

LATE EOCENE AND EARLY OLIGOCENE TURRIDAE
(GASTROPODA: PROSOBRANCHIATA) OF THE BROWN'S CREEK
AND GLEN AIRE CLAYS, VICTORIA, AUSTRALIA

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Abstract

Over 50 species of fossil gastropod belonging to the family Turridae or to turrid like genera occur in the late Eocene Brown's Creek Clay and the early Oligocene Glen Aire Clay of south west Victoria, Australia. As with other fossils from these deposits distinctive assemblages can be identified for various horizons—in this case BC1 and BC3 in the Brown's Creek Clay, and the horizon present at Geological Survey of Victoria locality AW1 in the Glen Aire Clay. Evidence from the turrids would thus give local stratigraphic correlations and it tends to support wider correlations achieved by other means. One specific identification is made with a New Zealand fossil of approximately the same age and there is evidence of common elements, some localised, in the late Eocene turrid faunas of the two areas. At the generic level the turrid fauna indicates conservatism; twelve possibly, thirteen, of the genera reported in this paper are still present in Australasian and Indo-Pacific waters.

New taxa proposed are: *Comitas wynyardensis cudmorei* subsp. nov., *Makiyamaia victoriae* sp. nov., *Apiotoma? wilkinsoni* sp. nov., *Johannaia darraghi* gen. et. sp. nov., *Marshallaria otwayensis* sp. nov., *Paramarshallena propebelloides* gen. et. sp. nov., *Turrinosyrinx denticulata* sp. nov., *Gemmula (Clavogemmula) prima* subgen. et sp. nov., *Borsonia tatei eocenica* subsp. nov., *Cryptocordieria variabilis* gen. et sp. nov., *Splendrilla hughesi* sp. nov., *Mauidrillia secta otwayensis* subsp. nov., *Conorbis atractoides otwayensis* subsp. nov., *Guraleus eocenicus* sp. nov., *Macteola eocenica* sp. nov., *Syngenchilus johannaensis* sp. nov., *Parasyngenchilus eocenicus* gen. et. sp. nov., *P. angustior* sp. nov.

Introduction

This paper is based on collections of fossils in the National Museum of Victoria, with some additional material from the collection of the writer. Three horizons are involved (Text Figure 1):

Locality FL11, BC1, 7.6 m dark grey clay with *Turritella* below greensand in Brown's Creek Clay, Washout 1 nearest Brown's Creek, Grid Reference Aire 277177; late Eocene (Abele *et al.*, 1976:225);

Locality FL13, BC3, 16 m of dark gritty clay above greensand, Brown's Creek Clay, Washout 1, Aire 277177, and FL14, BC3, dark gritty clay in Washout 2, forked gully nearest mouth of Johanna River, Aire 276179; late Eocene (Abele *et al.*, 1976:225);

Locality FL19, Geological Survey of Victoria locality AW1, Glen Aire Clay, Point Flinders, Cape Otway, Victoria, Aire 367097; early Oligocene (Abele *et al.*, 1976:226).

Although nearly 120 molluscan species have been described from the Australian Eocene and early Oligocene, nearly all by Tate (1878, 1886, 1888, 1890, 1893) from Blanche Point, Aldinga or from the Adelaide (Kent Town) Bore both South Australia, these include only nine names proposed for members of the turridae. No new

species of Mollusca have yet been described from the Brown's Creek Clay though the fauna is under study by T. A. Darragh, National Museum of Victoria. That this fauna is incompletely described is owing partly to the size of the problem facing palaeontologists working on the Australian Tertiary, partly owing to the inaccessibility of some of the localities, and also to the difficulties faced by early workers in dating Australian marine Tertiary deposits on a global basis. It is the aim of this report to fill one gap by description of the late Eocene and early Oligocene Turridae of Victoria.

Classification

The family Turridae Swainson, 1840 (emended), with the Conidae and Terebridae forms a heterogenous part of the Superfamily Conacea within the Prosobranch Suborder Stenoglossa. It is distinguished by the members possessing a more or less toxoglossate radula and, in general, fusiform shells with a pronounced posterior sinus produced by the mantle edge curving round the anal siphon. The inner shell of the spire whorls is not, except in the genus *Conorbis*, resorbed as it is in the Conidae. Within these criteria the genera of the family exhibit a considerable variety of form

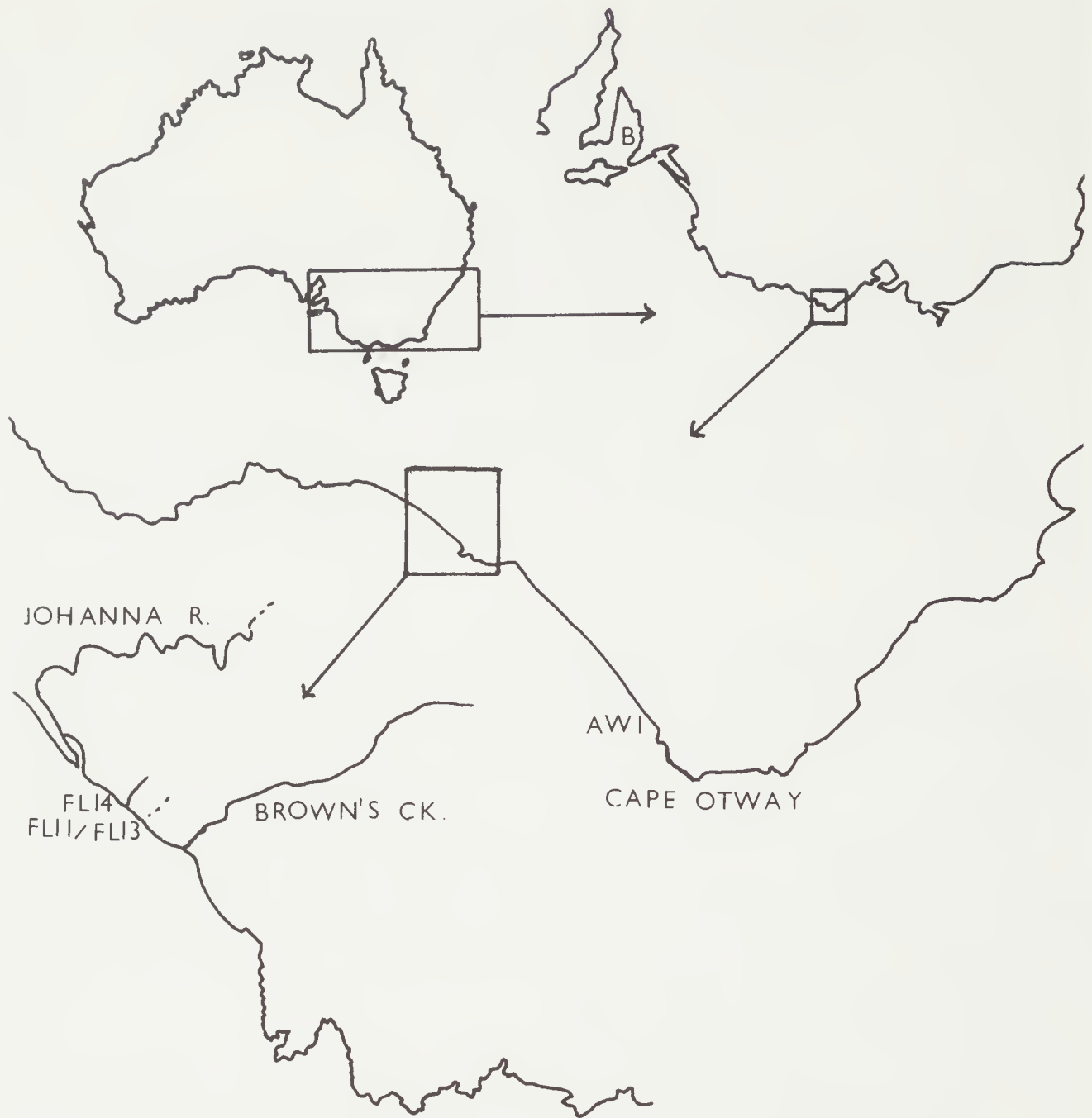


Fig. 1. Late Eocene-Early Oligocene fossil localities.
B=Blanche Point Aldinga.

often closely resembling genera of other families such as the Pyrenidae, Mitridae, or Buccinidae.

Various features have been used to attempt subfamilial classifications of the Turridae—the operculum or its absence (Fischer, 1887), the protoconch (Hedley, 1922, in conjunction with the operculum), the radula (Thiele, 1929), or, more recently a combination of characters (Powell, 1942; Powell, 1966; McLean, 1971). These latter classifications appear to be a better approximation to natural groupings than the earlier ones, but all such classifications must contain areas of uncertainty which derive partly from the great fossil and Recent diversity of the Turridae and partly from the fact that the vast majority of Recent species are still known only from shells.

The position is further complicated when dealing with fossils because one is forced ultimately to work from analogies with the shells of the Recent fauna. With the Turridae the only diagnostic shell feature for the family is the posterior sinus, and though a clearly identifiable sinus is a positive indicator for the family placement, its absence does not definitely eliminate a shell from consideration as a turrid. For this reason the ascription of many genera and species to the Turridae is doubtful, and further examples are given here, since a notable proportion of the Eocene and early Oligocene turrid-like fossils found in Victoria have a weak to very weak posterior sinus which makes their subfamilial or even familial placement uncertain.

The subfamilial divisions and order advocated by Powell (1966) have been used in this paper as they seem reasonably well adapted to the Australasian region, although the species of *Turrinosyrinx* and *Rugobela* dealt with below illustrate the difficulty of relying on shell characters to determine subfamilial classifications in the Turridae. In the Victorian Eocene and early Oligocene turrids are found which would fall into the Subfamilies Cochlespirinae,* Turrinae, Borsoniinae, Clavinae, Conorbiinae Mangeliinae and, atypically, the Daphnellinae.* Species whose familial placement is uncertain are dealt with at the end of the systematic descriptions.

Terminology and Definitions

For the purposes of this report the shell is basically divided into two portions:

- (a) the protoconch which is the larval shell and here includes parts of the shell grown during the planktonic larval stage; the sculpture differs from the teleoconch;
- (b) the teleoconch which includes the shell formed during immaturity, adulthood and old age.

The junction between the protoconch and teleoconch may be sharp and clearly defined, or there may be no clear break as elements of the teleoconch successively develop.

The term posterior sinus describes the adapical curvature of the outer lip of the aperture. This may be located in a sulcus. Most of the fossils considered here have suffered apertural damage and the shape of the posterior sinus has had to be deduced from the curvature of the axial growth lines.

All measurements are in millimetres.

L (Length) is the distance from the tip of the protoconch to the distal end of the anterior canal;

B (Breadth) is the maximum diameter of the body whorl at its periphery;

S (the Spire Height) is measured from the posterior suture at the top of the aperture to the tip of the protoconch.

Whorl counts are given separately for the protoconch and teleoconch.

Registration numbers prefixed with a P are those of the National Museum of Victoria (NMV); numbers prefixed with EA, EB, or EW are for material in the writer's collection.

Discussion

The major features of the three diverse faunas reviewed here are generic conservatism—many genera still live in Australasian

* Following Cernohorsky (1972b: 127), Cochlespirinae Powell, 1942 is used in preference to Turriculinae Powell, 1942 (*non* Turriculidae Carpenter, 1861, Turriculinae A. Adams, 1864). The writer uses Daphnellinae Casey, 1904 pending resolution of whether Raphitominae Bellardi, 1875 has priority for this subfamily.

and Indo-Pacific waters* or have long fossil records†—coupled with relatively rapid specific change as the listing of the fauna in Table 1 and the species level comparisons in Table 2 show. These reflect abilities to simultaneously maintain existing forms and evolve new lineages which appear to be characteristic of the Turridae throughout the Cenozoic since collation of the time range data on the family, worldwide, contained in Powell (1966) suggests that the proportion of genera implied as surviving from earlier epochs was about 5% in the Paleocene, 15% in the Eocene, 56% in the Oligocene and Miocene, 82% in the Pliocene and 96% in the Pleistocene, while new genera appeared at an approximate rate of 1.3 genera: MYr in the Paleocene, 3.8: MYr from the Eocene to the end of the Pliocene, and 2.7:MYr in the Pleistocene.

Because of this generic conservatism the turrids are mostly poor indicators of general age. However the presence of *Johannaia* (possibly allied to the Palaeocene *Eopleurotoma*) in BC1, *Tholitoma* (otherwise Paleocene—late Eocene New Zealand) in BC3, *Turrinosyrinx* (elsewhere Palaeogene) in all three faunas, *Marshallaria* (otherwise Palaeocene-Oligocene New Zealand) in AW1, and *Conorbis* (mainly Cretaceous-Oligocene) in BC3 and AW1 suggests that the faunas are Palaeogene.

Specific and subspecific changes between BC1 BC3 and AW1 clearly indicate that three separate faunal horizons are involved. No horizon has more than 41% of its species in common with any other (BC1 with BC3, Table 2). No identifications have been made with any species occurring later than the Longfordian (early Miocene)—*Syngenchilus radiapex*, again supporting a Palaeogene dating in general. More constraining is the specific identity of several turrids‡ with those occurring in the Blanche Point Formation at Aldinga,

South Australia. This phenomenon is best marked in the BC3 fauna; in BC1 and AW1 species in common with the Blanche Point Formation are nearly all recognizably different subspecifically. These findings are consistent with micro-palaeontological evidence (Abele *et al.*, 1976: 225-226), and it is not surprising that the turrids should have some local correlative value as this has already been demonstrated in other south east Australian Cenozoic mollusca (Darragh 1969, 1971).

The marked decrease in diversity in the AW1 turrid fauna compared with BC3—9 fewer genera and 12 fewer species—may possibly be associated with the major climatic cooling event at the Eocene-Oligocene boundary for which there is a mounting body of evidence (e.g. Keigwin, 1980). There is some evidence that benthic molluscan faunas were affected: Marinovich (1977:200) reported that the greatest extinction among Cenozoic naticids of western North America occurred at the close of the Eocene, and that early Oligocene naticids in the area suggested a distinctly cooler shallow-water hydro-climate than the late Eocene, and the reduction in the number of Indo-Pacific migrants into the New Zealand fauna in the Runangan stage (Fleming, 1967) may also be related. Furthermore data in Powell (1966) suggests that the Turridae in general were affected since about 46% of the genera whose presence is implied in the Eocene did not survive into the Oligocene while the corresponding Oligocene-Miocene figure is about 12%. When considered in detail, however, the evidence from the AW1 turrid fauna is inconclusive as an indicator of major palaeoenvironmental deterioration as there is as yet insufficient information on the distribution and temperature tolerances of the genera involved.

The three turrid faunas are fairly typical of the Palaeogene in that the Cochlespirinae, Borsoniinae and Clavinae are well represented, the Daphnellinae very little (one typical genus—*Asperdaphne*) and the Mangeliinae not in large numbers. With only two species of Turrinae (three if *Johannaia* is included) the assemblage differs from the European area where *Gemmula*, *Eopleurotoma* and their relatives are conspicuous; *Clavogemmula* and *Johannaia*

* *Comitas*, *Apiotoma*, *Makiyamaia*, *Cochlespira*, *Borsonia*, *Mitrolumna*, *Splendrillia*, perhaps *Conorbis*, *Guraleus*, *Antiguraleus*, *Macteola*, *Etrema* and *Asperdaphne*.

† *Veruturris*, *Mauidrillia* and *Rugobela*.

‡ *Comitas aldingensis*, *Makiyamaia victoriae*, *Cochlespira semiplana*, *Mauidrillia aldingensis*, *M. secta*, *Guraleus eocenicus*.

TABLE 1
Species of **Turridae** in the Brown's Creek and Glen Aire Clays

Species	BC1	BC3	BP	AW1	Jan	Mioc. Aust.	Plioc. Aust.	Recent Aust.	Recent Else- where
1. <i>Comitas?</i> sp.	S								
2. <i>C. aldingensis</i>		S	S	G	G	G		G	G
3. <i>C. w. cudmorei</i>				SS	SS				
4. n.gen.? sp. a.			S						
5. n.gen.? sp. b.		S							
6. n.gen.? sp. c.		S							
7. <i>Tholitoma</i> sp.		S							
8. <i>M. victoriae</i>	S	S	S						G
9. <i>Apiotoma?</i> sp. a.	S								
10. <i>Apiotoma?</i> sp. b.	S								
11. <i>Apiotoma? wilkinsoni</i>		S							
12. <i>A. bassi</i>				S	G	G			G
13. <i>?Insolentia</i> sp.		S			G				
14. <i>M. otwayensis</i>				S					
15. <i>P. propebelloides</i>	S	S							
16. <i>C. semiplana</i>	S		S		G	G		G	G
17. <i>T. denticulata</i>	S	S		S					
18. <i>J. darraghi</i>	S								
19. <i>G. prima</i>	S								
20. <i>Veruturris</i> sp.		S				G	G		
21. <i>Cordieria?</i> sp.	S								
22. <i>C. cf protensa</i>		S							
23. <i>C. protensa</i>				S					G
24. <i>?C.</i> sp.		S							
25. <i>B. t. eocenica</i>	SS				SS	G?		G	G
26. <i>?B.</i> sp. aff <i>tatei</i>		S							
27. <i>?Mitrolumna</i> sp.		S				G		G	G*
28. <i>C. variabilis</i>	S	S							
29. <i>?Splendrilla</i> sp.	S	S							
30. <i>S. hughesi</i>				S	G	G		G	G
31. <i>?Hauturua</i> sp.		S					G		G
32. <i>M. aldingensis</i>		S	S	G	G	G			
33. <i>M. secta</i>	SS	SS	SS	SS					
34. ?n. gen et sp.		S							
35. <i>Conorbis</i> sp.		S							G?
36. <i>C. a. otwayensis</i>				SS					
37. <i>G. eocenicus</i>	S?	S	S	S	G	G	G	G	
38. <i>Antiguraleus</i> sp. a.		S		S	G	G	G	G	G*
39. <i>Antiguraleus</i> sp. b.				S					
40. <i>?Antiguraleus</i> sp. c.		S		S					
41. <i>M. eocenica</i>	S	S						G	
42. <i>Etrema</i> sp.				S	G	G	G	G	G
43. <i>Asperdaphne</i> sp. a.	S	G	G	G		G	SG	G	G
44. <i>Asperdaphne</i> sp. b.	S		S	S					
45. <i>Asperdaphne</i> sp. c.		S							
46. <i>R. humerosa</i>	S				G	G			
47. <i>S. johannaensis</i>	S			G	G	G			
48. <i>S. radiapex</i>				S	S				
49. <i>P. eocenicus</i>		S		G					
50. <i>P. angustior</i>				S					
51. <i>?P.</i> sp. a.	S								
52. <i>?P.</i> sp. b.	S	S							

G = genus occurs; SG = subgenus occurs; S = species occurs; SS = subspecies occurs; BP = Blanche Point Formation; Jan. = Janjukian; Aust. = Australia; * = New Zealand.

TABLE 2

Victorian Eocene-early Oligocene Turridae
Numbers and Percentages (in brackets) of Species in
common

	BC1	BC3	AW1	Janjukian
BC1	22 (100)	9 (41)	4 (18)	1 (4.7)
BC3	9 (32)	28 (100)	5 (18)	0 (0)
AW1	4 (25)	5 (31)	16 (100)	2 (13)

may be regarded as local equivalents of *Gemmula* and *Eopleurotoma* but they have only been found so far in BC1. Cosmopolitan genera in the fauna amount to about 28% in BC1, 25% in BC3 and 21% in AW1; Indo-Pacific genera 28%, 30% and 36%; genera so far recorded only from Australia and New Zealand 18%, 25% and 29%, and genera apparently confined to southern Australia 28%, 20% and 14%; these percentages should be treated with caution as they are based on the small numbers of genera in each fauna and can easily be affected (as is the case of the southern Australian element) by taxonomic decisions, but the relatively high cosmopolitan element is roughly in accord with Darragh's (1980) finding on the Cenozoic mollusca of south east Australia as a whole.

Since Palaeogene marine deposits do not appear to have been reported yet from the east Antarctic continental shelf the only geographically close faunas outside Australia which are well enough known for comparison are those of New Zealand—in particular the Bortonian and Kaiatan (late Eocene); only *Austrotoma* was recorded from the New Zealand early Oligocene (Fleming, 1966), but P. A. Maxwell (pers. comm. 5.1.1981) also reports *Rugobela*.

