REVISTA ESPAÑOLA DE PALEONTOLOGÍA, 8 (1), 75-116. 1993. ISSN 0213-6937.

EOCENE OSTRACODA FROM THE BROWNS CREEK CLAYS AT BROWNS CREEK AND CASTLE COVE, VICTORIA, AUSTRALIA

K. G. McKENZIE[1], *R. A. REYMENT*[2] *and E. R. REYMENT*[3]

1) Department of Geology, University of Melbourne, Parkville, 3052 Victoria, Australia.
2) Paleontologiska Institutionen, Uppsala Universitet, Box 558, S75122 Uppsala, Sweden.

ABSTRACT

Australian Middle(?) - Late Eocene Ostracoda from the richly fossliferous Browns Creek Clays in the sections at Browns Creek and Castle Cove, Victoria are described and illustrated. The large fauna of almost one hundred species and subspecies includes many new taxa, in particular a new family, three new genera and many new species. The new family is **Nunanidae**, type genus *Nunana* gen. nov.; type species *N. australiae* sp. nov. The other new genera are *Bidgeecythere* gen. nov.; type species *B. barupa* sp. nov., and *Werribeeleberis* gen. nov.; type species *W. trispinosa* sp. nov. The forty six other new species and subspecies are *Cytherella pinnata* sp. nov., *Geelongella brevimargine* sp. nov., *Cytherelloidea hrycga* sp. nov., *Neonesidea austrotumida* sp. nov., *Argilloecia allungata* sp. nov., *A. mesa* sp. nov., *A. minys* sp. nov., *Maddocksella tarparriensis* sp. nov., *Loxocythere malzi* sp. nov., *Amphicytherura dinglei* sp. nov., *Saida daisa* sp. nov., *Paracytherois eocaenica* sp. nov., *Krithe postcircularis* sp. nov., *Foveoleberis minutissima* (Chapman, 1926) *sublaevis* subsp. nov., *Xestoleberis basiplana* sp. nov., *X. noccia* sp. nov., *Microcythere airella* sp. nov., *Munseyella pytta* sp. nov., *M. adaluma* sp. nov., *M. warringa* sp. nov., *M. dunoona* sp. nov., *M. bungoona* sp. nov., *Hemicytherura fulva* sp. nov., *Kangarina wareelacogarra* sp. nov., *Semicytherura costulopunctata* sp. nov., *Eucytherura delta* sp. nov., *E. horrida* sp. nov., *E. cameloides* sp. nov., *Oculocytheropteron aviformum* sp. nov., *O. megalops* sp. nov., *O. tinctum* sp. nov., *Aversovalva nairana* sp. nov., *A. yaringa yaringa* sp. and subsp. nov., *A. yaringa minor* subsp. nov., *Trachyleberis paucispinosa* sp. nov., *Deltaleberis delicata* sp. nov., *Echinocythereis karooma* sp. nov., *Idiocythere nunkeria* sp. nov., *Rugocythereis multiflora* sp. nov., *Cletocythereis taroona* sp. nov., *C. kurrawa* sp. nov., *Quasibradleya momitea* sp. nov., *Spinobradleya echinata* sp. nov., *Bradleya semiarata anteropytta* subsp. nov., *Hornibrookella(?) currimundria* sp. nov. and *Margocythere latticina* sp. nov. Eighteen species and subspecies have been described previously; thirty six species are left in open nomenclature. A brief assessment is made of the probable palaeoenvironments that obtained in this part of Victoria during the Middle(?) to Late Eocene.

Keywords: Australia; Victoria; Eocene ostracods; new taxa.

RESUMEN

Se ilustran y describen los ostracodos del Eoceno Medio(?) y Superior de las Browns Creek Clays de las secciones de Browns Creek y Castle Cove, Victoria, Australia. La rica fauna con cerca de cien especies y subespecies contiene numerosos taxones nuevos, en particular, una nueva familia, tres nuevos géneros y 49 nuevas especies o subespecies. La nueva familia es **Nunanidae**, generotipo *Nunana* gen. nov.; especie tipo *N. australiae* sp. nov. Los restantes nuevos géneros son *Bidgeecythere* gen. nov.; especie tipo *B. barupa* sp. nov., y *Werribeeleberis* gen. nov.; especie tipo *W. trispinosa* sp. nov. Las restantes especies o subespecies son *Cytherella pinnata* sp. nov., *Geelongella brevimargine* sp. nov., *Cytherelloidea hrycga* sp. nov., *Neonesidea austrotumida* sp. nov., *Argilloecia allungata* sp. nov., *A. mesa* sp. nov., *A. minys* sp. nov., *Maddocksella tarparriensis* sp. nov., *Loxocythere malzi* sp. nov., *Amphicytherura dinglei* sp. nov., *Saida daisa* sp. nov., *Paracytherois eocaenica* sp. nov., *Krithe postcircularis* sp. nov., *Foveoleberis minutissima* (Chapman, 1926) *sublaevis* subsp. nov., *Xestoleberis basiplana* sp. nov., *X. noccia* sp. nov., *Microcythere airella* sp. nov., *Munseyella pytta* sp. nov., *M. adaluma* sp. nov., *M. warringa* sp. nov., *M. dunoona* sp. nov., *M. bungoona* sp. nov., *Hemicytherura fulva* sp. nov., *Kangarina wareelacogarra* sp. nov., *Semicytherura costulopunctata* sp. nov., *Eucytherura delta* sp. nov., *E. horrida* sp. nov., *E. cameloides* sp. nov., *Oculocytheropteron aviformum* sp. nov., *O. megalops* sp. nov., *O. tinctum* sp. nov., *Aversovalva nairana* sp. nov., *A. yaringa yaringa* sp. and subsp. nov., *A. yaringa minor* subsp. nov., *Trachyleberis paucispinosa* sp. nov., *Deltaleberis delicata* sp. nov., *Echinocythereis karooma* sp. nov., *Idiocythere nunkeria* sp. nov., *Rugocythereis multiflora* sp. nov., *Cletocythereis taroona* sp. nov., *C. kurrawa* sp. nov., *Quasibradleya momitea* sp. nov., *Spinobradleya echinata* sp. nov., *Bradleya semiarata anteropytta* subsp. nov., *Hornibrookella(?) currimundria* sp. nov. y *Margocythere latticina* sp. nov. Previamente se habían descrito 18 especies y subespecies, otras 36 se dejan en nomenclatura abierta. Finalmente, se hace una breve discusión sobre las posibles condiciones paleoambientales durante el Eoceno Medio(?)-Superior en esta zona de Victoria.

Palabras clave: Australia; Victoria; Ostracodos eocenos; taxones nuevos.

https://doi.org/10.7203/sjp.24502

INTRODUCTION

The initial fieldwork underlying this monograph was carried out by McKenzie on several occasions over the period 1964 to 1967. A final period of collecting took place during a fieldtrip to the locality during the 11th International Ostracod Symposium held at Warrnambool, Victoria, in July 1991.

This richly ostracodiferous locality has long been in need of monographic treatment but all published information that has so far accrued has been as notes in widely dispersed articles dealing mainly with other questions. Our study of the fauna has exceeded our expectations in that the new information contained in our material provides many insights into what was happening in the ostracods of the southern hemisphere during the Paleogene. We make no claims to a complete coverage of the Australian Eocene ostracod associations. For this, a far more exhaustive collecting programme would be necessary, preferably encompassing samples obtained from trenching and shallow boreholes. It is nonetheless our belief that the present account will provide a useful first basis upon which later workers will be able to build. We must emphasize that some taxa have been erected on rather few individuals. This step has not been lightly taken and was in each individual case examined with respect to taxonomical viability and palaeobiogeographical relevance.

Until now (Dr. M. T. Warne, personal communication July 1991), the Greensand marker bed at Browns Creek has been known as the *Notostraea* Greensand member of the Browns Creek Clays, based on the presence in this unit of abundant fossils of the oyster *Notostraea*. It contains the important Late Eocene index foraminifer *Hantkenina primitiva* and has been correlated with the Tucketja Member of the basal Blanche Point Formation in the Willunga Embayment, South Australia (Cooper, 1979; Shafik, 1981; Lindsay, 1985). The use of a fossil to name a sedimentary unit is undesirable and informal. We therefore formally name the Greensand marker bed at Browns Creek the Johanna River Greensand member of the Browns Creek Clays, after the nearby township of Johanna River. In this

Table 1. Schematic representation of the main stratigraphical succession.

Tertiary Formations in the Aire District

Thickness	*Formation*
16 m	Fishing Point Marl
36 m	Upper Glen Aire Clay
17 m	Calder River Limestone
22 m	Lower Glen Aire Clay
28 m	Castle Cove Limestone (Castle Cove and Johanna River mouth)
53 m	Browns Creek Clay (Browns Creek, coastal sections, Hamilton Creek, Castle Cove, Laver's Hill)
27 m	Johanna River Sand (Base of sequence at Castle Cove)

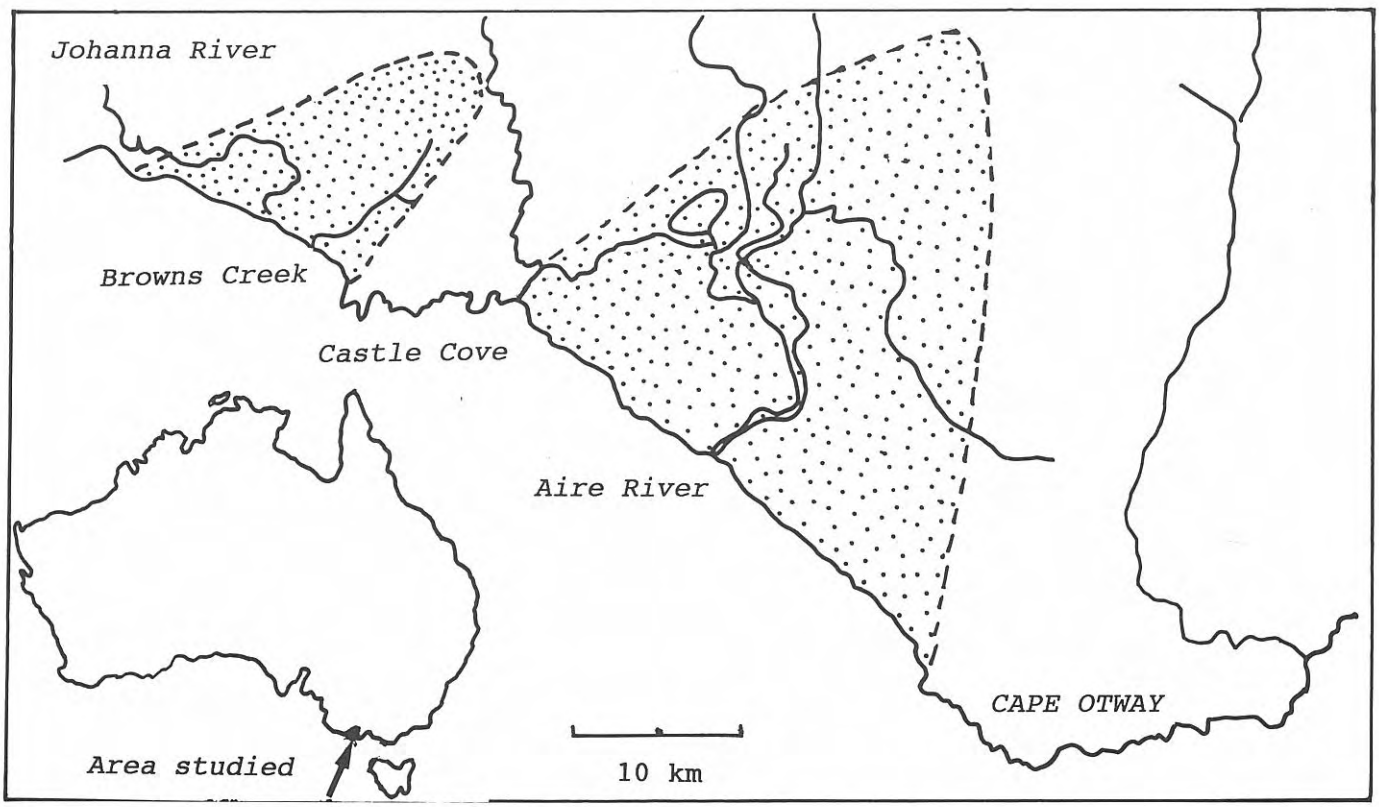


Figure 1. Sketch map showing the localities mentioned in the text. The dotted areas denote the extent of Tertiary rocks.

monograph, the Member is cited severally by its full name, as Johanna River Greensand, as the Greensand marker bed, or simply as the Greensand. It is best exposed in the type section of the Browns Creek Clays determined by Raggatt and Crespin (1955). It is not exposed at the Castle Cove locality (Carter, 1958). Fig. 1 shows the sites sampled and Table 1 provides a schematic account of the stratigraphical succession.

The Australian aboriginal words and place names and their meanings which we have used in this monograph have been taken from a most useful booklet which we recommend to taxonomists wishing to specify distinctively the still largely undescribed Australian microfaunas (Endacott, 1984).

We use the conventions L = left, R = right, LV = left valve, RV = right valve, and SEM = scanning electron microscope. All measurements of ostracods are given in mm. In the Browns Creek section, the locations of samples are given in cm or m above or below the Johanna River Greensand and located as accurately as possible into the measured section of Raggatt and Crespin (1955). At Castle Cove, the two samples from the Browns Creek Clays were located by one of us (KGM) in the field by measurement along the exposures with reference to Carter (1958). Our study is based on the examination of 34 samples and about 5000 specimens from the Browns Creek Clays, Castle Cove Formation and the Fishing Point Marl in the Victorian Aire district. Most samples were found to contain 200-300 specimens, but about 10 samples provided less than 50 ostracods when processed. All holotypes and paratypes are stored in the collections of the Paleontologiska Institutionen, Uppsala Universitet, Uppsala, Sweden under the registration numbers cited in this monograph. A set of paratypes of all new taxa will be deposited by McKenzie in the collections of the Museum of Victoria, Melbourne, Australia.

BIOSTRATIGRAPHY

The biostratigraphy of the Browns Creek section remains somewhat controversial. Shafik (1981) considered the entire outcrop to be Late Eocene, using nannoplankton. Correlation of the Johanna River Greensand with the Tucketja member of the Blanche Point Formation, South Australia, based on the occurrence at both localities of the important index foraminifer, *Hantkenina primitiva* Cushman and Jarvis, indicated that both greensands have a Late Eocene (P16) age. At Browns Creek, the beds below the Johanna River Greensand, while appearing to be conformable, are strikingly different lithologically and faunally, with a nautiloid-bearing zone of blackish-brown sediment about 0.7-1.0 m below the Greensand and dark coloured, glauconitic, sandy to gravelly clay deposits carrying large turrid and amphibolid gastropods characterizing the remaining stratigraphically lower exposures. It seems plausible that this greensand/dark sediment contact represents a depositional hiatus. Such an interpretation is signalled in the basal Johanna River Greensand and in the dark sediments immediately below it by an enrichment of ferruginous pellets. This resembles the transition zone between undifferentiated Blanche Point Formation and underlying Maslin Sands in the Willunga Embayment boreholes, which is considered to represent an interval of non-deposition (Cooper, 1979, Fig. 11). In these boreholes there is no lithology similar to the Tortachilla Limestone, which outcrops immediately below the Tucketja member in the classic coastal cliff sections at Maslin and Aldinga Bays, South Australia, and the underlying fossiliferous and glauconitic quartz sands (Cooper, 1985) which resemble the sub-greensand deposits at Browns Creek. Lindsay (1985) correlates this break in South Australia with a short regressive phase on the global eustatic sea level curve followed by onlap TE3 (his terminology), and places it in the lower Aldingan (Australian Stage name) or Kaiatan (New Zealand Stage name), which are equivalent to the P15 planktic foraminifer biozone (39-40 Ma). The underlying sands are regarded as having a Middle - Late Eocene age.

The beds below the Johanna River Greensand member of the Browns Creek Clays have not yet received the same degree of thorough analysis as summarized above. In the interim, we intend to use a Middle(?) Eocene age determination for ostracod species which occur below the Johanna River Greensand, while recognizing that this may need adjustment upwards to basal Late Eocene subsequent to such an appraisal.

The exposures of Browns Creek Clays at Castle Cove, however, since they represent the uppermost part of the formation are non-controversial with respect to their geological age. They were laid down during the Late Eocene, upper Aldingan, equivalent to the New Zealand Runangan Stage (P16/17), about 37-38 Ma. As yet there is no precise correlation between the Browns Creek and Castle Cove Eocene sections although it is accepted that the basal part of the latter is equivalent to the upper part of the former. Thus, all we can say with confidence is that our samples represent part of two onlap sedimentation cycles over about three million years, encompassing a regressive spike during the basal Aldingan.

The stratigraphical sequence is as follows (Raggatt and Crespin, 1955, p. 134).

Section 28 of Raggatt and Crespin

Exposed in gullies between the mouth of Brown's Creek and the mouth of the Johanna River

Thickness (metres)	**Sedimentary properties**
6	Well-bedded pebbly brown sandstone
1.1	Grey micaceous sandy clay
4	Alternating light and dark grey clayey marl
20	Light grey to black shelly clayey marl **(Sampled for ostracods)**
3	Glauconitic shelly sand with *Notostraea* and *Hantkenina* **(Sampled for ostracods, and one metre below)**
8	Grey to dark brown clay with abundant fossils
10	Outcrops obscured by dune sand

SYSTEMATIC PALAEONTOLOGY

Family **Cytherellidae** Sars, 1866
Genus *Cytherella* Jones, 1849
Cytherella pinnata sp. nov.
Pl. I, Figs. 1, 2

Holotypus: The specimen PM Au 356, a male carapace, figured in Pl. I, Fig. 2, from the Browns Creek Clays about 7 m above the Johanna River Greensand marker bed, in the Browns Creek section, near Johanna River, Victoria. Figured paratype PM Au 355.

Derivatio nominis: Pinnatus (L.) = feather-like; a reference to the large and striking central muscle scar pattern.

Diagnosis: A large compressed and subrotund *Cytherella* with a feather-like cluster of many adductor scars, trending obliquely backwards, located medially in adults but posteriorly in juveniles.

Description: A large *Cytherella* (length about 1.00 mm in adults), relatively compressed, with a subrotund shape in lateral view; surface smooth and porcellaneous. Dorsum sloping gently backwards; anterior more broadly rounded than the posterior; venter with a barely discernible inflexure. RV and LV subequal, if anything the former overlaps the latter slightly around most of the periphery. Narrowed anteriorly but broadened posteriorly in dorsal view; height about 60 % of the length. Internally, with narrow inner lamellae and lacking true marginal pore canals; normal pore canals scattered, simple; hingement a holosolenic ridge and groove; central muscle scar pattern large and very striking, comprising a pinnate cluster of many (about 20) scars which trends obliquely and is located medially; adductorial depression absent or very weakly expressed.

Sexual dimorphism distinct; males narrower posteriorly than females which have a two chamber brood space; size about the same in both sexes. Juveniles have a more regularly rounded profile and a posteriorly-located pinnate muscle scar cluster; the RV is clearly larger than the LV, overlapping it almost completely.

Measurements: The length of the carapace in mature males and females ranges from 0.92-1.03 mm; the height ranges from 0.59-0.64 mm; the breadth is 0.35 mm. Lengths of juvenile stages are 0.82 (A-1), 0.64 (A-2), 0.50 (A-3) and 0.34 (A-5).

Remarks: The very distinctive muscle scar pattern makes this species easy to recognize and differentiate from *C. bellsi* and *C. gullrockensis* (McKenzie, Reyment and Reyment, 1991); further, the latter species is more elongate while *C. bellsi* has a distinct posteromarginal ridge.

Material Studied: Fourteen specimens, carapaces and valves representing both sexes, including six adults.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Late Eocene.

Cytherella aff. *bellsi* McKenzie, Reyment and Reyment, 1991
Pl. I, Fig. 3

1991 *Cytherella bellsi* McKenzie, Reyment and Reyment, 138, Pl. I, Figs. 3, 14.

Remarks: The species is recognized by its posteromarginal ridge. Several specimens found in washings from the base of the Browns Creek section sampled by one of us (KGM) in 1964 (McKenzie, 1974, p. 174), display this feature but are also depressed along the anterior margin. If the latter is only a subspecific character, these specimens extend the range of *C. bellsi* to the Middle(?) Eocene. The length of a female RV is 0.83 mm, slightly less than females of the type set (0.87-1.03 mm).

Material Studied: Two carapaces and two valves.

Occurrence and Age: Browns Creek and Bells Headland, Victoria; Middle(?) Eocene - Late Oligocene.

Genus *Geelongella* McKenzie, Reyment and Reyment, 1991
Geelongella brevimargine sp. nov.
Pl. I, Figs. 4, 5

Holotypus: The specimen PM Au 358, figured in Pl. I, Fig. 4, a female LV from the Browns Creek Clays at Castle Cove, between CC8 and CC9 of Carter (1958). Figured paratype PM Au 359.

Derivatio nominis: Breve (L.) = short, and *margo* (L.) = rim; for the relatively narrow marginal rim or flange.

Diagnosis: A *Geelongella* characterized by a more narrow marginal rim than the type species.

Description: A large species (length about 1.00 mm) with a subrectangular shape in lateral view; surface smooth and porcellaneous; marginal flange (characteristic for the genus) distinct but relatively narrow, best developed anteriorly and posteroventrally. Dorsum straight, slopes gently backwards; anterior very broadly rounded (accentuated by the marginal flange); ventral margin inflexed posteromedially; posterior rounded but less high than the front. Shell compressed in dorsal view. Internal characters similar to other cytherellids except that the adductorial depression is weakly expressed and the feather-like cluster of adductor scars is located posterodorsomedially.

Sexual dimorphism marked; males larger than females; height in males less than half their length, in females height is about half the length; females have an indistinct two chamber brood space. Juveniles translucent early in ontogeny; more rounded overall than adults, but still displaying a definite marginal flange and a posteriorly-placed cluster of adductor scars.

Measurements: The carapace length of the mature male and female ranges from 0.91-0.97 mm; their height ranges from 0.53-0.55 mm; their breadth ranges from 0.33-0.36 mm. The length of A-1 juveniles ranges from 0.80-0.90 mm.

Remarks: The fact that the marginal flange is much narrower than in the type species suggests that *Geelongella* may have branched off as a distinct category from *Cytherella* in the Eocene.

Material Studied: Thirteen specimens, one adult male, one adult female, and eleven juveniles representing three growth stages.

Occurrence and Age: Browns Creek Clays at Castle Cove; Late Eocene.

Genus *Platella* Coryell and Fields, 1937
Platella sp.
Pl. I, Fig. 6

Remarks: A single adult female LV (length 0.72 mm) from the Johanna River Greensand in the section at Browns Creek, determined as to genus by its all-over punctation.

Occurrence and Age: Browns Creek, Victoria; Middle(?) Eocene.

Genus *Cytherelloidea* Alexander, 1929

Cytherelloidea hrycga sp. nov.

Pl. I, Figs. 7-9

Holotypus: The specimen PM Au 361, figured in Pl. I, Fig. 7 in the Browns Creek Clays from about 21 m above the Johanna River Greensand (both valves of the same individual). Figured paratype PM Au 363.

Derivatio nominis: Hrycg (Old English) = ridge; for the prominent marginal ridge.

Diagnosis: An elongate, relatively compressed *Cytherelloidea* dominated laterally by a powerful marginal ridge extending from the anterodorsal region around the entire ventral area and terminating posterodorsally.

Description: A large species (0.85 mm in length) with a subrectangular shape; ornamented by a prominent and thickened marginal ridge, with subsidiary longitudinal ribbing, that runs from anterodorsally around the ventral margin to posterodorsally; within the area defined by this ridge the valve surface is swollen around a deep adductorial depression. Dorsal margin concave behind the anterior then slopes obliquely to the rear; anterior broadly rounded; ventral margin inflexed medially; posterior more narrowly rounded than the front. Relatively compressed in dorsal view; height about 57 % the length. LV slightly larger than the RV. Internally, with narrow marginal areas (Pl. I, Fig. 8) and behind these a deep furrow around the entire periphery of the RV, LV with a complementary ridge; hingement as such not well defined dorsally (the closure is holosolenic); marginal pore canals absent; normal pore canals scattered, simple; central muscle scar pattern comprising a subvertical feather-like cluster on an oval medial platform (internal expression of the exterior adductorial depression).

Sexual dimorphism distinct, males smaller than females, which have a simple brood space. The shape of juveniles is less elongate and the ridge is curved, much shorter, and confined to the ventral region. In dorsal view, juveniles are broadest posteriorly and narrowed in front. Two juvenile stages occur in the collection.

Measurements: The length of mature males and females ranges from 0.85-0.90 mm; their height ranges from 0.47-0.52 mm; the breadth ranges from 0.31-0.36 mm. The lengths of juveniles range from 0.64-0.66 mm (A-1) and 0.50-0.52 mm (A-2).

Remarks: The new species is related to *C. jugifera*, from the Gull Rock Member of the Blanche Point Formation, South Australia, but lacks its yoke-like inner ridge. It also resembles *C. intermedia* (Chapman and Crespin, 1928) but in their species the marginal ridge is discontinuous, with a well defined anteroventral gap (McKenzie, 1974, Pl. 1, Fig. 2).

In the Browns Creek Clays at Castle Cove, a form represented by a series of six specimens (including four adults) has a narrower ridge than in the type series but otherwise is identical. We believe that this variation could represent an ecophenotypic effect.

Material Studied: Fifteen individuals including adults of both sexes, plus juveniles.

Occurrence and Age: Browns Creek Clays and Castle Cove, Victoria; Late Eocene.

Cytherelloidea jugifera McKenzie, Reyment and Reyment, 1991

1991 *Cytherelloidea jugifera*, McKenzie, Reyment and Reyment, 139, Pl. I, Figs. 10, 12.

Remarks: This large species persists in the Browns Creek section until about 10 cm below the Greensand. Occasional juveniles show a weak posterodorsal reticulation that was not evident in the type series. The length of our adult females ranges from 1.03-1.06 mm.

Material Studied: Eight individuals, including two adult females plus juveniles.

Occurrence and Age: Gull Rock, South Australia; Browns Creek, Victoria; Middle(?) - Late Eocene.

Cytherelloidea marginopytta McKenzie, Reyment and Reyment, 1991

Pl. I, Fig. 10

1979 *Cytherelloidea* sp., McKenzie, 93-94, Pl. 1, Fig. 6.
1991 *Cytherelloidea marginopytta* McKenzie, Reyment and Reyment, 140, Pl. II, Fig. 1; Pl. X, Figs. 2, 3.

Remarks: The specimens in our collections show a range of ornament which makes it clear that this species is synonymous with the taxon illustrated from South Australia by McKenzie (1979); although previously we have considered them distinct (McKenzie, Reyment and Reyment, 1991). At Browns Creek, it was identified in the section from about 1 m above to about 10 cm below the Greensand; and it also occurred in the upper part of the Browns Creek Clays at Castle Cove. The length of an adult male is 0.67 mm; and of an adult female LV is 0.75 mm. Thus, these specimens are slightly smaller than the types (0.76-0.82 mm).

Material Studied: Five carapaces (3 adult, 2 juvenile), plus an adult female LV.

Occurrence and Age: Willunga Embayment, South Australia; Browns Creek, Castle Cove and Bells Headland, Victoria; Late Eocene - Late Oligocene.

Family **Bairdiidae** Sars, 1888

Genus *Neonesidea* Maddocks, 1969

Neonesidea austrotumida sp. nov.

Pl. I, Figs. 11, 12

Holotypus: The specimen PM Au 515, figured in Pl. I, Figs. 11, 12 from the Browns Creek Clays about 1 m above the Johanna River Greensand (two valves of the same individual).

Derivatio nominis: Auster (L.) = south, and *tumidus* (L.) = swollen; for the distinctive tumid carapace of this southern *Neonesidea*.

Diagnosis: A high and tumid Australian *Neonesidea*.

Description: A moderately large bairdiid (length 0.75 mm); with the characteristic familial subtrapezoidal shape; shell surface completely smooth. LV and RV dissimilar, the former larger and overlapping the RV medioventrally, anterodorsally and posterodorsally. Dorsal margin in RV straight, sloping slightly backwards, falling away steeply on each side to give a mesa-like appearance; anterior margin rounded, trending anteroventrally; ventral margin gently inflexed anteromedially; posterior curved upwards to meet the dorsal margin; LV margin more rounded overall, because it overlaps the RV. Tumid in dorsal view, with greatest breadth medial; height (LV) about 60 % of the length. Internally with moderately large inner lamellae having regular inner margins; elongate anterior and posterior vestibules; marginal pore canals numerous, mostly straight; normal pore canals numerous, simple, rimmed; hingement ridge and groove typical; central muscle scar pattern dominated by a rosette of eight to nine large adductors plus a small round frontal scar.

Sexual dimorphism weakly expressed, females relatively higher than males. Juveniles similar to adults but thinner-

shelled and marginally denticulate antero- and posteroventrally.

Measurements: The length of adults is 0.75 mm; the height of an adult male is 0.45 mm; the height of an adult female is 0.47 mm; the breadth of an adult male is 0.35 mm, and of a mature female is 0.45 mm (estimated from LV and RV).

Remarks: Very like *N. chapmani* (Whatley and Downing, 1983) but not as drawn out posteriorly; quite unlike *N. whatleyi* and *N. fredericki* (Warne, 1988) in its anterior appearance; *Neonesidea* sp. McKenzie (1979, Pl. 1, Fig. 1) is more pointed dorsally.

Material Studied: Twenty three specimens (carapaces and valves), including adults of both sexes and juveniles plus many fragments.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Genus *Bairdoppilata* Coryell, Sample and Jennings, 1935

Bairdoppilata(?) cf. *fyansfordensis* Warne, 1986

1986 *Bairdoppilata fyansfordensis* Warne, 20, Figs. 8E, F, K, L, 10H-N.

