H.) elongata</i> Yoo												
<i>Stegocoelia (H.) tenuis</i> Yoo												
<i>Stegocoelia (H.)</i> sp. A												
<i>Stegocoelia (H.)</i> sp. B												
<i>Palaeozygopleura obesa</i> n. sp.												
<i>Pseudozygopleura gracilis</i> n. sp.												
<i>Leptozyga costata</i> n. sp.												
<i>Hemizyga decussata</i> Yoo												
<i>Cyclozyga sinuigera</i> Yoo												
<i>Cyclozyga</i> sp.												
SF Subulitoidea												
<i>Ceraunocochlis australis</i> n. sp.												
<i>Ceraunocochlis tenuis</i> n. sp.												
<i>Strobeus ovalis</i> n. sp.												
<i>Soleniscus callosus</i> Yoo												
<i>Soleniscus</i> sp.												
<i>Girtyspira inflata</i> n. sp.												
<i>Globbulimorpha costata</i> n. gen & n. sp.												
Order Uncertain												
SF Uncertain												
<i>Microcochlis parva</i> n. gen & n. sp.												
<i>Eucochlis australis</i> Yoo												
<i>Eucochlis depressa</i> n. sp.												
<i>Eucochlis umbiliparva</i> n. sp.												
<i>Eucochlis</i> sp.												
<i>Kyndalynia inflata</i> n. gen & n. sp.												
Order Heterogastropoda												
SF Uncertain												
<i>Kimina australis</i> n. gen & n. sp.												
<i>Kimina globosa</i> n. sp.												
<i>Kimina minor</i> n. sp.												
<i>Kimina</i> sp.												
<i>Palaeovalvania talenti</i> n. gen & n. sp.												
<i>Pseudoaclisina microspirulata</i> n. gen & n. sp.												
<i>Pseudoaclisina turgida</i> (Yoo)												
Order Opisthobranchia												
SF Uncertain												
<i>Donaldina filosa</i> Yoo												
<i>Donaldina minutissima</i> n. sp.												
<i>Donaldina</i> sp.												
<i>Streptacis elegantissima</i> (Yoo)												
<i>Streptacis gundyensis</i> n. sp.												
<i>Streptacis</i> sp.												

Fig. 3. Occurrences of Early Carboniferous gastropods from the Tamworth Belt.

to come from the same stratigraphic level.

Kyndalyn Mudstone Member of Merlewood Formation. The oolitic limestone at 'Kyndalyn' (Locality 24) yielded well preserved gastropods of a middle or late Visean age. The gastropods and many other invertebrates occurring in the mudstone and oolitic limestone indicate that the sediments were deposited in a shallow marine environment (Moore & Roberts, 1976). Brachiopods from the limestones of this Member are assigned to the *Gigantoproductus tenuirugosus* Subzone of the *Delpinea aspinosa* Zone, indicating a middle late Visean (V3b) age (Roberts, 1975; Jones *et al.*, 1973; Jones & Roberts, 1976). Two conodont species, *Patrognathus* sp. and *Rhachistognathus* cf. *muricatus* are recovered from this unit (Mory, 1980). Earlier Jenkins (1974) discriminated the *Patrognathus* cf. *capricornis* Zone in the upper part of the Flagstaff Formation at Brownmore and Lewinsbrook (equivalent to the upper part of the Merlewood Formation, including the Kyndalyn Mudstone Member), and suggested an early Visean age. The Brownmore section is the reference section for the *Gigantoproductus tenuirugosus* Subzone (middle late Visean) of Roberts (1975). Later Jenkins reconsidered the conodont faunas from the Kyndalyn Mudstone Member and the Flagstaff Formation, and assigned them a middle Visean age (Jenkins, personal communication). Accordingly there is some divergence between the ages indicated by the brachiopods and ages suggested by conodonts.

'Marohn'-Glenbawn Dam area. Upper part of Dangarfield Formation: The bioclastic limestone of the Dangarfield Formation was resampled at 'Marohn' (Locality 28), and from several different horizons at Glenbawn Dam (Localities 29 to 32). The samples yielded a large assemblage of gastropods. Roberts and Oversby (1974) referred these horizons to the *Schellwienella* cf. *burlingtonensis* Zone, indicating a late Tournaisian age. Conodonts indicative of the *Scaliognathus anchoralis* and *Gnathodus* sp. A (Jenkins) Zones from the same horizons indicate the same age (Jenkins, 1974).

Systematic Palaeontology

Gastropoda Cuvier, 1797

Order Uncertain

Bellerophontoidea M'Coy, 1851

Sinuitidae Dall, 1913

Bucanellinae Koken, 1925

Sinuitina Knight, 1945

Australian Carboniferous species. *Sinuitina portulacoides* Campbell & Engel (1963).

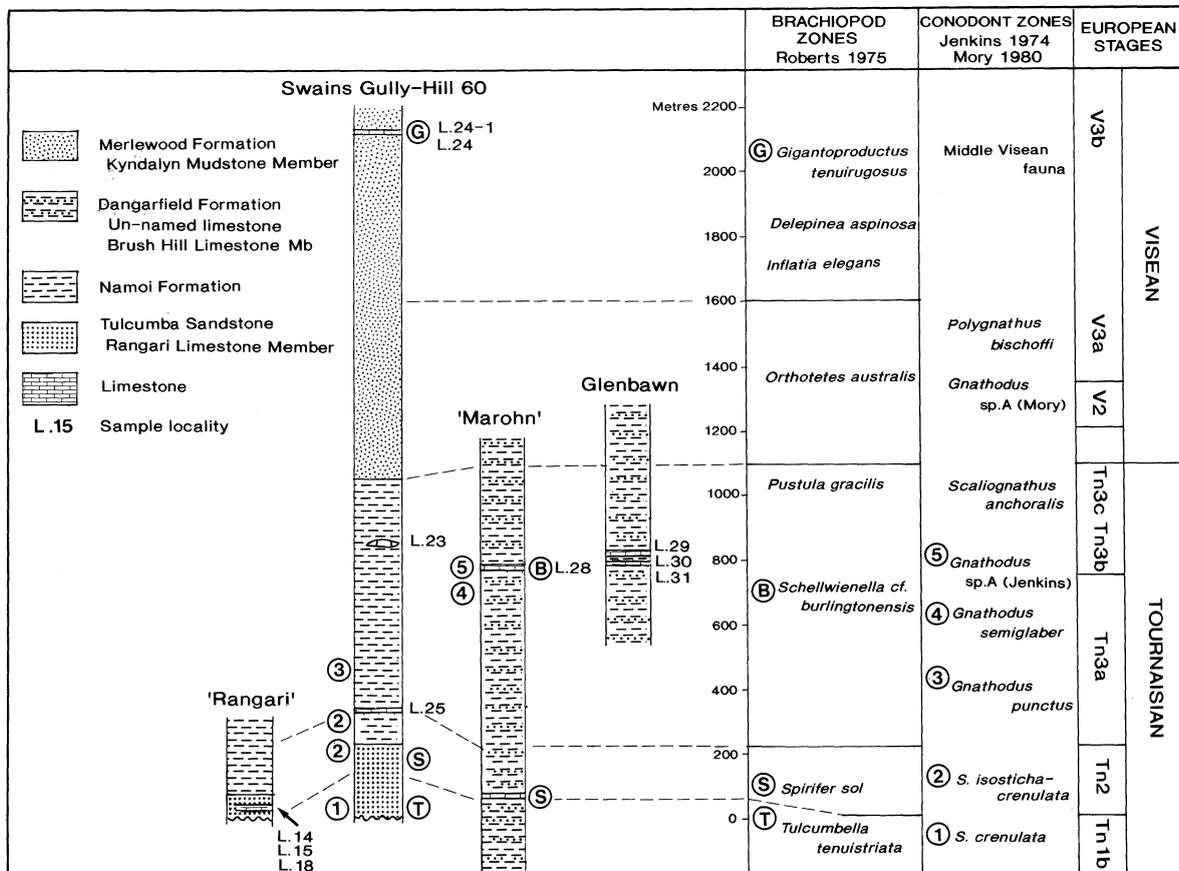


Fig. 4 Stratigraphic correlations of gastropod localities and comparison with brachiopod and conodont zones.

Sinuitina portulacoides Campbell & Engel

Sinuitina portulacoides Campbell & Engel, 1963: 90, pl.6 figs 20-24.

Sinuitina portulacoides Campbell & Engel.-Yoo, 1988: 239.

Dimensions. Figured specimen (F78340) MD 13.4 mm, TS 8.8 mm.

Type. The types have been transferred from the University of New England (UNE F7573, 7574-7580) to the Australian Museum, Sydney.

Material. 7 specimens from Swains Gully (Locality 25); 9 from 'Marohn' (Locality 28); 2 from south-east of 'Rangari' (Locality 18); 9 from Glenbawn (Localities 30, 31 and 32).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Remarks. The specimens from Swains Gully are smaller than the type (16 mm in diameter of the last whorl), but is larger than the specimens recovered from 'Marohn', Upper Hunter Valley. All specimens are regarded as the same species.

Euphemitinae Knight, 1956*Euphemites* Warthin, 1930

Australian Carboniferous species. *Euphemites labrosa* Campbell & Engel, 1963, from 'Rangari'; *Euphemites minutus* Maxwell, 1961: 62, pl. 7 figs 1-4, Late Tournaisian-Early Visean, Yarrol, Queensland; *Euphemites pustula* n.sp., from the lower part of the Namoi Formation.

Euphemites labrosa Campbell & Engel

Euphemites labrosa Campbell & Engel, 1963: 91, pl.6 figs 34-39.

Euphemites labrosa Campbell & Engel.-Yoo, 1988: 239.

Dimensions. Figured specimen MD 1.32 mm, TS 1.10 mm

Types. The types have been transferred from the University of New England (UNE F7569-7572) to the Australian Museum, Sydney.

Material. 17 specimens from Swains Gully (Locality 25) and 44 from 'Marohn' (Locality 28).

Geographic distribution. 'Rangari' to 'Marohn'.

Geological age. Middle to late Tournaisian.

Remarks. The specimens from 'Rangari', Swains Gully and 'Marohn' are identical in shell characters, although the specimens from 'Marohn' represent much smaller in size.

Euphemites pustula n.sp.

Pl. 1 figs 1-3

Description. Shell very small, relatively thin shelled, symmetrically coiled planispiral, anomphalous. Protoconch concealed, seemingly minute, planispiral. Teleoconch planispiral with involute whorls; last whorl completely embracing earlier whorls; about 18 strong sharp spiral cords in the first half volution; perinductura pustules continuing from the spiral cords occur in the last half volution; selenizone obscured by perinductura; shell consisting of 2 layers. Height of aperture corresponds to that of shell; slit seemingly broad and small.

Dimensions.	MD	TS	NL
Holotype (F78341)	4.6 mm	18 mm	—
Paratypes (F78342a)	3.4	18	—
(F78342b)	4.2	3.5	17

Types. Holotype (F78341), 2 figured paratypes (F78342) and 4 additional paratypes (F78529).

Type locality. About 250 m west of Babbins Lane, Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. In bioclastic limestone, 130 m above the base of Namoi Formation.

Geographic distribution. Swains Gully.

Geological age. Middle Tournaisian.

Etymology. Referring to perinductura pustules.

Remarks. *Euphemites minutus* Maxwell and *Euphemites labrosa* Campbell & Engel both have a globular form with a narrow and deep umbilicus. *Euphemites pustula* n.sp. resembles *E. minutus* in having a number of spiral cords, but differs in having a narrow peripheral profile, perinductura pustules and in lacking an umbilicus. The mode of life and shell structure of *Euphemites* has been discussed by Moore (1941), Yochelson (1960), Linsley (1978b), and Harper & Rollins (1985). *Euphemites pustula* is characterised by perinductura pustules which appear to be the continuation of the spiral cords of the shell. The shells also lack the second layer of coinductura in and adjacent to the aperture. *Euphemites pustula* would have had mantle flaps covering almost the entire shell lacking the secondary deposit of coinductura.

Bellerophontidae M'Coy, 1851**Bellerophontinae** M'Coy, 1851*Cymbularia* Koken, 1896

Australian Carboniferous species. *Cymbularia carinata* n.sp., from Swains Gully.

Remarks. The present specimens resemble *Warthia* Waagen (1880) in having a convolute spire and in lack of ornamentation, but differs in that *Warthia* has a rounded margin and short, wide slit.

Cymbularia carinata n.sp.

Pl. 1 fig. 4

Description. Shell very small with rather thick, biconvex lenticular form, isostrophic and smooth with an acute keel at periphery; umbilici closed on both sides by last whorl. Aperture with a deep angular sinus culminating at the periphery in a long narrow slit; lips thick.

Dimensions. Holotype (F78343) MD 2.3 mm, TS 1.8 mm

Types. Holotype (F78343) and 10 paratypes (F78530).

Type locality. About 250 m west of Babbinboon Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. In bioclastic limestone, 130 m above the base of the Namoi Formation.

Additional material. 3 specimens from 'Marohn' (Locality 28).

Geographic distribution. From Swains Gully to 'Marohn'.

Geological age. Middle to late Tournaisian.

Etymology. Derived from the Latin *carina* meaning carinate; referring to the spiral ridge at the periphery.

Remarks. This is a relatively rare species, and is characterised by a smooth biconvex shell with a long slit and peripheral keel. The specimens are similar to the type species *Cymbularia galeata* Koken in having a smooth convolute spire with a long narrow slit, but differs in that *C. galeata* has an asymmetrical adult shell and in lacking a keel on the periphery.

Bellerophon Montfort, 1808

Australian Carboniferous species. *Bellerophon* (*Bellerophon*) *kyndalynensis* n.sp., from 'Kyndalyn'; *Bellerophon* (*Bellerophon*) *swainsensis* n.sp., from Swains Gully.

Bellerophon (*Bellerophon*) *kyndalynensis* n.sp.

Pl. 1 figs 9-12

Description. Shell minute, subglobular, isostrophic, anomphalous. Protoconch concealed, seemingly minute, planispiral. Teleoconch with whorls moderately involute and with maximum diameter of whorl less than the height of spire; ornament consisting of regularly interspaced and curved transverse costae and wide selenizone marked by curved transverse lunulae, almost the same number as transverse costae. Aperture broadly crescentic with lips without flare anteriorly or laterally, but flaring somewhat backward in the umbilical region; parietal inductura covering a quarter of the last whorl with thickening in the umbilical region.

Dimensions.	MD	TS
Holotype (F78348)	1.2 mm	1.2 mm
Paratypes (F78349a)	1.2	1.4
(F78349b)	1.5	—

Types. Holotype (F78348) and 2 figured paratypes (F78349). There are 22 unfigured additional specimens (F78350) from the type locality.

Type locality. Behind 'Kyndalyn' homestead, 10 km south-west of Somerton, NSW (Locality 24).

Stratigraphic position. Base of oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation.

Geographic distribution. Type locality only.

Geological age. Middle or late Viséan.

Etymology. Referring to the geographical name of 'Kyndalyn' homestead, Somerton, NSW.

Remarks. This species resembles *Bellerophon* (*Bellerophon*) *swainsensis* n.sp. in ornament, but differs in having a much smaller shell with wider selenizone.

Bellerophon (*Bellerophon*) *swainsensis* n.sp.

Pl. 1 figs 5-8

Description. Shell small, subglobular, isostrophic, anomphalous. Protoconch concealed, seemingly minute, planispiral. Teleoconch whorls involute and with largest diameter of whorl slightly less than height of spire; ornament consisting of closely spaced transverse costae and narrow selenizone; transverse costae curved back into selenizone; selenizone marked by closely spaced short lunulae. Aperture broadly crescentic, lips without flare anteriorly or laterally, but flaring somewhat backward in the umbilical region; parietal inductura covering a quarter of the last whorl, with thickening in the umbilical region.

Dimensions.	MD	TS
Holotype (F78344)	5.7 mm	5.4 mm
Paratypes (F78346a)	5.3	5.6
(F78345)	6.0	6.4
(F78346b)	4.0	6.4

Types. Holotype (F78344) and 3 figured paratypes (F78345-6). There are 20 unfigured additional specimens (F78347) from the type locality.

Type locality. About 250 m west of Babbinboon Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. In bioclastic limestone, 130 m above the base of the Namoi Formation.

Geographic distribution. Type locality only.

Geological age. Middle Tournaisian.

Etymology. Referring to the geographical name of Swains Gully, Babbinboon, NSW.

Remarks. This species resembles *Bellerophon* (*Bellerophon*) *kyndalynensis* n.sp. in shell shape, but differs in having a much larger and globular form. It has a far narrower selenizone than *Bellerophon* (*Bellerophon*) *kyndalynensis*.

Knightitinae Knight, 1956*Knightites* Moore, 1941*Retispira* Knight, 1945

Australian Carboniferous species. *Knightites* (*Retispira*) *culleni* Campbell & Engel, 1963, from 'Rangari'; *Knightites* (*Retispira*) *multilirata* n.sp., from Swains Gully; *Knightites* (*Retispira*) *triangularis* n.sp., from Swains Gully.

Knightites (*Retispira*) *culleni* Campbell & Engel

Knightites (*Retispira*) *culleni* Campbell & Engel, 1963: 89, pl. 6 figs 27-33

Knightites (*Retispira*) *culleni* Campbell & Engel.-Yoo, 1988: 239.

Types. The types have been transferred from the University of New England (UNE F7434, 7435) to the Australian Museum, Sydney.

Additional material. 11 specimens from Swains Gully, 21 from 'Marohn' (Locality 28) and 13 from Glenbawn (Localities 30 and 31).

Stratigraphic position. Lower part of the Namaoi Formation.

Geological age. Middle to late Tournaisian.

Knightites (*Retispira*) *multilirata* n.sp.

Pl. 2 figs 4-7

Description. Shell small, isostrophic, widely phaneromphalous. Protoconch concealed. Teleoconch with whorl profile depressed, involute, broadly rounded across dorsum but becoming more sharply rounded laterally, then turning into a wide umbilicus; ornament reticulate, consisting of a large number of fine, sharp spiral and transverse lirae with small nodes developed at intersections; selenizone moderately wide, flush with the shell surface, ornamented by 4 central spiral lirae flanked with 2 weaker spiral lirae on both sides; curved lunulae numbering twice the transverse lirae; shell consisting of 2 layers. Aperture broadly crescentic; lips thickened, flared; slit probably obscured by thickening; parietal inductura thickened for almost a half of a volution.

Dimensions.	MD	TS
Holotype (F78353)	5.2 mm	7.0 mm
Paratypes (F78354)	5.3	6.1
(F78355)	6.3	—

Types. Holotype (F78353) and 2 figured paratypes (F78354-5).

Type locality. About 250 m west of Babbinboon Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. In bioclastic limestone, 130

m above the base of the Namaoi Formation.

Additional material. 2 specimens from the type locality.

Geographic distribution. Swains Gully.

Geological age. Middle Tournaisian.

Etymology. Referring to the multiple lirae of the shell.

Remarks. This species differs from *Knightites* (*R.*) *culleni* Campbell & Engel and *Knightites* (*R.*) *triangularis* n.sp. by having a wide and deep umbilicus, depressed whorls and neat reticulate ornamentation.

Knightites (*Retispira*) *triangularis* n.sp.

Pl. 2 figs 1-3

Description. Shell small, isostrophic with fan-like form, narrowly phaneromphalous; umbilicus partly obscured in lateral view by a flap-like extension from the parietal inductura. Protoconch concealed, seemingly minute planispiral. Teleoconch with whorls involute and with maximum diameter of whorl less than height of spire; ornament dominated by coarse spiral costae modified by weak transverse lirae with pustules formed at their intersection; spiral costae, about 18-20 in the last whorl, with 1 or 2 weaker spiral costae between the coarse costae; transverse lirae less prominent, but regularly spaced; side of selenizone raised, ornamented by 8 to 9 closely spaced spiral lirae and curved lunulae; shell consisting of 2 layers, the inner layer retaining the same ornamentation as the outer layer, but weaker. Aperture broad, crescentic, only slightly flared at the side; slit short; parietal inductura moderately thickened, approximately one quarter of a volution.

Dimensions.	MD	TS
Holotype (F78351)	7.3 mm	8.6 mm
Paratype (F78352)	6.4	7.1

Types. Holotype (F78351) and 1 figured paratype (F78352).

Type locality. About 250 m west of Babbinboon Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. In bioclastic limestone 130 m above the base of the Namaoi Formation.

Geographic distribution. Swains Gully.

Geological age. Middle Tournaisian.

Etymology. Referring to the triangular shape in the apertural view.

Remarks. This species resembles *Knightites* (*Retispira*) *culleni* Campbell & Engel and *Knightites* (*R.*) *multilirata* n.sp. in having reticulate shell ornamentation, but differs from the former by having a triangular shell shape and coarser ornamentation, and from the latter in having a narrow umbilicus and raised selenizone. *Knightites* (*Retispira*) *triangularis* n.sp. is characterised by coarse wave-like spiral costae with raised wide selenizone whereas *K. (R.) multilirata* has net-like ornament with flat selenizone.

'Archaeogastropoda' Theile, 1925

Euomphaloidea de Koninck, 1881

Onychochilidae Koken, 1925

Onychochilus Lindstrom, 1884

Australian Carboniferous species. *Onychochilus minutissimus* Yoo, 1988.

Onychochilus minutissimus Yoo

Onychochilus minutissimus Yoo, 1988: 240, figs 12-14.

Additional material. 3 specimens (F78356).

Remarks. This species is extremely rare and small in size; a total of seven specimens have been recovered from the type locality, including four specimens in previous investigations (Yoo, 1988). The shells exhibit perfectly balanced adult forms with a sharp boundary between protoconch and teleoconch. This species differs from the type species *O. physa* Lindstrom in being much smaller in size and in lacking ornamentation.

Euomphalidae de Koninck, 1881

Serpulospira Cossmann, 1916

Australian Carboniferous species. '*Serpulospira*' *scalariformis* n.sp., from 'Marohn'.

'*Serpulospira*' *scalariformis* n.sp.

Pl. 2 figs 8-10, Pl. 3 figs 1-5

Description. Shell minute, openly coiled. Protoconch bulbous, smooth, curved; margin with teleoconch sharp and distinct. Teleoconch openly coiled, in early whorls with asymmetric spire tending to be symmetric with contact between spires in later whorls; nearly smooth but growth lines distinct throughout, aperture rounded.

Dimensions.		MD	DA
Holotype	(F78360)	2.3 mm	0.8 mm
Paratypes	(F78357)	2.8	1.0
	(F78359)	2.1	0.6
	(F78361)	2.9	—
	(F78362)	1.3	0.3
	(F78358a)	1.4	0.4
	(F78358b)	1.3	0.4

Types. Holotype (F78360) and 6 figured paratypes (F78357-9, F78361-2). There are 48 unfigured additional specimens (F78390) from the type locality.

Type locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper

part of the Dangarfield Formation.

Additional material. 10 specimens from Oxley Highway (Locality 22-2), 3 from south-east of 'Rangari' (Locality 18) and 2 from Glenbawn (Locality 30).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Etymology. Referring to disjunct whorls.

Remarks. The bulbous and smooth protoconch of '*Serpulospira*' *scalariformis* n.sp. is similar to that of hyoliths. The difference is that the protoconch of this species is curved. The nature of spire and growth lines on the teleoconch suggest that the species could be referred to the macluritoidean gastropods proposed by Linsley (1978a). The species is tentatively placed in the Euomphaloidea, but that is considered problematic by Bandel (personal communication).

Straparollus de Montfort, 1810

Australian Carboniferous species. *Straparollus australis* Maxwell, 1961, between Splinter Creek and Mount Cannindah, Qld; *Straparollus brevis* n.sp., from 'Kyndalyn'; *Straparollus davidi* Dun & Benson, 1920, from Carroll.

Straparollus brevis n.sp.

Pl. 3 figs 6-8

Description. Shell very small, low-spined trochiform, widely phaneromphous. Protoconch of 5 or 6 smooth whorls with a sharp demarcation between the protoconch and teleoconch. Teleoconch of 2½ smooth and rounded whorls; whorl profile well arched between sutures; with broadly rounded revolving shoulder on its upper surface and slight flattening above; suture moderately deep; ornamentation of fine growth lines; base and umbilical surface strongly rounded. Aperture almost circular; parietal inductura thin; columellar lip thin, arcuate; outer lip with shallow sinus close to the upper suture, swinging forward below sinus and then rounding backward to cross the lower face and the base with a slight backward obliquity, becoming vertical on the umbilical face.

Dimensions.		H	W	PA	NW
Holotype	(F78363)	2.2 mm	1.2 mm	150°	—
Paratypes	(F78364a)	1.9	—	—	¾
	(F78364b)	2.3	1.4	145	5

Types. Holotype (F78363) and 2 figured paratypes (F78364). There are 20 unfigured additional specimens (F78365) from the type locality.

Type locality. Behind 'Kyndalyn' homestead, 10 km south-west of Somerton, NSW.

Stratigraphic position. From base of oolitic limestone, in the Kyndalyn Mudstone Member of the Merlewood Formation.

Geographic distribution. Type locality only.

Geological age. Middle or late Viséan.

Etymology. Derived from the Latin word *brevis* meaning short; referring to the low spire of the shell.

Remarks. This is smaller in size than any other species referred to subgenus *Straparollus*. This species has a larger pleural angle (145-150°) than in *S. davidi* Dun & Benson (120-130°) and the type species *Straparollus dionysii* Montfort (pleural angle about 80°) from Belgium. Another European species *Straparollus levigatus* (Leveille) and *Straparollus planorbiformis* de Koninck are rather flatly coiled.

Straparollus davidi Dun & Benson

Description. Campbell & Engel (1963:95).

Type. Lectotype (F78391).

Geographic distribution. From 'Rangari' south to Glenbawn.

Geological age. Middle to late Tournaisian.

Remarks. This is a very common species of relatively large size. The single specimen (F1773, Geological and Mining Museum, Sydney) described by Dun & Benson (1920) from Carroll is missing (Campbell & Engel, 1963). The specimen here chosen as lectotype is rather young and well preserved. It was recovered from the lower part of the Namoi Formation in Swains Gully, where the species occurs abundantly (Locality 25). The species has a short and smooth protoconch, and is planispiral in early whorls.

Pleurotomarioidea Swainson, 1940

Sinuopeidae Wenz, 1938

Platyschismatinae Knight, 1956

Platyschisma M'Coy, 1844

Australian Carboniferous species. *Platyschisma lingua* n.sp., from 'Rangari'; *Platyschisma vitrea* n.sp., from 'Marohn'.

Remarks. The Early Permian species *Platyschisma allandalensis* Mitchell (1922) and the form referred to *Platyschisma oculus* Sowerby by de Koninck (1876) are large in size. The width of *P. allandalensis* is 105 mm. The original figures of *P. allandalensis* does not show the detail of the shell, and its exact locality is not known. Comparison of *P. allandalensis* with the type species, *Platyschisma helicoides* Sowerby, suggests that *P. allandalensis* is better referred to *Keeneia* of Etheridge (1902).

Platyschisma lingua n.sp.

Pl. 4 figs 1-3

Description. Shell of about 5 whorls, very small, low spired, naticiform, thin, with spiral ornament,

phaneromphalous. Protoconch simple, sharply pointed. Teleoconch with whorls increasing rapidly in size with whorl profile inflated and sutures moderately deep; ornamentation of closely spaced fine spiral lirae; base rounded, pseudoselenizone narrow above periphery; aperture with columellar lip slightly thickened and sinuous; parietal inductura wanting; outer lip with a moderately deep and narrow sinus culminating in a small and narrow slit or notch; anterior margin of the lip with prominent tongue-like siphonal extension.

Dimensions.	H	W	PA	NW
Holotype (F78369)	2.4 mm	2.7 mm	135°	4½
Paratypes (F78370)	2.8	3.1	130	5
(F78371)	4.9	5.0	125	5

Types. Holotype (F78369) and 2 figured paratypes (F78370 and F78371).

