Records of the Western Australian Museum
Supplement No. 48

MAASTRICHTIAN SCAPHOPODA AND GASTROPODA

from the Miria Formation, Carnarvon Basin, northwestern Australia

Thomas A. Darragh and George W. Kendrick

MAASTRICHTIAN SCAPHOPODA AND GASTROPODA FROM THE MIRIA FORMATION, CARNARVON BASIN, NORTHWESTERN AUSTRALIA

Records of the Western Australian Museum
Supplement No. 48

MAASTRICHTIAN SCAPHOPODA AND GASTROPODA

from the Miria Formation, Carnarvon Basin, northwestern Australia

Thomas A. Darragh and George W. Kendrick

Western Australian Museum
1994

Cover: *Nododelphinula dracontis,* x3

World List Abbreviation:
Rec. West. Aust. Mus. Suppl. No. 48

ISBN 0 7309 5585 0
ISSN 0 313 122X

Printed and published by the Western Australian Museum,
Francis Street, Perth, Western Australia 6000.

CONTENTS

MAASTRICHTIAN SCAPHOPODA AND GASTROPODA FROM THE MIRIA FORMATION, CARNARVON BASIN, NORTHWESTERN AUSTRALIA

Thomas A. Darragh* and George W. Kendrick**

ABSTRACT

One scaphopod and 35 gastropod species are recorded from the Late Maastrichtian Miria Formation of the Carnarvon Basin, northwestern Australia. Preservation of the fossils suggests that the assemblage, which is inferred to contain herbivores, possible detrital feeders, grazers, predatory and ectoparasitic carnivores, is only partly representative of the original fauna. The original mineralogy of the shells has, in part, determined which mollusks have been preserved, their state at recovery, and whether or not they can be identified. Primary calcite has remained but argonite has been lost and partially replaced by secondary calcite. Six species are known only from internal moulds.

Five new species - *Conotomaria minacis* sp. nov., *Conotomaria (?) cypsela* sp. nov., *Leptomaria perancisa* sp. nov., *Nododelphinula dracontis* sp. nov. and *Euthriofusus (?) vandegraaffi* sp. nov. are described and named. The order of abundance is Neotaenioglossa > Archaeogastropoda > Neogastropoda > Heterobranchia > Opisthobranchia. Four species remain indeterminable.

All genera recognized were widely distributed in the combined Tethyan - Temperate Realms of the Late Cretaceous; some possible Tethyan elements are, at most, weakly represented. Two species are very close to described European taxa of the Late Cretaceous and two others are very close to described North American species. Affinities with the faunas of South India, Natal and Malagasy appear to be weak.

No generic endemism is noted among the gastropods and there is no support from this group for the concept of a faunal subprovince in the region during the Late Cretaceous. The climatic regime indicated by the gastropods is considered to have been temperate as was concluded from our previous study of the Bivalvia. Most of the species persisted to the Cretaceous - Tertiary boundary.

INTRODUCTION

This paper continues the description of Mollusca from the Late Maastrichtian Miria Formation of the Carnarvon Basin of northwestern Australia with an account of the gastropods and one scaphopod. The bivalves (excluding the Inoceramidae) and the general features of the formation have been described previously by Darragh and Kendrick (1991 and references). Subsequently, the Miria heteromorph ammonites have been described by Henderson, Kennedy and McNamara (1992); other faunal studies are listed in Darragh and Kendrick (1991).

The Late Maastrichtian Miria Formation overlies disconformably the Campanian-Early Maastrichtian Korojon Calcarenite and is overlain disconformably by the Late Paleocene Boongarooda Greensand (Hocking *et al.* 1987 and references therein).

* Museum of Victoria, 285 Russell Street, Melbourne, Victoria 3000

** Western Australian Museum, Francis Street, Perth, Western Australia 6000

Abbreviations used in the text and captions are:

GSWA – Geological Survey of Western Australia, Perth
NMV – Museum of Victoria, Melbourne
UWA – Geology Department University of Western Australia, Perth
WAM – Western Australian Museum, Perth

Specimen dimensions are given in millimetres. All specimens were whitened for photography except Figures 4F and 4G.

PRESERVATION

Gastropods and scaphopods are relatively uncommon in the Miria Formation, only a few specimens ever having been collected *in situ*. Most collectable material has been picked up from surface lag deposits or from fluvial deposits in erosion gullies and small streams. Specimens have rarely been screened from weathered matrix on undisturbed outcrops. The lag material may lie on the Miria Formation or on the underlying Korojon Calcarenite and may include material washed down from the overlying Boongarooda Greensand. The gully and stream material was collected at various distances from the source outcrop. The preservation of the Miria Formation gastropods allows easy separation from material derived from the other formations. An exception to this general picture of stratigraphic disassociation is provided by one species (undetermined gastropod Sp. A), known only as internal moulds from the nodule bed at the contact of the Miria Formation and Korojon Calcarenite (Table 1).

The present material has undergone the same post-mortem bioturbation, transportation, mechanical abrasion and chemical alteration as have the bivalves, cephalopods and other carbonate macrofossils of the Miria Formation (Henderson and McNamara 1985a; McNamara 1987; Darragh and Kendrick 1991; Henderson *et al.* 1992). All aragonitic shell in the gastropods and scaphopods has been destroyed and in some cases, this has been replaced with greater or lesser fidelity by secondary calcite. For the great majority of both specimens and species, at best, only a portion of the shell is retained with the mould.

Exceptions to this generally inferior preservation include the pleurtomariids, in which the outer shell layer is composed of primary calcite (Cox in Moore 1960), resulting in an occasional superior quality specimen. This is often true also for the turbinid *Nododelphinula dracontis* sp. nov., suggesting that in life, the shell of this species, or at least its outer layer, was calcitic. An outer calcitic layer in the shells of some other trochoidean genera is discussed by Hickman and McLean (1990: 14). The primary mineralogy of the epitoniid outer shell layer is also believed to be calcitic (Bøggild 1930). Epitoniids are rarely collected in the Miria Formation, but apart from mechanical damage specimens of this family are generally well preserved and this is consistent with a composition of stable calcite.

Some of the rarer gastropod taxa are known only from internal moulds and are difficult on present knowledge to assign to genera or even families. External moulds, from which details of sculpture and other external characters may be discerned, are rare and those to hand appear to have been derived from the nodule bed at the contact of the Miria Formation and Korojon Calcarenite.

Koch and Sohl (1983) studied the preservational state of molluscs in a range of Maastrichtian assemblages from the Eastern Gulf Coastal Plain Province of North America

and showed that those, in which both aragonite and calcite were well preserved, were more speciose and hence more representative of their original compositions than others of inferior preservation. The former were therefore more reliable sources of ecological and biogeographical information than the latter.

The preservational state of Miria Formation gastropods (and associated molluscs) in which

Table 1 Scaphopoda and Gastropoda from the Miria Formation; quantities of specimens in the study material.

	Species	No. of specimens examined
1.	*Conotomaria minacis* sp. nov.	293
2.	*Nododelphinula dracontis* sp. nov.**	183
3.	*Conotomaria* (?) *cypsela* sp. nov	81
4.	*Eovolutilithes* cf. *subsemiplicatus* (d'Orbigny)**	81
5.	*Euthriofusus* (?) *vandegraaffi* sp. nov.**	70
6.	Gastropod, *incertae sedis*, species A*	50
7.	*Xenophora (Xenophora)* sp.	35
8.	*Gyrodes (Gyrodes)* aff. *supraplicatus* (Conrad)	18
9.	*Leptomaria perancisa* sp. nov.**	16
10.	*Avellana* (?) sp.	12
11.	*Fusinus* (?) sp.**	11
12.	Cypraeoidean, family and genus undetermined, species A	9
13.	*Confusiscala* cf. *decorata* (Roemer)**	9
14.	*Cirsocerithium* sp.	8
15.	*Graphidula* aff. *melanopsis* (Conrad)	8
16.	*Dentalium (Dentalium)* sp.	7
17.	Gastropod, *incertae sedis*, species C**	6
18.	Nerineid (?), genus and species undetermined*	5
19.	*Hainaspira* sp.	4
20.	Gastropod, *incertae sedis*, species D	4
21.	Trochoidean, family and genus undetermined species A	3
22.	Cerithioidean, family and genus undetermined, species A	3
23.	Cerithioidean, family and genus undetermined, species B	3
24.	Aporrhaid (?), genus and species undetermined	3
25.	*Amaea (Littoriniscala?)* sp.	3
26.	*Woodsella* cf. *typica* Wade	3
27.	*Striaticostatum* sp.	2
28.	Volutid (?), genus and species undetermined*	2
29.	Gastropod, *incertae sedis*, species B	2
30.	*Boutillieria* (?) sp.	1
31.	Trochid, genus and species undetermined	1
32.	Trochoidean, family and genus undetermined, species B	1
33.	*Cimolithium* (?) sp.	1
34.	Cypraeoidean, family and genus undetermined, species B	1
35.	*Dolicholatirus* cf. *torquatus* Sohl	1
36.	*Bathraspira* (?) sp.	1
	Total of specimens	941

* denotes species from nodule bed at contact of Korojon Calcarenite and Miria Formation.

** denotes species from Miria Fm and nodule bed at contact of Korojon Calcarenite – Miria Formation.

(a) original calcite usually remains intact, (b) aragonite is totally dissolved and may or may not be replaced by secondary calcite, and (c) a proportion of the material survives only as moulds, corresponds to Koch and Sohl's (1983) Type III category. The nodule bed at the contact of the Miria Formation and Korojon Calcarenite, in which some primary – calcitic shells are preserved, all others, both calcitic and aragonitic, being reduced to moulds, corresponds to Type IV in the Koch and Sohl categorization.

Table 1 lists all scaphopod and gastropod species recognized in the Miria assemblage in order of frequency of occurrence in the study material. Bearing in mind the remarks of Koch and Sohl (1983), the tabulation should not be viewed as an approximation of the original composition of the Miria fauna as it has, without doubt, been influenced considerably by the loss of aragonite and the virtual disappearance of many, particularly smaller, elements. The tabulation also incorporates subjective collection biases such as those in favour of the better preserved, more visible and more readily collectible groups.

The present study has been hampered to some extent by the commonly poor condition of comparative material in many of the classical faunas described during the last century, by their often inadequate illustration and by the paucity of modern revisions. A further source of difficulty arises from the absence of other comparable assemblages in the entire Australian Cretaceous (see Darragh and Kendrick 1991). In the extensive and often richly fossiliferous Early Cretaceous deposits of central and eastern Australia, gastropods are uncommon and show few apparent affinities with those of the Miria Formation. Other Late Cretaceous fossil assemblages from Western Australia are inferior in gastropod numbers, diversity and preservation. In the Koch and Sohl (1983) categorization, these may be assigned to their Type IV preservation state.

PALAEOECOLOGY

The depositional environment and taphonomic history of the Miria Formation and its fossil material have been discussed by Henderson and McNamara (1985a) and Darragh and Kendrick (1991). Deposition took place on the middle shelf under moderately energised conditions, with macro-fossil material being subject to extensive *post-mortem* attrition. The gastropod evidence concerning palaeoecology will now be considered.

The recognition of gastropod diet in the fossil record is presumptive and proceeds by analogy with modern related groups, the actual diet of which may or may not be well known. The limitations of this method are self-evident. In modern seas, the trochoidean Turbinidae appear to be consistent herbivores (Wilson and Gillett 1979; Clarkson and Shepherd 1985), though Beu and Ponder (1979) considered that species of *Bolma* "probably do not graze on attached algae because most species live well below the limits of algal growth" and Morton (1955) reports one species which is both an algal and a detrital feeder. Three species of Turbinidae are present in the Miria assemblage, one of which, *Nododelphinula dracontis* sp. nov., is among the more common elements (Table 1). We regard this species as a probable herbivore and conclude that it lived either within or in proximity to the vegetated photic zone. Other Miria trochoideans (three species, none common) are possible herbivores. Modern trochids are commonly herbivorous (Wilson and Gillett 1979; Clarkson and Shepherd 1985) but some are believed to graze on hydroids and other sessile invertebrates (Perron 1975; Kohn 1983).

The cerithioideans, with four uncommon to rare species, are a minor element in the Miria assemblage. Modern forms have adapted to a wide range of habitats but all are either herbivores or detrital feeders (Graham 1955; Houbrick 1988: 96–97, Table 3). Cerithioideans often congregate in great numbers on soft substrates of the shallow sublittoral to intertidal zones but more sparsely in deeper waters. The few records of this group in the study material are consistent with deposition well offshore, for example, on the middle shelf. Other possible herbivores among the Miria gastropods are all rarities. They include the possible strombid, possible nerineid and the patelliform *incertae sedis* species D.

Kohn (1983) considered the Cypraeoidea to be essentially carnivorous grazers but noted one species also taking algal food. A sponge-grazing habit is attributed to cypraeids of the genus *Zoila* Jousseaume, which is allied with *Bernaya* and several other genera in the lineage group or tribe Bernayini (Wilson 1985). Our Miria cypraeoidean Species B is similar to *Bernaya* and may have been a sponge-grazer. The only fossil sponge recorded to date from the Miria Formation is the boring species *Entobia cretacea* Portlock (Henderson and McNamara 1985a: 310, figs 3a, b; Darragh and Kendrick 1991 and this paper, p. 36, Figure 7C; p. 64). Other sponges (e.g. WAM 83.3154) occur in the formation but remain unidentified.

The Cypraeidae are a tropical and temperate family, characterized in tropical seas by high species diversity and planktotrophic larval development. Cretaceous and modern distributions of the family are given by Sohl (1971: 1635, fig. 13).

Pleurotomariids (two common and one uncommon species) are prominent in the Miria assemblage (Table 1). Little is known of the feeding behaviour of modern pleurotomariids; a carnivorous diet of sponge tissue is thought to be "highly probable" for a living specimen of *Entemnotrochus adansoniana* observed at a depth of 160m by Yonge (1973), though the observer also noted a continuous rain of *Halimeda* fronds supplying plant detritus to the same level, originating from depths of 9–73m above. Limited examination of stomach contents of specimens of a species of *Perotrochus* from outer shelf waters off northwestern Australia suggests that the animals may be unspecialized omnivores (S. Slack-Smith, in litt.).

Ponder (1983: 15–17), summarizing the extremely cryptic behaviour of living xenophorids, noted that some species graze on fine algae, others on microfauna, gathered from the substrate beneath the extended periphery of the shell. We therefore include the Miria *Xenophora* on Table 3 with the group of unspecialized omnivores.

Modern epitoniids are ectoparasitic carnivores or scavengers, associated with anthozoan coelenterates (Robertson 1970, 1981; Kohn 1983). Fossil corals of at least two species (Darragh and Kendrick 1991: 76, fig. 20 and WAM collections) are found occasionally in the Miria Formation and may have been a food source for the three recorded epitoniids. Soft-bodied coelenterates, such as actinarians and zoanthids may have been present but this cannot be confirmed from the fossil record.

The predatory carnivorous Prosobranchia appeared first in the Early Jurassic with the family Naticidae and most of the other major families had become established by the Late Cretaceous. Taylor *et al.* (1980: 387, text fig. 7) show that by the Maastrichtian, at least 23 families of predatory carnivorous prosobranchs are represented in the fossil record, all of which are extant. Only four of Taylor *et al.*'s families, the Naticidae, Buccinidae, Fasciolariidae and Volutidae, are known from the Miria Formation, contributing eight species (Table 2) or 23% of all species and 21% of all specimens in the study material.

Table 2 Composition of the Miria Formation gastropod assemblage, including taxa from the nodule bed at the contact of the Miria and Korojon Calcarenite. Higher category taxa are based on Ponder and Warén (1988).

Orders	Families	Species
Archaeogastropoda	Pleurotomariidae	3
	Turbinidae	3
	Trochidae	1
	Other Trochoidea	2
	Sub total	9 = 25.7% of all species
Neotaenioglossa	Procerithiidae	2
	Other Cerithioidea	2
	Aporrhaidae ?	1
	Xenophoridae	1
	Cypraeoidea	2
	Naticidae	1
	Epitoniidae	3
	Sub total	12 = 34.3% of all species
Neogastropoda	Buccinidae	5
	Volutidae	2
	Sub total	7 = 20.0% of all species
Heterostropha	Mathildidae	1
	Nerineidae ?	1
	Sub total	2 = 5.7% of all species
Cephalaspidea	Ringiculidae	1
	Sub total	1 = 2.4% of all species
Incertae sedis	Sub total	4 = 11.4% of all species
All Gastropoda	Grand total	35 species

The Naticidae are major predators of other molluscs and also take foraminifers and ostracodes (Taylor *et al.* 1980: Table 1; Kohn 1983: 24). *Gyrodes (Gyrodes)* cf. *supraplicatus* (Conrad) represents this family in the Miria assemblage and has been held responsible for occasional naticiform boreholes in the attached-epifaunal oyster *Pycnodonte vesiculare* (Lamarck) and in the infaunal-burrowing arcoid *Grammatodon (Nanonavis) subdiscors* Darragh and Kendrick, 1991. To date in the Miria Formation, naticid predation has been noticed only on bivalves.

The Buccinidae, here employed in the sense of Ponder and Warén (1988) (to embrace the traditional Buccinidae, Nassariidae, Melongenidae and Fasciolariidae of authors which are reduced to subfamilial rank) was well diversified by the Maastrichtian and contributes five species to the Miria assemblage (Table 2). Modern Buccinidae are scavengers and also major predators of other molluscs (Taylor *et al.* 1980, Table 1; Kohn 1983); they also take polychaetes, cirripedes (see Buckeridge 1983) and other invertebrates; the Fasciolariinae show

similar though less diverse feeding preferences (Taylor *et al.* 1980,Table 1). In the Miria material, buccinids range from the common *Euthriofusus* (?) *vandegraaffi* sp. nov. to the rare *Dolicholatirus* sp. cf. *D. torquatus* Sohl; these include the largest gastropod known from the Miria, *Fusinus* (?) sp. (see Figure 11).

The Volutidae have a lengthy Cretaceous history and are represented in the study material by two species (Table 2). *Eovolutilithes* cf. *subsemiplicatus* (d'Orbigny) is common in the

Table 3 Inferred, possible feeding strategies of Miria Formation gastropods and scaphopod.

1.	Herbivores	*Nododelphinula dracontis* sp. nov.* *Hainaspira* sp. *Boutillieria* (?) sp.
2.	Herbivores and/or detrital feeders	*Cirsocerithium* sp. *Cimolithium* (?) sp. undetermined cerithioideans (2 species) possible aporrhaid possible nerineid *Incertae sedis* Species D
3.	Herbivores and/or grazing carnivores	undetermined trochid (1 species) undetermined trochoideans (2 species)
4.	Sponge grazers	cypraeoid Species A cypraeoid Species B
5.	Unspecialized omnivores	*Conotomaria minacis* sp. nov. * *Conotomaria* (?) *cypsela* sp. nov.* *Leptomaria perancisa* sp. nov.* *Xenophora (Xenophora)* sp.*
6.	Symbiotic carnivores	*Striaticostatum* sp. *Confusiscala* cf. *decorata* (Roemer) *Amaea (Littoriniscala?)* sp.
7.	Micro-carnivore	*Dentalium (Dentalium)* sp.
8.	Predatory carnivores, some also scavengers	*Gyrodes (Gyrodes)* aff. *supraplicatus* (Conrad)* *Woodsella* cf. *typica* Wade *Dolicholatirus* cf. *torquatus* Sohl *Euthriofusus* (?) *vandegraaffi* sp. nov.* *Fusinus* (?) sp. *Graphidula* aff. *melanopsis* (Conrad) *Eovolutilithes* cf. *subsemiplicatus* (d'Orbigny)* undetermined volutid (1 species) *Incertae sedis* Species B
9.	Others	*Incertae sedis* Species A* *Incertae sedis* Species C *Avellana* (?) sp.* *Bathraspira* (?) sp.

* Denotes the ten most abundant species in the study material (see Table 1). These aggregate 839 specimens (89%) of a total of 941 specimens examined.

Miria Formation and is also present, together with a second rare and undetermined volutid, in the nodule bed at the contact of the Miria and Korojon Calcarenite. Modern volutids are major predators on other molluscs (Taylor *et al.* 1980, Table 1), presumably as were their Late Cretaceous antecedents.

Our *incertae sedis* Species B may prove to be a turbinellid and if so would have been a probable predatory carnivore but this remains to be confirmed.

The Scaphopoda are sedentary, infaunal micro-carnivores, capturing foraminifers and other such organisms.

Inferred, possible feeding strategies for the present material are summarized in Table 3.

PREDATION

Shell fracture patterns consistent with crab peeling and subsequent repair (Allmon *et al.* 1990) have been observed on occasional specimens of *Conotomaria minacis* sp. nov., for example paratypes WAM 60.25, 71.193a and UWA 37076b. The peeling seems to have been directed along the plane of the apertural slit and selenizone. On specimen 71.193a, the selenizone on the repaired shell shows temporary displacement. Occasional crab remains are found in the Miria Formation (e.g., WAM 90.253) but no identifications are available.

CORRELATION AND STRATIGRAPHY

The age, correlation and stratigraphy of the Miria Formation have been reviewed by Henderson and McNamara (1985b), McNamara *et al.* (1988), Shafik (1990) and by Henderson *et al.* (1992). Ammonites from the upper, calcisiltite member of the formation (e.g. *Eubaculites carinatus*, *Glyptoxoceras rugatum*) indicate a close correlation with the upper part of the Valudayur Formation of the Pondicherry District, South India, for which a Late Maastrichtian age has been determined from planktic foraminifers (Govindan 1972; Kennedy and Henderson 1992). Foraminiferal evidence for the location of the calcisiltite upper member of the Miria Formation within the uppermost subdivision of the Maastrichtian (*Abathomphalus mayaorensis* Zone) comes from McGowran (1968), Wright and Apthorpe (1976) and Caron (1985). Shafik (1990) reaches a similar conclusion from the coccolith evidence.

Fossil material from the nodule bed at the contact of the Miria Formation and Korojon Calcarenite has been included in this study (see Table 1) and in Darragh and Kendrick (1991). The nodule bed has been taken as the top of the Korojon by McNamara *et al.* (1988) and by Henderson *et al.* (1992); however Shafik (1990) regards the same nodule bed as the basal unit of the Miria Formation. Fossil material from this unit is assigned to the Early Maastrichtian. Here, as elsewhere in Western Australia, the Middle Maastrichtian seems to have been regressive (McNamara *et al.* 1988; Shafik 1990.) The foraminiferal calcarenite member, which forms the major part of the Miria Formation, is assigned to the Late Maastrichtian.

All evidence suggests that, except for those elements restricted to the basal nodule bed, the Miria fauna persisted right to the Cretaceous – Tertiary boundary and may be presumed to have been participants in the global environmental crisis that brought the Cretaceous to a close.

PALAEOBIOGEOGRAPHY

Cretaceous gastropod distributions in the Tethyan (tropical) and Temperate Realms have been compared by Sohl (1987), though with slight input from the meagre Australian record then available for this group. The present material, comprising 35 species of gastropod (and one scaphopod) is the most diverse and best preserved gastropod assemblage known from the Australian Cretaceous. Its limitations, however, arise from its narrow time range, its limited ecological derivation and imperfect state of preservation. Thus, of the 35 gastropod species recognized herein, 14 (40%) have not been assignable with reasonable confidence to genera and in some cases even to families (most of these are internal moulds), so that wider interpretations concerning palaeobiogeography must remain tentative.

The study material from the Miria Formation, including that from the nodule bed at the contact of the Miria and Korojon Calcarenite, is notably deficient in characteristic and widely distributed Cretaceous marine-Tethyan elements such as *Trajanella, Haustator, Torquesia, Procampanile, Calyptraea, Architectonica, Perissoptera* and other aporrhaids and *Trochacteon*; however a possible weak Tethyan influence is suggested by the presence of a rare single nerineid (?). This record remains subject to confirmation. Cephalaspid snails of the Acteonidae were abundant and speciose in the Late Cretaceous, mainly in the shallow sublittoral environment. Their absence from the Miria assemblage may reflect facies constraints.

The Miria assemblage is characterized by groups recorded widely from within both the Tethyan and Temperate Realms during the Late Cretaceous. These include the Pleurotomariidae (with genera *Conotomaria* and *Leptomaria*), Turbinidae (*Nododelphinula, Hainaspira* and possible *Boutillieria*), Procerithiidae (*Cirsocerithium* and possible *Cimolithium*), Xenophoridae (*Xenophora* s. str.), Cypraeoidea (two undetermined genera), Gyrodinae (*Gyrodes* s. str.), Epitoniidae (*Striaticostatum, Confusiscala* and *Amaea*), Buccininae (*Woodsella*), Fasciolariinae (*Dolicholatirus*, possible *Euthriofusus*, possible *Fusinus* and *Graphidula*), Volutidae (*Eovolutilithes*) and Ringiculidae (possible *Avellana*).

The scaphopod genus *Dentalium* attained a cosmopolitan distribution during the Cretaceous and may therefore be joined with the wide ranging gastropod genera listed above. The three Miria pleurotomariid species seem to be not closely related to previously described forms and may have evolved from resident Australian stocks, possibly extending back to the Jurassic. Sohl (1987, figs. 10, 11) notes that the group was in decline toward the close of the Cretaceous and that from the Campanian to Maastrichtian was common only in temperate faunas of northern Europe, North America and Japan and, in the Southern Hemisphere, in Chile, Antarctica, New Zealand, South India (Ariyalur Group) and Pondoland (Natal). The present records from the Carnarvon Basin agree well with Sohl's distributional pattern, bearing in mind Australia's global position in the Late Cretaceous (Barron 1987, figures 4–6).

Cypraeid gastropods are recorded in the Late Cretaceous from temperate to warm temperate faunas of Europe, North America, Brazil, South Africa, Malagasy and South India, (Sohl 1971; Groves 1990), having regard for India's global position at that time. We are aware of no report of a cypraeid from the Cretaceous of New Zealand, southern South America and Antarctica. The presence in the Miria Formation of two cypraeoids, though undetermined, is thus consistent with temperate to warm temperate conditions there during the Late Maastrichtian.

Evidence of an apparent North American Late Cretaceous affinity among the Miria gastropods is suggested by occurrences of the genera *Striaticostatum*, *Woodsella*, *Dolicholatirus* and *Graphidula*, the last-mentioned being on record also from Japan. Miria specimens of *Woodsella* and *Dolicholatirus* are very close to described North American species. Likewise, the Miria *Eovolutilithes* is very close to, if not identical with, the Late Cretaceous *C. decorata* (Roemer) of Europe.

On the other hand, and nearer to home, affinities of the Miria assemblage to the Late Cretaceous gastropods of South India, East Africa and Malagasy appear to be weak but this conclusion should be reviewed against future faunal studies, bearing in mind that much of the study material remains either unidentified or only partly identified.

