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TASMANIAN TERTIARY FORAMINIFERIDA. PART 3.

DISCORBACEA (EPONIDIDAE) TO NONIONACEA

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(with three text-figures and six plates)

ABSTRACT

QUILTY, P.G., 1982 (31 viii): Tasmanian Tertiary Foraminiferida. Part 3. Discorbacea (Eponididae) to Nonionacea. *Pap. Proc. R. Soc. Tasm.*, 116: 5-51. https://doi.org/10.26749/rstpp.116.5 ISSN 0080-4703. Antarctic Division, Department of Science, Kingston, Tasmania.

This final part recording the Tasmanian Tertiary benthonic Foraminiferida documents the occurrence of 77 taxa of which 65 are previously defined, four are compared with previously defined species and eight are identified generically only. No species are new. Five forms recorded in parts 1 and 2 are noted from a newly discovered sample from Welcome River.

INTRODUCTION

This is the third part of a series of papers in this journal designed to document the Oligo-Miocene Foraminiferida of Tasmania and completes discussion of the benthic forms. The previous papers are those by Quilty (1974, 1977) and the conventions of occurrence are common to the three papers and are explained in Quilty (1974). Several new forms were described by Quilty (1980) are are simply recorded here. The stratigraphic framework of the Tasmanian Tertiary marine rocks was explained in Quilty (1972).

The classification of the Foraminiferida followed here is the same as in Quilty (1977) and is that proposed by Loeblich and Tappan (1974). Ages are quoted in terms of the N zones of Blow (1969). Occurrences are listed approximately from oldest to youngest.

Since the last of the series was published, another locality has been sampled and has yielded an interesting foraminiferid fauna. The locality is near the mouth of the Welcome River (figure 1) and was sampled by Mr G. van der Geer of the Geography Department, University of Tasmania. The rock specimen is catalogued in the collections of the Geology Department, University of Tasmania (UTGD) under the catalogue number UTGD 45979. The rock consists of a friable partly recrystallised bryozoal calcarenite. Preservation is quite good.

Several species from this new fauna are relevant to parts 1 and 2 of this series. They are:

Textularia gramen d'Orbigny (r); *Gaudryina convexa* (Karrer) (r); *Heronallenia lingulata* (Burrows & Holland) (r); *Glabratella crassa* Dorreen (r); *Pileolina* sp. indet. (r).

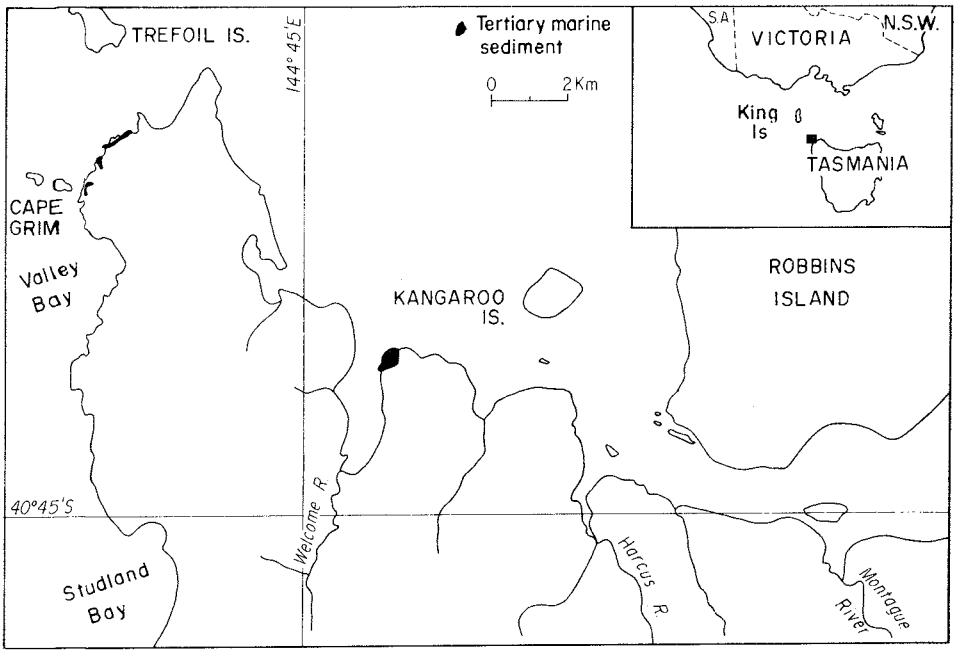

FIG. 1 - The location of Tertiary marine sediments at Welcome River.

SYSTEMATICS

Order FORAMINIFERIDA
Suborder ROTALIINA
Superfamily DISCORBACEA
Family EPONIDIDAE
Genus *EPONIDES* de Montfort, 1808
Eponides lornensis Finlay, 1939
(Pl.1, figs 1,2)

Eponides lornensis Finlay, 1939a, pp.521,522.
E. lornensis Finlay 1939, *Trans. R. Soc. N.Z.* (69(1): 121, pl.13, figs 52,53.
E. lornensis; Carter 1958, p.44, pl.5, figs 48-50.
E. lornensis; Hornibrook 1961, p.109, pl.15, figs 323,325.

Type locality and stratigraphic level - 0.5 km NW of Lorne Railway Station, New Zealand; Late Eocene.

The specimens found in the Great Musselroe Bay sample are much more typical of Finlay's (1939) figures than is the specimen figured by Carter (1958). Some quite irregular forms are found with a much more open umbilicus than Carter figured. The form is here regarded as a variant of, intergrading with, and often not separable from *E. repandus*. It is considered ancestral to *E. repandus* although as a morphotype, *E. repandus* is found as far back in time as the Late Eocene.

Occurrence: Great Musselroe Bay - 84483 (r).
Age: Late Oligocene, N3.

Eponides repandus (Fichtel and Moll), 1798.
(pl.1, figs 3,4)

Nautilus repandus Fichtel and Moll, 1798: *TESTACEA MICROSCOPICA* ..., (Camesina: Vienna) 35, pl.3, figs a-d.
Pulvinulina repanda (Fichtel and Moll); Howchin 1889, p.14.
P. repanda; Howchin 1891, p.353.
P. repanda; Heron-Allen and Earland 1924: *J. R. microscop. Soc.* (1924): 179.
Eponides repandus (Fichtel and Moll); Chapman, Parr and Collins 1934, p.565, pl.9, fig.18.
E. repandus; Crespin 1943, p.79.
E. repandus; Carter 1958, pp.45,46, pl.6, figs 51-53.
E. repandus; Ludbrook 1961, p.57 *et seq.*, pl.2, figs 6,7.
E. repandus; Carter 1964, p.83, pl.4, fig.86.
E. repandus; Reed 1965, p.78.

Type locality and stratigraphic level - Mediterranean Sea; Holocene.

This species is very widespread, being found in all sections except Fossil Bluff. It is well preserved only in the Great Musselroe Bay samples. In the few complete specimens, no pores could be seen on the apertural face. Several Great Musselroe Bay specimens can be referred to *E. lornensis* Finlay, and it seems that the two species are intergradational as suggested by Hornibrook (1961) rather than conspecific, a belief apparently held by Reed (1965). Intergradational species would be separated into a population with a high proportion of *E. lornensis* Finlay which would be older (Eocene-Oligocene) than another population with a higher proportion of *E. repandus* (F. and M.). The forms are separated here, although regarded as intergradational.

Occurrence: (a) Great Musselroe Bay - 84483(f), 84481(f), 84482(r); (b) King Island - 84084(q), 84085(r), 84081(r), 84082(r), 84083(f), 84086(a), 84089(p), 84475(q), 84476(q), 84477(q); (c) Daisy Creek - 84478(r); (d) Cape Grim - 84006(v); (e) Mt Cameron West - 84121(v), 84120(v), 84117(c); (f) Preservation Island - 84479(q); (g) Brittons Swamp - 84480(r); (h) Redpa - 84097(r), 84093(q), 84094(r), 84095(q), 84096(r); (i) Cape Barren Island - 84554(f); (j) Marrawah district - 84561(r), 84109(r), 84110(r), 84111(r), 84113(q), 84114(q), 84104(v), 84101(r), 84106(r), 84107(q).

Age: Late Oligocene-Early Miocene, N3-N8.

Family SIPHONINIDAE
Genus *SIPHONINA* Reuss, 1850
Siphonina australis Cushman, 1927
(Pl.1, fig.5)

Siphonina australis Cushman, 1927: *Proc. U.S. natn. Mus.* 77, art.20: 8,9,pl.2, figs 6a-c; pl.3, figs 7a-c, 8a-c.
S. australis; Chapman, Parr and Collins 1934, p.567, pl.10, figs 23a-c.
S. australis; Crespin 1943, p.83.
S. australis; Carter 1964, p.93, pl.7, figs 127-129.
S. australis, Reed 1965, p.69.

Type locality and stratigraphic level - lower beds at Muddy Creek, Victoria; Middle Miocene.

Occurrence: (a) Great Musselroe Bay - 84483(v), 84481(v), 84482(v); (b) Fossil Bluff - 84010a(v), 84010b(r), 84011(q), 84013(v), 84014(r), 84017(r), 84019(v), 84025a (v), 84025b(v); (c) Cape Grim - 84008(v), 84006(r), 84005(v), 84001(v); (d) Mt Cameron West - 84118(f), 84121(r), 84120(f); (e) Marrawah district -

84092(v), 84561(q), 84104(r), 84101(r), 84105(v), 84106(r), 84107(q).

Age: Late Oligocene-Early Miocene, N3-N8.

Family AMPHISTEGINIDAE
Genus *AMPHISTEGINA* d'Orbigny, 1826
Amphistegina lessonii d'Orbigny, 1826
(Pl.1, figs 6,7)

Amphistegina lessonii d'Orbigny, 1826: *Annls Sci. nat.* ser.1, 7: 304, pl.17, figs 1.4.
A. lessonii; Howchin 1889, p.16.
A. lessonii; Chapman, 1910: *Proc. R. Soc. Vict.* n.s., 22: 294, pl.53, fig.6.
A. lessonii; Heron-Allen and Earland, 1924: *J. R. microsc. Soc.* (1924), pt.2: 185.
A. lessonii; Chapman, Parr and Collins 1934, p.568, pl.10, figs 25a-c.
A. lessonii; Crespin 1936, pl.1, fig.9.
A. hauerina; Howchin and Parr, 1938: *Trans. R. Soc. S. Aust.* 62 (2): 311, pl.18, fig.1.
A. hauerina; Parr, 1939: *Min. geol. J.* 1 (4): 69.
A. lessonii; Crespin 1943, p.77.
A. "lessonii"; Ludbrook 1961, p.87 *et seq.*, pl.4, fig.1.
A. lessonii; Carter 1964, p.115, pl.11, figs 223-225.
A. lessonii; Cooper, 1979: *Rept Invest. geol. Surv. S. Aust.* 50: pl.19, fig.3.

Type locality and stratigraphic level - Mauritius; Holocene.

The species listed above in the synonomy quite clearly refer to the species found here. Carter (1964) has given reasons for believing it to be *A. lessonii* and he is followed here.

Occurrence: (a) Preservation Island - 84479(a); (b) Brittons Swamp - 84480(c); (c) Cape Barren Island - 84554(r); (d) Marrawah district - 84113(f), 84114(f), 84115 (a), 84104(f), 84101(c).
Age: Early Miocene.

Family CIBICIDIDAE
Subfamily PLANULININAE
Genus *HYALINEA* Hofker, 1951
Hyalinea sp.
(Pl.1, figs 8,9)

A single specimen from King Island [84084(v)] is tentatively referred to this genus. Both sides of the test are evolute, one (the dorsal) completely evolute, the other semi-evolute. There are 12 chambers in the final whorl. Apertural details cannot be ascertained. The specimen could equally well be a discorbid.

Age: Early Miocene, N4.

Genus *CRESPINELLA* Parr, 1942

Crespinella parri Quilty, 1980
(Pl.1, figs 10-12)

Crespinella sp. nov. A: Ludbrook 1961, p.87 *et seq.*, pl.3, figs 7-9.
C. parri Quilty 1980, p.302, figs 4-6.

Type locality and stratigraphic level - Fossil Bluff, Wynyard, Tasmania; Early Miocene.

Occurrence: (a) Great Musselroe Bay - 84483(v); (b) Fossil Bluff - 84011(r), 84012(c), 84013(q), 84025b(v).
Age: Late Oligocene-Early Miocene, N3, N4.

Crespinella umbonifera (Howchin and Parr), 1938
(Pl.1, figs 13,14)

?Operculina umbonifera Howchin and Parr, 1938: *Trans. R. Soc. S. Aust.* 62(2): 309, pl.18, figs 3,4,6,13,14.
Crespinella umbonifera Parr, 1942: *Min. geol. J.* 2(6): 361.
C. umbonifera; Crespin 1943, p.78.
C. umbonifera; Crespin 1944, p.13.
C. umbonifera; Ludbrook 1961: p.87.

Type locality and stratigraphic level - 175-189 m Metropolitan Abattoirs Bore, Adelaide; "Miocene".

A single specimen which has eleven chambers in the final whorl is recorded from Preservation Island. Crespin (1944) recorded it from Cape Barren Island but as I have seen no material from her locality, it is not recorded here. It is mentioned in dealing with the Cape Barren Island deposit.

Occurrence: Preservation Island - 84479(v).

Age: Early Miocene, N8.

Genus *VALVULINERIA* Cushman, 1926
Valvulineria kalimnensis (Parr), 1939
(Pl.1, figs 15-18)

Planulina kalimnensis Parr, 1939: *Min. geol. J.* 1(4): 69, pl.1, figs 19a-c.
P. kalimnensis; Crespin 1943, p.82.
Valvulineria kalimnensis; Carter 1964, p.101, pl.8, figs 157-167.