Rugobela humerosa (Marwick, 1926) occurs both in the Kaiatan and BC1, but it has not so far been possible to equate any other New Zealand Eocene turrid species with south east Australian fossils. Nevertheless there are similarities; these stem in part from their having features in common with world-wide Palaeogene turrid faunas, such as a strong representation of Cochlespirinae, and also in part from the presence of smaller phylogenetic groups in

which the same genus or related genera occur in both areas (Table 3). Some of these have both cosmopolitan or Indo-Pacific affinities and local representatives (*Apiotoma/Zemacies*, *Gemmula/G.(Clavogemmula)*, *Cochlespira/Turrinosyrinx/Tahusyrinx* and the Borsoniinae). Others are more local, notably *Tholitoma*, *Rugobela* and the problematic *Syngenchilus/Parasyngenchilus* group, but caution must be exercised in claiming highly localized groups of genera as further work elsewhere may well reveal major extensions of range (as with *Parasyrinx* in Hickman, 1976 or *Turrinosyrinx*, this paper). There are also some differences, in particular the presence of *Conorbis*, a more numerous Clavinid representation, Mangeliinae and *Asperdaphne* in south east Australia. In general all these late Eocene-early Oligocene turrid faunas reflect local development from a diversity of turrid lineages that had already become widely, in some cases globally, dispersed by the late Eocene.

None of the fossils recorded in this paper extend the known time range of the subfamilies recognised by Powell, 1966, but the presence of *Guraleus*, probably *Antiguraleus*, and *Mac-teola* in the Australian late Eocene is interesting since otherwise (Powell, 1966: 22-23) Eocene records of Mangeliinae are European and North American. A number of generic ranges are extended back in time—*Veruturris* (late Eocene vice early Miocene-Pliocene); *Mitrolumna* (possibly late Eocene, vice Oligocene-Recent), *Asperdaphne* (late Eocene, vice middle Miocene-Recent) and *Syngenchilus* (late Eocene-late Oligocene, vice late Oligocene only). Additionally the range in Australia of *Rugobela*, and probably *Apiotoma* is extended back to the late Eocene.

Systematic Description

Sub-family COCHLESPIRINAE Powell, 1942
Genus *Comitas* Finlay, 1926

Type species (o.d.) *Surcula oamarutica* Suter, 1917 = *Drillia fusiformis* Hutton, 1877.

Diagnosis: Protoconch papillate, of two smooth whorls, carinate or subcarinate over the last whorl. Teleoconch elongate fusiform with a tall spire and moderately long, slightly flexed,

TABLE 3

Comparison of the Bortonian and Kaiatan turrid faunas of New Zealand with the late Eocene and early Oligocene Turridae of Victoria, Australia

	Bortonian	BC1	Kaiatan	BC3	AW1
	—	<i>Comitas?</i>	—	<i>Comitas</i>	<i>Comitas</i>
	—	—	<i>Tholitoma</i>	<i>Tholitoma</i>	—
	—	<i>Makiyamaia</i>	—	<i>Makiyamaia</i>	—
	<i>Zemacies</i>	? <i>Apiotoma</i>	<i>Zemacies</i>	? <i>Apiotoma</i>	<i>Apiotoma</i>
	<i>Insolentia</i>	—	—	? <i>Insolentia</i>	—
Cochlespirinae	<i>Marshallena</i>	<i>Paramarshallena</i>	<i>Marshallena</i>	<i>Paramarshallena</i>	—
	<i>Marshallaria</i>	—	<i>Marshallaria</i>	—	<i>Marshallaria</i>
	<i>Notogenota</i>	—	<i>Notogenota</i>	—	—
	—	<i>Cochlespira</i>	—	—	—
	—	<i>Turrinosyrinx</i>	<i>Tahusyrinx</i>	<i>Turrinosyrinx</i>	<i>Turrinosyrinx</i>
	—	<i>Johannaia</i>	—	—	—
Turrinae	—	—	<i>Eoturris</i>	—	—
	<i>Gemmula</i>	<i>G (Clavogemmula)</i>	<i>Gemmula</i>	<i>Veruturris</i>	—
Borsoniinae	<i>Borsonia</i>	<i>Borsonia</i>	—	? <i>Borsonia</i>	—
	—	? <i>Cordieria</i>	<i>Cordieria</i>	<i>Cordieria</i>	<i>Cordieria</i>
	—	<i>Cryptocordieria</i>	—	<i>Cryptocordieria</i>	—
	—	—	<i>Eoscobinella</i>	—	—
	—	—	—	? <i>Mitrolumna</i>	—
Clavinae	—	? <i>Splendrillia</i>	—	? <i>Splendrillia</i>	<i>Splendrillia</i>
	—	<i>Inquisitor</i>	—	—	—
	—	<i>Mauidrillia</i>	—	<i>Mauidrillia</i>	<i>Mauidrillia</i>
	—	—	<i>Tahudrillia</i>	—	—
Conorbiinae	—	—	—	<i>Conorbis</i>	<i>Conorbis</i>
Mangeliinae	—	<i>Guraleus</i>	—	<i>Guraleus</i>	<i>Guraleus</i>
	—	—	—	<i>Antiguraleus</i>	<i>Antiguraleus</i>
	—	—	—	<i>Macteola</i>	—
	—	—	—	—	<i>Etrema</i>
Daphnellinae	—	<i>Asperdaphne</i>	—	<i>Asperdaphne</i>	<i>Asperdaphne</i>
	—	<i>Rugobela</i>	<i>Rugobela</i>	—	—
Uncertain	—	<i>Syngenchilus</i>	—	—	<i>Syngenchilus</i>
	—	<i>Parasyngenchilus</i>	<i>Parasyngenchilus</i>	<i>Parasyngenchilus</i>	<i>Parasyngenchilus</i>

New Zealand data based on Fleming, 1966 with additions from P. Maxwell (pers. comm.).

unnotched anterior canal. Adult sculpture of long fold-like axials crossed by dense spiral lirae. Suture margined by a weak fold at most. Sinus moderately deep, rather broadly U-shaped, on the shoulder slope but nearer to the periphery than to the suture (after Powell, 1966: 28).

?*Comitas* sp.
(Plate 4, figure 1)

Comments: A *Comitas*-like shell characterised by its long slightly concave shoulder slope and 9-11 broad abapical ribs per whorl is known by nine incomplete specimens from FL 11 (P33342 six, P33343 two, P33345 one). Extrapolation

indicates a length of about 49.0 mm for the largest specimen. It will not be possible to name or firmly place this species until complete material is available. Apart from the relatively wide shoulder slope it appears to fit broadly into *Comitas*.

***Comitas aldingensis* Powell, 1974**

(Plate 4, figures 2, 3)

1944: *Comitas (Carinacomitas) aldingensis* Powell; Powell, *Rec. Auckland Inst. Mus.* 3(1): 18-19, Pl. 1, fig. 7.

1969: *Comitas aldingensis* Powell 1944; Powell, *Indo-Pacific Mollusca* 2(10): 292.

Description: Protoconch broadly dome-shaped of 1.75-2.5 smooth whorls with a median carina developing on the first or second whorl, merging into the teleoconch by the gradual development of adult sculpture with either a sub-carinal or a supra-carinal spiral thread or axial ribs developing first. Teleoconch: fusiform, fairly thin; spire about 0.5 height of shell, turreted; whorls medially angulated, convex anteriorly with a concave shoulder slope; suture well-marked, sloping, with a fine subsutural margining thread; body whorl excavate anteriorly into a moderately long, slightly flexed, open, unnotched anterior canal. Axial sculpture: 8-11 (usually 10-11) rounded, slightly opisthocline ribs per whorl, from periphery to suture on spire whorls, fading out on the body whorl just anterior to the periphery; numerous fine growth lines which may be slightly raised on the shoulder. Spiral sculpture: sharp narrow threads which develop flattened tubercles as they override the axials; beside the subsutural thread there are 0-3 fine threads on the shoulder slope and, anterior to the periphery, typically 3 but up to 6 threads on spire whorls and 16-29 (usually 24-28) threads on the body whorl and anterior canal. Aperture: lanceolate, elongated below into the anterior canal; columella slightly twisted; inner lip a glaze on the columella extending to just below the end of the canal; outer lip sharp edged with a well-marked U-shaped posterior sinus on the shoulder, curved forward anteriorly, and straightening down the anterior canal.

Types: Holotype, TM-953, and one paratype, Auckland Museum.

Type Locality: Blanche Point Formation, Blanche Point, Aldinga Bay, S. Australia, Aldingan, late Eocene.

Dimensions:				Protoconch	Teleoconch
	L.	B.	S.	Whorls	Whorls
Holotype	6.8	2.9			
Paratype	7.75	3.0			
P33449	8.1	3.5	4.0	1.75	4.6
(topotypes)	8.3	3.5	4.0	2.0	4.0
	7.3	3.0	4.0	2.0	4.1
	6.9	2.5	3.5	2.0	3.5
	6.8	3.0	3.5	2.0	3.5
P33442	9.0	3.25	4.5	2.5	3.8
(3 of 7)	8.2	3.15	4.1	2.3	3.6
specimens)	8.0	3.0	4.0	2.3	3.8
P33387	12.2	5.0	6.5	2.2	5.0

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Blanche Point Fmn.—Blanche Point (P33449 five topotypes, EA002 one topotype), midway between Blanche Point and Port Willunga (EW001 two specimens, EW002 three fragments); Brown's Creek Clay—FL14 (P33442 seven, P33412 two, EB013 one specimen); FL13 (P33383 one, P33387 one specimen).

Comments: One shell from Brown's Creek (P33387) which is exceptionally large, lacks the subsutural thread and has no sculpture at all on the anterior canal; this latter feature may be due to senescence.

***Comitas wynyardensis cudmorei* subsp. nov.**
(Plate 4, figures 4,5)

Description: Protoconch: 1.75-2.0 whorls, smooth, shining, sub-cylindrical to slightly globose, apex flattened; tip slightly deviated; suture deep; first whorl may slightly overhang second; merges into teleoconch by development of axial sculpture, subsutural cord, and spiral sculpture in that order. Teleoconch: fusiform, fairly thin; spire averaging 0.55-0.56 of shell length, turreted; whorls convex, widest at the bluntly angulate median periphery; shoulder slightly concave; suture well-marked, sloping, with a weak subsutural margining cord at the posterior edge of each whorl, which is strongest on the early whorls; body whorl gently excavate anteriorly into a long, open, slightly flexuous anterior canal, usually with a rounded end. Axial sculpture: 8-13, typically 10-12, rounded,

opisthocline ribs per whorl, about equal to interspaces; from the subsutural cord to the anterior suture on the first 2-3 whorls, thereafter reaching from just posterior to the periphery to the anterior suture, weakening on the body whorl in larger specimens, and not extending to the anterior canal; numerous very fine incised growth lines. Spiral sculpture: close packed fine threads all over the teleoconch whorls, over-riding the axial ribs and extending to the tip of the anterior canal; the threads are very fine on the shoulder, tending to become obsolete on the later whorls of large specimens, stronger and slightly raised anterior to the periphery, up to 50 on the body whorl and 40 on the anterior canal; after about the third whorl the threads may become alternately weaker and stronger. Aperture: lanceolate, elongated below into a large open anterior canal; columella slightly twisted; inner lip a smooth porcellanous glaze on the columella extending to just above the end of the anterior canal; outer lip (none complete) probably sharp edged, with a well-marked posterior sinus with its apex in mid-shoulder occupying the whole shoulder slope, curved gently forward anteriorly, straightening down the anterior canal.

Types: Holotype P42956, Paratype 1 P42957, Paratype 2 P42958, all F. A. Cudmore collection, National Museum of Victoria.

Type Locality: Geological Survey of Victoria locality AW1, Point Flinders, Cape Otway, Victoria, Aire 367097.

<i>Dimensions:</i>	L.	B.	S.	Protoconch Teleoconch	
				Whorls	Whorls
Holotype	27.7	8.6	16.0	2.0	8.0
Paratype 1	27.4	8.4	15.0	1.75	8.0
Paratype 2	22.8	7.5	12.0	1.8	7.0

Stratigraphic Range: Aldingan, early Oligocene.

Material and Occurrence: Type locality; types plus numerous topotypes (P42913 15; P42914 98; P42915 2; P42916 3; P42917 one; P42918 7; P42919 13; P42920 one; P42921 4; P42922 7; P42955 one).

Comments: *C. wynyardensis cudmorei* differs from *C. wynyardensis wynyardensis*: Tasmania (Pritchard, 1896) Fossil Bluff, Wynyard, Tasmania early Miocene in its greater number of axial ribs (typically 10-12 compared with typically 9) and in the even, fine, spiral

sculpture compared with the regular development of strong threads separated by several finer ones in *C. wynyardensis wynyardensis*. The relationships between the various described Australian late Oligocene *Comitas* spp. are not clear from the material seen by the writer; *C. wynyardensis wynyardensis*, *C. torquayensis* Powell, 1944 and *C. pseudoclarae* Powell, 1944 have been distinguished by the numbers of axial ribs per whorl, details of the protoconch, and size. Assemblages from individual locations show variations in these characters, but a common feature is that there are fewer axial ribs per whorl than *C. wynyardensis cudmorei* and the spiral sculpture is generally stronger. The writer has so far been unable to recognise *C. crenularoides* (Pritchard, 1896) which is based on imperfect material or *Turris altispira* (May, 1922) which may be a *Comitas*. Both subspecies of *C. wynyardensis* are smaller than the recent Japonic *C. kaderlyi* (Lischke, 1872), the south east Australian *C. murrayolga* (Garrard, 1961) and the South African *C. stolidi* (Hinds, 1843), and have a less concave shoulder slope.

C. wynyardensis cudmorei is variable both in shape and in minor details of sculpture such as an occasional tendency for some of the spiral threads to strengthen presaging *C. wynyardensis wynyardensis*. A few specimens (e.g. P42915, P42955) develop markedly angulated whorls but otherwise have the protoconch and sculpture of the subspecies.

Genus ?nov. (allied to *Comitas*)
(Plate 4, figure 6)

Comment: Fossils of three species, up to 9.0 mm long from the Aldingan, late Eocene, resemble *Comitas* but differ in the protoconch having prosocline axial ribs on the last half whorl. In no case is there sufficient material to name them.

Material: a. Blanche Point Formation, Blanche Point (EA003 two specimens);
b. FL14 (P33429 one spire, P42912 one spire, EB003 one specimen);
c. FL14 (P42911, one specimen).

Genus *Tholitoma* Finlay and Marwick, 1937

Type species: (o.d.) *T. dolorosa* Finlay and Marwick, 1937.

Tholitoma sp.

(Plate 4, figure 7)

Material: Brown's Creek Clay BC3, FL14, (P33417, one specimen).

Comments: *Tholitoma* was described from the Paleocene of New Zealand. It also occurs there in the late Eocene (Kaiatan) where probably two species are represented (P. A. Maxwell pers. comm. 1 December 1980), one from GS4872 Port Elizabeth beach near Greymouth Westland, the other from GS11,200 (Kapua Tuffs, Waihao R., South Canterbury). The Brown's Creek fossil has weaker spiral sculpture and somewhat stronger axial sculpture than any of the New Zealand fossils but it has a very similar shape to the species from GS4872. More material is necessary to evaluate these records.

Genus Makiyamaia MacNeil, 1960

Type species (o.d.) *Pleurotoma coreanica* Adams and Reeve, 1850.

Diagnosis: Protoconch: paucispiral, smooth, subnaticoid, slightly wider than first post-nuclear whorl. Teleoconch: fusiform (resembling *Turricula*), spire pagodiform with a usually nodulose peripheral angulation. Anterior canal fairly short; posterior sinus narrowly U-shaped, on shoulder slope, nearer to periphery than suture. (Operculum has a medio-lateral nucleus on the columella side.)

Makiyamaia victoriae sp. nov.

(Plate 4, figure 8)

Description: Protoconch: smooth, glossy, naticoid, paucispiral 1.5-1.75 whorls; junction with teleoconch often clear and sometimes exhibits a posterior sinus. Teleoconch: small (up to 9.75 mm), dextral, fusiform, slightly polished; spire just over half length of shell (c. 0.53), slightly turreted; whorls widest at periphery which is at or anterior to mid-whorl; shoulder shallowly concave; suture often inconspicuous, slightly margined by posterior edge of whorl. Axial sculpture: 6-9, usually 8, rounded slightly opisthocline ribs per whorl which start at the periphery where they are strongest and nodulose, just reach the suture on spire whorls, and die out before the anterior

canal on the body whorl, on which they tend to fade. Spiral sculpture: numerous slightly undulating spiral lines or very fine flattish cords, very variable in strength from shell to shell and best developed on later whorls (25-39 on body whorl and anterior canal). Aperture pyriform; inner lip a glaze on the columella; outer lip apparently sharp; posterior sinus fairly narrow, U-shaped, on the shoulder, nearer periphery than suture, with lip curving forward anterior to it. Anterior canal open, moderately long, end rounded.

Types: Holotype P42834, Paratype 1 P42835, Paratype 2 P42836, National Museum of Victoria, all coll. T. A. Darragh and H. E. Wilkinson 6 December 1968.

Type Locality: Brown's Creek Clay, FL14.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	8.0	3.0	4.3	1.75	4.8
Paratype 1	8.8	3.4	4.75	1.5	5.2
Paratype 2	8.7	3.5	4.5	1.5	5.0
P33396	9.75	4.0	5.0	1.5	5.25

Stratigraphic Range: Aldinga, late Eocene.

Material and Occurrence: Brown's Creek Clay; FL11 (P42838 one); FL13 (P42837 one, P33396 one); FL14 (types plus topotypes — P33434 thirteen, EB004 3, P33414 one; P42839 3, P42840 one). Blanche Point Fmn, Blanche Point (EA004 one).

Comments: *Makiyamaia* MacNeil, 1960 has been used for four species and two subspecies of Turriculinid turrids from the late Eocene to Recent of the Japonic region, with one species (*M. subdeclevis* (Yokoyama, 1926)) extending to the South China sea (Powell, 1969: 307-310). All these are medium sized shells, 18-34 mm long, but size alone is no criterion for rejecting a generic placement, nor is geographical separation; for instance the Australian Oligocene-Miocene genus *Optoturris* has been recorded from the Japanese Lower Pliocene (*O. kyushuensis* Shuto, 1961). In protoconch, teleoconch shape, sculpture, sinus, and anterior canal this new Australian species appears to fit best into *Makiyamaia*, but the margination of the suture is not typical.

P42838 from FL11 may be conspecific but

has two protoconch whorls which are (probably pathologically) askew in relation to the teleoconch; the spiral sculpture is very weak, so is the axial sculpture which is reduced to a peripheral keel on the last two whorls. The one congeneric specimen available to the writer from Blanche Point (EA004) differs from Brown's Creek Clay material in having more axials (11-12 per whorl) and relatively strong spiral sculpture, but without more Blanche Point material these differences cannot be evaluated.

Genus *Apiotoma* Cossmann, 1889

Type species (o.d.) *Pleurotoma pirulata* Deshayes, 1834.

Diagnosis: Shell attenuate-fusiform; spire tall of rapidly increasing whorls; anterior canal long, unnotched; spiral sculpture usually dominant; shoulder area with posterior sinus, more or less sunken; protoconch smooth, globose to narrowly conic, 1½-2½ whorls with small asymmetric tip.

Comments: In addition to *A. bassi* Pritchard, 1904 from AW1 three species from the Brown's Creek Clay appear to belong to *Apiotoma*, but the material for two of these, both from FL11 (a. P33353 (Pl. 4, fig. 13); b. P33356 (Pl. 4, fig. 14, 15)) is insufficient for full identification.

Apiotoma? wilkinsoni sp. nov. (Plate 4, figures 9-11)

Description: Shell fusiform, anterior canal long and nearly straight. Protoconch: 1.7-2.0 whorls, smooth; first whorl rounded, second sub-cylindrical; tip deviated and immersed; merges into teleoconch. Teleoconch: fusiform, spire slightly less than half height of shell; whorls shallowly concave above a rounded median periphery, gently convex below; suture flatly margined by posterior edge of whorls. Axial sculpture: very faint axial growth lines. Spiral sculpture: very numerous low cords extending over whole whorl and to end of anterior canal, usually 8 increasing to 13-15 on spire whorls; more numerous above than below the periphery and slightly more prominent anterior to it; 70 plus on body whorl and anterior canal.

Aperture: lanceolate; columella straight; inner lip a glaze on the columella; outer lip (not complete) evidently curved gently forward below periphery; posterior sinus deep, narrow, in mid-shoulder.

Types: Holotype P42832, Paratype 1 P42833 both coll. T. A. Darragh and H. E. Wilkinson 6 December 1968, Paratype 2 P33403 coll. T. A. Darragh 20 November 1970, National Museum of Victoria.

Type Locality: Brown's Creek Clay, FL14.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype (apex missing)	35.0 (+)	12.0	15.0 (+)	—	5.7 preserved
Paratype 1 (incomplete anteriorly)	20.0	c.8.0	14.0	c.1.7	c.6.0(+)
Paratype 2 (part of outer lip lost)	29.8	9.8	14.0	c.1.7	6.5

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Types plus 10 topotypes (P33436 5, P33410 3, EB001 2); FL13 (P33392 one).

Comments: Although every available specimen of this fossil is imperfect there is enough material to reconstruct its appearance fairly fully. *A? wilkinsoni* seems to be related to *Turris janjukiensis* Chapple, 1934 (placed in *Apiotoma* by Powell, 1944:20) and also possibly to *Pleurotoma salebrosa* Harris, 1897 (placed in *Comitas* by Powell, 1944:18 though it has no axial sculpture). The generic placement is tentative; the teleoconch of *A? wilkinsoni* resembles *Turricula* in many respects.