With the sole exceptions of some pleurotomariids and a possible species of *Avellana*, the Miria gastropods have little in common with the seemingly depauperate Early Cretaceous gastropod faunas of Australia.

Unlike the situation recognized among the bivalves, in which one, and possibly up to four, endemic genera were indicated (Darragh and Kendrick, 1991), generic endemism among the Miria gastropods has not been observed. From present levels of knowledge, therefore, the gastropods provide no substantiation for a local faunal subprovince during the Late Cretaceous.

SYSTEMATIC PALAEONTOLOGY

Class Scaphopoda Bronn, 1862
Family Dentaliidae Gray, 1847
Genus *Dentalium* Linnaeus, 1758

Type species
Dentalium elephantinum Linnaeus, 1758, by subsequent designation of Montfort, 1810.

Subgenus *Dentalium* sensu stricto

***Dentalium (Dentalium)* sp.**
(Figures 5 H, I)

Material
WAM 80.647; 7 specimens, all fragmentary.

Description
Shell gently curved, slender, tapering; cross section circular; sculpture of 15–17 evenly spaced, thin, longitudinal ribs, the interspaces with six to nine close-set, very fine, longitudinal striae; apical and apertural characters unknown.

Dimensions
The specimens, none of which is complete, range in length from 3.5 to 9 mm with maximum diameters of 1.5 to 2.5 mm.

Remarks

Dentalium has a cosmopolitan distribution in the Cretaceous but we have located only two species that are similar in general features to the Miria material. These are *D. (D.) multicostatum* Favre, 1869 from the Upper Senonian of the Lvov Region and uppermost Maastrichtian of the Middle Vistula Valley (Poland). A specimen of this species from the latter horizon figured by Abdel-Gaward (1986: 85, fig. 11) shows two fine riblets between the principal ribs. The species is also recorded from the Senonian of Braunschweig, Germany (Griepenkerl 1889) as having 10–12 fine principal ribs, with two much finer riblets in the interspaces.

D. (D.) decussatum Sowerby 1815, from the Gault (Albian), as interpreted by d'Orbigny (1843: 400, pl. 236, figs 1–6), has 13 principal ribs with fine riblets between them. Gardner (1878: 58, 59, pl. 3, figs 1, 2) redescribed and refigured this species as having 12 unequal, rounded, longitudinal ribs at the apical end, increasing to about 50 at about the anterior third, after which they become obsolete. The whole shell bears fine longitudinal striae.

The Miria species is possibly new but this cannot be determined positively from the limited material now to hand. One specimen shows two episodes of shell fracture and repair, possibly as a consequence of crab predation.

A poorly preserved, fragmentary scaphopod specimen (WAM 90.229) from the Miria Formation has a length of 20 mm and diameters of 2.5 and 3.5 mm and shows no trace of longitudinal ribbing. Whether this represents another taxon or is merely an eroded or ribless individual of the above mentioned species is at present uncertain.

WAM specimen 80.647 was obtained from bulk sediment screening of the lower calcarenite unit of the formation.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Class Gastropoda Cuvier, 1797
Subclass Prosobranchia Milne Edwards, 1848
Order Archaeogastropoda Theile, 1925
Superfamily Pleurotomarioidea Swainson, 1840
Family Pleurotomariidae Swainson, 1840
Genus *Conotomaria* Cox, 1959

Type species

Pleurotomaria mailleana d'Orbigny, 1843, by original designation.

Conotomaria minacis sp. nov.

(Figures 1 A–G)

Holotype

WAM 71.283a. Mature shell lacking aperture; interior and most of umbilicus with phosphatic infilling. From CY Creek, Giralia Range, Cardabia station; west bank of southern tributary (KV 039677).

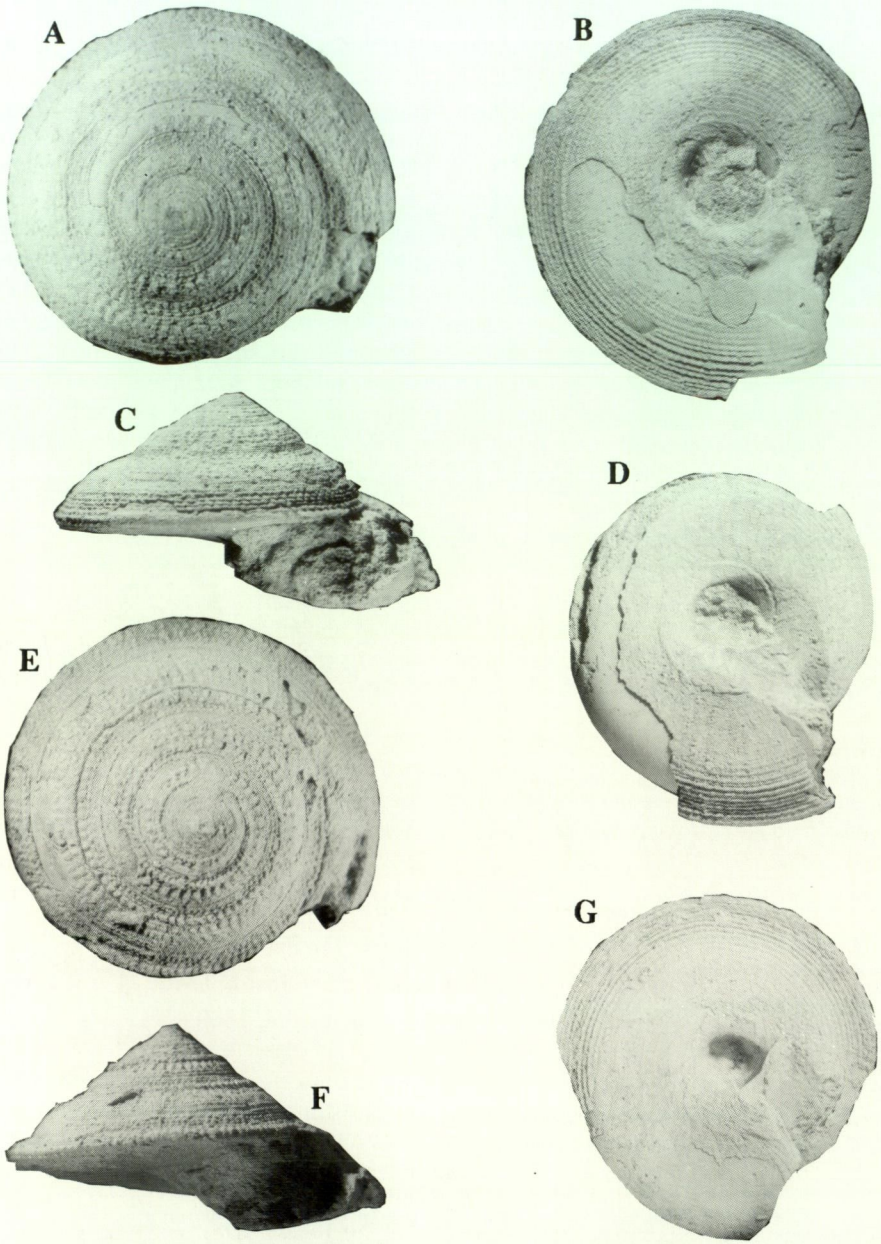

Figure 1 *Conotomaria minacis* sp. nov. **A–C**, WAM 71.283a, holotype, locality 25; **A**, apical, x 1; **B**, basal, x 1; **C**, apertural, x 1; **D**, WAM 80.635h, paratype, locality 26, basal, x 1; **E, F**, WAM 71.193a, paratype, locality 24. **E**, apical, x 1; **F**, apertural, x 1; **G**, WAM 83.3004a, paratype, locality 6, basal, showing inner lip of aperture, x 1.

Paratypes

WAM 60.25g, 60.70a, 71.193a, 71.283b, 80.635a,d,e,f,g,h,k, 83.3004a. Twelve specimens. NMV P101588, P101853; 2 specimens. UWA 37076a,b; 2 specimens.

Other material

WAM G10582, 60.25a–f, 60.70b–e, 71.193b–i, 71.261a,b, 74.583a,b, 80.635b,c,i,j,l,m, 80.689a,b, 80.751, 80.858, 80.879, 80.957, 83.2873a–d, 83.2890a,b, 83.2898a–c, 83.2917a–e, 83.2929a–d, 83.2943, 83.2944, 83.2954a,b, 83.2969, 83.2983, 83.3004b–f, 83.3020a–h, 83.3032a–d, 83.3037a,b, 83.3046, 83.3059a–e, 83.3085, 83.3109, 83.3143, 83.3156, 83.3166, 84.954, 89.1255; 93 specimens. NMV P97578, P97581–4, P98235–6, P98287–90, P101547, P101551, P101569, P101630–4, P101665–70, P101682–6, P101718–9, P101755–62, P101830–52, P101854–9, P101972, P101974–6, P102034–43, P102060, P102097, P102215–6, P102264–72, P102306–11, P102333–41, P102361–3, P102399–404, P119527–8, P119544, P119578, P119602–3, P119642; 138 specimens. UWA 91461; 2 specimens. GSWA F9368, F9388, 30083; 43 specimens.

Diagnosis

A broadly conical, umbilicate *Conotomaria* with height about half the diameter and spire angle between 95°–115°; selenizone at or below mid-whorl; spiral sculpture strongly gemmate. Differs from *C. mailleana* (d'Orbigny, 1843), *C. secans* (d'Orbigny, 1843), *C. disticha* (Goldfuss, 1841), *C. dumonti* (d'Archiac, 1846) and other species of *Conotomaria* by the position of the selenizone and by the bold gemmate sculpture.

Description

Shell of medium size, thin, broadly conical, extended at periphery, height about half diameter; apex almost papillate but usually worn or broken; spire angle variable, from 95° to 115°; whorls gently convex with or without up to two weak shoulders located at, above or below mid-whorl; spire more or less flatly conical according to prominence of shoulders; last whorl projecting, forming a prominent carina; suture linear, slightly impressed; aperture poorly preserved, wider than high, with thickened parietal lip which slightly transgresses umbilicus; columella short, obliquely curved and thickened; sinus not observed but a few specimens show a partial indication on internal mould (WAM 80.635a, h); selenizone narrow, shallowly impressed, located at or slightly below mid-whorl and well below shoulder; selenizone not usually reproduced on internal mould; lunulae faint. Base slightly convex to almost flat, centrally excavate; umbilicus open, moderately wide, deep, extending almost to apex and formed by visible, adaxial sides of whorls; spiral rib or collar encircling umbilicus of some specimens (possibly associated with siphonal fasciole), low, broad, smooth meeting aperture at columellar lip.

Sculpture of numerous close, spiral cords, on spire gemmate and of variable prominence, those at periphery and posterior suture being strongest; three or four very fine cords lie anterior to the selenizone and three narrow and two stronger cords with coarse gemmae lie posterior to the selenizone and against the suture; rarely, because of imperfect preservation or abrasion, adapical four whorls may show fine, close, axial microsculpture, prosocline above selenizone and opisthocline below it; on last whorl of mature shells, gemmae become less prominent; basal sculpture weaker than that of spire, with numerous fine, close, granose, spiral cords and threads, stronger peripherally and rarely extending across base to circumbilical rib or area; spiral sculpture occasionally obsolete on adaxial part of base; transverse-sinuate growth striae present on circumbilical collar (where present) and extending over base in proximity to aperture.

Dimensions

	Height	Max. diameter	Whorls	Spire angle
WAM 71.283a, holotype	26.9	52.9	5+	112°
WAM 60.25g, paratype	31.4	57.8	5+	113°
WAM 71.193a, paratype	27.3	51.5	5+	112°
WAM 80.635g, paratype	24.5	43.5	5+	101°
NMV P101588, paratype	25	47	7 (est.)	108°
NMV P101853, paratype	27	57	9 (est.)	105°
UWA 37076b, paratype	28.1	46.8	4+	95°

No aperture or apex on the present material is intact and the above dimensions should be taken as approximations only; heights and diameters are less than the original values.

Remarks

In proportions and basic sculpture, *Conotomaria minacis* agrees substantially with Cox's (1959, 1960b) generic diagnosis of *Conotomaria* but differs in the position of the selenizone. In Cox's material, this is located at or above mid-whorl; in the present species, the selenizone lies at or slightly below mid-whorl and we suggest that the generic concept be developed so as to admit this point. In most other respects, *C. minacis* compares generally with the Cenomanian *C. mailleana* (d'Orbigny), the type species of *Conotomaria*, figured by Cox in Moore (1960, fig. 131–9) and other European species, for example the Turonian-Senonian *C. secans* (d'Orbigny) (Ziegler 1984) and the Cenomanian *C. dumonti* (d'Archiac) (d'Archiac, 1846: 342, pl. 24, figs, 3a–c). From the descriptions and figures, these species appear to lack the strongly gemmate spiral cords of *C. minacis*. This form of sculpture recalls to some extent those of some species located by Cox (1960b) in the genera *Leptomaria, Bathrotomaria* and even *Pleurotomaria*. A further example seems to be the Lower Turonian *Leptomaria seriatogranulata* (Goldfuss, 1841) from Bohemia (Ziegler 1984: 273–274, pl. vi, figs 1–5, pl. viii, fig. 10), which bears a secondary sculpture of tubercles and granules. The Campanian *C. disticha* (Goldfuss) has a similar morphology to *C. minacis* and also a mid-whorl selenizone but has finer, more regular granulation on the lirae. The present species does not appear to be closely related to any known Late Cretaceous pleurotomariid from South India (Stoliczka 1868) or elsewhere around the Pacific margin.

A phosphatised internal mould (WAM 60.19) of depressed-conical form and consistent with that of a species of *Conotomaria* has been collected from the type section of the Turonian-Coniacean Molecap Greensand at Molecap Hill, Gingin (Perth Basin). The (internal) whorl profile of this specimen is rather more evenly rounded than that of *C. minacis* and, whatever the generic relationship, the two are clearly not conspecific.

Variation in *C. minacis* may be seen in small differences of sculptural detail, some of which could be due to abrasion and/or imperfections in the calcite replacement process (see Darragh and Kendrick 1991). There is also minor variation in the prominence of the shoulder(s) on the spire whorls, in the position of the selenizone and in the strength of the circumbilical rib-collar; the apical angle appears to enlarge with growth.

On the adapical surface of the last whorl many specimens show a breakage pattern consistent with that attributed to crab predation (shell peeling) (see Allmon *et al.* 1990 and

references). The crab attack seems to have been directed around the plane of the marginal slit and selenizone. In such specimens, the mould of the whorl side shows an excavated channel, commonly with slightly raised margins, in contrast to the basal mould, which is usually intact.

C. minacis is a common and characteristic fossil of the Miria Formation and is distributed generally along the entire line of outcrop in the Giralia Range.

Etymology

The name is from Latin *minax*, *–acis* (adjective, feminine), jutting out or protruding, from the projecting peripheral carination of the last whorl.

Stratigraphic Range

Miria Formation. Late Maastrichtian. This extends the stratigraphic range of the genus above that given by Cox in Moore (1960: I219) (Bajocian-Senonian).

Conotomaria (?) cypsela sp. nov.

(Figures 2 A–F; 3 A, B)

Holotype

WAM 80.637a. From CY Creek, Giralia Range, Cardabia station; junction of main channel and northward-draining tributary (KV 046 670).

Paratypes

WAM 60.29, 80.637b,c, 80.690, 83.2918, 85.329; 6 specimens. NMV P101866, P101906; 2 specimens.

Other material

WAM G10583, 60.68, 60.81, 71.195, 71.285, 80.881, 80.887, 83.2885, 83.2900, 83.2910, 83.2930, 83.2956, 83.2971, 83.3006, 83.3061, 83.3071, 84.727, 85.52, 85.320, 86.1461, 89.1274; 27 specimens. NMV P97577, P97580, P97585, P98268–9, P98275, P101570, P101592, P101596, P101646–9, P101673, P101722–3, P101736–7, P101753, P101865, P101867–9, P101948, P101971, P102016–7, P102237–9, P102292, P102326–7, P102364, P102384, P119641; 36 specimens. UWA 68277, 91458, NW 179; 3 specimens. GSWA 30083; 6 specimens.

Diagnosis

A medium-large, conical-trochiform *Conotomaria*, about as high as wide, spire angle 55°–69°, whorls slightly convex and with slight peripheral overhang; columella short with prominent spiral fold; base almost flat, centrally a little excavate; umbilicus narrow, shallow; selenizone broad, shallow, located at or anterior to mid-whorl; sculpture (spire) of gemmate spirals with two stronger chords on periphery. Differs from *C. percevali* Cox, 1960 in its more anterior selenizone, more convex whorls and smaller umbilicus; from *C. chardstockensis* Cox, 1960 differs in its greater relative width, the presence of spiral chords posterior to the selenizone and greater size. From the associated *C. minacis* Darragh and Kendrick (this paper), differs in its height to width ratio.

Description

Shell of medium to large size, thin, conical-trochiform, usually a little higher than wide;

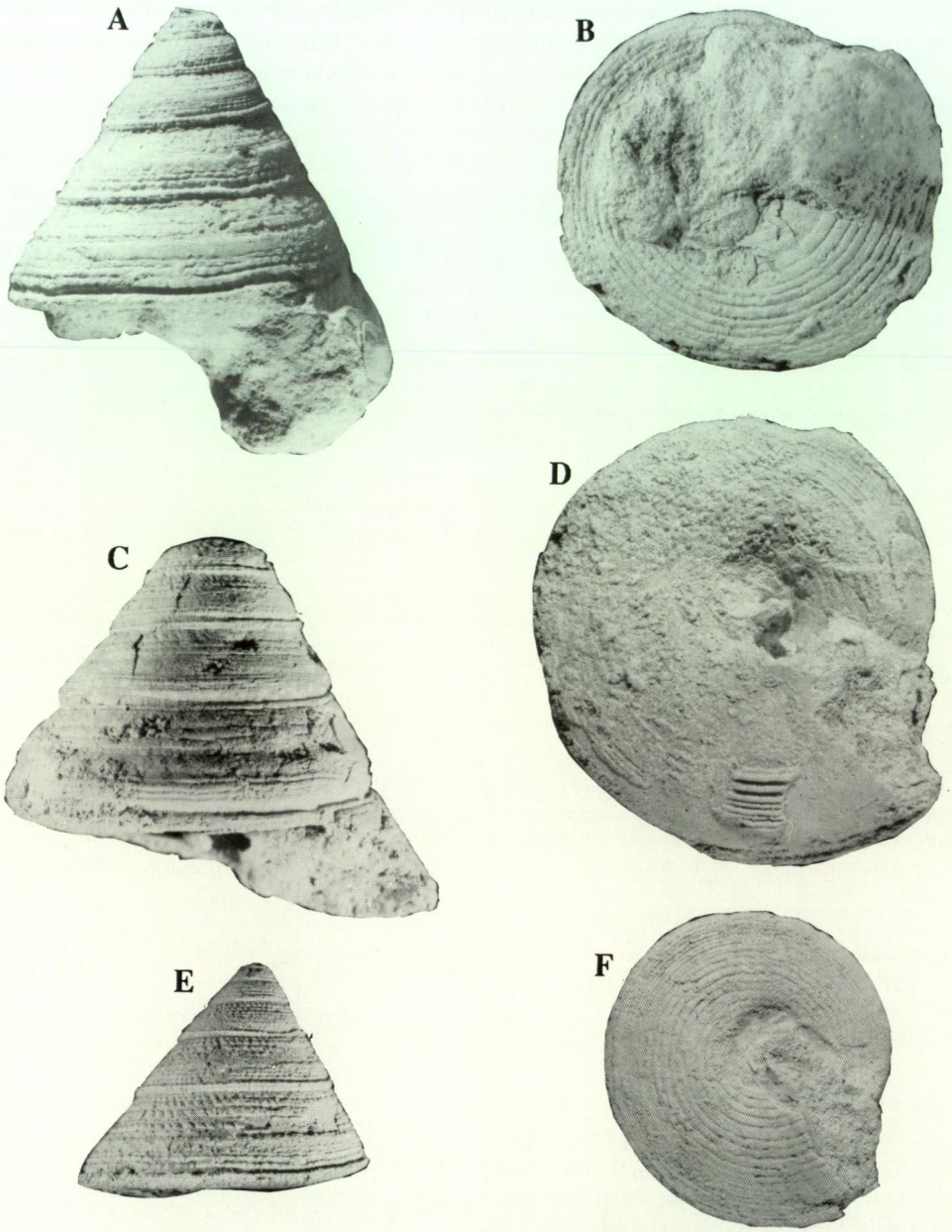

Figure 2 *Conotomaria (?) cypsela* sp. nov. **A, B**, WAM 80.637a, holotype, locality 26; **A**, apertural, x 1.4; **B**, basal, x 1.3; **C, D**, WAM 80.637b, paratype, locality 26. **C**, apertural, x 1.3; **D**, basal, x 1.3; **E**, WAM 83.2918, paratype, locality 48, 180° from aperture, x 1.5; **F**, WAM 80.637c, paratype, locality 26, basal, x 1.1.

spire angle 55°–69°, tending to increase with growth, profile straight, slightly concave or slightly gradate; whorls slightly convex to almost flat, sometimes with weak shoulder, located variously; periphery at base of whorl, angular and sharply carinate in juveniles, becoming more rounded on adult whorls (poorly preserved); plane of attachment just anterior to periphery, producing a slight overhang at suture; sutures a little impressed; aperture poorly preserved but clearly wider than high, subtrapezoidal and discontinuous; columella short, oblique, thickened and twisted; base almost flat, a little excavate; umbilicus shallow, narrowing rapidly and margined with a thin spiral fold. Spire whorls sculptured with about 12 narrow to wide, close set, gemmate spiral cords generally stronger and narrower on juvenile whorls; gemmae less prominent on adult whorls; selenizone relatively wide, at or slightly anterior to mid-whorl, occasionally located on a weak shoulder; beading posterior to selenizone shows clear prosocline alignment, anterior to selenizone, a corresponding very faint opisthocline alignment; spirals stronger anterior to selenizone, culminating in strong double cord on periphery; basal sculpture of up to 24 low, rounded, close spiral cords of irregular width; cords stronger toward umbilicus; umbilicus with single weak spiral fold.

Dimensions

	Height	Max. diameter	Whorls	Spire angle
WAM 80.637a, holotype	43 (est.)	41 (est.)	5+	60°
WAM 60.29, paratype, mould	74 (est.)	70 (est.)	6+	63°
WAM 60.68, mould	62 (est.)	55 (est.)	7+	55°
WAM 71.285, part-mould	45 (est.)	43 (est.)	6+	60°
WAM 80.637b, paratype	50 (est.)	50 (est.)	4+	60°
WAM 80.637c, paratype	38 (est.)	37 (est.)	4+	57°
WAM 80.690, paratype, part-mould	75 (est.)	74 (est.)	3+	59° (est.)
WAM 80.881, part-mould	45 (est.)	47 (est.)	3+	68°
WAM 83.2918, paratype	30 (est.)	31 (est.)	5+	62°
WAM 85.329, paratype	39 (est.)	39 (est.)	3+	64°
NMV P101866, paratype	24	28	3+	65°
NMV P101906, paratype	37	34	6+	65°

Because all specimens to hand have incomplete apices and apertures, some substantially so, all of the above heights and diameters are estimates of the presumed originals. The largest specimen to hand is an internal mould with estimated original height of 95 mm, width 93 mm. It is among the larger gastropods known from the Miria Formation.

Remarks

Assignment of the present species to *Conotomaria* is made with reservations as it appears to share few of the available characters with *Pleurotomaria mailleana* d'Orbigny, the type species of that genus (Cox, 1959, 1960b). However, our species recalls in general proportions several high-spired, trochiform species from the English Cenomanian (e.g., *Conotomaria percevali* Cox, *C. chardstockensis* Cox, on which the selenizone is said to be "almost at mid-whorl" and "*Pleurotomaria* (*Conotomaria*) sp. H", all of Cox, 1960b), differing in its more beaded sculpture and selenizone position. The latter character is shared with the associated *C. minacis* (see above, p. 11).

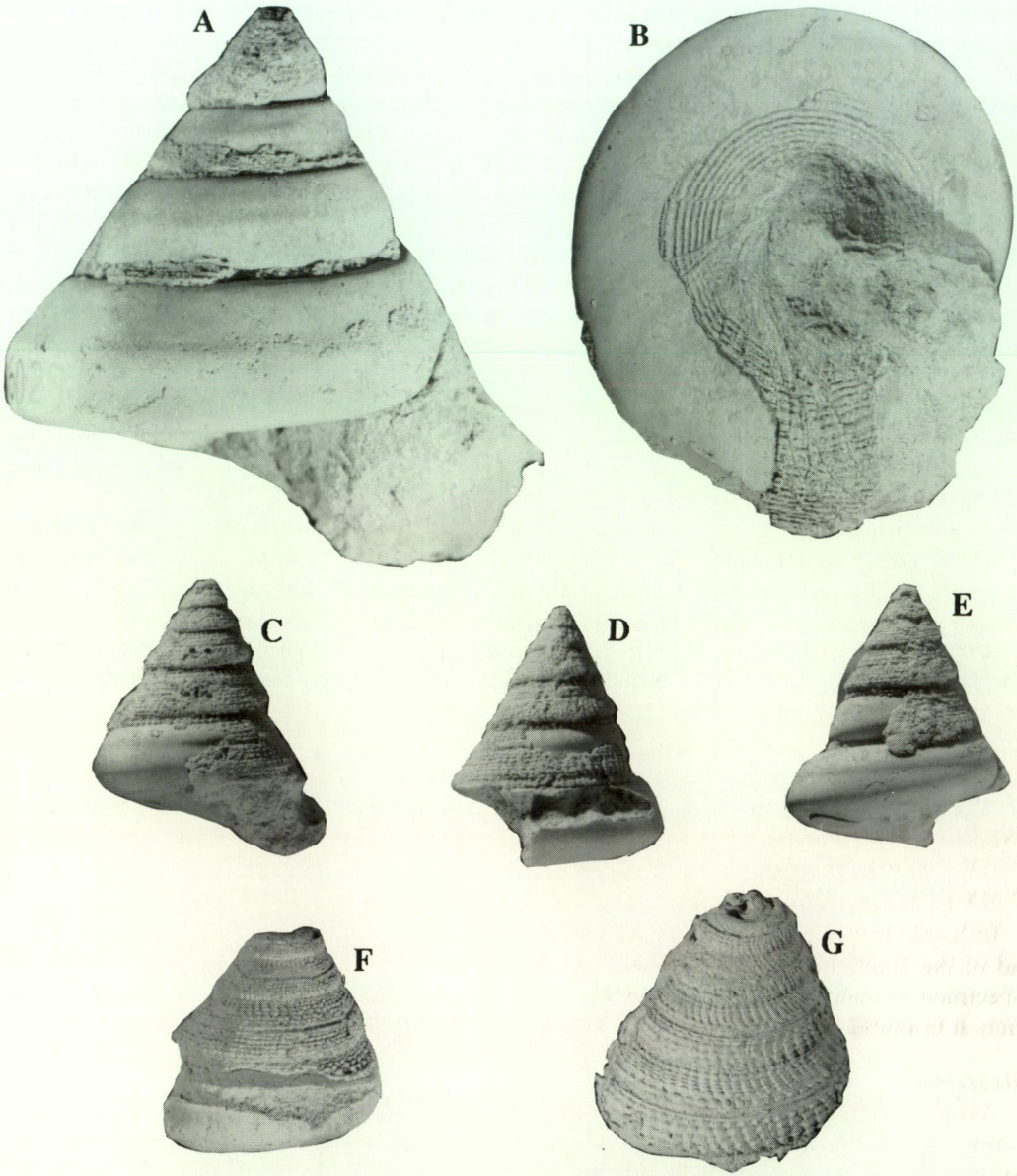

Figure 3 **A, B**, *Conotomaria* (?) *cypsela* sp. nov. WAM 60.29, paratype, locality 37, internal mould with shell remnants; **A**, apertural, x 1; **B**, basal, x 1.1. **C–G**, *Leptomaria perancisa* sp. nov. **C–E**, WAM 80.860, holotype, locality 18; **C**, apertural, x 1.1; **D**, 90° from aperture, x 1.1; **E**, 180° from aperture, x 1.1; **F**, WAM 83.3029, paratype, locality 47, 90° from aperture, x 1.2; **G**, WAM 86.1462, paratype, locality 30, latex cast of natural external mould in phosphatic nodule, x 1.2, camera positioned 90° to the plane of the spire surface.