Type locality. The holotype is from 4 km south-east of 'Rangari' homestead on the Gunnedah-Barraba roadside, 34 km north-east of Gunnedah, NSW (Locality 18); 1 paratype is from Glenbawn (Locality 30) and the other paratype is from Swains Gully (Locality 25).

Stratigraphic position. In bioclastic limestone from the middle limestone lens in the Tulcumba Sandstone, from the lower part of the Namoi formation, and from the upper part of the Dangarfield Formation.

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Etymology. Derived from the Latin *lingua* meaning tongue, referring to the shape of the anterior siphonal extension.

Remarks. This species is characterised by a large aperture and a long tongue-like anterior siphonal extension. It resembles *Platyschisma vitrea* n.sp. in having a low spire and in being smaller in size, but differs in having fine spiral lirae.

Platyschisma vitrea n.sp.

Pl. 3 figs 9-12

Description. Shell of 4½ whorls, very small, low spired, naticiform, thin, shelled, with glossy surface, broadly phaneromphalous. Protoconch simple, smooth, rather flatly coiled, with no defined boundary between protoconch and teleoconch. Teleoconch whorls increasing in size gradually, whorl profile rounded; sutures moderately deep; surface glossy smooth with faint growth lines; base rounded but angled towards umbilicus; numerous revolving lirae and conspicuous growth lines within and near umbilicus; selenizone narrow just above periphery; aperture subcircular with columellar lip thin and reflexed; parietal inductura wanting, outer lip thin with a strongly developed sinus culminating just below periphery without generating a slit.

Dimensions.	H	W	NW
Holotype (F78366)	— mm	2.5 mm	4½
Paratypes (F78367a)	—	2.1	—
(F78367b)	1.0	1.3	—

Types. Holotype (F78366) and 2 figured paratypes

(F78367). There are 32 unfigured additional specimens (F78368) from the type locality.

Type locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Geographic distribution. Type locality only.

Geological age. Late Tournaisian.

Etymology. Derived from the Latin *vitrea* meaning glossy, referring to the glossy surface of shell.

Remarks. This species is similar to *Straparollus brevis* n.sp. in having a low spired shell with a large umbilicus, but is very different in the shape of aperture and shell thickness. *Platyschisma vitrea* is characterised by having a thin glossy shell, suggesting that it may have been an algal dweller.

Raphistomatidae Koken, 1896

Liospirinae Knight, 1956

Angyomphalus Cossmann, 1916

Australian Carboniferous species. *Angyomphalus depressus* Campbell & Engel (1963), from 'Rangari'; *Angyomphalus radianodosa* n.sp.

***Angyomphalus radianodosa* n.sp.**

Pl. 4 figs 4-10

Description. Shell very small low-spired lenticular, with 4½ whorls, phaneromphalous. Protoconch seemingly simple, smooth, without sharp boundary between protoconch and teleoconch; suture shallow; upper whorl face sloping gently toward the periphery and decorated by narrow radiating nodes which are slightly sigmoidal just below the suture; growth lines extending beyond the nodes, prosocline above the peripheral selenizone, but faint below the selenizone, swinging forward for a short distance and then backward into the umbilicus; columellar lip thin next to the parietal wall but with a thick subtriangular section at the circumumbilical funicle, outer lip thin, sharply angulated at periphery, size of slit and lunulae unknown.

Dimensions.		H	W
Holotype (F78372)		2.5 mm	3.9 mm
Paratypes (F78376a)		—	3.8
(F78373)		2.5	3.9
(F78376b)		—	3.4
(F78375)		—	3.2

Types. Holotype (F78372) and 6 figures paratypes (F78373-6). There are 42 unfigured additional specimens (F78377) from the type locality.

Type locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Additional material. 25 from Swains Gully (Locality 25), 6 from south-east of 'Rangari' (Locality 18) and 6 from Glenbawn (Locality 31).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Etymology. Derived from the Latin *radian* meaning radial, and *nodosus* meaning nodose; referring to the radial nodes below the sutures.

Remarks. This form differs from the only described Australian species, *Angyomphalus depressa* Campbell & Engel in that the latter has a low spired shell with more acute periphery and more closely spaced and longer nodes just below the suture. It resembles the Belgian type species *Angyomphalus radians* (de Koninck, 1881) in shell character but differs in being much smaller.

Eotomariidae Wenz, 1938

Eotomariinae Wenz, 1938

Eotomaria Ulrich & Scofield, 1897

Australian Carboniferous species. *Eotomaria umbilicata* n.sp., from 'Marohn'.

Remarks. *Eotomaria* resembles somewhat *Mourlonia* de Koninck (1883), but differs in that *Mourlonia* has a taller, more globular shell with minute umbilicus. *Eotomaria* was previously recorded as having the range from Ordovician to Silurian. If it is correctly placed, this record may extend to early Carboniferous.

***Eotomaria umbilicata* n.sp.**

Pl. 5 figs 1-3

Description. Shell of about 4 whorls, very small, low spired, rotelliform, and widely phaneromphalous. Protoconch simple, first 1½ whorls smooth, the remainder with faint reticulate ornament, with spiral and collabral cords appearing on the third whorl. Teleoconch with whorls increasing in size rapidly; whorl profile inflated with area above selenizone rather flat; sutures moderately deep; ornamentation of strong regularly spaced collabral cords with lighter spiral threads, collabral cords orthocline below suture, but curved backward towards upper margin of selenizone; cords more finely spaced below selenizone with strong sinus extended to the base. Selenizone wide, bordered by raised spiral thread; lower margin of selenizone on whorl periphery slightly concave, ornamented with curved lunulae. Aperture simple, inner lip thin, arcuate; outer lip with a deep sinus culminating in a moderately deep slit above periphery.

Dimensions.		H	W	PA	NW
Holotype (F78379)		1.6 mm	2.2 mm	125°	4
Paratypes (F78380a)		—	2.5	—	—
(F78380b)		—	1.9	—	4

Types. Holotype (F78379) and 2 figured paratypes (F78380). There are 42 unfigured additional specimens (F78381) from the type locality.

Type locality. 150 m west of 'Marohn', homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Additional material. 12 specimens from various horizons of the Dangarfield Formation, east of Glenbawn Dam (Localities 29-31).

Geographic distribution. Glenbawn area.

Geological age. Late Tournaisian.

Etymology. Referring to umbilicus.

Remarks. This species is characterised by a low spired shell with strong sinuous collabral cords and an exceptionally wide umbilicus. This form resembles the type species *Eotomaria canalifera* Ulrich in Ulrich & Scofield from Tennessee, in having a coeloconoidal, sublenticular shell with deep sinus and selenizone above the periphery, but differs from in having round whorl profile and round aperture. This is different from any known species of the Australian euomphaloideans.

Glabrocingulum Thomas, 1940

Australian Carboniferous species. *Glabrocingulum obesum* Yoo, 1988, from 'Marohn'; *Glabrocingulum ornatum* (Dun & Benson), 1920, from south of Somerton; *Glabrocingulum pustulum* n.sp., from Swains Gully; *Glabrocingulum* sp. (in this study), from 'Marohn'.

Glabrocingulum obesum Yoo

Pl. 6 figs 4-10

Glabrocingulum obesum Yoo, 1988: 241, figs 33-35.

Dimensions.	H	W	PA
Figured specimens			
(F78394a)	1.5 mm	1mm	98°
(F78394b)	2.3	2.4	100
(F78394c)	2.2	2.5	100
(F78393)	5.0	5.0	80
(F78395)	3.2	2.6	85

Additional material. 30 additional specimens of *G. obesum* Yoo, 1988 were recovered from the type locality and east of Glenbawn Dam (Locality 30).

Remarks. The figured specimens (Pl. 6 figs 6, 9, 10) appear to be immature. The specimens (Pl. 6 figs 4, 5) have straight whorl profiles with smaller pleural angle, coarser ornamentation and smaller umbilicus, which appears to be relatively mature. This species differs from *Glabrocingulum ornatum* (Dun & Benson) in having smaller and low-spired shell.

Glabrocingulum pustulum n.sp.

Pl. 7 figs 1-4

Description. Shell small, trochiform, with 5 whorls, narrowly phaneromphalous. Protoconch simple, smooth, round. Teleoconch conical, whorl profile round in early whorls becoming rather flat in later whorls with deep suture, about 3½ whorls with broadly subangular periphery; ornamentation of sharp spiral lirae bearing nodes where crossed by prosocline collabral threads; ornamentation below selenizone is weaker. Selenizone narrow and flat to just above periphery, ornamented with curved lunulae, present from third whorl. Aperture with inner lip straight, thickened, slightly extended towards umbilicus, outer lip with gentle labral sinus culminating in a small notch.

Dimensions.	H	W	PA	NW
Holotype (F78397)	5.6 mm	5.5 mm	80°	5
Paratype (F78398)	5	5	85	5½

Types. Holotype (F78397), 1 figured paratype (F78398) and 10 paratypes (F78392).

Type locality. Approximately 250 m west of Babbins Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. In bioclastic limestone, 130 m above the base of the Namoi Formation.

Additional material. 8 specimens from Oxley Highway (Locality 22-2), 2 from north-east of 'Rangari' (Locality 15), 2 from 'Marohn' (Locality 28), and 2 from Glenbawn (Localities 30 and 31).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Etymology. Referring to the nodes covering the shell surface.

Remarks. This species differs from *G. obesum* Yoo in having a conical shell with a narrower umbilicus, and a different pattern of the selenizone ornamentation. *Glabrocingulum* sp. has a low spired shell with round and inflated whorl profile, while *G. pustulum* n.sp. has rather flat whorl profile with subangular periphery.

Glabrocingulum sp.

Pl. 6 figs 11-12

Dimensions. Figured specimen (F78396) H 3.5 mm, W 3.7 mm

Locality. Approximately 250 m west of Babbins Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. 130 m above the base of the Namoi Formation.

Campbellospira n.gen.

Type species. *Campbellospira conica* n.sp.

Definition. Turbiniform, low-spired, conical shell; moderately phaneromphalous; ornamented by transverse cords and spiral lirae, most prominent near upper suture; selenizone concave between a pair of conspicuous cords just above periphery.

Geological age. Middle Tournaisian.

Etymology. This genus is named for Professor K.S.W. Campbell of the Australian National University for his contribution to the study of eastern Australian Carboniferous geology and palaeontology.

Remarks. This genus is similar to other pleurotomarioideans in general, but is different in having a planktotrophic protoconch. Specimens belonging to this genus are very common at the type locality.

Australian Carboniferous species. *Campbellospira conica* n.sp., *Campbellospira* sp. A, B and C, all from Swains Gully.

Campbellospira conica n.sp.

Pl. 5 figs 4-7

Description. Very small, conically spired turbiniform shell of 5½ whorls, phaneromphalous. Protoconch simple, with 2 whorls with faint growth lines and with distinct varix. Teleoconch with conical spire subtending an angle of 85-90°, 3½ whorls with sutures incised; ornamentation of strong collabral cords and faint spiral threads, with approximately 30 collabral cords in the final whorl; cords orthocline above selenizone and shallow sinus below selenizone extending to base. Selenizone moderately wide, bordered by spiral ridges high on the whorl, slightly concave, ornamented with fine spiral threads. Aperture with thickened arcuate inner lip; outer lip with a broad, shallow sinus culminating in a broad, seemingly shallow slit above the periphery.

Dimensions.	H	W	PA	NW
Holotype (F78382)	4.3 mm	4.2 mm	90°	5½
Paratypes (F78384)	3.8	3.5	88	5½
(F78383)	3.6	—	90	5

Type. Holotype (F78382) and 2 figured paratypes (F78383-4). There are 65 unfigured additional specimens (F78378) from the type locality.

Type locality. Approximately 250 m west of Babbinboon Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. In bioclastic limestone, 130 m above the base of the Namoi Formation.

Additional material. 1 specimen from south-east of 'Rangari' (Locality 18).

Geographic distribution. 'Rangari' to Swains Gully.

Geological age. Middle Tournaisian.

Etymology. Referring to the conical shell shape.

Remarks. *Campbellospira conica* n.sp. differs from other species of *Campbellospira* in many respects: *Campbellospira* sp. A has a low spire with convex whorl profile, more closely spaced collabral cords above the selenizone and a smooth surface except for growth lines below selenizone. *Campbellospira* sp. B has a relatively

high spire with canaliculate profile, and prominent spiral cords below the selenizone; *Campbellospira* sp. C is a low-spired biconvex lenticular form with a larger pleural angle (117°).

Campbellospira sp. A

Pl. 5 figs 8-10

Dimensions.	H	W	PA
Figured specimens			
(F78385)	3.4 mm	3.8 mm	90°
(F78386)	2.7	3.0	95

Locality. Approximately 250 m west of Babbinboon Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. 130 m above the base of the Namoi Formation.

Campbellospira sp. B

Pl. 5 figs 11-12

Dimensions. Figured specimen H 2.7 mm, PA 75°, NW 5½.

Locality. Approximately 250 m west of Babbinboon Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. 130 m above the base of the Namoi Formation.

Campbellospira sp. C

Pl. 6 figs 1-3

Dimensions.	H	W	PA
Figured specimens			
(F78388)	3.0 mm	3.1 mm	117°
(F78389)	3.1	3.5	120

Locality. Approximately 250 m west of Babbinboon Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. 130 m above the base of the Namoi, Formation.

Agnesiinae Knight, 1956

Hesperiella Holzapfel, 1889

Australian Carboniferous species. *Hesperiella elongata* n.sp., from 'Rangari'; *Hesperiella planorbis* n.sp., from 'Marohn'; *Hesperiella robertsi* Yoo, 1988, from 'Marohn'.

Remarks. The structure of the submerged protoconch of *Hesperiella* has been discussed by Knight (1941), Batten (1966) and Yoo (1988). It is almost certain that this genus has a hyperstrophically coiled dextral shell. *Hesperiella* has a narrow selenizone seen only in the final whorl. The slit is observed in the juvenile specimens (Pl. 7 figs 10-12), although it is not obvious in the adult shells.

***Hesperiella elongata* n.sp.**

Pl. 7 figs 5-7

Description. Shell very small, rather high spired, sinistral, anomphalous or hemiophalous. Protoconch coiling inward and hidden by later whorls, apex a funnel-like hole. Teleoconch with whorl profile rather straight; collabral costae widely spaced, opisthoclinal, with about 40 cords in the final whorl. Selenizone narrow, concave, smooth, adjacent to lower suture, seen only in the final whorl. Aperture subangular.

Dimensions.	H	W	PA	NW
Holotype (F78399)	4.1 mm	3.7 mm	50°	4½
Paratype (F78400)	2.5	2.7	—	—

Types. Holotype (F78399) and 3 paratypes (F78400, F78405).

Type locality. 4 km south-east of 'Rangari' homestead, on the Gunnedah-Barraba roadside, 34 km north-east of Gunnedah, NSW (Locality 18).

Stratigraphic position. In bioclastic limestone, the middle limestone lens in the Tulcumba Sandstone.

Additional material. 1 specimen each from north of 'Rangari' (Locality 14), north-east of 'Rangari' (Locality 15) and Glenbawn (Locality 29).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Etymology. Derived from the Latin *elongatus* meaning elongate, referring to the tall spire of shell.

Remarks. This species is characterised by a tall-spired shell with a rather flat whorl profile, which is very different from any other *Hesperiella* species.

***Hesperiella planorbis* n.sp.**

Pl. 7 figs 9-13

Description. Shell very small, low spired, sinistral, broadly phanerocephalous. Protoconch coiling inward and hidden by later whorls, but seen in umbilicus, smooth, one and one eighth whorls, apex bulbous. Teleoconch with first 1? whorls planispiral, becoming ultradextral, growth lines in early whorls but gradually becoming stronger; collabral lirae above selenizone, opisthoclinal below selenizone; fine collabral thread extended to umbilicus. Selenizone present from early teleoconch whorl, narrow on periphery. Aperture round; inner and parietal lips thin, outer lip thickened; slit is seen in juvenile shells.

Dimensions.	H	W
Holotype (F78402)	1.7 mm	2.6 mm
Paratype (F78403)	0.8	1.3

Types. Holotype (F78402) and 3 figured paratypes (F78403). There are 15 unfigured additional specimens (F78404) from the type locality.

Type locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, in upper part of the Dangarfield Formation.

Additional material. 1 specimen from Glenbawn (Locality 31) and 1 from Swains Gully (Locality 25).

Geographic distribution. Swains Gully to Glenbawn.

Geological age. Middle to late Tournaisian.

Etymology. Referring to the planispirally coiled early stage of development of the shell.

Remarks. This species differs from other species of this genus in having a low-spired shell, a very wide umbilicus, and a flattened selenizone. The protoconch and nepionic whorls are planispiral and the early ontogenetic pattern of development is seen through the umbilicus. Two figured paratypes are juveniles.

***Hesperiella robertsi* Yoo**

Pl. 7 fig. 8

Hesperiella robertsi Yoo, 1988: 241, figs 36-41.

Additional material. 34 specimens from the type locality, 16 from various horizons at Glenbawn (Localities 29-31) and 8 from south-east of 'Rangari' (Locality 18). 1 from 'Lorrina' (Locality 23).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Remarks. This species is abundant at Glenbawn, and occurs commonly at 'Rangari', but has not been recovered at Swains Gully (Locality 25). A single specimen recovered at 'Lorrina', from a stratigraphically higher horizon in the Namoi Formation, is here temporarily assigned to this species. Figured specimen (Pl. 7 fig. 8) is an immature form.

***Agnesia* de Koninck, 1883**

Australian Carboniferous species. *Agnesia reticulata* n.sp., from Swains Gully.

Remarks. This is the first record of *Agnesia* in Australia. *Agnesia* resembles *Hesperiella* in having a sinistrally coiled shell, with an inturned protoconch, and moderately wide umbilicus, but differs in having a reticulate ornamentation and the narrow, deep peculiar selenizone. The protoconch of *Agnesia* has not yet been observed, but because of the inward coiling, as seen in *Hesperiella*, it is assumed that *Agnesia* has a hyperstrophically coiled dextral shell.

Agnesia reticulata n.sp.

Pl. 8 figs 1-3

Description. Shell medium, trochiform, sinistral, moderately phaneromphalous. Protoconch coiling inward and hidden by later whorls, apex a funnel-like hole. Teleoconch conical with sunken top, whorl profile gently arched between sutures, rather deep, base gently convex, ornamentation of opisthocline collabral lirae and weaker spiral threads making small nodes in intersections. Selenizone relatively narrow; lower margin of selenizone on sutures with a narrower and deeper channel in the middle of the elevated selenizone; regularly spaced lunulae in the deeper channel and regularly spaced inclined streaks in outer selenizone. Aperture subcircular with inner lip thin, arcuate, deflected towards umbilicus; outer lip opisthocline from the upper suture, slit seemingly very narrow; parietal inductura lacking.

Dimensions.	H	W	PA	NW
Holotype (F78406)	10 mm	7.1 mm	70°	4½
Paratype (F78410)	6.3	5.2	72	4

Types. Holotype (F78406) and 3 paratypes (F78410, F78416).

Type locality. Approximately 250 m west of Babbinboon Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. In bioclastic limestone, 130 m above the base of the Namoi Formation.

Geographic distribution. Type locality only.

Geological age. Middle Tournaisian.

Etymology. Referring to the network of obliquely intersecting linear ridges.

Remarks. The shell consists of two distinct layers. Of interest is the mark of the deeper channel and the lunulae remaining on the inner shell layer.

Neilsoniinae Knight, 1956

Peruvispira J. Chronic, 1949

Australian Carboniferous species. *Peruvispira gundyensis* Yoo, 1988, from 'Marohn'; *Peruvispira kempseyensis* Campbell, 1962, from Sherwood, 17 km west-north-west of Kempsey; *Peruvispira kuttungensis* Campbell 1961, from the Booral Formation, south-east of the Gloucester Trough.

Peruvispira gundyensis Yoo

Pl. 8 figs 4-8

Peruvispira gundyensis Yoo, 1988: 242, figs 29-32.

Dimensions.	H	W	PA	NW
Figured specimens				
(F78408)	4.1 mm	3.4 mm	67°	6½
(F78409a)	2.8	2.1	70	5½

(F78407)	2.3	2.1	71	5½
(F78409b)	2.9	2.4	68	5½

Additional material. 57 specimens from 'Marohn' (Locality 28), 23 from south-east of 'Rangari' (Locality 18), 15 from Swains Gully (Locality 25), 61 from various horizons at Glenbawn (Localities 29-32).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Early to late Tournaisian.

Remarks. The difference of this species from *Peruvispira kempseyensis* Campbell, 1962 and *Peruvispira kuttungensis* Campbell, 1961 has already been discussed (Yoo, 1988). This species is very common between 'Rangari' and Glenbawn with some minor variations. The ontogenetic development of this species is well displayed in Plate 8 figure 6.

Lophospiridae Wenz, 1938

Ruedemanninae Knight, 1956

Ruedemannia Foerste, 1914

Australian Carboniferous species. *Ruedemannia bembexiformis* Campbell & Engel, 1963, from Rangari; *Ruedemannia* sp. (in this study), from Swains Gully.

Remarks. As Knight *et al.* (1960) suggested, Carboniferous *Ruedemannia* appears to converge in various characters on *Worthenia*. In this investigation, specimens possessing conspicuous collabral cords are tentatively referred to *Ruedemannia*.

Ruedemannia sp.

Pl. 8 figs 9-10, Pl. 9 figs 1-4

Description. Shell medium, turbiniform, moderately phaneromphalous with convex crenulated selenizone in the middle of whorl; protoconch seemingly smooth, collabral threads in the nepionic whorls; 1 spiral cord above and 2 below selenizone; collabral cords sharp, regularly spaced; outer lip with a wide shallow sinus culminating at the periphery in a short slit.

Dimensions.	H	W
Figured specimens (F78411)	9.7 mm	7.1 mm
(F78414)	6.3	4.4
(F78417)	5.2	4.4
(F78418)	3.8	3.1

Locality. Approximately 250 m west of Babbinboon Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. 130 m above the base of the Namoi Formation.

Additional material. 4 specimens from the same locality.

Geographic distribution. Above locality only.

Geological age. Middle Tournaisian.

Remarks. *Ruedemannia* sp. differs from *R. bembexiformis* Campbell & Engel in having spiral cords on the base and a minute umbilicus.

Worthenia de Koninck, 1883

Australian Carboniferous species. *Worthenia*(?) *canaliculata* Etheridge, 1907, from Carrol; *Worthenia crenilunula* n.sp., from Swains Gully; *Worthenia* sp. Campbell & Engel, 1963, from 'Rangari'; *Worthenia* sp. (in this study), from Swains Gully.

Worthenia crenilunula n.sp.

Pl. 8 figs 11-14, Pl. 9 figs 5-8

Description. Shell small, turbiniform, heavily ornamented, narrowly phaneromphalous to anomphalous. Protoconch with first whorl seemingly smooth. Teleoconch in 2 distinct layers, the outer layer thin; approximately 5 whorls; suture shallow, whorl profile with strong angulations; selenizone most prominently protruded with upper and lower spiral cords falling just below and above suture, more obtuse; transverse lirae sharp, closely spaced, forming sharp points at the intersection with the protruded selenizone; base with several spiral cords. Selenizone moderately wide, convex, ornamented by the same number of pointed lunulae, as collabral lirae. Aperture with inner lip thin, more or less straight, outer lip with a v-shaped sinus culminating at the angulation in a short slit giving rise to a convex, ornamented selenizone.

Dimensions.	H	W	PA	NW
Holotype (F78419)	6.4 mm	4.9 mm	65°	5½
Paratypes (F78413a)	4.5	3.6	63	5½
(F78415)	4.9	3.9	63	6
(F78413b)	6.6	4.4	60	6½

Types. Holotype (F78419) and 3 figured paratypes (F78413, F78415). There are 25 unfigured additional specimens (F78412) from the type locality.

Type locality. Approximately 250 m west of Babinboon Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. In bioclastic limestone, 130 m above the base of the Namoi Formation.

Additional material. 7 specimens from south-east of 'Rangari' (Locality 18) and 1 from Glenbawn (Locality 30).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Etymology. Referring to the prominent crenate lunulae of the selenizone.

Remarks. This species resembles *Ruedemannia* sp. and *Worthenia* sp. (both in this study), but differs from the former in having more conspicuous spiral cords on the whorls including the base, and from the latter in having a taller shell and more narrowly phaneromphalous.

Worthenia sp.

Pl. 9 figs 9-11

Dimensions.	H	W
Figured specimens (F78420)	2.1 mm	1.8 mm
(F78421)	1.8	1.7

Locality. 1.8 km east from the southern end of Glenbawn Dam, 13 km north-east of Aberdeen, NSW (Localities 30 and 31).

Stratigraphic position. In the upper part of the Dangarfield Formation.

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Late Tournaisian.

Phymatopleuridae Batten, 1956

Borestus Thomas, 1940

Australian Carboniferous species. *Borestus costatus* Yoo, 1988, from 'Marohn'.

Borestus costatus Yoo

Pl. 10 figs 1-5

Borestus costatus Yoo, 1988: 242, figs 25-28.

Dimensions.	H	W	PA
Figured specimens (F78422)	6.6 mm	5.0 mm	60°
(F78423)	2.7	2.1	65
(F78424)	3.9	3.4	75

Additional material. 3 specimens from south-east of 'Rangari' (Locality 18), 2 from Swains Gully (Locality 25), 4 from 'Marohn' (Locality 28), 3 from Glenbawn (Locality 31).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Early to late Tournaisian.

Patelloidea Rafinesque 1815

Family Uncertain

Lepetopsis Whitfield, 1882

Remarks. The investigated specimen is a very small juvenile and has a well preserved, seemingly planispiral apex. No muscle scar was observed. The specimen resembles the type species in having a similar shell shape and concentric ornamentation. One small juvenile specimen with an asymmetric spiral apex is noticed. The placement of this specimen to '*Lepetopsis*' is uncertain.

'Lepetopsis' sp.

Pl. 10 figs 11-12

Dimension. Maximum diameter of figured specimen (F78428) is 1.4 mm.

Material. 3 juvenile specimens from 'Marohn' and Glenbawn (Localities 28, 31).

Trochoidea Cox & Knight, 1960**Holopeidae** Wenz, 1938**Gyronematinae** Knight, 1956**Araeonema** Knight 1933

Australian Carboniferous species. *Araeonema microspirulata* Yoo, 1988, from 'Marohn'.

Araeonema microspirulata Yoo

Pl. 13 fig. 12

Araeonema microspirulata Yoo, 1988: 243, figs 46-49.

Dimensions. Holotype (F61958) H 1.2 mm, W 1.1 mm.

Additional material. 73 specimens from 'Marohn' (Locality 28), 2 from Glenbawn (Locality 29) and 1 from 'Lorrina' (Locality 23).

Geographic distribution. 'Lorrina' to Glenbawn.

Geological age. Late Tournaisian.

Remarks. This species has a very thin shell, yet is extremely well preserved. It is one of the most abundant species at the type locality. A single worn specimen recovered from the upper part of the Namoi Formation at 'Lorrina' is tentatively referred to this species.

Rhabdotocochlis Knight, 1933

Australian Carboniferous species. *Rhabdotocochlis turgida* n.sp., from Glenbawn.

Rhabdotocochlis turgida n.sp.

Pl. 11 figs 1-10

Description. Shell very small, medium-spined turbiniiform, coeloconoid, narrowly phaneromphalous. Protoconch of 1¼ smooth whorls, and a rather flat apex. Teleoconch whorl profile gently arched between sutures, rounded on the final whorl, sutures moderately deep, spiral lirae rising gradually on the second whorl, then becoming gradually stronger; 18 lirae between sutures, shell consisting of two layers. Aperture with straight inner lip thickened, slightly reflexed; outer lip orthocone.

