Pleistocene and Recent Ostracoda from Goose Lagoon Drain, Victoria and Kingston, South Australia.

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The Ostracoda described in this paper come from the Pleistocene of the Warrnambool district, Victoria and localities along the Younghusband Peninsula, South Australia. Fifty-eight species are described. Of these, two are placed in *incertae sedis,* 15 in open nomenclature, 21 have been previously described, and 20 are described as new species. The new genus is *Chavocythere* (type species *C. australis* sp.nov.). The species described as new are: *Cytherella kingstonensis; Cytherelloidea posteropunctata; Keijcyoidea sudaustralis; Paranesidea norrisi; Neonesidea centuncula; Papillatabairdia elongata; Loxocythere postventrobullata; Cytheralison anserlagunae; Callistocythere sherwoodi; Morkhovenia hingstoni; Paracytheroma generodubia; Hemicytherura austropytta; Hemicytherura bellezza; Neobuntonia foveata, Neobuntonia sudaustralis; Bradleya gilli; Doratocythere ornata; Doratocythere indistincta; Mackencythere robusta;* and *Chavocythere australis.*

Of these 58 species, 20 are known to range from the Pleistocene-Recent based either on this record or previous work; and one taxon, *Cletocythereis rastromarginata* (Brady, 1880), may range from Eocene-Recent. We use the known environmental preferences of these species and the Australian Quaternary literature to interpret the palaeoecology of the Goose Lagoon Drain site.

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Introduction

The Recent nearshore marine Ostracoda of southern Australia, including those from such marginal environments as lakes, lagoons and estuaries, are relatively well known thanks to the work of McKenzie (1964, 1967, 1978) and Hartmann (1979, 1980, 1981, 1982a). Further, Yassini and Kendrick (1988) have recorded a Holocene fauna from the Swan River estuary, Western Australia. On the other hand, little work has been done on southern Australian Pleistocene nearshore marine and other marginal environment Ostracoda apart from that by McKenzie and Pickett (1984). During the 1986 'Shallow Tethys 2' international conference, (and again in January 1989) the opportunity arose to collect Recent and Pleistocene assemblages. Consequently, we collected the swash-mark along the beach near the jetty at Kingston, South Australia on 19 September 1986 and in January 1989; and the Pleistocene Goose Lagoon Drain locality, between Port Fairy and Warrnambool, Victoria on 20 September 1986.

Additional material was also obtained from Robe, below Kingston, and in The Coorong, a long lagoon stretching along the Younghusband Peninsula of South Australia. The aim of the present paper is to give a taxonomic report on these collections.

Quaternary Environments of Southern Australia – Previous Work

Several major studies of southern Australian Quaternary environments have been published in recent years and provide a more or less complete picture of the variety and complexity of the environments encountered in this region, which ranges over some 6,000 kilometres of coastline from Perth in Western Australia to Newcastle in New South Wales (Figure 1).

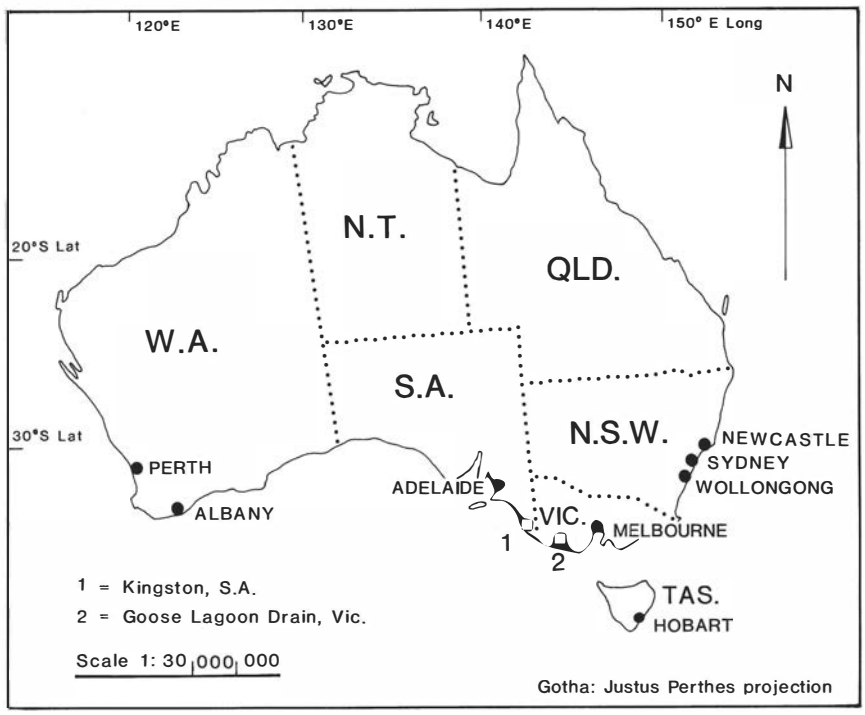

Figure 1. Map showing the localities referred to in the text

In Western Australia (W.A. in Fig. 1) an ongoing programme of coastal research is oriented particularly towards coastal geomorphology (Searle and Semeniuk, 1985). Some more diverse parameters of the southwestern estuarine systems near Albany, W.A. are recorded in McKenzie (1964), and for the Middle Holocene of the Swan River estuary by Yassini and Kendrick (1988).

In South Australia (S.A. in Fig. 1), the Spencer Gulf region has received special study (Hails and Gostin, 1984); the Coorong lagoonal system has been studied by a number of authors, most recently by De Deckker and Geddes (1980).

In Victoria (Vic. in Fig. 1), the Pleistocene and Holocene of the Warrnambool district have benefited from detailed study over several decades by the late Edmund T. Gill and his associates (Gill, 1967; Gill and Lang, 1982). Further to the east, the National Museum of Victoria Port Phillip Bay Survey is the basic reference for Recent environments around Melbourne (*Memoirs of the National Museum of Victoria* 27 (1966) and 32 (1971)), and it is complemented by the Phase One report of the Port Phillip Bay Environmental Study (MMBW and FWD, 1973). These references detail the hydrology, substrates, chemistry and biology of Port Phillip Bay.

In New South Wales (N.S.W. in Fig. 1), much recent research has been initiated by public concern at the increasing pollution of coastal waters especially around the metropolis of Sydney and the nearby cities of Newcastle and Wollongong (Albani and Brown, 1976). Some of this work is oriented towards microfossil studies (Johnson and Albani, 1973; Bentley 1988; Yassini and Wright, 1988). Dr. I. Yassini is engaged in similar work, based on ostracods, around Lake Illawarra, near Wollongong, for the Lake Illawarra Management Committee (Yassini and Jones, 1987).

The Quaternary of the New South Wales coast generally is under active study (Roy, 1980; Albani, 1981) and has also been worked on respective to its ostracod assemblages as environmental indices for better understanding of the Pleistocene deposits (McKenzie and Pickett, 1984).

While the research we have reported on so briefly above represents but a small fraction of the relevant available literature, we can claim that our summary provides a reasonable indication of its scope and applications. Our paper concludes with a necessarily brief environmental interpretation of the Goose Lagoon Drain site *vis à vis* its ostracod assemblage which is founded on this body of work.

Systematic Part

Family CYTHERELLIDAE Sars, 1866

Genus CYTHERELLA Jones, 1849

Cytherella kingstonensis sp. nov.

Plate 1, Fig. 1.

Holotype: The specimen PAMAu 100 figured in Plate 1, Fig. 1 from Kingston Beach.

Derivatio Nominis: From Kingston, South Australia where this taxon was collected.

Diagnosis: A species of *Cytherella* with the following characteristics: smooth shell with a supracentral muscle scar depression and regularly rectangular periphery.

Description: The shape is typical for a shallow water *Cytherella,* regularly rectangular and relatively broad in dorsal aspect – when an entire carapace is viewed. The feather-like adductor muscle scar group is located on the internal surface of a shallow supracentral external depression.The dorsum trends obliquely so that the anterior is somewhat broader than the posterior, but the venter is straight. In dorsal view the carapace is relatively broad and regularly subelliptical, rather flattened at the anterior and posterior.

Internally, the inner lamella is narrow, the hinge adont, marginal (radial) pore canals are lacking, while normal pore canals are small, simple and scattered.

Sexual dimorphism is distinct. Females are more swollen posteriorly in dorsal view; males are relatively more elongate than females.

Measurements: The length of the carapace ranges from 0.92–1.03 mm; the height ranges from 0.53–0.55 mm.

Remarks: The genus appears to be rather uncommon in southern Australian waters. Hartmann (1979, p. 219, Tafel I, Fig. 1–5) recorded *Cytherella* spec. from Albany and Frenchmans Bay in southwest Western Australia. His taxon is easily differentiated from our species because it is micropunctate along the anterior and posterior margins whereas *C. kingstonensis* is completely smooth.

Material Studied: Four growth stages; comprising 70 valves (6 adult, 64 juvenile) representing both sexes [Kingston = KG]; and 2 juvenile valves [Goose Lagoon Drain = GL].

Occurrence and Age: The Recent of Kingston, South Australia [KG]. Collected from the beach swash-mark near the town jetty on 19 September 1986 following stormy weather over the previous several days. Also occurring, but very rare, at Goose Lagoon Drain, Victoria, Pleistocene Stage 5E [GL].

Genus CYTHERELLOIDEA Alexander, 1929

Cytherelloidea posteropunctata sp. nov.

Plate 1, Fig. 2

Holotype: The specimen PAMAu 161, figured in Pl. 1, Fig. 2 from Kingston boat-landing.

Derivatio Nominis: Postero (L.) = posterior; -punctata (L.) = punctate. For the punctate posterior.

Diagnosis: A *Cytherelloidea* without any other surface ornament than a posterior transverse ridge which is punctate.

Description: Shape subrectanglar; surface without any ornament other than a posterior transverse ridge which is punctate. The shell is more inflated in this ridge area in females than in males. Dorsal and ventral margins subparallel; anterior broadly rounded; posterior subtruncate. In dorsal view rather compressed; broadest posteriorly.

Internally, the inner lamella is narrow; true marginal pore canals are lacking; normal pore canals are small, simple and scattered; the hinge is adont. The feather-like muscle scar pattern is medial and anterodorsally of it are several dorsal scars which undoubtedly represent attachment sites for mandibular, antennal and antennular extrinsic muscles; there are also several posterodorsally-placed dorsal muscle scars.

Sexual dimorphism is distinct. Females are larger, and broader posteriorly than males.

Measurements: The length ranges from 0.74–0.82 mm; the height ranges from 0.37–0.45 mm.

Remarks: The only previously recorded species which resembles our new taxon is *Cytherella* spec. Hartmann, (1979) – he found only a few specimens at the southern end of Goode Beach, Frenchmans Bay, south Western Australia. However, his description was restricted to its location and habitat in a *Posidonia* bed at 1.50 m depth; and he did not figure the muscle scars.

Material Studied: 5 valves all mature; 4 males (2LV, 2 RV) and 1 female RV.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e, Recent, Kingston boat-landing.

Cytherelloidea sp.

Plate 1, Figs 3, 4

Remarks: This relatively small species (length 0.58 mm; height 0.32 mm) has a very distinctive ornament, in particular, the meandering ribbing pattern, but the limited material precludes description of a new species.

Material Studied: A single male LV, damaged ventrally, and a complete left valve.

Occurrence and Age: Goose Lagoon Drain, Pleistocene, stage 5e and Recent, Kingston boat-landing.

Genus KEIJCYOIDEA Malz, 1981

Keijcyoidea sudaustralis sp.nov.

Plate 1, Fig. 5; Plate 8, Fig. 1

Holotype: The specimen PAMAu 101 figured in Plate 1, Fig. 5, from Goose Lagoon Drain.

Derivatio Nominis: from southern Australia where it was collected.

Diagnosis: A species of *Keijcyoidea* marked by a deep anteromarginal depression and relatively short dorsal rib.

Description: The subrectangular shape with is broadly rounded anterior and posterior and inflexed dorsum is typical for *Keijcyoidea* in which the dorsal inflexure marks the position of a broad LV projection (LV 'marginal rim tooth' of some authors) which is accommodated in the RV. The anterior is more broadly rounded than the posterior and the venter is medially inflexed (more weakly than the dorsum).

The most striking feature of the surface ornament is a deep elongate depression running the whole anterior height of each valve behind a thick marginal rim. From the posterior of each valve trend two well defined ridges of which the more dorsal is distinctively shorter. Much of the surface, expecially posteriorly and mid-dorsally, is punctate.

The inner lamella is narrow, lacking marginal pore canals; normal pore canals are small, simple and scattered, and difficult to observe except by the SEM. The adductor muscle scar group has a feather-like pattern as is characteristic for the family. The hinge is adont but in this genus features the LV 'marginal rim tooth' already referred to.

Sexual dimorphism is pronounced. Males are more slender and longer, while females are broader posterodorsally, shorter and higher in lateral view; in the internal posterior of each valve they have a two embryo broodchamber.

Measurements: The length of the carapace is 0.72 mm; the height is 0.38 mm.

Remarks: Two other species of *Keijcyoidea* are known from southern Australia, namely *Keijcyoidea keiji* (McKenzie, 1967) and *Keijcyoidea goodbeachensis* (Hartmann, 1979). Our species differs from these others above all by the deep elongate anteromarginal depression; also the ornament of ridges and punctation is more prominent in the two other species. Malz (1981) established *Keijcyoidea* on the basis of the marginal rim projection in the LV that is atypical of *Cytherelloidea* Alexander, 1929 in which these taxa were previously recorded. Soft parts are known for *K. keiji* (McKenzie, 1967) and the hemipenis of *K. goodbeachensis* also has been illustrated (Hartmann 1978, 1979). Apart from details of the hemipenis, there is little to distinguish *Keijcyoidea* species in their soft anatomy from other cytherellids.

Material Studied: Three growth stages; comprising 1 adult male carapace (holotype), fragment of female valve; 1 juvenile carapace, 20 juvenile valves, of indeterminate sex.

Occurrence and Age: The Pleistocene of Victoria. Collected from Goose Lagoon Drain, a few kilometres east of Port Fairy, on the main road to Warrnambool. The site has been dated at 110,000−130, 000 B.P. in Gill (1986), making it equivalent to Stage 5e of a worldwide warm interglacial age.

Keijcyoidea keiji (McKenzie, 1967)

Plate 1, Figs. 6, 7

1967 *Cytherelloidea keiji* n.sp. McKenzie, p. 63, text. fig. 3 p., pl. 11, fig. 1.
1978 *Cytherelloidea keiji* McKenzie, Hartmann, p. 66, textfigs. 1−6, pl. 1, Figs. 1−3.
1979 *Cytherelloidea keiji* McKenzie, Hartmann, p. 220.

1980 *Cytherelloidea keiji* McKenzie, Hartmann, p. 112, pl. 1, figs. 1–7, 9.
1981 *Cytherelloidea* cf. *keiji* McKenzie, Hartmann, p. 98, pl. 1, figs. 1–3.
1981 *Keijcyoidea keiji* (McKenzie), Malz, p. 16.
1989 *Keijcyoidea keiji* (McKenzie), Howe and McKenzie, p. 4.

Remarks: This is the most frequently recorded species of *Keijcyoidea*, its distribution ranging from the southwestern Pacific (Malz, 1981) to northwestern Australia (Hartmann, 1978) and southern Australia (Hartmann 1979, 1980). There is pronounced sexual dimorphism in this species – a characteristic, indeed, of most cytherellids – and its surface punctation is more complete *vis à vis K. sudaustralis.*

Material Studied: Three growth stages, comprising 2 adult female carapaces and 68 valves (44 adult, 24 juvenile) representing both sexes [KG]; 3 juvenile valves [GL]. Carapace length is 0.68–0.79 mm; the height is 0.37–0.47 mm.

Occurrence and Age: This species occurs in both the samples on which our paper is based, i.e. both at Kingston beach, South Australia and at Goose Lagoon Drain, Victoria. Thus, it is one of many taxa we record that range Pleistocene-Recent.

Family BAIRDIIDAE Sars, 1888

Genus NEONESIDEA Maddocks, 1969

Neonesidea guildertonensis Hartmann, 1978

Plate 1, Fig. 8.

1978 *Neonesidea guildertonensis* n.sp. Hartmann, p. 70, figs. 38–46, pl. 2, figs. 1, 2.
1979 *Neonesidea guildertonensis* Hartmann, Hartmann, p. 221, pl. 2, figs. 1–3.
1980 *Neonesidea guildertonensis* Hartmann, Hartmann, p. 114, fig. 6, pl. 2, figs. 11, 15–16.

Remarks: Many Neogene-Recent bairdiids of southern Australia possess the anterior and posterior terminal hinge "dentition" that would justify a placement in *Bairdoppilata* Coryell, Sample and Jennings, 1935. While the shell of this taxon strongly resembles most typical *Bairdoppilata* species no such hinge "dentition" occurs making the reference to *Neonesidea* mandatory. *Neonesidea* itself is due for reappraisal which is based on the general agreement among ostracodologists that *Nesidea* Costa, 1849 cannot be determined in terms of its type species since the types are lost and Costa's illustrations are thought to be inadequate to indicate a specific bairdiid affinity. It seems to us, however, that Costa's illustrations cannot indicate any other Ostracoda than bairdiids especially the figure which includes the strongly chitinised mandible coxae while his illustration of the shell is clearly bairdiid. An attempt in 1963 to collect a bairdiid resembling Costa's illustration from his type locality (the volcanic islet of Nesidea in the Bay of Naples near Pozzuoli) was unsuccessful although a large group of ostracodologists did the collecting. Nevertheless, Costa's illustration of the shell is not unlike those of Müller for his species *Nesidea mediterranea, minor* and *frequens* (Müller 1894, pl. 14, figs. 1–4, 12) or even *Nesidea longevaginata* (Müller, 1894, pl. 14, figs. 6, 7). Clearly, the issue requires to be resolved by the ICZN because the 1963 discussion of the validity of *Nesidea* at the Naples meeting means that it cannot be considered a *nomen oblitum.* The length is about 0.95 mm; the height is about 0.60 mm.