Type locality and stratigraphic level - Jemmys Point, near Kalimna, Victoria; Pliocene.

The septal structure of this species is identical with that of *Crespinella* (Quilty 1980) and thus it is a true *Valvulineria*. It is an almost ubiquitous and abundant species in the Fossil Bluff section.

Occurrence: (a) Great Musselroe Bay - 84481(r), 84482(r); (b) Fossil Bluff - 84010a(c), 84010b(f), 84011(f), 84012(c), 84014(q), 84015(r), 84016(q), 84017(r), 84021(a), 84022(a), 84023(r), 84025a(q), 84024(q), 84025b(q); (c) Marrawah district - 84561(v).

Age: Early Miocene, N4.

Subfamily CIBICIDINAE
Genus *CIBICIDES* de Montfort, 1808

I have separated the cibicidid species into two genera - *Cibicides* and *Cibicidoides*. For the purpose of the following discussion, they are considered together.

Carter (1964, p.147) presented a diagram of a morphological series involving four species of *Cibicides* - *perforatus, mediocris, thiara* and *cygnorum* - suggesting (a) branching of *C. mediocris* from *C. perforatus* at about the Faunal Unit 7-Faunal Unit 8 boundary, and (b) a branching of *C. cygnorum* from *C. thiara* at about the Faunal Unit 8-Faunal Unit 9 boundary. The time ranges of the various species involved are not completely known, and all that can be done at the moment in these "genera" is to list groups of closely related species - a very subjective judgement at best.

Text-figure 2 is a range chart of the species of *'Cibicides'* listed by Carter (1958, 1964), Hornibrook (1961) and Reed (1965). Reed's record of *C. pseudoungerianus* is here recorded as *C. perforatus* and *C. verrucosus* is ignored as the available figures and descriptions are insufficient to help place it in a group.

The 22 species recorded in the Australasian region can be broken down into three main groups. They are:

(a) *C. ihungia-lobatulus-notocenicus-pseudoconvexus-thiara-vortex,*
(b) *C. collinsi-opacus-robertsonianus-subhaidingeri,* and
(c) all those that do not fit into one of the above groups.

The first group includes those species with flat dorsal surfaces and often strongly convex ventral surfaces. They all show strong evidence of an attached existence and, in fact, represent true *Cibicides*. The second group contains free living biconvex species with low diameter/thickness ratios and weakly angled margins. *C. victoriensis* may fit

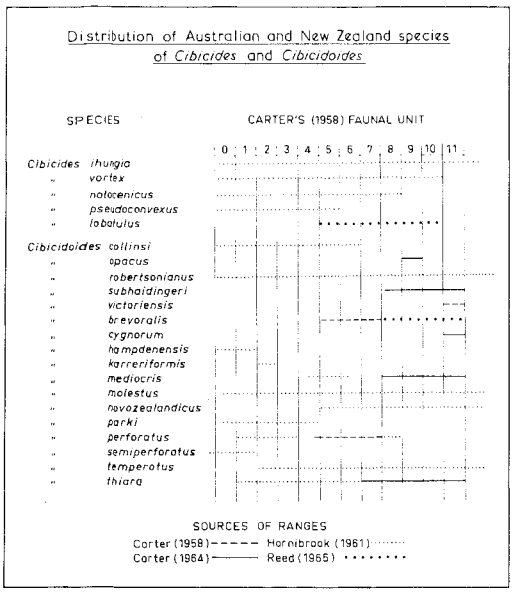

FIG. 2 - The time ranges of various Australian species of *Cibicides* and *Cibicidoides*.

here. The last group - the largest - contains biconvex species with angled margins, higher diameter/thickness ratios. *C. karreriformis* is placed here for convenience although its position is rather doubtful.

In this diagram, no effort is made to construct an evolutionary tree. The diagram only covers that time subdivided by Carter's Faunal Units. This figure suggests that the morphological series depicted by Carter (1964) is not an evolutionary sequence.

Cibicides refulgens de Montfort, 1808
(Pl.1, figs 19,20)

Cibicides refulgens de Montfort, 1808: CONCHYLIOLOGIE SYSTEMATIQUE ET CLASSIFICATION METHODIQUE DES COQUILLES, (F. Schoell: Paris) 1: 123, fig.122.
Truncatulina refulgens (Montfort); Heron-Allen and Earland, 1924: *J. R. microsc. Soc.* (1924), pt.2: 175.
Cibicides refulgens; Crespin 1943, p.78.

Type locality and stratigraphic level - neither designated; localities listed - Tuscany, fossil and Holocene.

Some of the specimens recorded are close to *C. ihungia* Finlay or *C. lobatulus* Walker and Jacob.

Occurrence: (a) King Island - 84084(v), 84081(v), 84475(f), 84476(c), 84477(r); (b) Granville Harbour - 54144(r); (c) Marrawah district - 84114(v).

Age: Early Miocene, N4-N8.

Cibicides thiara (Stache), 1865
(Pl.1, figs 21,22)

Rosalina thiara Stache, 1865: "NOVARA" EXPEDN, GEOL. THEIL, 1(2): 279, pl.24, figs 29-30.
Cibicides thiara (Stache); Carter 1958, p.97, pl.7, figs 136-138.
C. thiara; Hornibrook 1971, p.52, pl.11, figs 188-190.

Type locality and stratigraphic level - Whaingaroa Harbour, New Zealand; Oligocene.

Occurrence: (a) Great Musselroe Bay - 84483(r), 84481(c), 84482(c); (b) Fossil Bluff - 84010a(q), 84010b(q), 84012(f), 84013(q), 84014(f), 84015(f), 84016(c), 84017 (q), 84019(q), 84021(f), 84022(f), 84023(a), 84025a(a), 84024(a), 84025b(c); (c) Mt Cameron West - 84121(f), 84120(c); (d) Brittons Swamp - 84480(f); (e) Cape Barren Island - 84554(q); (f) Marrawah district - 84092(r), 84561(c), 84109(q), 84110(q), 84111(q), 84113(q), 84114(q), 84104(q), 84101(q), 84107(f).

Age: Late Oligocene-Early Miocene, N3-N8.

Cibicides vortex Dorreen, 1948
(Pl.1, figs 23-25)

Cibicides vortex Dorreen, 1948: *J. Paleont.* 23: 299, pl.41, fig.5.
C. vortex; Raggatt and Crespin, 1955: *Proc. R. Soc. Vict.* n.s. 67(1): 128.
C. vortex; Hayward and Buzas 1979, p.49, pl.11, figs 138,139.

Type locality and stratigraphic level - Ethel Creek, 8 km southeast of Greymouth, South Island, New Zealand; Late Eocene.

The specimens from King Island are generally poorly preserved and error may exist in some identifications. The most common species being misidentified is probably poorly preserved *C. perforatus*.

Occurrence: (a) Great Musselroe Bay - 84483(r), 84481(r), 84482(r); (b) Fossil Bluff - 84011(v), 84013(v); (c) King Island - 84084(c), 84085(f), 84081(q), 84082(c), 84083(c), 84086(c), 84090(p), 84087(q), 84475(r), 84476(r); (d) Daisy Creek - 84478(r); (e) Cape Grim - 84008(q), 84007(q), 84006(q), 84005(a+), 84003(a), 84002(a), 84001(a); (f) Mt Cameron West - 84118(v), 84121(r), 84120(v); (g) Granville Harbour - 54144(f); (h) Brittons Swamp - 84480(v); (i) Cape Barren Island - 84554(r); (j) Redpa - 84093(v), 84094(v), 84095(q), 84096(v); (k) Marrawah district - 84561(q); (l) Welcome River - 45979(c).

Age: Late Oligocene-Early Miocene, N3-N8.

Genus *CIBICIDOIDES* Thalman, 1939
Cibicidoides brevoralis (Carter), 1958
(Pl.1, figs 26,27)

Cibicides molestus Finlay in Battey, 1949: *Trans. R. Soc. N.Z.*, 77: 455. (*Nomen nudum.*)
C. brevoralis Carter 1958, pp. 47,48, pl.6, figs 54-56.
C. molestus; Hornibrook 1961, p. 163, pl.24, figs 478,479,483.
C. brevoralis; Carter 1964, p.95.
C. brevoralis; Reed 1965, p.69.
C. brevoralis; Gibson 1967, p.67, pl.19, figs 275,276.
Cibicidoides brevoralis; Hayward and Buzas 1979, p.49.

Type locality and stratigraphic level - West bank of Barwon River 1 km south of Birregurra, Victoria; Early Miocene.

I have followed the opinion of Gibson (1967) and Hayward and Buzas (1979) in regarding *C. brevoralis* and *C. molestus* as synonyms. Preservation generally is poor.

Occurrence: (a) Fossil Bluff - 84025b(r); (b) Mt Cameron West - 84120(v); (c) Brittons Swamp - 84480(f); (d) Cape Barren Island - 84554(r); (e) Marrawah district - 84109(r), 84111(r), 84113(q), 84114(r).

Age: Early Miocene, N4-N8.

Cibicidoides collinsi (Finlay), 1940

Cibicides collinsi Finlay 1940, p.466.
C. collinsi; Hornibrook 1961, p.161, text figures 5a-c.

Type locality and stratigraphic level - lower part Amuri Limestone, Stoneyhurst, New Zealand; Middle Eocene.

Only a few poorly preserved specimens are referred to this species and it is not figured. It differs from the holotypes figured by Hornibrook (*op. cit.*) in lacking the obvious coarse pores on the dorsal surface. However, in all other respects, it seems almost identical.

Occurrence: (a) Great Musselroe Bay - 84482(v); (b) Fossil Bluff - 84010b(v), 84011(v), 84025b(v); (c) Brittons Swamp - 84480(r); (d) Marrawah district - 84561(q).

Age: Early Miocene, N4-N8.

Cibicidoides perforatus (Karrer), 1864
(Pl.2, figs 1.2)

Rotalia perforata Karrer, 1864: "NOVARA" EXPDN, GEOL. THEIL, 1(2): 81, pl.16, fig.13.
Cibicides perforatus (Karrer); Carter 1958, pp.46,47, pl.6, figs 57-59.
C. perforatus (Karrer); Hornibrook 1961, p.161, pl.25, figs 503-505.
C. perforatus; Carter 1964, p.96.
C. pseudoungerianus (Cushman); Reed 1965, p.79.
Cibicidoides perforatus; Hayward and Buzas 1979, p.49.

Type locality and stratigraphic level - Orakei Bay, New Zealand; Late Oligocene or Early Miocene.

Reed (1965, *op. cit.*) stated that specimens referable to this species are identical with the types of *C. pseudoungerianus* (Cushman). If this is so, the latter is a junior synonym of *C. perforatus* (Karrer). It is probable that many earlier records of *C. ungerianus* (e.g. Howchin 1889, 1891; Chapman, Parr and Collins 1934 etc.) refer to this species.

This is by far the most abundant of the cibicidids in the Tasmanian Tertiary, making up more than 80% of the total fauna in five cases and 40-80% in another ten.

The King Island population of this species has a lower diameter/thickness ratio and can be distinguished from mainland Tasmanian specimens on this basis.

Occurrence: (a) Great Musselroe Bay - 84483(c), 84481(c), 84482(c); (b) Fossil Bluff - 84010a(q), 84010b(a), 84011(c), 84012(f), 84013(c), 84014(c), 84015(a), 84016(a), 84017(a), 84019(a), 84021(c), 84022(q), 84023(f), 84025a(f), 84024(f), 84025b(c); (c) Cape Portland - 84553(r); (d) King Island - 84084(a+), 84085(a+), 84081(a++), 84082(a+), 84083(a+), 84086(a+), 84089(p), 84090(p), 84087(a+), 84475(a+), 84476(a), 84477(a+); (e) Daisy Creek - 84478(a+); (f) Cape Grim - 84008(r), 84007(r), 84006(f), 84005(q), 84003(r), 84002(r), 84001(r);

(g) Mt Cameron West - 84118(a), 84121(a+), 84120(a), 84117(a); (h) Granville Harbour - 54144(a+); (i) Preservation Island - 84479(q); (j) Brittons Swamp - 84480(a); (k) Cape Barren Island - 84554(r); (l) Redpa - 84097(a+), 84093 (a++), 84094(a++), 84095(a++), 84096(a++); (m) Marrawah district - 84092(c), 84561(f), 84109(a+), 84110(a), 84111(a+), 84113(a), 84114(a), 84104(a), 84101 (c), 84105(a), 84106(a), 84107(a); (n) Welcome River - 45979(a).

Age: Late Oligocene-Early Miocene, N3-N8.

Cibicidoides subhaidingeri (Parr), 1950
(Pl.2, figs 3,4)

Cibicides subhaidingeri Parr, 1950: *B.A.N.Z. Antarct. Res. Expedn Rep.* ser.B, vol.5(6): 364, pl.15, figs 79a-c.
C. subhaidingeri; Carter 1964, p.95, pl.9, figs 145-147.
C. subhaidingeri; Reed 1965, p.70.

Type locality and stratigraphic level - B.A.N.Z.A.R.E. Station 115, 148°42'E; 41°03'S: Holocene.

Occurrence: (a) Fossil Bluff - 84010a(v), 84010b(v); (b) Marrawah district - 84104(v).

Age: Early Miocene, N4-N8.

Cibicidoides temperata (Vella), 1957
(Pl.2, figs 5,6)

Cibicides temperata Vella, 1957: *Geol. Surv. N.Z., Pal. Bull.* 28: 40, pl.9, figs 201-203.
C. temperata; Hornibrook 1961: p.162, pl.24, figs 476,477,482.
Cibicidoides temperatus; Hayward and Buzas 1979, p.49, pl.11, figs 135-137.

Type locality and stratigraphic level - off North Cape, New Zealand, in 135 m; Holocene.

Occurrence: (a) Great Musselroe Bay - 84483(q); (b) Fossil Bluff - 84010b(v), 84025a (v); (c) King Island - 84087(v).