Apiotoma bassi Pritchard, 1904 (Plate 4, figure 12)

- 1904 *Apiotoma bassi* Pritchard; Pritchard, *Proc. R. Soc. Vict.* 17:328, Pl. 19, fig. 11.
1914 *Apiotoma bassi* Pritchard; Chapman, *Mem. natn Mus. Vic.* 5:19
1944 *Apiotoma bassi* Pritchard; Powell, *Rec. Auckland Inst. Mus.* 3(1):20
1969 *Apiotoma bassi* Pritchard; Powell, *Indo-Pacific Mollusca* 2(10):247.

Description: Protoconch mammilate, of 1.6-1.8 smooth, rounded whorls; tip deviated and immersed; suture well-defined. Teleoconch: elongately fusiform, moderately thin; spire turretted, about 0.45 length of shell; whorls develop a variable, usually well-marked, postero-medial peripheral angulation, a shallowly concave shoulder slope, and an almost straight-sided anterior portion narrowing slightly to the suture which is inclined, well-defined, and margined by a low subsutural fold on later whorls; body whorl slightly convex, long, narrow, tapering with a slight excavation into the long, almost straight, open, unnotched anterior canal. Axial sculpture: low variable opisthocline ribs from periphery rarely reaching the anterior suture, and often reduced to nodulations of the peripheral angulation; they are strongest on the second and third whorls where they number 14-19 per whorl, and may persist for up to seven whorls or be completely obsolete; numerous very fine growth lines interrupt the spiral sculpture. Spiral sculpture: very numerous fine spiral threads of variable width but even strength cover the teleoconch, up to 100-105 on the body whorl and anterior canal. Aperture: narrowly lanceolate, tapering into the anterior canal; inner lip a dull glaze on the smooth tapering columella which is almost straight or twisted anteriorly; outer lip curved back into a well-marked U-shaped posterior sinus occupying the shoulder slope, produced gently forward below the periphery and straightening, with a very shallow concavity, down the anterior canal.

Types: Holotype, MUGD 1825 Melbourne University Geology Department.

Type Locality: "the clays of the Cape Otway section near Point Flinders" (Pritchard, 1904:329) = Glen Aire Clay, GSV loc AW1.

Dimensions: "Average specimens have length of about 33 mm by a breadth of 10 or 11 mm; length of aperture and canal 20 mm; greatest width of aperture about 3.5 mm. Specimens on the large side range from 45-50 mm in length by a breadth of about 13 mm, while small specimens range about 24 mm in length by 8 mm breadth." (Pritchard, 1904:329).

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
P42897	38.5	11.0	17.25	1.75	6.5
		(+)			
	35.5	10.0	16.5	c.1.7	7.0
	35.5	9.25	18.0	c.1.7	7.0
	25.3	7.2	11.5	c.1.8	5.5
	14.0	4.0	6.8	c.1.7	4.75

Stratigraphic Range: Upper Aldingan, early Oligocene.

Material and Occurrence: Type Locality (P42897, P42898, 159 topotypes coll. T. A. Darragh, T. Hughes, 1 December 1972).

Comments: *A. bassi*, the Janjukian (late Oligocene) *A. pritchardi* Powell, 1944, and what is probably another species from the Batesfordian (early Miocene) (FL43 Kennedy's Creek) form a series that is very close in shape to the type species of *Apiotoma*.

Genus *Insolentia* Finlay, 1926

Type species (o.d.) *Pleurotoma pareoraensis* Suter, 1907

?*Insolentia* sp.

(Plate 4, figures 16, 17)

Material and Occurrence: Brown's Creek Clay; FL13 (P33385, one specimen); FL14 (P33400 2, P33420 one, EB002 one, P33416 apex/spire only).

Comments: This moderately large 'turriculid', probably 30.0(+) mm long, with axial sculpture on the spire only, is only represented by incomplete specimens. The only protoconch available (P33416) is turbinat, dome-shaped above, of about 3 smooth whorls, tip not deviated, merging into the teleoconch on which spiral sculpture appears before the axials; however it is associated with a few spire whorls only. If P33416 does come from this species, then the genus is not *Comitas* or *Apiotoma*. The shape of the teleoconch in the other specimens resembles *Insolentia* (Eocene-Miocene New Zealand, late Oligocene Australia, Powell, 1966), and *Typhlosyrinx* Thiele, 1925, not recorded as a fossil.

Genus *Marshallaria* Finlay and Marwick, 1937

Type species (o.d.) *Verconella spiralis* Allan, 1926.

Diagnosis: Shell biconic-fusiform (bucciniform), spire turreted with strong peripheral angulation, and a capacious body whorl, gradually contracted to a moderately long, unnotched, anterior canal. Adult sculpture fairly prominent axials overridden by numerous spiral cords and threads. Protoconch dome-shaped, of about 3½ whorls, the first one and a half smooth, the remainder with strong spiral cords. Sinus regularly shallowly concave, occupying the shoulder slope.

***Marshallaria otwayensis* sp. nov.**

(Plate 5, figures 3, 4)

Description: Protoconch: 2.9-3.3 whorls, dome-shaped, tip exsert, whorls rounded, initially smooth, 5 gradually strengthening spiral cords on last 0.3-0.9 of a whorl. Teleoconch: thin, buccinoid; spire about half height of shell; suture unmarginated; shoulder slightly concave occupying about a third of whorl height; periphery well marked but rounded; body whorl large, tapering below into anterior canal. Axial sculpture: numerous basically opisthocline ribs, narrower than interspaces, from just above periphery to suture on spire whorls, dying out above anterior canal on body whorl, 17-23, mostly 19-21, per whorl; numerous fine, thread-like axial growth lines. Spiral sculpture overrides axials: very numerous spiral threads, about every tenth one stronger than those intervening, present over whole teleoconch. Aperture pyriform; open below into a short, round-ended anterior canal, inclined slightly to left; inner lip a glaze on columella which is slightly twisted, with a slight oblique fold near the base; outer lip curved gently forward below periphery. Posterior sinus (indicated by growth lines) shallow, on shoulder slope, with a mid-shoulder centre.

Types: Holotype P42844, Paratype 1 P42845 both F. A. Cudmore collection, Paratype 2 P42846 coll. T. A. Darragh and T. Hughes 1 December 1972, National Museum of Victoria.

Type Locality: Glen Aire Clay, GSV locality AW1.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	19.5	9.5	8.5	3.0	4.25

Paratype 1	15.0	7.8	7.0	2.9	4.0
Paratype 2	33.2	10.5	c.15.0	3.0	4.75
					(traces to 5.0)

Stratigraphic Range: Upper Aldingan, early Oligocene.

Material and Occurrence: Type locality; types plus 17 topotypes (P33333 5, P33335 9, P42935 one, P42936 two).

Comments: This species is not uncommon at AW1, but its fragility has resulted in nearly all available specimens being damaged. *Marshallaria otwayensis* clearly belongs to a group of bucciniform turrids (*Marshallena* Allen, 1927:291, *Marshallaria*, *Austrotoma* Finlay, 1924: *Belophos* Cossmann, 1901:162, *Liratolina* Powell, 1942: *Belotolina* Powell 1942, mostly characteristic of the New Zealand and Australian Tertiary, though Powell (1966, 1969) has also included several recent Indo-Pacific species in *Marshallena*. *M. otwayensis* lacks the subsutural margining fold, the notching of the anterior canal and the ridge-margined fasciole of *Austrotoma*; the protoconch has 3, not the 4-5 whorls of *Austrotoma* and it is not smooth like that of *Marshallena*; the teleoconch has a gently concave shoulder slope, not the sloping shoulder slope of *Marshallena*. *Belophos* has a notched anterior canal, a much thicker shell, and a 4-5 whorled, not a 3-whorled, protoconch. *Belotolina* and *Liratolina* have a very different teleoconch and a paucispiral protoconch. Since the only difference between *Marshallaria* as diagnosed and *M. otwayensis* seems to be the weaker and later development of spiral sculpture on the protoconch, the latter seems best placed in this genus. *Marshallaria* has not been previously recorded outside the Paleocene to late Oligocene of New Zealand.

Genus *Paramarshallena* gen. nov.

Type species: *Paramarshallena propebelloides* sp. nov.

Diagnosis: Shell buccinoid; spire turreted; whorls angulate at about one-third whorl height, weakly margined posteriorly; spire about half height of shell. Body whorl

capacious, tapering gently below into an open unnotched anterior canal. Posterior sinus on shoulder curved gently, very shallow, apex at mid-shoulder. Protoconch paucispiral, dome-shaped, 1.5-2.0 whorls, tip partly immersed, first whorl smooth, second developing orthocone axial ribs before merging into teleoconch. Teleoconch thin; sculpture dominated by thin, opisthocline, axial ribs which extend above periphery to suture on spire whorls, but do not extend to anterior canal on body whorl. Aperture: narrow, ovate; inner lip a glaze on columella which is nearly straight and inclined slightly to left; outer lip thin, sharp, curved back in shallow sinus on shoulder, and produced gently forward below.

Comments: The relationships of this small bucciniform turrid genus are uncertain; it resembles two different groups of which the first is the genus *Marshallena* Allan, 1926. *Paramarshallena* resembles *Marshallena* in the general form and sculpture of the teleoconch, but differs from *Marshallena* in having a paucispiral protoconch, a weak subsutural margining fold, and more strongly opisthocline sculpture.

The second group of genera consists of:

1. the circum-arctic *Propebela* Iredale, 1918 which is about the same size as *Paramarshallena* (c.f. *P. exquisita* Bartsch, 1941—Powell 1966, Pl 19, fig. 2), but the paucispiral protoconch of *Propebela* develops carinae and fine axial threads; *Propebela's* shoulder is more nearly flat, and the axial sculpture is orthocone not basically opisthocline;
2. the Japonic *Nodotoma* Bartsch, 1941, a poorly defined genus;
3. the Antarctic *Belalora* Powell, 1951 which has a different protoconch;
4. the Antarctic *Lorabela* Powell, 1951 in which the protoconch is described as narrowly papillate, and the posterior sinus deep and rounded.

None of this second group develops the subsutural margining of *Paramarshallena*. Until further evidence emerges to enable its inclusion in another genus it appears best to isolate *P. propebelloides* in a genus of its own.

***Paramarshallena propebelloides* sp. nov.**
(Plate 5, figure 5)

Description: protoconch: dome-shaped, tip partly immersed, and oblique; 1.5-2.0 whorls, the first smooth the second developing up to 10 orthocone to slightly prosocline axial ribs before merging into the teleoconch. Teleoconch: buccinoid; spire turreted about ½ height of shell, post-medially angulated at about one-third whorl height below suture; suture oblique with a weak margining fold on posterior edge of whorls. Body whorl pyriform, large, tapering gently below into short, open, unnotched anterior canal. Axial sculpture: narrow, sharp, spaced, axial ribs, prosocline and slightly curved on shoulder, slightly nodulose on periphery, opisthocline below periphery, from suture to suture on spire whorls, dying out on body whorl above anterior canal, 10 increasing to up to 16 per whorl, tending to weaken after about 4 whorls; numerous close-set growth lines. Spiral sculpture: very fine spiral threads, up to 10-12 below shoulder of spire whorls, and weak posterior to shoulder, 30-35 on body whorl and anterior canal; variable in strength and may be obsolete. Aperture: narrowly ovate, angulated posteriorly; inner lip a glaze on the nearly straight columella which tapers off at the end of the anterior canal, and on the curve of the parietal region; outer lip (as preserved) sharp, thin, with a shallow sinus on shoulder, and curved forward below the periphery.

Types: Holotype P42847, Paratype 1 P42848 both coll. T. A. Darragh 24 February 1971; Paratype 2 P33375 coll. T. A. Darragh 20 November 1970, National Museum of Victoria.

Type Locality: Brown's Creek Clay, BC1, FL11.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	13.1	6.2	6.3	c.1.75	4.5
Paratype 1	8.6	4.9	4.5	1.5	3.5
Paratype 2	11.4	5.8	5.2	2.0	4.0
P33398	13.5	6.5	7.0	c.1.75	4.2

Stratigraphic Range: BC1-BC3, Aldingan, Late Eocene.

Material and Occurrence: Type locality, types plus 14 topotypes (P33359 9, P33364 5); FL13 (P33391 one, P33398 one).

Genus *Cochlespira* Conrad, 1865

Type species (by virtual monotypy) *Pleurotoma cristata* Conrad, 1847.

Diagnosis: Shell elongate-fusiform with a tall pagodiform spire, and a long body whorl gradually tapered to a long unnotched anterior canal. Protoconch subglobose or subcylindrical, of two smooth whorls, sometimes angulate towards its termination. Adult whorls with a more or less median peripheral carina, flange-like, either serrated or coronated by posteriorly directed spinose processes. Suture may be gemmately submarginated. Shoulder slope concave, smooth or with spiral sculpture. Anterior to the periphery, whorls may vary from smooth to densely spirally sculptured, and may have a second keel above the start of the anterior canal. Sinus on the shoulder slope, broadly arcuate or restricted to above a median lamella.

***Cochlespira semiplana* (Powell, 1944)**
(Plate 5, figure 6)

1944 *Coronasyrinx semiplana* Powell. *Rec. Auckland Inst. Mus.* 3(1):22 Pl. 1, Fig. 2.

1969 *Cochlespira semiplana* (Powell, 1944); Powell, *Indo-Pacific Mollusca* 2(10): 402.

Description: Protoconch: globose to subglobose, tip deviated, of 1.5-2.0 smooth whorls, the second developing a median or submedian smooth keel; merges with the teleoconch. Teleoconch: fusiform, thin, spire pagodiform; whorls with a prominent antero-median flanged peripheral keel and a long concave shoulder slope; suture indistinct, margined above and below by a fine thread; body whorl with a second keel anterior to the peripheral keel, excavate anteriorly into a long, nearly straight, anterior canal. Axial sculpture: 18-26 posteriorly directed denticulations per whorl on the peripheral keel; anterior keel on body whorl smooth or finely denticulate; very faint growth lines. Spiral sculpture: beside the peripheral keel, fine sub-sutural and supra-sutural margining threads develop which may be smooth or finely gemmulate; the body whorl may develop

3-4 weak spiral threads between the peripheral and anterior keels; 17-21 smooth to finely gemmulate threads anterior to the second keel on the body whorl, extending down the anterior canal. Aperture: apparently lanceolate (matrix filled and fractured); outer lip with a U-shaped posterior sinus in the smooth shoulder area below the subsutural thread, and curved forward anterior to the periphery.

Type: Holotype, TM956, Auckland Institute (confirmed W. O. Cernohorsky in lit. 9 Feb 1978; TM957, Powell, 1969:402, is an error).

Type Locality: Aldinga lower beds (= Blanche Point Fmn, Blanche Point, Aldinga, S.A.).

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	9.6	3.9	—	1.5	4.0
P33446	11.0	4.8	5.5	2.0	5.0
EA001	11.0	—	—	—	(incomplete)
	(+)				complete)
P33445	10.0	4.5	5.0	2.0	c.4.0 (incomplete)

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Type Locality (P33446 1, EA001 1); Brown's Creek Clay FL11 (P33445 1).

Comments: Although much of the material is damaged this is clearly a *Cochlespira*. *C. venusta* (Powell, 1944), late Oligocene-Middle Miocene south east Australia has more numerous, but more conspicuously gemmulate, finer spiral threads, a much weaker anterior keel on the body whorl, and a more flattened protoconch on which the median keel develops on the first whorl.

Genus *Turrinosyrinx* Hickman, 1976

Type species (o.d.) *Turris packardi* Weaver, 1916

Diagnosis: Protoconch: paucispiral, smooth. Teleoconch: fusiform; spire pagodiform with a prominent peripheral carina; body whorl narrowing rapidly below into a moderately long, open, round-ended, anterior canal. Posterior sinus usually shallow, V-shaped, apex immediately posterior to or on the peripheral carina. Spiral sculpture more prominent than axial sculpture which is weakly developed.

***Turrinosyrinx denticulata* sp. nov.**
(Plate 5, figure 7)

Description: Protoconch: paucispiral, 1.5-1.75 whorls, tip deviated and slightly immersed; first whorl globose, the second developing a rounded median angulation, and, usually 3-6, orthocone axials which show traces of the posterior sinus just before the well-defined start of the teleoconch. Teleoconch: fusiform; spire pagodiform, slightly under ½ height of shell; whorls with a denticulate, flanged, median keel and a long, nearly straight, shoulder slope. Body whorl slightly ventricose just anterior to the peripheral keel, then narrows rapidly into a long open anterior canal. Suture well-defined, unmarginated. Axial sculpture: numerous fine axial growth lines; 20-30 denticulations on the peripheral keel. Spiral sculpture: very weak spiral cords with linear interspaces, usually only present, if at all, on the body whorl, and only developed on the shoulder as a weak trace; Paratype 1 has three spirals on the peripheral keel on the penultimate and body whorls, five on the anterior part of the penultimate whorl, and 27 on the body whorl and anterior canal. Aperture: elongately wedge-shaped; outer lip (not fully preserved) probably thin, deeply cut by a V-shaped sinus with its apex on the peripheral keel, and curved forward anteriorly; inner lip a glaze on the columella, which is slightly sigmoidally curved, and tapers to a point just above the end of the anterior canal. Anterior canal open, unnotched, long, inclined slightly to the left.

Types: Holotype P33354 coll. T. A. Darragh 24 February 1971; Paratype 1 P33361, Paratype 2 P42850 both coll. T. A. Darragh 18 October 1971, National Museum of Victoria.

Type Locality: Brown's Creek Clay, BC1, FL11.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	10.5	4.8	5.0	1.5	4.0
Paratype 1	9.4	4.1	4.3	1.5	4.0
Paratype 2	9.8	3.7	4.5	1.5	c.4.0 (slightly broken)
P42849	9.0	4.2	(5.0)	c.2.0	c.4.0 (slightly broken)

Stratigraphic Range: Aldingan, late Eocene-early Oligocene.

Material and Occurrence: Type locality (Types plus P42849 one); FL13 (P33390 one); GSV loc. AW1 (P42929 one).

Comments: This species has the essential generic characters of *Turrinosyrinx* which was erected by Hickman (1976) for a group of species of cochlespirine form from the early Oligocene of Oregon USA. It differs from them in having a denticulate flanged peripheral keel and in having the apex of the relatively deep anal sinus on the centre of the peripheral keel and not posterior to it. As *T. denticulata* is the stratigraphically earliest species so far assigned to *Turrinosyrinx* this latter feature is consistent with the trend demonstrated by Hickman (1976: 76) for the apex of the anal sinus to migrate posteriorly in successively later species. *T. denticulata* also provides a link additional to those reported by Hickman (*op. cit.*) between the Paleogene Turridae of the north west Pacific and the Australasian region.

Genus ***Johannaia*** gen. nov.

Type species: *J. darraghi* sp. nov.

Diagnosis: Protoconch paucispiral, smooth; first whorl rounded, tip deviated; second sub-cylindrical, with 3-5 vertical axial ribs in last ¼ whorl. Teleoconch elongate-fusiform, spire tall anterior canal short; whorls medially angulated. Axial sculpture long flexuous ribs, not nodulated at periphery, more or less continuous from whorl to whorl. Posterior sinus shallow occupying all of shoulder slope, apex just above the periphery. Aperture lanceolate.

Comments: *Johannaia* seems to have no close relatives in either the Australian or the New Zealand Tertiary, nor is it like any genus recognized by Powell (1966, 1969) as falling within the sub-family Cochlespirinae with which it seems to have features in common. On the other hand the style of sinus and axial sculpture approach *Eopleurotoma* Cossmann, 1889 but it differs from *Eopleurotoma* in its larger paucispiral protoconch with a few axial ribs on the last ¼ whorl, and in the strong peripheral angulation of the protoconch.

Johannaia darraghi sp. nov.

(Plate 5, figures 1, 2)

Description: Protoconch: paucispiral, two whorls, first smooth, rounded, tip deviated, second subcylindrical, smooth apart from 3-5 vertical axial ribs in the last quarter whorl. Teleoconch: narrow, fusiform; surface rather smooth and slightly polished; spire just over $\frac{1}{4}$ height of shell; whorls medially angulated, widest at periphery with a long nearly straight shoulder slope. Body whorl tapered rapidly below to a moderately long, round-ended, anterior canal, curved slightly to the right. Axial sculpture: low, rounded ribs, 7-12 per whorl, prosocline adapically, angulated at the periphery and opisthocline abapically, from the posterior suture to the anterior suture, more or less in alignment from whorl to whorl and dying out above the anterior canal; many fine growth lines on shoulder. Spiral sculpture: numerous striae usually present, extending to the end of the anterior canal; up to 22 on spire whorls and c.30 on body whorl and canal. Aperture lanceolate, angulated posteriorly, with a short, open, square-ended, slightly inclined anterior canal; inner lip a glaze on the columella; outer lip curved slightly forward below periphery; posterior sinus shallow, occupying all of shoulder slope, apex near periphery, not confluent with the axial ribs.