Material Studied: Three growth stages, comprising 5 carapaces (1 adult female, 4 juvenile) and 94 valves (males, females, juveniles) [GL]; 1 juvenile carapace 86 valves (males, females, juveniles) [KG].

Occurrence and Age: Goose Lagoon Drain, Stage 5e Pleistocene (110,000-130,000 B.P.); Kingston Beach, Recent.

Neonesidea sp.

Description: Shell large, bairdiid shape; surface patch pattern consists of a large median patch and small anterior and posterior patches on each valve. Dorsum straight, sloping backwards; ventral margin inflexed medially; anterior broadly rounded; posterior caudate. Subelliptical in dorsal view.

Internally, inner lamella broad, with large anterior and posterior vestibules and numerous marginal pore canals; normal pore canals simple, rimmed; hinge adont, without any terminal dentitions; muscle scars arranged in a rosette of 8 main scars, with small scars in front and above.

Sexual dimorphism present. Males smaller and relatively less high than females.

Measurements: The length ranges from 0.95–1.05 mm; the height ranges from 0.55–0.63 mm.

Remarks: Unlike any previously described Australian *Neonesidea* in its patch pattern and muscle scar arrangement (the rosette pattern).

Material Studied: 3 RV all mature; 2 female, 1 male.

Occurrence and Age: Kingston Beach; Recent.

Genus PARANESIDEA Maddocks, 1969

Paranesidea norrisi n.sp.

Plate 1, Fig. 9; Plate 3, Fig. 5

Holotype: The specimen PAMAu 164, figured in Plate 1, Fig. 9 from Kingston Beach.

Derivatio Nominis: For Mr. Clarence Norris of Junee, New South Wales, who contracted to transport our party on the "Shallow Tethys 2" Tertiary field trip.

Diagnosis: A species of *Paranesidea* characterised by a distinctively flexuous outline and relatively finer surface punctation than most other species in the genus.

Description: The shape of this taxon is characterised by a strongly convex dorsum that falls away rapidly to the front and rear, a broadly rounded anterior margin, subacuminate posterior and a ventral outline which is inflexed just anteromedially. The dorsal outline becomes weakly concave immediately before it reflexes to form the ventral margin (both anteriorly and posteriorly). The LV overlaps the RV dorsally, but this overlap is not as marked as in *N. guildertonensis* which is characterised by very strong LV/RV asymmetry.

The surface of the carapace is ornamented throughout by fine punctation or pitting.

The hinge is adont and the adductor muscle scars form a typical bairdiid rosette. Inner lamellae are moderately broad and traversed by numerous long marginal pore canals. Normal pore canals are scattered, simple and rimmed.

Sexual dimorphism is distinct. Females are much higher with respect to their length than males.

Measurements: The length of the carapace ranges from 0.95–1.05 mm; the height ranges from 0.55–0.63 mm.

Remarks: One other similar *Paranesidea* has been described from southern Australia – *P. posidonicola* Hartmann, 1979 from Point Peron (near Perth) and Frenchmans Bay in Western Australia. Unfortunately, only a female shell was illustrated by Hartmann (*cit.*, figs. 8, 9; pl. 2, figs. 4–10). Notwithstanding this, *P. posidonicola* is clearly higher than *P. norrisi* and also differs in internal and outline detail at the anterior and posterior marginal reflexures – see particularly pl. 2, figs. 6, 8 of Hartmann (1979). On the other hand, *Paranesidea fracticorallicola* Maddocks, 1969 which Hartmann (1981, pl. 1, figs. 6–9) recorded from Heron Island is much more coarsely pitted than our species.

Material Studied: Three growth stages; comprising 4 valves (2 adult, 2 juvenile) both sexes.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Paranesidea parva Hartmann, 1978

1978 *Paranesidea parva* n.sp., Hartmann, p. 72, figs. 57–65, pl. 2, figs. 8–10.

Remarks: Distinctive by the relatively small size of mature individuals. Our specimens (length about 0.65–0.70 mm) are similar in size to the types (length 0.68 mm).

Material Studied: 3 mature valves; 1 RV (GL), 1 RV, 1 LV (KG).

Occurrence and Age: Goose Lagoon Drain and Kingston Beach; Pleistocene-Recent.

Genus PAPILLATABAIRDIA Bentley, 1981

Papillatabairdia elongata sp.nov.

Plate 1, Fig. 10

Holotype: The specimen PAMAu 108, figured in Plate 1, Fig. 10 from Goose Lagoon Drain.

Derivatio Nominis: Elongata (L.) = elongate.

Diagnosis: A species of *Papillatabairdia* which is more elongate than the type-species and not dentate ventrally.

Description: Shape almost lozenge-like, elongate subrectangular; dorsal margin weakly convex falling away abruptly at the rear and gently to the front, anterior broadly and evenly rounded, posterior broadly rounded in the ventral part, venter nearly straight but weakly inflexed medially. In dorsal view, subelliptical.

The surface ornament comprises small rounded and flattened papillae which densely cover both valves. There is no ventral denticulation.

The hinge is adont; muscle scars form a typical bairdiid rosette, normal pore canals are scattered, simple and rimmed.

Sexual dimorphism is not as well defined as in most bairdiids. Nevertheless, as is usual, females are relatively higher than males.

Measurements: The length of the carapace is 0.68 mm; the height is 0.33 mm.

Remarks: The type-species of *Papillatabairdia* is *P. dentata* Bentley, 1981 which was described living from around Sydney, New South Wales; and has also been recorded by Hartmann (1978, p. 73, pl. 2, figs. 1–16) from Port Hedland, northwest Western Australia and by Hartmann (1981, p. 100, pl. 1, figs. 12, 14) from Heron Island, Queensland; both records as *Bythocypris* spec. Most recently, Howe and McKenzie (1989, p. 6) recorded the species, with a cf. qualification from Port Hedland. Our species is clearly more elongate than *P. dentata*, otherwise it seems closely related and probably represents the ancestral lineage of the Recent species.

Material Studied: 3 growth stages. 1 adult female carapace, 2 juvenile RV.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Genus *Bythocypris* Brady, 1880

Bythocypris sp.

Plate 1, Figs. 11a, b

Remarks: A single carapace was obtained from the Kingston boatlanding during the collecting trip in January 1989. – The two valves are illustrated here.

Family MACROCYPRIDIDAE Müller, 1912

Genus MACROCYPRINA Triebel, 1960

Macrocyprina sp.

Plate 1, Fig. 12.

Remarks: The genus *Macrocyprina* is ornamented typically by three large purplish or brownish patches on its rather elongate valves. Environmentally, it tends to indicate inshore or offshore continental shelves. Our specimen which seems close to *Macrocyprina maculata* (Brady, 1866) (cf. Brady, 1880, p. 44, pl. 1, figs 2a–d) probably lived near the shore among *Posidonia* stocks in shallow water from where it was dislodged during stormy weather and washed onto the beach swash-mark where it was collected. The length is 1.11 mm; the height is 0.40 mm.

Material Studied: A single adult carapace, probably a male.

Occurrence and Age: Kingston beach; Recent.

Family PARACYPRIDIDAE Sars,

Genus PARACYPRIS Sars,

Paracypris bradyi McKenzie, 1967

Plate 2, Fig. 1

1967 *Paracypris bradyi* n.sp., McKenzie, p. 64, 65; Fig. 2d.
1974 *Paracypris bradyi* McKenzie, p. 166.

Remarks: This species has been rarely recorded since its original description, yet in our experience it is not uncommon along the southern Australian coastline (McKenzie unpublished). The length of our specimens ranges from 0.79–0.84 mm; the height ranges from 0.32–0.34 mm.

Material Studied: 3 mature female valves (1 LV, 2 RV).

Occurrence and Age: Kingston Beach; Recent.

Family PONTOCYPRIDIDAE Müller, 1894

Genus PROPONTOCYPRIS Sylvester Bradley, 1947

Propontocypris sp.

Plate 2, Fig. 2.

Remarks: We cannot refer our specimen to any of the several *Propontocypris* species described from southern Australia by Hartmann (1979, 1980). Unlike *P. cedunaensis* Hartmann, 1980 the maximal height of this LV is medial – it is clearly anteromedial in Hartmann's taxon (Hartmann, 1980, fig. 187); and the other Hartmann species, *P. argilloecoidea* and *P. albaniensis*, have quite different lateral outlines (Hartman, 1979, figs. 223, 224; 231, 232). The length of our specimen is 0.72 mm; the height is 0.38 mm.

Material Studied: A single adult LV, possibly a female.

Occurrence and Age: Kingston beach; Recent.

Genus AUSTRALOECIA McKenzie, 1967

Australoecia victoriensis McKenzie, 1967

Plate 2, Fig. 6.

1967 *Australoecia victoriensis* n.sp. McKenzie, p. 68.

Remarks: Although infrequently recorded, the genus *Australoecia,* which may be monotypic, is readily differentiated from *Maddocksella* McKenzie, 1981 which has a thicker shell, a pronounced LV overlap and strong sex dimorphism. *Australoecia* is characterised by a RV overlap and lacks well developed sex dimorphism. The length of our specimen is 0.61 mm; its height is 0.25 mm.

Material Studied: A single adult carapace, possibly a male.

Occurrence and Age: Kingston beach; Recent. The previous record is from Port Phillip Bay, near Melbourne, Victoria (McKenzie, 1967).

Genus MADDOCKSELLA McKenzie, 1981

Maddocksella mackenziei (Maddocks, 1969)

Plate 2, Figs. 3, 4.

1969 *Australoecia mckenziei* n.sp. Maddocks, p. 49, figs. 35 k-p.
1981 *Maddocksella mackenziei* Maddocks, McKenzie, p. 106.

Remarks: The original description by Maddocks (1969) was based on material from South Australia. Our specimens are clearly conspecific and show well defined sexual dimorphism with males more elongate than females. The length ranges from 0.77–0.90 mm; the height ranges from 0.38–0.48 mm.

Material Studied: 1 adult female LV, 1 juvenile carapace, 4 juvenile valves [GL]; and three growth stages, comprising 1 adult male carapace and 13 valves (4 adult females, the rest juvenile) [KG].

Occurrence and Age: Goose Lagoon Drain and Kingston beach; Pleistocene-Recent.

Family CYPRIDIDAE Baird, 1850

Genus HETEROCYPRIS Claus, 1893

Heterocypris sp.

Remarks: The importance of this record lies in its indication of some freshwater influence near the collection locality. Unfortunately, we have not yet found a RV which would fix the generic determination more satisfactorily, since in *Heterocypris* the RV is denticulate ventrally. The length is 1.28 mm; the height is 0.75 mm.

Material Studied: A single adult female LV damaged anteroventrally.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Genus CANDONOCYPRIS Sars, 1894

Candonocypris sp.

Plate 2, Fig. 5.

Remarks: Out specimens seem close to *Candonocypris candonoides* (King, 1855). Like the previous record, they indicate some freshwater influence near the collection locality. The length is 0.88 mm; the height is 0.43 mm.

Material Studied: A single adult LV, possibly female, plus 2 juvenile LV.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Family CYTHERIDAE Baird, 1850

Genus LOXOCYTHERE Hornibrook, 1952

Loxocythere postventrobullata sp.nov.

Plate 2, Fig. 7.

Holotype: The specimen PAMAu 116, figured in Plate 2, Fig. 7, from Goose Lagoon Drain.

Derivatio Nominis: Postventro (L.) = posteroventral; bullata (L.) = swollen; for the diagnostic characteristic of this species.

Diagnosis: A species of *Loxocythere* characterised by a more swollen posteroventral part of each valve than occurs in other species.

Description: Shell subquadrate and with a distinct medial posterior cauda. Anterior broadly rounded and slightly higher than the posterior, dorsum and venter both virtually straight. Posteroventer swollen in both valves.

The surface is ornamented by a lightly raised

reticulation which runs parallel to the margin especially anteriorly and ventrally. Within each reticule the surface is finely punctate.

The hinge is merodont with small crenulate terminal teeth in the RV separated by an elongate smooth furrow, with the LV complementary. Normal pore canals are scattered and sieve type; marginal pore canals are few and straight. The central muscle scar group consists of four subvertical adductors plus a large indistinctly and broadly V-shaped frontal scar and two small mandibular scars.

Sexual dimorphism is weakly expressed. Females are relatively higher with respect to their length than males.

Measurements: The length of the carapace (holotype) is 0.51 mm; the height is 0.29 mm.

Remarks: The species which seem closest to our taxon are *Microcytherura difficilis* McKenzie, 1978 and *Microcytherura (Loxocythere) aesturicola* Hartmann, 1980. However, neither of these possesses the posteroventral swelling in each valve that characterises our species.

The soft parts of *Microcytherura* and *Loxocythere* are so close that Hartmann cogently regards the latter as a subgenus of the former. Our preference for *Loxocythere* is biassed by the fact that its overall shape and ornament are typical of Australian and New Zealand forms. In European species of *Microcytherura*, the shape typically is more elongate and the ornament less strongly developed.

Material Studied: Adult male LV, and juvenile female LV.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Family BYTHOCYTHERIDAE Sars, 1926

Genus CYTHERALISON Hornibrook, 1952

Cytheralison anserlagunae sp.nov.

Plate 2, fig. 8.

1979 Cytheride spec. Mandurah 6 Hartmann, p. 226, pl. 2, figs. 18, 19.

Holotype: The specimen PAMAu 118, figured in Plate 2, Fig. 8, from Goose Lagoon Drain.

Derivatio Nominis: Anser (L.) = a goose; laguna (L.) = lagoon. For the collection locality.

Diagnosis: A species of *Cytheralison* which lacks the elongate muscle scar pit that characterises other described Cainozoic species.

Description: A species of *Cytheralison* characterised by a subrectangular carapace with broadly rounded anterior and posterior, a straight dorsal margin and a weakly inflexed ventral margin. A small anterodorsal node may indicate a weak eye.

The ornament consists of deep reticulate pits over the entire surface of each valve.The pattern of reticulation runs parallel to the outline near the anterior, ventral and posterior margins. There is no elongate muscle scar pit and not much of a cauda.

The hinge comprises lobate, toothlike terminal elements separated by a long, smooth median furrow in the RV and a complementary arrangement in the LV. Marginal pore canals are relatively numerous and straight; normal pore canals are scattered, simple and rimmed. The central adductor muscle scar group consists of five scars in a subvertical arrangement that is characteristic for the genus (see McKenzie, 1974, pl. 4, fig. 14).

Sexual dimorphism not confirmed in our material.

Measurements: The length of the carapace ranges from 0.72–0.74 mm; the height ranges from 0.40–0.42 mm.

Remarks: This species has several striking features that separate it from such well known Recent *Cytheralison* species as *C. fava* and *C. pravacauda* (Hornibrook, 1952). Most obviously, it lacks any muscle-scar pit in the surface ornament. Secondly, there is almost no posteromedial cauda; and, thirdly, the small anterodorsal node may indicate the occurrence of a weakly developed eye, whereas all known Recent taxa are blind. It seems to be identical with Cytheride spec. of Hartmann (1979) which he collected between Mandurah and Margaret River in southwest Western Australia.

Material Studied: Three growth stages, including 3 juvenile carapaces and 19 valves (adults plus juveniles), possibly representing both sexes.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Cytheralison cf. *pravacauda* Hornibrook, 1952

Plate 2, Figs. 9, 10

1952 *Cytheralison pravacauda* n.sp. Hornibrook, p. 66, figs. 285, 286, 288.
1974 *Cytheralison* sp. McKenzie, pl. 4, figs. 13, 14.

Remarks: Our material is somewhat abraded and also more heavily calcified than Hornibrook's species as illustrated by him (reference in the synonymy cited above). We regard the heavy calcification of the shell as a rhopic factor effect (McKenzie, 1986) and the abrasion as due to an offshore habitat from which these specimens have been washed ashore *post mortem* following stormy weather. The species characters of a deep elongate muscle scar pit and a more or less concentric ornament of pits and reticular muri are well displayed. Length ranges from 0.71–0.75 mm; height ranges from 0.34–0.41 mm.

Material Studied: Three growth stages; comprising 26 valves (19 adult, 7 juvenile), possibly representing both sexes.

Occurrence and Age: Kingston beach swash mark; Recent.

Genus NEALOCYTHERE Schornikov, 1982

Nealocythere sp.

Plate 2, fig. 11

Remarks: Like the previous species this taxon is probably allochthonous. Although several Recent *Baltraella* species have been described from the Indopacific (Keij, 1979), none of them have the same outline as our specimen. However, the taxon presently under study by Yassini (personal communication May 1988) seems identical. His material comes from Twofold Bay and Bass Strait.

Material Studied: A single adult LV, possibly a female. The length is 0.62 mm; the height is 0.27 mm.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Family LEPTOCYTHERIDAE Hanai, 1957

Genus CALLISTOCYTHERE Ruggieri, 1953

Callistocythere purii McKenzie, 1967

Plate 2, Fig. 12

1967 *Callistocythere purii* n.sp. McKenzie, p. 81, pl. 12, fig. 2, text.fig. 31.
1980 *Callistocythere purii* McKenzie, Hartmann, p. 124, pl. 7, figs. 3, 6.

