CENOZOIC OSTRACODA OF SOUTHEASTERN AUSTRALIA WITH THE DESCRIPTION OF *HANAICERATINA* NEW GENUS

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ABSTRACT

The history of studies on Australian fossil Cenozoic Ostracoda is briefly reviewed. *Hanaiceratina* new genus is described, with the subspecies *H. arenacea arenacea, H. arenacea balcombensis* and the species *H. posterospinosa* and *H. henryhowei.* Consideration of some useful taxa leads to a resume of the palaeoecology of the local stages in which the importance of recognizing facies differences is emphasized by comparison of the fossil assemblages with similarly prepared assemblages from Recent local marine environments and, in some cases, with Recent Sahul Shelf Ostracoda. This is followed by brief conclusions upon the regional palaeobiogeography that stress the influences of Tethys, the West Wind Drift, and endemism upon development of the southern Australian faunas.

INTRODUCTION

The first record of fossil Ostracoda from Australia was that of two Palaeozoic species by Morris, in Strzelecki (1845, p. 921), and it was not until much later that the first identifications of Australian Tertiary species were made, *fide* Crespin (1959, p. 140). Most of the early work on Tertiary marine forms was done by Chapman (1910 *et seq.*) and continued in a few papers by Crespin (notably 1943).

Similarly, Chapman (1914b *et seq.*) did the early work on Tertiary and Quaternary fossil freshwater species. But in general Cenozoic Ostracoda have been neglected in Australian micropalaeontology, as noted some years ago in McKenzie (1965).

The major taxonomic papers for the region as a whole are those by Kingma (1948) on Indonesian Neogene faunas, and by Hornibrook (1952) on the Tertiary of New Zealand. The most complete Australian reference is the paper by Crespin (1943) in which, however, many of the 72 species listed cannot be used with any confidence because they are misidentified with Recent *Challenger* species. The most recent papers either have dealt only with single species, *e.g.,* Keij (1966), McKenzie (1967a), or have used open nomenclature, *e.g.,* McKenzie (1969). The state of present knowledge on the Australian Tertiary and Pleistocene faunas is represented by Table 1 which lists the new species or undetermined species so far recorded for the continent.

Meanwhile, foraminiferal research has been comparatively prolific, and recent reviews have established good correlations between the Tertiary of Australasia and that of the rest of the world, based upon the Foraminifera, see Ludbrook (1967) and Hornibrook (1967). Table 2 gives the correlation accepted here for southeastern Australia, which is principally that of Ludbrook (1967), but the local Stage names will be used throughout in the paper.

The Tertiary stratigraphy of southeastern Australia is well known. Useful notes on the sections covered by my samples are located in the 1967 Melbourne

Table 1. List of marine and freshwater Tertiary, Pleistocene, and subfossil new species (or species in open nomenclature of Ostracoda recorded from Australia

AUTHOR	DATE	SPECIES (marine)
Chapman	1910	*Cytheropteron batesfordiense*
Chapman	1914a	*Bythocypris tumefacta*
		Bairdia australis
		Cythere flexicostata
		C. postdeclivis
		Krithe eggeri
		Cytherura capellifera
		C. ouyenensis
		C. postumbonatum
		C. praeantarcticum
		C. reticosum
		C. rostratum
		Cytherella auriculus
		C. subtruncata
Chapman	1926	*Bairdia minutissima*
		Cythere kincaidiana
Chapman and Crespin	1928	*C. sorrentae*
		C. caudispinosa
		C. baragwanathi
		Bythocythere keblei
		Cytherura praemucronata
		Cytherella intermedia
		C. araneosa
Chapman	1935	(?) *Cythere queenslandiae*
		cf. *Cythere* sp.
		cf. *Paradoxostoma* sp.
		(?) *Pontocypris* sp.
		Cardobairdia balcombensis
McKenzie		*Paradoxostoma* spp. (2)
McKenzie		*Cytherois* sp.
		? *Paracythere* sp.
		Microcythere sp.
		Paracytherois sp.
		Sclerochilus sp.
		SPECIES (freshwater)
Chapman	1914b	*Limnicythere mowbrayensis*
Chapman	1919	*Cypris tenuisculpta*
		Limnocythere sicula
Chapman	1935	*Erpetocypris aequalis*
		Cypridopsis compressa
Chapman	1936	*Cypris praenuncius*
Beasley	1945	*C. munduraensis*
		Cyprinotus punctatus
		Ilyodromus ? concentricus
		Erpetocypris ? subtriangularis
		Stenocypris lowmeadensis
		Cypridopsis linearis
Ludbrook	1956	(?) *Cypris* sp.
McKenzie and Gill	1968	*Candonocypris* sp.
		Diacypris n. sp.?
		Cypretta sp.

Table 1 (continued)

AUTHOR	DATE	SPECIES (freshwater)
		Diacypris sp.
		? *Diacypris* sp.
		'Eucypris' sp.
McKenzie, in Waldman and Handby	1968	*Mytilocypris* sp.
McKenzie and Hussainy	1968	*Gomphocythere* sp.

ANZAAS, Section C, Excursions Handbook, see under Singleton (1967), Spencer-Jones (1967), and Gostin (1967), and in earlier papers by Carter (1964) and Wilkins (1963).

Regional palaeobiogeography for New Zealand has been dealt with by Fleming (1962) in a general palaeontological approach, and specifically for some marine Cenozoic ostracode genera by McKenzie (1967a). The Tertiary palaeoclimatology of New Zealand has been reviewed in a recent symposium (cf. Devereaux *et al.*, 1968) and that of Australia has been discussed by Gill (1961, 1968).

For this paper the ostracode faunas of more than 50 samples from the Cenozoic of Victoria, southeastern Australia, have been analyzed (Text-fig. 1). Counts have been made of "floats" from washings prepared by me from stratigraphically located collections made mostly between September, 1964, and March, 1965, but supplemented later by a few samples collected during January, 1967. For most samples, the "floats" yielded more than 150 specimens suitable for counting (see Kornicker, 1964, p. 49, fig. 3), but in a few the ostracode faunules were impoverished.

SYSTEMATICS

Subfamily BYTHOCYTHERINAE
Genus HANAICERATINA n. gen.

Bythocythere (partim) : Brady (1880, p. 142)
Bythocythere ? : Keij (1953, p. 164)
Monoceratina : Crespin (1943, p. 28)
New genus of Bythocytherinae : Hanai (1961, p. 357, Text-fig. 1); McKenzie (1967b, p. 229).

Derivation of name: For Professor Tetsuro Hanai, pioneer worker in Japanese Cenozoic Ostracoda.

Table 2. Local Stage names in the Tertiary of Victoria, Australia, with their epochal equivalents

LOCAL STAGE NAME	EPOCH	
Kalimnan-Cheltenhamian		Pliocene
Mitchellian		
Bairnsdalian	Upper	
Balcombian		Miocene
Batesfordian	Middle	
Longfordian	Lower	
Janjukian		Oligocene
Aldingan	Upper	
Johannian	Middle	Eocene

Comparative diagnosis: As recognized by Keij (1953) and by Hanai (1961), this genus is characterized by its hinge, in which the median element is crenulate; the termini of this element consist of strong tooth-like projections, unlike other bythocytherine genera. The general shape of *Hanaiceratina* also is distinctive in that it lacks the prominent horns, alae, and pronounced swellings of some bythocytherines (*e.g., Monoceratina, Bythoceratina, Bythocythere).* It differs from *Cytheralison,* which also lacks such features, because *Cytheralison* is broader, lacks a caudal process, and has a different adductor muscle scar pattern and a different hinge.

Type species: Hanaiceratina arenacea (Brady) 1880.

Geologic Range: Neogene–Recent.

Hanaiceratina arenacea arenacea n. subsp.
Plate 4, figure 4, 5; Text-figure 2e

Bythocythere arenacea Brady (1880, p. 142, Pl. 33, fig. 3a–g, recorded as *arenosa* on Pl. 33); Hornibrook (1952, p. 17); Chapman, Crespin, and Keble (1928, p. 15, 171), (not *arenacea arenacea).*

Bythocythere arenosa (*sic*); Crespin (1943, p. 26, 27, 101) (not *arenacea arenacea*).

Monoceratina arenosa (*sic*); Crespin (1943, p. 28), (not *arenacea arenacea*).

Bythocythere ? sp.; Keij (1953, p. 164, Pl. 2, fig. 3a–e).

Partial description: Carapace medium sized, subrectangular; surface covered by a network of raised polygonal reticules, presenting a spiky appearance overall; median sulcus absent, or weakly present (in females); colour yellowish to creamy or whitish; dorsal margin straight; ventral margin slightly sinuated medially; anterior broadly rounded, dentate

TEXT-FIGURE 1. Map of Victoria showing localities collected or mentioned in the text. Scale of inset about 4/3 that of main map. 1, Myaring Bridge; 2, Port Campbell; 3, The Gorge; 4, Gibsons Steps; 5, Johanna River; 6, Browns Creek; 7, Castle Cove; 8, Fishing Point; 9, Apollo Bay; 10, Anglesea; 11, Bells Headland; 12, Bird Rock (near and west of Torquay); 13, Barwon Heads; 14, New Quarry, Batesford; 15, Seaholme; 16, Beaumaris; 17, Ricketts Point; 18, Port Phillip Bay; 19, Mornington (Fossil Beach on Balcombe Bay is nearby and to the south); 20, Westernport Bay; 21, Penguin Parade; 22, Tidal River, Wilsons Promontory; 23, Longford (Glencoe Parish is immediately east); 24, Bairnsdale; 25, Tambo River Bridge, at Swan Reach; 26, Lakes Entrance (Bunga Creek is a few kilometers to the east); 27, Banks Strait; 28, Ouyen (the Mallee Bores described by Chapman (1914a) were put down near here).

marginally; posterior produced into a distinct truncated subposterodorsal cauda; height subequal throughout the length and about ½ the length. In dorsal view: subhastate; greatest width medial; anterior tapered broadly, subacuminate; posterior abruptly truncated and produced into the cauda. Internally: inner lamellae broad, with prominent anterior and posterior vestibules, the anterior vestibule broad, the posterior vestibule long and narrow; lines of concrescence fairly regular; radial pore canals numerous, long, fine, straight to wavy, slightly widened at their bases; normal pore canals simple (difficult to observe); muscle scars consisting of an oblique row of 5 adductors with a fulcral scar slightly in front of and above this group; 2 frontal scars, the upper of them larger than the lower; and a mandibular scar ventrally; hinge complex; in RV consisting of small terminal teeth with a crenulate median furrow; in LV consisting of terminal sockets for the teeth of the RV, with a crenulate bar between them, the termini of which are divided into several separate tooth-like projections (Text-fig. 2e), the whole a highly evolved lophodont type. Sex dimorphism distinct, females shorter and broader than males, especially posteriorly. Soft parts not yet known.

Dimensions: Mature female: L 0.72mm; H 0.36mm; B 0.42 mm.
Mature male: L 0.80mm; H 0.37 mm; B 0.40mm.
BM (NH) 1969.8.8.5

Material: One male carapace, two male LV; one female RV, one female LV. A hypotype is also registered at the United States National Museum as USNM 127243.

Locality: Scripps Station V-27, Sahul Shelf Cruise I, "Malita;" Latitude 09°46.0'S., Longitude 128°-21.5'E., depth 290 feet (about 90m); bottom type, muddy sand.

Date collected: 28 November, 1960.

Discussion: The specimens were compared directly with the lectotype of *Bythocythere arenacea*, selected by Dr. H. S. Puri and Dr. N. C. Hulings out of the original *Challenger* material from Torres Strait and registered under B.M.(N.H.) 81.5.50. The lectotype is a mature male LV, the subposterodorsal cauda of which is broken off near its end. The length of this slightly damaged lectotypic specimen is 0.76 mm.

Hanaiceratina arenacea balcombensis n. subsp.
Plate 4, figure 1, 2; Text-figure 3i

Bythocythere arenacea Brady 1880; Chapman, Crespin, and Keble (1928, Pl. 15, 171).
Bythocythere arenosa (*sic*); Crespin (1943, p. 26, 27, 101).
Monoceratina arenosa (*sic*); Crespin (1943, p. 28).

Derivation of name: From the type locality.

Comparative diagnosis: As the Stereoscan photographs indicate, there are very slight differences between the two subspecies of *arenacea* in lateral view, although it is apparent that medioventrally *balcombensis* is angularly rounded whereas *arenacea* is smoothly rounded. In dorsal view the greatest breadth of *balcombensis* is seen to be posteromedial, not medial as in *arenacea*. Further, sex dimorphism is not apparent in my series of *balcombensis* specimens.

Dimensions: Mature specimen: L 0.78mm, H 0.37-mm, B 0.44mm; B.M.(N.H.) Reg. No. Io.5009 (holotype).

Material: Three mature LVs, two mature RVs; one immature LV and RV. A paratype is registered at the National Museum of Victoria under NMV P27228.

Rock unit: Balcombe Clay.

Age: Helvetian, cf. also Ludbrook (1967, p. 12, fig. 2).

Type locality: The type locality for the Balcombe Clay at Fossil Beach, between Mornington and Balcombe, Victoria, in the type section of the local Balcombian Stage.

Collector: K. G. McKenzie, September, 1964.

Discussion: Crespin (1943) has reported the presence of this subspecies at several localities in the Gippsland Basin. I cannot confirm all her records, as the species does not occur in my "floats" from the Mitchellian section at the Bairnsdale Pumping Station locality nor in those from the Tambo River Formation at its type locality, and I have not seen her bore material. But the subspecies does occur in Crespin's—"lower bed" at the type locality for the local Bairnsdalian Stage, see Crespin (1943, p. 23), and also occurs in the Bairnsdalian of the Port Campbell area. According to Crespin the subspecies ranges from Batesfordian to Kalimnan.

Hanaiceratina posterospinosa n. sp.
Plate 4, figure 6,7; Text-figure 3h

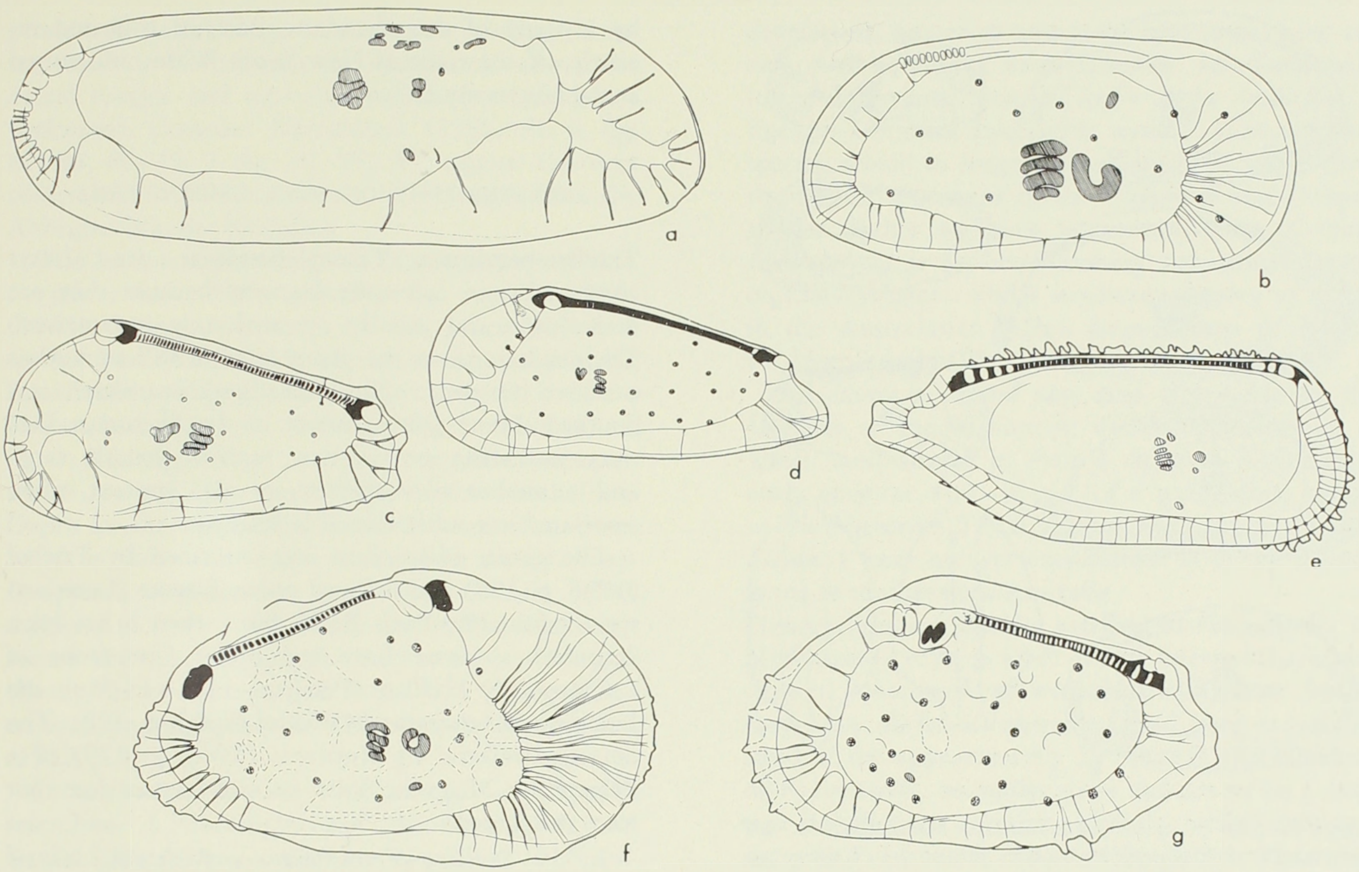
Derivation of name: For the small medioventral posterior spine on each valve.

Comparative diagnosis: A species of *Hanaiceratina* distinguished from all other species in the genus by the feature that is described in the specific name. Sex dimorphism present, males longer than females.

Dimensions: Mature male L 0.80 mm, H 0.38 mm, B 0.51 mm; USNM 127242 (holotype). Mature female, L 0.73 mm, H 0.40 mm, B 0.48 mm; BM (NH) 1969.8.8.4 (paratype). Mature male, L 0.78 mm, H 0.39 mm, B 0.05 mm; BM(NH) 1969.8.8.3 (paratype). Mature male, L 0.77 mm, H 0.39 mm, B 0.48; Aust. Mus. (paratype). Mature male, L 0.80 mm, H 0.39 mm, B 0.53 mm; HVH 8091 (paratype).

Material: Four mature male LVs, two mature male RVs; two mature female RVs.

Type locality: Scripps Station V-27, Sahul Shelf Cruise I "Malita"; Latitude 09° 46.0'S, Longitude 128° 21.5'E.; depth 290 feet (about 90m); bottom type, muddy sand.



TEXT-FIGURE 2. a, *Neocytherideinid* sp. Rutledge Creek. LV internal lateral view, n. p. c. not shown, 0.59 mm (closer to *Copytus* than to *Neocytherideis*); b, *Parakrithe* sp. Balcombian. LV internal lateral view, 0.41 mm; c, *Munseyella* sp. Balcombian. RV internal lateral view, 0.35 mm; d, *Pectocytherinid* sp. Rutledge Creek. RV internal lateral view, 0.35 mm; e, *Hanaiceratina arenacea arenacea* n. gen., n. subsp. Sahul Shelf. LV internal lateral view, n. p. c. very obscure, not shown except anteroventrally, 0.80 mm; f, *Ambocythere* sp. Rutledge Creek. LV internal lateral view, female, 0.45 mm; g, *Amphicytherura* sp. BCC @ CC 1. RV internal lateral view, 0.40 mm.

Date collected: 28 November, 1960.

Discussion: Although the type series of this species comes from the same sample as hypotypes of *H. arenacea arenacea,* the small medioventral posterior spine on this species is sufficiently distinctive so that no confusion between the two forms is possible.