Types: Holotype P42841, Paratype 1 P42842, Paratype 2 P42843, all coll. T. A. Darragh 24 February 1971, National Museum of Victoria.

Type Locality: Brown's Creek Clay, BC1 FL11.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	15.3	4.6	8.4	2.0	6.0
Paratype 1	16.0	4.25	8.5	2.0	6.0
Paratype 2	18.8	5.1	10.5	2.0	6.2
P33347	15.0	4.0	8.5	2.0	6.25

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Type locality, types plus nine topotypes (P33351 3, P33367 3, P33349 2, P33347 one).

Sub-family TURRIDAE Swainson, 1840

Genus *Gemmula* Weinkauff, 1875

Type species (s.d. Cossmann, 1896) *Pleurotoma gemmata* Reeve, 1843 = *Gemmula hind-siana* Berry, 1958.

Diagnosis: Shell elongate-fusiform, spire tall, anterior canal long, straight, unnotched. Protoconch tall, conical, polygyrate, axially costate. Adult sculpture is spiral keels and cords, with a gemmulated, often double, peripheral keel. Posterior sinus deep and narrow, on the peripheral keel. usually rather large, 24-88 mm.

Subgenus Clavogemmula subgen. nov.

Type species: *Gemmula (Clavogemmula) prima* sp. nov.

Diagnosis: Shell fusiform, spire tall, anterior canal short, twisted slightly. Protoconch: conoidal, polygyrate, 5.5-6.0 whorls, the early whorls smooth, the last whorl or so axially costate. Teleoconch has a dominant sculpture of spiral threads and cords; the posterior sinus is deep, V-shaped, narrowed near the periphery, with its apex on the peripheral cord which is heavily gemmate on the first teleoconch whorl. The gemmules weaken after 2-3 whorls to become at most barely discernible thickenings of the peripheral cord.

Comments: *Clavogemmula* differs from *Gemmula* s.s. by the mostly smooth protoconch, the short, twisted (not long and straight) anterior canal, and the rapid degeneration of the axial gemmules. *Unedogemmula* MacNeil, 1960 also has degenerating peripheral gemmulation and a similar protoconch to *Clavogemmula*, but has a long straight anterior canal. *Ptychosyrinx* Thiele, 1925 has a teleoconch of similar form to *Clavogemmula*, but with a broadly V-shaped not very deep sinus and persistent peripheral gemmules; the protoconch of the species ascribed to *Ptychosyrinx* by Powell (1964) is not known except for the type species, *P. bisinuata* (Martens, 1901), where it is narrowly conic, polygyrate, and closely axially ribbed. *Clavogemmula* does not show any signs of the spout-like projection of the outer lip anterior to the sinus which is intermittently present in *P. bisinuata* and *P. timorensis teschi* (Powell, 1964).

Clavogemmula is clearly very closely related to the widespread and geologically persistent group of Turrinae with a polygyrate protoconch and gemmate peripheral keel of which *Gemmula* is the typical genus. In its claviform appearance with a long spire and short anterior canal it also resembles certain later Australian Tertiary Turrinae (*Veruturris* spp.) in which there may also be traces of peripheral gemmulation and an initially smooth, later axially costate protoconch which is, however, paucispiral with a large immersed tip.

***Gemmula (Clavogemmula) prima* sp. nov.**
(Plate 5, figures 9, 10)

Description: Protoconch: polygyrate, 5.0-5.7 whorls, tip exposed, not deviated, conoidal, the first 4.5 or so whorls smooth, the last 1.1-1.3 whorls with 20-24 gently curved orthocline axial ribs; the junction with the teleoconch is well defined by the initiation of a shoulder sulcus and a subsutural margining cord. Teleoconch: fusiform; spire long, pointed, about two-thirds height of shell; whorls medially angulated, widest at the periphery, shoulder concave, anterior portion almost straight; body whorl short, excavated anteriorly into a short and twisted anterior canal. Axial sculpture: 15-20 gemmulations per whorl centred on the periphery, strong and elongate on the first 1-2 whorls, becoming progressively weaker by the fourth and later whorls; numerous close, very fine growth lines. Spiral sculpture is narrow threads and the peripheral keel; one fairly prominent thread submargins the suture, with a gradually increasing number of weak threads, usually 2-3 but up to 7, on the shoulder; the peripheral keel is either simple or double threaded (to produce a double row of weak gemmulations); there is a gradually increasing number, usually 1-3 but again up to 7, of threads anterior to the periphery on spire whorls, 7-12 threads of varying strength on the anterior of the body whorl (depending on age) and 14-17 undulose threads on the anterior canal. Aperture: broadly lanceolate; outer lip probably sharp (all fractured) directed sharply back on shoulder to a narrow posterior sinus with its apex on the peripheral keel and curved gently forward below the posterior sinus; inner

lip smooth, porcellanous, slightly incised into body whorl; columella slightly twisted and attenuating below into a short, straight ended anterior canal, twisted slightly to the left.

Types: Holotype P33350, Paratype 1 P42851, Paratype 2 P42852, all collected T. A. Darragh 24 February 1971, National Museum of Victoria.

Type Locality: Brown's Creek Clay, BC1, FL11.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	13.4	5.0	8.75	4	5.75
				preserved	
Paratype 1	8.0	3.2	4.5	5.0	3.5
Paratype 2	7.8	3.0	4.5	5.5	3.3
P42853	10.5	4.1	7.5+	1.5	5.0
				preserved	
P42853	7.0	2.9	4.0	5.7	3.0

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Type locality; types plus P42853 (two topotypes).

Comments: The salient points of this species are those of the genus. The spiral sculpture is the major variable.

Genus *Veruturris* Powell, 1944

***Veruturris* sp.**

(Plate 5, figure 8)

Stratigraphic Range: Aldingan, late Eocene

Material and Occurrence: Brown's Creek Clay, FL13 (P33393 one); FL14 (P33433).

Comments: This is the earliest member of the *Veruturris* line so far discovered. Compared with other *Veruturris* species it has a relatively globose protoconch, and short anterior canal, and the sculpture is simple with the spiral cords not tending to be bi-partite.

Sub-family BORSONIINAE Bellardi, 1875

Genus *Cordieria* Rouault, 1848

Type species (s.d. Cossmann, 1896) *Cordieria iberica* Rouault, 1850.

Diagnosis: Protoconch small, 1½-2 smooth whorls. Teleoconch ovate-fusiform with a tall conical spire of weakly convex whorls; body whorl elongate-ovate, hardly excavated on merging into a short unnotched anterior canal;

axial sculpture broad axial folds; spiral sculpture rather dense spiral lirations. Outer lip thin edged, with a shallowly arcuate subsutural sinus; two oblique median plaits on the columella.

?Cordieria sp. a.
(Plate 5, figure 11)

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: BC1, FL11 (P33348 5, P33373 1).

Comments: Though this small species (largest specimen L. 9.1 mm, B. 3.8 mm) has a better defined anterior canal than is perhaps typical and a very weak posterior sinus, it, the BC3 fossil referred to below and ultimately *Borsonia protensa* Tate, 1898 relate to a series of New Zealand fossils placed in *Cordieria* of which the writer has seen *C. rudis* (Hutton, 1885), *C. verrucosa* (Finlay, 1930) and *C. haasti* (Finlay, 1930).

Cordieria protensa (Tate, 1898)
(Plate 5, figures 14-16)

1898 *Borsonia protensa* Tate, *Proc. R. Soc. N.S.W.* 31:394, Pl. 19, fig. 6.

1898 *Borsonia polycesta* Tate, *Ibid* 31:395, Pl. 19, fig. 2.

1898 *Borsonia otwayensis* Tate, *Ibid* 31:394, Pl. 19, fig. 4.

1944 *Borsonia protensa* Tate; Powell, *Rec. Auckland Inst. Mus.* 3(1):42.

1944 *Borsonia polycesta* Tate; Powell, *Ibid* 3(1):42.

1944 *Borsonia otwayensis* Tate; Powell, *Ibid* 3(1):42.

Description: Protoconch: paucispiral, 1.75-2.2.smooth whorls, subcylindrical, merging into teleoconch; top dome-shaped; tip deviated and inrolled; suture distinct. Teleoconch: fusiform; spire acute, slightly more than 1/2 height of shell; whorls, especially the early ones, usually gently rounded, but a few specimens develop a weak (*polycesta*) or even a well-marked peripheral angulation (*otwayensis*) producing a shoulder slope extending over the posterior 1/2 or third of the whorl; upper whorls slightly polished; body whorl tapers gently below to a square-ended, moderately long anterior canal curved slightly to the left; suture distinct, margined on upper whorls. Axial sculpture: spaced, rounded, slightly opisthocline axial ribs best developed on the upper whorls where they help produce a narrow concave shoulder and strongest below

periphery; the ribs may persist for up to 8 whorls or may start to fade after 5 and become obsolete after 6 or so whorls; the ribs number 9-12 on the first whorl, 7-11 on the next two or three, and then become fewer and broader; numerous very fine axial growth lines. Spiral sculpture: very fine very numerous spiral threads, overriding the axials, from suture to suture on spire whorls and extending to the end of the anterior canal on the body whorl. Aperture narrowly lanceolate, open anteriorly into a square-ended anterior canal slightly shorter than, or about equal in length to the rest of the body whorl; outer lip sharp, curved backwards into a gentle sinus which can be traced as persistent back to the first teleoconch whorl and produced forwards in a gentle curve anteriorly, straightening down the anterior canal; inner lip a moderately broad glaze on the columellar and parietal region, extending to near the tip of the anterior canal and polished in well-preserved specimens; two oblique lamellae terminate at the top of the columella just below its junction with the parietal lip and continue internally as strong parallel lamellae for at least 4-5 whorls towards the apex. (In specimens with a complete outer lip these lamellae appear inconspicuous as they merge into the columella at the aperture.)

Types: South Australian Museum: Holotype T340D, Holotype of *Borsonia polycesta* T327C, Holotype of *B. otwayensis* T320D.

Type Locality: Glen Aire Clay, GSV locality AW1, Pt. Flinders, near Cape Otway, Vic. (given as 'Eocene, Cape Otway, Victoria' Tate, 1898).

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	35.5	8.6		(1.5)	(8.0)
T327C	13.6	4.8			
T320D	20.8	7.0			(7.0)
P42895	40.25	11.4	21.8	?1.5 (eroded)	8.1
P42895	35.25	12.5	16.3	1.75	8.3
P42895	31.9	10.3	16.25	?1.5 (eroded)	c.8.0
P42895	21.0	6.2	11.0	1.8	6.4
P42895	18.0	6.0	9.5	1.75	6.25
P42895	8.5	3.3	4.5	1.8	4.5

Stratigraphic Range: Upper Aldingan, early Oligocene.

Material and Occurrence: P42895, 65 topotypes coll. T. A. Darragh, T. Hughes, 25.11.1975.

Comments: Like the other abundant Glen Aire Clay turrids *Comitas wynyardensis cudmorei* and *Apiotoma bassi*, *Cordieria protensa* is very variable, but the protoconch, early whorls, and the rate of growth are reasonably constant characters and indicate that only one species is involved. Tate's three species are based on fairly large typical specimens (*protensa*), specimens with heavily angulated whorls (*otwayensis*), and a small specimen (*polycesta*). Of Tate's three names *protensa* takes page priority. *C. protensa* has been placed in *Borsonia* in the past, as its large size and prominent anterior canal are characters often held to be characteristic of *Borsonia*. However the BC3 material (see below) indicates that it probably developed from a *Cordieria*-like source similar to the late Eocene New Zealand fossil species also assigned to *Cordieria*, *C. rudis* (Hutton, 1895), *C. haasti* (Finlay, 1930), *C. verrucosa* (Finlay, 1930) and *C. huttoni* (Finlay, 1930). The assignment of these Borsoniid turrids with two columellar lamellae from Australia and New Zealand into two different genera is an artifact and tends to obscure their relationships.

***Cordieria* sp. cf. *protensa* (Tate, 1898)**
(Plate 5, figure 12)

Description: Protoconch: c.1.5 whorls, smooth, semi-cylindrical, first whorl dome-shaped, tip slightly deviated, overhanging second whorl. Teleoconch: biconic-fusiform, spire about three-fifths height of shell; whorls nearly straight sided with a slightly concave shoulder and the periphery at about ¼ of the whorl height anterior to the suture; body whorl rounded, narrowed gently below into a short, open, anterior canal. Axial sculpture: broad, rounded, nearly orthocline ribs about equal to interspaces, 8-11 per whorl, starting just below the subsutural cord on the two upper whorls and at the periphery on later whorls, extending to the suture anteriorly on spire whorls, noticeably fewer and weaker after about 5 whorls, and dying out above the anterior canal on the body whorl; numerous faint axial growth lines becoming fold-like on the end of the anterior canal. Spiral sculpture: a double

subsutural cord margins the posterior edge of each whorl; numerous fine spiral threads over-ride the axials, from suture to suture on the spire whorls and extending almost to the end of the anterior canal, about 5 on the first whorl increasing to 19-20 on the 5th, 40-50 on body whorl, and 9-10 on anterior canal. Aperture narrow, lanceolate, open below; inner lip smooth; two oblique folds at the posterior end of the anterior canal; columella slopes slightly to the left. Outer lip (fractured); growth lines indicate a weak posterior sinus in the shoulder sulcus, and a straight outer edge anterior thereto; anterior canal short, open, rounded, inclined slightly to left.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
P33384	13.2	4.9	7.75	c.1.5	5.75
P33419	13.75	5.0	7.5	c.1.5(worn)	5.5

Stratigraphic Range: Aldingan, late Eocene

Material and Occurrence: BC3 FL13 (P33384 1), FL14 (P33419 1).

Comments: The limited amount of BC3 material only differs from the polymorphic *C. protensa* (Tate, 1898) in having a shorter, poorly defined anterior canal and is probably an early form of that species, particularly as its dimensions fall within the range shown by *C. protensa*. Compared with the New Zealand species mentioned above (under ?*Cordieria* sp.) it shows a relatively shallow posterior sinus and a broader protoconch but the general morphology is the same.

?*Cordieria* sp. b.
(Plate 5, figure 13)

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay, FL14 (P33423 4).

Comments: This small fossil has a superficial resemblance to *Splendrillia* Hedley, 1922 and *Tahudrillia* Powell, 1942 Kaiatan (late Eocene) New Zealand, neither of which has columellar lamellae whereas this species has two very faint oblique plaits or a slight thickening about the middle of the columella. There is insufficient material to fully describe it.

Type species (monotypy) *Borsonia prima* Bellardi, 1839

Diagnosis: Protoconch: small, c.1.5 smooth whorls. Teleoconch: elongate-fusiform, whorls usually angulated. Aperture narrow, pyriform, with a slightly flexed unnotched anterior canal; typically one, sometimes two, lamellae at about the middle of the columella; outer lip sharp; posterior sinus broadly rounded and moderately deep, covering the whole shoulder slope.

***Borsonia tatei* Powell, 1944**

1944 *Borsonia tatei* Powell, *Rec. Auckland Inst. Mus.* 3(1):42, Pl. 3, fig. 8.

Comment: As a new subspecies, *B. tatei eocenica* is proposed below, the Janjukian fossil should be *Borsonia tatei tatei* Powell, 1944.

***Borsonia tatei eocenica* subsp. nov.**

(Plate 5, figure 18)

Description: Protoconch: paucispiral, 1.0-1.5 whorls, rounded; first whorl smooth; the second has six axials before merging into the teleoconch. Teleoconch: narrowly fusiform with a moderately long, straight, anterior canal. Axial sculpture: low, slightly opisthoclinal ribs about equal to the interspaces, strongest anterior to the periphery but extending almost to the suture on upper whorls, 7-10, usually 9, per whorl, weakening by the 6th whorl and not extending far below the periphery on the body whorl; numerous very fine growth lines. Spiral sculpture: regular threads, strongest below the periphery where they develop to weak cords on the body whorl, wider than or equal to interspaces; on the shoulder there are usually one, sometimes two subsutural threads, and from nil to five other weak threads; there are one or two peripheral threads, and below the periphery 3-6 cords on the spire whorls and 20-35 cords on the body whorl extending to the tip of the anterior canal. Aperture: lanceolate, pointed above; outer lip probably sharp, with a very shallow arcuate posterior sinus occupying the whole of the shoulder slope, slightly produced anteriorly; inner lip a glaze; one oblique columellar lamella at the top of the columella which tapers

gradually to a point above the round-ended anterior canal.

Types: National Museum of Victoria; Holotype P42854, Paratype 1 P42853, Paratype 2 P42856 all coll. T. A. Darragh 24 February 1971.

Type Locality: Brown's Creek Clay, BC1, FL11.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	14.0	4.3	6.6	c.1.5	5.5
Paratype 1	16.0	4.5	8.25	c.1.3	6.0
Paratype 2	13.0	3.6	6.6	1.5	5.5

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Type locality, types and six topotypes (P33379 4, P33374 one, P33357 one).

Comments: *B. tatei eocenica* differs from *B. tatei tatei* in that the spiral sculpture of cords and threads is wider than or equal to the interspaces, and not narrower than or equal to the interspaces as in *B. tatei tatei*. There seem to be no other constant differences between *B. t. eocenica* and *B. t. tatei* although the latter is slightly larger as described (Powell, 1944:42), but this may be because the measurements are of an aged specimen. The protoconch of *B. t. eocenica* with its development of axial ribs in the last half whorl is not strictly typical of *Borsonia* which is said to have a smooth protoconch.

?*Borsonia* sp. aff. *B. tatei* Powell, 1944

(Plate 5, figure 17)

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay BC3, FL13 (P33397 2); FL14 (P33437 3, P33404 2, P33405 one, P42903 one).

Comments: *B. tatei eocenica* has yet to be recorded from the BC3 fauna, but this material appears to be a development of it in which the whorls have lost most of their median angulation, the spiral sculpture has become somewhat stronger especially above the periphery, and the weak posterior sinus has virtually disappeared. Although *B. t. tatei* and *B. t. eocenica* fit reasonably into *Borsonia* as diagnosed, the BC3 fossil has no strongly turrid characteristics and

raises doubts as to the validity of the familial placement of the *B. tatei* complex.

Genus *Mitrolumna* Bucquoy, Dautzenberg and Dollfus, 1883

Type species (o.d.) *Mitra olivoidea* Cantraine, 1835

1922 *Mitrihara* Hedley, *Rec. Aust. Mus.* 13(6):233

Type species (o.d.) *Columbella alba* Petterd, 1879.

Comment: The writer agrees with Cernohorsky (1975:232) that there are no significant conchological differences between *Mitrolumna* and *Mitrihara*.

?*Mitrolumna* sp.
(Plate 6, figure 1)

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay, FL14 (P33435 3).

Comments: Although lacking internal lirations of the outer lip this fossil resembles *Mitrolumna*. It has a small, elongate-ovate, fairly strong, teleoconch; 11-14 low inconspicuous orthocone ribs per whorl produce tubercles where they cross the spiral cords. Its relatively conspicuous domed protoconch resembles *Itia* Marwick, 1931 (type *I. clathrata* Marwick 1931) which Powell (1966) regarded as a subgenus of *Mitrihara*, but lacks *Itia's* half whorl of brephic axials.

Genus *Cryptocordieria* gen nov.

Type species: *Cryptocordieria variabilis* sp. nov.

Diagnosis: Protoconch: paucispiral, smooth, dome-shaped, 1.6-1.8 whorls followed by up to a whorl of brephic axials. Teleoconch: strong, fusiform, tending to ovate-fusiform; spire about 0.5 height of shell; whorls supramedi ally angulated with a slightly concave shoulder slope; body whorl narrowing (scarcely excavated below) into a short, open, round-ended anterior canal. Axial sculpture: slightly sigmoidal and opisthocline axial ribs from suture to suture on spire whorls, becoming more spaced and weaker with age. Spiral sculpture: numerous fine cords of variable strength, sometimes obsolete over whole whorl. Aperture

narrowly pyriform to slightly rhomboid; columella slightly concave anteriorly and twisted; outer lip sharp, simple, slightly curved forward below periphery; posterior sinus shallow, on shoulder slope.

Comments: The relationships of this genus are not clear. In the writer's view it resembles *Antiguraleus* Powell, 1942 which is placed in the subfamily *Mangeliinae*, but it is also a relatively large, thick-shelled, fossil with a shallow posterior sinus and a twisted, slightly thickened, columella suggestive of a link with *Cordieria*, *Borsonia* and their allies.