Remarks: A relatively common southeastern Australian species, apparently restricted to the region between Port Augusta, South Australia (Hartmann 1980) and Port Phillip Bay, Victoria (McKenzie 1967). Our single abraded LV has a length of 0.53 mm and a height of 0.28 mm.

Material Studied: A mature female LV.

Occurrence and Age: Kingston Beach; Recent.

Callistocythere dorsotuberculata Hartmann, 1979

Plate 2 Fig. 13

1979 *Callistocythere dorsotuberculata* n.sp. Hartmann, p. 227, textfigs. 27–30, pl. 3, figs. 9–15.
1980 *Callistocythere dorsotuberculata* Hartmann, Hartmann, p. 124, textfigs. 39–45, pl. 6, figs. 1–17.
1981 *Callistocythere dorsotuberculata* Hartmann, Hartmann, p. 102, pl. 3, fig. 4.
1989 *Callistocythere dorsotuberculata* Hartmann, Howe and McKenzie, p. 28.

Remarks: This very distinctive species is now known over the coastline of southern and southeastern Australia from Port Augusta, South Australia to the Clarence River, northern New South Wales; and, most recently, from Port Hedland in northwest Western Australia. It seems likely that future work will establish it as one of a small group of known pan-Australian species. The Pleistocene specimens differ in small details (size of the frontal node, for example) but seem clearly conspecific. Hartmann's (1979, 1980) figures show that there is considerable polyphenism in the ornament.

Material Studied: Two growth stages; comprising 31 carapaces of both sexes, mostly adult [GL]; 1 male carapace, 1 female LV, both adult [KG]. The length ranges from 0.43–0.45 mm; the height ranges from 0.24–0.29 mm.

Occurrence and Age: Goose Lagoon Drain, Pleistocene Stage 5e; Kingston Beach, Recent.

Callistocythere sherwoodi sp.nov.

Plate 2, Figs. 14, 15

Holotype: the specimen PAMAu 123, figured in Plate 2, Fig. 14, from Goose Lagoon Drain, a female specimen.

Derivatio Nominis: For Dr. John Sherwood, Warrnambool Institute of Advanced Education, Warrnambool, Victoria, who helped collect the Goose Lagoon Drain sample.

Diagnosis: A *Callistocythere* characterised by strong sexual dimorphism and a pattern of yoked ridges anteriorly that is unlike that in other species of this highly diverse genus.

Description: Carapace subrectangular with nearly straight to very weakly convex dorsal margin, straight ventral margin, broadly rounded anterior and truncated posterior.

Surface ornament typical for the genus, comprising relatively broad anastomosing ridges and intervening smooth depressions. This species has a characteristic pattern of yoked anterior ridges and a transverse posteromarginal ridge. The intervening pattern is somewhat variable, but includes well developed nodes in the anteromediodorsal and posterodorsal regions.

LV hinge consists of a large anterior knob-like tooth followed by several tooth-like crenulations then a crenulate median furrow and finally an elongate crenulate posterior element; the RV is complementary. Medial muscle scars of typical cytheracean type, i.e. four subvertical adductors, a broadly V- or U-shaped frontal scar and two small mandibular scars.

Sex dimorphism striking; males are distinctly smaller than females and have a different medial surface ornament although other features of the ornament, as indicated above, are common also to females.

Measurements: The length of the carapace ranges from 0.45–0.47 mm; the height ranges from 0.25–0.26 mm.

Remarks: In spite of numerous species descriptions by authors (McKenzie 1967, Hartmann 1978, 1979, Howe and McKenzie, 1989) the diversity of *Callistocythere* still provides a fertile field for more taxonomic work. This new species seems to belong to the same group as *C. purii* McKenzie, 1967 described from Port Phillip Bay, Victoria (McKenzie, 1967, p. 81, pl. 12, fig. 2, textfig. 3).

Material Studied: Two growth stages; comprising 39 mostly adult carapaces of both sexes and 6 valves (5 adult, 1 juvenile) of both sexes.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Family PECTOCYTHERIDAE Hanai, 1957

Genus MORKHOVENIA Teeter, 1975

Morkhovenia hingstoni sp.nov.

Plate 3, Fig. 1.

Holotype: The specimen PAMAu 125, figured in Plate 3, Fig. 1, from Goose Lagoon Drain.

Derivatio Nominis: For Mr John Hingston, Acting-Principal Christian Brothers High School, Warrmambool, Victoria who assisted in guiding the "Shallow Tethys 2" field party around the Warrnambool district.

Diagnosis: A *Morkhovenia* characterised by two prominent and heavily calcified posteroventral nodes on each valve.

Description: Shell small; subrectangular in lateral view and subhastate in dorsal view. Dorsum gently convex, venter slightly indented medially, anterior broadly rounded and posterior subtruncate.

The ornament consists of the usual *Morkhovenia* reticulate pattern, with more or less deep pits within the reticular muri, plus two well calcified posteroventral nodes and an elongate but small medial muscle scar pit.

The hinge is pentodont. Internal lamellae are moderately broad with few straight marginal canals and large anterior vestibules. Medial muscle scars are of cytheracean type.

Sexual dimorphism present with females relatively higher with respect to their length than males.

Measurements: The length of the carapace ranges from 0.39–0.42 mm; the height is around 0.25 mm; the breadth is 0.21 mm.

Remarks: The taxon described by Hartmann (1980, p. 123, pl. 3, figs. 14–17) as *Pectocythere* spec. Ceduna 120 is a typical *Morkhovenia* and, likely, is descended from our Pleistocene species. Hartmann (1981, p. 120, textfigs. 58–61b, pl. 10, figs. 1–6) later assigned this form to *Morkhovenia* cf. *inconspicua* (Brady, 1880). We do not propose to discuss these assignments other than to stress the diagnostic features of our species (noted above) which enable it to be differentiated readily from the Recent southern Australian forms.

Material Studied: All adults; 5 carapaces (4 female, 1 male), 2 female RV.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Genus MACKENZIEARTIA Bentley, 1988

Mackenzieartia portjacksonensis (McKenzie, 1967)

Plate 3, Fig. 2

1967 *'Hemicytheridea' portjacksonensis* n.sp. McKenzie, p. 85, textfig. 3 i-j, pl. 12, fig. 6.
1978 *Pectocythere?* cf. *portjacksonensis* (McKenzie), Hartmann, p. 143, textfigs. 605–618, pl. 14, figs. 4–11, 14.
1979 *Pectocythere? portjacksonensis* (McKenzie), Hartmann, p. 266, pl. 13, figs. 4, 5.
1980 *Pectocythere portjacksonensis* (McKenzie), Hartmann, p. 122, pl. 5, fig. 17.
1988 *Mackenzieartia portjacksonensis* (McKenzie), Bentley, p. 445, pl. 1, figs. e, f, text-fig. 4a, b.

Remarks: Like *Morkhovenia*, which it otherwise scarcely resembles (refer to our illustrations of *M. hingstoni* above), *Mackenzieartia* has a definite muscle scar pit which is a characteristic generic feature separating it from *Tanella* Kingma, 1948 some species of which also have a reticulate ornament – but of a type distinct from that of *Mackenzieartia*. (Compare Hartmann, 1980, pl. 5, fig. 17 with pl. 7, figs. 11–15). The length is 0.50 mm; the height is 0.24 mm.

Material Studied: 3 adult LV (2 male, 1 female).

Occurrence and Age: Kingston beach swash mark; Recent.

Family EUCYTHERIDAE Puri, 1954

Genus ROTUNDRACYTHERE Mandelshtam, 1958

Rotundracythere sp. 1

Remarks: Unlike any previously described Quaternary eucytherid species (cf. Hornibrook 1952). Our specimen has a length of 0.46 mm; and a height of 0.28 mm.

Material Studied: A mature female LV.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Rotundracythere sp. 2

Plate 3, Figs. 4, 5

Remarks: This rare species was obtained from the swash-mark at the Kingston boat-landing on January 14th, 1989. It is noteworthy that the shell contains many mycelian solution tracks, a common occurrence in the Kingston environment.

Material Studied: Two valves of the same individual.

Occurrence and Age: Kingston; Recent.

Family OSTICYTHERIDAE Hartmann, 1980

Genus OSTICYTHERE Hartmann, 1980

Osticythere reticulata Hartmann, 1980

Plate 3, Figs. 6, 7

Remarks: Hartmann (1980, p. 119) erected the genus *Osticythere* for a species occurring preferentially in an estuarine environment. The material referred here was obtained from near Woods Well in the Coorong, the long lagoon stretching along the Younghusband Peninsula in South Australia; this environment is lagoonal with normal to elevated salinities. Hartmann (*op. cit.*) supported the erection of a monotypic genus and family by reference to the special nature of the lateral pores.

Material Studied: One right valve, a male adult and one adult female right valve.

Occurrence and Age: Woods Well, The Coorong; Recent.

Family CYTHEROMATIDAE Elofson, 1939

Genus PARACYTHEROMA Juday, 1907

Paracytheroma generodubia sp.nov.

Plate 3, fig. 8.

Holotype: The specimen PAMAu 127, figured in Plate 3, Fig. 8, from Goose Lagoon Drain.

Derivatio Nominis: Generis (L., infinitive) = of the genus, dubia (L.) = doubt; because we are not wholly certain that our generic assignment is correct.

Diagnosis: A *Paracytheroma* characterised by a distinctive ventral outline; deeply indented medially and backswept posteriorly.

Description: Shell with a nearly straight dorsal margin, and broadly rounded anterior. The poster-

ior is much less high than the anterior because the ventral margin, which is also deeply indented medially, sweeps back posteriorly.

Surface ornament mostly smooth. There are scattered large shallow pits over the medial region, smaller more closely set pits along the anterior margin and some large posteroventral indentations set inwards from the margin so that the marginal zone itself is flat posteroventrally.

Hinge a modified lophodont type. RV with anterior antislip lobe, medial groove and posterior lobe; LV complementary. Inner lamellae broad with large anterior and posterior vestibules and rather numerous short marginal pore canals. Normal pore canals are scattered, large and sieve type. The central muscle scars are typically cytheracean.

Sexual dimorphism is weak; males are relatively more elongate.

Measurements: The length of the carapace ranges from 0.36–0.37 mm; the height is 0.18 mm.

Remarks: Cytheromatid species are often difficult to assign to genus because the diagnostic feature which differentiates *Cytheroma* Müller, 1894 from *Paracytheroma* is a well defined 'Genitalhöcker' in the female soft anatomy (Elofson, 1939). In general, however, *Paracytheroma* tends more towards a bean-like shape, as occurs in our taxon, whereas typical *Cytheroma* are elongate subtriangular, as in the type species *C. variabilis* Müller (1894, p. 350, pl. 26, figs. 5, 9–15). Most Australian cytheromatids belong in *Paracytheroma.*

Material Studied: Three adult carapaces (2 female, 1 male).

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Family LEPTOCYTHERIDAE Hanai, 1957

Genus LEPTOCYTHERE Sars, 1928

Leptocythere lacustris De Deckker, 1981

Plate 3, Figs. 9, a–b; 10

Remarks: This seems to be a eurytopic species and in the present material it occurs in an association indicative of normal salinity in The Coorong (for example, presence of drilling gastropods). There are also features in common with *Leptocythere hartmanni* McKenzie, as figured by Hartmann (1978, 1979, 1980 and 1981). The closest agreement lies, however, with *L. lacustris* (cf. De Deckker, 1981, pp, 129–132, figs. 24, 25).

Material Studied: Several right and left valves.

Occurrence and Age: Near Woods Well, The Coordong; Recent.

Family CYTHERIDEIDAE Sars, 1925

Subfamily CYTHERIDEINAE Sars, 1925

Genus CYPRIDEIS Jones, 1857

Cyprideis australiensis Hartmann, 1978

Plate 3, Figs. 11–13; Plate 8, Figs. 2–4

Remarks: This species was originally recorded by Hartmann (1978, p. 85) from estuarine localities in northwestern Australia. It was also briefly noted as occurring in more southerly Australian waters. Living individuals were collected in the Chapman River estuary by Hartmann at a salinity of around 7‰ at 20.8°C and pH = 8. The water in which specimens were obtained from the Greenough River had a salinity of 32.1‰. It is possible that the material we obtained from The Coorong has a past history and could be displaced.Against this opinion, however, speaks the fact that one of our specimens bears a naticid drill-hole – naticids can certainly hunt in the intertidal zone, but they must relate, to a normal marine salinity. *C. australiensis* has fine pore-meshes, occurring often in pairs (Fig. 3). There is also a rather strange kind of calcification in the ornamental pits (Fig. 4) which, however was also observed in other species in out collections. Naticid rasp-marks on the drilled specimen are shown in Fig. 2.

Material Studied: 20 adult valves and carapaces, 10 juvenile shells.

Occurrence and Age: Near Woods Well, The Coorong; Recent.

Family CYTHERURIDAE Müller, 1894

Genus SEMICYTHERURA Wagner, 1957

Semicytherura cryptifera (Brady, 1880)

Plate 4, Fig. 1

1880 *Cytherura cryptifera* n.sp. Brady, p. 134, pl. 32, figs. 4 a–c.

1967 *Semicytherura cryptifera* Brady, McKenzie, p. 73, textfig. 3 e, pl. 11, fig. 4.
1978 *Semicytherura* cf. *cryptifera* Brady, Hartmann, p. 111, textfigs. 306–308, pl. 11, figs. 4–6.
1979 *Semicytherura cryptifera* Brady, Hartmann, p. 243, pl. 9, figs. 3–6.
1980 *Semicytherura cryptifera* Brady, Hartmann, p. 141, pl. 12, figs. 4–6.
1989 *Semicytherura* cf. *cryptifera* Brady, Howe and McKenzie, p. 47.

Remarks: Hartmann (cf. synonymy) has already pointed out that this is the most commonly encountered Australian species of *Semicytherura*. It is sufficiently distinctive so that identification is easy although several morphotypes are known. The length ranges from 0.45–0.50 mm; the height ranges from 0.24–0.26 mm.

Material Studied: Two growth stages; comprising 7 valves (5 adult, 2 juvenile) including 3 female LV, 1 female RV, 1 male RV, 2 male juveniles (1 RV, 1 LV).

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Semicytherura sp.

Plate 3, fig. 14

Remarks: This relatively unornamented taxon is unlike any previously described Australian species of the genus, although its general shape resembles that of *Semicytherura insulakangarooensis* Hartmann, 1980. Our single specimen has a length of 0.37 mm; and a height of 0.20 mm.

Material studied: Single A-1 female RV

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Genus HEMICYTHERURA Elofson, 1941

Hemicytherura austropytta sp.nov.

Plate 4, Fig. 2.

1981 *Hemicytherura* spec. Batemans Bay 158 Hartmann, p. 121, pl. 10, figs. 9, 10.

Holotype: The specimen PAMAu 130, figured in Plate 4, Fig. 2, from Goose Lagoon Drain, a female?

Derivatio Nominis: Auster (L.) = south, pytta (Anglo-Saxon) = a pit; from the generally pitted surface ornament and its Australian habitat.

Diagnosis: An Australian *Hemicytherura* characterised by the overall surface pitting of the carapace.

Description: Shell small, with a strongly convex dorsum, subacuminate and dentate anterior, gently convex venter and subcaudate posterior. Eye regions indistinct comprising a low anterodorsal ridge with reduced ornament on each valve.

Surface ornamented all over with large pits, except in the caudal region; dorsally the pitting is much finer and close set. There are also two prominent, short anteroventral ribs. The median part of each valve is slightly swollen and large pits are absent in the muscle scar region.

Hinge a merodont type comprising terminal crenulate tooth-like elements and a median groove, with the opposing valve complementary. Marginal pore canals grouped and flexuous anteriorly; and including two long flexuous posterior canals. Normal pore canals scattered, simple and rimmed. Muscle scars typically cytheracean.

Sexual dimorphism distinct. Females are relatively much higher than males.

Measurements: The length of the carapace is 0.27 mm; the height is 0.18 mm.

Remarks: The only taxon against which this distinctive species merits comparison is *Hemicytherura delicatula* Hornibrook, 1952 from New Zealand but its surface ornament is described as comprising a fine reticulate pattern with weak latitudinal ridges (Hornibrook, 1952, p. 60, pl. 1, figs. 213–216). The ornament of our species is much more strongly developed.

Some workers in describing *Hemicytherura* shells neglect to mention the eye ridges. Elofson (1941, p. 314) made it clear that two separated eye cups are always present in the living animals.

Material Studied: Two growth stages; comprising adult female RV and A-1 female carapace.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Hemicytherura bellezza sp.nov.

Plate 4, Fig. 3.

1979 *Hemicytherura* spec. (Eucla 1196) Hartmann, p. 245, pl. 10, fig. 19.

Holotype: The specimen PAMAu 129, figured in Plate 4, Fig. 3, from Goose Lagoon Drain.

Derivatio Nominis: Bellezza (Italian) = beauty; for the beautifully ornamented shell.

Diagnosis: A *Hemicytherura* with an unique surface ornament of coarse ridges, polygonal reticules and associated micropunctate or micropapillate areas.

Description: Shell small; dorsal marginal strongly convex in female less convex in male; anterior subacuminate but not dentate; posterior caudate; ventral margin weakly convex. Eye regions consist of an elongate ridge over a rounded area in each valve.

Ornament very beautiful and complex. It comprises a prominent latitudinal medial ridge off which several minor ridges proceed creating a number of areas which are further subdivided by stout muri into a distinctive pattern of reticules. Additionally, there are micropunctate areas in the anterior, anterodorsally and posteriorly; also some areas are micropapillate rather than micropunctate for example, posterodorsally and dorsomedially.

Hinge and other internal features as for the previously described species.