Hanaiceratina henryhowei n. sp.
Plate 4, figure 3; Text-figure 3j

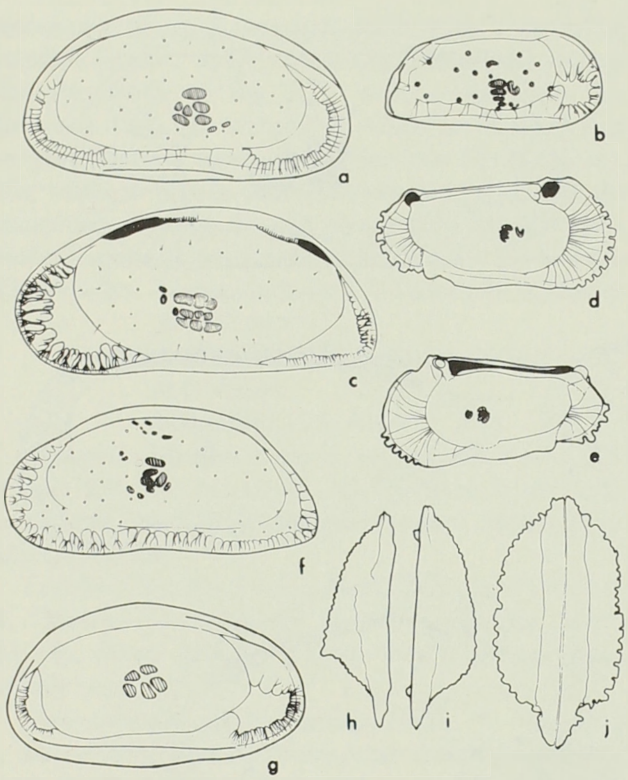
Derivation of name: For the late Professor H. V. Howe, ostracode taxonomist.

Comparative diagnosis: A species of *Hanaiceratina* distinguished by coarser surface spines than in the other species and by a differing shape in dorsal view (see figs.). It is also distinctive because of a well-developed marginal keel, which is easily observed in both dorsal and ventral views, and by a flange that, in the LV, extends much more prominently in the anterodorsal region than it does in any other species of the genus. Sex dimorphism present, females broader than males.

Dimensions: Mature male, L 0.85 mm, H 0.40 mm, B 0.42 mm; HVH 8092 (paratype). Mature male, L0.88 mm, H 0.40 mm, B 0.42 mm; BM(NH) 1969.8.8.1 (holotype). Mature female, L 0.88 mm, H 0.42 mm, B 0.45 mm; BM(NH) 1969.8.8.2 (paratype). Mature female: L 0.86 mm, H 0.42mm, B 0.45mm; Aust. Mus. (paratype).

Material: Three mature males; three mature females; 8 worn, ? mature specimens of indeterminate sex.

Type locality: Station M-278, Latitude 38°38.2'S., Longitude 144°59.2'E., Bass Strait, near Banks Strait.



TEXT-FIGURE 3. a, ? *Aglaiella* sp. Mitchellian 3. LV internal lateral view, 1.03 mm; b, *Krithe* sp. Balcombian. LV internal lateral view, 0.68 mm; c, *Macrocyprissa* sp. Bass Strait. RV internal lateral view, 1.43 mm; d, ? *Idiocythere* sp. Fishing Point Marl 1. LV internal lateral view, n.p.c. not shown, 0.75 mm; e, *Idiocythere* sp. BCC 5 equivalent. RV internal lateral view, n.p.c. not shown, 0.77 mm; f, *Phlyctenophora* sp. Sahul Shelf. 12°28.4' S Lat., 128° 19.3' E Long. RV internal lateral view, 1.01 mm; g, *Australoecia tumefacta* (Chapman) 1914. Kalimnan?. LV internal lateral view; n.p.c. not shown, 0.96 mm; h, *Hanaiceratina posterospinosa* n. gen., n. sp. Sahul Shelf. LV external dorsal view, 0.74 mm; i, *Hanaiceratina arenacea balcombensis* n. gen., n. subsp. Balcombian. RV external dorsal view, 0.77 mm; j, *Hanaiceratina henryhowei*, Banks Strait, 38° 38.2' S Lat., 144° 59.2' E Long. External dorsal view; 0.85 mm.

Discussion: Because Hornibrook (1952, p. 17) has recorded *Hanaiceratina* only from the warm water Aupourian Province of New Zealand and because most of the other records (including all the other Australian ones) are from warm water, *H. henryhowei* may well be a relictual species from a former period of warmer sea temperatures, and this may also be the role of the Japanese form illustrated by Hanai (1961, p. 357, fig. 1) Confirmation, or otherwise, of this interpretation would be assisted by a study of the abundant material collected recently off the coast of New South Wales and stored at the University of Sydney.

STRATIGRAPHY OF SOME USEFUL TAXA

Trachyleberidinae: Trachyleberidinae are always conspicuous in ostracode faunules because they are often large and usually are strikingly ornamented. Their taxonomy at the genus level is still somewhat confused but their regional stratigraphic utility is undoubted. Many genera occur in the Victorian Tertiary, including several new taxa of generic rank, and numerous new species are also present, often associated in readily traceable lineages.

The genus *Idiocythere* was described by Triebel (1958, p. 105) and is based on an Eocene (Lutetian) species from the Paris Basin. Since then it has been described at least from the upper Cretaceous of California by Holden (1964, p. 422) and from the Lutetian of Aquitaine by Deltel (1964, p. 190). The tentative referral by Reyment (1963, p. 179) of a Palaeocene Nigerian form to this genus does not seem warranted.

In the Tertiary of southeastern Australia, *Idiocythere* is represented by two species. The first of these, which is similar to the typical forms illustrated by Triebel (1958, Pl.1) and Deltel (1964, Pl.6, fig. 131–133), occurs in the Browns Creek Section (BCC 6) above the *Notostraea* greensand and also in the Castle Cove Section at the very top (CC2 and CC 2 + 1m) of the profile measured by Carter (1958, fig. 3). In these sections its range is from Aldingan to Janjukian (Text-fig. 3e). The second species is younger, occurring in the basal 1m of the Fishing Point Marl section (FPM 1) and is a less typical *Idiocythere* (Pl.1, fig. 12,13; Text-fig. 3d). Thus it seems that in Victoria *Idiocythere* may range into the lowermost Miocene. The more typical species is a useful Aldingan-Janjukian local index.

The genus *Alatacythere* is distinguished from the genus *Pterygocythereis* by its hinge type. The Australian group, 2 forms of which are illustrated (Pl. 2, fig. 6, 7) has a weakly crenulate posterior hinge tooth in the right valve, and therefore it is placed in *Alatacythere.* It differs from typical *Alatacythere* in that the ventral ala is often perforated (and in 1 form there is also a perforated weak near dorsum ridge). These forms differ from typical *Bradleya* in that they have a caudal process, are smooth surfaced, lack a prominent dorsal ridge, or else such a ridge (if interpreted to be present) is immediately above the dorsal margin and typically is coarsely toothed, not perforated. Compare Hornibrook (1952, Pl. 6, fig. 80, 83, 86; Pl. 7, fig. 90, 93, 96) against the taxa illustrated. In Victoria *Alatacythere* ranges from the Aldingan into the Neogene.

The known species and the biogeography of *Ambocythere* have been reviewed by van den Bold (1965). Australian records for this genus include 2 species from Sahul Shelf, off northwestern Australia, Bass Strait and Banks Strait (Pl. 2, fig. 2-5) in the Recent, and from the Rutledge Creek beds (Pl. 2, fig. 1; Text-fig. 2f) in the Port Campbell Limestone, which are a deeper water facies of the Mitchellian. Depth for the record from Banks Strait is about 50m, which is close to the depth recorded for the *Challenger* species, *Ambocythere stolonifera* (Brady) 1880, collected in Simons Bay, South Africa. The Bass Strait record is from 85m depth. Incidentally, *stolonifera* (Brady) has been reported from New Zealand faunules during and since the Oligocene by Hornibrook (1952, p. 14).

In its external features, the Rutledge Creek species resembles *A. stolonifera* and the Bass Strait and Banks Strait forms, rather than the Sahul Shelf species, one of which, on the other hand, is close to *A. bodjonegoroensis* (Kingma) 1948 from the Pliocene of Java.

The genus *Ponticocythereis* ranges today from the Marianas (Saipan) via the Indo-Pacific to southern Australasia. It first appears in my samples in the basal Mitchellian, 2m above the Bairnsdalian-Mitchellian contact in the Bairnsdale Pumping Station Section, and occurs regularly after this. Recent Australian records apart from those listed earlier by McKenzie (1967c, p. 97) include several other collections from Port Phillip Bay, also Bass Strait (at 85m), Banks Strait, Penguin Parade on Philip Island, the beach at Tidal River Wilsons Promontory, and Sahul Shelf off northwestern Australia. The genus appears to have radiated widely since the early Neogene.

The species *Cythere caudispinosa* Chapman and Crespin 1928 (Pl. 1, fig. 4) was described from the Sorrento Bore, on the Mornington Peninsula in Victoria. It is representative of a lineage that ranges from the upper part of the Johannian to the Mitchellian in southeastern Australia. Specimens from the type locality appear to be mature forms with an hemiamphidont hinge (the terminal teeth well developed), numerous rather straight radial pore canals, well-developed inner lamellae, etc. Frequently in the collections, however, forms in the *caudispinosa* lineage are associated with mature *Cletocythereis* species, which in length are about 25% larger than the largest specimens of the Chapman and Crespin species. Either we have homeomorphy or *Cythere caudispinosa* is an adult-looking penultimate stage of *Cletocythereis,* which is already known to range in the Australasian region from Eocene to Recent (cf. Hornibrook, 1952, p. 13, 17, 19.

An example of the new taxa that occur in the faunules is the distinctive *Trachyleberidine* sp. 1, which is illustrated in Plate 1, figure 6. This apparently endemic form is part of a group that ranges in the Victorian Tertiary from Aldingan to Bairnsdalian. I have not yet encountered it in the Recent fauna of southeastern Australia.

Hemicytherinae: Species ascribed to *Pokornyella* in McKenzie (1967a, p. 232) possess internal characters close to *Pokornyella* s.s. with these differences: firstly, they have about 40 anterior radial pore canals instead of the approximately 25 that are characteristic of *Pokornyella;* secondly, there appears to be a narrow but distinct anterior vestibule, which does not occur in *Pokornyella limbata* (Bosquet) as illustrated by Howe and Reyment in Moore (1961, p. Q305). The latter character is typical of some species of *Aurila,* which, however, has a strongly crenulate median hinge element and "a little more than 75" anterior radial pore canals, according to Pokorny (1955, p. 20). Further, there are only 2 frontal muscle scars in the Australian forms whereas 3 such scars characterize *Aurila.* The external appearance of the Australian forms (Pl. 1, fig. 5) is like that of both *Aurila* and *Pokornyella.* On balance, an ascription to *Pokornylla* s.l. sems justified. In the Victorian Tertiary, *Pokornyella* s.l. is restricted to the Oligocene, occurring in the Bells Headland beds and Point Addis Limestone facies of the local Janjukian Stage, near Torquay; and also at the top of the Castle Cove Section (CC 2 + 1m) in Carter's "Upper Glen Aire Clays," which were assigned to the lower Longfordian in Carter (1964, p. 53), but are now thought to be Janjukian.

Hemicytherines are not common in the Recent fauna, the few exceptions including such species as *Ambostracon* s.l. *pumila* (Brady) 1866 and *Hemicythere* s.l. *kerguelensis* (Brady) 1880 (Pl. 1, fig. 9,10). Ancestral forms of these 2 species first appear in the samples during the Neogene and are never numerous. I noted earlier that *Ambostracon* s.l. *pumila* has fewer radial pore canals than the type species (McKenzie 1967c, p. 93), and recorded its correspondence in this respect with some South African species.

Cythere flexicostata Chapman 1914 comes in very strongly during the Batesfordian, as do lineages associated with 1 or 2 as yet undescribed forms. At present, because all the specimens are preserved entire, I am not completely certain that these forms that I have counted as Trachyleberidinae are not in fact hemicytherines. The taxa are useful because they characterize the typical Batesfordian facies of the Geelong area and also the Batesfordian in the Gippsland Basin (Glencoe Limestone).

Leptocytherinae: Leptocytherinae are represented typically by *Callistocythere* and (Pl. 2, fig. 12) *Munseyella* and by the apparently restricted Australasian and Indo-Pacific genus *Arcacythere*. I am here considering pectocytherines as a tribe of Leptocytherinae. Several different *Munseyella* forms occur in the Victorian Cenozoic, where it ranges at least from Johannian to Recent. Two of the common ones are illustrated (Pl. 2, fig. 9, 10; Text-fig. 2c).

There are 2 lineages of *Arcacythere*, both of which range into the Recent. One of these (Pl. 4, fig. 11) occurs in Victoria in sediments of Johannian-Longfordian age and is represented in the Recent Australian fauna by a form living on Sahul Shelf. The other lineage, which comprises taxa similar to the type species of *Arcacythere* (Pl. 4, fig. 10), ranges from Aldingan-Recent in Victoria, the Recent records coming from Banks Strait. In the Castle Cove Section, this second lineage occurs on its own, but in several Janjukian samples from the Torquay section both lineages are found together. The small pectocytherinid sp. that is illustrated (Text-fig. 2d) seems to belong in a new generic category. It has a punctate surface ornamentation.

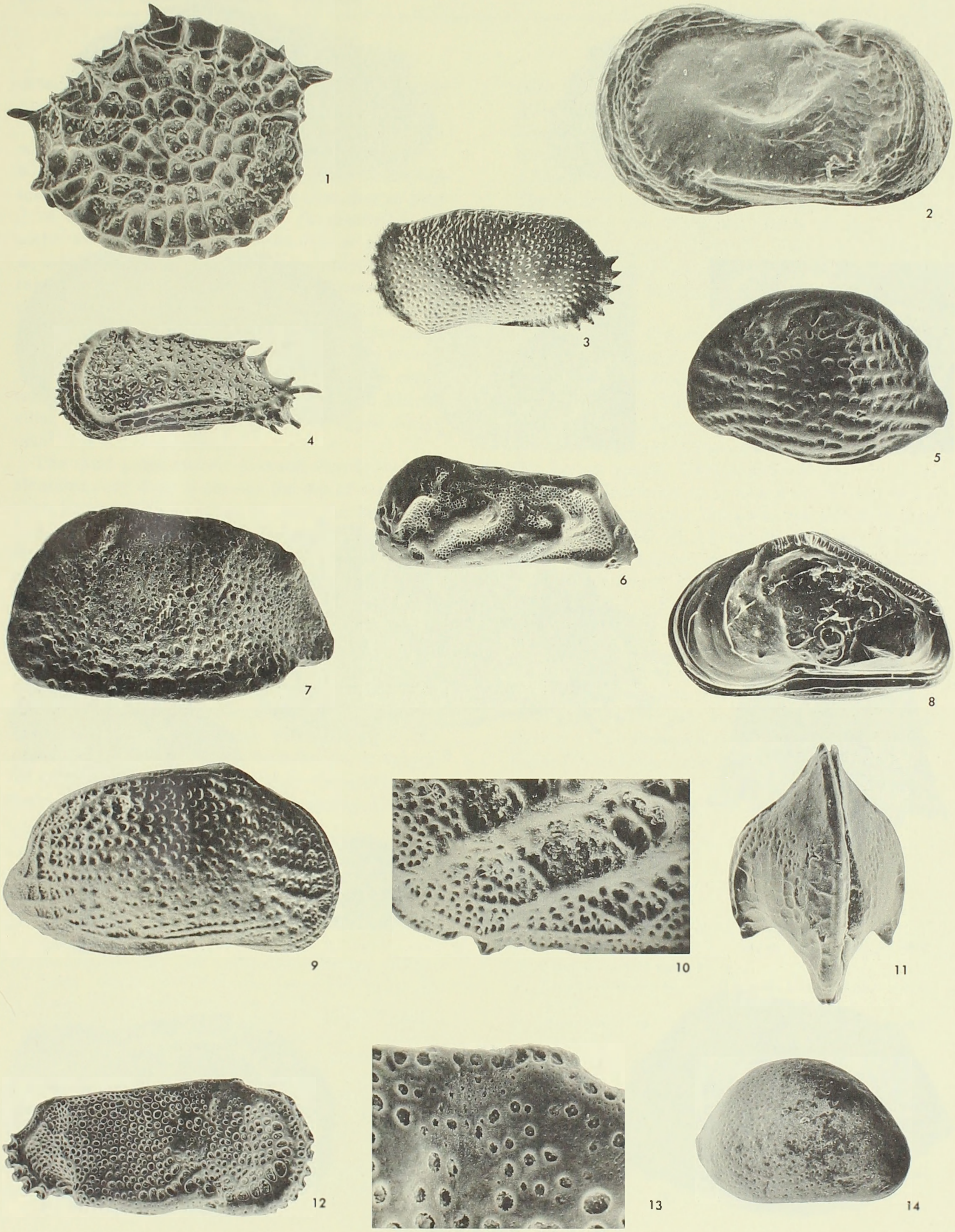
Bythocytherinae: *Bythocythere*, a cosmopolitan genus, first appears in these collections in the Bairnsdalian, then occurs again in the Kalimnan ? sample (Table 5). It lives today both in Bass Strait and on Sahul Shelf. Its appearance in the 2 Neogene samples may well be fortuitous, for in both cases only single specimens are involved and one of them is a juvenile.

The *Bythoceratina* that is illustrated (Pl. 4, fig. 8,9) appears to be restricted to the Cheltenhamian-Kalimnan of Victoria. It is quite unlike any of Hornibrook's (1952, p. 63–65) several New Zealand species, nor does it resemble any of the species that are living on Sahul Shelf.