Age: Late Oligocene-Early Miocene, N3-N4.

Genus *DYOCIBICIDES* Cushman and Valentine, 1930
Dyocibicides biserialis Cushman and Valentine, 1930
(Pl.2, figs 7,8)

Dyocibicides biserialis Cushman and Valentine, 1930: *Contr. Dept Geol. Stanford Univ.* 1(1): 31, pl.10, figs 1,2.
D. biserialis; Chapman, Parr and Collins 1934, p.572, pl.11, figs 43a-c.
D. biserialis; Carter 1964, p.94, pl.7, figs 130-132.
D. biserialis; Hayward and Buzas 1979, p.52, pl.12, fig.155.

Type locality and stratigraphic level - type locality not given. Leeward side of San Clemente, Santa Catalina, Santa Cruz and Anacapa Islands, California; Holocene.

Following Nyholm (1961) this species should be placed, biologically speaking, within *Cibicides*, *Dyocibicides* being a junior synonym of that genus. Reed (1965) would also place *Vagocibicides* (now *Karreria*) here, but several authors (Carter 1964; Loeblich and Tappan 1964, etc.) have given ample reasons for regarding *Vagocibicides* as a genus quite distinct from *Cibicides*.

Whether this species is a separate one, or derived from normal *Cibicides* is not clear. It could be an irregular attached form of *C. thiara* or of several other species. It is here taken as a distinct species.

As well as typical specimens, many irregular variants of *Cibicides* are included here.

Occurrence: (a) Great Musselroe Bay - 84483(r), 84481(r); (b) Fossil Bluff - 84010b(v), 84014(r), 84015(r); (c) Cape Grim - 84008(q), 84007(r), 84006(q); (d) Mt Cameron West - 84118(v); (e) Granville Harbour - 54144(r); (f) Redpa - 84097(q), 84093(q), 84096(v); (g) Marrawah district - 84110(v), 84113(r), 84114(r), 84104(q), 84105(r), 84106(q), 84107(r).

Age: Late Oligocene-Early Miocene, N3-N8.

Family PLANORBULINIDAE
Genus *PLANORBULINA* d'Orbigny, 1826
Planorbulina mediterranensis d'Orbigny, 1826
(Pl.2, fig.9)

Planorbulina mediterranensis d'Orbigny, 1826: *Annls Sci. Nat.* ser.1, 7: 280, pl.14, figs 4-6.
P. mediterranensis; Howchin 1889, p.13.
P. mediterranensis; Howchin 1891, p.352.
P. mediterranensis; Heron-Allen and Earland, 1924: *J. R. microsc. Soc.* (1924): 173.
P. mediterranensis; Howchin and Parr, 1938: *Trans. R. Soc. S. Aust.* 62: 311, pl.19, fig.12.
P. mediterranensis; Crespin 1943, p.82.

Type locality and stratigraphic level - Mediterranean coast; Holocene.

Occurrence: (a) Great Musselroe Bay - 84481(v); (b) Cape Grim - 84001(v); (c) Cape Portland - 84553(r); (d) Mt Cameron West - 84120(v).

Age: Early Miocene, N4.

Genus *PLANORBULINELLA* Cushman, 1927
Planorbulinella inaequilateralis (Heron-Allen and Earland), 1924
(Pl.2, figs 10-12)

Planorbulina larvata var. *inaequilateralis* Heron-Allen and Earland, 1924: *J. R. microsc. Soc.* (1924): 174, pl.12, figs 85-90.
Planorbulinella inaequilateralis; Crespin 1936: *Palaeont. Bull., Canberra* 2: pl.1, fig.6.
P. inaequilateralis; Crespin 1943, p.82.
P. inaequilateralis; Carter 1958, p.58.
P. inaequilateralis; Carter 1964, p.126, pl.13, figs 269-271.

Type locality and stratigraphic level - "Dryden" or "Filter Quarry", Moorabool River, Victoria; "Miocene".

From Fossil Bluff (84010a) a few specimens of *Planorbulinella* were recovered. One of these was sectioned. The specimen is not easy to place specifically, probably being intermediate between *P. johannae* Carter and *P. inaequilateralis*. Externally it is indistinguishable from *P. inaequilateralis* and internally is closer to it than to *P. johannae*. A protoconch of 0.07 mm is followed by a deuteroconch of 0.09 mm. At each side of the junction of this pair is a primary auxiliary chamber. Each of these gives rise to two spirals of interauxiliary chambers. The spiral alongside the protoconch has only one interauxiliary chamber in each case and both terminate at a symmetrical interauxiliary chamber. Each spiral alongside the deuteroconch has two interauxiliary chambers. The specimen thus differs from *P. inaequilateralis* in having only one interauxiliary chamber in each spiral alongside the protoconch. This amount of variation could perhaps be expected within the species.

If this species does fit within the variation of *P. inaequilateralis* this is probably the earliest record of it. Carter (1958, 1964) used it as an index species for the advent of Faunal Unit 7.

Occurrence: (a) Fossil Bluff - 84010a(v); (b) Preservation Island - 84479(r); (c) Cape Barren Island - 84554(r); (d) Marrawah district - 84104(v).

Age: Early Miocene, N4-N8.

Planorbulinella plana (Heron-Allen and Earland), 1924
(Pl.2, figs 13,14)

Planorbulina plana Heron-Allen and Earland, 1924: *J. R. microsc. Soc.* (1924): 174, pl.12, figs 92-95.
Planorbulinella plana (Heron-Allen and Earland); Crespin 1936: *Palaeont. Bull., Canberra* 2: 4,5,6.
P. plana; Howchin and Parr, 1938: *Trans. R. Soc. S. Aust.* 62: 306.
P. plana; Crespin 1943, p.82.
P. plana; Carter 1958, p.58, pl.8, figs 79-80.
P. plana; Carter 1964, p.126.
P. plana; Cooper 1979: *Rept Invest. Geol. Surv. S. Aust.* 50: pl.19, fig.7.

Type locality and stratigraphic level - "Dryden" or "Filter Quarry", Moorabool River, Victoria; "Miocene".

Only a single specimen was recovered from each of the samples listed. One specimen was sectioned. It is a microspheric specimen beginning with an initial coiled portion.

Occurrence: (a) Cape Barren Island - 84554(r); (b) Marrawah district - 84114(v), 84104(v).

Age: Early Miocene, N8.

Family ACERVULINIDAE
Genus *GYPSINA* Carter, 1877
Gypsina globulus (Reuss), 1848
(Pl.2, fig.15)

Ceriopora globulus Reuss, 1848: *Naturw. Abh. Berl.* 2(1): 33.
Gypsina globulus (Reuss); Howchin 1889, p.14.
G. globulus; Chapman, 1910: *Proc. R. Soc. Vict.* n.s., 22: 290.
G. globulus; Heron-Allen and Earland, 1924: *J. R. microsc. Soc.* (1924): 183, pl.14, figs 117-118.
G. globulus; Crespin 1943, p.80.

Type locality and stratigraphic level - Nüssdorf, Vienna, Austria; Tertiary.

The specimens from the Great Musselroe Bay and Fossil Bluff samples are much smaller than is usual for the species and are not only globular, but often have a flattened area on one side of the "sphere". They have been compared with Holocene specimens from Timor.

A few abraded specimens from Marrawah (84114) are placed here. They lack the distinctive embryonic chamber arrangement and regular adult chamber arrangement of *G. howchini*. The specimens are not spherical but discoidal to inflated discoidal.

Occurrence: (a) Great Musselroe Bay - 84481(r), 84482(r); (b) Fossil Bluff - 84010a(v); (c) Cape Barren Island - 84554(q); (d) Marrawah district - 84114(r).

Age: Early Miocene, N4-N8.

Gypsina howchini Chapman, 1910
(Pl.2, fig.16)

Gypsina howchini Chapman, 1910: *Proc. R. Soc. Vict.* n.s. 22: 291, pl.2, figs 4a,b; pl.3, figs 3-5.
G. howchini; Heron-Allen and Earland, 1924: *J. R. microsc. Soc.* (1924): 183.
G. howchini; Crespin, 1936: *Palaeont. Bull., Canberra* 2: pl.1, figs 7,8.
G. howchini; Howchin and Parr, 1938: *Trans. R. Soc. S. Aust.* 62: 312.
G. howchini; Crespin 1943, p.80.
G. howchini; Carter 1958, p.23.
G. howchini; Ludbrook 1961, pp.87 *et seq.*, pl.4, fig.3.
G. howchini; Carter 1964, p.82, pl.4, figs 82-85; pl.15, fig.283.

Type locality and stratigraphic level - Batesford Limestone (1) Upper Quarry Batesford and (2) Filter Quarry, Moorabool River, Victoria; Early Miocene.

Occurrence: Cape Barren Island - 84554(v).

Age: Early Miocene, N8.

Gypsina sp.
(Pl.2, fig.17)

A few specimens of a large encrusting species were recovered from Cape Grim and the Marrawah district. The general growth pattern resembles that of *G. mastelensis* Bursch, or *G. vesicularis* (Parker and Jones) var. *squamiformis* Chapman. Maximum diameter is about 2 mm and the test is composed of a layer of irregularly formed chambers.

Occurrence: (a) Cape Grim - 84007(r), 84006(v); (b) Marrawah district - 84092(v), 84108(r).

Age: Early Miocene, N4-N8.

Family HOMOTREMATIDAE
Subfamily VICTORIELLINAE
Genus *CARPENTERIA* Gray, 1858
Carpenteria balaniformis Gray, 1858
(Pl.2, figs 18,19)

Carpenteria balaniformis Gray, 1858: *Proc. Zool. Soc.* (1858): 296, figs 1-4 (p.268).
C. balaniformis; Loeblich and Tappan 1964, C707, fig.580, 1-4.

Type locality and stratigraphic level - Philippine Islands; Holocene.

Occurrence: (a) Great Musselroe Bay - 84483(v); (b) Fossil Bluff - 84010a(v).

Age: Late Oligocene-Early Miocene, N3, N4.

Carpenteria rotaliformis Chapman and Crespin, 1930
(Pl.2, fig.20)

Carpenteria rotaliformis Chapman and Crespin, 1930: *Proc. R. Soc. Vict.* n.s., 43: 98,99, pl.5, figs.7,8.
C. rotaliformis; Chapman, Parr and Collins 1934, pp.572,573, pl.11, fig.44.
C. rotaliformis; Howchin and Parr 1938: *Trans. R. Soc. S. Aust.* 62: 312, pl.19, figs 3,4.
C. rotaliformis; Crespin 1943, p.77.
C. rotaliformis; Glaessner and Wade 1959: *Micropaleontology* 5: 200, pl.2, fig.6.
C. rotaliformis; Carter 1964, p.81.
C. rotaliformis; Reed 1965, p.80, pl.12, figs 4,7,8,11.

Type locality and stratigraphic level - No.1 Bore, Parish of Bumberrah (Metung), Victoria; "Tertiary".

Occurrence: (a) Great Musselroe Bay - 84483(q), 84481(r), 84482(r); (b) Mt Cameron West West - 84118(r), 84120(r), 84117(f); (c) Granville Harbour - 54144(r); (d) Preservation Island - 84479(v); (e) Cape Barren Island - 84554(v); (f) Marrawah district - 84110(v), 84113(r), 84114(v).

Age: Late Oligocene-Early Miocene, N3-N8.

Superfamily ROTALIACEA
Family ROTALIIDAE
Genus *AMMONIA* Brunnich, 1772
Ammonia cf. *beccarii* (Linné), 1767

Nautilus beccarii Linné, 1767: SYSTEMA NATURAE, 12th edn: 1162.
Ammonia beccarii; Margerel, 1968: FORAM. REDONIEN,: 133, pl.24, figs 29-31; pl.25, figs 1.3.

Type locality and stratigraphic level - Adriatic and Mediterranean Seas; Holocene.

From Cape Portland, northeastern Tasmania, come a few fragmentary specimens which may belong here and which, by virtue of their position, may be part of the Tertiary sequence.

Occurrence: Cape Portland - 84553(v).

Subfamily CHAPMANININAE
Genus *SHERBORNINA* Chapman, 1922
Sherbornina atkinsoni Chapman, 1922
(Pl.2, figs 21-26)

Sherbornina atkinsoni Chapman, 1922: *J. Linn. Soc.* 34(230): 501-503, pl.32, figs 1-5.
S. atkinsoni; Crespin 1943, p.83.
S. atkinsoni; Wade and Carter 1957: *Micropaleontology* 3(2): 157,158, pl.1, figs 1-5; pl.2, figs 1-3; pl.3, figs 1-3.
S. atkinsoni; Carter 1958, pp.17 *et seq.*
S. atkinsoni; Ludbrook 1961, pp.87 *et seq.*
S. atkinsoni; Hayward 1978, p.231, pl.1, figs 9-12; pl.2, figs 24-26; pl.3; pl.4, figs 40, 41.
S. atkinsoni; Cooper 1979: *Rept Invest. geol. Surv. S. Aust.* 50: pl.19, fig.10.

Type locality and stratigraphic level - Fossil Bluff, Wynyard, Tasmania; Early Miocene.

Sherbornina cuneimarginata is superficially distinct from *S. atkinsoni* in being concavo-convex rather than simple discoidal. A single well preserved specimen from Mt Cameron West (84118) was placed in *S. cuneimarginata* before sectioning, on the basis of its superficial characters. It was almost identical with Wade and Carter's figures 6a-c (pl.1). When sectioned however, it is more like *S. atkinsoni* and is recorded as that species. It is probably a young specimen of *S. atkinsoni*, about Faunal Unit 7 in age.

The Brittons Swamp occurrence is in a different specimen from other Brittons Swamp species recorded herein. The rock is well indurated. The particular boulder is probably older than the other one studied.