From the French Aptian, two broadly comparable species are "*Pleurotomaria*" *matheroniana* d'Orbigny (d'Orbigny 1843: 264, 265, pl. 201, figs 1–4) and "*P.*" *fleuriausa* d'Orbigny (d'Orbigny 1843: 265, 266, pl. 201, figs 5, 6); the Miria species appears from the figures to be less granulose than the former and more so than the latter and with a less prominent selenizone. Comparable in proportions and selenizone position to the present species is *Conotomaria oshimensis* Kase (1984: 49, pl. 1, figs 2a–e) from the Aptian Hiraiga Formation of Miyako, northeastern Japan but it appears to lack the beading of *C. cypsela*. Much the same could be said also of "*Pleurotomaria*" *glabella* Stoliczka from the (probable) Cenomanian Utatur Group of South India (Stoliczka 1868: 386, pl. 25, figs 8, 9).

The above-mentioned species and probably others appear to share a distinctive morphology which is not recognised adequately in the current classification of the family and which may prove to have phylogenetic and taxonomic validity. Such a question may be worth consideration in a future revision of the Mesozoic pleurotomariids, a subject beyond the scope of this paper.

Etheridge (1909: 239–240, pl. 68) recorded pleurotomariid internal moulds (as *Leptomaria* ? sp.) from the Early Cretaceous of Queensland. Though poorly preserved, these specimens are proportioned not unlike some of the present material, e.g., WAM 85.329.

A phosphatised and incomplete internal mould (WAM 78.3675) of 1.5 gently convex whorls and maximum diameter 43 mm from the Santonian Gingin Chalk of Dandaragan recalls in shape some of the specimens in the study material and may be related. Confirmation of this would require the obtaining of better specimens from the Chalk.

Conotomaria cypsela, though nowhere common, is distributed generally along the outcrop of the Miria Formation in the Giralia Range. Most specimens occur as fragmentary internal moulds with or without shell remnants.

Etymology

The specific name, which incorporates that of the type locality, is derived from the Greek *kypsele*, a hollow vessel.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Genus *Leptomaria* Eudes-Deslongchamps, 1864

Type species

Pleurotomaria amoena Eudes-Deslongchamps, 1864, by original designation.

Leptomaria perancisa sp. nov.

(Figures 3 C–G)

Holotype

WAM 80.860. From 3 to 6 km NNW of Whitlock Dam, Giralia Range, Giralia station; float from head and left bank of gully that flows down to Coronation Bore (KV 115812–115832).

Paratypes

WAM 86.1462, 83.3029; 1 external mould and 1 other specimen. NMV P101589, P101727; 2 specimens.

Other material

WAM 83.3048, 86.1461; 2 specimens. NMV P101664, P101696, P101873–4, P102009, P102329, P102373–4; 8 specimens. UWA 91482; 1 specimen.

Diagnosis

A small thin-shelled *Leptomaria*, higher than wide; basal periphery carinate; sculpture of fine, close axial and spiral cords, gemmate at their intersections; selenizone at mid-whorl, incised. Differs from "*Pleurotomaria*" *glabella* Stoliczka, 1868 by its stronger beaded sculpture and incised selenizone; from *Conotomaria cypsela* (this paper) by its more elevated spire, prominently beaded sculpture and incised selenizone.

Description

Shell small, thin, conical-trochiform, higher than wide; spire angle 54°–69°, increasing with growth; early whorls flat to slightly concave, becoming slightly convex in maturity; periphery at base and carinate; plane of attachment located just below periphery, producing an overhang above suture; base slightly convex across whorl; umbilicus open, narrow; aperture not preserved but evidently wider than high and discontinuous. Sculpture of fine, close spiral and axial cords, gemmate at points of intersection; axials a little more prominent than spirals, prosocline posterior to selenizone, opisthocline anterior to selenizone; six to eight spirals anterior and five to six posterior to selenizone; selenizone incised conspicuously at mid-whorl; sculpture of numerous low, close, spiral cords across base.

Dimensions

	Height	Max. diameter	Whorls	Spire angle
WAM 80.860, holotype	34.5 (est.)	30.5 (est.)	6+	55°
WAM 83.3029, paratype	33 (est.)	32 (est.)	4+	67°
WAM 83.3048	36 (est.)	36+ (est.)	5+	–
NMV P101589, paratype	28 (est.)	33 (est.)	8 (est.)	58°
NMV P101664	33 (est.)	34 (est.)	6 (est.)	69°
NMV P101727, paratype	31 (est.)	32 (est.)	6+	62°
UWA 91457	26 (est.)	25 (est.)	5+	59°

All apices and apertures are incomplete and the dimensions above are estimates of the original values. WAM 83.3048 is deformed; the given diameter is probably a little excessive and the spire angle has not been measured.

Remarks

The species is referred to *Leptomaria* Eudes-Deslongchamps with reservations in view of its carinate periphery, which is not a feature of the type species of that genus and rather more suggestive of *Conotomaria* Cox. However, several of the species assigned to *Leptomaria* by Cox (1960b) are said to be peripherally "subcarinate" to "sharply carinate"; the present species differs from all of these in its smaller spire angle, incised selenizone and gemmate sculpture. *Leptomaria perancisa* resembles the associated *Conotomaria cypsela* Darragh and Kendrick but differs in its more elevated spire, incised selenizone and finely gemmate sculpture. WAM 86.1462 is an external mould in a phosphatic nodule and the cast (Figure

3G) gives a good idea of the original sculpture of the later whorls. In general form, the species is not unlike "*Pleurotomaria*" *glabella* Stoliczka from the Utatur Group of South India (Stoliczka 1868: 386, pl. 25, figs 8, 9) but differs in its beaded sculpture and incised selenizone.

Leptomaria perancisa is an uncommon species, thinly distributed along the outcrop of the Miria Formation in the Giralia Range.

Etymology

The specific name is from the Latin *per*, and *ancisa*, cut around (feminine), referring to the prominently incised selenizone.

Stratigraphic Range

Nodule bed at contact of the Korojon Calcarenite and Miria Formation; Miria Formation. Maastrichtian.

Superfamily Trochoidea Rafinesque, 1815
Family Turbinidae Rafinesque, 1815
Subfamily Angariinae Thiele, 1924
Genus *Nododelphinula* Cossmann, 1916

Helicacanthus Dacqué in Wenz, 1938 (pro *Metacanthus* Dacqué, 1936, non Costa, 1847).

Type species

Delphinula buckmani Morris and Lycett, 1851, by original designation.

Remarks

We follow the systematic arrangement of Hickman and McLean (1990: 41) in locating *Nododelphinula* Cossmann within the subfamily Angariinae of the family Turbinidae.

Kase (1984) synonymised *Helicacanthus* with *Nododelphinula* because the features of the umbilicus and sculpture thought to separate the two, in fact, intergraded. Our species supports this interpretation, since it lacks prominent axial sculpture on the adult whorls and has a prominent bicarinate, gradate spire like *Helicacanthus* but also a wide umbilicus as in *Nododelphinula*; the apertural features seem to be identical with those of the type species of *Nododelphinula*.

Nododelphinula dracontis sp. nov.

(Figures 4 A–C)

Holotype

WAM 83.2874a. From gullies draining south, 0.4 km south of the northern boundary of Bungarra Paddock, Giralia Range, Giralia station (KV 160870).

Paratypes

WAM G10584, 80.636a–l, 86.1457, 87.321; 15 specimens. NMV P102231; 1 specimen.

Other material

WAM G10585, 60.26, 71.194, 71.262, 71.284, 71.302, 71.303, 80.752, 80.859, 80.880, 83.2874b,c, 83.2892, 83.2899, 83.2955, 83.2970, 83.2976, 83.2984, 83.3005, 83.3021, 83.3033, 83.3047, 83.3060,

83.3086, 83.3151, 83.3157, 84.712, 84.726, 89.1275, 92.265; 74 specimens. NMV P98244–7, P98306, P101562–3, P101575–6, P101593–4, P101599, P101638, P101652–4, P101658–62, P101713–7, P101733, P101875–9, P101904, P101931, P101941–2, P101946–7, P101949, P101962–4, P102022–9, P102099–100, P102230–6, P102285–6, P102312–3, P102354, P102358, P102380–3, P119513–5, P119539, P119579–83; 79 specimens. UWA 21156, 91457, NW141; 6 specimens. GSWA F9368, F9388, 30083; 7 specimens.

Diagnosis

A large *Nododelphinula* with an elevated, gradate spire and strongly bicarinate whorls; sculpture of gemmate spiral cords which are fine and close on the spire, strong and spaced on the base. Differs from *N. buckmani* (Morris and Lycett, 1851) by its greater height relative to width and absence of nodose sculpture; from *N. thurmani* (Pictet and Campiche, 1868), differs in its greater relative height, weaker anterior keel, fewer basal spirals and larger umbilicus.

Description

Shell large and somewhat elevated for genus, thin, turbiniform, higher than wide (ratio of 1.2–1.4); spire moderately elevated, gradate; whorls bicarinate, adapical and stronger keel forming periphery; plane of attachment immediately below abapical keel making both keels visible on spire; suture linear, a little adpressed; subsutural ramp wide, descending, flat or slightly concave, bearing five to nine fine, spaced, gemmate cords; a stronger beaded cord lies immediately adapical to gemmate peripheral keel; outer face of whorl concave, with up to eight fine, beaded spirals of variable strengths; lower keel a little weaker than upper and finely gemmate; base convexly rounded, bearing four to eight strong, spaced, gemmate spiral cords; umbilicus open, of medium size, smooth apart from very fine growth striae, spirally twisted and, in mature specimens, opening onto a wide, spiralled groove, terminating at columellar margin; aperture rarely preserved intact, subcircular, discontinuous, outer lip prosocline and apparently without thickening (internal or external); columella concavely curved, slightly thickened and reflected a little over umbilical groove; callus thin, extending across parietal area of mature specimens; protoconch deviated, smooth, of about one whorl; post-embryonic sculpture usually not well preserved but apparently comprising axial ribs covering 1¼ whorls followed by development of spiral cords (anticipating adult sculpture) beaded where crossed by axials; axials becoming obsolete by about fourth teleoconch whorl but beading persisting on spirals; entire external surface of exceptionally well-preserved specimens with a microsculpture of fine, close, prosocline, colabral striae. Internal moulds bear two angulate shoulders corresponding to keels of external sculpture; likewise, basal mould ribbed spirally.

Dimensions

	Height	Max. diameter	Whorls	Spire angle
WAM 83.2874a, holotype	35 (est.)	25.9	4.5+	54°
WAM G10584, paratype	28 (est.)	23 (est.)	4+	56°
WAM 80.636g, paratype	36 (est.)	27 (est.)	5.5+	56°
WAM 87.321, paratype	35 (est.)	26.8	4.5+	54°
WAM 80.859*	42 (est.)	28.5	5+	49°
NMV P102231, paratype	29 (est.)	22.5	5+	55°

* The largest known specimen to hand.

Remarks

Related species include *N. leblancii* d'Archiac from the Cenomanian of Tournai, Belgium (d'Archiac 1846: 339, pl. 23, fig. 8a–c), which is somewhat similar in shape to the present species but has more prominent nodules on the spiral sculpture. *N. guerangeri* (d'Orbigny, 1843) from the Cenomanian of Mans, France (d'Orbigny 1843: 226, pl. 186b, figs 1,2) and Albian of Losenstein, Austria is somewhat similar in sculpture but the spire is lower and umbilicus smaller than on our species, which also has fewer basal spirals.

As noted above, *N. dracontis* is similar in shape and sculpture to *N. thurmani* but has a developed umbilicus more like *N. buckmani*. The genus is represented in the Aptian-Albian of Japan by *N. hiraigensis* Kase (Kase 1984: 100–101, pl. 11, figs 13–16) but that species differs substantially from *N. dracontis* in proportions, sculpture and umbilical characters. No other congener has been recognised in the Cretaceous basins of the Pacific and Indian Ocean margins; however a specimen assigned to the related genus *Trochacanthus* Dacqué is reported from the Late Neocomian – ? Early Aptian Nanutarra Formation of the Carnarvon Basin by Cox (1961: 31, pl. 7, fig. 1).

Variation in the present species appears to be limited to minor differences in the height to width ratio and in the number of spiral cords on the whorls and base.

N. dracontis is a common species, often well-preserved, along the entire outcrop of the Miria Formation in the Giralia Range.

Etymology

The specific name is derived from the Greek *drakon*, a fabulous lizard-like animal, alluding to the station paddock where the type locality is situated.

Stratigraphic Range

Nodule bed at contact of the Korojon Calcarenite and Miria Formation; Miria Formation. Maastrichtian. This appears to be the first confirmed record of the genus from the Maastrichtian and Late Cretaceous.

Genus *Hainaspira* Kase, 1984

Type species

Delphinula annularis Stoliczka, 1868, by original designation.

Hainaspira sp.

(Figures 4 D, E)

Material

WAM 71.263, 80.638; 3 specimens. NMV P101598; 1 specimen.

Description

Shell small for genus, robust, conical-turbiniform, diameter slightly exceeding height; spire gradate; whorls convex, bicarinate or tricarinate and with well-formed subsutural ramp, bounded by strong carination; a second carina forming periphery; a third weaker carina, if

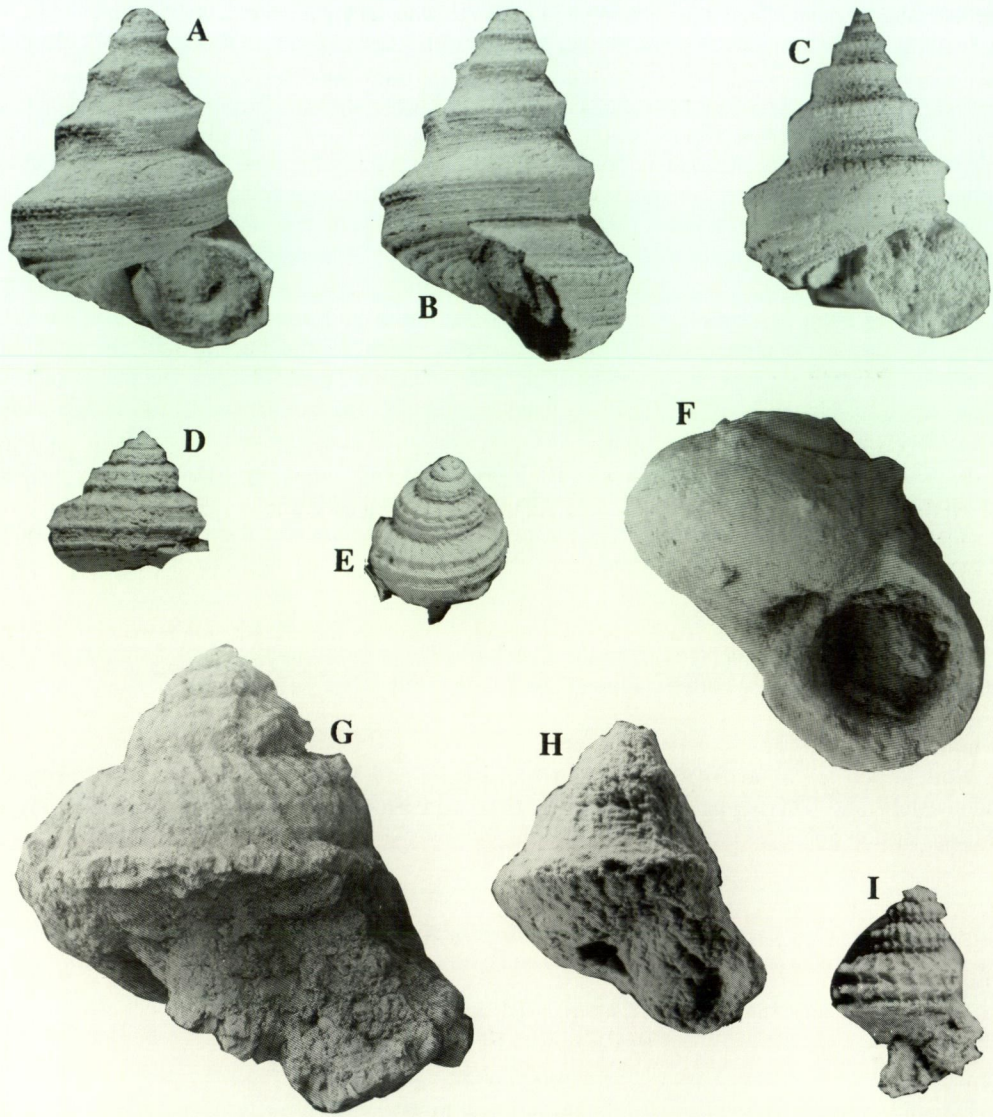

Figure 4 **A–C**, *Nododelphinula dracontis* sp. nov. **A, B**, WAM 83.2874a, holotype, locality 17; **A**, apertural, x 1.4; **B**, oblique to aperture showing prosocline outer lip, x 1.4; **C**, WAM 86.1457, paratype, locality 17 (approx.). apertural, x 1.5. **D, E**, *Hainaspira* sp. **D**, WAM 80.638a, locality 26, 180° from aperture, x 3.3; **E**, NMV P101598, locality 27 (approx.), camera positioned 90° to plane of spire surface, 180° from aperture, x 3.3. **F**, *Boutillieria* (?) sp. WAM 85.53, locality 26, apertural, x 25.5. **G**, Trochid, genus and species undetermined, WAM 80.641, locality 26, apertural, x 29; **H**, Trochoidean, family and genus undetermined, species A, WAM 83.3088, locality 13, apertural, x 1.8. **I**, Trochoidean, family and genus undetermined, species B, WAM 80.640, locality 26, apertural, x 5.3.

present, anterior to plane of attachment defining base; sutures impressed; aperture poorly defined, a little wider than high, obliquely descending and slightly reflected over moderately wide umbilicus; base convexly rounded, passing evenly without a rib or carination into umbilicus; spire whorls axially plicate, about 25 prosocline plicae on last whorl, nodulate at intersections with carinae and fading anteriorly; microsculpture of very fine close spiral threads present over entire spire; basal sculpture of obscure, thin to very thin close spiral threads.

Dimensions

	Height	Max. diameter	Whorls
WAM 71.263	6 (est.)	6 (est.)	5 (est.)
WAM 80.638a	7 (est.)	8 (est.)	6 (est.)

Remarks

The material to hand appears to be all incomplete, juvenile specimens, on which the full suite of mature characters are probably undeveloped. All apices are missing and the last whorls are either incomplete or missing. The primary spiral sculpture of the Miria form is not as strong as that of *H. annularis* (Stoliczka), the type species of the genus but the limited nature of the material does not allow a more detailed comparison. The present species may be new but further determination requires access to better material.

Kase (1984) distinguished *Hainaspira* from *Nododelphinula* Cossmann by its "larger shell size, horizontal or weakly excavated shoulder and spirally ornamented and rounded whorl sides." When available, mature specimens of the present species should be compared with *Nododelphinula* and also with the related genus *Trochacanthus* Dacqué.

Kase (1984) gives a synonymy for *H. annularis* (Stoliczka) and assigns to his genus species from Japan, South India, Malagasy, The Levant, France, England, Texas and Mexico with a stratigraphic range of Aptian to Turonian. The Miria record now extends the range of the genus to the Maastrichtian.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Subfamily Colloniinae Cossmann, 1916

Genus *Boutillieria* Cossmann, 1888

Type species

Turbo eugenei Deshayes, 1863, by original designation.

Boutillieria (?) sp.

(Figure 4 F)

Material

WAM 85.53; 1 specimen.

Description

Shell minute (possibly juvenile), solid, depressed-conical; wider than high; spire short, cyrtoconoid, of few whorls; suture linear; periphery convexly rounded; last whorl relatively large; aperture circular, continuous, effusely expanded around the basal margin; columella short, curved and thickened where it merges into the basal margin; umbilical fissure very small, without an associated callus; base convexly rounded; protoconch poorly preserved; spire whorls apparently smooth but suggestion of faint spiral striae below suture on last whorl; outer face of whorls and base apparently smooth.

Dimensions

	Height	Max. diameter	Whorls
WAM 85.53	1.2	2.0	ca. 2.5

Remarks

The genus, sometimes regarded as a subgenus of *Homalopoma* Carpenter, 1864 is distinguished from that by its reduced spiral sculpture and anteriorly expanded aperture. The type species, *Boutillieria eugenei* (Deshayes, 1863), from the Eocene of the Paris Basin, has been refigured by Hickman and McLean (1990, fig. 17E); their specimen shows much weaker spiral sculpture than those of that species in Cossmann and Pissarro (1910, pl. 3, fig. 23–1) and in Keen (in Moore 1960, p. 1271, fig. 174–3).

The Miria specimen is very small and resembles that figured by Hickman and McLean (1990). It lacks the strong parietal callus characteristic of *Teinostoma* H. and A. Adams but this aspect requires confirmation from other more mature specimens when these become available. From "*Teinostoma*" *cretacea* (d'Orbigny, 1847) as figured by Stoliczka (1868: 350, pl. 25, fig. 7) from the Campanian-Maastrichtian Ariyalur Group of South India, the Miria species differs in its more elevated spire and rounded periphery.

This rare species was picked from sediment screenings.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Family Trochidae Rafinesque, 1815

Trochid, genus and species undetermined

(Figure 4 G)

Material

WAM 80.641; 1 specimen.

Description

Shell minute, probably juvenile, thin, conical-turbiniform with moderately elevated spire; spire angle about 70°; whorls rounded with narrow subsutural shelf and adjacent rounded shoulder and peripheral angulation at base, corresponding to plane of attachment; outer face almost flat; aperture poorly preserved; columella oblique, thickened, reflected a little over

umbilicus; base convex; umbilicus open, bounded by weak angulation; sculpture obscure, possibly of faint growth striae.

Dimensions

	Height	Max. diameter	Whorls
WAM 80.641	2.2	2.5	3.8

Remarks

Determination of this very small specimen is deferred until a better range of material becomes available. The whorl profile and open umbilicus suggest a possible location in the Gibbulinae.

The specimen was among a suite of small gastropods picked from screened sediment samples.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Trochoidean, family and genus undetermined, species A

(Figure 4 H)

Material

WAM 80.639?, 83.3088; 1 or 2 specimens. NMV P101728; 1 specimen.

Description

Shell of medium size, trochiform, higher than wide; spire height a little in excess of half total height; spire angle 62°; whorls concave, periphery basal, angulate, forming a flange-like projection over subsequent whorl; sutures lightly impressed, plane of attachment located anterior to peripheral flange; base convexly rounded; umbilicus possibly open; aperture roundly subangular, descending, higher than wide, outer lip probably prosocline; sculpture of spire whorls of about eight spiral cords overlain by low, spaced, prosocline, axial folds, forming cancellate pattern; basal sculpture poorly preserved but comprising weak axial and granose, spiral elements.

Dimensions

	Height	Max. diameter	Whorls
WAM 83.3088	26 (est.)	21.0	5+
NMV P101728	38 (est.)	21.2*	4+

* diameter of mould without the shell.

Remarks

Poor preservation of the few available specimens precludes assignment to any genus or even family of the Trochoidea. WAM specimen 83.3088 retains most of the spire and last whorls but the apertural and umbilical characters are poorly preserved and the specimen has been

deformed by sediment compaction. WAM specimen 80.639 is a juvenile (3.8 x 3.3 mm) and referred to this species with reservation. NMV specimen P101728 in an internal mould with only a few shell remnants on the spire.

A location in the trochid genus *Tectus* Montfort, 1810 seems possible but further determination of this species must await the collection of additional material.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Trochoidean, family and genus undetermined, species B

(Figure 4 I)

Material

WAM 80.640; 1 specimen.

Description

Shell small, probably juvenile, higher than wide; spire a little elevated, gradate; whorls convexly rounded, sutures deeply impressed; whorls with broad, inclined, subsutural ramp; outer face with two strong, spaced, spiral ribs, adapical one slightly more prominent and forming periphery; base bounded by a finer, beaded, spiral cord located along plane of attachment; thin axial costae crossing whorls, forming strong erect scales at intersections with two principal spirals; aperture poorly preserved; columella thickened, concave; apical whorls missing.

Dimensions

	Height	Max. diameter	Whorls
WAM 80.640	6 (est.)	4.1	4.5+

Remarks

This little shell appears to be the juvenile of a trochoidean species not otherwise known from the Miria Formation. Further material is required for positive determination. The specimen was picked from sediment screenings.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Superorder Caenogastropoda Cox, 1960

Order Neotaenioglossa Haller, 1892

Superfamily Cerithioidea Fleming, 1822

Family Procerithiidae Cossmann, 1906

Subfamily Paracerithiinae Cossmann, 1906

Genus *Cirsocerithium* Cossmann, 1906

Type species

Cerithium subspinosum d'Orbigny, 1843 = *Cerithium subspinosum* Deshayes, 1842, by original designation.

Remarks

The genus *Cirsocerithium* has been recorded from the Aptian to Cenomanian of France, England, Germany, Austria, Algeria, Malagasy and Japan (Abbass 1973; Kollmann 1979; Kase 1984). A species, apparently undescribed and comparable with *C. gracile* (J. de C. Sowerby, 1813), occurs in the Cenomanian of the Utatur Group of South India (G.W. Kendrick, unpublished data).