Remarks: The single large mature carapace of this distinctive taxon that we recovered from the upper Browns Creek Clays at Castle Cove was firmly closed, thus making it impossible to be certain of the generic determination. It is very close to *B. fyansfordensis* being thick shelled, micropunctate over the entire surface and similar in shape, with a few widely spaced denticles anteriorly in both valves. The shell was lustrous on this well preserved individual. The measurements on the carapace are: length 1.22 mm; height 0.73 mm; breadth 0.58 mm. This is very close to the size given by Warne (1988). We also have three juvenile carapaces from the Johanna River Greensand and up to about 7 m below it.

Occurrence and Age: Castle Cove, Victoria, equivalent to bed CC3 of Carter (1958); Late Eocene. If a larger series of specimens is found at Browns Creek or Castle Cove and the generic determination can be confirmed, then the species will range in Victoria from Browns Creek to Fyansford (near Geelong) and in age from Late Eocene to early Middle Miocene.

Family **Bythocyprididae** Maddocks, 1969

Genus *Bythocypris* Brady, 1880

Bythocypris sudaustralis McKenzie, Reyment and Reyment, 1991

Pl. I, Fig. 13

1991 *Bythocypris sudaustralis* McKenzie, Reyment and Reyment, 142, Pl. II, Figs. 2, 3.

Remarks: Our species is very close to *B.* cf. *affinis* (Brady, 1886) *sensu* Warne (1990), described from the Miocene of central coastal Victoria, but is distinctly more elongate with respect to its height in adults as is brought out by the fine specimen of an adult male which is illustrated here. Certainly, both taxa belong to the same lineage. The length of our adult male is 0.94 mm; that of two adult females ranges from 0.98-1.03 mm. The lengths of juveniles are 0.83-0.86 mm (A-1); 0.65-0.67 mm (A-2) and 0.43-0.45 mm (A-4).

Material Studied: Thirty five carapaces and eight valves, including adults of both sexes and several stages of juveniles.

Occurrence and Age: Gull Rock, South Australia; Browns Creek and Castle Cove, Victoria; Middle(?) - Late Eocene.

Genus *Orlovibairdia* McKenzie, 1978

Orlovibairdia sp.

Pl. I, Fig. 14

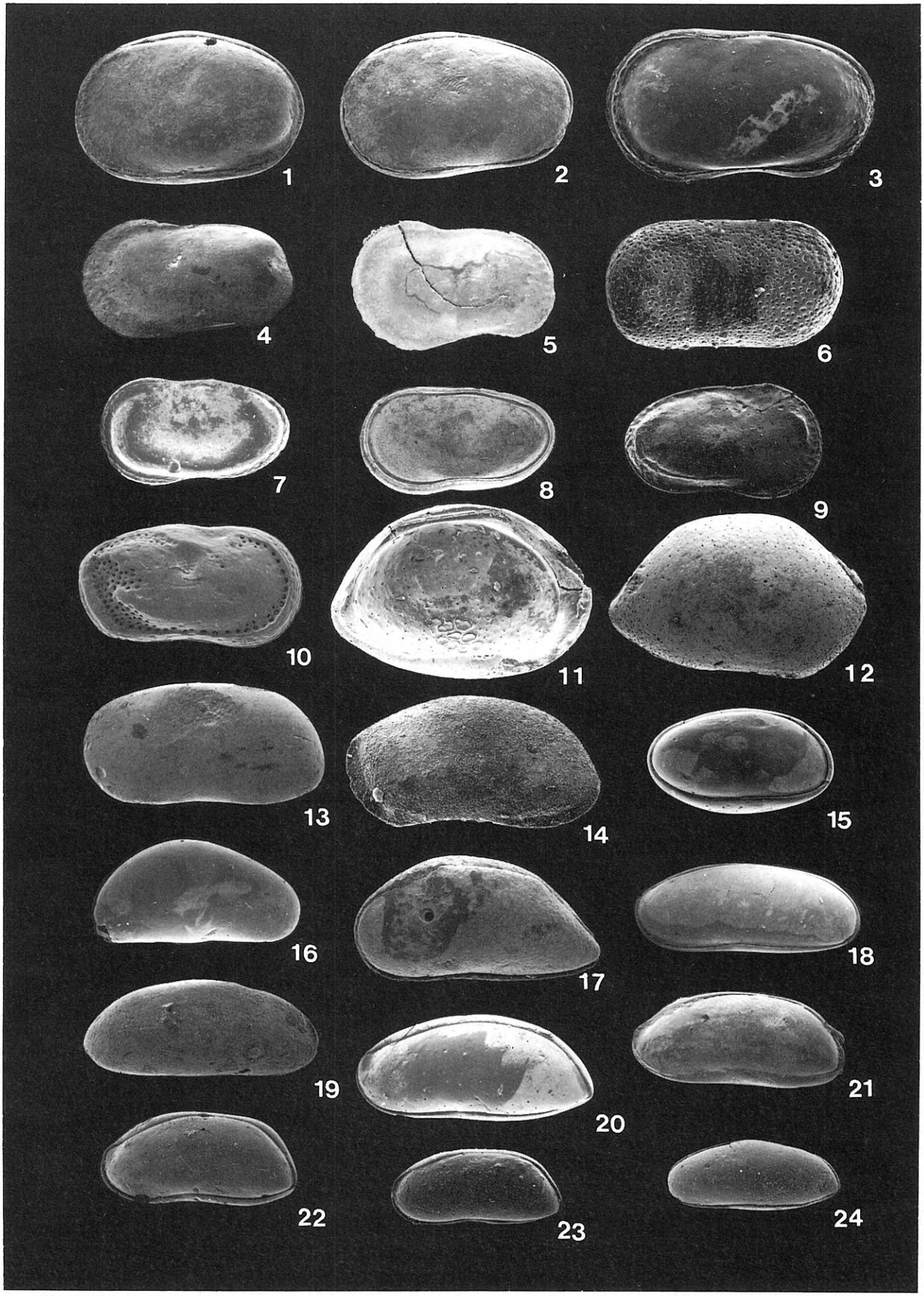
Remarks: We have a single carapace only, probably a mature male (length 0.58 mm) from the Johanna River Greensand member of the Browns Creek Clays at Browns Creek. It is somewhat smaller than *O. mooraboolensis* (Warne, 1990) from the early Middle Miocene of the Port Phillip Basin, Victoria. Further unlike that species, our specimen displays

---

Plate I

1 *Cytherella pinnata* sp. nov. PM Au 355, stub Vic-13. Female carapace. Browns Creek Clays, 7 m above Johanna River Greensand. × 45.
2 Same species and provenance. Holotypus, PM Au 356, stub Vic-13. Male carapace. × 45.
3 *Cytherella* aff. *bellsi* McKenzie, Reyment and Reyment. PM Au 357, stub Vic-12. Castle Cove. × 70.
4 *Geelongella brevimargine* sp. nov. Holotypus. PM Au 358, stub Vic-6. Castle Cove. Female LV. × 45.
5 Same species and provenance. PM Au 359, stub Vic-6. × 45.
6 *Platella* sp. PM Au 360, stub Vic-11. Female LV. Browns Creek. × 70.
7 *Cytherelloidea hrycga* sp. nov. Holotypus. PM Au 361, stub Vic-4. Browns Creek Clays, 21 m above Johanna Greensand. Male LV. × 50.
8 Same species and provenance. PM Au 362, stub Vic-4(K2). Male RV, interior. × 50.
9 Same species and provenance. PM Au 363, stub Vic-9. Male RV. × 50.
10 *Cytherelloidea marginopytta* McKenzie, Reyment and Reyment. PM Au 513, stub Vic-10. Browns Creek Clays at Castle Cove. Male RV. × 70.
11 *Neonesidea austrotumida* sp. nov. Holotype. PM Au 515, stub Vic-4. Interior LV. Browns Creek Clays, 1 m above Johanna R. Greensand. × 70.
12 Other valve of same individual. PM Au 515A. × 70.
13 *Bythocypris sudaustralis* McKenzie, Reyment and Reyment. PM Au 364, stub Vic-6. Male LV carapace. Browns Creek. × 45.
14 *Orlovibairdia* sp. PM Au 365, stub Vic-11. Male LV carapace. Johanna River Greensand, Browns Creek Clays at Browns Creek. × 100.
15 *Cardobairdia* sp. PM Au 366, stub Vic-12. Female carapace RV. Browns Creek. × 100.
16 Paracypridid, sp. indet. PM Au 367, stub Vic-2(K1). RV immature carapace. Castle Cove. × 70.
17 *Propontocypris* sp. PM Au 368, stub Vic-1(K2). LV carapace. Browns Creek, 1 m above Johanna R. Greensand. Note naticid drill-hole. × 100.
18 *Argilloecia allungata* sp. nov. Holotypus. PM Au 369, stub Vic-1(K2). Female LV carapace. Browns Creek Clays at Castle Cove. × 100.
19 Same species and provenance. PM Au 370, stub Vic-7. Female RV carapace. × 100.
20 *Argilloecia mesa* sp. nov. Holotypus. PM Au 371, stub Vic-3(K4). Female LV carapace. Browns Creek Clays, 2 m below Johanna R. Greensand. × 100.
21 Same species and provenance. PM Au 372, stub Vic-7. Male LV carapace. × 100.
22 Same species and provenance. PM Au 373, stub Vic-10. Female LV carapace. × 100.
23 *Argilloecia minys* sp. nov. Holotypus. PM Au 374, stub Vic-9. Female LV carapace. Browns Creek Clays at Castle Cove. × 100.
24 *Argilloecia* sp. PM Au 375, stub Vic-10. LV carapace. Castle Cove. × 100.

Plate I



only one minute anteroventral marginal spine, whereas several anteroventral and posteroventral marginal spines are characteristic (although not universal) for the genus. Nevertheless, the lateral profile is that of *Orlovibairdia* rather than of any Australian species of *Bythocypris*.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Family **Sigilliidae** Mandelshtam, 1960
Genus *Cardobairdia* van den Bold, 1960

Cardobairdia sp.
Pl. I, Fig. 15

1979 *Cardobairdia* sp., McKenzie, 94, 100, Fig. 3.

Remarks: We have but two specimens of this interesting taxon and note that the genus is always rare in the Cainozoic of southeastern Australia. Thus, the two Late Eocene records from South Australian boreholes in McKenzie (1979, p. 94) are both singletons. The species lacks a caudal spine in the RV, unlike *Cardobairdia balcombensis* McKenzie, 1967 from the Miocene of central coastal Victoria (McKenzie, 1967a; Whatley and Downing, 1983).

Occurrence and Age: Bores WLG40 and WLG42, Willunga Embayment, South Australia; Browns Creek Clays at Browns Creek, Victoria, about 7 m above the Johanna River Greensand; Late Eocene.

Family **Macrocyprididae** Müller, 1912
Genus *Macromackenzia* Maddocks, 1990

Macromackenzia(?) sp.

Remarks: Two fragments of different adult valves and a very juvenile LV of this genus which is identified herein by its rounded anterior and subacuminate posterior were found in the Browns Creek Clays at Browns Creek, about 1 m above the Johanna River Greensand. Length of the larger fragment allows us to estimate adult valve length at around 1 mm; the length of the small juvenile LV is 0.55 mm. This is the oldest record so far of macrocyprids in southeastern Australia. The only other Late Eocene determination was of *Macrocyprina (sic.)* in Bore WLG42 of the Willunga Embayment, South Australia about 40 m below the Eocene-Oligocene boundary (McKenzie, 1979).

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Family **Paracyprididae** Sars, 1923

Paracypridid sp. indet.
Pl. I, Fig. 16

Remarks: We have one carapace, which is probably an A-1 individual (length 0.75 mm) but is too tightly closed to determine to genus with confidence. Microscopic examination prior to coating for the SEM indicated paracypridid muscle scars. It may be close to *Tasmanocypris eurylamella* McKenzie, Reyment and Reyment, 1991. The specimen came from the lower Browns Creek Clays at Castle Cove.

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Family **Pontocyprididae** Müller, 1894
Genus *Propontocypris* Sylvester Bradley, 1948

Propontocypris sp. nov.?
Pl. I, Fig. 17

Description: Shell relatively small (length about 0.50 mm) and beanlike in shape; surface smooth and translucent; valves subequal. Dorsum evenly convex; anterior rounded; venter inflexed anteromedially; posterior subacuminate. Subelliptical in dorsal view; greatest height near-medial and 55% the length. Internally with broad anterior inner lamellae, more elongate posterior inner lamellae; inner margin regular; large anterior and posterior vestibules; marginal pore canals mostly short and straight; normal pore canals scattered, simple and rimmed; central muscle scar pattern biserial, with three anterior and two posterior scars; hinge adont.

Sexual dimorphism weak. Juveniles are highest anterodorsally.

Measurements: Length of adults ranges from 0.48-0.53 mm; height ranges from 0.28-0.30 mm; breadth is 0.20-0.22 mm. Length of A-1 juvenile carapaces 0.40 mm.

Remarks: As pontocyprids are usually fragile they are almost always rare in Australian Tertiary sediments. The figured specimen bears a naticid drill-hole, almost certainly the cause of death of the animal.

Material Studied: Five mature carapaces (two crushed) and two juvenile carapaces.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Propontocypris sp.

Remarks: We only have a single mature LV, which is damaged dorsally and has a length of 0.72 mm, from the Browns Creek Clays at Browns Creek about 21 m above the Johanna River Greensand. Apart from being distinctly larger it is also more compressed than *Propontocypris* sp. nov.?

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Genus *Argilloecia* Sars, 1866

Argilloecia allungata sp. nov.
Pl. I, Figs. 18, 19

Holotypus: The specimen PM Au 369, figured in Pl. I, Fig. 18, from the Browns Creek Clays at Castle Cove, equivalent to CC3 of Carter (1958). Figured paratype PM Au 370.

Derivatio nominis: Allungata (Italian) = elongate; for the characteristic shape.

Diagnosis: The most elongate species of *Argilloecia* known in the Cainozoic of Australia.

Description: Shell medium-sized (length about 0.60 mm); elongate, cigar-shaped; surface smooth, translucent; RV slightly overlapping LV. Dorsum gently convex; anterior subrounded; venter weakly inflexed anteroventrally; posterior subacuminate. Height only 40% the length; elongate subelliptical in dorsal view. Internally with broad anterior and less broad posterior inner lamellae; inner margin regular; anterior vestibule deep but not wide, posterior vestibule rather large; marginal pore canals flexuous anteriorly, short and straight posteriorly; normal pore canals scattered, simple and rimmed; central muscle scar pattern a rosette of five wedge shaped adductor scars; hinge adont to lophodont.

Sexual dimorphism distinct, females longer than males; juveniles similar in shape but thinner shelled and with narrow inner lamellae.

Measurements: Length of a mature male is 0.55 mm, its height is 0.21 mm, the breadth is 0.15 mm; length of a mature female is 0.60 mm, the height is 0.25 mm, the breadth is 0.18 mm. Lengths of juveniles 0.46 mm (A-1), 0.36 mm (A-2).

Remarks: This species is not only unusual in its elongate shape, it is also the largest yet described from the Tertiary of

Australia, except for *A.* aff. *bulbifera* Müller, 1894 of Whatley and Downing (1983, Pl. 2, Fig. 14) which, however, differs in its posterior shape by the presence of a terminal tip. In our new species the posterior is smoothly rounded.

Material Studied: Ten specimens, including six carapaces and two valves, encompassing adults of both sexes and four juveniles.

Occurrence and Age: Lower Castle Cove Formation, Castle Cove, Victoria; Late Eocene.

Argilloecia mesa sp. nov.

Pl. I, Figs. 20-22

Holotypus: The specimen PM Au 371, figured in Pl. I, Fig. 20, from the Browns Creek Clays at Browns Creek, about 2 m below the Johanna River Greensand. Figured paratype PM Au 372, 373.

Derivatio nominis: Mesa (Spanish) = table-like; for the characteristic appearance of the dorsal margin.

Diagnosis: An *Argilloecia* in which both ends of the dorsal margin slope downwards to produce a mesa-like dorsal profile.

Description: A small-medium sized species (length about 0.45 mm); subtrapezoidal in lateral view; surface entirely smooth; valves unequal, RV overlapping LV. Dorsal margin straight medially, sloping downwards anteriorly and, more steeply, posteriorly; anterior margin meets the dorsal margin at an oblique juncture then curves away ventrally; ventral margin weakly convex except at the near-medial inflexure; posteroventral margin curved making a subacuminate juncture with the posterodorsal margin. Height about 45 % of the length; subelliptical in dorsal view. Internally with broad anterior, ventral and posterior inner lamellae; anterior and posterior vestibules broad and deep; marginal pore canals longest ventrally, rather short elsewhere; normal pore canals scattered, simple and rimmed; central muscle scar pattern of five wedge shaped adductors in a rosette; hinge adont, RV groove and LV ridge.

Sexual dimorphism distinct, males smaller than females which are also broader and display a more marked RV overlap. Juveniles similar to adults but thinner shelled and with narrow inner lamellae.

Measurements: Length in males ranges from 0.43-0.46 mm, height ranges from 0.19-0.20 mm, breadth is 0.19 mm; length of a mature female ranges from 0.48-0.49 mm, the height is 0. 22 mm, breadth is 0.22 mm. Length of A-1 juveniles is 0.35-0.36 mm.

Remarks: Closest to a valve of *A. australomiocenica* as illustrated by Whatley and Downing (1983, Pl. 2, Fig. 20), except that in our species the dorsal margin has a more mesa-like profile and the anterior vestibule is cuplike not axehead-shaped as in the Whatley and Downing *(cit.)* figure. The species ranges from the upper Browns Creek Clays at Castle Cove to about 7 m below the Greensand marker bed at Browns Creek.

Material Studied: Fifty eight specimens, including adults of both sexes and juveniles (mostly in the samples from Castle Cove).

Occurrence and Age: Browns Creek and Castle Cove, Victoria (the species ranges from the upper Browns Creek Clays at Castle Cove to about 7 m below the Johanna River Greensand at Browns Creek); Middle(?) - Late Eocene.

Argilloecia minys sp. nov.

Pl. I, Fig. 23

Holotypus: The specimen PM Au 374, figured in Pl. I, Fig. 23, in the Browns Creek Clays at Castle Cove, Victoria.

Derivatio nominis: Minys (Gk.) = small; for its small size.

Diagnosis: An *Argilloecia* with a mesa-like dorsal profile but smaller than *A. mesa* sp. nov.

Description: Shell small (length about 0.38 mm); subtrapezoidal in lateral view; surface smooth, translucent; valves subequal. Dorsal margin mesa-like, as in *A. mesa*, but more truncated posteriorly; anterior and posterior rounded as in *A. mesa*; ventral margin convex on either side of a medial inflexure. Height almost half the length; subelliptical in dorsal view. Internally with broad anterior and posterior inner lamellae; ventral inner lamellae not as broad as in *A. mesa*, with a concave inner margin; marginal pore canals widely spaced, rather short; normal pore canals simple, rimmed; muscle scars as in the other *Argilloecia* species, but set a little more posteriorly; hinge adont, RV groove and LV ridge.

Sexual dimorphism weak, females relatively higher and broader than males. Juveniles thinner shelled than adults and with narrow inner lamellae.

Measurements: Length (both sexes) ranges from 0.37-0.39 mm; the height in males is 0.16 mm and in females is 0.18 mm; breadth in males is 0.16 mm and in females is 0.18 mm. The length of A-1 juveniles is 0.28 mm.

Remarks: Distinguished from *A. mesa* by its smaller size when mature and steeper posterodorsal profile; more truncate posteriorly than either *A. timida* or *A. kritheformae* Whatley and Downing.

Material Studied: Twelve carapaces (3 males, 6 females, 3 juveniles).

Occurrence and Age: Browns Creek and Castle Cove, Victoria (a similar stratigraphic range to *A. mesa*); Middle(?) - Late Eocene.

Argilloecia sp.

Pl. I, Fig. 24

Remarks: Only two specimens of this species, the smallest *Argilloecia* collected by us (length 0.35 mm), were found in the upper Browns Creek Clays at Castle Cove. Its almost regular elongate oval shape is unlike that of the two small species described by Whatley and Downing (1983) namely, *A. timida* and *A. bella*. If anything, it is closer to the latter but the anterodorsal margin does not slope as much anteriorly, and the ventral inner lamella (observed through the translucent shell) is much broader than in their species (Whatley and Downing, cit., Pl. II, Fig. 6).

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Genus *Maddocksella* McKenzie, 1981

Maddocksella tarparriensis sp. nov.

Pl. II, Figs. 1-3

1979 *Australoecia* n. subgen. McKenzie, 94, Pl. 1, Fig. 2.
1991 *Maddocksella argilloeciaformis* (Whatley and Downing); McKenzie, Reyment and Reyment, 148, Pl. III, Fig. 9.

Holotypus: The specimen PM Au 377, an adult male carapace, figured in Pl. II, Fig. 2, from the Browns Creek Clays at Browns Creek about 7 m above the Johanna River Greensand. Figured paratypes PM Au 376, 378.

Derivatio nominis: Tarparrie (Aboriginal) = a muddy creek, a reference to the Browns Creek Clays.

Diagnosis: A strongly sexual dimorphic *Maddocksella* with an oblong shell that is rounded posteriorly.

Description: Shell thick, moderately large sized (length of adult male 0.80 mm); oblong in lateral view; surface smooth and porcellaneous in adults; LV larger than RV, overlapping it over most of the RV periphery. Dorsal margin straight medially, sloping obliquely to front and rear (steeper behind);

anterior rounded, posterior less so; ventral margin weakly inflexed (best observed by turning a carapace on its side in RV view). Height less than half the length; box-like in dorsal view, with rather flattened extremities. Internally, with broad inner lamellae anteriorly, ventrally and posteriorly; inner margin somewhat irregular and falling away in the posteroventral region; marginal pore canals shortish, rather difficult to observe anteriorly because of the thick shell, longer and more flexuous ventrally and short posteriorly; normal pore canals simple, rimmed; central muscle scar pattern comprising a rosette of five large wedge-shaped adductors, set just posteromedially; hinge adont, RV ridge into LV groove.

Sexual dimorphism very marked, males much longer, but less high and broad, than females. Juveniles translucent, generally broad, but lacking well developed inner lamellae; and with posteromedially located adductor scars.

Measurements: Length of an adult male is 0.80 mm, its height is 0.32 mm, the breadth is 0.29 mm; length of an adult female is 0.75 mm, its height is 0.35 mm, the breadth is 0.32 mm. The lengths of juveniles are 0.52-0.62 mm (A-1); 0.43-0.45 mm (A-2); 0.32-0.37 mm (A-3); 0.26-0.28 mm (A-4).

Remarks: Shape in between *M. argilloeciaformis* and *M. obscura* (Whatley and Downing, 1983); like the former posteriorly but more truncate, although not as truncate posteriorly as *M. obscura*. The large series of well preserved specimens makes it obvious that some shells ascribed by us previously to *M. argilloeciaformis* from the Late Eocene of Gull Rock, South Australia belong rather to *M. tarparriensis*, the carapace figured then being an A-1 male juvenile of our new species; (see Synonymy above).

Material Studied: Ninety eight carapaces and fifteen valves, including only one each mature male (the holotypus) and female, plus one hundred and eleven juveniles belonging to several different growth stages.

Occurrence and Age: Browns Creek and Castle Cove, Victoria (at Browns Creek the species ranges to 7 m below the Johanna River Greensand); Gull Rock and Willunga Embayment boreholes, South Australia; Middle(?) - Late Eocene.

Maddocksella cf. *obscura* (Whatley and Downing, 1983)

Pl. II, Fig. 4

1983 *Australoecia obscura* Whatley and Downing, 362-363, Pl. 3, Figs. 5-7.

1991 *Maddocksella obscura* (Whatley and Downing); McKenzie, Reyment and Reyment, 148, Pl. III, Figs. 8, 9.

Remarks: In the same sample as the large set attributed to *M. eocaenica* were four specimens which, when brushed over with a wet brush, were observed to be mature in development of inner lamellae and vestibules. They closely resemble *M. obscura*.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Family **Cytheridae** Baird, 1850
Subfamilia **Cytherinae** Baird, 1850
Genus *Loxocythere* Hornibrook, 1952

Loxocythere malzi sp. nov.

Pl. II, Fig. 5

Holotypus: The specimen PM Au 380, figured in Pl. II, Fig. 5, from the lower Browns Creek Clays at Castle Cove.

Derivatio nominis: For Dr. Heinz Malz, the Senckenberg Museum, Frankfurt-am-Main, Germany, who has contributed recently to the description of an important Mesozoic Australian ostracod fauna.

Diagnosis: A *Loxocythere* which is tumid in dorsal view.

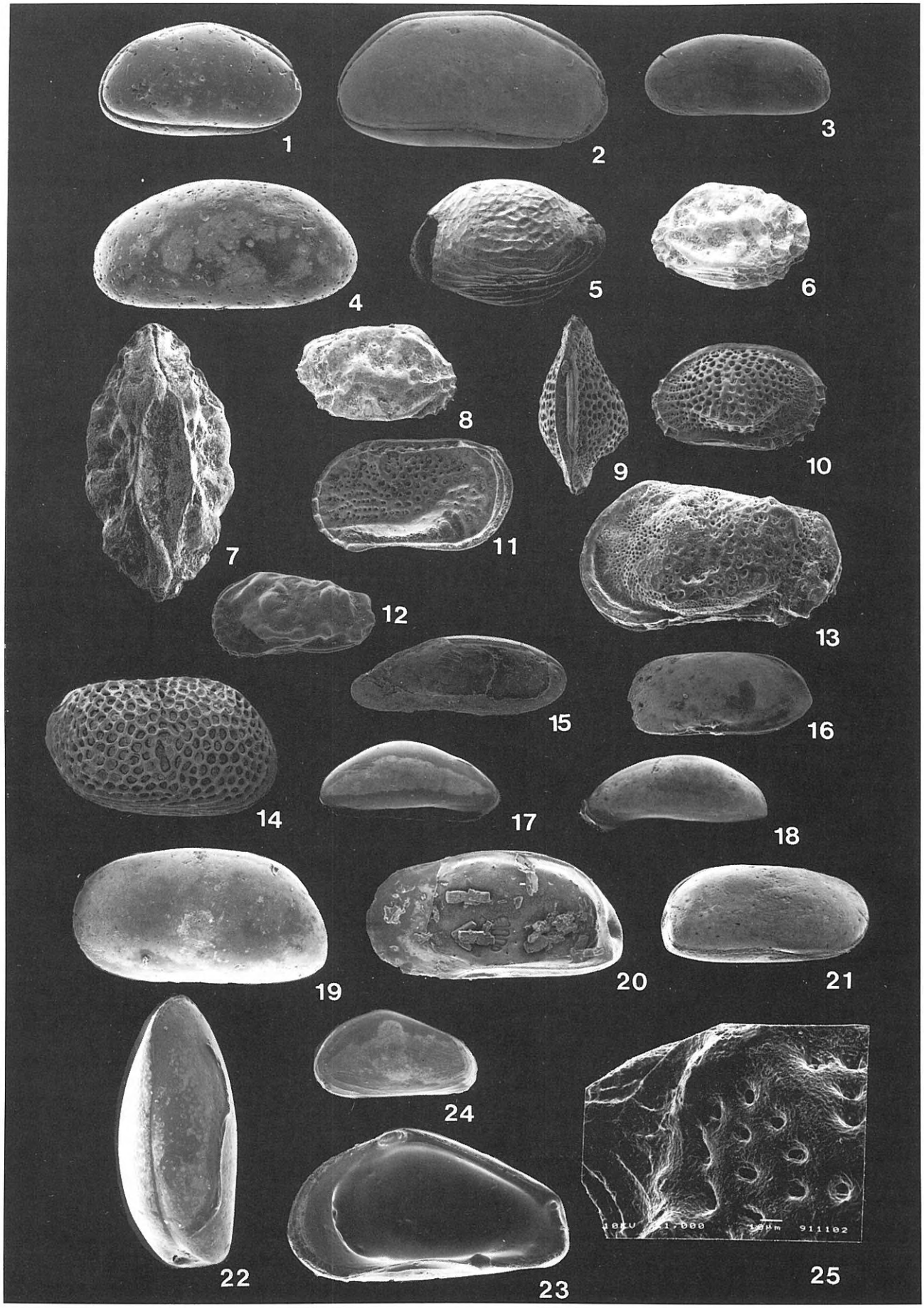
Description: A small-medium sized species (length about 0.40 mm); sub-semicircular in lateral view; surface punctate, also striated anteriorly and ventrally; valves subequal. Dorsum strongly convex; anterior rounded, trending anteroventrally; venter inflated in both valves and overlapping the ventral

---

Plate II

1 *Maddocksella tarparriensis* sp. nov. PM Au 376, stub Vic-3(K4). (A-1) female RV carapace. Browns Creek Clays, 7 m above Johanna River Greensand. × 70.
2 Same species and provenance. Holotypus. PM Au 377, stub Vic-13. Male RV. × 100.
3 Same species and provenance. PM Au 378, stub Vic-13. Male LV. × 70.
4 *Maddocksella* cf. *obscura* (Whatley and Downing). PM Au 379, stub Vic-12. Female LV carapace. Browns Creek. × 100.
5 *Loxocythere malzi* sp. nov. Holotypus. PM Au 380, stub Vic-7. Female LV carapace. Lower Browns Creek Clays at Castle Cove. × 100.
6 *Amphicytherura dinglei* sp. nov. Holotypus. PM Au 381, stub Vic-7. Female LV carapace. Lower Browns Creek Clays at Castle Cove. × 100.
7 Same species and provenance. PM Au 382, stub Vic-7. Dorsal female carapace. × 170.
8 Same species and provenance. PM Au 383, stub Vic-7. Male RV carapace. × 100.
9 *Saida daisa* sp. nov. PM Au 385. Dorsal male carapace. Browns Creek Clays at Castle Cove. × 100.
10 Same species and provenance. Holotypus. PM Au 384. Female LV carapace. × 100.
11 *Saida* sp. PM Au 386, stub Vic-6. Male LV carapace. Castle Cove. × 100.
12 *Callistocythere* sp. PM Au 387, stub Vic-10. Male LV carapace. × 100.
13 *Cluthia?* sp. PM Au 350, stub Vic-12. Female RV carapace. × 170.
14 *Cytheralison* sp. PM Au 389, stub Vic-9. Female RV carapace. Browns River Clays. × 70.
15 *Sclerochilus* sp. PM Au 390, stub Vic-9. Male RV. Browns Creek Clays, 2 m above Johanna R. Greensand. × 70.
16 *Phlyctobythocythere?* sp. PM Au 391, stub Vic-11. Browns Creek Clays, 21 m above Johanna R. Greensand. × 100.
17 *Paracytherois eocaenica* sp. nov. Holotypus. PM Au 392, stub Vic-4(K3). Male LV. Lower Browns Creek Clays at Castle Cove. × 100.
18 Same species and provenance. PM Au 393, stub Vic-4(K3). × 100.
19 *Krithe postcircularis* sp. nov. PM Au 394, stub Vic-2(K1). Female LV. Lower Browns Creek Clays at Castle Cove. × 100.
20 Same species and provenance. PM Au 395, stub Vic-2(K1). × 100.
21 Same species and provenance. Holotypus. Male LV. PM Au 396, stub Vic-6. × 70.
22 Same species and provenance. PM Au 397, stub Vic-3(K4). Female dorsal carapace. × 100.
23 *Pseudeucythere parapubera* (Whatley and Downing). PM Au 398, stub Vic-2(K1). Browns Creek, 7 m below Johanna R. Greensand. × 155.
24 Same species and provenance. PM Au 399, stub Vic-2(K1). Male LV. × 100.
25 *Kangarina wareelacogarra* sp. nov. Detail of the ornamental development of the posterior of PM Au 445 figured in Pl. IV, Fig. 22. × 225.