Dimensions.	H	W	PA	NW
Holotype (F62002)	4.9 mm	4.7 mm	90°	4½
Paratypes (F78429a)	5.0	5.2	88	5½
(F78429b)	2.9	2.9	90	4
(F78430)	3.5	3.4	90	4

Types. Holotype (F62002) 3 figured paratypes (F78429-30) and 12 unfigured paratypes (F78433).

Type locality. 1.8 km east from the southern end of Glenbawn Dam wall, 13 km north-east of Aberdeen, NSW (Locality 30).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Additional material. 6 specimens from south-east of 'Rangari' (Locality 18), and 10 from various horizons at Glenbawn (Locality 31).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Etymology. Derived from the Latin *turgidus* meaning swollen, referring to the inflated last whorl.

Remarks. *Rhabdotocochlis turgida* n.sp. differs from *Araeonema microspirulata* in having a larger and thicker shell consisting of two layers, and coarser spiral lirae, and from the type species, *Rhabdotocochlis rugata* Knight, in having the more inflated last whorl and finer spiral lirae.

Gyronema Ulrich in Ulrich & Scofield, 1897

Australian Carboniferous species. *Gyronema nacreformis* n.sp.

Gyronema nacreformis n.sp.

Pl. 10 figs 6-10

Description. Shell small, moderately high-spined turbiniiform, narrowly phaneromphalous. Protoconch simple, seemingly smooth, with a sharp boundary between protoconch and teleoconch. Teleoconch consisting of 2 layers with nacreous lining on inner surface with whorl profile moderately arched, suture moderately deep, first 1¼ whorls smooth with growth lines very faint remainder of teleoconch with spiral lirae, 15 in the final whorl, growth lines obscure. Aperture suboval, with finer lip thin, straight to slightly arcuate, reflexed, anterior end somewhat extended; outer lip thin with a shallow sinus.

Dimensions.	H	W	PA	NW
Holotype (F78425)	5.4 mm	3.6 mm	60°	5
Paratype (F78426)	2.7	2.2	65	4½

Types. Holotype (F78425), 1 figured paratype (F78426) and 9 unfigured paratypes (F78427).

Type locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Additional material. 10 specimens from Swains Gully (Locality 25).

Geographic distribution. Swains Gully to 'Marohn'.

Geological age. Middle to late Tournaisian.

Etymology. Referring to the nacreous internal surface layer of the shell.

Remarks. *Gyronema nacreformis* n.sp. is characterised by having a double layered shell with nacreous inner lining, which is commonly seen in Recent species of Trochidae. The shell surface is generally buff in color, but the original nacre is observed on the inner surface of a number of specimens. *Gyronema nacreformis* differs from the type species, *Gyronema subsinuata* (Meek & Worthen), in lacking parietal inductura. The tall, smooth protoconch and absence of selenizone preclude this form from the pleurotomarioidean gastropods.

Microdomatidae Wenz, 1938

Microdoma Meek & Worthen, 1867

Australian Carboniferous species. *Microdoma angulata* Yoo, 1988, from 'Marohn'.

Microdoma angulata Yoo

Pl. 11 Figs 11-13

Microdoma angulata Yoo, 1988: 243, Figs 58-60.

Dimensions.	H	W
Figured specimens (F78434a)	3.4 mm	2.2 mm
(F78434b)	2.6	1.4
(F78434c)	3.1	1.9

Additional material. 27 specimens from 'Marohn' (Locality 28), 1 from Swains Gully (Locality 25) and 7 from south-east of 'Rangari' (Locality 18).

Geographic distribution. 'Rangari' to 'Marohn'.

Geological age. Middle to late Tournaisian.

Remarks. *Microdoma angulata* Yoo is similar to the European species *Microdoma uniserrata* Batten, but differs in having a large pleural angle and more collabral cords. This species is very different from other European species *Microdoma triserrata* Batten, *Microdoma bicrenulata* de Koninck, as well as North American species *Microdoma conica* Meek & Worthen and *Microdoma ornata* Sayre.

Neritoidea Rafinesque, 1815

Neritopsidae S.A. Miller, 1889

Naticopsis M'Coy, 1884

Australian Carboniferous species. *Naticopsis (Naticopsis) minuta* n.sp., from 'Kyndalyn'; *Naticopsis*

obliqua Dun & Benson, 1920: 362, pl. 22 Figs 13, 14, from south-east of Babbinsboon, NSW; *Naticopsis (Naticopsis) osbornei* Yoo, 1988: 244, Figs 65-66, from 'Marohn'.

Remarks. Two *Naticopsis* forms from Carroll and Babbinsboon are referred to the Belgian species *Naticopsis brevispira* (Ryckholt) and *Naticopsis globosa* (Hoeninghaus) by Dun & Benson (1920). However, their identifications cannot be confirmed, as the illustration of these species is too poor, and the figured specimens appear to be lost.

Naticopsis (Naticopsis) minuta n.sp.

Pl. 14 Figs 9-12

Description. Shell minute, globular, neritiform, anomphalous. Protoconch of about 1½ smooth whorls, apex bulbous. Teleoconch of about 2½, convex whorls, suture with whorls adpressed, surface ornamented with fine collabral threads, whorl embracing much of previous whorl. Aperture convex, lenticular in shape; columella lip slightly thickened, arched; inner lip and outer lip thin.

Dimensions.	H	W	PA
Holotype (F78463)	1.1 mm	1.1 mm	130°
Paratype (F78464)	1.2	1.1	130

Types. Holotype (F78463) and 1 figured paratype (F78464). There are 50 unfigured additional specimens (F78462) from the type locality.

Type locality. Behind 'Kyndalyn' homestead, 10 km south-west of Somerton, NSW (Locality 24).

Stratigraphic position. In base of oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation.

Geographic distribution. Type locality only.

Geological age. Middle or late Viséan.

Etymology. Derived from the Latin *minutus* meaning little, small.

Remarks. This is a small shell with a thin callus, commonly occurring in the type locality.

Naticopsis (Naticopsis) osbornei Yoo

Pl. 14 Figs 1-8

Naticopsis (Naticopsis) osbornei Yoo, 1988: 244, Figs 65-66.

Dimensions.	H	W	PA	NW
Figured specimens (F78457a)	2.8mm	2.4 mm	113°	3½
(F78456)	1.8	2.0	125	3
(F78457b)	2.1	2.3	115	3½
(F78458)	3.9	3.5	124	4
(F78459a)	4.5	3.6	—	—
(F78459b)	6.0	5.6	130	3
(F78460)	3.4	3.3	120	4

Additional material. 8 specimens from 'Marohn' (Locality 28) and 1 specimen from Glenbawn (Locality 30).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Remarks. Fifty specimens recovered between 'Rangari' and Glenbawn show a considerable variability in shell shape, ornamentation and callus rugae. Some forms are elongate while others seem distorted. The shape and size of callus are also variable. Specimens are usually ornamented by collabral striae which are more distinct in the last whorl. Plate 14 figure 6 shows stronger striae developed just below the suture of the last whorl.

Turbonitella de Koninck, 1881

Turbonitella sp.

Pl. 15 figs 1-2

Description. Shell very small, turbiniform, anomphalous. Protoconch of about 1¼ smooth whorls, apex bulbous. Teleoconch of about 2½ whorls; shell profile strong convex, suture shallow, whorl embracing much of previous whorl, a row of nodes between suture and collar-like adpressed zone, continues to a row of collabrally lengthened pustules at upper face of whorl. Aperture convex, lenticular in shape, columellar and inner lips thickened with strongly excavated, outer lip thin.

Dimensions.	H	W	PA	NW
Figured specimens				
(F78466)	5.0 mm	3.7 mm	90°	5
(F78465)	2.6	2.3	95	3½

Stratigraphic position. In bioclastic limestone, 130 m above the base of the Namoi Formation.

Material. 7 specimens from south-east of 'Rangari' (Locality 18), 3 from Swains Gully (Locality 25), 2 from 'Marohn' (Locality 28) and 1 from Glenbawn (Locality 29).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Remarks. The figured specimens resemble the holotype *Turbonitella biserialis* (Phillips) designated by Knight (1941) in being a turbiniform with strong collabral ribs on shoulder, but differs in lacking a row of ribs on the lower whorl face.

Order Uncertain

Murchisonioidea Koken, 1896

Murchisoniidae Koken, 1896

Murchisonia d'Archiac & de Verneuil, 1841

Australian Carboniferous species. *Murchisonia* sp. (in this study), from 'Marohn'.

Murchisonia sp.

Pl. 16 fig. 5

Description. Shell small, high-spired turreted form, thick, anomphalous or possibly with pseudoumbilicus. Protoconch unknown. Teleoconch of about 8 whorls; whorl profile angular at the periphery, but straight between pseudosuture and selenizone, and between selenizone and lower suture. Selenizone narrow, smooth on the periphery between 2 lirae. Aperture broken, pentagonal in shape with outer lip angled.

Dimensions. Figured specimen (F78482): H 5.8 mm, W 3.1 mm, PA 30°, NW 7½

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Additional material. 4 specimens from the same locality.

Geographic distribution. 'Marohn'.

Geological age. Late Tournaisian.

Remarks. The species is characterised by a tall-spired and angular whorl with a selenizone on the periphery, resulting in a pentagonal shaped aperture. Specimens recovered are usually poorly preserved with the protoconch missing.

Caenogastropoda Cox, 1959

Loxonematoidea Koken, 1889

Family Uncertain

Stegocoelia Donald, 1889

Australian Carboniferous species. *Stegocoelia* (*Stegocoelia*) *nodosa* Yoo, 1988, from 'Marohn'; *Stegocoelia* (*Hypergonia*) *elongata* Yoo, 1988, from 'Marohn'; *Stegocoelia* (*Hypergonia*) *tenuis* Yoo, 1988, from 'Marohn'; *Stegocoelia* (*Hypergonia*) sp. A (in this study), from 'Kyndalyn'; *Stegocoelia* (*Hypergonia*) sp. B (in this study), from 'Kyndalyn'.

Remarks. *Stegocoelia* is transferred from the Murchisonioidea to Loxonematoidea on the basis of the morphological similarity of the protoconch to Loxonematoidea. *Stegocoelia* has a tall, smooth sinuated protoconch and dominant spiral cords on teleoconch without a distinct selenizone. In contrast, *Murchisonia* seems to have a simple protoconch and a distinct selenizone.

Stegocoelia (*Stegocoelia*) Donald, 1889

Stegocoelia (*Stegocoelia*) *nodosa* Yoo

Pl. 15 fig. 3

Stegocoelia (*Stegocoelia*) *nodosa* Yoo, 1988: 245, figs 67-71.

Dimensions. Figured specimen (F78467): H 3.7 mm, W 1.2 mm

Additional material. 75 specimens from 'Marohn' (Locality 28), 1 from Swains Gully (Locality 25) and 16 from south-east of 'Rangari' (Locality 18).

Geographic distribution. 'Rangari' to 'Marohn'.

Geological age. Middle to late Tournaisian.

Stegocoelia (Hypergonia) Donald, 1892

Stegocoelia (Hypergonia) elongata Yoo

Stegocoelia (Hypergonia) elongata Yoo, 1988: 245, figs 73-75.

Additional material. 28 from 'Marohn' (Locality 28), 3 from Swains Gully (Locality 25) and 1 from Glenbawn (Locality 29).

Geographic distribution. Swains Gully to Glenbawn.

Geological age. Middle to late Tournaisian.

Stegocoelia (Hypergonia) tenuis Yoo

Pl. 15 figs 4-8

Stegocoelia (Hypergonia) tenuis Yoo, 1988: 245, figs 76-79.

Dimension.	H	W	PA	NW
Figured specimens				
(F78468)	2.5 mm	0.5mm	9°	12
(F78470)	2.0	0.5	10	10½
(F78469)	2.4	—	—	12

Additional material. 62 specimens from 'Marohn' (Locality 28).

Geographic distribution. Type locality.

Geological age. Late Tournaisian.

Remarks. This species is easily confused in size and shape with other *Stegocoelia (Hypergonia)* spp., *Donaldina* spp. and species belonging to Pseudozygopleuridae, but is characterised by the deep sinus in the protoconch and three spiral striae in the lower face of whorl.

Stegocoelia (Hypergonia) sp. A

Pl. 15 figs 9-10

Stegocoelia (Hypergonia) sp. B

Pl. 15 figs 11-15

Dimensions.	H	W	PA	NW
Figured sp. A				
(F78472)	1.8 mm	0.8 mm	24°	8
(F78471)	2.6	0.9	18	8

Figured sp. B

(F78473)	2.8	—	—	10
(F78474)	3.9	—	—	12
(F78475)	2.8	—	—	9½

Locality. In base of oolitic limestone, behind 'Kyndalyn' homestead, 10 km south-west of Somerton, NSW (Locality 24).

Stratigraphic position. Base of oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation.

Material. 24 specimens from 'Kyndalyn' (Locality 24).

Geographic distribution. Above locality only.

Geological age. Middle or late Viséan.

Palaeozygopleuridae Horny, 1955

Palaeozygopleura Horny, 1955

Australian Carboniferous species. *Palaeozygopleura obesa* n.sp., from 'Marohn'.

Palaeozygopleura obesa n.sp.

Pl. 16 figs 1-4

Palaeozygopleura sp. Yoo, 1988: 238, table 2.

Description. Shell small, high-spired cyrtocoid, anomphalous. Protoconch of about 1½ smooth whorls, tending to be globose. Teleoconch of about 7 whorls with whorl profile of the upper surface flattened and the lower surface slightly convex; suture shallow, collabral ribs evenly spaced across the whorl and slightly opisthocyrt with transition from protoconch to teleoconch not distinct. Aperture incomplete (broken specimen).

Dimensions.	H	W	PA	NW
Holotype (F78477)	10 mm	3.2 mm	25°	8
Paratypes (F78479)	5.2	2.5	28	8
(F78478)	5.6	2.2	24	8

Types. Holotype (F78477) and 2 figured paratypes (F78478-9). There are 14 additional specimens (F78476) from the type locality.

Type locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Additional material. 4 specimens from 'Rangari' area (Localities 15 and 18) and 26 from various horizons at Glenbawn (Localities 29-32).

Geographic distribution. 'Rangari' to Glenbawn.

Geological age. Middle to late Tournaisian.

Etymology. Derived from the Latin *obesus* meaning swollen.

Remarks. This is only species referred to

Palaeozygopleura, characterised by its high-spined cyrtococonoid shell with smooth globose protoconch. With the additional specimens recovered between 'Rangari' and Glenbawn, *Palaeozygopleura* sp. Yoo (1988) is here named *obesa*.

Pseudozygopleuridae Knight, 1930

Pseudozygopleura Knight, 1930

Australian Carboniferous species. *Pseudozygopleura gracilis* n.sp., from 'Kyndalyn'.

Pseudozygopleura gracilis n.sp.

Pl. 16 figs 10-11

Description. Shell minute, slender, high spired, many whorled, anomphalous. Protoconch of about 3 whorls, the first whorl smooth, and the others with deeply sinuated transverse costae, transition from protoconch to teleoconch abrupt. Teleoconch of about 7 whorls; whorl profile rounded and somewhat pendant, suture moderately deep, surface smooth or ornamented by faint growth lines. Aperture circular in shape; inner lip thin, reflexed; parietal wall lacking, outer lip sharp with only a very slight sinus, nearly straight; base rounded.

Dimensions. Holotype (F78483): H 1.5 mm, W 0.5 mm, PA 20°, NW 9.

Types. Holotype (F78483) and 1 paratype (F78493).

Type locality. Behind 'Kyndalyn' homestead, 10 km south-west of Somerton, NSW (Locality 24).

Stratigraphic position. In base of oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation.

Geographic distribution. Type locality only.

Geological age. Middle or late Viséan.

Etymology. Derived from the Latin *gracilis* meaning slender, slim.

Remarks. This is a very rare species. Two specimens recovered for this study are characterised by the presence of the typical pseudozygopleurid protoconch, tall smooth teleoconch whorls which are almost symmetrically arched, and a circular shape of aperture. There is no other form comparable to this species.

Leptozyga Knight, 1930

Australian Carboniferous species. *Leptozyga costata* n.sp., from 'Kyndalyn'.

Leptozyga costata n.sp.

Pl. 16 figs 8-9

Description. Shell minute, high spired, cyrtococonoid

with 7 whorls, anomphalous. Protoconch of 3 whorls, the first 1/4 whorls are smooth, and the remaining one and three quarter whorls have deeply sinuated strong collabral costae; the transition from protoconch to teleoconch abrupt, although transition within the protoconch gradual. Teleoconch of 4 whorls, whorl profile gently arched, suture moderately deep, first whorl of teleoconch ornamented by growth line only, remainder bearing collabral costae. Aperture subcircular in shape, columellar lip thin, nearly straight somewhat reflexed; parietal inductura lacking; outer lip thin, nearly straight, orthocone; base somewhat extended.

Dimensions. Holotype (F78481): H 1.6 mm, W 0.4 mm, PA 28°, NW 9.

Types. Holotype (F78481).

Type locality. Behind 'Kyndalyn' homestead, 10 km south-west of Somerton, NSW (Locality 24).

Stratigraphic position. In base of oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation.

Geographic distribution. Type locality only.

Geological age. Middle or late Viséan.

Etymology. Derived from the Latin *costatus* meaning a rib; referring to collabral ribs on shell.

Remarks. This is an extremely rare species. Although a single specimen is available, the excellent preservation of the specimen warrants the naming of the specimen. *Leptozyga costata* n.sp. resembles *Palaeozygopleura obesa* n.sp. and *Hemizyga decussata* Yoo in being a cyrtococonoid with collabral cords, but differs in being minute and in having deep sinuous ornament on the protoconch.

Hemizyga Girty, 1915

Australian Carboniferous species. *Hemizyga decussata* Yoo, 1988, from 'Marohn'.

Hemizyga decussata Yoo

Pl. 16 figs 12-14

Hemizyga (Hemizyga) decussata Yoo, 1988: 246, figs 88-91.

Dimensions.

	H	W
Figured specimens (F78484)	3.5 mm	1.7 mm
(F78485)	2.3	1.4
(F78486)	3.2	1.7

Additional material. 10 specimens from 'Marohn' (Locality 28), and 10 specimens from various horizons at Glenbawn (Localities 29-31).

Geographic distribution. Glenbawn area.

Geological age. Late Tournaisian.

Remarks. An excellently preserved protoconch with reticulate ornamentation is illustrated by Yoo (1988: figs 89, 90).

Cyclozyga Knight, 1930

Australian Carboniferous species. *Cyclozyga sinusigera* Yoo, 1988, from 'Marohn'; *Cyclozyga* sp. (in this study), from 'Kyndalyn' (Pl. 19 figs 5-8).

Cyclozyga sinusigera Yoo

Pl. 16 figs 6-7

Cyclozyga sinusigera Yoo, 1988: 247, figs 92-94.

Dimensions. Figured specimen (F78480): H 1.3 mm, W 0.4 mm.

Additional material. 1 specimen from 'Marohn' (Locality 28).

Stratigraphic position. In upper part of the Dangarfield Formation.

Remarks. This is an extremely rare species. *Cyclozyga* sp. (Pl. 19 figs 5-8) from 'Kyndalyn' resembles *C. sinusigera* Yoo in shell shape and ornamentation, but differs in having closely spaced collabral lirae on teleoconch. Only two specimens of *Cyclozyga* sp. are obtained. The systematic position of *Cyclozyga* was discussed by Knight (1930a), and Hoare & Sturgeon (1978). The North American species of *Cyclozyga* have more strongly developed revolving costellae and are more attenuate in form.

Subulitoidea Lindstrom, 1884

Subulitidae Lindstrom, 1884

Subulitinae Lindstrom, 1884

Ceraunocochlis Knight, 1931

Australian Carboniferous species. *Ceraunocochlis australis* n.sp., from 'Marohn' (= *Ceraunocochlis* sp., Yoo, 1988: 238, table 2); *Ceraunocochlis tenuis* n.sp., from 'Marohn'.

Ceraunocochlis australis n.sp.

Pl. 17 figs 6-10

Description. Shell very small, subulate, high spired, thin, axis of shell slightly curved, anomphalous. Protoconch of about 1½ smooth whorls, flattened top slightly tilted with strongly arched whorl profile; transition from protoconch to teleoconch sharp and gently sinuated. Teleoconch of about 7 smooth whorls, whorl profile flat to arched, suture shallow but distinct; length of whorl increases with growth. Aperture sharp triangular in shape; columellar lip merging with the parietal lip, thin, straight; distinct anterior siphonal notch; columellar fold obscured; outer lip straight,

slightly prosocline; base pointed and extended.

Dimensions.	H	W	NW
Holotype (F78490)	3.4 mm	0.8 mm	8
Paratypes (F78491a)	3.7	0.8	8
(F78491b)	3.2	0.8	4½
(F78491c)	3.0	0.7	5

Types. Holotype (F78490) and 3 figured paratypes (F78491). There are 46 unfigured additional specimens (F78492) from the type locality.

Type locality. 150 m west of 'Marohn' homestead, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. Bioclastic limestone, upper part of the Dangarfield Formation.

Geographic distribution. Type locality only.

Geological age. Late Tournaisian.

Etymology. Derived from the Latin *australis* meaning southern.

Remarks. This species differs from *Ceraunocochlis tenuis* n.sp. in having more subulate shell, higher whorls and a sharp-angled aperture. The type species, *Ceraunocochlis fulminula* Knight, differs from *australis* in having the final whorl occupying more than half of the shell length.

Ceraunocochlis tenuis n.sp.

Pl. 17 figs 11-13

Description. Shell very small, high-spired with many whorls, thin, anomphalous. Protoconch of about 1½ smooth whorls, flattened top with strongly arched whorl profile; the transition from protoconch to teleoconch sharp and gently sinuated. Teleoconch of 7½ smooth whorls, whorl profile arched, suture moderately deep, deeper in neanic stage; length of whorl gradually increased with growth. Aperture D-shaped; inner lip almost straight, broad anterior notch, columellar fold obscured, parietal inductura thin; outer lip straight, strong prosocline; base pointed.

Dimensions. Holotype (F78494): H 2.3 mm, W 0.5 mm, NW 9.

Types. Holotype (F78494) and 1 paratype (broken).

Type locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Geographic distribution. Type locality only.

Geological age. Late Tournaisian.

Etymology. Derived from the Latin *tenuis* meaning thin, slender; referring to its slender shell shape.

Soleniscinae Wenz, 1938

Strobeus de Koninck, 1881

Australian Carboniferous species. *Strobeus ovalis* n.sp., from 'Marohn' (= *Ianthinopsis* sp. Yoo, 1988: 238).

Strobeus ovalis n.sp.

Pl. 18 figs 8-12

Description. Shell very small, globular fusiform, moderately thick, anomphalous. Protoconch of small with simple, smooth whorls. Teleoconch of about 3½ whorls. First 2 whorls of the shell small, with other whorls markedly inflated, forming a shoulder on the upper part of the third whorl; whorl profile between sutures round in early whorls and rather straight in later whorls, suture shallow, not impressed. Aperture suboval; columellar lip moderately thickened, with a strong fold at the lower end of the columellar, fold obscured by columellar lip in some specimens; anterior siphonal canal broadly rounded.

Dimensions.	H	W	PA	NW
Holotype (F78501)	1.9 mm	1.4 mm	68°	4
Paratype (F78498)	1.7	1.4	74	4
Figured specimens				
(F78500a)	3.0	1.5	70	4
(F78500b)	1.9	1.4	70	4½
(F78500c)	2.6	1.9	—	4

Types. Holotype (F78501) and 1 figured paratype (F78498). There are 10 unfigured additional specimens (F78499) from the type locality.

Type locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Additional material. 3 figured specimens (F78500) from Glenbawn (Locality 30).

Geographic distribution. Glenbawn area.

Geological age. Late Tournaisian.

Etymology. Derived from the Latin *ovatus* meaning like an egg.

Soleniscus Meek & Worthen, 1861

Australian Carboniferous species. *Soleniscus callosus* Yoo, 1988, from 'Marohn'; *Soleniscus* sp. (in this study) from Swains Gully.

Soleniscus callosus Yoo

Pl. 18 figs 2-4

Soleniscus callosus Yoo, 1988: 247, figs 95-102.

Dimensions.	H	W	PA	NW
Figured specimens				
(F78502a)	7.2 mm	4.3 mm	52°	7
(F78502b)	7.3	4.4	50	8
(F78502c)	7.7	4.6	52	7½

Geographic distribution. 'Rangari' to Glenbawn.

Additional material. 15 specimens from 'Marohn' (Locality 28), 15 from Swains Gully (Locality 25), 12 from south-east of 'Rangari' (Locality 18), 51 from various horizons at Glenbawn (Localities 29-31).

Geological age. Middle to late Tournaisian.

Remarks. Ninety-three specimens recovered from 'Rangari' to Glenbawn demonstrate a considerable variation in shell shape and whorl profile.

Soleniscus sp.

Pl. 18 figs 1, 5-7

Description. Shell small, moderately high-spired fusiform, anomphalous. Protoconch small, simple. Teleoconch of about 4½ smooth whorls, shell profile gently rounded, suture shallow; last whorl much inflated; base rounded. Aperture suboval, pointed posteriorly, rounded anteriorly; outer lip moderately thick, arcuate; columellar lip arcuate with columellar fold; parietal inductura covered with a cluster of nodules.

Dimensions.	H	W	PA	NW
Figured specimens				
(F78504)	6.5 mm	4.4 mm	60°	6½
(F78505)	3.8	2.6	65	6

Locality. Approximately 250 m west of Babbinboon Lane in Swains Gully, 15 km south-east of Somerton, NSW (Locality 25).

Stratigraphic position. In bioclastic limestone, 130 m above the base of Namoi Formation.

Geological age. Middle Tournaisian.

Remarks. This form is identical to *S. callosus* Yoo in size and shape; the only difference is that this form has a slightly larger pleural angle and the parietal inductura which is covered with a cluster of nodules. The nodules seem to disappear inside the shell probably by resorption. One specimen (Pl. 18 fig. 1), with a broken aperture, has no sign of nodules on the parietal area, but is considered to be the same form on the basis of the pleural angle and the much inflated final whorl.

Meekospiridae Knight, 1956

Girtyspira Knight, 1936

Australian Carboniferous species. *Girtyspira inflata* n.sp., from Swains Gully.

Remarks. Kollmann & Yochelson (1976) transferred *Girtyspira* from the subulitoideans to the opisthobranchs, on the basis of a deviated protoconch and sutural ramp. Erwin (1988) also placed *Girtyspira* in the opisthobranchs. The studied form *Girtyspira inflata* n.sp. has a deviated protoconch, but not seen clearly as heterostrophic. It is, here, retained in the Subulitoidea.

Girtyspira inflata n.sp.

Pl. 19 figs 9-11

Description. Shell very small, thick, canaliculate fusiform, anomphalous. Protoconch of smooth, simple. Teleoconch of 4½ smooth whorls, whorl profile very gently arched; but with a narrow flattened shoulder, close to upper suture; angular, shallow suture formed between shoulder and whorl; base considerably extended. Aperture elongate, anteriorly extended with siphonal notch, columellar lip arcuate; adapical channel of aperture angled.

Dimensions.	H	W	NW
Holotype (F78515)	2.2 mm	1.3 mm	6
Paratype (F78516)	2.6	1.4	4½

Types. Holotype (F78515) and 1 figured paratype (F78516).

Type locality. 'Lorrina' homestead, 8 km south-west Somerton, NSW (Locality 23).

Stratigraphic position. In bioclastic limestone, upper part of the Namoi Formation.

Additional material. 2 more specimens from the type locality and 3 unfigured specimens from Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Geographic distribution. Swains Gully area.

Geological age. Middle to late Tournaisian.

Etymology. Derived from the Latin *inflatus* meaning swollen.

Remarks. This is only species so far referred to *Girtyspira* in Australia. *Girtyspira inflata* n.sp. has more canaliculate whorl shoulders and more inflated last whorl than the type species *Girtyspira canaliculata* (Hall).

Family Uncertain

Globulimorpha n.gen.