Occurrence: In none of the Tasmanian occurrences is *Sherbornina* associated with warm-water large foraminiferids as Hayward (1978) suggested it should be. However, it is never common.
(a) Great Musselroe Bay - 84483(v); (b) Fossil Bluff topotypes - 84010a(v); (c) King Island - 84477(r); (d) Daisy Creek - 84478(r); (e) Mt Cameron West -

84118(v); (f) Brittons Swamp; (g) Marrawah district - 84561(v).

Age: Late Oligocene-Early Miocene, N3-N4.

Genus *TENISONINA* Quilty, 1980
Tenisonina tasmaniae Quilty, 1980
(Pl.3, figs 1-6)

Tenisonina tasmaniae Quilty 1980, p.305, figs 7,8.

Type locality and stratigraphic level - Cape Grim, Tasmania; Early Miocene.

Hayward (1978) figured as *Sherbornina atkinsoni* variant B, specimens from the Oligocene of France, which have most of the features of this genus. Hayward suggested that this may be "a schizogonous resting stage in the life cycle of *S. atkinsoni*, similar to the planorbulinoid forms of *Cibicides lobatulus*."

I have taken *Tenisonina* as a distinct genus because at Cape Grim and at Welcome River, it occurs abundantly in many samples, without any specimens which could be referred to *Sherbornina s.s.* Also, taking this as *Sherbornina* would invalidate the generalisation (Hayward, p.236) that the association is invariably with large shallow warm water foraminiferids when common.

Occurrence: In Tasmania this species is known only from Cape Grim and Welcome River. (a) Cape Grim - 84008(v), 84007(f), 84006(f), 84005(f), 84003(a), 84002(f), 84001(f); (b) Welcome River - 45979(f).

Age: Early Miocene, N4.

Family CALCARINIDAE
Genus *CALCARINA* d'Orbigny, 1826

Two species, *C. mackayi* (Karrer) and *C. verriculata* (Howchin and Parr), are recognised and both are placed in *Calcarina* although some recent works (e.g. Hornibrook 1971) have placed *C. mackayi* in *Pararotalia*.

The form identified here as *C. verriculata* has the characteristics of *Calcarina*, including solid peripheral spines, clearly visible on pl.3, fig.10, which shows how these spines are overgrown by later whorls. On a purely morphological basis, that form identified here as *C. mackayi* could be placed in *Pararotalia*, lacking peripheral spines and having characteristics of that genus. Samples from Fossil Bluff and Great Musselroe Bay contain both forms and they seem to intergrade suggesting that they should at least be placed in the same genus (and thus also the same family). Historically, it is interesting to note that Chapman, Parr and Collins (1934) equated *C. mackayi* with *C. spengleri*, taken by Loeblich and Tappan (1964) as the type species for *Calcarina*.

Calcarina mackayi (Karrer), 1865
(Pl.3, figs 7,8)

Rosalina mackayi Karrer, 1865: "NOVARA" EXPDN GEOL. THEIL 1: 82, pl.16, figs 14a-d.
Rotalia calcar; Heron-Allen and Earland 1924: *J. R. microsc. Soc.* (1924): 181.
Calcarina cf. *spengleri*; Chapman, Parr and Collins 1934, p.568, pl.9, figs 15a-c.
C. mackayi; Carter 1958, p.68, pl.2, figs 10-12.
Pararotalia mackayi; Hornibrook, 1971, p.19, pl.3, figs 55-57; pl.13, figs 3-7.

Type locality and stratigraphic level - Orakei Bay Greensand, Hobson Bay, Waitemata Harbour, New Zealand; Early Miocene.

Unabraded specimens of both *C. mackayi* and *C. verriculata* (Howchin and Parr) are found in the same samples from Great Musselroe Bay and Fossil Bluff. They are often hard to distinguish, but can be separated on several bases. *C. mackayi* has a more or less conical ventral surface and clearly angled margin. *C. verriculata* has roughly parallel ventral and dorsal surfaces and rounded margins. The latter species generally is more pustulose on the dorsal surface. However, it may occasionally be more or less plane. It also appears to be larger than *C. mackayi*. *C. mackayi* generally has a less "ornamented" ventral surface. *C. verriculata* has the well-developed large peripheral spines characteristic of *Calcarina*. The origin of the coarse pores visible on both surfaces is unknown.

In the samples from Preservation Island, both species are recorded but this may be a result of the apparent fact that *C. mackayi*, when somewhat abraded, looks rather like *C. verriculata*.

Occurrence: (a) Great Musselroe Bay - 84483(v), 84481(q); (b) Fossil Bluff - 84010a(v), 84012(v), 84025a(r); (c) Cape Portland - 84553(v); (d) Mt Cameron West - 84118(q), 84121(v), 84117(r); (e) Preservation Island - 84479(c); (f) Cape Barren Island - 84554(a+); (g) Marrawah district - 84092(q), 84561(v); (h) Welcome River - 45979(c).

Age: Late Oligocene-Early Miocene, N3/4, N8.

Calcarina verriculata (Howchin and Parr), 1938
(Pl.3, figs 9,10)

Rotalia calcar; Chapman 1910: *Proc. R. Soc. Vict.* 22(2): 289, pl.53, fig.2.
Calcarina defrancii, Heron-Allen and Earland 1924: *J. R. microsc. Soc.* (1924), pt.2: 182.
Rotalia verriculata Howchin and Parr 1938: *Trans. R. Soc. S. Aust.* 62(2): 310, pl.19, figs 8,9,11,15.
Calcarina verriculata; Crespin 1943, p.77.
C. verriculata; Ludbrook 1961, pp.50,87 etc., pl.4, figs 6,7.
Pararotalia verriculata; Cooper 1979: *Rept Invest. geol. Surv. S. Aust.* 50: pl.19, fig.4.

Type locality and stratigraphic level - 216-259 m Metropolitan Abattoirs Bore, Adelaide; "Lower Miocene".

Occurrence: (a) Great Musselroe Bay - 84483(v); (b) Fossil Bluff - 84010a(r); (c) Preservation Island - 84479(c); (d) Marrawah district - 84114(v), 84104(q), 84101(a).

Age: Late Oligocene-Early Miocene, N3-N8.

Family ELPHIDIIDAE
Subfamily ELPHIDIINAE
Genus *CRIBROELPHIDIUM* Cushman and Bronnimann, 1948
Cribroelphidium poeyanum (d'Orbigny), 1839
(Pl.3, fig.11)

Polystomella poeyana, d'Orbigny (in de la Sagra, 1839): HISTOIRE PHYSIQUE, POLITIQUE, ET NATURELLE DE L'ÎLE DE CUBA, (A. Bertrand: Paris): 55, pl.6, figs 25-26.

Type locality and stratigraphic level - Cuba and Jamaica; Holocene.

There seems to be no previous record of this species from Tertiary rocks in Australia. The specimens found here agree in most details with the descriptions and figures of *C. poeyanum* in Cushman (1939, p.54, pl.14, figs 25,26) and Loeblich and Tappan (1964, p.C635, fig.508,3,4), except that the present species is less compressed, the figured specimen having a diameter/thickness ratio of 2:1 instead of 5:2. The difference does seem to be a consistent one.

Occurrence: (a) Great Musselroe Bay - 84481(v); (b) Fossil Bluff - 84022(r), 84025a(q), 84024(r), 84025b(v); (c) Cape Portland - 84553(a+).

Age: Early Miocene, N4.

Genus *ELPHIDIUM* de Montfort, 1808
Elphidium chapmani Cushman, 1936
(Pl.3, fig.12)

Elphidium chapmani Cushman 1936: *Contr. Cushman Lab. foramin. Res.* 12: 80, pl.14, fig.6.
E. parri Cushman 1936, *ibid.*: 81, pl.14, fig.7.
E. chapmani; Howchin and Parr 1938: *Trans. R. Soc. S. Aust.* 62(2): 308.
E. chapmani; Cushman 1939: *Prof. Pap. U.S. geol. Surv.* 191: 47, pl.12, fig.17.
E. parri; Cushman 1939, *ibid.*: 47,48, pl.12, fig.18.
E. chapmani; Crespin 1943, p.79.
E. parri; Crespin 1943, p.79.
E. chapmani; Carter 1964, p.120, pl.12, figs 245,246.
E. parri; Reed 1965, p.70.

Type locality and stratigraphic level - Neumerella, Victoria; "Miocene".

Elphidium chapmani and *E. parri* are here regarded as synonymous. Cushman noted several differences between the two "species" when he erected them. They are -
(a) *E. chapmani* has a rhomboid cross section whereas *E. parri* has flattened, parallel sides.
(b) *E. chapmani* has 25-30 chambers in the final whorl while *E. parri* has only 20-25.
(c) *E. chapmani* has 20 or more retral processes on each chamber whereas *E. parri* has only 7-8.
(d) *E. chapmani* has a diameter of 1.25 mm while *E. parri* has one of 0.70-0.80 mm.

In most other respects he regarded the species as very similar. The types of both species probably come from the same sample from Neumerella, Victoria. The first three differences cited are fairly clearly the result of the fourth. As test size increases, the number of chambers per whorl increases, the number of retral processes per chamber increases, and probably the outline changes. There seems to be a complete intergradation. This is also evident in previously published figures of the species. Carter (1964) illustrated a specimen of *E. chapmani* with only 21 chambers in the final whorl — an *E. parri* character — but a rhomboid section — an *E. chapmani* character. He gave the size of the specimen as 0.95 mm — another intermediate property. Carter may have considered them synonyms, as he stated that *E. chapmani* has 20-30 chambers in the final whorl.

Occurrence: (a) Great Musselroe Bay - 84481(v); (b) Fossil Bluff - 84010a(r), 84010b(v), 84011(q), 84012(q), 84013(r), 84022(r), 84025a(v), 84024(r), 84025b(r); (c) King Island - 84476(r); (d) Preservation Island - 84479(v); (e) Brittons Swamp - 84480(v).

Age: Early Miocene, N4-N8.

Elphidium crassatum Cushman, 1936
(Pl.3, fig.13)

Elphidium crassatum Cushman 1936: *Contr. Cushman Lab foramin. Res.* 12: 81, pl.14, figs 8a,b.
E. crassatum; Cushman 1939: *Prof. Pap. U.S. geol. Surv.* 191: 41, pl.11, figs 3a,b.
E. crassatum; Crespin 1943, p.79.
E. crassatum; Carter 1964, p.120, pl.12, figs 242-244.

Type locality and stratigraphic level - Muddy Creek, Victoria, brown marl lower beds; "Oligocene" (strictly perhaps Early to Middle Miocene transition).

Occurrence: Marrawah - 84527.

Age: Early Miocene, N8.

Elphidium crespinae Cushman, 1936
(Pl.3, fig.14)

Elphidium crespinae Cushman 1936: *Contr. Cushman Lab. foramin. Res.* 12: 78, pl.14, figs 1a,b.
E. crespinae; Cushman 1939: *Prof. Pap. U.S. geol. Surv.* 191: 41, pl.11, fig.1.
E. crespinae; Crespin 1943, p.79.
E. crespinae; Carter 1964, p.121, pl.12, figs 240,241.
E. crespinae; Reed 1965, p.70.

Type locality and stratigraphic level - Muddy Creek, Victoria, brown marl lower beds; "Oligocene" (strictly perhaps Early to Middle Miocene transition).

There seems to exist a similar confusion concerning this species to that concerning *E. chapmani* and *E. parri*. Small specimens are lenticular and after a certain ontogenetic stage has been reached, there is no appreciable increase in thickness, giving rise to flat, parallel sided, specimens.

Cushman (1939, p.41) stated that an adult specimen has 16-18 chambers per whorl, 12-15 retral processes per chamber and no keel. However, his figure (pl.11, fig.1) seems to show a keel. Carter (1964, p.121) said that it has up to 15 chambers per whorl and 10-12 retral processes. The two descriptions are mutually exclusive.

The specimens included here have 12-17 chambers per whorl. The smaller specimens are lenticular with 12-15 chambers per whorl and only five or so retral processes. This sample seems to be intermediate between Cushman's and Carter's concept and it seems probable that this species is more variable than either Cushman or Carter realised. It may also be that *E. crespinae* and possibly *E. howchini* are conspecific. Specimens of both species occur in the lower beds at Muddy Creek, Victoria.

Occurrence: (a) Great Musselroe Bay - 84483(r), 84481(q), 84482(q); (b) Fossil Bluff - 84010a(q), 84010b(v), 84012(r), 84013(f), 84022(r), 84025a(q), 84024(q), 84025b(r); (c) King Island - 84085(q); (d) Preservation Island - 84479(r); (e) Mt Cameron West - 84118(r), 84121(v), 84120(r); (f) Marrawah district - 84092(f), 84561(f), 84109(r), 84110(r), 84111(r), 84113(r), 84114(v), 84104(r), 84105(v), 84107(r).

Age: Late Oligocene-Early Miocene, N3-N8.

Elphidium grimensis Quilty, 1980
(Pl.3, figs 15,16)

Elphidium grimensis Quilty 1980, p.308, figs 10,11.

Type locality and stratigraphic level - Cape Grim, Tasmania; Early Miocene.

Occurrence: (a) King Island - 84082(r), 84083(r); (b) Cape Grim - 84008(v), 84007(q), 84003(q), 84002(q), 84001(q); (c) Preservation Island - 84479(r); (d) Marrawah district - 84561(v).

Age: Early Miocene, N4-N8.

Elphidium helenae Quilty, 1980
(Pl.3, figs 17,18)

Elphidium helenae Quilty 1980, p.309, figs 12,13.

Occurrence: (a) Fossil Bluff - 84010a(q), 84010b(q), 84013(c), 84014(q), 84015(r), 84016(f), 84017(f), 84019(f), 84021(f), 84022(c), 84023(f), 84025a(c),

84024(f), 84025b(c); (b) Cape Portland - 84553(r); (c) Mt Cameron West - 84121(v), 84120(v); (d) Marrawah district - 84092(r).

