Yoo, E. K., 1988. Early Carboniferous Mollusca from Gundy, Upper Hunter, New South Wales. *Records of the Australian Museum* 40(4): 233–264. [16 December 1988].

doi:10.3853/j.0067-1975.40.1988.157

ISSN 0067-1975

Published by the Australian Museum, Sydney

Records of the Australian Museum (1988) Vol. 40: 233–264. ISSN 0067 1975

Early Carboniferous Mollusca from Gundy, Upper Hunter, New South Wales

E.K. YOO

New South Wales Department of Mineral Resources
G.P.O. Box 5288, Sydney, NSW 2000, Australia

ABSTRACT. Minute mollusc fauna of Late Tournaisian age from thin limestone bands of the upper part of the Dangarfield Formation near Gundy, Upper Hunter, New South Wales are classified and described. Eighteen species among 38 gastropod species referable to 31 genera are described as new — *Onychochilus minitissimus, Peruvispira gundyensis, Glabrocingulum obesum, Hesperiella robertsi, Borestus costatus, Araeonema microspirulata, Microdoma angulata, Eucochlis australis, Naticopsis* (*Naticopsis*) *osbornei, Aclisina turgida, Stegocoelia* (*Stegocoelia*) *nodosa, Stegocoelia* (*Hypergonia*) *elongata, Stegocoelia* (*H.*) *tenuis, Loxonema elegantissima, Hemizyga* (*Hemizyga*) *decussata, Cyclozyga sinusigera, Soleniscus callosus* and *Donaldina filosa.* Twenty European and North American generic names are introduced for the first time to the Australian gastropod fauna.

Two new scaphopod genera, *Scissuradentalium* and *Pipadentalium,* and four new species, *Fissuradentalium longistriatum, Scissuradentalium runnegari, Plagioglypta numerosa* and *Pipadentalium protruberans*, are proposed. One species of hyolitha, *Hyolithes minutissimus*, is described. Nine bivalve forms including two unknown taxa are illustrated, but not described here. All mollusc specimens are chloritised.

YOO, E.K., 1988. Early Carboniferous Mollusca from Gundy, Upper Hunter, New South Wales. Records of the Australian Museum 40(4): 233–264.

Contents

Rich marine fossil faunas consisting of assemblages of brachiopods, gastropods, bivalves, crinoids, corals, fenestellid bryozoa, cephalopods and trilobites, are present in the calcareous mudstone and the bioclastic limestone of the upper part of the Dangarfield Formation. Microfossil faunas comprising gastropods, bivalves, scaphopods, hyoliths, ostracods, hexactinellid sponge spicules, conodonts and fish teeth were recovered from the bioclastic limestone by using standard acetic acid techniques. In this paper, a well-preserved minute molluscan fauna totalling approximately 2,000 specimens are classified.

Carboniferous molluscs have been known in New South Wales since the work of Etheridge (1890a,b, 1896, 1898, 1907) on fauna from the Port Stephens, Paterson, and Babbinoon Districts. Occasional descriptions of molluscs (de Koninck, 1898; Dun & Benson, 1920) and faunal lists (Benson, 1921) have appeared. Additional new species of molluscs have been described from Old Cannindah, Qld (Maxwell, 1961), from near Sherwood, west northwest of Kempsey (Campbell, 1961, 1962), from the Werrie and Belvue Synclines (Campbell & Engel, 1963) and from near Barrington (Campbell & McKelvey, 1971).

Materials and Methods

Each limestone sample weighing about 20 kg was acidised by using standard acetic acid techniques as applied for conodont preparation.

The residues were hand sorted beneath a low power binocular microscope. Illustrations were obtained using scanning electron microscope, JEOL JSM-U3.

All type specimens are given Australian Museum registration numbers unless stated otherwise, and are housed in the Australian Museum, Sydney.

Abbreviations used at the higher taxonomic levels are as follows: C.–Class, S.C.–Subclass, O.–Order, S.O.–Suborder, S.F.–Superfamily, T.–Tribe.

Type Locality

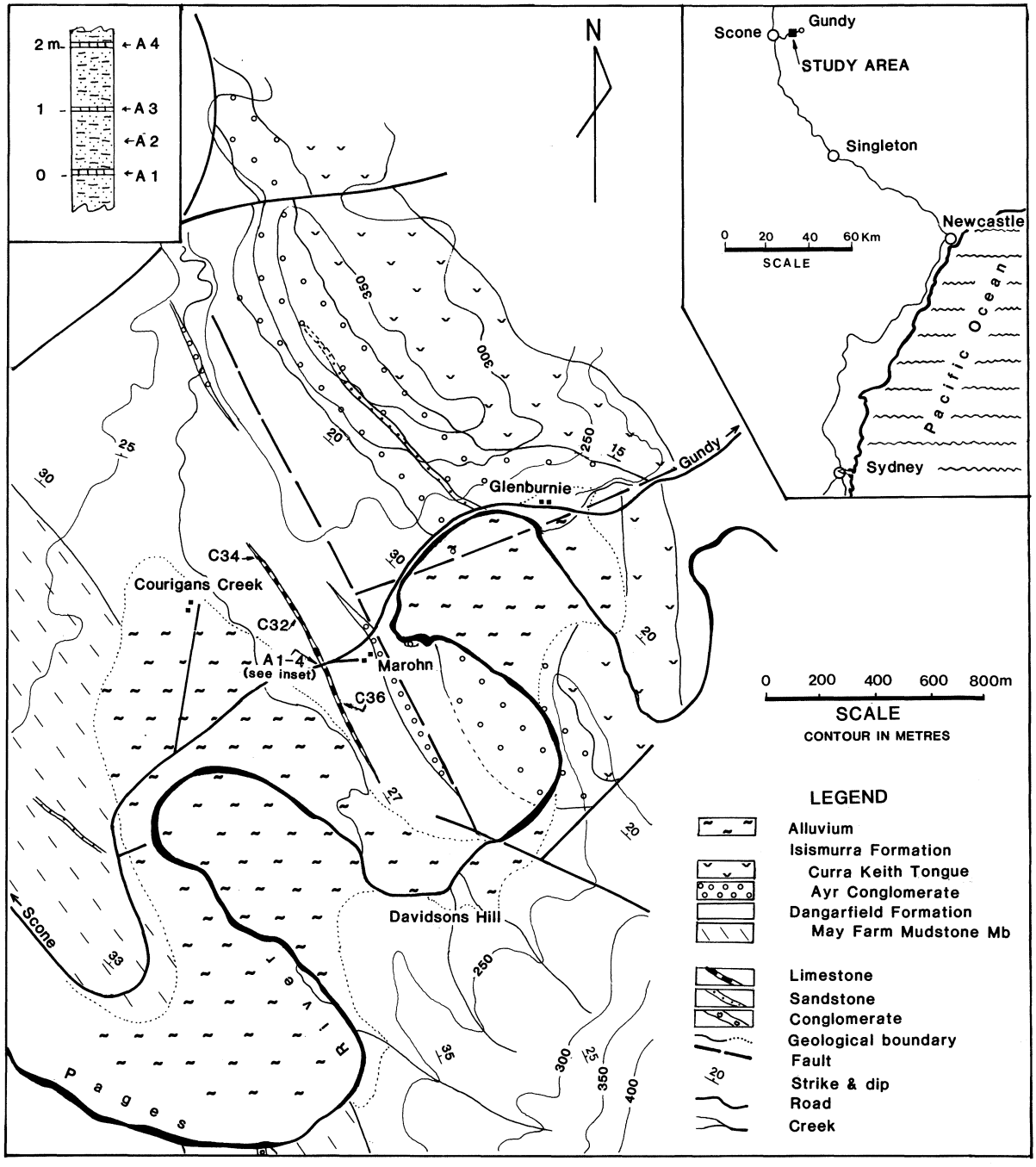
Bioclastic limestone lenses of the Dangarfield Formation; 70 m west to the junction of the Scone–Gundy road and the entrance to 'Marohn' homestead, 2.6 km southwest of Gundy, NSW. All localities mentioned in systematics (A–1, A–3, A–4, C–32, C–34 and C–36) are located within the extension of the limestone lenses as shown in Map 1.

Stratigraphy

DANGARFIELD FORMATION. The Dangarfield Formation was originally defined by Oversby & Roberts (1973) as the thick sequence of mudstone and subordinate lithic sandstone and oolitic and crinoidal limestones overlying the tuffs and tuffaceous sandstones of the Kingsfield Beds. The lowermost part of the formation which consists of lithic sandstones and siltstones grading into calcareous skeletal mudstones and wackestones was separated by Mory (1978) as a new formation and named the Macqueen Formation. He further divided the lower part of the Dangarfield Formation into two members: the Wroxley Lithic Sandstone Member and Brushy Hill Limestone Member. The name Brushy Hill Limestone was first used for the oolitic limestone sequence by Osborne (1928, 1950) in referring to sedimentary rocks now known as the Dangarfield Formation and volcanic rocks now known to belong to the Isismurra Formation. The succeeding sequence of the Dangarfield Formation is subdivided into two units, on the basis of lithology, and the lower part is named the May Farm Mudstone Member. The upper part is undivided and retained as Dangarfield Formation. The geology and stratigraphy of the study area are shown in Map 1 and Section 1.

MAY FARM MUDSTONE MEMBER. The May Farm Mudstone Member consists largely of monotonous brown and grey mudstones with minor lithic sandstone and limestone. It is delineated by the top of the underlying Brushy Hill Limestone Member and by the base of the lowest medium to coarse calcareous lithic sandstone cropping out along the western foot of the MacIntyres Mountain. This member was initially named by Mory (1975) after 'May Farm' homestead which lies near the northern foreshores of Lake Glenbawn, east of Brushy Hill. At the base of the member, the mudstone contains ooids gradually decreasing upwards and abundant allochtonous solitary rugose corals, as well as common brachiopods and crinoid stems. A 1.5 m thick fine grained calcareous sandstone outcropping along the strike direction through 'May Farm' homestead appears to be unfossiliferous. The thickness of the member is approximately 480 m.

UPPER PART OF THE DANGARFIELD FORMATION. The base of the unit is gradational and taken at the base of the lowest lithic/calcareous sandstone overlying conformably the May Farm Mudstone Member. The upper limit is the base of the Ayr Conglomerate Member of the Isismurra Formation. The unit consists of a thick sequence of greenish-grey to brownish-grey sandy mudstone, calcareous to lithic sandstone, conglomerate, and bioclastic limestone lenses. This unit outcrops on the western slope of the MacIntyres Mountain where the thickness ranges from 510 to 540 m. The lithofacies to the north of Pages River are noticeably different from that to the south of the river. About 70 m west of the entrance to 'Marohn' homestead, three bands of grey bioclastic limestone interbedded in mudstone, crop out at the roadside connecting Scone and Gundy (Map 1). Each limestone band ranges in thickness from 0.1 to 0.2 m and the limestones can be traced 800 m in northwest-southeast direction. The



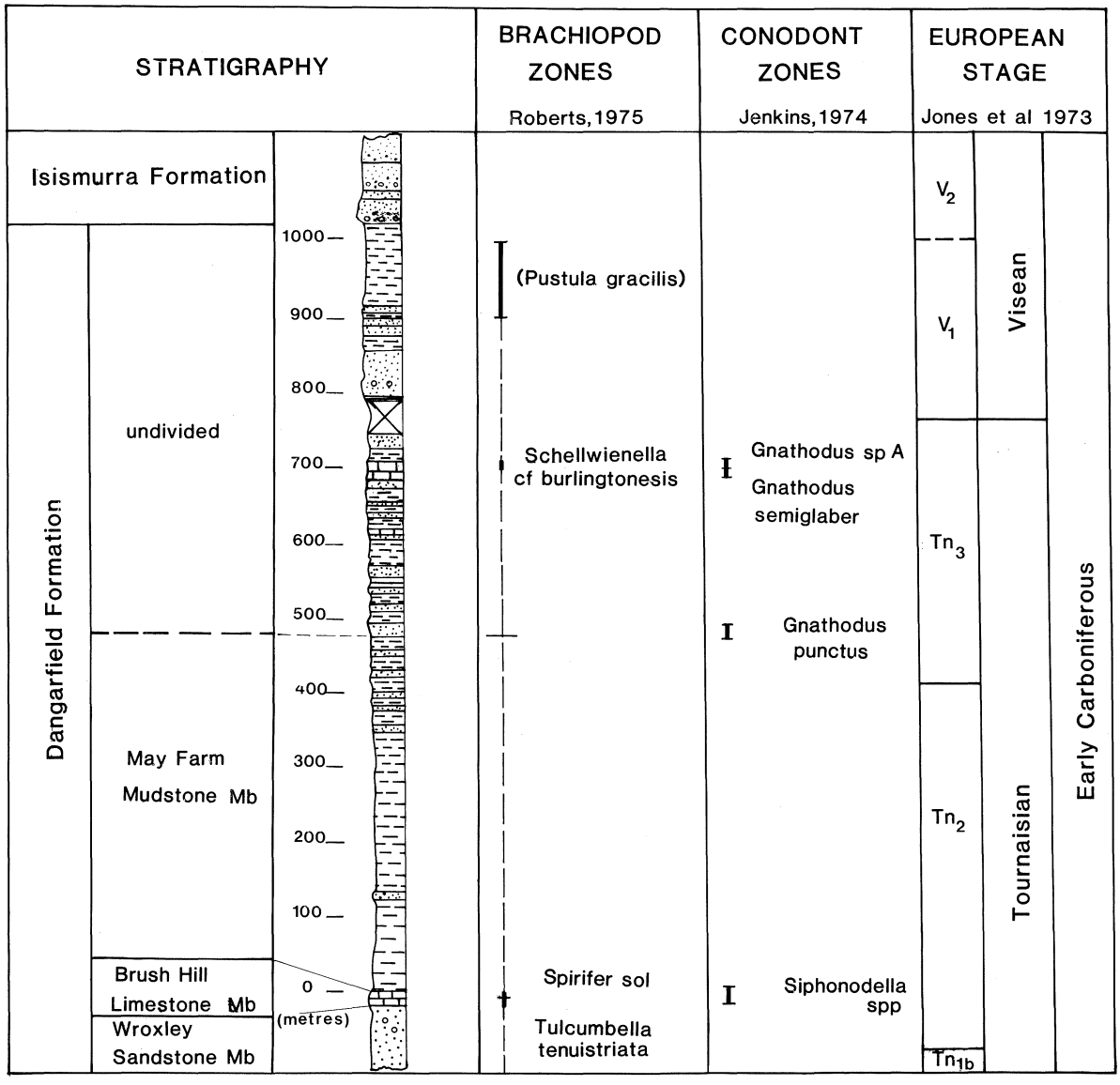
Map 1. Geology and location map of the study area.

upper part of the formation, on the upper hill of the MacIntyres Mountain consists of a greenish-grey sandy mudstone containing abundant fenestellid bryozoa as well as brachiopods, macro-gastropods and crinoid stems.

Geological Age of Fossil Assemblage

EVIDENCE FROM OTHER LOCAL FAUNA. Research on Early Carboniferous brachiopods and conodonts has been extensively carried out in the study area (Roberts & Oversby, 1974; Jenkins, 1974; Roberts, 1975).

Four conodont zones were proposed by Jenkins (1974) in the Dangarfield Formation, and were correlated with sequences from North America and Belgium. The bioclastic limestone of the Dangarfield Formation on the Scone-Gundy road near 'Marohn' homestead lies within conodont *Gnathodus* sp. A zone. This zone, on comparison with the Belgian



Section 1. Stratigraphy of the study area and faunal zones (graphic section between Brush Hill and 'Glenburnie', modified from Roberts & Oversby, 1974).

stratotypes, correlates with Tn_{3a} or, more probably, Tn_{3b} (the late, not latest, Tournaisian) (Jenkins, 1974).

Three brachiopod zones were identified in the Dangarfield Formation (Section 1). The bioclastic limestone lenses lie also within the brachiopod *Schellwienella* cf *burlingtonensis* zone which is widespread throughout the Rouchel district (Roberts & Oversby, 1974). Ammonoid data in this area of Germany suggest that *S.* cf *burlingtonensis* zone is Cu_{IIa} in age (Jones *et al.*, 1973) which is consistent with the age indicated by the conodonts.

EVIDENCE FROM GASTROPOD FAUNA. Thirty-four genera and subgenera of gastropods recognised in this study were originally named in Europe or North America and most of them are known to occur in both continents. However *Scalitina, Hesperiella, Turbonitella* and *Palaeozygopleura* have not yet been recorded in North America, while *Rhabdotocochlis, Eucochlis, Hemizyga* and *Cyclozyga* have not yet been recorded in Europe.

The gastropod genera found in the present study area have various ranges within the Palaeozoic and only *Naticopsis* persists into the Mesozoic. Two genera, *Aclisina* and *Turbonitella*, and one subgenus, *Angyomphalus*, are known to be restricted to the Early Carboniferous, while six genera, *Paragoniozona, Eucochlis, Hemizyga* (*Hemizyga*), *Cyclozyga* and *Rhabdotocochlis* (herein identified), are previously recorded from Pennsylvanian strata of North America but not found in the Mississippian strata and correlatives outside Australia.

Table 1. Analyses of fossil molluscs (oxides) and number of ions calculated.

	Knightites (Retispira)	*Eucochlis*	*Palaeozygopleura*	*Ianthinopsis*	*Nuculopsis*	*Plagioglypta*
	(%)	(%)	(%)	(%)	(%)	(%)
SiO_2	28.29	28.78	28.67	27.73	29.18	27.94
Al_2O_3	18.26	16.94	17.03	16.47	17.19	17.6
FeO	35.76	34.84	31.55	37.66	34.83	34.68
MgO	8.97	9.3	12.57	8.13	9.14	10.63
CaO	0.36	0.54	0.54	0.49	0.61	0.41
TOTAL	91.62	90.4	90.36	90.49	90.94	91.27
Number of ions						
Si	5.914 } 8	6.182 } 8	6.147 } 8	5.977 } 8	6.032 } 8	5.899 } 8
Al	2.086 }	1.818 }	1.853 }	2.023 }	1.968 }	2.101 }
Al	2.306 }	2.475 }	2.413 }	2.523 }	2.256 }	2.463 }
Fe+2	6.139 } 11.89	6.171 } 11.67	6.223 } 11.72	6.313 } 11.74	6.851 } 11.85	6.414 } 11.81
Mg	3.353 }	2.886 }	2.960 }	2.824 }	2.636 }	2.840 }
Ca	0.093	0.138	0.124	0.081	0.114	0.102
(OH)	16	16	16	16	16	16

Preservation

Nine specimens comprising seven gastropods, one bivalve and one scaphopod have been analysed by electron probing microanalyser. Table 1 shows the result of analyses and the number of ions which are calculated from the analyses on the basis of 28 oxygen equivalents, ignoring H_2O^+, i.e., $O_{20}(O,OH)_{16}$ – the same approach as Deer, Howie & Zussman (1965). The percentage of oxides and number of ions of all specimens are similar and lie within the ranges of published chlorite analyses.