Cryptocordieria variabilis sp. nov.
(Plate 6, figures 2, 3)

Description: Protoconch: paucispiral, 1.6-1.8 whorls, slightly assymetric, dome-shaped, flattened above; tip semi-immersed, not deviated; smooth; merging into teleoconch by development of 10 or more rounded, nearly orthocone brephic ribs from suture to suture. Teleoconch: fusiform to ovate-fusiform; spire slightly more than half height of shell; whorls with a shallow concave shoulder after about 2 whorls, widest at the rounded periphery; body whorl tapering gently below into a fairly short, broad, open, round-ended anterior canal; suture margined by a narrow cord on upper two whorls. Axial sculpture: spaced, narrow, slightly sigmoidal and opisthocline ribs traceable from suture to suture on spire whorls, dying out anterior to periphery when present on body whorl, elongately tuberculate on and near the periphery; axials number 14-23 (including brephic axials) on first whorl, and 10 or 11-7 per whorl, tending to reduce with age, on succeeding whorls; they may persist for up to 6 whorls or weaken and gradually disappear after 3.5-4.0 whorls (see comments); numerous threadlike growth lines allow the former posterior sinus position to be traced. Spiral sculpture: numerous fine threads, strongest below periphery over spire whorls and extending to very near end of anterior canal, variable in strength. In some specimens the growth lines and spiral threads create a reticulation. Aperture: elongate, narrowly pyriform, slightly rhomboid; inner lip a glaze on the columella which is slightly twisted anteriorly and excavate

posteriorly with a tendency to a median swelling; outer lip thin, sharp-edged, curved back on shoulder in a narrow posterior sinus with apex just above the periphery (traceable from start of shoulder on teleoconch whorls), and curved very gently forward anteriorly; anterior canal moderately long to short, nearly straight, open, unnotched.

Types: National Museum of Victoria; Holotype P33395, Paratype 1 P42857, Paratype 2 P33394 all coll. T. A. Darragh, 20 November 1970.

Type Locality: Brown's Creek Clay, BC3, FL13.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	23.2	7.4	12.5	1.8	6.2
Paratype 1	13.5	5.0	7.1	c.1.8	4.8
Paratype 2	11.0	4.3	6.0	1.85	4.1
P33363	11.7	4.25	6.1	1.75	4.9

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay; FL11 (P33363 1, P42859 2); Type locality (FL13) (types plus P42858 1, P33386 1); FL14 (P33402 2, P33413 1, P33418 4, P33439 10, EB007 1).

Comments: Both the axial and the spiral sculpture of *Cryptocordieria variabilis* varies in strength. The specimens available from FL11 and FL13 have relatively persistent axials, crisp spiral sculpture, and well-marked growth lines, while those from FL14 have fine low spiral sculpture (though the difference is somewhat exaggerated as specimens are often somewhat rolled), and a greater tendency for the axial sculpture to weaken. However, all the material falls within a range of variation which it is reasonable to expect in one species.

Subfamily: CLAVINAE Casey, 1904

Genus *Splendrillia* Hedley, 1922

Type species (o.d.) *Drillia woodsi* Beddome, 1883.

Diagnosis: Protoconch paucispiral, bluntly rounded, smooth. Teleoconch claviform; spire tall; body whorl rapidly contracted below into a short, rather straight, shallowly notched anterior canal. Sculpture: prominent axial ribs separated from the posterior suture by the

shoulder sulcus; shell surface typically smooth and glossy (Hedley's, 1922:250, distinguishing characteristic for *Splendrillia*; Powell, 1966:83, mentions that *Splendrillia* spp can develop spiral striae or lirations). Aperture: ovate lanceolate, open below into a short wide anterior canal which is shallowly notched; outer lip thin edged, slightly thickened behind, with a slight stromboid notch; a heavy entering callus pad at the posterior end of the inner lip; posterior sinus on the shoulder.

?*Splendrillia* sp.

(Plate 6, figures 4, 5)

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay; FL11 (P42860 1), FL 14 (P33409 1, P33422 2).

Comments: These four specimens clearly relate to *Splendrillia* but have a porcellanous rather than a glossy surface, and lack both a parietal callus pad and, apparently, a 'stromboid' notch on the outer lip.

Splendrillia hughesi sp. nov.

(Plate 6, figure 6)

Description: Protoconch: paucispiral, of 2 whorls; first whorl rounded above with tip partially immersed, may overhang second whorl; suture well defined; either merges into teleoconch or has a well defined junction with a rounded posterior sinus; smooth. Teleoconch: fusiform, glossy; spire about 0.6 height of shell; whorls widest at the rounded periphery which is median on upper whorls and slightly supra-median and sharp on lower whorls; shoulder concave; suture slightly oblique, weakly margined by posterior edge of whorls; body whorl short, rendered ovate in section by a prominent rounded varix-like rib about half a whorl before the aperture (in the holotype—the only complete specimen) extending to the top of the anterior canal, excavated below into a short, nearly straight anterior canal. Axial sculpture: 10-14 rounded, opisthocline, slightly flexuous axial ribs per whorl, usually extending slightly above the periphery on early whorls but cut off sharply at the periphery on the body whorl, and there not extending far below it (usually reaching anterior suture on upper whorls), markedly weaker or obsolescent after

the prominent rib on the body whorl described above; very fine growth lines discordant with the axial ribs. Spiral sculpture: 3-7, usually 6, low cords on the anterior canal; subsutural margining occasionally developed as a weak cord and, rarely, faint linear traces of sculpture on the penultimate and body whorls. Aperture: narrow, lanceolate; inner lip a relatively thick glaze on the columella with, sometimes, a parietal callus; outer lip sharp, curved back and reflected round a deep semicircular posterior sinus occupying the whole of the shoulder, strongly curved forward below the periphery; there is a weak notch in the outer lip opposite the posterior end of the anterior canal; anterior canal short, very weakly notched (notch only noted in holotype which has a complete aperture).

Types: National Museum of Victoria; Holotype P42862, Paratype 1 P42863, Paratype 2 P42864 all coll. T. A. Darragh and T. Hughes 1 December 1972.

Type Locality: Glen Aire Clay, GSV Loc. AW1.

Dimensions:

	L.	B.	S.	Protoconch	Teleoconch
				Whorls	Whorls
Holotype	10.5	3.8	5.7	2.0	6.0
Paratype 1	11.6	3.9	6.6	2.0	7.0
Paratype 2	9.0	3.0	5.0	2.0	5.9

Stratigraphic Range: Upper Aldingan, early Oligocene.

Material and Occurrence: Type locality (types and topotypes; P33340 13, P42933 15, P42934 7).

Comments: This species is named after one of the collectors of the types. It is not quite typical of *Splendrillia* as the parietal callus pad is poorly developed and not always present, and there is a varix-like rib on the body whorl. The only described Australian fossil *Splendrillia* with similarly weak spiral sculpture is the Pliocene *S. trucidata* (Ludbrook, 1941) which is larger and has a heavily developed parietal callus. *S. hughesi* also resembles the Recent *S. lygdina* (Hedley, 1922) which lacks the spiral sculpture on the anterior canal and the varix-like rib on the body whorl. South-east Australian Middle Miocene fossils, to which the

names *Austroclavus glaber* Powell, 1944, *A. teres* Powell, 1944, *A. brevicaudalis* Powell, 1944 and ?*A. lygdinopsis* Powell, 1944 have been applied, have a paucispiral protoconch and are not typical of *Austroclavus* Powell, 1942; they also sometimes (coll. writer MM035, MM076) exhibit a varix like fold on the body whorl and are probably congeneric with *S. hughesi*. Probably related early Miocene (Batesfordian) material occurs at Kennedy's Creek (FL43). On the other hand *Austroclavus* with a typical polygyrate protoconch occurs in the early Miocene (Longfordian and Batesfordian) of Victoria (undescribed material, coll. writer, LF015, LF016, MK062, MK063, MK064).

Subgenus *Hauturua* Powell, 1942

Type species (o.d.) *Syntomodrillia (Hauturua) vivens* Powell, 1942.

Splendrillia (?*Hauturua*) sp.

(Plate 6, figure 7)

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay, FL13 (P33381 1); FL14 (P42890 1).

Comments: This small fossil somewhat resembles *Hauturua* Powell, 1942 in its general form and axial sculpture, but has definite spiral sculpture which *Hauturua* is said to lack. There is insufficient material to describe it.

Genus *Mauidrillia* Powell, 1942

Type species (o.d.) *Mangilia praecophinodes* Suter, 1917.

Diagnosis: Protoconch: smooth, globular, of 2 whorls. Teleoconch: claviform; spire turretted, moderately tall; body whorl with a short, very shallowly notched, anterior canal. Axial sculpture: weak to moderately strong axials, mainly on periphery. Spiral sculpture: dense cords or threads overriding axials; subsutural margining cord weak or absent. Posterior sinus broad, rather shallow, occupying most of shoulder area. Parietal callus absent.

Mauidrillia aldingensis Powell, 1944

(Plate 6, figure 8)

1944 *Mauidrillia aldingensis* Powell, *Rec. Auckland Inst. Mus.* 3(1): 36, Pl. 4 fig. 6.

1966 *Mauidrillia aldingensis* Powell, 1944; Powell, *Bull. Auckland Inst. Mus.* 5:87.

Description: Protoconch: 1.3-c.2.0, usually 1.5, whorls, dome-shaped, smooth, tip deviated, slightly flattened; junction with teleoconch not distinct. Teleoconch: claviform; spire about two-thirds height of shell; whorls slightly angled at the periphery with a weakly concave shoulder slope; body whorl very slightly excavate into a short open anterior canal, curved slightly to the left. Axial sculpture: low, rounded, slightly opisthocline axial ribs, somewhat tuberculate on the periphery, 11-15 on first whorl, 8-14, usually about 10, per whorl on succeeding whorls, from just above periphery to anterior suture on spire whorls but weakening and largely confined to the periphery by the fourth to fifth whorls; numerous fine growth lines, slightly thread-like on the shoulder. Spiral sculpture: a narrow sharp subsutural cord followed on the shoulder by spiral threads which increase in number from one up to 5 with age; a cord on the peripheral angulation is followed by 1-3 (usually 2-3) fine cords anteriorly; on the body whorl the subsutural cord is often no stronger than the rest of the spiral sculpture on the shoulder; on, and anterior to, the periphery about 21-27 cords extend to the end of the anterior canal. Aperture: lanceolate, constricted at top of anterior canal; inner lip smooth, columella almost straight; outer lip sharp edged, curved back on shoulder in a round-apexed, V-shaped, posterior sinus with the apex in mid-shoulder; curved gently forward below periphery (no apparent 'stromboid' notch); anterior canal short, termination slightly oblique and weakly notched.

Types: Auckland Institute and Museum; Holotype TM1024, and one Paratype.

Type Locality: Blanche Point Formation, Blanche Point, Aldinga, S. Australia.

Dimensions:

	Protoconch			Teleoconch	
	L.	B.	S.	Whorls	Whorls
Holotype	9.5	3.8	—	—	—
P33447	7.8	2.8	4.5	1.5	5.0
P33447	8.5	3.4	5.0	1.5	4.9
P33443	8.9	3.3	5.0	1.5	5.2
P33443	7.6	2.9	4.3	1.5	4.5
EB005	11.5	4.2	6.5	?2.0 (worn)	6.0

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Type Locality (P33447 2 topotypes); Brown's Creek Clay, FL14 (P33443 6, EB005 4).

Comments: The large EB005 specimen whose dimensions are given above develops a broad subsutural margining fold after the fourth and later whorls. *M. aldingensis* is likely to be ancestral to the Oligocene-Miocene species *M. torquayensis* Powell, 1944, *M. pullulascens* (Tenison Woods, 1877), *M. trispiralis* Powell, 1944, *M. consutilis* (Tenison Woods, 1879), *M. partinoda* Powell, 1944 and *M. serrulata* Powell, 1944.

***Mauidrillia secta secta* (Powell, 1944)**
(Plate 6, figures 9, 10)

1944 *Mauidrillia secta* Powell, *Rec. Auckland Inst. Mus.* 3(1):37, Pl. 4, fig. 10.

1966 *Mauidrillia secta* Powell, Powell, *Bull. Auckland Inst. Mus.* 5:87.

Description: Protoconch 1.5 whorls, rounded, tip deviated slightly flattened; smooth with three weak corrugations just before the junction with the teleoconch; suture well-marked; junction with teleoconch well-defined, with a posterior sinus. Teleoconch: fusiform; spire turreted, about 0.54 height of shell; whorls widest at periphery with a strong angulation, median on upper whorls, post-median on lower whorls; shoulder concave; suture slightly oblique; body whorl angulated at periphery, slightly excavated below into a short open anterior canal turned slightly to the left. Axial sculpture: 11-13 sharp opisthocline, abapical ribs, slightly tuberculate at shoulder; from periphery to anterior suture on spire whorls, and from periphery to top of anterior canal on body whorl. Spiral sculpture: a well-defined subsutural cord tending to fade on the body whorl; 2-3 faint incised lines on anterior slope of spire whorls; 5 spiral lines on the body whorl below the periphery, and 4 on the upper part of the anterior canal; 2-5 weak spiral ribs on the lower part of the anterior canal. Aperture (imperfect and matrix-filled) pyriform, narrowed below into anterior canal; inner lip smooth, slightly incised into columella margin; outer lip probably sharp; well-defined rounded posterior sinus on shoulder, apex in mid-shoulder; lip curved forward anteriorly.

Types: Auckland Institute and Museum; Holotype TM1031.

Type Locality: Blanche Point Formation, Blanche Point, Aldinga, S. Australia.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
(Holotype) (Powell, 1944:37)	12.0	4.5	—	—	—
P33448	11.1	4.5	6.1	1.5	4.75
P33444	10.4	4.25	5.5	c.1.5	4.5

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Topotype, P33448 (G. B. Pritchard collection); Brown's Creek Clay, FL14 (P33444 1, EB018 1 spire).

Comments: *Mauidrillia secta secta* seems not to be a common species. An early form from BC1, which may merit sub-specific separation is recorded below, and a later form from AW1 with more persistent and numerous axials is described as *M. secta otwayensis* subsp. nov. The *Mauidrillia secta* series seems to have developed by a progressive strengthening of both the spiral and axial sculpture, and eastern (Victorian) and western (S. Australian) populations may also have separable differences but more material is necessary to verify this. The holotype approaches the BC1 material in having axial ribs which do not reach the anterior suture, but in P33448, P33444 and EB018 the axials reach the anterior suture on the spire. Both BC3 specimens have more axials per whorl than the holotype and topotype, 14-17 on P33444 and 15 on EB018.

Mauidrillia sp. cf. *secta* Powell, 1944
(Plate 6, figure 12)

Description: Protoconch: 1.5-2.0 smooth rounded whorls, tip deviated, flattened on top; on one specimen the junction with the teleoconch is well-defined and sinuate; another has brephic axials. Teleoconch: narrowly claviform; spire about 0.56 height of shell, turreted; whorls medially sharply angulate, widest at periphery; shoulder sloping, shallowly concave; body whorl slightly excavate anteriorly into a short, oblique-ended, unnotched, almost straight anterior canal. Axial sculpture: short, low, narrow, opisthocline, abapical ribs, ex-

tending slightly above the periphery on the first whorl, not reaching the anterior suture and confined to the periphery by the body whorl, 10-16, averaging about 14, per whorl. Spiral sculpture: a weak, slightly beaded subsutural cord which becomes obsolete after 4-5 whorls; one or two faint traces of spiral lines on the shoulder; 1-3 faint incised spiral lines develop anteriorly to the periphery starting on the second-fourth whorls; 10-12 low, slightly rounded to flat spiral cords on the anterior part of the body whorl and the anterior canal. Aperture (broken on all specimens): lanceolate; inner lip a glaze on the columella; the outer lip has a U-shaped posterior sinus occupying the whole shoulder slope, and is produced forward anteriorly.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
P33377	13.8	4.5	8.0	1.5	5.8
P33377	10.9	4.0	6.0	c.2.0	5.3
P33377	11.0	3.8	6.3	1.5	5.6

Stratigraphic Range: Aldingan, Late Eocene.

Material and Occurrence: Brown's Creek Clay BC1 FL11 (P33377 3).

Comments: These stratigraphically earlier specimens differ from *M. secta secta* in being narrower in proportion to their length; in the weak and evanescent subsutural cord, in the weak development of the axial ribs, and in a relatively longer and less concave shoulder. It is probably subspecifically distinct from *M. secta secta* but more material is needed to verify this.

Mauidrillia secta otwayensis subsp. nov.
(Plate 6, figure 11)

Description: Protoconch: paucispiral, 1.5-1.75 whorls; tip slightly immersed; first whorl dome-shaped, somewhat flattened on top, second sub-cylindrical to slightly angulate; smooth apart from occasional weak corrugations near the junction with the teleoconch; junction with teleoconch variable, either indistinct, or well-defined with a rounded posterior sinus. Teleoconch: fusiform; spire turreted, about 0.57 height of shell; whorls post-medially angulate with a narrow sulcate shoulder; body whorl excavate anteriorly into a fairly short, straight, unnotched anterior canal inclined

slightly to left; suture slightly oblique, margined anteriorly. Axial sculpture: close opisthoclinal slightly curved narrow ribs about equal to interspaces, from periphery to anterior suture on spire whorls and traceable to top of anterior canal on body whorl, 15-24 (usually more than 17 and occasionally up to 28) per whorl. Spiral sculpture: a persistent subsutural cord, usually finely beaded by the intersection of axial growth lines; often 1-2 faint spiral lines on the shoulder; 1-4 (usually 2-3) incised spiral lines below the periphery on spire whorls; 5-6 deeply incised spiral lines on body whorl, the interspaces becoming progressively more convex to develop as 8-10 cords on the anterior canal. The degree of depth of sculpture varies, and in some cases, the interspaces between the spiral lines on the body whorl develop as convex cords anteriorly, and the intersection of the spiral and axial sculpture often produces a reticulate tuberculation on the body whorl. Aperture: lanceolate, pointed posteriorly, open below into the anterior canal; inner lip a porcellanous glaze on the columella which tapers to a point at the termination of the anterior canal; outer lip sharp, curved back in an open U-shaped posterior sinus, with a mid-shoulder apex, occupying the whole shoulder, produced in a strong forward curve anteriorly, and curved back to the anterior canal.

Types: National Museum of Victoria, Holotype P42865, Paratype 1 P42866, Paratype 2 P42867, all collected T. A. Darragh, T. Hughes 1 December 1972.

Type Locality: Glen Aire Clay, GSV locality AW1.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	11.1	4.25	6.5	1.6	5.0
Paratype 1	10.6	4.0	6.2	1.5	5.0
Paratype 2	11.4	4.5	6.2	1.5	5.0

Stratigraphic Range: Upper Aldingan, early Oligocene.

Material and Occurrence: Type locality (types plus topotypes: P33330 12, P33341 5, P42935 1, P42936 2).

Comments: *M. secta otwayensis* differs from the limited amount of *M. secta secta* material

available in its generally stronger sculpturing, more numerous axial ribs (15-28 vice 11-17 per whorl) which persist farther anteriorly, slightly narrower shoulder sulcus, and longer anterior canal which carries 8-10 cords compared with 2-5 in *M. secta secta*, in being slightly narrower in proportion to its height (breadth = c.0.37 of height in *M. secta otwayensis*, c.0.39 in *M. secta secta*), and in the spire being slightly longer in proportion to total length (0.58 total length in *M. secta otwayensis*, 0.54 in *M. secta secta*). Whether it is sufficiently different from *M. secta secta* to be regarded as a separate species is questionable; it does not depart from *M. secta secta* in developing any completely new features, and it is possible that the BC3 population of *M. secta* will prove with more material to be intermediate between the population at the type locality and that at GSV locality AW1.

Genus nov?

(Plate 6, figure 13)

Comments: Three specimens, one from FL13 (P33388 sinistral) and two from FL14 (P33427 sinistral, P33430 dextral) represent a genus of 'clavinid' turrids. However no described 'clavinid' genus combines a protoconch followed by a half whorl of brephic axials, a relatively long shoulder slope, and variability in the direction of its coiling.

Subfamily CONORBIINAE Pilgrim in
Vredenburg, 1925

Genus *Conorbis* Swainson, 1840

Type Species (monotypy) *Conus dormitor*
Solander, 1766.

Diagnosis: Shell coniform. Protoconch smooth, broadly conical, paucispiral. Teleoconch: spire broadly conical; body whorl long and evenly tapered; axial sculpture dense interstitial growth lines; spiral sculpture numerous cords. Aperture long, narrow, parallel sided. Posterior sinus well marked with a straight, prosocline posterior edge and apex just above periphery. Anterior lip produced forward in a sweeping curve below the periphery. Inner lip a smooth glaze on the columella.

Comment: *Conorbis* spp. are found both in the

Brown's Creek Clay (BC3) and the Glen Aire Clay; they are like, but not identical to, *C. attractoides* Tate, 1890.

Conorbis sp.

Material and Occurrence: Brown's Creek Clay, FL14 (EB006 one complete, one crushed).

Comments: The only complete specimen is probably a juvenile. There is not enough material to describe the BC3 fossils which differ from *C. attractoides* Tate, 1890 in a more simply sculptured spire and spaced linear sculpture on the body whorl.

***Conorbis attractoides* (Tate, 1890)**
(Plate 6, figure 14)

1890 *Conus (Conorbis) attractoides* Tate, *Trans. R. Soc. S. Aust.* 13(2):200, Pl. 13, fig. 7.