Age: Early Miocene, N4.

Elphidium musselroeensis Quilty, 1980
(Pl.3, figs 19-21)

Elphidium musselroeensis Quilty 1980, p.310, fig.14.

Type locality and stratigraphic level - Great Musselroe Bay, Tasmania; Late Oligocene or Early Miocene.

Occurrence: Great Musselroe Bay - 84483(v).

Age: Late Oligocene, N3.

Elphidium pseudoinflatum Cushman, 1936
(Pl.3, figs 22,23)

Elphidium pseudoinflatum Cushman 1936: *Contr. Cushman Lab. foramin. Res.* 12: 80, pl.14, figs 5a,b.
E. subinflatum Cushman 1936: *ibid.*: 84, pl.15, figs 1a,b.
E. pseudoinflatum; Cushman 1939: *Prof. Pap. U.S. geol. Surv.* 191: 41,42, pl.11, fig.8.
E. subinflatum; Cushman 1939: *ibid.*: 48, pl.12, figs 20a,b.
E. pseudoinflatum; Crespin 1943, p.79.
E. pseudoinflatum; Carter 1964, pp.122,123, pl.13, figs 254,255.
E. pseudoinflatum; Hayward and Buzas 1979, p.53, pl.13, figs 166-168.

Type locality and stratigraphic level - *Lepidocyclina* Limestone, Batesford, Victoria; Early Miocene.

Carter (1964) may have been correct in regarding *E. subinflatum* and *E. pseudoinflatum* as synonymous. Specimens referable to both species are found here but the preservation of the *E. pseudoinflatum* morphotype specimens is so poor that no conclusions can be made from a study of the Tasmanian material. The Great Musselroe Bay specimens are closer to the *E. subinflatum* morphotype.

Many specimens seem to have more than the typical seven to nine chambers most of the older specimens having about nine to ten chambers in the final whorl.

Occurrence: (a) Great Musselroe Bay - 84483(r), 84481(r), 84482(r); (b) Brittons Swamp - 84480(v); (c) Marrawah district - 84114(v).

Age: Late Oligocene-Early Miocene, N3-N8.

Elphidium sp. 1
(Pl.3, figs 24-25)

In several Cape Grim samples, there is a small species with a bluntly angled (non-carinate) margin. It is very similar to Cushman's (1939) figure (pl.12, fig.1) of *E. orterburgense* (Egger) except that the species I record here is noncarinate. It may be either (a) *E. orterburgense*, (b) a new species or (c) a juvenile variant of *E. grimensis* Quilty from which it seems to differ in being less regular, smaller and less carinate.

Occurrence: Cape Grim - 84008(v), 84002(v), 84001(v).

Age: Early Miocene, N4, N8.

Elphidium sp. 2
(Pl.3, figs 26,27)

Many specimens were recovered from the Cape Grim section of a species of the *E. pseudoinflatum-subinflatum* type, i.e. with flaring sides to the last few chambers. They are distinct from either of those morphotypes in having 12-14 chambers in the final whorl. They seem to be distinct from any previously described species but the preservation is not very good so they are only listed informally. Two very poorly preserved specimens from Cape Barren Island are also tentatively placed here.

Occurrence: (a) Cape Grim - 84008(r), 84007(q), 84006(v), 84005(v), 84002(v), 84001(r);
(b) Cape Barren Island - 84554(r).

Age: Early Miocene, N4, N8.

Subfamily FAUJASININAE
Genus *NOTOROTALIA* Finlay, 1939

I include in *Polystomellina*, *P. australis* Cushman, *P. discorbinoides* Yabe and Hanzawa, and *P. miocenica* Cushman. *Notorotalia zelandica* Finlay is excluded and thus stands as the type of *Notorotalia* and the generic name *Porosorotalia* Voloshinova is a junior synonym. *N. zelandica* is excluded because of its strongly reticulated surface pattern which is characteristic of *Notorotalia* but not of *Polystomellina*.

Polystomellina is characterised by being quite compressed, and in having the properties of *Elphidium* except in being trochospiral. It has probably been derived from a compressed species of *Elphidium*. The species assigned to *Notorotalia*, *Cribrorotalia* and *Porosorotalia* are probably derived from a different stock altogether. They are not so compressed, have much less well developed retral processes and seem to be much more distinct from *Elphidium*. They characteristically also have a more strongly reticulated surface pattern.

Most of the species placed in *Porosorotalia* are here considered to belong to *Notorotalia*. The diagnosis of the genus given by Loeblich and Tappan (1964) must be amended to allow the number of chambers in the final whorl to vary within wider limits than those set at 10-13.

Notorotalia howchini (Chapman, Parr and Collins), 1934
(Pl.4, figs 1-3)

Rotalia howchini Chapman, Parr and Collins 1934, p.566, pl.9, figs 20a-c.
Notorotalia crassimura Carter 1958, p.64, pl.10, figs 101-103.
N. howchini; Carter 1958, *ibid.*: p.65, pl.10, figs 104-106.
N. crassimura; Ludbrook 1961, pp. 87 *et seq.*, pl.2, figs 4,5.
N. howchini; Cooper 1979: *Rept Invest. geol. Surv. S. Aust.* 50: pl.19, fig.9.

Type locality and stratigraphic level - Altona Bay Coal Shaft, Port Phillip area, Victoria; Middle Miocene.

It is impossible to separate Carter's species *N. crassimura* from *N. howchini* using Carter's description. The species is very common in the Tasmanian Tertiary but only one species seems to be identifiable.

Carter stated that *N. crassimura* has 17-20 chambers in the final whorl. He figured a specimen with 14. Ludbrook (1961) figured a specimen with about 13. Specimens referable to *N. crassimura* here have 9-15 chambers in the final whorl. Carter stated that *N. howchini* has 8-11 chambers in its ultimate whorl, whereas the original description lists the figure as 10-12. Another distinguishing character Carter lists is in the umbonal boss. His species has a large umbonal boss and *N. howchini* should have none. The original

description of the latter species lists a beaded umbilical region. This only seems to occur if there is an umbilical boss. The beaded umbilical region is common in *N. crassimura*. In any population, specimens range between those with an umbonal boss and those without one. The dorsal "ornamentation" varies from simple beaded sutures (similar to Carter's figures of *N. crassimura*) to anastomosing vermiform markings.

There may be more than one species of *Notorotalia* in this part of the Australian Tertiary, and *N. crassimura* may be distinguishable from *N. howchini*, but the problem needs more study. The "species" do not appear to be distinct.

Many of the specimens may be referable to some of the morphotypes of this genus recognised by New Zealand palaeontologists.

Occurrence: (a) Great Musselroe Bay - 84483(q), 84481(f), 84482(f); (b) Fossil Bluff - 84010a(q), 84010b(f), 84011(r), 84012(v), 84013(q), 84014(q), 84015(q), 84017(f), 84019(f), 84025a(r), 84024(q), 84025b(r); (c) King Island - 84475 (r), 84476(r), 84477(q); (d) Cape Grim - 84008(f), 84007(c), 84006(f), 84005(c), 84003(c), 84002(q), 84001(f); (e) Granville Harbour - 54144(r); (f) Preservation Island - 84479(q); (g) Brittons Swamp - 84480(c); (h) Redpa - 84094(v); (i) Marrawah district - 84561(c); (j) Welcome River - 45979(c).

Age: Late Oligocene-Early Miocene, N3-N8.

Notorotalia spp. indet.

Preservation in chalky rocks makes species of this genus particularly hard to identify. Any recrystallisation makes the task virtually impossible, rendering much of the delicate "ornamentation" indecipherable. In most of the King Island and Marrawah samples, members of this genus are thus rendered unidentifiable. In a few samples the species appear close to *Cribrorotalia dorreeni* Hornibrook. In most samples the specimens are unidentifiable even tentatively.

Specimens (one well preserved, UTGD 84434) of an apparently undescribed species were extracted from the Granville Harbour material.

Occurrence: I *Cribrorotalia* cf. *dorreeni* - (a) King Island - 84084(r), 84085(q), 84083(q), 84090(p); (b) Marrawah district - 84110(q);
II *Nororotalia* spp. indet. - (a) Great Musselroe Bay - 84481(v); (b) King Island - 84084(c), 84085(r), 84083(v); (c) Mt Cameron West - 84118(v), 84121(q), 84120(f), 84117(c); (d) Cape Barren Island - 84554(q); (e) Marrawah district - 84092(c), 84113(q), 84114(q), 84104(r), 84101(q), 84105 (f), 84106(f), 84107(c).
III *Notorotalia?* n. sp. - Granville Harbour - 54144(q).

Age: Early Miocene, N4-N8.

Genus *POLYSTOMELLINA* Yabe and Hanzawa, 1923
Polystomellina miocenica Cushman, 1936
(Pl.4, figs 4,5)

Polystomellina miocenica Cushman 1936: *Contr. Cushman Lab. foramin. Res.* 12: 87, pl.15, figs 8a-c.
P. miocenica; Cushman 1939: *Prof. Pap. U.S. geol. Surv.* 191: 69, pl.19, fig.13.
P. miocenica; Crespin 1943, p.82.
Notorotalia miocenica; Carter 1964, p.125, pl.13, figs 260-262.
N. miocenica; Hayward and Buzas 1979, p.67, pl.22, figs 274-278.

Type locality and stratigraphic level - Filter Quarries, Batesford, Victoria; "Miocene".

Although Carter (1964) placed this species in *Notorotalia* it is placed more properly in *Polystomellina* because of the compressed test and low ventral surface. This species normally has of the order of 16 or more chambers in an adult whorl. The specimen figured here has only 14 but it is chosen because it is about the best preserved specimen recovered. The curvature of the sutures is very atypical of *Porosorotalia* and the "ornament" of the ventral surface is much more like that of *Polystomellina*. Although Carter's diagnosis of the species stated that the species has more than 20 chambers in the final whorl, this is not so. It may be so in a few specimens, but most have less than 20, and more than 16. His figured specimen has 17, and Cushman's (1939) figured specimen has 18.

Occurrence: Marrawah district - 84104(q), 84101(q).

Age: Early Miocene, N8.

Family NUMMULITIDAE
Genus *OPERCULINA* d'Orbigny, 1826
Operculina victoriensis Chapman and Parr, 1938
(Pl.4, figs 6,7)

Operculina complanata; Chapman 1910: *Proc. R. Soc. Vict.* n.s. 22: 294.
O. complanata Defrance var. *granulosa*; Chapman 1910: *ibid.*: 294.
O. victoriensis Chapman and Parr 1938: *Proc. R. Soc. Vict.* n.s. 50: 284, pl.16, figs 3-8.
O. victoriensis; Howchin and Parr 1938: *Trans. R. Soc. S. Aust.* 62: 305, pl.18, fig.10.
O. bartschi; Crespin 1936: *Palaeont. Bull., Canberra* 2: 4, pl.1, fig.12.
O. victoriensis; Crespin 1943, p.82.
O. victoriensis; Carter 1958, p.23.
O. victoriensis; Ludbrook 1961, pp.87 *et seq.*, pl.5, fig.3.
O. victoriensis; Carter 1964, p.128, pl.13, figs 266,267.
Camerina complanata; Reed 1965: p.80, pl.12, figs 2,5,9,10,12.

Type locality and stratigraphic level - Red Bluff, Shelford, Victoria; "Lower Miocene".

O. victoriensis is taken as being different from *O. complanata* mainly in having a greater rate of increase of chamber height.

The Brittons Swamp occurrence is in samples other than 84480.

Occurrence: (a) Great Musselroe Bay - 84482(r); (b) Preservation Island - 84479(r); (c) Brittons Swamp; (d) Redpa - 84095(v); (e) Cape Barren Island - 84554(r); (f) Marrawah district - 84111(r), 84114(r), 84115(r), 84104(f), 84101(q).

Age: Early Miocene, N4-N8.

Superfamily ORBITOIDACEA
Family LEPIDOCYCLINIDAE
Genus *LEPIDOCYCLINA* Gümbel, 1870
Lepidocyclina howchini Chapman and Crespin, 1932
(Pl.4, fig.8)

Lepidocyclina howchini Chapman and Crespin 1932: *Proc. R. Soc. Vict.* n.s. 44: 94, pl.13, figs 18,19.
L. howchini; Carter 1964, p.137, pl.17, figs 290-292.
L. howchini; Lindsay 1969: *Bull. geol. Surv. S. Aust.* 42: pl.2, fig.10.
L. howchini; Cooper 1979: *Rept Invest. geol. Surv. S. Aust.* 50: pl.19, fig.5.

An extensive synonymy of this species is too long to give here. For more details see the references cited by Carter (1964).

Type locality and stratigraphic level - 24-26 m Hamilton Bore, Victoria; Early Miocene.

Banks in Hughes (1957, p.72) stated that *Lepidocyclina* occurs in limestone in the Redpa district (his locality A, fig.45). I visited this area and sampled an outcrop over 6 m thick quite closely but found no *Lepidocyclina*. Chapman in Nye (1941) did not list *Lepidocyclina* from the Marrawah district, although I found it in each of four samples studied from Banks' (1957 *op. cit.*) locality E. Only two (84101, 84104) are recorded here.

Occurrence: (a) Redpa - (Banks, 1957); (b) Marrawah district - 84114(c), 84115(c), 84104(v), 84101(r).

Age: Early Miocene, N8.

Superfamily CASSIDULINACEA
Family ANNULOPATELLINIDAE
Genus *ANNULOPATELLINA* Parr and Collins, 1930
Annulopatellina annularis (Parker and Jones), 1860
(Pl.4, fig.9)

Orbitolina annularis Parker and Jones 1860: *Ann. Mag. nat. Hist.* ser.3, 6: 31.
Patellina annularis (Parker and Jones): Parker and Jones, 1865: *Phil. Trans. R. Soc.* 155: 438.
Annulopatellina annularis (Parker and Jones); Parr and Collins, 1930: *Proc. R. Soc. Vict.* n.s. 43: 93, pl.4, figs 8-10.