Cirsocerithium sp.

(Figures 5 A,B)

Material

WAM 80.643, 83.2891; 8 specimens.

Description

Shell small with elevated spire; whorls convexly rounded below broad, inclined subsutural ramp; apparently without varices; sutures impressed; apex missing on all specimens; aperture poorly preserved, apparently subcircular; parietal lip with spreading callus; columellar lip short, straight; outer lip rounded and thickened externally by a small varix; base rounded; umbilicus small, partly covered by parietal callus; spire whorls sculptured with four granose spiral cords; first cord anterior to suture on ramp, thin strongly beaded; second cord anterior to suture, on edge of ramp, strongest; fourth cord with weak or absent granulation; last whorl with six or seven cords, becoming obsolete anteriorly.

Dimensions

	Height	Max. diameter	Whorls
WAM 83.2891	11 (est.)	5.4	6+

Remarks

The Miria specimens have a weaker whorl shoulder and also lack the rugose axials of *Cirsocerithium subspinosum* (Deshayes) from the English Albian, type species of the genus (see Abbass 1973: 119–120, pl. 2, figs 1, 2). *C. reticulatum* (Nagao, 1934) from the Aptian of Japan (Kase 1984: 131–132, pl. 20, figs 12–13) has more prominent spiral cords, crossed by axial costae. In overall appearance, the present species approaches *C. lallierianum* (d'Orbigny, 1843) from the French Albian (Cossmann 1906: 194, pl. 6, figs 32–36) but differs in its fewer cords (particularly on the adapical surface of the whorls), lack of strong axial sculpture and more prominent shoulder.

The present species appears to be undescribed but the incomplete nature of the material makes it unsuitable at present for further determination. The specimens are not obviously abraded and it seems possible that their breakage is due to crab predation. Most specimens have been obtained by screening of the lower, calcarenite unit of the Formation.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Subject to confirmation from further material, the present record would appear to be the first for the genus from the Maastrichtian.

Subfamily Metacerithiinae Cossmann, 1906
Genus *Cimolithium* Cossmann, 1906

Type species
Cerithium belgicum Munster, 1844, by original designation.

Cimolithium (?) sp.
(Figures 5 C, D)

Material
WAM 83.2919; 1 specimen.

Description
Shell small, elevated, slender, turriculate, lacking apex and part of last whorl; spire angle 15°; whorls a little concave medially, slightly convex both anterior and posterior to slightly undulating sutures, particularly the former; aperture poorly preserved but evidently ovate, oblique, higher than wide; parietal and columellar callus present; no columellar plaits visible; non-umbilicate; mould suggests neither anterior canal nor internal varix on outer lip. Sculpture of numerous narrow, spaced slightly prosocline, axial costae, about 15 on last whorl; some axials aligned from whorl to whorl and all enlarged immediately posterior and anterior to sutures; weak tubercles present on some axials immediately anterior to sutures; no varices evident; secondary sculpture of fine, close spiral threads, about 22 on penultimate whorl, and faint, slightly sigmoidal growth striae.

Dimensions

	Height	Max. diameter	Whorls
WAM 83.2919	38 (est.)	11 (est.)	6.5+

Remarks
Discussing the genus, Abbass (1973: 138) remarks that, "Only the type species *C. belgicum* (Munster), 1844, [sic.] of those listed by Cossmann (1906: 58) in his original description of *Cimolithium* can still be included in this genus with certainty" and reservations persist as to its true familial location, a consequence of the rarity and imperfect preservation of most of the relevant material. The present species, represented by one incomplete specimen, adds nothing toward the resolution of these uncertainties.

Our material is assigned to *Cimolithium* from its resemblance to a specimen from the Cenomanian of Devon, determined by Abbass (1973: 140–141, pl. 2, fig. 5) as *Cimolithium* aff. *eleanorae* Allison, 1955. The Miria specimen differs from that of Abbass in its less stepped, more slender whorl profile and much weaker nodosity on the axials anterior to the sutures; a congeneric relationship of the two appears likely. *C. eleanorae* is from the Albian of Mexico; the holotype has a distinct anterior canal (Allison 1955: 419, pl. 42, fig. 4).

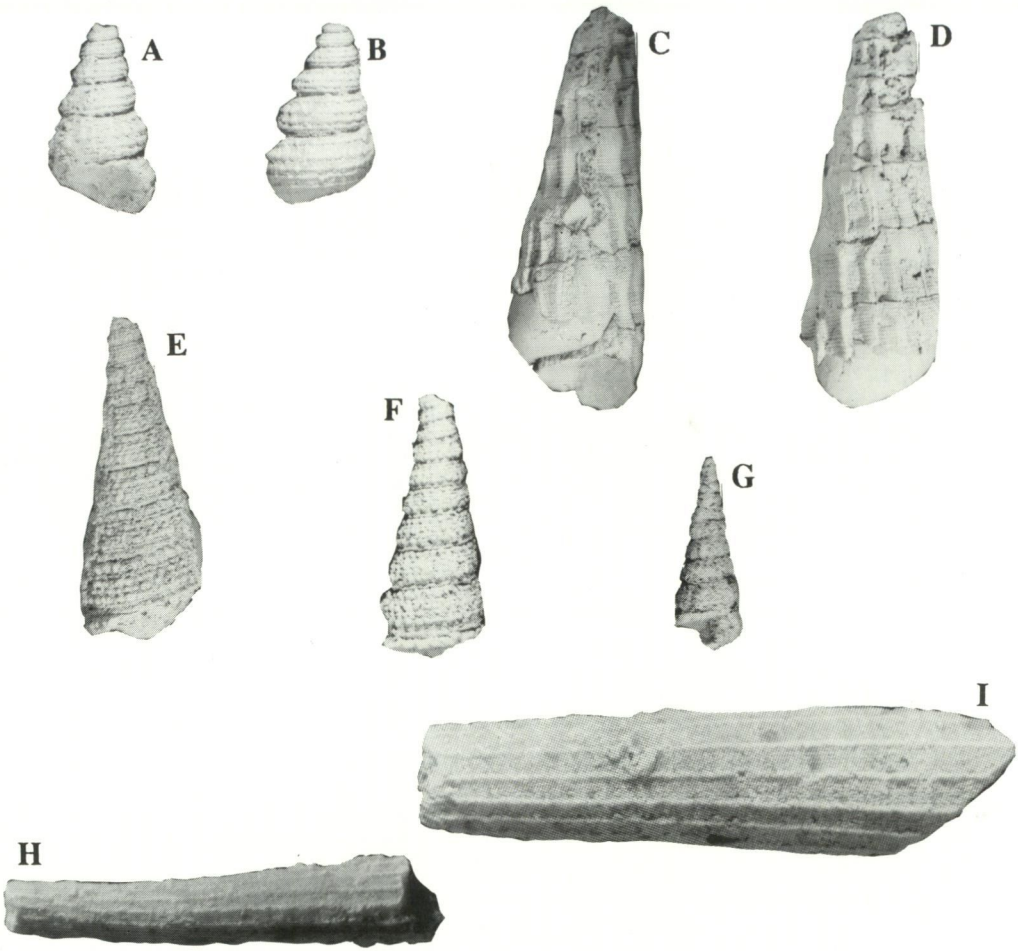

Figure 5 **A, B**, *Cirsocerithium* sp. WAM 83.2891, locality 15; **A**, apertural, x 2.8; **B**, 180° from aperture, x 2.8. **C, D**, *Cimolithium* (?) sp. WAM 83.2919, locality 48; **C**, apertural, x 1.8; **D**, 180° from aperture, x 1.9; **E, F**, Cerithioidean, family and genus undetermined, species A; **E**, WAM 92.266, locality 13, deformed specimen lacking aperture, x 1.8; **F**, WAM 80.644a, locality 26, specimen slightly deformed but with better preserved sculpture than E, x 2.4. **G**, Cerithioidean, family and genus undetermined, species B WAM 80.642a, locality 26, apertural, x 2.2. **H, I**, *Dentalium (Dentalium)* sp. WAM 80.647, locality 26, shell fragments; **H**, near-apical portion, x 8.3; **I**, near-apertural portion, x 8.2.

The identity and affinities of the present species remain speculative until further better specimens come to hand.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Superfamily Cerithioidea Fleming, 1822

Cerithioidean, family and genus undetermined, species A

(Figures 5 E, F)

Material

WAM 80.644, 92.266; 3 specimens.

Description

Shells small to medium in size, all lacking apices and apertures; spire turriculate, the angle 20°; whorls moderately convex; sutures impressed; brephic sculpture of two primary, spiral cords noded at intersections of low, axial costae; spirals increasing with growth, up to seven in number and prominently beaded on a specimen with estimated original height of 28 mm; cord adapical to anterior suture more finely beaded than those posterior to it; microsculpture of fine, close spiral threads; no varices apparent.

Dimensions

	Height	Max. diameter	Whorls
WAM 80.644	20 (est.)	6	8.5+
WAM 92.266	30 (est.)	8 (est.)	10.5+

The largest specimen to hand, WAM 92.266, is deformed by compaction; the estimated diameter is the mean of the greater and lesser diameters.

Remarks

The sculpture of this rare species is not unlike that of a number of cerithioidean taxa, for example *Potamides cowickeensis* Sohl, 1964, from the Upper Cretaceous Coffee Sands of Mississippi (Sohl 1964b: 363–364, pl. 53, figs 10–16) but further comparison seems futile without knowledge of the apertural characters. Specimens WAM 80.644 were obtained by screening the lower calcarenite unit of the Formation.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Cerithioidean, family and genus undetermined, species B.

(Figure 5 G)

Material

WAM 80.642; 3 specimens.

Description

Shell small, probably juvenile, anterior whorl(s) missing, apex almost intact on one specimen; spire turriculate, slightly coeloconoid; spire angle 17°; whorls slightly convex, periphery anterior to mid-whorl; aperture poorly indicated, probably subcircular; columella short, thickened, possibly with narrow anterior canal; small, irregularly spaced varices on spire from about sixth whorl; sculpture of low axial folds, about 16 per whorl, crossed by fine, close spiral threads.

Dimensions

	Height	Max. diameter	Whorls
WAM 80.642a	14(est.)	4.0	10+

Remarks

The specimens recall an immature potamidid such as of the genus *Pyrazus* Montfort, 1810. All are worn and fragmentary and lack diagnostic characters of any of the cerithioid families. Further determination requires better, additional material. The specimens were picked from sediment screenings.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Superfamily Stromboidea Rafinesque, 1815
Family Aporrhaidae Gray, 1850
Aporrhaid (?), genus and species undetermined

(Figures 6 A, B)

Material

WAM 83.3023, 87.310; 2 specimens. GSWA F30083; 1 specimen.

Description

Shell of medium size, robust, fusiform and slightly compressed dorso-ventrally; spire elevated-conical, about equal to half total height and slightly concave in profile; spire angle 40°; whorls slightly convex; sutures linear, adpressed; aperture poorly preserved but somewhat higher than wide, oblique to shell axis; columella thickened, spirally twisted, smooth and produced anteriorly; outer lip possibly sinuate; basal lip not retained; apex missing; shell surface apparently smooth with little or no sculpture.

Dimensions

	Height	Max. diameter	Whorls
WAM 83.3023	53 (est.)	21	4+
WAM 87.310	55 (est.)	22	2.5+
GSWA F30083	66 (est.)	28	4+

Remarks

It is with some reservations that we assign this material to the Aporrhaidae, its preservation, particularly in the apertural area, being so poor. However, we can see no more likely location for the species and this may suffice for the present.

The general shell form and the few apertural characters available suggest a possible affinity with the strombid genus *Hippochrenes* Montfort, 1810; if so, all of the specimens would be immature, lacking the expanded outer lip of the adult shell. It is possible that the slight dorso-ventral flattening noted on GSWA F30083 and WAM 87.310 is a consequence of sediment compaction; alternatively, this might be viewed as evidence supporting a strombid affinity. Further material is essential to clarify the identity of this rather rare species.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Superfamily Xenophoroidea Troschel, 1852
Family Xenophoridae Troschel, 1852

Genus *Xenophora* Fischer von Waldheim, 1807

Type species

Xenophora laevigata Fischer von Waldheim, 1807 (ICZN Opinion 715 (1964) (= *Trochus conchyliophorus* Born, 1780), by subsequent designation of Harris 1897.

Subgenus *Xenophora* sensu stricto
Xenophora (Xenophora) sp.

(Figures 6 C–F; 7 A–C)

Xenophora sp. Ponder, 1983: 29–30, figs 18g–i.

Material

WAM 60.30, 71.304, 80.825, 80.861, 80.954, 83.2875, 83.2886, 83.2901, 83.2931, 83.3049, 83.3072, 83.3089, 85.600, 92.267; 18 specimens. NMV P97579, P101532–3, P101541, P101573, P101688–9, P101720, P101892, P101970, P101973, P102030, P102031, P102293, P102365, P102377, P119695; 17 specimens.

Description

Shell (and mould) moderately large for family, conical–trochiform, wider than high, of about six or seven rapidly enlarging, spreading, convex whorls, each slightly overhanging the succeeding whorl; spire short, gradate, spire angle 65°–76° (adult), up to 92° in juveniles; periphery basal, descending, outline somewhat irregular; base concave, apparently non-umbilicate in adult, possibly narrowly umbilicate when immature (WAM 83.3072); aperture poorly indicated but clearly wider than high, oblique, columellar lip short, thickened and rounded.

Dorsal surface of last whorl sculptured apparently with uneven, irregular, prosocline (? co-labral) growth ridges, crossed by fine, close-set, undulating spiral threads (WAM 85.600);

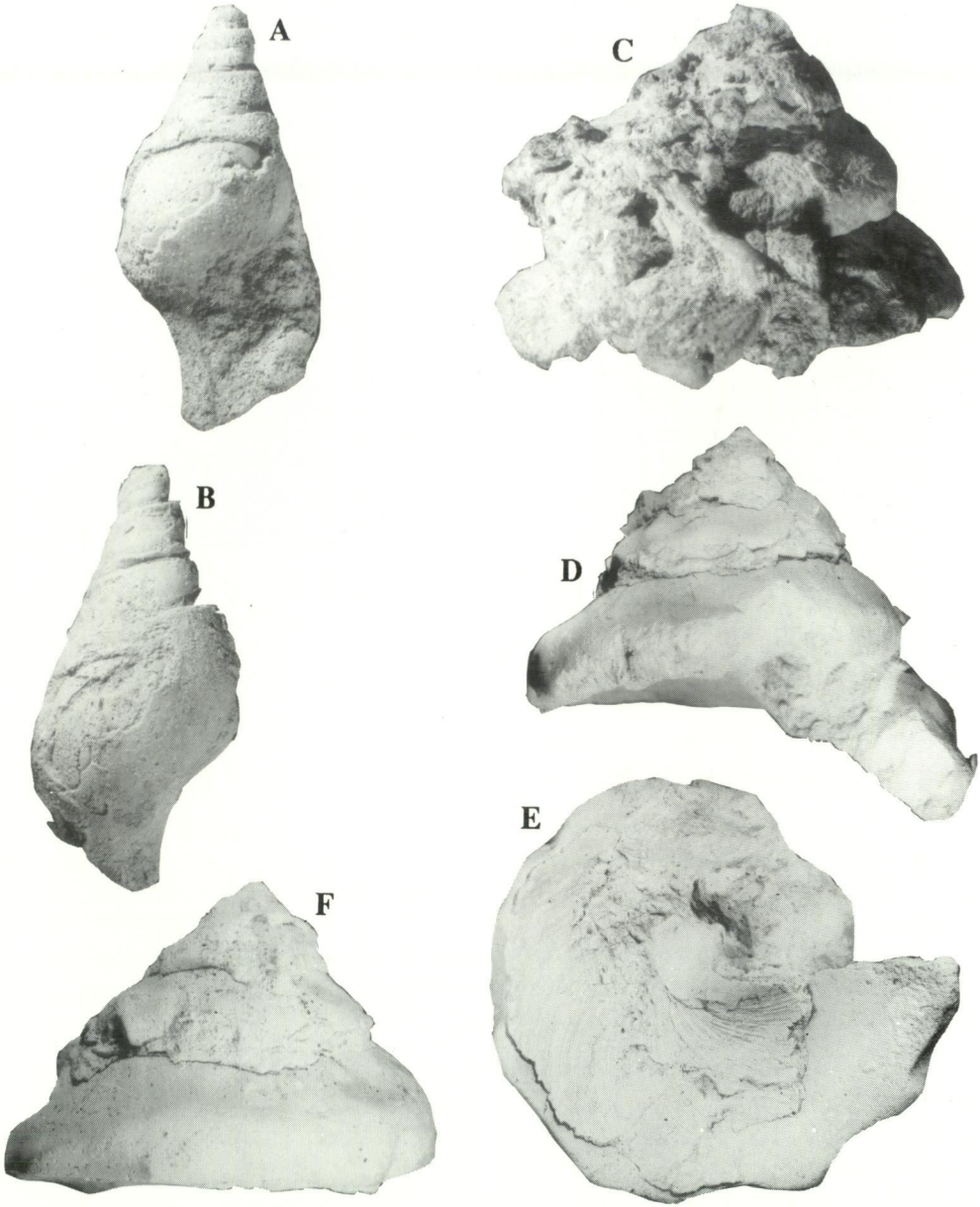

Figure 6 **A, B**, Aporrhaid (?), genus and species undetermined, GSWA F30083, locality 43; **A**, apertural, x 1; **B**, 180° from aperture, x 1. **C–F**, *Xenophora (Xenophora)* sp. **C**, WAM 92.267, locality 13, internal mould with phosphatic adhesions and two attached inoceramid fragments, 90° from aperture, x 0.75; **D–F**, NMV P101533, locality 49, internal mould with shell remnants, mainly on the base; **D**, apertural, x 1; **E**, basal, x 1; **F**, 180° from aperture, x 0.9.

areas of randomly aligned, sub-parallel ribbing and other marks on spire whorls apparently represent impressions of attached bivalve shell fragments (e.g. Inoceramidae), pebbles and ammonite internal moulds. Basal sculpture of shell (from NMV P101533) of prominent, fine, close colabral growth lines, crossed by very fine, irregular, discontinuous and more or less radial threads; spiral rib closely encircling umbilical area of some specimens (absent on others), evidently a feature of base near apertural lip; internal mould showing weak, circumbilical "rib", corresponding to external rib of shell base and abaxial to "rib", (on mature specimens only) a deep spiral groove; weak internal basal ribs around centre of base on some moulds indicated by several spaced, shallow, spiral grooves.

Dimensions

	Height	Max. diameter	Whorls	Spire angle
WAM 83.3049a	45 (est.)	50	2.4+	73°
WAM 83.3049b	18 (est.)	29	3+	92°
WAM 92.267	53 (est.)	66	4.7+	74°
NMV P101533	51 (est.)	62	7	75°
NMV P101970	41 (est.)	51	7 (est.)	74°

Remarks

The material comprises internal moulds, several of which retain shell remnants preserved as replacement calcite.

Preservation of the present material is generally poor but enables us to endorse the conclusion of Ponder (1983: 29–30, figs 18g–i) that, "the size and shape and the pattern of the agglutination scars indicate that this species was probably a member of the *conchyliophora* group". The distributional history of this group is discussed by Ponder (1983: 11–14, fig. 5). Unfortunately, figured specimens of the Cretaceous *Xenophora* species from Europe, North America and Africa are not well preserved so that comparisons with the Miria material are inconclusive. However, on the available evidence, the present species does seem very close to *X. onusta* (Nilsson, 1827) and to *X. leprosa* (Morton, 1834) as Ponder (1983) has suggested. He noted its similarity to illustrations of *X. onusta* from the Upper Senonian and Maastrichtian of Malagasy (Cottreau 1922; Basse 1931). *X. onusta* occurs widely in the Upper Cretaceous of Europe, being recorded from the Lower Senonian of Bohemia, the Upper Senonian of Germany, Limburg, Sweden and Austria, the Lower Maastrichtian of the Lvov region, the Donbas Basin and Bulgaria and the Maastrichtian of the Middle Vistula valley. *X. leprosa* occurs in the Maastrichtian of Alabama (Sohl 1960). Judging from the figure, the Miria species has little resemblance to *X. carnatica* Stoliczka, 1868 from the Ariyalur Group of South India. Further comparison of the Miria species requires better material.

Variation in the present species is evident in the spire angle and the height of the spire relative to width. One immature specimen (WAM 83.3072) may have been umbilicate, a feature not matched by others.

Shell remnants on WAM 85.600 and NMV P101970 show numerous small cavity fills consistent with those attributed to the boring sponge *Entobia cretacea* (Portlock) (Figure 7 C) (Henderson and McNamara, 1985a). Nowhere common, the species is found regularly along the entire outcrop of the Miria Formation in the Giralia Range.

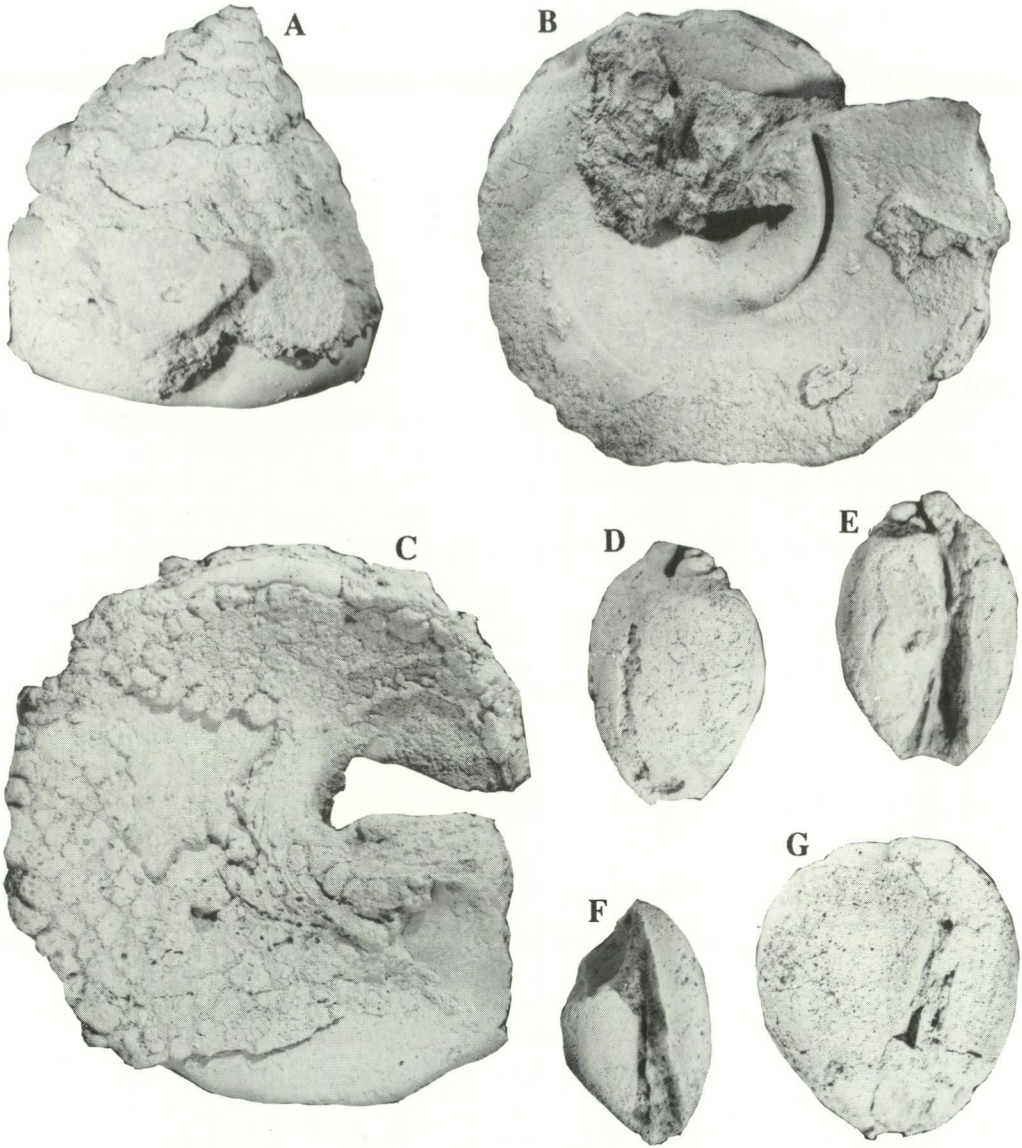

Figure 7 **A–C**, *Xenophora (Xenophora)* sp. **A**, NMV P101970, locality 18, internal mould, 90° from aperture, showing two attachment objects, x 1.2; **B**, WAM 83.2875a, locality 17, internal mould, base showing circumbilical groove, x 1.2; **C**, WAM 85.600, locality 3. Fragmentary internal mould with basal shell extensively perforated by the sponge *Entobia cretacea* (Portlock), x 1.2. **D–F**, Cypraeoidean, family and genus undetermined, species A. D,E WAM 90.235, locality 42, internal mould; **D**, dorsal, x 1.6; **E**, apertural, x 1.6; **F**, WAM 80.645, locality 26, internal mould lacking left-posterior portion; compare anterior profile with that of E, x 1.7. **G**, Cypraeoidean, family and genus undetermined, species B, NMV P102012, locality 27, internal mould, apertural, x 1.1.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Superfamily Cypraeoidea Rafinesque, 1815

Cypraeoidean, family and genus undetermined, species A

(Figures 7 D–F)

Material

WAM 80.645, 83.2932, 87.309, 90.213, 90.235; 5 specimens. NMV P101540, P119537; 2 specimens. UWA 91489; 2 specimens.

Description

Shell small; mould involute but shell presumably convolute, compressed dorso-ventrally; maximum diameter at adapical third, tapering and subacuminate anteriorly; aperture of medium width, widening anteriorly and almost straight, slightly oblique to axis of coiling; outer lip strongly incurved, without evidence (on mould) of crenulation and produced well beyond apex; inner lip apparently smooth.

Dimensions

	Height	Max. diameter
WAM 83.2932	25	15.4

Remarks

The material comprises internal moulds only. The superfamily is well represented in the Late Cretaceous and on all continents (Groves 1990). The present material is inadequate for meaningful comparison and determination.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Cypraeoidean, family and genus undetermined, species B

(Figure 7 G)

Material

NMV P102012; 1 specimen.

Description

Internal mould of medium size, globular, convolute, a little higher than wide; maximum diameter at mid-whorl; spire slightly projecting; aperture slightly extended posteriorly, apparently sinuate, without evidence of crenulation.