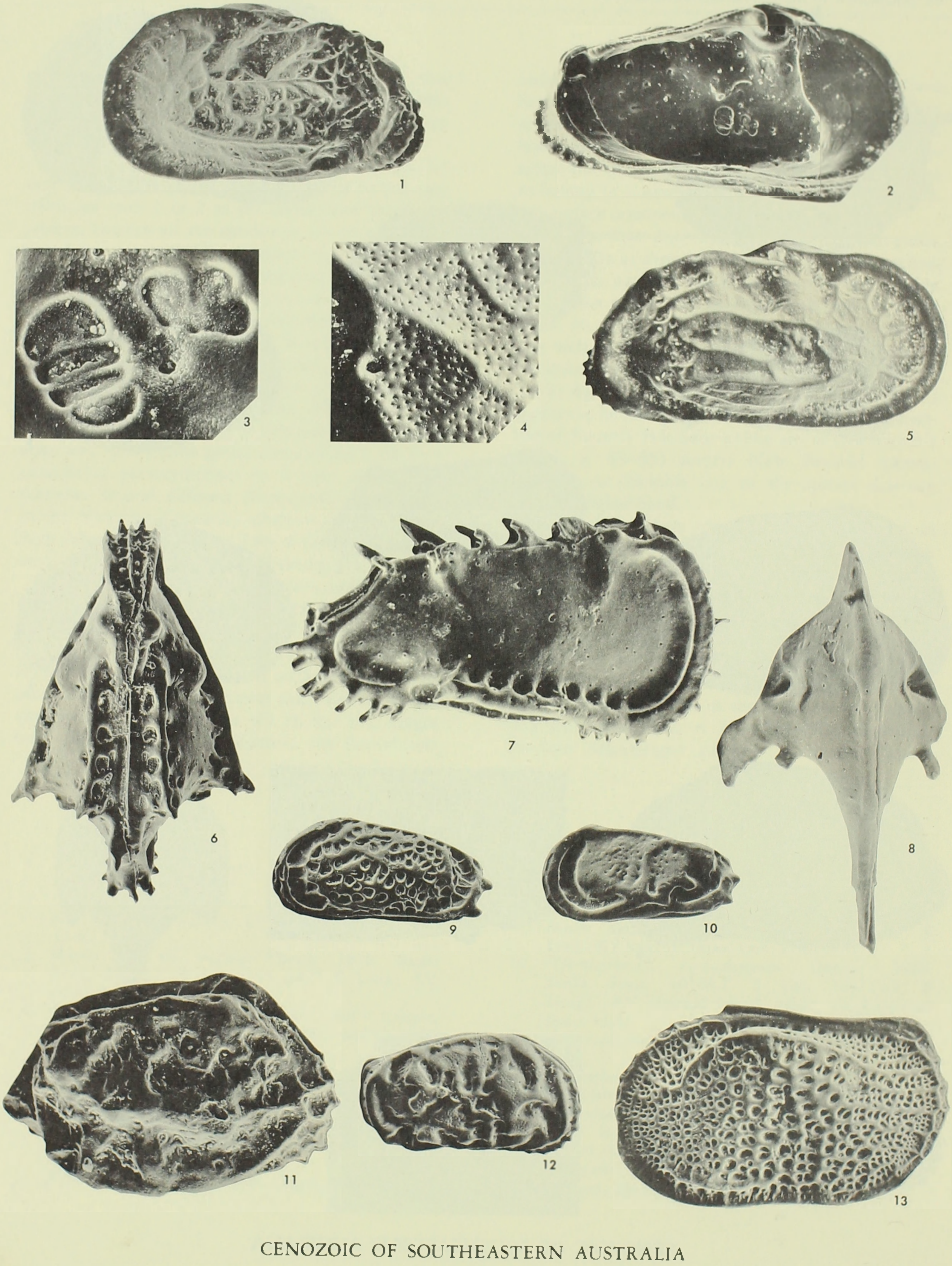
Cytheralison (here considered as belonging in Bythocytherinae, but having separate tribal status) is an Australasian endemic so far as is yet known. It ranges in the assemblages from the middle Castle Cove Limestone (Aldingan) to the Recent. The Recent form, which is illustrated in Pl. 4, fig. 12–14, comes from Banks Strait and resembles the New Zealand species *C. pravacauda* Hornibrook (1952, p. 66), which he notes is restricted to the Aupourian province (1952, p. 17). The SEM (Scanning Electron Microscope) pictures show much more

PLATE 1

1 *Polycope* sp. Balcombian; RV external lateral view, x246.
2 *Cytherelloidea intermedia* (Chapman and Crespin) 1928. Balcombian; LV external lateral view, x136.
3 *Bairdia* sp. aff. *angulata* Brady 1870. Banks Strait, 40°53.1' S Lat., 148 28.7' E Long.; LV external lateral view, x126.
4 *Cythere candispinosa* Chapman and Crespin 1928. Rutledge Creek; LV external lateral view, x123.
5 *Pokornyella* s. l. sp. Bells Hedland 2; LV external lateral view, x148.
6 Trachyleberidine sp. 1. Bells Headland 1; LV external lateral view, x149.
7 Trachyleberidine sp. 2. Bells Headland 1; LV external lateral view, x145.
8 *Rotundracythere* sp. Banks Strait, 40°53.1' S Lat., 148°28.7' E Long.; RV internal lateral view, x146.
9 *"Hemicythere" kerguelenensis* (Brady) 1880. Banks Strait, 40°48.2' S Lat., 148°12.8' E Long.; RV external lateral view, x148.
10 *"Hemicythere" kerguelenensis* (Brady) 1880. Banks Strait, 40°48.2' S Lat., 148°12.8' E Long.; RV external lateral view, posteroventral detail, x740.
11 *Cytheropteron* sp. Gellibrand Clay; dorsal view, x235.
12 *?Idiocythere* sp. Fishing Point Marl 1; RV external lateral view, x140.
13 *?Idiocythere* sp. Fishing Point Marl 1; RV external lateral view, anterodorsal detail indicating absence of eye tubercule, x690.
14 *Uroleberis minutissima* (Chapman) 1926; Balcombian; RV external lateral view; x130.



CENOZOIC OF SOUTHEASTERN AUSTRALIA



CENOZOIC OF SOUTHEASTERN AUSTRALIA

detail of the hinge of this genus than was previously known (cf. Hornibrook, 1952, p. 18).

The distribution of my new genus, *Hanaiceratina,* is given in the Systematics section of this paper.

Krithinae: Three krithinid genera occur in the Victorian Cenozoic. It will be shown later that at least 2 of these genera (*Krithe* and *Parakrithella*) are useful palaeoecological indicators, but at present it is sufficient to indicate their discontinuous time ranges in the samples analyzed. Thus, *Krithe* by itself occurs in the Johannian, Aldingan, type Balcombian (Text-fig. 36) and Kalimnan?-Cheltenhamian samples whereas *Parakrithella* by itself is found in several Janjukian-Bairnsdalian samples. Tte 2 genera occur together in some Janjukian-Longfordian and Mitchellian collections (Text-fig. 4). *Krithe eggeri* Chapman 1914 is a *Parakrithella.*

The third genus known to occur, *Parakrithe,* was identified only three times—at the top of the Castle Cove Section (CC 2, Table 3), near the top of the Fishing Point Marl Section (Table 3) and in the Balcombian (Table 4; Text-fig. 2b). Although infrequently recorded from Recent faunas, *Parakrithe* is known to live on Sahul Shelf, and a species close to *P. dactylomorpha* Ruggieri 1962 lives in the Bay of Naples.

Saida. The systematic affinities of *Saida* may be with the Cytherinae, which would associate it with *Loxocythere* which is considered next.

Although *Saida* today may be restricted to the Australasian region and the Indo-Pacific, it ranged far more widely during the Upper Cretaceous and Tertiary (cf. Deltel, 1964, p. 196; Herrig 1966, p. 944). Two lineages occur in the Victorian Cenozoic from Aldingan-Recent. Of these, the more common lineage (Pl. 2, fig. 13) was identified from several samples throughout the stratigraphic columm, and a Recent representative lives today near Banks Strait. The second lineage a more elongate form, occurs only during the Janjukian (Table 4) and in the Kalimnan ? sample (Table 5). *Saida* does not occur at all in the type Longfordian and Batesfordian nor in the Western Beach, Geelong facies of the Bairnsdalian.

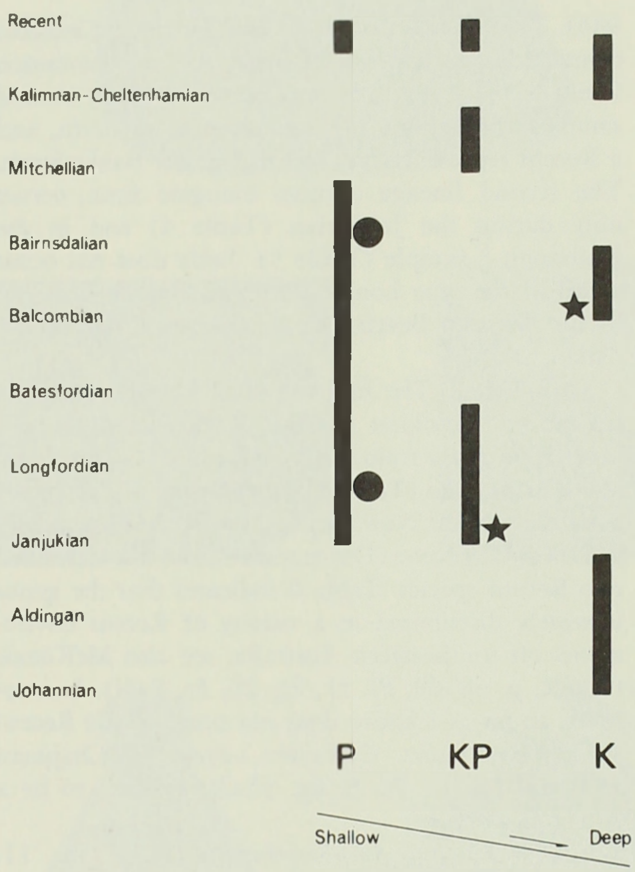
Loxocythere. The first record of *Loxocythere* is in the upper Janjukian at Bird Rock (Table 4) and other records are from the Batesfordian (Glencoe Lst) and Bairnsdalian (Table 5). Hornibrook (1952, p. 30) gave the earliest New Zealand record known to him as Lower Oligocene (Duntroonian) and also described two Recent species. Table 6 indicates that the genus is widely distributed in a variety of Recent environments off southeastern Australia, see also McKenzie (1967c, p. 68–69, Pl. 11, fig. 2b, 5e, 7a–i). *Loxocythere,* so far as I know, does not occur in the Recent Sahul Shelf fauna. *Cytherura ouyenensis* Chapman 1914 (p. 44–45, Pl. 8, fig. 35a,b) appears to be a good *Loxocythere.*

Schizocytherinae: *Amphicytherura* (Pl. 2, fig. 11; Text-fig. 2g) has a narrow time range in the Victorian Tertiary where it is confined, in these collections, to the Aldingan, and is most numerous near the top of the Browns Creek Clays in the section at Castle Cove (Table 3 and Appendix I).

Paijenborchella, on the other hand, which was first described from the Tertiary of Victoria by Keij

PLATE 2

1 *Ambocythere* sp. Rutledge Creek; LV external lateral view, x253.
2 *Ambocythere* sp. aff. *stolonifera* (Brady) 1880; Banks Strait, 39°44.4' S Lat., 146°41.5' E Long.; LV internal lateral view, x248.
3 *Ambocythere* sp. aff. *stolonifera* (Brady) 1880. Banks Strait, 39°44.4' S Lat., 146°41.5' E Long.; LV internal lateral view, detail of muscle scars, x1260.
4 *Ambocythere* s. aff. *stolonifera* (Brady) 1880. Banks Strait, 39°44.4' S Lat., 146°41.5' E Long.; RV external lateral view, detail of anterior, x1260.
5 *Ambocythere* sp. aff. *stolonifera* (Brady) 1880. Banks Strait, 39°44.4 S Lat., 146°41.5' E Long.; RV external lateral view, x252.
6 *Alatacythere* sp. BCC 6; dorsal view, x123.
7 *Alatacythere* sp. 1 m above Bird Rock; RV external lateral view, x156.
8 *Paijenborchella* sp. Gellibrand Clay; dorsal view x235.
9 *Munseyella* sp. Bells Headland 1; LV external view, x143.
10 *Munseyella* sp. BCC 6; LV external lateral view, x150.
11 *Amphicytherura* sp. middle CC Lst; RV external lateral view, x287.
12 *Callistocythere*s p. 1 m above Bird Rock; RV external lateral view, x146.
13 *Saida* sp. Bells Headland 1; LV external lateral view, x240.



TEXT-FIGURE 4. Distribution of Krithinae. The distribution of *Parakrithella* (P), *Krithe* and *Parakrithella* together (KP) and Krithe (K) in samples from the Cenozoic of Victoria, as a palaeoceological index of the depositional depth. At the shallow end, depositional depths are at most 50 m , but usually less than 25 m . At the deep end, depositional depths are at least 75 m , but usually more than 100 m. Closed circles = atypical *Parakrithella;* closed stars = *Parakrithe.* Note how these define changing depositional depths.

(1966, p. 343, 345, 350, Pl. 2, fig. 14a–c) ranges from Longfordian to Mitchellian, occuring in 10 samples overall, including at least 2 from each main area collected (Tables 3, 4). In this time range it is missing from the typical facies of the Longfordian, Batesfordian, and Bairnsdalian stages, also from the Western Beach, Geelong, facies of the Bairnsdalian. It is not known from the Recent fauna off south-eastern Australia.

The species illustrated (Pl. 2, fig. 8), which has an indistinct bar across the sulcus, seems closer to *P. iocosa* Kingma 1948 than to *P. solitaria* Ruggieri 1962, to which the form recorded by Keij (1966) was referred.

Cytherurinae: Cytherurinae occur consistently throughout the Victorian Cenozoic assemblages. Particularly characteristic in the faunules are many small species with affinities to *Cytheropteron* (e.g., Pl. 3, fig. 1; Pl. 1, fig. 11).

Recognizable lineages have certainly developed in these cytheropteronids, but here I prefer to concentrate upon 3 other, easily identifiable genera, *Hemicytherura, Kangarina,* and *Eucytherura,* which range in Victoria at least from Johannian to Recent. The New Zealand representatives of these genera have a similar range as noted by Hornibrook (1952, Pl. 13, fig. 195–212; Pl. 14, fig. 213–228; and *Hemicytherura radiata* Hornibrook 1952, Pl. 15, fig. 245–247, which is a *Kangarina).*

All three genera are small, typically less than 0.5 mm, and their often spectacular surface ornamentation (cf. Pl. 3, fig. 3,4) makes them particularly good subjects for the SEM. The high resolution of detail by this instrument at moderate magnifications (x500 to x1000) allows evolution of the lineages to be clearly demonstrated especially in broadly similar facies. Part of a *Kangarina* lineage is illustrated to make this clear (Pl. 3, fig. 5-10; Pl. 5). Some *Eucytherura* forms are also illustrated (Pl. 3, fig. 11–13; Pl. 5, fig. 7–11) the photographs showing that in *Eucytherura,* very satisfying shell characteristics, from an evolutionary point of view, are the medioventral muscle nodes and the posteroventral alae.

Eucytherinae: The characteristic eucytherine genus of the Australasian region is *Rotundracythere* Mandelstam which was based upon the New Zealand species *Eucythere rotunda* Hornibrook 1952. A recent *Rotundracythere* from Banks Strait that seems close to the type species is illustrated (Pl. 3, fig. 2; Pl. 1, fig. 8).

In the Recent fauna, Eucytherinae are absent from protected Port Phillip Bay but do occur in assemblages from oceanic littorals and, as noted, in those from Banks Strait. The subfamily has no representatives among the almost 160 species from Sahul Shelf (only part of the large fauna) for which I have comparative material, or in the collections I made around Heron Island, Carpenteria Group, Great Barrier Reef.

Eucytherinae range from Johannian-Recent in Victoria but are absent or virtually so in the Bates-

Table 3. Abundances in subfamilies of Tertiary Ostracoda from the Port Campbell-Aire District of Victoria

Figures given are percentages, except for the asterisked samples where they represent actual number of specimens counted in the "floats."

	Trachyleberidinae	Hemicytherinae	Eucytherinae	*Loxocythere*	*Saida*	Schizocytherinae	Cytherurinae	Neocytherideinae	Krithinae	*Paracytheridea*	Loxoconchinae	Xestoleberidinae	Leptocytherinae	Bythocytherinae	Paradoxostomatinae	Microcytherinae	incertae sedis	Saipanettidae	Macrocypridinae	Paracypridinae	Pontocypridinae	Bairdiinae	Bythocyprinae	Cytherellidae	Polycopidae
*The Gorge	18		11	3			13		2			6	16	4	2	1	3				8	2		9	
Rutledge Creek	16.5		4.5		1.0	1.0	28.5	3.5	1.0	1.0	0.5	13.0	11.0		1.5		1.0	0.5			10.0	3.0		2.5	
Gellibrand Clay	11.5				3.5	1.5	22.5		0.5			13.5	3.5								28.5	5.5	7.5	2.0	
Gibsons Steps	6.0	1.0			2.0		10.5		6.0		0.5	11.5	2.5		1.5				0.5		35.0	5.5	5.5	12.0	
Fishing Point Marl III	70.5	2.0	1.0				5.5				2.0	2.0	4.5	0.5	0.5						4.0	2.5	1.0	4.0	
Fishing Point Marl IV	41.0	0.5	2.5			1.0	10.5		12.0	0.5		5.0	2.5	0.5	0.5	0.5					9.0	4.0	6.5	3.5	
Fishing Point Marl I	72.0		3.5		1.5		2.0					2.0	8.0	0.5	1.0	1.0	0.5				3.0	2.5		2.5	
Fishing Point Marl II	50.0		2.0		0.5		9.0		1.0		0.5	6.0	15.0	0.5	0.5		2.0	0.5			2.5	4.0	3.0	3.0	
CC2 + 2m	80.0	0.5	2.0				8.5				1.0	0.5	2.0			1.0					0.5	1.5		2.5	
CC2 + 1m	87.0	3.0	1.0				2.5				0.5	0.5	2.5								0.5	1.5	0.5	0.5	
CC 2	34.5	1.0	3.5		0.5	0.5	23.0		1.0		8.5	6.0	6.0	1.0	1.0						3.5	2.0	6.0	2.0	
CC 3	66.5		3.0				9.5				0.5	5.0	4.0				1.0				1.5	1.0	6.5	1.5	
CC 4	13		1				1				1	3	2				1					1		1	
CC 5	31.5		2.5				19.5		2.5		2.0	8.0	7.5		0.5						5.0	6.0	8.5	6.5	
CC 6	5.5		6.5				20.5		1.0		2.5	0.5	59.0	0.5							0.5	0.5	2.5	0.5	
middle CC Lst	25.0		3.5		0.5	1.0	5.5		0.5		5.5		54.5	1.5							1.5	0.5	0.5		
BCC @ CC I	6.5		0.5		0.5	1.5	25.5		3.0		8.0	9.0	36.0	0.5	0.5						3.5	0.5	2.0	2.5	
BCC @ CC II	16.5	1.0	3.5		1.5		23.0		1.5		7.0	2.0	37.0	0.5							2.5	1.0	1.5	1.5	
BCC 2	42.0		1.5				23.0				3.5	4.0	15.0	0.5							3.5	2.0	2.5	2.5	
BCC 5	16.0								1.0			0.5	3.0	2.0				0.5			59.5	1.5	7.0	7.0	
BCC 6	31.5		1.0		0.5		15.5		0.5		1.0	4.5	9.5	0.5	0.5				2.5		18.0	6.5	3.0	5.0	
**Notostraea* Greensand	11		5				12				2	14	17		3						11	7	3		
*BCC 7a	50		5				9		2		4	9	13								22	4	3	10	
*BBC 7b	5						9					3	1								1		1		
*BCC 7c	12								1			1									3	1			
*BCC 8	35		2				30		3			1	14								25	4	1	6	

CC - Castle Cove Lst.; BCC @ CC = Browns Creek Clays at Castle Cove: BCC = Browns Creek Clays (see also Appendix I).

fordian and in most of the Bairnsdalian-Kalimnan samples.

Paradoxostomatinae, Microcytherinae: I have already commented on the distribution of these groups in the Australian Tertiary in McKenzie (1969, p. 61, table 2). These records can be amplified from Tables 4 and 5, which indicate that the subfamilies are more abundant in the upper Janjukian (at Bird Rock, Table 4) and also in the mid-Longfordian (at Fishing Point Marl 4 and 1, Table 3), than in the other samples.

Xestoleberidinae: Xestoleberidinae occur regularly in the samples but, with the exception of the lineage associated with *Uroleberis minutissima* (Chapman) 1926 (Pl. 1, fig. 14) the species concerned may not be as useful stratigraphically as are species of some other subfamilies.

The genus *Uroleberis* was described by Triebel (1958, p. 110) for an Eocene (Lutetian) species, *Eocytheropteron parnensis* Apostolescu 1954. In southeastern Australia *Uroleberis* ranges at least from Aldingan to Recent, and the *U. minutissima* lineage is closer in appearance to the type species, and to the Recent species from near Adelaide figured by Triebel (1958, Pl. 3, fig. 14a, b) than it is to the characteristic Indo-Pacific species *U. foveolata* (Brady) that Triebel also illustrated (1958, Pl. 3, fig. 15a, b).

Loxoconchinae: In the Tertiary assemblages, Loxoconchinae are most abundant in the Browns Creek Clays at Castle Cove, which belong to the Aldingan Stage (Table 3), in the Batesford Limestone (Table 4) and Glencoe Limestone (Table 5), and in the Kalimnan ?-Cheltenhamian samples (Table 5). In the Recent series of samples, the subfamily is well represented at Ricketts Point, in Bass Strait, and in Banks Strait (Table 6).

The Batesfordian form is a *Loxoconcha* of the *L. australis* Brady 1880 type and is restricted, as

Table 4. Abundances in subfamilies and families of Tertiary Ostracoda from the Melbourne-Geelong-Torquay districts of Victoria

Figures given are percentages (see also Appendix I).