Type locality and stratigraphic level - Australian shore sands; Holocene.

Occurrence: Fossil Bluff - 84010a(v).

Age: Early Miocene, N4.

Family CASSIDULINIDAE
Genus *CASSIDULINA* d'Orbigny, 1826
Cassidulina laevigata d'Orbigny, 1826
(Pl.4, figs 10-11)

Cassidulina laevigata d'Orbigny 1826: *Annls Sci. nat.* ser.1, 7: 282, pl.15, figs 4-5.
C. laevigata; Howchin 1889: *Trans. Proc. R. Soc. S. Aust.* 12: 8.
C. laevigata; Chapman 1910: *Proc. R. Soc. Vict.* 22: 275.
C. laevigata; Heron-Allen and Earland 1924: *J. R. microsc. Soc.* (1924): 145.
C. laevigata; Crespin 1943, p.77.
C. laevigata; Reed 1965, p.69.
C. laevigata; Hayward and Buzas 1979, p.46, pl.7, fig.90.

Type locality and stratigraphic level - not given.

Two different species are included under this taxon here. The more common type is very close to d'Orbigny's type figure, but has more depressed sutures than in the figures given by Loeblich and Tappan (1964, p.C737, fig.604, 1).

The other species included here is found only in the limestone at Brittons Swamp and seems identical to a specimen figured by Hornibrook (1961, pl.10, fig.99) as *C. laevigata*.

Occurrence: (a) Great Musselroe Bay - 84481(v), 84482(r); (b) Mt Cameron West - 84118 (v); (c) Brittons Swamp - 84480(v); (d) Marrawah district - 84092(r), 84561 (q), 84110(v), 84104(v), 84105(v), 84106(r).

Age: Early Miocene, N4-N8.

Cassidulina neocarinata Thalmann, 1950
(Pl.4, fig.12)

Cassidulina laevigata; Brady 1884: "CHALLENGER" EXPEDN SCIENT. RESULTS ZOOL. 9: 428, pl.54, figs 2,3.
C. laevigata var. *carinata* Cushman 1922: *Bull. U.S. natn. Mus.* 104: 124, pl.25, figs 6,7.
C. neocarinata Thalmann 1950: *Contr. Cushman Fdn foramin. Res.* 1: 44.
C. caribeana Redmond 1952, p.729, pl.77, fig.6.

Type locality and stratigraphic level - Ragged Key, Florida; Holocene.

This identification is tentative. The species figured by Brady and Cushman is carinate, but Redmond's species is only sometimes carinate and his figures show a specimen with almost rounded margins. The present species is identical with the lateral aspects figured by Brady (1884) and with a section very much like that figured by Redmond (1952).

Occurrence: (a) Great Musselroe Bay - 84483(v), 84482(v); (b) Fossil Bluff - 84015(r), 84019(v), 84025a(r), 84024(v); (c) Granville Harbour - 54144(r); (d) Marrawah district - 84113(v).

Age: Late Oligocene-Farly Miocene, N3-N8.

Cassidulina translucens Cushman and Hughes, 1925
(Pl.4, figs 13,14)

Cassidulina translucens Cushman and Hughes 1925: *Contr. Cushman Lab. foramin. Res.* 1: 15, pl.2, fig.5.

Type locality and stratigraphic level - Lomita Quarry, Palos Verdes Hills, Los Angeles, California; Pleistocene.

Specimens from Tasmania have all the main characteristics of *C. translucens*, such as carinate margin, elongate, straight-sided chambers which expand distally, etc. However it is not quite as inflated as the type figures suggest and the identification is thus a little tentative.

Occurrence: (a) Fossil Bluff - 84010b(v); (b) Cape Grim - 84008(v), 84006(r), 84003 (v); (c) Granville Harbour - 54144(r); (d) Redpa - 84097(r), 84093(r), 84096(q); (e) Marrawah district - 84113(v).

Age: Early Miocene, N4-N8.

Genus *CASSIDULINOIDES* Cushman, 1927

Carter (1964, pp.70,71) recorded three species of this genus from Victorian rocks with faunas belonging to Faunal Units 4-11. On p.147, he listed these species in a morphological series. In the light of time ranges recorded here, the concept of time ranges and evolutionary relationships of these species needs revision. In Tasmania, Carter's *C. aequilatera* (included here in *C. chapmani*) ranges from F.U. 6 to F.U. 9, *C. campana* (as defined by Carter) from F.U. 6 to F.U. 9 and *C. chapmani* (here recorded as *C.* sp. A) within F.U. 7 and F.U. 8. Thus all three species coexisted for much of their geological life.

All three species found here were sectioned and seem to show a granular perforate wall structure. The genus *Cassidulinoides* is therefore placed in the Cassidulinidae.

The three species regarded by Carter (1964) and referred to him to *C. aequilatera*, *C. campana* and *C. chapmani* Parr are found in Tasmania. However, his terminology is not followed completely here. The specimen figured and described by him as *C. aequilatera* is

very similar to Parr's (1931) figures of *C. chapmani*, and also to a specimen figured by Chapman, Parr and Collins (1934, pl.10, figs 28a-c). *C. campana* is clearly different and is recorded here as such. However the specimen figured as *C. chapmani* bears very little resemblance to the type figure and description of that species and very little to Carter's description. It seems more similar to a juvenile specimen of *C. campana*.

In this work three species are recorded — *C. campana* (in the sense that Carter defined it), *C. chapmani* (including *C. aequilatera*) and *C.* sp. A, the latter probably different from the others and doubtfully separable from *Cassidulina*. This may be the species regarded by Carter as *C. chapmani*.

Cassidulinoides campana Carter, 1964
(Pl.4, figs 15-17)

Cassidulinoides campana Carter 1964, p.69, pl.2, figs 43-45.

Type locality and stratigraphic level - west side of Bell Headland, Torquay, Victoria; mid Oligocene.

Occurrence: (a) Great Musselroe Bay - 84482(v); (b) Fossil Bluff - 84024(r); (c) Cape Grim - 84008(v), 84006(f); (d) Mt Cameron West - 84118(v); (e) Redpa - 84097(v); (f) Marrawah district - 84092(v), 84561(r), 84113(r), 84114(v), 84104(v).

Age: Early Miocene, N4-N8.

Cassidulinoides chapmani Parr, 1931
(Pl.4, fig.18)

Cassidulinoides chapmani Parr 1931: *Victorian Nat.* 48: 99-100, figs a-c.
C. chapmani; Parr 1932: *Proc. R. Soc. Vict.* n.s., 44: 231, pl.22, figs 36,37.
C. chapmani; Chapman, Parr and Collins 1934, p.560, pl.10, figs 28a-c.
C. chapmani; Crespin 1943, p.78.
C. aequilatera Carter 1964, p.70, pl.2, figs 40-42.

Type locality and stratigraphic level - Rocky Point, Torquay, Victoria, soapy clay bed below echinoid band; "Miocene".

Occurrence: (a) Great Musselroe Bay - 84483(r), 84481(v), 84482(v); (b) Fossil Bluff - 84010a(r), 84017(q), 84023(q), 84025a(r), 84024(v), 84025b(v); (c) Cape Grim - 84008(v), 84006(r), 84005(r); (d) Mt Cameron West - 84121(v); (e) Granville Harbour - 54144(r); (f) Brittons Swamp - 84480(r); (g) Marrawah district - 84114(v).

Age: Late Oligocene-Early Miocene, N3-N8.

Cassidulinoides sp. A

Occurrence: (a) Cape Grim - 84006(f); (b) Granville Harbour - 54144(r); (c) Brittons Swamp - 84480(v); (d) Redpa - 84097(r), 84093(r), 84095(v), 84096(v); (e) Marrawah district - 84113(r).

Age: Early Miocene, N4-N8.

Genus *EHRENBERGINA* Reuss, 1850
Ehrenbergina healyi Finlay, 1947
(Pl.4, figs 19,20)

Ehrenbergina healyi Finlay 1947: *N.Z. J. Sci. Technol.* 28: 284, pl.7, figs 106-115.
E. healyi; Hornibrook 1961, p.87.
E. osbornei Finlay; Reed 1965, p.69.

Type locality and stratigraphic level - 15 km south of Mt Horrible, New Zealand; Early Miocene.

Occurrence: Marrawah district - 84110(r), 84111(r), 84101(v), 84106(r).

Age: Early Miocene, N8.

Ehrenbergina serrata Reuss, 1850
(Pl.4, figs 21,22)

Ehrenbergina serrata Reuss 1850: *Denkschr. Akad. Wiss., Wien* 1: 377, pl.48, fig.7.
E. serrata; Howchin 1889, p.8.
E. serrata; Chapman 1907: *J. Linn. Soc.* 30: 33, pl.4, figs 85-87.
E. serrata; Chapman 1910: *Proc. R. Soc. Vict.* n.s., 22: 276, 303.
E. serrata; Crespin 1943, p.79.

Type locality and stratigraphic level - Baden bei Wien, Germany; "Tertiary".

This form is separated from *E. healyi* by the presence of lateral grooves and spines which give the test a serrated margin.

Occurrence: Great Musselroe Bay - 84483(v).

Age: Late Oligocene, N3.

Genus *GLOBOCASSIDULINA* Voloshinova, 1960
Globocassidulina subglobosa (Brady), 1881
(Pl.4, figs 23,24)

Cassidulina subglobosa Brady 1881: *J. R. microsc. Soc.* n.s., 21: 60.
C. subglobosa; Brady 1884: "CHALLENGER" EXPEDN SCIENT. RESULTS, ZOOL. 9: 430, pl.54, fig.17.
C. subglobosa; Howchin 1889, p.8.
C. subglobosa; Howchin 1891, p.351.
C. subglobosa; Chapman 1907: *J. Linn. Soc.* 30: 33, pl.4, fig.84.
C. subglobosa; Chapman 1910: *Proc. R. Soc. Vict.* n.s., 22: 275.
C. subglobosa; Crespin 1943, p.78.
C. subglobosa; Reed 1965, p.69.
Globocassidulina subglobosa; Hayward and Buzas 1979, p.59, pl.17, figs 219,220.

Type locality and stratigraphic level - not given. Figured specimen from "Challenger" station 120, 34°28'W, 8°37'S, off Brazil; Holocene.

Occurrence: (a) Great Musselroe Bay - 84483(f), 84481(c), 84482(f); (b) Fossil Bluff - 84010a(q), 84010b(f), 84011(r), 84012(r), 84013(v), 84014(r), 84016(a), 84017(a), 84019(c), 84021(a), 84022(f), 84023(a), 84025a(a), 84024(f), 84025b (c); (c) King Island - 84084(f), 84085(q), 84081(f), 84082(f), 84083(f), 84086(q), 84087(f), 84475(f), 84476(a), 84477(a); (d) Daisy Creek - 84478(c); (e) Cape Grim - 84008(v), 84006(r), 84005(r), 84001(v); (f) Mt Cameron West - 84118(a+), 84121(a), 84120(c), 84117(r); (g) Granville Harbour - 54144(c); (h) Preservation Island - 84479(r); (i) Brittons Swamp - 84480(q);

(j) Cape Barren Island - 84554(q); (k) Redpa - 84097(v), 84093(f), 84094(q), 84095(f), 84096(v); (l) Marrawah district - 84092(a), 84561(c), 84109(a), 84110(a), 84111(a), 84113(c), 84114(c), 84104(c), 84101(f), 84105(a), 84106(a), 84107(a).

Age: Late Oligocene-Early Miocene, N3-N8.

Superfamily NONIONACEA
Family NONIONIDAE
Subfamily NONIONINAE
Genus *ASTRONONION* Cushman and Edwards, 1937
Astrononion australe Cushman and Edwards, 1937
(Pl.5, fig.1)

Astrononion australe Cushman and Edwards 1937: *Contr. Cushman Lab. foramin. Res.* 13: 33, pl.3, figs 13,14.
A. australe; Cushman 1939: *Prof. Pap. U.S. geol. Surv.* 191: 37,38, pl.10, figs 7,8.
A. australe; Crespin 1943, p.77.
A. australe; Carter 1958, p.60, pl.9, figs 91,92.
A. australe; Carter 1964, p.111, pl.11, fig.207.
A. australe; Hornibrook 1964: *Micropaleontology* 10: 335.
A. australis; Reed 1965, p.70.

Type locality and stratigraphic level - Muddy Creek, Victoria; Middle Miocene.

Occurrence: (a) Great Musselroe Bay - 84482(v); (b) Fossil Bluff - 84013(v), 84014(r), 84015(r); (c) Cape Grim - 84001(v); (d) Mt Cameron West - 84118(v); (e) Marrawah district - 84107(v).

Age: Early Miocene, N4-N8.

Astrononion centroplax Carter, 1958
(Pl.5, figs 2,3)

Astrononion centroplax Carter 1958, p.61, pl.9, figs 95-97.
A. centroplax; Carter 1964, p.36.
A. centroplax; Reed 1965, p.70.
A. centroplax; Cooper 1979: *Rept Invest. geol. Surv. S. Aust.* 50: pl.19, fig.11.

Type locality and stratigraphic level - Aire coast, Victoria; Late Oligocene.

The species is recorded in sediments here as young as Faunal Unit 9. Previous records (e.g. Carter 1958, 1964) record it as high as Faunal Unit 8 only. Although poorly preserved, it is recorded here in samples with *Lepidocyclina howchini* (84104, 84114).

Occurrence: (a) Great Musselroe Bay - 84483(v), 84481(v), 84482(r); (b) Fossil Bluff - 84010a(r), 84010b(r), 84011(r), 84012(r), 84013(v), 84014(v), 84019(r), 84024 (v); (c) King Island - 84084(v); (d) Daisy Creek - 84478(r); (e) Mt Cameron West - 84118(q), 84121(v), 84120(r); (f) Preservation Island - 84479(v); (g) Brittons Swamp - 84480(v); (h) Marrawah district - 84092(r), 84561(r), 84110(r), 84113(r), 84114(r), 84104(v).