Dimensions

	Height	Max. diameter
NMV P102012	35	31

Remarks

This somewhat globose species resembles in shape *Bernaya (Protocypraea) kayei* (Forbes, 1846) from the Trichinopoly and Ariyalur Groups (Turonian – Maastrichtian) of South India but further determination must await the collection of better material.

A second internal mould of a cypraeoid (WAM 92.268) may represent the juvenile form of this or a similar species. It lacks the mould of the developed outer lip of NMV P102012 and seems to possess a short, oblique anterior canal; dimensions 33 x 25 mm.

The matrix of WAM 92.268 contains abundant glauconite grains and the specimen may have originated in a Paleocene unit of the Cardabia Group.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Superfamily Naticoidea Guilding, 1834
Family Naticidae Guilding, 1834
Subfamily Gyrodinae Wenz, 1938

Genus *Gyrodes* Conrad, 1860

Type species

Rapa supraplicata Conrad, 1858 [= *Natica (Gyrodes) crenata* Conrad, 1860], by subsequent designation of Gardner, 1916.

Subgenus *Gyrodes* sensu stricto

Gyrodes (Gyrodes) aff. *supraplicatus* (Conrad, 1858)

(Figures 8 A–D)

cf. *Rapa supraplicata* Conrad, 1858: 332, pl. 35, fig. 20.

cf. *Gyrodes supraplicatus* (Conrad): Sohl, 1960: 117–118, pl. 16, figs 1–5, 9, 13, 19.

Material

WAM 60.112, 71.265, 80.889, 83.3022, 83.3038, 83.3090; 6 specimens. NMV P98249, P98303, P101534–6, P101773, P101965–7, P102290, P102372; 11 specimens. UWA 91477; 1 specimen.

Description

Shell of medium size for genus, compressed – naticiform; spire low, about ¼ of total height; whorls few, enlarging rapidly, inclined strongly to axis; sutures impressed; subsutural ramp narrow, sunken, bounded by a subangulate shoulder; outer face broadly rounded; base markedly concave, meeting outer face at strongly angulate carination which forms umbilical

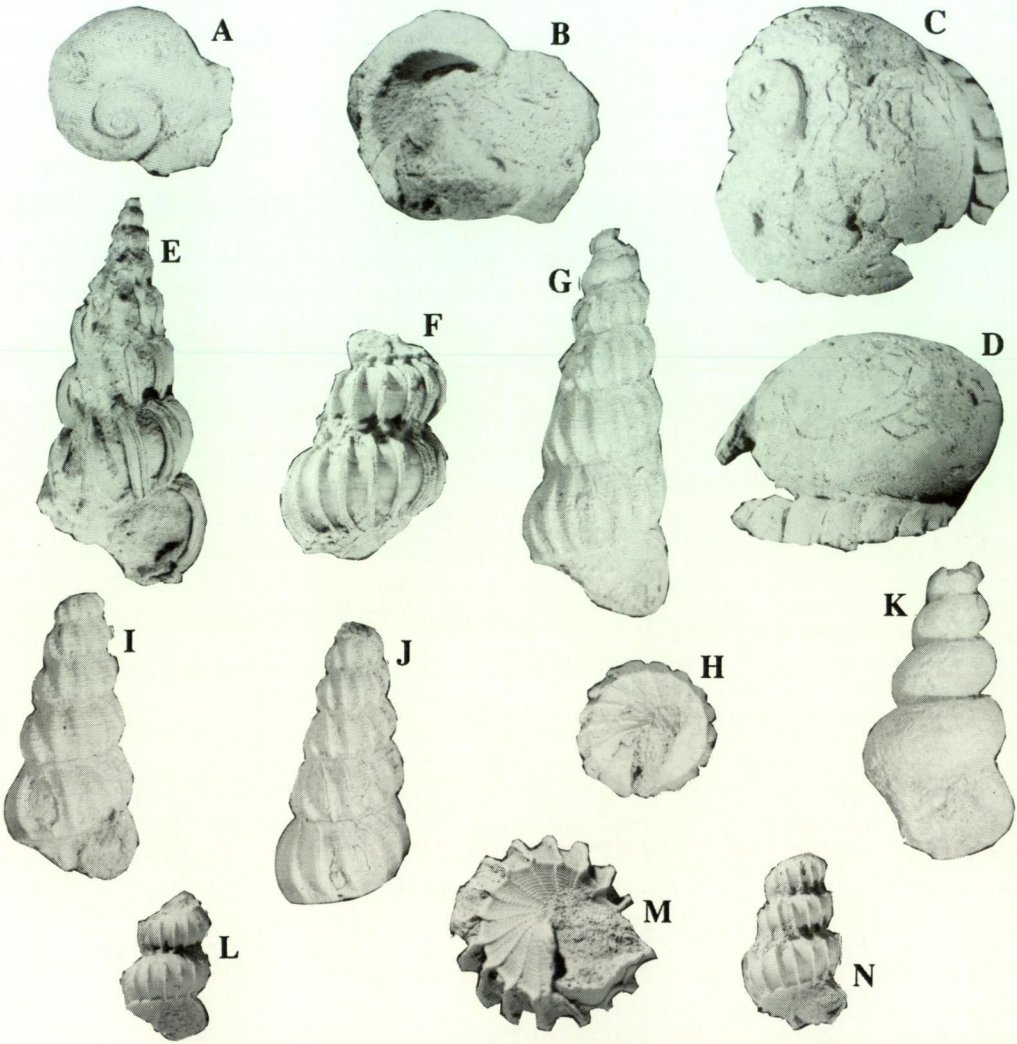

Figure 8 **A–D**, *Gyrodes (Gyrodes)* aff. *supraplicatus* Conrad. **A, B**, WAM 60.112, locality 36, internal mould of immature specimen retaining some shell on the spire and base, phosphatic nodule obscures aperture and part of base; **A**, apical, x 1; **B**, basal, showing carina, x 1.4; **C, D**, NMV P102290, locality 51, internal mould of mature specimen with impressions of spiked carina on phosphatic nodule; **C**, apical, x 1; **D**, 180° from aperture, x 1. **E, F**, *Striaticostatum* sp. **E**, WAM 75.1219, locality 30, internal mould retaining axial costae and basal carina, apertural, x 1.1; **F**, UWA 91474, locality 40, portion of shell (two whorls), 90° from aperture, x 1. **G–K**, *Confusiscala* cf. *decorata* (Roemer). **G, H**, WAM 71.264, locality 25; **G**, apertural, x 1; **H**, basal, x 1; **I, J**, WAM 87.402, locality 7; **I**, apertural, x 1; **J**, 180° from aperture, x 1; **K**, WAM 84.713, locality 13, internal mould (from nodule bed), possibly this species, apertural, x 1. **L–N**, *Amaea (Littoriniscala?)* sp. **L**, WAM 83.3079, locality 1, anterior 2.5 whorls, apertural, x 1; **M, N**, NMV P98274, locality 46; **M**, basal, x 2; **N**, anterior 3.0 whorls, x 1.

margin; carination weakly granose on immature specimens, developing into prominent V shaped scales or spikes on larger specimens; umbilical cavity occupies entire base; umbilicus presumably present but obscured on all specimens to hand by sediment infilling; aperture poorly indicated but evidently lenticular, oblique, strongly angulate anteriorly, outer lip strongly prosocline; sculpture of spire comprising weak colabral growth striae, intensified on shoulder into sinuate, axial wrinkles; base with fine axial striae.

Dimensions

	Height	Max. diameter	Whorls
WAM 60.112	15	21	4+
WAM 80.889	27 (est.)	36 (est.)	4+
NMV P98303	40 (est.)	43 (est.)	4+

Remarks

This species is very close to *Gyrodes supraplicatus* (Conrad) from the Maastrichtian of Mississippi, Tennessee and Texas, as redescribed and figured by Sohl (1960). Conrad's species has a sharp, crenulate umbilical margin, a feature shared with the Miria species in immature specimens (WAM 60.112) but not in the adult form (NMV P102290), on which these are extended to form prominent, slightly curved spikes. Another difference is that Conrad's species has a second circumbilical carination within the basal cavity. This appears to be absent on the immature WAM 60.112.

Other somewhat similar species, such as *G. manuannensis* Newton, 1909 from the Late Cretaceous of Zululand (Newton 1909) and Malagasy (Basse 1931), *G. pansus* Stoliczka, 1868 from the Late Cretaceous of South India (Stoliczka 1868: 305, pl. 22, figs 9–13) and *G. dowelli* White, 1889 from the Late Cretaceous of the west coast of North America (Popenoe *et al.* 1987: 75–76, figs 4.1, 4.5, 4.7) all have crenulate rather than spiked umbilical margins.

The material to hand is, in the main, poorly preserved, and specific determination must await the collection of better specimens. This species is an Australian representative of a genus that was virtually cosmopolitan during the Late Cretaceous, as noted by Sohl (1960: 116).

Darragh and Kendrick (1991) implicated this species in predation on bivalves from the Miria Formation.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Superfamily Janthinoidea Lamarck, 1812
Family Epitoniidae Berry, 1910
Subfamily Epitoniinae Berry, 1910
Genus *Striaticostatum* Sohl, 1963

Type species

Striaticostatum harbisonae Sohl, 1963, by monotypy.

Striaticostatum sp.
(Figures 8 E,F)

Material
WAM 75.1219; 1 specimen. UWA 91474; 1 fragmentary specimen.

Description
Shell of medium size, elongate-turriculate, non-umbilicate, with rounded whorls and deep sutures (the latter mostly obscured by sediment on material to hand); sculpture of strong, lamellose, slightly sinuate and slightly prosocline axial costae, nine to 14 on last whorl; microsculpture of very fine, close spiral threads covering intercostal spaces; basal carination discontinuous, formed from opisthocyrt, spur-like outgrowths of axial costae; axials passing over base to join columella; plane of whorl attachment lying just abapical to basal carina; carina partially visible on spire as "sutural rib"; aperture damaged but evidently a little higher than wide, ovate; apex missing.

Dimensions

	Height	Max. diameter	Whorls	Spire angle
WAM 75.1219	50 (est.)	20.4	12 (est.)	31°

Remarks
Sohl (1964a) recorded seven species of *Striaticostatum* from the Late Cretaceous formations of the Atlantic and Gulf coastal plains of North America, which appears to be the area of greatest diversity for the genus. A further probable congener is *Amaea (Littoriniscala) hassani* Abbass from the Maastrichtian of Egypt (Abbass 1963: 66, pl. 3, fig. 1). Sohl (1964a) also refers to possible congeners in Pondoland and India but we are unable to confirm or negate that suggestion.

Despite poor preservation, the two Miria specimens are similar in morphology to both *S. harbisonae* Sohl and *S. sparsum* Sohl (figured Sohl 1963: 747–748, pl. 89, figs 16–19; Sohl 1964a: 318–320, pl. 52, figs 10, 15, 16, 21, 24–27) but lack the intricate pitting ("honeycomb structure") of the costae of Sohl's species.

The two records of this rare and probably undescribed species are from Section Hill and "Twin Hill-Remarkable Hill", both on Cardabia station. The material to hand is considered to be inadequate for formal description and naming.

Stratigraphic Range
Miria Formation. Late Maastrichtian.

Genus *Confusiscala* de Boury, 1909

Type species
Scalaria dupiniana A. d'Orbigny, 1842, by original designation.

Confusiscala cf. *decorata* (Roemer, 1841)
(Figures 8 G–K)

Melania decorata Roemer, 1841: 82, pl. 12, fig. 11.

Material

WAM 71.264, 80.865, 80.890? (internal mould), 84.713? (internal mould), 87.308, 87.402; 6 specimens. NMV P101734, P110971, P119597? (internal mould); 3 specimens.

Description

Shell of medium size for genus, elongate-turriculate, non-umbilicate; spire angle 23°–24°, increasing a little with growth; whorls convex; sutures moderately impressed and slightly undulating; whorls bearing strong, spaced, orthocline to slightly prosocline, rounded axial costae, 14–17 on last whorl axials not aligned (disjunct) across sutures; intercostal spaces a little wider than costae; each costa emerging from beneath a thin, everted, apertural lip, retained along crest of rib; varices absent; secondary sculpture of low, rounded, spiral threads of irregular strength, passing over axial costae and numbering 32–40 on the last whorl; tertiary microsculpture of very fine, colabral lamellae covering entire surface of spire; basal disc defined by strong, spiral carination, over which pass reduced extensions of primary axials; disc also bearing fine to very fine secondary (ca. 20 threads) and tertiary sculpture similar to that of spire; plane of whorl attachment just covering basal carination; aperture poorly preserved but apparently more or less circular; columella thickened, concave; parietal area with callus extending onto basal disc; apex missing.

Dimensions

	Height	Max. diameter	Whorls	Spire angle
WAM 71.264	57 (est.)	19 (est.)	6+	23°
WAM 87.402	50 (est.)	18 (est.)	5	24°

Remarks

The genus *Confusiscala* attained a widespread, near-cosmopolitan distribution during the Cretaceous (Late Hauterivian to Late Maastrichtian) but seems not to have survived into the Tertiary. It has not been recorded hitherto from Australia.

C. decorata (Roemer) was described from the Lower Senonian of Aachen and has been recorded widely throughout the Late Cretaceous (Turonian-Late Maastrichtian) of Central Europe. Our material resembles closely a specimen from Lusberg near Aachen (Lower Senonian) figured by Holzapfel (1888: 165, pl. 19, fig. 1) as *Scalaria* cf. *decorata* (Roemer). The similarity and close relationship between *C. decorata* and *C. dupiniana* (d'Orbigny) from the European Albian (d'Orbigny 1842: 54, pl. 154, figs 10–13) has been remarked on by Holzapfel (1888) and Mueller (1898), among others; possibly the two forms represent earlier and later parts of a common lineage. Compared with d'Orbigny's species, our material has less-inflated whorls, so that the suture is less impressed, and the posterior part of the whorl on our species develops a slight concavity close to the suture.

The present material is close to that figured by Blank (1974: 133, pl. 51, fig. 6) as *Confusiscala decorata* from the Donbas Basin, Ukraine, though this may have fewer primary axials than the Miria specimens. Other records of *C. decorata* from the Middle Turonian-Lower Senonian of Germany, the Lower Maastrichtian of the Lvov region and the Donbas Basin and the Upper Campanian to Upper Maastrichtian of the Central Vistula valley, Poland, are presented by Abdel-Gawad (1986).

Comparable species of *Confusiscala* from the Pacific Rim include *C. mathewsonii* (Gabb,

1864) from the Late Cretaceous of California and figured by Stewart (1927: 321–322, pl. 24, fig. 20) and Durham (1937: 504, pl. 56, fig. 23). This species has rather more incised whorls than the Miria material. Other species somewhat similar to *C. mathewsi* from the Turonian of California have been tentatively assigned to *Confusiscala* by Saul and Popenoe (1993). Kase (1984: 165–167, pl. 28, figs 11,12,18) records two species from the Upper Hauterivian and Albian-Aptian respectively of Japan, the latter close to *C. novemvaricosa* (Whitfield, 1891) from the Aptian of Syria; Kase's material differs from ours mainly in the smaller spire angle. The first of Kase's species (compared by him with *C. dupiniana*) appears to be the earliest record for the genus.

C. shutanurensis (Stoliczka, 1868) from the Trichinopoly Group (Turonian-Santonian) of South India (Stoliczka 1868: 233, pl. 18, figs 6–8) has, judging from the figures, stronger spiral lirae but otherwise seems quite close to our material and also as noted by Stoliczka (1868), to both *C. dupiniana* and *C. ornata* (Baily, 1855), the latter from the Senonian of Pondoland (figured Woods, 1906: 314, pl. 38, figs 2,3). Woods' figures of *C. ornata* have much finer spiral lirae than ours. The similarity of *C. ornata* to both *C. dupiniana* and *C. decorata* is noted by Woods, while maintaining a distinction between Baily's and d'Orbigny's species.

The intra-specific variation (if any) and relationships of this array of rather similar species of *Confusiscala*, distinguished mainly by small differences in sculpture, whorl inflation and spire angle, would seem to justify a closer comparative study afforded by a generic revision, something beyond the scope of this work.

Stratigraphic Range

Nodule bed at contact of Korojon Calcarenite and Miria Formation (internal mould); Miria Formation. Maastrichtian.

Genus *Amaea* H. and A. Adams, 1853

Type species

Scalaria magnifica Sowerby, 1843, by subsequent designation of Fischer, 1885.

Subgenus *Littoriniscala* de Boury, 1887

Type species

Littoriniscala lapparenti de Boury, 1887, by original designation.

Amaea (*Littoriniscala* ?) sp.

(Figures 8 L–N)

Material

WAM 83.3079; 1 specimen. NMV P98274, P101691; 2 specimens.

Description

Shell medium sized for genus with well-rounded whorls, deeply impressed sutures, no umbilicus and well-defined basal disc; spire sculptured with thin, erect, widely spaced, slightly sinuate axial lamellae, 16 on the last whorl and not strictly aligned from whorl to whorl; lamellae below suture emphatically prosocline over flattened subsutural ramp; axials with

erect, scalariform or spur-like process coinciding with shoulder of ramp, below shoulder axials realigned (less prosocline) to meet and pass over basal carination, extending (much reduced) across basal disc to terminate at columella; microsculpture of very fine, close spiral threads occupies interspaces of spire and basal disc; aperture poorly preserved but apparently subcircular; columella thickened, where visible, slightly concave.

Dimensions

	Height	Max. diameter	Whorls
WAM 83.3079	?	11.5	2.4+
NMV P98274	35 (est.)	13.5	3+

Remarks

The material comprises the abapical portions only (2.4, 2.6 and 3.0 whorls).

The present species bears some resemblance to "*Scalaria*" *labrosa* Wanner, 1902 from the Late Cretaceous of Libya (Wanner 1902: 126, pl. 18, fig. 18) but that species seems to lack spiral sculpture. There is also some resemblance to "*Scalaria*" *climaspira* Gardner, 1876, from the Albian Upper Greensand of Blackdown, Devon (Gardner 1876: 109, pl. 3 figs 12,13); however it is not clear from the figures whether the axials are as lamellate as on our species; the spur on the lamellae which characterises the Miria specimens seems also to be absent. It is unlikely that the two are conspecific.

Further consideration of this rare species is deferred until the collection of other more complete material.

An abraded, incomplete specimen of a species of *Amaea* (WAM 88.66) from the Giralia Range at map reference Giralia. KV 174880 is not unlike the present species, differing in its more crowded axials which number 23 on the last whorl. The matrix contains glauconite grains, which suggests a possible origin in the Wadera Calcarenite (Paleocene), which overlies the Miria Formation in this area.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Order Neogastropoda Wenz, 1938

Remarks

In the familial arrangement of the Neogastropoda, we follow Ponder and Warén (1988), in which the oft-recognized families Nassariidae Iredale, 1916, Melongenidae Gill, 1871 and Fasciolariidae Gray, 1853 are reduced to subfamilies of the Buccinidae.

Superfamily Muricoidea Rafinesque, 1815
Family Buccinidae Rafinesque, 1815
Subfamily Buccininae Rafinesque, 1815
Genus *Woodsella* Wade, 1926

Type species
Woodsella typica Wade, 1926, by original designation.

Woodsella cf. *typica* Wade, 1926
(Figure 9 A)

cf. *Woodsella typica* Wade, 1926: 130, pl. 46, figs 1, 5.

cf. *Woodsella typica*: Sohl, 1964a: 228–229, pl. 31, figs 29, 30.

Material
WAM 86.1221; 1 specimen. NMV P101597, P101957; 2 specimens.

Description
Shell of medium size, robust, fusiform, spire about equal to half total height; whorls convex and shouldered at periphery, maximum convexity anterior to mid-whorl on spire and at posterior third on last whorl, sutural ramp concave; sutures depressed; last whorl contracting rapidly to anterior canal; aperture elongate, lenticular, angulate adapically, produced abapically into narrow, twisted canal; columella a little sinuate, without visible plaits. Sculpture of prominent, spaced, axial costae, about 14 (est.) on last whorl, becoming varicose on periphery (shoulder) but absent on ramp; costae extending to anterior suture on spire whorls, fading at about middle of last whorl and absent from base; secondary sculpture of spiral lirae, about ten on penultimate whorl and about 20 on last whorl with additional finer lirae extending on to canal.

Dimensions

	Height	Max. diameter	Whorls
NMV P101957	55 (est.)	25 (est.)	3.5+

Remarks
One of our specimens (NMV P101957) is sufficiently well preserved for comparison with the unique type of *Woodsella typica* Wade from the Maastrichtian Ripley Formation of Coon Creek, Tennessee, which has been refigured by Sohl (1964a). The Miria specimen is a little more elongate than Wade's type but overall the sculpture and shape are so similar that, until more is known of the extent of variation within both of the Ripley and Miria populations of *Woodsella*, it seems prudent to refer our material, with qualification, to Wade's species.

Two other species, both from the Late Cretaceous of Pondoland, Natal, may be assigned to *Woodsella*. These are "*Voluta*" *rigida* Baily, 1855 in Rennie (1930: 225–227, pl. 27, figs 9–12, as *Cryptorhytis*) and *Cryptorhytis pseudorigida* Rennie (1930: 227–228) and figured by Woods (1906, pl. 39, fig. 2a–c, as *C. rigida*). The Pondoland species appear from the figures to have less twisted siphonal canals and less prominent shoulders than the Miria material.

Stoliczka (1867: 109–110, pl. 10, figs 10–16, as *Fasciolaria*) recorded *W. rigida* from the Turonian-Santonian Trichinopoly Group of South India but both Woods (1906) and Rennie (1930) have noted significant sculptural differences between the African and Indian material and also, more importantly, pointed to the presence of columellar plaits on the Indian material. These differences suggest that Stoliczka's material is unlikely to be referrable to *Woodsella*.

Baily's species has also been recorded from the Maastrichtian of southwestern France by Termier (1954: 381, fig. 73).

Roman and Mazeran (1920: 64, pl. 4, fig. 22) have compared *Cryptorhytis renauxianus* (d'Orbigny, 1843) (d'Orbigny 1843: 339. pl. 223, fig. 10) with "*Voluta*" *rigida* Baily; however the former species is much more slender and with a long, straight canal and in our view is probably not congeneric.

Blank (1974) has recorded *Woodsella nereidis* (Münster in Goldfuss, 1844) from the Maastrichtian of the Donbas (Ukraine), a species described originally from the Maastrichtian of Haldem, Germany (Goldfuss 1844 pl. 151, fig. 20). Though Blank's material is poorly preserved and difficult to appraise from the figure, it seems that this assignment may well be correct; indeed, Goldfuss' figure shows some resemblance to *W. typica*. Kollmann (1980: 206, pl. 3, fig. 30) assigns "*Fusus*" *turbinatus* Zekeli, 1852 from the Santonian of the Gosau Basin, Austria, to *Woodsella*. These records of *Woodsella* from North America, Europe, southern Africa and now Australia indicate a wide distribution for the genus in the Late Cretaceous.

The present species is a rarity in the Miria Formation and precise determination of its identity would require access to further, well-preserved material.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Subfamily Fasciolariinae Gray, 1853

Genus *Dolicholatirus* Bellardi, 1884

Type species

Turbinella bronni Michelotti, 1846, by subsequent designation of Cossmann, 1901.

Dolicholatirus cf. *torquatus* Sohl, 1964

(Figures 9 B, C)

cf. *Dolicholatirus torquatus* Sohl, 1964a: 209, pl. 26, figs 9, 10, 16, 17.

Material

WAM 89.1050; 1 specimen.

Description

Shell small, narrowly fusiform; apical region not preserved. Whorls convex with posterior collar against suture; spire angle 30°; aperture long, narrow, oblique and with small posterior notch; columella straight, thinly callused and bearing two strong, slightly oblique plaits; outer lip not preserved; canal long and straight. Axial sculpture of strong, sharp costae, seven on last whorl, not present on collar and fading anteriorly on last whorl; spiral sculpture of strong lirae, narrower than interspaces and covering entire whorl and canal; lirae finer on collar, numbering eight on penultimate whorl and eleven on last whorl.

Dimensions

	Height	Max. diameter
WAM 89.1050	21 (est.)	7.5 (est.)

Remarks

Dolicholatirus, a genus widely distributed in the Tertiary, was first recorded from the Late Cretaceous by Sohl (1964a) with *D. torquatus* Sohl from the Upper Maastrichtian Owl Creek Formation of Mississippi. From the very limited available material, the present species appears to be indistinguishable from Sohl's. It is quite similar in overall morphology to the type species of the genus, differing in its finer, more regular lirae.

Further determination of this rare species requires access to additional material.

Stratigraphic Range

Miria Formation, upper calcisiltite unit. Late Maastrichtian.

Genus *Euthriofusus* Cossmann, 1901

Type species

Fusus burdigalensis Basterot, 1825, by original designation.

Euthriofusus (?) vandegraaffi sp. nov.

(Figures 9 D–H)

Holotype

GSWA F9368. From Giralia Range, Giralia Station: near head of an eastward-draining gully 3 km south of the Bullara – Giralia road. Yanrey (1:250 000 series) 202170 = Giralia (1:100 000 series) KV 164882 (approx.).

Paratypes

WAM 83.2945, 83.3063a,b, 83.3113, 89.1254, 92.373; 6 specimens. NMV P101650; 1 specimen.

Other material

WAM 60.27, 60.113, 71.286, 80.692, 80.753, 80.862, 80.882, 80.891, 80.958, 83.2876, 83.2903, 83.2921, 83.2933, 83.2957, 83.2972, 83.2987, 83.3007, 83.3034, 83.3051, 83.3074, 83.3091, 84.714, 84.729, 86.1463; 32 specimens. NMV P97586, P98272, P98291–2, P98307–9, P101558, P101600–1, P101680, P101958–61, P102061, P102242, P102291, P102328, P102359, P119518, P119577; 24 specimens. UWA 91460; 4 specimens. GSWA F9388, 30083; 2 specimens.

Diagnosis

A medium-sized *Euthriofusus* with strongly shouldered, axially plicate whorls. Differs from *E. burdigalensis* (Basterot) in its more pronounced shoulder and more plicate whorls; lacks the posterior callus and notch and internal subsutural gutter of that species. Differs from *E. (?) mesozoicus* (Wade, 1926) and *E. (?) convexus* (Wade, 1926) by its more angular, shouldered whorls and stronger axials.