1944 *Conorbis attractoides* Tate, 1890, Powell, *Rec. Auckland Inst. Mus.* 3(1):23.

1966 *Conorbis attractoides* Tate, 1890, Powell, *Bull. Auckland Inst. Mus.* 5:95.

Types: South Australian Museum, Adelaide, Holotype T750A, Kent Town Bore, late Eocene.

***Conorbis attractoides otwayensis* subsp. nov.**
(Plate 6, figure 15)

Description: Protoconch: 1.75-2.0 whorls, smooth, tip inrolled and slightly depressed; second whorl rounded; suture distinct; junction with teleoconch straight, indicated by start of spiral sculpture. Teleoconch: biconic; spire conical, straight, or slightly convex or concave sided depending on tightness of coiling of shell; whorls rounded, in some specimens with an indistinct periphery; body whorl with a rounded posterior angulation, a short sloping shoulder slope, and a long posterior portion tapering gradually to a short open anterior canal. Axial sculpture: very numerous fine, incised axial growth lines, most prominent as reticulations in the interspaces between cords on the upper part of the whorls but traceable to the end of the anterior canal. Spiral sculpture: a sometimes bifid subsutural cord is followed by up to four major and two minor spiral cords with sulcate interspaces on the shoulder; on the anterior part of the spire whorls and often obscured by succeeding whorls are up to seven close flat spiral cords with linear interspaces, often indistinct; on the body whorl up to 40 fine flat

spiral cords with linear interspaces are crossed by axial growth lines; the interspaces become wider anteriorly so that up to 14 low cords are developed on the anterior canal. Aperture: narrowly lanceolate, widening slightly at the top of the anterior canal; inner lip a glaze on the columella, smooth (with traces of underlying spiral sculpture near the edge) forming a callus on the anterior canal; outer lip sharp edged; a wide, shallowly curved, posterior sinus occupies the entire shoulder slope with its apex slightly anterior to the mid-shoulder; the lip is then curved gently but pronouncedly forward in a long curve anteriorly. Anterior canal short, straight, open, square-ended.

Types: National Museum of Victoria, Holotype P42959, Paratype 1 P42960 both coll. T. A. Darragh 10 March 1977; Paratype 2 P42868 coll. T. A. Darragh and T. Hughes 1 December 1972.

Type Locality: Glen Aire Clay, GSV Locality AW1.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	19.75	8.75	8.2	1.75	5.9
Paratype 1	22.8	10.2	9.0	2.0	6.2
Paratype 2	16.9	8.6	5.8	1.8	5.25

Stratigraphic Range: Upper Aldingan, early Oligocene.

Material and Occurrence: Type locality (Types plus topotypes P33332 12, P42869 1, P42870 1, P42937 32, P42938 9).

Comments: *C. attractoides otwayensis* differs from *C. attractoides* s.s. in having a protoconch of 1.75-2.0 rather than 2.5 whorls, in being slightly wider in proportion to its length with a relatively more obtuse spire, in developing more numerous spiral cords (up to 11 vice 6 on spire whorls), in the growth lines producing reticulation rather than punctuations in the cord interspaces on the spire whorls, and in the lack of punctuation of the cord interspaces on the body whorl.

subfamily MANGELIINAE Fischer, 1887

Genus *Guraleus* Hedley, 1918

Type species (o.d.) *Mangelia picta* Adams and Angas, 1864.

Diagnosis: Shell small, elongate fusiform, spire tall, usually turreted; body whorl narrow, tapering to a relatively short, weakly notched anterior canal. Protoconch small, broadly conical with a small, smooth, symmetrical nucleus; second whorl also smooth but much larger, the third whorl with fine axial riblets gradually merging into the adult sculpture. Adult sculpture with dominant axials usually crossed by weak cords and fine threads. Aperture rather narrow, outer lip thin. Posterior sinus a broad shallow excavation occupying most of the shoulder slope.

***Guraleus eocenicus* sp. nov.**
(Plate 7, figure 2)

Description: Protoconch: polygyrate, conoid, 3.0-3.75 rounded whorls with a deep suture; mostly smooth but numerous (20-30) arcuate axial ribs from suture to suture on the last half whorl; tip exposed, slightly depressed below top of protoconch and slightly deviated; protoconch merges gradually into teleoconch as axials become more spaced. Teleoconch: small, buccinoid-fusiform; spire about, or slightly less than, 0.5 height of shell; suture well marked, slightly oblique; first two spire whorls rounded; a peripheral angulation and a shoulder slope, which becomes shallowly concave, develop by the third whorl and the anterior portion of the whorl is then almost straight. Body whorl angulated posteriorly, rounded anteriorly, and gently excavated into a short anterior canal curved slightly to the left. Axial sculpture: 13-17, usually 10-13 narrow axial ribs per whorl, with slightly wider interspaces, curved on the upper part of the whorl and opisthoclinal anteriorly, from suture to suture on spire whorls, and to just above the anterior canal on the body whorl; by the third whorl the ribs are much weaker on the shoulder, where they parallel the posterior sinus, and are slightly spinose on the whorl periphery; numerous fine axial growth lines indicate the position of the posterior sinus on early whorls and are not quite parallel with the axial ribs. Spiral sculpture: spiral threads overriding the axials, finer on the upper part of the whorl and shoulder than anteriorly, and extending to the end of the anterior canal; 7-13 on the first

whorl, increasing to 7-8 spirals on the shoulder and up to 11 anteriorly on spire whorls, and up to 20-30 variable threads on the body whorl, plus 10-12 fine cords on the anterior canal. Aperture: narrowly rhomboidal; inner lip smooth, slightly incised on the parietal wall of the body whorl; the glaze on the columella lip narrows anteriorly to disappear before the end of the short, open, round-ended, unnotched anterior canal; outer lip sharp edged with a well defined curved posterior sinus occupying the whole of the shoulder, apex in mid-shoulder (traceable by growth lines to early whorls), and produced gently forward anteriorly with a suggestion of a weak sinus at the top of the anterior canal.

Types: National Museum of Victoria; Holotype P42871 coll. D. C. Long 11 June 1972, Paratype 1 P42872, Paratype 2 P42873 both coll. T. A. Darragh and H. E. Wilkinson 6 December 1968.

Type Locality: Brown's Creek Clay, BC3, FL14.

Dimensions:

				Protoconch	Teleoconch
	L.	B.	S.	Whorls	Whorls
Holotype	6.2	2.75	3.0	c.3.75	3.0
Paratype 1	4.5	2.1	2.4	c.3.3	2.6
Paratype 2	4.9	2.3	2.6	3.5	2.5
P33411	6.25	2.6	3.5	c.3.2	3.5

Stratigraphic Range: Aldingan, late Eocene—? early Oligocene.

Material and Occurrence: Type locality (types plus EB008 7, P33411 1, P33425 2). Blanche Point Formation; Blanche Point (EA005 2 juveniles); cliff base ½ mile N. of Port Willunga (EW003 2 juveniles). Glen Aire Clay, GSV locality AW1 (?P42940 1 juvenile).

Comments: The material registered under P33425 is intermediate in character between the BC1 specimens and the types. On balance the fossil appears to be *Guraleus* ss. See below for comments on Australian fossil relations.

***Guraleus* sp. cf. *eocenicus* nov.**
(Plate 7, figure 1)

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay BC1, FL11 (P33370 3).

Comments: This fossil differs from *G. eocenicus* sp. nov. in the teleoconch whorls being more strongly angulated, in having slightly fewer axial ribs per whorl (10, not 13-17), and in having slightly more protoconch whorls. It is probably not specifically distinct from *G. eocenicus*. *G. eocenicus* is the first of a series of fossil Australian *Guraleus* spp. with a polygyrate protoconch of which the early whorls are smooth and the latter part is axially ribbed, and in which adult sculpture besides axial ribs consists of fine spiral threads and axial growth lines. Later fossils in this series occur from at least the Janjukian (U. Oligocene) to the Balcombian (M. Miocene) and include the named species *G. janjukiensis* Powell, 1944 and *G. harrisi* Powell, 1944; the main evolutionary trend appears to be towards progressively less angulated whorls.

Genus *Antiguraleus* Powell, 1942

Type species (o.d.) *Antiguraleus otagoensis* Powell, 1942.

?*Antiguraleus* sp. a.
(Plate 7, figure 5)

Stratigraphic Range: Aldingan, late Eocene-early Oligocene.

Material and Occurrence: Brown's Creek Clay, FL14 (EB009 one juvenile, one body whorl 4.0 mm long); Glen Aire Clay, GSV loc. AW1 (P42889 1).

Comments: This small fossil with a paucispiral protoconch, 19-20 sinuous ribs per rounded teleoconch whorl, a spiral sculpture of 10-15 faint spiral lines on the anterior of the body whorl and 7-8 low cords on the canal is probably an *Antiguraleus* but there is insufficient material to describe it or determine if the Brown's Creek Clay and Glen Aire Clay specimens are the same species.

Antiguraleus sp. b.
(Plate 7, figure 3)

Stratigraphic Range: Upper Aldingan, early Oligocene.

Material and Occurrence: Glen Aire Clay, GSV locality AW1 (P33338 2, P42942 1, P42943 1, P42944 1).

Comments: A small, ovately fusiform, shell with a smooth paucispiral protoconch of 1.5-1.75 whorls and teleoconch sculpture of 14-16 flexuous ribs and numerous fine over-riding spiral threads; it has a weak but clear posterior sinus on the shoulder. It appears to be a typical *Antiguraleus* and differs from ?*A.* sp. a. in its fewer axial ribs and more prominent spiral sculpture.

?*Antiguraleus* sp. c.
(Plate 7, figure 4)

Stratigraphic Range: Aldingan, late Eocene-early Oligocene.

Material and Occurrence: Brown's Creek Clay, BC3, FL14 (P42892 4, ?EB011 1); Glen Aire Clay, GSV locality AW1 (P42941 4).

Comments: A small, relatively thick-shelled *Antiguraleus*-like shell, with a very shallow posterior sinus. The 13-15 axial ribs dominate the sculpture of the slightly polished teleoconch on which spiral sculpture is reduced to faint lines on the body whorl and low cords on the anterior canal. AW1 material has even weaker spiral sculpture than that from FL14. It differs from species a. and b. above in the weaker spiral sculpture, shallower posterior sinus, polished surface, and more turreted spire.

Genus *Macteola* Hedley, 1918

Type species (o.d.) *Purpura (Cronia) anomala* Angas, 1877.

Diagnosis: Small; broadly biconical; protoconch, 1.5-2.0 smooth whorls with a blunt tip. Axial sculpture; broad ribs, absent from the shoulder slope and fading over the base. Spiral sculpture: fine threads over whole surface. Aperture subovate; anterior canal short, unnotched; outer lip thin with a very slight sinus occupying the shoulder slope.

Macteola eocenica sp. nov.
(Plate 7, fig. 6)

Description: Protoconch: smooth, polished, subcylindrical, usually 1.5 but up to 1.75 whorls, first rather globose, tip slightly deviated and immersed; usually a slightly sinuate scar at the junction with the teleoconch. Teleoconch: small, fusiform, surface slightly polished, spire 0.5 height of shell; whorls turreted, with a well

defined slightly sulcate, almost level shoulder slope, and supra-medial peripheral angulation, straight sided and narrowing slightly from periphery to suture; body whorl capacious, excavate below into a short anterior canal. Axial sculpture: 10-13 (usually 10-11) very slightly opisthocline, spaced, straight, narrow, axial ribs per whorl, starting about 0.2 whorl after the protoconch scar, in alignment from whorl to whorl, from just below the posterior suture to the anterior suture on spire whorls, dying out at the top of the anterior canal on the body whorl, high and slightly coronated at the peripheral angulation; very faint incised axial growth lines. Spiral sculpture: incised spiral lines over the whole of the spire whorls, the interspaces developed as very flat cords on the body whorl and low cords on the anterior canal, variable in strength, 0-5 lines posterior to the peripheral angulation; up to seven lines anterior to it on spire whorls, 12-18, usually about 15, on the body whorl plus 7-10 low cords on the anterior canal. Aperture: narrow, elongate, bluntly angulated posteriorly, open below; outer lip sharp, nearly straight, very slightly bent back to produce a broad shallow posterior sinus with its apex on the peripheral angulation and very slightly produced forward anteriorly; inner lip a flat matt glaze on the columella, slightly concave in the parietal region, curved gently to the left along the columella; anterior canal, short, open, inclined slightly to the left, unnotched.

Types: National Museum of Victoria; Holotype P42874, Paratype 1 P42875, Paratype 2 P42876 all coll. T. A. Darragh and H. E. Wilkinson, 6 December 1968.

Type Locality: Brown's Creek Clay, BC3, FL14.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	4.5	2.25	2.25	1.5	3.5
Paratype 1	4.5	2.0	2.25	1.5	3.5
Paratype 2	4.45	2.0	c.2.3	c.1.5 (worn)	c.3.6
P33371	4.8	1.9	c.2.5	2.0	3.5

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay, BC1, FL11 (P33371 1); type locality (types plus P33432 12).

Comments: *M. eocenica* differs from typical *Macteola* in that the axial ribs almost reach the posterior suture, and the extremely shallow sinus has a low apex at the shoulder angulation. However, its other features are typical of the genus. Another possible generic placement is *Mangaoparia* Vella, 1954, only species *M. powelli* Vella, 1954, late Miocene, New Zealand, in which however the aperture is not fully known and in which the axial ribs are absent above the periphery, the protoconch is little more than one whorl, and there is a sub-sutural fold. Powell (1966, 108) considered it likely that *Mangaoparia* was related to *Macteola*. No other fossil *Macteola* species have yet been recorded.

Genus *Etrema* Hedley, 1918

Type species (o.d.) *Mangilia (Glyphostoma) aliciae* Melvill and Standen, 1895.

Comments: *Etrema* has been diagnosed as having axial ribs which do not extend to either base or suture (e.g. Powell, 1966:112). However, Hedley (1922, Pl. 47, fig. 70) shows a specimen of the type species in which the axial ribs extend from near the posterior suture to the anterior suture on the spire and to the top of the anterior canal on the body whorl. The axials also extend from suture to suture and to the top of the anterior canal in for example *E. capillata* Hedley, 1922, *E. catapasta* Hedley, 1922, *E. culmea* Hedley, 1922, *E. curtisiana* Hedley, 1922 and *E. elegans* Hedley, 1922.

Etrema sp.

(Plate 7, figure 7)

Stratigraphic Range: Upper Aldingan, early Oligocene.

Material and Occurrence: Glen Aire Clay, GSV loc. AW1 (P33337 2, P42939 2).

Comments: This fossil is a typical *Etrema*. It differs from *E. janjukiensis* Powell, 1944 (late Oligocene, Victoria) in developing more spiral cords per whorl, in having secondary spiral threads, and in having more markedly opisthocline axial ribs extending to the posterior suture. More material is needed to fully describe this species, which is the earliest record of *Etrema* to date.

Subfamily DAPHNELLINAE Casey, 1904

Genus *Asperdaphne* Hedley, 1922

Nom. nov. for *Scabrella* Hedley, 1918, type species (o.d.) *Daphnella versivestita* Hedley, 1912 (non *Scabrella* Sacco, 1890).

Asperdaphne sp. a.

(Plate 7, figure 8)

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay BC1, FL11 (P42899 1).

Comments: The spiral sculpture of the protoconch with 4-5 sharp ridges per whorl is coarser than in any Australian Tertiary *Asperdaphne* spp, but the fossil otherwise fits best into *Asperdaphne* (see also general comment on *Asperdaphne* below).

Asperdaphne sp. b.

(Plate 7, figure 9)

Stratigraphic Range: Aldingan-Upper Aldingan, late Eocene-early Oligocene.

Material and Occurrence: Brown's Creek Clay, BC1, FL11 (P33368 1); Blanche Point Fmn, ½ mile N. of Port Wilunga (EW004 1); Glen Aire Clay GSV loc. AW1 (P42900 1 incomplete, P42901 1, P42945 3 incomplete).

Comments: More material is needed to evaluate this species complex. Its characteristics are a protoconch with numerous spirals visible under magnification, rounded axial ribs, and more or less closely spaced spiral cords.

Asperdaphne sp. c.

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay BC3, FL14, (P33426 1).

Comments: Differs from *Asperdaphne* sp. a. in its much smoother protoconch, smaller size, and more angulated whorls, and from *Asperdaphne* sp. b. in the smoother protoconch, sharper axial ribs, and weaker sculpture of the posterior sulcus.

General Comments: These fossils carry the history of *Asperdaphne* back to the late Eocene; they are all very similar in general morphology—especially in possessing a distinctive sulcus band marking former positions of the

posterior sinus. The Balcombian *A. balcombensis* Powell, 1944 and *A. contigua* Rowell 1944 and undescribed Longfordian to Balcombian material also show this band, though it is generally narrower, and so does the poorly known Recent *A. compacta* Hedley, 1922.

Genus *Rugobela* Finlay, 1924

Type species (o.d.) *Ptychatractus tenuiliratus* Suter, 1917.

Diagnosis: Rather small, up to c. 15.0 mm. Protoconch conical, of 4-5 smooth whorls. Teleoconch elongately ovate-fusiform resembling *Daphnella*; with rounded axial ribs which often die out on later whorls and subsidiary spirals; posterior sinus adjacent to suture, shallow, almost vertical; outer lip produced forwards in a broad arc anteriorly. There are usually several weak oblique plications on the inner lip near the base of the columella.

Rugobela humerosa (Marwick, 1926)

(Plate 7, figures 10, 11)

1926: *Clavatula humerosa* Marwick. *Trans. N.Z. Inst.* 56: 315 Pl. 72 f. 19.

1942: *Rugobela humerosa* (Marwick, 1926). Powell, *Bull. Auckland Inst. Mus.* 2: 160.

1966: *Rugobela humerosa* (Marwick, 1926). Fleming, *Bull. N.Z. Dep. Sci. Ind. Res.* 173: 76.

1966: *Rugobela humerosa* (Marwick, 1926). Powell, *Bull. Auckland Inst. Mus.* 5: 138.

Description: Protoconch: conoidal, smooth, about 3-4 whorls, tip inrolled and deviated; suture simple; junction with teleoconch indistinct. Teleoconch: ovate-fusiform; spire subconoidal averaging 0.5 (0.46-0.54) height of shell; whorls with a weak angulation at about 0.3 whorl height below periphery producing a narrow shoulder, and very slightly convex anteriorly; body whorl large, tapering with a very slight, excavation into a short anterior canal. Axial sculpture: 10-15, usually 12-14, low rounded opisthocline axial ribs from below the subsutural angulation of the whorl to the anterior suture on the first two whorls; they become obsolete after 2-2½ whorls, or even earlier; numerous very fine axial growth lines. Spiral sculpture: a weak subsutural margining cord on the first two or so whorls; 3-4 faint spiral lines distributed above and below the shoulder on the first three or so whorls; 10-16

flat weak spiral cords with linear interspaces on the lower half of the body whorl, and 10-15 low oblique cords on the anterior canal. Aperture: lanceolate; outer lip sharp with a narrow U-shaped sinus immediately anterior to the suture, produced broadly forward anteriorly; inner lip smooth; anterior canal short, open, unnotched.

Types: New Zealand Geological Survey; Holotype TM5791.

Type locality: NZGS microfossil locality GS 1100, tuffaceous conglomerate, slumped block on hillside above former Lorne railway station near Weston, North Otago-Waireka Volcanics formation, Kaiatan, late Eocene (P.A. Maxwell pers. comm. 5.1.1981).

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	11.5	5.0		c.4.0	5.0
Topotype 9481	12.4	c.4.5	6.1	c.3.0.	c.5.0.
Topotype 9481	12.9	5.1	6.7	c.3.0.	c.5.1.
P42877	15.5	5.8	8.2	3.0	5.5
P42878	12.5	5.4	6.3	2.0	5.0

preserved

Stratigraphic Range: late Eocene (Kaiatan and Aldingan)-Early Oligocene (Runangan and possibly Whaingaroan) P. A. Maxwell pers. comm. 5.1.1981.

Material and Occurrence: New Zealand: type locality (NZGS Reg. Nr. 9481, 9 topotypes). Victoria: BC1, FL11 (P33355 5, P33362 1, P33376 1, P42877 1, P42878 1).

Comments: *R. humerosa* has weaker spiral sculpture than other species of *Rugobela*; it is also characterised by a lack of oblique plications at the anterior end of the columellar lip. The other Eocene species tentatively assigned to *Rugobela*, ?*R. oborni* Marwick, 1960 has very strong columellar plications. *R. humerosa* is the only late Eocene New Zealand turrinid species identified in this paper as also occurring in the late Eocene of Victoria. From the limited amount of material available no significant differences are observable between New Zealand and Victorian specimens.