Two specimens (*Eucochlis* and *Nuculopsis*) have also been analysed by X-ray diffraction at the New South Wales Institute of Technology. The diffraction data, examined by Dr E. Slansky, represent peaks at 14, 7.1, 3.55 A, indicating the presence of chlorite (and an admixture of quartz). This supports the conclusion, from electron microprobe analyses, that the fossils are chloritised. The specimens are generally greenish grey to dark grey in colour.

Chlorite replacement has made the isolation of complete shells from the limestone matrix possible and led to the preservation of delicate shell ornamation. Thin minute shells are more perfectly preserved by chlorite replacement than big and thick shells. No macrospecimens have been isolated by acid digestion probably due to only partial replacement. Pyrite crystals are disseminated commonly in the chloritised shells.

Systematics

For systematic arrangement as well as the definition of genera, families and higher taxa, the Treatise on Invertebrate Paleontology, Part I — Mollusca 1 (chitons, scaphopods, gastropods), Part N — Mollusca 6 (pelecypods), and Part W — Miscellanea (worms, conodonts, problematical fossils) was mainly consulted. To avoid repetition, only emended diagnoses are given in full in the systematic descriptions of taxa.

A systematic list of mollusc fauna from the investigated bioclastic limestone of the Dangarfield Formation is presented in Table 2.

C. GASTROPODA Cuvier, 1797

O. ARCHAEOGASTROPODA Theile, 1925

S.F. BELLEROPHONTACEA M'Coy, 1851

SINUITIDAE Dall, 1913

BUCANELLINAE Koken, 1925

Sinuitina Knight, 1945

Type species. *Tropidocyclus cordiformis* Newell, 1935: 349; from the Middle Pennsylvanian of Oklahoma.

Definition. See Knight *et al.*, 1960: 175.

Stratigraphic range. Silurian to Middle Permian.

Table 2. A systematic list of Mollusc Fauna from a bioclastic limestone in the Dangarfield formation. + = listed only; ° = listed and illustrated; * = illustrated and described in text.

Superfamily	Family	Genus, species and author	Fig.No.
Gastropoda			
Bellerophontacea	Sinuitidae	* *Sinuitina portulacoides* Campbell & Engel	1-3
		* *Euphemites* cf. *labrosa* Campbell & Engel	4-6
		* *sinuitid* n.gen.	7-8
	Bellerophontidae	* *Knightites* (*Retispira*) *culleni* Campbell & Engel	9-11
Macluritacea	Onychochilidae	* *Onychochilus minutissimus* n.sp.	12-14
Euomphalacea	Euomphalidae	° *Straparollus* (*Straparollus*) sp.	15-17
		+ *Straparollus* (*Serpulospira*) sp.	
Pleurotomariacea	Raphistomatidae	+ *Scalitina* sp.	
		* *Trepospira* (*Angyomphalus*) sp.	18-20
	Eotomariidae	° *Eotomaria* sp.	21-24
		* *Peruvispira gundyensis* n.sp.	29-32
		+ *Spiroscala* sp.	
		* *Glabrocingulum obesum* n.sp.	33-35
		* *Hesperiella robertsi* n.sp.	36-41
	Lophospiridae	° *Worthenia* sp.	55-57
	Phymatopleuridae	* *Borestus costatus* n.sp.	25-28
		° *Paragoniozona* sp.	42-45
Platyceratacea	Holopeidae	* *Araeonema microspirulata* n.sp.	46-49
		° *Rhabdotocochlis* sp.	50-51
		°"*Rhabdotocochlis*" sp.	52-54
	Platyceratidae	+ *Platyceras* sp.	
Microdomatacea	Microdomatidae	* *Microdoma angulata* n.sp.	58-60
	Elasmonematidae	* *Eucochlis australis n.sp.*	61-64
Neritacea	Neritopsidae	* *Naticopsis* (*Naticopsis*) *osbornei* n.sp.	65-66
		+ *Turbonitella sp.*	
Murchisoniacea	Murchisoniidae	* *Aclisina turgida* n.sp.	80-81
		* *Stegocoelia* (*Stegocoelia*) *nodosa* n.sp.	67-71
		* *Stegocoelia* (*Hypergonia*) *elongata* n.sp.	73-75
		* *Stegocoelia* (*Hypergonia*) *tenuis* n.sp.	76-79
		° *Stegocoelia* (*Hypergonia*) sp.	72,82,83
Loxonematacea	Loxonematidae	* *Loxonema elegantissima* n.sp.	84-87
	Palaeozygopleuridae	+ *Palaeozygopleura* sp.	
	Pseudozygopleuridae	* *Hemizyga* (*Hemizyga*) *decussata* n.sp.	88-91
		* *Cyclozyga sinusigera* n.sp.	92-94
		+ *Microptychia* sp.	
Subulitacea	Subulitidae	+ *Ceraunocochlis* sp.	
		* *Soleniscus callosus* n.sp.	95-102
		° *Ianthinopsis* sp.	103
Pyramidellacea	Streptacididae	* *Donaldina filosa* n.sp.	104-109
		° *Donaldina* sp.	110-111
Bivalvia			
Nuculacea	Nuculidae	°"*Nucula*" sp.	112-117
		°"*Nuculopsis*" sp.	118-123
	Malletiidae	° *Palaeoneilo acarinata* Campbell & Engel	124-125
Nuculanacea	Nuculanidae	+ *Phestia* sp.	
Pectinacea	Euchondriidae	+ *Euchondria* sp.	
Arcacea	Parallelodontidae	° *Parallelodon fossa* (Campbell & Engel)	126-127
		° *Edmondia* sp.	128-130
?Limopsacea		°n.gen. et n.sp.	131-133
? Modiomorphacea		°n.gen. et n.sp.	134-140
Scaphopoda	Dentaliidae	* *Fissidentalium? longistriatum* n.sp.	141-143
	Laevidentaliidae	* *Scissuradentalium runnegari* n.gen. et n.sp.	144-147
		* *Plagioglypta numerosa* n.sp.	148-151
		* *Pipadentalium protruberans* n.gen. et n.sp.	152-154
Hyolitha	Hyolithidae	* *Hyolithes minutissimus* n.sp.	155-162, 165
		° *Hyolithes* sp.	163-164

Australian Carboniferous species. *Sinuitina portulacoides* Campbell & Engel, 1963 seems to be the only described species from the Australian Carboniferous.

Sinuitina portulacoides Campbell & Engel
Figs 1–3

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

Type material. Holotype (F.7573) and paratypes (F.7574–80) at the University of New England, Armidale, NSW.

Additional material examined. 32 specimens, from localities A–3 and C–34, 2.6 km south-west of Gundy, NSW.

Description. See Campbell & Engel, 1963: 90.

Dimensions. Fig. 2 (F.61940): largest diameter 2.42 mm, thickness of spire 1.52 mm. Fig. 3: largest diameter 1.56 mm, thickness of spire 1.43 mm.

Type locality. Namoi Formation; Swain's Gully and Rangari, 15 km south-west of Somerton and 37 km north-east of Gunnedah, respectively.

Stratigraphic range. Middle – Upper Tournaisian.

Remarks. Although the examined specimens are much smaller than the types, which are 16 mm in height, the present forms are similar to the types in shell character and regarded as a same species.

EUPHEMITINAE Knight, 1956

Euphemites Warthin, 1930

Type species. *Bellerophon urii* Fleming, 1828; from the Lower Carboniferous of Scotland.

Definition. See Knight *et al.*, 1960: 178.

Stratigraphic range. Lower Carboniferous to Permian.

Australian Carboniferous species. *Euphemites labrosa* Campbell & Engel, 1963, from Rangari, NSW; *Euphemites minutus* Maxwell, 1961: 62, pl. 7, figs 1–4 from Yarrol, Qld.

Euphemites labrosa Campbell & Engel
Figs 4–6

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

Type material. Holotype (F.7569) and paratypes (F.7570l–72) at the University of New England, Armidale, NSW.

Additional material examined. 50 juvenile specimens from localities A–3, C–32 and C–34, 2.6 km south-west of Gundy, NSW.

Description. See Campbell & Engel, 1963: 91.

Dimensions. Fig. 4: largest diameter 108 mm, thickness of spire 1.00 mm; Fig. 5: largest diameter 1.14 mm, thickness of spire 1.10 mm; Fig. 6: largest diameter 1.76 mm, thickness of spire 1.36 mm.

Type locality. Near the top of the Tulcumba Sandstone, 1.5 km north-east of Rangari homestead, 37 km north-east of Gunnedah, NSW.

Stratigraphic range. Middle–Upper Tournaisian.

Remarks. The juvenile specimens recovered here have smaller shells with fewer spiral cords than the types. As they grow, cords increase by intercalation, and new ones rapidly attain normal size. The present form is tentatively regarded as conspecific as *E. labrosa* until an adult shell is recovered from the same locality.

BELLEROPHONTIDAE M'Coy, 1851

KNIGHTITINAE Knight, 1956

Knightites Moore, 1941

Knightites (*Retispira*) Knight, 1945

Type species. *Retispira bellireticulata* Knight, 1945: 335, pl. 49, figs la–c; from the Early Pennsylvanian age at the top of the Bend group of Texas.

Definition. See Knight *et al.*, 1960: 184.

Stratigraphic range. Devonian to Middle Permian.

Australian Carboniferous species. *Knightites* (*Retispira*) *culleni* Campbell & Engel seems to be the only figured species referred to this subgenus from the Australian Carboniferous.

Knightites (*Retispira*) *culleni* Campbell & Engel
Figs 9–11

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

Type material. Holotype (F.7534) and paratypes (F.7535) at the University of New England, Armidale, NSW.

Additional material examined. 76 specimens from localities A–1, A–3 and C–34, 2.6 km south-west of Gundy, NSW.

Description. See Campbell & Engel, 1963: 89.

Dimensions. Fig. 9 (F.61943): largest diameter 3.04 mm, thickness of spire 3.60 mm; Fig. 10 (F.61943): largest diameter 1.20 mm, thickness of spire 1.18 mm; Fig. 11 (F.61943): largest diameter 1.45 mm, thickness of spire 1.60 mm; unfigured specimen: largest diameter 3.40 mm, thickness of spire 4.10 mm; unfigured specimen: largest diameter 4.36 mm, thickness of spire 5.60 mm; unfigured specimen: largest diameter 1.70 mm, thickness of spire 1.30 mm.

Type locality. Namoi Formation; Swain's Gully and Rangari, 15 km south-west of Somerton, and 37 km north-east of Gunnedah, respectively.

Stratigraphic range. Middle–Upper Tournaisian.

Remarks. The specimens examined are mostly

juvenile and are tentatively referred to this species. The specimens differ from the holotype, which possesses a short slit and thickened parietal inductura (Campbell & Engel, 1963: 90). One specimen (Fig. 9) with flared aperture has no slit. The slit may have disappeared as it attained maturity. *K. (R.) bellireticulata* Knight (1945) resembles the specimens, but differs in having a convex selenizone.

S.O. MACLURITINA Cox & Knight, 1960

S.F. MACLURITACEA Fischer, 1885

ONYCHOCHILIDAE Koken, 1925

ONYCHOCHILINAE Koken, 1925

Onychochilus Lindström, 1884

Type species. *Onychochilus physa* Lindström, 1884 (subsequent designation by Cossmann, 1915: 252); from the uppermost limestone (bed c), Middle Silurian, Slite, Gotland, Sweden.

Definition. See Knight *et al.*, 1960: 187.

Remarks. The type species, *Onychochilus physa*, is reported to occur from the Middle Silurian Gotland, Sweden. The Australian form is very similar to the type species in shell character but different in being much smaller in shell size and lacks ornamentation. There are not enough significant differences to create a new genus.

***Onychochilus minutissimus* n.sp.**

Figs 12–14

Type material. Holotype (F.61944) and 3 paratypes (F.61945).

Additional material examined. 4 specimens.

Description. Shell minute, sinistral, pupiform, with smooth, convex whorls. Shell layer very thin; protoconch smooth, simple paucispiral. Sutures shallow, base slightly flattened with weak circumumbilical ridge, moderately phaneromphalous, lips of aperture thin, arcuate, outer lip opisthocline, straight without sinuosity, parietal lip narrow.

Dimensions. Holotype (Fig. 12): height 0.76 mm, width 0.54 mm, pleural angle 50°, number of whorls 3.75; paratype (Fig. 13): height 0.88 mm, width 0.54 mm, height of aperture 0.32 mm, pleural angle 45°, number of whorls 4.

Type locality. Locality A–4, 2.6 km south-west of Gundy, NSW.

Remarks. This is the only species referred to the genus *Onychochilus* in Australia, and appears to be the only post-Silurian record of the genus.

Etymology. Derived from the latin word *minutus* meaning lessened and *-issima* meaning superlative or extreme.

S.O. PLEUROTOMARIINA Cox & Knight, 1960

S.F. PLEUROTOMARIACEA Swainson, 1840

RAPHISTOMATIDAE Koken, 1896

LIOSPIRINAE Knight, 1956

Trepospira Ulrich & Scofield, 1897

Type species. *Pleurotomaria sphaerulata* Conrad, 1842: 272; from the Upper Carboniferous, "inclined plane of the Alleghany Mountain", Pennsylvania, USA.

Definition. See Knight *et al.*, 1960: 201.

Stratigraphic range. Devonian to Middle Permian.

Trepospira (Angyomphalus) Cossman, 1916

Type species. *Euomphalus radians* de Koninck, 1843: 442, pl. 23, fig. 5; from the Lower Carboniferous of Tournai, Belgium.

Definition. See Knight *et al.*, 1960: 201.

Stratigraphic range. Lower Carboniferous.

Australian Carboniferous species. *Angyomphalus depressus* Campbell & Engel, 1963, from Rangari, NSW.

Trepospira (Angyomphalus) sp.

Figs 18–20

Material examined. 32 juvenile specimens from locality A–3, 2.6 km south-west of Gundy, NSW.

Description. Shell small, low spired, lenticular form with 4.5 whorls. Protoconch seemingly simple, smooth. No sharp boundary between protoconch and teleoconch. Suture shallow; upper whorl face slopes gently toward periphery, decorated by narrow radiating nodes which are slightly sigmoidal just below suture. Growth lines extended beyond nodes, prosocline above selenizone which appears to be on periphery. Growth lines below selenizone faint, swinging forward for short distance, then backward into umbilicus. Columellar lip thin next to parietal wall but with thick subtriangular section at the circumumbilical funicle, outer lip thin, sharply angulated at periphery, size of slit and lunulae unknown, phaneromphalous.

Dimensions. Fig. 18 (F.61947): thickness of spire 1.40 mm, maximum diameter of spire 2.10 mm.

Remarks. This form is different from the only Australian species, *Trepospira (Angyomphalus) depressus* (Campbell & Engel) which has a lower spire, more acute periphery and a greater number of closely spaced, longer nodes just below the sutures. This form is similar to the Belgian type species *T. (A.) radians* (de Koninck) in shell character but differs in having smaller shell. All specimens here are juveniles and may be larger when fully grown.

EOTOMARIIDAE Wenz, 1938

EOTOMARIINAE Wenz, 1938

Glabrocingulum Thomas, 1940

Type species. *Glabrocingulum beggi* Thomas, 1940: 38; from the Upper Calciferous Sandstone Series, Scotland.

Definition. See Thomas, 1940: 38.

Stratigraphic range. Lower Carboniferous to Middle Permian.

Remarks. *Mourlonia ornata* Dun & Benson, 1920 is now transferred to *Glabrocingulum*, because of its stronger spiral cords.

Glabrocingulum obesum n.sp.

Figs 33–35

Type material. Holotype (F.61952) and 10 paratypes (F.61953).

Additional material examined. 10 specimens from localities A–4 and C–34.

Description. Shell small, conical turbiniform, with about 6 heavily ornamented convex whorls; suture moderately deep; base very convex, moderately phaneromphalous. Shell composed of 2 distinct layers; no distinct boundary between protoconch and teleoconch, first 1.5 whorls of neanic stage apparently showing faint growth lines. Selenizone, spiral and collabral cords start to occur on about second whorl, become gradually stronger. Spiral cords, 4 above selenizone, about 7 below selenizone; 30–34 collabral cords in last whorl. Spiral and collabral cords form distinct nodes at their intersections. Selenizone impressed, moderately wide, situated on the periphery. About 40 nodes in selenizone of last whorl. Collabral cords prosocline above selenizone but orthocline below it. Inner lip slightly reflected, outer lip thin with slit.

Dimensions. Holotype (Fig. 33): height 1.17 mm, width 1.47 mm, pleural angle 117°, number of whorls 3.5; paratype (Fig. 34): height 150 mm, width 1.45 mm, pleural angle 108°, number of whorls 4.

Type locality. Locality A–4, 2.6 km south-west of Gundy, NSW.

Remarks. This species is similar to the Scottish type species *Glabrocingulum beggi* Thomas in shell shape but different in having coarser ornamentation and a row of nodes in the selenizone. This species differs from *G. ornata* (Dun & Benson) in having much smaller and low-spired shell.

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

AGNESIINAE Knight, 1956

Hesperiella Holzapfel, 1889

Type species. *Pleurotomaria contraria* de Koninck, 1843; from Visé, Belgium.

Definition. See Knight *et al.*, 1960: 206.

Stratigraphic range. Lower Devonian to Upper Carboniferous.