Description

Shell of medium size for genus, thin, fusiform; spire less than half total height, gradate and with strong peripheral shoulder at mid-whorl; spire angle 55°–60°; protoconch large, smooth, globular, of 1.5 whorls; first whorl deviated at right angle to shell axis and overhanging subsequent whorl; second whorl merging imperceptibly with spire; aperture higher than wide, angulate posteriorly, produced and tapering anteriorly into straight, robust canal, probably of moderate length (all specimens incomplete); Outer lip poorly indicated but apparently orthocline, roundly subangulate, everted, meeting parietal margin at acute angle, notched

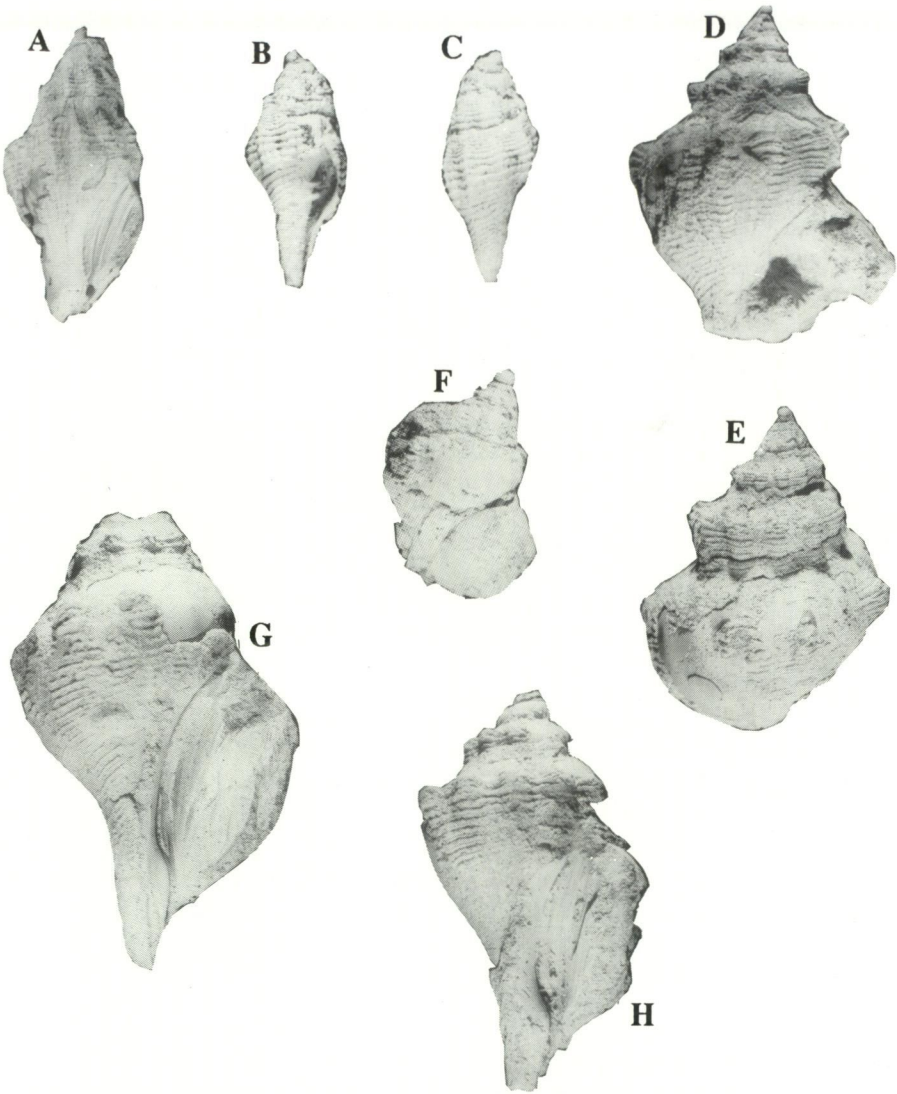

Figure 9 **A**, *Woodsella* cf. *typica* Wade, NMV P101957, locality 18, apertural, x 0.8. **B, C**, *Dolicholatirus* cf. *torquatus* Sohl, WAM 89.1050, locality 3; **B**, apertural, x 1.7; **C**, 180° from aperture, x 1.7. **D–H**, *Euthriofusus* (?) *vandegraaffi* sp. nov. **D, E**, GSWA F9368, holotype, locality 44 (approx.); **D**, apertural, x 0.8; **E**, 180° from aperture, x 0.8; **F**, WAM 83.3113, paratype, locality 7, specimen with large, well preserved apex, apertural, x 0.8; **G**, WAM 83.2945, paratype, locality 15, specimen with columellar flange and most of the anterior canal, apertural, x 0.9; **H**, NMV P101650, paratype, locality 27, specimen showing peripheral plicae and columellar flange, apertural, x 0.9.

anteriorly to merge into canal; no parietal callus evident; columella thickened, slightly concave and terminating in strong, blade-like projection constricting canal; whorls sculptured with varicose axial costae, strongly plicate on shoulder and extending onto base below plane of attachment; costae number about 10–13 on last whorl; sutures undulating, adpressed over the base of the costae; secondary spiral sculpture of fine, close-set spiral cords passing over axials, about 15 on penultimate whorl and about 45 on last whorl.

Dimensions

	Shell height	Spire height	Max. diameter	Whorls
GSWA F9368, holotype	80 (est.)	28	43	6
WAM 83.2945, paratype	80 (est.)	30 (est.)	41 (est.)	2.5+
WAM 83.3063a, paratype	73 (est.)	28	36	6
WAM 89.1254, paratype	78 (est.)	30 (est.)	40	3.5+
WAM 92.373, paratype	70 (est.)	24	37 (est.)	6+
NMV P101650, paratype	60 (est.)	25 (est.)	35	4+

The diameter of the holotype is measured across both axial plicae; that of paratype 92.373 incorporates an estimate for one axial plication, the other being intact. Diameters for the other three WAM specimens are taken directly from the mould without an estimate for the shell and its plicate axials.

Remarks

The generic location of the present species remains subject to confirmation as the material to hand is fragmentary and generally not well preserved. It resembles in some features *Fusus burdigalensis* Basterot, the type species of *Euthriofusus*, from the Middle Miocene of Europe, the differences being noted above.

Euthriofusus has, with reservations, been utilised by Sohl (1964a: 225–226, pl. 31, figs 27, 28, 33–36) for two similarly proportioned Maastrichtian species, *E. mesozoicus* (Wade) and *E. convexus* (Wade), from the Ripley Formation of Tennessee. The form of the protoconch on Wade's species was unknown to Sohl (1964a); that of the present species is distinctly globose and comparable with that of the type species.

Blank (1974) has recorded *Euthriofusus carinatus* (Munster in Goldfuss, 1844) from the Campanian and Maastrichtian of the Donbas (Ukraine). The species was described originally from the greensand of Cösfeld. Though not well preserved, Blank's material appears to be assigned correctly to *Euthriofusus*.

Abdel-Gawad (1986: 119, pl. 16, figs 3–4) has placed *Fusus (Hemifusus) nereidiformis* Kaunhowen, 1897 from the Maastrichtian of the Netherlands and Poland in *Euthriofusus*. This species is based on poorly preserved material but appears to lack the concave subsutural ramp and coarse axial shoulder plications of the Miria species. Several Eocene forms attributed tentatively to *Euthriofusus* by Wrigley (1927) were relocated by Glibert (1963) to a new subgenus (of *Euthriofusus*), *Wrigleyia*, based on the absence of the posterior callus and of the oblique plait at the beginning of the canal present on *Euthriofus s.s.* Tembrock (1968) synonymised *Wrigleyia* and several other taxa with *Scalaspira* Conrad, 1862 (type species *Fusus strumosus* Conrad, 1832). Species of that genus have shorter, more twisted canals than that of the present species.

E. vandegraaffi is common and widely distributed along the outcrop of the Miria Formation in the Giralia Range. Good specimens retaining significant shell remnants are, however, scarce.

Etymology

The species is named after Dr W.J.E. ("Eric") van de Graaff in recognition of his contributions to the geology of the Carnarvon Basin. The holotype was collected by him whilst in the service of the Geological Survey of Western Australia.

Stratigraphic Range

Nodule bed at contact of Korojon Calcarenite and Miria Formation; Miria Formation. Maastrichtian.

Genus *Fusinus* Rafinesque, 1815

Type species

Murex colus Linnaeus, 1779, by monotypy.

Fusinus ? sp.

(Figures 10 A, B; 11)

Material

WAM 75.1220, 80.826, 83.2922, 83.3025, 86.1220, 86.1399, 92.384; 7 specimens. NMV P101679, P101692, P102370; 3 specimens. UWA 91459; 1 specimen.

Description

Internal mould large, elongately fusiform; spire height about equal to that of aperture; spire angle variable from 38°–48°; whorls strongly convex with distinct subsutural ramp and peripheral shoulder, latter a little posterior to mid-whorl; last whorl tapering gently to anterior canal; aperture poorly preserved but somewhat higher than wide, lenticular, oblique to principal axis, attenuated anteriorly into canal of moderate or greater length; outer lip probably orthocline, everted (WAM 86.1220); columella slightly concave, without plaits; sculpture on spire whorls of strong axial costae, about as wide as interspaces and numbering about 10–14 per whorl; costae somewhat nodulose on shoulder; axials crossed by strong, close-set spiral cords, numbering about 15 on penultimate whorl and extending over entire shell.

Dimensions

	Height	Ht aperture	Max. diameter	Spire angle	Whorls
WAM 86.1399	140 (est.)	70 (est.)	70 (est.)	38°	4.5+
WAM 92.384	145 (est.)	70 (est.)	70 (est.)	48°	4.5+

Remarks

All specimens to hand are internal moulds, of which three (WAM 86.1399, NMV P101679, P101692) retain shell remnants.

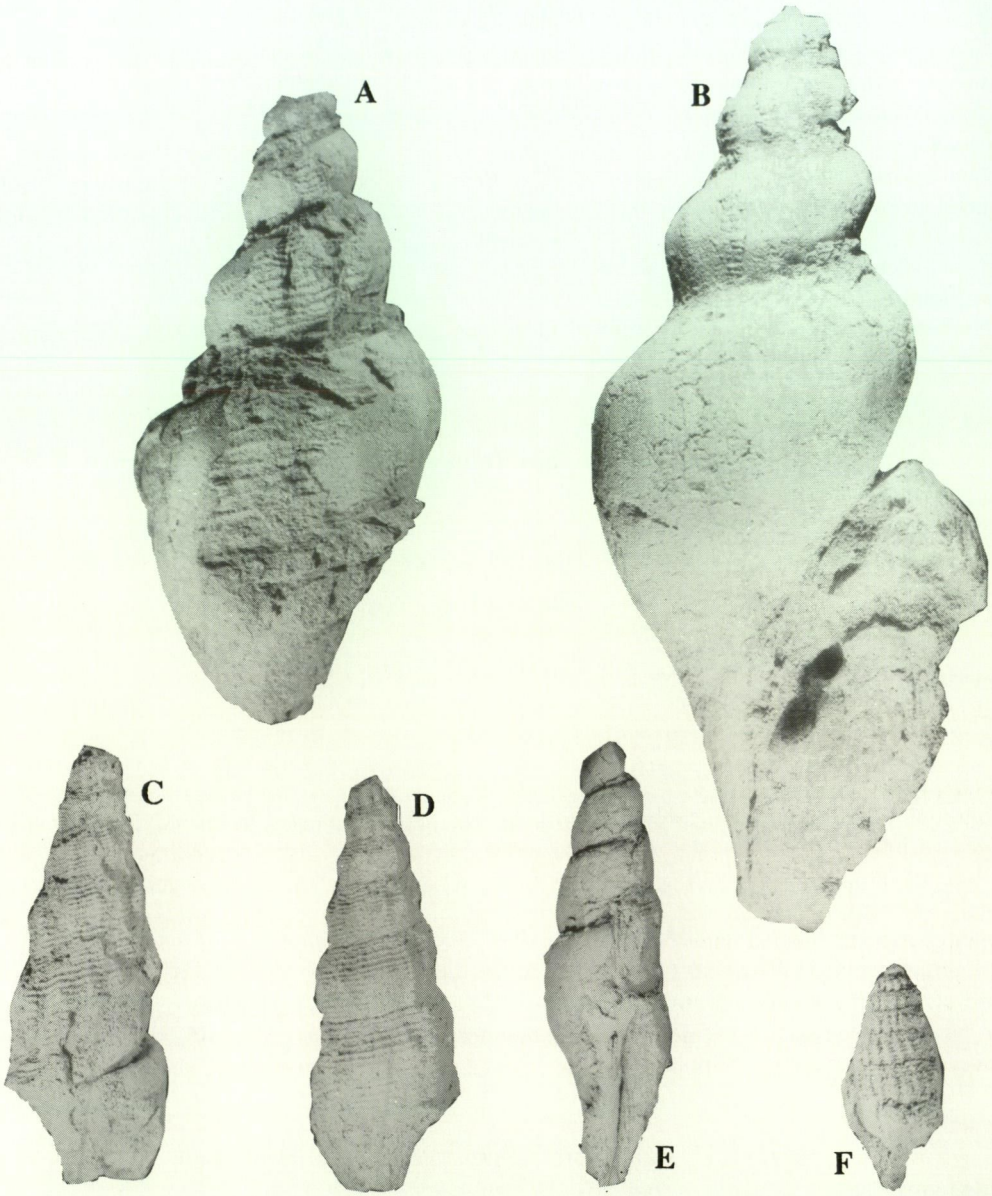

Figure 10 **A, B**, *Fusinus* (?) sp. **A**, NMV P101692, locality 3, internal mould with shell remnants showing spiral sculpture, 180° from aperture, x 1; **B**, WAM 86.1399, locality 13, internal mould, apertural, x 1. **C–F**, *Graphidula* aff. *melanopsis* (Conrad). **C, D**, WAM 83.2985, locality 13; **C**, apertural, x 1; **D**, 180° from aperture, x 1; **E**, WAM 92.269, locality 13, internal mould with shell remnants showing near-straight columella and canal, apertural, x 1.1; **F**, NMV P119707, locality 10, immature shell showing brephic sculpture, x 1.1.

In the present material variation is most evident in the spire angle (compare Figures 10B and 11); possibly more than one species is represented here but in view of the prevailing state of preservation we defer consideration of that question. This is the largest known gastropod species in the Miria Formation assemblage.

This species is very similar in overall morphlogy of the spire and in sculpture to *"Fusus" rigidus* J. de C. Sowerby, 1836 but the largest known specimen of that species is about 50 mm in height (N.J. Morris and R.J. Cleevely *in litt.*) which is considerably less than that of the Miria specimens. *"Fusus" rigidus* has a short, slightly twisted canal. The canal region of all Miria specimens is missing but the columellar configuration suggests that the canal may have been straight.

We have been able to locate only one Cretaceous taxon that is comparable with the present material. This is *"Fusus" espaillaci* d'Orbigny, 1843 from the Late Cretaceous of France (d'Orbigny 1843: 340, pl. 224), which is known only from moulds (Termier 1954). Compared with the Miria species, this has a more angulate shoulder and more prominent costae (on the mould); given sufficient length to the canal, it would probably resemble some extant species of *Fusinus*.

Stratigraphic Range

Nodule bed at contact of Korojon Calcarenite and Miria Formation; Miria Formation. Maastrichtian.

Genus *Graphidula* Stephenson, 1941

Type species

Graphidula terebreformis Stephenson, 1941, by original designation.

Remarks

Sohl (1964a, 1967) has pointed out that *Graphidula* is very close to *Piestochilus* Meek, 1876 but distinguished *Graphidula* from the latter on the basis of the more elongate shape of the species included in *Graphidula*. We follow Sohl (1964a, 1967) and Erickson (1974) in retaining *Graphidula* and assign to it a species from the Miria Formation. This appears to be the first record of the genus outside the Late Cretaceous of North America and Japan (Erickson 1974). Species from the Senonian to Maastrichtian of northern and eastern Europe have been assigned to *Graphidula* by Abdel-Gawad (1986) but, though similar in shape to American species of that genus, lack any axial sculpture and presence of a columellar plait is not demonstrated.

Graphidula aff. *melanopsis* (Conrad, 1860)

(Figures 10 C–F)

aff. *Turbonilla (Chemnitzia) melanopsis* Conrad, 1860: 287, pl. 46, fig. 35.

aff. *Graphidula melanopsis* (Conrad): Sohl, 1964a: 212–213, pl. 28, figs 18,23,27,32–35.

Material

WAM 83.2985, 83.3062 (internal mould), 90.234, 92.269; 4 specimens. NMV P98304, P101574, P101952, P119707 (?); 4 specimens.

Description

Shell of medium size, elongate-fusiform, somewhat turriculate; spire angle 23°; whorls gently convex with weak shoulder located posterior to mid-whorl; sutures slightly adpressed; aperture poorly preserved but much higher than wide, lanceolate; parietal margin smooth, with thin callus; columella long, almost straight, with single, strongly oblique plait, located internally; anterior canal extended, narrow, slightly curved at extremity. Sculpture of low, spaced axial costae, orthocline to slightly prosocline and often but not always aligned from whorl to whorl; axials and interspaces crossed by fine, close, spiral cords of equal strength except for slightly stronger adapical cord; cords numbering 13 on penultimate whorl and about 30 on last whorl, continuing on to anterior canal.

Dimensions

	Height	Max. diameter	Whorls
WAM 83.2985	75 (est.)	23 (est.)	5½+
WAM 92.269	65 (est.)	16 (est.)	4+
NMV P98304	50 (est.)	16 (est.)	4+

Remarks

The available material is not very well preserved but sufficient shell remains on four specimens to enable the above limited description to be made. NMV P119707 (Figure 10F) is included here with reservations; it is considered to be a juvenile. Though the shell is substantially preserved, comparison with the other specimens is inconclusive as these all lack well preserved juvenile sculpture.

Of the various North American species of *Graphidula* figured by Sohl (1964a), our species comes closest to *G. melanopsis* in shape and sculpture; however the shoulder of the latter is scarcely developed on the spire whorls and is weak on the penultimate and last whorls; the spiral and axial sculpture is also very weak on the last whorl. Another comparable North American species is *G. pergracilis* (Wade, 1926) (figured by Sohl 1964a: pl. 28, figs 19–22, 30, 31) in which the spiral cords are more prominent than the axials.

The present species is probably new but further description and naming are deferred until better material comes to hand. All of the known localities for this uncommon species lie along the northern part of the outcrop on Giralia station.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Family Volutidae Rafinesque, 1815
Subfamily Volutoderminae Pilsbry and Olsson, 1954
Genus *Eovolutilithes* Akopyan, 1976

Type species

Volutilithes abadiei Collignon, 1951, by original designation.

Figure 11 *Fusinus* (?) sp. WAM 92.384, locality 3, internal mould (? nodule bed), apertural, x 1.3.

Remarks

In erecting the genus *Eovolutilithes*, Akopyan (1976) assigned to it species from France, Germany, Armenia, Baluchistan, South India, North Africa and Malagasy, ranging in age from Cenomanian to Maastrichtian. The type species is from the Maastrichtian of Malagasy. The salient characters of *Eovolutilithes* may be summarised thus: elongate form with extended anterior canal, prominent axial costae, no fasciole and 2–4 columellar plaits.

The genus *Volutilithes* Swainson, 1829, to which a number of species of *Eovolutilithes* had been assigned previously (Akopyan 1976), has a short canal, prominent fasciole, a single strong columellar plait and numerous subsidiary plaits. Its affinities lie with genera such as *Voluta* and *Lyria* in the subfamily Volutinae (Darragh 1989).

Eovolutilithes cf. *subsemiplicatus* (d'Orbigny, 1850)

(Figures 12 A–E)

cf. *Fusus subsemiplicatus* d'Orbigny, 1850: 229, nom. nov. pro *Pleurotoma semiplicata* Goldfuss, 1844: 19, pl. 170, fig. 11 non Nyst, 1841 nec Bonelli, 1841.

Material

WAM G10581, 60.24, 60.71, 60.111, 71.266, 74.584, 80.693, 80.863, 80.864, 83.2877, 83.2887, 83.2904, 83.2958, 83.2973, 83.3008, 83.3024, 83.3075, 83.3092, 83.3101, 83.3110, 83.3161, 84.716, 84.720, 86.1222, 89.1253, 89.1277, 92.270; 42 specimens. NMV P97575–6, P98238, P98276, P101568, P101590–1, P101690, P101908, P101930, P101950–1, P101953–5, P102228, P102273, P102394–6, P119516–7, P119685–8; 26 specimens. UWA NW141, 91477, 91488; 9 specimens. GSWA F9388, 30083; 4 specimens.

Description

Shell of medium-large size, thin, elongately fusiform, spire height greater than half total height; spire angle 25°; whorls rapidly descending, convex, shouldered at adapical two fifths; whorls slightly concave posterior to shoulder, outer face flattened and parallel to principal axis; whorl outer face of internal mould slightly concave; sutures adpressed, attached anterior to periphery; last whorl constricted anteriorly; aperture elongate, height 3.5 times width, narrowing anteriorly to form moderately extended anterior canal; columella slightly concave with two strong, oblique plaits set somewhat anteriorly and sometimes a third, weak posterior plait; sculpture poorly preserved, comprising low, narrow slightly sinuate axial costae, about 16 on last whorl, accentuated on shoulders, obsolete anterior to sutures and probably also on base; costae weakly replicated on internal mould; secondary spiral sculpture of close, granulate lirae extending over entire spire and last whorl, finer and more crowded on shoulder.

Dimensions

	Height	Max. diameter	Whorls
WAM 80.863	100 (est.)	26	8+ (est.)
WAM 83.2973	85 (est.)	23	7+ (est.)
WAM 86.1222	120 (est.)	32	8+ (est.)
GSWA F9388	120 (est.)	33	8+ (est.)

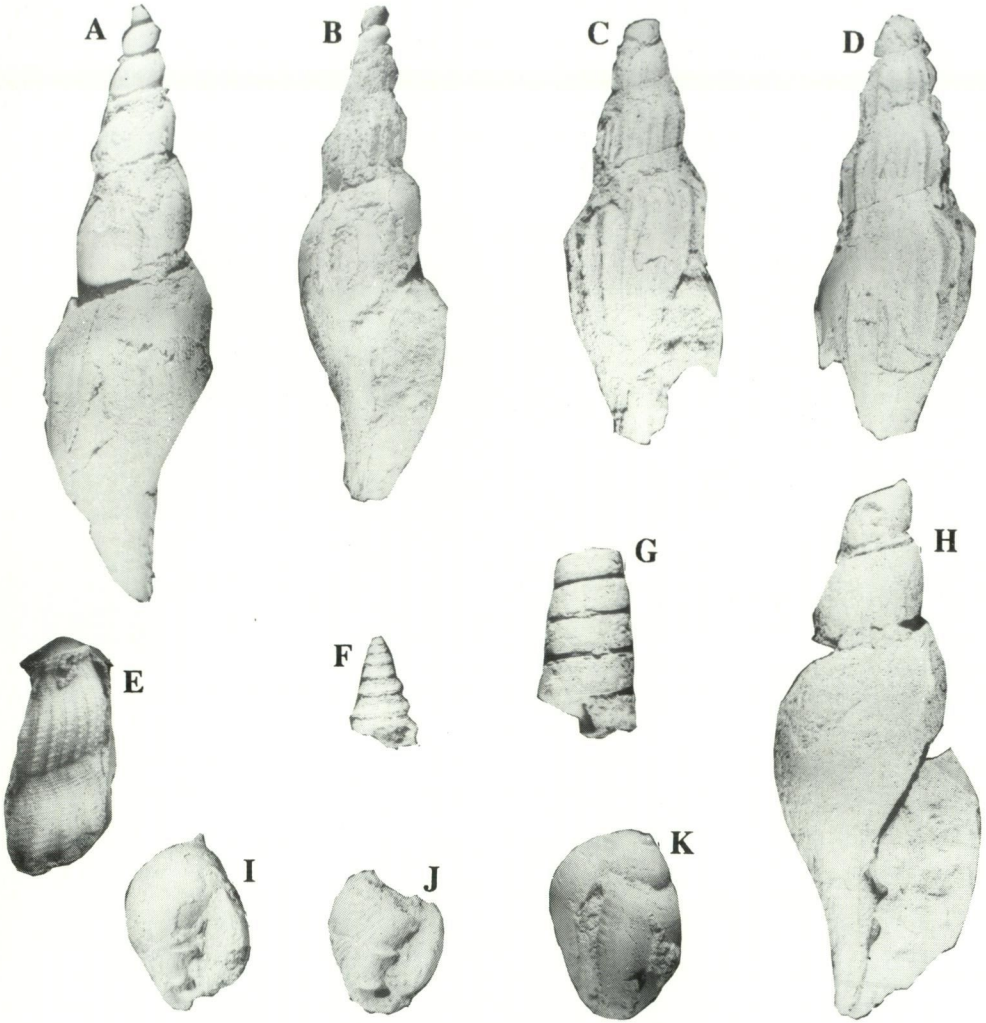

Figure 12 **A–E**, *Eovolutilithes* cf. *subsemiplicatus* (d'Orbigny). **A**, WAM 80.863, locality 18, internal mould with shell remnants, 180° from aperture, x 0.9; **B**, WAM 83.2973, locality 3, internal mould with shell remnants, apertural, x 0.9; **C, D**, NMV P101908, locality 50, internal mould with shell remnants; **C**, apertural, x 0.9; **D**, 180° from aperture, x 0.8; **E**, UWA NW 141 (part), locality 53, latex cast of natural external mould in phosphatic nodule, x 1.1. **F**, *Bathraspira* (?) sp. WAM 90.251, locality 41, apertural, x 1.7; **G**, Nerineid (?), genus and species undetermined, UWA NW 146 (part), locality 51, nodule bed, internal mould, apertural, x 1.1; **H**, Volutid (?) genus and species undetermined WAM 83.2999, locality 10 (nodule bed), internal mould, apertural, x 0.9. **I–K**, *Avellana* (?) sp. **I**, WAM 90.212a, locality 13, specimen shows spiral sculpture, apex and columellar plaits, apertural, x 1.8; **J**, WAM 83.3009, locality 6, showing aperture, anterior extremity and columellar plaits, apertural, x 1.7; **K**, WAM 83.2974, locality 3, internal mould viewed across aperture to show impressions of internal crenulae of outer lip, x 1.6.

Remarks

The material to hand is inadequately preserved for positive determination but, as far as can be seen and from the available figures, resembles the specimens of *Eovolutilithes subsemiplicatus* (d'Orbigny) recorded from the Senonian of Aachen and Vaals by Holzapfel (1888: 95, pl. 10, figs 1–3) and from Brunswick by Mueller (1898: 123, pl. 16, figs 10, 18–21). Akopyan (1976: 282, pl. 59, figs 4, 5) has extended the distribution of this species to the Coniacian of Zakavkasia, Armenia.

The present species is not uncommon in the Miria Formation, usually as fragmentary internal moulds; specimens retaining elements of shell are of infrequent occurrence.

Stratigraphic Range

Nodule bed at contact of Korojon Calcarenite and Miria Formation; Miria Formation. Maastrichtian.

Volutid (?) genus and species undetermined

(Figure 12 H)

Material

WAM 83.2999, 85.93; 2 specimens.