	Trachyleberidinae	Hemicytherinae	Eucytherinae	*Loxocythere*	*Saida*	*Puijenborchella*	Cytherurinae	Neocytherideinae	Krithinae	*Paracytheridea*	Loxoconchinae	Xestoleberidinae	Leptocytherinae	Bythocytherinae	Paradoxostomatinae	Microcytherinae	incertae sedis	Saipanettidae	Macrocypridinae	Paracypridinae	Pontocypridinae	Bairdiinae	Bythocyprinae	Cytherellidae	Polycopidae
Western Beach, Geelong	26.0	1.5	0.5				6.0		12.0		1.5	15.5	4.0	1.0	0.5	1.0			1.0	1.0	11.5	14.0	1.5	1.5	
Balcombian	21.5		0.5		2.5	1.5	15.0		7.5			4.0	6.0	3.0				3.0	4.0		9.0	12.0	0.5	5.0	5.0
Batesfordian	43.0	6.0					2.0				24.0	5.0	1.0							0.5	1.0	10.0	3.0	4.5	
Zeally Lst.	53.5	6.0	7.0				12.0				10.0	2.0	3.0	4.0								0.5		2.0	
1m above Bird Rock	10.5	3.5	2.0	0.5		0.5	18.5		1.5	0.5	0.5	5.0	34.0		2.5	3.5					4.0	2.5		10.5	
1-2m below Bird Rock	12.0	3.5	1.0		0.5	0.5	20.0				1.0	7.5	30.0		2.5	1.5	0.5		0.5		8.5	0.5		10.0	
Point Addis Lst. I	62.0	11.0	2.0				6.0				2.5	1.5	10.5	1.0		0.5			0.5			0.5		1.0	
Point Addis Lst. II	39.0	4.5	2.5				14.0					4.5	31.0	0.5		0.5	1.5					1.0		0.5	
Bells Headland I	23.0	7.5	4.5		2.0		18.5		1.5		4.0	4.0	26.0	1.0					0.5		5.0	1.0		25	
Bells Headland II	16.0	40.0	1.5		0.5		5.5				4.0	4.5	16.0	0.5	0.5	0.5	1.5				3.0	2.0		3.0	

Table 5. Abundances in subfamilies and families of Tertiary Ostracoda from the Gippsland district of Victoria (see also Appendix I)

Figures given are percentages, except for the asterisked sample where they represent number of specimens counted in the "float."

	Trachyleberidinae	Hemicytherinae	Eucytherinae	*Loxocythere*	*Saida*	*Puijenborchella*	Cytherurinae	Neocytherideinae	Krithinae	Paracytheridea	Loxoconchinae	Xestoleberidinae	Leptocytherinae	Bythocytherinae	Paradoxostomatinae	Microcytherinae	incertae sedis	Saipanettidae	Macrocypricinae	Paracypridinae	Pontocypridinae	Bairdiinae	Bythocyprinae	Cytherellidae	Polycopidae
Kalimnan I	23											5	6							5					
* Kalimnan II	16.5						13.0	4.0	12.5		1.0	2.0	42.5			1.0					0.5	1.0		6.0	
Kalimnan ?	10.0	6.0					6.0	1.5		0.5	12.5	20.0	10.0	5.0	1.0				1.5	1.5	2.5	7.5		12.5	2.0
Cheltenhamian	25.0	1.0				0.5	7.5	0.5			13.0	6.0	3.0	6.0					4.0	0.5	4.5	5.5	1.0	20.5	2.0
Mitchellian I	5.5		2.0			2.0	64.5				3.0	3.5	14.0				3.0				1.5	1.0		1.5	
Mitchellian II	20.5						44.0	2.5			0.5	2.5	19.0		0.5		2.0				3.0	1.5		2.0	
Mitchellian III	40.0						6.5	2.5	4.0		1.0	3.5	21.5						7.0	7.0	1.0	2.0		4.0	
Bairnsdalian	26.0	1.0		1.5			5.5	1.5	5.0		5.5	3.0	41.0	2.0	0.5		1.5				3.0	2.0		1.0	
Glencoe Lst.	40.5	2.0	0.5	3.0			2.0		21.0		14.5	2.0	12.5							1.0		1.0			
Longfordian I	51.5		2.0				9.5		6.0		3.0	6.0	12.5	1.5	0.5	0.5	1.5			2.5	1.5	0.5	0.5	0.5	
Longfordian II	67.0	4.5	4.5				7.5		2.0			0.5	7.0	0.5			1.5			2.0				3.0	

an *abundant* fossil, to the Batesfordian. Another characteristic *Loxoconcha* is a small (about 0.45 mm) form which ranges from Johannian-Aldingan, but is only abundant in the upper Aldingan (at Castle Cove, see above).

I have not seen *Loxoconchella* yet in fossil assemblages from Victoria, although it occurs in Port Phillip Bay, also in Bass Strait and in Banks Strait in the Recent fauna.

Neocytherideinae: Species of this family do not appear in the assemblages reported on here until the Bairnsdalian (Table 5) but occur regularly after this. Hornibrook (1952, p. 13) records *Cytherideis novaezealandiae* Brady, 1898 as persisting in New Zealand since the Eocene. One of the Australian Tertiary forms is illustrated (Text-fig. 2a) and a Recent species in the subfamily was described as *Copytus rara* from Port Phillip Bay in McKenzie (1967c, p. 71, fig. 2j) where the distributions of some related taxa were also recorded. In the Recent off southeastern Australia, the subfamily occurs in the Tidal River sample, also in Bass Strait and Banks Strait (Table 6).

Bairdiidae: The taxonomy of bairdiids has been recently reviewed by Maddocks (1969a). The family is cosmopolitan, but includes several taxa with ecologically restricted distributions. One of these is the genus *Triebelina,* to which a Tertiary Australian record from the type Batesfordian can now be added to those figured earlier in McKenzie (1967b, p. 226,

Table 6. Abundances in subfamilies and families of Recent Ostracoda from the coasts of Victoria, from Bass Strait and from Banks Strait

Figures given are percentages, except for the asterisked samples where they represent actual number of specimens counted.

	Trachyleberidinae	Hemicytherinae	Eucytherinae	*Loxocythere*	*Saida*	*Paijenborchella*	Cytherurinae	Neocytherideinae	Krithinae	Cytherideinae	*Paracytheridea*	Loxoconchinae	Xestoleberidinae	Leptocytherinae	Bythocytherinae
*Apollo Bay	2	1	3	1			7					5	5	10	
*Anglesea	1		4				9		1					9	
Barwon Heads	0.5	0.5	1.5	1.5			19.0		1.0			1.0	2.0	69.5	
Seaholme	9.5	5.0		2.0			27.0	1.0	2.0	3.0		8.0	7.0	20.0	
Ricketts Point	3.5	16.0		2.0			3.5		3.5	2.5		17.5	19.5	7.5	
Mornington	1.0	2.0					39.0		3.0			4.0	2.0	48.0	
*Penguin Parade	3		2				1					4		33	
Tidal River	1.0	1.0	5.5				16.5	18.0						57.5	
Bass Strait	11.0						1.5	1.0	1.5			10.5	0.5	22.0	6.5
Banks Strait I	9.5	5.0	4.0	2.5					1.5			2.5	7.0	20.5	9.5
Banks Strait II	2.5		0.5	0.5	1.0		11.0	0.5				1.0	1.5	17.0	1.5
Banks Strait III	10.5	14.5					6.5					15.0	1.5	31.5	0.5
Banks Strait IV	4.5		2.0				14.5		0.5			6.5	6.0	41.0	2.0

	Paradoxostomatinae	Microcytherinae	Cytheromatinae	incertae sedis	Saipanettidae	Macrocypridinae	Paracypridinae	Pontocypridinae	Cypridinae	Ilyocypridinae	Bairdiinae	Bythocyprinae	Cytherellidae	Polycopidae
*Apollo Bay	1							3			2		1	
*Anglesea														
Barwon Heads	1.5	0.5		0.5									1.5	
Seaholme	7.0	3.0					2.0	2.0			0.5		1.0	
Ricketts Point	2.0					0.5	11.0	3.0			4.0		4.0	
Mornington													1.0	
*Penguin Parade								1			1		3	
Tidal River													0.5	
Bass Strait	4.0	1.0				16.0		12.0	1.5	1.5	3.0		6.0	0.5
Banks Strait I	1.5			1.5		1.5		4.0			25.5	4.0		
Banks Strait II	2.5	5.5				1.0		12.0			39.0		3.0	
Banks Strait III		1.5	1.0			0.5		1.0			14.0		2.0	
Banks Strait IV	4.0	6.0				0.5		1.5			10.5		0.5	

fig. 3). Eventually species of *Paranesidea* may also prove to have restricted distributions—the genus certainly is "abundantly represented in tropical seas" (cf. Maddocks, 1969a, p. 41).

Bairdia aff. *angulata* Brady 1870 ranges throughout the New Zealand region today according to Hornibrook (1952, p. 17), and a related form from southeastern Australia, which was first figured by Triebel (1960, Pl. 20, fig. 44a,b), is reillustrated here from a Banks Strait specimen (Pl. 1, fig. 3). As the SEM picture shows, this Australian species is an ornamented form, and one very similar also occurs today in the Sahul Shelf fauna. But *Bairdia angulata* Brady 1870 is a relatively smooth form with scattered small punctae, and it is much closer to some Australian Tertiary fossil bairdiids which range from Aldingan–upper Longfordian. *B. angulata* today apparently is distributed as follows: Magellan Straits (the types), Torres Strait (in deeper water), off the Azores (in deep water), according to Brady (1880, p. 60); and in George Sound, New Zealand; and off the southern tip of South America, according to Maddocks (1969a, p. 113).

Saipanettidae: The known distribution of Saipanettidae is worldwide. The Victorian Tertiary records range from Aldingan–Balcombian (Tables 3, 4). There are no Recent records off southeastern Australia, but there is at least one Recent Australian record—from deep water off Sahul Shelf.

Macrocypridinae: The Macrocypridinae were reviewed recently by Triebel (1960). Of the new taxa established by Triebel, the genus *Macrocyprina* is particularly important in the Australian Cenozoic, where it ranges from Aldingan–Recent. Unfortunately, undamaged carapaces or valves of fossil *Macrocyprina,* which is a large genus (its species typically more than 1.5 mm in length), are hard to come by, and most of my Tertiary records from Australia are based on valve fragments. Recent species are known from Bass Strait, Banks Strait, and Sahul Shelf.

Another interesting taxon in Macrocypridinae is the genus *Macrocyprissa,* originally described by Triebel (1960, p. 116) as a new subgenus of *Macrocypris.* As noted in McKenzie (1967b, p. 223), the Recent species of *Macrocyprissa* may be confined to the Australasian region and the Indo-Pacific, and one such species, from Bass Strait, is illustrated (Text fig. 3c). In the Victorian Tertiary, the only record of *Macrocyprissa* is a single specimen (left valve and right valve disarticulated) from the lower Mitchellian (Mitchellian 3, Table 5) where it is associated with several complete carapaces and undamaged valves of a *Macrocyprina* species.

Paracypridinae: The shape of *Macrocyprissa* is such that poor fossils might well be confused with the common Australasian and Indo-Pacific paracypridinid genus *Phlyctenophora,* although in well-preserved material, the respective muscle scars and hingements of the two genera make distinction between them straightforward. As the Tertiary assemblages analyzed in this paper are well preserved, the problem of homeomorphic confusion does not arise. A typical Recent *Phlyctenophora* from Sahul Shelf is illustrated (Text-fig. 3f).

A second possible source of homoeomorphic confusion is the paracypridinid genus ?*Aglaiella* Daday, for which a Recent South African species has been described and illustrated by Benson and Maddocks (1964, p. 16–17, Pl. 1, fig. 7, 9, 10; Text-fig. 7). ?*Aglaiella* occurs only once in the fossil assemblages, in sample Mitchellian 3 (Table 5; Text-fig. 3a) and ?*Aglaiella setigera* (Brady) 1880 is the only known Recent Australian representative. This genus may be confused with *Phlyctenophora* and *Macrocyprina.*

The other common paracypridinid genus of south-eastern Australia is *Paracypris,* for which a local Recent species, *Paracypris bradyi,* was described by McKenzie from Port Phillip Bay (1967c, p. 64–65, Text-fig. 2d). *Paracypris* is rare in the Tertiary of Victoria, where it ranges from the Longfordian. There are at least two Recent Sahul Shelf species.

Pontocypridinae: The taxonomy of Pontocypridinae has been revised recently by Maddocks (1969b.) Australian Tertiary records of *Propontocypris* are few, and the majority of pontocypridines identified belong to the genera *Australoecia* and *Argilloecia* s.l., both of which range from Johannian–Recent.

Maddocks, in her diagnosis of *Australoecia,* notes that, "either left or right valve may be the larger" (1969b, p. 49). Most Tertiary fossils have a larger left valve, unlike the type species in which the right valve is larger, and warrant at least separate subgeneric rank. *Bythocypris tumefacta* Chapman 1914, which is illustrated (Text-fig. 3g), is an *Australoecia* with a larger left valve. The geologic range of these groups is: Johannian–Recent for *Australoecia* with a larger left valve, and Neogene for the forms with a larger right valve.

In Recent local environments, *Australoecia* with larger left valve occur in the Banks Strait faunule, and *Australoecia* with larger right valve in Port Phillip Bay. On Sahul Shelf three species of *Australoecia* are known to me, one resembling *A. abyssophila* Maddocks 1969 (a form homeomorphic with *Saipanetta* except for the distinctive muscle scar pattern) and the other two similar to *A. mckenziei* Maddocks 1969.

Argilloecia is a cosmopolitan genus which, as van Morkhoven noted (1963, p. 78), can also be split readily into two subgroups. Taxa resembling the type species, *A. cylindrica* Sars 1866, do not occur in the Australian Tertiary to my knowledge, but species in the other subgroup (cf. *A. acuminata* Müller 1894, illustrated in van Morkhoven, 1963, p. 77, fig. 104–106), are common throughout the section studied and always exhibit a definite right valve ventral overlap.

In the Recent of Australia, *Argilloecia* of this second subgroup occur in Bass Strait and Banks Strait and there is also a Sahul Shelf species.

Cytherellidae: Both *Cytherella* and *Cytherelloidea* are found in the Tertiary of Australia, and *Cytherelloidea intermedia* (Chapman and Crespin) 1928 is illustrated (Pl. 1, fig. 2). This species is part of a lineage that ranges from the Johannian and possibly includes *Cytherelloidea auriculus* (Chapman) 1941 as an end member.

A second *Cytherelloidea* lineage is that associated with the species *Cytherelloidea keiji* McKenzie (1967, p. 63, Pl. 11, fig. 1; Text-fig. 3p). This lineage also ranges, in the assemblages analyzed, from Johannian–Recent.

There are several *Cytherella* lineages and representatives of these were illustrated by Chapman (1941a, Pl. 9, figs. 44–48). Like *Cytherelloidea, Cytherella* ranges from Johannian-Recent in the collections.

Polycopidae: The polycopids occur only rarely in Tertiary assemblages generally (see McKenzie, 1967b, p. 221 for some records), and the most significant Australian form is a highly sculptured Balcombian species (Pl. 1, fig. 1), which is an index for the type Balcombian facies. The lone other record, from the Kalimnan? sample (Table 5), resembles a relatively smooth species that lives today in Bass Strait. It is noteworthy that 4 of the 6 polycopids known from Sahul Shelf are strikingly ornamented species.

Apart from the Polycopidae, no Myodocopida are known as fossils in the Australian Cenozoic, and very few benthonic myodocopids occur in samples from the Recent environments covered by Table 6, but at least 15 Recent species of Myodocopina are known to occur in Westernport Bay, Victoria, which is the next large bay east of Port Phillip Bay (McKenzie unpublished data from samples provided by A. J. Gilmour, Fisheries and Wildlife Department of Victoria).

PALAEOECOLOGY

The Comparative Series

The samples in Table 6 were selected to cover a variety of local marine environments. Thus, those from Apollo Bay, Anglesea, and Penguin Parade reflect differing open coastline conditions, the first a wide unprotected bay, the second a cliffed shore, and the third part of a relatively rocky shore. The assemblages from Barwon Heads and Tidal River, on the other hand, may reflect the influence of nearby rivers on littoral faunas.

Of these five samples, a sufficient count was obtained only with the Barwon Heads and Tidal River samples. In both, the ostracode assemblages are dominated by Leptocytherinae, and to a lesser extent by the Cytherurinae, with other groups making up an insignificant part of the total count. (The high count for Neocytherideinae at Tidal River represents the local abundance of a single species, as yet undescribed, and is anomalous when compared against all the other samples.)

Open coast assemblages appear to be similar in character to the river influenced beach samples, *i.e.*, Leptocytherinae and Cytherurinae dominate, but are distinguished by a comparative paucity of specimens.

The samples from Port Phillip Bay indicate the assemblages to be expected in a protected environment. Two of the collections have been reported on in a taxonomic paper by McKenzie (1967c), and the third sample, from near Mornington Pier, was collected much nearer the constricted entrance to the bay than these previous samples. Once again Leptocytherinae and Cytherurinae characterize the faunas but, in addition, there are significant percentages (about 10 percent or more) of such groups as Trachyleberidinae, Hemicytherinae, Loxoconchinae, Xestoleberidinae, and Paracypridinae in at least one of the samples.

All the samples discussed so far (except Mornington Pier) were collected from beach swash marks or littoral tide pool concentrates and hence represent the total local faunule down to about wave base, *i.e.*, to about 15 m. The Mornington Pier sample came from within this depth range also.

The remaining comparative samples are all from deeper water (25–100m) and come from the holomarine sublittoral shelf that comprises Bass Strait between southeastern Australia and Tasmania and smaller Banks Strait between Flinders Island and Tasmania.

In the Banks Strait samples, the assemblages are characterized by Trachyleberidinae, Hemicytherinae, Cytherurinae, Leptocytherinae, Pontocypridinae and, surprisingly, by consistently high percentages of Bairdiinae (10.5–39 percent). Of the four samples counted, which provide a broad coverage of the three main subenvironments in Banks Strait (cf. McKenzie and Baker, 1968), the most offshore sample has 9.5 percent Bythocytherinae and the most nearshore sample has 15 percent Loxoconchinae. The high numbers of Bairdiinae (large forms) may represent a sorting effect, because almost all the Banks Strait sediments rate coarse grained or higher in the grade.

The single sample from Bass Strait is centrally located in the Strait toward its eastern end and is the only sample from the area that I was able to obtain. It is characterized by an abundance of Cyprididae (15 percent Macrocypridinae, 12 percent Pontocypridinae) and significant percentages of Leptocytherinae, Bythocytherinae, and Cytherellidae. The depth of this sample was about 85 m.

The substrates of the littoral and nearshore comparative samples have a high terrigenous component, but offshore samples are dominantly bryozoal marly clays. This is the characteristic offshore facies of the southern Australian shelf, and is distinctly different from the reefal facies off the Queensland coast, which have been reviewed recently by Maxwell (1968).

The year-round mean sea temperature off southeastern Australia is about 14°C, in Dorman (1966, p. 50, Table 1), and water temperatures in Port Phillip Bay range between about 10°–20°C, according to Rochford (1966, p. 113, fig. 5).

Salinities in Bass Strait are about 36‰, and in Port Phillip Bay can range yearly from about 31.5–36.5‰ in winter–summer; the winter low represents the effect of discharges by rain-swollen rivers, see Rochford (1966, p. 110, fig. 1).

The Fossil Assemblages—Depth Indicators

Samples from the Gellibrand Clay, Gibsons Steps, BCC 5, BCC6, (Table 3) and the type Balcombian (Table 4) are characterized by a combination of clay substrates, and of significantly higher percentage abundances of Cyprididae and significantly lower percentage abundances of Trachyleberidinae and Leptocytherinae than in the other samples. The Recent samples that match these characteristics most closely are those from Bass Strait and Banks Strait, where depths are greater than 50 m (Table 6). The fossil assemblages, therefore, are interpreted as indicating moderate depths of deposition (75–100 m).

Other samples in which the percentage abundances of Trachyleberidinae are relatively low differ in that they also contain high percentage abundances of Leptocytherinae. Such samples include the section from BCC at CC 1 to CC 6 (Table 3) and the two Bird Rock samples (Table 4). Checking against the comparative series, it seems that the samples that most nearly approach these characteristics are those from oceanic littorals (Table 6). The presence of glauconite in the substrates associated with the assemblages suggests a depth greater than about 20 m, so that overall the depth of deposition for these samples might have been about 25–50 m.