Remarks. In this paper the genus *Hesperiella* is recorded for the first time in Australia, although species belonging to this genus have been discovered in many places in Europe. The coiling of shell and protoconch of *Hesperiella* is basically the same as in Recent species of Architectonicidae. The protoconch of both groups is inturned and the apex is seen through the umbilicus without change of coiling direction.

In the early embryonic stage, *Hesperiella* is dextrally coiled and Architectonicidae is sinistrally coiled, and immediately after the embryonic stage they change the direction of growth, not direction of coiling, viz ultradextral in *Hesperiella* and ultrasinistral in Architectonicidae.

Knight (1941) suggested that this genus is a hyperstrophically coiled dextral shell. However the lack of a calcified operculum prevents the testing of this hypothesis (Batten, 1966).

Hesperiella robertsi n.sp.

Figs 36–41

Type material. Holotype (F.61954) and 10 paratypes (F.61955).

Additional material examined. 33 specimens from localities A–3, A–4 and C–34.

Description. Shell small, sinistral, early whorls depressed completely, hidden by later whorls. First 1.75 planispiral smooth whorl including protoconch seen through umbilicus in broken shell. Teleoconch 3.5 whorls inflated, collabral cords from suture to selenizone weaker in early whorls, gradually stronger, more widely spaced with growth, 30–32 cords in last whorl. Selenizone seen only in last whorl, concave, distinct; no lunulae. Aperture nearly round, inner lip thick, reflected, base rather flat, more numerous fine collabral cords than present above selenizone, phaneromphalous.

Dimensions. Holotype (Fig. 36): height 3.30 mm, width 2.92 mm, height of aperture 1.48 mm, pleural angle 65°, number of whorls 3.5; paratype (Fig. 38): height 2.70 mm, width 2.45 mm, height of aperture 66°, number of whorls 3.5.

Type locality. Locality C–34, 2.6 km south-west of Gundy, NSW.

Remarks. This is the only known Australian species belonging to *Hesperiella.* There are two described European species, *H. thomsoni* (de Koninck) and *H. loudoni* Thomas. *H. thomsoni* has larger and more conical shell, while *H. loudoni* Thomas differs from *H. robertsi* n.sp. in being lower spired with more fine collabral cords.

Etymology. This species was named after Professor J. Roberts, University of New South Wales as an

acknowledgement of his contribution to the Carboniferous geology of the Hunter Valley District, NSW.

NEILSONIINAE Knight, 1956

Peruvispira J. Chronic, 1949

Type species. *Peruvispira delicata* J. Chronic, 1949; from Peru.

Definition. See Knight *et al.*, 1960: 207.

Stratigraphic range. Lower Permian to Middle Permian.

Australian Carboniferous species. *Peruvispira kempseyensis* Campbell, 1962, from Sherwood, 17 km west-north-west of Kempsey; *Peruvispira kuttungensis* Campbell, 1961, from the Booral Formation, south-eastern side of the Gloucester Trough, NSW.

Peruvispira gundyensis n.sp.

Figs 29–32

Type material. Holotype (F.61950) and 20 paratypes (F.61951).

Additional material examined. 38 specimens from localities A–3, A–4 and C–34.

Description. Shell small, globose, turbiniform, with 5.5 whorls. Protoconch changes gradually to teleoconch. First 2 whorls show fine spiral threads, prosoclinal growth lines; selenizone and collabral lirae first occur at third whorl. Collabral lirae, about 42–46 in the last whorl, evenly spaced, swinging backward above selenizone, orthocline below selenizone except for short forward segment just below lower margin of selenizone. Selenizone wide, slightly concave, with almost same number of curved lunules as collabral lirae. Aperture simple, columella straight, inner lip reflected, outer lip oblique from upper suture backward above selenizone; slit at selenizone; base rounded, moderately phaneromphalous.

Dimensions. Holotype (Fig. 29): height 2.80 mm, width 260 mm, pleural angle 65°, number of whorls 5.5; paratype (Fig. 31): height 3.16 mm, width 2.66 mm, pleural angle 65°, number of whorls 4.75; paratype (Fig. 30): height 2.22 mm, width 2.00 mm, pleural angle 67°, number of whorls 5.5; paratype (Fig. 32): height 2.12 mm, width 1.80 mm, pleural angle 65, number of whorls 5.

Type locality. Locality C–34, 2.6 km south-west of Gundy, NSW.

Remarks. This species differs from *P. kempseyensis* Campbell, 1962 and *P. kuttungensis* Campbell, 1961 in having smaller size of shell with a moderate umbilicus. *P. kempseyensis* has more closely spaced collabral lirae, while *P. kuttungensis* has taller spire and stronger collabral lirae.

Etymology. Referring to the geographical name of the township of Gundy, NSW.

PHYMATOPLEURIDAE Batten, 1956

Borestus Thomas, 1940

Type species. *Borestus wrighti* Thomas, 1940: 54, pl. 3, fig. la,b; from the Charlestown Main Limestone, Lower Limestone Group (P2), Rosocobie Quarry, Fife, Scotland.

Definition. See Thomas, 1940: 53.

Stratigraphic range. Lower Carboniferous to Middle Permian.

Remarks. No Australian form has previously been referred to this genus.

Borestus costatus n.sp.

Figs 25–28

Type material. Holotype (F.61956) and 5 paratypes (F.61957).

Additional material examined. 9 specimens from localities A–3 and C–34.

Description. Shell small, conical trochiform, with about 5.75 heavily sculptured whorls, showing gradual change between protoconch and teleoconch, first 2 whorls nearly evenly spaced fine spiral threads with slightly prosocline, distinct growth lines. Selenizone and collabral lirae first occur at third whorl. Collabral ornament evenly spaced, regularly developed, about 36–40 cords in the last whorl; intersecting spiral cords at nodes, first at fourth whorl in median position above selenizone. Selenizone wide, deeply concave, its margins sharply keeled. Lunulae well developed, same number as collabral cords,]-shape. Base flat, reticulate ornamentation, moderately phaneromphalous.

Dimensions. Holotype (Fig. 25): height 3.00 mm, width 2.40 mm, apical angle 67°, number of whorls 6; paratype (Fig. 26): height 2.74 mm, width 2.00 mm, apical angle 70°, number of whorls 6.

Type locality. Locality C–34, 2.6 km south-west of Gundy, NSW.

Remarks. This is a very heavily ornamented form and is the first Australian species referred to this genus. This species resembles the Belgian species *B. similis* (de Koninck) but differs in being much smaller and in the detail of the ornamentation.

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

S.O. TROCHINA Cox & Knight, 1960

S.F. PLATYCERATACEA Hall, 1859

HOLOPEIDAE Wenz, 1938

GYRONEMATINAE Knight, 1956

Araeonema Knight, 1933

Type species. *Araeonema virgatum* Knight, 1933a: 52, pl. 9, fig. 3a–f; from the Labette Shale, Henrietta Formation, St. Louis, Missouri, USA.

Definition. See Knight, 1933: 40.

Stratigraphic range. Lower to Upper Carboniferous.

Remarks. This is the first record of the genus in Australia.

Araeonema microspirulata n.sp.

Figs 46–49

Type material. Holotype (F.61958) and 20 paratypes (F.61959).

Additional material examined. 43 specimens from A–3, A–4 and C–34.

Description. Shell minute, thin, globose, height slightly more than width of shell. Protoconch simple, boundary between protoconch and teleoconch not distinct, teleoconch about 3.5 convex whorls, first whorl smooth then equally spaced fine spiral lirae with fine orthocline growth lines. Suture deep, inner lip thin, gently arcuate, slightly reflected, outer lip orthocline without slit or selenizone, base round, moderately phaneromphalous.

Dimensions. Holotype (Fig. 46): height 1.07 mm, width 1.12 mm, height of aperture 0.67 mm, pleural angle 90°, number of whorls 4; paratype (Fig. 47): height 1.56 mm, width 1.48 mm, height of aperture 0.80 mm, pleural angle 85°, number of whorls 4.5.

Type locality. Locality A–4, 2.6 km south-west of Gundy, NSW.

Remarks. This species is superficially similar to *Araeonema virgatum* Knight (1933) described from St. Louis County, Missouri, USA., but differs in having a globose shell with a larger umbilicus and more inflated whorls with finer spiral lirae. This is the first species to be referred to the genus *Araeonema* in Australia.

Etymology. Referring to the microspiral ornamentation of shell.

S.F. MICRODOMATACEA Wenz, 1938

MICRODOMATIDAE Wenz, 1938

Microdoma Meek & Worthen, 1867

Type species. *Microdoma conicum* Meek & Worthen, 1867: 269; from the Carbondale Formation (Middle Pennsylvanian) Hodges Creek, Macoupin County, Illinois, USA.

Definition. See Knight *et al.*, 1960: 242.

Stratigraphic range. Lower Devonian to Lower Permian.

Remarks. No form has previously been referred to this genus in Australia.

Microdoma angulata n.sp.

Figs 58–60

Type material. Holotype (F.61960) and 20 paratypes (F.61961).

Additional material examined. 46 specimens from localities A–3, A–4, C–32 and C–34.

Description. Shell small, conical turbiniform, sutures deep, protoconch simple, rather globose 2.5 whorls, closely paced collabral threads, teleoconch of 2 whorls with uniformly strong collabral cords. Two strong spiral cords on last 2 whorls, one on periphery, the other just below suture. Collabral cords straight, prosocline, about 25° from vertical, evenly spaced but gradually wider with growth, 22–25 in last whorl, extending to umbilicus. Aperture subangular square in shape, inner lip thin nearly straight, raised, outer lip thin, prosocline, narrowly phaneromphalous.

Dimensions. Holotype (Fig. 58): height 2.20 mm, width 1.12 mm, height of aperture 0.76 mm, pleural angle 48°, number of whorls 5.25; paratype: height 1.84, width 1.24, height of aperture 0.78; paratype: height 2.20 mm, width 2.00 mm, height of aperture 0.90 mm; paratype: height 1.38, width 1.30 mm, height of aperture 0.68 mm; paratype (Fig. 59): height 2.20 mm; width 1.46 mm, pleural angle 50°, number of whorls 5.

Type locality. Locality A–3, 2.6 km south-west of Gundy, NSW.

Remarks. This species is similar to *M. uniserrata* Batten (1966) described from the Hotwells Limestone, Compton Martin, England, in having flattened whorls and low periphery with strengthened collabral cords which form nodes. It differs in having a larger pleural angle and more numerous collabral cords.

Etymology. Derived from the latin word *angulatus* meaning angular.

ELASMONEMATIDAE Knight, 1956

Eucochlis Knight, 1933

Type species. *Eucochlis perminuta* Knight, 1933a: 41, pl. 9, fig. 2a-f (monotypy); from the Labette Shale, Henrietta Formation, St. Louis County, Missouri, USA.

Definition. See Knight, 1933: 40.

Stratigraphic range. Lower Carboniferous to Upper Carboniferous.

Remarks. This is the first record of the genus in Australia.

Eucochlis australis n.sp.

Figs 61–64

Type material. Holotype (F.61962) and 20 paratypes (F.61963).

Additional material examined. 160 specimens from localities A–3, A–4 and C–32.

Description. Shell minute, cyrtoconoidal, rather short spired, protoconch 1.75 whorls with fine growth lines, teleoconch 2.5 strong convex with narrowly and evenly spaced sharp collabral cords, weak spiral lirae throughout teleoconch, collabral

cords about 43 in last whorl, prosocline, 26° from (vertical) axis and much more prominent than spiral lirae. Suture deep. Aperture simple, round. Lips slightly thickened, inner lip considerably separated from base abapically, moderately phaneromphalous.

Dimensions. Holotype (Fig. 61): height 1.28 mm, width 1.15 mm, height of aperture 0.65 mm, pleural angle 84°, number of whorls 4.25; paratype: height 1.13 mm, width 1.20 mm, height of aperture 0.60 mm; paratype (Fig. 62): height 1.45 mm, width 1.36 mm, height of aperture 0.70 mm, pleural 84°, number of whorls 3.75; paratype: height 1.20 mm, width 1.16 mm, height of aperture 0.66 mm.

Type locality. Locality A–3, 2.6 km south-west of Gundy, NSW.

Remarks. Knight (1933) described *Eucochlis perminuta* from St. Louis, Missouri, USA. The genus *Eucochlis* has remained monotypic until now, *australis* being the second species referred to the genus. *Eucochlis australis* is the most abundant and best preserved species in this study. It is superficially similar to *Eucochlis perminuta* in its size but differs in having a lower spire, bigger umbilicus, closer collabral cords and in being more conical.

Etymology. Derived from the latin word *australis* meaning southern.

S.O. NERITOPSINA Cox & Knight, 1960

S.F. NERITACEA Rafinesque, 1815

NERITOPSIDAE Gray, 1847

Naticopsis M'Coy, 1884

Naticopsis (*Naticopsis*) M'Coy, 1844

Type species. *Naticopsis phillipsii* M'Coy, 1844: 33 (subsequent designation by Meek & Worthen, 1866: 364); from the "Lower Limestone", Lower Carboniferous of Kilcommock, Longford, Ireland.

Definition. See Knight *et al.*, 1960: 276.

Stratigraphic range. Middle Devonian to Triassic.

Australian Carboniferous species. *Naticopsis brevispira* (Ryckholt, 1847), Dun & Benson, 1920 (361, pl. 22, fig. 8) from Carroll, NSW; *Naticopsis globosa* (Hoeninghaus, 1829), Dun & Benson, 1920 (361, pl. 22, figs 15,16) from south-east of Babbinboon, NSW; *Naticopsis obliqua* Dun & Benson, 1920 (362, pl. 22, figs 13,14) from south-east of Babbinboon, NSW.

Naticopsis (*Naticopsis*) *osbornei* n.sp.

Figs 65–66

Type material. Holotype (F.61964) and 10 paratypes (F.61965).

Additional material examined. 3 specimens from locality A–3.

Description. Shell small, subglobular, neritopsid form with about 4 whorls, protoconch about 1.25 smooth, rounded whorls, teleoconch inflated, whorls embrace much of previous whorl, last 2 whorls ornamented by fine prosocline collabral threads displayed from suture to columellar region. Upper whorl surface flattened, with low subangular periphery. Columellar lip arcuate, parietal wall thickened with inductura which is crossed obliquely by 3 transverse rugae in parietal region, outer lip sharp and thin, anomphalous.

Dimensions. Holotype (Fig. 65): height 2.25 mm, width 2.20 mm, pleural angle 118°, number of whorls 4; paratype (Fig. 66): height 2.20 mm, width 2.10 mm, pleural angle 117°, number of whorls 4.5.

Type locality. Locality C–34, 2.6 km south-west of Gundy, NSW.

Remarks. This species resembles Belgian species *Naticopsis* (*Naticopsis*) *consimilis* de Koninck in shell ornamentation but differs in having a taller spire and thicker parietal wall. The Australian species, *N. brevispira*, has a more globose and larger shell; *N. globosa* may have no collabral threads; *N. obliqua* has a much taller shell.

Etymology. This species is named after Dr G.D. Osborne, formerly of the University of Sydney for his contribution to geology of Muswellbrook-Scone District which includes the present study area.

S.O. MURCHISONIINA Cox & Knight, 1960

S.F. MURCHISONIACEA Koken, 1896

MURCHISONIIDAE Koken, 1896

Aclisina de Koninck, 1881

Type species. *Murchisonia striatula* de Koninck, 1843: 415, pl. 40, figs 7a,b (subsequent designation by S.A. Miller, 1889: 395); from the $V_3b(=D_2)$ zone, Visé, Belgium.

Definition. See Knight *et al.*, 1960: 293.

Stratigraphic range. Lower Carboniferous to Upper Carboniferous.

Remarks. This is the first record of *Aclisina* in Australia.

Aclisina turgida n.sp.

Figs 80–81

Type material. Holotype (F.61966) and 15 paratypes (F.61967).

Additional material examined. 10 specimens from localities A–3 and C–32.

Description. Shell small, relatively low spired, globose form, whorl profile rounded, suture deeply incised, protoconch 1 smooth whorl, teleoconch about 5 whorls with 6 evenly spaced spiral costae. Aperture subcircular, but slightly higher than wide, inner lip slightly arcuate, outer lip thin, convex, slit unknown may be small and narrow, giving rise to an obscure selenizone, anomphalous.

Dimensions. Holotype (Fig. 80): height 2.12 mm,

width 1.00 mm, height of aperture 0.74 mm, pleural angle 35°, number of whorls 5.5.

Type locality. Locality C–34, 2.6 km south-west of Gundy, NSW.

Remarks. The slit and selenizone are not clearly observed in the holotype, seemingly not a mature form. The other specimen (Fig. 81) is also juvenile, having few whorls but same pleural angle (35°) as the holotype. This is the first species to be referred to *Aclisina* in Australia.

Etymology. Derived from the latin word *turgidus* meaning swollen.

Stegocoelia Donald, 1889

Stegocoelia (*Stegocoelia*) Donald, 1889

Type species. *Murchisonia* (*Stegocoelia*) *compacta* Donald, 1889: 624, pl. 20, figs 9–13; from the Upper limestone series (Lower Carboniferous), Glencart, Dalry, Scotland.

Definition. See Knight *et al.*, 1960: 293.

Stratigraphic range. Lower Carboniferous to Upper Carboniferous.

Remarks. No Australian form has previously been referred to the genus *Stegocoelia.*

Stegocoelia (*Stegocoelia*) *nodosa* n.sp.

Figs 67–71

Type material. Holotype (F.61968) and 20 paratypes (F.61969).

Additional material examined. 150 specimens from A–3, A–4, C–32 and C–34.

Description. Shell small, relatively thick, tall spired, whorl profile convex. Protoconch 2 smooth whorls its labral sinus culminating in a sharp notch in periphery (see Fig. 71); teleoconch 5 whorls with 4 strong spiral carinae with fine orthocline growth lines. One spiral carina abapical to suture weaker than other 3, but has about 2–30 nodes in last whorl. Aperture simple, inner lip thin, slightly arcuate, reflexed, outer lip shallow opisthocyst just below suture, slit absent or seemingly very shallow, selenizone obscured between second and third carinae below suture, anomphalous.

Dimensions. Holotype (Fig. 68): height 2.40 mm, width 1.00 mm, height of aperture 0.58 mm, pleural angle 20°, number of whorls 7.5; paratype (Fig. 70): height 2.76 mm, width 1.06 mm, pleural angle 22°, number of whorls 7; paratype (Fig. 67): height 2.42 mm, width 0.92mm, pleural angle 22°, number of whorls 6.5.