Description

Internal mould fusiform with few, moderately inflated whorls; plane of attachment located well anterior of periphery; outer lip everted; apertural height more than twice its width (35 to 15 mm); aperture narrowing anteriorly to a canal; columella with two strong, oblique plaits.

Dimensions

	Height	Max. diameter	Whorls
WAM 83.2999	105 (est.)	35 (est.)	2.3+

Remarks

Both specimens are internal moulds devoid of shell remains. The material suggests the presence of a second species of Volutidae in the Miria assemblage, but requires the collection of better-preserved specimens for confirmation. It is distinguished readily from the associated and much more common *Eovolutilithes* cf. *subsemiplicatus* (d'Orbigny) by its more inflated whorls and wider aperture.

Stratigraphic Range

WAM specimen 83.2999 was collected from the nodule bed at the contact of the Korojon Calcarenite and the Miria Formation. The preservation state of 85.93 is suggestive of a similar origin for that specimen and the occurrence of the species in the Miria Formation proper is unconfirmed. Early Maastrichtian.

Subclass Heterobranchia Gray, 1840
Order Heterostropha Fischer, 1885
Superfamily Architectonicoidea Gray, 1840
Family Mathildidae Dall, 1889
Genus *Bathraspira* Cossmann, 1906

Type species
Cerithium tectum d'Orbigny, 1842, by original designation.

Bathraspira (?) sp.
(Figure 12 F)

Material
WAM 90.251; 1 specimen.

Description
Shell small with a turriculate spire subtending an angle of 35°; whorls strongly carinate a little posterior to suture; whorls posterior to keel, sloping steeply and slightly concave; anterior whorl slope is short and slightly concave; sculpture of fine, close, spiral lirae, slightly narrower than interspaces, numbering about seven posterior and three anterior to keel; keel slightly notched on anterior whorls.

Dimensions

	Height	Max. diameter	Whorls
WAM 90.251	8.9	5.4	6.5

Remarks
The apical extremity and the anterior portion of the shell are missing.

The apertural characters of this rarity being unknown, the generic assignment remains tentative until more material is to hand. However we note that the specimen bears some resemblance to *Bathraspira tecta* (d'Orbigny), type species of the genus, as figured by Cossmann (1906, pl. 6, figs 25–27) and by Abbass (1973, pl. 3, fig. 1) but the posterior whorl slope does not form as prominent a shoulder as in that species. *B. tecta* is recorded from the Albian of England, France, Germany, Switzerland and Malagasy according to Abbass (1973: 129).

The Miria specimen also bears some resemblance to *B. fouadi* Abbass from the English Albian but, in comparison, the keel is less sharp and the spiral lirae are of equal thickness, they being unequal in the latter species. *B. fouadi* is said to "show considerable variation in both ornament and the form of the adapical [i.e., posterior] slope", according to Abbass (1973: 129).

A species of *Bathraspira* is recorded from the Aptian-Albian of Honshu by Kase (1984: 133–134, pl. 20, figs 14, 15) but its whorl profile and sculpture differ substantially from those of the present specimen.

Stratigraphic Range
Miria Formation. Late Maastrichtian.

Superfamily Nerineoidea Zittel, 1873
Family Nerineidae Zittel, 1873
Nerineid (?), genus and species undetermined

(Figure 12 G)

Material

NMV P102020, P102240; 2 specimens. UWA 91449, NW 146; 3 specimens.

Description

Internal mould turriculate; spire multi–whorled, slender, sides straight; spire angle of 15°; outer faces of mould flat; suture impressions incised, parallel; periphery basal, angulate, a little expanded on the last whorl suggesting the presence on the shell of a basal astragal; base very slightly convex; aperture poorly indicated, the outer and basal lips forming an angle of about 70°; columella with at least one fold.

Dimensions

	Height	Max. diameter	Whorls
UWA NW146	22	12	4.5+

The above are the actual measurements of the mould. The original shell height was probably about 45–50 mm.

Remarks

All specimens are fragmentary internal moulds of turriculate, nerineiform shells, the largest comprising six whorls.

The material to hand is generically indeterminable and does no more than establish the possible presence of the Nerineidae in the Miria assemblage. All specimens are phosphatised internal moulds, entirely devoid of shell remnants and may have originated within the nodule bed at the basal contact of the Miria Formation. This suggestion requires confirmation from field study.

Stratigraphic Range

Nodule bed at contact of Korojon Calcarenite and Miria Formation. Early Maastrichtian.

Subclass Opisthobranchia Milne Edwards, 1848
Order Cephalaspidea Fischer, 1883
Superfamily Acteonoidea d'Orbigny, 1842
Family Ringiculidae Meek, 1863
Genus *Avellana* d'Orbigny, 1843

Type species

Cassis avellana Brongniart, 1822, by tautonomy.

***Avellana* (?) sp.**
(Figures 12 I–K)

Material

WAM 71.197, 83.2974, 83.2988, 83.3009, 85.323, 90.212, 90.226; 8 specimens. NMV P102021, P119596, P119706; 3 specimens. UWA 91457; 1 specimen.

Sohl (1964a: 295–296) has discussed the apparently small differences that distinguish the globose ringiculid genera *Avellana* and *Oligoptycha* Meek, 1876. These concern chiefly the dispositions of the columellar and parietal plaits and the presence or absence of denticulation within the outer lip. Summarised these are: in *Avellana*, the outer lip is denticulate within, the columellar plait is single and horizontal and the two parietal plaits extend fully around the whorl into the aperture (i.e., as far as the columellar plait); in *Oligoptycha*, the outer lip may be smooth or moderately denticulate within, the single columellar plait is much the strongest and is oblique and the parietal plaits may number 0–2 and if present do not extend into the aperture as far as the columellar plait.

By these criteria, the limited Miria material would seem to lie closer to *Avellana*, a conclusion which remains subject to confirmation as additional, better material comes to hand.

Description

Shell small, ovate, higher than wide; spire short, of about three whorls, apex acute; last whorl large, inflated and basally constricted; aperture oblique, higher than wide, acutely angulate posteriorly, broadly rounded anteriorly; parietal and columellar margins with broad callus, the former bearing two widely spaced plaits, adapical one weaker; columella short, concave, thickened, with one basal plait, equal in strength and slightly convergent to abapical parietal plait; mould of outer lip shows impression of a weak, denticulate internal varix, associated possibly with an external varix; sculpture of fine, close, beaded, spiral cords (conversely, chain-like, spiral grooves), a projection of which may be observed sometimes on surface of internal mould.

Dimensions

	Height	Max. diameter	Whorls
WAM 71.197	15 (est.)	11	4 (est.)
WAM 83.2974	16 (est.)	12.5	4 (est.)
WAM 83.2988	16 (est.)	11	4 (est.)
WAM 90.212a	17.5 (est.)	12.3	4 (est.)
WAM 90.226a	15 (est.)	10.5	4 (est.)
WAM 90.226b	17.5 (est.)	13.2	4 (est.)
UWA 91457	16 (est.)	11	4 (est.)

With the partial exception of 90.212a, the measured specimens are essentially internal moulds and the dimensions apply to the moulds. The exception retains a substantially intact apex though the basal extremity is missing.

Remarks

As noted above, most of the material is internal moulds devoid of shell. Exceptions are

WAM 83.3009 and 90.212a which, taken together, retain the parietal, columellar and basal margins of the aperture and elements of the spire and last whorl showing sculpture.

The present species shows some resemblance in shape to *A. cassis* d'Orbigny, 1843 from the Late Cretaceous of France but appears to be a little smaller. It is also close to *A. inversestriata* Kner, 1852 from the Late Cretaceous of Belgium, Poland and Malagasy (Basse 1931) but the Miria species is a little wider relative to height, the spire whorls are less convex and the lirae may be finer and more numerous.

The genus *Avellana* attained a cosmopolitan distribution in the Early Cretaceous and remained common and widespread into the Late Cretaceous. The oldest Australian records are from the Albian of the Great Artesian Basin (Ludbrook 1966).

WAM 90.211 is an internal mould (estimated dimension 15 x 10 mm) of a ringiculid species from the Miria Formation of the northern Giralia Range having less globose proportions and a more elevated spire than the above material. It may represent a second species of the family but consideration of this is deferred until other material is available. WAM specimen 76.2230 is the internal mould of a small ringiculid from the Gingin Chalk (Santonian) of the Perth Basin at Gingin. It shows the impressions of a lightly denticulate outer lip, one columellar and two parietal plaits and may represent a species of *Avellana*.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Incertae sedis

Gastropod, species A

(Figures 13 A–C)

Material

WAM G10580, 60.28, 60.69, 60.89, 65.543, 71.196, 71.305, 71.308, 80.646, 80.691, 80.883, 80.892, 83.2902, 83.2920, 83.2934, 83.2998, 83.3050, 83.3073, 83.3100, 84.715, 84.719, 84.728, 84.943, 85.325, 89.1276; 41 specimens. NMV P97573–4, P102227, P102330; 4 specimens. UWA NW141, 91473; 5 specimens.

Description

Internal mould of up to medium-large size, fusiform, spire elevated and exceeding half the total height; spire profile straight, of few, rapidly descending whorls; spire angle of 33° in juvenile specimens increasing to about 43° in maturity; periphery low, subangulate in immature specimens, more rounded in maturity; periphery coincident with plane of attachment; aperture higher than wide, oblique, broadly lenticular, angulate posteriorly siphonate anteriorly; columella apparently straight and thickened, moderately produced, without plaits; growth pauses shown by impressions of internal varices of outer lip; varices prosocline and in most cases crenulated, occasionally extending onto base; varices commonly randomly dispersed but occasionally with a weak, ca. 180°, periodicity from whorl to whorl; spire outer face of internal moulds with shallow spiral grooves in places, suggesting a comparable external shell sculpture; base with fine, close spiral sculpture.

Figure 13 Gastropod, *incertae sedis* species A. **A**, WAM 80.646, locality 26, nodule bed, internal mould showing impressions of three internal apertural crenulae, apertural, x 1.1; **B**, WAM 71.196, locality 24, nodule bed, internal mould with expanded last whorl, impressions of internal spiral grooves and smooth columella, apertural, x 1.2; **C**, WAM 80.883, locality 51, nodule bed, internal mould of immature specimen showing slightly concave spire profile, apertural, x 1.2.

Dimensions

	Height	Height spire	Max. diameter	Spire angle
WAM 71.196	110 (est.)	65 (est.)	54	43°
WAM 80.646	110 (est.)	60 (est.)	47	41°
WAM 80.883	75 (est.)	45 (est.)	35	36°
WAM 80.892	140 (est.)	75 (est.)	66	43°

Remarks

All specimens to hand are internal moulds, one of which retains shell remnants.

Because of the limited preservation of the material, the affinities of this species and its identity remain unclear. It resembles to some extent moulds of *Pterodonta ? terebralis* Stoliczka, 1867, from the Cenomanian Utatur Group of South India (Stoliczka 1867: 42, pl. 5, figs 6–8) but the Miria species is much wider relative to height and has no trace of the columellar plaits that are shown on Stoliczka's fig. 7. The mould of the columellar surface has been examined on WAM specimens 60.28b, 71.196 and 71.305 and no trace of plaits is present on these.

The data available to us, together with our own observations, lead us to the conclusion that the species is probably confined to the nodule bed at the contact of the Korojon Calcarenite and Miria Formation. The species is quite common in this horizon; however examples with remnant shell are rare. WAM 89.1276b shows moulds of the boring sponge *Entobia cretacea* Portlock.

Stratigraphic Range

Nodule bed at contact of Korojon Calcarenite and Miria Formation. Early Maastrichtian.

Gastropod, family and genus undetermined, species B

(Figures 14 A–C)

Material

NMV P119599, P102229; 2 specimens.

Description

Shell small to medium in size, robust, fusiform with prominent projecting keel at or below midwhorl; sutures adpressed, plane of attachment anterior to keel, which is retained on spire whorls; apical whorls missing; aperture broadly lenticular, notched posteriorly and passing abruptly into anterior canal, missing on both specimens; columella regularly concave, without callus or visible plaits; sculpture on posterior slope of four, fine, well-spaced lirae; immediately posterior to keel a strong cord; keel comprising two strong cords, serrated by ten (on last whorl) projecting tubercles; basal sculpture, anterior to keel of about seven, strong, spiral cords, weakening toward canal; weak radial varicosities extend over base from the peripheral tubercles, becoming obsolete toward canal.

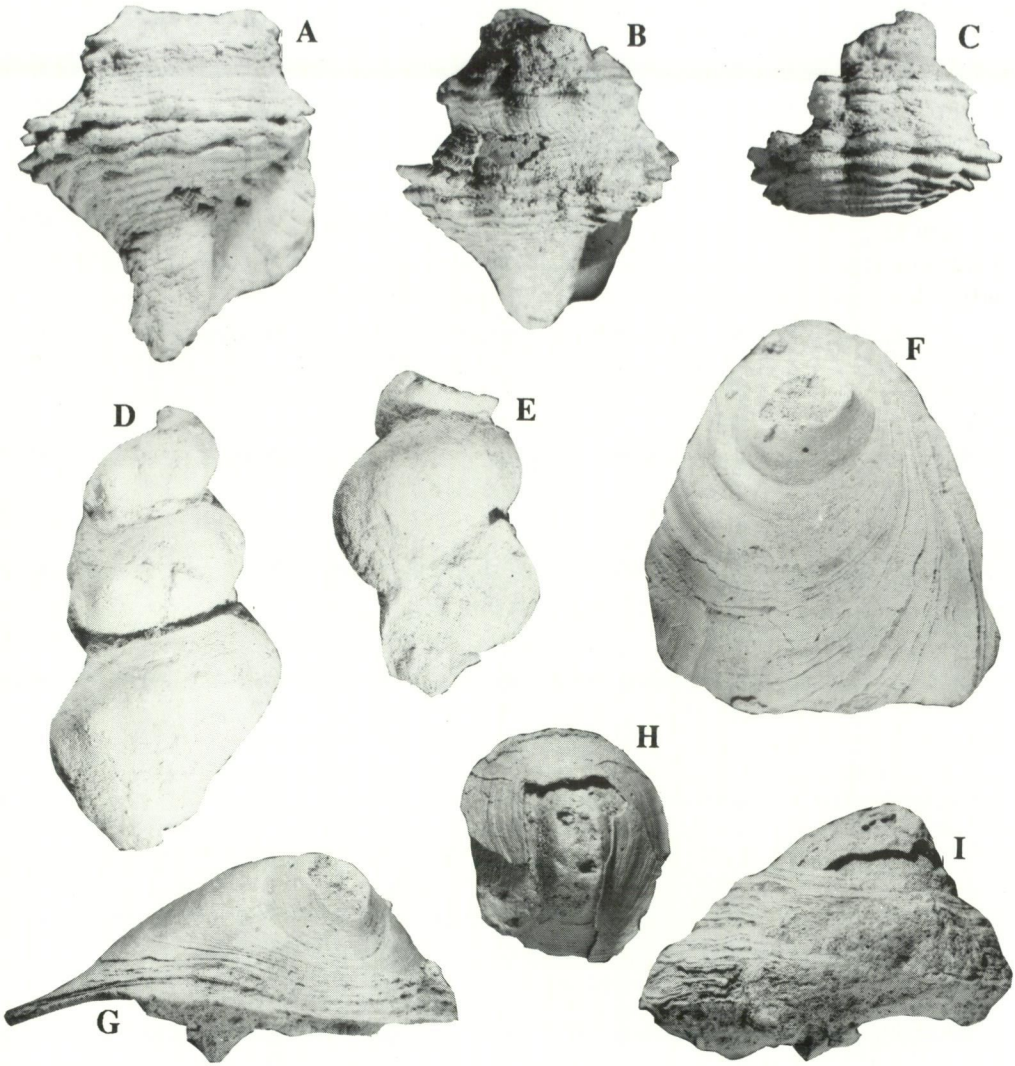

Figure 14 **A–C** Gastropod, *incertae sedis* species B. **A, B**, NMV P119599, locality 45, specimen of 1.5 whorls, lacking most of the spire and canal, **A**, apertural, x 2.4; **B**, 180° from aperture, x 2.3; **C**, NMV P102229, locality 22, fragmentary specimen, 180° from aperture, x 2.2. **D, E**, Gastropod, *Incertae sedis*, species C. **D**, WAM 83.3053, locality 1, internal mould, 180° from aperture, x 1.3; **E**, WAM 84.718, locality 6 (nodule bed), fragmentary internal mould, apertural, x 1.4. **F–I**, Gastropod, *incertae sedis*, species D. **F, G**, WAM 87.392, locality 3, left-posterior portion of shell showing abraded apex; **F**, apical-oblique, x 1.25; **G**, horizontal, from left-posterior quadrant showing sinuous margin, x 1.8; **H**, UWA 91458 (part), locality 40, viewed from above, missing are apical and left-posterior portions, shows transverse posterior compression, x 1.3; **I**, NMV P101678, locality 13, left-posterior portion of shell (apex missing) showing rugose-laminar sculpture.

Dimensions

	Height spire	Height aperture	Max. diameter
NMV P119599	20 (est.)	8	16
NMV P102229	15 (est.)	–	14

Without the anterior canals, the total height of these species cannot be determined.

Remarks

The identity of these rare, fragmentary specimens remains problematic. The available characters suggest a location in the Turbinellidae, perhaps near *Columbarium* Martens, 1881; further determination requires access to better preserved material.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

Gastropod, family and genus undetermined, species C

(Figures 14 D,E)

Material

WAM 80.890, 83.2986, 83.2997, 83.3053, 84.718; 5 specimens. NMV P101956; 1 specimen.

Description

Internal moulds, medium sized, fusiform with turriculate spire and strongly convex whorls, shouldered a little above mid-whorl and plicate or nodose around periphery; about ten plicae per whorl; aperture higher than wide, subrectangular, roundly angulate at outer face (periphery); columella oblique, concave, apparently passing into a broad anterior canal, possibly extended (NMV P101956); no internal varices apparent on mould.

Dimensions

	Height	Max. diameter	Whorls
WAM 83.2986	80 (est.)	27 (est.)	2.2+
WAM 83.2997	65 (est.)	21 (est.)	2.5+
WAM 83.3053	75 (est.)	26 (est.)	3.0+
WAM 84.718	60 (est.)	21 (est.)	2.0+

The height estimates makes no allowance for the presence of a presumed anterior canal.

Remarks

All specimens to hand are fragmentary internal moulds, mostly devoid of shell remains.

This distinctive but poorly preserved species is indeterminable without additional better material. Two of the specimens (WAM 83.2997, 84.718) were collected from the nodule bed at the contact of the Korojon Calcarenite and Miria Formation and the condition of several others is consistent with the same derivation.

Stratigraphic Range

Nodule bed at contact of Korojon Calcarenite and Miria Formation; Miria Formation. Maastrichtian.

Gastropod; family and genus undetermined, species D

(Figures 14 F–I)

Material

WAM 87.312, 87.392; 2 specimens. NMV P101678?; 1 specimen. UWA 91458; 1 specimen.

No specimen is complete; all lack the apex and significant other portions of the shell. Juvenile specimen UWA 91458 shows some internal features.

Description

Shell of medium size, thin, irregularly capuliform, apex of variable height, located centrally very close to posterior margin and curved posteriorly; outline not precisely determinable but probably more or less oval, longer than wide; juvenile shell transversely compressed posteriorly, a little expanded anteriorly; on anterior slope and to left of midline is a narrow, weak, radial rib terminating in small marginal indentation; muscle attachment scar (on juvenile specimen) well-formed, about 1 mm wide and continuous around presumed anterior margin at a distance of about 1.5 mm. In lateral view, shell margin sinuous, posterior margin higher than anterior; from posterior view, margin saddle-shaped or arched in cross section. Sculpture of irregular, broad, colabral folds and irregular growth lines, crossed by obscure, very fine, short, shallow, radial incisions.

Dimensions

	Length	Width	Height
WAM 87.312	55 (est.)	43 (est.)	20 (est.)
WAM 87.392	–	60 (est.)	15 (est.)
NMV P101678	40 (est.)	30 (est.)	20 (est.)
UWA 91458	20 (est.)	18 (est.)	10 (est.)

Remarks

Owing to poor preservation of the limited material to hand, the systematic position and identity of this species remain problematical. It bears some resemblance to *Brunonia grandis* Mueller, 1898 (type species of *Brunonia* Mueller, 1898) from the early Senonian of Brunswick, Germany and to a lesser extent to *B. annulata* (Yokoyama, 1890) from the Barremian to Aptian of Honshu. The Miria species differ from these in that the apex is much closer to the posterior margin and the colabral folds are fewer, much broader and less prominent. However, Kase (1988) has shown that *Brunonia annulata* is a probable carinariid mesogastropod, consistent with its very thin shell. We conclude that the present species is unlikely to belong in that genus or family.

The sinuous outline of the shell margin of the large specimen among the Miria material suggests that the body of the animal extended beyond the shell as in the extant fissurellid *Scutus* Montfort, 1810 and that the shell was not used for protection in the manner of most limpets.

Specimen NMV P101678 retains very little of the shell but sufficient, with the mould, to indicate that it is much thicker and higher than the others. In shape it is somewhat similar to the specimen of "*Patella*" *inconstans* Geinitz from the Late Turonian of Zatschke near Pirna, Saxony (Geinitz 1875: 167, pl. 30, figs 1–2) referred to by Mueller (1898) as belonging to *Brunonia*.

Somewhat similar patelliform shells occur in the Late Cretaceous of North America and have been assigned to the genus *Anisomyon* Meek and Hayden, 1860 but these seem to lack the sinuate margin of the Miria specimens. *Anisomyon* has been located within the Siphonariidae from the form of the muscle attachment scar observed in some specimens of the genus (Sohl, 1964a: 323).

Clarification of the identity and affinities of the Miria species depends on the collection of further, better preserved material.

Stratigraphic Range

Miria Formation. Late Maastrichtian.

ACKNOWLEDGEMENTS

Valued assistance in the course of this study from the undermentioned is acknowledged with sincere thanks. Responsibility for all questions of interpretation lies solely with the authors. The Head, Geology Department, University of Western Australia and the Director, Geological Survey Division, Western Australian Department of Minerals and Energy approved the loan of study material from their collections and assisted with the loan of literature. Dr A.V. Dhondt, Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels and Dr N.J. Morris, Natural History Museum, London, facilitated access by G.W. Kendrick to their respective research collections and assisted generously with literature and in other ways. Dr A.D. Agate, Director, Agharkar Research Institute, Pune, and Dr R.M. Badve, of the Institute's Department of Geology and Palaeontology provided access by G.W Kendrick to research collections and facilities and assisted generously with library services and accommodation whilst in Pune. For arranging participation by G.W. Kendrick in visits to Cretaceous sites in South India, special thanks are due to Dr Badve. Dr J.D. Taylor, Natural History Museum, London, Mr R. Burn, Geelong, Victoria and Mrs S.M. Slack-Smith, Western Australian Museum, kindly assisted in locating literature. Mr D. Tworek, Museum of Victoria, provided translation of Russian-language published work. For the collection of fossil material of considerable value to this study, we are indebted to the following: Drs A. Baynes, E. Frankel, A. Gale, Mr K. Grey, Drs D. Haig, R.A Henderson, R. Holst, J.A. Long, Mr A.F. Longbottom, Drs J. Maisey, K.J. McNamara, Mr G. Milner and Mrs L.C. Schekkerman. SEM photography was performed by Mr C. Bryce, other photography by Mr D. Elford and Miss K. Brimmell. Manuscript preparation was performed by Mrs A. Nevin and Mrs S. Dalton. We thank the managements of Cardabia and Giralia stations for access to their leases and the use of facilities.

REFERENCES

Abbass, H.L. (1963). A monograph on Egyptian Cretaceous gastropods. *United Arab Republic Geological Survey Palaeontological Series Monographs* **2:** 146 pp.

Abbass, H.L. (1973). Some British Cretaceous gastropods belonging to the families Procerithiidae, Cerithiidae and Cerithiopsidae (Cerithiacea). *Bulletin of the British Museum (Natural History), Geology* **23:** 105–175.

Abdel-Gawad, G.I. (1986). Maastrichtian non-cephalopod mollusks (Scaphopoda, Gastropoda and Bivalvia) of the Middle Vistula Valley, Central Poland. *Acta Geologica Polonica* **36:** 69–224.

Adams, H. and Adams, A. (1853). *The genera of recent Mollusca arranged according to their organization.* Volume 1. London.

Akopyan, V.T. (1976). [Late Cretaceous gastropods from the Armenian S.S.R. Erevan.] *Izd. -vo Akademiya Nauk Armyanskoy S.S.R.* 344 pp. [In Russian].

Allison, E.C. (1955). Middle Cretaceous Gastropoda from Punta China, Baja California, Mexico. *Journal of Paleontology* **29:** 400–432.

Allmon, W.D., Nieh, J.C. and Norris, R.D. (1990). Drilling and peeling of Turritelline gastropods since the Late Cretaceous. *Palaeontology* **33:** 595–611.

Archiac, A.d' (1846). Rapport sur les fossiles de Tourtia. *Mémoires de la Société Géologique de France, 2ième Series* **2:** 291–351.

Barron, E.J. (1987). Global Cretaceous paleogeography – International Geologic Correlation Program Project 191. *Palaeogeography, Palaeoclimatology, Palaeoecology* **59:** 207–214.

Basse, É. (1931). *Monographie paléontologique du Crétacé de la Province de Maintirano, Madagascar.* Service deS Mines, Tananarive. 86 pp.

Bellardi, L. (1884). *I Molluschi dei terreni Terziarii del Piemonte e della Liquria 4.* Turino, Loescher, 62p.

Berry, S.T. (1910). Review of W.H. Dall Report on a collection of shells from Peru... Proc. U.S.N.M. 37, p. 147–291, p.s. 20–28, 1904. *Nautilus* **23(10):** 130–132.

Beu, A.G. and Ponder, W.F. (1979). A revision of the species of *Bolma* Risso, 1826 (Gastropoda: Turbinidae). *Records of the Australian Museum* **32:** 1–68.

Blank, M. Ya. (1974). [Class Gastropoda]. *In* Blank, M. Ya *et al., Atlas of the Upper Cretaceous fauna of Donbass*, pp. 118–157. Ministerstvo Vysshego i Srednego Spetsialnogo Obrazovaniya U.S.S.R. Kommunarskiy Gornometallurgicheskiy Institut, Nedra, Moskva. [In Russian].

Boury, E. de. (1887). *Étude sur les sousgenres de Scalidae du Bassin de Paris.* de Boury, Paris, 43p.

Boury, E. de. (1909). Catalogue des sous-genres de Sclidae. *Journal de Conchyliologie* **57:** 255–258.

Bøggild, O.B. (1930). The shell structure of the mollusks. *Det Kongelige Danske Videnskabernes Selskabs Skrifter. Naturvidenskabelig og Mathematisk Afdelinger* (9) **2:** 231–326.