Sexual dimorphism marked. Males are not only much less high relatively than females; they also have more prominent anterodorsal eye regions (cf. Hartmann, 1979, pl. 10, fig. 19).

Measurements: The length of the carapace ranges from 0.33–0.37 mm; the height ranges from 0.20–0.24 mm.

Remarks: While many *Hemicytherura* species are beautifully ornamented, as becomes rapidly apparent when they are studied under the scanning electron microscope, the extravagant surface detail of *H. bellezza* makes it easily and instantly recognisable. Most other Australian and New Zealand *Hemicytherura* seem to be related more or less closely to the *H. cellulosa* (Norman, 1865), group (cf. McKenzie, 1967, p. 79).

Material Studied: 5 valves all adult; 2 RV, 1 LV (female) and 1 RV, 1 LV (male).

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Genus OCULUCYTHEROPTERON Bate, 1972

Oculocytheropteron sp.

Plate 4, figs. 4, a–b

Remarks: When Bate (1972) pointed out that many shallow water *Cytheropteron* species possess a small but usually recognisable eye tubercle or eye ridge he resolved the paradox that so many Cytheropteroninae occur on inshore shelves, although the *Cytheropteron* Sars, 1866 species worked on by classical authors were virtually diagnostic for deep water. But *Cytheropteron* is a blind genus and specialists are now aware, following the work of Benson (1975), that many such taxa lose their eyes at depths where the available light is insufficient for phototropic functions. Length of our specimen is 0.38 mm; the height is 0.21 mm.

Material Studied: Single adult carapace.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Family LOXOCONCHIDAE Sars, 1925

Genus LOXOCONCHA Sars, 1866

Loxoconcha australis Brady, 1880

Plate 4, Figs. 5–7

1880 *Loxoconcha australis* n.sp., Brady, p. 119, pl. 28, figs. 5 a–f, pl. 29, figs. 3 a–d.
1964 *Loxoconcha* sp. 1, McKenzie, pp. 448–452.
1967 *Loxoconcha australis* Brady, McKenzie, 1967, p. 86, textfigs. 3 n–o, 9 h–s, pl. 12, figs. 10, 11.
1979 *Loxoconcha* cf. *australis* Brady, Hartmann, p. 228.

Remarks: This distinctive species is probably pan-Australian. The subspecies *L. australis minor* Hartmann, 1979 is known from Point Peron, near Perth, Western Australia (Hartmann, 1979) all round the southern and eastern Australia coastline to Maryborough in Queensland (Hartmann, 1981). It is also known as a fossil from the Pleistocene near Lismore, New South Wales (McKenzie and Pickett, 1984).

The nominate species and subspecies has a characteristic valve asymmetry, with the LV higher anterodorsally than the RV, which is overlapped by the LV in this region.

Material Studied: Three growth stages; comprising 4 adult carapaces (2 female, 2 male), and 155 valves all but 4 adult (93 female, 62 male)[GL]; and 40 valves, including adults and juveniles of both sexes [KG]. The length ranges from 0.61–0.66 mm; the height ranges from 0.39–0.42 mm.

Occurrence and Age: Goose Lagoon Drain, Pleistocene Stage 5e; and Kingston beach swash-mark; Robe, Recent.

Loxoconcha trita McKenzie, 1967

Plate 4, Fig. 8

1967 *Loxoconcha trita* n.sp. McKenzie, p. 87, textfig. 3m, pl. 11, fig. 10.
1979 *Loxoconcha* cf. *trita* McKenzie *dunsboroughensis* subsp.nov. Hartmann, p. 239, textfigs. 70–72, pl. 8, figs. 5–7 (see Remarks below).
1980 *Loxoconcha* cf. *trita* McKenzie *dunsboroughensis* Hartmann, p. 138, pl. 10, figs. 5–9 [*nec dunsboroughensis*].
1984 *Loxoconcha trita* McKenzie, McKenzie and Pickett, p. 229, fig. 3x.

Remarks: In our opinion, Hartmann's (1979) subspecies *dunsboroughensis* is sufficiently distinctive at its type locality to be readily separated from *L. trita trita*; on the other hand, the taxon illustrated by Hartmann (1980) seems referable to the nominate subspecies rather than to *L. trita dunsboroughensis*. The length is about 0.48 mm; the height is about 0.26 mm.

Material Studied: All adult; 2 carapaces (1 female, 1 male) and 9 valves (7 female, 2 male).

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Family XESTOLEBRIDIDAE SARS, 1928

Genus XESTOLEBERIS Sars, 1866

Xestoleberis cf. *tigrina* (Brady, 1866)

Plate 4, Figs 9, 10; Plate 8, Figs. 5, 6

1866 *Cytherideis tigrina* n.sp. Brady, p. 369, pl. 58, figs. 5 a–d.
1967 *Xestoleberis tigrina* (Brady), McKenzie, p. 97, fig. 4 a, figs. 10 e–n.
1979 *Xestoleberis quasirotunda* n.sp. Hartmann, p. 253, textfigs. 134–141, pl. 12, fig. 5 (see *Remarks* below).

Remarks: The new species described by Hartmann (1979) as *X. quasirotunda* seems to resemble closely in its carapace, and in such features of the illustrated soft anatomy as can be compared, the taxon assigned to *X. tigrina* by McKenzie (1967). However McKenzie (cit.) did not illustrate nor describe the male hemipenis and since this is critical for species recognition in *Xestoleberis* – and most cytheraceans – *X. quasirotunda* may well be distinct, but convergent to *X. tigrina* in carapace features. The length ranges from 0.61–0.68 mm; the height ranges from 0.34–0.39 mm. The material referred here has two kinds of pores – sieves that lie flush with the surface (Plate 8, Fig. 5) and sieves provided with a thick rim (Plate 8, Fig. 6).

Material Studied: Three growth stages; comprising 16 carapaces and 41 valves [GL]; and 2 carapaces (adult, juvenile), 15 valves (10 adult, 5 juvenile) [KG], including numerous specimens of both sexes.

Occurrence and Age: Goose Lagoon Drain, Pleistocene Stage 5e; Kingston beach swash mark, Recent.

Xestoleberis portaugustensis Hartmann, 1980

1980 *Xestoleberis portaugustensis* n.sp., Hartmann, p. 152–153, figs. 126–130
1989 *Xestoleberis* cf. *portaugustensis* Hartmann, Howe and McKenzie, p. 18, fig. 10.

Remarks: This is a distinctive species, relatively higher with respect to its length than other Australian *Xestoleberis* and with a diagnostic subacuminate anteroventral region. Our specimen (length 0.47 mm; height 0.33 mm) is larger than the male types (length 0.37–0.39 mm; height 0.27 mm) but this is easily accounted for since it is a female.

Material Studied: A mature female RV.

Occurrence and Age: Kingston Beach; Recent.

Xestoleberis sp.

Plate 5, Fig. 3.

Remarks: Our specimen appears to be a male adult or possibly an A-1 carapace. It shows no similarity in shape or size to any previously described southern Australian species (McKenzie 1967, Hartmann 1979, 1980, 1981), but the limited material precludes description of a new taxon. The length is 0.36 mm; the height is 0.16 mm.

Material Studied: Single male carapace, possibly adult or A-1, plus 3 more juvenile specimens (2 carapaces, 1 LV).

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Xestoleberis cedunaensis Hartmann, 1980

Plate 5, Figs. 1, 2

Remarks: The characteristically shaped left valve of our material agrees closely with a figured female (Hartmann, 1980, pl 15, fig. 1) from Ceduna in South Australia. This species seems to occur in a

tidal flat environment in fine sand and shell débris with seaweed.

Material: Two valves.

Occurrence and Age: Kingston boat-landing; Recent.

Genus FOVEOLEBERIS Malz, 1980

Foveoleberis sp.

Plate 5, Fig. 4; Plate 8, Fig. 7

1958 *Uroleberis* sp. Triebel, p. 110, pl. 3, figs. 14 a–b.
1974 *Uroleberis* sp. Triebel, McKenzie, p. 163.

Remarks: *Foveoleberis* Malz, 1980 was established on the basis of its crenulate median hinge element versus a smooth median element in *Uroleberis* Triebel, 1958. Recent work, however, has indicated that the two taxa may merge into one another in which case *Uroleberis* is the senior synonym. Our specimen has the crenulate median hinge element of *Foveoleberis* s.s. but the smooth shell of a typical *Uroleberis*.

In Australia, the *Uroleberis/Foveoleberis* complex is known to range from the Late Eocene to the Recent (McKenzie, 1974, p. 163); the southern Australian taxa all being part of the smooth to finely punctate *U. minutissima* (Chapman, 1926) lineage. Northern Australian species, however, are related to *Foveoleberis foveolata* (Brady, 1880) which is deeply pitted over virtually its entire surface, except the cauda. Length of an A-1 valve is 0.53 mm; its height is 0.37 mm. Plate 8, Fig. 7 illustrates the pore-structure of *Foveoleberis* sp.

Material Studied: Three growth stages; comprising 12 valves (10 female, 2 male) of which 2 (both female RV) are A-1.

Occurrence and Age: Goose Lagoon Drain, Pleistocene Stage 5e.

Family HEMICYTHERIDAE Puri, 1953

Subfamily HEMICYTHERINAE Puri, 1953

Genus SERRATOCYTHERE Hartmann, 1979

Serratocythere australiensis Hartmann, 1979

Plate 5, Figs. 5–8

1964 *Hemicythere kerguelenensis* (Brady, 1880), McKenzie, p. 448 [*nec kerguelensis*].
1974 *'Hemicythere' kerguelenensis* (Brady, 1880), McKenzie, p. 159, pl. 1, figs. 9, 10. [nec *kerqulenensis*].
1979 *Procythereis (Serratocythere) australiensis* n.sp. Hartmann, p. 236, textfigs. 54–60, pl. 7, figs. 1–9.
1980 *Procythereis (Serratocythere) australiensis* Hartmann, Hartmann, p. 134.
1981 *Procythereis (Serratocythere) australiensis* Hartmann, Hartmann, p. 110, pl. 7, figs. 1, 2.

Remarks: Since Hartmann (1979) has established the distinctiveness of *Serratocythere* from the South American and South African species of *Procythereis (Procythereis)* we choose to upgrade *Serratocythere* to full generic rank. In our zoogeographical assessment, therefore, *Procythereis* is restricted to South America and South Africa whereas *Serratocythere* characterises the fauna of Kerguelen Island (Brady, 1880), Australia and New Zealand (synonymy above, plus Hartmann, 1982a). The length ranges from 0.89–0.95 mm; the height ranges from 0.37–0.42 mm. The pores are illustrated in Plate 5, Fig. 8.

Material Studied: Three growth stages; comprising 13 carapaces and 25 valves [GL], and 11 adult carapaces and 34 valves (28 adult, 6 juvenile) [KG] including many adult of both sexes.

Occurrence and Age: Goose Lagoon Drain, Pleistocene Stage 5e; Kingston beach swash mark, Recent. Aug. 1986 and Jan. 1989.

Genus MUTILUS Neviani, 1928

Mutilus pumila (Brady, 1866)

Plate 5, Figs. 9–11

1866 *Cythere pumila* n.sp. Brady, p. 378, pl. 60, figs. 7 a–d.
1967 *'Ambostracon' pumila* (Brady), McKenzie, p. 93, textfigs. 4 b, 5 i, pl. 12, fig. 8.
1974 *'Ambostracon' pumila* (Brady), McKenzie, p. 159.
1979 *Mutilus pumila* (Brady), Hartmann, p. 234, textfigs. 48–53, pl. 6, figs. 8–13.
1980 *Mutilus pumila* (Brady), Hartmann, p. 133, pl. 11, figs. 1–14.
1982 *Mutilus pumila* (Brady), Hartmann, p. 366, pl. 1.
1988 *Mutilus pumila* (Brady), Reyment, Bookstein, McKenzie and Majoran, p. 11.

Remarks: The phenotypic plasticity of the shell surface in this species has provoked review (Hartmann, 1982b) and tensor biometric analysis (Reyment *et al.*, 1988). The results suggest that temperature combined with geographic separation of the populations sampled were responsible for the observed variations.

Although mean temperatures during Pleistocene

Stage 5e were probably some 3–5°C higher than today along the southern Australian coastline they clearly were tolerable for *M. pumila*. The length ranges from 0.58–0.63 mm; the height ranges from 0.29–0.34 mm.

Material Studied: Two growth stages; comprising 43 adult carapaces (19 female, 24 male) and 37 valves (17 females, 17 males, 3 juveniles) [GL]; and 9 adult carapaces (6 female, 3 male) and 39 valves (2 juvenile, the rest adult) both sexes [KG].

Occurrence and Age: Goose Lagoon Drain, Pleistocene stage 5e; Kingston beach swash mark, Recent.

Subfamily ORIONINAE Puri, 1974

Genus CAUDITES Coryell and Fields, 1937

Caudites yambaensis Hartmann, 1981

Plate 6, Fig. 2.

1981 *Caudites yambaensis* n.sp., Hartmann, p. 112, text-figs: 34–36, pl. 7, figs. 14, 15.

Remarks: Our adult specimen seems identical with *C. yambaensis* particularly in the posteroventral indistinct rib ornament of the shell which serves to distinguish it from the closely-related *C. litusorienticola* Hartmann, 1981.

Since the type locality for *C. yambaensis* is the coastal town of Yamba in northern New South Wales, this record provides confirmation that sea temperatures along the southern Australian coast were warmer during Pleistocene Stage 5e (110,000–130,000 years ago). The length is 0.52 mm; the height is 0.28 mm.

Material Studied: Two growth stages; comprising 1 adult female carapace and a juvenile carapace.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Subfamily INCERTAE SEDIS

Genus NEOBUNTONIA Hartmann, 1981

Neobuntonia foveata sp.nov.

Plate 6, Fig. 1.

Holotype: The specimen PAMAu 143, figured in Plate 6, Fig. 1, from Goose Lagoon Drain.

Derivatio Nominis: Foveata (L.) = foveate, for the overall pitted surface of the valves.

Diagnosis: A species of *Neobuntonia* distinguished by its overall pitted surface.

Description: Shell relatively rotund in lateral view; dorsal margin nearly straight; anterior broadly rounded; posterior produced in a medial cauda; venter inflexed anteromedially; greatest height anteromedial. In dorsal view, swollen with the greatest breadth behind the middle. Eye tubercle large and distinct.

The surface ornament comprises large shallow pits or foveoles which cover virtually the entire valves (viewed laterally); and tend to parallel the margin anteriorly.

The hinge is powerful and holoamphidont. Inner lamellae are moderately broad and are traversed by about 20–25 marginal pore canals anteriorly, fewer posteriorly. Normal pore canals are scattered, simple and rimmed. The central muscle scars consist of 4 adductors in a subvertical series (the second from the top sometimes divided) and 2 frontal scards; mandibular scars probably present but not confirmed.

Sexual dimorphism (by analogy with Recent species of the genus) is distinct, males being larger and more elongate than females.

Measurements: The length of the carapace ranges from 0.61–0.63 mm; the height ranges from 0.37–0.42 mm.

Remarks: Hartmann (1981, pp. 114, 115) compares this genus with *Buntonia* Howe, 1935 basing his opinion on the species *Buntonia corpulenta* (Brady and Norman, 1889) as decribed by Elofson (1943). In the opinion of one of use (K.G.M.), Buntoniinae show more similarities to Cytherettidae Triebel. This opinion is based on the relatively broad antennules and antennae in Buntoniinae and Cytherettidae versus the more slender antennules and antennae in trachyleberidids and hemicytherids.

On shell-characters, *Neobuntonia* seems close to such genera as *Bosquetina* Keij, 1957, *Incongruellina* Ruggieri, 1958 and *Carinovalva* Sissingh, 1973. The oldest available family name which might accommodate plausibly such taxa is Brachycytheridae Puri, 1954, wherein, indeed, Keij (1957) placed *Bosquetina*.

The soft anatomy of *Bosquetina dentata* (Müller, 1894) is known in detail (Müller, 1894; McKenzie and Bonaduce unpublished). It is characterised by a six-jointed antennule; short and unequal flagella on the male and female antennae; a mandible epipod

with five Strahlen; 16 Strahlen on the maxillule epipod none of them downward pointing or otherwise aberrant; a thick proximodorsal bristle on the P1 protopodite but slender proximorsal bristles on the P2 and P3 protopodites; complexly chitinised protopodite distal joints. Compared with this, *Neobuntonia* has an indistinctly six-jointed antennule; well developed antennal flagella in both sexes; a mandible epipod with 4 Strahlen; and also has complexly chitinised knee joints on the walking legs.

The variation in size of the antennal flagella not only discriminates between *Bosquetina* and *Neobuntonia* but also suggests that *Neobuntonia* is neither a brachycytherid nor a trachyleberidid nor a thaerocytherid since in these families the antennal flagella (Spinnborsten) are characteristically short, with the male flagellum slightly longer than the female flagellum.

The antennal Spinnborsten and complexly chitinised knee joints on the walking legs are regarded by most workers as important characters at the family level and in these respects *Neobuntonia* seems an acceptable hemicytherid. It also has similar proximodorsal bristles on the P1–P3 protopodites. But we echo Hartmann's uncertainty as to its subfamilial placement, since the indistinctly six-segmented antennule separates it from other hemicytherid subfamilies, in which the antennule is distinctly five-segmented.

The strongly foveate shell may be taken as a confirmatory indication that temperatures during Stage 5e of the Pleistocene were warmer than today along the southern coast of Australia since in many groups of marine Ostracoda the more foveate or pitted species are associated with warmer regimes (compare *N. foveata* with the next described species).