Type locality. Locality A–3, 2.6 km south-west of Gundy, NSW.

Remarks. This is one of the most common species in the investigated fauna. *S.* (*S.*) *nodosa* is very similar to *S.* (*S.*) *okawensis* Thein & Nitecki (1974) from Upper Mississippian of Illinois Basin, North America in the form of the shell and type of ornamentation, but is different in having nodes on the upper spiral cords.

Etymology. Derived from the latin word *nodosus* meaning nodose, referring to nodes on the upper spiral cords.

Stegocoelia (*Hypergonia*) Donald, 1892

Type species. *Murchisonia quadricarinata* M'Coy, 1844: 42, pl. 5, fig. 9; from the Carboniferous limestone of Blacklion, Enniskillen, Northern Ireland.

Definition. See Knight *et al.*, 1960: 293.

Stratigraphic range. Lower Carboniferous to Upper Carboniferous.

Stegocoelia (*Hypergonia*) *elongata* n.sp.

Figs 73–75

Type material. Holotype (F.61970) and 14 paratypes (F.61971).

Additional material examined. 7 specimens from locality C–32.

Description. Shell small, high spired, turriculate with flattened base, whorl profile rather flat, suture shallow. Protoconch 1 smooth whorl, prominent varix between protoconch and teleoconch forming deep labral sinus culminating in sharp notch in upper part of whorl; teleoconch about 8 whorls with 4 strong spiral carinae of which 2 middle carinae being stronger than those above and below. Slit seemingly shallow selenizone obscure between 2 uppermost carinae. Aperture almost square in shape, outer lip with slight angulations both anteriorly and posteriorly. Growth lines very faint, swing moderately backward above selenizone, forward between selenizone and lower suture, backward on base, anomphalous.

Dimensions. Holotype (Fig. 73): height 3.76 mm, width 1.30 mm, height of aperture 0.68 mm, pleural angle 19°, number of whorls 9.25.

Type locality. Locality A–4, 2.6 km south-west of Gundy, NSW.

Remarks. This species resembles *Stegocoelia* (*Hypergonia*) *cincta* (Donald, 1895) from the Upper Limestone Group (=E2) of Ayrshire, but differs in that *S.* (*H.*) *cincta* has a more coeloconoid form.

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

Stegocoelia (*Hypergonia*) *tenuis* n.sp.

Figs 76–79

Type material. Holotype (F.61972) and 12 paratypes (F.61973).

Additional material examined. 3 specimens from locality C–32.

Description. Shell minute, slender, tall spired, turritelliform with round base, shell profile rounded,

suture deeply incised. Protoconch about 2 smooth whorls, labral sinus culminating in sharp notch in upper part of whorl; teleoconch about 7 whorls with 3 distinct spiral cords consistently in lower half of whorl. Selenizone may be along the groove which is just below suture. Growth lines faint, slightly backward above groove, forward strongly below groove. Slit unknown. Aperture round, inner lip arcuate, slightly reflected, anomphalous.

Dimensions. Holotype (Fig. 76): height 1.10 mm, width 0.35 mm, pleural angle 15°, number of whorls 8; paratype (Fig. 77): height 1.07 mm, width 0.32 mm, pleural angle 14°, number of whorls 8.5.

Type locality. Locality A–4, 2.6 km south-west of Gundy, NSW.

Remarks. This species is somewhat similar to *Donaldina filosa* n.sp. in shell size and teleoconch ornamentation but very different in the nature of its protoconch and the sharp notch between protoconch and teleoconch. Fine meandering grooves on the shell surface, which may have been caused by algae or bacteria, are common, particularly on the protoconch.

Etymology. Derived from the latin word *tenuis* meaning thin, slender, referring to the slender shell shape.

O. CAENOGASTROPODA Cox, 1959

S.F. LOXONEMATACEA Koken, 1889

LOXONEMATIDAE Koken, 1889

Loxonema Phillips, 1841

Type species. *Terebra*? *sinuosa* J. de C. Sowerby, 1839 (subsequent designation, King, 1850: 209); from Middle Silurian, near Aymestry, Shropshire, England.

Definition. See Knight *et al.*, 1960: 311.

Stratigraphic range. Middle Ordovician to Lower Carboniferous.

Australian Carboniferous species. *Loxonema babbinboonensis* Etheridge Jr., 1907 (194, pl. 38, figs 5,6), from Babbinboon; *Loxonema lamellosa* Maxwell, 1961 (69, pl. 9, figs 6–11), from late Tournaisian–early Visean, Yarrol, Qld; *Loxonema* sp. Dun & Benson, 1920 (362, pl. 22, figs 11,12), from Babbinboon; *Loxonema* sp. (cf. *lefevrei*) Etheridge Jr. 1907 (195, pl. 37, figs 4,5); *Loxonema acutissima* de Koninck, *L. constricta* W. Martin, *L. difficilis* de Koninck, and *L. rugifera* J. Phillips (all figured in de Koninck, 1898) do not seem to be *Loxonema.*

Loxonema elegantissima n.sp.

Figs 84–87

Type material. Holotype (F.61974) and 10 paratypes (F.61975).

Additional material examined. 16 specimens from A–3, A–4 and C–34.

Description. Shell minute, slender, high spired, 7–9 whorls, whorl profile rounded, sutures deep. Protoconch simple, rather slightly deviated 1.25 smooth whorls; teleoconch about 6–8 convex whorls with very fine collabral cords. Collabral cords pass obliquely backward from upper suture at an angle of about 40° to axis of shell, forward sharply across whole lower face of whorl at an angle of about 30° to axis. Aperture oval, inner lip slightly arcuate, outer lip thin, with deep rounded labral sinus culminating high on whorl; base round, anomphalous.

Dimensions. Holotype (Fig. 84): height 1.36 mm, width 0.50 mm, height of aperture 0.32 mm, pleural angle 15°, number of whorls 6.5; paratype (Fig. 85): height 2.50 mm, width 0.70 mm, height of aperture 0.44 mm, pleural angle 13°, number of whorls 7.5.

Type locality. Locality A–4, 2.6 km south-west of Gundy, NSW.

Remarks. *Donaldina filosa* n.sp. is similar to this species in shell shape but different in having spiral cords and a more blunt topped protoconch. *L. elegantissima* n.sp. is similar to *Donaldina* sp. (Figs 110, 111) but *Donaldina* sp. has a more deviated protoconch and spiral cords.

Bored holes appear on the shell as in *Stegocoelia* (*Hypergonia*) *tenuis* n.sp. Their size suggests that they are caused by algae or bacteria, not by molluscan predators.

Etymology. Derived from the latin word *elegantissimus* meaning most elegant.

PSEUDOZYGOPLEURIDAE Knight, 1930

Hemizyga Girty, 1915

Hemizyga (Hemizyga) Girty, 1915

Type species. *Hemizyga elegans* Girty, 1915: 362, pl. 32, figs 7A, B; from the Cherokee Shale (Upper Carboniferous) on Honey Creek, Garland, Missouri, U.S.A. Subsequent designation Knight, 1930: 17.

Definition. Shell very small, cyrtoconoidal fusiform, anomphalous, high spired but relatively few whorls, with extremely fine collabral costae or lirae, base rather extended subconical, aperture somewhat elongate auriform, protoconch 3–4 whorls with fine reticulate sculpture (emend.).

Stratigraphic range. Lower to Upper Carboniferous.

Remarks. No Australian form has previously been referred to the family Pseudozygopleuridae and its genera.

Hemizyga (Hemizyga) decussata n.sp.

Figs 88–91

Type material. Holotype (F.61976) and 5 paratypes (F.61977).

Additional material examined. 5 specimens from locality C–34.

Description. Shell minute, cryptoconoidal fusiform, whorl profile gently arched, with rapidly increasing, last whorl very much inflated. Sutures shallow, protoconch 4.25 whorls, first 1.75 whorls smooth, rest 2.5 whorls strong decussate ornamentation, gradually transformed into teleoconch pattern; teleoconch about 2 whorls with straight orthoclinal collabral cords which extend onto base. Aperture elongate auriform, inner lip thick, reflexed; outer lip thin, no sinus, arcuate; lower lip extended, siphonate; anomphalous.

Dimensions. Holotype (Fig. 88): height 2.00 mm, width 1.45 mm, height of aperture 1.20 mm, pleural angle 56°, number of whorls 4+; paratype: height 1.72 mm, width 1.20 mm, height of aperture 0.74mm; veliger shell (Fig. 89): height 0.90 mm, width 0.61 mm, height of aperture 0.40 mm.

Type locality. Locality A–3, 2.6 km south-west of Gundy, NSW.

Remarks. This is the first Australian species referred to the genus *Hemizyga* (*Hemizyga*).

Etymology. Derived from the latin word *decusso* meaning to divide crosswise in the shape of an X.

Cyclozyga Knight, 1930

Type species. *Cyclozyga mirabilis* Knight, 1930: 74, pl. 5, fig. 7; from the top of the Labette Shale, Henrietta Formation, St. Louis County, Missouri, USA.

Definition. Shell minute, protoconch first 1–1.5 whorls smooth, strong collabral ornament on 2nd to 4th whorls, spiral threads on adult shell, shallow sinus low on whorl (emend.).

Stratigraphic range. Lower to Upper Carboniferous.

Cyclozyga sinusigera n.sp.

Figs 92–94

Type material. Holotype (F.61978) and 1 paratype (F.61979).

Additional material examined. 2 specimens.

Description. Shell minute, slender, moderately high spired, whorls rounded, sutures moderately deep, protoconch 2.5 whorls, first 1 whorl smooth, blunt, rest 1.5 whorls strong collabral cords shown, abrupt change to teleoconch with exceptionally deep sinus of a peculiar deep–U shape; teleoconch about 4.5 whorls with 3–4 equal spiral cords, all equally spaced, confined generally to lower part of whorl, fine collabral threads inclined obliquely backward below suture but immediately turned forward with an angle of 30° to axis of shell; inner lip arcuate, somewhat reflexed, outer lip thin but not well known in detail, base flat, anomphalous.

Dimensions. Holotype (Fig. 92): height 1.45 mm, width 0.50 mm, height of aperture 0.32 mm, pleural angle 20°, number of whorls 7.5; paratype (Fig. 93): height 0.82 mm, width 0.40 mm, height of aperture 0.20 mm, pleural angle 22°, number of whorls 6+.

Type locality. Locality A–3, 2.6 km south-west of Gundy, NSW.

Remarks. This species differs from the other known three congeneric species, *C. mirabilis* Knight (1930), *C. carinata* Knight (1930) and *C. attenuata* Hoare & Sturgeon (1978), all from the Pennsylvanian of USA, in having a much smaller and more slender shell, and also in having strongly oblique opisthoclinal growth lines. This species is rare in the fauna described in this paper, but is well preserved although the later whorls of the paratype are slightly damaged. The high-spired larval shell with deep sinus indicates that this species had a planktotrophic development.

Etymology. Derived from the latin words *sinus* meaning a curve, and *gero* meaning to bear; referring to the shape of the protoconch.

S.F. SUBULITACEA Lindström, 1884

SUBULITIDAE Lindström, 1884

SOLENISCINAE Wenz, 1938

Soleniscus Meek & Worthen, 1861

Type species. *Soleniscus typicus* Meek & Worthen, 1861; Upper Carboniferous, from Springfield, Illinois, USA.

Definition. See Knight *et al.*, 1960: 321.

Stratigraphic range. Lower Carboniferous to Middle Permian.

Soleniscus callosus n.sp.

Figs 95–102

Type material. Holotype (F.61980) and 7 paratypes (F.61981).

Additional material examined. 12 specimens from A–4 and C–34.

Description. Shell small, moderately high spired fusiform but shell profile slightly concave; whorl profile gently rounded, suture shallow, distinct; protoconch of small size, simple; teleoconch with fine transverse lirae, last whorl markedly inflated, 2 times as high as preceding spire. Aperture suboval, pointed posteriorly, rounded anteriorly; outer lip thin, arcuate; columellar lip slightly arcuate, with small siphonal notch, strong columellar fold internally in last 2 whorls; parietal inductura slightly thickened, base round, anomphalous.

Dimensions. Holotype (Fig. 100): height 1.80 mm, width 1.00 mm, pleural angle 52°, number of whorls 6; paratype (Fig. 101): height 1.50 mm, width 1.00 mm, pleural angle 56°, number of whorls 5+; paratype (Fig. 96): height 1.43 mm, width 0.86, pleural angle 50°, number of whorls 5.5; paratype (Fig. 97): height 1.80 mm, width 1.10 mm, pleural angle 55°, number of whorls 5.5; paratype (Fig. 98):

height 2.50 mm, width 1.50 mm, pleural angle 53°, number of whorls 5.

Type locality. Locality A–3, 2.6 km south-west of Gundy, NSW.

Remarks. This is a very common species in the fauna here described. It displays a striking amount of variability in shell shape, whorl profile, ornament and columellar lip.

Etymology. Derived from the latin word *callosus* meaning calloused, referring to the columellar callus.

S.C. OPISTHOBRANCHIA Milne Edwards, 1848

O. Uncertain

S.F. PYRAMIDELLACEA d'Orbigny, 1840

STREPTACIDIDAE Knight, 1931

Donaldina Knight, 1933

Type species. *Aclisina grantonensis* Donald, 1898: 60, pl. 4, figs 7–9; from the Calciferous Sandstone Group, at Woodhall, near Edinburgh, Scotland.

Definition. See Knight *et al.*, 1960: 322.

Stratigraphic range. Devonian? Lower Carboniferous to Lower Permian.

Remarks. This genus is introduced for the first time to the Australian fauna to accommodate *Donaldina filosa* n.sp. and *Donaldina* sp.

Donaldina filosa n.sp.

Figs 104–109

Type material. Holotype (F.61982) and 20 paratypes (F.61983).

Additional material examined. 9 specimens from localities A–3 and C–34.

Description. Shell minute, slender, high spired turriculate form. Whorl profile between sutures more or less symmetrically rounded, sutures deep, well impressed. Protoconch of 1.5 smooth whorls with flat top to slightly submerged spire. Varix between protoconch and teleoconch distinct orthocline, teleoconch about 8 convex whorls with 5–6 evenly spaced spiral cords and closely spaced collabral threads. Spiral ornamentation confined generally to lower ⅔ of each whorl. Collabral threads deflected strongly backward below suture but swinging immediately and strongly forward with an angle of 25° to axis of shell. Aperture oval, columellar lip slightly arcuate, base rounded, anomphalous.

Dimensions. Holotype (Fig. 105): height 1.77 mm, width 0.50 mm, pleural angle 14°, number of whorls 9; paratype (Fig. 104): height 1.66 mm, width 0.55 mm, pleural angle 15°, number of whorls 7.5.

Type locality. Locality A–4, 2.6 km south-west of Gundy, NSW.

Remarks. This species is very similar to *Loxonema elegantissima* n.sp. in shell size, shape, protoconch and strong opisthoclinal collabral ornamentation but different from it in having spiral cords. This species is also similar to *Donaldina* sp. but that form has a more deviated protoconch.

Etymology. Derived from the latin word *filosus* meaning threaded, bearing threads.

C. SCAPHOPODA Bronn, 1862

O. DENTALIOIDA Palmer, 1974

DENTALLIIDAE Gray, 1834

Fissidentalium Fischer, 1885

Type species. *Dentalium ergasticum* Fischer, 1882; Recent, Gulf of Gascony and Atlantic Ocean, in deep water.

Definition. Shell large, solid, circular in outline, sculptured with numerous longitudinal striae; apex typically with long apical fissure on convex side, rarely simple or with apical slit divided into a series of fissures (Emerson, 1962).

Stratigraphic range. ?Early Carboniferous; Cretaceous to Recent.

Remarks. The present two specimens resemble *Prodentalium* in having fine longitudinal riblets extending seemingly the entire length of tube, but differ in that *Prodentalium* is a very large scaphopod, 20 cm long, without observed slit or plug. The Recent genus *Fissidentalium* resembles those present specimens in having fine longitudinal riblets and long apical slit (Palmer, 1974), but differs in being a long tube, reaching 10 cm long. The size of complete tubes are not known as both specimens recovered here have the anterior part damaged. Therefore the present specimens are tentatively referred to *Fissidentalium.*

Fissidentalium? longistriatum n.sp.

Figs 141–143

Type material. Holotype (F.61992) and 1 paratype (F.61993).

Additional material examined. 2 specimens.

Description. Shell minute, nearly straight, circular in section, surface sculptured with numerous close very fine longitudinal riblets extending seemingly entire length of tube, posterior orifice round with relatively long, narrow apical slit.

Dimensions. Holotype (Fig. 141): length 3.00 mm, diameter of anterior end 0.80 mm; paratype: length 2.50 mm, diameter of anterior end 0.60 mm.

Type locality. Locality A–3, 2.6 km south-west of Gundy, NSW.

Remarks. This is the first record of a Palaeozoic species referred to this genus.

Etymology. Derived from the latin word *longus* meaning long, and *striatus* meaning striated.

LAEVIDENTALIIDAE Palmer, 1974

Scissuradentalium n.gen.

Type species. *Scissuradentalium runnegari* n.sp. (monotypy).

Definition. Shell minute to small (up to 7 mm long), slightly curved, with circular or nearly circular cross section, exterior and interior surfaces smooth, rapidly tapering posteriorly; very long, narrow apical slit on ventral side.

Stratigraphic range. Lower Carboniferous.

Remarks. *Scissuradentalium* n.gen. resembles *Rhytiodentalium* Pojeta & Runnegar (1979) in having a slightly curved smooth shell, but differs in having a very long, narrow apical slit. This genus is similar to *Pseudantalis* Monterosato, which ranges from Lower Cretaceous to Recent, in having a smooth shell with long apical slit, but *Pseudantalis* differs in having a large, less tapering shell. *Scissuradentalium* may be an ancestor of *Pseudantalis* and could have evolved from *Rhytiodentalium.*

Etymology. Derived from the latin word *scissura* meaning a slit, referring to the character of the posterior end; *Dentalium*, a genus of scaphopods.

Scissuradentalium runnegari n.sp.