Type species. *Globulimorpha costata* n.sp.

Definition. Shell minute, thin, globular fusiform with round base. Protoconch deviated with final whorl embracing much of earlier whorl ornament of fine collabral threads; aperture large with strong columellar siphonal fold.

Geological age. Late Tournaisian.

Remarks. No existing genus can be compared with *Globulimorpha*. The protoconch of the genus is deviated, but it is not clearly seen as heterostrophic.

Australian Carboniferous species. *Globulimorpha costata* n.sp.

Globulimorpha costata n.sp.

Pl. 23 figs 1-7

Description. Shell minute, low-spined globose, fusiform, anomphalous. Protoconch of 1-1¼ smooth whorls, deviated. Teleoconch of about 3 whorls of

thin shell, last whorl embracing much of previous whorls; whorl profile strongly arched; suture deep; ornament consisting of fine prosocline collabral lirae; base rounded. Aperture large, subcircular; columellar lip with a strong siphonal fold; siphonal channel below fold very wide; parietal inductura lacking or narrowly confined to the region close to the columellar, outer lip thin, straight.

Dimensions.	H	W	PA	NW
Holotype (F78495)	1.9 mm	1.5 mm	94°	4½
Paratypes (F78496a)	1.7	1.3	79	4
(F78496b)	2.0	1.6	—	—
(F78497)	1.5	1.1	85	4

Types. Holotype (F78495) and 4 figured paratypes (F78496-7).

Type locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Additional material. 26 specimens from the type locality (F78507).

Geographic distribution. Type locality only.

Geologic age. Late Tournaisian.

Etymology. Derived from the Latin *costatus* meaning costate, bearing ribs.

Remarks. This species resembles *Strobeus ovalis* n.sp., and species of *Soleniscus* in possessing a columellar fold, but differs in having a thinner shell layer, strongly arched whorls ornamented with fine collabral lirae.

Order, Superfamily and Family Uncertain

Microcochlis n.gen.

Type species. *Microcochlis parva* n.sp.

Definition. Minute, turbiniform with shallow sutures, somewhat flat whorl profile, and narrow umbilicus; ornament of rather widely spaced prosocline collabral cords with weak spiral cords.

Geological age. Late Tournaisian.

Remarks. *Microcochlis* n.gen. differs from *Eucochlis* Knight and *Kyndalynia* n.gen. in having a flat whorl profile and coarser collabral cords modified with weaker spiral cords. It has a narrow umbilicus as seen in some species of *Eucochlis*, but differs from *Kyndalynia* in that the latter has a round whorl profile and a wide umbilicus.

Australian Carboniferous species. *Microcochlis parva* n.sp.

Microcochlis parva n.sp.

Pl. 12 figs 1-5

Description. Shell minute, relatively high-spined turbiniform, narrowly phaneromphalous. Protoconch

simple consisting of one and one eighth smooth whorls, with sharp irregular boundary between protoconch and teleoconch. Teleoconch whorl profile arched in early stage and rather straight in late stage, suture shallow, base subangular; first 1¼ whorls with gently prosocline, fine collabral lirae followed by strong collabral cords extended to umbilicus, with cords straight, prosocline, and evenly spaced but becoming gradually wider with growth, ornamented by 4 spiral rows of pustules on final whorl between periphery and the upper suture. Aperture subrectangular, inner lip thin, nearly straight, outer lip thin, straight prosocline.

Dimensions.	H	W	PA	NW
Holotype (F78437)	2.1 mm	1.5 mm	56°	4½
Paratypes (F78438a)	1.4	1.2	54	3½
(F78438b)	1.3	1.0	56	4

Types. Holotype (F78437), 2 figured paratypes (F78438) and 2 unfigured paratypes (F78439).

Type locality. Behind 'Kyndalyn' homestead, 10 km south-west of Somerston, NSW (Locality 24).

Stratigraphic position. In base of oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation.

Geographic distribution. Type locality only.

Geological age. Middle or late Viséan.

Etymology. Derived from the Latin *parvus* meaning minute.

Remarks. *Microcochlis parva* n.sp. differs from *Eucochlis umbiliparva* n.sp. in having a smaller shell, short blunt protoconch and prominent spiral rows of pustules. Figures 1 and 2 in Plate 12 are juveniles, showing an arched whorl profile and only faint expression of spiral cords. The spiral angulation begins to appear at 2½ whorls.

Elasmonematidae Knight, 1956

Eucochlis Knight, 1933

Australian Carboniferous species. *Eucochlis australis* Yoo, 1988, from 'Marohn'; *Eucochlis depressa* n.sp., from Swains Gully; *Eucochlis umbiliparva* n.sp., from Swains Gully; *Eucochlis* sp., from Glenbawn.

Remarks. All four Australian forms are similar in size and ornament. *Eucochlis australis* Yoo, *Eucochlis depressa* n.sp. and *Eucochlis* sp. are moderately phaneromphalous and have fine spiral threads, while *Eucochlis umbiliparva* n.sp. is minutely phaneromphalous and has no spiral threads. *Eucochlis depressa* has an exceptionally depressed final whorl, and *Eucochlis* sp. has a low spire and much inflated final whorl.

Eucochlis australis Yoo

Pl. 13 figs 2-3

Eucochlis australis Yoo, 1988: 243, figs 61-64.

Dimensions.	H	W
Figured specimens (F78446)	2.2 mm	1.5 mm
(F78447)	1.4	0.8

Additional material. 75 specimens from 'Marohn' (Locality 28), 7 and 15 from Glenbawn (Localities 29 and 30 respectively).

Eucochlis depressa n.sp.

Pl. 13 figs 7-11

Description. Shell minute, turbiniform, compressed, moderately phaneromphalous. Protoconch of 1¼ whorls with fine growth lines. Teleoconch of 2½ strongly convex whorls with narrowly and evenly spaced sharp collabral cords and weak spiral lirae, collabral cords (about 52 in the last whorl) strong, oblique, prosocline, 40° from axis, suture deep. Aperture almost rectangular, lips thin, outer lip strongly retracted.

Dimensions.	H	W	PA	NW
Holotype (F78451)	1.6 mm	1.5 mm	85°	4½
Paratypes (F78453)	1.6	1.6	95	4½
(F78452)	1.6	1.4	90	4

Types. Holotype (F78451) and 2 figured paratypes (F78452-3). There are 2 unfigured additional specimens (F78435) from the type locality.

Type locality. Approximately 250 m west of Babbins Lane, in Swains Gully, 15 km south-west of Somerton, NSW (Locality 25).

Stratigraphic position. In bioclastic limestone, 130 m above the base of the Namoi Formation.

Geographic distribution. Type locality only.

Geological age. Middle Tournaisian.

Etymology. Derived from the Latin *depressus* meaning low-lying, sunk down; referring to depressed shell.

Remarks. This species is characterised by an exceptionally depressed last whorl with strongly retracted outer lip.

Eucochlis umbiliparva n.sp.

Pl. 13, figs 4-6

Description. Shell-minute, turbiniform, minutely phaneromphalous. Protoconch of 1¼ smooth whorls with fine growth lines. Teleoconch of 3½ strong convex whorls between deeply impressed sutures, with approximately 42 gently prosocline collabral cords evenly spaced in the last whorl, spiral threads restricted on the base. Aperture simple, almost rectangular, lips slightly thickened, parietal inductura wanting, outer lip nearly straight prosocline or very slightly concave forward.

Dimensions.	H	W	PA	NW
Holotype (F78448)	1.7 mm	1.7 mm	75°	4½
Paratypes (F78449)	1.8	1.5	68	4¼
(F78450)	1.8	—	72	4

Types. Holotype (F78448) and 2 figured paratypes (F78449-50). There are 5 unfigured additional specimens (F78436).

Type locality. 1.8 km east from the southern end of Glenbawn Dam wall, 13 km north-east of Aberdeen, NSW (Locality 31).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Additional material. 1 specimen from 'Marohn' (Locality 28) and 1 from Glenbawn (Locality 29).

Geographic distribution. Glenbawn area.

Geological age. Late Tournaisian.

Etymology. Derived from the Latin *umbilicus* meaning centre, *parvus* meaning little, small; referring to a small umbilicus.

Eucochlis sp.

Pl. 13 fig. 1

Dimensions. Figured specimen (F78445): H 1.6 mm, W 1.8 mm, PA 100°, NW 4.

Stratigraphic position. Upper part of the Dangarfield Formation.

Locality. 1.8 km east of the southern end of Glenbawn Dam wall, NSW (Locality 31).

Kyndalynia n.gen.

Type species. *Kyndalynia inflata* n.sp.

Definition. A very small, turbiniform gastropod with rounded whorls; protoconch smooth, bulbous; whorls expand rapidly, widely phaneromphalous; ornament a prosocline to orthocline collabral cords with faint spiral threads.

Geological age. Middle or late Visean.

Etymology. Referring to the geographical name of the homestead where this genus occurs.

Remarks. *Kyndalynia* n.gen. is different in shell character from any other described Palaeozoic gastropods. The closest form is *Eucochlis*, but *Kyndalynia* has more inflated whorls and wider umbilicus.

Australian Carboniferous species. *Kyndalynia inflata* n.sp.

Kyndalynia inflata n.sp.

Pl. 12 figs 6-11

Description. Shell minute, cyrtoconoidal, widely phaneromphalous. Protoconch of 1½ smooth whorls with slightly deviated bulbous apex, boundary with teleoconch sharp. Teleoconch with first whorl with fine growth line, followed by 2½ rounded whorls with evenly spaced collabral riblets with about 32 in the last whorl, spire outline very convex, suture impressed.

Aperture circular, lips slightly thickened, with outer lip prosocline.

	H	W	PA	NW
Holotype (F78440)	1.3 mm	– mm	70°	4½
Paratypes (F78441a)	1.1	1.0	70	4¼
(F78441b)	1.1	1.0	68	4
(F78443)	1.2	1.0	67	4
(F78442)	1.0	1.0	76	4

Types. Holotype (F78440) and 4 figured paratypes (F78441-3). There are 14 unfigured additional specimens (F78444) from the type locality.

Type locality. Behind 'Kyndalyn' homestead, 10 km south-west of Somerton, NSW (Locality 24).

Stratigraphic position. In base of oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation.

Geographic distribution. Type locality only.

Geological age. Middle or late Visean.

Etymology. Derived from the Latin *inflatus* meaning swollen; referring to inflated whorls.

Remarks. This species is characterised by having very inflated whorl profile. This is relatively rare in the type locality. No other Australian form has so far been referred to this genus.

Heterogastropoda

Superfamily and Family Uncertain

Kimina n.gen.

Type species. *Kimina globosa* n.sp.

Definition. Shell minute, thin, globose to elongate, narrowly phaneromphalous. Surface smooth except for very weak growth lines. Protoconch deviated, aperture simple, circular.

Geological age. Late Tournaisian.

Etymology. This genus is named after my wife Kim to record her contributions throughout this study.

Remarks. This genus is similar to recent genus *Rissoella* in shell and protoconch characters, and is different from any known Palaeozoic gastropods. *Rissoella* which is characterised by a simple, sometime deviated protoconch was included tentatively in the Heterogastropoda by Ponder & Yoo (1977), a group which shows mixed opisthobranch and prosobranch characters. Climo (1975) has outlined the characteristics of some families of the Heterogastropoda and suggested that the Heterogastropoda shows more affinities with opisthobranchs than mesogastropods. However, Ponder & Warren (1988) assigned the Heteromorpha to the same rank as the Opisthobranchia under subclass Heterobranchia. *Kimina* is tentatively included in the Heterogastropoda.

Australian Carboniferous species. *Kimina australis* n.sp., from 'Kyndalyn'; *Kimina globosa* n.sp., from 'Marohn'; *Kimina minor* n.sp., from 'Marohn'; *Kimina* sp. from 'Marohn'.

Kimina australis n.sp.

Pl. 19 figs 1-4

Description. Shell minute, high spired, smooth, thin, narrowly phaneromphalous. Protoconch of 1¼ smooth whorls, the apex slightly deviated hiding the first half whorl in side view. Teleoconch of up to 4 convex whorls, smooth except for very fine prosocline growth lines. Aperture simple, almost circular, with thin lips.

Dimensions.	H	W	PA	NW
Holotype (F78513)	1.3 mm	0.8 mm	46°	4½
Paratypes (F78511)	1.4	0.8	43	4½
(F78512)	1.3	0.9	50	4½

Types. Holotype (F78513) and 2 figured paratypes (F78511-2). There are 112 unfigured additional specimens (F78514).

Type locality. Behind 'Kyndalyn' homestead, 10 km south-west of Somerton, NSW (Locality 24).

Stratigraphic position. In base of oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation.

Geographic distribution. Type locality only.

Geological range. Middle or late Viséan.

Etymology. Derived from the Latin *australis* meaning southern.

Remarks. Differs from *K. globosa* n.sp. in having prosocline growth lines.

Kimina globosa n.sp.

Pl. 20 figs 1-7

Description. Shell minute, thin, globose, rather short spired, narrowly phaneromphalous. Protoconch of 1¼ smooth whorls, apex deviated, between protoconch and teleoconch sharp straight line; teleoconch of 3-4 very convex whorls, with surface smooth except for very distinct opisthocline growth lines, suture deep. Aperture simple, complete circular, lips thin.

Dimensions.	H	W	PA	NW
Holotype (F78508)	2.2 mm	1.4 mm	48°	5¼
Paratypes (F78509a)	1.4	1.0	60	4
(F78509b)	1.2	0.8	56	4½
(F78509c)	1.0	0.9	50	4¼
(F78509d)	1.1	0.8	60	4

Types. Holotype (F78508) and 4 figured paratypes (F78509).

Type locality. 150 m west of 'Marohn' homestead, 4 km south-west of Gundy, NSW.

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Geographic distribution. Type locality only.

Geological age. Late Tournaisian.

Etymology. Derived from the Latin *globosus* meaning globose.

Remarks. *Kimina globosa* n.sp. and *Kimina australis* n.sp. are similar in having a smooth shell with a deviated protoconch and moderate umbilicus, but different each other in that the former has opisthocline growth lines, while the latter has prosocline growth lines.

Kimina minor n.sp.

Pl. 17 figs 1-5

Description. Shell minute, moderately high spired, narrowly phaneromphalous. Protoconch of 1½ whorls, simple, smooth apex rather flat; margin of protoconch with teleoconch sharp. Teleoconch of about 4 whorls, whorl profile convex; sculpture of weak, axial growth lines. Aperture almost circular; anterior and posterior corners slightly angled; lips thin, parietal inductura lacking.

Dimensions.	H	W	PA	NW
Holotype (F78487)	5.3 mm	2.1 mm	30°	7
Paratypes (F78488)	2.1	1.2	40	4½
(F78489a)	2.0	1.3	40	5
(F78489b)	2.2	1.3	40	5½

Types. Holotype (F78487) and 2 paratypes (F78488-9).

Type locality. 150 m west of 'Marohn' homestead, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Additional material. 8 unfigured specimens from Swains Gully (Locality 25), 2 from 'Lorrina' (Locality 23) and 2 from Glenbawn (Locality 28).

Geographic distribution. Swains Gully to Glenbawn.

Geological age. Middle to late Tournaisian.

Remarks. This species resembles the other *Kimina* species in shell shape, but differs in having a simple protoconch.

Kimina sp.

Pl. 22 figs 6-9

Dimensions.	H	W	NW
Figured specimens			
(F78526a)	1.9 mm	0.9 mm	6
(F78526b)	1.5	0.8	5¼

Locality. 150 west of 'Marohn' homestead, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Geographic distribution. Above locality only.

Geological age. Late Tournaisian.

***Palaeoalvania* n.gen.**

Type species. *Palaeoalvania talenti* n.sp.

Definition. Shell minute, rather high-spired, narrowly phaneromphalous. Surface ornament of spiral cords and opisthocline growth lines. Protoconch deviated; aperture simple, circular.

Geological age. Late Tournaisian.

Remarks. *Palaeoalvania* is very similar to *Kimina* in shell and protoconch characters, but differs in having spiral cords.

Australian Carboniferous species. *Palaeoalvania talenti* n.sp.

***Palaeoalvania talenti* n.sp.**

Pl. 20 figs 8-13

Description. Shell minute, thin, rather high-spired, narrowly phaneromphalous. Protoconch of 1½ smooth whorls, apex deviated; sharp straight line between protoconch and teleoconch. Teleoconch of 4 very convex whorls, first ½ whorls smooth, remainder ornamented with spiral cords and distinct opisthocline growth lines; suture deep. Aperture simple, complete. circular and with thin lips.

Dimensions.	H	W	PA	NW
Holotype (F78454)	1.6 mm	1.1 mm	40°	4
Paratypes (F78455a)	1.9	1.0	32	4
(F78455b)	1.6	0.9	35	4

Types. Holotype (F78454) and 2 figured paratypes (F78455).

Type locality. 150 m west of 'Marohn' homestead, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Geographic distribution. Type locality only.

Geological age. Late Tournaisian.

Etymology. This species was named after Professor J.A. Talent, Macquarie University as an acknowledgment for his supervision of this work.

Remarks. This species differs from *Kimina globosa* n.sp. in possessing spiral cords, and from *Pseudoaclisina turgida* (Yoo) in having more convex whorls. *Palaeoalvania talenti* n.sp. resembles some Recent rissoids, particularly *Alvania*, in shell shape and ornament, but differs in having a deviated protoconch.

***Pseudoaclisina* n.gen.**

Type species. *Aclisina turgida* Yoo, 1988: 244, figs 80-81.

Definition. Shell minute, with tall-spired convex whorls; protoconch smooth, deviated; teleoconch covered by numerous spiral threads; anomphalous.

Geological age. Middle to late Tournaisian.

Etymology. Derived from Genus *Aclisina* a genus of similar shape.

Remarks. The species *turgida* was originally placed in *Aclisina* (Yoo, 1988). A further examination of *A. turgida* indicates that it has a deviated protoconch. No selenizone or notch exists. The species *A. turgida* is here transferred from *Aclisina* to *Pseudoaclisina* n.gen.

Australian Carboniferous species. *Pseudoaclisina microspirulata* n.sp., from 'Marohn'; *Pseudoaclisina turgida* (Yoo), 1988 from 'Marohn'.

***Pseudoaclisina microspirulata* n.sp.**

Pl. 21 figs 7-10

Description. Shell minute, high-spired, pupiform, anomphalous. Protoconch of 1½ smooth whorls, deviated and submerged, transition from protoconch to teleoconch abrupt. Teleoconch of about 7 whorls with about 22 fine spiral costae in the final whorl; opisthocline growth lines cover the teleoconch; whorl profile more or less symmetrically rounded; suture deep, well impressed; base rounded. Aperture oval, columellar lip arcuate; outer lip, thin, opisthocline.

Dimensions.

	H	W	NW
Holotype (F78519)	2.7 mm	0.7 mm	8
Paratype (F78520)	1.8	0.6	6

Types. Holotype (F78519) and 1 figured paratype (F78520).

Type locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Geographic distribution. Type locality only.

Geological age. Late Tournaisian.

Etymology. Referring to the microspiral ornamentation of shell.

Remarks. This form is characterised by densely spaced fine spiral lirae and a deviated protoconch.

***Pseudoaclisina turgida* (Yoo)**

Pl. 21 figs 11-13

Aclisina turgida Yoo, 1988: 244, figs 80-81.

Dimensions.

Figured specimens	H	W	NW
(F78461a)	1.6 mm	0.8 mm	4½
(F78461b)	2.3	1.0	5½

Additional material. 7 specimens from Swains Gully (Locality 25), 19 from 'Marohn' (Locality 28), and 4 from Glenbawn (Locality 30).

Geographic distribution. Swains Gully to Glenbawn.

Geological age. Middle to late Tournaisian.

Remarks. This species differs from *Pseudoaclisina microspirulata* n.sp. in possessing coarser spiral threads.

Opisthobranchia Milne Edwards, 1848

Superfamily Uncertain

Streptacididae Knight, 1931*Donaldina* Knight, 1933

Australian Carboniferous species. *Donaldina filosa* Yoo, 1988, from 'Marohn'; *Donaldina minutissima* n.sp., from 'Marohn'; *Donaldina* sp. (in this study), from 'Kyndalyn'.

Donaldina filosa Yoo

Pl. 22 figs 12-14

Donaldina filosa Yoo, 1988: 248, figs 104-109.

Dimensions. Figured specimens (F78521a): H 2.2 mm, W 0.5 mm; (F78521b): H 1.4, W 0.5.

Additional material. 42 specimens from 'Marohn' (Locality 28) and 1 from Glenbawn (Locality 29).

Donaldina minutissima n.sp.

Pl. 21 figs 1-6

Donaldina sp. Yoo, 1988: 238 (table 2), figs 110-111.

Description. Shell minute, slender, high-spired turriculate anomphalous. Protoconch of 1½ smooth whorls with deviated spire, the transition from protoconch to teleoconch indistinct orthocone. Teleoconch of about 8 convex whorls with early whorls smooth and later whorls ornamented with 6 evenly spaced spiral cords; whorl profile more or less symmetrically rounded; suture deep, well impressed. Aperture oval, columellar lip slightly arcuate; base rounded.

Dimensions.	H	W	NW
Holotype (F78517)	1.7 mm	0.6 mm	7½
Paratypes (F78510a)	1.7	0.4	7¼
(F78518)	2.6	0.6	10¼
(F78510b)	1.1	0.4	5¼

Types. Holotype (F78517) and 3 figured paratypes (F78510, 78518).

Type locality. 150 m west of 'Marohn' homestead, on the Scone-Gundy roadside, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Geographic distribution. Type locality only.

Geological age. Late Tournaisian.

Etymology. Derived from the Latin *minutissima* meaning extremely small.

Remarks. Six specimens recovered for this study are sufficiently well preserved to justify basing a new species. This new species resembles *Donaldina filosa* Yoo and *Pseudoaclisina microspirulata* n.sp. in having

a minute, slender and tall shell with fine spiral ornament, but it differs in having a more highly deviated protoconch.

Donaldina sp.

Pl. 22 figs 10-11

Dimensions. Figured specimen (F78527): H 1.7 mm, W 0.5 mm, NW 9.

Locality. Behind 'Kyndalyn' homestead, 10 km south-west of Somerton, NSW (Locality 24).

Stratigraphic position. In base of oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation.

Geographic distribution. Above locality only.

Geological age. Middle or late Viséan.

Streptacis Meek, 1872

Remarks. This genus is introduced for the first time to the Australian fauna to accommodate *Loxonema elegantissima* Yoo, 1988, *Streptacis gundyensis* n.sp. and *Streptacis* sp. *Loxonema elegantissima* is here transferred to the genus *Streptacis* because of its minute shell with strong sinuous collabral lirae.

Australian Carboniferous species. *Streptacis elegantissima* (Yoo), from 'Marohn'; *Streptacis gundyensis* n.sp., from 'Marohn'; *Streptacis* sp. (in this study), from 'Kyndalyn'.

Streptacis elegantissima (Yoo)

Pl. 22 figs 1-3

Loxonema elegantissima Yoo, 1988: 246, figs 84-87.

Dimensions. Figured specimens (F78524) H 1.9 mm, W 0.5 mm, NW 8¼; (F78523) H 1.6, W 0.5 mm, NW 7½.

Additional material. 50 specimens from 'Marohn' (Locality 28), one each from two horizons at Glenbawn (Localities 29 and 31).

Remarks: This species occurs commonly at the type locality. Fifty two specimens recovered for this study are extremely well preserved and readily referred to this species.

Streptacis gundyensis n.sp.

Pl. 23 figs 8-13

Description. Shell minute, high-spired, anomphalous. Protoconch of 1¼ whorls, deviated. Teleoconch of 5 to 6 smooth, moderately convex whorls, with faint growth lines. Aperture circular to oval, lips thin, no

columnellar fold.

Dimensions.		H	W	NW
Holotype	(F78522)	2.5 mm	0.9 mm	7
Paratypes	(F78528a)	2.1	0.8	6
	(F78528b)	2.7	1.0	8
	(F78531)	1.4	0.7	5

Types. Holotype (F78522) and 3 figured paratypes (F78528, 78531).

Type locality. 150 m west of 'Marohn' homestead, 4 km south-west of Gundy, NSW (Locality 28).

Stratigraphic position. In bioclastic limestone, upper part of the Dangarfield Formation.

Geographic distribution. Type locality only.

Geological age. Late Tournaisian.

Etymology. Referring to the township of Gundy, New South Wales.

Remarks. This species is similar to *Kimina* sp., in having smooth convex whorls with deviated protoconch, but *Kimina* sp. has a moderate umbilicus and more convex whorls with opisthocline growth lines.

Streptacis sp.

Pl. 22 figs 4-5

Description. Shell minute, very slender, high-spired, anomphalous. Protoconch of heterostrophic but initial portion missing. Teleoconch of about 9 whorls with only opisthocline growth lines; whorl profile symmetrically rounded, suture deep. Aperture oval, inner lip arcuate; outer lip thin, opisthocline.

Dimensions. Figured specimen (F78525) H 2.0 mm, W 0.5 mm, NW 10.

Locality. Behind 'Kyndalyn' homestead, 10 km south-west of Somerton, NSW (Locality 24).

Stratigraphic position. In base of oolitic limestone in the Kyndalyn Mudstone Member of the Merlewood Formation.

Geological age. Middle or late Viséan.

Remarks. This specimen resembles *Streptacis elegantissima* (Yoo) in shell shape and ornament, but differs in having finer collabral threads and a helical heterostrophic protoconch.

Concluding Remarks

During the present study, the largest assemblage to date of Australian Early Carboniferous gastropods (early Tournaisian to late Viséan) was recovered from the limestones interbedded in the Tulcumba Sandstone and the Namoi Formation in the western limb of the Belvue-Werrie Syncline, in the Merlewood Formation about 10 km southwest of Somerton, and in the Dangarfield Formation in the Glenbawn area. The faunal assemblage consists almost entirely of minute shells preserved by chlorite replacement, making possible the isolation from the limestone matrix of complete shells with preservation

of extremely delicate shell ornamentation. The gastropod shells in the Luton Formation, the Namoi Formation and the Caroda Formation in the northernmost Tamworth Belt do not appear to be replaced by chlorite. Only a small number of clayey internal molds was recovered after acidisation.

During this study, a total of 79 forms of gastropods referable to 47 genera and subgenera was discriminated, of which 40 forms are described as new species. The Australian gastropod faunas can be viewed as a mixture of both European and North American affinities. This agrees in a general way with the conclusions of previous workers that the Early Carboniferous marine invertebrate faunas of the Tasman Belt in eastern Australia were diverse and cosmopolitan. However, three genera (*Kimina*, *Palaeovalvania* and *Pseudoaclisina*) placed to the Heterogastropoda and two genera (*Microcochlis* and *Kyndalynia*) which I am unable to place to an order have not been observed outside Australia. Two other new genera, *Campbellospira* and *Globobulimorpha*, placed to Pleurotomarioidea and Subulitoidea respectively, are also unique in shell characters, and need further investigations. The Heterogastropoda and related forms had already diversified during the early Carboniferous. The origin of these groups are yet to be investigated.