Material Studied: 4 valves, all adult females (3 RV, 1 LV).

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Neobuntonia sudaustralis sp.nov.

Plate 6, Figs. 3, 4, 5; Plate 8, Figs. 8–10, 13, 14

1980 *Trachyleberis* (?) spec. (Exmouth 43 aff.) Hartmann, p. 133, pl. 9, fig. 12.

Holotype: The specimen PAMAu 144, figured in Plate 6, Fig. 4, from Kingston Beach, a left valve (male).

Derivatio Nominis: For South Australia, where it was collected.

Diagnosis: A *Neobuntonia* characterised by irregularly distributed surface pitting, individual pits being much smaller than in *N. foveata.*

Description: Shell large, subquadrate, dorsal margin inflexed anteromedially in the LV but relatively straight in the RV; the ventral margin nearly straight; anterior broadly rounded; posterior outline curved and trending posteroventrally where there are three or four stout denticles. The eye tubercle is large. In its dorsal aspect, the carapace is swollen with the greatest breadth being approximately medial.

Surface ornament of the valves consists of irregularly distributed small pits which show some tendency to parallel the swollen ventral periphery. Along the anterior margin the ornament appears as a fine punctation. Internal features are as described for N. *foveata*. There are two kinds of pores at least. The more common of these is a sieve-pore, and there are pores with a countersunk rim (Plate 8, Fig. 13), a basket-like structure (Plate 8, Fig. 10) and sieves underlying ornamental pits (Plate 8, Fig. 14).

Sexual dimorphism distinct; females are relatively higher with respect to their length than males. Juveniles are more uniformly pitted (Plate 8, Fig. 9).

Measurements: The length of the carapace ranges from 0.69–0.74 mm; the height ranges from 0.45–0.46 mm.

Remarks: This species is clearly the same taxon as that given open nomenclature and illustrated by Hartmann (1980). His material, which was collected at Hallett Cove, near Adelaide, South Australia, did not include juveniles. When our juvenile specimens are compared against *N. foveata* the two species are obviously closely related; indeed, *N. sudaustralis* might well be a lineal descendant of *N. foveata*.

Material Studied: Three growth stages; comprising 23 valves (5 adult, 18 juveniles) representing both sexes.

Occurrence and Age. Kingston beach swash mark; Recent.

Family NEOCYTHERIDEIDAE Puri, 1957

Genus COPYTUS Skogsberg, 1939

Copytus rara McKenzie, 1967

1967 *Copytus rara* n.sp. McKenzie, p. 71, fig. 2 j.

Remarks: The only specimen was lost while transferring it to the scanning electron microscope stub.

This species seems to be relatively rare in nearshore southern Australian environments – thus, it was never collected by Hartmann (1979, 1980, 1981); and only appeared once among 70 samples from Port Phillip Bay, near Melbourne, Victoria (McKenzie unpublished) collected subsequent to its original descritpion.

Material Studied: Single adult LV.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Family THAEROCYTHERIDAE Hazel, 1967

Genus BRADLEYA Hornibrook, 1952

Bradleya gilli sp.nov.

Plate 6, Figs. 7, 8

Holotype: The specimen PAMAu 147, figured in Plate 6, Fig. 7, from Kingston Beach, a male LV.

Derivatio Nominis: For the late Edmund T. Gill, former Deputy Director of the National Museum of Victoria, whose pioneering work on the Pleistocene of the Warrnambool district (Gill, 1967) led eventually to location of the Goose Lagoon Drain deposit.

Diagnosis: A *Bradleya* characterised by a prominent and deeply fossate ventral ridge, large rounded subcentral tubercule and variable – reticulate or punctate – surface ornament; there is also a minor ridge yoking the eye tubercle to the subcentral tubercle.

Description: Shell large, subrectangular; dorsal margin relatively straight, projecting anterodorsally and posterodorsally; venter straight; anterior broadly rounded; posterior subtrianglar with several broad posteroventral denticles. Eye-tubercle present but rather small. Hastate in dorsal view.

The major feature of the shell ornament is a heavy ventral ridge which is deeply fossate along its entire length, the number of fossae amounting to eight. This ridge is the continuation of an anteromarginal ridge which thickens gradually and also becomes more alate from the anteroventral region posteriorwards to its abrupt end. The anterior behind the marginal ridge is also fossate but there fossae are relatively shallow and fewer (five) in number. Additionally, there is a yoking ridge between the small eye tubercle and large subcentral tubercle, as well as a minor dorsal ridge with minor fossae. The anterior margin is denticulate; at the posterior margin are three or four stout separate denticles. In front of the subcentral tubercle the valve surface is finely pitted whereas behind it the surface is reticulate becoming pitted in the posterior part. The posterodorsal margin is thickened and raised and fossate (four fossae) on its inner side.

Internal features include moderately broad inner lamellae without vestibules and traversed by rather numerous marginal pore canals; two types of normal pore canals – simple, rimmed and sieve type –; and a central muscle scar grouping characterised by 2 frontal scars. The hinge is hemiamphidont.

Sexual dimorphism could not be confirmed from the limited available material. Probably, males are relatively less high with respect to their length than females.

Measurements: The length of the carapace ranges from 0.75–0.80 mm; the height ranges from 0.36–0.40 mm.

Remarks: The species closest to *B. gilli* is *Bradleya arata* (Brady, 1880); but as illustrated by Hornibrook (1952, pl. 6, fig. 80) the ventral and dorsal ridge fossae in this species continue into indistinct transverse ridgelets which are not apparent in B. *gilli*. Further, the shell ornament behind the subcentral tubercle is quite different in *B. arata* being finely pitted, rather than reticulate as in *B. gilli*.

As noted for several taxa in our collections, the Pleistocene fossil is more heavily ornamented than its Recent descendant. This supports an hypothesis of higher coastal temperatures in the area during Stage 5e of the Pleistocene.

Material Studied: Two broken adult LV [GL]; one entire adult LV [KG]. The latter is a male; of the others [GL], one is female the other male.

Occurrence and Age: Goose Lagoon Drain, Pleistocene Stage 5e; Kingston beach swash mark, Recent.

Family TRACHYLEBERIDIDAE Sylvester Bradley, 1948

Genus CLETOCYTHEREIS Swain, 1963

Cletocythereis rastromarginata (Brady, 1880)

Plate 6, Fig. 9; Plate 8, Fig. 11, 12

1880 *Cythere rastromarginata* n.sp. Brady, p. 83, pl. 16, figs. 1 a–d (figs. 1 a–d not *rastromarginata*).

1952 *Bradleya rastromarginata* (Brady), Hornibrook, p. 17.
1963 *Cletocythereis rastromarginata* (Brady), Swain, p. 824.
1967 *Cletocythereis rastromarginata* (Brady), McKenzie p. 95, textfigs. 6 b, 10 a–b, pl. 13, figs. 1, 2.
1978 *Cletocythereis* cf. *rastromarginata* (Brady), Hartmann, p. 97, pl. 6, fig. 16.
1979 *Cletocythereis* cf. *rastromarginata* (Brady), Hartmann, p. 234, pl. 6, figs. 5–7.
1979 *Cletocythereis* sp. McKenzie, p. 91, pl. 2, figs. 4, 5.
1981 *Cletocythereis rastromarginata* (Brady), Hartmann, p. 108, pl. 5, figs. 15, 16.

Remarks: This species represents the modern descendants of a characteristic Australian Tertiary Recent species complex which ranges in age from Late Eocene to the present. The morphotypes of different ages are so like each other that it seems reasonable to conclude that they represent a single species that has survived since at least the Late Eocene with only minor phenotypic changes. It could prove useful to analyse such a complex as having general importance for the better understanding of evolutionary modes. There are sieve-pores, surrounded by a central opening (Plate 8, Fig. 11) and funnel pores (Plate 8, Fig. 12).

Material Studied: Two growth stages; comprising 3 adult carapaces (2 female, 1 male) and 1 adult female LV [GL]; and 3 carapaces and 15 valves representing both sexes, all adults [KG]. The length ranges from 0.68–0.76 mm; the height ranges from 0.37–0.39 mm.

Occurrence and Age: Goose Lagoon Drain, Pleistocene Stage 5e; Kingston beach swash mark, Recent.

Genus TRACHYLEBERIS Brady, 1898

'*Trachyleberis*' sp.

Plate 6, Fig. 10

Remarks: It is difficult to place this taxon generically with confidence, especially since our only specimens are juveniles. It resembles *Ponticocythereis* McKenzie, 1967 in some characters but that genus lacks the frill-like ventral ridge which is such a feature of this form. The length is 0.56 mm; the height is 0.32 mm.

Material Studied: 2 (A-1) RV, 1 (A-1) LV [KG]; and 1 (A-1) RV [GL].

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e; Kingston beach swash mark; Recent.

Genus DORATOCYTHERE McKenzie, 1967

Doratocythere ornata sp.nov.

Plate 6, Fig. 13

Holotype: The specimen PAMAu 151, figured in Plate 6, Fig. 13, from Kingston Beach, a male RV.

Derivatio Nominis: Ornata (L.) = ornamented, for the ornateness of its ornament which is more conspicuous than in other *Doratocythere* species.

Diagnosis: A *Doratocythere* ornamented over its entire surface with large shallow pits making it easily the most ornate species yet described in the genus.

Description: Shell large, elongate bean-shaped; dorsal margin gently convex except where inflexed anteromedially; ventral margin also weakly convex but inflexed in the mouth region (anteromedially); anterior well rounded; posterior subacuminate with several stubby posteroventral denticles. Eye-tubercle large and relatively flat. The carapace is inflated posteromedially.

The surface ornament comprises numerous large shallow pits of which the largest occur posteroventrally. In particular, many pits parallel the dorsal margin and between them run low indistinct ridges which are most prominent anterodorsally. The most prominent ridge, however, follows the anterior margin; behind it lies a pitted transverse furrow. This anterior ridge/furrow and the posterodorsal swelling of each valve plus the elongate bean shape are all good generic characters for *Doratocythere* (see McKenzie 1967, pl. 13, fig. 3).

Internal features match those of the type species *D. foveata* McKenzie, 1967 and include an amphidont hingement, with an associated subanterodorsal platform such as characterizes campylocytherine genera, plus a normal cytheracean central muscle scar complex – four subvertical adductors, a broadly U- or V-shaped frontal scar and two small mandibulars.

Sex dimorphism distinct: males more elongate than females.

Measurements: The length of the carapace ranges from 0.72–0.75 mm; the height ranges from 0.33–0.35 mm.

Remarks: *Doratocythere* is an endemic Australian genus, unless *Waiparacythereis* Swanson, 1968 is synonymous in which case its distribution extends to New Zealand. Its geological range is Neogene to Recent depending on whether it is regarded as an

Australian or as an Australasian taxon. Howe and McKenzie (1989, p. 44) discuss the taxonomy and family group placement of Australian genera related to *Doratocythere* and reiterate the original opinion of McKenzie (1967) re their campylocytherine affinities.

Material Studied: Single adult male RV, and 1 female LV.

Occurrence and Age: Kingston beach swash mark; Recent.

Doratocythere indistincta sp.nov.

Plate 7, Figs. 1, 2, 10, 11

Holotype: The specimen PAMAu 152, figured in Plate 7, Fig. 1, from Goose Lagoon Drain, a carapace.

Derivatio Nominis: From Latin, relevant to its rather indistinct surface ornament, subcentral tubercle and eye tubercle.

Diagnosis: A *Doratocythere* with an ornament of pits and indistinct reticulations.

Description: Shell large, elongate bean-shaped; dorsal margin convex posterodorsally, to accommodate the characteristic posterior swelling of the shell in this genus, but inflexed weakly in front of this and behind the anterodorsal eye node; anterior well rounded; posterior subtriangular; ventral margin inflexed medially otherwise gently convex. Subcentral tubercle indistinct; eye tubercle likewise indistinct. Subhastate in dorsal view.

The surface ornament consists of scattered pits, two indistinct ridges (one posterodorsal, the other posteromedial) and an indistinct ventral reticulation. The anteromarginal ridge is narrow and the depression behind it comparatively broad. There is a much broader depression, however, behind the posterior swollen part of each valve which ends with a narrow posteromarginal ridge.

The hinge is amphidont and consists, in the RV, of a rather weak stepped anterior tooth followed by a crenulate median furrow and an indistinctly lobate posterior tooth. The shell wall below the anterior part of the hinge is characteristically thickened – it may function as an antislip feature or as a dorsal muscle scar platform for muscles to the anterior limbs. The muscle scars are normal cytheracean in type, with a small micropunctate fulcral scar between the upper adductor and the frontal scar.

Sex dimorphism distinct: males are longer than females.

Measurements: The length of the carapace ranges from 0.74–0.79 mm; the height ranges from 0.32–0.35 mm.

Remarks: *D. indistincta* is one of the many taxa which are common to both of our collections. This indicates that many marine Ostracoda have been able to cope with the temperature variation between Pleistocene Stage 5e and today which is likely to have been about 3–5°C.

Material Studied: Two growth stages; comprising 3 adult and 1 juvenile carapaces, plus an adult LV [GL]; and 1 male carapace, 3 valves (2 female, 1 male), all adults [KG].

Occurrence and Age: Goose Lagoon Drain, Pleistocene Stage 5e; Kingston beach swash mark, Recent.

Genus MACKENCYTHERE Malz and Ikeya 1982

Mackencythere robusta sp.nov.

Plate 6, Figs. 11, 12; Plate 7, Fig. 12

Holotype: The specimen PAMAu 154, figured in Plate 6, Fig. 12, from Kingston Beach, a carapace.

Derivatio Nominis: Robusta (L.) = robust, for the strong carapace.

Diagnosis: A *Mackencythere* with a stout shell and narrow, prominent, adductor muscle scar depression behind the weak subcentral tubercle on each valve.

Description: Shell medium sized and bean shaped to subrectangular; dorsal margin nearly straight; anterior broadly rounded; ventral margin inflexed medially; posterior subtriangular. When viewed dorsally it is apparent that the dorsalmost part of each valve slopes inwards from the dorsal ridge to the hingeline; otherwise subhastate in dorsal view. Subcentral tubercle weak and eye accommodation likewise indistinct.

The ornament consists mainly of shallow pits, including four on either side of the hinge line (in dorsal or obliquely dorsal view) and others located posteroventrally and in the depression behind the broadly thickened anteromarginal rim of each valve. On the medial surface there is a central ridge which recurves downwards posteriorly giving it the overall shape of a shepherd's crook. About where this ridge

first becomes clearly expressed, and behind the indistinct subcentral tubercle is an arcuate and elongate muscle scar pit, concave to the front. There is also a narrow dorsal ridge and the posterior margin is thickened although not as much as the anterior margin. Sieve-pores occur.

The hinge is a merodont type, comprising crenulate terminal teeth in the RV on either side of a well developed median furrow with the LV complementary. Anterodorsally, the shell wall is thickened below the hinge elements. The inner lamellae are broad with definite anterior vestibules. The muscle scars are similar to those in *Doratocythere.*

Sexual dimorphism is relatively distinct, males are less high than females.

Measurements: The length of the male carapace is about 0.71 mm; the height is about 0.36 mm.

Remarks: McKenzie (1967, p. 101) originally referred this genus to *Doratocythere* juveniles but noted some anomalous features, including the wide inner lamellae with anterior vestibules, which van den Bold (pers. comm. 1966) had drawn to his attention. Malz and Ikeya (1982) obviously agreed with van den Bold and, further, considered the distinctions from typical *Doratocythere* to be sufficient to sustain a new genus. They compared it with the Chinese genus *Sinoleberis* Hu, 1979 which, however, has an amphidont hingement.

Material Studied: Two growth stages; comprising 2 adult male carapaces and 4 valves (2 adult females, 2 juveniles).

Occurrence and Age: Kingston beach swash mark; Recent.

Genus AUSTRALIMOOSELLA Hartmann, 1978

Australimoosella rockinghamensis Hartmann, 1979

Plate 7, Figs. 3, 4

1979 *Australimoosella rockinghamensis* n.sp. Hartmann, p. 233, textfigs. 43–47, pl. 6, figs. 1–4.
1980 *Australimoosella rockinghamensis* Hartmann, Hartmann, p. 133, pl. 9, figs. 1–3.

Remarks: *Australimoosella* is clearly part of the same group of genera as *Doratocythere* and *Mackencythere,* a group that Hartmann (1978) has already provided with the tribal name Australimoosellini. Howe and McKenzie (1989) consider that the Australimoosellini are an endemic Australiasian tribe related to the Campylocytherinae Puri, 1960.

Hartmann's specimens came from Western Australia (Exmouth Gulf; Point Peron, near Rockingham) and South Australia (Blanche Harbour, South of Port Augusta). The length ranges from 0.61–0.67 mm; the height ranges from 0.26–0.33 mm.

Material Studied: Two growth stages; comprising 1 adult female carapace and 15 valves (1 juvenile, the rest adult) representing both sexes (11 females, 4 males).

Occurrence and Age: Kingston beach; Recent.

Genus CHAVOCYTHERE gen.nov.

Type Species: *Chavocythere australiae* sp.nov.

Diagnosis: A trachyleberidid genus characterised by a flexuous median ridge, an ornament of pits or reticulations and an anteromarginal depression behind a broken up anteromarginal ridged area. The eye tubercle is small and elliptical. The overall carapace shape is subrectangular. Internal features comprise: moderately broad inner lamellae anteriorly; no vestibules; marginal pore canals relatively straight and numerous; normal pore canals simple, open, rimmed and scattered over the shell surface; hinge holamphidont, median ridge may be weakly crenulate; central muscle scars consisting of 4 subvertical adductors and an open v-shaped frontal scar plus 1–2 small mandibulars. Selvage distinct in LV, less so in RV.