Plate II



margin which is rather straight except where inflexed anteromedially; posterior subacuminate, produced into a weak cauda. Subhastate and swollen in dorsal view, greatest breadth posteromedial; height about 55 % the length. Internally with moderately broad inner lamellae, a small anterior vestibule and few and straight marginal pore canals; median selvage distinct; normal pore canals scattered, sieve type; central muscle scar pattern comprising four slender adductors in a subvertical row plus a v-shaped frontal scar; hinge merodont, RV with crenulate terminal teeth and a smooth median furrow, LV complementary .

Sexual dimorphism rather weak, males relatively more elongate (less high) than females. Juveniles translucent, displaying anterior and ventral striations well, but with very narrow inner lamellae.

Measurements: Length of mature male 0.40 mm, height 0.22 mm, breadth 0.23 mm; length of mature female 0.42 mm, height is 0.24 mm, breadth 0.27 mm. Lengths of juveniles 0.30-0.32 mm (A-1); 0.25 mm (A-2).

Remarks: *Loxocythere* is regarded as forming a continuum with *Microcytherura* Müller, 1894 (Howe and McKenzie, 1989). Our species is less noticeably reticulate than *L. crassa* and *L. kingi* (Hornibrook, 1952) and differs in shape, being more convex dorsally. The latter feature also differentiates it from species described by McKenzie (1967a) and Hartmann (1980).

Material Studied: Twelve carapaces and two valves, adults of both sexes and five juveniles, 17 specimens in all.

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Subfamily **Schizocytherinae** Mandelshtam, 1960
Genus *Amphicytherura* Butler and Jones, 1957
Amphicytherura dinglei sp. nov.
Pl. II, Figs. 6-8; Pl. VIII, Fig. 1

1974 *Amphicytherura* sp., McKenzie, 161, Pl. 2, Fig. 11, text-fig. 2g.

Holotypus: The specimen PM Au 381, figured in Pl. II, Fig. 6, from the lower Browns Creek Clays at Castle Cove. Figured paratypes PM Au 382, 383.

Derivatio nominis: For Dr. R. V. Dingle, South African Museum, Cape Town, South Africa, who has described other Southern Hemisphere species of this genus.

Diagnosis: An *Amphicytherura* ornamented with a distinctive pattern of thick ridges.

Description: Shell robust but small (length about 0.36 mm); subrhomboidal in lateral view; surface ornamented by a thick marginal ridge extending from the anterodorsal around to the posterodorsal area, plus a subdiagonal medial ridge, and other shorter irregular ridges; eye tubercle weakly developed, anterodorsal; valves subequal. Dorsal margin straight; anterior margin incurved below the anterodorsal corner but rounded below and marginally denticulate; ventral margin straight, overlapped by the ventromarginal ridge; posterior subcaudate. Roughly parallel-sided in dorsal view with a narrowed anterior and caudate posterior; height about 60 % the length. Internally with broad inner lamellae and a small anterior vestibule; selvage distinct; marginal pore canals flexuous, clustered anteroventrally, more widely spaced elsewhere; normal pore canals scattered, sieve type; central muscle scar pattern of four adductors in a subvertical row plus a v-shaped frontal scar (Plate VIII, Fig. 1); hinge conspicuously schizodont, RV with split anterior tooth and a deep, divided postjacent socket followed by a crenulate median furrow (the last few posterior crenulations widely spaced), then a crenulate terminal toothplate; LV complementary.

Sexual dimorphism weak, males relatively less high than females. Juveniles (A-1) also robust but definitely smaller.

Measurements: Length of mature adults 0.35-0.38 mm, height 0.21-0.23 mm, breadth 0.17-0.19 mm. The length of A-1 juveniles is 0.27 mm.

Remarks: As noted by Dingle (1981), schizocytherines such as *Amphicytherura* and *Apateloschizocythere* Bate, 1972 can be differentiated on their hingement, schizodont in the former but antimerodont in the latter which also lacks an eye tubercle. Ours is the first description of an Australian Tertiary species of *Amphicytherura*. Apart from the Castle Cove records, a single male carapace was recovered from the Johanna River Greensand at Browns Creek.

Material Studied: Fourteen carapaces (one juvenile) of both sexes and one male LV.

Occurrence and Age: Castle Cove (where the species ranges into the overlying Castle Cove Limestone) and Browns Creek, Victoria; Late Eocene.

Subfamily **Saidiinae** Aranki, McKenzie, Reyment and Reyment, 1992
Genus *Saida* Hornibrook, 1952
Saida daisa sp. nov.
Pl. II, Figs. 9-10

Holotypus: The specimen PM Au 384, figured in Pl. II, Fig. 10. Figured paratype PM Au 385.

Derivatio nominis: Daisa = anagram of *Saida.*

Diagnosis: A *Saida* characterized by a medioventral ala with a well defined keel and carrying a short rounded spine just behind the maximum height of the ala.

Description: Shell small (length about 0.40 mm); subrectangular in lateral view; surface punctate, the punctation coarser medially than antero- and posteromarginally; each valve with a prominent keeled ala (typical for *Saida*). In our new species this ala is quite convex and there is a short round-tipped spine just below the maximum height of the ala; there is also a short posterodorsal ridge; valves subequal. Dorsal margin straight; anterior margin slightly more broadly rounded than the posterior margin, both margins bearing large denticles; ventral margin inflexed medially. Subhastate in dorsal view; height about 60 % the length. Internally with broad anterior and posterior inner lamellae; regular inner margins; no vestibules; selvages distinct; ventral flange scarcely developed; marginal pore canals widely-spaced, few and straight; normal pore canals scattered, sieve type; central muscle scar pattern comprising four small adductors in a subvertical row plus a small v-shaped frontal scar; RV hinge with weakly crenulate terminal teeth separated by a crenulate(?) median furrow, LV complementary.

Sexual dimorphism seems to be weak, males relatively less high than females. Juveniles not present in our collection.

Measurements: Length of adult males 0.37-0.39 mm, height 0.23 mm, breadth 0.19 mm; length of mature females 0.40-0.41 mm, height is 0.25 mm, breadth 0.21 mm.

Remarks: Differentiated from *S. bellsensis* McKenzie, Reyment and Reyment, 1991 by a more convex alar keel and its small spine; and from *S. torresi* Brady, 1880 (Whatley and Downing, 1983, Pl. 3, Fig. 8) by a less well developed ventral flange and because its posterodorsal ridge is short rather than long. The distinctive nature of this new species justifies its formal recognition, despite the small amount of material available.

Material Studied: Seven adult carapaces - four females, three males.

Occurrence and Age: Browns Creek Clays about 1 m above the Greensand at Browns Creek, basal Castle Cove Formation, and upper Castle Cove Formation, Castle Cove, Victoria; Late Eocene.

Saida sp.
Pl. II, Fig. 11

Remarks: The two available carapaces, from the lower part of the Browns Creek Clays at Castle Cove, probably are mature males although small sized (length 0.28 mm). This extends the stratigraphic range in Victoria of the more elongate lineage of *Saida* into the Late Eocene (cf. McKenzie, 1974, p. 161).

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Subfamily **Leptocytherinae** Hanai, 1957
Genus *Callistocythere* Ruggieri, 1953

Callistocythere sp.
Pl. II, Fig. 12

Remarks: This is the earliest record of *Callistocythere* from Australia and was noted as such in McKenzie (1987). Our two specimens came from the lower Browns Creek Clays at Castle Cove; both seem to be mature males (length 0.37 mm).

Occurrence and Age: Castle Cove; Late Eocene.

Genus *Cluthia* Neale, 1973

Cluthia(?) sp.
Pl. II, Fig. 13

Remarks: A single mature LV (length 0.35 mm) from the Browns Creek section just below the Johanna River Greensand seems to belong in this genus which hitherto was not known for the Australian microfauna. The variety of the posterior and anterior surface ornament is brought out well under the SEM.

Occurrence and Age: Browns Creek, Victoria; Middle(?) Eocene.

Family **Bythocytheridae** Sars, 1926
Genus *Cytheralison* Hornibrook, 1952

Cytheralison sp.
Pl. II, Fig. 14

Remarks: The two specimens (one very poorly preserved) seem specifically distinct in that the deep pits which cover the surface are circular rather than reticulate as in other species: This is the oldest record for *Cytheralison* in the Tertiary of southeastern Australia. The better specimen (which we have figured) has a length of 0.72 mm and was found in the upper part of the Browns Creek Clays at Castle Cove.

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Genus *Sclerochilus* Sars, 1866

Sclerochilus sp.
Pl. II, Fig. 15

Remarks: The figure illustrates a damaged RV of our only specimen (length 0.48 mm) which was determined to genus on the flexuous, elongate bean shape with rounded extremities and the obliquely-aligned five adductor muscle scars. It was collected from the Browns Creek section about 2 m above the Johanna River Greensand. This is the oldest record of *Sclerochilus* from Australia.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Genus *Phlyctobythocythere* Bonaduce, Masoli and Pugliese, 1976

Phlyctobythocythere(?) sp.
Pl. II, Fig. 16

Remarks: Like Whatley and Downing (1983), we are uncertain of the correctness of this generic determination. Dr. I. Yassini (personal communication May 1988) is describing several new southern Australian bythocytherids and may well provide a more apposite generic name for the taxon. The single carapace is rather compressed and has a length of 0.40 mm; it came from the upper part of the Browns Creek Clays at Browns Creek, about 21 m above the Greensand.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Family **Paradoxostomatidae** Brady and Norman, 1889
Genus *Paracytherois* Müller, 1894

Paracytherois eocaenica sp. nov.
Pl. II, Figs. 17, 18; Pl. VIII, Fig. 2

1969 *Paracytherois* sp., McKenzie, 61.

Holotypus: The specimens PM Au 392 and PM Au 393 (LV and RV of the same individual) figured in Pl. II, Figs. 17 and 18 from the lower Browns Creek Clays at Castle Cove.

Derivatio nominis: Eocaenica = Eocene, for its geological age.

Diagnosis: A small flexuous *Paracytherois*, narrowly lanceolate in dorsal view.

Description: Shell rather small (length 0.36 mm); elongate beanshaped and flexuous in lateral view by reason of the marked anteroventral inflexure; surface smooth. Dorsal margin convex, curved more steeply in the rear; anterior more rounded than the posterior; venter weakly convex, apart from the inflexure noted above. RV larger than LV and overlapping it dorsally. Greatest height just posteromedial and over a third of the length; narrowly lanceolate in dorsal view, with greatest breadth almost medial. Internally with broad anterior, ventral and posterior inner lamellae, the ventral inner margins of the lamellae being somewhat irregular; broad anterior and a small posterior vestibule; marginal pore canals relatively few; normal pore canas simple and scattered; central muscle scars comprising four large adductors in an oblique series, plus some dorsal scars; hinge adont.

Sexual dimorphism weak, males relatively less high than females; juveniles smaller and thin-shelled, with narrow inner lamellae.

Measurements: Length of adults ranges from 0.37-0.39 mm; height from 0.19-0.21 mm; breadth from 0.17-0.19 mm. The lone A-1 juvenile LV has a length of 0.28 mm.

Remarks: Their fragility means that paradoxostomatids are rarely encountered in quantity in fossil assemblages. The shape of this species at first led to it being determined as a *Sclerochilus* but our camera lucida drawings of both valves show that it has four rather than five adductor scars (Pl. VIII, Fig. 2). This instance highlights the need to determine internal features accurately, as well as provide SEMs of the external shape and ornament of species. Also present in the Browns Creek section 1-7 m above the Greensand.

Material Studied: Eight adult carapaces and one A-1 LV juvenile.

Occurrence and Age: Castle Cove and Browns Creek, Victoria; Late Eocene.

Family **Krithiidae** Mandelshtam, 1960
Genus *Krithe* Brady, Crosskey and Robertson, 1874

Krithe postcircularis sp. nov.

Pl. II, Figs. 19-22; Pl. VIII, Fig. 3

1979 *Krithe* sp., McKenzie, 94.
1991 *Krithe nitida* Whatley and Downing; McKenzie, Reyment and Reyment, 150, Pl. II, Fig. 14.

Holotypus: The specimen PM Au 396, figured in Pl. II, Fig. 21, from the lower Browns Creek Clays at Castle Cove. Figured paratypes PM Au 394, 395, 397.
Derivatio nominis: Post (L.) = behind; *circulus* (L.) = circular; for the circular posterior declivity.

Diagnosis: A *Krithe* in which the posterior declivity (generic character) is circular rather than elongate as in other species.

Description: Shell medium-sized (length about 0.60 mm); subrectangular in lateral view; surface smooth, the muscle scars standing out clearly on most specimens (Pl. II, Fig. 20); LV overlapping RV ventrally. Dorsum weakly convex; anterior broadly rounded; ventral margin almost straight, inflexed medially; posterior truncated. Typical dorsal profile for a *Krithe*, narrowed anteriorly, broadest posteromedially and invaginated posteriorly; height a little more than half the length. Internally with broad anterior inner lamellae, moderately broad ventral and posterior inner lamellae, the inner margin of the line of concrescence extends all the way round from anterodorsal to posterodorsal; anterior vestibule rather large and axehead-shaped in all specimens; no posterior vestibule; marginal pore canals relatively short anteriorly, longer and more flexuous ventrally and posteroventrally, pseudomarginal pore canals also present; normal pore canals scattered, sieve type; central muscle scar pattern comprising four large elongate adductors in a vertical series plus an unusual and large J-shaped frontal scar (Pl. VIII, Fig. 3); hinge adont.

Sexual dimorphism distinct, males relatively less high and more slender than females. Juveniles are thinner shelled with narrow inner lamellae and lack a posterior declivity.

Measurements: Length of mature males ranges from 0.59-0.62 mm, height ranges from 0.28-0.31 mm, breadth from 0.25-0.26 mm; length of females ranges from 0.60-0.66 mm, height ranges from 0.30-0.33 mm, breadth from 0.28-0.34 mm. Lengths of juveniles are 0.48-0.50 mm (A-1); 0.39-0.41 mm (A-2); 0.30 mm (A-3).

Remarks: As with *Maddocksella tarparriensis*, the limited number of poorly preserved adult specimens from Gull Rock, South Australia, led to our assignation of the *Krithe* species from that locality to a previously described species, *K. nitida* (see Synonymy above). The more numerous and better preserved Browns Creek Clays series makes it clear that the Eocene forms are specifically distinct from the Late Oligocene-early Middle Miocene taxon. In the Willunga Embayment boreholes WLG40 and WLG42, South Australia, *K. postcircularis* occurs only in the Eocene part of the section (mainly as juveniles); in these samples it ranges from the lower Browns Creek Clays at Castle Cove to about 7 m below the Greensand at Browns Creek. The Middle(?) Eocene specimens below the Johanna River Greensand are shorter relative to their length and may represent a different subspecies.

Material Studied: Thirty one carapaces and five valves, most of the adults are females.

Occurrence and Age: Gull Rock and Willunga Embayment boreholes, South Australia; Browns Creek and Castle Cove, Victoria; Middle(?) - Late Eocene.

Family **Eucytheridae** Puri, 1954
Genus *Pseudeucythere* Hartmann, 1989

Pseudeucythere parapubera (Whatley and Downing, 1983)

Pl. II, Figs. 23, 24

1983 *Eucythere (Eucythere) parapubera* Whatley and Downing, 366-367, Pl. III, Figs. 19-21.

Remarks: Our four specimens (length about 0.36 mm) are close to *P. parapubera*, especially with respect to the pattern of surface striations in which they seem virtually identical to it. They occur about 7 m below the Johanna River Greensand at Browns Creek and occasionally in younger sediments of the upper Browns Creek Clays at Castle Cove.

Occurrence and Age: Browns Creek, Castle Cove and Balcombe Bay, Victoria; Middle(?) Eocene - early Middle Miocene.

Pseudeucythere pseudosubovalis (Whatley and Downing, 1983)

Pl. III, Fig. 1

1983 *Eucythere (Rotundracythere) pseudosubovalis* Whatley and Downing, 368, Pl. IV, Figs. 4-6.
1991 *Pseudeucythere pseudosubovalis* (Whatley and Downing); McKenzie, Reyment and Reyment, 150, Pl. V, Figs. 1-3, Pl. XI, Fig. 7.

Remarks: Four individuals (length 0.38-0.40 mm) of this distinctive species were identified in the Browns Creek section, from about 1 m above the Johanna River Greensand to about 7 m below it. These records extend the stratigraphic range of *P. pseudosubovalis* into the Eocene. When the surface pattern of punctation, reticulation and ventral striations are compared with *Rotundracythere* cf. *rotunda* (Hornibrook, 1952) (see below) the assignment to that genus by Whatley and Downing (cf. Synonymy) seems reasonable. However, typical *Rotundracythere* species are more fragile and this type of surface ornament is characteristic of many Australasian taxa, e.g. species of *Oculocytheropteron*, whatever this may signify.

Occurrence and Age: Browns Creek, Bells Headland and Balcombe Bay, Victoria; Middle(?) Eocene - early Middle Miocene.

Pseudeucythere sp. 1

Pl. III, Fig. 2

Remarks: The translucent RV from the upper Browns Creek Clays at Castle Cove is clearly mature though small (length 0.31 mm). It resembles no other previously described species in the genus. Two other specimens were found at Browns Creek, below the Johanna River Greensand.

Occurrence and Age: Castle Cove and Browns Creek, Victoria; Middle(?) - Late Eocene.

Pseudeucythere sp. 2

Remarks: We only have two specimens (length 0.38 mm), from the upper Browns Creek Clays at each locality. The elongate shape and medial thickening is unlike previously described taxa but we lack sufficient material to describe it as new.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Late Eocene.

Genus *Rotundracythere* Mandelshtam, 1960

Rotundracythere cf. *rotunda* Hornibrook, 1952

Pl. III, Fig. 3

1952 *Eucythere rotunda* Hornibrook, 30, Pl. 2, Figs. 22, 23, 25.
1960 *Rotundracythere rotunda* (Hornibrook); Mandelshtam, 378-379, Fig. 1065.
1979 *Rotundracythere* sp., McKenzie, 94.

Remarks: We have five specimens –3 female carapaces, 1 male carapace and a male RV (length 0.39-0.41 mm)– from the Browns Creek Clays at Castle Cove. Sexual dimorphism is distinct, with males longer and less high than females. The shell is translucent, so it was relatively easy to match most internal features with those described by Hornibrook (1952). Externally the valves carry the same kind of ventral striations as his species: A further match is that *R. rotunda* makes its first appearance in New Zealand in the Late Eocene (Runangan). Our SEMs give previously unknown detail of the pattern of punctation and reticulation that marks the surface ornament of this species.

Occurrence and Age: New Zealand; Willunga Embayment, South Australia; Castle Cove, Victoria; Late Eocene of Australia, ranging younger in New Zealand.

Family **Loxoconchidae** Sars, 1925
Genus *Myrena* Neale, 1967
Myrena lindsayi McKenzie, Reyment and Reyment, 1991
Pl. III, Figs. 4-7

1979 *Myrena* sp., McKenzie, 93, 94, 100, Pl. 1, Fig. 10, Fig. 2.
1991 *Myrena lindsayi* McKenzie, Reyment and Reyment, 152, Pl. IV, Fig. 4, Pl. V, Fig. 10.

Remarks: Our collections from the Browns Creek Clays above the Johanna River Greensand contain numerous specimens of this taxon (length of adults 0.36-0.40 mm) that was relatively rare in the South Australian localities from which it was originally described.

Material Studied: Eighty six individuals, carapaces and a few valves, adults of both sexes plus a few juvenile carapaces.

Occurrence and Age: Gull Rock and Willunga Embayment boreholes, South Australia; Castle Cove and Browns Creek, Victoria; Late Eocene.

Genus *Loxoconcha* Sars, 1866
Loxoconcha sp.
Pl. III, Fig. 8

1991 *Loxoconcha* sp., McKenzie, Reyment and Reyment, 152, Pl. V, Fig. 3.

Remarks: Only one mature female carapace (length 0.40 mm), from the upper part of the Browns Creek Clays at Castle Cove.

Occurrence and Age: Castle Cove and Bells Headland, Victoria; Late Eocene - Late Oligocene.

Family **Xestoleberididae** Sars, 1928
Genus *Foveoleberis* Malz, 1980
Foveoleberis minutissima (Chapman, 1926) *sublaevis* subsp. nov.
Pl. III, Fig. 9

1979 *Uroleberis* sp., McKenzie, 94.
1991 *Foveoleberis minutissima* (Chapman); McKenzie, Reyment and Reyment, 154, Pl. V, Fig. 12.

Holotypus: The specimen PM Au 410, figured in Pl. III, Fig. 9 from the upper part of the Browns Creek Clays at Castle Cove.

Derivatio nominis: Sublaevis (L.) = almost smooth; for the shell's appearance.

Diagnosis: Like *F. minutissima*, but with smoother surface.

Description: Shell medium-sized (length about 0.55 mm); subglobose; elongate anterodorsal scar distinct; surface almost completely smooth except for some scattered punctillae; LV slightly overlaps RV for much of the periphery. Dorsum strongly convex; anterior subrounded anteroventrally; venter slightly inflexed medially; posterior displaying a small cauda. Subglobose dorsally, broadest posteromedially, narrowed anteriorly, caudate posteriorly; breadth and height each about two-thirds the length. Internally with moderately broad inner lamellae; small anterior vestibule; selvage submarginal and distinct; marginal pore canals multibranched anteriorly, straight or weakly flexuous elsewhere; normal pore canals scattered, large, sieve type; central muscle scar pattern comprising four large adductors in a subvertical series plus a large v-shaped frontal scar; hinge merodont type, RV with crenulate terminal toothplates on either side of a crenulate medial groove, LV complementary.

Females more inflated than males. Juveniles similar to adults but with narrow inner lamellae.

Measurements: Length of adult female 0.53-0.55 mm, height 0.38 mm, breadth same as height. Length of juveniles 0.40 mm (A-1 male); 0.33 mm (A-2).

Remarks: These specimens and those (less numerous) from Bells Headland are much less punctate than the nominate subspecies figured in McKenzie (1974) and in Whatley and Downing (1983) from the early Middle Miocene (Balcombian) of Victoria.

Material Studied: Forty carapaces and valves, including several adult females and males, an A-1 juvenile male and other juveniles.

Occurrence and Age: Browns Creek Clays, Castle Cove, lower Castle Cove Formation, Castle Cove, and Bells Headland, Victoria; Willunga Embayment borehole WLG40, South Australia; Late Eocene - Late Oligocene.

Genus *Xestoleberis* Sars, 1866
Xestoleberis basiplana sp. nov.
Pl. III, Figs. 10-12

Holotypus: The specimen PM Au 413, figured in Pl. III, Fig. 12 from the lower Browns Creek Clays at Castle Cove. Figured paratypes PM Au 411, 412.

Derivatio nominis: Basis (L.) = base; and *planus* (L.) = flat; for the flattened venter.

Diagnosis: A *Xestoleberis* with a flattened venter and also slightly beaked anteroventrally.

Description: Shell medium-sized (length 0.40-0.45 mm); elongate, ovate; surface smooth; elongate anterodorsal scar showing up clearly in many specimens; LV greater than RV, overlapping it along most of the dorsum and venter. Dorsum convex; anterior slightly beaked anteroventrally; ventral margin straight, with weak inflexure; posterior subrounded. Subovate in dorsal view, rounded posteriorly and narrowed anteriorly; height about 55 % the length; observed to be much flattened ventrally in vertical view. Internally with relatively broad inner lamellae anteriorly, narrower ventrally; anterior vestibule present but small, posterior vestibule unconfirmed because obscured by the flattened venter; marginal pore canals short and straight, regularly spaced ventrally (likely to be multibranched anteriorly); normal pore canals scattered, sieve

type; central muscle scars consisting of four adductors in a subvertical row plus a broadly v-shaped frontal scar; hinge merodont, RV with crenulate terminal teeth either side of a crenulate median furrow, LV complementary.

Sexual dimorphism marked, females broader than males, but males are longer. Juveniles similar to adults but smaller and with narrow inner lamellae.

Measurements: Length of males ranges from 0.42-0.44 mm, height 0.20 mm, breadth 0.22-0.24 mm; length of females ranges from 0.39-0.41 mm, height 0.21 mm, breadth ranges from 0.25-0.28 mm. Length of juveniles 0.35-0.36 mm (A-1); 0.28 mm (A-2).

Remarks: Distinguished by its strongly flattened venter from other described Tertiary Australian species of *Xestoleberis* (Whatley and Downing, 1983).

Material Studied: Forty eight carapaces, adults of both sexes plus juveniles.

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Xestoleberis noccia sp. nov.

Pl. III, Figs. 13, 14; Pl. VIII, Fig. 4

Holotypus: The specimen PM Au 415, figured in Pl. III, Fig. 14 from the lower Browns Creek Clays at Castle Cove. Figured paratype PM Au 414.

Derivatio nominis: Noccia (Italian) = a nut; for the shape in dorsal view.

Diagnosis: A relatively small, nut-like *Xestoleberis.*

Description: Shell small-medium (length about 0.35 mm); subovate in lateral view; surface smooth; anterodorsal scar showing up distinctly through the translucent shell; LV larger than RV, overlapping it most conspicuously in the rear. Dorsum convex; anterior subrounded ventrally; venter virtually straight; posterior broadly rounded. Sides mostly subparallel and with a nut-like appearance in dorsal view; height about 60 % the length. Internally, with moderately broad anterior inner lamellae, remainder of the inner lamella is rather narrow; broad anterior vestibule and narrow, small posterior vestibule; selvage submarginal; marginal pore canals short and close together anteroventrally but widely spaced and longer elsewhere; normal pore canals scattered, sieve type; muscle scars and hinge as illustrated (see Pl. VIII, Fig. 4).

Sexual dimorphism weak, females broader than males. Juveniles similar but thinner shelled and with narrow inner lamellae.

Measurements: Length of mature female 0.36 mm, height 0.22 mm, breadth 0.25 mm, male length 0.33 mm, height 0.21 mm, breadth 0.22 mm. Length of juveniles 0.27 mm (A-1); 0.20-0.22 mm (A-2).

Remarks: This species could be close to *X. paratruncata* Whatley and Downing, 1983 but those authors neither figure nor describe their species shape in dorsal view. The camera lucida drawing is of the only mature separate valve from the Johanna River Greensand.

Material Studied: Twenty individuals, ten carapaces and ten valves, including adults of both sexes plus juveniles.

Occurrence and Age: Castle Cove, and also in the Browns Creek section (from about 1 m above the Greensand to about 7 m below it), Victoria; Middle(?) - Late Eocene.

Xestoleberis sp.