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APPENDIX

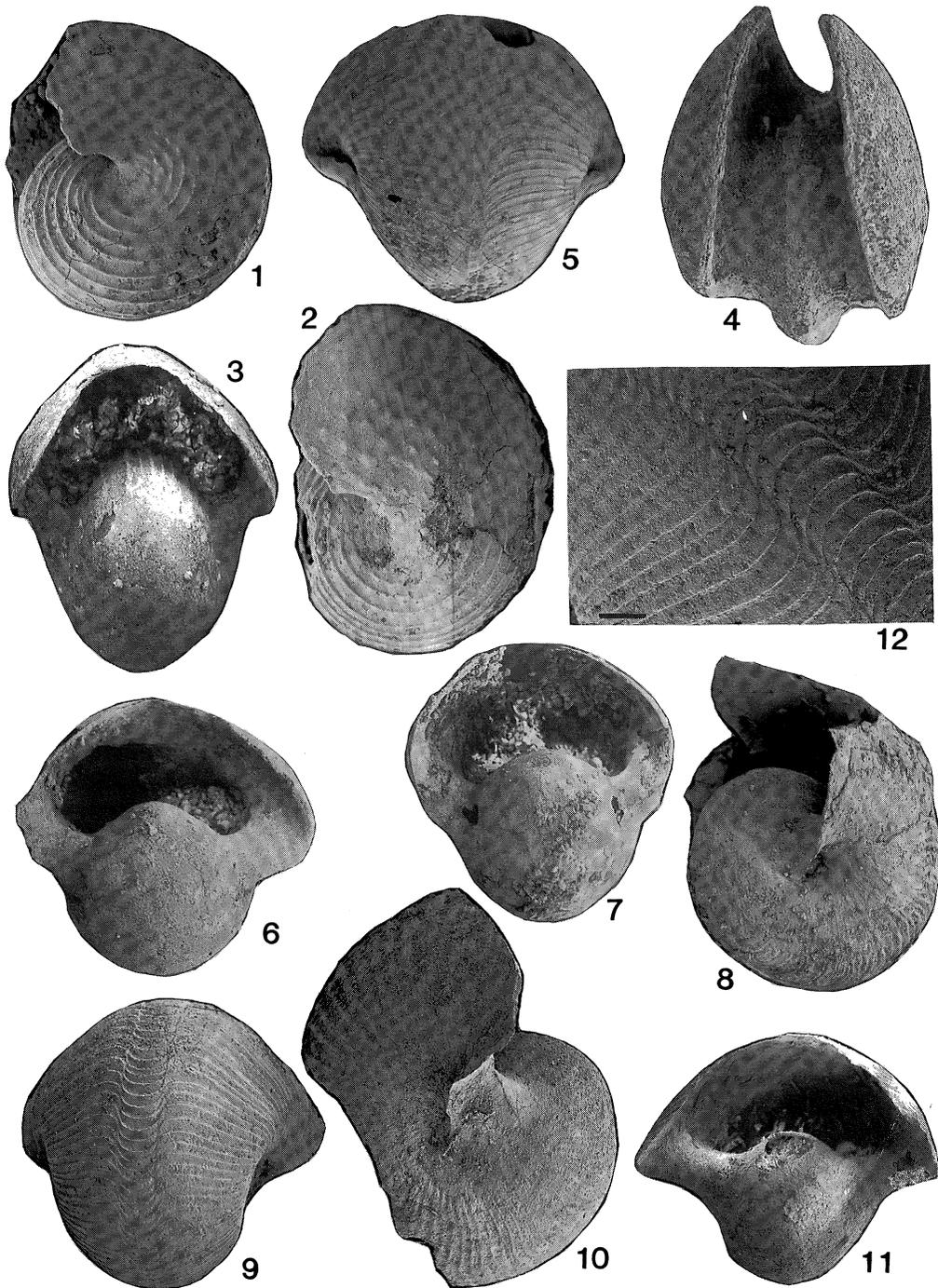


Plate 1. Figs 1-3. *Euphemites pustula* n.sp. 1. Paratypes, left lateral view, maximum diameter 3.4 mm (F78342). 2. Holotype, left lateral view, maximum diameter 4.6 mm (F78341). 3. Paratype, apertural view, maximum diameter 4.2 mm (F78342). Locality 25. Fig. 4. *Cybularia carinata* n.sp. Holotype, apertural view, maximum diameter 2.3 mm (F78343). Locality 25. Figs 5-8. *Bellerophon (Bellerophon) swainsensis* n.sp. 5. Paratype, anterior dorsal view 6.0 mm x 6.4 mm (F78345). 6. Paratype, apertural view 5.3 mm x 5.6 mm (F78346a). 7. Holotype, apertural view 5.7 mm x 5.4 mm (F78344). 8. Paratype, left lateral view 4.0 mm x 6.4 mm (F78346b). Locality 25. Figs 9-12. *Bellerophon (Bellerophon) kyndalynensis* n.sp. 9. Holotype, anterior dorsal view 1.2 mm x 1.2 mm (F78348). 10. Paratype, right lateral view, largest diameter, 1.5 mm (F78349b). 11. Paratype, apertural view 1.2 mm x 1.4 mm (F78349a). 12. Selenizone of Fig. 9. Locality 24. Bar scale 0.1 mm.

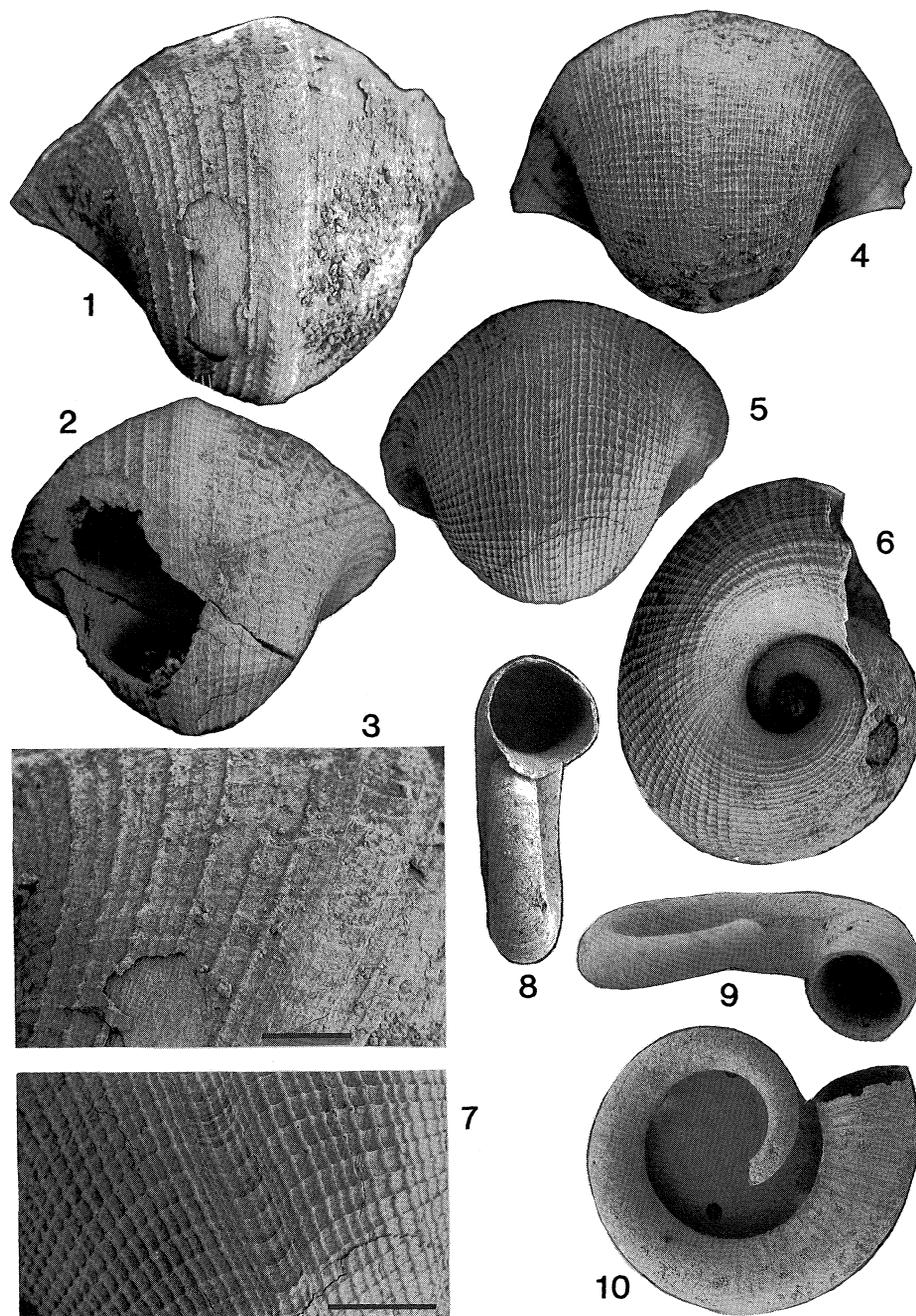


Plate 2. Figs 1-3. *Knightites (Retispira) triangularis* n.sp. 1. Holotype, anterior dorsal view 7.3 mm x 8.6 mm (F78351). 2. Paratype, anterior dorsal view 6.4 mm x 7.1 mm (F78352). 3. Shell and selenizone ornamentation of holotype. Locality 25. Figs 4-7. *Knightites (Retispira) multilirata* n.sp. 4. Holotype, anterior dorsal view 5.2 mm x 7.0 mm (F78353). 5. Paratype, anterior dorsal view 5.3 mm x 6.1 mm (F78354). 6. Paratype, right lateral view, maximum diameter 6.3 mm (F78355). 7. Shell and selenizone ornamentation of paratype. Locality 25. Figs 8-10. *Serpulospira scalariformis* n.sp. 8. Paratype, apertural view 2.8 mm x 1.0 mm (F78357). 9. Paratype, apertural view 1.4 mm x 0.4 mm (F78358a). 10. Paratype, umbilical view 1.3 mm x 0.4 mm (F78358b). Locality 28. Bar scale 1 mm.

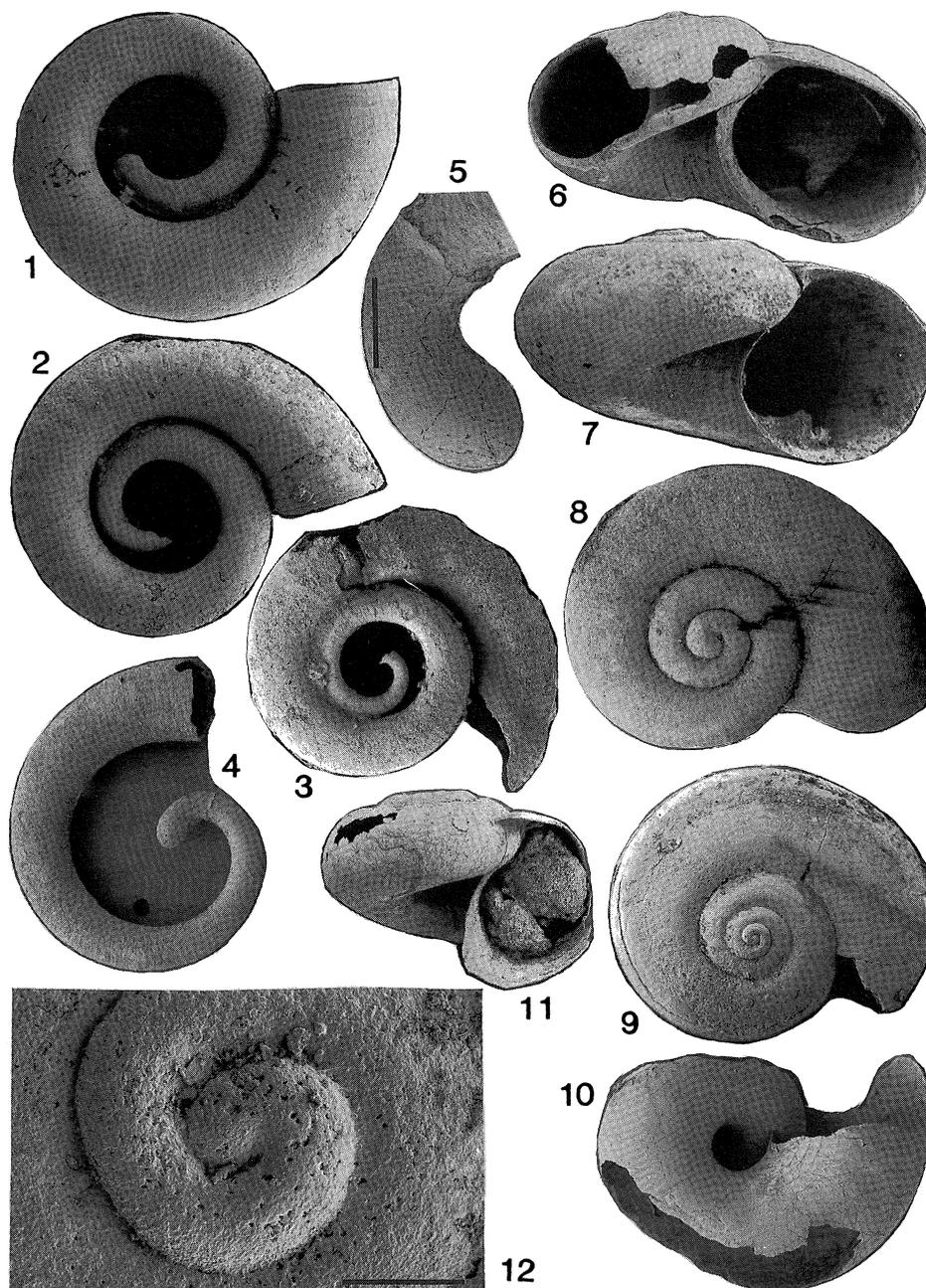


Plate 3. Figs 1-5. '*Serpulospira* scalariformis' n.sp. 1. Paratype, umbilical view 2.1 mm x 0.6 mm (F78359). 2. Holotype, apical view 2.3mm x 0.8mm (F78360). 3. Paratype, apical view, maximum diameter 2.9 mm (F78361). 4. Paratype, apical view 1.3 mm x 0.3 mm (F78362). 5. Protoconch of Fig. 4. Locality 28. Figs 6-8. *Straparollus brevis* n.sp. 6. Paratype, apertural view 2.3 mm x 1.4 mm (F78364b). 7. Holotype, apertural view 2.2 mm x 1.2 mm (F78363). 8. Paratype, apical view, maximum diameter 1.9 mm (F78364a). Locality 24. Figs 9-12. *Platyschisma vitrea* n.sp. 9. Holotype, apical view, maximum diameter 2.5 mm (F78366). 10. Paratype, umbilical view, maximum diameter 2.1 mm (F78367a). 11. Paratype, apertural view 1.0 mm x 1.3 mm (F78367b). 12. Protoconch of holotype. Locality 28. Bar scale 0.1 mm.

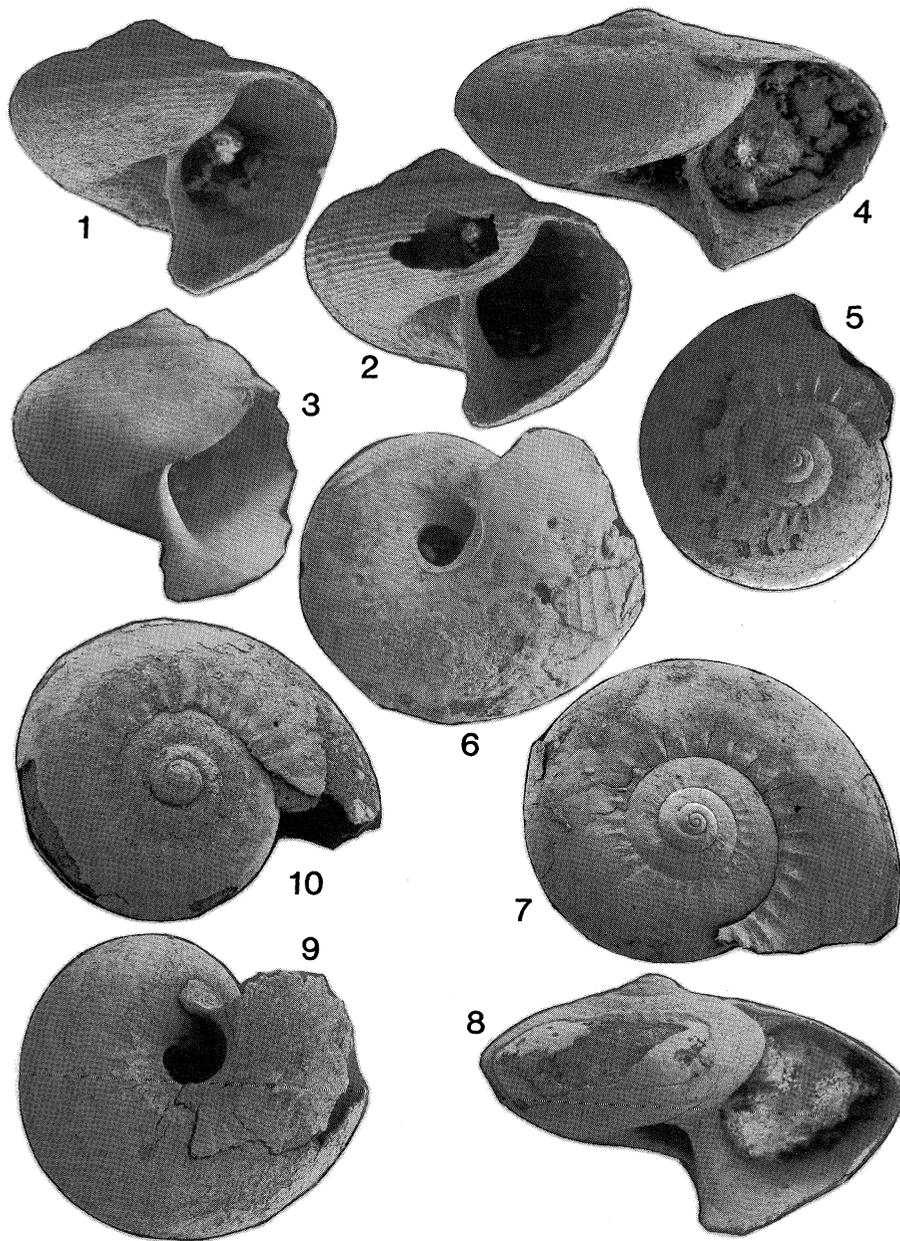


Plate 4. Figs 1-3. *Platyschisma lingua* n.sp. 1. Paratype, apertural view 2.8 mm x 3.1 mm (F78370). 2. Holotype, apertural view 2.4 mm x 2.7 mm (F78369). 3. Paratype, apertural view 4.9 mm x 5.0 mm (F78371). Localities 30, 18 and 25. Figs 4-10. *Angyomphalus radianodosa* n.sp. 4. Paratype, apertural view 2.5 mm x 3.9 mm (F78373). 5. Figured specimen, apical view (F78374). 6. Paratype, umbilical view, maximum diameter 3.2 mm (F78375). 7. Paratype, apical view, maximum diameter 3.8 mm (F78376a) 8. Holotype, apertural view 2.5 mm x 3.9 mm (F78372). 9. Paratype, umbilical view, maximum diameter 3.2 mm (F78376). 10. Paratype, apical view, maximum diameter 3.4 mm (F78376b). Locality 28.

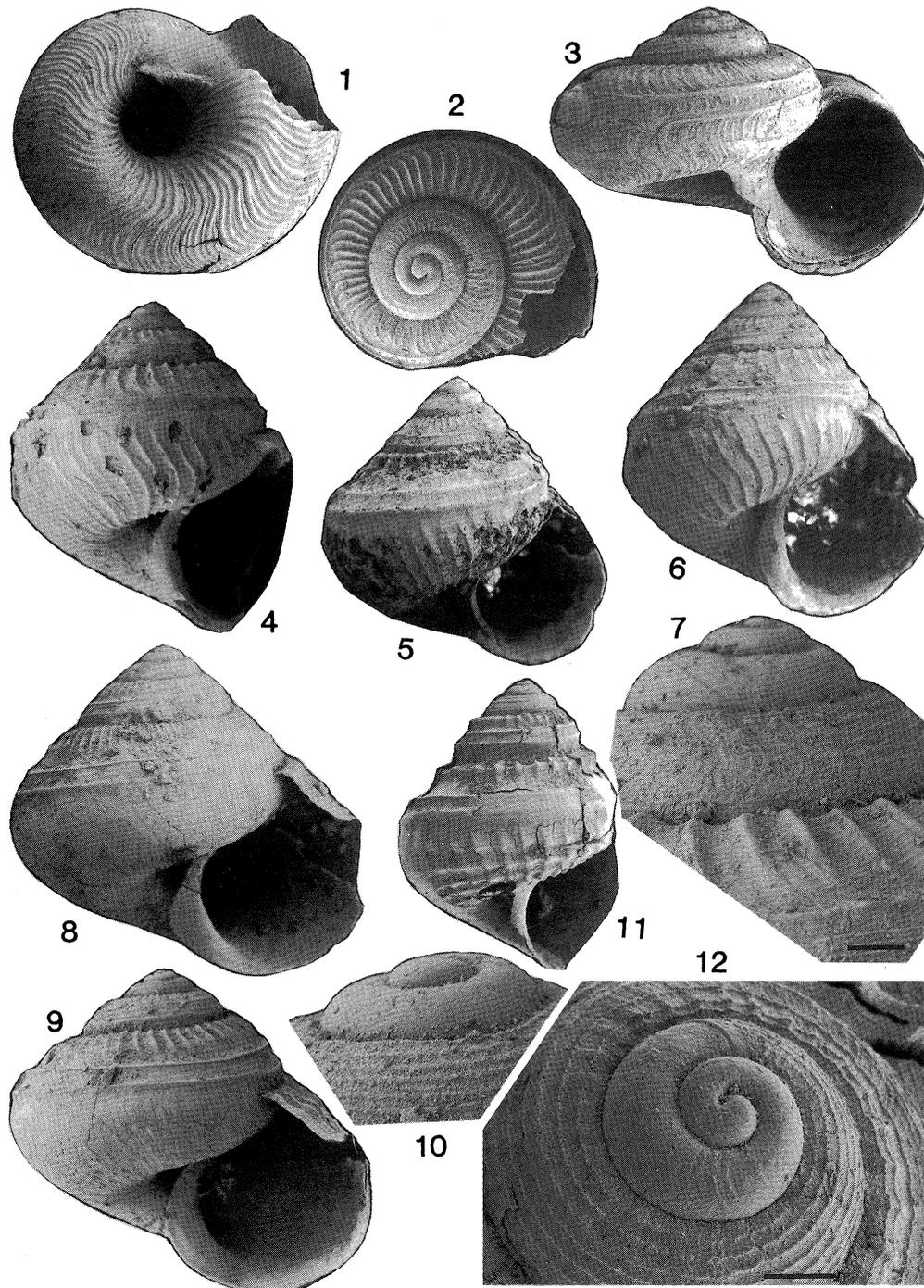


Plate 5. Figs 1-3. *Eotomaria umbilicata* n.sp. 1. Paratype, umbilical view, maximum diameter 2.5 mm (F78380a). 2. Paratype, apical view, maximum diameter 1.9 mm (F78380b). 3. Holotype, apertural view 1.6 mm x 2.2 mm (F78379). Locality 28. Figs 4-7. *Campbellospira conica* n.gen., n.sp. 4. Paratype, apertural view, height 3.6 mm (F78383). 5. Holotype, apertural view 4.3 mm x 4.2 mm (F78382). 6. Paratype, apertural view 3.8 mm x 3.5 mm (F78384). 7. Protoconch and early stage of teleoconch of Fig. 4. Locality 25. Figs 8-10. *Campbellospira* sp. A. 8. Apertural view 3.4 mm x 3.8 mm (F78385). 9. Apertural view 2.7 mm x 3.0 mm (F78386). 10. Protoconch of Fig. 9. Locality 25. Figs 11-12. *Campbellospira* sp. B. 11. Apertural view, height 2.7 mm (F78387). 12. Protoconch and early stage of teleoconch of Fig. 11. Locality 25. Bar scale 0.1 mm.

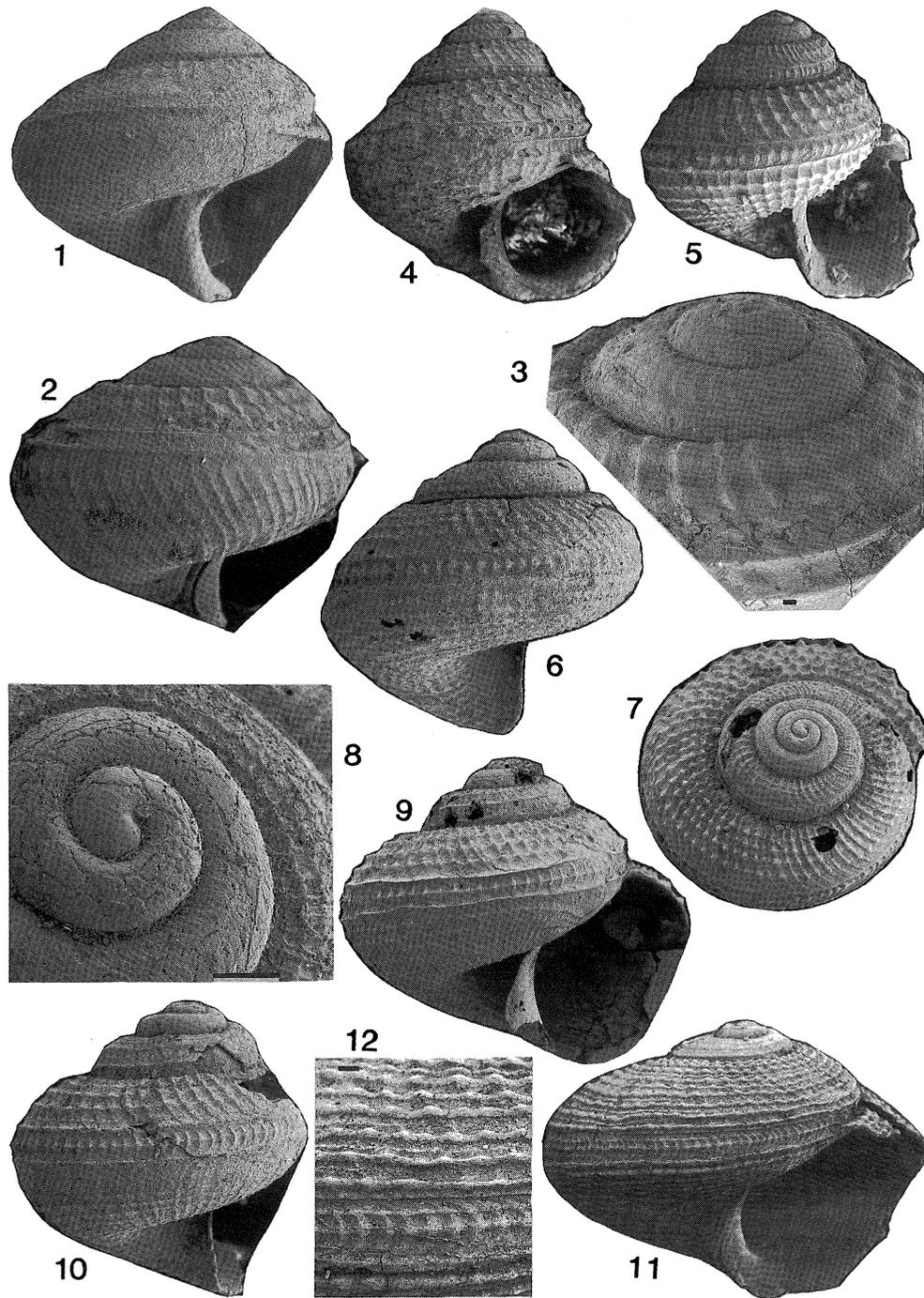


Plate 6. Figs 1-3. *Campbellospira* sp. C. 1. Apertural view 3.0 mm x 3.1 mm (F78388). 2. Apertural view 3.1 mm x 3.5 mm (F78389). 3. Protoconch and early stage of teleoconch of Fig. 2. Locality 25. Figs 4-10. *Glabrocingulum obesum* Yoo. 4. Apertural view 5.0 mm x 5.0 mm (F78393). 5. Apertural view 3.2 mm x 2.6 mm (F78395). 6. Apertural view 2.3 mm x 2.4 mm (F78394b). 7. Apical view (F78394). 8. Protoconch of Fig. 7. 9. Apertural view 2.2 mm x 2.5 mm (F78394c). 10. Apertural view 1.5 mm x 1.5 mm (F78394a). Locality 28. Figs 11-12. *Glabrocingulum* sp. 11. Apertural view 3.5 mm x 3.7 mm (F78396). 12. Selenizone ornamentation of Fig. 11. Locality 25. Bar scale 0.1 mm.