Figs 144–147

Type material. Holotype (F.61994) and 8 paratypes (F.61995).

Additional material examined. 9 specimens.

Description. Shell small, rather short, slightly curved, rapidly attenuated posteriorly. Shell smooth, composed of 2 layers. Anterior aperture large, round; posterior aperture small, round, with very long, narrow spical slit on ventral side.

Dimensions. Holotype (Fig. 144): length 6.2 mm, diameter of anterior end 1.7 mm; paratype (Fig. 147): length 7 mm, diameter of anterior end 2 mm; paratype (Fig. 145): length 5.5 mm, diameter of anterior end 1.4 mm.

Type locality. Locality A–3, 2.6 km south-west of Gundy, NSW.

Remarks. This species differs from any other known Palaeozoic scaphopod from Australia or overseas.

Etymology. This species is named after Professor B. Runnegar of the University of New England for his contributions to the study of Australian Palaeozoic molluscs.

Plagioglypta Pilsbry & Sharp, 1897

Type species. *Dentalium undulatum* Münster, 1844; from Triassic, St. Cassian, Tyrol Mountains.

Definition. See Ludbrook, 1960: 39.

Stratigraphic range. Upper Devonian to Upper Cretaceous.

Remarks. The Australian forms of this genus appear to be so similar that they may be considered congeneric with the northern hemisphere counterparts.

Plagioglypta numerosa n.sp.

Figs 148–151

Type material. Holotype (F.61996) and 20 paratypes (F.61997).

Additional material examined. 30 specimens from localities A–3, A–4 and C–34.

Description. Shell small, slightly curved, slightly attenuate posteriorly. Shell surface throughout shows close but rather strong oblique wrinkles encircling whole shell, no longitudinal sculpture. Wrinkles sometimes rhythmically change from coarse to fine. Circular in cross section, slit and pipe absent.

Dimensions. Holotype (Fig. 148): length 3.60 mm, diameter of anterior end 0.76 mm; paratype (Fig. 149): length 3.30 mm, diameter of anterior end 0.72 mm.

Type locality. Locality A–3, 2.6 km south-west of Gundy, NSW.

Remarks. This is the first species to be referred to this genus in Australia.

Etymology. Derived from the latin word *numerosus* meaning rhythmical, alluding to the rhythmic change in size and frequency of the transverse wrinkles.

Pipadentalium n.gen.

Type species. *Pipadentalium protruberans* n.sp. (monotypy).

Definition. Shell minute, tapering (up to 6 mm long), slightly curved with loosely and smoothly encircling wrinkles, very fine longitudinal riblets throughout shell. Posterior orifice a distinct pipe.

Stratigraphic range. Lower Carboniferous.

Remarks. This genus resembles *Plagioglypta* Pilsbry & Sharp, 1897 in having encircling wrinkles but differs in having a distinct apical pipe and very fine longitudinal riblets.

Etymology. Derived from the latin word *pipare* meaning a tube, referring to the siphonal pipe at the posterior end; *Dentalium*, a genus of scaphopods.

Pipadentalium protruberans n.sp.

Figs 152–154

Type material. Holotype (F.61998) and 1 paratype (F.61999).

Additional material examined. 2 specimens.

Description. Shell small, slightly curved, slightly

attenuated posteriorly, shell surface loosely and slightly oblique wrinkled, showing very fine longitudinal riblets throughout. Circular in cross section, pipe at posterior end.

Dimensions. Holotype (Fig. 152): length 6.2 mm, diameter of anterior end 1.0 mm.

Type locality. Locality A–3, 2.6 km south-west of Gundy, NSW.

Remarks. This species is so similar to *Plagioglypta numerosa* n.sp. in shell size and shape that it can be confused when the specimen has the apical pipe broken off. Its characteristics are the apical pipe and faint encircling wrinkles with fine longitudinal lirae.

Etymology. Derived from the latin word *protruberans* meaing protruding, referring to the protruding apical pipe.

C. HYOLITHA Matthew, 1899

O. HYOLITHIDA Matthew, 1899

HYOLITHIDAE Nicholson, 1872

Hyolithes Eichwald, 1840

Type species. *Hyolithes acutus* Eichwald, 1840: 97; from Ordovician, Estonia.

Definition. See Fisher, 1962: 124.

Stratigraphic range. Lower Cambrian to Middle Permian.

Hyolithes minutissimus n.sp.

Figs 155–162, 165

Type material. Holotype (F.62000) and 10 paratypes (F.62001).

Additional material examined. 10 specimens from locality C–32.

Description. Shell minute; bilaterally symmetrical with straight or slightly curved, subtriangular cross section, embryonic portion smooth globular, sharply delimited from main part of shell; inside of embryonic chamber simple hole, wider in middle and top end than lower part of chamber, no septum between embryonic chamber and rest of shell. Shell next to embryonic chamber cylindrical but becoming subtriangular in cross section. Exterior and interior surfaces are ornamented by fine transverse striae which are coarser on exterior than interior. Lip extended from ventral side of aperture, transverse ornamentation on ventral side arched. Aperture subtriangular; operculum and arms unknown.

Dimensions. Holotype (Fig. 157): length 3.60 mm, maximum width 1.08 mm; paratype (Fig. 155): length 3.52 mm, maximum width 1.00 mm.

Type locality. Locality C–34, 2.6 km south-west of Gundy, NSW.

Remarks. The specimens recovered here are consistently small, ranging from 3 to 6 mm long, and the ratio of protoconch length to teleoconch averages 1:20, which may indicate the attainment of maturity. This species differs from all other Palaeozoic hyolith species in having much smaller size of shell. This is the only Carboniferous species found in Australia.

Etymology. Derived from the latin word *minutus* p.p. of minuere, meaning lessen, and *-issima* meaning superlative or extreme.

Discussion

Large molluscan faunas have been described from the British Isles, Europe and North America. However, only a small number of species have been described from the Australian Carboniferous sediments.

During the present study, the largest assemblage of Carboniferous mollusc faunas (with other groups of marine faunas), was discovered in a bioclastic limestone lens interbedded in mudstone of the Dangarfield Formation. The limestone is interpreted to have formed in a shallow marine shelf environment. The limestone lens extends 800 m in a northwest-southeast direction, and consists of three thin bands of limestone ranging in thickness from 0.1 to 0.2 m. In this paper, gastropods, scaphopods and hyoliths are systematically classified. This mollusc assemblage (56 species including unidentified forms) is also the largest to be recovered from a single locality in Australian Palaeozoic rocks.

The faunal assemblage consists almost entirely of minute shells preserved by chlorite replacement, which has made possible the isolation of complete shells from the limestone matrix, and has led to the preservation of extremely delicate shell ornamentation.

While Recent and Tertiary micro-molluscs have received much attention in recent years, very little was known of the Australian pre-Tertiary minute molluscs. Systematic studies suggest that a large assemblage of macro- and micro-molluscs existed in the Early Carboniferous of Australia.

Thirty-four genera and subgenera of gastropods identified in this study were originally named in the British Isles–Europe and/or North America. Most of them occur in both continents. Only four genera occurring in Australia and Europe have not been found in North America, and another four genera occurring in Australia and North America have not been found in Europe. There are no endemic genera. The Australian fauna is a mixture of both European and North American affinities, of which some are restricted to the Early Carboniferous period. This agrees with the conclusion of Roberts (1987) that the Early Carboniferous marine invertebrate faunas of the Tasman Belt in Eastern Australia are cosmopolitan.

Correlations of conodont, ammonoid, brachiopod and other groups of marine assemblage from the study area with those of North America and Europe

suggest consistently that the sequence correlates with the Late Tournaisian (Early Carboniferous) of Europe.

Some species in the assemblage are recognised as typical planktotrophic gastropods which have potential dispersal ability for a wide geographical distribution. Lecithotrophic gastropods are also found. These gastropods have reduced dispersal ability.

ACKNOWLEDGEMENTS. This paper was written as a part of a MSc. thesis at the University of Sydney. I wish to thank Dr T.B.H. Jenkins for his supervision of this work and for constructive criticism of the manuscript. I am indebted to Dr W.F. Ponder of the Australian Museum, Sydney for his support. Mrs B. Simpson, New South Wales Department of Mineral Resources typed the final manuscript.

This article is published with the permission of the Secretary, New South Wales Department of Mineral Resources.

References

Batten, R.L., 1966. The Lower Carboniferous gastropod fauna from the Hotwells Limestone of Compton Martin, Somerset. Palaeontographical Society Monographs, London. Part I: 1–52, pls 1–5; Part II: 53–109, pls 6–10.

Benson, W.N., 1921. A Census and Index of the Lower Carboniferous Burrindi Fauna. Record of the New South Wales Geological Survey 10(1): 12–74.

Campbell, K.S.W., 1961. Carboniferous fossils from the Kuttung rocks of New South Wales. Palaeontology 4(3): 428–474.

——— 1962. Marine fossils from the Carboniferous glacial rocks of New South Wales. Journal of Paleontology 36(1): 38–52.

Campbell, K.S.W. & B.A. Engel, 1963. The Faunas of the Torunaisian Tulcumba Sandstone and its Members in the Werrie and Belvue Synclines, New South Wales. Journal of the Geological Society of Australia 10(1): 55–122, 9 pls.

Campbell, K.S.W. & B.C. McKelvey, 1971. The geology of the Barrington District, N.S.W. Pacific Geology 5: 7–48.

Deer, W.A., R.A. Howie & J. Zussman, 1965. Rock Forming Minerals. Volume 3, sheet silicates. (Chlorite: 131–163). Longmans.

Donald, J., 1889. Descriptions of some new species of Carboniferous gastropoda. Quarterly Journal of the Geological Society of London 45: 619–625.

——— 1895. Notes on the genus *Murchisonia* and its allies; with a revision of the British Carboniferous species and descriptions of some new forms. Quarterly Journal of the Geological Society of London 51: 210–234.

Dun, W.S. & W.N. Benson, 1920. The geology and petrology of the Great Serpentine Belt of New South Wales. Part IX, section B. Palaeontology. Proceedings of the Linnean Society of New South Wales 45(3): 337–374, pls 18–24.

Emerson, W.K., 1962. A classification of the scaphopod mollusks. Journal of Paleontology 36: 461–482.

Etheridge, R. Jr., 1890a. Carboniferous mollusca in the Lower Carboniferous or *Rhacopteris* Series of the Port Stephens District, New South Wales. Annual Report for 1889, Department of Mines, New South Wales. p. 239.

——— 1890b. Additional Carboniferous mollusca in the Lower Carboniferous Series of the Port Stephens District, New South Wales. Annual Report for 1889, Department of Mines, New South Wales. p.240.

——— 1896. Palaeontologia Novae Cambriae Meridionalis — Occasional descriptions of New South Wales fossils, No. 2. Records of the Geological Survey of New South Wales 5(1): 14–18.

——— 1898. Palaeontologia Novae Cambriae Meridionalis — Occasional descriptions of New South Wales fossils, No. 3. Records of the Geological Survey of New South Wales 5(4): 175–179.

——— 1907. Palaeontogia Novae Cambriae Meridionalis - Occasional descriptions of New South Wales fossils, No. 5. Records of the New South Wales Geological Survey 8(3): 192–196.

Fisher, D.W., 1962. Small conoidal shells of uncertain affinities. pp. W98–W143. **In** Moore, R.C., (ed.). Treatise on Invertebrate Palaeontology, Part W, Miscellanea. Geological Society America and University of Kansas Press.

Hoare, R.D. & M.T. Sturgeon, 1978. The Pennsylvanian gastropod genera *Cyclozyga* and *Heminthozyga* and the classification of the Pseudozygopleuridae. Journal of Paleontology 52(4): 850–858.

Jenkins, T.B.H., 1974. Lower Carboniferous Conodont Biostratigraphy of New South Wales. Palaeontology 17(4): 909–924.

Jones, P.J., K.S.W. Campbell & J. Roberts, 1973. Correlation chart for the Carboniferous System of Australia. Bulletin of the Bureau of Mineral Resources Australia 156A: 1–40.

Knight, J.B., 1930. The gastropods of the St. Louis, Missouri, Pennsylvanian outlier: the Pseudozygopleurinae. Journal of Paleontology 4, suppl. 1, 88 pp., 4 figs, 5 pls.

——— 1933. The gastropods of the St. Louis, Missouri, Pennsylvanian outlier: V. The Trocho-Turbinidae. Journal of Paleontology 7(1): 30–58, pls 8–12.

——— 1941. Palaeozoic gastropod genotypes. Special Papers of the Geological Society of America 32: 510pp., 32 figs, 96 pls.

——— 1945. Some new genera of the Bellerophontacea. Journal of Paleontology 19(4): 333–340, pl. 49.

Knight, J.B., L.R. Cox, A.M. Keen, R.L. Batten, E.L. Yochelson & R. Robertson, 1960 (Systematic Descriptions). Knight, J.B., Batten, R.L., Yochelson, E.L. & Cox, L.R. 1960 (Supplement Palaeozoic and some Mesozoic Caenogastropoda and Opisthobranchia). pp. I169–I330. **In** Moore, R.C., (ed.). Treatise on Invertebrate Paleontology, Part I, Mollusca 1. Geological Society of America and University of Kansas Press. 351 pp., 216 figs.

Koninck, L.G. de, 1898. Descriptions of the Palaeozoic Fossils of New South Wales (Australia). Memoirs of the New South Wales Geological Survey (Palaeontology) 6: 1–298, pls 1–24.

Ludbrook, N.H., 1960. Scaphopoda. Pt. I, Mollusca 1. pp. I37–I41. **In** Moore, R.C. (ed.). Treatise on Invertebrate Paleontology. Geological Society of America and University of Kansas Press.

Maxwell, W.G.H., 1961. Lower Carboniferous gastropod faunas from Old Cannindah, Queensland. Palaeontology 4(1): 59–70.

Mory, A., 1975. Geology and conodont biostratigraphy of the Brushy Hill area, Glenbawn, N.S.W. B.Sc. (Hons.) thesis, University of Sydney (unpubl.).

——— 1978. The Geology of Brushy Hill, Glenbawn, New South Wales. Journal and Proceedings of the Royal Society of New South Wales 111: 19–27.

Newell, N.D., 1969. Classification of Bivalvia. pp. N205–N224 **In** Moore, R.C. (ed.). Treatise on Invertebrate Paleontology, Part N. Mollusca 6(1 of 3). Geological Society of America and University of Kansas Press.

Osborne, G.D., 1928. The Carboniferous rocks in the Muswellbrook-Scone district with special reference to their structural relations. Proceedings of the Linnean Society of New South Wales 53: 588–597.

——— 1950. The Structural Evolution of the Hunter-Manning-Myall Province, New South Wales. Monograph of the Royal Society of New South Wales 1: 1–80.

Oversby, B. & J. Roberts, 1973. A revision of the sequence at Glenbawn, New South Wales. Search 4(6): 198–199.

Palmer, C.P., 1974. A suprageneric classification of the scaphopod mollusca. Veliger 17: 115–123.

Pojeta, J. Jr. & B. Runnegar, 1979. *Rhytiodentalium kentuckyensis*, a new genus and new species of Ordovician scaphopod and the early history of scaphopod mollusks. Journal of Paleontology 53: 530–541.

Roberts, J., 1975. Early Carboniferous Brachiopod zones of eastern Australia. Journal of the Geological Society of Australia 22(1): 1–32.

——— 1987. Carboniferous faunas: their role in the recognision of tectonostratigraphic terranes in the Tasman Belt, eastern Australia. pp. 93–102. **In** Leitch, E.C. & Scheibner, E. (eds). Terrane Accretion and Orogenic Belts. A.G.U. Geodynamic Series, Vol. 19.

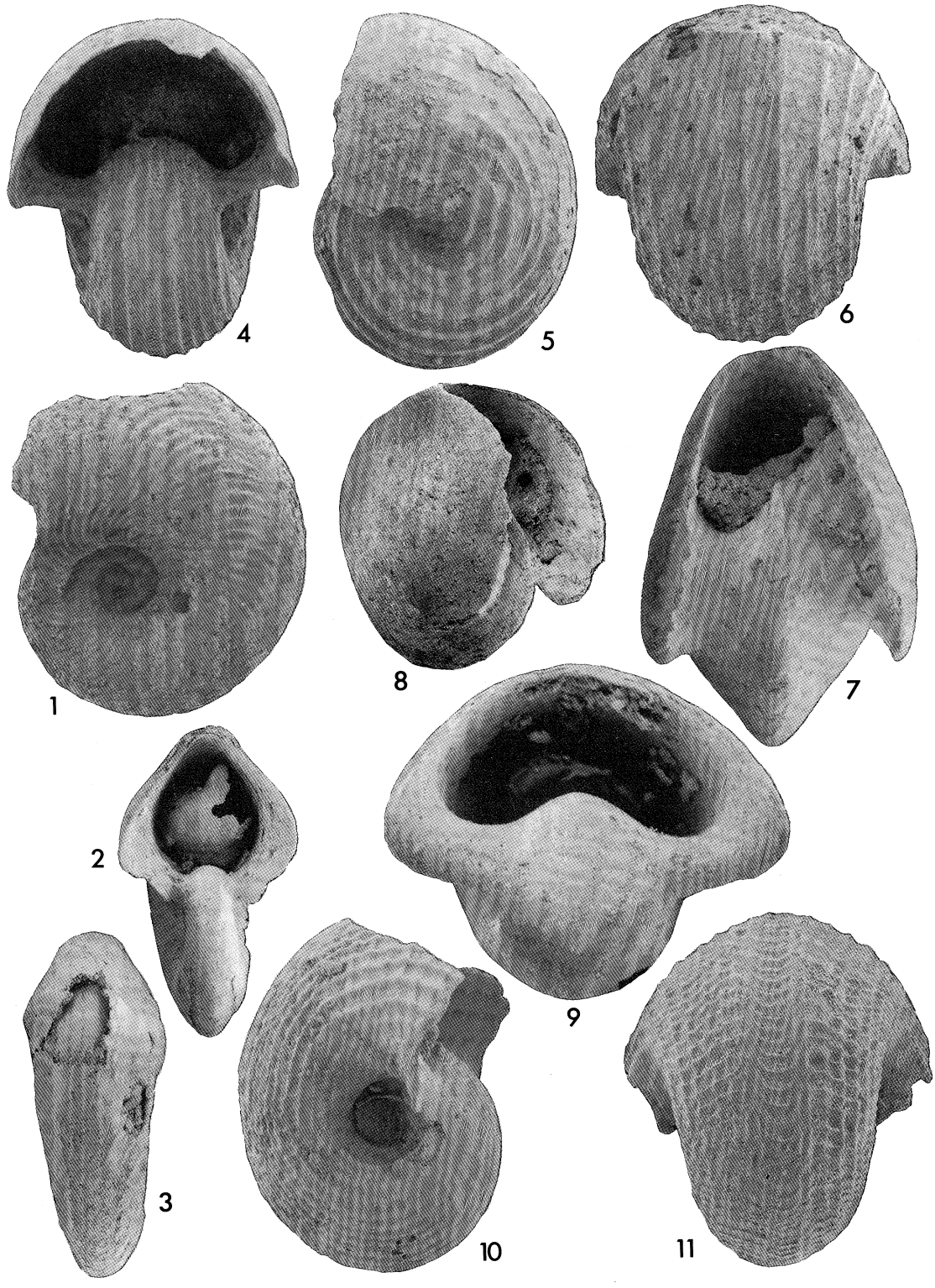
Roberts, J. & B. Oversby, 1974. The Lower Carboniferous geology of the Rouchel District, New South Wales. Bulletin of the Bureau of Mineral Resources Australia 147: 1–93.