In Australia *R. exsculpta* Powell, 1944 has more numerous and persistent axial ribs. *R.*

columbelloides (Tenison Woods, 1877) has a stronger spiral sculpture and columellar plications; *R. columbelloides* appears to be a senior synonym of *R. conospira* (Tate, 1898, nom. nov. for *Thala marginata* Tenison Woods, 1877) as May (1919: 22) considered *Thala marginata* a synonym of *R. columbelloides* (Tenison Woods, 1877); (*Daphnella columbelloides* Tenison Woods, 1877: 103 has page priority over *Thala marginata* Tenison Woods, 1877: 108). The writer has not been able to examine types or topotypes of *R. columbelloides* but Longfordian-Bairnsdalian material (coll. writer) does not appear to include more than one species of *Rugobela*. These Victorian fossils not only differ from *R. humerosa* as does *R. columbelloides*, as described, but also differ in having a less rounded posterior sinus more like the genotype, in tending to develop axial ribs on the last half whorl of the protoconch, and in having an exert tip to the protoconch present in well preserved, usually juvenile, material.

Doubtfully Turrinid species

Genus *Syngenchilus* Powell, 1944

Type species (o.d.) *Syngenchilus radiapex* Powell, 1944

Diagnosis: Shell ovate-fusiform with a bluntly rounded apex. Protoconch small, flattened, one half whorl with a flattened tip followed by a whorl of usually slightly opisthocline axial ribs merging into the teleoconch. Teleoconch whorls have a subsutural sulcus, anterior to which whorls are straight sided; adult sculpture rounded axial ribs and narrow spiral cords or incised lines. Aperture narrow; posterior sinus scarcely produced; weak oblique plications present on the columella.

Comments: Resembles *Teleochilus* Harris, 1897 (Type species *Daphnella gracillima* Tenison Woods, 1876) which has a spirally striate not a radially costate protoconch, weak oblique columellar plications like *Syngenchilus*, and is a late Oligocene to Recent south east Australian genus. The assignment of *Teleochilus*, and by analogy, *Syngenchilus*, to the Turrinidae is commented on below under *Parasyngenchilus* gen. nov.

Syngenchilus johannaensis sp. nov.

(Plate 7, figure 12)

Description: Protoconch: dome-shaped, about 1.5 whorls; the first half whorl is flat and smooth; the next full whorl develops 12-16 slightly curved axial ribs as it merges gradually into the teleoconch. Teleoconch: ovate fusiform; spire 0.42-0.43 height of shell; whorls post-medially angulate with a narrow sloping, slightly concave, shoulder, straight-sided anteriorly; body whorl large, tapered with a very slight excavation into a short anterior canal. Suture with a weak postero-marginal fold. Axial sculpture: 8-16, usually 10-12, spaced low narrow axial ribs per whorl, slightly prosocline on the shoulder, orthocline anteriorly; from suture to suture on the spire whorls, weaker and reaching to the top of the anterior canal on the body whorl; the ribs are weak on the shoulder slope and strongest on the anterior of the whorl, appearing slightly tuberculate at the whorl periphery; numerous fine axial growth lines. Spiral sculpture: numerous even incised spiral lines, 4, increasing to 10, close together on the posterior slope and 5-7 spaced anteriorly on spire whorls; 23-29 on the body whorl and 10-12 weak oblique cords on the anterior canal. Aperture: elongate-lanceolate; outer lip sharp edged, straight; posterior sinus a minor sutural indentation; inner lip a smooth glaze on the columella and parietal regions, with occasional (in two of eight available specimens) weak traces of a few oblique columellar plaits; anterior canal short, straight, open, unnotched with a nearly square termination.

Types: National Museum of Victoria; Holotype P33360 coll. T. A. Darragh 18 October 1971; Paratype 1 P33380, Paratype 2 P42879 both coll. T. A. Darragh 24 February 1971.

Type Locality: Brown's Creek Clay, BC1, FL11.

Dimensions:

	Protoconch			Teleoconch	
	L.	B.	S.	Whorls	Whorls
Holotype	14.25	5.9	6.5	1.5	4.25
Paratype 1	12.9	5.0	5.7	1.5	4.0
Paratype 2	15.75	5.9	6.75	1.5	4.5
P42880	12.3	4.2	5.3	1.5	4.0

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Type locality; (Types plus P33378 3, P42880 1, P42881 1).

Comments: *S. johannaensis* differs from *S. radiapex* Powell, 1944 in having widely spaced, persistent, (not close and evanescent), axial ribbing; in having pronouncedly angulated, not rounded, whorls, and in the, at most, weak development of columellar plications. Nevertheless the apex and general morphology of the shell are typical of *Syngenchilus*.

Syngenchilus radiapex Powell, 1944

(Plate 7, figures 13-15)

1944 *Syngenchilus radiapex* Powell, *Rec. Auckland Inst. Mus.* 3(1): 66, Fig 9, Pl 6 fig 4.

1966 *Syngenchilus radiapex* Powell; Powell, *Bull. Auckland Inst. Mus.* 5: 138.

Description: Protoconch: first whorl flat, smooth; second radially costate, merging into teleoconch. Teleoconch: ovate-fusiform; spire about 0.46 height of shell; whorls with a narrow subsutural margin followed by a narrow sulcus, otherwise straight-sided. Body whorl rounded, straightening slightly into a short anterior canal. Axial sculpture: 14-21 strong rounded slightly opisthocline axial ribs per whorl, from suture to suture on spire whorls, becoming obsolete on the body whorl of larger specimens, otherwise fading before reaching the anterior canal; numerous growth lines. Spiral sculpture: crisp narrow spiral cords with linear interspaces cover all whorls and extend to the tip of the anterior canal, 10-14 on spire whorls, 28-35 on body whorl, overriding axials. Aperture: narrow, elongate-ovate, angulate above with a minute sutural sinus; outer lip sharp edged, almost straight, a weak internal rib about 1.0 mm from the edge; inner lip slightly incised into the columellar and parietal regions, smooth except for 3, increasing with age up to 8, oblique plications on the lower part of the columella; anterior canal very short, open, unnotched, with an almost square end.

Types: Auckland Institute and Museum; Holotype TM-1123, and 4 Paratypes.

Type Locality: Torquay Upper Beds, Victoria. (Puebla Formation ?).

Dimensions:

	L.	B.	S.	Protoconch	Teleoconch
				Whorls	Whorls
Holotype	7.25	3.25	—	2.0	3.0
P33334	6.0	3.0	2.0	1.5	2.5
P33334	14.5	5.5	6.7	c.1.5	4.5
P33334	13.2	5.0	6.2	c.1.5	4.5

Stratigraphic Range: Upper Aldingan-Longfordian? (early Oligocene-early Miocene).

Material and Occurrence: Glen Aire Clay, GSV loc. AW1 (P33334 18, P42946 17, P42947 6); Jan Juc formation, Bed B100, clay immediately below Pt. Addis Limestone, W. side Bell's Headland, Victoria (OB019 1, coll. K. N. Bell 20 January 1975); above ledge, Bird Rock Cliffs, Torquay, F. A. Cudmore Collection, 2.

Comments: The holotype of *S. radiapex* is probably not fully grown; however the Glen Aire Clay material appears to be the same species, and indicates that the axial sculpture tends to disappear with age, a feature also shown by the fossil from Bell's Headland. It seems, from comparison with Powell (1944, P1 6, fig 4) and the Bell's Headland specimen, that the Glen Aire material has a slightly wider shoulder sulcus, and is less ovate in form, but more Janjukian-Longfordian material is needed to evaluate this.

Genus *Parasyngenchilus* gen. nov.

Type species *P. eocenicus* sp. nov.

Diagnosis: Protoconch: paucispiral, about 1.5 whorls, dome-shaped, top flattened, tip depressed, first whorl smooth, remainder with strengthening orthocline axial ribs merging into the teleoconch. Teleoconch: ovate-fusiform; spire about half height of shell; whorls bluntly angulate, with a subsutural margining fold and concave shoulder slope, sulcate on earlier whorls. Body whorl slightly contracted below into a short open, unnotched, anterior canal. Sculpture of orthocline narrow ribs, often slightly spinulose at the shoulder, with fine spiral lines or flattened cords. Aperture ovate lanceolate; outer lip straight, sharp; inner lip smooth; columella slightly twisted and thickened above termination; posterior sinus at most a slight subsutural notch.

Comments: The general morphology of *Parasyngenchilus* is similar to *Syngenchilus*

Powell, 1944; however the smooth portion of the protoconch is dome-shaped and not flat, and the columella does not have oblique plications near its end, although some specimens of the type species have traces of weak lamellae near the mid-columella. *Parasyngenchilus* also appears similar to *Awateria* Suter, 1917 (type species *A. streptophora* Suter, 1917; Miocene-Pleistocene, New Zealand) in which the protoconch is, however, "smooth, of 1½ carinated whorls, the tilted pullus minute, its little apex erect, then immersed into the spire, rising again, leaving a semicircular depression" (Suter, 1917:57), and has some resemblance to late Oligocene-Miocene Australian fossils placed in *Scrinium* Hedley, 1922 by Powell (1944) (*S. duplicatum* Powell, 1944 and *S. nanum* Powell, 1944). Both *Syngenchilus* and the conchologically similar *Teleochilus* Harris, 1897 (late Oligocene-Recent, Australia) have been allied to *Daphnella* (e.g. by Powell, 1966: 138) on account of their having a sculptured protoconch and oblique folds on the columella, although Laseron (1954: 22) regarded *Teleochilus* as a Borsonioid. However, *S. johannaensis* sp. nov. has at best sporadic and weak columella plaits which indicates that they are probably not original features of the *Syngenchilus* stock, but a later development and, hence, not necessarily of value in establishing the relationship of *Syngenchilus* at a subfamilial level. The resemblance between *Teleochilus*, *Syngenchilus*, *Parasyngenchilus*, *Awateria*, and *Scrinium*, particularly the fossils tentatively ascribed to *Scrinium* such as *S. duplicatum* Powell, 1944, suggests the presence of a discrete group of Prosobranchs, having small buccinoid shells with paucispiral protoconchs and little or no posterior sinus, in Australasian waters since at least the late Eocene. To discover how these fossils relate to the Turridae requires further work; in particular an examination of the soft parts of *Teleochilus royanus* Iredale, 1924 and *Scrinium brazieri* (Smith, 1891) would be of value. One New Zealand species assigned to *Scrinium*, *S. neozelanica* (Suter, 1908) has been verified as a Turrid (Powell, 1966: 66). Certainly a close relationship between *Syngenchilus* and *Teleochilus* on the one hand and

Daphnella on the other is, on balance, improbable.

Besides the Australian fossils reported below *Parasyngenchilus* is also known by limited material from the late Eocene (Kaiatan)—one specimen—and late Oligocene (Waitakian)—two specimens—of South Canterbury, New Zealand (P. A. Maxwell pers. comm. 1 December 1980).

***Parasyngenchilus eocenicus* sp. nov.**
(Plate 7, figure 16)

Description: Protoconch: paucispiral, about 1.5 whorls; dome-shaped, top flattened, tip depressed; first whorl smooth, remainder with strengthening orthocline axials merging into the teleoconch. Teleoconch: ovate-fusiform, fairly strong; spire 0.50-0.54 height of shell; whorls with a subsutural fold, a narrow concave (sulcate) shoulder slope and an angulation at about 0.25 of whorl height below the suture; they narrow slightly from periphery to anterior suture. Body whorl rounded, narrowing gently anteriorly to a short, open canal. Axial sculpture: 10-14, occasionally up to 19, narrow orthocline ribs per whorl which nodulate the subsutural fold and the whorl periphery, extend from suture to suture on spire whorls and die out about the middle of the body whorl. Spiral sculpture variable and weak; up to six faint incised spiral lines below the periphery on spire whorls, and occasionally developed on the shoulder slope on the penultimate and body whorls; up to 20, usually fewer, faint spiral lines anterior to the periphery on the body whorl, and usually 6-8 (in one case two in another c.13) low fine oblique cords on the anterior canal. Aperture: elongate-ovate; outer lip sharp, almost straight, curved slightly back on the anterior canal; inner lip, smooth, a dull glaze on the columella, slightly curved; anterior canal short, widely open, squarely truncated. Posterior sinus not observed.

Types: National Museum of Victoria; Holotype P42882, Paratype 1 P42883, Paratype 2 P42884, all coll. T. A. Darragh and H. E. Wilkinson 6 December 1968.

Type Locality: Brown's Creek Clay, BC3, FL14.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	9.4	4.5	4.75	1.5	3.5
Paratype 1	11.1	4.8	6.0	c.1.25 (worn)	4.5
Paratype 2	8.8	4.1	4.5	c.1.5	4.5

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Type Locality (types plus P33406 2, P33438 6).

Comments: (see also under genus). In P33438 two specimens have two weak columellar lamellae just below the mid-columella, one has three; all of these have broken outer lips.

***Parasyngenchilus angustior* sp. nov.**
(Plate 7 figure 17)

Description: Protoconch: paucispiral, 1½-2 whorls dome-shaped, tip slightly immersed (in one case flattened), first whorl smooth, second with orthocline to slightly opisthocline rounded strengthening axial ribs, merging gradually into the teleoconch. Teleoconch: elongately ovate-fusiform; spire about 0.55 height of shell; whorls with a narrowly sulcate shoulder slope and a subsutural margining fold, almost straight-sided anteriorly; suture well marked, very slightly oblique; body whorl slightly narrowed anteriorly into a short anterior canal. Axial sculpture: 14-22 (usually 16-19) orthocline ribs per whorl, narrower than interspaces, from suture to suture on spire whorls, dying out above the anterior canal on the body whorl, slightly nodulose on the subsutural fold and on the cord margining the shoulder; numerous very fine axial growth lines. Spiral sculpture: numerous fine threads and cords from suture to suture on spire whorls and extending as fine cords on to the anterior canal; the threads may become doubled and spaced, or closely crowded with linear interspaces; up to 44 on the body whorl. Aperture: narrow, lanceolate; outer lip sharp edged, curved very slightly forward below the periphery and then slightly back to the anterior canal. Inner lip smooth, porcellanous, slightly curved and slightly incised into the body whorl; two specimens show a weak median fold and thickening on the columella, and one specimen has traces of two minute folds in the same posi-

tion; anterior canal short, open, scarcely distinguished from the body whorl, curved slightly to the left, end almost straight or with a weakly concave edge.

Types: National Museum of Victoria: Holotype P42961, Paratype 1 P42962, Paratype 2 P42963 all F. A. Cudmore collection.

Type Locality: Glen Aire Clay, GSV locality AW1.

Dimensions:

	L.	B.	S.	Protoconch Whorls	Teleoconch Whorls
Holotype	10.0	3.5	5.75	1.45	4.4
Paratype 1	10.5	3.8	6.0	1.75	4.0
Paratype 2	9.1	3.75	5.0	1.6	3.8

Stratigraphic Range: Upper Aldingan, early Oligocene.

Material and Occurrence: Type locality (Types plus P42885 3, P42886 1, P42887 1, P42888 1, P42948 14, P42949 1, P42955 2).

Comments: Differs from *P. eocenicus* in its elongate form, more numerous axial ribs, and better developed spiral sculpture. The indication of columella thickening is more like the fold on *Borsonia* and its allies than the plications of the distal end seen in *Syngenchilus* and *Teleochilus*. One specimen of a *Parasyngenchilus* from the late Eocene (Kaiatan) of GS9508, McCulloch's Bridge, Waihao R. South Canterbury, New Zealand (P. A. Maxwell pers. comm. 1 December 1980) is very similar to *P. angustior* but lacks the nodulation of the subsutural fold and has more widely spaced, rounded, axial ribs. More material is needed to establish its relationships.

?*Parasyngenchilus* sp. a.

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay, B1, FL11 (P33369 2, P33365 2).

Comments: Differs from *Parasyngenchilus* in the conspicuously twisted short anterior canal, in the sharply angulate whorls, the sloping rather than sulcate shoulder slope and in having a subsutural cord rather than a fold. There is otherwise a general resemblance to *Parasyngenchilus* and this fossil may be allied to it.

?*Parasyngenchilus* sp. b.

(Plate 7, figure 18)

Stratigraphic Range: Aldingan, late Eocene.

Material and Occurrence: Brown's Creek Clay, BC1, FL11 (P42905 2); BC3, FL14 (P42906 1, ?EB012 1).

Comments: Like *Parasyngenchilus* sp. a. this fossil is more angulated than *P. eocenicus* or *P. angustior*, with a faintly concave not sulcate shoulder slope; the protoconch and aperture are, however, in agreement with *Parasyngenchilus*.

***Mitra citharelloides* Tate, 1889**

(Plate 7 figure 19)

Type Locality: Lower beds, Aldinga.

Comment: Cernohorsky (1972a) placed this species in the mitromorph Turridae, close to *Vexithara* Finlay, 1926 on the grounds of its possessing two columellar plaits, a siphonal spout and an unnotched and slightly reverted siphonal canal. The writer has seen no material referable to his species. A photograph of the holotype (T631B) shows it to have more rounded whorls than Tate's figure (1889, Pl 5 fig. 11) suggests and than *Vexithara nodosolirata* (Suter, 1917 Powell, 1966, Pl 10 fig 8); the aperture is matrix filled, and there is no clear evidence from the photograph of a posterior sinus.

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References

- ABELE, C., KENLEY, P. R., HOLDGATE, G. AND RIPPER, D., 1976. Otway Basin (in) *Geology of Victoria*: J. G. Douglas and J. A. Ferguson Eds. *Spec. Publ. geol. Soc. Aust.* 5: 198-229.
- ADAMS, A., AND REEVE, L., 1850. Mollusca (in) *The Zoology of the Voyage of H.M.S. Samarang*. London: Reeve, Benham, and Reeve.
- ADAMS, A., AND ANGAS, G. F., 1864. Descriptions of new species of shells from the Australian seas in the collections of George French Angas. *Proc. zool. Soc. Lond.* (for 1863):
- ALLAN, R. S., 1926. Fossil Mollusca from the Waihao Greensands. *Trans. N.Z. Inst.* 56: 338-346, pl 76-77.
- ALLAN, R. S., 1927. The Geology and Palaeontology of the Lower Waihao Basin, South Canterbury, New Zealand. *Trans. N.Z. Inst.* 57: 265-309.
- ANGAS, G. F., 1877. Description of two Genera and twenty Species of Marine Shells from New South Wales. *Proc. zool. Soc. Lond.*: 34-40, pl 5.
- BARTSCH, P., 1941. The Nomenclatorial Status of Certain Northern Turritid Mollusks. *Proc. biol. Soc. Wash.* 54: 1-14.
- BEDDOME, C. E., 1883. Description of some marine shells of Tasmania. *Pap. Proc. R. Soc. Tasm.* (for 1882): 167-170.
- BELLARDI, L., 1839. *Borsonia*, nouveau genre de coquille fossile. *Bull. Soc. géol. Fr.* 10: 30-31.
- BELLARDI, L., 1875. Novae Pleurotomidarum Pedemontii et Liguriaee fossilium dispositionis prodromus. *Bullettino della Societa Malacologica Italiana* 1 (1): 16-24.
- BERRY, S. S., 1958. Notices of new eastern Pacific Mollusca. *Leaflet Malac.* 1 (15): 83-90.
- BUCQUOY, E., DAUTZENBERG, P., AND DOLLFUS, G. F., 1883. *Les Mollusques marins du Rousillon* 1 (3). Paris: J. B. Baillièere.
- CANTRAINE, F., 1835. (no title). *Bull. Acad. r. Belg.* 2: 380-401.
- CASEY, T. L., 1904. Notes on the Pleurotomidae with descriptions of some new genera and species. *Trans. Acad. Sci. St. Louis* 14 (5): 123-170.
- CERNOHORSKY, W. O., 1972a. A taxonomic evaluation of recent and fossil non-mitrid species proposed in the family *Mitridae* (Mollusca: *Gastropoda*). *Rec. Auckland Inst. Mus.* 9: 205-229.
- CERNOHORSKY, W. O., 1972b. Comments on the Authorship of Some Subfamilial Names in the Turritidae (Mollusca: *Gastropoda*). *The Veliger* 15 (2): 127-128.
- CERNOHORSKY, W. O., 1975. The Taxonomy of some Indo-Pacific Mollusca. Part 3. with descriptions of new taxa and remarks on an Ecuadorian fossil species of Turritidae. *Rec. Auckland Inst. Mus.* 12: 213-234.
- CHAPMAN, F., 1914. On the Succession and Homotaxial Relationships of the Australian Cainozoic System. *Mem. natn. Mus. Vict.* 5: 5-52.
- CHAPPLE, E. H. 1934. Additions to the Tertiary Mollusca of Victoria. *Mem. natn. Mus. Vict.* 12: 119-124, pl 14.
- CONRAD, T. A., 1847. Observations on the Eocene formation, and descriptions of one hundred and five new fossils of that period, from the vicinity of Vicksburg, Mississippi, with an Appendix. *J. Acad. nat. Sci. Philad.* (new series) 1: 111-134, pl 11-34.
- CONRAD, T. A., 1865. Catalogue of the Eocene and Oligocene Testacea of the United States. *Am. J. Conch.* 1: 1-35.
- COSSMANN, M., 1889. Catalogue illustré des Coquilles Fossiles de L'Éocène des Environs de Paris: *Annls. Soc. malac. Belg.* 24: 3-381, pl 1-12.
- COSSMANN, M., 1896. *Essais de Paléoconchologie Comparée* 2. Paris: Author: pp 179 pl 1-8.
- COSSMANN, M., 1901. *Essais de Paléoconchologie Comparée* 4. Paris: Author: pp 293, pl 1-10
- DARRAGH, T. A., 1969. A revision of the family Columbariidae (Mollusca: *Gastropoda*). *Proc. R. Soc. Vict.* 83: 63-114, pl 2-6.
- DARRAGH, T. A., 1971. Revision of the Australian Tertiary Volutidae (Mollusca: *Gastropoda*). 1. The subfamily *Athletinae*. *J. malac. Soc. Aust.* 2: 163-185, pl 14-16.
- DARRAGH, T. A., 1980. Composition and origin of the molluscan fauna of the Tertiary of South Eastern Australia. *J. Malac. Soc. Aust.* 4 (4): 228-229.
- DESHAYES, G. P., 1834. (1824-37) *Description des Coquilles Fossiles des Environs de Paris*. 3 Vols. Paris: Levrault.
- FINLAY, H. J., 1924. The Molluscan Fauna of Target Gully. *Trans. N.Z. Inst.* 55: 514-516.
- FINLAY, H. J., 1926. New Shells from New Zealand Tertiary Beds. *Trans N.Z. Inst.* 56: 251-255.
- FINLAY, H. J., 1930. New Shells from New Zealand Tertiary Beds. *Trans. N.Z. Inst.* 61: 49-84, pl 1-6.
- FINLAY, H. J. AND MARWICK, J., 1937. The Wangaloan and associated molluscan faunas of the Kaitangata—Green Island subdivision. *Palaeont. Bull. Wellington* 156.
- FISCHER, P., 1880-1887. *Manuel de conchyliologie et de paléontologie conchyliologique*. Paris: F. Savy.
- FLEMING, C. A., 1966. Marwick's illustrations of New Zealand Shells, with a Checklist of New Zealand Cenozoic Mollusca. *Bull. N.Z. Dep. scient. ind. Res.* 173: 1-456, figs 1-1753.
- FLEMING, C. A., 1967. Cenozoic History of Indo-Pacific and other Warm-Water Elements in the Marine Mollusca of New Zealand. *Venus* 25(3-4): 105-117.
- GARRARD, T., 1961. Mollusca collected by the m.v. "CHALLENGE" off the East Coast of Australia. *J. malac. Soc. Aust.* 1 (5): 3-38, pl 1-2.
- HARRIS, G. F., 1897. *Catalogue of the Tertiary Mollusca in the Department of Geology. Part 1. Australasia*. London: British Museum (Nat. Hist.).