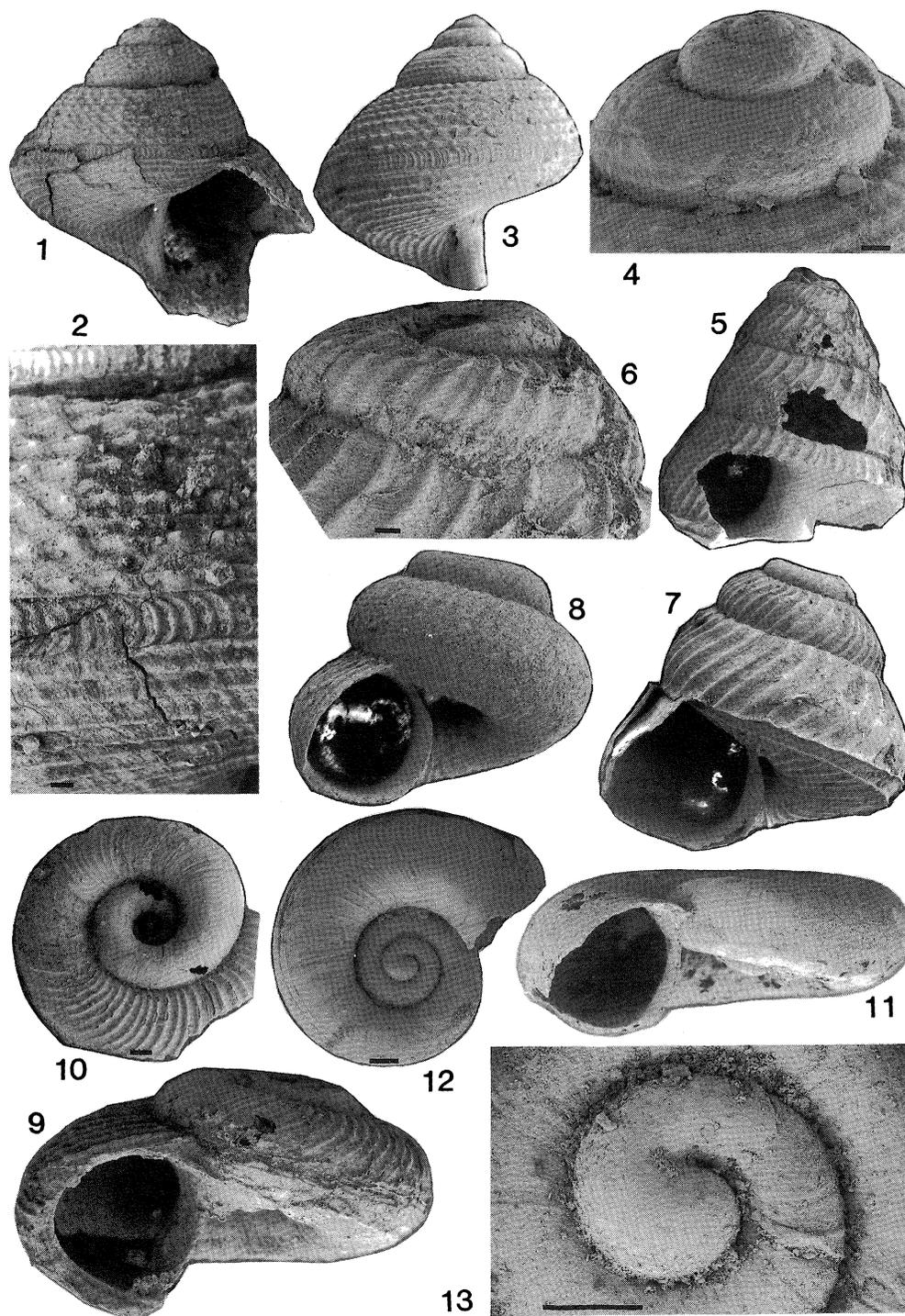


Plate 7. Figs 1-4. *Glabrocingulum pustulum* n.sp. 1. Holotype, apertural view 5.6 mm x 5.5 mm (F78397). 2. Selenizone and last whorl ornamentation of holotype. 3. Paratype, apertural view 5+ mm x 5+ mm (F78398). 4. Protoconch of Fig. 3. Locality 25. Figs 5-7. *Hesperielliella elongata* n.sp. 5. Holotype, apertural view 4.1 mm x 3.7 mm (F78399). 6. Apex of holotype, protoconch hidden. 7. Apertural view, immature 2.5 mm x 2.7 mm (F78400). Localities 18 (Fig. 5) and 29 (Fig. 7). Fig. 8. *Hesperielliella robertsi* Yoo. Apertural view of juvenile 1.7 mm x 1.8 mm (F78401). Locality 31. Figs 9-13. *Hesperielliella planorbis* n.sp. 9. Holotype, apertural view 1.7 mm x 2.6 mm (F78402). 10. Paratype, apical view, protoconch sunken (F78403). 11. Paratype, apertural view 0.8 mm x 1.3 mm (F78403). 12. Paratype, umbilical view, protoconch visible (F78403). 13. Protoconch of Fig. 12. Locality 28. Bar scale 0.1 mm.

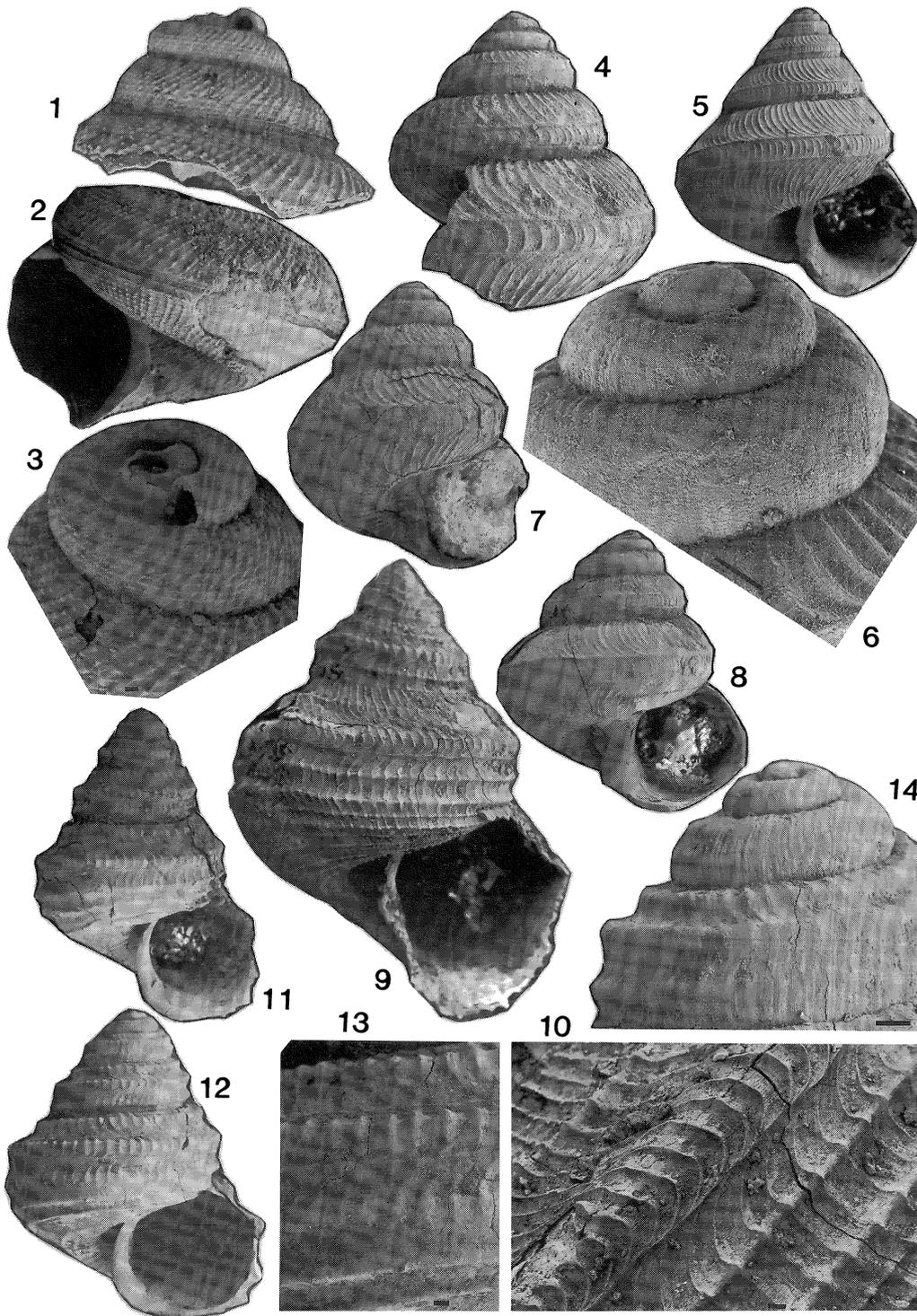


Plate 8. Figs 1-3. *Agnesia reticulata* n.sp. 1, 2. Shell broken, width of last whorl 7.1 mm (F78406). 3. Oblique apical view of Fig. 1, protoconch sunken and early stage of teleoconch broken. Locality 25. Figs 4-8. *Peruvispira gundyensis* Yoo. 4. Figured specimen, side view 2.3 mm x 2.1 mm (F78407). 5. Apertural view 4.1 mm x 3.4 mm (F78408). 6. Protoconch and early stage of teleoconch of Fig. 5. 7. Apertural view 2.8 mm x 2.1 mm (F78409a). 8. Apertural view 2.9 mm x 2.4 mm (F78409b). Localities 25 (Fig. 5) and 31 (Figs 4, 7, 8). Figs 9-10. *Ruedemannia* sp. 9. Apertural view 9.7 mm x 7.1 mm (F78411). 10. Teleoconch and selenizone ornamentation of Fig. 9. Locality 25. Figs 11-14. *Worthenia crenilunula* n.sp. 11. Paratype, apertural view 4.5 mm x 3.6 mm (F78413a). 12. Paratype, apertural view 6.6 mm x 4.4 mm (F78413b). 13. Teleoconch and selenizone ornamentation of Fig. 12. 14. Protoconch and early stage of teleoconch of Fig. 12. Locality 25. Bar scale 0.1 mm.

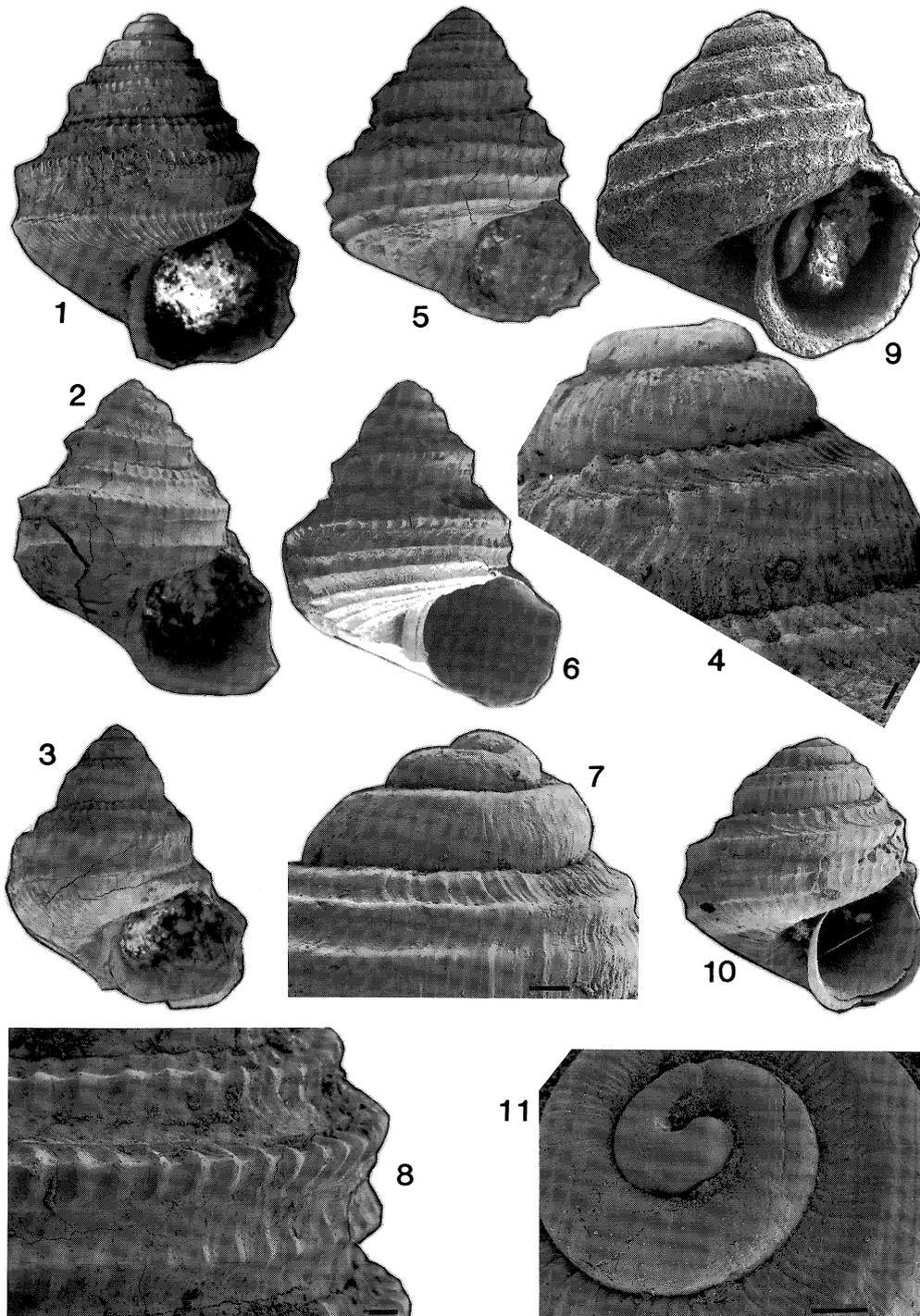


Plate 9. Figs 1-4. *Ruedemannia* sp. 1. Apertural view 6.3 mm x 4.4 mm (F78414). 2. Apertural view 5.2 mm x 4.4 mm (F78417). 3. Apertural view 3.8 mm x 3.1 mm (F78418). 4. Protoconch and early stage of teleoconch of Fig. 1. Locality 25. Figs 5-8. *Worthenia crenilunula* n.sp. 5. Paratype, apertural view 4.9 mm x 3.9 mm (F78415). 6. Holotype, apertural view 6.4 mm x 4.9 mm (F78419). 7. Protoconch and early stage of teleoconch of Fig. 6. 8. Teleoconch and selenizone ornamentation of Fig. 6. Localities 25 (Fig. 5) and 18 (Fig. 6). Figs 9-11. *Worthenia* sp. 9. Apertural view 1.8 mm x 1.7 mm (F78421). 10. Apertural view 2.1 mm x 1.8 mm (F78420). 11. Protoconch and early stage of teleoconch of Fig. 10. Localities 30 (Fig. 9) and 31 (Fig. 10). Bar scale 0.1 mm.

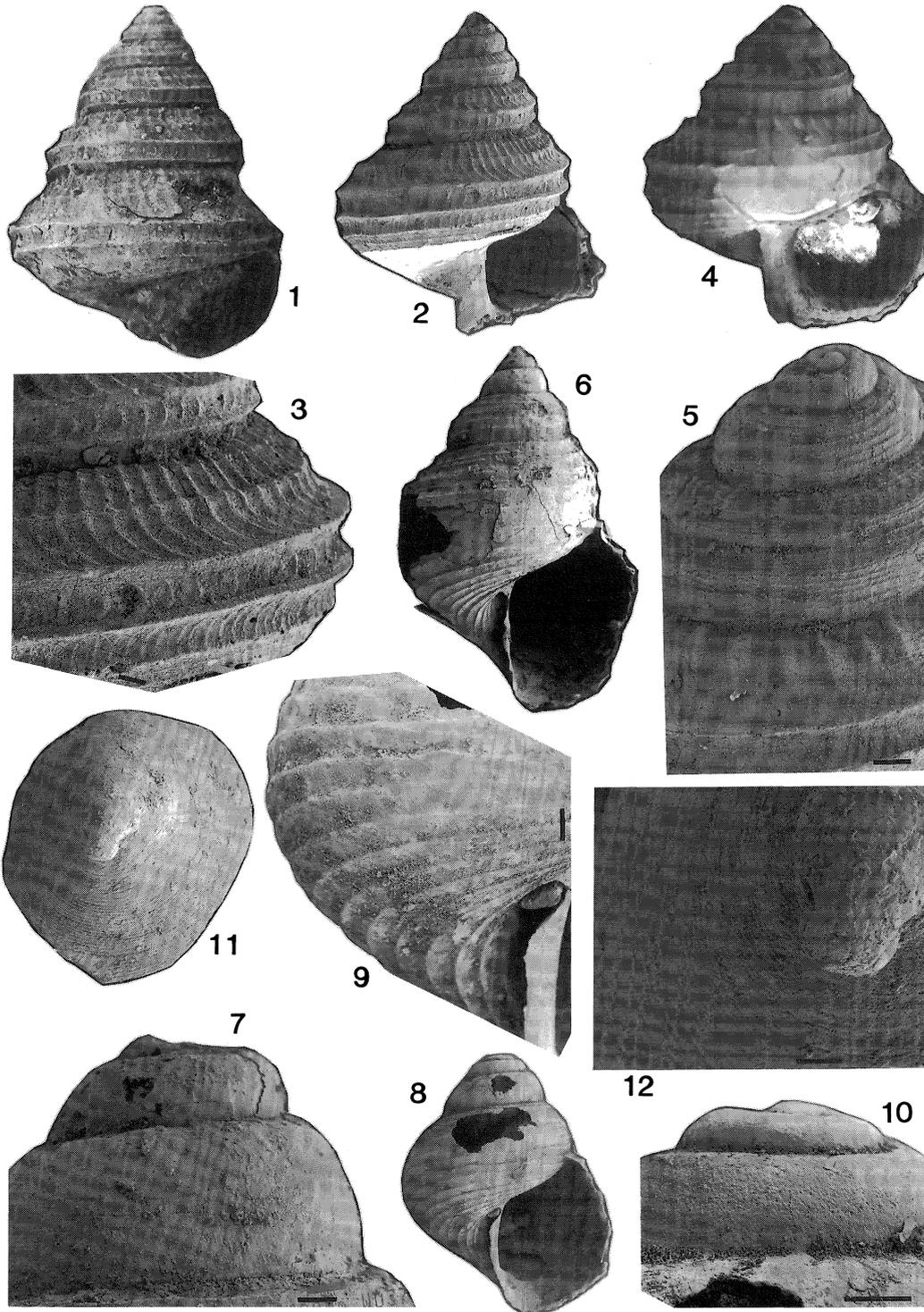


Plate 10. Figs 1-5. *Borestus costatus* Yoo. 1. Apertural view 6.6 mm x 5.0 mm (F78422). 2. Apertural view 2.7 mm x 2.1 mm (F78423). 3. Teleoconch and selenizone ornamentation of Fig. 2. 4. Apertural view 3.9 mm x 3.4 mm (F78424). 5. Protoconch and early stage of teleoconch of Fig. 4. Localities 25 (Figs 1, 4, 5) and 31 (Figs 2, 3). Figs 6-10. *Gyronema nacreformis* n.sp. 6. Holotype, apertural 5.4 mm x 3.6 mm (F78425). 7. Protoconch of holotype. 8. Paratype, apertural view 2.7 mm x 2.2 mm (F78426). 9. Base and umbilicus of Fig. 8. 10. Protoconch of Fig. 8. Locality 25. Figs 11-12. '*Lepetopsis*' sp. 11. Apical view, maximum diameter of shell 1.4 mm (F78428). 12. Protoconch of Fig. 11. Locality 28. Bar scale 0.1 mm.

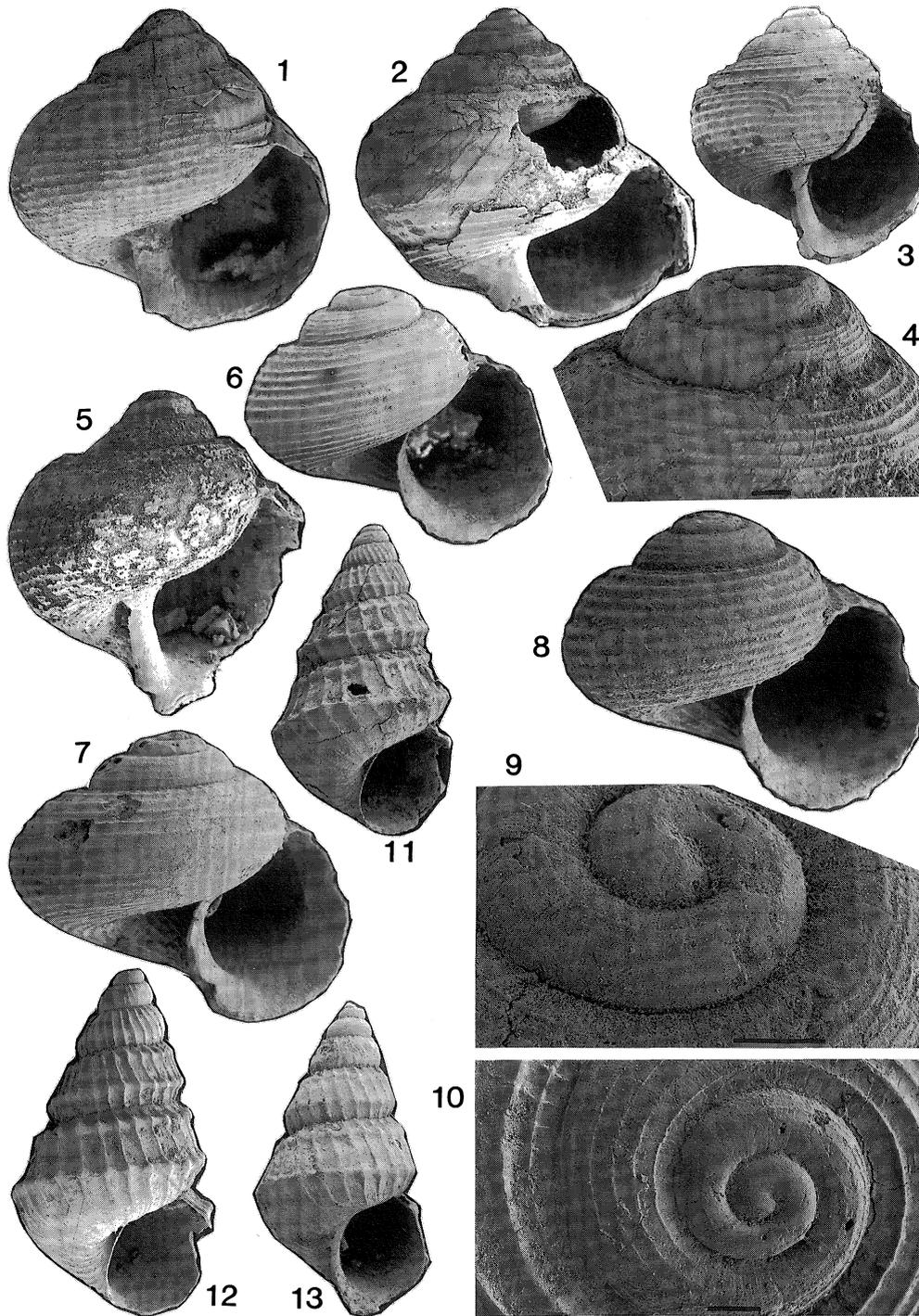


Plate 11. Figs 1-10. *Rhabdotocochlis turgida* n.sp. 1. Paratype, apertural view 2.9 mm x 2.9 mm (F78429b). 2. Paratype, apertural view 5.0 mm x 5.2 mm (F78429a). 3. Holotype, apertural view 4.9 mm x 4.7 mm (F62002). 4. Protoconch and early stage of teleoconch of Fig. 2. 5. Paratype, apertural view 3.5 mm x 3.4 mm (F78430). 6. Figured specimen, juvenile apertural view 1.6 mm x 1.6 mm (F78431). 7. Figured specimen, juvenile apertural view 1.7 mm x 1.9 mm (F78432). 8. Figured specimen, juvenile apertural view 1.8 mm x 2.0 mm (F78432). 9. Protoconch and early stage of teleoconch of Fig. 2. 10. Protoconch and early stage of teleoconch of Fig. 8. Localities 18 (Figs 1, 5), 28 (figs 6, 8) and 32 (figs 3, 5). Figs 11-13. *Microdoma angulata* Yoo. 11. Figured specimen, apertural view 3.5 mm x 2.2 mm (F78434a). 12. Apertural view 2.6 mm x 1.4 mm (F78434b). 13. Apertural view 3.1 mm x 1.9 mm (F78434c). Locality 28. Bar scale 0.1 mm.

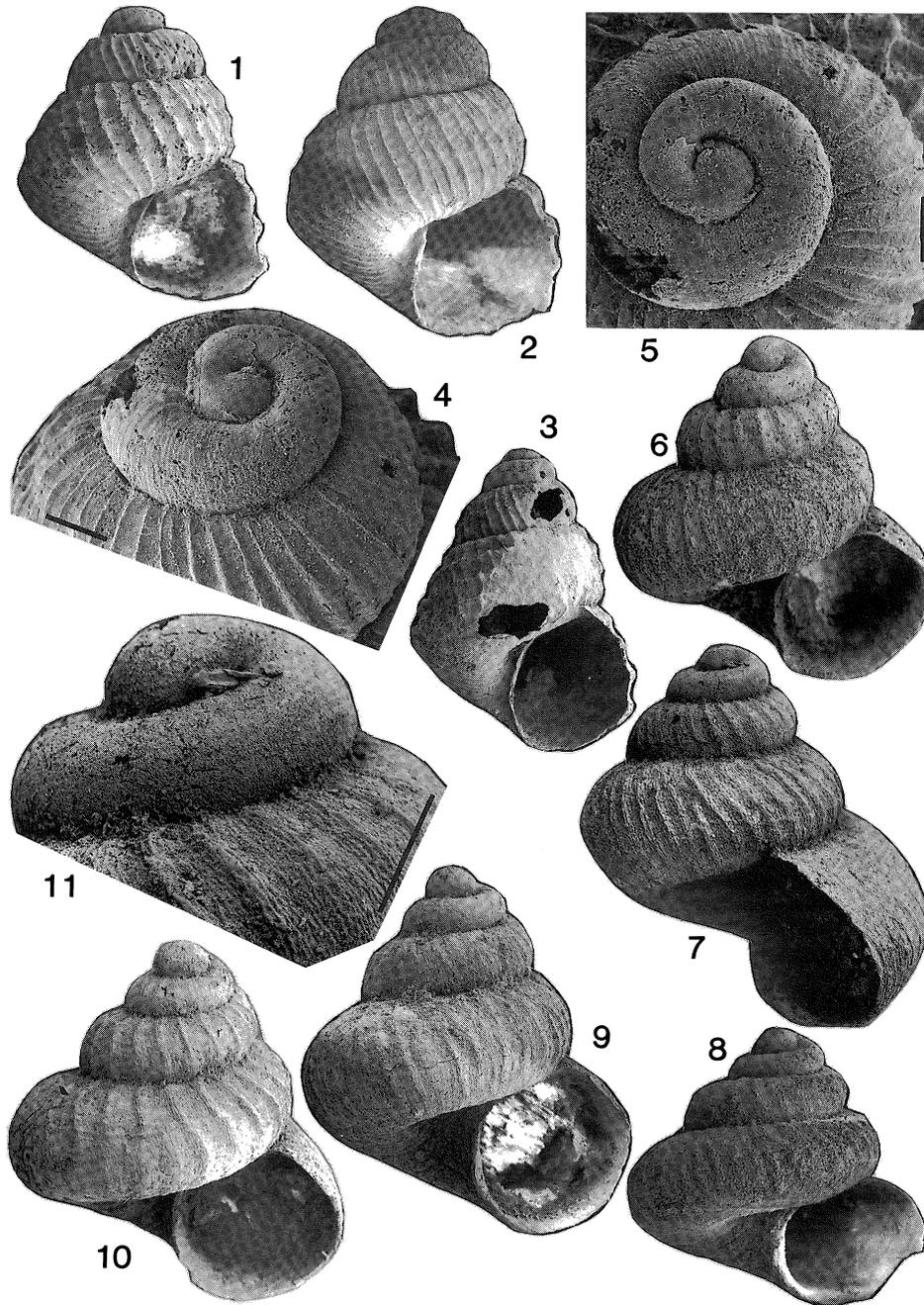


Plate 12. Figs 1-5. *Microcochlis parva* n.gen., n.sp. 1. Paratype, apertural view 1.4 mm x 1.2 mm (F78438a). 2. Paratype, apertural view 1.3 mm x 1.0 mm (F78438b). 3. Holotype, apertural view 2.1 mm x 1.5 mm (F78437). 4. Oblique apical view, protoconch and early stage of teleoconch of Fig. 1. 5. Apical view. Locality 24. Figs 6-11. *Kyndalynia inflata* n.gen., n.sp. 6. Paratype, apertural view, slightly tilted forward 1.1 mm x 1.0 mm (F78441a). 7. Holotype, side view, height 1.3 mm (F78440). 8. Paratype, apertural view 1.0 mm x 1.0 mm (F78442). 9. Paratype, apertural view 1.2 mm x 1.0 mm (F78443). 10. Paratype, apertural view, slightly tilted forward 1.1 mm x 1.0 mm (F78441b). 11. Protoconch of holotype. Locality 24. Bar scale 0.1 mm.