Thein, M.T. & M.H. Nitecki, 1974. Chesterian (Upper Mississippian) gastropoda of the Illinois Basin. Fieldiana (Geology) 34: 238 pp., 103 figs, 70 tables.

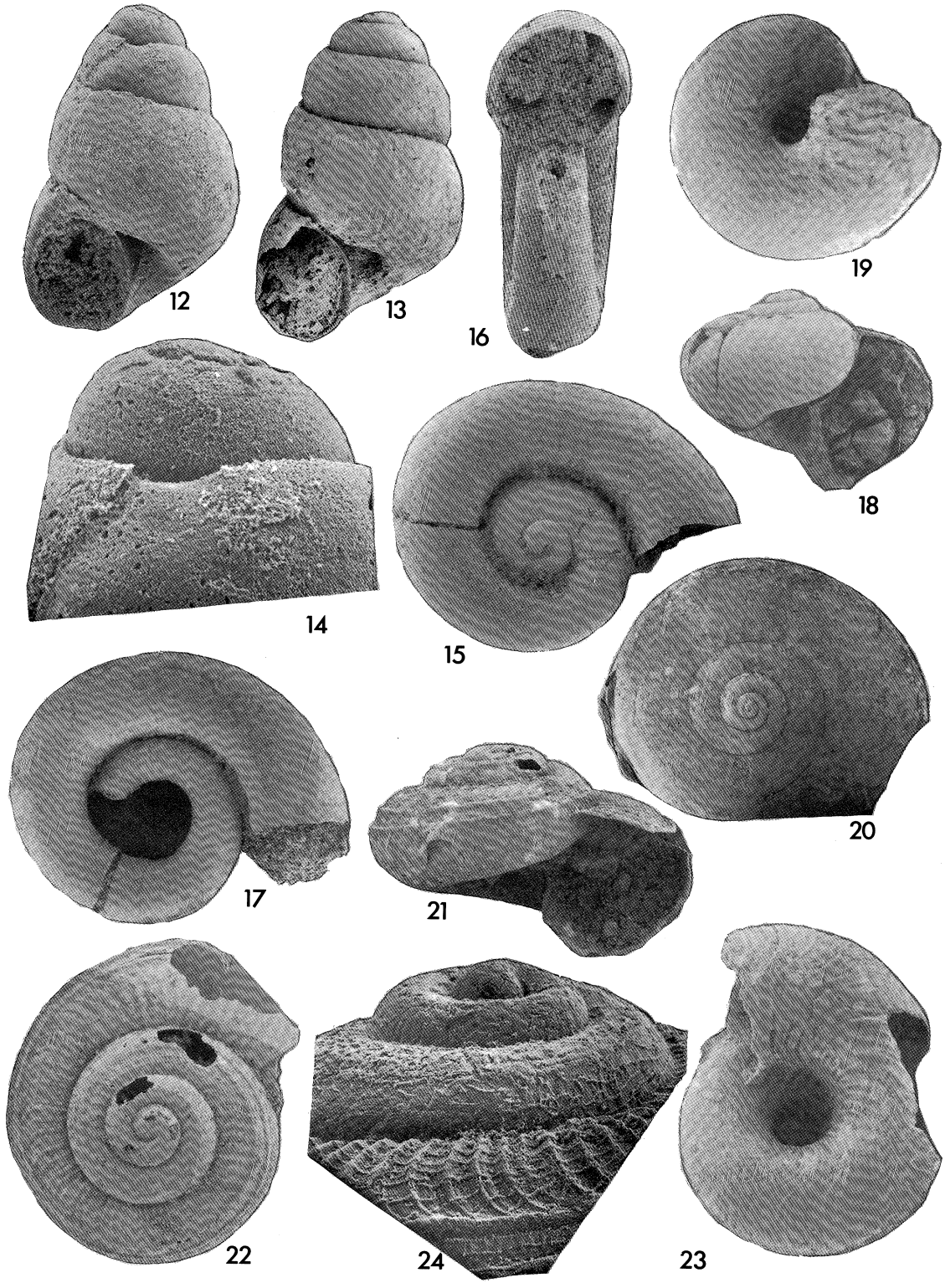
Thomas, E.G., 1940. Revision of the Scottish Carboniferous Pleurotomariidae. Transactions of the Geological Society of Glasgow 20: 30–72, pls 1–4.

Yoo, E.K., 1982. Geology and palaeontology of an area between Brushy Hill and Gundy, Upper Hunter Valley. MSc Thesis, University of Sydney (unpublished).

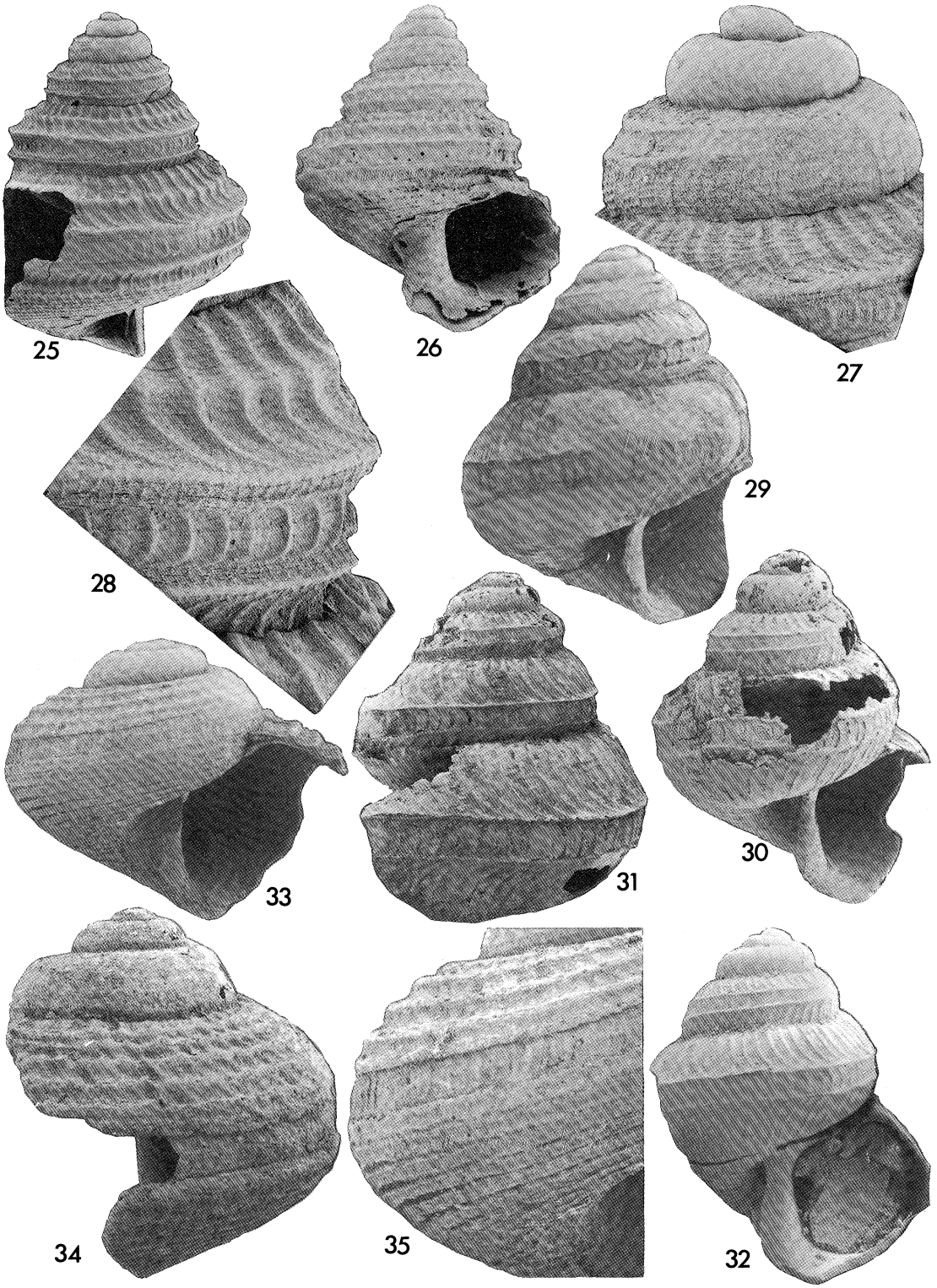
Accepted 1 October 1987



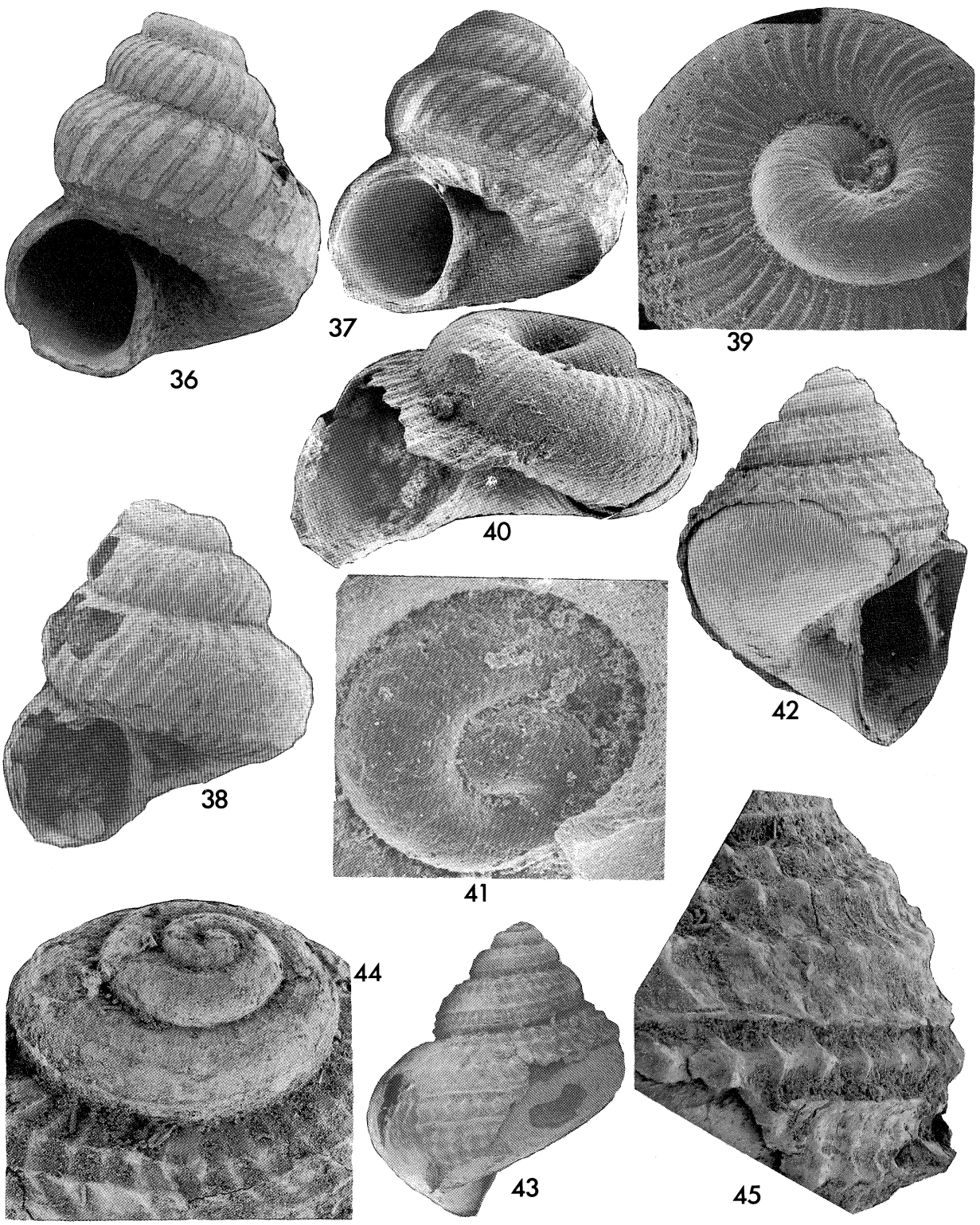
Figs 1–11. **1–3** *Sinuitina portulacoides* Campbell & Engel. **1.** left lateral view, X28; **2.** apertural view, X20; **3.** anterior dorsal view, X35. Locality A–3 (F.61940). **4–6** *Euphemites* cf. *labrosa* Campbell & Engel. **4.** apertural view, X53. **5.** left lateral view, X48. **6.** anterior dorsal view, X30. Locality A–3 (F.61941). **7–8** *Sinuitid* n.gen. et n.sp. **7.** apertural view, X28. **8.** oblique right lateral view of same specimen, X20. Locality C–34 (F.61942). **9–11** *Knightites* (*Retispira*) *culleni* Campbell & Engel. **9.** apertural view, X17. **10.** right lateral view, X46. **11.** anterior dorsal view, X38. Locality A–3 (F.61943).



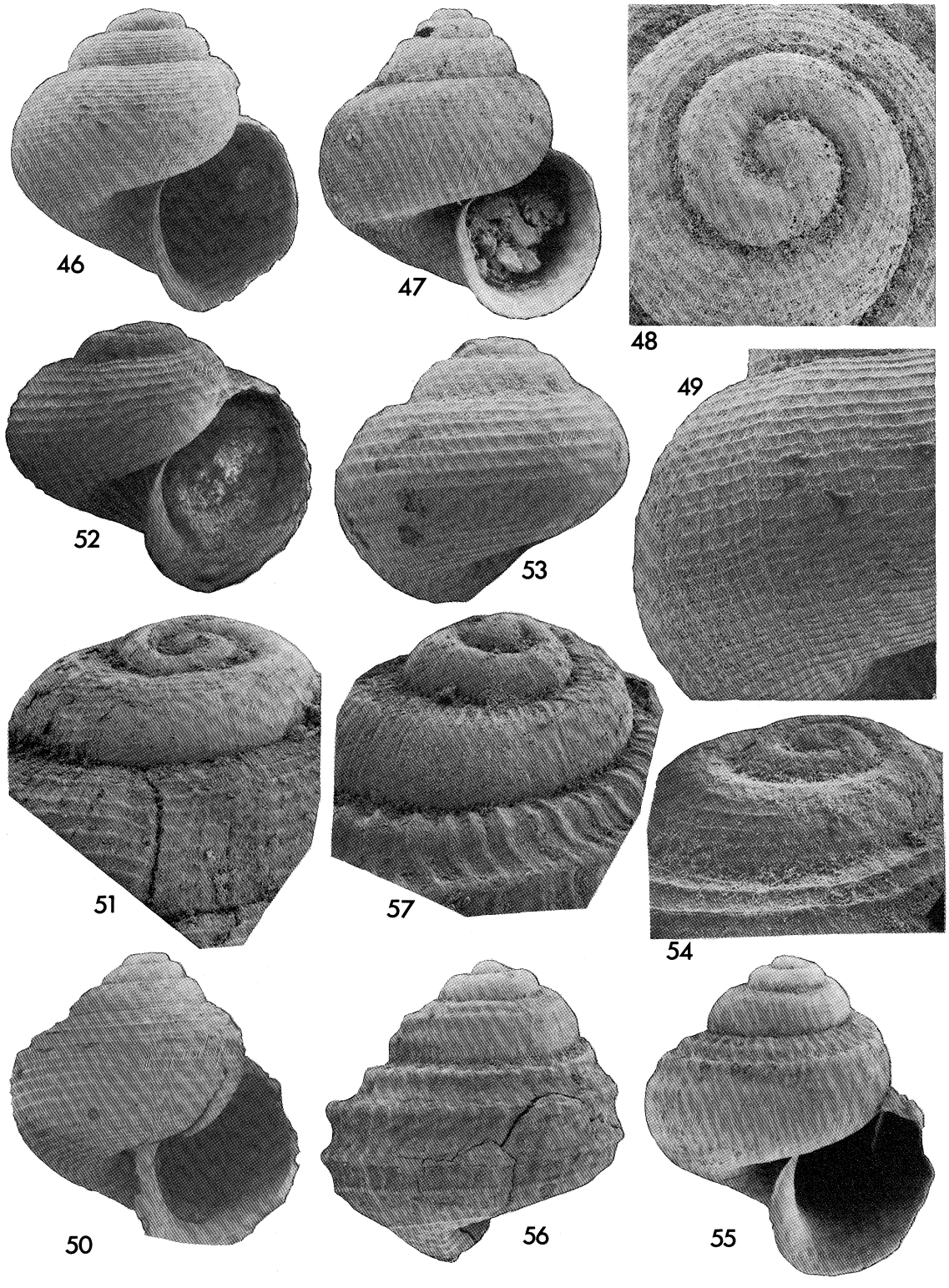
Figs 12–24. **12—14** *Onychochilus minutissimus n.sp.* **12.** apertural view of holotype, X66 (F.61944). **13.** apertural view of paratype, X60 (F.61945). **14.** protoconch of holotype, X230. Locality A–4. **15–17** *Straparollus* (*Straparollus*) sp. **15.** apical view, specimen is incomplete, X85. **16.** apertural view, X60. **17.** umbilical view, early whorls are broken, X45. Localities A–3 (F.61946) and C–34 (F.62004). **18–20** *Trepospira* (*Angyomphalus*) sp. **18.** apertural view, juvenile, X25. **19.** umbilical view, X40. **20.** apical view, X30. Locality A–3 (F.61947). **21–24** *Eotomaria* sp. **21.** apertural view, X50. **22.** apical view, X45. **23.** umbilical view, X50. **24.** protoconch, X120. Localities A–3 (F.61948) and A–4 (F.62005)