Age: Late Oligocene-Early Miocene, N3-N8.

Astrononion tasmaniensis Carter, 1964
(Pl.5, figs 4,5)

Astrononion novo-zealandicum Cushman and Edwards 1937: *Contr. Cushman Lab. foramin. Res.* 13: 35, pl.3, figs 18a,b.
Nonion novozealandicus; Howchin and Parr 1938: *Trans. R. Soc. S. Aust.* 62: 308, pl.18, fig.15.
Astrononion novo-zealandicum; Cushman 1939: *Prof. Pap. U.S. geol. Surv.* 191: 36, pl.10, fig.12.
A. tasmaniensis Carter 1964, p.111, pl.10, figs 203,204.
A. novozealandicum; Hornibrook 1964: *Micropaleontology* 10: 335, pl.1, fig.20.

Type locality and stratigraphic level - Rose Hill, Mitchell River, Victoria; Late Miocene.

Following Carter (1964), this name is given to *Astrononion novozealandicum* Cushman and Edwards 1937, a subjective homonym of *Nonion novozealandicum* Cushman 1936. The latter species is regarded, probably correctly, by Carter as an *Astrononion*. It seems worth noting that the original spelling of the trivial name of both homonyms was *novozealandicum*, not *novozelandicum* as recorded by Carter.

The record from Great Musselroe Bay appears to be the earliest so far.

Occurrence: (a) Great Musselroe Bay - 84483(v), 84481(v); (b) Fossil Bluff - 84010a(r), 84010b(q), 84011(f), 84012(r), 84013(q), 84014(f), 84015(f), 84017(q), 84019 (f), 84021(f), 84022(f), 84023(q), 84025a(q), 84024(q), 84025b(r); (c) Cape Grim - 84008(v), 84006(v), 84003(v), 84001(v); (d) Brittons Swamp - 84480(r); (e) Marrawah district - 84561(r), 84104(v).

Age: Late Oligocene-Early Miocene, N3-N8.

Genus *FLORILUS* de Montfort, 1808
Florilus victoriense (Cushman), 1936
(Pl.5, fig.6)

Nonion victoriense Cushman 1936: *Contr. Cushman Lab. foramin. Res.* 12: 67, pl.12, figs 10a,b.
N. victoriense; Cushman 1939: *Prof. Pap. U.S. geol. Surv.* 191: 17, pl.4, fig.14.
N. victoriense; Parr 1939: *Min. geol. J.* 1: 69, pl.1, fig.20.
N. victoriense; Crespin 1943, p.81.
N. victoriense; Carter 1964, p.109, pl.10, figs 201,202.
N. victoriense; Reed 1965, p.70.

Type locality and stratigraphic level - near Lake Bunga, eastern Victoria; Pliocene.

This species is transferred to *Florilus* de Montfort, as it fits the diagnosis of that genus better than that of *Nonion*. *Nonion* includes those species with a slower rate of increase of chamber height than shown in this group. The difference in amount is shown clearly in the figures of the respective genera in Loeblich and Tappan (1964, p.C745).

Occurrence: (a) Fossil Bluff - 84010a(v), 84010b(r), 84011(v), 84012(r), 84013(r), 84014(c), 84015(q), 84016(q), 84017(r), 84019(r), 84021(f), 84022(r), 84023(r), 84025a(v), 84024(v); (b) Cape Grim - 84008(v).

Age: Early Miocene, N4.

Genus *PULLENIA* Parker and Jones, 1862
Pullenia bulloides (d'Orbigny), 1846

Nonionina sphaeroides d'Orbigny, 1826: *Annls Sci. nat.* ser.1, 7: 293 (*nom. nud.*).
N. bulloides d'Orbigny, 1846: FORAMINIFERES FOSSILES DU BASSIN TERTIARE DE VIENNE (Gide and Co.: Paris): 107, pl.5, figs 9,10.
Pullenia bulloides (d'Orbigny); Karrer 1868: *Sber. Akad. Wiss., Wien* 58: 172.
P. sphaeroides (d'Orbigny); Howchin 1891, p.352.
P. sphaeroides; Chapman, Parr and Collins 1934, p.568, pl.10, figs 30a-b.
P. sphaeroides; Crespin 1943, p.82.
P. bulloides; Cushman and Todd 1943: *Contr. Cushman Lab. foramin. Res.* 19: 13, pl.12, figs 15-18.
P. bulloides; Hayward and Buzas 1979, p.72, pl.24, figs 303,304.

Type locality and stratigraphic level - not given.

Occurrence: (a) Great Musselroe Bay - 84482(v); (b) Fossil Bluff - 84025a(v), 84024(v); (c) King Island - 84084(v), 84081(v), 84087(q); (d) Cape Grim - 84008(v); (e) Marrawah district - 84561(v).

Age: Early Miocene, N4.

Pullenia miocenica Kleinpell, 1938
(Pl.5, figs 7,8)

Pullenia miocenica Kleinpell, 1938: MIOCENE STRATIGRAPHY OF CALIFORNIA (Am. Assoc. Petrol. Geol.: Tulsa): 338, pl.14, fig.6.
P. miocenica; Carter 1964, p.71, pl.2, figs 46-47.

Type locality and stratigraphic level - LSJU Locality 691, Reliz Canyon, Monterey County, California; Lower Luisian.

Carter (1964) regarded *Pullenia sphaeroides* as recorded by Chapman, Parr and Collins (1934, p.568) and Crespin (1943, p.82) as synonymous with *P. miocenica*. Chapman *et al.* figured a specimen and the figure is of a species more inflated than *P. miocenica* and with only four chambers in the last whorl. It seems more likely that it is *P. bulloides* than *P. miocenica*. Also, as *P. sphaeroides* and *P. bulloides* are now regarded as synonyms, it seems more likely that these records refer to *P. bulloides* (*q.v.*).

Occurrence: (a) Mt Cameron West - 84120(v); (b) Marrawah district - 84107(v).

Age: Early Miocene, N4, N8.

Pullenia quinqueloba (Reuss), 1851
(Pl.5, fig.9)

Nonionina quinqueloba Reuss, 1851: *Z. dt. geol. Ges.* 3: 71, pl.5, fig.31.
Pullenia quinqueloba; Howchin 1891, p.352.
P. quinqueloba; Heron-Allen and Earland 1924: *J. R. microsc. Soc.* (1924): 166.
P. quinqueloba; Chapman, Parr and Collins 1934, p.568, pl.10, figs 29a,b.
P. quinqueloba; Crespin 1943, p.82.
P. quinqueloba; Cushman and Todd 1943: *Contr. Cushman Lab. foramin. Res.* 19: 10,11, pl,2, fig.5; pl.3, fig.8.
P. quinqueloba; Carter 1958, p.32, pl.2, figs 8,9.
P. quinqueloba; Carter 1964, p.71.
P. quinqueloba; Reed 1965, p.69.

Type locality and stratigraphic level - Hemsdorf, Germany; Eocene.

Occurrence: (a) Great Musselroe Bay - 84481(r); (b) Fossil Bluff - 84010b(v), 84011 (v), 84012(v), 84013(v), 84017(r), 84019(v); (c) Marrawah district - 84104(v).

Age: Early Miocene, N4, N8.

Pullenia salisburyi R.E. and K.C. Stewart, 1930
(Pl.5, fig.10)

Pullenia salisburyi R.E. and K.C. Stewart, 1930: *J. Paleont.* 4: 72, pl.8, fig.2.
P. salisburyi; Cushman and Todd 1943: *Contr. Cushman Lab. foramin. Res.* 19: 20, pl.3, figs 10,11.

Type locality and stratigraphic level - Mud pits at the Dent Mud Plant about 3 km north of Ventura, and 600 m east of Ventura Avenue at the head of Franklin Lane, Ventura County, California; Pliocene.

Occurrence: Fossil Bluff - 84010b(v), 84011(v).

Age: Early Miocene, N4.

Family ALABAMINIDAE
Genus *ALABAMINA* Toulmin, 1941
Alabamina tenuimarginata (Chapman, Parr and Collins), 1934
(Pl.5, figs 11,12)

Pulvinulinella tenuimarginata Chapman, Parr and Collins, 1934: *J. Linn. Soc.* 38 (262): 565, pl.9, fig.19.
P. tenuimarginata; Crespin 1943, p.82.
Alabamina tenuimarginata; Carter 1964, p.114, pl.11, figs 220-222.
A. tenuimarginata; Reed 1965, p.69.
A. tenuimarginata; Hayward and Buzas 1979, p.38, pl.4, fig.41.

Type locality and stratigraphic level - Kackeraboite Creek, Port Phillip area, Victoria; Oligocene.

Occurrence: (a) Great Musselroe Bay - 84482(v); (b) Cape Grim - 84006(v); (c) Marrawah district - 84113(r), 84114(r), 84104(q), 84106(r).

Age: Early Miocene, N4, N8.

Genus *GYROIDINA* d'Orbigny, 1826

Loeblich and Tappan (1964) placed *Gyroidina* in the Alabaminidae and *Gyroidinoides* in the Osangulariidae without having the knowledge of the wall structure of the type species of *Gyroidina* (*G. orbicularis*). Thus there seems little basis for placing them definitively in separate families. Generic differentiation was based on *Gyroidinoides* having an aperture along the entire base of the apertural face whereas in *Gyroidina* it is restricted to a small central point at the base of the apertural face and this difference in apertural character was also taken as the basis for a family differentiation. In my experience some species show all gradations from small *Gyroidina* type apertures to longer *Gyroidinoides* type and it is my opinion that the differentiation of two genera is unnecessary, until some wall structure difference can be proven. Thus all are included here in *Gyroidina*. Hayward and Buzas (1979) seem to have adopted the same procedure.

In the Tasmanian samples, *Gyroidina* can be divided into two groups:
(a) those with 10-11 chambers per whorl which are identified as *G. allani* Finlay and are commonly well preserved, and
(b) those specimens with fewer chambers per whorl, and with a less rounded margin to the dorsal surface: these are often poorly preserved and are identified as *G. zelandica* Finlay, although this group may also contain some *G. neosoldanii* Brotzen.

Gyroidina allani Finlay, 1939
(Pl.5, figs 13-18)

Gyroidina zelandica Finlay, 1939: *Trans. R. Soc. N.Z.* 69: 323, pl.28, figs 134-136.
Gyroidinoides allani; Hornibrook 1961, p.112, pl.16, figs 340-342.
G. allani; Reed 1965, p.77.

Type locality and stratigraphic level - Otiake, North Otago, New Zealand; Late Oligocene.

Hornibrook (1961) recorded this species only in rocks as young as Late Oligocene, but Reed (1965) found it in Early Miocene rocks in the Heywood bore, Victoria. The latter occurrence is in keeping with its occurrence here.

Two specimens of *G. allani* are figured. One is a typical specimen, large, with about 11 chambers in the final whorl and a proloculus diameter of about 0.04 mm. The other specimen is much smaller, has only about six to seven chambers in the final whorl and has a proloculus diameter of 0.08 mm, the large proloculus being very prominent. The smaller specimens made up 50% of a sample of *G. allani* from Cape Grim (84008). Overall, the specimens with the small proloculus (microspheric?) are more abundant than the "megalospheric", so the smaller specimens may represent a new species as it is very seldom that the microspheric generation is the dominant one.

Occurrence: (a) Cape Grim - 84008(r), 84007(r), 84006(r), 84005(v), 84001(v);
(b) Mt Cameron West - 84120(r); (c) Marrawah district - 84561(f).

Age: Early Miocene, N4.

Gyroidina neosoldanii Brotzen, 1936
(Pl.5, figs 21-23)

Gyroidina neosoldanii Brotzen, 1936: *Sverig. geol. Unders. Arh.* 30(3), ser.C, no.396: 158.
Gyroidinoides neosoldanii (Brotzen); Hornibrook 1961, p.112, pl.16, figs 338,343.

Type locality and stratigraphic level - "Challenger" Station 302, 82°11'W, 42°43'S; Holocene.

Occurrence: Marrawah district - 84561(v).

Age: Early Miocene, N4.

Gyroidina prominula (Stache), 1864
(Pl.5, figs 19,20)

Rotalia soldanii d'Orbigny var. *prominula* Stache, 1864: "NOVARA" EXPEDN, GEOL. THEIL. 1(2): 274, pl.24, fig.24.
Gyroidina prominula; Hornibrook 1961, p.111, pl.16, figs 348,349.

Type locality and stratigraphic level - Raglan Harbour, New Zealand; Early Oligocene.

The name is used for the species described under this name by Hornibrook (1961). However, the same is strictly a *nomen dubium* following Hornibrook (1971).

Occurrence: Marrawah district - 84561(r).

Age: Early Miocene, N4.

Gyroidina zelandica Finlay, 1939
(Pl.6, figs 1-3)

Gyroidina zelandica Finlay, 1939b, p.323, pl.28, figs 138-140.
Gyroidinoides zelandica; Hornibrook 1961, p.113, pl.16, figs 339,344.
G. zelandicus; Reed 1965, p.69.
Gyroidina zelandica; Hayward and Buzas 1979, p.60, pl.18, figs 221-223.

Type locality and stratigraphic level - Island Creek, Tutamoe, New Zealand; Miocene.

More than one species of the *G. zelandica* lineage may be included here, but the preservation generally is not good and finer subdivision is impossible.

Occurrence: (a) King Island - 84085(r), 84081(v); (b) Mt Cameron West - 84118(v); (c) Marrawah district - 84092(q), 84109(q), 84110(r), 84111(q), 84113(r), 84104(r), 84101(v), 84106(r), 84107(r).