Pl. III, Fig. 15

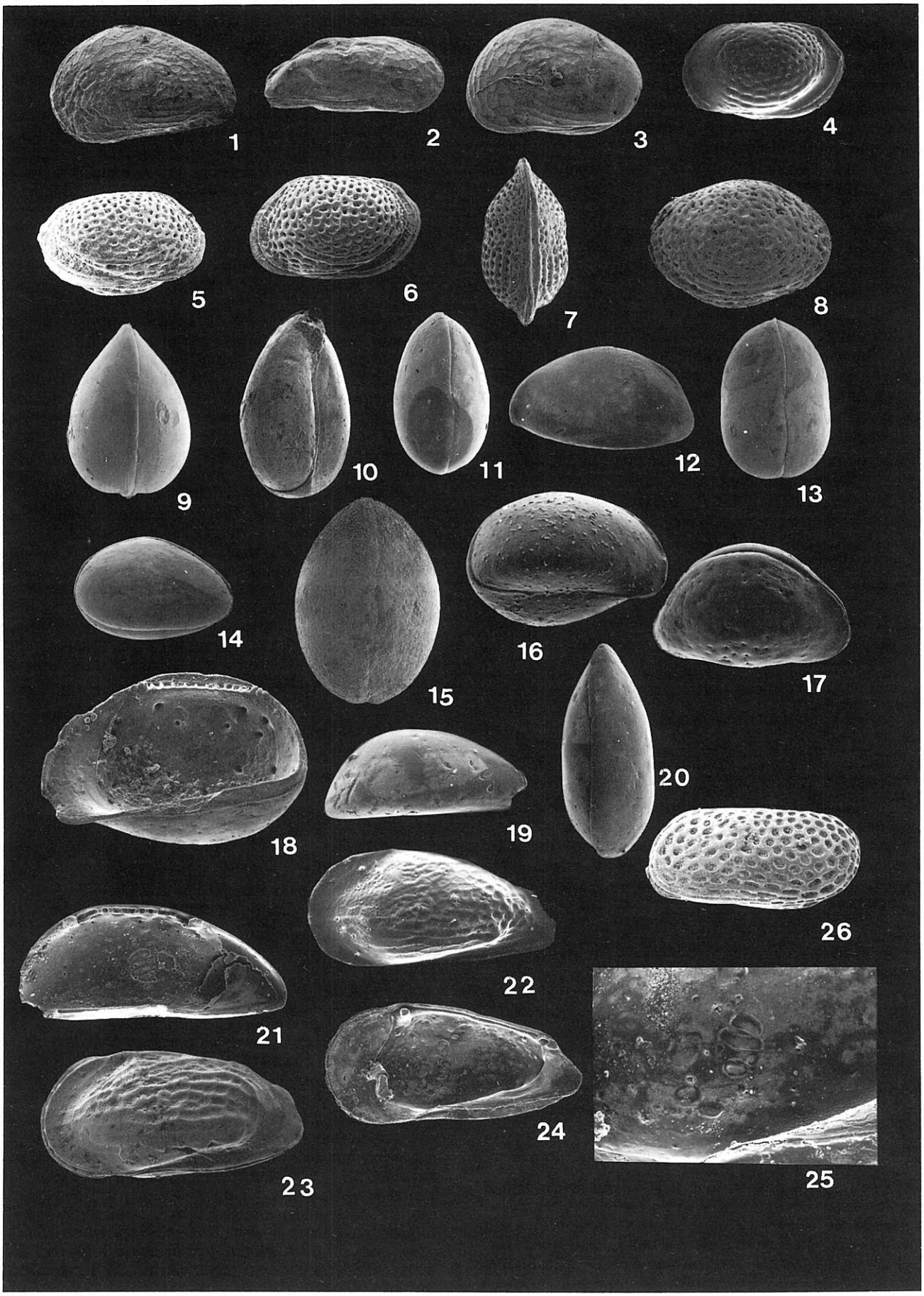
Remarks: There are only two mature females plus three juveniles of this species (length 0.42 mm) from the Johanna River Greensand. It is like *X. basiplana* in that the venter is flattened, but instead of the ventral bulge making an angular junction with the flattened part of the valve, in these females the junction is quite rounded. Further, they do not show the anterior beaked overlap by the LV over the RV which characterizes *X. basiplana.*

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Plate III

1 *Pseudeucythere pseudosubovalis* (Whatley and Downing). PM Au 400, stub Vic-13. Female LV. Browns Creek. × 100.
2 *Pseudeucythere* sp. PM Au 401, stub Vic-8. Male RV. Upper Browns Creek Clays. × 100.
3 *Rotundracythere* cf. *rotunda* Hornibrook. PM Au 402, stub Vic-13. Female LV. Castle Cove. × 100.
4 *Myrena lindsayi* McKenzie, Reyment and Reyment. PM Au 403, stub Vic-3(K4). Male LV carapace. Browns Creek Clays above Johanna Greensand. × 100.
5 Same species and provenance. PM Au 404, stub Vic-7. Female RV carapace. × 100.
6 Same species and provenance. PM Au 405, stub Vic-7. × 100.
7 Same species and provenance. PM Au 406, stub Vic-7. Dorsal view of male carapace. × 100.
8 *Loxoconcha* sp. PM Au 407, stub Vic-13. Male RV. Castle Cove. × 100.
9 *Foveoleberis minutissima* (Chapman) *sublaevis* subsp. nov. Holotypus. PM Au 410, stub Vic-10. Dorsal view of male carapace. Upper part of Browns Creek Clays at Castle Cove. × 70.
10 *Xestoleberis basiplana* sp. nov. PM Au 411, stub Vic-8. Ventral view of male carapace. Lower Browns Creek Clays at Castle Cove. × 100.
11 Same species and provenance. PM Au 412, stub Vic-3(K4). Dorsal view of (A-1) carapace. × 100.
12 Same species and provenance. Holotypus. PM Au 413, stub Vic-13. Female RV. × 100.
13 *Xestoleberis noccia* sp. nov. PM Au 414, stub Vic-13. Dorsal view of female carapace. Castle Cove. × 100.
14 Same species and provenance. Holotypus, a carapace. PM Au 415, stub Vic-13. × 100.
15 *Xestoleberis* sp. PM Au 416, stub Vic-13. Dorsal view of carapace. × 100.
16 *Nunana australiae* sp. nov. PM Au 417, stub Vic-13. Female RV carapace. Upper Browns Creek Clays, Castle Cove. × 155.
17 Same species and provenance. Holotypus. PM Au 418, stub Vic-13. Male RV. × 155.
18 Same species and provenance. PM Au 419, stub Vic-13. Female RV, interior. × 225.
19 *Microcythere airella* sp. nov. Holotypus. PM Au 420, stub Vic-4(K3). Female RV. Lower Browns Creek Clays at Castle Cove. × 225.
20 Same species and provenance. PM Au 421, stub Vic-4(K3). Carapace. × 225.
21 Same species and provenance. PM Au 422, stub Vic-4(K3). × 225.
22 *Bidgeecythere barupa* sp. nov. PM Au 423, stub Vic-4(K3). Male LV. Lower Browns Creek Clays. × 225.
23 Same species. Holotypus. PM Au 424, stub Vic-9, LV carapace. Upper Browns Creek Clays about 21 m above Johanna R. Greensand. × 225.
24 Same species, lower Browns Creek Clays. PM Au 425, stub Vic-4(K3). Male RV. × 225.
25 Same species. Detail of PK Au 425 showing the muscle scars. × 450.
26 *Arcacythere* aff. *chapmani* Hornibrook. PM Au 426, stub Vic-10. Female LV. Browns Creek Clays. × 100.

Plate III



Family **Nunanidae** fam. nov.

Type Genus: *Nunana* gen. nov.

Diagnosis: A family of very small ostracods marked by a smooth shell with a strongly convex dorsum, ventral inflation, well developed anterior flange, especially in adult females, prominent sieve type normal pore canals, and a merodont hinge.

Remarks: The new family can be compared against other families which have very small genera and species, particularly the Xestoleberididae. The genera *Microxestoleberis* Müller, 1894 and *Aspidoconcha* de Vos, 1953 differ from nunanids by virtue of the fact that they both have the anterodorsal elongate scar which is a xestoleberidid characteristic but is lacking in Nunanidae. Further, both genera have an adont hingement; in nunanids the hinge is merodont (Müller, 1894; McKenzie, 1972). The family Cytheruridae may include the small genus *Laocoonella* de Vos and Stock, 1956 but this genus is reticulate over the shell surface and anteroventrally denticulate; probably it has simple normal pore canals (McKenzie, 1972) unlike nunanids. The genera *Redekea* de Vos, 1953 and *Paracythere* Müller, 1894 of uncertain familial affiliation seem closely related to each other but are unlike nunanids because their shells are relatively compressed and have vestibules and adont hinges (McKenzie, 1972). *Nannocythere* Schaefer, 1953 is presumably small, although the size was not given in the original description, and is ventrally inflated with prominent sieve type normal pores, but the general shape is more oblong, the dorsum is straight not convex, the ornament is punctillate, and the hinge is rectodont.

Genus *Nunana* gen. nov.

Type Species: *Nunana australiae* sp. nov.

Diagnosis: As for the family, which at present is monogeneric and may be monospecific.

Remarks: See the family diagnosis above.

Occurrence and Age: Known only from the Late Eocene of Victoria and Recent of SE Australia (Drs. I. Yassini and B. Jones, personal communication December 1992).

Derivatio nominis: Nunana (Aboriginal) = little, for its minute size. The gender is feminine.

Nunana australiae sp. nov.

Pl. III, Figs. 16-18; Pl. VIII, Fig. 5

Holotypus: The specimen PM Au 418, figured in Pl. III, Fig. 17, from the upper Browns Creek Clays at Castle Cove, Victoria. Figured paratypes PM Au 417, 419.

Derivatio nominis: Australiae (L.) = of Australia.

Diagnosis: A *Nunana* with an inflated and striate ventral region in females.

Description: Shell very small (length about 0.25 mm); subtriangular in lateral view; surface smooth, translucent, marked by prominent normal pore sites, except for some ventral striations (female only); LV overlaps RV, especially dorsally. Dorsum strongly convex; anterior subrounded anteroventrally, with a well developed flange; venter inflexed medially; posterior subacuminate. Subovate in dorsal view and broadest posteromedially; height over 60 % the length. Internally with moderately broad inner lamellae; distinct but small anterior and posterior vestibules; selvage marginal; the marginal pore canals are rather few in number and tend to be flexuous, some are pseudocanals which do not traverse the entire width of the lamellae; normal pore canals relatively large, scattered, sieve type; central muscle scar pattern consisting of four adductors in a subvertical series, plus a frontal scar (observed on male before SEM microscopy) and a large oval dorsal scar, but without a xestoleberidid-type anterodorsal scar; hinge merodont, RV with small trilobate terminal teeth and between them a coarsely reticulate median furrow, LV complementary.

Sexual dimorphism distinct, males not as broad posteriorly nor striate posteroventrally as are females. Juveniles not yet known.

Measurements: Length of males 0.24-0.25 mm, height 0.16 mm, breadth 0.15 mm; length of females 0.26 mm, height 0.16-0.17 mm, breadth 0.17-0.18 mm.

Remarks: See remarks for the family above. Further, the recognition of small ostracod taxa is made difficult by the size factor. Not only are they hard to spot when picking through washed sediments but they are also very difficult to open when the valves are closed. Fortunately, *N. australiae* is translucent, thus enabling its internal features to be recognized under appropriate magnification and drawn using a camera lucida (Pl. VIII, Fig. 5). The species also occurs at Browns Creek, in the Greensand marker bed and about 1 m above it.

Material Studied: Twenty specimens in all; seven carapaces (four females and three males) and two female RVs. Additional material four females, two males three juveniles and two unsexed adult valves.

Occurrence and Age: Castle Cove Formation at Castle Cove and Browns Creek, 15 cm below the *Notostraea* greensand, 1 m below the Greensand and 2 m below the Greensand, Victoria; Late Eocene.

Family **Microcytheridae** Klie, 1938
Genus *Microcythere* Müller, 1894

Microcythere airella sp. nov.

Pl. III, Figs. 19-21

Holotypus: The specimen PM Au 420, figured in Pl. III, Fig. 19 from the lower Browns Creek Clays at Castle Cove. Figured paratypes PM Au 421, 422.

Derivatio nominis: Airella, for the nearby Aire River.

Diagnosis: A *Microcythere* with distinct RV overlap and an unusual (non-adont) hinge.

Description: Shell small (length 0.36-0.39 mm); subtriangular in shape; surface smooth; RV greater than LV, overlapping it dorsally and posteriorly. Dorsal margin convex, steeper at the rear; anterior rather narrowly subrounded, posterior broadly subacuminate; venter virtually straight. Greatest height posteromedial and over 40 % the length; lanceolate in dorsal view, broadest posteromedially. Internally with broad anterior, narrow ventral and less broad posterior inner lamellae; anterior and posterior vestibules present; marginal pore canals rather few and straight; normal pore canals scattered, simple and rimmed; central muscle scars comprising four large adductors in a subvertical row plus a heart-shaped frontal scar and two large mandibulars; hinge unusual, consisting in the LV of comparatively large terminal teeth between which is a denticulate median furrow characterized by elongate terminal depressions and 5 or 6 large median denticles; RV complementary. (In spite of this relatively powerful hinge, valves separate quite easily when brushed firmly with a wet brush.)

Sexual dimorphism weak to fairly distinct, males relatively less high (more elongate) than females. The only juvenile is thin shelled with undeveloped inner lamellae.

Measurements: Length of adults 0.36-0.39 mm, height of males 0.14 mm, of females 0.15-0.16 mm; the breadth is 0.14-0.15 mm. Length of the A-1 juvenile is 0.26 mm.

Remarks: The best set of descriptions of *Microcythere* species remains that in the classic Bay of Naples monograph by Müller (1894); this includes taxa with unusual hinges, e.g. *M. dentata* Müller, 1894. While the shape of *M. airella* is somewhat conservative, its hingement is distinctly different from that of any previously described species of *Microcythere.*

Material Studied: Eleven specimens, adults of both sexes and an A-1 juvenile.

Occurrence and Age: Castle Cove and Browns Creek, Victoria; Late Eocene.

Family **Pectocytheridae** Hanai, 1957

Genus *Bidgeecythere* gen. nov.

Type Species: *Bidgeecythere barupa* sp. nov.

Diagnosis: A small genus, unusually shaped for a pectocytherid with a broadly rounded anterior and narrower, subacuminate posterior; surface reticulate and finely punctate; valves subequal. Inner lamellae broad, with regular inner margins and a cup-shaped anterior vestibule; selvage distinct; marginal pore canals rather few and straight to flexuous anteriorly, widely spaced ventrally, and few, relatively long and flexuous posteroventrally; normal pore canals scattered, simple and rimmed; central muscle scars comprising four small adductors and a small heart-shaped frontal scar; hinge modified pentodont, consisting in RV of a small circular anterior socket, followed by a large rounded tooth-like knob behind which is a long, narrow and smooth bar terminating in an elongate tooth-like knob, then a posterior circular socket and finally a large posterior tooth; LV complementary. Sexual dimorphism weakly expressed.

Remarks: The shape of the new genus is unique among pectocytherids which tend to be subrectangular *(Munseyella, Pectocythere, Morkhovenia)* or elongate subrectangular *(Keijia, Labutisella)* in lateral aspect; but the strong pentodont hinge confirms the familial assignment. Although pectocytherids are already diverse generically in the Australian Cainozoic we are well aware that other genera remain to be defined (Dr. M. T. Warne personal communication December 1987), hence our reference to *Munseyella s.l.* for some species described below.

Derivatio nominis: Bidgee (Aboriginal) = river (Browns Creek, Johanna River and Aire River are all nearby); plus suffix *-cythere.* The gender is feminine.

Occurrence and Age: Eocene to Middle Miocene (McKenzie, 1974, p. 157, text-fig. 2d) of Victoria, southeastern Australia.

Bidgeecythere barupa sp. nov.

Pl. III, Figs. 22-25

Holotypus: The specimen PM Au 424, figured in Pl. III, Fig. 23, from the upper Browns Creek Clays at Browns Creek, about 21 m above the Johanna River Greensand. Figured paratypes PM Au 423, 425.

Derivatio nominis: Barup (Aboriginal) = water in little droplets, for the fine inter-reticular punctation which typifies its ornament.

Diagnosis: A species of *Bidgeecythere* which has a different ornament from the only other known species in the Miocene of Rutledge Creek, Victoria (in McKenzie's personal collection).

Description: A small species (length about 0.35 mm); wedge shaped in lateral view; surface finely punctate within a shallow reticulation; valves subequal. Dorsal margin straight, sloping backwards; anterior broadly rounded; venter almost straight with an anteromedial inflexure; posterior narrowly subrounded. Greatest height anterior and about half the length; elliptical in dorsal view. Internal features as in the generic diagnosis.

Sexual dimorphism weak, presumed females slightly shorter than presumed males. Juveniles not yet known.

Measurements: Length of a presumed mature male 0.36-0.38 mm, length of a presumed mature female 0.34 mm; height (both sexes) 0.17-0.18 mm; breadth (both sexes) 0.14-0.15 mm.

Remarks: Additionally, it is distributed in the Browns Creek section, from 21 m above the Johanna River Greensand to about 7 m below it, but is always rare.

Material Studied: Twelve adult carapaces and valves, encompassing both sexes.

Occurrence and Age: Castle Cove and Browns Creek, Victoria; Middle(?) - Late Eocene.

Genus *Arcacythere* Hornibrook, 1952

Arcacythere aff. *chapmani* Hornibrook, 1952

Pl. III, Fig. 26; Pl. VIII, Fig. 6

Remarks: While the ornament of our few specimens (length 0.40-0.45 mm) from the Browns Creek Clays at Castle Cove is similar to that of Hornibrook's species, our figures show some distinct differences. Firstly, the valve surface has all-over circular pitting without the thickened anterior and posterior ridges of Hornibrook's taxon; secondly, our specimens differ markedly in dorsal view (compare our Pl. III, Fig. 26 with Hornibrook, 1952, Pl. 2, Fig. 35) being regularly rounded posteriorly not truncate, and lanceolate not subhastate. More material would certainly justify the naming of a new species. As a point of further interest, it was difficult to obtain a good camera lucida drawing for our taxon, presumably because of the optical deflection caused by rounded valves. Note also, that since the hinge is not typically pentodont in this genus it probably deserves at least separate tribal status.

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Arcacythere sp.

Pl. IV, Fig. 1

1979 *Arcacythere* sp., McKenzie, 93, 94, Pl. 1, Fig. 9.

Remarks: Two specimens (length 0.40 mm) from the Browns Creek Clays at Browns Creek about 7 m above the Johanna River Greensand. A few other individuals occur below the Greensand at Browns Creek. The anterior ornament of patterned ribbing (a corduroy effect) is highly distinctive and would motivate the erection of a new species if more specimens were available.

Occurrence and Age: Browns Creek, Victoria; Willunga Embayment, South Australia; Middle(?) - Late Eocene.

Genus *Munseyella* van den Bold, 1957

Munseyella pytta sp. nov.
Pl. IV, Fig. 2; Pl. VIII, Fig. 7

Holotypus: The specimen PM Au 425, figured in Pl. IV, Fig. 2 from the Browns Creek Clays at Castle Cove.
Derivatio nominis: Pytt (Anglo Saxon) = pit, for the strongly pitted surface ornament.

Diagnosis: A relatively large species of *Munseyella s.l.* characterized by an unusual anterior vestibule compared against other species described herein for the genus.

Description: Shell medium-sized (length reaches just more than 0.50 mm); subrectangular in lateral view and dentate posteriorly; surface marked by an overall deep pitting, with a thickened anteromarginal ridge behind which lie two deep transverse loculi (one above the other) separated by a narrow murus; each valve surface falls away abruptly in the rear to a narrow platform traversed by weak costulae, then terminates in a posteromarginal ridge that is coarsely edentate (two dentae); valves subequal. Dorsal margin straight to weakly convex; anterior broadly rounded; venter inflexed medially; posterior margin subtruncate and edentate. Height about half the length; irregularly subhastate in dorsal view. Internally, with broad inner lamellae and regular inner margins; anterior vestibule unusual, shaped like the head of a rake, posterior vestibule elongate; marginal pore canals are short off the "rake head" vestibule, rather long and straight elsewhere but not numerous; normal pore canals simple and rimmed; central muscle scars comprising four adductors in a subvertical row plus an oblong frontal scar; hinge pentodont (cf. Pl. VIII, Fig. 7).

Sexual dimorphism distinct, females shorter than males. Juveniles also robust but without well developed inner lamellae.

Measurements: Length of mature males 0.45-0.51 mm, height 0.23 mm, breadth 0.22 mm; length of mature females 0.39-0.43 mm, height 0.22-0.23 mm, breadth 0.20-0.22 mm. Length of A-1 juveniles 0.33 mm.

Remarks: The unusual vestibule, pitted surface and relatively large size distinguish this from *M. splendida* Whatley and Downing, 1983 the only other described Australian species of *Munseyella*.

Material Studied: Eighteen specimens, including carapaces and valves, adults of both sexes and several juveniles.

Occurrence and Age: Castle Cove, also at Browns Creek (21 m above the Greensand marker bed), Victoria; Late Eocene.

Munseyella adaluma sp. nov.
Pl. IV, Figs. 3-6; Pl. VIII, Fig. 8

Holotypus: The specimen PM Au 429, figured in Pl. IV, Fig. 5 from the lower Browns Creek Clays at Castle Cove. Figured paratypes PM Au 427, 428, 430.
Derivatio nominis: Adaluma (Aboriginal) = a watercourse, for the nearby Johanna and Aire Rivers.

Diagnosis: A *Munseyella* with a more typical broad anterior vestibule, ornamented by pits and marginal ridges.

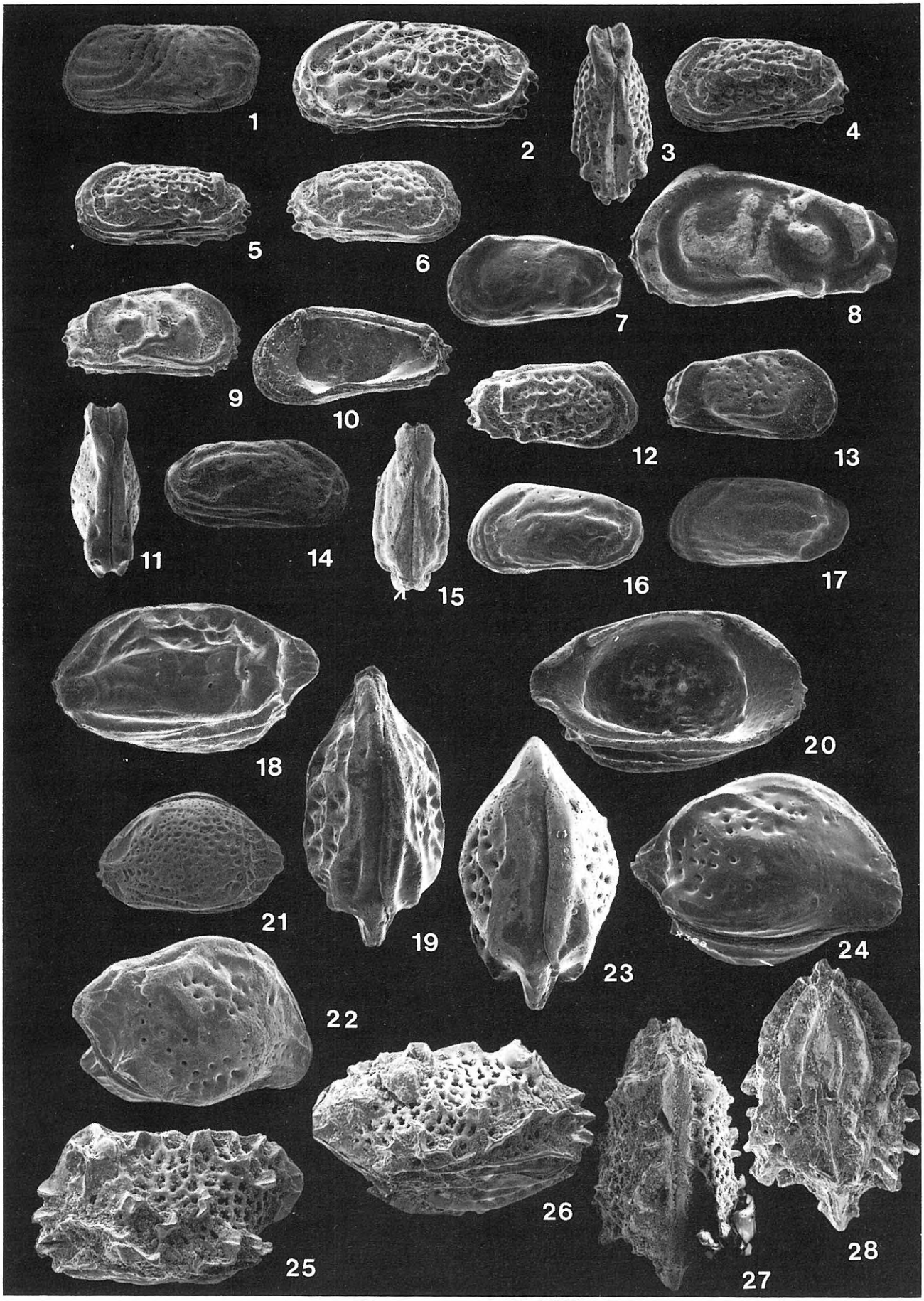
Description: Shell small-medium sized (length about 0.40 mm); subquadrate in lateral view, surface ornamented by pits and intervening muri and with thickened marginal ridges, posteroventrally and posteromedially are prominent nodes which show up well in dorsal view (their location is reminiscent of *Morkhovenia*), while behind the anteromarginal ridge are two subequal arcuate loculi, one above the other; valves subequal. Margins as in *M. pytta* except the dorsum is somewhat more convex than in that species. Greatest height anteromedial and

---

Plate IV

1 *Arcacythere* sp. Specimen lost. Female LV. Browns Creek. × 100.
2 *Munseyella pytta* sp. nov. Holotypus. PM Au 425, stub Vic-9. Female LV carapace. Browns Creek Clays at Castle Cove. × 100.
3 *Munseyella adaluma* sp. nov. PM Au 427, stub Vic-8. Dorsal male view. Lower Browns Creek Clays. × 100.
4 Same species and provenance. PM Au 428, stub Vic-8. Female LV. × 100.
5 Same species and provenance. Holotypus. PM Au 429, stub Vic-8. Male LV. × 100.
6 Same species and provenance. PM Au 430, stub Vic-8. Male RV. × 100.
7 *Munseyella dunoona* sp. nov. PM Au 431, stub Vic-2(K1). Male LV carapace. Lower Browns Creek Clays at Castle Cove. × 100.
8 Same species and provenance. PM Au 432, stub Vic-1(K2). Male LV. × 155.
9 Same species and provenance. Holotypus. PM Au 433, stub Vic-8. Female RV. × 100.
10 Same species and provenance. PM Au 434, stub Vic-8. Internal RV of male. × 100.
11 *Munseyella warringa* sp. nov. PM Au 435, stub Vic-1(K2). Dorsal male carapace. Browns Creek Clays at Castle Cove. × 100.
12 Same species and provenance. Holotypus. PM Au 436, stub Vic-8. Female RV carapce. × 100.
13 Same species and provenance. PM Au 517, stub Vic-9. Male RV. × 100.
14 *Munseyella bungoona* sp. nov. PM Au 437, stub Vic-8. Male RV. Browns Creek Clays at Castle Cove, about 21 m above the Johanna R. Greensand. × 100.
15 Same species and provenance. PM Au 438, stub Vic-8. Dorsal view of female carapace. × 100.
16 Same species. Holotypus. PM Au 439, stub Vic-8. Male LV. Lower Browns Creek Clays. × 100.
17 Same species. Provenance as for Fig. 14. PM Au 440, stub Vic-9. Female LV. × 100.
18 *Hemicytherura fulva* sp. nov. Holotypus. PM Au 441, stub Vic-2(K1). Male LV carapace. Upper Browns Creek Clays at Castle Cove. × 155.
19 Same species and provenance. PM Au 442, stub Vic-1(K2). Dorsal view of female carapace. × 155.
20 Same species and provenance. PM Au 443, stub Vic-3(K4). Interior of male LV. × 155.
21 *Hemicytherura* sp. PM Au 444, stub Vic-9. Female LV. Upper Browns Creek Clays at Castle Cove. × 100.
22 *Kangarina wareelacogarra* sp. nov. PM Au 445, stub Vic-1(K2). Female RV. Browns Creek Clays, 21 m above Johanna R. Greensand. × 155.
23 Same species and provenance. PM Au 446, stub Vic-3(K4). Dorsal view of male carapace. × 155.
24 Same species. Holotypus. PM Au 447, stub Vic-3(K4). Female RV carapace. Browns Creek Clays at Browns Creek, 7 m above Johanna R. Greensand. × 155.
25 *Eucytherura horrida* sp. nov. PM Au 448, stub Vic-7. Female LV. Lower Browns Creek Clays at Castle Cove. × 155.
26 Same species and provenance. Holotypus. PM Au 449, stub Vic-7. Female RV carapace. × 155.
27 Same species and provenance. PM Au 450, stub Vic-7. Dorsal view of female carapace. × 155.
28 Same species and provenance. PM Au 451, stub Vic-7. Ventral view of female carapace. × 155.

Plate IV



about half the length; subhastate in dorsal view. Internally, with broad inner lamellae, regular inner margins and large anterior and posterior vestibules (cf. Pl. VIII, Fig. 8); marginal pore canals less than 10 both anteriorly and posteriorly, short and straight; normal pore canals simple, rimmed; central muscle scars comprising four adductors in a subvertical row plus an oblong frontal scar; hinge pentodont.

Sexual dimorphism distinct, females shorter than males. Juveniles similar but smaller and with undeveloped inner lamellae.

Measurements: Length of males 0.40-0.42 mm, height 0.20-0.22 mm, breadth 0.16 mm; length of females 0.35-0.39 mm, height 0.22 mm, breadth 0.16-0.17 mm. The length of A-1 juveniles is 0.30 mm.

Remarks: We were initially inclined to assign this species to *Morkhovenia* because of the similarity noted above but its ornament is close to that of *M. pytta*. Moreover, typical *Morkhovenia* species lack the arcuate anterior loculi that characterize Australian species placed in *Munseyella*. We note here that *Munseyella* is the most abundant genus, in terms of numbers of specimens, in the Victorian Eocene localities on which this monograph is based.

Material Studied: Two hundred and seventy four specimens, carapaces and valves, adults of both sexes plus a few juveniles.

Occurrence and Age: Castle Cove and Browns Creek (about 21 m above the Greensand marker bed), Victoria; Late Eocene.

Munseyella dunoona sp. nov.

Pl. IV, Figs. 7-10

Holotypus: The specimen PM Au 433, figured in Pl. IV, Fig. 9 from the lower Browns Creek Clays at Castle Cove. Figured paratypes PM Au 431, 432, 434.

Derivatio nominis: Dunoon (Aboriginal) = a ridge, for the species' most distinctive feature.