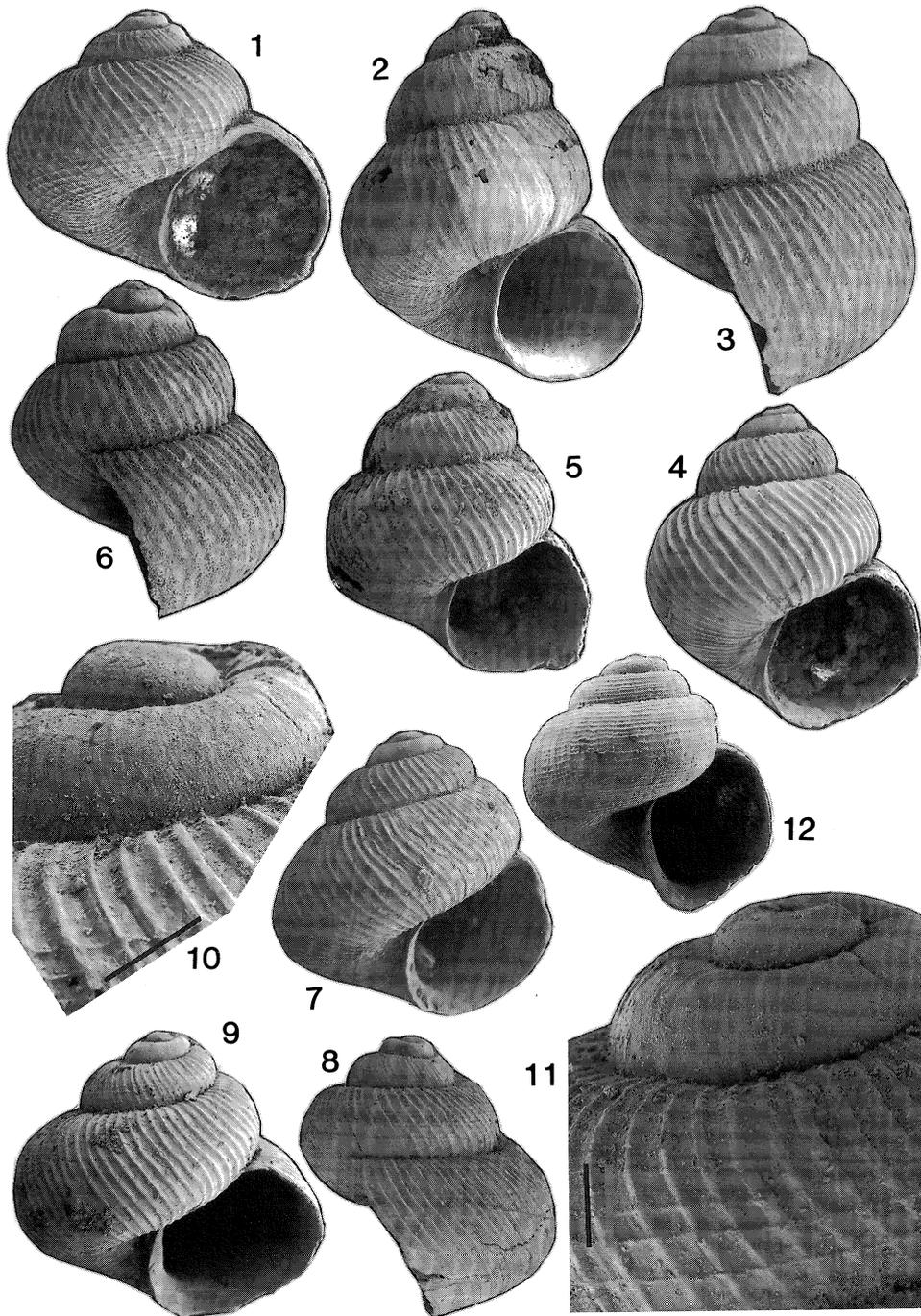


Plate 13. Fig. 1. *Eucochlis* sp. Apertural view 1.6 mm x 1.8 mm (F78445). Locality 31. Figs 2-3. *Eucochlis australis* Yoo. 2. Apertural view 2.2 mm x 1.5 mm (F78446). 3. Side view 1.4 mm x 0.8 mm (F78447). Locality 28. Figs 4-6. *Eucochlis umbiliparva* n.sp. 4. Holotype, apertural view 1.7 mm x 1.7 mm (F78448). 5. Paratype, apertural view 1.8 mm x 1.5 mm (F78449). 6. Paratype, side view, height 1.8 mm (F78450). Localities 31 (Fig. 4), 28 (Fig. 5) and 29 (Fig. 6). Figs 7-11. *Eucochlis depressa* n.sp. 7. Holotype, apertural view 1.6 mm x 1.5 mm (F78451). 8. Paratype, side view showing strong prosocline outer lip 1.6 mm x 1.4 mm (F78452). 9. Paratype, apertural view 1.6 mm x 1.6 mm (F78453). 10. Protoconch of Fig. 9. 11. Protoconch and early stage of teleoconch of holotype. Locality 25. Fig. 12. *Araeonema microspirulata* Yoo. Holotype, apertural view 1.2 mm x 1.1 mm (F61958). Locality 28. Bar scale 0.1 mm.

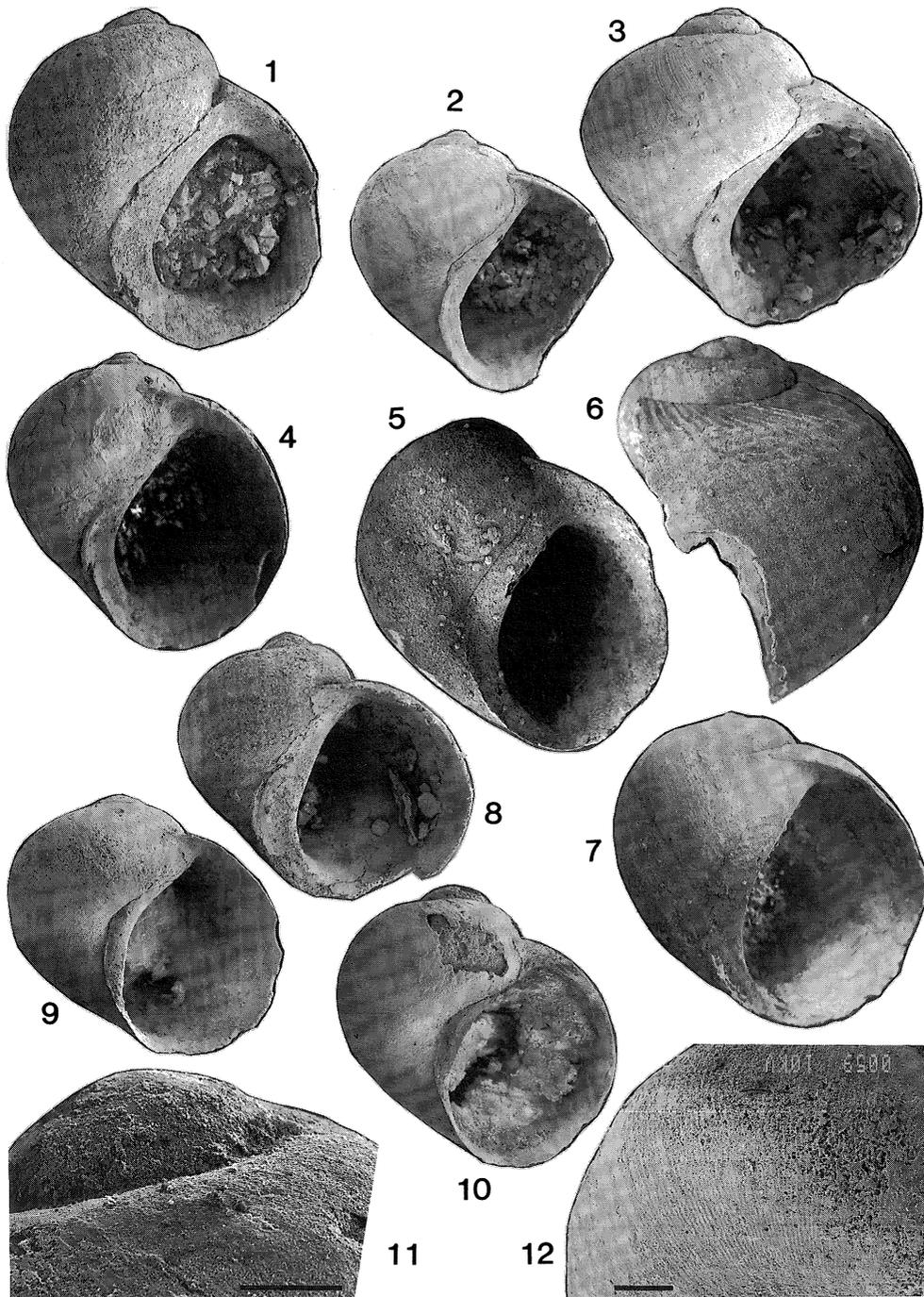


Plate 14. Figs 1-8. *Naticopsis (Naticopsis) osbornei* Yoo. 1. Apertural view 2.8 mm x 2.4 mm (F78457a). 2. Apertural view 3.4 mm x 3.3 mm (F78460). 3. Apertural view 2.1 mm x 2.3 mm (F78457b). 4. Apertural view 3.9 mm x 3.5 mm (F78458). 5. Apertural view 4.5 mm x 3.6 mm (F78459a). 6. Side view, height 4.6 mm (F78459c). 7. Apertural view 6.0 mm x 5.6 mm (F78459b). 8. Apertural view 1.8 mm x 2.0 mm (F78456). Locality 25 except Fig. 8 (Locality 28). Figs 9-12. *Naticopsis (Naticopsis) minuta* n.sp. 9. Holotype, apertural view 1.1 mm x 1.1 mm (F78463). 10. Paratype, apertural view 1.2 mm x 1.1 mm (F78464). 11. Protoconch of Fig. 9. 12. Teleoconch ornamentation of Fig. 9. Locality 24. Bar scale 0.1 mm.

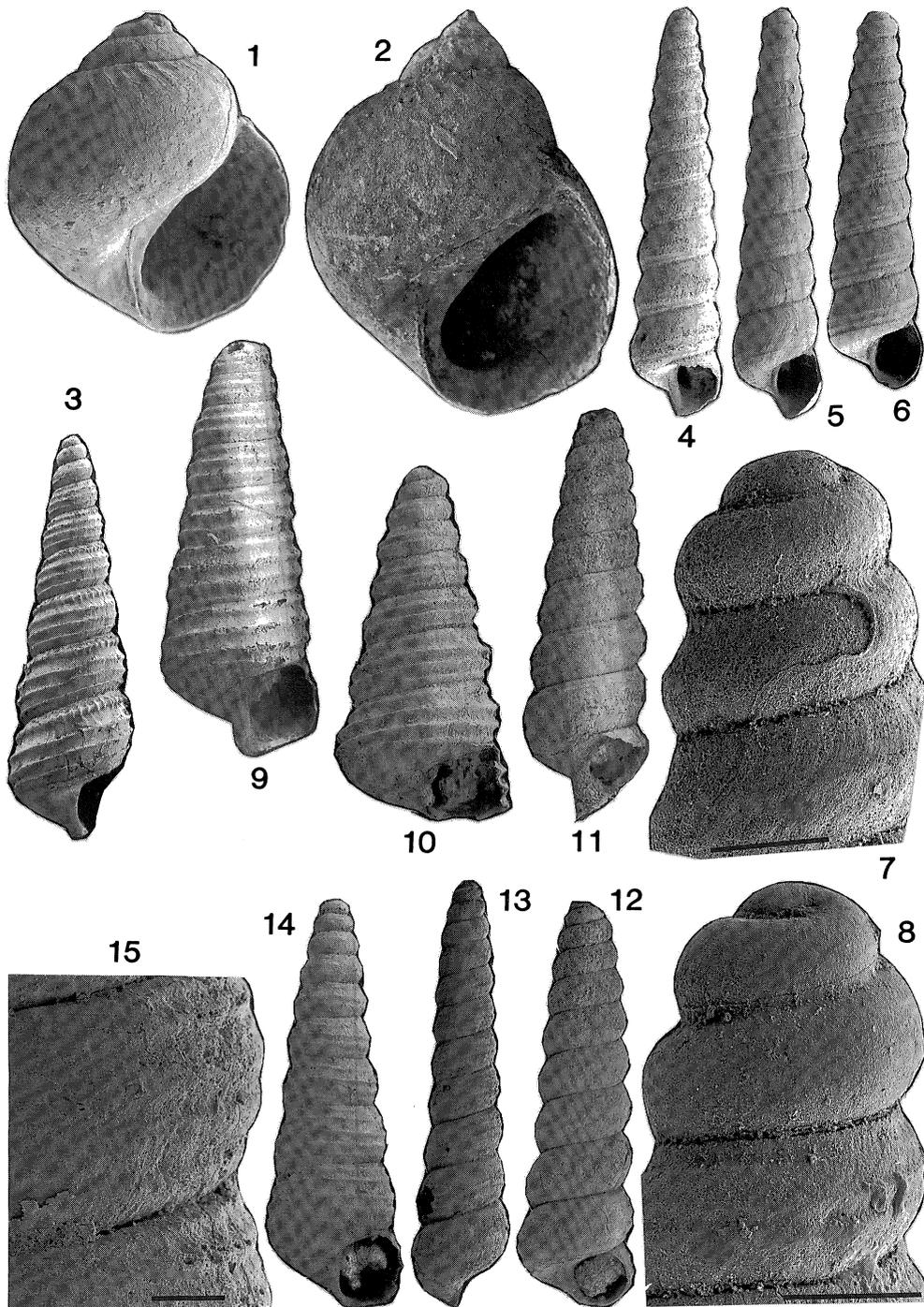


Plate 15. Figs 1-2. *Turbonitella* sp. 1. Apertural view 2.6 mm x 2.3 mm (F78465). 2. Apertural view 5.0 mm x 3.7 mm (F78466). Localities 25 (Fig. 2) and 28 (Fig. 1). Fig. 3. *Stegocoelia* (*Stegocoelia*) *nodosa* Yoo. Figured specimen 3.7 mm x 1.2 mm (F78467). Locality 28. Figs 4-8. *Stegocoelia* (*Hypergonia*) *tenuis* Yoo. 4. Figured specimen, height 2.5 mm (F78468). 5. Figured specimen, height 2.4 mm (F78469). 6. Figured specimen, height 2.0 mm (F78470). 7, 8. Protoconchs. Locality 28. Figs 9-10. *Stegocoelia* (*Hypergonia*) sp. A. 9. Figured specimen, height 2.6 mm (F78471). 10. Figured specimen, height 1.8 mm (F78472). Locality 24. Figs 11-15. *Stegocoelia* (*Hypergonia*) sp. B. 11. Aperture broken, height 2.4 mm (F78473). 12. Apertural view, height 2.8 mm (F78473); 13. Aperture broken, height 3.9 mm (F78474). 14. Apertural view, height 2.8 mm (F78475). 15. Teleoconch ornamentation of Fig. 13. Locality 24. Bar scale 0.1 mm.

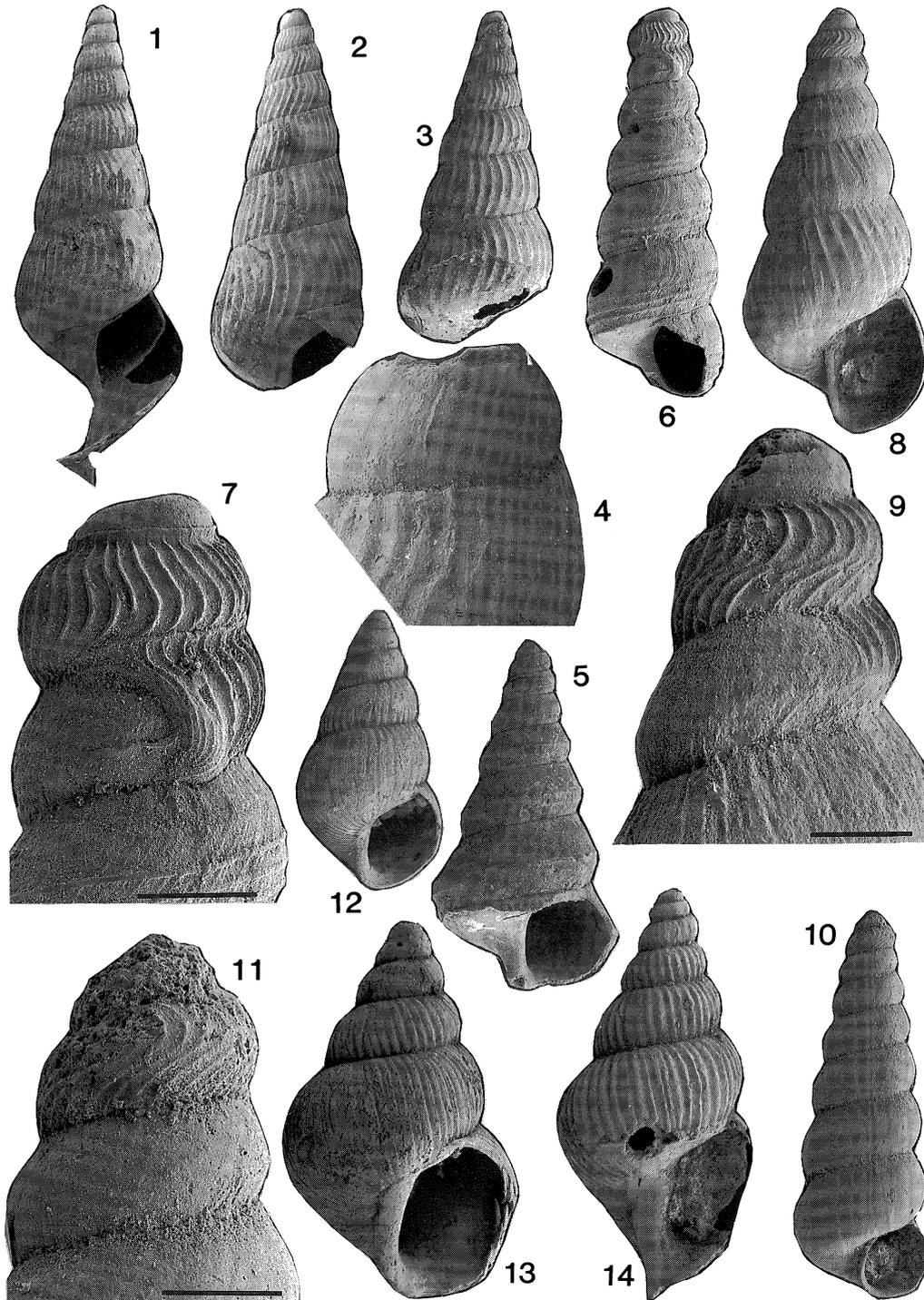


Plate 16. Figs 1-4. *Palaeozygopleura obesa* n.sp. 1. Holotype, aperture broken 10+ mm x 3.2 mm (F78477). 2. Paratype, aperture broken 5.6 mm x 2.2 mm (F78478). 3. Paratype, aperture broken 5.2 mm x 2.5 mm (F78479). 4. Protoconch of Fig. 2. Locality 28. Fig. 5. *Murchisonia* sp. Apertural view, aperture broken, height 5.8 mm (F78482). Figs 6-7. *Cyclozyga sinusigera* Yoo. 6. Side view 1.3 mm x 0.4 mm (F78480). 7. Protoconch of Fig. 6. Locality 28. Figs 8-9. *Leptozyga costata* n.sp. 8. Holotype, apertural view 1.6 mm x 0.4 mm (F78481). 9. Protoconch and early stage of teleoconch of holotype. Locality 24. Figs 10-11. *Pseudozygopleura gracilis* n.sp. 10. Holotype, apertural view 1.5 mm x 0.5 mm (F78483). 11. Protoconch and early stage of teleoconch of holotype. Locality 24. Figs 12-14. *Hemizyga decussata* Yoo. 12. Apertural view 3.2 mm x 1.7 mm (F78486). 13. Apertural view 2.3 mm x 1.4 mm (F78485). 14. Apertural view 3.5 mm x 1.7 mm (F78484). Locality 28. Bar scale 0.1 mm.

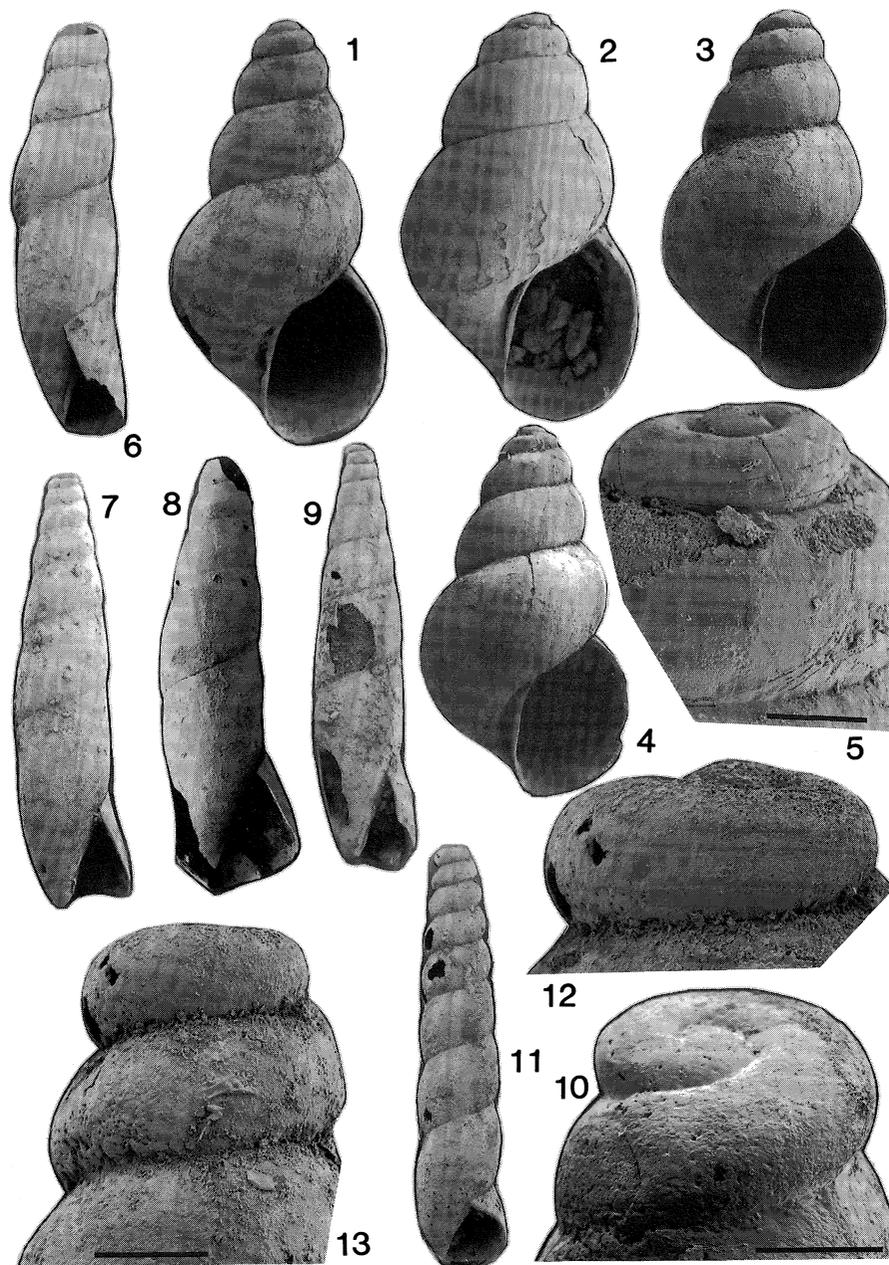


Plate 17. Figs 1-5. *Kimina minor* n.gen., n.sp. 1. Holotype, apertural view 5.3 mm x 2.1 mm (F78487). 2. Paratype, apertural view 2.1 mm x 1.2 mm (F78488). 3. Paratype, apertural view 2.0 mm x 1.3 mm (F78489a). 4. Paratype, apertural view 2.2 mm x 1.3 mm (F78489b). 5. Protoconch of Fig. 2. Localities 28 (Figs 1, 3, 4) and 25 (Fig. 2). Figs 6-10. *Ceraunocochlis australis* n.sp. 6. Paratype, apertural view 3.2 mm x 0.8 mm (F78491b). 7. Holotype, apertural view 3.4 mm x 0.8 mm (F78490). 8. Paratype, aperture broken 3.0 mm x 0.7 mm (F78491c). 9. Paratype, apertural view 3.7 mm x 0.8 mm (F78491a). 10. Protoconch of Fig. 8. Locality 28. Figs 11-13. *Ceraunocochlis tenuis* n.sp. 11. Holotype, apertural view 2.3 mm x 0.5 mm (F78494). 12. Protoconch of holotype. 13. Protoconch and early stage of teleoconch of holotype. Locality 28. Bar scale 0.1 mm.