Remarks: Hartmann (1981, p. 105, pl. 4, fig. 13) illustrated a form recorded by him as *Actinocythereis* spec . 177/78 which seems close to our new genus although specifically distinct from our type species. Howe and McKenzie (1989, p. 41), however, discount the probability of *Actinocythereis* Puri, 1953 s.s. occurring in Australia basing their discussion on imnportant differences between the soft anatomy of *Ponticocythereis* McKenzie, 1967 and *Actinocythereis* s.s. These include the respective hemipenes. In *Actinocythereis* s.s. the copulatory tube is very short, in *Ponticocythereis* it is long and powerful; while the nearby appendage is wedge-shaped in *Actinocythereis* but hook-like in *Ponticocythereis.*

Nevertheless, *Ponticocythereis* does show resemblances to *Actinocythereis* in its shape and ornament. *Chavocythere,* however, is distinctly unlike *Actinocythereis* in these features; its shape is not as elongate, and is more truncated posteriorly; and its ornament of all over pits or reticulations does not occur in typical *Actinocythereis.*

With respect to the other Australian genera discussed by us previously, *Chavocythere* is more truncated posteriorly than *Doratocythere, Mackencythere* and *Australimoosella* and a similar comment can be made about its comparison with *Yassinicythere* McKenzie (Howe and McKenzie, 1989). All these genera have a more or less distinct depression behind the anteromarginal thickened rim or ridge. In *Chavocythere,* however, this marginal rim is not entire but irregularly broken up which makes our new genus immediately recognizable.

Derivatio Nominis: Chavo = a child (Romanès) and Savo = a child (Sanskrit); and the cythereacean suffix – *cythere.*

Occurrence and Age: *Chavocythere* at present is restricted to Australia, its distribution ranging from Heron Island, off Queensland (Hartmann, 1981) to our record from near Warrnambool, Victoria; but it is likely to range more widely than this along the Australian coasts.

The known geological age range is Pleistocene-Recent.

Chavocythere australiae sp. nov.

Plate 7, Figs. 5 a, b

Holotype: The specimen PAMAu 157, figured in Plate 7, Figs. 5, from Goose Lagoon Drain.

Derivatio Nominis: Australiae (L.) = for its Australian occurrence.

Diagnosis: A *Chavocythere* characterised by a flexuous median ridge which curves downwards posteriorly; and an ornament of large shallow pits in a reticulate surface.

Description: Shell medium sized and subrectangular; dorsal margin is regular; anterior broadly rounded; posterior truncated and also broadly rounded below a small but distinct posterodorsal corner; ventral margin inflexed medially, otherwise gently convex. Eye tubercle small but distinct.

The most prominent feature of the medial surface is a flexuous ridge which runs from the anteroventral area diagonally across the shell to the posterodorsal region and then curves downwards before terminating. Also notable is the irregularly broken up thickened anteromarginal rim and the depression behind this. Otherwise, the entire surface is covered by a reticulate mesh with intervening large shallow pits. Ventrally, these tend to parallel the ventral margin but no such pattern is apparent on the median surface. The shell flattens posteriorly where the thickened rim is also broken up into small separate nodes. Internal features are as those recorded for the generic diagnosis.

Sex dimorphism present; males larger than females.

Measurements: The length of the carapace ranges from 0.68–0.74 mm; the height ranges from 0.34–0.37 mm.

Remarks: *C. australiae* is readily differentiated from the Heron Island species illustrated by Hartmann (1981, pl. 4, fig. 13) which has a flexuous median ridge that does not curve downwards posteriorly, and a surface ornament of relatively elongate reticules rather than rounded shallow pits.

Material Studied: All adults, comprising 4 carapaces (3 female, 1 male) and 1 LV, 1 RV (both female).

Occurrence and Age: Goose Lagoon Drain; Pleistocene, Stage 5e.

Subfamily: ARCULACYTHEREINAE Hartmann, 1981

Arculacythereine sp.

Plate 7, Fig. 6

Remarks: Our specimen (length 0.76 mm; height 0.40 mm) seems referrable to the subfamily because of the elongate subdorsal muscle scar platform in the only valve we found. It may be close to Campylocytherid sp. of McKenzie (1967, p. 101–102, pl. 12, fig. 7, text-fig. 5d), from Port Phillip Bay, Victoria.

Material Studied: A mature female LV.

Occurrence and Age: Kingston Beach; Recent.

Family INCERTAE SEDIS

Genus INCERTAE SEDIS

Incertae Sedis sp. 1

Plate 7, Fig. 7

Remarks: The shape of this taxon resembles that of some forms referred to *Callistocythere* but its orna-

ment is not unlike that illustrated by Hartmann (1981, pl. 5, figs. 9, 10) for his genus *Arculacythereis*. Our material is insufficient for a more detailed analysis. The length is 0.60 mm; the height is 0.30 mm.

Material Studied: Single subadult LV, probably female.

Occurrence and Age: Kingston beach swash mark; Recent.

Incertae Sedis sp. 2

Plate 7, Fig. 8

Remarks: The single carapace is reminiscent of some forms referred to *Semicytherura* species but is more elongate, approaching the genus *Tanella* Kingma, 1948 in general shape. In ornament, however, it is quite unlike *Tanella* species which are reticulate, and distinctively patterned.

Material Studied: Single adult carapace, probably a male. The length is 0.34 mm; the height is 0.15 mm.

Occurrence and Age: Goose Lagoon Drain; Pleistocene Stage 5e.

Conclusions

When the ostracod assemblages from Goose Lagoon Drain and Kingston Beach are compared at the family level, it is immediately obvious that there are many more Cytherellidae in the Kingston Beach assemblage but, on the other hand, many more Leptocytheridae, Cytheruridae, Loxoconchidae and Xestoleberididae in the Goose Lagoon Drain assemblage. Further, the group of genera we place in Campylocytheridae (*Doratocythere, Australimoosella, Mackencythere*) are much more common at Kingston Beach, than in the Goose Lagoon Drain sample where only *Doratocythere* occurs. There are similar numbers of Bairdiidae, Bythocytheridae and Hemicytheridae in both samples.

Cytherellidae probably live in the seagrass meadows offshore from Kingston Beach so it is unlikely that this environment was represented in the Goose Lagoon Drain milieu. On the other hand, Leptocytheridae and Cytheruridae are very common along shorelines where tide pools and algae occur, including the shores of protected bays, such as Port Phillip Bay, Victoria (McKenzie, 1967). Loxoconchidae and Xestoleberididae also thrive in such protected environments. Bairdiidae and Hemicytheridae are not particularly diagnostic in this regard; likewise the genus *Cletocythereis* in the family Trachyleberididae.

The fact that Bythocytheridae are equally common in both assemblages is interesting. In both samples, the genus concerned is *Cytheralison,* which is not usually found inside protected bays far from the open sea – for example, McKenzie (19967) did not record it in either of the samples he collected at the head of Port Phillip Bay, Victoria. Thus, *Cytheralison* in the Goose Lagoon Drain assemblage suggests nearness to the open ocean.

Taxa which are rare in the assemblages may yet have environmental significance. So, the occurrence of *Macrocyprina* sp. in the Kingston Beach assemblage confirms the open ocean milieu; while the few valves of freshwater cyprididae (*Heterocypris, Candonocypris*) in the Goose Lagoon Drain assemblage indicate a nearby riverine source.

Summarising, the comparative analysis suggests that, unlike Kingston Beach, which has a typical open ocean nearshore assemblage, the environment represented by the Goose Lagoon Drain sample probably came from a protected bay or lagoon open to the sea and near its seaward end, while the head of this lagoon or bay was susceptible to riverine influences. A somewhat less likely alternative environment for the sample would be near the mouth of an estuary.

There are several indications that temperatures were warmer during the Pleistocene Stage 5e (about 125.000 years ago) than today, along the southern Australian coastline. Several species recorded from Goose Lagoon Drain either now live at higher (and warmer) latitudes, e.g. *Caudites yambaensis,* or have more punctate carapaces, usually regarded as indicative of higher temperatures, e.g. *Neobuntonia foveata.* We already know that this temperature difference was around 3–5°C (Gill, 1986). Nevertheless, the majority of species listed occur in both these samples which indicates that, generally speaking, Ostracoda have maintained their niches along the shores of southern Australia from about 125.000 years ago to the present.

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PLATES

Plate 1

Fig. 1. *Cytherella kingstonensis* sp. nov. Holotype. PM-Au100, Kingston Beach, × 50. Aug., 1986.

Fig. 2. *Cytherelloidea posteropunctata* sp. nov. Holotype. PM-Au161, Boat-landing, Kingston, × 75. Jan. 1989.

Fig. 3. *Cytherelloidea* sp. 1. PM-Au162, Goose Lagoon Drain, × 75.

Fig. 4. *Cytherelloidea* sp. 2. PM-Au163, Boat-landing, Kingston, × 100. Jan. 1989.

Fig. 5. *Keijcyoidea sudaustralis* sp. nov. Holotype. PM-Au101. Left side of carapace, Goose Lagoon Drain, × 75.

Fig. 6. *Keijcyoidea keiji* (McKenzie). PM-Au102, Kingston jetty, × 75. Aug. 1986.

Fig. 7. Same species and provenance. Adductor muscle field, × 380. Jan. 1989.

Fig. 8. *Neonesidea guildertonensis* Hartmann, PM-Au105, Goose Lagoon Drain, × 50.

Fig. 9. *Paranesidea norrisi* sp. nov. Holotype, a right valve, PM-Au164, Goose Lagoon Drain, × 50.

Fig. 10. *Papillatabairdia elongata* sp. nov. Holotype, right side of carapace, Goose Lagoon Drain, × 75.

Fig. 11, a–b.*Bythocypris* sp. Two valves of the same specimen, (A) interior of the right valve showing the muscle-scar pattern and (B), the left valve, boat-landing, Kingston, PM-Au191, × 50. Jan. 1989.

Fig. 12. *Macrocyprina* sp. PM-Au109, carapace, Kingston beach, × 50, Aug. 1986.

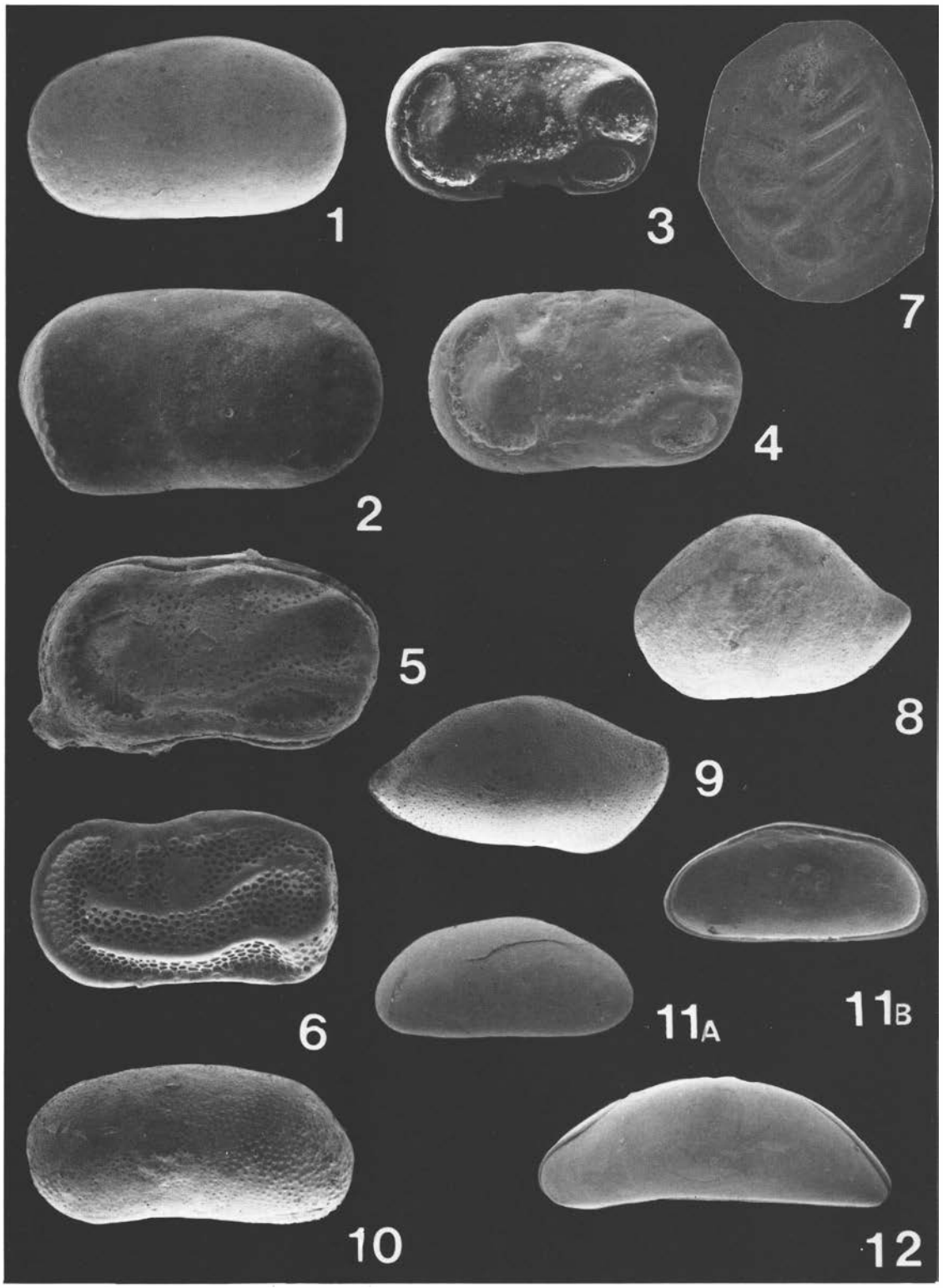
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Plate 2

Fig. 1. *Paracypris bradyi* McKenzie. PM-Au165, × 50, Kingston Beach, Aug. 1986.
Fig. 2. *Propontocypris* sp. PM-Au110, Kingston Beach, × 75. Aug. 1986.
Fig. 3. *Maddocksella mackenziei* (Maddocks), PM-Au112, Goose Lagoon Drain; × 75.
Fig. 4. Same species, PM-Au113, Kingston Beach; × 50. Aug. 1986.
Fig. 5. *Candonocypris* sp. PM-Au114, Goose Lagoon Drain; × 50. Left female valve.
Fig. 6. *Australoecia victoriensis* McKenzie, PM-Au111, Kingston Beach; × 100. Right side of carapace. Aug. 1986.
Fig. 7. *Loxocythere postventrobullata* sp. nov. Holotype, PM-Au116, Goose Lagoon Drain; × 75. Left valve.
Fig. 8. *Cytheralison anserlagunae* sp. nov. Holotype, PM-Au118, Goose Lagoon Drain; × 75. Left valve.
Fig. 9. *Cytheralison* cf. *pravacauda* Hornibrook, PM-Au119, Kingston beach swash-mark; × 50. Aug. 1986.
Fig. 10. Same species, Kingston boat-landing, PM-Au190; × 50. Internal view of right valve. Jan. 1989.
Fig. 11. *Nealocythere* sp., PM-Au120, Goose Lagoon Drain; × 75.
Fig. 12. *Callistocythere purii* McKenzie, PM-Au166, Kingston beach; × 75. Aug. 1986.
Fig. 13. *Callistocythere dorsotuberculata* Hartmann, PM-Au121, Goose Lagoon Drain; × 100.
Fig. 14. *Callistocythere sherwoodi* sp. nov. Holotype, a female, PM-Au123, Goose Lagoon Drain; × 100. Left side of a carapace.
Fig. 15. Same species and provenance, PM-Au167; × 100. Paratype, a male, left side of a carapace.