Diagnosis: A *Munseyella* with a "rake head" type anterior vestibule and a marginal ridge that is almost complete save for the part between the anterodorsal edge and the mid-dorsum.

Description: A small species (length about 0.40 mm); subquadrate; apart from some scattered fine punctation the main ornament is a marginal ridge which extends from the anterodorsal corner around anteriorly, ventrally and posteriorly then breaks briefly before ending as a more slender posterodorsal ridge; ventrally this ridge is marked by a strong medial inflexure at the apex of which other flat ridges branch away medially forming a "crossroad" feature (Pl. IV, Fig. 8); many specimens display anteromarginal denticulation (4-6 denticles); valves subequal. Dorsum straight, slightly inclined backwards; anterior broadly rounded; venter nearly straight; posterior truncate and edentate. Greatest height anteromedial and less than half the length; narrowly subhastate in dorsal view. The anterior vestibule is "rake head"-like resembling *M. pytta*; other internal features are similar to the species already described.

Sexual dimorphism distinct, males longer than females. Juveniles similar in shape but smaller and with undeveloped inner lamellae.

Measurements: Length of adult males 0.40-0.42 mm, height 0.20-0.22 mm, breadth 0.17 mm; length of mature females 0.37-0.39 mm, height 0.21-0.24 mm, breadth 0.19-0.20 mm. Length of A-1 juveniles 0.30-0.33 mm.

Remarks: This species is like *M. splendida* Whatley and Downing, 1983 except that their taxon lacks the medioventral "crossroad" of ridges we describe above (cf. Whatley and Downing, 1983, Pl. VI, Figs. 18, 20). *M. dunoona* occurs stratigraphically in our samples from the upper Browns Creek Clays at Castle Cove to 7 m below the Johanna River Greensand at Browns Creek. It is the only *Munseyella* to persist below the Greensand in our material.

Material Studied: Two hundred and thirty specimens, carapaces and valves, including adults of both sexes and numerous juveniles.

Occurrence and Age: Castle Cove and Browns Creek, Victoria; Middle(?) - Late Eocene.

Munseyella warringa sp. nov.

Pl. IV, Figs. 11-13; Pl. VIII, Fig. 9

1979 *Munseyella(?)* sp., McKenzie, 93, 94, Pl. 1, Fig. 12.

Holotypus: The specimen PM Au 436, figured in Pl. IV, Fig. 12 from the Browns Creek Clays at Castle Cove. Figured paratypes PM Au 435, 517.

Derivatio nominis: Warringa (Aboriginal) = sea, because the outcrops in which this marine species occurs are along the coast.

Diagnosis: A *Munseyella* with a punctate surface ornament having a transverse pattern and a low medioventral ala that terminates posteriorly in a thick knob.

Description: Shell rather small (length a little less than 0.40 mm); subquadrate; surface punctate in a regular transverse pattern but dominated by a low medioventral ala ending posteriorly in a thick knob, there is also a short vertical ridge near the posterodorsal corner and a thick anteromarginal ridge behind which are the usual arcuate loculi, plus a moderately broad posterior platform; valves subequal and edentate posteriorly (two dentae); LV overlaps the RV anterodorsally via a broad "rim tooth" (Pl. VIII, Fig. 9). Polymorphism is manifested in the development of the punctation (cf. Pl. IV, Fig. 12 and Pl. 4, Fig. 13). Dorsum straight, sloping backwards; anterior broadly rounded; posterior truncate and edentate; venter weakly inflexed medially. Greatest height anterior and about half the length; subhastate in dorsal view. Internal features similar to other *Munseyella* species herein except that the anterior vestibule is axehead-shaped, rather than broad or "rake head"-like.

Sexual dimorphism distinct, males longer than females. Juvenile smaller and with immature inner lamellae.

Measurements: Adult male length 0.39-0.40 mm, height 0.20 mm, breadth 0.16 mm; length of mature females 0.36-0.38 mm, height 0.20 mm, breadth 0.17-0.18 mm. Length of A-1 juvenile 0.29 mm.

Remarks: While very distinctive, because it has an ala ventrally not a ridge, this species is comparatively uncommon in our samples although occurring at both localities. It is also rare in the Eocene of the Willunga Embayment, South Australia.

Material Studied: Twelve specimens, carapaces and valves, including adults of both sexes and one juvenile carapace.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Willunga Embayment, South Australia; Late Eocene.

Munseyella bungoona sp. nov.

Pl. IV, Figs. 14-17; Pl. VIII, Fig. 10

Holotypus: The specimen PM Au 439, figured in Pl. IV, Fig. 16 from the lower Browns Creek Clays at Castle Cove. Figured paratypes PM Au 437, 438, 440.

Derivatio nominis: Bungoona (Aboriginal) = sandy creek; Browns Creek is locally sandy and shallow.

Diagnosis: A *Munseyella s.l.* that is relatively plump and smooth surfaced, with an unusual anterior vestibule.

Description: Shell small (length reaches about 0.40 mm)

and robust; rounded subquadrate in lateral view; surface smooth, displaying a poorly expressed median longitudinal "ridge" plus a thickened anteromarginal ridge behind which lie the usual two arcuate loculi; valves subequal and not edentate posteriorly. Dorsal margin evenly convex; anterior broadly rounded, posterior also rounded but less broadly; venter nearly straight. Greatest height anterior and about half the length; rather plump dorsally, but still subhastate in profile. Internally with broad inner lamellae; anterior vestibule rather small and reflexed upwards (cf. Pl. VIII, Fig. 10), posterior vestibule also small; marginal pore canals short off the vestibules, longer elsewhere but not numerous; selvage distinct; normal pore canals simple; muscle scars and hinge as in other species of this genus herein except that the anterior tooth-like element of the RV is definitely crenulate, LV complementary.

Sexual dimorphism weak, presumed females are more inflated than presumed males. Juveniles not known.

Measurements: Length of males 0.37-0.39 mm, height 0.19 mm, breadth 0.17 mm; length of females 0.38 mm, height 0.20 mm, breadth 0.20 mm.

Remarks: This is an atypical form, perhaps more like *Pectocythere* Hanai, 1957 than a *Munseyella* s.s.; on the other hand, its anterior vestibule is of the same type as that of most the species that we have described above whereas in *Pectocythere* this vestibule is large and crescent shaped (Hanai, 1957, text-figs. 1, 2, 6). Combined with the variation in the anterior tooth-like element of the RV hinge this should be sufficient to justify future erection of a new genus.

Material Studied: Nineteen individuals, carapaces and valves, including adults of both sexes.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Late Eocene.

Family **Cytheruridae** Müller, 1894
Subfamily **Cytherurinae** Müller, 1894
Genus *Pedicythere* Eagar, 1965

Pedicythere sp.

Remarks: The single mature male LV (length 0.33 mm), from about 7 m above the Greensand at Browns Creek, imploded when being vacuum-coated for SEM micrography, leaving only the main spine.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Genus *Hemicytherura* Elofson, 1941

Hemicytherura fulva sp. nov.

Pl. IV, Figs. 18-20

Holotypus: The specimen PM Au 441, figured in Pl. IV, Fig. 18 from the upper Browns Creek Clays at Castle Cove. Figured paratypes PM Au 442, 443.

Derivatio nominis: Fulva (L.) = brown, for Browns Creek.

Diagnosis: A *Hemicytherura* with a distinctive meshwork-like ornament composed of a major medial rib and marginal ridges plus intervening finer ribs.

Description: Shell small (length about 0.40 mm), oval in lateral view, with a short cauda; ornament featuring a longitudinal median rib and a marginal ridge that almost continuously rims each valve; within the areas thus created are intervening diagonal ribs, some trending to the front others backwards, and between these, often, a finer reticulation can be observed; valves subequal. Polymorphic, there being a rare morph with lattice-work costulations and a rare morph with excessive coarsening of the main ribs. Dorsum convex; anterior subacuminate anteroventrally where there a few marginal denticles; venter nearly straight (partly overlapped by the ventromarginal ridge); posterior cauda forming a depressed platform behind the posteromarginal ridge. Greatest height medial, nearly 60% the length; subhastate in dorsal view, broadest posteromedially. Internally with moderately broad inner lamellae and regular inner margins; anterior vestibule small, posterior vestibule not confirmed in the specimens examined; marginal pore canals rather few and flexuous, clumped in two groups of three canals each anteroventrally plus a posterior cluster of three long canals in the caudal region; normal pore canals rather few, scattered simple and rimmed; central muscle scars comprising four adductors in a vertical row (outlined by a surrounding riblet) plus a broadly v-shaped frontal scar and two mandibulars in front and below; hinge merodont, RV with weakly crenulate terminal teeth and an intervening smooth furrow, LV complementary.

Sexual dimorphism not very distinct, females larger than males; A-1 juvenile robust but undeveloped internally.

Measurements: Length of mature males 0.36-0.37 mm, height 0.20-0.22 mm, breadth 0.16-0.18 mm; length of adult females 0.37-0.41 mm, height 0.22-0.24 mm, breadth 0.18-0.20 mm. The length of an A-1 juvenile is 0.30 mm.

Remarks: The surface ornament of this species is unlike that of any previously described Australian species. The large available sample offers an opportunity for geometric morphometric analysis of shape variation (cf. Reyment, 1991). *Hemicytherura*, with *Kangarina* and *Eucytherura*, is likely to display stratigraphically useful changes in ornament (McKenzie, 1974). At Browns Creek, *H. fulva* ranges to 7 m below the Greensand but is only abundant in the upper part of the section.

Material Studied: Eighty nine specimens; all but five are carapaces, representing adults of both sexes except for one A-1 juvenile.

Occurrence and Age: Castle Cove and Browns Creek, Victoria; Middle(?) - Late Eocene.

Hemicytherura sp.

Pl. IV, Fig. 21

Remarks: This species is somewhat larger than the former (length 0.42 mm) but we only have two mature females from the upper Browns Creek Clays at Castle Cove. The punctate surface ornament is unlike that of most other Australian species of *Hemicytherura*.

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Genus *Kangarina* Coryell and Fields, 1937

Kangarina wareelacogarra sp. nov.

Pl. II, Fig. 25; Pl. IV, Figs. 22-24

1974 *Kangarina* sp. BCC 7b and BCC 6, McKenzie, 162, Pl. 3, Figs. 5, 6, Pl. 5, Figs. 1, 2.
1979 *Kangarina* sp., McKenzie, 94, 100, Fig. 1.

Holotypus: The specimen PM Au 447, figured in Pl. IV, Fig. 24 from the Browns Creek Clays at Browns Creek about 7 m above the Greensand. Figured paratypes PM Au 445, 446.

Derivatio nominis: Wareelacogarra (Aboriginal) = the sunrise, for the Eocene.

Diagnosis: A *Kangarina* with a distinctive pattern of pitting.

Description: Shell small (length about 0.35 mm), wedge shaped in lateral view, with a short cauda; surface ornament consisting of low thickened ribs and flexuous or straight ridges, with a distinctive pattern of deep circular pits between them, and costulate ventrally; valves subequal. Dorsum con-

vex, falling away more markedly to the anterior; anterior subrounded anteroventrally; venter inflexed anteromedially, otherwise straight, overlapped by the ventral ridge; posterior cauda making a depressed platform behind the vertical posterior ridge; valves subequal. Greatest height about medial and rather more than half the length; subhastate in dorsal view. Internally, with moderately broad inner lamellae and regular inner margins, anterior vestibule small, posterior vestibule elongate; marginal pore canals flexuous, more numerous anteriorly than posteriorly and tending to cluster anteroventrally, they include the typical 2-3 long caudal canals; normal pore canals scattered simple and rimmed; central muscle scars comprising four adductors in a subvertical row plus a heart shaped frontal scar and two mandibulars; hinge merodont, RV with crenulate terminal teeth and a crenulate medial furrow, LV complementary.

Sexual dimorphism distinct, males more elongate (less high) than females, also smaller overall. A-1 juveniles still robust but smaller than the adults.

Measurements: Length of males 0.28-0.32 mm, height 0.17-0.19 mm, breadth 0.16-0.18 mm; length of females 0.32-0.38 mm, height 0.19-0.22 mm, breadth 0.18-0.20 mm. Length of A-1 juveniles 0.25 mm.

Remarks: Unlike the previous species, this taxon is about equally distributed above and below the Greensand marker bed. The pitting pattern differs in specimens below the Greensand in being more definite, especially in the triangular area in front of the vertical posterior ridge (compare McKenzie, 1974, Pl. 5, Figs. 1 and 2). The overall habitus of Australian *Kangarina* species is very distinctive compared to those of the Mediterranean-Atlantic and Caribbean. Our species ranges from the upper part of the Eocene section at Castle Cove to about 7 m below the Johanna River Greensand at Browns Creek.

Material Studied: Forty two specimens, carapaces plus some valves, mostly adults (both sexes) but including several A-1 juveniles.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Willunga Embayment, South Australia; Middle(?) - Late Eocene.

Genus *Eucytherura* Müller, 1894

Eucytherura horrida sp. nov.

Pl. IV, Figs. 25-28

Holotypus: The specimen PM Au 449, figured in Pl. IV, Fig. 26 from the lower Browns Creek Clays at Castle Cove. Figured paratypes PM Au 448, 450, 451.

Derivatio nominis: Horrida (L.) = heavily spined, dreadful, for the overall menacing appearance.

Diagnosis: A species of *Eucytherura* characterized by an ornament of spikes and blades giving it a "horrid" appearance.

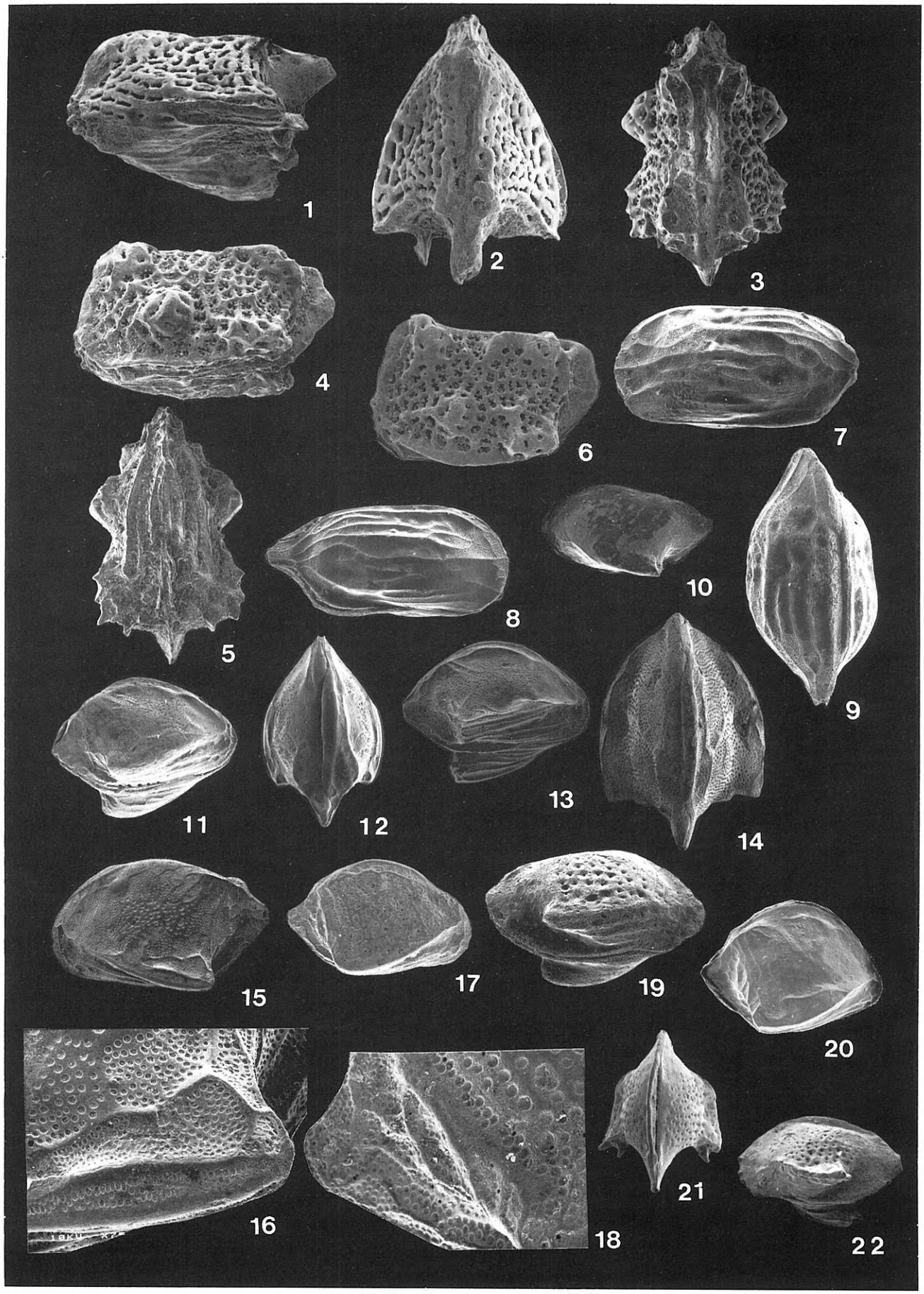
Description: A small species (length about 0.35 mm); subrectangular in lateral view, with a small cauda; surface ornamented by deep reticules with intervening muri, and by coarse spikes and blades coming off this base, especially antero- and posteroventrally, coarsely dentate anteroventrally, further ornamented by three curved ventral ridges the inner two progressively shorter than the outer one; valves subequal; anterodorsal eye tubercle large and distinct. Dorsum straight behind the anterodorsal corner; anterior rounded above, dentate (four teeth) anteroventrally; venter inflexed near medially, overlapped by the outermost ventral ridge; cauda small and depressed, traversed by costulae. Greatest height anterodorsal and almost 60 % the length; imperfectly subhastate in dorsal view, greatest breadth posteromedial. Internally, with moderately broad inner lamellae and regular inner margins; anterior vestibule small but distinct, posterior vestibule absent; marginal pore canals few, including three-four off the anterior vestibule and two flexuous posterodorsal canals; normal pore canals not numerous, scattered simple and rimmed; central muscle scars comprising four adductors in a subvertical row plus a broadly v-shaped frontal scar, mandibulars probably present ventrally but hidden in the ventral bulge; hinge merodont, RV with strong trilobate terminal teeth and a distinctly crenulate median furrow, LV complementary.

Sexual dimorphism not well expressed, males shorter than females and less high. Juveniles absent from our material.

Plate V

1 *Eucytherura delta* sp. nov. Holotypus. PM Au 452, stub Vic-7. Lower Browns Creek Clays at Castle Cove. Dorsal view of female carapace. × 155.
2 Same species and provenance. PM Au 453, stub Vic-7. Left angled view of female carapace. × 155.
3 *Eucytherura cameloides* sp. nov. PM Au 454, stub Vic-7. Dorsal view of female carapace. Upper Browns Creek Clays at Castle Cove. × 155.
4 Same species and provenance. Holotypus. PM Au 455, stub Vic-8. LV female carapace. × 155.
5 Same species and provenance. PM Au 456, stub Vic-8. Ventral view of male carapace. × 155.
6 *Eucytherura* sp. PM Au 457, stub Vic-13. Female LV. Browns Creek Clays at Browns Creek. × 155.
7 *Semicytherura costulopunctata* sp. nov. Holotypus. PM Au 458, stub Vic-4(K3). Female LV. Browns Creek Clays, 7 m above Johanna R. Greensand. × 155.
8 Same species and provenance. PM Au 459, stub Vic-4(K3). Male RV. × 155.
9 Same species and provenance. PM Au 460, stub Vic-4(K3). Dorsal view of female carapace. × 155.
10 *Cytheropteron* sp. 2. PM Au 461, stub Vic-11. Male LV. Johanna River Greensand at Browns Creek.
11 *Oculocytheropteron aviformum* sp. nov. Holotypus. PM Au 462, stub Vic-2(K1). RV of female carapace. Upper Browns Creek Clays at Castle Cove. × 100.
12 Same species and provenance. PM Au 463, stub Vic-2(K1). Dorsal view of male carapace. × 100.
13 Same species and provenance. PM Au 464, stub Vic-2(K1). RV of male carapace. × 100.
14 *Oculocytheropteron australopunctatarum* McKenzie, Reyment and Reyment. Dorsal view of carapace. PM Au 465, stub Vic-6. Castle Cove. × 100.
15 *Oculocytheropteron megalops* sp. nov. Holotypus. PM Au 466, stub Vic-13. Male LV. Browns Creek Clays at Castle Cove. × 100.
16 Same specimen as Fig. 15. Detail of ornament. × 340.
17 *Oculocytheropteron tinctum* sp. nov. Holotypus. PM Au 467, stub Vic-13. Male RV. Browns Creek Clays, 7 m above Johanna R. Greensand. × 100.
18 Same specimen as shown in Fig. 17. Detail of ornament. × 340.
19 *Oculocytheropteron* sp. 1. PM Au 468, stub Vic-1(K2). Male RV carapace. Upper Browns Creek Clays at Castle Cove. × 155.
20 *Oculocytheropteron* sp. 2. PM Au 469, stub Vic-11. Female RV. Johanna River Greensand at Browns Creek. × 100.
21 *Aversovalva nairana* sp. nov. PM Au 470, stub Vic-7. Dorsal view of male carapace. Lower Browns Creek Clays at Castle Cove. × 100.
22 Same species and provenance. Holotypus. PM Au 471, stub Vic-7. LV of female carapace. × 100.

Plate V



Measurements: Length of males 0.34 mm, height 0.20 mm, breadth 0.19 mm; length of females 0.35-0.36 mm, height 0.21-0.22 mm, breadth 0.21-0.22 mm.

Remarks: A very distinctive species, especially when in full ornament. One specimen from the upper Browns Creek Clays, probably an ecophenotypic variant, is not well furnished with blades and spikes. *Eucytherura* sp. 3 of Whatley and Downing (1983, Pl. V, Figs. 14, 15) is similar but more finely reticulate overall.

Material Studied: Twenty one specimens, all but one are complete carapaces, including adults of both sexes.

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Eucytherura delta sp. nov.

Pl. V, Figs. 1, 2

Holotypus: The specimen PM Au 452, figured in Pl. V, Fig. 1 from the lower Browns Creek Clays at Castle Cove. Figured paratype PM Au 453.

Derivatio nominis: Delta (Gk.) = triangular, like the fourth letter of the Greek alphabet; from its shape in dorsal view.

Diagnosis: A *Eucytherura* that is triangular in dorsal aspect.

Description: A small species (length about 0.30-0.35 mm); subrectangular in lateral view, with a relatively long cauda; surface ornament of deep elongate pits everywhere except on the cauda, with a very prominent ventral ala that is widest posteroventrally, surface below this ala without elongate pits and costulate, there is also a minor posterodorsal projection; eye tubercle distinct but low; valves subequal. Dorsal margin straight behind the convex anterodorsal region; anterior subtruncate above, edentate (four small teeth) anteroventrally; venter nearly straight, overlapped slightly by the ala on each valve, cauda subposterodorsal. Greatest height anterodorsal and about half the length; arrowhead-shaped in dorsal view and displaying a minor spine about one-third of the breadth out from the ventral valve margin (on both sides in undamaged specimens); greatest breadth in the rear and equal to about 75 % the length. Internally, like the previous species but with relatively broad inner lamellae and a very small anterior vestibule.

Sexual dimorphism distinct; females are larger. Juveniles absent in our small collection.

Measurements: Length of males 0.26-0.28 mm, height 0.16-0.18 mm, breadth 0.21 mm; length of females 0.34-0.37 mm, height 0.18-0.20 mm, breadth 0.25-0.27 mm.

Remarks: Similar to *Eucytherura* sp. 1 of Whatley and Downing (1983, Pl. V, Figs. 10, 11), except that the pits of their species are less distinctly elongate and the cauda is an extension of the dorsal margin. Both taxa belong in the same lineage.

Material Studied: Five adult carapaces (both sexes) and an adult male RV.

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Eucytherura cameloides sp. nov.

Pl. V, Figs. 3-5; Pl. VIII, Fig. 11

1974 *Eucytherura* sp. BCC 7b McKenzie, 162, Pl. 3, Fig. 11, Pl. 5, Fig. 11.

Holotypus: The specimen PM Au 455, figured in Pl. V, Fig. 4 from the upper Browns Creek Clays at Castle Cove. Figured paratypes PM Au 454, 456.

Derivatio nominis: Cameloides (L.) = camel-like, because of its Bactrian double hump.

Diagnosis: A *Eucytherura* with a Bactrian-like double hump on each valve.

Description: A small species (length about 0.30 mm); subrectangular in lateral view, with a short cauda; ornament of widespread surface reticulation (the reticules rather deep); additionally, each valve is elevated posterodorsally and anterodorsally, into a ridge-like feature and a bulge with short spines respectively, and has a round ventromedial boss; eye tubercle distinct; valves subequal. Dorsal margin straight between the anterodorsal and posterodorsal corners; anterior margin truncate above, edentate (three or four dentae) anteroventrally; venter straight; cauda, itself smooth, making a depressed platform behind the posterior reticulation. Greatest height about even throughout and over half the length; very distinctive in dorsal view, each valve double-humped; greatest breadth posterior and about two-thirds the length. Internally, as illustrated in the figure (Pl. VIII, Fig. 11).

Sexual dimorphism distinct, males smaller than females. There are no juveniles in our material.

Measurements: Length of males 0.28-0.30 mm, height 0.17-0.18 mm, breadth 0.17 mm; length of females 0.32-0.35 mm, height 0.18-0.20 mm, breadth 0.19-0.21 mm.

Remarks: Closely similar to *Eucytherura* sp. 2 of Whatley and Downing (1983, Pl. V, Figs. 12, 13) which, however, is more finely reticulate overall and is also reticulate on its cauda. In addition to the figured types and other paratypes from Castle Cove there are further specimens in the Browns Creek section, from about 7 m below the Greensand to the Greensand itself. These are narrower in dorsal view than the Castle Cove forms but have all other features, including the bactrian outline, in common.

Material Studied: Twenty three specimens, adult carapaces and valves of both sexes.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Middle(?) - Late Eocene.

Eucytherura sp.

Pl. V, Fig. 6

Remarks: There are only three mature valves of this taxon (length 0.28 mm, height 0.18 mm) from the Browns Creek Clays at Browns Creek about 7 m above the Greensand marker bed. It is similar to *E. cameloides* but higher with respect to its length and lacks the large medioventral boss and prominent posteroventral hump which distinguish that species, although there is small posteroventral bulge. The surface ornament comprises clover-leaf reticules with broad intervening muri. If more material had been available, we could certainly have erected a new species.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Genus *Semicytherura* Wagner, 1957

Semicytherura costulopunctata sp. nov.

Pl. V, Figs. 7-9

Holotypus: The specimen PM Au 458, figured in Pl. V, Fig. 7 from the Browns Creek Clays at Browns Creek about 7 m above the Greensand marker bed. Figured paratypes PM Au 459, 460.

Derivatio nominis: Costula (L.) = a fine rib, and *punctata* (L.) = punctate; for the costulate valves which have an intervening finely punctate ornament.

Diagnosis: A strongly sexual dimorphic *Semicytherura* distinguished by the ornament described in its specific name.

Description: A small species (length about 0.35-0.40 mm); elongate subrectangular in shape with a distinct cauda; orna-

mented by thin and roughly parallel longitudinal costulae between which the valve surface is micropunctate (shown by examination of our SEMs with a 5x reading glass), there is also a weak reticulation in the rear; valves subequal; eye tubercle present anterodorsally but poorly defined in this species. Dorsum straight; anterior broadly rounded; posterior with a subposterodorsal cauda and rounded below; ventral margin inflexed anteromedially. Height about half the length; in dorsal view, the shells are inflated medially and pointed anteriorly and posteriorly. Internally, with broad inner lamellae, inner margins regular except where invaginated in the rear of each valve (generic character); no vestibules; marginal pore canals long and flexuous, forming clusters of three or four anteriorly, the characteristic long posterior canals not particularly distinct; normal pore canals scattered, simple and rimmed; central muscle scars comprising a subvertical row of four adductors plus a small v-shaped frontal scar and two mandibulars; hinge merodont, RV with crenulate terminal teeth separated by a smooth medial furrow, LV complementary.

Sexual dimorphism strong, females shorter and fatter than males. A-1 juveniles are smaller and more slender than adults.

Measurements: Length of mature males 0.33-0.36 mm, height 0.16-0.17 mm, breadth 0.16 mm; length of mature females 0.39-0.42 mm, height 0.20-0.21 mm, breadth 0.18-0.19 mm. Length of A-1 juveniles 0.25-0.28 mm.

Remarks: This species seems to lie between *Semicytherura* sp. 1 and sp. 2 of Whatley and Downing (1983, Pl. VI, Figs. 3-5), both of which are also costulate. It is less strikingly reticulate posteriorly than the former but more so than the finely micropunctate latter taxon. The costulae in our species converge anteriorly but they remain subparallel anteriorly in the forms illustrated by Whatley and Downing. Our species ranges stratigraphically from the upper Browns Creek Clays at Castle Cove to about 1 m above the Greensand at Browns Creek; and we found a single mature male about 7 m below the Greensand.

Material Studied: Eighteen individuals, mostly adult carapaces representing both sexes plus one adult LV and two juvenile carapaces.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Middle(?) - Late Eocene.