Still shallower depositional depths probably best explain the assemblages characterized by high counts of both Leptocytherinae and Cytherurinae, commonly associated also with numerous trachyleberidines (*e.g.,* Mitchellian 1 and 2, Kalimnan 1, all in Table 5) and with a high terrigenous component in the substrates (see also middle Castle Cove Lst, Table 3). Also significant in such samples is the absence or near absence of Bythocytherinae and Macrocypridinae. The most likely depth of deposition for such assemblages is less than 25m.

Wherever glauconite is very abundant (*e.g.,* the *Notostraea* greensand member at Browns Creek; the basal part of the Tambo River Formation at Tambo River), stable shelf conditions and depositional depths between 20–200m are indicated. The presence of abundant *Notostraea* in the Browns Creek greensand member and the general ostracode assemblage in the Tambo River sample (= Mitchellian 2, Table 5) both point to depths shallower than 50m, probably less than 25 m, for these greensands.

Very often the ostracode genera in the assemblages are reliable indicators. For example, *Parakrithe* and *Krithe* indicate moderately deep water deposition (=75 m), as do *Eucytherura, Cardobairdia, Paijenborchella* and *Hanaiceratina;* whereas *Saida,* many trachyleberidines, *Kangarina,* and Eucytherinae indicate shallower depths (25-75 m); while taxa such as *Parakrithella, Callistocythere,* Paradoxostomatinae, Microcytherinae, *Loxocythere* and most Loxoconchinae, Xestoleberidinae and Neocytherideinae are typical of depths less than 50 m (usually less than 25 m) and are often associated with littorals. Text-figure 4 indicates the usefulness of *Parakrithella* and *Krithe* in indicating variations in depths of deposition through the Victorian Tertiary section.

The Fossil Assemblages—Temperature Indicators

Another facies in the collections is one characterized by very high percentage abundances of Trachyleberidinae and low percentage abundances of all other groups, except that the abundances of Leptocytherinae and Cytherurinae occasionally exceed 10 percent. The samples concerned are CC 3 to Fishing Point Marl 3 (Table 3) Zeally Lst (Table 4) and Longfordian 1 and 2 (Table 5). This facies cannot be matched in the comparative series, which is not surprising because the Recent samples are from temperate environments and the fossil assemblages record subtropical conditions. Similarly, the Batesfordian facies, which at its type exposure and elsewhere is characterized by a flood of *Lepidocyclina* foraminiferans, is a tropical facies and is not matched in the comparative series.

Thus, it seems clear that seawater temperatures off southeastern Australia must have fluctuated considerably during the Tertiary. The latest version of these fluctuations—based upon isotopic analyses—is that given in Gill (1968, p. 59, fig. 1), and it should be noted that the evidence from Ostracoda is corroborative, as is the evidence from Foraminifera, according to McGowran and Wade (1967, p. A9).

Genera that act as indices for warm seawater temperatures (20°–25°C) include highly sculptured *Polycope, Saida, Hanaiceratina, Uroleberis, Triebelina, Cytherelloidea, Kangarina,* and *Phlyctenophora.* Because several of these genera still live in the area under a temperate regime, it is important to understand that they, and others, qualify as warm water indices because, first, they occur today most abundantly in tropical and subtropical environments; second, they first reached southeastern Australia during warm Stages, either prior to the Tertiary, *e.g., Cytherelloidea,* or in the Tertiary, *e.g., Hanaiceratina* during the Balcombian, *Saida* during the Aldingan.

There are also the relatively deepwater genera seen to be associated with warm seas, such as *Cardobairdia, Paijenborchella,* and *Parakrithe,* and more cosmopolitan genera with distinctive tropical forms, *e.g., Ambocythere* species related to *A. bodjonegoroensis* (Kingma) 1948.

Rather fewer taxa are indicators for the cooler Stages of the Tertiary, but they include *Pokornyella* s.l. in the Janjukian, ?*Aglaiella* and the Rutledge Creek *Ambocythere* in the lower Mitchellian, and a trachyleberidine related to *Trachyleberis tridens* Hornibrook 1952. Taxa that may also belong in this category include a pseudocytherine related to *Baltraella* Pokorny, in the lower Mitchellian and trachyleberidine sp. 2 (Pl. 1, fig. 7), that is prominent in Janjukian assemblages. Sometimes size is an indicator of temperature. Thus note that the "cool" Janjukian

Eucytherura (Pl. 3, fig. 12) is larger than the "warm" upper Johannian species (Pl. 3, fig. 11). A similar size variation is apparent in the *Trachyleberis tridens* lineage.

The Fossil Assemblages—Salinity Indicators

Salinities appear to have been marine throughout for the intervals sampled, but thick sections of the Tertiary of Victoria, which have not been included in this paper, reflect littoral marsh and marshy hinterland facies, so that for the Tertiary deposits as a whole, marine episodes alternated with those dominated by continental sedimentation. Ostracoda, of course, are equally useful as palaeoecological indicators in freshwater facies but occur only rarely in the best studied areas along the coast and in the immediate hinterland. Where they do occur, however, they are extremely abundant, as noted by Waldman and Handby (1968, p. 95).

The euryhaline index *Cyprideis* apparently does not occur in these Tertiary Victorian faunas, although it is abundant in the Recent and as a subfossil in southwestern Australia (cf. McKenzie 1964, p. 455).

The Fossil Assemblages—Substrates

The fossil substrates of the Palaeogene are dominantly bryozoal clays, which form the characteristic offshore facies of southern Australia at the present day, as noted earlier.

Frequently, the sediments have a significant glauconite component, an index for shelf sedimentation, with the glauconite grains ranging from sappy green to limonitized brown in colour, and often pellet-shaped. In some sections, *e.g.,* at Castle Cove, glauconite occurs more or less continuously through the outcrops but elswhere, *e.g.,* in Dowds Quarry, it is concentrated in interbeds about 15 mm thick.

Quartz is not usually very abundant until the Pliocene and the sand-sized grains are typically subrounded or rounded and have polished surface textures. Occasionally, as at about 8–10m below the *Notostraea* greensand member at Browns Creek, or in the basal to middle part of the Castle Cove Limestone at Castle Cove, the Palaeogene sediments are gritty, even gravelly, and quartz makes up 50 percent or more of the coarse (>0.5mm) washings. Clean quartzose sands characterize the Kalimnan facies at the type exposures near Jemmys Point and also nearby at Bunga Creek. Commonly the quartz in these sandy sediments is iron-stained, a feature that, like the presence of the terrigenous component itself, implies nearshore sedimentation.

The fresh color of the samples ranges from dark brownish-green to brownish to creamy in the shallower Neogene facies, and from fawnish to brownish and greenish, or bluish grey, or blackish in the shallower to moderately deep Palaeogene facies. The deeper water facies are uniformly dark bluish grey when fresh.

Overall, the sediments are well bedded and thin to medium bedded, laminated zones being uncommon. Rarely, massive or thick– to indistinctly bedded sections are exposed, the most striking of these being the *Lepidocyclina* coquinas of the type Batesfordian in the New Quarry, northwest of Geelong (Spencer-Jones 1967, map between p. 160-161). Indurated interbeds are found in most sections, although the sediments generally are weakly consolidated.

Conclusions

Taylor (1967, p. A3–A4), in a brief review based upon his foraminiferal counts, has described several marine transgressive patterns for the Victorian Tertiary. Ostracode assemblages can provide the palaeoecological detail that such syntheses lack, and in the previous paragraphs, percentage abundances of some higher heirarchic categories and presence or absence of some genera or species have been used to develop such detail.

STRATIGRAPHY

Johannian Stage

My section begins in the upper Johannian at Browns Creek (Appendix 1) with assemblages characterized by a paucity of specimens; these are brown stained. Paleoecologically, the occurrence of such genera as *Eucytherura, Kangarina, Argilloecia, Krithe,* together with Eucytherinae and Leptocytherinae, indicates offshore deposition at about 50–75 m depth, which is substantiated by the general abundance of glauconite pellets. The blackish overall color of the sediments, which has impregnated the glauconite, the fragile cephalopod shells, and the brown-stained microfauna indicate reducing conditions on the bottom. The shoreline could not have been far away because occasional gravelly horizons occur. We know from other sections that the coasts of that time were low lying and characterized by littoral marsh and marshy hinterland facies. The sea was warm.

Aldingan Stage

The Aldingan facies sampled at Browns Creek and Castle Cove (Appendix 1) are less monotonous than those of the upper Johannian. The Stage begins with the brightly coloured *Notostraea* greensand member, representing a stillstand, oxygenating conditions on the bottom, and relatively shallow depositional depth (<50 m); after which there is a section, about 20 m thick in the Browns Creek exposures, of greenish-grey glauconitic, richly fossiliferous, dominantly bryozoal clays, which are a very typical offshore facies, followed by nearshore to littoral, laminated, micaceous silts, sands and puggy clays containing the littoral or nearshore index foraminiferan *Cyclammina;* and then a return to offshore conditions but with sufficient terrigenous component to indicate a near shoreline. Water temperatures were higher than in the Johannian, and the Tethyan affinities of the Ostracoda are indicated by the presence of such genera as *Cardobairdia, Idiocythere, Amphicytherura,* and *Saida.* Of these, *Amphicytherura* is an index for the Stage.

The lower Castle Cove Lst. at Castle Cove is the uppermost Eocene unit, according to Carter (1964, p. 53, Table 4), and the Aldingan exposures that follow this indicate a gradual shallowing due to regression. The sediments become first gritty, then gravelly, with limonite and limonitized quartz abundant. Water temperatures were becoming cooler also, as shown by the entry of such forms as *Pokornyella* s.l. and the undetermined trachyleberidine sp. 2 (Pl. 1, fig. 7).

Janjukian Stage

The thin section from Castle Cove [called "tongue of Calder River Lst." by Carter (1958, Text-fig. 3)], which is within the Janjukian according to Carter (1964, Table 4), adds a little detail to our understanding of this Stage. The sediment is a gritty bryozoal calcarenite, with rare brachiopods and echinoids, poor microfaunally (foraminiferans and ostracodes); the occasional glauconite grains are usually ferruginised. The facies is shallow water (about 25 m).

The Janjukian is typically exposed in the cliffs west of Torquay. The Jan Juc Marl was probably deposited offshore at a depth of about 25–50 m, based on the presence of abundant turrid gastropods and of scaphopods, the silty sediment grade, the abundance of bryozoans, the presence of glauconite; and, as far as Ostracoda are concerned, the abundance of Hemicytherinae and Leptocytherinae, as well as the occurrence together of *Krithe* and *Parakrithella,* also of *Paijenborchella* and *Loxocythere.* The lowest part of the Jan Juc Marl at Bells Headland is characterized by an abundance of *Pokornyella* s.l. which I interpret as a "cool" index. *Pokornyella* s.l. is typical for this Stage, which is also marked by the first appearance in southeastern Australia of the genus *Callistocythere.*

The calcarenitic Point Addis Limestone beds represent a lateral facies change with the Jan Juc Marl. The ostracode assemblages differ from those of the Jan Juc Marl especially in the greater abundance of trachyleberidines. This difference reflects the different substrates.

Unfortunately, I have no material from the Janjukian of the Gippsland Basin.

Longfordian Stage

The type locality for the Longfordian is the exposure at Dowds Quarry in the Gippsland Basin, but the Stage is also well expressed at Fishing Point and, of my Torquay samples, which are analyzed herein, the Zeally Limestone is referred to it, see Ludbrook (1967, fig. 3).

It is difficult to place the Zeally Limestone on the basis of its ostracode assemblage because there are rather few correspondences at the species level with other units thought to be of an equivalent age. Singleton (1967, p. 122) notes its lithologic correspondence with the Point Addis Lst. The Zeally ostracodes resemble the Point Addis faunules in the abundance of trachyleberidines, but include fewer Leptocytherinae and more Loxoconchinae and Bythocytherinae than occur in the Point Addis assemblages.

The typical lower Longfordian (Longfordian 2, Table 5) has a very high abundance of trachyleberidines (67 percent). The terrigenous component is low but glauconite is very abundant in the substrate. Bryozoans are not as abundant (in the sample collected) as in the Longfordian 1 sample. The Ostracoda indicate that water temperatures were increasing again, after the early Janjukian cooling. Depositional depths were about 25–50 m.

The Longfordian at Fishing Point likewise is characterized by large numbers of trachyleberidines and a low terrigenous component. The facies changes from one deposited at about 25–50m depth (Fishing Point Marl 1 and 2) to a slightly deeper water facies with *Parakrithe* and *Paijenborchella* (50-75 m), then returns to the shallower regime. The abundance of trachyleberidines is in itself an indicator of warming and a typical form is similar to *Cythere flexicostata* Chapman 1914.

This form is typical also in the Longfordian 1 sample, which is representative of the uppermost part of the stage, see Carter (1964, Table 4) and Appendix I.

Batesfordian Stage

The flood of *Lepidocyclina* forams that marks the type Batesfordian is considered to be representative of tropical conditions, with water temperatures about 25°C, according to the oxygen isotope curve in Gill (1968, p. 59, fig. 1). The characteristic Ostracoda, which occur in the type locality as well as in the equivalent Gippsland Basin unit, the Glencoe Limestone, are *Cythere flexicostata* Chapman 1914 and *Cytheropteron batesfordiense* Chapman 1910 (the latter is a brachycytherinid trachyleberidine). In the type locality (New Quarry), Loxoconchinae are also abundant. A different *Loxoconcha* species is common in the Glencoe Lst sample (uppermost Batesfordian), which also has many *Parakrithella* and is a shallow water facies. Depositional depths for these Batesfordian assemblages were 25 m or less. This interpretation is supported by the fact that at the New Quarry locality the 10 m of section below the quarry floor is an arkosic calcarentic sand with a heavy mineral content that increases toward the base. Further, granite outcrops not far to the north.

A moderately deepwater facies equivalent (depth about 75 m) occurs in the Gellibrand Clay, near the base of the shoreline cliff at Gibsons Steps (Table 3), which has a fauna with *Krithe, Saida,* abundant *Argilloecia* etc., and a Batesfordian? trachyleberidinid.

Balcombian Stage

As noted earlier, the type Balcombian is a moderately deepwater facies (75–100m depositional depth). The depth indicators include *Cardobairdia, Paijenborchella, Parakrithe,* and *Krithe.* Water temperatures were still warm but beginning to decrease from the Batesfordian high. *Hanaiceratina* makes its first appearance in the Australian Tertiary at this Stage, so far as my samples are concerned. The type Balcombian section has been fully described by Gostin (1966). I have no Balcombian from the Gippsland Basin.

Bairnsdalian Stage

I sampled Crespin's "lower bed" at the type locality for the Stage in the cliff section at Pound Swamp, Bairnsdale (cf. Crespin, 1943, p. 23). According to Carter (1964, p. 50) this represents the upper part of the Bairnsdalian.

The ostracode assemblage (Table 5) contains numerous Leptocytherinae and Trachyleberidinae, and is a typical offshore facies (bryozoans very abundant in the sample) probably deposited at about 25–50 m. *Callistocythere* is very common and there are rare *Hanaiceratina.*

A distinctly punctate and posteroventrally dentate member of the *Cytheropteron batesfordiense* lineage also occurs at this level. The sea was still warm.

The Bairnsdalian section at Western Beach, Geelong (Table 4) represents a shallow water facies (depositional depth about 25 m or a little greater). This is indicated by the sediment grade, the numerous Xestoleberidinae, the reappearance of *Parakrithella* and *Callistocythere,* and a slight increase in the percentage abundance of Trachyleberidinae. The latter include a high count (42 carapaces) of a lineage that first appeared, though not as abundantly, in the Batesfordian and that was used above to correlate the Gibsons Steps locality.

Mitchellian Stage

During the early Mitchellian, there was a short period of cooling (cf. Mitchellian 3, Table 5, and Rutledge Creek, Table 3), followed by a return to warmer seas, although these warmer seas were subtropical rather than tropical as in the Batesfordian (see the Gorge, Table 3), and Mitchellian 1, 2, Table 5).

The Mitchellian 3 sample represents an offshore facies (25–50 m depth), dominated by trachyleberidines and leptocytherines, but also with significant numbers of Paracypridinae and Macrocypridinae, the paracypridines including an *?Aglaiella* species that is interpreted as a "cool" index. *Ponticocythereis,* which first appeared in the Tertiary of southeastern Australia during the Balcombian "warm," is notably abundant in Mitchellian 3 (22 individuals counted).

The "cool" index in the Rutledge Creek sample, which is a moderately deepwater assemblage, with *Paijenborchella, Krithe,* and numerous *Argilloecia,* is an Ambocythere species related to *A. stolonifera* (Brady) 1880.

The return to warmer conditions in the upper Mitchellian is signalized by abundant glauconite in the Tambo River Formation (Mitchellian 1 and 2) and by the presence of *Hanaiceratina* in the Gorge sample.

Kalimnan-Cheltenhamian Stage

The Kalimnan and Cheltenhamian are considered together because it seems likely that the Cheltenhamian Stage is "equivalent to some part of the lower Kalimnan." See Wilkins (1963, p. 49–56, fig. 2) for a full discussion of the problem, the quotation coming from his Conclusion (p. 56). Certainly, so far as its ostracode assemblage is concerned, the sample correlated tentatively with the Kalimnan by Darragh (personal communication), is very similar to the Cheltenhamian sample I collected at the type locality for the Cheltenhamian Stage in the Melbourne area (Kalimnan?, Cheltenhamian, Table 5). Both these samples are iron stained.

The lower Kalimnan facies was one of shallow water offshore deposition (25–50 m) indicated by the presence of *Bythoceratina, Cytheralison,* and a pseudocytherine close to *Baltraella.* Water temperatures were in the temperate range (about 15 °C). The significant terrigenous component indicates a near shoreline. Chapman's Mallee Bores paper (1914a)—in which the new species described from bores in northwestern Victoria included, particularly, *Cytherura capillifera* Chapman 1914, a neocytherideinid (!) which I have from the Cheltenhamian cality—indicates that the typical facies of this time was very widespread in Victoria.

The two upper Kalimnan samples (1 and 2, Table 5) have a dominant clean, quartzose, terrigenous component and represent nearshore facies similar to those of the present day from the same area (near Lakes Entrance, Gippsland).

Werrikooian Stage

This stage presumably correlates with Ludbrook's Yatalan Stage (1967, fig. 3). My single sample (not incorporated into the tables) was collected West of Myaring Bridge, near the type locality on the Glenelg River. The bed sampled was indurated and the ostracode faunule impoverished. Of the 40 specimens (13 species), 19 are Leptocytherinae, 11 Cytherurinae, and 7 Hemicytherinae. Six of the hemicytherines are "*Ambostracon*" *pumila* (Brady) 1866. The assemblage overall is close to that of some Port Phillip Bay samples, which does not conflict with the original interpretation of these beds as representing estuarine deposits.

PALAEOBIOGEOGRAPHIC CONCEPTS

The paleobiogeographic avenues for dispersal and integration of marine taxa leading to faunal development have been modified through time because of continuing alterations in the relative positions of the continental masses involved, both as a result of continental drift in the Southern Hemisphere and, on a smaller scale, as a result of more local tectonic adjustments. Further, they have widened or narrowed in rhythm with episodes of marine incursion or regression.

The Recent marine ostracode fauna of southeastern Australia is an amalgam that can be analyzed into three principal palaeogeographic elements, with a fourth subsidiary element, the significance of which is difficult to establish. These elements are: "warm" taxa with Tethyan affinities such as those recorded in McKenzie (1967a); "cool" taxa with austral affinities such as those noted here, *Pokornyella* s.l., ? *Aglaiella*, "*Hemicythere*" *kerguelenensis* (Brady) 1880, etc.; endemic taxa, which are always an important element in austral faunas, as shown for South America by Ohmert (1968), such as *Cytheralison*, trachyleberidine sp. 1, etc.; and, fourth, peri-Pacific taxa. These elements characterize not only assemblages of Ostracoda but equally those of foraminiferans (*e.g., Austrotrillina*, a "warm" taxon), molluscs (*e.g., Trigonia*), brachiopods (*e.g., Magellania,* an austral taxon) and bryozoans, see Lagaaij (1968). Fleming (1962, p. 95–100), in a general palaeontological approach, makes the same point although using a different terminology.