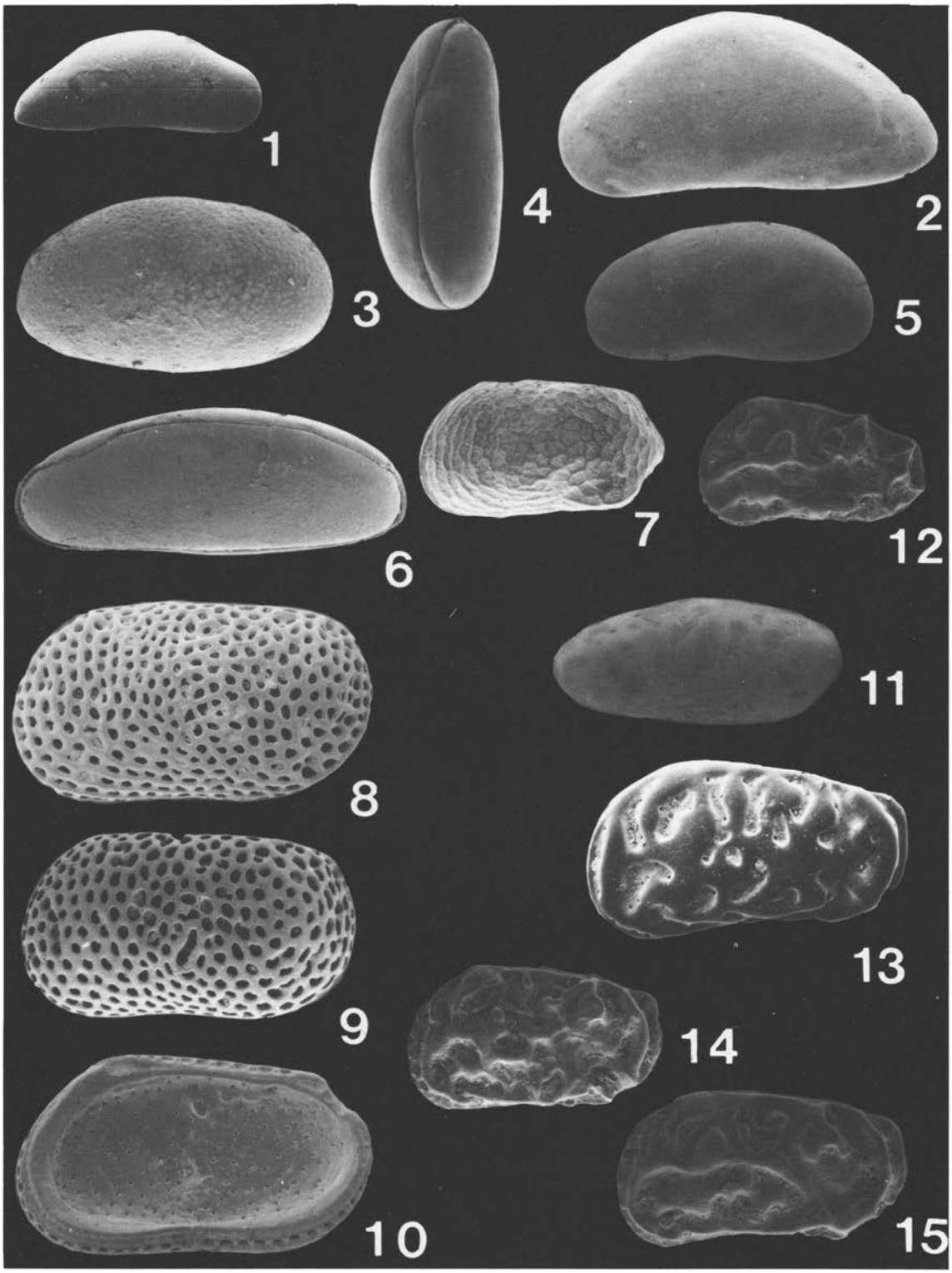
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Plate 3

Fig. 1. *Morkhovenia hingstoni* sp. nov. Holotype. PM-Au125, Goose Lagoon Drain; × 100. Left side of carapace.

Fig. 2. *Mackenziartia portjacksonensis* (McKenzie), PM-Au126, Kingston beach swash-line; × 100. Aug. 1986.

Fig. 3. *Paranesidea norrisi* sp. nov. PM-Au168, Goose Lagoon Drain; × 75. Right valve.

Fig. 4. *Eucythere* sp. PM-Au169, Kingston boat-landing; × 100. Jan. 1989.

Fig. 5. Same species and provenance; × 175. Internal view of a left valve. Jan. 1989.

Fig. 6. *Osticythere reticulata* Hartmann, PM-Au171, female right valve; × 50, near Woods Well, The Corong. Jan. 1989.

Fig. 7. Same species and provenance, PM-Au 170, male left valve; × 50.

Fig. 8. a, b *Paracytheroma generodubia* sp. nov. Holotype. Stereopair of the left side of a carapace, PM-Au127, Goose Lagoon Drain; × 100.

Fig. 9. a, b *Leptocythere hartmanni* McKenzie. Stereopair of right side of a carapace, PM-Au173, near Woods Well, The Coorong; × 100, Jan. 1989.

Fig. 10. Same species and provenance, PM-Au172; × 100. Jan. 1989.

Fig. 11. *Cyprideis australiensis* Hartmann, dorsal aspect of a carapace (male?), near Woods Well, The Coorong, PM-Au178; × 50. Jan. 1989.

Fig. 12. Same species and provenance, PM-Au174, internal view of left valve showing mycelian tracks, hinge and muscle-field; × 50.

Fig. 13. Same species and provenance. Right side of a carapace, PM-Au175; × 50. Jan. 1989.

Fig. 14. *Semicytherura* sp. PM-Au179, Goose Lagoon Drain; × 100.

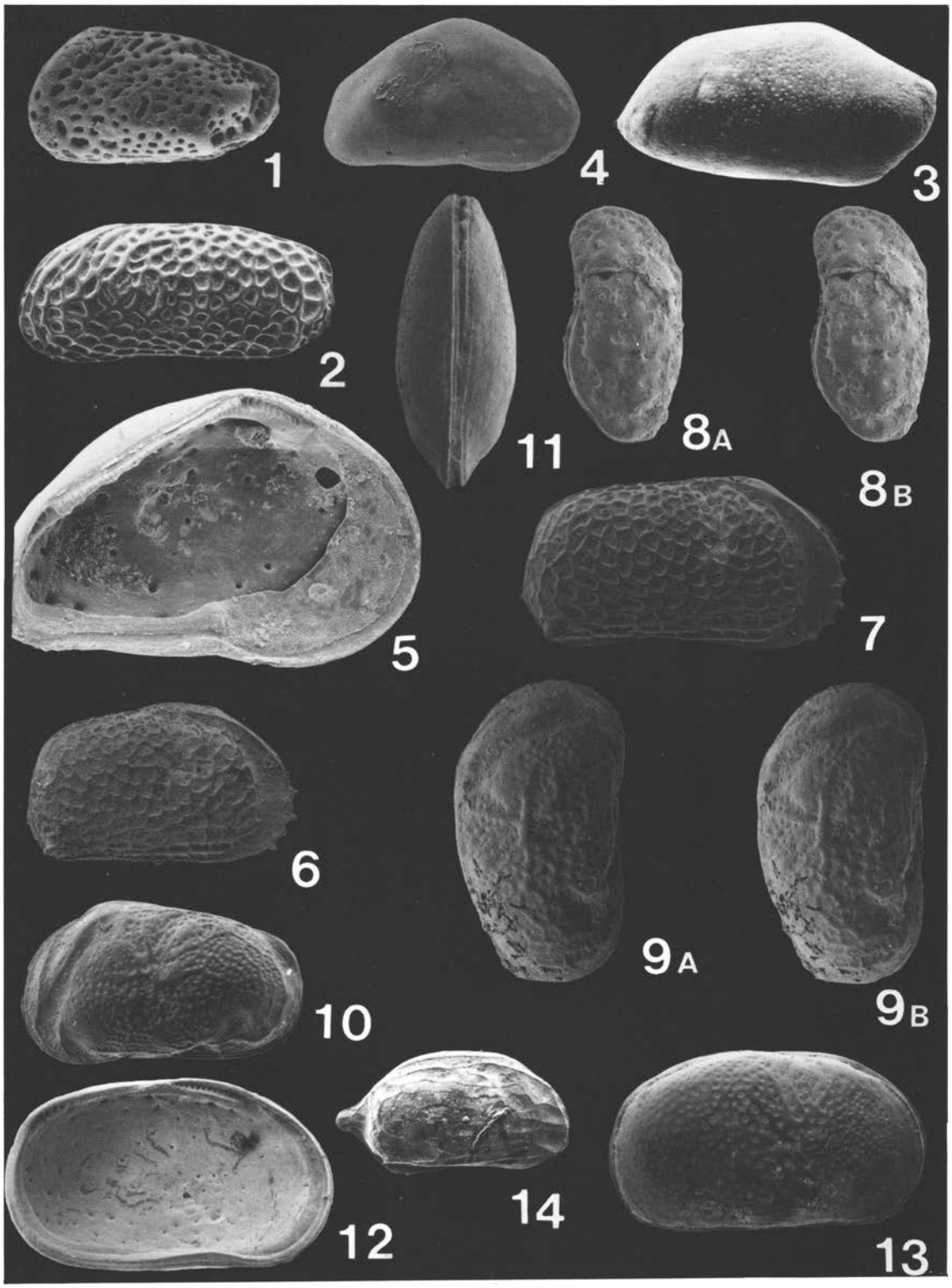
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Plate 4

Fig. 1. *Semicytherura cryptifera* (Brady), PM-Au128; Goose Lagoon Drain; right valve. × 100.

Fig. 2. *Hemicytherura austropytta* sp. nov. Holotype, a female?; PM-Au130; Goose Lagoon Drain. × 175.

Fig. 3. *Hemicytherura bellezza* sp. nov. Holotype; PM-Au129; Goose Lagoon Drain. × 175.

Figs. 4, a–b. *Oculocytheropteron* sp. Stereomicrographs of the ventral aspect of a carapace; PM-Au180. × 100.

Fig. 5. *Loxoconcha australis* Brady, PM-Au132; Kingston Beach. × 75. This specimen bears a muricid borehole. Aug. 1986.

Fig. 6. Same species; PM-Au133; Goose Lagoon Drain. × 75.

Fig. 7. Same specimen as Fig. 6; detail of the postero-ventral ornament, right valve. × 500.

Fig. 8. *Loxoconcha trita* McKenzie, PM-Au134; Goose Lagoon Drain. × 75.

Fig. 9. *Xestoleberis* cf. *tigrina* (Brady), PM-Au135; Kingston boat-landing. × 100. Jan. 1989.

Fig. 10. Same species and provenance, PM-Au181. × 75.

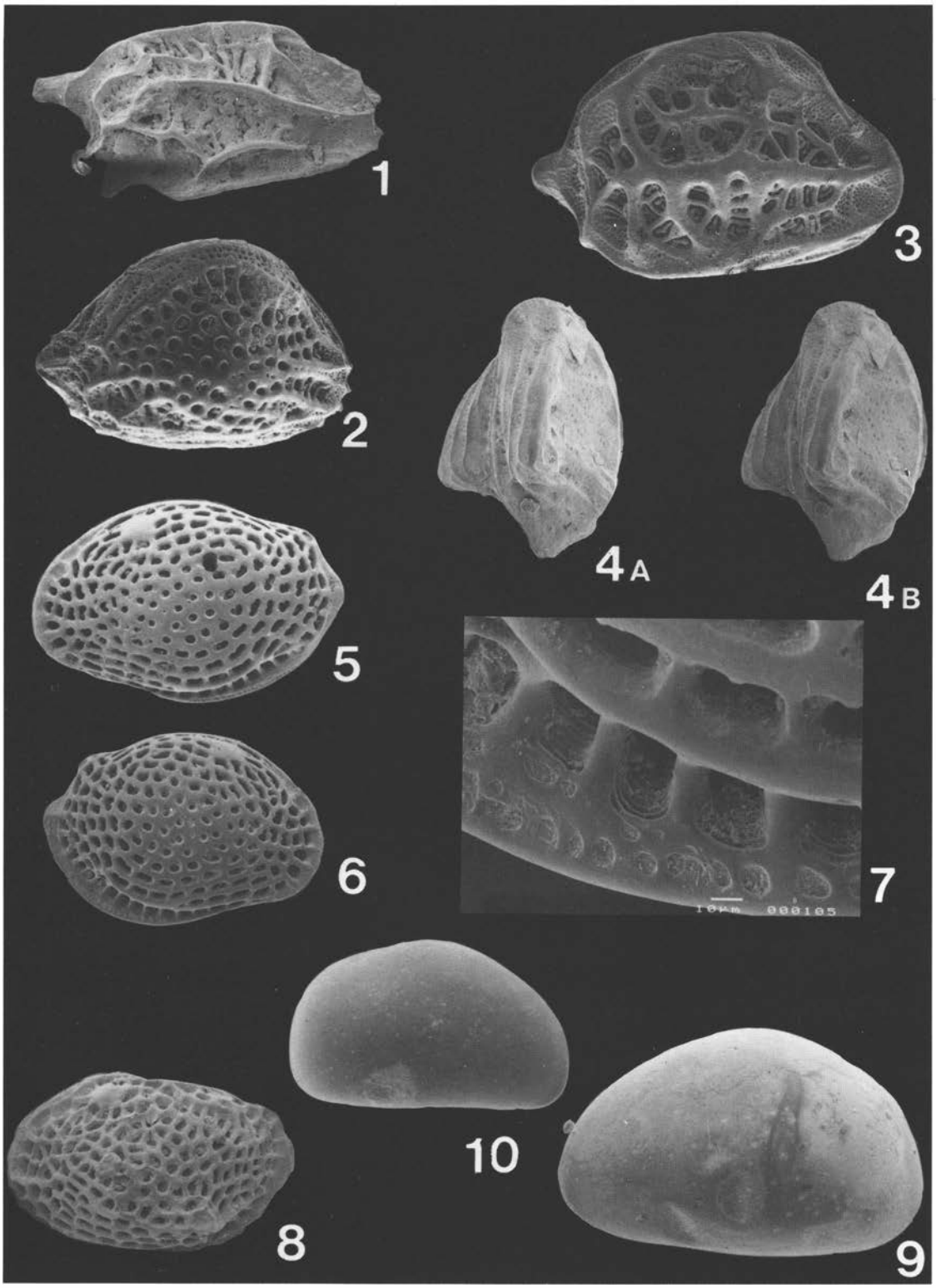
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Plate 5

Fig. 1. *Xestoleberis cedunaensis* Hartmann. PMAu183. Right valve, Goose Lagoon Drain. × 100.
Fig. 2. Same species and provenance, PMAu184, Goose Lagoon Drain. × 100.
Fig. 3. *Xestoleberis* sp. PMAu137. Dorsal aspect of carapace, Goose Lagoon Drain. × 100.
Fig. 4. *Foveoleberis* sp. PM-Au137, right side of a carapace, Goose Lagoon Drain. × 100.
Fig. 5. *Serratocythere australiensis* Hartmann. PMAu138, right side of a carapace, Kingston jetty. × 75. Aug., 1986.
Fig. 6. Same species and provenance. PM-Au185, left side of a carapace. × 75.
Fig. 7. Same species. PMAu187, Kingston boat-landing, view of left hinge. × 75. Jan., 1989.
Fig. 8. Same species and provenance. View of sieve-pore located in an ornamental depression. × 7500.
Fig. 9. *Mutilus pumilus* (Brady). PM-Au141. Right valve, Kingston Beach. × 100
Fig. 10. Same species. PM-Au188, Kingston Boat landing; View of interior of a right valve. × 100. Jan., 1989.
Fig. 11. Same species and provenance. PM-Au189. View of interior of a left valve. × 100.

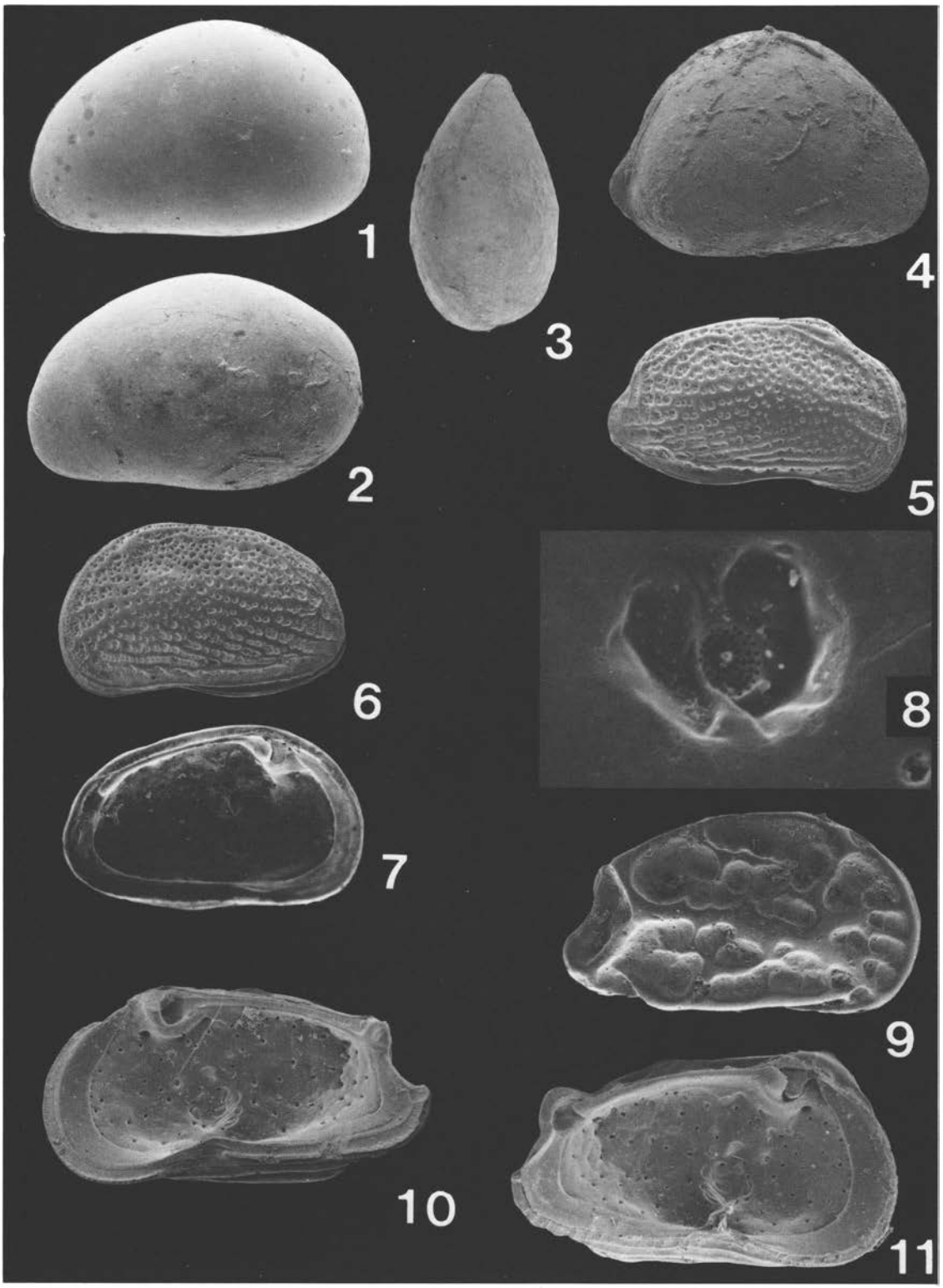
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Plate 6

Fig. 1. *Neobuntonia foveata* sp. nov. Holotype, PM-Au143; right valve, Goose Lagoon Drain. × 100.