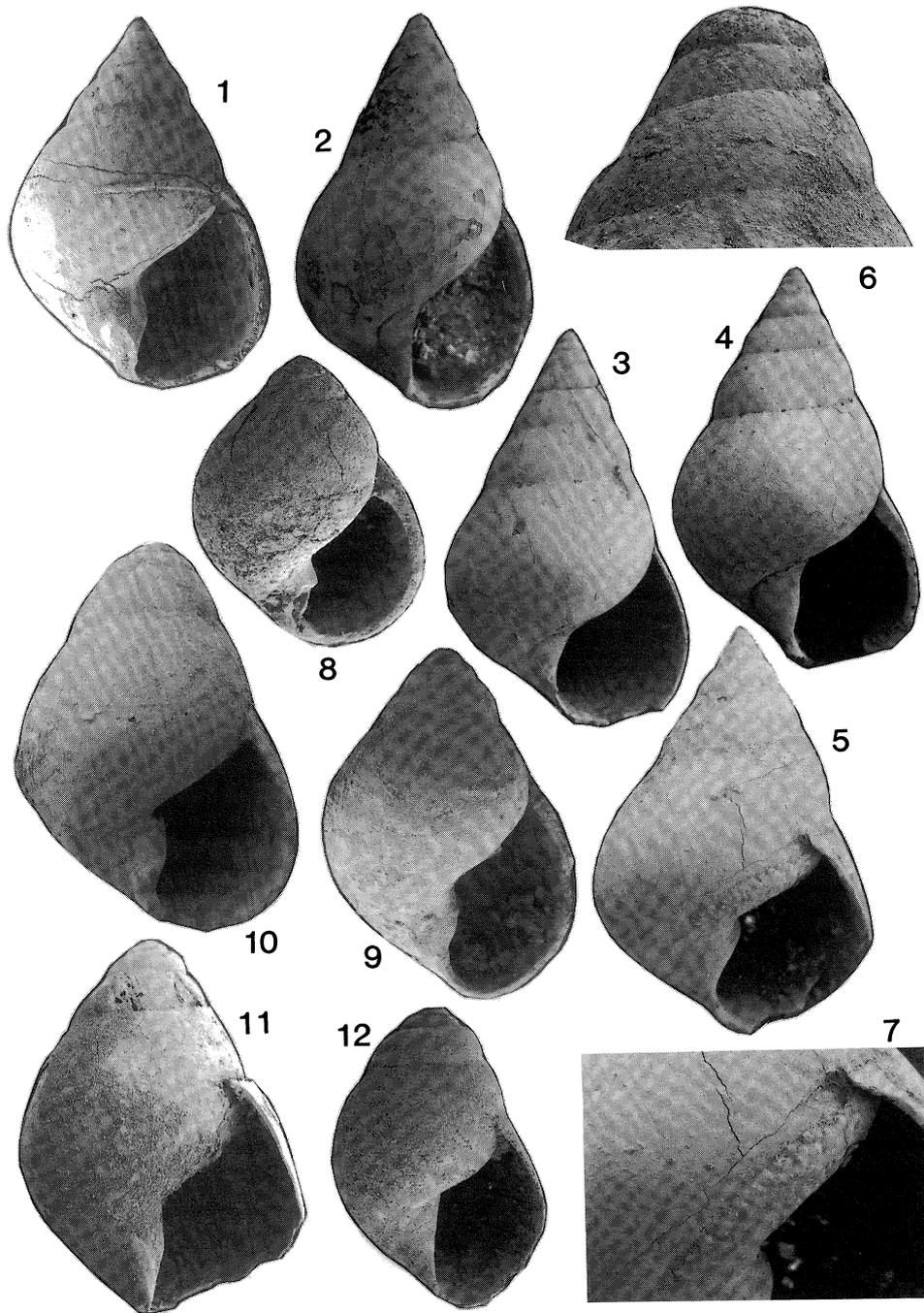


Plate 18. Figs 2-4. *Soleniscus callosus* Yoo. 2. Apertural view 7.2 mm x 4.3 mm (F78502a). 3. Apertural view 7.3 mm x 4.4 mm (F78502b). 4. Apertural view 7.7 mm x 4.6 mm (F78502c). Locality 25. Figs 1, 5-7. *Soleniscus* sp. 1. Apertural view, broken 3.8 mm x 2.6 mm (F78505). 5. Apertural view 6.5 mm x 4.4 mm (F78504). 6. Protoconch of Fig. 5. 7. Cluster of nodules on parietal inductura. Locality 25. Figs 8-12. *Strobeus ovalis* n.sp. 8. Paratype, apertural view 1.7 mm x 1.4 mm (F78498). 9. Figured specimen, apertural view 1.9 mm x 1.4 mm (F78500b). 10. Figured specimen, apertural view 3.0 mm x 2.1 mm (F78500a). 11. Figured specimen, apertural view 2.6 mm x 1.9 mm (F78500c). 12. Holotype, apertural view 1.9 mm x 1.4 mm (F78501). Localities 28 (holotype and paratypes) and 30 (figured specimens).

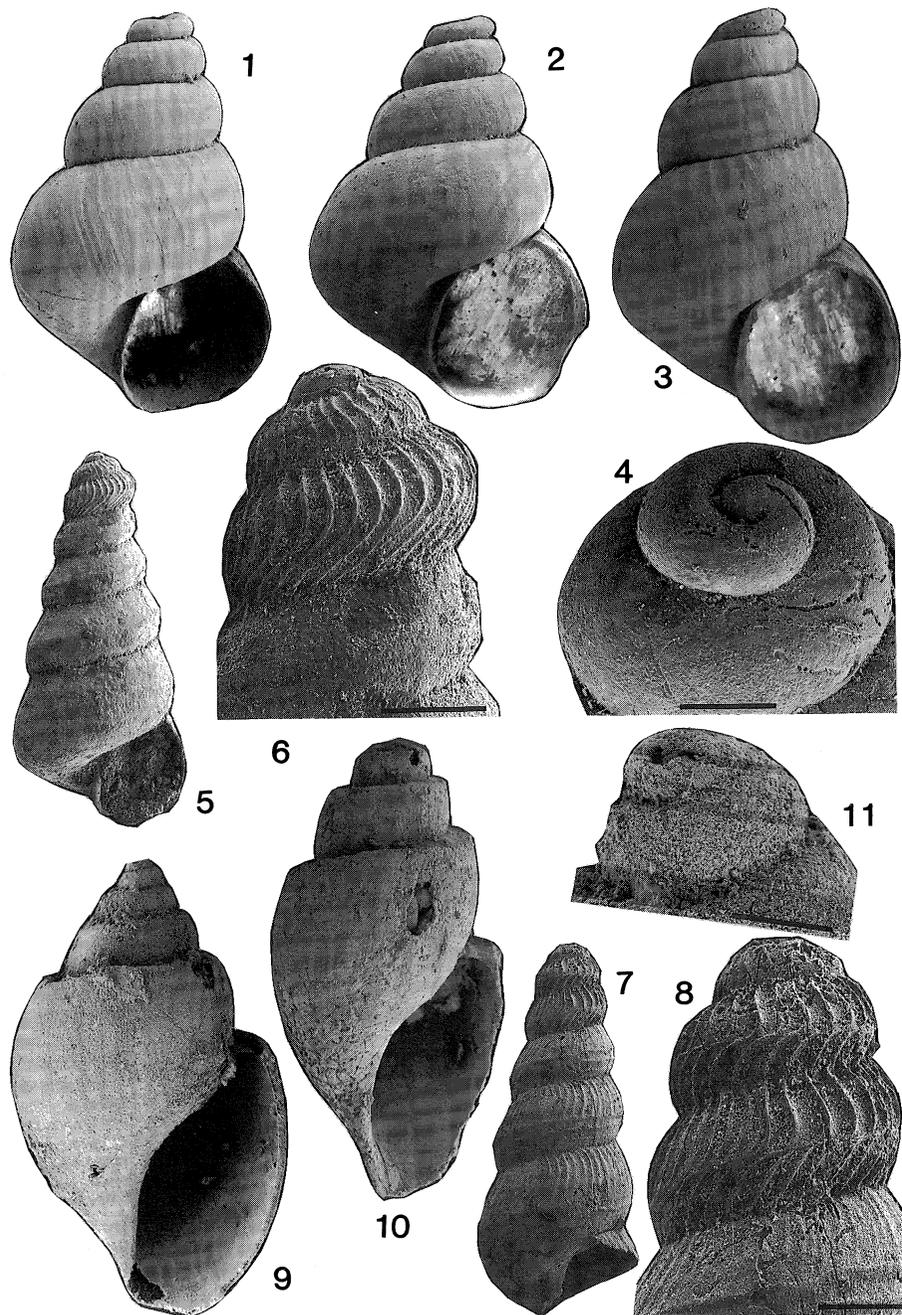


Plate 19. Figs 1-4. *Kimina australis* n.sp. 1. Paratype, apertural view 1.4 mm x 0.8 mm (F78511). 2. Paratype, apertural view 1.3 mm x 0.9 mm (F78512). 3. Holotype, apertural view 1.3 mm x 0.8 mm (F78513). 4. Oblique apical view of protoconch. Locality 24. Figs 5-8. *Cyclozyga* sp. 5. Apertural view 1.3 mm x 0.6 mm (F78503). 6. Protoconch of above specimen. 7. Apertural view 1.4 mm x 0.6 mm (F78506). 8. Protoconch of above specimen. Locality 24. Figs 9-11. *Girtyspira inflata* n.sp. 9. Holotype, apertural view 2.2 mm x 1.3 mm (F78515). 10. Paratype, apertural view, protoconch broken 2.6 mm x 1.4 mm (F78516). 11. Protoconch of holotype. Locality 23. Bar scale 0.1 mm.

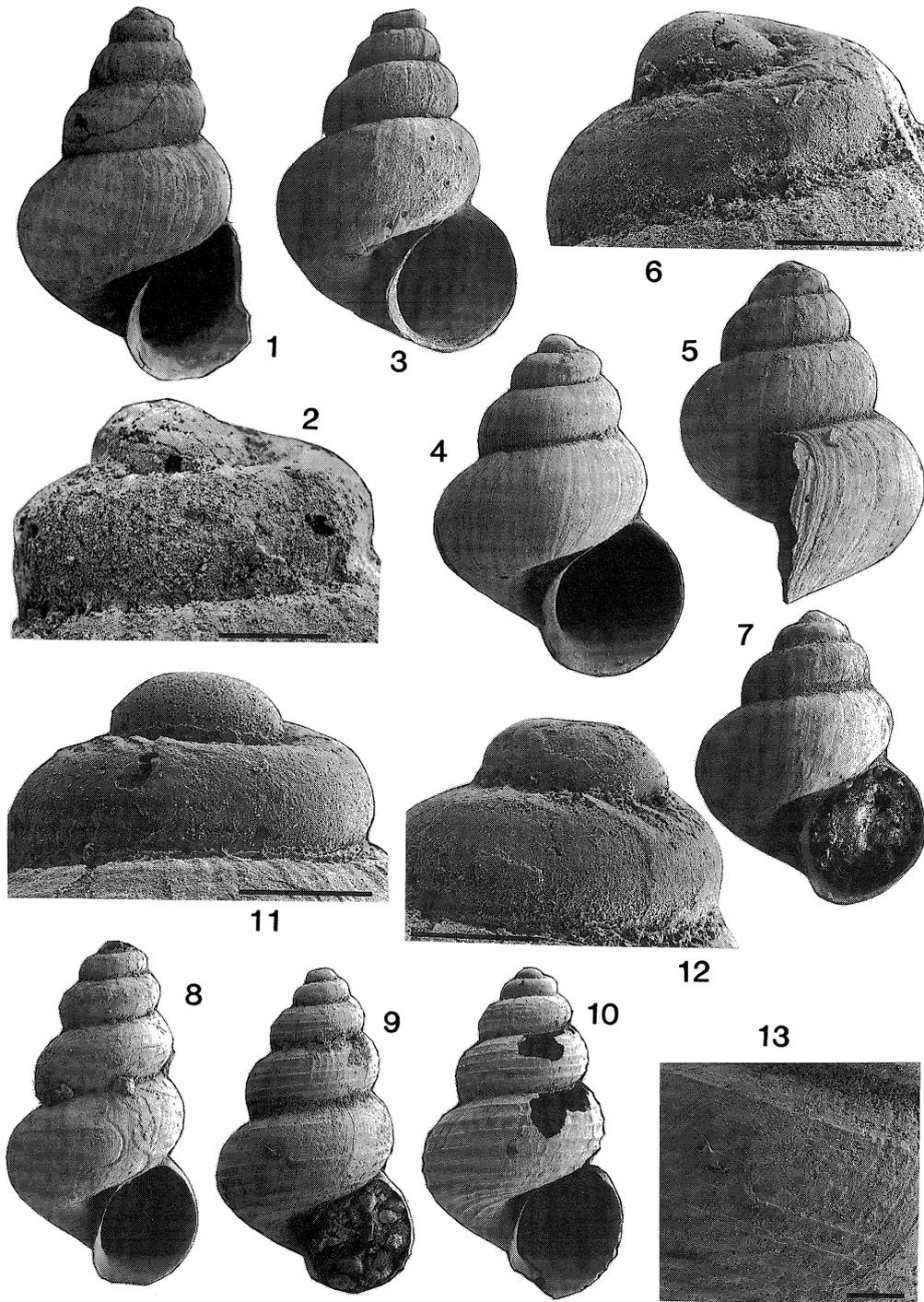


Plate 20. Figs 1-7. *Kimina globosa* n.sp. 1. Holotype, apertural view 2.2 mm x 1.4 mm (F78508). 2. Protoconch of holotype. 3. Paratype, apertural view 1.4 mm x 1.0 mm (F78509a). 4. Paratype, apertural view 1.0 mm x 0.9 mm (F 78509c). 5. Paratype, side view 1.2 mm x 0.8 mm (F78509b). 6. Protoconch of Fig. 5. 7. Paratype, apertural view 1.1 mm x 0.8 mm (F78509d). Locality 28. Figs 8-13. *Palaeoalvania talenti* n.gen., n.sp. 8. Paratype, apertural view 1.9 mm x 1.0 mm (F78455a). 9. Paratype, apertural view 1.6 mm x 0.9 mm (F78455b). 10. Holotype, apertural view 1.6 mm x 1.1 mm (F78454). 11. Protoconch of holotype. 12. Protoconch of Fig. 9. 13. Teleoconch ornamentation of Fig. 9. Locality 28. Bar scale 0.1 mm.

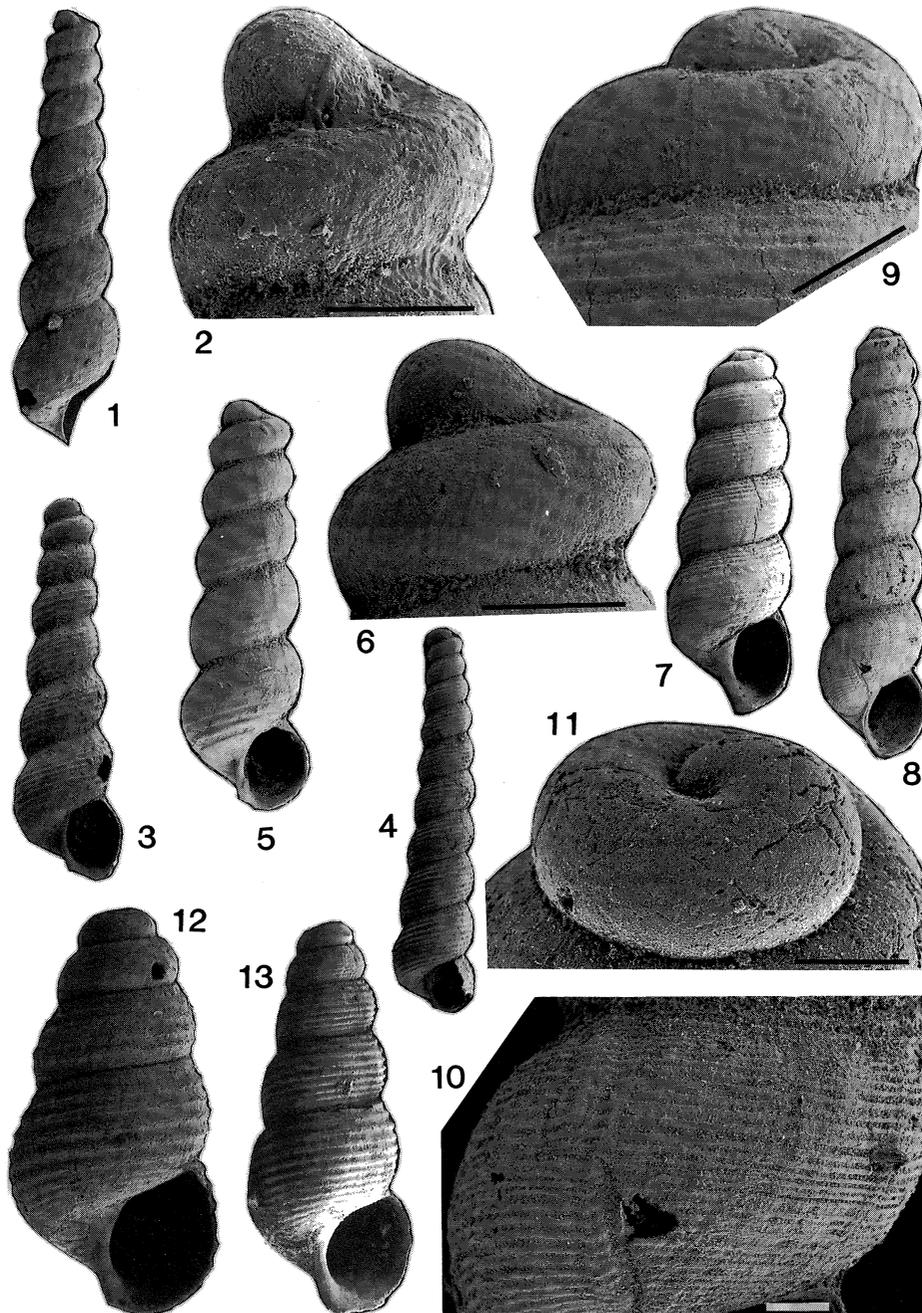


Plate 21. Figs 1-6. *Donaldina minutissima* n.sp. 1. Paratype, apertural view 1.7 mm x 0.4 mm (F78510a). 2. Protoconch of Fig. 1. 3. Holotype, apertural view 1.7 mm x 0.6 mm (F78517). 4. Paratype, apertural view 2.6 mm x 0.6 mm (F78518). 5. Paratype, apertural view 1.1 mm x 0.4 mm (F78510b). 6. Protoconch of Fig. 3. Locality 28. Figs 7-10. *Pseudoaclisina microspirulata* n.gen, n.sp. 7. Paratype, apertural view 1.8 mm x 0.6 mm (F78520). 8. Holotype, apertural view 2.7 mm x 0.7 mm (F78519). 9. Protoconch of Fig. 5. 10. Ornamentation of final whorl of holotype. Locality 28. Figs 11-13. *Pseudoaclisina turgida* (Yoo). 11. Protoconch of Fig. 12. 12. Figured specimen 1.6 mm x 0.8 mm (F78461a). 13. Figured specimen 2.3 mm x 1.0 mm (F78461b). Locality 28. Bar scale 0.1 mm.

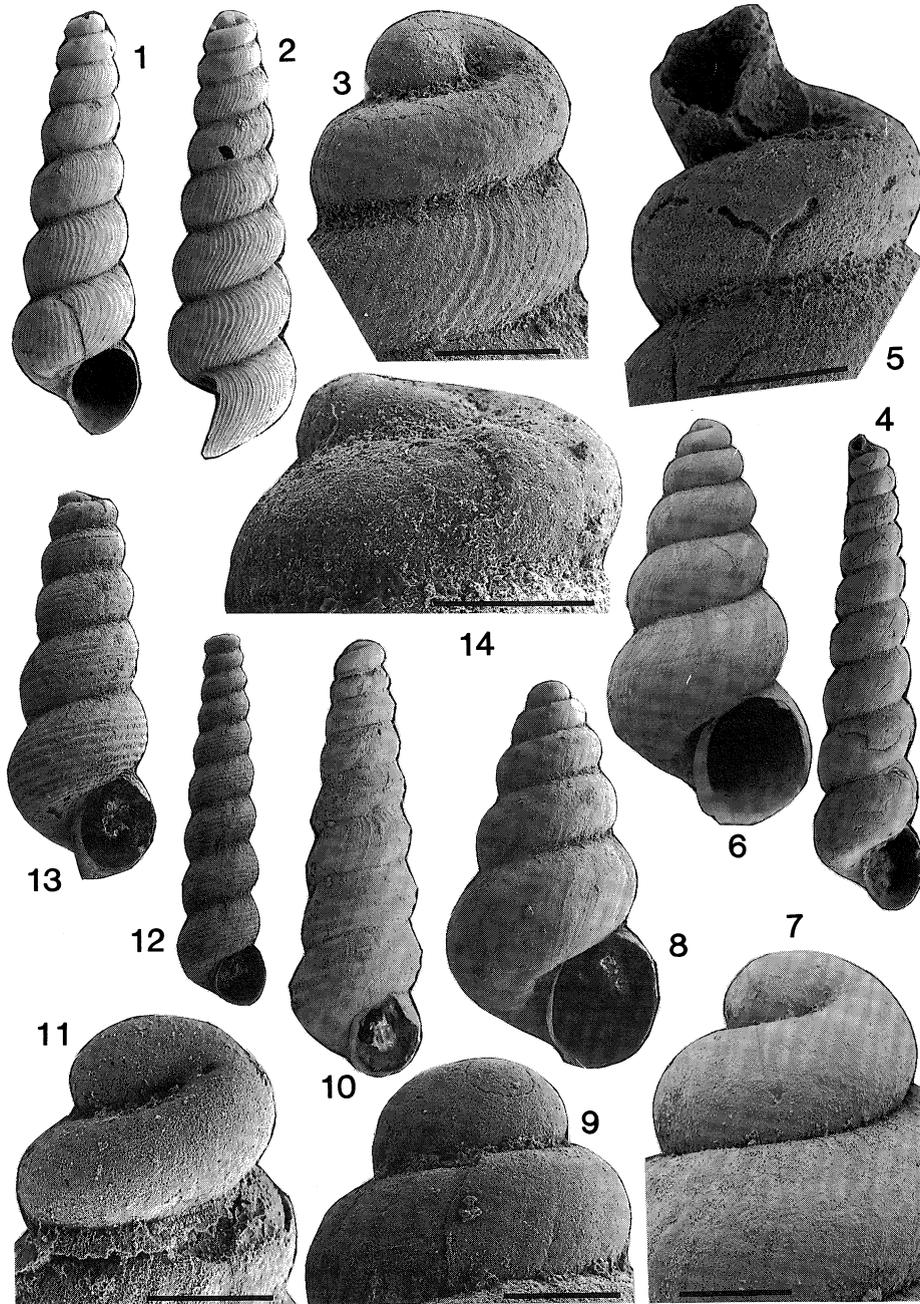


Plate 22. Figs 1-3. *Streptacis elegantissima* (Yoo). 1. Apertural view 1.6 mm x 0.5 mm (F78523). 2. Side view 1.9 mm x 0.5 mm (F78524). 3. Protoconch and early stage of teleoconch of Fig. 2. Locality 28. Figs 4-5. *Streptacis* sp. 4. Apertural view 2.0 mm x 0.5 mm (F78525). 5. Heterostrophic protoconch of Fig. 4, initial portion broken. Locality 24. Figs 6-9. *Kimina* sp. 6. Apertural view 1.9 mm x 0.9 mm (F78526a). 7. Protoconch and early stage of teleoconch of Fig. 6. 8. Apertural view 1.5 mm x 0.8 mm (F78526b). 9. Protoconch of Fig. 8. Locality 28. Figs 10-11. *Donaldina* sp. 10. Apertural view 1.7 mm x 0.5 mm (F78527). 11. Protoconch of Fig. 8. Locality 24. Figs 12-14. *Donaldina filosa* Yoo. 12. Apertural view 2.2 mm x 0.5 mm (F78521a). 13. Apertural view 1.4 mm x 0.5 mm (F78521b). 14. Protoconch of Fig. 13. Locality 28. Bar scale 0.1 mm.

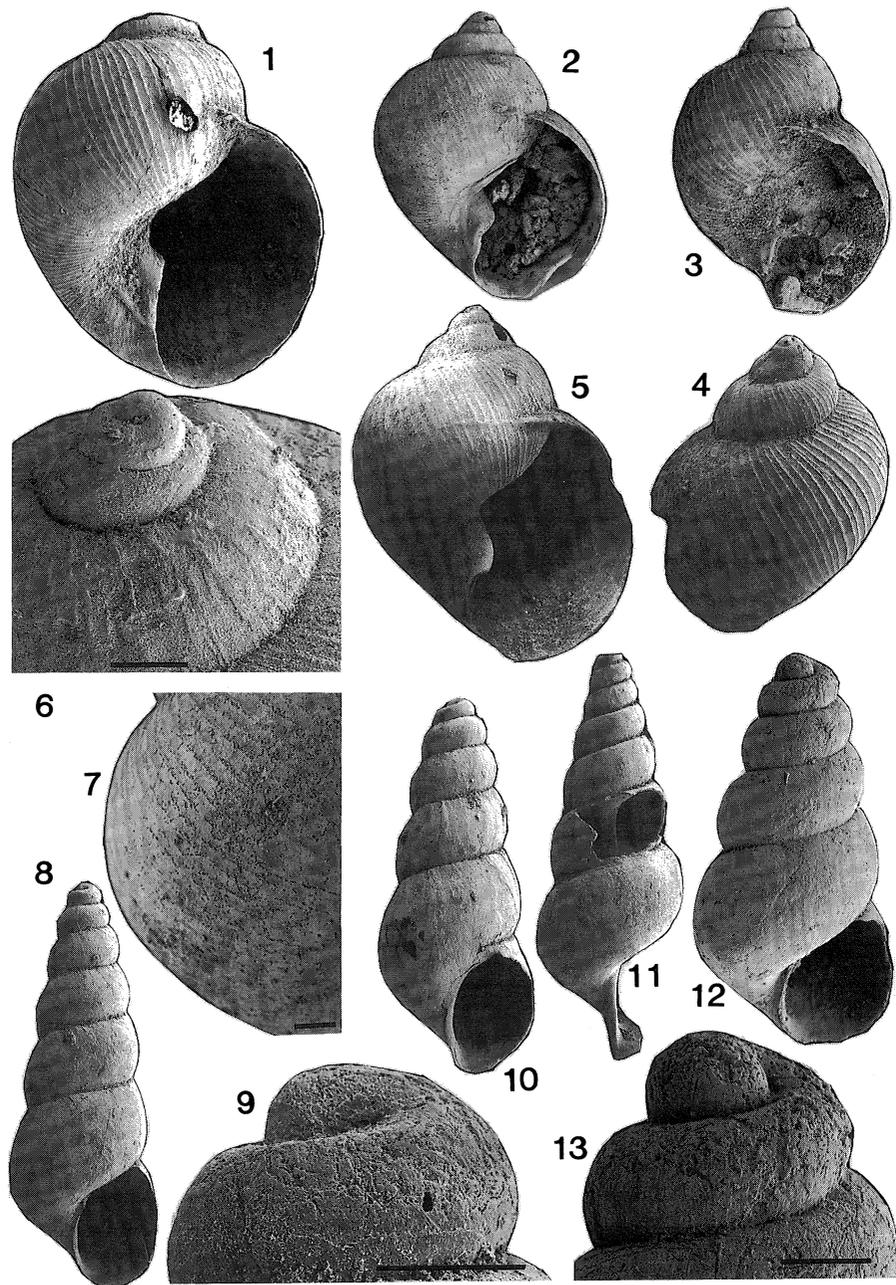


Plate 23. Figs 1-7. *Globobulimorpha costata* n.gen., n.sp. 1. Paratype, apertural view 2.0 mm x 1.6 mm (F78496b). 2. Holotype, apertural view 1.9 mm x 1.5 mm (F78495). 3. Paratype, apertural view 1.7 mm x 1.3 mm (F78496a). 4. Paratype, dorsal view (F78497b). 5. Paratype, apertural view 1.5 mm x 1.1 mm (F78497a). 6. Protoconch and early stage of teleoconch of Fig. 1. 7. Teleoconch ornamentation of Fig. 1. Locality 28. Figs 8-13. *Streptacis gundyensis* n.sp. 8. Holotype, apertural view 2.5 mm x 0.9 mm (F78522). 9. Protoconch of holotype. 10. Paratype 2.1 mm x 0.8 mm (F78528a). 11. Paratype 2.7 mm x 1.0 mm (F78528b). 12. Paratype 1.4 mm x 0.7 mm (F78531). 13. Protoconch of Fig. 12. Locality 28. Bar scale 0.1 mm.