- HEDLEY, C., 1912. Descriptions of new or noteworthy shells in the Australian Museum. *Rec. Aust. Mus.* 8 (3): 131-160, pl 40-45.
- HEDLEY, C., 1918. A check-List of the Marine Fauna of New South Wales. Part 1. *J. Proc. R. Soc. N.S.W.* 51 supp: M1-M120.
- HEDLEY, C., 1922. A Revision of the Australian Turridae. *Rec. Aust. Mus.* 13 (6): 213-359, pl 42-56.
- HICKMAN, C. S., 1976. Bathyal Gastropods of the Family Turridae in the Early Oligocene Keasey Formation in Oregon, with a review of some deep-water genera in the Paleogene of the Eastern Pacific. *Bull. Amer. Paleont.* 70 (292): 1-119, pl 1-7.
- HINDS, R. B., 1843. On new species of *Pleurotoma*, *Clavatula*, and *Mangelia*. *Proc. zool. Soc. Lond.:* 36-46.
- HUTTON, F. W., 1877. Description of some new Tertiary Mollusca from Canterbury. *Trans. N.Z. Inst.* 9: 593-598, pl 16.
- HUTTON, F. W., 1885. Description of new Tertiary Shells. Part 1. *Trans N.Z. Inst.* 17: 313-332, pl 18.
- IREDALE, T., 1918. Molluscan Nomenclatural Problems and Solutions. *Proc. Malac. Soc. Lond.* 13: 28-40.
- IREDALE, T., 1924. Results from Roy Bell's Molluscan Collections. *Proc. Linn. Soc. N.S.W.* 49: 179-278, pl 33-36.
- KEIGWIN, L. D., 1980. Palaeoceanographic change in the Pacific at the Eocene-Oligocene boundary. *Nature* 287: 722-725.
- LASERON, C. F., 1954. The New South Wales Turridae. *R. zool. Soc. N.S.W. Handb.* pp 56, pl 1-12.
- LISCHKE, C. E. 1872. Diagnosen neuer Meeres Conchylien von Japan. *Malakozool. Bl.* 19: 100-109.
- LUDBROOK, N. H., 1941. Gastropoda from the Abattoirs bore, Adelaide, South Australia, together with a list of some miscellaneous fossils from the bore. *Trans. R. Soc. S. Aust.* 65: 79-102, pl 4-5.
- MCLEAN, J. H., 1971. A Revised Classification of the Family Turridae, with the Proposal of New Subfamilies, Genera, and Subgenera from the Eastern Pacific. *Veliger* 14 (1): 114-130, 4 pl.
- MACNEIL, F. S. 1960. Tertiary and Quaternary Gastropoda of Okinawa. *Prof. Pap. U.S. geol. Surv.* 339: pp 148, 31 pl.
- MARINCOVITCH, L., 1976. Cenozoic Naticidae (Mollusca: Gastropoda) of the Northeastern Pacific. *Bull. Amer. Paleont.* 70 (294): 169-494, pl 17-42.
- VON MARTENS, E., 1901. Einige neue Meer-Conchylien von der deutschen Tiefsee-Expedition. *Sber. Ges. naturf. Freunde. Berl.:* 14-26.
- MARWICK, J., 1926. Molluscan Fauna of the Waiarekan Stage of the Oamaru Series. *Trans N.Z. Inst.* 56: 307-316, pl 72.
- MARWICK, J., 1931. The Tertiary Mollusca of the Gisborne District. *Palaeont. Bull. Wellington* 13: i-vii, 1-162, pl 1-18.
- MARWICK, J., 1960. Early Tertiary Mollusca from Otaio Gorge South Canterbury. *Palaeont. Bull. Wellington* 33: 5-30, pl 1-2.
- MAY, W. L., 1919. Critical Remarks on the Table Cape Fossil Mollusca in the Johnston Collection. *Pap. Proc. R. Soc. Tasu.* (for 1918): 69-73.
- MAY, W. L., 1922. New Species of fossil shells from Table Cape. *Pap. Proc. R. Soc. Tasm.* (for 1921): 9-12, pl 4.
- MELVILLE, J. C., AND STANDEN, R., 1895. Notes on a collection of shells from Lifu and Uvea, Loyalty Islands, formed by the Rev. James and Mrs. Hadfield, with list of species. *J. Conch. Lond.* 8: 84-132, pl 2-3.
- PETTARD, W. F., 1879. New species of Tasmanian marine shells. *J. Conch. Lond.* 2: 102-105.
- POWELL, A. W. B. 1942. The New Zealand Recent and fossil Mollusca of the Family Turridae, with general notes on Turrid nomenclature and systematics. *Bull. Auckland Inst. Mus.* 2: 5-180, pl 1-14.
- POWELL, A. W. B., 1944. The Australian Tertiary Mollusca of the Family Turridae. *Rec. Auckland Inst. Mus.* 3 (1): 1-68, pl 1-7.
- POWELL, A. W. B., 1951. Antarctic and Subantarctic Mollusca: Pelecypoda and Gastropoda collected by the Ships of the Discovery Committee during the years 1926-1937. *Discovery Reports* 26: 49-196, pl 5-10.
- POWELL, A. W. B., 1964. The Family Turridae in the Indo-Pacific. Part 1. The subfamily Turrinae. *Indo-Pacific Mollusca* 1 (5): 227-345, pl 172-262.
- POWELL, A. W. B., 1966. The Molluscan Families Speightiidae and Turridae. *Bull. Auckland Inst. Mus.* 5: 1-184, pl 1-23.
- POWELL, A. W. B., 1969. The Family Turridae in the Indo-Pacific. Part 2. The subfamily Turriculinae. *Indo-Pacific Mollusca* 2 (10): 203-415, pl 188-324.
- PRITCHARD, G. B., 1896. A revision of the fossil fauna of the Table Cape beds, Tasmania, with descriptions of new species. *Proc. R. Soc. Vict.* 8: 74-156, pl 2-6.
- PRITCHARD, G. B. 1904. Contributions to the palaeontology of the older Tertiary of Victoria. Gastropoda Part II. *Proc. R. Soc. Vict.* 17: 320-337, pl 18-19.
- REEVE, L., 1843. *Pleurotoma. Conchologica Iconica* 1, pl 10 f 83.
- ROUAULT, A., 1848. Description des fossiles du terrain éocène des environs de Pau. *Bull. soc. géol. Fr.* 2 (5): 207-208.
- ROUAULT, A., 1850. Description des fossiles du terrain éocène des environs de Pau. *Mem. Soc. géol. Fr.* 3 (2): 457-502, pl 14-18.
- SACCO, F., 1890. *I molluschi dei terreni terziarii del Piemonte e della Liguria, descritti da Luigi Bellardi.* Pt. VI. Torino: Carlo Clausen.
- SHUTO, T., 1961. Conacean Gastropoda from the Miyazaki Group 9. *Mem. Fac. Sci. Kyushu Univ. Ser. D. Geol.* 11 (2): 71-150, pls 3-10.
- SMITH, E. A., 1891. Descriptions of new species of Shells from New South Wales, New Guinea, the Caroline and Solomon Islands. *Proc. zool. Soc. Lond.:* 486-491, pl 40.
- SOLANDER, D. C., 1766. *Fossilia Hantoniensis collecta, et in Musaeo Britannico deposita, a Gustavo Brander.*
- SUTER, H., 1907. Descriptions of some Tertiary shells from New Zealand. *Proc. malac. Soc. Lond.* 7: 207-210, pl 8.

- SUTER, H., 1908. Descriptions of New Zealand Marine Shells. *Proc. malac. Soc. Lond.* 8: 178-191, pl 7.
- SUTER H., 1917. Descriptions of new Tertiary Mollusca occurring in New Zealand, accompanied by a few notes on necessary changes in nomenclature. *Palaeont. Bull. Wellington* 5: 1-93, pl 1-13.
- SWAINSON, W., 1840. *A Treatise on Malacology*. London: Longman, Orme, Brown, Green and Longman.
- TATE, R., 1878. The fossil Marginellidae of Australasia. *Trans. phil. Soc. Adelaide* for 1877-78: 90-98.
- TATE, R., 1886. The Lamellibranchs of the Older Tertiary of Australia (Part 1). *Trans. R. Soc. S. Aust.* 8: 96-158, pl 2-12.
- TATE, R., 1887. The pteropods of the Older Tertiary of Australia. *Ibid.* 9: 194-196, pl 20.
- TATE, R., 1888. The Gastropods of the Older Tertiary of Australia—Part 1. *Ibid.* 10: 91-176, pl 1-13.
- TATE, R., 1889. The Gastropods of the Older Tertiary of Australia—Part 2. *Ibid.* 11: 116-174, pl 2-10.
- TATE, R., 1890. The Gastropods of the Older Tertiary of Australia—Part 3. *Ibid.* 13: 185-235.
- TATE, R., 1893. The Gastropods of the Older Tertiary of Australia—Part 4. *Ibid.* 17: 316-345, pl 6-10.
- TATE, R., 1898. A second supplement to a census of the fauna of the Older Tertiary of Australia. *J. Proc. R. Soc. N.S.W.* 31: 381-416, pl 19-20.
- TENISON WOODS, J. E., 1876. On some Tertiary fossils from Table Cape. *Pap. Proc. R. Soc. Tasm.* for 1875: 13-26, 3 pl.
- TENISON WOODS, J. E., 1877. Notes on the fossils referred to in the foregoing paper (i.e. by R. M. Johnston). *Ibid.* for 1876: 91-116.
- TENISON WOODS, J. E., 1879. On some Tertiary fossils. *Proc. Linn. Soc. N.S.W.* 4(1): 1-20, pl 1-4.
- THIELE, J., 1925. Gastropoda der deutschen tiefsee-expedition II. *Deutsche Tiefsee-Expedition 1898-1899*, 17(2): 35-382, pl 25-27.
- THIELE, J., 1929: *Handbook der Systematische Weichterkunde*. Jena: I. Fischer: pp. 376.
- VELLA, P., 1954. Tertiary Mollusca from South-East Wairarapa. *Trans. R. Soc. N.Z.* 81(4): 539-555, pl 25-27.
- VREDENBURG, E., 1925. Description of Mollusca from the post-Eocene Tertiary formation of North-Western India: Cephalopoda, Opisthobranchiata, Siphonostomata. *Mem. Geol. Surv. India* 50 (1): i-xii, 1-350, Index i-xvi, pls 1-13.
- WEAVER, C. E., 1916. Tertiary faunal horizons of western Washington. *Univ. Washington Pubs. Geol.* 1 (1): 1-67 pls 1-5.
- WEINKAUFF, H. C., 1875. Ueber eine Kritische Gruppe des Genus *Pleurotoma* Lam. sensu stricto. *Jb. dt. Malakozool. Ges.* 2: 285-292, pl 9.
- WOODRING, W. P., 1928. Miocene Mollusks from Bowden, Jamaica, Pt. 2. *Carnegie Inst. Washington* publ. nr. 385: pp i-vii, 1-564, pl 1-40, 3 text figs.
- YOKOYAMA, M., 1926. Tertiary Mollusca from Southern Tôdômi. *Tokyo Imper. Univ. Faculty Sci. Journ. sec. 2* 1 (9): 313-364, pl 38-41.

Explanation of Plates

PLATE 4

- Fig. 1— ? *Comitas* sp., P33342, FL 11, × 2.3.
- Fig. 2— *Comitas aldingensis* Powell 1944, paratype, Blanche Pt., × 9.6.
- Fig. 3— *Comitas aldingensis* Powell 1944, TM 953, holotype, Blanche Pt., × 11.
- Figs. 4, 5— *Comitas wynyardensis cudmorei* supsp. nov., P42956, holotype, AW 1, × 2.5 and × 9.
- Fig. 6— Genus ? nov (allied to *Comitas*), P33429, BC 3, × 10.
- Fig. 7— *Tholitoma* sp., P33417, BC 3, × 4.6.
- Fig. 8— *Makiyamaia victoriae* sp. nov., P42834, holotype, BC 3, × 8.
- Fig. 9— *Apiotoma ? wilkinsoni* sp. nov., P42832, holotype, BC 3. × 2.
- Figs. 10, 11— *Apiotoma ? wilkinsoni* sp. nov., P42833, paratype, BC 3, × 3.5 and × 9.
- Fig. 12— *Apiotoma bassi* Pritchard 1904, MUGD 1825, holotype, AW 1, × 2.
- Fig. 13— ?*Apiotoma* sp. a. P33353, BC 1, × 2.5.
- Figs. 14, 15— *Apiotoma* sp. b. P33356, BC 1, × 4 and × 7.3.
- Fig. 16— ? *Insolentia* sp. P33416, BC 3, × 6.7.
- Fig. 17— ? *Insolentia* sp. P33400, BC 3, × 2.8.

PLATE 5

- Figs. 1, 2— *Johannaia darraghi* gen. et sp. nov., P42841, holotype, BC 1, × 5 and × 15.
- Figs. 3, 4— *Marshallaria otwayensis* sp. nov., P42844, holotype, AW 1, × 3.3 and 7.4.
- Fig. 5— *Paramarshallena propebelloides* gen. et sp. nov. P42847, holotype, BC 1, × 5.5.
- Fig. 6— *Cochlespira semiplana* (Powell 1944), TM 956, holotype, Blanche Point, × 8.
- Fig. 7— *Turrinosyrinx denticulata* sp. nov., P33354, holotype BC 1, × 6.
- Fig. 8— *Veruturris* sp., P33433, BC 3, × 4.
- Fig. 9— *Gemmula (Clavogemmula) prima* subgen. et sp. nov., P33350, holotype, BC 1, × 5.
- Fig. 10— *Gemmula (Clavogemmula) prima* subgen. et sp. nov., P42851, paratype, BC 1, × 8.5.
- Fig. 11— ? *Cordieria* sp. a., P33348, BC 1, × 7.5.
- Fig. 12— *Cordieria* sp. cf. *protensa* (Tate 1898), P33384, BC 3, × 6.
- Fig. 13— ? *Cordieria* sp. b., P33423, BC 3, × 12.
- Fig. 14— *Cordieria protensa* (Tate 1898), T340D, holotype, AW 1, × 2.
- Fig. 15— *Cordieria protensa* (Tate 1898), T320D, AW 1, × 4. (holotype of *Borsonia otwayensis* Tate 1898, pl. 19, fig. 4).
- Fig. 16— *Cordieria protensa* (Tate 1898), T327C, AW 1, × 6.5. (holotype of *Borsonia polycesta* Tate 1898, pl. 19, fig. 2).
- Fig. 17— ? *Borsonia* sp. cf. *tatei* Powell 1944, P33405, BC 3, × 6.
- Fig. 18— *Borsonia tatei eocenica* subsp. nov., P42854, holotype, BC 1, × 4.5.

PLATE 6

- Fig. 1— ? *Mitrolunna* sp., P33435, BC 3, × 11.
- Figs. 2, 3— *Cryptocordieria variabilis* gen. et sp. nov., P33395, holotype, BC 3, × 7.5 and × 3.
- Fig. 4— ? *Splendrillia* sp., P33422, BC 1, × 8.
- Fig. 5— ? *Splendrillia* sp., P33409, BC 1, × 5.

- Fig. 6— *Splendrillia hughesi* sp. nov., P42862, holotype, AW 1, $\times 7$.
 Fig. 7— ? *Hauturua* sp., P33381, BC 3, $\times 12$.
 Fig. 8— *Mauidrillia aldingensis* Powell 1944, TM 1024, holotype, Blanche Point, $\times 8$.
 Fig. 9— *Mauidrillia secta secta* Powell 1944, TM 1031, holotype, Blanche Point, $\times 7$.
 Fig. 10— *Mauidrillia secta secta* Powell 1944, P33448, topotype, $\times 7$.
 Fig. 11— *Mauidrillia secta otwayensis* subsp. nov., P42865, holotype, AW 1, $\times 6.3$.
 Fig. 12— *Mauidrillia* sp. cf. *secta* Powell 1944, P33377, BC 1, $\times 5$.
 Fig. 13— Genus nov. ?, P33388, BC 3, $\times 10$.
 Fig. 14— *Conorbis atractoides* (Tate 1890), T750A, holotype, Adelaide Bore, $\times 5$.
 Fig. 15— *Conorbis atractoides otwayensis* subsp. nov. P42959, holotype, AW 1, $\times 4$.

PLATE 7

- Fig. 1— *Guraleus* sp. cf. *eocenicus* sp. nov., P33370, BC 1, $\times 10$.
 Fig. 2— *Guraleus eocenicus* sp. nov., P42871, holotype, BC 3, $\times 11$.
- Fig. 3— *Antiguraleus* sp. b., P33338, AW 1, $\times 6$.
 Fig. 4— ?*Antiguraleus* sp. c., P42941, AW 1, $\times 10$.
 Fig. 5— ?*Antiguraleus* sp. a., P42889, AW 1, $\times 10$.
 Fig. 6— *Macteola eocenicica* sp. nov. P42874, holotype, BC 3, $\times 15$.
 Fig. 7— *Etrema* sp., P42939, AW 1, $\times 6$.
 Fig. 8— *Asperdaphne* sp. a., P42899, BC 1, $\times 8$.
 Fig. 9— *Asperdaphne* sp. b., P42901, AW 1, $\times 10$.
 Fig. 10, 11— *Rugobela humerosa* (Marwick 1926), P42877, BC 1, $\times 5$ and $\times 12$.
 Fig. 12— *Syngenochilus johannaensis* sp. nov., P33360, holotype, BC 1, $\times 5$.
 Fig. 13, 14— *Syngenochilus radiapex* Powell 1944, P42946, AW 1, $\times 6$ and $\times 7.5$.
 Fig. 15— *Syngenochilus radiapex* Powell 1944, TM 1123, holotype, Upper Beds Torquay, $\times 9$.
 Fig. 16— *Parasyngenochilus eocenicus* gen. et sp. nov., P42882, holotype, BC 3, $\times 6$.
 Fig. 17— *Parasyngenochilus angustior* gen. et sp. nov., P42961, holotype, AW 1, $\times 6$.
 Fig. 18— *Parasyngenochilus* sp. b., P42905, BC 3, $\times 5$.
 Fig. 19— *Mitra citharelloides* Tate 1899, T631B, holotype, Aldinga, $\times 7$.