Subfamily **Cytheropteroninae** Hanai, 1957
Genus *Cytheropteron* Sars, 1866
Cytheropteron sp. 1
Pl. VIII, Fig. 12

Remarks: There are only two RV specimens, the smaller is an A-1 juvenile. Both came from the Browns Creek Clays at Browns Creek, about 21 m above the Johanna River Greensand marker bed. The dimensions of the adult valve are length 0.53 mm, height 0.38 mm, breadth 0.35 mm; thus, an entire specimen would have a breadth about 0.65 mm or considerably more than its length. There is no eye tubercle (generic character) suggesting that the local palaeoenvironment was well offshore during this interval of the Late Eocene. The functional significance of the two large scars in the ala is puzzling for us, but they are known to occur in other species of *Cytheropteron* as was pointed out to one of us (KGM) many years ago by Dr. R. H. Benson. They might represent the bases of extrinsic muscles to the mandible and antenna.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Cytheropteron sp. 2
Pl. V, Fig. 10

Remarks: Unlike the previous species, this form has a low ala similar to such species as *C. rotundatum* Müller, 1894 and, more appositely, the New Zealand species *C. curvicaudum* Hornibrook, 1952. Our single specimen, an adult RV, has a length of 0.40 mm, and comes from the Johanna River Greensand at Browns Creek.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Genus *Oculocytheropteron* Bate, 1972
Oculocytheropteron aviformum sp. nov.
Pl. V, Figs. 11-13

1991 *Oculocytheropteron* cf. *microfornix* Whatley and Downing; McKenzie, Reyment and Reyment, 156, Pl. VI, Fig. 2, Pl. VII, Fig. 3.

Holotypus: The specimen PM Au 462, figured in Pl. V, Fig. 11 from the upper Browns Creek Clays at Castle Cove. Figured paratypes PM Au 463, 464.

Derivatio nominis: Avis (L.) = bird, and *forma* (L.) = form; for the bird-like shape in dorsal view.

Diagnosis: An *Oculocytheropteron* with an aviform shape in dorsal view and a finely punctate surface ornament.

Description: Shell small-medium sized (length about 0.45 mm); subsemicircular in lateral view; surface finely punctate and weakly reticulate with a weak dorsal riblet, striations feature ventrally; ventral ala highest posteroventrally and keeled, with a small deep depression just behind the muscle scars, eye tubercle small, circular and clear; valves unequal, RV overlapping LV dorsally. Dorsal margin strongly convex; anterior subrounded anteroventrally; ventral margin overlapped by the ala and with a weak anteromedial inflexure; posterior curved below and terminating in a small subdorsal cauda. Height about 55 % the length; aviform in dorsal aspect. Internally, with moderately broad inner lamellae in front but narrower ventrally and behind; inner margins regular; selvage marginal; small anterior vestibule; marginal pore canals few, flexuous and tending to cluster anteroventrally, longer posteriorly; normal pore canals simple, rimmed;'central muscle scars comprising four subvertical adductors plus a v-shaped frontal scar, mandibulars probably present but hidden in the ala; hinge merodont, RV with lobate terminal teeth on either side of a coarsely crenulate median furrow, LV complementary.

Sexual dimorphism weakly expressed, presumed females shorter than presumed males. The one juvenile carapace is smaller and thinner shelled than adults.

Measurements: Length of adult males 0.47 mm, height 0.26 mm, breadth 0.30 mm; length of mature females 0.43-0.45 mm, height 0.27 mm, breadth 0.30-0.32 mm. Length of A-1 juvenile 0.34 mm.

Remarks: It seems to us now that the present material, added to the large collection from Bells Headland, Victoria and the few specimens from Gull Rock, South Australia (cf. Synonymy above), characterize a different species from *O. microfornix* or even *O. fornix* (Hornibrook, 1952). The latter is similar in ornament but distinctly larger and has striations along the posterior ala; the former, while similarly sized, lacks the deep indentation behind the muscle scars which features in our species and has stronger ribbing, especially near the tip of the ala.

Material Studied: Eleven specimens, carapaces and valves, including adults of both sexes and one juvenile carapace.

Occurrence and Age: Castle Cove, Browns Creek (above the Greensand), and Bells Headland, Victoria; Gull Rock, South Australia; Late Eocene - Late Oligocene.

Oculocytheropteron australopunctatarum McKenzie, Reyment and Reyment, 1991
Pl. V, Fig. 14

1991 *Oculocytheropteron australopunctatarum* McKenzie, Reyment and Reyment, 154, Pl. VI, Fig. 1, Pl. VII, Figs. 1, 2.

Remarks: Our figure shows the dorsal view and highlights the depression at about the middle of the keeled ala which is less obvious in our earlier figures (cf. Synonymy above). This, the previous species, and *O. parawellmani* Whatley and Downing, 1983 are the only Australian *Oculocytheropteron* species to display such a depression. They can be readily differentiated from each other because the ala is much higher in *O. aviformum*, thus it has a more squat appearance in dorsal view. The effect is heightened by the fact that *O. australopunctatarum* is a larger species, with a length in adults ranging from 0.48-0.55 mm. The distinctions with respect to *O. parawellmani* have already been published (McKenzie, Reyment and Reyment, 1991).

Material Studied: Twelve individuals, carapaces and valves, adults and juveniles.

Occurrence and Age: Castle Cove and Browns Creek, Victoria; Gull Rock, South Australia; Middle(?) - Late Eocene.

Oculocytheropteron megalops sp. nov.
Pl. V, Figs. 15, 16; Pl. VIII, Fig. 13

Holotypus: The specimen PM Au 466, figured in Pl. V, Figs. 15 and 16 from the Browns Creek Clays at Castle Cove.

Derivatio nominis: Megalos (Gk.) = large, and *ops* (Gk.) = eye, for the large eyespot on each valve.

Diagnosis: An *Oculocytheropteron* with a translucent shell and a large eyespot anterodorsally on each valve.

Description: Shell medium sized (length about 0.50 mm); roughly hemicircular in lateral shape; translucent and dominated by the large clear and circular anterodorsal eyespot on each valve; ventral ala high posteriorly with a subrounded tip; surface ornament consisting of low reticules and fine punctae, and striate ventrally; valves unequal, RV larger and overlapping the LV dorsally. Dorsum strongly convex in the RV, less so in the LV; anterior broadly rounded; ventral margin nearly straight and overlapped by the ala; posterior curved below, terminating in a broad subdorsal cauda. Height about 60 % the length; aviform in dorsal view with backswept alae. Internal features are illustrated in Pl. VIII, Fig. 13; note the rather large anterior vestibule and marginal selvage.

Sexual dimorphism weak, presumed females are higher than presumed males. There are no juveniles in our collection.

Measurements: Length of mature male RV 0.51 mm, height 0.30 mm; length of adult females 0.47-0.50 mm, height 0.28-0.31 mm, breadth 0.34 mm.

Remarks: Although we only have a few specimens, we feel that the record is sufficiently important to justify naming a new species. This is because the usual eye tubercle in *Oculocytheropteron* is weak, elongate and typically associated with a dorsal riblet; in this species it is large and circular, at the end of a rather flat broad ridge. The translucent shell is also atypical. The surface ornament is of a kind that is common in Australasian *Oculocytheropteron* while differing in detail between species.

Material Studied: Eleven individuals, a carapace and nine valves - the carapace is a female, plus one juvenile.

Occurrence and Age: Browns Creek (from 7 m below the Greensand to 1 m above it) and lower Castle Cove Formation at Castle Cove, Victoria; Middle(?) - Late Eocene.

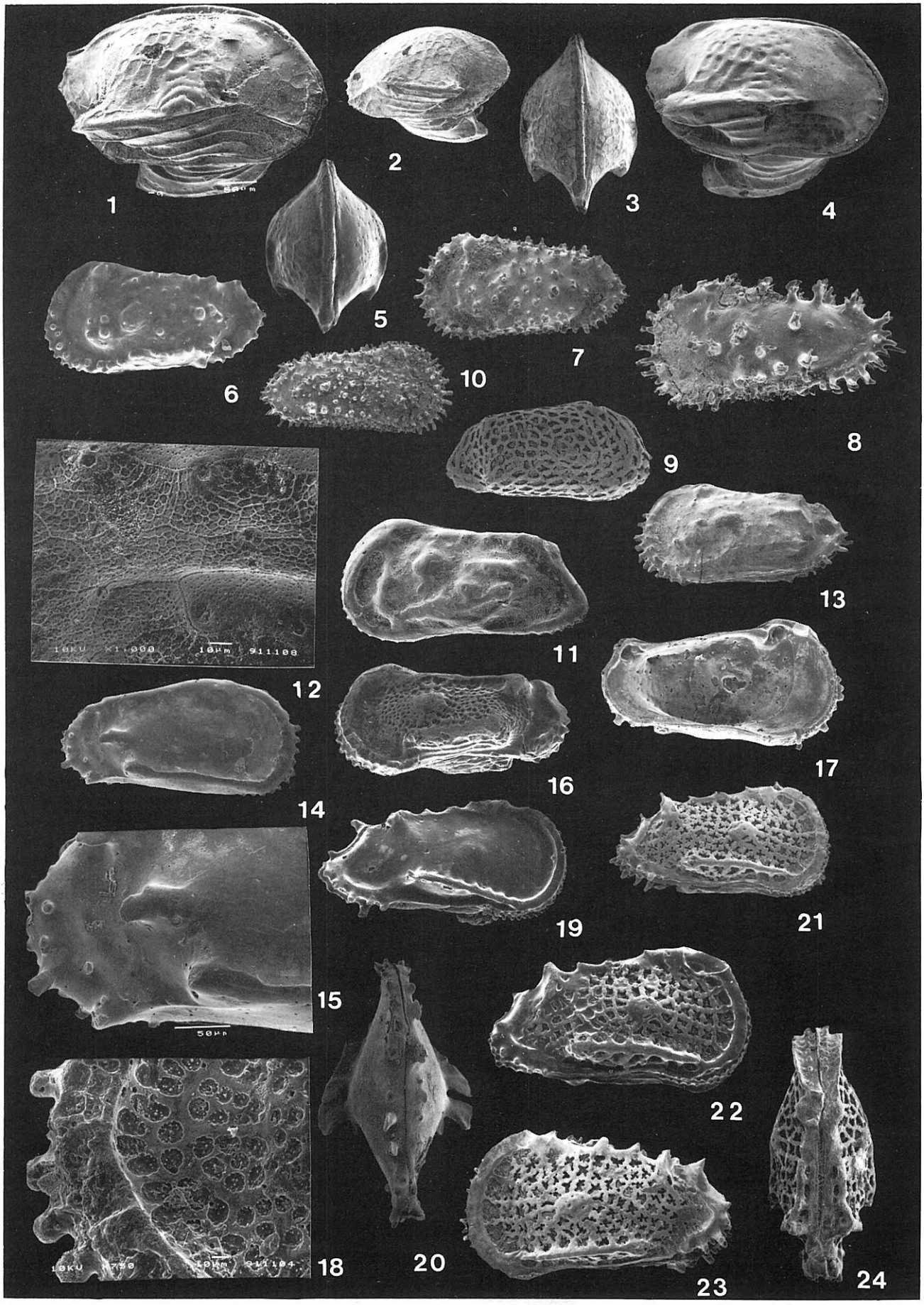
Oculocytheropteron tinctum sp. nov.
Pl. V, Figs. 17, 18; Pl. VIII, Fig. 14

1979 *Oculocytheropteron* sp., McKenzie, 94, Pl. 1, Fig. 14.

Plate VI

1 *Aversovalva yaringa* sp. nov. *yaringa* subsp. nov. Holotypus. PM Au 472, stub Vic-8. RV of female carapace. Lower Browns Creek Clays at Castle Cove. × 155.
2 Same species and provenance. PM Au 473, stub Vic-8. LV of carapace. × 100.
3 Same species and provenance. PM Au 474, stub Vic-8. Dorsal view of carapace. × 100.
4 *Aversovalva yaringa* sp. nov. *minor* subsp. nov. Holotypus. PM Au 475, stub Vic-1(K2). RV of male carapace. Lower Browns Creek Clays at Castle Cove. × 155.
5 Same species and provenance. PM Au 476, stub Vic-1(K2). Dorsal view of female carapace. × 100.
6 *Trachyleberis* cf. *careyi* McKenzie, Reyment and Reyment. PM Au 477, stub Vic-2(K1). Male LV. Browns Creek Clays at Castle Cove. × 45.
7 *Trachyleberis brevicosta major* McKenzie, Reyment and Reyment. PM Au 479, stub Vic-13. LV of male carapace. Castle Cove. × 45.
8 *Trachyleberis paucispinosa* sp. nov. Holotypus. PM Au 479, stub Vic-13. LV of male carapace. Browns Creek section, 10 cm below Johanna River Greensand. × 70.
9 *Acanthocythereis* sp. PM Au 480, stub Vic-13. RV of male carapace. Browns Creek. × 45.
10 *"Cythereis"* sp. PM Au 481, stub Vic-11. Male RV. Browns Creek Clays 21 m above Johanna R. Greensand. × 45.
11 *Deltaleberis delicata* sp. nov. Holotypus. PM Au 482, stub Vic-12. LV of female carapace. Browns Creek Clays, 7 m below Johanna R. Greensand. × 100.
12 Same specimen as illustrated in Fig. 11. Detail of ornament. × 450.
13 *Werribeeleberis trispinosa* sp. nov. PM Au 483, stub Vic-13. LV of female carapace. Browns Creek Clays at Castle Cove. × 70.
14 Same species. Holotypus. PM Au 484. Browns Creek Clays at Browns Creek, 7 m below Johanna R. Greensand. Female RV. × 100.
15 Detail of posterior zone of specimen shown in Fig. 14. × 225.
16 *Idiocythere nunkeria* sp. nov. Holotypus. PM Au 485, stub Vic-2(K1). LV of male carapace. Browns Creek Clays at Browns Creek, 1 m above Johanna R. Greensand. × 70.
17 Same species and provenance. PM Au 486, stub Vic-3(K4). × 70.
18 Same species and provenance. Detail of posterior of male LV. × 340.
19 *Alataleberis johannae* McKenzie and Warne. PM Au 487, stub Vic-2(K1). RV carapace. Browns Creek. × 70.
20 *"Alatacythere"* sp. PM Au 488, stub Vic-10. Dorsal aspect. Castle Cove. × 70.
21 *Cletocythereis taroona* sp. nov. PM Au 489, stub Vic-1(K2). RV male carapace. Browns Creek, 1 m above Johanna R. Greensand. × 70.
22 Same species. Holotypus. PM Au 490, stub Vic-1(K2). RV of male carapace. Browns Creek Clays at Browns Creek, 7 m above Johanna R. Greensand. × 100.
23 Same species. PM Au 491, stub Vic-8. Female LV. Browns Creek Clays at Browns Creek. × 100.
24 Same species and provenance. PM Au 492, stub Vic-8. Dorsal view of female carapace. × 100.

Plate VI



Holotypus: The specimen PM Au 467, figured in Pl. V, Figs. 17, 18 from the section at Browns Creek 7 m below the Johanna River Greensand.

Derivatio nominis: Tincta (L.) = coloured, because all the specimens at the type locality are stained a russet brown.

Diagnosis: A species of *Oculocytheropteron* with a distinctive surface ornament of punctae, lineations and striations.

Description: A small species (length about 0.40-0.45 mm); hemicircular in lateral view; with an ornament consisting of fine punctation, posterior lineations and some riblets, plus ventral striations below the ala; the ala is relatively low, coming to a subrounded apex posteroventrally; there is no depression near the muscle scars; eye tubercle elongate and indistinct; valves subequal, with the RV slightly larger. Outline details similar to *O. aviformum*. Height a little more than half the length; subhastate in dorsal view. Internal features illustrated in Pl. VIII, Fig. 14; note the lack of a posterior vestibule.

Sexual dimorphism weak, females relatively higher than males; no juveniles in our material.

Measurements: Length of adults 0.40-0.45 mm, height of presumed males 0.21 mm, height of presumed females 0.24 mm; breadth the same as the height (all specimens).

Remarks: Apart from the fact that *O. tinctum* has no external depression near the muscle scars in the median part of the alar keel, the respective lengths of their shells and their appearances when viewed dorsally are a convenient way to distinguish between *O. australopunctatarum, O. aviformum* and *O. tinctum*. The latter is the smallest of these three species (enabling rapid separation from *O. australopunctatarum*), and is narrower when viewed dorsally than *O. aviformum*. It is also narrower in dorsal aspect than *O. microfornix* which, additionally, lacks the posterior lineations that characterize our new species.

Material Studied: Twenty one individuals, carapaces and valves, including adults of both sexes and two A-1 juveniles.

Occurrence and Age: Browns Creek and Castle Cove (upper part of the Browns Creek Clays), Victoria; Willunga Embayment, South Australia; Middle(?) - Late Eocene.

Oculocytheropteron sp. 1

Pl. V, Fig. 19

Remarks: We only have four specimens (length 0.42 mm), from the upper Browns Creek Clays at Castle Cove, of this species with its distinctive pitted ornament. The taxon is clearly new.

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Oculocytheropteron sp. 2

Pl. V, Fig. 20

Remarks: Two specimens only (length 0.40 mm) from the Johanna River Greensand at Browns Creek. The distinctive feature of this species is the leaf-like pattern along the posterior of its relatively high ventral ala, which we show a detail of in Pl. V, Fig. 20. With more material we could doubtless name a new species.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Genus *Aversovalva* Hornibrook, 1952

Aversovalva nairana sp. nov.

Pl. V, Figs. 21, 22; Pl. VIII, Fig. 15

Holotypus: The specimen PM Au 471, figured in Pl. V, Fig. 22 from the lower Browns Creek Clays at Castle Cove. Figured paratype PM Au 470.

Derivatio nominis: Nairana (Aboriginal) = eagle, for its shape in dorsal view, like a diving bird of prey.

Diagnosis: An *Aversovalva* with wide double-pointed ventral alae, having the look of a diving bird of prey in dorsal view.

Description: Shell small (length 0.36-0.39 mm); subrhombic in lateral view; surface finely pitted medially but apparently smooth anteriorly and on the posterior cauda; ventral ala very prominent and high coming to a spine-like point posteroventrally with a second spine below this (sometimes broken off); eye tubercle small and indistinct; valves unequal, LV overlapping the RV dorsally. Dorsal margin straight in the RV, convex in the LV; anterior broadly rounded, displaying several minute denticles anteroventrally; ventral margin straight; posterior upswept, terminating in a small subdorsal cauda. Height a bit more than half the length; very broadly subhastate in dorsal view (Pl. V, Fig. 21). Internal features illustrated in Pl. VIII, Fig. 15; RV hinge consisting of small crenulate terminal teeth with a crenulate median furrow between them, LV complementary .

Sexual dimorphism distinct, males relatively less high than females; juveniles smaller, with undeveloped internal features.

Measurements: Length of adults ranges from 0.36-0.39 mm, height in males 0.18 mm, in females 0.19-0.21 mm; breadth in males 0.28 mm, in females 0.29-0.30 mm. Length of juvenile A-1 valve 0.28 mm.

Remarks: This very distinctive small species ranges throughout the section at both localities but is more frequent above the Greensand. The other described or figured species of *Aversovalva* lack the double-pointed alae of *A. nairana.*

Material Studied: Seventeen individuals, carapaces and valves, including adults of both sexes and A-1 juvenile LV.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Middle(?) - Late Eocene.

Aversovalva yaringa sp. nov. *yaringa* subsp. nov.

Pl. VI, Figs. 1-3; Pl. VIII, Fig. 16

Holotypus: The specimen PM Au 472, figured in Pl. VI, Fig. 1 from the lower Browns Creek Clays at Castle Cove. Figured paratypes PM Au 473, 474.

Derivatio nominis: Yaringa (Aboriginal) = near the sea, because both localities are coastal.

Diagnosis: An *Aversovalva* with an ornament of punctae, shallow reticules and indistinct ribbing, with muscle scars well defined on the external valve surface.

Description: A small subspecies (length just less than 0.40 mm); subrhombic in lateral view; surface ornament of punctae (more anteriorly on the ala), and shallow reticules aligned so as to suggest an indistinct ribbing over the rest of the ala, but apparently smooth elsewhere in front and in the rear; ventral ala large, with a curved upper surface and costulate ventrally, terminating posteroventrally in a short spine (often broken off); eye tubercle absent or represented by a tiny raised anterodorsal spot; valves subequal, LV just overlaps the RV dorsally. Dorsum convex; anterior broadly rounded with several distinct anteroventral denticles; venter gently convex, overlapped by the ala; posterior upswept, terminating in an indeterminate cauda. Greatest height medial and about 60 % the length; plump in dorsal view, with backswept alar tips. The adductor muscle scars are clearly outlined externally. Internal features illustrated in Pl. VIII, Fig. 16; note the marginal selvage.

Sexual dimorphism weak, females higher than males; juveniles thinner shelled, smaller and less developed than adults.

Measurements: Length of males 0.35-0.36 mm, height 0.22 mm, breadth 0.26 mm; length of females 0.35-0.39 mm, height 0.23-0.24 mm, breadth 0.27-0.28 mm. Length of A-1 juveniles 0.30 mm.

Remarks: The plump shape in dorsal view of the species is its most distinctive characteristic; this subspecies is distinguished by less incurved backswept alar tips than the other subspecies (to be described next), on which also the muscle scars do not stand out externally. Like *A. nairana*, it occurs throughout the section at both localities but is most common at Castle Cove.

Material Studied: Seventy six specimens, mainly closed carapaces but including some separated valves, adults of both sexes and a few juveniles.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Middle(?) - Late Eocene.

Aversovalva yaringa sp. nov. *minor* subsp. nov.
Pl. VI, Figs. 4, 5

1979 *Cytheropteron (sic)* sp., McKenzie, 93-94, 96, Pl. 1, Fig. 15.

Holotypus: The specimen PM Au 475, figured in Pl. VI, Fig. 4 from the lower Browns Creek Clays at Castle Cove. Figured paratype PM Au 476.

Derivatio nominis: Minor (L.) = lesser, because it is a little smaller than the nominate subspecies.

Diagnosis: An *Aversovalva* subspecies with similar features to the nominate subspecies but smaller-sized, and with more incurved alar tips. Further, the muscle scars are not well defined on the external valve surface.

Description: Very like the nominate subspecies in all main features of the shell and ornament. However, the ornament detail does differ slightly in that there is little if any anterior punctation on the alae; further, the reticulation is more open and does not show any suggestion of faint ribbing. Other differences are given in the diagnosis. Sexual dimorphism weak.

Measurements: Length of adults (both sexes) 0.33-0.35 mm, height in males 0.19 mm, in females 0.20-0.21 mm.; breadth 0.20-0.22 mm. The length of the A-1 juvenile RV is 0.26 mm.

Remarks: This subspecies also occurs at both localities but is about equally distributed between them. It is commoner above than below the Johanna River Greensand. The South Australian representatives show the characteristic incurved alar tips, but are more strongly ornamented than our Victorian specimens.

Material Studied: Forty two specimens, carapaces and five valves, adults of both sexes and one juvenile RV.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Willunga Embayment, South Australia; Middle(?) - Late Eocene.

Family **Trachyleberididae** Sylvester Bradley, 1948
Subfamily **Trachleberidinae** Sylvester Bradley, 1948
Genus *Trachyleberis* Brady, 1898

Trachyleberis cf. *careyi* McKenzie, Reyment and Reyment, 1991
Pl. VI, Fig. 6

Remarks: Most of our specimens are stained a yellowish brown, and we only have two A-1 juveniles, thus the species may represent a thanatocoenose component in parts of the section. Further, the ornament is apparently tuberculate throughout rather than spinose as in the types, although a female RV from 7 m above the Greensand at Browns Creek does display some spinosity. Nevertheless, when we compare the pattern of this tuberculation it coincides almost exactly with the spinose pattern of *T. careyi*, supporting our tentative referral to that species. Under higher magnification a faint reticulation appears between the spines of the surface ornament. This material ranges stratigraphically from the upper Browns Creek Clays at Castle Cove to about 10 cm below the Greensand at Browns Creek.

Material Studied: Sixteen carapaces and valves, representing adults of both sexes and two juvenile carapaces plus a fragment.

Occurrence and Age: Castle Cove, Browns Creek and Bells Headland, Victoria; Middle(?) Eocene - Late Oligocene.

Trachyleberis brevicosta major McKenzie, Reyment and Reyment, 1991
Pl. VI, Fig. 7

Remarks: We have compared these specimens (length 0.91-0.97 mm) with the illustrated types and find them to be identical. *Trachyleberis* sp. McKenzie (1979, Pl. 1, Fig. 17) is closely similar to this subspecies in its ornament but is considerably smaller and may be a variant of *T. brevicosta australis* McKenzie, Reyment and Reyment, 1991.

Material Studied: Twenty nine carapaces and valves, representing adults of both sexes and three juveniles.

Occurrence and Age: Castle Cove and Browns Creek (same ranges as the previous species), also Bells Headland, Victoria; Gull Rock, South Australia; Middle(?) Eocene - Late Oligocene.

Trachyleberis paucispinosa sp. nov.
Pl. VI, Fig. 8

Holotypus: The specimen PM Au 479, figured in Pl. VI, Fig. 8 from the Browns Creek section 10 cm below the Johanna River Greensand.

Derivatio nominis: Paucispinosus (L.) = with relatively few spines, distinguishing this taxon from others in the genus.

Diagnosis: A *Trachyleberis* distinguished by its relatively few but strong surface spines.

Description: A moderately large species (length about 0.75 mm); oblong in shape; ornament comprising relatively few spines over the lateral valve surface, but these are stout and furcate terminally, with an intervening faint reticulation; valves subequal. Dorsal margin straight; anterior broadly rounded and marginally denticulate; ventral margin inflexed anteromedially; posterior margin subacuminate to subrounded and dentate. Height a little more than half the length. When the lateral and marginal spines are ignored, rather slender in dorsal view and with blunted extremities; otherwise prickly in appearance. Internally, with moderately broad inner lamellae but lacking vestibules; selvage distinct; marginal pore canals numerous anteriorly and mostly straight, widely spaced ventrally, and clustered again posteroventrally but not so numerous; normal pore canals simple, rimmed; central muscle scars comprising four adductors in a subvertical row plus a v-shaped frontal scar and two mandibulars; hinge holamphidont, RV with a strong anterior tooth, postjacent socket leading into a smooth median groove and a broad posterior tooth, LV complementary.

Sexual dimorphism distinct, males longer than females but less high. There are no juveniles in our material.

Measurements: Length in males 0.79 mm, height 0.39 mm, breadth 0.24 mm (without spines) or 0.32 mm (with spines);

length in females 0.72-0.76 mm, height 0.42 mm, breadth as for males.

Remarks: The locations of the lateral spines are close to those of *Acanthocythereis incerta* McKenzie, Reyment and Reyment, 1991 but that species has a subsidiary ornament of interspersed and clumped spinules that is completely absent in our taxon. In addition to the type locality, the new species also occurs in the lower Browns Creek Clays at Castle Cove, and from about 7 m above the Greensand at Browns Creek to 7 m below it. The specimens are not stained and most spines are entire, so we believe that *T. paucispinosa* occurred *in situ.*

Material Studied: Ten adult carapaces, representing both sexes.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Middle(?) - Late Eocene.

Genus *Acanthocythereis* Howe, 1963

Acanthocythereis sp.

Pl. VI, Fig. 9

Remarks: We have three adult (two females, one male) and two juvenile carapaces of this species which, with its dense spinosity and intervening weak reticulation, is more typical of *Acanthocythereis* than the other Australian Tertiary species ascribed to the genus *(A. incerta).* The adults have a length ranging from 0.80-0.85 mm. In our samples, the species first appears in the Browns Creek section 10 cm below the Johanna River Greensand and continues to 7 m below it.

Occurrence and Age: Browns Creek, Victoria; Middle(?) Eocene.

Genus *Cythereis* Jones, 1849

"Cythereis" sp.

Pl. VI, Fig. 10

Remarks: There is one specimen, an adult male RV (length 0.91 mm) from the Browns Creek Clays about 21 m above the Johanna River Greensand. It has an ornament of deepset reticulations closely similar to that of *Cythereis gravizea* Hornibrook, 1952 described from New Zealand but lacks the "strong, curved, midrib postjacent to the prominent subcentral tubercle" (Hornibrook, 1952, p. 37). However, we note that, although Hornibrook's illustrated types were all from the Recent, he cited a Lower Eocene (Mangaorapan) - Recent range for his species. Possibly, the older New Zealand representatives might be closer in ornament to our form. This could well be a new genus and species.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Genus *Deltaleberis* McKenzie, Reyment and Reyment, 1991

Deltaleberis delicata sp. nov.

Pl. VI, Figs. 11, 12

Holotypus: The specimen PM Au 482, figured in Pl. VI, Figs. 11 and 12 from the Browns Creek Clays at Browns Creek about 7 m below the Greensand marker bed.

Derivatio nominis: Delicatus (L.) = delicate, for the very fine inter-ridge reticulation that characterizes its surface ornament.

Diagnosis: A *Deltaleberis* with a delicate and very fine inter-ridge surface reticulation, not visible under a light microscope.