Fig. 2. *Caudites yambaensis* Hartmann. PM-Au142. Left side of a carapace, Goose Lagoon Drain. × 100.

Fig. 3. *Neobuntonia sudaustralis* sp. nov. PM-Au145. Right valve, Kingston Beach. × 75. Aug., 1986.

Fig. 4. Same species and provenance. PM-Au144. Holotype. × 75. Aug., 1986.

Fig. 5. Same species and provenance. PM-Au146, Juvenile left valve. × 100.

Fig. 6. Same species. Ornamental pit of the holotype; note strutting due to calcification. × 2500.

Fig. 7. *Bradleya gilli* sp. nov. Holotype, PM-Au147. A male left carapace. Kingston Beach. × 75. Aug., 1986.

Fig. 8. Same species. PM-Au 148. Damaged female left valve. Goose Lagoon Drain. × 75.

Fig. 9. *Cletocythereis rastromarginata* (Brady). PM-Au149. Right valve. Goose Lagoon Drain. × 75.

Fig. 10. *"Trachyleberis"* sp. PM-Au160, Kingston beach. × 100. Aug., 1986.

Fig. 11. *Mackencythere robusta* sp. nov. Holotype. PM-Au154. Left side of a carapace, Kingston Beach. × 75. Aug., 1986.

Fig. 12. Same species and provenance. Dorsal aspect. × 75.

Fig. 13. *Doratocythere ornata* sp. nov. Holotype. PM-Au151. Kingston Beach swash-mark. × 75. Aug., 1986.

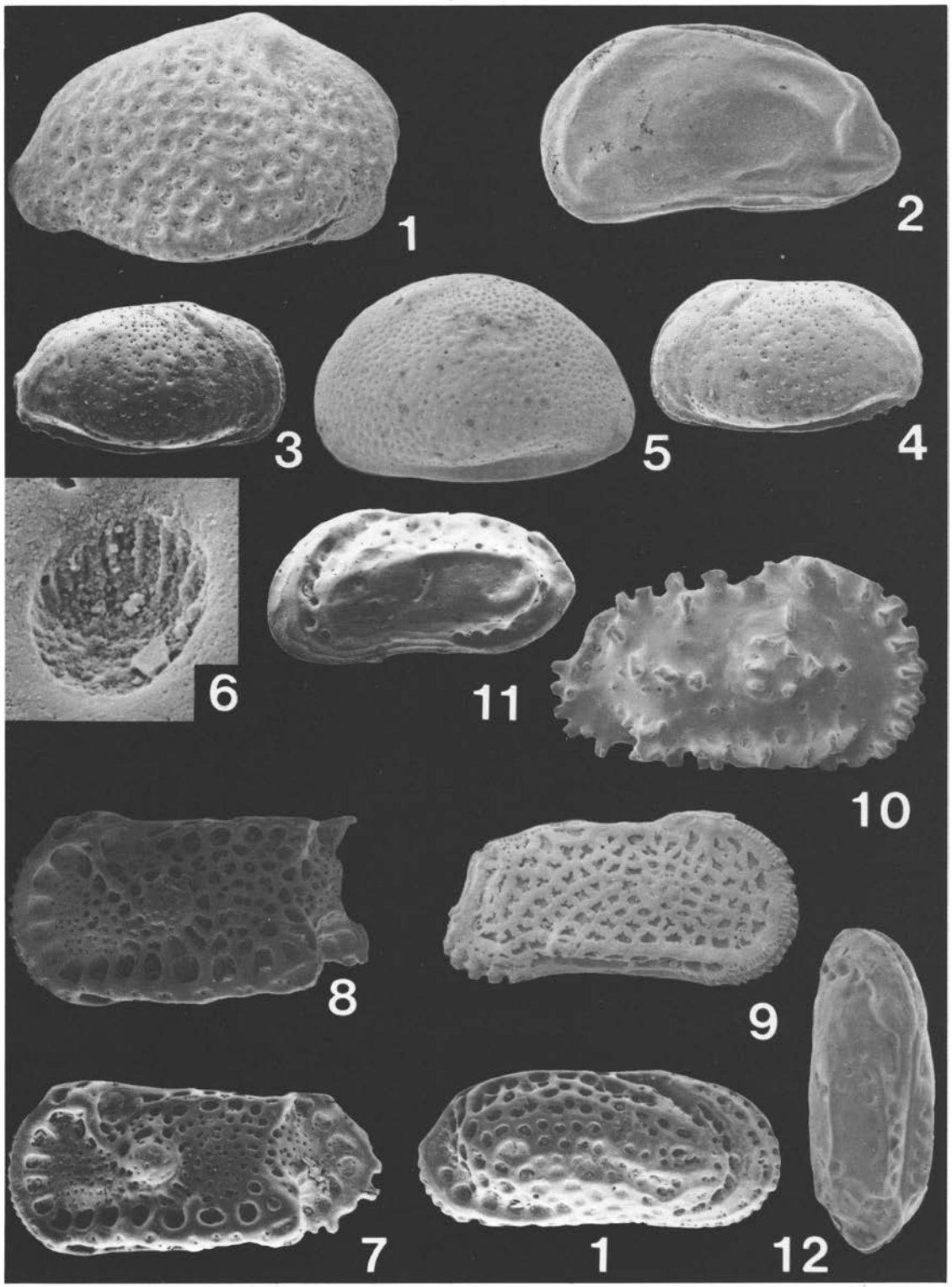
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Plate 7

Fig. 1. *Doratocythere indistincta* sp. nov. Holotype, PM-Au152. Left side of a carapace, Goose Lagoon Drain. × 75.

Fig. 2. Same species. PM-Au153. Male right valve. Kingston Beach. × 75. Aug., 1986.

Fig. 3. *Australimoosella rockinghamensis* Hartmann. PM-Au 187. Left side of a carapace, Kingston Beach. × 100. Aug., 1986.

Fig. 4. Same species, a right valve. PM-Au188, Kingston boat-landing. × 100. Jan., 1989.

Figs. 5, a–b. *Chavocythere australiae* sp. nov. Holotype, PM-Au157. Stereopair of the left side of a carapace. Goose Lagoon Drain. × 75.

Fig. 6. Arculicythereine sp. PM-Au158. Kingston Beach. × 75. Aug., 1986.

Fig. 7. Incertae sedis sp. 1. PM-Au159. Kingston Beach. × 75. Aug., 1986.

Fig. 8. Incertae sedis sp. 2. PM-Au160. Goose Lagoon Drain. × 75.

Fig. 9. *Serratocythere australiensis* Hartmann. Adductor muscle scars. PM-Au138. Kingston Beach. × 500. Aug., 1986.

Fig. 10. *Doratocythere indistincta* sp. nov. PM-Au153, detail of the lateral pores. × 750.

Fig. 11. Same species. Detail of pore-patterns. Holotype, left valve. PM-Au152. × 500.

Fig. 12. *Mackenecythere robusta* sp. nov. PM-Au155. Sieve-pore on dorsal surface. × 2500.

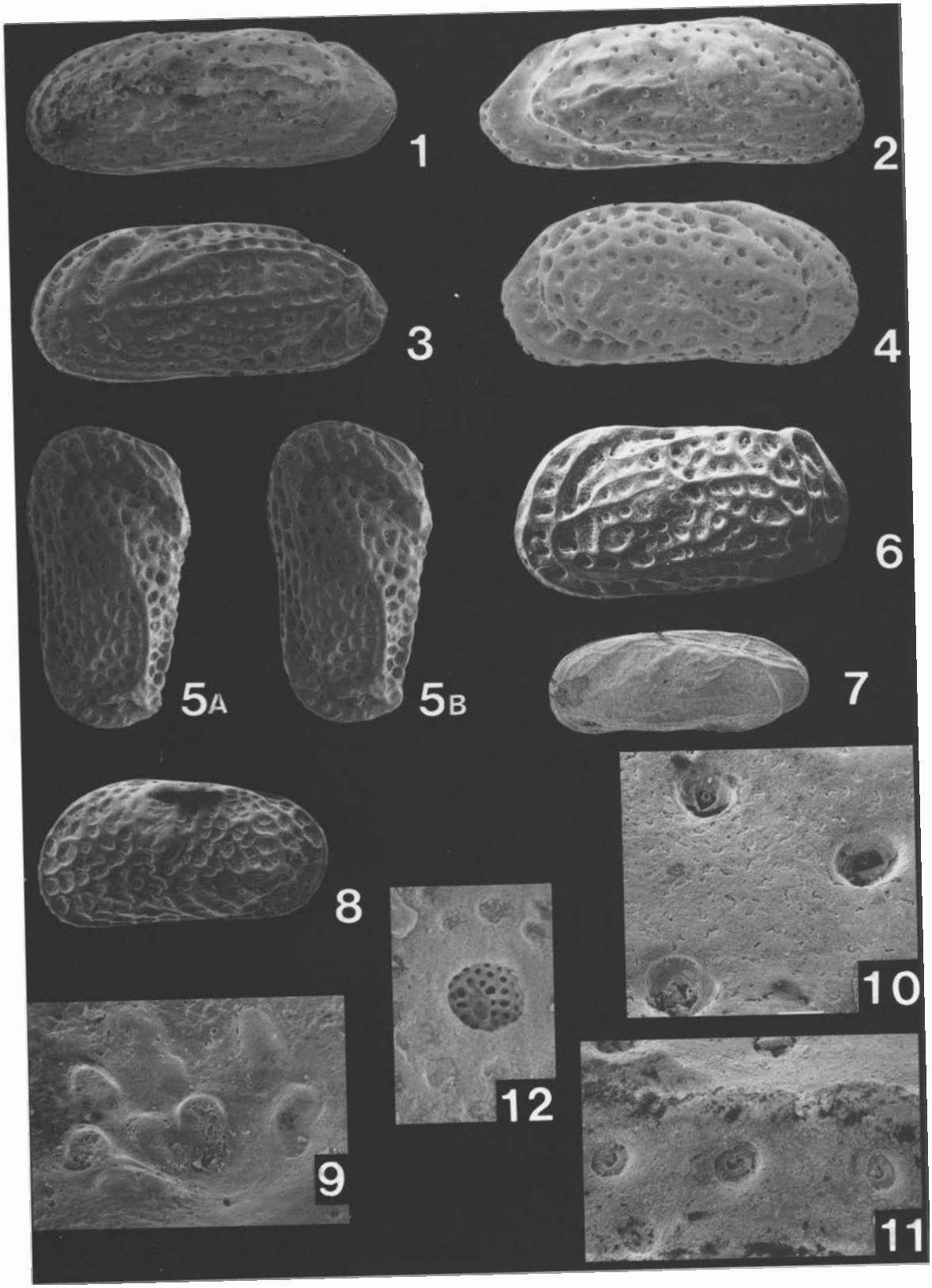
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Plate 8

Examples of ultrastructures.

Fig. 1. *Keijcyoidea sudaustralis* sp. nov. Ornamental detail; × 1750. Kingston Beach. Aug., 1986.

Fig. 2. *Cyprideis australiensis* Hartmann. Radula marks in a scraped zone of a naticid borehole; PM-Au177. × 2500. The Coorong, Jan., 1989.

Fig. 3. Same species. Grill-pores in ornamental depressions. PM-Au175. × 1000.

Fig. 4. Same individual as foregoing. Ornamental detail. × 1750.

Fig. 5. *Xestoleberis* cf. *tigrina* (Brady). Lateral pore. × 5000. Kingston boat-landing, Jan., 1989.

Fig. 6. Same species and provenance. Rimmed lateral pore. × 3750.

Fig. 7. *Foveoleberis* sp. Lateral pore. × 5000. Kingston boat-landing, Jan., 1989.

Fig. 8. *Neobuntonia sudaustralis* sp. nov. Lateral pore. × 5000. Kingston Beach, Aug., 1986.

Fig. 9. Same species and provenance. Rimmed lateral pore of a juvenile specimen (cf. Plate 6, Fig. 5). × 2500.

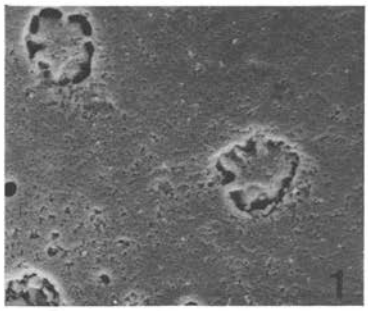
Fig. 10. Same species and provenance. Lateral pore of specimen figured in Plate 6, Fig. 4. × 2500.

Fig. 11. *Cletocythereis rastromarginata* (Brady). Sieve pore of specimen PM-Au149. × 5000.

Fig. 12. Same individual as foregoing. Fine pitting of ribbing and a funnel-shaped pore-canal. × 1000.

Fig. 13. *Neobuntonia sudaustralis* sp. nov. Holotype, PM-Au14. Stereopair of a rimmed and countersunk lateral pore with the vestiges of a perforated lid. × 3750.

Fig. 14. Same individual as in Fig. 13. Stereopair of sieve-pore located beneath an ornamental pit. × 3750.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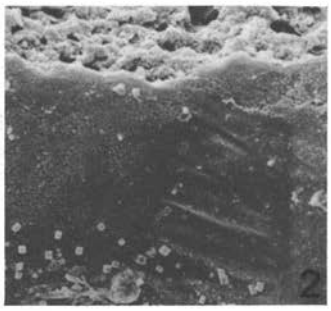
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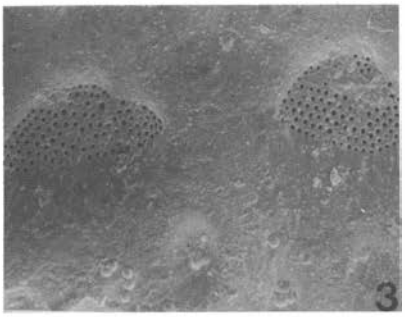
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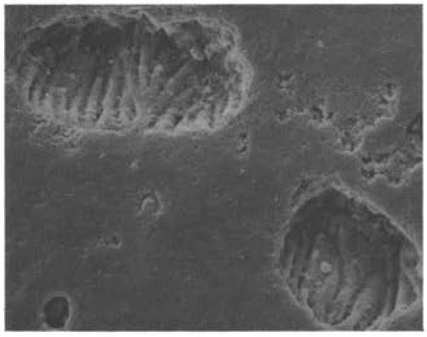

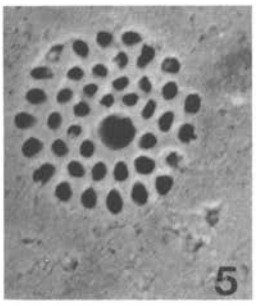
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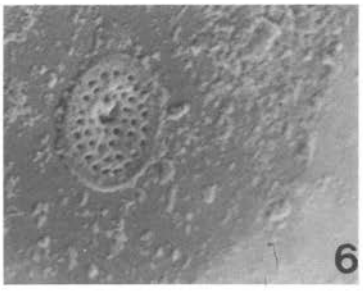
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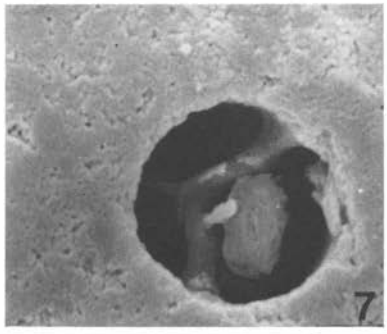
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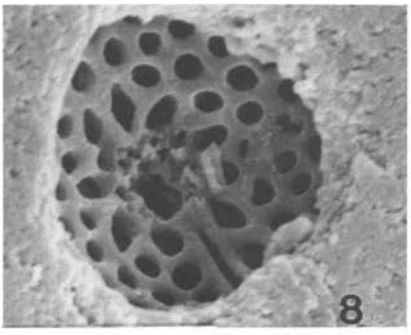
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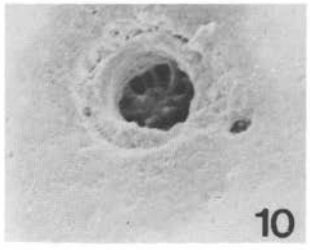
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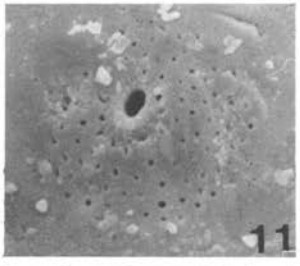
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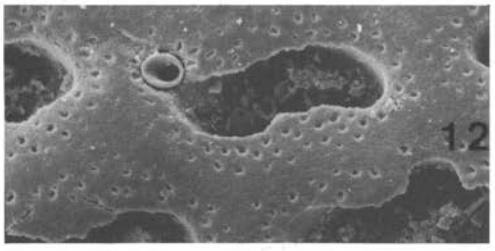
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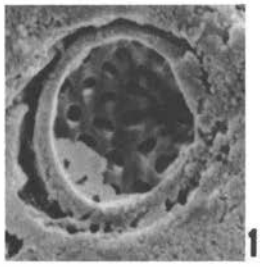
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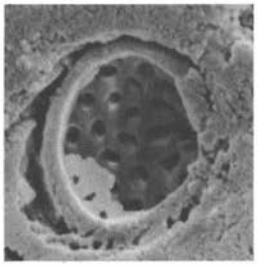


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