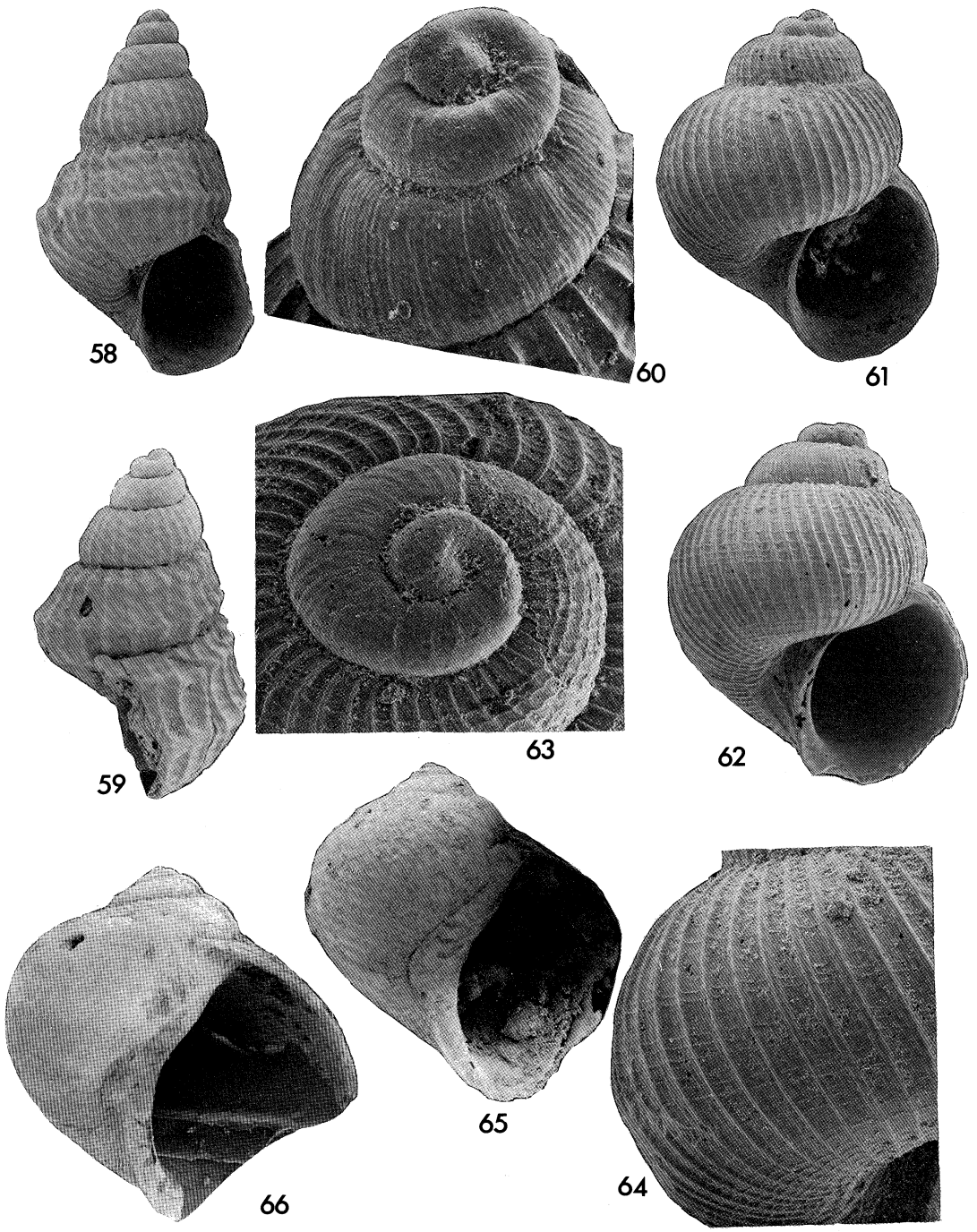
Figs 25–35. **25–28** *Borestus costatus* n.sp. **25.** apertural view of holotype, X18 (F.61956). **26.** apertural view of paratype, X18 (F.61957). **27.** protoconch of holotype, X140. **28.** microsculpture of teleoconch of holotype, X140. Locality C–34. **29–32** *Peruvispira gundyensis* n.sp. **29.** apertural view of holotype, X21. **30.** apertural view of paratype, X25. **31.** side view of paratype, X17. **32.** apertural view of paratype, X26. Locality C–34, holotype (F.61950); paratypes (F.61951). **33–35** *Glabrocingulum obesum* n.sp. **33.** apertural view of holotype, X38. **34.** side view of paratype, X38. **35.** microsculpture of last whorl of holotype, X65. Locality A–4, holotype (F.61952); paratype (F.61953).



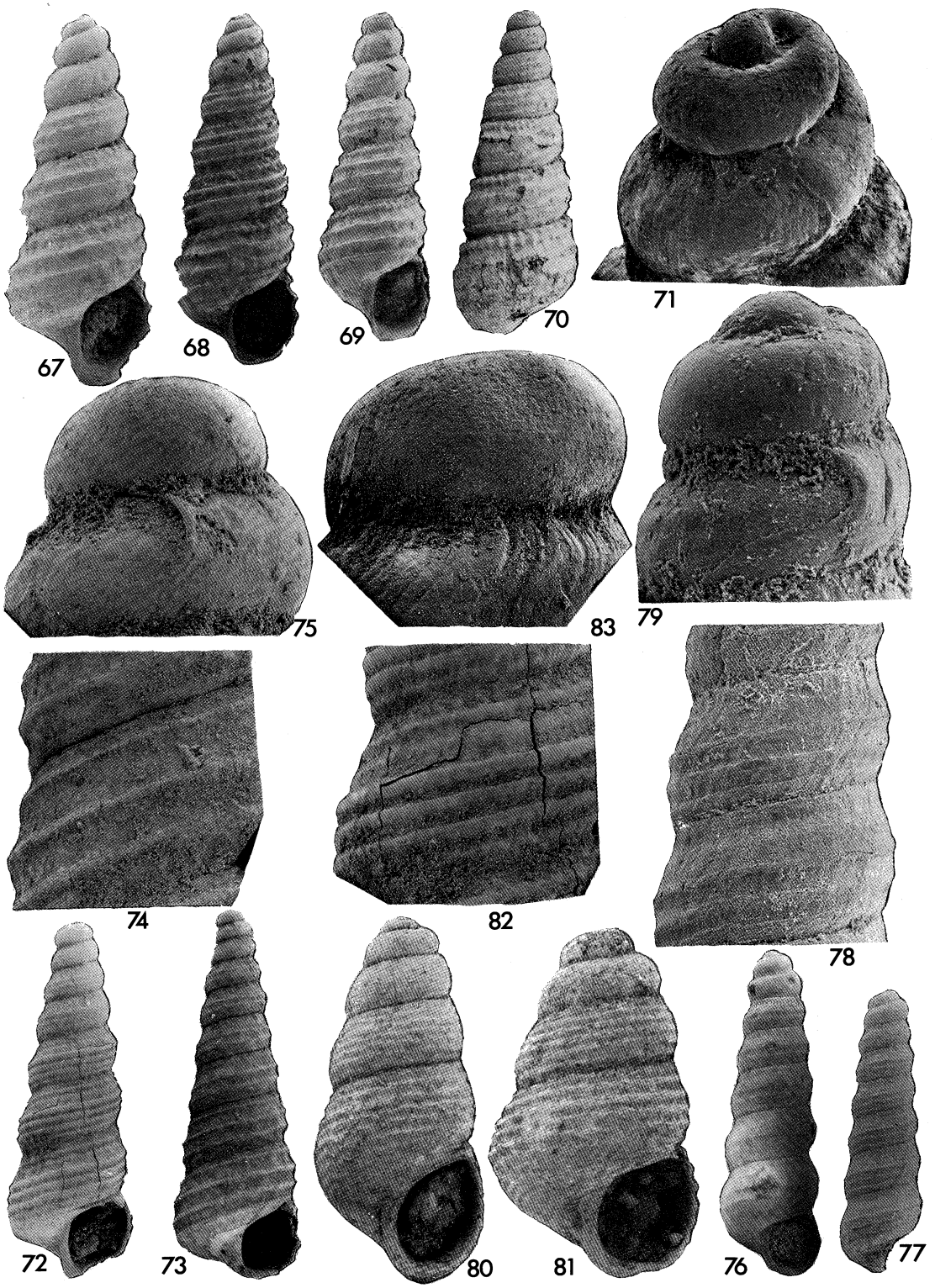
Figs 36–45. **36–41** *Hesperiella robertsi* n.sp. **36.** apertural view of holotype, X18 (F.61954). **37.** oblique umbilical view of holotype, X20. **38.** apertural view of paratype, X23 (F.61955). **39.** apical view of protoconch, X60 (F.62003). **40.** side view of apical whorls, X40 (F.62003). **41.** umbilical view of protoconch, X120 (F.62003). Localities C–34 (36–38) and A–3 (39–41). **42–45** *Paragoniozona* sp. **42.** apertural view, X28. **43.** dorsal view, X20. **44.** protoconch, X60. **45.** microsculpture of teleoconch, X65. Locality A–3 (F.61949).



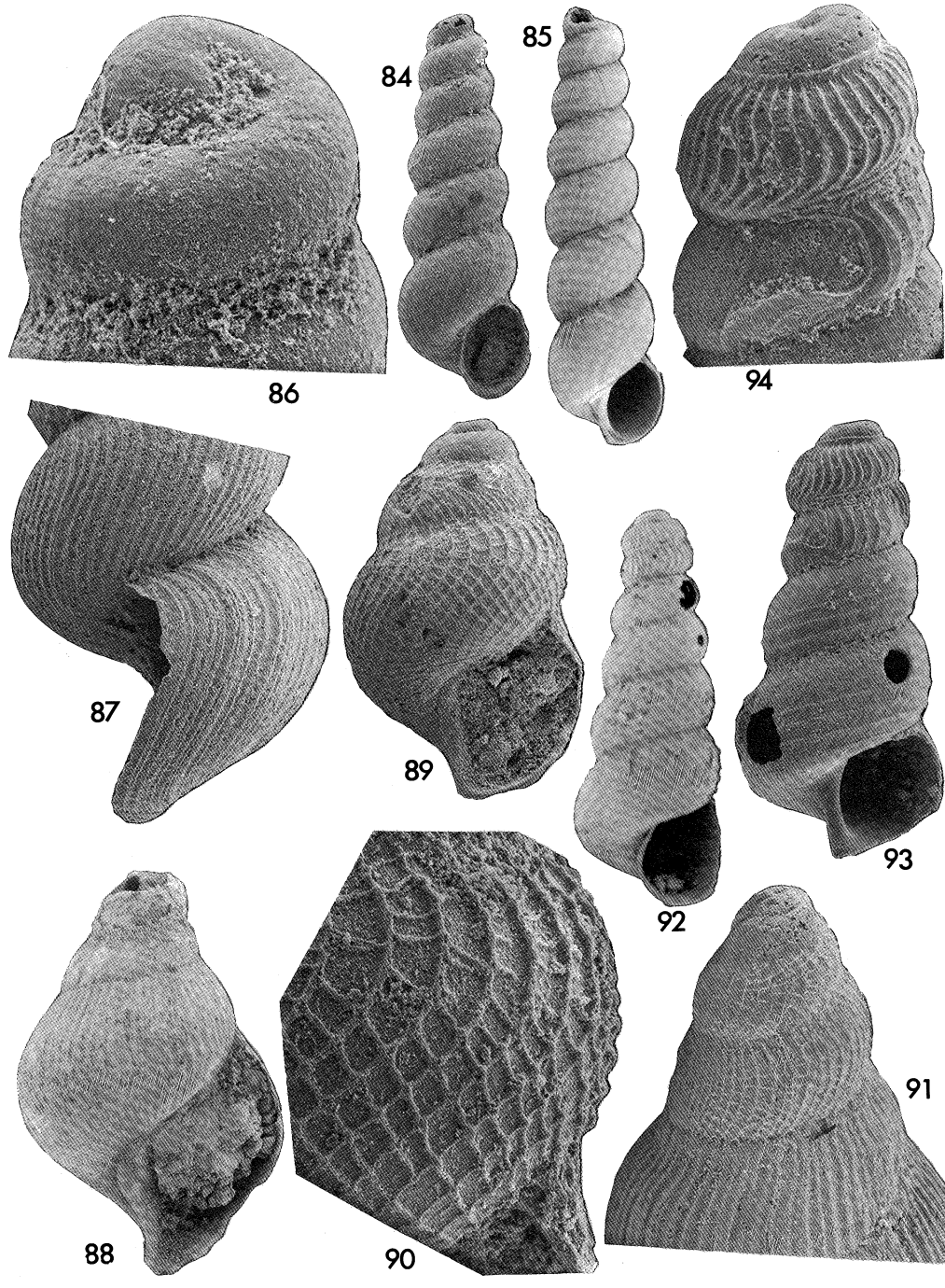
Figs 46–57. **46–49** *Araeonema microspirulata* n.sp. **46.** apertural view of holotype, X40 (F.61958). **47.** apertural view of paratype, X30 (F.61959). **48.** apical view, X120. **49.** microsculpture of teleoconch of holotype, X100. Locality A–4. **50–51** *Rhabdotocochlis* sp. **50.** apertural view, X18. **51.** protoconch of Fig. 50, X85. Locality A–3 (F.62002). **52–54** "*Rhabdotocochlis*" sp. **52.** apertural view, X34. **53.** dorsal view, X36. **54.** protoconch. Locality A–3 (F.62002). **55–57** *Worthenia* sp. **55.** apertural view, X38. **56.** dorsal view, X38. **57.** protoconch of Fig. 55, X88. Locality A–3.



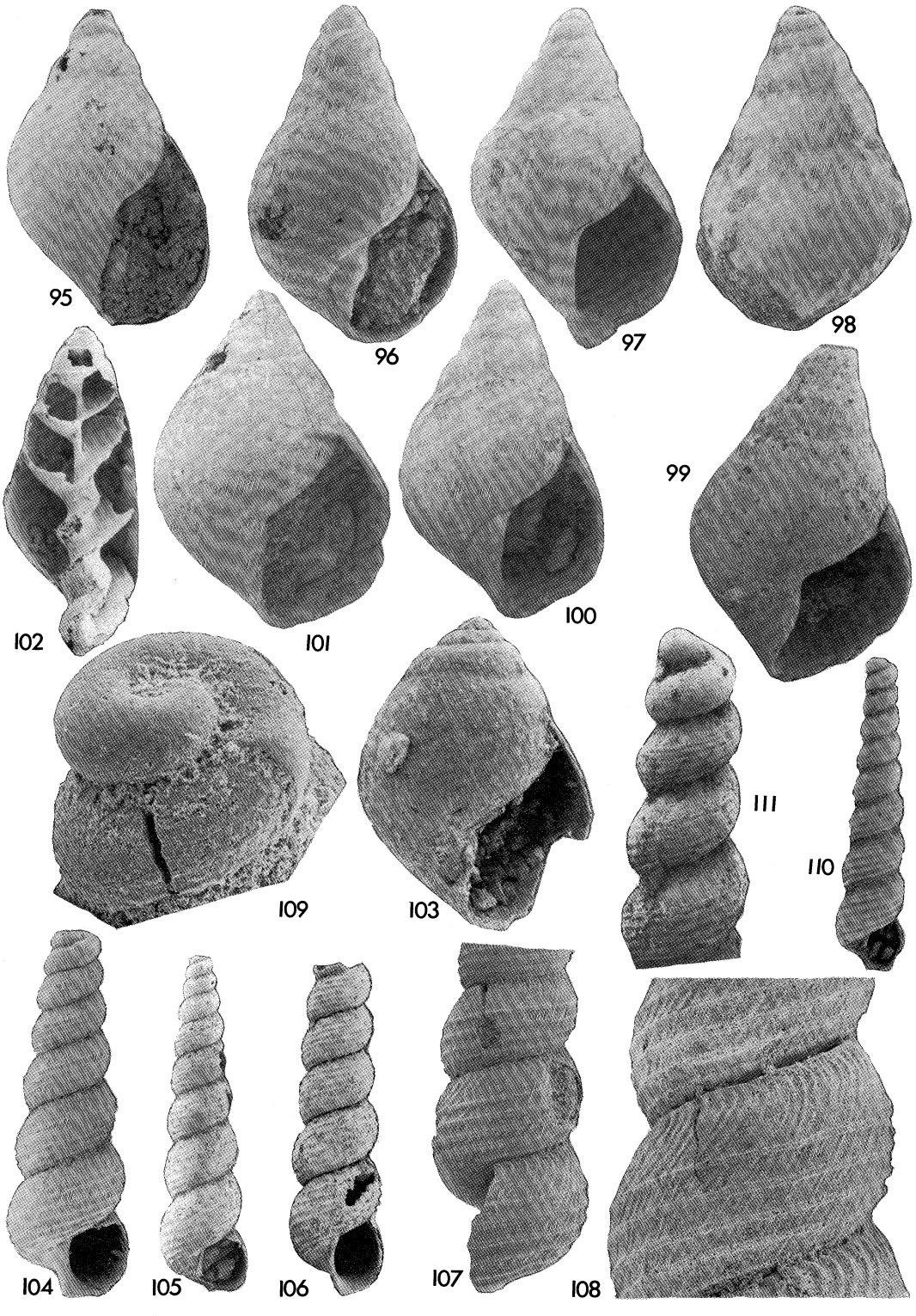
Figs 58–66. **58–60** *Microdoma angulata* n.sp. **58.** apertural view of holotype, X25 (F.61960). **59.** side view of paratype, X23 (F.61961). **60.** protoconch, X145. Locality A–3. **61–64** *Eucochlis australis* n.sp. **61.** apertural view of holotype, X39 (F.61962). **62.** apertural view of paratype, X36 (F.61963). **63.** apical view of paratype, X110. **64.** microsculpture of teleoconch of holotype, X83. Locality A–3. **65–66** *Naticopsis* (*Naticopsis*) *osbornei* n.sp. **65.** apertural view of holotype, X22 (F.61964). **66.** apertural view of paratype, X24 (F.61965). Locality C–34.