Bramwell, M. (ed.) (1977). *The Macmillan Atlas of the Oceans.* Mitchell Beazley Publishers, London. 208 pp.

Bronn, H.G. (1862). Malacozoa Acephela. *Die Klassen und Ordnungen des Thier-Reichs* **3(1):** 1–518.

Buckeridge, J.S. (1983). Fossil barnacles (Cirripeda: Thoracica) of New Zealand and Australia. *New Zealand Geological Survey Palaeontological Bulletin* **50:** 151 pp.

Caron, M. (1985). Cretaceous planktic Foraminifera. *In* Bolli, H.M., Saunders, J.B. and Perch-Neilson, K. (eds). *Plankton Stratigraphy*, pp. 17–86. Cambridge University Press, Cambridge.

Clarkson, P.S. and Shepherd, S.A. (1985). Distribution and feeding of archaeogastropods in a boulder habitat at West Island, South Australia. *Journal of the Malacological Society of Australia* **7:** 35–44.

Conrad, T.A. (1858). Observations on a group of Cretaceous fossil shells found in Tippah County, Mississippi, with descriptions of fifty-six new species. *Journal of the Academy of Natural Sciences of Philadelphia* (2) **3:** 323–336.

Conrad, T.A. (1860). Descriptions of new species of Cretaceous and Eocene fossils of Mississippi and Alabama. *Journal of the Academy of Natural Sciences of Philadelphia* (2) **4:** 275–298.

Cossmann, M. (1901). Essais de Paléoconchologie comparée 4. Cossmann, Paris.

Cossmann, M. (1906). *Essais de Paléoconchologie comparée*, **7:** 261 pp. Author and F.R. de Rudeval, Paris.

Cossmann, M. (1915) (1916). *Essais de Paléoconchologie comparée*, **10:** 292 pp. Author, Paris.

Cossmann, M. (1916). *In* Cossmann, M. and Peyrot, A. Conchologie néogénique de l'Aquitaine. *Actes de la Société Linnéenne de Bordeaux* **69:** 157–365.

Cossmann, M. and Pissarro, G. (1910–1913). *Iconographie Complète des Coquilles Fossiles de l'Éocéne des Environs de Paris*, **2.** Paris.

Cottreau, J. (1922). Paléontologie de Madagascar X. Fossiles Crétacés de la côte orientale. *Annales de Paléontology* **11:** 109–192.

Cox, L.R. (1959). Diagnoses of two new genera of Mesozoic Pleurotomariidae. *Proceedings of the Malacological Society of London* **33:** 238.

Cox, L.R. (1960a). Thoughts on the classification of the Gastropoda. *Proceedings of the Malacological Society of London* **33:** 239–261.

Cox, L.R. (1960b). The British Cretaceous Pleurotomariidae. *Bulletin of the British Museum (Natural History), Geology* **4:** 385–423.

Cox, L.R. (1961). The molluscan fauna and probable Lower Cretaceous age of the Nanutarra Formation of Western Australia. *Australian Bureau of Mineral Resources, Geology and Geophysics Bulletin* **61:** 40 pp.

Cuvier, G. (1797). *Tableau élémentaire de l'histoire naturelle des animaux.* Paris.

Dall, W.H. (1889). Reports on the results of dredging, under the supervision of Alexander Agassiz in the Gulf of Mexico (1877–78) and in the Caribbean Sea (1879–80), by the U.S. Coast Survey Steamer "Blake," Lieut.-Commander C.D. Sigsbee, U.S.N., and Commander J.R. Bartlett, U.S.N., Commanding. XXIX Report on the Mollusca. Part II Gastropoda and Scaphopoda. *Bulletin of the Museum of Comparative Zoology, at Harvard College* **18:** 1–492.

Darragh, T.A. (1989). A revision of the Tertiary Volutidae (Mollusca: Gastropoda) of south-eastern Australia. *Memoirs of the Museum of Victoria* **49:** 195–307.

Darragh, T.A. and Kendrick, G.W. (1991). Maastrichtian Bivalvia (excluding Inoceramidae) from the Miria Formation, Carnarvon Basin, north western Australia. *Records of the Western Australian Museum Supplement* **36:** 102 pp.

Durham, J.W. (1937). Gastropods of the family Epitoniidae from Mesozoic and Cenozoic rocks of the west coast of North America, including one new species by F.E. Turner and one by R.A. Bramkamp. *Journal of Paleontology* **11:** 479–512.

Erickson, J.M. (1974). Revision of the Gastropoda of the Fox Hills Formation Upper Cretaceous (Maestrichtian) of North Dakota. *Bulletins of American Paleontology* **66** (284): 127–254.

Etheridge, R. (1909). Lower Cretaceous fossils from the sources of the Barcoo, Ward and Nive Rivers, south Central Queensland. Part II – Cephalopoda. *Records of the Australian Museum* **7:** 235–240.

Eudes-Longchamps, E. (1864). *Notes Paléontologiques* **1**(6). Caen, Paris.

Fischer, P. (1880–87). *Manuel de conchyliologie.* 1369 pp. Paris.

Fischer von Waldheim, G. (1807). *Muséum Demidoff, ou catalogue systématique et raisonnées de la nature et de l'art etc.* Moscow, 3 volumes (1806–1806), Volume 3 (1807).

Fleming, J. (1822). *Encyclopaedea Brittanica* edition 6, Supplement, Edinburgh.

Gardner, J.S. (1876). On Cretaceous Gastropoda – family Scalidae. *Geological Magazine (new series, December 2)* **3:** 105–114.

Gardner, J.S. (1878). On the Cretaceous Dentaliidae. *Quarterly Journal of the Geological Society of London* **34:** 56–65.

Geinitz, H.B. (1875). Das Elbthalgebirge in Sachsen II. *Palaeontographica* **20**(2): 1–245.

Glibert, M. (1963). Les Muricacea et Buccinacea fossiles du Cénozoic Étranger des collections de l'Institut Royal des Sciences naturelles de Belgique. *Mémoires de l'Institut Royal des Sciences naturelles de Belgique* (2) **74:** 1–179.

Goldfuss, G.A. (1841–1844). *Petrefacta Germaniae* 3: I–IV: 1–128. Arnz, Düsseldorf.

Govindan, A. (1972). Upper Cretaceous planktonic Foraminifera from the Pondicherry area, South India. *Micropalaeontology* **18:** 160–193.

Graham, A. (1955). Molluscan diets. *Proceedings of the Malacological Society of London* **31:** 144–159.

Gray, J.E. (1840). *Synopsis of the contents of the British Museum.* 42nd edn., 248 pp. London.

Gray, J.E. (1847). *List of the genera of Recent Mollusca.* Taylor, London.

Gray, J.E. (1850). Systematic arrangement of the figures. *In* Gray, M.E. *Figures of molluscous animals.* **4:** 63–206. London.

Gray, J.E. (1853). On the division of ctenobranchous gasteropodous Mollusca into larger groups and families. *Annals and Magazine of Natural History.* 2, **11**: 124–133.

Griepenkerl, O. (1889). Die Versteinerungen der Senonen Kreide von Königslutter im Herzogthum Braunschweig. *Palaeontologische Abhandlungen* **4:** 303–419.

Groves, L.T. (1990). New species of Late Cretaceous Cypraeacea (Mollusca: Gastropoda) from California and Mississippi and a review of Cretaceous Cypraeaceans of North America. *The Veliger* **33:** 272–285.

Guilding, L. (1834). Observations on *Naticina* and *Dentalium*, two genera of molluscous animals. *Transactions of the Linnean Society of London* **17:** 29–36.

Haller, B. (1892). Die Morphologie der Prosobranchier.. III Naticiden und Calyptraeiden. *Morphologisches Jahrbuch* **18:** 451–543.

Henderson, R.A., Kennedy, W.J. and McNamara, K.J. (1992). Maastrichtian heteromorph ammonites from the Carnarvon Basin, Western Australian. *Alcheringa* **16:** 133–170.

Henderson, R.A. and McNamara, K.J. (1985a). Taphonomy and ichnology of cephalopod shells in a Maastrichtian chalk from Western Australia. *Lethaia* **18:** 305–322.

Henderson, R.A. and McNamara, K.J. (1985b). Maastrichtian non-heteromorph ammonites from the Miria Formation, Western Australia. *Palaeontology* **28:** 35–88.

Hickman, C.S. and McLean, J.H. (1990). Systematic revision and suprageneric classification of trochacean gastropods. *Natural History Museum of Los Angeles County Science Series* **35:** 169 pp.

Hocking, R.M., Moors, H.T. and van de Graaff, W.J.E. (1987). Geology of the Carnarvon Basin, Western Australia. *Geological Survey of Western Australia Bulletin* **133.**

Holzapfel, E. (1887–1888). Die Mollusken der Aachener Kreide (Pt 1). *Palaeontographica* **34:** 29–180.

Houbrick, R.S. (1988). Cerithioidean phylogeny, *In* Ponder, W.F. (ed.), *Prosobranch phylogeny*. Symposium on prosobranch phylogeny, Ninth International Malacological Congress, Edinburgh, August-September 1986. *Malacological Review Supplement* **4:** 88–128.

Kase, T. (1984). *Early Cretaceous Marine and Brackish-water Gastropoda from Japan.* National Science Museum, Tokyo. 262pp.

Kase, T. (1988). Reinterpretation of *Brunonia annulata* (Yokoyama) as an early Cretaceous carinariid mesogastropod. (Mollusca). *Journal of Paleontology* **62:** 766–771.

Kennedy, W.J. and Henderson, R.A. (1992). Non-heteromorph ammonites from the Upper Maastrichtian of Pondicherry, South India. *Palaeontology* **35:** 381–442.

Koch, C.F. and Sohl, N.F. (1983). Preservational effects in paleoecological studies: Cretaceous mollusc examples. *Paleobiology* **9:** 26–34.

Kohn, A.J. (1983). Feeding biology of gastropods. *In* Saleuddin, A.S.M. and Wilbur, K.M. (eds), *The Mollusca* **5:** 1–63. Academic Press, London.

Kollman, H.A. (1979). Gastropoden aus den Losensteiner Schichten der Umgebung von Losenstein (Oberösterreich) 3, Teil: Cerithiacea (Mesogastropoda). *Annalen des Naturhistorischen Museums in Wien* **82:** 11–51.

Kollman, H.A. (1980). Gastropoden aus der Sandkalkbank (Hochmoosschichten Obersanton) des Beckens von Gosau (Oö.). *Annalen des Naturhistorischen Museums in Wien* **83:** 197–213.

Lamarck, J.B.P. (1812). *Extrait de cours de zoologie du Muséum d'Histoire naturelle sur les animaux invertébrés,...* 127 pp. Paris.

Linnaeus, C. (1758). *Systema naturae*, ed. 10.

Ludbrook, N.H. (1966). Cretaceous biostratigraphy of the Great Artesian Basin in South Australia. *Geological Survey of South Australia Bulletin* **40:** 223 pp.

McGowran, B. (1968). Late Cretaceous and Early Tertiary correlations in the Indo-Pacific Region. *Memoirs of the Geological Society of India* **2:** 335–360.

McNamara, K.J. (1987). The holasteroid echinoid *Echinocorys* from the Maastrichtian of Western Australia. *Records of the Western Australian Museum* **13:** 419–426.

McNamara, K J., Rexilius, J.P., Marshall, N.G. and Henderson, R.A. (1988). The first record of a Maastrichtian ammonite from the Perth Basin, Western Australia, and its biostratigraphical significance. *Alcheringa* **12:** 163–168.

Meek, F.B. (1863). Remarks on the family Actaeonidae, with descriptions of some new genera and sub-genera. *American Journal of Science* **2nd ser. 35:** 84–94.

Milne Edwards, H. (1848). Note sur la classification naturelle des mollusques gastéropods. *Annales des Sciences naturelles Zoologie.* ser. 3, **9:** 102–112.

Moore, R.C. (ed.) (1960). *Treatise on Invertebrate Paleontology Part I. Mollusca* 1. Geological Society of America and University of Kansas Press.

Morton, J.E. (1955). The structure and function of the stomach and sorting caecum in *Lunella smaragda* (Martyn) (Turbinidae). *Proceedings of the Malacological Society of London* **31:** 123–137.

Mueller, G. (1898). Die Molluskenfauna des Untersenon von Braunschweig und Ilsede. 1. Lamellibranchiaten und Glossophoren. *Abhandlungen der Königlich Preussichen Geologischen Landesanstalt, Neue Folge* **25:** 1–142.

Newton, R.B. (1909). Cretaceous Gastropoda and Pelecypoda from Zululand. *Transactions of the Royal Society of South Africa* **1:** 1–106.

Orbigny, A.d' (1842–1843). *Paléontologie Française. Terrain Crétacés* **2:** 456 pp. Masson, Paris.

Orbigny, A.d' (1850). *Prodrome de paléontologie stratigraphique universelle des animaux. Mollusques et Rayonnés* **1–2.** Masson, Paris.

Perron, F.E. (1975). Carnivorous *Calliostoma* (Prosobranchia: Trochidae) from the northeastern Pacific. *The Veliger* **18:** 52–54.

Pilsbry, H.A. and Olsson, A.A. (1954). Systems of the Volutidae. *Bulletins of American Paleontology* **35(152):** 271–306.

Ponder, W.F. (1983). A revision of the Recent Xenophoridae of the World and of the Australian fossil species. *Australian Museum Memoir* **17:** 1–126.

Ponder, W.F. and Warén, A. (1988). Classification of the Caenogastropoda and Heterostropha – a list of the family-group names and higher taxa. *In* Ponder, W.F. (ed.), *Prosobranch phylogeny.* Symposium on prosobranch phylogeny, Ninth International Malacological Congress, Edinburgh, August-September 1986. *Malacological Review Supplement* **4, Appendix:** 288–328.

Popenoe, W.P., Saul, L.R. and Susuki, T. (1987). Gyrodiform gastropods from the Pacific coast Cretaceous and Paleocene. *Journal of Paleontology* **61:** 70–100.

Rafinesque, C.S. (1815). *Analyse de la Nature, ou Tableau de l'univers et des corps organisés.* Palermo.

Rennie, J.V.L. (1930). New Lamellibranchia and Gastropoda from the Upper Cretaceous of Pondoland (with an Appendix on some species from the Cretaceous of Zululand). *Annals of the South African Museum* **28:** 159–260.

Robertson, R. (1970). Review of the predators and parasites of stony corals, with special reference to symbiotic prosobranch gastropods. *Pacific Science* **24:** 43–54.

Robertson, R. (1981). *Epitonium millecostatum* and *Coralliophila clathrata*: Two prosobranch gastropods symbiotic with Indo-Pacific *Palythoa* (Coelenterata: Zoanthidae). *Pacific Science* **34:** 1–17.

Roemer, F.A. (1841). *Die Versteinerungen des Norddeutschen Kreidebirges.* 145 pp. Hannover.

Roman, F. and Mazeran, P. (1920). Monographie paléontologique de la fauna du Turonien du Bassin d'Uchaux et de ses dépandances. *Archives du Muséum d'Histoire naturelle de Lyon* **12(2), 1:** 1–138.

Saul, L.R. and Popenoe, W.P. (1993). Additions to Pacific Slope Turonian Gastropoda. *The Veliger* **36:** 351–388.

Shafik, S. (1990). Late Cretaceous nannofossil biostratigraphy and biogeography of the Australian western margin. *Australian Bureau of Mineral Resources, Geology and Geophysics Report* **295:** 1–164.

Sohl, N.F. (1960). Archaeogastropoda, Mesogastropoda and stratigraphy of the Ripley, Owl Creek and Prairie Bluff Formations. *U.S. Geological Survey Professional Paper* **331-a:** 1–151.

Sohl, N.F. (1963). New gastropod genera from the late Upper Cretaceous of the east Gulf Coast Plain. *Journal of Paleontology* **37:** 747–757.

Sohl, N.H. (1964a). Neogastropoda, Opisthobranchia and Basommatophora from the Ripley, Owl Creek and Prairie Bluff Formations. *U.S. Geological Survey Professional Paper* **331-B:** 153–344.

Sohl, N.F. (1964b). Gastropods from the Coffee Sand (Upper Cretaceous) of Mississippi. *U.S. Geological Survey Professional Paper* **331-C:** 345–394.

Sohl, N.F. (1967). Upper Cretaceous gastropods from the Pierre Shale at Red Bird, Wyoming. *U.S. Geological Survey Professional Paper* **393-B:** 1–46.

Sohl, N.F. (1971). North American Cretaceous Biotic Provinces delineated by gastropods. *Proceedings of the North American Paleontological Convention, September 1969,* Part L: 1610–1638.

Sohl, N.H. (1987). Cretaceous gastropods: Contrasts between Tethys and the Temperate Provinces. *Journal of Paleontology* **61:** 1085–1111.

Stephenson, L.W. (1941). The larger invertebrate fossils of the Navarro Group of Texas. (Exclusive of corals and crustaceans and exclusive of the fauna of the Escondito formation. *University of Texas Publication* 4101, 641p.

Stewart, R.B. (1927). Gabb's California fossil type gastropods. *Proceedings of the Academy of Natural Sciences of Philadelphia* **78:** 287–447.

Stoliczka, F. (1867–1868). Cretaceous fauna of South India. Gastropoda. *Palaeontologica Indica* Series 5, parts 1–10, 13. 497 pp.

Swainson, W. (1840). *A treatise on Malacology.* Longman, London.

Taylor, J.D., Morris, N.J. and Taylor, C.N. (1980). Food specialization and the evolution of predatory prosobranch gastropods. *Palaeontology* **23:** 375–409.

Tembrock, M.L. (1968). Taxionomisch – stratigraphische Studie zur *Scalaspira* – Gruppe (Gastropoda, Tertiär). *Paläontologische Abhandlungen* **Abt. A3(2):** 193–322.

Termier, G. (1954). Gastéropodes du Crétacé Supérieur dans le Sud-Ouest de la France. Groupe II. *Bulletin de la Société d'Histoire naturelle de Toulouse* **89**(3–4): 323–382.

Thiele, J. (1924). Revision des Systems der Trochacea. *Mitteilungen aus dem zoologischen Museum in Berlin* **11:** 47–74.

Thiele, J., (1925). Mollusca *Handbuch der Zoologie* **5:** 15–258.

Troschel, F.H. (1852). Bericht über die Leistungen im Gebiete der Naturgeschichte der Mollusken während des Jahres 1851. *Archiv für Naturgeschichte* **18 (2):** 257–307.

Wade, B. (1926). The fauna of the Ripley Formation on Coon Creek, Tennessee. *U.S. Geological Survey Professional Paper* **137:** 1–271.

Wanner, J. (1902). Die Fauna der obersten weisser Kreide der Libyschen Wüste. *Palaeontographica* **30:** 91–152.

Wenz, W. (1938–1944). *Handbuch der Paläeozoologie* 6 Gastropoda **1(6):** 1–1639pp. Borntraeger, Berlin.

Wilson, B.R. (1985). Direct development in southern Australian cowries (Gastropoda: Cypraeidae). *Australian Journal of Marine and Freshwater Research* **36:** 267–280.

Wilson, B.R. and Gillett, K. (1979). *A Field Guide to Australian Shells. Prosobranch Gastropods.* Reed, Sydney. 287 pp.

Woods, H. (1906). The Cretaceous fauna of Pondoland. *Annals of the South African Museum* **4:** 275–350.

Wright, C.A. and Apthorpe, M. (1976). Planktonic foraminiferids from the Maastrichtian of the Northwest Shelf, Western Australia. *Journal of Foraminiferal Research* **6:** 228–240.

Wrigley, A.G. (1927). Notes on English Eocene Mollusca with descriptions of new species. II The Fusinidae. *Proceedings of the Malacological Society of London* **17:** 216–249.

Yokoyama, M. (1890). Versteinerungen aus der japanischen Kreide. *Palaeontographica* **36:** 159–202.

Yonge, C.M. (1973). Observation of the pleurotomariid *Entemnotrochus adansoniana* in its natural habitat. *Nature* **241:** 66–68.

Ziegler, V. (1984). Family Pleurotomariidae Swainson, 1840 (Gastropoda, Archaeogastropoda) from the Bohemian Cretaceous Basin. *Sbornik Narodniho Muzea v Praze* **39B:** 255–291.

Zittel, K.A. (1873). Die Gastropoden der Stramberger Schichten. *Palaeontographica* **suppl. 2**(3): 194–373.

APPENDIX

Localities

Fossil localities that have yielded study material are covered by the Mia Mia (Sheet 1751) and Giralia (sheet 1752) 1:100,000 topographic series; grid references have been calculated from the first edition, 1974.

Localities listed hereunder relate to type and figured specimens of scaphopods and gastropods only. Locality numbers 1 to 40 follow those listed in Darragh and Kendrick (1991) for bivalves. Additional scaphopod/gastropod localities where relevant are numbered beginning with 41.

Locality 1. Creek sides and bed near northern extremity of anticline, Giralia station. KV 180 945.

Locality 2. Creek bed 10.8km west from Giralia homestead on Bullara-Giralia road, Giralia station. KV 189 914.

Locality 3. Gully draining east, 0.3km southwest of grid on Bullara-Giralia road (12km west of Giralia homestead), Giralia station. KV 180 910.

Locality 4. One km south of Bullara-Giralia road, Giralia station. KV 175 903.

Locality 5. Gully draining east, 1.5km south of Bullara-Giralia road, Giralia station. KV 168 898.

Locality 6. Gully draining east, 3km northwest of West Tank, Giralia station. KV 160 895.

Locality 7. Gully draining southeast, ca. 2km south of Bullara-Giralia road, Giralia station. KV 176 893.

Locality 8. Giralia station. KV 145 890.

Locality 9. Gully draining east, 3.1km south of Bullara-Giralia road, Giralia station. KV 159 883.

Locality 10. Gully draining east in Wallatharra Paddock, ca. 1km northwest of West Tank, Giralia station. KV 175 883.

Locality 11. Gully draining east in Wallatharra Paddock, ca. 3.1km south of Bullara-Giralia road, Giralia station. KV 175 881.

Locality 12. Right bank of creek, draining northwest, Giralia station. KV 145 880.

Locality 13. Gully draining east, 1km west-northwest of West Tank, Giralia station. KV 174 880.

Locality 14. Gully draining east, 2.9km south of Bullara-Giralia road, Giralia station. KV 177 884.

Locality 15. Gully draining east, 2.7km south of Bullara-Giralia road, Giralia station. KV 163 877.

Locality 16. Gully draining northwest, 4.0km south of Bullara-Giralia road, Giralia station. KV 143 873.

Locality 17. Gullies draining south, 0.4km south of the northern boundary of Bungarra Paddock, Giralia station. KV 160 870.

Locality 18. Float from head and left bank of gully (which drains down to Coronation Bore), 3–6km north-northwest of Whitlock Dam, Giralia station. Approx. KV 115 820.

Locality 19. Toothawarra Creek, 0.2km upstream from Miria Formation type section, Cardabia station. KV 071 726.

Locality 20. Toothawarra Creek, at Miria Formation type section, Cardabia station. KV 069 726.

Locality 21. Southern tributary of Toothawarra Creek, ca. 0.4km south of Miria Formation type section, Cardabia station. KV 069 722.

Locality 22. Southern tributary of Toothawarra Creek, ca. 0.8km south of Miria Formation type section, Cardabia station. KV 067 720.

Locality 23. Float from right bank of gully on north side of northern tributary of CY Creek, Cardabia station; ca. 1.5km upstream from fence-line across creek. KV 070 708.

Locality 24. CY Creek, Cardabia station, 2.8–3.2km east of No. 37 bore. Approx. KV 038 679.

Locality 25. CY Creek, Cardabia station. KV 039 677.

Locality 26. Junction of main CY Creek and southern tributary, Cardabia station. KV 046 670.

Locality 27. Above a prominent cliff of Korojon Calcarenite in north-south tributary of CY Creek on east side of fence, about 3/4 mile (ca. 1.2km) south along fence from where it crosses creek, Cardabia station. KV 043 660.

Locality 28. Right bank of unnamed creek south of CY Creek (incorrectly designated "Toothawarra Creek" on Giralia 1:100 000 sheet 1752, 1st ed., 1974). Within 2 km of KV 026 630.

Locality 29. Near junction of two gullies, Cardabia station. KV 997 579.

Locality 30. Section Hill, Cardabia station. KV 011 544.

Locality 31. About 0.4km southwest from Remarkable Hill, Cardabia station. KV 001 499.

Locality 32. Float 0.9km west-southwest from Remarkable Hill, Cardabia station. KV 004 498.

Locality 33. Small hill ca. 2km south-southwest from Remarkable Hill, Cardabia station. KV 005 485.

Locality 34. Colluvial surface derived from Boongerooda Greensand near southwest corner of Wier Paddock, Cardabia station. JV 973 183.

Locality 35. 1.0–1.5km east to northeast of Round Knob Hill, Mia Mia station; colluvial surface. JV 975 175.

Localities without map references

Locality 36. East side of Wallatharra Paddock, south of Bullara-Giralia road, Giralia station.

Locality 37. Toothawarra Creek, Cardabia station.

Locality 38. Outcrop in CY Creek, Cardabia station.

Locality 39. Central Pirie Paddock, Cardabia station.

Locality 40. Twin Hill-Remarkable Hill, Cardabia station.

Locality 41. Gullies within 2.5km west from map reference Giralia KV 195893.

Locality 42. Eastward draining gully ca. 0.7km south of Bullara-Giralia road. KV 175905.

Locality 43. Eastward draining gully 1.9km south of Bullara-Giralia road. Approx. KV 169892.

Locality 44. Near head of eastward-draining gully 3 km south of Bullara-Giralia road at approximate map ref KV 164882.

Locality 45. Small eastward draining gullies immediately east of north-south track, ca. 1km north of south fence of Walatharra Paddock, Giralia station. KV 160885.

Locality 46. Westward draining gully 0.2km west of north-south track 1km north of the southern fence of Walatharra Paddock, Giralia station. KV 156885.

Locality 47. Gully draining west, 2.2km south of the Bullara-Giralia road. KV 150890.

Locality 48. Gully 3.5km south of the Bullara-Giralia road. KV 145877.

Locality 49. Float in small gully about 200m south of fence near NE corner of Range Paddock; 2.5km west-northwest of Whitlock Dam, Giralia station. KV 115790.

Locality 50. Small west draining gully on north side of Open Country Paddock, ¾km south of north side fence, Cardabia station. KV 090760.

Locality 51. 3.5km north-northwest of Section Hill, Cardabia station; sides of two gullies which join near Giralia. JV 097579.

Locality 52. South west of Remarkable Hill, Cardabia station. No map reference available.

Locality 53. West side of Mt. Remarkable (= Remarkable Hill).

ISBN 0-7309-5585-0