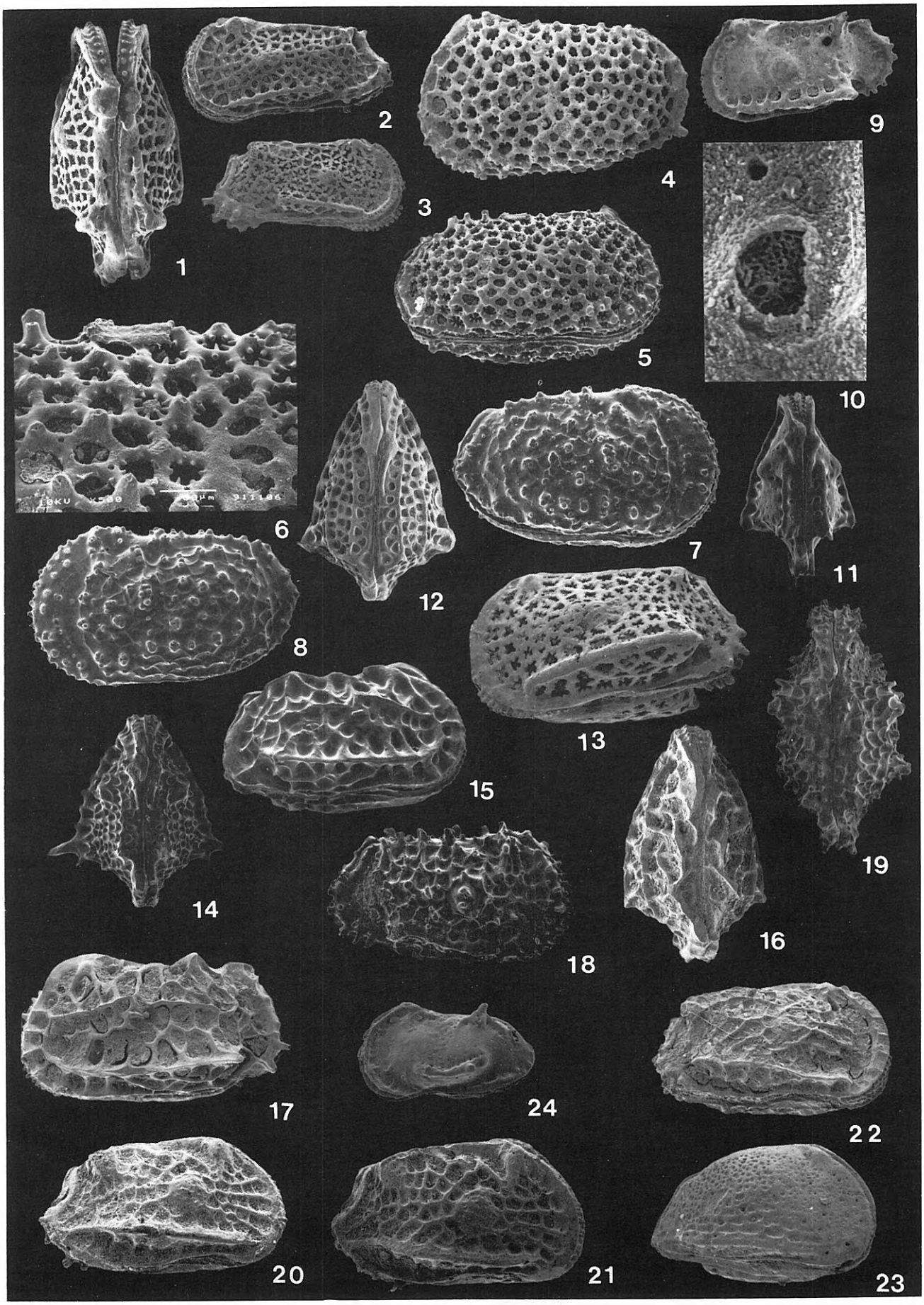
Description: A medium sized species (length about 0.65 mm); subtrapezoid in lateral view; surface ornamented with low ridges, including prominent anterior and posterior ridges, plus a round node (just above the site of the central muscle scars), and between these features an open meshwork of weak shallow reticules within which lies a much finer

---

Plate VII

1 *Cletocythereis kurrawa* sp. nov. Holotypus. PM Au 493, stub Vic-2(K1). Dorsal view of open valves of a carapace. Browns Creek section, 2 m above the Johanna R. Greensand. × 100.
2 Same species and provenance. PM Au 494, stub Vic-3(K4). Female LV. × 70.
3 *Cletocythereis* aff. *rastromarginata* (Brady). PM Au 495, stub Vic-6. Castle Cove. × 45.
4 *Rugocythereis multiflora* sp. nov. PM Au 496, stub Vic-8. Female LV. Browns Creek section, 1 m above the Greensand. × 100.
5 Same species. Browns Creek section, 7 m below the Greensand. Holotypus, RV carapace. PM Au 497, stub Vic-12. × 100.
6 Same species and provenance. Detail of the ornament of pores. × 225.
7 *Echinocythereis karooma* sp. nov. Holotypus. PM Au 498, RV female carapace. Browns Creek section, 7 m below Greensand. × 100.
8 Same species and provenance. PM Au 499, stub Vic-12. Female LV. × 100.
9 *Bradleya semiarata anteropytta* subsp. nov. Holotype. PM Au 500, stub Vic-12. Male LV. Browns Creek section, 21 m above Greensand. × 45.
10 Same species and provenance. Details of a pore. × 1125.
11 Same species from 7 m below Greensand in the Browns Creek section. PM Au 501, stub Vic-12. Dorsal view of a female carapace. × 45.
12 *Bradleya regularis* McKenzie, Reyment and Reyment. PM Au 502, stub Vic-12. Dorsal view of female carapace. Castle Cove. × 45.
13 *"Bradleya" lungalata* McKenzie, Reyment and Reyment. PM Au 503, stub Vic-6. Castle Cove. × 70.
14 *Bradleya* sp. PM Au 504, stub Vic-11. Dorsal view of a female carapace. Browns Creek. × 45.
15 *Quadibradleya momitea* sp. nov. Holotypus. PM Au 505, stub Vic-3(K9). RV of female carapace. Lower Browns Creek Clays at Castle Cove. × 70.
16 Same species and provenance. PM Au 506, stub Vic-6. Female carapace in dorsal aspect. × 70.
17 Same species and provenance. PM Au 518, stub Vic-9. Male RV. × 70.
18 *Spinobradleya echinata* sp. nov. Holotypus. PM Au 507, stub Vic-10. Male LV. Upper Browns Creek Clays at Castle Cove. × 70.
19 Same species and provenance. PM Au 508, stub Vic-13. Dorsal view of male carapace. × 70.
20 *Hornibrookella (?) currimundria* sp. nov. PM Au 509, stub Vic-7. Male RV. Browns Creek Clays exposed at Castle Cove. × 100.
21 Same species from the lower Browns Creek Clays, 21 m above Greensand. Holotypus. PM Au 510, stub Vic-10. × 100.
22 *Margocythere latticina* sp. nov. Holotypus. PM Au 511, stub Vic-10. RV female carapace. Browns Creek section, 21 m above Greensand. × 70.
23 *Neobuntonia* sp. PM Au 512, stub Vic-10. Male RV. Browns Creek. × 70.
24 Indet. gen. sp. Specimen lost. LV of female? Browns Creek Clays, 21 m above Johanna River Greensand. × 100.

Plate VII



reticulation, the normal pore conuli also form part of this distinctive pattern; valves subequal. Dorsal margin straight; anterior broadly rounded and denticulate; venter with a weak medial inflexure; posterior subtriangular and denticulate posteroventrally; valves subequal. Eye tubercle present but indistinct: Height less than half the length; almost parallelsided in dorsal view, broader posteromedially. Internally with moderately broad inner lamellae; a distinct selvage; no vestibules; marginal pore canals more numerous anteriorly than posteriorly, straight to flexuous; normal pore canals raised into conuli, simple; central muscle scars consisting of four adductors in a subvertical row plus a v-shaped frontal scar; mandibulars probably present but not observed; hinge holamphidont, RV with a strong anterior tooth, postjacent socket and crenulate median furrow plus a weakly lobate posterior tooth, LV complementary.

Sexual dimorphism distinct, females relatively higher than males. There are no juveniles in our material.

Measurements: Length of males 0.64 mm, height 0.29 mm, breadth 0.28 mm; length of females 0.55-0.58 mm, height 0.28 mm, breadth 0.29 mm.

Remarks: The only other described species of *Deltaleberis, D. rugosapytta* McKenzie, Reyment and Reyment, 1991, from the Late Oligocene of Bells Headland, Victoria, has a finely pitted interridge ornament. With such well marked variations in surface ornament between the Late Oligocene and Eocene forms, the genus might well prove an useful stratigraphic index for the Tertiary of southeastern Australia, especially as it is known to range into the Middle Miocene of Victoria (Mr. J. V. Neil, personal communication September 1991). Apart from the localities of the figured specimens, this new species also occurs in the Johanna River Greensand marker bed.

Material Studied: Seven adult carapaces (five female, one male and one unsexed individual).

Occurrence and Age: Browns Creek, Victoria; Middle(?) - basal Late Eocene.

Genus *Werribeeleberis* gen. nov.

Type Species: *Werribeeleberis trispinosa* sp. nov.

Diagnosis: A trachyleberidine genus marked by a smooth surfaced shell, with prominent marginal ridges forming an u-shaped loop and with three posterior spines. Two of these spines terminate the dorsal and ventral ridges respectively, the third is located posteromedially between them; valve surface depressed behind the anteromarginal ridge then swells towards the rear and drops abruptly behind the spines; valves edentate anteriorly and posteriorly; eye tubercle absent. Height about half the length; subhastate in dorsal view, breadth about the same as the height. Internally, with moderately broad inner lamellae; no vestibules; distinct marginal selvage; marginal pore canals straight to flexuous, numerous anteriorly, widely spaced ventrally, fewer posteriorly; normal pore canals scattered, simple and rimmed; central muscle scars comprising four adductors in a subvertical row, plus a v-shaped frontal scar; hinge holamphidont, RV with a strong, stepped anterior tooth, deep postjacent socket and smooth median furrow, followed by a large weakly lobate posterior tooth; LV complementary. Females relatively higher than males.

Remarks: The closest genus to *Werribeeleberis* is *Curfsina* Deroo, 1966 which has an ornament dominated by ridges and a smooth surface and is about the same size But *Curfsina*, a typical European North Atlantic Cretaceous genus, is thicker shelled, has three definite longitudinal ridges not two, the dorsal and ventral ridges are not united with an anteromarginal ridge to form a loop, nor are the ridges spine-tipped as in the new genus, and the posterior is subtriangular not subtruncate. At present, *Werribeeleberis* is monotypic.

Derivatio nominis: Werribee (Aboriginal) = spine; and suffix *-leberis* (Gk.) = sloughed skin (because ostracods are ecdysists). The gender is feminine.

Occurrence and Age: Middle(?) - Late Eocene of Victoria.

Werribeeleberis trispinosa sp. nov.

Pl. VI, Figs. 13-15; Pl. VIII, Fig. 17

Holotypus: The specimen PM Au 484, figured in Pl. VI, Figs. 14 and 15 from the Browns Creek Clays at Browns Creek about 7 m below the Greensand. Figured paratype PM Au 483.

Derivatio nominis: Trispinosus (L.) = bearing three spines, for the most characteristic feature of its ornament.

Diagnosis: A *Werribeeleberis* with three well defined posterior spines on each valve.

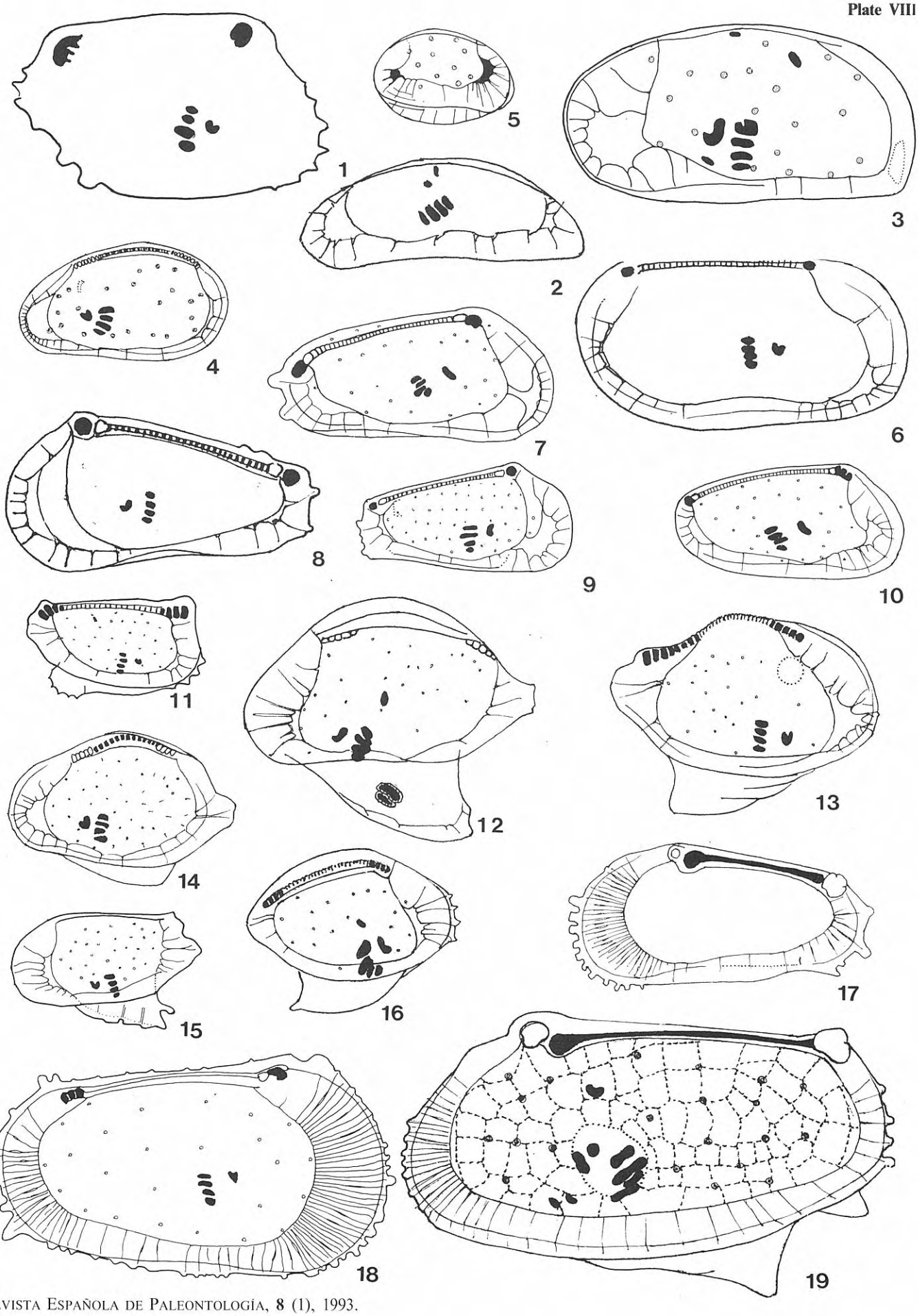
Description: Shell medium sized (length about 0.55 mm); oblong; ornament as described in the generic diagnosis but note further that in this taxon the ventral ridge is much the strongest longitudinal feature of each valve; also, the ventral spine occurs more anteriorly and the dorsal spine more posteriorly than the medial spine. Dorsal margin straight sloping slightly backwards; anterior broadly rounded and coarsely edentate; ventral margin with a weak medial inflexure; posterior margin subtruncate and edentate (with some teeth larger than those of the anterior margin). Internal features as in the generic diagnosis because the genus is monotypic in the current state of our knowledge.

Plate VIII

Camera lucida drawings of internal features, all × 125.

1 *Amphicytherura dinglei* sp. nov. Male LV of adult.
2 *Paracytherois eocaenica* sp. nov. RV of adult male.
3 *Krithe postcircularis* sp. nov. RV of adult female.
4 *Xestoleberis noccia* sp. nov. Male RV.
5 *Nunana australiae* sp. nov. Adult female; note, there is no xesteroleberidid spot.
6 *Arcacythere* cf. *chapmani* Hornibrook. Adult male LV.
7 *Munseyella pytta* sp. nov. Male LV.
8 *Munseyella adaluma* sp. nov. Adult male RV.
9 *Munseyella warringa* sp. nov. Adult male LV.
10 *Munseyella bungoona* sp. nov. Female LV.
11 *Eucytherura cameloides* sp. nov. Adult male LV.
12 *Cytheropteron* sp. Adult female RV.
13 *Oculocytheropteron megalops* sp. nov. Adult female LV.
14 *Oculocytheropteron tinctum* sp. nov. Male? RV.
15 *Aversovalva nairana* sp. nov. Adult male RV.
16 *Aversovalva yaringa yaringa* subsp. nov. Adult female LV.
17 *Werribeeleberis trispinosa* sp. nov. Female RV.
18 *Rugocythereis multiflora* sp. nov. Male LV.
19 *"Bradleya" lungalata* McKenzie, Reyment and Reyment. Adult female RV.

Plate VIII



Measurements: Length of adults (both sexes) 0.55-0.57 mm, height of male 0.27 mm, height of female 0.28-0.30 mm; breadth of male 0.27 mm, breadth of female 0.30 mm. Length of A-1 juvenile 0.4 mm.

Remarks: No other Australian trachyleberidine resembles this species; nor did Hornibrook (1952) describe any similar New Zealand species. Since it does not occur, as far as we are aware, in the Miocene facies of Victoria it may prove to be an useful biostratigraphical index.

Material Studied: Eleven specimens in all. Eight carapaces, one of which (the holotypus) was opened to enable illustration of the internal features using a camera lucida. Two further adults of both sexes are represented in the material studied, plus an A-1 juvenile (male?) carapace.

Occurrence and Age: Browns Creek and Castle Cove; lower Fishing Point Marl, near Castle Cove, Victoria; Middle(?) Eocene - Oligocene.

Genus *Idiocythere* Triebel, 1958

Idiocythere nunkeria sp. nov.

Pl. VI, Figs. 16-18

Holotypus: The specimen PM Au 485, figured in Pl. VI, Fig. 16 from the Browns Creek Clays at Browns Creek, about 1 m above the Johanna River Greensand. Figured paratype PM Au 486.

Derivatio nominis: Nunkeri (Aboriginal) = beautiful; for the attractive ornament of this species.

Diagnosis: An *Idiocythere* with an attractive and distinctive ornament; and with well marked ventral and dorsal ridges.

Description: Shell moderately large (length about 0.70-0.75 mm); subrectangular in lateral view; surface dominated by a large subcentral tubercle, prominent ventral and dorsal ridges which rise towards the rear, a flattened anterior behind a low anteromarginal ridge, and a depressed posterior subcauda; ornament of shallow circular pits, which are larger anteriorly than ventrally or dorsally (except for some pits above the subcentral tubercle); with distinct costulae below the ventral ridge; eye tubercle relatively small but well defined. Valves unequal, LV overlaps the RV dorsally via an anterodorsal "rim tooth". Dorsal margin straight, slopes slightly towards the rear; anterior margin broadly rounded and denticulate; ventral margin with a weak anteroventral inflexure; posterior subcaudate and dentate posteroventrally. Height a little less than half the length; subhastate in dorsal view, greatest breadth posteromedial and less than the height. Internally, with moderately broad inner lamellae; marginal selvage; no vestibules; numerous straight to flexuous marginal pore canals; normal pore canals scattered, simple and rimmed; central muscle scars located in the adductorial depression (internal view), consisting of four adductors in a subvertical row plus a broadly v-shaped frontal scar; hinge amphidont, RV with a strong anterior tooth, postjacent socket, smooth median furrow, and bilobate posterior tooth (the anterior lobe much smaller than the posterior lobe); LV complementary. Sexual dimorphism weak, males relatively less high than females. We found no juveniles.

Dimensions: Length of adults (both sexes) 0.72-0.75 mm, height in males 0.35 mm, in females 0.39 mm; breadth of males 0.32 mm, of females 0.35 mm.

Remarks: Like some other genera, *Idiocythere* shows well defined variation between Eocene, Oligocene and Miocene (McKenzie, 1974, Pl. 1, Fig. 12) species. It remains to be seen whether these differences are consistent stratigraphically, thus making the genus a good biostratigraphical index, or whether the primary control is environmental and linked to facies rather than time. The fact that *Idiocythere* is characteristically rare in the Victorian Tertiary, however, limits its possible utility.

Material Studied: Ten specimens. Five mature carapaces and a LV, representing both sexes. Additionally, three females and a male.

Occurrence and Age: Browns Creek Clays, 1 m above the Greensand, Browns Creek, upper Castle Cove Formation at Castle Cove, Victoria; Late Eocene.

Subfamily **Pterygocytherideinae** Puri, 1957

Genus *Alataleberis* McKenzie and Warne, 1986

Alataleberis johannae McKenzie and Warne, 1986

Pl. VI, Fig. 19

1979 n. gen. *D* aff. *Alatacythere* sp., McKenzie, 94, 101, Fig. 7.
1986 *Alataleberis johannae* McKenzie and Warne, 34, 36, Figs. 2E, 3A-C, 4A.

Remarks: This very distinctive species (length about 0.95 mm) is already known from the Browns Creek section. Our previous illustration of the internal features was of a male valve; on this occasion we figure a female. The species ranges from about 21 m above the Greensand to 7 m below it; it does not occur in our samples from the Eocene at Castle Cove.

Material Studied: Twenty five individuals, mostly juveniles, but including adults of both sexes.

Occurrence and Age: Browns Creek, Victoria; Middle(?) - Late Eocene.

Alataleberis robusta McKenzie and Warne, 1986

Remarks: All adult specimens of *A. robusta* (length 0.90-0.96 mm) from the Browns Creek Clays now repose in the collections of the British Museum (Natural History), London (McKenzie, 1974, Pl. 2, Fig. 6) or the Museum of Victoria, Melbourne (McKenzie and Warne, 1986, Figs. 2A-C, 3D-F, 4B). McKenzie's original collection retains only one juvenile carapace in the Johanna River Greensand picking; and at Castle Cove, *A. robusta* also occurs in lower beds of the overlying Castle Cove Limestone. McKenzie and Warne (1986) regard *A. robusta* as the ancestral species for *Alataleberis.*

Occurrence and Age: Browns Creek and Castle Cove; Middle(?) - Late Eocene.

Genus *Alatacythere* Murray and Hussey, 1942

"Alatacythere" sp.

Pl. VI, Fig. 20

Remarks: Represented by six individuals (four carapaces, two LV), all of them juveniles (length about 0.75 mm) from the upper Browns Creek Clays at Castle Cove. It is unlike typical *Alatacythere* species in the Eocene-Oligocene of the Gulf Coast region of the United States (McKenzie and Warne, 1986, Figs. 4C, D, K, L, M) in that the ala is far less robust. Additionally, it lacks the characteristic LV dorsal overlap of *Pterygocythere* Hill, 1954, which also has an American type species. On these counts, we consider that when adults are found a new genus and species could be described probably for the taxon.

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Subfamily **Oertliellinae** Liebau, 1975

Genus *Cletocythereis* Swain, 1963

Cletocythereis taroona sp. nov.
Pl. VI, Figs. 21-24

1979 *Oertliella* sp., McKenzie, 93, 94, 96, 97, Pl. 2, Fig. 1.
1991 *Cletocythereis* cf. *caudispinosa* (Chapman, Crespin and Keeble); McKenzie, Reyment and Reyment, 172, Pl. 7, Fig. 14, Pl. IX, Fig. 6.

Holotypus: The specimen PM Au 490, figured in Pl. VI, Fig. 22 from the Browns Creek Clays at Browns Creek about 7 m above the Greensand. Figured paratypes PM Au 489, 491, 492.
Derivatio nominis: Taroona (Aboriginal) = seashell, because it is a marine species.

Diagnosis: A *Cletocythereis* characterized by three-four sharp dorsal ridge spines of which the strongest arises posterodorsally at the end of the dorsal ridge.

Description: Shell medium sized (length about 0.60 mm); subrectangular in lateral view; ornament of reticulations and ridges, the reticules appearing to radiate from the distinct subcentral tubercle; the ridges include marginal anterior, dorsal and posterior ridges plus a strong ventral ridge that rises to the rear; eye tubercle anterodorsal and distinct; valves subequal, LV overlaps the RV anterodorsally by a "rim tooth". Dorsal margin adorned with sharp spines, slopes slightly backwards; anterior margin broadly rounded and denticulate; ventral margin inflexed anteromedially; posterior margin subtriangular and coarsely dentate ventrally. Height about half the length; subhastate in dorsal view, breadth a little less than the height. Internally, with moderately broad inner lamellae; marginal selvage; no vestibules; numerous straight to flexuous marginal pore canals; normal pore canals simple, rimmed; central muscle scars consisting of four adductors in a subvertical row plus a v-shaped frontal scar; hinge amphidont, RV with a strong anterior tooth, postjacent socket, crenulate median furrow and large lobate posterior tooth; LV complementary.

Sexual dimorphism distinct, females relatively higher and broader than males, but males are longer. Juveniles few, thinner shelled and with immature internal characters.

Measurements: Length of males 0.59-0.61 mm, height 0.29-0.31 mm, breadth 0.25 mm; length of females 0.58-0.59 mm, height 0.26-0.27 mm. Length of A-1 juveniles 0.46-0.49 mm.

Remarks: The specimens from the Willunga Embayment and Gull Rock, South Australia, that we referred previously to *Oertliella* sp. and *C.* cf. *caudispinosa* respectively (see Synonymy above), display the typical dorsal spinosity of our new species. *C. caudispinosa* s.s., on the other hand, is pronouncedly spinose at the rear, including a posterodorsal ridge spine and caudal spines, as the species name suggests (McKenzie, 1974, Pl. 1, Fig. 4; Whatley and Downing, 1983, Pl. 7, Figs. 10, 11). In Victoria, apart from the Browns Creek specimens, which occur up to 7 m below the Greensand, we also have four carapaces from the Browns Creek Clays at Castle Cove.

Material Studied: One hundred and thirty one carapaces and valves, mainly adults, both sexes represented.

Occurrence and Age: Gull Rock and Willunga Embayment boreholes, South Australia; Browns Creek and Castle Cove, Victoria; Middle(?) - Late Eocene.

Cletocythereis kurrawa sp. nov.
Pl. VII, Figs. 1-2

1979 *Cletocythereis* sp., McKenzie, Pl. 2, Figs. 4, 5.

Holotypus: The specimen PM Au 493, figured in Pl. VII, Fig. 1 from the Browns Creek section about 2 m above the Greensand. Figured paratype PM Au 494.
Derivatio nominis: Kurrawa (Aboriginal) = sea, for the marine provenance of this species.

Diagnosis: A *Cletocythereis* in which the valves have a low elevation and are without sharp dorsal or posterior spines.

Description: Shell medium sized (length about 0.65 mm); shape subrectangular in lateral view; ornament of reticulations and ridges but without dorsal ridge spines and posterior spines; the reticulations do not show much of a radiating pattern with respect to the subcentral tubercle, which is lower than in the previous species, there are large reticulations anteriorly and on the subtriangular caudal platform; the ridges are low, including the ventral ridge, the dorsal ridge makes a right-angled corner posterodorsally, the anteromarginal ridge is lined with pits; eye tubercle distinct; LV overlaps the RV anterodorsally via a "rim tooth". Dorsal margin straight, sloping slightly backwards; anterior margin broadly rounded and denticulate; venter inflexed anteromedially; posterior subtriangular and dentate ventrally. Height somewhat less than half the length; almost parallel sided in dorsal view (weakly subhastate). Internally, as for the previous species.

Sexual dimorphism distinct, males longer and relatively less high and broad than females. The two juvenile carapaces are less robust and smaller, and are certain to be immature internally.

Measurements: Length of males 0.65-0.70 mm, height 0.31-0.32 mm, breadth 0.21 mm; length of females 0.61-0.66 mm, height 0.31-0.33 mm, breadth 0.24 mm. Length of the A-1 juveniles 0.54-0.55 mm.

Remarks: This species can be compared with *C. rastromarginata* (Brady, 1880) and *C. curta* McKenzie, 1967 both of which have a generally similar shape in lateral view. The latter is similar in size and lack of spinosity, but has a relatively high ventral ridge like *C. caudispinosa*; the former is distinctly larger, also non spinose, and its nearest Eocene relative (see next species) differs further in that the reticules of the surface ornament tend to be clover-like in outline rather than rectangular. Apart from the type locality, the new species also occurs in the lower Browns Creek Clays at Castle Cove, and both 1 m above and in the Johanna River Greensand at Browns Creek. The South Australian representatives (see Synonymy) are confined to the Late Eocene.

Material Studied: Twenty two carapaces and valves, including adults of both sexes and two juvenile carapaces.

Occurrence and Age: Willunga Embayment, South Australia; Browns Creek and Castle Cove, Victoria; Late Eocene.

Cletocythereis aff. *rastromarginata* (Brady, 1880)
Pl. VII, Fig. 3

Remarks: A synonymy is given in McKenzie, Reyment and Reyment (1991, p. 171). The single specimen of the present record is a large male carapace (length 0.88 mm) which was found in the lower Browns Creek Clays at Castle Cove and displays clover-leaf reticules, especially posteriorly. Otherwise, it closely resembles the Recent types and is rather larger than our Late Oligocene material from Bells Headland. But the latter were all females so may yet prove to be conspecific, as males in *Cletocythereis* are distinctly longer than females.

Occurrence and Age: Castle Cove, Victoria; Late Eocene.

Subfamily **Penneyellinae** Neale, 1975
Genus *Rugocythereis* Dingle, Lord and Boomer, 1990

Rugocythereis multiflora sp. nov.
Pl. VII, Figs. 4-6; Pl. VIII, Fig. 18

Holotypus: The specimen PM Au 497, figured in Pl. VII, Fig. 5 from the Browns Creek section, about 7 m below the Greensand. Figured paratype PM Au 496.

Derivatio nominis: Multiflora (L.) = many-flowered *(flos-floris)*, for the all-over deep flower-like pitting of its interspinose ornament.

Diagnosis: A *Rugocythereis* with flower-like overall pitting.

Description: Shell moderately large (length about 0.85 mm); subrectangular in lateral view; surface covered almost entirely by spines and between the spines a strong meshwork of deep pits which when well preserved are seen to be flower-like in outline; valves swollen over much of the surface except anteriorly and posteriorly; no eye tubercle or distinct subcentral tubercle; valves subequal. Dorsal and ventral margins straight and parallel, although the latter has a slight anteromedial inflexure; anterior more broadly rounded than the posterior and marginally denticulate. Height a bit over half the length; plump in dorsal view, with compressed extremities, breadth about the same as the height. Internally characterized by broad inner lamellae, with regular inner margins; no vestibules; marginal pore canals numerous, straight to flexuous, some branched; normal pore canals simple; central muscle scars comprising four adductors in a subvertical row plus a v-shaped frontal scar or two separate smaller scars that could link into a v-shape; hinge subamphidont, RV with a weakly defined anterior tooth, postjacent socket, apparently smooth and narrow median furrow and large trilobate posterior tooth; LV complementary (Pl. VIII, Fig. 18).