It must be remembered that the Tethys has been, at different times in its history and in different parts of its compass: a corridor (*e.g.,* in the Upper Eocene); a filter (*e.g.,* the Panamanian passage); a sweepstakes route (*e.g.,* as it is today between the Caribbean and northwestern Africa). The West

Wind Drift pathway, on the other hand, once the southern continents broke up and began to spread apart, has always been only a sweepstakes route. Hence, there are more Tethyan elements than austral ones in the southeastern Australian Cainozoic fanua. The notable tendency to endemism exhibited by these faunules is undoubtedly favored by the past as well as present position of Australasia, at a terminus of the entire dispersal system for shallow water marine animals in the Southern Hemisphere.

Acknowledgments

The paper owes much to the generous provision of comparative material by many coworkers. I wish to acknowledge Drs. Benson, van den Bold, Howe, Pokorny, Ruggieri, and Swain for providing washings from the Tertiary of North America and Europe. Several taxonomic problems were made considerably simpler by correspondence with Drs. van den Bold, Hazel Ishizaki, and Triebel. T. A. Darragh, Curator of Fossils, at the National Museum of Victoria, Melbourne, allowed access to syntype collections on which my identifications of Chapman, and Chapman and Crespin species are based.

Hanaiceratina species are deposited at the Australian Museum, Sydney (Aust. Mus.), the National Museum of Victoria, Melbourne (NMV), the H. V. Howe Collection, Louisiana State University (HVH), the United States National Museum (USNM), and the British Museum (Natural History) (BM(NH)).

The SEM pictures were taken by myself at the Electron Microscope Unit of the British Museum (Natural History). Mrs. S. M. Mullins and Miss G. Halil typed the manuscript. Mrs. R. L. Sayers and M. T. Harris assisted in making up the plates.

APPENDIX

Port Campbell District Section (Table 3); see also Singleton (1967, p. 126–127).

The Gorge, near Lochard Cemetery: upper 10 m of the coastal cliffs. Ostracodes not analyzed for this paper. Bairnsdalian.

Creamy brown, porous, indurated, fossiliferous, medium-grained calcarenite. Thick to massive bedded. Quartz grains rare, well rounded and frosted. Macrofossils include *Ditrupa* tubes and fragments; microfossils include occasional *Orbulina* foraminiferans.

The Gorge, near Lochard Cemetery: about 10 m below top of coastal cliffs (The Gorge, Table 3). Bairnsdalian.

Brownish greenish, porous, friable (when dried), highly glauconitic, fine to medium-grained calcarenite. Well bedded, medium bedded. Macrofauna includes *Ditrupa* tubes and fragments, mollusc debris, echinoid spines and bryozoans; microfauna of foraminiferans and ostracodes.

The Gorge, near Lochard Cemetery: about 5 m above base of coastal cliffs. Not analyzed for this paper. Bairnsdalian.

Brownish, porous, slightly friable, fossiliferous calcarenite. Medium- to thick-bedded. Characterized by absence of *Ditrupa,* presence of some pelecypod detritus. Microfauna includes abundant *Orbulina,* rare ostracodes. Underlain by two indurated, shelly bands, at base of the coastal cliffs here.

Near base of cliffs at Gibsons Steps (Gibsons Steps, Table 3). ? Batesfordian.

Blackish grey (dries greyish), scarcely permeable, fossiliferous, silty clay with a blocky fracture when fresh (it crumbles when dried). Macrofauna of occasional pelecypods, bryozoans, echinoid spines *Ditrupa* absent. Microfauna includes foraminiferans (abundant planktonics) and ostracodes.

Browns Creek Section (Table 3); see also Raggatt and Crespin (1955, p. 134–135); Carter (1958, p. 10–11, Text-fig. 1, 2); Singleton (1967, p. 122–124, fig. 2).

Castle Cove Limestone: exposed between Browns Creek and Johanna River. Not analyzed for this paper. Aldingan.

Brownish whitish, porous, friable, gravelly, quartzose, occasionally glauconitic, fossiliferous calcarenite. Quartz usually brownstained, with frosted and fractured surface textures. The glauconite is brownish yellowish and weathered. There are rare "heavies" in the sample. Macrofauna includes bryozoans and distinctive brachiopods; microfauna includes foraminiferans and ostracodes.

This member was interbedded with brownish, dense, medium-bedded (with irregular bedding surfaces) quartzose, calcarenitic limestones.

Browns Creek Clays: about 23 m above *Notostraea* greensand, at section W. of Browns Creek. Equivalent to 4' bed of Raggatt and Crespin (1955, p. 134). Not analyzed for this paper. Aldingan.

Brownish and bluish grey, laminated, sandy micaceous clay. Sand grains subrounded, with frosted or polished surface textures; several large ferruginized grains observed. Fossils rare, include fragments of bryozoans, gastropod and pelecypod impressions, also occasional foraminiferans. No leaf impressions seen.

Browns Creek Clays, BCC 2 (Table 3): about 21 m above *Notostraea* greensand. Equivalent to upper part of 12' bed of Raggett and Crespin (1955, p. 134–135). Aldingan.

Dark brownish grey, gritty to pebbly, and glauconitic, fossiliferous silt. Most pebbles have polished surface textures. Macrofauna of gastropods (especially turrids), rare brachiopods, rare small circular bryozoans, small solitary corals, and serpulid-like calcareous tubes; microfauna includes foraminiferans and ostracodes.

Browns Creek Clays: about 17 m above *Notostraea* greensand. Equivalent to upper part of 62' bed of Raggatt and Crespin (1955, p. 134–135). Not analyzed for this paper. Aldingan

Dark greyish (drying to brownish grey), glauconitic, bryozoal marly clay. Massive to thick bedded. Rare grains of quartz gravel also present. *In situ,* the bryozoans show as well-preserved large colonies and large fragments of colonies. Fine washings (<0.5 mm) dominated by unidentifiable fragments of organic carbonate, plus numerous small echinoid spines and a rich foraminiferan and ostracode microfauna.

Browns Creek Clays: about 13 m above *Notostraea* greensand. Equivalent to upper middle to 62' bed of Raggatt and Crespin(1955). Not analyzed for this paper. Aldingan.

Bluish grey to fawnish grey, glauconitic, bryozoal marly clay. Apart from the dominant bryozoans, the macrofauna contains small turreted gastropods; microfauna includes foraminiferans and ostracodes. Abundant unidentifiable shell fragments and small echinoid spines in fine washings (< 0.5mm) .

Browns Creek Clays, BCC5 (Table 3): about 7 m above *Notostraea* greensand. Equivalent to lower part of 62' bed of Raggatt and Crespin (1955, p. 134-135). Aldingan.

Greyish (drying to pale fawnish grey), rarely glauconitic, bryozoal marly clay. Massive to thick bedded. Bryozoans chalky and fragile, of punctate, "stick" type; Fauna also includes rare pectenid pelecypods and pelecypod fragments, echinoid spines, foraminiferans, and ostracodes.

Browns Creek Clays, BCC 6 (Table 3): about 1 m above the *Notostraea* greensand marker bed. Aldingan.

Greenish to dark grey, occasionally quartzose, fossiliferous greensand. Quartz rare in fine washings but some gravel retained on the coarse sieve (>0.5 mm). Rich fauna includes small circular bryozoans, gastropods, pelecypods, scaphopods, echinoid spines, foraminiferans and ostracodes.

Browns Creek Clays, *Notostraea* greensand (Table 3): marker beds. Aldingan.

Bright bluish green, medium grained fossiliferous greensands about 1.3 m thick. Richly fossiliferous, in the lower 0.7 m, the macrofauna including bryozoans, solitary corals, brachiopods, echinoid spines, pelecypods, and gastropods (particularly turrids). Of this macrofauna, the pelecypod *Notostraea* is most conspicuous. The microfauna includes foraminiferans and ostracodes.

The upper part (of about 0.6 m thickness) is generally poor in macrofossils.

Johanna River Sands. BCC 7a, 7b, 7c, (Table 3): 0-15 cm, 0.7-1.0 m and about 2 m respectively below the *Notostraea* greensand. Equivalent to upper pai of 25' bed of Raggatt and Crespin (1955, p. 134-135). Johannian.

Dark brownish to blackish fossiliferous, glauconitic clay. Most of the glauconite is pellet shaped. The macrofauna includes a diverse assemblage of mollusks (notably several turrids), rare corals, bryozoans, and brachiopods, echinoid spines; microfauna is poor.

BCC 7b is a thin horizon, which carries the fragile shells of a nautiloid cephalopod.

Johanna River Sands BCC 8 (Table 3): about 7m below the *Notostraea* greensand. Equivalent to lower 1.5 m of 25' bed of Raggatt and Crespin (1955, p. 134-135. Johannian.

Dark brownish to blackish, fossiliferous glauconitic, sandy to gravelly clay. Large "*Turritellas*" concentrated in a 15 cm-thick horizon but also dispersed. Also present are amphibolid-like gastropods, pelecypods, small circular bryozoans, and echinoid spines. Microfauna is poor.

Castle Cove Section (Table 3); see also Carter (1958, p. 11–18, Text-fig. 3).

"Upper Glen Aire Clays" CC2 + 1 m, Table 3): about 1 m above top of Carter Section (1958, p. 11-18, Text-fig. 3). Janjukian.

Greenish grey, rarely glauconitic bryozoal clay. Quartz apparently absent. Bryozoan fragments predominate but here are also occasional brachiopods; microfauna includes foraminiferans and ostracodes.

Mottled in part, greyish marly bryozoal clay, with rare glauconite and quartz sand grains. Medium bedded and interbedded with several indurated horizons. Limonitized fragments common. "Stick" type bryozoans abundant; microfauna rich, includes foraminiferans, ostracodes, also spicules and echinoid spines.

"Upper Glen Aire Clays" (CC3, Table 3): about equivalent to Carter's CC34 (1958, p. 11-18, Text-fig. 3). Janjukian.

Pale greenish grey (dries to whitish grey) marly bryozoal clay, containing occasional white limey concretions. Medium bedded. Glauconite rare, occurs as sappy green pellets. Bryozoans predominate in macrofauna; microfauna includes foraminiferans and ostracodes.

"Tongue of Calder River Limestone" (CC4, Table 3): equivalent to Carter's CC32 (1958, p. 11-18, Text-fig. 3). Janjukian.

Yellowish to greenish brown, gritty bryozoal calcarenite with a silty cement. Thickness of the unit, which is medium bedded and friable in the lower half, about 0.7 m. Quartz abundant, the grains usually rounded and frosted, although some are rounded and polished; this quartz comprises about half the fraction coarser than 0.5 mm. Glauconite rare, usually limonitized. This lithology distinctly different from that in the beds immediately above and below. Bryozoans dominant, especially the "stick" type species; echinoids and brachiopods rare. Microfauna includes foraminiferans and ostracodes.

Underlain by dark greenish to greyish, laminated, puggy clays.

"Lower Glen Aire Clays" (CC5, Table 3): about equivalent to Carter's CC46 (1958, p. 11–18, Text-fig. 3). Aldingan.

Dark brownish to greyish, gravelly, fossiliferous clay, containing abundant limontized quartz grains, ranging from sand to small pebble grade, and occasional grains of limonitized glauconite. Macrofauna of bryozoans, echinoids, rare corals, pelecypods, but apparently no brachiopods; microfauna includes foraminiferans and ostracodes.

Castle Cove Limestone (CC6, Table 3): about equivalent to Carter's CC22 (1958, p. 11–18, Text-fig. 3). Aldingan.

Dark brownish, gritty, fossiliferous clay, containing abundant limonite grains some limonitized glauconite, and much limonitized quartz. Macrofauna characterized by a small brachiopod, bryozoans not as abundant as in other sample from this section, echinoids represented by spines and test fragments; microfauna includes foraminiferans and ostracodes.

Browns Creek Clays (BCC at CC1, Table 3): lies between Carter's CC8 and CC9 (1958, p. 11–18, Text-fig. 3). Aldingan.

Greyish (dries to bluish grey with oxidized pink to orange streaks), glauconitic bryozoal marly clay. Macrofauna characterized by the bryozoans—"stick" type species less abundant here than in the next lower sample—and by shell fragments. Microfauna rich, (stained pinkish or brownish) includes foraminiferans and ostracodes.

Browns Creek Clays (BCC at CC2, Table 3): equivalent to Carter's CC3 (1958, p. 11–18, Text-fig. 3). Aldingan.

Brownish grey (dries fawnish), glauconitic sandy, bryozoal marly clay. Medium bedded. The glauconite occurs as pellets, the quartz is usually subrounded and polished. Macrofauna dominated by bryozoans, especially the "stick" type species, shell fragments common as are echinoid spines and bits of echinoid tests; microfauna containing rich assemblages of foraminiferans and ostracodes.

Fishing Point Section (Table 3); see also Carter (1958, p. 18–19), and Singleton (1967, p. 124). The total section exposed is about 16 m thick: about 1.5 m below top of exposure at Fishing Point (Fishing Point Marl 3, Table 3). Longfordian.

Brownish, porous, friable, coarse-grained bryozoal calcarenite. Medium bedded. Matrix of comminuted bryozoan debris. Bryozoans predominate in the macrofauna; microfauna of foraminiferans and ostracodes.

Johanna River Sands: about a meter above the Mesozoic "basement complex." Carter's CC1 (1958, p. 11–18, Text-fig. 3. Johannian.

Dark brownish to blackish, streaked with yellowish bands, carbonaceous, micaceous, sparsely fossiliferous sands. Bedding poor. Quartz frosted, subangular, fine grained, moderately sorted. Rare glauconite. The only fossil noted was the foraminiferan, *Cyclammina*.

About 6 m below top of exposure at Fishing Point (Fishing Point Marl 4, Table 3). Longfordian.

Fawn, porous, friable, bryozoal marly clays interbedded with greyish, fossiliferous silty clays. Thin to medium bedded, well bedded. Bryozoans predominate in the macrofauna; the rich microfauna includes foraminiferans and ostracodes.

Occasionally the thin beds of bryozoal marly clays are well indurated, forming brownish bryozoal limestone.

About 0.7 m above the base of the exposure at Fishing Point (Fishing Point Marl 1, Table 3). Longfordian.

Lithologically, very similar to the above sample. Macrofauna dominated by bryozoans; microfauna including abundant foraminiferans and ostracodes.

Base of the exposure at Fishing Point (Fishing Point Marl 2, Table 3). Longfordian.

Brownish, porous, friable, bryozoal marly clay. Thin to medium bedded. Bryozoans dominate the macrofauna; the rich microfauna includes foraminiferans and ostracodes.

Melbourne-Geelong-Torquay District Section (Table 4, Table 5). See also Singleton (1967, p. 121–122), Spencer-Jones (1967, p. 162), Gostin (1967, p. 218).

0.2 m thick shell bed; about 1m above hard shell bed at base of shoreline cliff, near Beaumaris Yacht Club (Cheltenhamian, Table 5). Cheltenhamian.

Brownish, porous, friable, poorly fossiliferous quartzose sands. Massive bedded, cross bedded. Overlying brownish, porous, friable, glauconitic fossiliferous quartzose sand. The quartz grains are mostly of fine grade and medium sorted and are usually rounded and polished; typically they are iron stained. Glauconite very abundant, as brown oblong pellets. Macrofauna dominated by pelecypods, but their shells are strongly decomposed and fragile, thus mollusk debris is rare in the washings. Microfauna rich; includes foraminiferans and ostracodes.

Balcombe Clay: between tide marks, Fossil Beach, Balcombe Bay, near Mornington (Balcombian, Table 4). Balcombian.

Blackish grey (dries to bluish grey), impermeable, glauconitic richly fossiliferous, silty clay to clayey silt. Well bedded, medium bedded, with a blocky fracture. Pyrite and free gypsum present in the exposures. Apart from the rich molluscan fauna, characterized by turrids and muricids, there are bryozoans, echinoids, serpulids, and solitary corals in the macrofauna; and sponge spicules, foraminiferans, and ostracodes in the microfauna.

Batesford Limestone: New Quarry, Australian Portland Cement Ltd. near Batesford northwest of Geelong (Batesfordian, Table 4). Batesfordian.

Yellowish, creamy yellowish or yellow brown, porous, friable, *Lepidocyclina* coquina. Massive bedded, about 13 m thick. Macrofauna includes bryozoans; microfauna dominated by *Lepidocyclina* foraminiferans; ostracodes also present.

Batesford Limestone: locality as for previous sample. Not analyzed for this paper. ?Batesfordian or Longfordian.

Earthy whitish, porous, consolidated, bryozoal, coarse- to medium-grained calcarenite. Massive to irregularly thick bedded; about 22 m thick. Bryozoans dominate the macrofauna; microfauna includes foraminiferans and ostracodes.

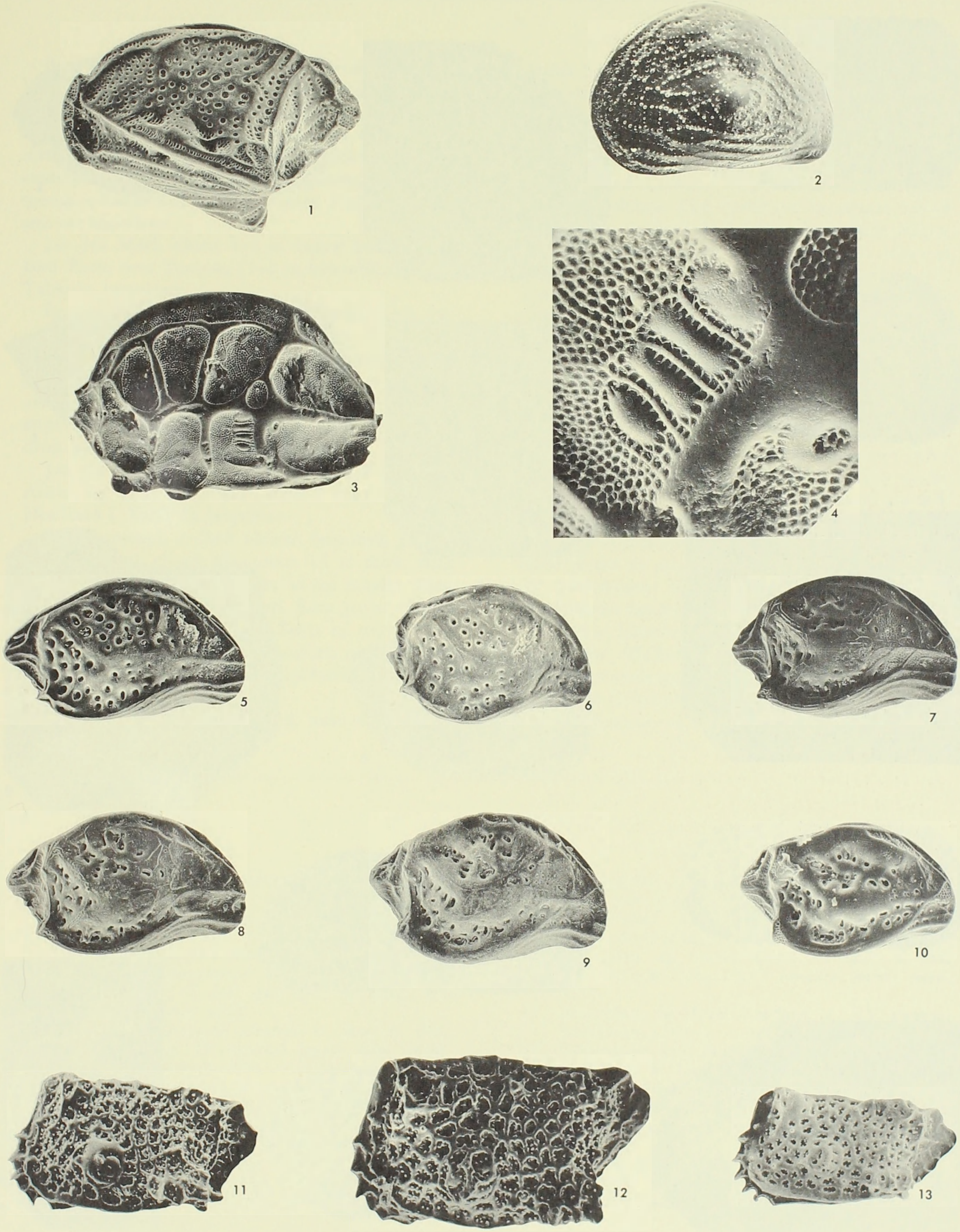
Locality as for two previous samples: below quarry floor. Not analyzed for this paper. ?Batesfordian or Longfordian.