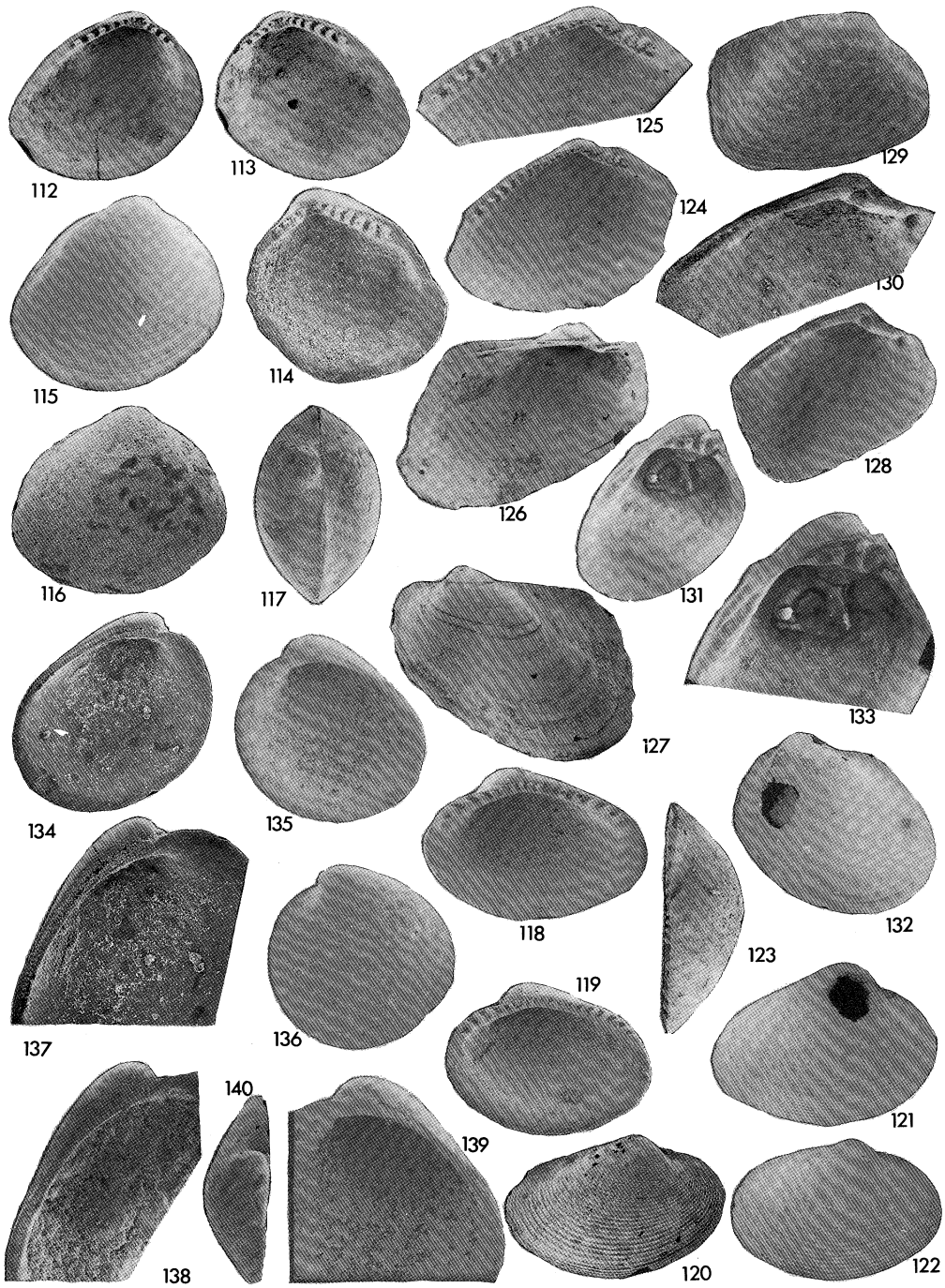
Figs 67–83. **67–71** *Stegocoelia* (*Stegocoelia*) *nodosa* n.sp. **67.** apertural view of paratype, X23. **68.** apertural view of holotype, X37. **69.** apertural view of paratype, X25. **70.** dorsal view of paratype, X18. **71.** protoconch of paratype, X110. Locality A–3, holotype (F.61968) and paratypes (F.61969). **73–75** *Stegocelia* (*Hypergonia*) *elongata* n.sp. **73.** apertural view of holotype, X18 (F.61970). **74.** teleoconch spiral sculpture of holotype, X60. **75.** protoconch of holotype, X190. Locality A–4. **76–79** *Stegocoelia* (*Hypergonia*) *tenuis* n.sp. **76.** apertural view of holotype, X45 (F.61972). **77.** apertural view of paratype, X40 (F.61973). **78.** teleoconch of paratype, X130. **79.** protoconch of paratype, X200. Locality A–4. **72,82,83** *Stegocoelia* (*Hypergonia*) sp. **72.** apertural view, X17. **82.** teleoconch sculpture, X60. **83.** protoconch, X180. Locality A–4. **80–81** *Aclisina turgida* n.sp. **80.** apertural view of holotype, X27 (F.61966). **81.** apertural view of juvenile specimen, X55. Locality C–34.



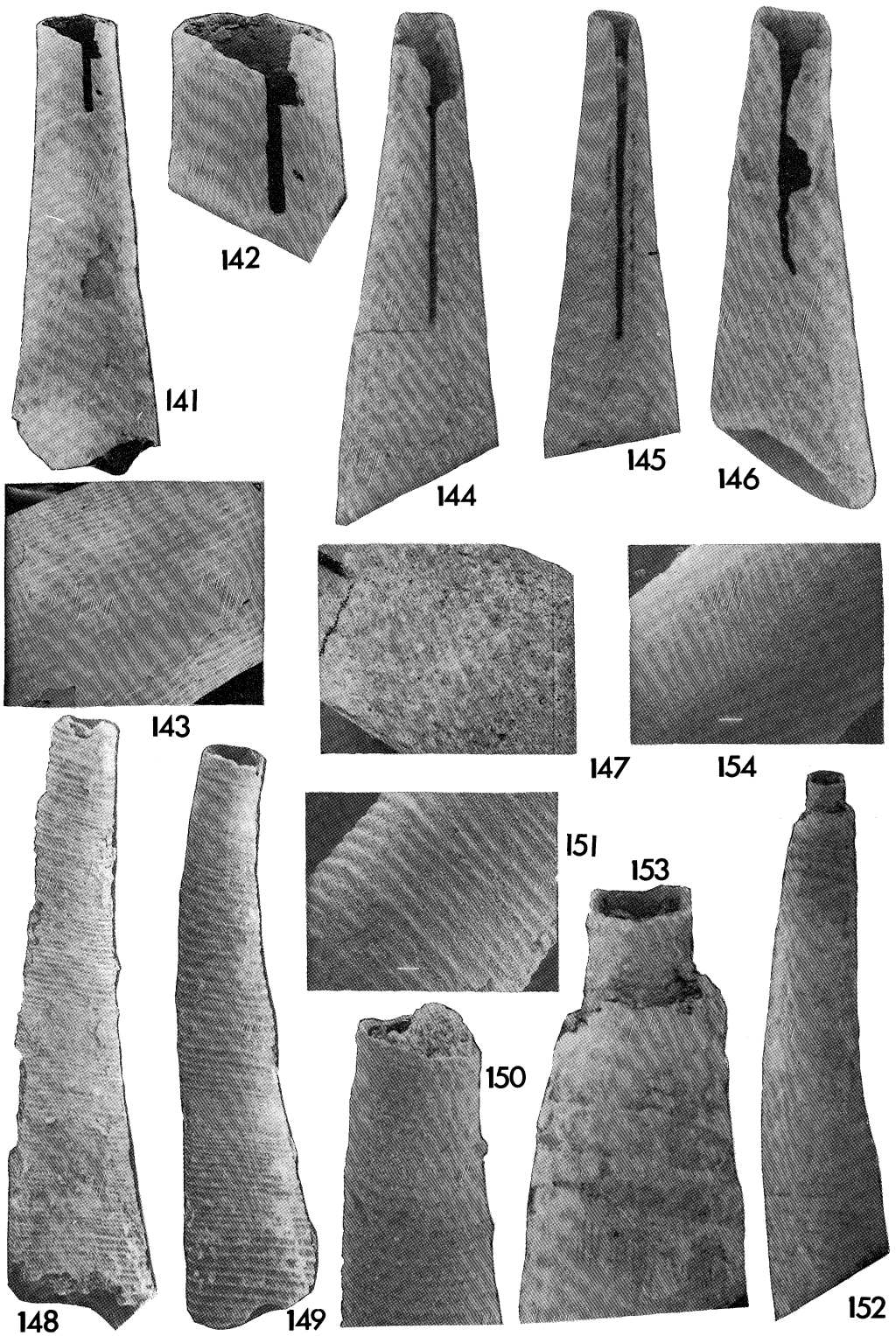
Figs 84–94. **84–87** *Loxonema elegantissima* n.sp. **84.** apertural view of holotype, X40 (F.61974). **85.** apertural view of paratype, X25 (F.61975). **86.** protoconch of paratype, X230. **87.** microsculpture of last whorl of paratype, side view, X96. Locality A–4. **88–91** *Hemizyga* (*Hemizyga*) *decussata* n.sp. **88.** apertural view of holotype, X28 (F.61976). **89.** veliger larval shell, X60 (F.61977). **90.** reticulate microsculpture of veliger shell, X200. **81.** protoconch and first whorl of teleoconch, X60. Locality A–3. **92–94** *Cyclozyga sinusigera* n.sp. **92.** apertural view of holotype, X38 (F.61978). **93.** apertural view of paratype, X75 (F.61979). **94.** protoconch of paratype, X180. Locality A–3.



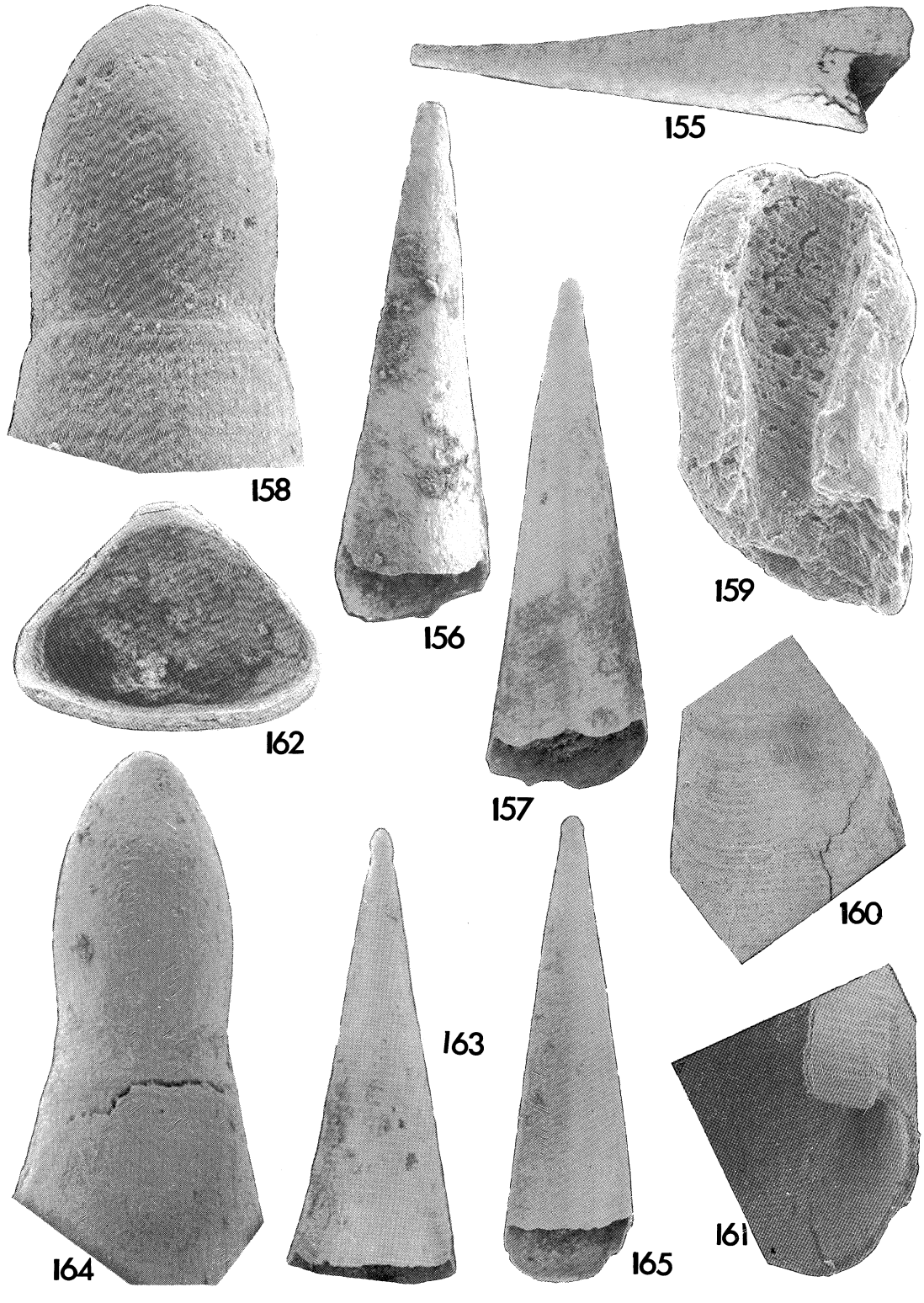
Figs 95–111. **95–102** *Soleniscus callosus* n.sp. **95.** apertural view of paratype, X36. **96.** apertural view of paratype, X36. **97.** apertural view of paratype, X32. **98.** apetural view of paratype, X22. **99.** apertural view of paratype, X38. **100.** apertural view of holotype, X28. **101.** apertural view of paratype, X38. **102.** broken section of shell, showing columella plates, X26. Locality A–3, holotype (F.61980); paratypes (F.61981). **103** *Ianthinopsis* sp. apertural view of shell, X27. Locality A–4. **104–109** *Donaldina filosa* n.sp. **104.** apertural view of paratype, X40 (F.61983). **105.** apertural view of holotype, X30 (F.61982). **106.** apertural view of paratype, protoconch broken, X23. **107.** side view of paratype, protoconch broken, X70. **108.** microsculpture of teleoconch of paratype, X120. **109.** protoconch of paratype, X180. Locality A–4. **110–111** *Donaldina* sp. **110.** apertural view, X24. **111.** deviated protoconch, X80. Locality C–34 (F.61984).



Figs 112–140. **112–117** "*Nucula*" sp. **112.** right valve; **113–116.** left valves. **117.** dorsal view. Locality A–3, all X35 (F.61985). **118–123** "*Nuculopsis*" sp. **118–122.** left valves; **123.** dorsal view. Locality A–4, all X25 (F.61986). **124–125** *Palaeoneilo acarinata* Campbell & Engel. **124.** right valve X20; **125.** enlarged hinge part, X40. Locality A–4 (F.61987). **126–127** *Parallelodon fossa* (Campbell & Engel). **126–127.** right valves X15. Locality A–3 (F.61988). **128–130** *Edmondia* sp. **128.** right valve, X15; **129.** left valve, X20. **130.** enlarged hinge of Fig. 128, X28. Locality A–3 (F.61989). **131–133** *Limopsid bivalves* n.gen. et n.sp. **132–133.** right valves, X15. **133.** enlarged hinge of Fig. 131, X28. Locality A–4 (F.61990). **134–140** *Mordiomorphoid bivalves* n.gen. et n.sp. **134,135.** right valves, X35; **136.** left valve, X35. **137.** enlarged hinge of Fig. 134, X50. **138.** enlarged hinge, X55. **139.** enlarged hinge of Fig. 135, X45. **140.** dorsal view, X35. Locality A–4 (F.61991).



Figs 141–154. **141–143** *Fissidentalium? longistriatum* n.sp. **141.** holotype, X23, anterior end damaged (F.61992). **142.** posterior end showing the slit, X80. **143.** shell ornamentation showing the longitudinal striae and growth lines, X100. Locality A–3. **144–147** *Scissuradentalium runnegari* n.gen. et n.sp. **144.** holotype, X15, anterior end damaged (F.61994). **145–146.** paratypes, X13 (F.61995). **147.** smooth shell surface showing a part of slit, X45. Locality A–3. **148–151** *Plagioglypta numerosa* n.sp. **148.** holotype, X26 (F.61996). **149.** paratype, X30 (F.61997) shell ornamentation showing rhythmic annulation. **150.** posterior end. **151.** shell ornamentation showing strong annulation. Locality A–3. **152–154** *Pipadentalium protruberans* n.gen. et n.sp. **152.** holotype, X15, anterior end damaged (F.61998). **153.** posterior end showing a pipe. **154.** shell ornamentation showing fine longitudinal lirae and weak annulations, X30. Locality A–3.



Figs 155–165. **155,157–162,165** *Hyolithes minutissimus* n.sp. **155.** side view of paratype, slightly curved near posterior end, X23 (F.62001). **157.** dorsal view of holotype, X22 (F.62000) **158.** embryonic shell, showing smooth shell surface and fine transverse ornamentation on early stage, X280. **159.** inside embryonic chamber, X280. **160.** transverse ornamentation on ventral side, X50. **161.** part of shelf, showing ornamentation of inside and outside the shell, X60. **162.** triangular transverse section, X60. **165.** dorsal view of shell, X25 (F.62001). Locality C–34. **156,163–164** *Hyolithes* sp. **156.** dorsal view of shell, X27. **163.** dorsal view of shell, X23. **164.** embryonic shell; elongate with sharp apex, X300. Locality C–34.