Sexual dimorphism distinct, males are clearly longer than females and not as plump in dorsal view. Juveniles thinner shelled and immature internally.

Measurements: Length of males 0.87-0.88 mm, height 0.45-0.46 mm, breadth 0.41 mm; length of adult females 0.80-0.85 mm, height 0.46 mm, breadth 0.44-0.45 mm. Length of A-1 juveniles 0.69-0.72 mm.

Remarks: Our material includes specimens from the upper Browns Creek Clays at Castle Cove. The peculiar flower-like interspine pitting distinguishes this species from others in the genus listed by Dingle, Lord and Boomer (1990). We note, however, that *Cythereis hostizea* Hornibrook, 1952 with similar flower-like pitting, plump shape in dorsal view and subamphidont hinge also belongs in *Rugocythereis*, although illustrated with a tiny eye tubercle (Hornibrook, 1952, p. 37-38, Pl. 5, Figs. 72, 75, 78). Hornibrook *(cit.)* regards it as one of the most typical species of the Eocene and Early Oligocene in New Zealand.

Material Studied: Twenty three individuals plus fragments, including adults of both sexes and juveniles.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Middle(?) - Late Eocene.

Subfamily **Echinocythereidinae** Hazel, 1967
Genus *Echinocythereis* Puri, 1954
Echinocythereis karooma sp. nov.
Pl. VII, Figs. 7-8

Holotypus: The specimen PM Au 498, figured in Pl. VII, Fig. 7 from the Browns Creek Clays at Browns Creek about 7 m below the Greensand.

Derivatio nominis: Karoom (Aboriginal) = native currant, for the berry-like shape and discoloration of the specimens.

Diagnosis: An *Echinocythereis* with a distinctive berry-like appearance, due to its pustulose surface ornament.

Description: Shell medium sized (length about 0.60-0.65 mm); shape subrectangular with more or less rounded extremities; surface ornament of scattered pustules with an intervening meshwork of low reticules, individual pustules are small and tend to clump in twos and threes, the largest such cluster (of six pustules) lies on the apex of the otherwise indistinct subcentral tubercle; median part of each valve swollen, anterior and posterior flattened; eye tubercle missing; valves unequal, LV overlapping RV ventrally and posteriorly. Dorsal margin straight, with some marginal pustules; anterior broadly rounded, marginally denticulate; venter gently convex except where inflexed anteromedially; posterior rounded in overlapping LV, subacuminate in RV. Internally with moderately broad inner lamellae; no vestibules; numerous straight to flexuous marginal pore canals; normal pore canals simple (a few are sited on the apex of a pustule and, thus, are celated), plus some celated sieve pores; central muscle scars comprising four adductors in a subvertical row plus two small frontal scars; hinge amphidont, RV with strong anterior tooth, postjacent socket, crenulate median furrow, and lobate posterior tooth, LV complementary.

Sexual dimorphism distinct, males are longer and less high and broad than females. No juveniles in our material.

Measurements: Length of males 0.63-0.67 mm, height 0.36-0.37 mm, breadth 0.31-0.32 mm; length of females 0.60-0.64 mm, height 0.37-0.39 mm, breadth 0.33 mm.

Remarks: The species identified as *Quadracythere (sic.)* sp. by McKenzie (1974, Pl. 1, Fig. 18, Pl. 2, Figs. 15-17) from the Willunga Embayment, South Australia, is clearly very similar to *E. karooma* but differs in being much more pustulose. It is also younger, occurring regularly in the Early Miocene - Oligocene part of the section in borehole WLG38.

Material Studied: Twenty adult carapaces, plus a female RV.

Occurrence and Age: Browns Creek, Victoria; Middle(?) - Eocene.

Family **Thaerocytheridae** Hazel, 1967
Subfamily **Bradleyinae** Benson, 1972
Genus *Bradleya* Hornibrook, 1952
Bradleya semiarata Hornibrook, 1952 *anteropytta* subsp. nov.
Pl. VII, Figs. 9-11

Holotypus: The specimen PM Au 500, figured in Pl. VII, Fig. 9 from Browns Creek about 21 m above the Greensand.

Derivatio nominis: Anteropytta (L.) = pitted in front, for the distinguishing subspecific characteristic.

Diagnosis: A *Bradleya* subspecies differentiated from the nominate subspecies by its large shallow reticules behind the anterior ridge.

Description: A moderately large subspecies (length 0.85-0.90 mm); subquadrate in lateral view; surface generally smooth, with prominent dorsal and ventral ridges, the latter continuing into an anteromarginal ridge, both dorsal and ventral ridges terminate in stout spines, and have reticules along their length on either side of each ridge keel, there are also six large reticules behind the anteromarginal ridge, and a hint of similar reticules in front of the posterior margin; subcentral tubercle low but large and distinct; eye tubercle large and subspherical; valves unequal, LV larger and overlapping the RV dorsally along the dorsal margin and anterodorsally by a "rim tooth". Dorsal and ventral margins straight, overlapped slightly by their respective submarginal ridges; anterior broadly rounded and marginally denticulate; posterior concave above, and convexly curved below where it is edentate. Height about half the length; arrowhead-shaped in dorsal view, with dorsal and ventral ridges, subcentral tubercle, eye tubercle and "rim tooth" all figuring prominently in the dorsal profile. Internally with moderately broad inner lamellae; no vestibules; distinct marginal selvage; numerous marginal pore canals generally straight or branched; normal pore canals both simple and celated sieve type (Pl. VII, Fig. 10); central muscle scars

consisting of four rather elongate adductors in a subvertical row plus two small frontal scars; hinge hemiamphidont, RV with stepped anterior tooth, postjacent socket, crenulate median furrow, and trilobate posterior tooth, LV complementary.

Sexual dimorphism weak, males longer than females and relatively less high and broad. Juveniles thinner shelled and undeveloped internally, although A-1s are comparatively robust *vis à vis* the younger stages available in our material.

Measurements: Length of adult male 0.90 mm, height 0.44 mm; length of mature female 0.86 mm, height 0.44 mm, breadth 0.50 mm. Lengths of juveniles 0.75 mm (A-1); 0.57 mm (A-2); 0.35 mm (A-4).

Remarks: Our specimens are similar in size, shape and most ornamental features to the Hornibrook (1952) species, differing only in the shallow anterior reticules and in a concave posterodorsal lateral profile. His New Zealand taxon is also younger (Altonian = earliest Miocene).

Material Studied: Thirteen individuals, eight adults of each sex and five juveniles (two A-1, two A-2, one A-4).

Occurrence and Age: Browns Creek, about 1 m above the Greensand and Castle Cove Formation at Castle Cove, Victoria; Late Eocene.

Bradleya regularis McKenzie, Reyment and Reyment, 1991

Pl. VII, Fig. 12

1991 *Bradleya regularis* McKenzie, Reyment and Reyment, 164, 166, Pl. VI, Figs. 11-12.

Remarks: Our few adult specimens (length about 0.85 mm) from the Browns Creek section about 1 m above the Greensand marker bed, are closer to the holotypus and paratypus than to the syntype determined as *B.* cf. *regularis* (McKenzie, Reyment and Reyment, 1991, Pl. VI, Fig. 13). The figures herein provide a dorsal view, ornament detail and a camera lucida drawing which usefully complement our lateral view illustrations of the original specimens.

Material Studied: Eighteen individuals plus fragments, including adults of both sexes, and several A-1 juveniles (length 0.69 mm).

Occurrence and Age: Browns Creek and Bells Headland, Victoria; Late Eocene - Late Oligocene.

"Bradleya" lungalata McKenzie, Reyment and Reyment, 1991

Pl. VII, Fig. 13; Pl. VIII, Fig. 19

1991 *Bradleya lungalata* McKenzie, Reyment and Reyment, 154, Pl. VI, Fig. 8, Pl. X, Figs. 9, 10.

Remarks: This species (length 0.81-0.86 mm) is very distinctive, and is easily recognized not only by the long alate ventral ridge indicated in its specific name but also by a very characteristic delta-like shape in dorsal and ventral view. These Eocene specimens come from both samples collected in the Browns Creek Clays at Castle Cove. It is not a typical *Bradleya*, because it has no castrum only a prominent subcentral tubercle, which may eventually prove to warrant the erection of a new genus.

Material Studied: Ten carapaces, two of them juvenile the others representing adults of both sexes.

Occurrence and Age: Castle Cove, Victoria; Late Eocene - Late Oligocene.

Bradleya sp.

Pl. VII, Fig. 14

Remarks: The one carapace of this species (a mature female, length 0.88 mm) comes from the Browns Creek section about 2 m below the Greensand. It is certainly different from any other *Bradleya* described from Australasia. This can be appreciated not only by careful examination of our illustration of the dorsal view, but also by checking the microornament of its valve surface against that of a related species, *B. regularis*.

Occurrence and Age: Browns Creek, Victoria; Middle(?) Eocene.

Genus *Quasibradleya* Benson, 1972

Quasibradleya momitea sp. nov.

Pl. VII, Figs. 15-17

Holotypus: The specimen PM Au 505, figured in Pl. VII, Fig. 15 from the lower Browns Creek Clays at Castle Cove. Figured paratypes PM Au 506, 518.

Derivatio nominis: Momite (Aboriginal) = dawn, for the Eocene.

Diagnosis: A *Quasibradleya* defined by its atypical dorsal ridge in adults.

Description: Shell moderately large (length about 0.80 mm); subrectangular in lateral view; ornamented by a characteristic pattern of large irregular reticules and ridges; of the latter, the ventral ridge is strong, the central ridge interrupted (generic character) and the dorsal ridge is atypical for this genus because it is undulose rather than straight or gently curved; the elevated posteroventral peak of the dorsal ridge, behind which it drops away again, creates a diagnostic diamond pattern (broad in front, narrower behind) when a carapace is viewed dorsally; castrum of the subcentral tubercle typically defined as for the genus; eye tubercle small but distinct; valves subequal; LV overlaps the RV slightly at the antero- and posterodorsal cardinal angles. Dorsal margin straight but obscured by the undulose ridge in lateral view; anterior broadly rounded and marginally denticulate; venter nearly straight, anteromedial inflexure weak; posterior gently convex above and concave below, produced into a small cauda, dentae of the cauda not well differentiated. Height little more than half the length; subhastate in dorsal view, breadth greater than the height. Internally, similar to species of *Bradleya*. Polymorphic with respect to ornament and shape.

Sexual dimorphism distinct, males longer and relatively less high than females. Juveniles less robust, immature internally, having a straight dorsal ridge.

Measurements: Length of adult males 0.81-0.83 mm, height 0.41-0.42 mm, breadth 0.47 mm; length of adult females 0.75-0.79 mm, height 0.40-0.41 mm, breadth 0.46-0.47 mm. Length of A-1 juveniles 0.60 mm.

Remarks: The Australasian *Quasibradleya* species described by Benson (1972, Pl. 8, Figs. 2, 3, 4), which range in age from Early Oligocene to Early Miocene, all have a gently and convexly curved dorsal ridge. In our previously described species *Q. janjukiana* (Late Oligocene to Middle Miocene) this ridge is nearly straight, as is the case in the early Middle Miocene species *Q. praemackenziei* (Whatley and Downing, 1983). Thus, it would seem that the Eocene-Miocene evolutionary trends in this feature were from undulose to nearly straight in one lineage and undulose to gently convex in the other. Apart from the localities already cited for the types, other paratypes came from the Browns Creek section –in the Greensand and also about 1 m above and 7 m below it– and from the upper Browns Creek Clays at Castle Cove.

Material Studied: Thirty three carapaces and valves, plus a few fragments, adults of both sexes and four A-1 juveniles.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Middle(?) - Late Eocene.

Genus *Spinobradleya* McKenzie, Reyment and Reyment, 1991

Spinobradleya echinata sp. nov.

Pl. VII, Figs. 18, 19

Holotypus: The specimen PM Au 507, figured in Pl. VII, Fig. 18 from the upper Browns Creek Clays at Castle Cove. Figured paratype PM Au 508.

Derivatio nominis: Echinatus (L.) = spiny, for its major ornament.

Diagnosis: A *Spinobradleya* dominated by an ornament of pointed spines and interspine reticulations, with a strong posteroventral spine being particularly prominent.

Description: Shell moderately large (length about 0.75 mm); subrectangular in lateral view; surface ornamented mostly with hollow spines, although the largest spine on each valve which terminates the well defined ventral ridge is solid; there is also a (weaker) dorsal ridge; between the spines is a reticulate meshwork; valves swollen medially, flattened anteriorly and posteriorly; castrum of the subcentral tubercle distinct; if an eye tubercle is present anterodorsally it is very small and subspherical, but we are not certain that the feature so described is an eye tubercle; valves subequal, LV overlaps RV slightly posterodorsally and anterodorsally. Dorsum gently concave; anterior broadly rounded with a low marginal ridge and denticulate; ventral margin with a weak anteromedial inflexure; posterior gently concave above, convexly curved and dentate below. Height a little more than half the length; dorsal view irregular with compressed extremities, dominated by the main spines of the castra and, especially, the large posteroventral spines, widest in the plane of the latter. Internally with moderately broad inner lamellae and regular inner margins; selvage distinct; no vestibules; marginal pore canals numerous and mostly straight; normal pore canals include both simple and celated sieve types; central muscle scars comprising four adductors in a subvertical row plus two small frontal scars; hinge hemiamphidont, RV with strong anterior tooth, postjacent socket, crenulate median furrow, and lobate posterior tooth; LV complementary.

Sexual dimorphism distinct, males longer and relatively less high than females. Juveniles thinner-shelled and immature internally.

Measurements: Length of males 0.74-0.79 mm, height 0.39 mm, breadth 0.39 mm (excluding the large posteroventral spines); length of mature females 0.71-0.74 mm, height 0.39 mm, breadth 0.39 mm (excluding spines), 0.50 mm (including spines). Length of A-1 juveniles 0.63 mm.

Remarks: Even when the strong posteroventral spines are broken the dorsal profile of this species distinguishes it from *S. acantha* McKenzie, Reyment and Reyment, 1991; the latter also lacks an interspine meshwork. In addition to the Castle Cove locality, the new species also occurs at Browns Creek about 21 m above the Greensand marker bed.

Material Studied: Twelve individuals, mostly adult carapaces representing both sexes but including two LV A-1 juveniles.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Late Eocene.

Family **Hemicytheridae** Puri, 1953

Subfamily **Hemicytherinae** Puri, 1953

Genus *Hornibrookella* Moos, 1965

Hornibrookella(?) currimundria sp. nov.

Pl. VII, Figs. 20, 21

Holotypus: The specimen PM Au 510, figured in Pl. VII, Fig. 21 from the Browns Creek section about 21 m above the Greensand. Figured paratype PM Au 509.

Derivatio nominis: Currimundri (Aboriginal) = wing of the flying fox.

Diagnosis: A *Hornibrookella* (?) with a well developed ventral ridge and also a prominent subcentral tubercle.

Description: Shell medium sized (length about 0.55 mm); shape subquadrate in lateral view; ornament of reticulations which radiate from the large subcentral tubercle, but dominated by a large keeled ventral ridge; eye tubercle distinct; valves subequal. Dorsal margin very weakly convex; anterior broadly rounded; ventral margin inflexed anteromedially; posterior concave above, curved and upswept below, with a few posteroventral dentae. Height about 60 % the length; subhastate in dorsal view. Internally with moderately broad inner lamellae, regular inner margins, no vestibules; selvage distinct; numerous mostly straight, but including some branched, marginal pore canals; both simple and sieve type normal pore canals; central muscle scars consisting of four adductors, the second of these from the top divided, in a subvertical row, plus two small frontal scars; hinge holamphidont, RV with strong anterior tooth, postjacent socket, smooth and curved median furrow and large posterior tooth, LV complementary.

Sexual dimorphism distinct, males longer than females. Juveniles absent from our material.

Measurements: Length of males 0.58-0.59 mm, height 0.31 mm, breadth 0.26 mm; length of females 0.52-0.55 mm, height 0.31-0.32 mm, breadth 0.31-0.32 mm.

Remarks: None of the *Hornibrookella* species previously described by us (McKenzie, Reyment and Reyment, 1991) are ventrally alate or have such a well marked subcentral tubercle. We know from Mr. J. V. Neil (personal communication August 1991) that the intends revising this group of hemicytherids in a forthcoming paper. This taxon may then warrant transfer to a new genus. Apart from the localities given above, the species also occurs in the upper Browns Creek Clays at Castle Cove.

Material Studied: Six adult carapaces - four females, two males. Additional material from the upper Browns Creek Clays at Castle Cove.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Late Eocene.

Genus *Margocythere* McKenzie, Reyment and Reyment, 1991

Margocythere latticina sp. nov.

Pl. VII, Fig. 22

Holotype: The specimen PM Au 511, figured in Pl. VII, Fig. 22 from the Browns Creek section about 21 m above the Greensand marker bed.

Derivatio nominis: Latticino (Italian) = a criss-cross pattern developed by Venetian glassmakers, and characteristic of this new species.

Diagnosis: A *Margocythere* with a crisscross reticulation.

Description: A medium sized to moderately large species (length 0.70-0.74 mm); shell subrectangular in lateral view, raised medially but flattened in front and posteriorly; ornament of rather large reticules in a crisscross pattern plus a low slender ventral ridge, anterior margin relatively broad and traversed by widely spaced costulae (typical for the genus), dorsal ridge indistinct anteriorly but produced posteriorly into a ridge ear; subcentral tubercle rather low; eye tubercle distinct; valves subequal. Dorsal margin straight, slopes slightly backwards; anterior broadly rounded; ventral margin inflexed anteromedially; posterior subcaudate and dentate posteroventrally. Height about 55 % the length; parallel sided in dorsal view, with compressed extremities, breadth less than the height

and about half the length. Internally with moderately broad inner lamellae, regular inner margins, no vestibules; distinct selvage; numerous mostly straight marginal pore canals; normal pore canals simple (celated sieve type normal pores may also be present but could not be confirmed); central muscle scars consisting of a subvertical row of four adductors plus two small frontal scars; hinge hemiamphidont, RV with a strong anterior tooth, postjacent socket, smooth median furrow, and lobate posterior tooth; LV complementary.

Sexual dimorphism distinct, males longer than females. The single juvenile A-1 carapace is thinner shelled and immature internally.

Measurements: Length of adult males 0.73-0.74 mm, height 0.42 mm, breadth 0.37 mm; length of mature females 0.70-0.71 mm, height 0.40-0.41 mm, breadth 0.36 mm. Length of the A-1 carapace 0.60 mm.

Remarks: Easily distinguished from the type species, *M. aspreta* McKenzie, Reyment and Reyment, 1991, by the criss-cross pattern of its reticulations. We have transferred the genus out of bradleyine Thaerocytheridae because it does not show the typical castrum on the subcentral tubercle which distinguishes that subfamily (Benson, 1972), and is parallel sided not subhastate in dorsal view. Apart from the locality given above, the new species also occurs in both samples of the Browns Creek Clays at Castle Cove, but is always rare.

Material Studied: Eight carapaces and valves, and one juvenile representing both sexes. Additional material also available from the Browns Creek Clays at Castle Cove, and the upper Castle Cove Formation.

Occurrence and Age: Browns Creek and Castle Cove, Victoria; Late Eocene.

Subfamily **Incertae Sedis**
Genus *Neobuntonia* Hartmann, 1982

Neobuntonia sp.
Pl. VII, Fig. 23

Remarks: We only have a single carapace (length 0.71 mm) from the Browns Creek Clays at Browns Creek about 21 m above the Greensand. It is clearly referable to the same generic taxon as *Neobuntonia airella* McKenzie, Reyment and Reyment, 1991 and may well be a new species, but the singleton precludes describing one.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

Family **Incertae Sedis**

Indet. sp. nov.
Pl. VII, Fig. 24

Remarks: The length of our specimen is 0.42 mm. The specimen was picked out of washings from the Browns Creek Clays at Browns Creek about 21 m above the Johanna River Greensand.

Occurrence and Age: Browns Creek, Victoria; Late Eocene.

PALAEOCOLOGY AND CONCLUSIONS

Procceding stratigraphically from oldest to youngest in the richly fossiliferous Browns Creek Clays at the type locality, the section begins with about 8 m of dark brown to blackish glauconitic (secondarily limonitized), occasionally sandy to gravelly, fossiliferous clays. These contain turrids *(Spirocolpus aldingae* (Tate)), brachiopods, rare solitary corals, small circular bryozoans, echinoid spines and, towards the top, fragments of the nautiloid *Aturia clarkei* Teichert and Cotton as well as ostracods and the index foraminiferan *Hantkenina australis* Finlay. Several species of ostracods are restricted to this zone, among them *Krithe postcircularis, Kangarina wareelacogarra, Eucytherura cameloides, Oculocytheropteron tinctum, Deltaleberis delicata* and *Rugocythereis multiflora.* The properties of the sediment, its glauconite content, and the association of genera such as *Krithe, Kangarina, Eucytherura, Cytheropteron* all indicate an offshore environment, not too far from the strand (the gravels), with depths of 50-70 m. The brown staining may indicate reducing conditions on the bottom.

The Johanna River Greensand member is characterized by its bluish to apple-green colour and medium-grained texture. It is about 1 m thick and represents a depositional stillstand. Macrofossils are abundant near the base but poorly represented in the upper 60 cm. The member is typified by the ostraeid *Notostraea lubra* Finlay, brachiopods including *Stenothyris pectoralis* (Tate), pelecypods, echinoid spines, bryozoans and solitary corals. The ostracods are almost always well aggraded, confirming the interpretation of a stillstand on a warm, lime-enriched bottom at moderate depth. This unit carries the index foraminiferan *Hantkenina primitiva* Cushman and Jarvis.

Overlying the Greensand are almost 20 m of pale fawn-grey (base) to dark grey (summit) glauconitic and bryozoal marly clays. These sediments are massive to thick-bedded. Bryozoans are the dominant faunal element. Scaphopods and rare pectinid pelecypods occur in the lower beds; small echinoid spines are abundant throughout. Characteristic ostracods include *Cytherella pinnata, Neonosidea austrotumida, Maddocksella tarparriensis, Myrena lindsayi, Alataleberis johannae, Cletocythereis taroona, C. kurrawa* and rare *Macromackenzia, Propontocypris* and *Cardobairdia.* Bryozoal marly clays are typical offshore facies of southeastern Australia today, thus the depositional depths of these Eocene equivalents may have reached 100 m. The darker upper layers may have been laid down in shallower water as to which points the occurrence of occasional quartz gravel.

The uppermost beds sampled by us at the Browns Creek section are brown, gritty to pebbly glauconitic fossiliferous silts. The macrofauna includes turrids, small solitary corals, rare brachiopods, small circular bryozoans and serpulid-like worm-tubes. Foraminifers and ostracods dominate the microfauna. This is interpreted as a nearshore sublittoral facies deposited at around 25 m.

At Castle Cove, the lower part of the exposed beds also belong to the Browns Creek Clays (Carter, 1958; McKenzie, 1974). Our two samples correspond to levels CC3 and between CC8 and CC9 of Carter (1958). The lower sample was from a medium-bedded brown to grey glauconitic (pelletal) and sandy bryozoal, marly clay. The dominant macrofauna consists of "stick-type" bryozoans and there are fragments of pectinids, echinoid spines and test-fragments. The upper sample is a grey, glauconitic bryozoal marly clay with a bryozoal macrofauna. Both samples are rich in foraminiferans

and ostracods. The latter feature such genera as *Cytherelloidea, Loxocythere, Munseyella, Eucytherura, Hemicytherura, Amphicytherura, Oculocytheropteron, Trachyleberis, Bradleya* and *Quasibradleya*. The presence of numerous *Krithe postcircularis* in the lower sample suggests it was deposited in a deeper sublittoral environment, although not greater than about 50 m as indicated by the considerable terrigenous component.

In summary, the Eocene Browns Creek Clays of Victoria, both at the type locality and at Castle Cove, comprises marine sediments indicative of warm sea temperatures and of varying depths of deposition. As discussed in McKenzie (1967, 1974), the formation exhibits relationships with the Palaeogene Tethys, South Africa and New Zealand, but it also contains many important endemic taxa.

ACKNOWLEDGEMENTS

We express our thanks to the Swedish Natural Science Research Council and the Swedish Institute for grants to enable McKenzie to work in Uppsala for three months in 1991. Part of the work was defrayed by a grant to Richard Reyment from the Swedish Natural Science Research Council.

BIBLIOGRAPHY

Benson, R. H. 1972. The *Bradleya* problem, with descriptions of two new ostracode genera *Agrenocythere* and *Poseidonamicus* (Ostracoda, Crustacea). *Smithsonian Contributions to Paleobiology,* **12**, 1-138.

Carter, A. N. 1958. Tertiary Foraminifera from the Aire River district, Victoria. *Geological Survey of Victoria, Bulletin,* **55**, 1-76.

Cooper, B. J. 1979. Eocene to Miocene stratigraphy of the Willunga Embayment. *Geological Survey of South Australia, Report of Investigations,* **50**, 1-101.

Cooper, B. J. 1985. The Cainozoic St. Vincent Basin - tectonics, structure, stratigraphy. In: *Stratigraphy, Palaeontology, Malacology: Papers in Honour of Dr. Nell Ludbrook*, Lindsay, J. M. (Ed.), 35-49. Special Publication, South Australian Department of Mines and Energy No. **5**. Adelaide. Geological Survey of South Australia.

Dingle, R. V., Lord, A. R. and Boomer, I. D. 1990. Deep-water Quaternary Ostracoda from the continental margin off south-western Africa (SE Atlantic Ocean). *Annals of the South African Museum,* **99**, 245-366.

Endacott, S. J. 1984. *Australian Aboriginal Words and Place Names and their Meanings.* 10th Edition, 3rd Reprinting, 64 pp. Blackburn, Victoria. Acacia Press.

Hartmann, G. 1980. Die Ostracoden der Ordnung Podocopida G. W. Müller, 1894, der warmtemperierten (antiborealen) West- und Südwestküste Australiens (zwischen Ceduna im Westen und Lakes Entrance im Osten). Teil 5. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut,* **77**, 111-204.

Hornibrook, N. de B. 1952. Tertiary and Recent marine Ostracoda of New Zealand. *Palaeontological Bulletin New Zealand Geological Survey,* **18**, 1-82.

Lindsay, J. M. 1985. Aspects of South Australian Tertiary foraminiferal biostratigraphy, with emphasis on studies of *Massilina* and *Subbotina*. In: *Stratigraphy, Palaeontology, Malacology: Papers in Honour of Dr. Nell Ludbrook*, Lindsay, J. M. (Ed.), 187-232. Special Publication South Australian Department of Mines and Energy No. **5**. Adelaide. Geological Survey of South Australia.

McKenzie, K. G. 1967a. Recent Ostracoda from Port Phillip Bay, Victoria. *Proceedings of the Royal Society of Victoria,* **80**, 61-106.

McKenzie, K. G. 1967b. Saipanellidae: a new family of podocopid Ostracoda. *Crustaceana,* **13**, 103-113.

McKenzie, K. G. 1969. Notes on the paradoxostomatids. In: *The Taxonomy, Morphology and Ecology of Recent Ostracoda*, Neale, J. W. (Ed.), 48-66. Edinburgh. Oliver & Boyd.

McKenzie, K. G. 1972. New data on the ostracode genera *Laocoonella* de Vos & Stock, *Redekea* de Vos, and *Aspidoconcha* de Vos; with a key to the family Xestoleberididae and a resume of symbiosis in Ostracoda. *Beaufortia,* **19**, 151-162.

McKenzie, K. G. 1974. Cenozoic Ostracoda of southeastern Australia with the description of *Hanaiceratina* new genus. *Geoscience and Man,* **6**, 153-182.

McKenzie, K. G. 1979. Appendix 2. Notes on Ostracoda from Willunga Embayment boreholes WLG38, WLG40 and WLG42. In: *Eocene to Miocene Stratigraphy of the Willunga Embayment*, Cooper, B. J. (Ed.), 90-101. *Geological Survey of South Australia, Report of Investigations,* **50**.

McKenzie, K. G. 1987. Tethys and her progeny. In: *Shallow Tethys 2*, McKenzie, K. G. (Ed.), 501-523. Rotterdam. Balkema.

McKenzie, K. G., Reyment, R. A. and Reyment, E. R. 1991. Eocene-Oligocene Ostracoda from South Australia and Victoria, Australia. *Revista Española de Paleontología,* **6**, 135-175.

McKenzie, K. G. and Warne, M. T. 1986. *Alataleberis* new genus (Crustacea, Ostracoda) from the Tertiary of Victoria and South Australia. *Proceedings of the Royal Society of Victoria,* **98**, 31-40.

Raggatt, H. G. and Crespin, I. 1955. Stratigraphy of Tertiary rocks between Torquay and Eastern View, Victoria. *Proceedings of the Royal Society of Victoria,* **6**, 75-142.

Reyment, R. A. 1991. *Multidimensional Palaeobiology*, 377 pp. Oxford. Pergamon Press.

Shafik, S. 1981. Nannofossil biostratigraphy of the *Hantkenina* (foraminiferid) interval in the Upper Eocene of southeastern Australia. *BMR Journal of Australian Geology and Geophysics,* **6**, 108-116.

Warne, M. T. 1988. *Neonesidea* and *Bairdoppilata* (Ostracoda) from the Miocene of the Port Phillip and Western Port Basins, Victoria, Australia. *Alcheringa,* **12**, 7-26.

Warne, M. T. 1990. Bythocyprididae (Ostracoda) from the Miocene of the Port Phillip and Western Port Basins, Victoria. *Proceedings of the Royal Society of Victoria,* **102**, 105-115.

Whatley, R. C. and Downing, S. 1983. Middle Miocene Ostracoda from Victoria, Australia. *Revista Española de Micropaleontología,* **15**, 347-407.

Manuscrito recibido: 5 de junio, 1992
Manuscrito aceptado: 8 de noviembre, 1992