Whitish, porous, friable, arkosic, fossiliferous calcarenitic medium-grained sand. Bedding not observed, thickness about 10 m. Heavy mineral content, increasing toward base.

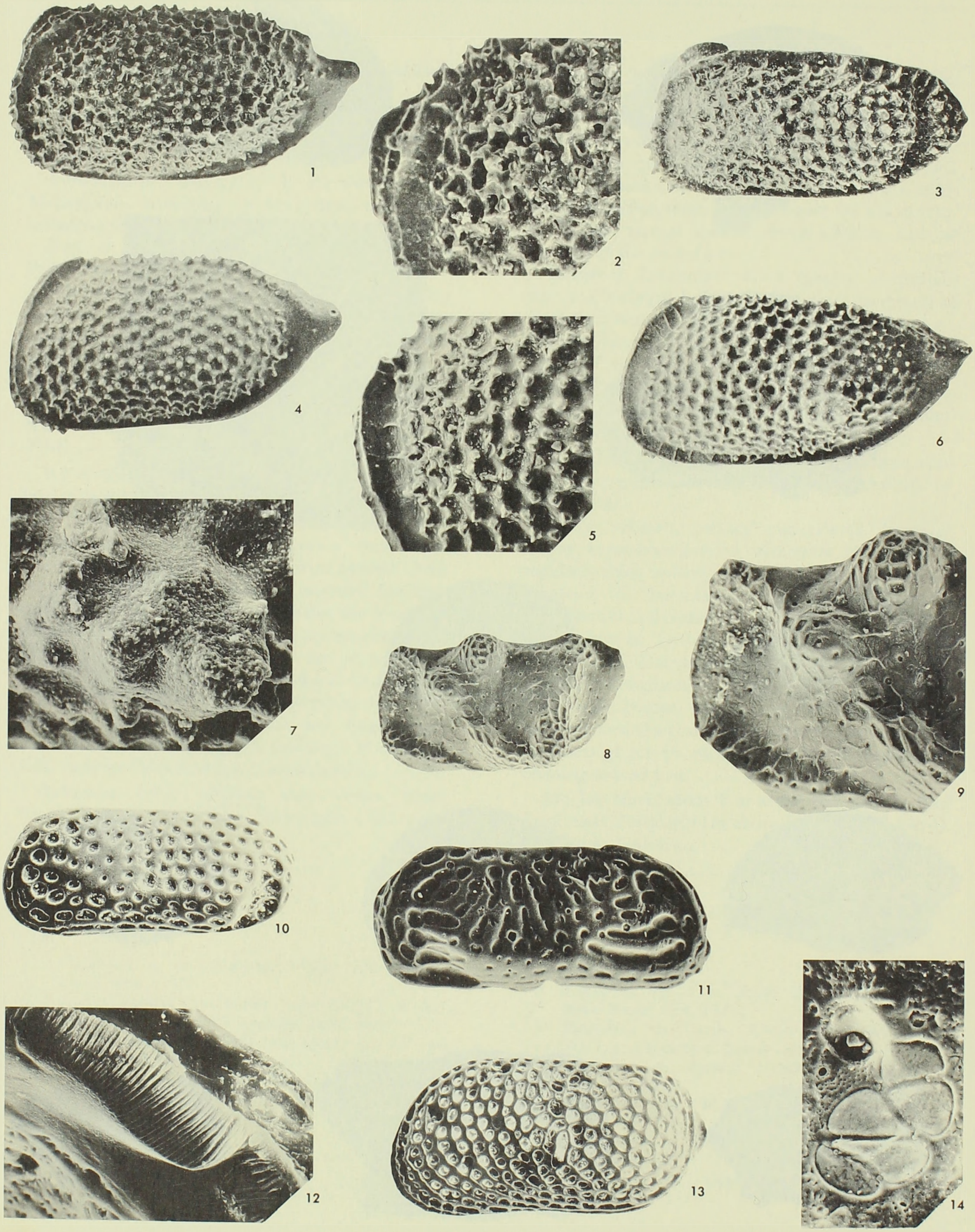
Jan Juc Marl: about 1 m above bed capping Bird Rock, near Torquay. (1m above Bird Rock, Table 4). Uppermost Janjukian.

PLATE 3

1 *Cytheropteron* sp. Rutledge Creek; LV external lateral view, x243.
2 *Rotundracythere* sp. Banks Strait, 40°53.1' S Lat., 148°28.7' E Long.; LV external lateral view, x125.
3 *Hemicytherura* sp., Bells Headland 1; RV external lateral view, x290.
4 *Hemicytherura* sp. Bells Headland 1; RV external lateral view, detail of muscle scars, x1460.
5 *Kangarina* sp. BCC 7b; RV external lateral view, x240.
6 *Kangarina* sp. BCC 6; RV external lateral view, x213.
7 *Kangarina* sp. Bells Headland 2; RV external lateral view, x195.
8 *Kangarina* sp. 1 m above Bird Rock; RV external lateral view, x214.
9 *Kangarina* sp. Tambo River Formation, Mitchellian 1, 2; RV external lateral view, x214.
10 *Kangarina* sp. Barwon Heads; RV external lateral view, x212.
11 *Eucytherura* sp. BCC 7b; LV external lateral view, x240.
12 *Eucytherura* sp. Bells Headland 1; LV external lateral view, x275.
13 *Eucytherura* sp. Gellibrand Clay; L external lateral view, x235.



CENOZOIC OF SOUTHEASTERN AUSTRALIA



CENOZOIC OF SOUTHEASTERN AUSTRALIA

Bluish greyish, glauconitic, fossiliferous silty clay. Well bedded, medium bedded. Macrofauna dominated by thin-shelled pelecypods (*Chione*) and bryozoan fragments; also present are fragments of echinoid tests. In the rich microfauna are foraminiferans (including rare large miliolids), ostracodes, serpulids, sponge spicules, and echinoid spines. Planktonic forams not abundant.

Jan Juc Marl: about 1–2 m below bed capping Bird Rock, near Torquay (1–2 m below Bird Rock, Table 4). Janjukian.

Brownish greyish, slightly porous, glauconitic, fossiliferous, clayey silt. Well bedded, thin to medium bedded. Occasional subrounded polished quartz grains occur. Macrofauna dominated by gastropods, includes bryozoans; microfauna of foraminiferans, serpulids, echinoid spines, sponge spicules, ostracodes. Planktonic forams not abundant.

Jan Juc Marl: Bells Headland, west of Torquay. About 1.3 m below Point Addis Limestone (Bells Headland 1, Table 4). Janjukian.

Dark brownish to dark pinkish brownish, glauconitic, bryozoal, clayey silt, about 0.3 m thick, with a cemented concretionary zone in the middle. Most of the glauconite is limonitized. Rare grains of subrounded polished quartz and flakes of mica occur. Macrofauna dominated by bryozoans, mollusk shell debris also present. Microfauna includes foraminiferans, ostracodes, echinoid spines.

Jan Juc Marl: Bells Headland, west of Torquay. About 5m below Point Addis Lst (Bells Headland 2, Table 4). Janjukian.

Brownish, glauconitic, sandy, shelly, bryozoal marl. Thin bedded, unit only 0.2 m thick. Glauconite generally not limonitized. Quartz grains, angular to subrounded, and fractured to polished, fairly frequent in fine washings. The dominant bryozoans are of "stick" type, mollusk shell debris also present. Microfauna includes foraminiferans, ostracodes, echinoid spines.

Longford District Section (Table 5); see also Carter (1964, p. 19, 49–50, 53, fig. 4) and Crespin (1943, p. 16–23).

Glencoe Limestone (Table 5): 1 m below apparent unconformable contact with the Lake Wellington Gravels at Brocks Quarry, Glencoe Parish. Batesfordian.

Creamy yellowish, porous, friable quartzose bryozoal calcarenite. Bedding indistinct, tending to be massive. The quartz is greyish, medium grained, often frosted, subrounded to subangular. The increase in quartz content upwards through the Glencoe Limestone points to progressive shallowing. Apart from the predominant bryozoans, there is a microfauna that includes foraminiferans and ostracodes.

Glencoe Limestone: about 15 m below contact with Lake Wellington Gravels, same locality as above. Not analyzed for this paper. Batesfordian.

Creamy yellowish to whitish, porous, friable, bryozoal calcarenite—a bryozoan coquina. Bedding in-

PLATE 4

1 *Hanaiceratina arenacea balcombensis* n. gen., n. subsp.. Balcombian; LV external lateral view, detail of anterodorsal region, x290.
2 *Hanaiceratina arenacea balcombensis* n. gen., n. subsp. Balcombian; LV external lateral view, x170.
3 *Hanaiceratina henryhowei* n. gen., n. sp. Banks Strait, 38°38.2' S Lat. 144°59.2' E Long.; LV external lateral view, x125.
4 *Hanaiceratina arenacea arenacea* n. gen., n. subsp.; Sahul Shelf; LV external lateral view, detail of anterodorsal region, x290.
5 *Hanaiceratina arenacea arenacea* n. gen., n. subsp. Sahul Shelf; LV external lateral view, x145.
6 *Hanaiceratina posterospinosa* n. gen., n. sp. Sahul Shelf; LV external lateral view, detail of medioventral posterior spine, x730.
7 *Hanaiceratina posterospinosa* n. gen., n. sp. Sahul Shelf; LV external lateral view, x146.
8 *Bythoceratina* sp. Kalimnan?; LV external lateral view, x146.
9 *Bythoceratina* sp. Kalimnan?; LV external lateral view, detail of anterior, x290.
10 *Arcacythere* sp. Banks Strait, 38°28.2' S Lat., 144°59.2' E Long.; LV external lateral view, x255.
11 *Arcacythere* sp. Bells Headland 1; RV external lateral view, x280.
12 *Cytheralison* sp. Banks Strait, 40°53.1' S Lat., 148°28.7' E Long; RV internal lateral view, detail of anterior hinge tooth, x1280.
13 *Cytheralison* sp. Banks Strait, 40°53' S Lat., 148°28.7' E Long.; LV external lateral view, x127.
14 *Cytheralison* sp. Banks Strait, 40°53.1' S Lat., 148°28.7' E Long.; RV internal lateral view, detail of muscle scars, x620.

distinct. After preparation of the sample, some lumps of bluish grey limey clay (of about 2.5 cm diameter) were found in the coarse washings. The microfauna includes foraminiferans and ostracodes.

Glencoe Limestone: 1 m above contact with Longford Limestone at Quarry in Allotment 36, Glencoe Parish. Not analyzed for this paper. Batesfordian.

Yellowish brown, porous, friable, bryozoal calcarenite—a bryozoan coquina. Bedding indistinct. Quartz rare. Besides the bryozoans, large colonial fragments of which remained in the washings, the macrofauna includes rare brachiopods; microfauna includes foraminiferans and ostracodes.

Contact zone at Quarry in Allotment 36, Glencoe Parish. Not analyzed for this paper. Batesfordian/Longfordian.

Greenish white (when dried), leached, porous, friable, limey, glauconitic, and rarely quartzose calcarenite. The quartz occurs as greyish grains with frosted surface textures. Bryozoans predominate in macrofauna, which also incorporates some brachiopods; microfauna includes foraminiferans and ostracodes.

Longford Limestone (1, Table 5): 1 m below contact zone at Quarry in Allotment 36, Glencoe Parish. Longfordian.

Ochreous brownish, porous, friable, bryozoal calarenite—a bryozoan coquina. Bedding poor. Occasionally glauconitic sand and silt matrix present. Bryozoans predominate but macrofauna also includes infrequent worm tubes, echinoids, and mollusks; microfauna includes foraminiferans and ostracodes.

Longford Limestone (2, Table 5): lowest exposed glauconitic marl bed at Dowds Quarry, Coolungoolun Parish. Longfordian.

The section consists of interbedded yellow brown dense limestones (about 40 cm thick) and brownish-green friable glauconitic marls (about 15 cm thick). During preparation of the latter unit, the brownish marl matrix washes out and the sample left on the sieves is dominantly glauconitic.

The bed sampled is richly fossiliferous, the macrofauna including mollusks (?) and brachiopods (casts only), as well as fragments of echinoids and bryozoan colonies; the microfauna includes foraminiferans and ostracodes.

The localities sampled are the type localities for the two limestone units named, both of which have now been amalgamated into the Gippsland Limestone, see Hocking and Taylor (1967, p. 127, fig. 2).

Lakes Entrance to Bairnsdale Section (Table 5); see also Wilkins (1963, p. 44), Crespin (1943, p. 23–27).

Jemmys Point Formation at South Bunga Creek (Kalimnan 1, Table 5): equivalent to bed (c) of Wilkins (1963, p. 44). Kalimnan.

Brownish (with a matrix of greyish silt and clay), porous, friable, carbonaceous, micaceous, shelly, quartzose, fine-grained sand. At close quarters indistinctly bedded. Seen to be medium bedded at a distance of some meters, with indistinct low angle cross-bedding. Pelecypods abundant in the macrofauna, which includes an echinoid; microfauna of foraminiferans and ostracodes.

Jemmys Point Formation at North Bunga Creek: equivalent to bed (g) of Wilkins (1963, p. 44.) Not analyzed for this paper. Kalimnan.

Brownish (with a matrix of greyish silt and clay), porous, weakly consolidated, carbonaceous, micaceous, shelly, quartzose, fine-grained sand. Indistinctly to medium bedded, with indistinct low angle cross-bedding. Rare grains of glauconite appear in the washings. The quartz is angular to subangular, with a fractured surface texture. Mollusks are the dominant fossils, especially the pelecypods. There are also rare turreted gastropods. Microfossils include foraminiferans and ostracodes.

Jemmys Point Formation at North Bunga Creek (Kalimnan 2, Table 5): equivalent to bed (b) of Wilkins (1963, p. 44.). Kalimnan.

Greyish brownish, porous, friable, slightly carbonaceous, micaceous, shelly, quartzose, very fine sand. Quartz is about 50 percent of the fine washings (<0.5 mm), usually greyish, often iron stained, angular to subangular with a fractured surface texture. Biotitic mica is abundant. Macrofauna dominated by the molluscs, especially gastropods (cerithiids, buccinids, etc.), although pelecypod debris is abundant; there are also rare bryozoans. All the mollusks seem to be abraded. Microfauna includes foraminiferans (especially large miliolids) and ostracodes.

Tambo River Formation (Mitchellian 1 and 2, Table 5): at Tambo River Bridge, Swan Reach. Mitchellian.

Dark brownish green, porous, friable (when dried), glauconitic, partly ferruginized, fossiliferous, fine-grained sand. Medium to thick bedded. Macrofauna characterized by pectenids and thick echinoid spines, with rarer (usually worn) bryozoans; microfauna includes foraminiferans (miliolids, elphidiids) and ostracodes.

Mitchellian 2 (collected at the base of the exposure) is distinctly more glauconitic than Mitchellian 1 (collected near the top).

Bairnsdale Pumping Station Section (Mitchellian 3, Table 5): 2 m above Mitchellian-Bairnsdalian contact. Mitchellian.

Brownish, porous, friable, glauconitic, quartzose, fossiliferous calcarenite. Indistinctly bedded. Abundant mollusk debris, mostly thin shelled pelecypods (in the >0.5 mm washings); microfauna of well-preserved foraminiferans and ostracodes.

Bairnsdale Pumping Station Section: about 0-0.2 m above Mitchellian-Bairnsdalian contact. Not analyzed for this paper. Mitchellian.

Brownish, porous, weakly consolidated, glauconitic, quartzose, fossiliferous calcarenite. Medium to thick bedded. Abundant highly abraded organic carbonate debris present, also ferruginized (chocolate coloured) glauconite. The quartz is greyish and subangular. Macrofauna of large pelecypod shells and casts; microfauna includes well-preserved foraminiferans and ostracodes.

Bairnsdale Pumping Station Section: immediately below Mitchellian-Bairnsdalian contact. Not analyzed for this paper. Bairnsdalian.

Brownish and slightly mottled, (with rare friable lenses), bryozoal calcarenite. Macrofauna of dominant abraded bryozoan debris, with occasional gastropods, brachiopods, and large pelecypods; microfauna includes foraminiferans and ostracodes.

Cliff near Pound Swamp, Bairnsdale (Bairnsdalian, Table 5): equivalent to upper part of Crespin's "lower bed" (1943, p. 23–25). Bairnsdalian.

Yellowish brownish, porous, moderately indurated, bryozoal calcarenite. Irregularly thin to medium bedded. Quartz rare to absent; when present the grains are rounded and polished. Bryozoans predominate in macrofauna, which also contains mollusk fragments. Microfauna includes foraminiferans and ostracodes.

References

*Asterisked references are those dealing with Australian Cenozoic Ostracoda. Not all of these references are are cited in the text.

*BEASLEY, A. W., 1944, *Ostracods in relation to Queensland oil shales and Tertiary stratigraphy:* Austral. Jour. Sci., v. 7, p. 6–8, n. 1.

*——— 1945, *Ostracods from some Queensland Tertiary basins, and their bearing on the correlation of the strata:* Roy. Soc. Queens.,Proc., v. 56, n. 11, pl. 6, fig. 1.

BENSON, R. H. and MADDOCKS, R. F., 1964, *Recent ostracodes of Knysna Estuary, Cape Province, Union of South Africa:* Univ. Kans. Paleont. Contr., Arthr., Art. 5, p. 1–39, pl. 1–6, fig. 1–22.

BOLD, W. A. VAN DEN, 1958, *Ostracoda of the Brasso formation of Trinidad:* Micropaleontology, v. 4, n. 4, p. 391–418, pl. 1–5, fig. 1–2.

——— 1965, *New species of the ostracod genus* Ambocythere: Ann. Mag. Nat. Hist., ser. 13, v. 8, p. 1–18, pl. 1, fig. 1–9.

*BRADY, G. S., 1880, *Report on the Ostracoda dredged by H. M. S. Challenger during the years 1873–1876:* Rept. voyage Challenger, Zoology, v. 1, n. 3, 184 p., 44 pl.

CARTER, A. N., 1958, *Tertiary Foraminifera from the Aire District, Victoria:* Geol. Survey. Vict., Bull. n. 55, p. 1–76, pl. 1–10, fig. 1–4.

——— 1959, *Guide Foraminifera of the Tertiary stages in Victoria:* Min., Geol. Jour., v. 6, n. 3, p. 47–51, table 1.

——— 1964, *Tertiary Foraminifera from Gippsland, Victoria, and their stratigraphical significance:* Geol. Survey Vict. Mem., n. 23, p. 1–154, pl. 1–17, fig. 1–36.

CHAPMAN, F., 1910, *A study of the Batesford limestone:* Roy. Soc. Vict. Proc., n.s., v. 22, n. 2, p. 263–314, pl. 52–55.

——— 1914a, *Description of new and rare fossils obtained by deep boring in the Mallee, Pt. 3, Ostracoda to fishes, With a complete list of fossils found in the Borings:* Roy. Soc. Vict. Proc., n.s., v. 27, n. 1, p. 28–71, pl. 6–10.

*——— 1914b, *Notes on Testacea from the Pleistocene marl of Mowbray Swamp, North-west Tasmania:* Nat. Mus., Melbourne, Mem., v. 5, p. 55–61.

——— 1918, *Report on a collection of Cainozoic fossils from the oil-fields of Papua:* Bull. Terr. Papua, n. 5, p. 8–17, pl. 1–2.

*——— 1919a, *On some smaller fossils from the Red Limestone at Grange Burn, near Hamilton, with a note on a new species of* Bolivina: Victorian Nat., v. 32, n. 10, p. 144–146.

*——— 1919b, *On an ostracod and shell marl of Pleistocene age from Boneo Swamp, west of Cape Schanck, Victoria:* Roy. Soc. Vict. Proc., n.s., v. 32, n. 1, p. 24–32, pl. 3–4.

*——— 1926, *Geological notes on* Neumerella, *and the section from Bairnsdale to Orbost:* Roy. Soc. Vict. Proc., n.s., v. 38, p. 125–142, pl. 10, fig. 1–2.

*——— 1931, *A report on samples obtained by boring into Michaelmas Reef, about 22 miles N.E. of Cairns, Queensland:* Great Barrier Reef Comm. Dept., v. 3, n. 3, p. 32–42, pl. 9, 10.

*——— 1935, *Report on samples of surface Tertiary rocks and a bore sample containing Ostracoda from Queensland:* Roy. Soc. Queens. Proc., v. 46, n. 6, p. 66–71, pl. 2.

*——— 1936, *Cypridiferous limestone from the Mallee:* Rec. Geol. Surv. Vict., v. 5, n. 2, p. 296–298.

*——— 1937, *Cherty limestone with* Planorbis, *from the Mount Elder Range, western Australia:* Roy. Soc. Vict. Proc., n.s., v. 50, n. 1, p. 59–66, pl. 6.

*CHAPMAN, F., CRESPIN, I., and KEBLE, R. A., 1928, *The Sorrento Bore, Mornington Penninsula, with a description of new or little-known fossils:* Rec. Geol. Survey Vict., v. 5, n. 1, p. 1–195, pl. 1–12.

*CHAPMAN, F. and GABRIEL, C. J., 1918, *On a shell-bed underlying volcanio tuff near Warrnambool, with notes on the age of the deposit:* Roy. Soc. Vict., Proc., n.s., v. 30, n. 1. p. 4–14.

*CRESPIN, I., 1943, *The stratigraphy of the Tertiary marine rocks in Gippsland, Victoria:* Palaeont. Bull., Canberra, n. 4, p. 1–101, figs. 1–8.

——— 1945a, *Middle Miocene limestone from Cape Barren Island, Furneaux Group, Bass Strait:* Roy. Soc. Tas. Proc. Paper, v. 1944, p. 13–14.

*——— 1945b, *Middle Miocene limestones from King Island, Tasmania:* Roy. Soc. Tas. Proc., Pap., v. 1944, p. 15–18.

*——— 1959, *Microfossils in Australian and New Guinea stratigraphy:* Roy. Soc. N. S. W., Jour. Proc., v. 92, p. 133–147.

DELTEL, B. 1964, *Nouveaux Ostracodes de l'Éocène et de l'Oligocène de l'Aquitaine méridionale:* Acta. Soc. Linn. Bordeaux, v. 100, p. 127–221, pl. 1–6.

DORMAN, F. H., 1966, *Australian Tertiary paleotemperatures:* Jour. Geol.,v. 74, n. 1, p. 49–61, fig. 1–3.

EAMES, F. E., BANNER, F. T., BLOW, W. H., and CLARKE, W. J., 1962, *Fundamentals of Mid-Tertiary stratigraphical correlation:* Cambridge Univ. Press, 171 p.

ETHERIDGE, R., 1876, *South Australian post-Tertiary Foraminifera and Ostracoda:* Geol. Mag., n.s., Dec. 2, v. 3, n. 7, p. 334–335.

FLEMING, C. A., 1962, *New Zealand biogeography, A paleontologist's approach:* Tuatara, v. 10, n. 2, p. 53–108, fig. 1–15b.

GILL, E. D., 1961, *The climates of Gondwanaland in Kainozoic times:* in Descriptive palaeoclimatology, ed. Nairn, A. E. M., p. 332–353, New York, Interscience Publ.

——— 1968, *Oxygen isotope palaeotemperature determinations from Victoria, Australia:* Tuatara, v. 16, n. 1, p. 56–61, fig. 1.

GOSTIN, V. A., 1966, *Tertiary stratigraphy of the Mornington district, Victoria:* Royal Soc. Vict., Proc., n.s., v. 79, n. 2, p. 459–512, pl. 51, text-figs. 1–22, fig. 1, 2, tables 1–4.

——— 1967, *Mornington Peninsula:* Austral. N. Z. Assoc. Adv. Sci., 39th Cong., sect.C, Excurs. Hdbk., n. 42, p. 213–219, fig. 1–4.

HANAI, T., 1961, *Studies on the Ostracoda from Japan, Hingement:* Jour. Fac. Sci., Tokyo Univ., sect. 2, v. 13, n. 2, p. 345–377, fig. 1–14.

HERRIG, E., 1966, *Ostracoden aus der Weissen Schreibkreide (Unter-Maastricht) der Insel Rügen:* Paläont. Abhandl. Berl. A, v. 2, n. 4, p. 693–1024, pl. 1–45, fig. 1–144.

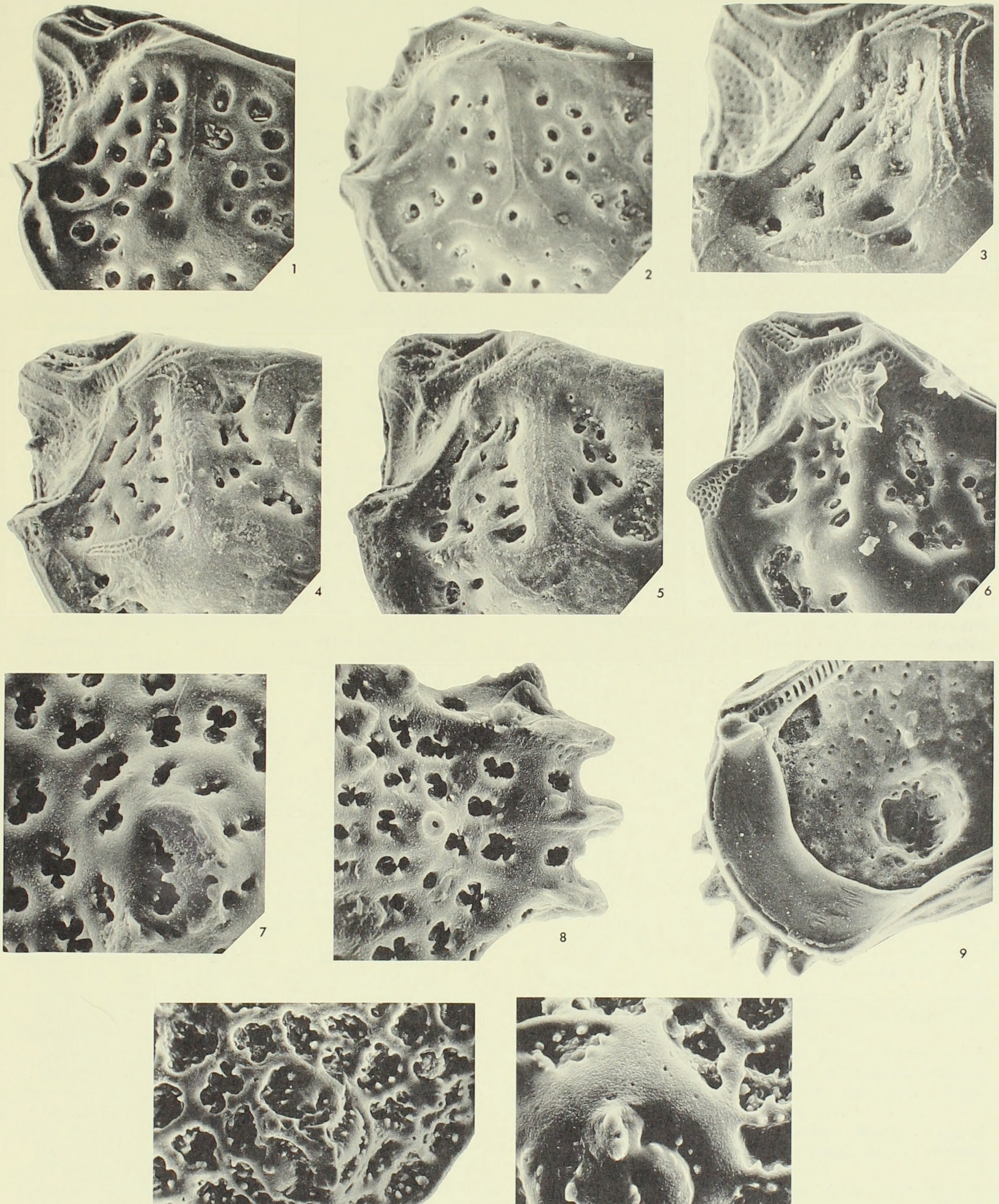
HOCKING, J. B. and TAYLOR, D. J., 1964, *The initial marine transgression in the Gippsland Basin, Victoria:* Jour. Austral Petrol. Expls. Assoc., v. 1964, p. 125–132.

HOLDEN, J. C. 1964, *Upper Cretaceous ostracods from California:* Palaeontology, v. 7, n. 3, p. 393–429, fig. 1–28.

*HORNIBROOK, N. DE B., 1952, *Tertiary and Recent marine*

PLATE 5

1 *Kangarina* sp. BCC 7b; RV external lateral view, detail of posterior, x600.
2 *Kangarina* sp. BCC 6; RV external lateral view, detail of posterior, x535.
3 *Kangarina* sp. Bells Headland 2; RV external lateral view, detail of posterior, x725.
4 *Kangarina* sp. 1 m above Bird Rock; RV external lateral view, detail of posterior, x535.
5 *Kangarina* sp. Tambo River Formation, Mitchellian 1, 2; RV external lateral view, detail of posterior, x535.
6 *Kangarina* sp. Barwon Heads; RV external lateral view, detail of posterior, x530.
7 *Eucytherura* sp. Gellibrand Clay; LV external lateral view, detail of medioventral muscle scar node, x1200.
8 *Eucytherura* sp. Gellibrand Clay; LV external lateral view, detail of posterior, x1100.
9 *Eucytherura* sp. Gellibrand Clay; RV internal lateral view, detail of anterior, x590.
10 *Eucytherura* sp. Bells Headland 1; LV external lateral view, detail of medioventral muscle scar node, x685.
11 *Eucytherura* sp. BCC 7b; LV external lateral view, detail of medioventral muscle scar node, x1200.



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Ostracoda of New Zealand, Their origin, affinities, and distribution: Palaeont. Bull. Wellington, n. 18, p. 1–82, pl. 1–82, pl. 1–18, fig. 1–4.

*——— 1953, *A Note on the Ostracoda* Limnicythere mowbrayensis *Chapman, 1914, and* L. sicula *Chapman, 1919:* Nat. Mus. Vict, Mem. n. 18, p. 155–156, pl. 1.

*——— 1955, *Ostracoda in the deposits of Pyramid Valley Swamp:* Canterbury Mus. Rec., v. 6, n. 4, p. 267–278, fig. 1–34.

——— 1963, *The New Zealand ostracode family Punciidae:* Micropaleontology, v. 9, n. 3, p. 318–320, fig. 1–9.

——— 1967, *New Zealand Tertiary microfossil zonation, correlation and climate:* in Tertiary correlations and climatic changes in the Pacific, H. Kotora (ed.), p. 29–39, fig. 1–6, Sendai, Japan, Sasaki Publ. Co., Ltd.

ISHIZAKI, K., 1966, *Miocene and Pliocene ostracodes from the Sendai area, Japan:* Sci. Rept., Tohoku Univ., 2nd ser. (Geol.), v. 37, n. 2, p. 131–163, pl. 16–19, fig. 1–9.

KEIJ, A. J., 1953, *Preliminary note on the recent Ostracoda of the Snellius expedition:* Kon. Nederl. Akad. Wetensch., Proc., ser. b., v. 56, n. 2, p. 155–168, 2 pl.

*——— 1966, *Southeast Asian Neogene and Recent species of* Paijenborchella *(Ostracoda):* Micropaleontology, v. 12, n. 3, p. 343–354, 3 pl.

*KINGMA, J. T., 1948, *Contributions to the knowledge of the young Caenozoic Ostracoda from the Malayan region:* Utrecht, Kemink Ptrs., 11 pl., 3 fig., 118 p.

KORNICKER, L. S., 1964, *A seasonal study of living Ostracoda in a Texas bay (Redfish Bay) adjoining the Gulf of Mexico:* Publ. Staz. Zool. Napoli, v. 33, suppl., p. 45–60, fig. 1–14.

LAGAAIJ, ROBERT, 1968, *First fossil finds of six genera of Bryozoa Cheilostomata:* Atti Soc. Ital. Sci. Nat., v. 108, p. 345–360, pl. 11–12, fig. 1–4.

*LUDBROOK, N. H., 1956, *Microfossils from Pleistocene to Recent deposits, Lake Eyre, South Australia:* Royal Soc. S. Austral.,Trans., v. 79, p. 37–45, pl. 1.

——— 1967, *Correlation of Tertiary Rocks of the Australasian Region:* in Tertiary correlations and climatic changes in the Pacific, ed. Kotora, H., p. 7–19, fig. 1–4, Sendai, Japan, Sasaki Publ. Co., Ltd.

MAXWELL, W. G. H., 1968, *Atlas of the Great Barrier Reef:* Elsevier, London, 258 p.

MCGOWRAN, B. and Wade, M., 1967, *Latitudinal variation in the foraminiferal content of biogenic sediments:* Austral.-N. Z. Assoc. Adv. Sci., 39th Cong., sect. C, Abstr., p. A9–A11.

*MCKENZIE, K. G., 1965, *Ostracoda, A neglected micropalaeontological tool in Australian oil search:* Australas. Oil, Gas Jour., v. 11, N. 8, p. 32, 34.

*——— 1967a, *The distribution of Caenozoic marine Ostracoda from the Gulf of Mexico to Australasia:* in Aspects of Tethyan biogeography, C. G. Adams and D. V. Ager (eds.), Publs. Syst. Assoc., n. 7, p. 219–238, fig. 1–5.

*——— 1967b, *Saipanellidae, A new family of Podocopid Ostracoda:* Crustaceana, v. 13, n. 1, p. 103–113, fig. 1–3.

*——— 1967c, *Recent Ostracoda from Port Phillip Bay, Victoria:* Roy. Soc. Vict., Proc., n.s., v. 80, n. 1, p. 61–106, pl. 11–13, fig. 1–10.

*——— 1969, *Notes on the Paradoxostomatids:* in The taxonomy, morphology and ecology of Recent Ostracoda, ed. Neale, J. W., p. 48–66, fig 1–5, Edinburgh, Oliver and Boyd.

MCKENZIE, K. G. and BAKER, L. J., 1968, *Ostracode assemblages and sedimentary environments in Bass Strait:* (abstr. only), Geol. Soc. Austral. Spec. Symp., Canberra, p. 17.

*MCKENZIE, K. G. and GILL, E. D., 1968, *Ostracoda from the Murray River Valley west of Wentworth, N. S. W.:* Aust. Jour. Sci., v. 30, n. 11, p. 463.

MCKENZIE, K. G. and HUSSAINY, S. U., 1968, *Relevance of a freshwater Cytherid (Crustacea, Ostracoda) to the continental drift hypothesis:* Nature, v. 220, n. 5169, p. 806–808.

MADDOCKS, R. F., 1969a, *Revision of Recent Bairdiidae (Ostracoda):* U.S. Nat. Mus., Bull. n. 295, p. 1–126, fig. 1–63.

——— 1969b, *Recent Ostracodes of the Family Pontocyprididae chiefly from the Indian Ocean:* Smithson. Inst. Contr. Zool., n. 7, p. 1–56, fig. 1–35.

MORKHOVEN, F. P. C. M. VAN, 1963, *Post-Paleozoic Ostracoda, Their morphology, taxonomy, and economic use, II, Generic descriptions:* Amsterdam, Elsevier Publ. Co., 478 p.

OHMERT, W., 1968, *Die Coquimbinae, eine neue Unterfamilie der Hemicytheridae (Ostracoda) aus dem Pliozän von Chile:* Mitt. Bayer. Staatssamml. Paläont. Hist. Geol., v. 8, p. 127–165, fig. 1–38.

POKORNY, V., 1955, *Contribution to the morphology and taxonomy of the Subfamily* Hemicytherinae *Puri 1953 (Crust., Ostracoda):* Acta Univ. Carol. Geol., v. 3, p. 1–35, fig. 1–19.

RAGGATT, H. G. and CRESPIN, I., 1955, *Stratigraphy of Tertiary rocks between Torquay and Eastern View, Victoria:* Royal Soc. Vict. Proc., n.s., v. 67, n. 1, p. 75–142, pl. 4–7, fig. 1–8.

REYMENT, R. A., 1963, *Studies on Nigerian Upper Cretaceous and Lower Tertiary Ostracoda. Pt. 2: Danian, Paleocene, and Eocene Ostracoda:* Stockh. Contr. Geol., v. 10, p. 1–286, pl. 1–23, fig. 1–81.

ROCHFORD, D. J., 1966, *Port Phillip Survey 1957-1963, Hydrology:* Nat. Mus. Vict., Mem., n. 27, p. 107–118, fig. 1–11.

RUGGIERI, G., 1962, *Gli Ostracodi marini del Tortoniano (Miocene medio superiore) di Enna, nella Sicilia centrale:* Palaeont. Ital., v. 56, (n.s., v.26) n. 2, p. 1–68, pl. 11–17, (1–7), fig. 1–15.

——— 1967, *The Miocene and later evolution of the Mediterranean Sea:* in Aspects of Tethyan biogeography, C. G. Adams and D. V. Ager (eds.), Publs. Syst. Assoc., n. 7, p. 283–290, fig. 1–2.

SINGLETON, O. P., 1967, *Otway Region:* Austral. N. Z. Assoc. Adv. Sci., 39th Cong., sect. C, Excurs. Hdbk., n. 12, p. 117–131, fig. 1–4.

SOHN, I. G., 1964, *The ostracode genus* Cytherelloidea, *a possible indicator of paleotemperature:* Pubbl. Staz. zool. Napoli, v. 33, suppl., p. 529–534.

SPENCER-JONES, D., 1967, *Geelong District:* Austral.-

N.Z. Assoc. Adv. Sci., 39th Cong., sect. C, Excurs. Hdbk., n. 33, p. 159–164, fig. 1–3.

STRZELECKI, P. E. de, 1845, *Physical description of New South Wales and Van Diemen's Land:* London, Longman, Brown, Green, and Longmans, 481 p.

TAYLOR, D. J., 1965, *Preservation, composition and significance of Victorian Lower Tertiary* "Cyclammina" *faunas:* Roy. Soc. Vict., Proc., n.s., v. 78, n. 2, p. 143–160, fig. 1–5.

TAYLOR, D. F., 1967, *Marine transgressive patterns in Victoria:* Austral.-N.Z. Assoc. Adv. Sci., 39th Cong., sect. C, Abstr., p. A3–A4.

TRIEBEL, E., 1958, *Zwei neue Ostracoden-Gattungen aus dem Lutet des Pariser Beckens:* Senckenbergiana Lethaea, v. 39, n. 1/2, p. 105–117, pl. 1–3.

——— 1960, *Die taxionomische Stellung und die Gattungen der Unterfamilie Macrocypridinea (Ostracoda):* Senckenbergiana Biol., v. 41, n. 1/2, p. 109–124, pl. 13–20.

*WALDMAN, M. and HANDBY, P. L., 1968, *Tertiary fish from Morwell, Victoria:* Roy. Soc. Vict., Proc., n.s., v. 81, n. 2, p. 95–96, fig. 1.

WILKINS, R. W. T., 1963, *Relationships between the Mitchellian, Cheltenhamian, and Kalimnan stages in the Australian Tertiary:* Roy. Soc. Vict. Proc., n.s., v. 76, n. 1, p. 39–60, fig. 1.