Age: Early Miocene, N4-N8.

Family ANOMALINIDAE
Subfamily ANOMALININAE
Genus *ANOMALINA* d'Orbigny, 1826
Anomalina cf *humilis* (Brady), 1884
(Pl.6, figs 4,5)

Truncatulina humilis Brady, 1884, p.665, pl.94, figs 7a-c.

Type locality and stratigraphic level - not designated. Localities given - North Atlantic and North Pacific Ocean; Holocene.

This species occurs in two Cape Grim samples [84008(v), 84006(v)] and only one specimen was found in each. The closest figured species appears to be that listed here, but the specimens may well be unusual forms of *Anomalinoides macraglabrus* or *A. nonionoides*. The generic name follows Thalmann (1932). The umbilical details in Brady's figures are not clear enough to allow positive comparison.

Age: Early Miocene, N4.

Anomalina sp.1
(Pl.6, figs 6-8)

A single unidentified specimen is referred to this genus. The appearance of the wall is typical of *Anomalina* or *Anomalinoides*, but the apertural details are obscure. The specimen has seven chambers in the final whorl, no umbilicus at all and is little compressed.

Occurrence: Marrawah district - 84113(v).

Age: Early Miocene, N8.

Genus *ANOMALINOIDES* Brotzen, 1942

The main part of the Tasmanian *Anomalinoides* can be broken down into two groups:
(a) those specimens with a clear thickened central part of the dorsal surface and in which the early whorls are clearly visible (examples are *A. pinguiglabrus* and *A. macraglabrus*).
(b) those specimens which have a considerably thickened opaque central area on the dorsal surface and in which early whorls are not visible (an example is *A. nonionoides*). Members of this group generally have a thicker, more coarsely perforate wall and more lobulate periphery than members of group (a).

The species of these groups are generally distinguished to a large extent on the number of chambers in the final whorl. All the specimens are referred to *Anomalinoides* because in any population, the aperture passes onto the dorsal surface in many specimens.

Anomalinoides macraglabrus (Finlay), 1940
(Pl.6, figs 9,10)

Anomalina glabrata Cushman; Chapman, Parr and Collins 1934, p.570, pl.11, figs 39a-c.
A. macraglabra Finlay, 1940: *Trans. R. Soc. N.Z.* 69: 460, pl.65, figs 141-143.
A. glabrata; Crespin 1943, p.77.
Anomalinoides macraglabra; Hornibrook 1961, p.155, pl.24, figs 473-475.
Anomalina macraglabra; Carter 1964, p.99, pl.8, figs 151-153.
A. macraglabra; Reed 1965, p.70.
Anomalinoides macraglabrus; Hayward and Buzas 1979, p.40, pl.5, figs 52,53.

Type locality and stratigraphic level - Kakanui Beach, New Zealand; Early Miocene.

The dominant species of *Anomalinoides* in Tasmania is that referred by Carter (1964 *op. cit.*) to *Anomalina macraglabra* Finlay. However, the description of *A. macraglabra* does not include all the variations found in a large sample. To give some idea of the variation in number of chambers in the final whorl, the Fossil Bluff samples were examined individually. The samples had between 13 and 70 specimens of the species in each. The results of final whorl chamber counts for each sample are shown in figure 3, in which each sample has been statistically reduced to a size of about 20 (13-28) to make comparison simpler. An average specimen has between eight and ten chambers in the final whorl with a range from 5-13. In most samples, results fit a unimodal histogram. Sample 84011 shows two peaks, perhaps suggesting separation into micro- and megalospheric generations. Many smaller specimens have only one whorl and often have a larger proloculus. However, a simple alternation-of-generations hypothesis does not explain it all, as many small specimens have two whorls and a small proloculus.

Thus, in this work, *A. macraglabrus* is interpreted more widely than by Carter (1964), who suggested that the species has 12 chambers in the final whorl, or by Finlay (1940), who suggested 10 to 11. An average specimen recovered here has between eight and ten chambers in the final whorl.

In several cases, the variation of the species is wide enough to include the robust species *A. pinguiglabrus* (Finlay). It may also include *A. parvumbilius* (Finlay). In the samples studied, the very rare specimens referable to *A. pinguiglabrus* are recorded as *A. macraglabrus*. In the Redpa, Marrawah and Mt Cameron West samples, identification is a little tentative and some specimens may be *A. nonionoides*.

Occurrence: (a) Great Musselroe Bay - 84482(r); (b) Fossil Bluff - 84010a(f), 84010b(f), 84011(f), 84012(f), 84013(q), 84014(a), 84015(c), 84016(c), 84017(f), 84019(c), 84021(f), 84022(q), 84023(q), 84025a(q), 84024(r), 84025b(c); (c) Cape Grim - 84008(v); (d) Mt Cameron West - 84118(v), 84121(r), 84120(q); (e) Granville Harbour - 54144(q); (f) Redpa - 84097(q), 84093(r), 84094(r), 84095(r), 84096(v); (g) Marrawah district - 84561(r), 84109(r), 84110(v), 84113(r), 84104(r), 84106(r), 84107(r).

Age: Early Miocene, N4-N8.

Anomalinoides nonionoides (Parr), 1932
(Pl.6, figs 11-13)

Anomalina nonionoides Parr, 1932: *Proc. R. Soc. Vict.* n.s., 44: 231, pl.22, figs 38a-c.
A. nonionoides; Crespin 1943, p.77.
A. nonionoides; Carter 1964, p.100, pl.8, figs 154-156.

Type locality and stratigraphic level - Station 7, Narrabeen, New South Wales; Holocene.

In some instances, misidentification of this species for *A. macraglabrus* may have occurred in samples from Mt Cameron West and the Marrawah district where preservation is poor.

Occurrence: (a) Great Musselroe Bay - 84483(q), 84481 (r); (b) Fossil Bluff - 84010b(v), 84019(q); (c) King Island - 84475(q), 84476(f), 84477 (f); (d) Cape Grim - 84008(v), 84007(r), 84006(r), 84005 (r), 84003(q), 84001(r); (e) Mt Cameron West - 84121(r); (f) Cape Barren Island - 84554(r); (g) Marrawah district - 84092(q), 84561(f), 84110(r), 84114(r), 84101(r), 84105(r).

Age: Late Oligocene-Early Miocene, N3-N8.

Anomalinoides cf *planulatus* Carter, 1964
(Pl.6, figs 14,15)

?Cibicides lobatulus (Walker & Jacob); Chapman, Parr and Collins 1934, p.570, pl.11, figs 41a-c.
?Anomalinoides planulatus Carter 1964, p.99, pl.8, figs 148-150.

Type locality and stratigraphic level (*A. planulatus*)- Skinner's, Mitchell River, Victoria; Early Miocene.

A few very poorly preserved specimens, quite similar to Chapman, Parr and Collins' (1934, *op. cit.*) figures, are found in Tasmania.

Occurrence: (a) King Island - 84084(q), 84081(v), 84086(r); (b) Redpa - 84095(v).

Age: Early Miocene, N4, N8.

Anomalinoides subnonionoides (Finlay), 1940
(Pl.6, figs 16,17)

Anomalina subnonionoides Finlay, 1940: *Trans. R. Soc. N.Z.* 69: 459, pl.66, figs 172-180.
Anomalinoides subnonionoides; Hornibrook 1961, p.155, pl.23, figs 467-469.

Type locality and stratigraphic level - Kakanui Beach, New Zealand; Early Miocene.

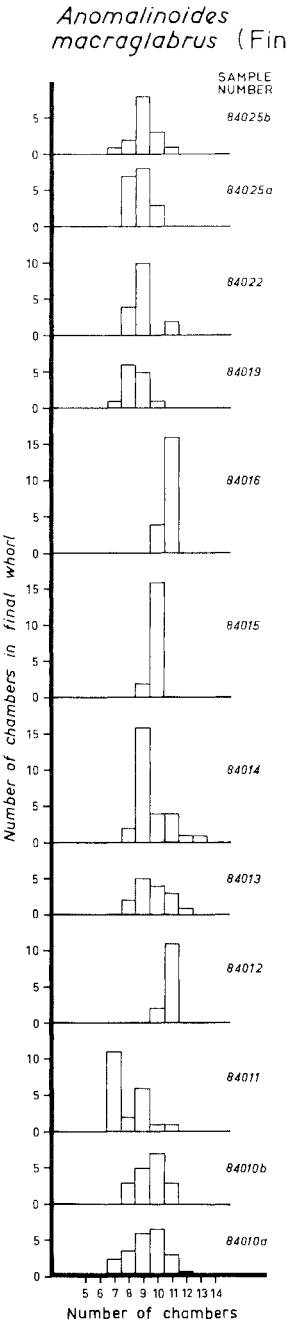

FIG.3 - Chamber counts for *Anomalinoides macraglabra* at various levels in the Fossil Bluff section.

Occurrence: Cape Barren Island - 84554(v).

Age: Early Miocene, N8.

Anomalinoides cf *sphericus* (Finlay), 1940
(Pl.6, figs 18,19)

Anomalina spherica Finlay, 1940: *Trans. R. Soc. N.Z.* 69: 460, pl.66, figs 166-171.

Type locality and stratigraphic level (*A. sphericus*) - north of Hen and Chickens, in 55 m, New Zealand; Holocene.

A few small, poorly preserved specimens from King Island are referred tentatively to this species. Following Finlay (1940) they may be stratigraphically too old to be true *A. sphericus*.

Occurrence: King Island - 84085(r), 84082(r), 84083(v).

Age: Early Miocene, N4.

Genus *HANZAWAIA* Asano, 1944
Hanzawaia procolligera (Carter), 1958
(Pl.6, figs 20,21)

Anomalina rotula d'Orbigny: Chapman, Parr and Collins 1934, p.570, pl.11, figs 38a-c.
Anomalinoides procolligera Carter 1958, p.49, pl.6, figs 60-63.
A. procolligera; Reed 1965, p.70.

Type locality and stratigraphic level - Barwon River, Birregurra, Victoria; Late Oligocene or Early Miocene.

Only five specimens were recovered, of which two are from Great Musselroe Bay. The Fossil Bluff specimen is well preserved and is figured.

Occurrence: (a) Great Musselroe Bay - 84483(v); (b) Fossil Bluff - 84011(v); (c) Mt Cameron West - 84117(r); (d) Marrawah district - 84561(r), 84110(v).

Age: Late Oligocene-Early Miocene, N3-N8.

Genus *KARRERIA* Rzehak, 1891
Karreria maoria (Finlay), 1939
(Pl.6, figs 22,23)

Vagocibicides maoria Finlay 1939b, p.326, pl.29, figs 148-151,158.
V. maoria; Carter 1964, p.90, pl.6, figs 116-120.
Karreria maoria (Finlay); Loeblich and Tappan 1964, p.C761, fig.623,9.
K. maoria; Hayward and Buzas 1979, p.61, pl.19, figs 233,234.

Type locality and stratigraphic level - East Grey River, New Zealand; Miocene/Pliocene.

Reed (1965, p.79) suggested that *Vagocibicides* is a synonym of *Cibicides*, believing it to have developed from *Cibicides* in a similar manner to *Dyocibicides*. The wall of species referable to this genus has been examined several times (e.g. Loeblich and Tappan 1964, Carter 1964), and ample evidence has been forthcoming to show that it is very different from the wall of *Cibicides*. Loeblich and Tappan (1964) placed *Vagocibicides* in synonymy of *Karreria* and their judgement is followed here.

Occurrence: (a) Great Musselroe Bay - 84483(v), 84482(v); (b) King Island - 84085(v); (c) Marrawah district - 84561(v), 84113(v), 84104(r).

Age: Late Oligocene-Early Miocene, N3-N8.

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PLATE 1

Figure in parentheses is maximum dimension of figured specimen.

FIGS 1, 2 *Eponides lornensis* Finlay, Great Musselroe Bay; UTGD 84338, x24; (1.1 mm); from UTGD 84483.

FIGS 3, 4 *Eponides repandus* (Fichtel and Moll), Great Musselroe Bay; UTGD 84339, x30; (0.9 mm); from UTGD 84483.

FIG. 5 *Siphonina australis* Cushman, Fossil Bluff; UTGD 84455, x86; (0.35 mm); from UTGD 84011.

FIGS 6, 7 *Amphistegina lessonii* d'Orbigny, Marrawah; UTGD 84351, x10; (2.55 mm); from UTGD 84113.

FIGS 8, 9 *Hyalinea* sp., King Island; UTGD 84369, x70; (0.35 mm); from UTGD 84084.

FIGS 10-12 *Crespinella parri* Quilty, Fossil Bluff; holotype, UTGD 84286; 10,11 - x40, 12 - details of aperture, x40; (0.65 mm); from UTGD 84010a.

FIGS 13, 14 *Crespinella umbonifera* (Howchin and Parr), Preservation Island; UTGD 84505, x30; (0.85 mm); from UTGD 84479.

FIGS 15-18 *Valvulineria kalimmensis* (Parr), Fossil Bluff; 15 - UTGD 84506, equatorial section, x54; (0.57 mm); 16,17 - UTGD 84470, x45; (0.6 mm); 18 - detail of supplementary sutural apertures, x120; 15 - from UTGD 84011; 16 to 18 - from UTGD 84010b.

FIGS 19, 20 *Cibicides refulgens* de Montfort, King Island; UTGD 84279, x65; (0.4 mm); from UTGD 84084.

FIGS 21, 22 *Cibicides thiara* Stache, Fossil Bluff; UTGD 84284, x80; (0.38 mm); from UTGD 84010b.

FIGS 23-25 *Cibicides vortex* Dorreen, Cape Grim; UTGD 84285, x75; (0.38 mm); from UTGD 84008.

FIGS 26, 27 *Cibicidoides brevoralis* (Carter), Fossil Bluff; UTGD 84277, x60; (0.5 mm); from UTGD 84025b.

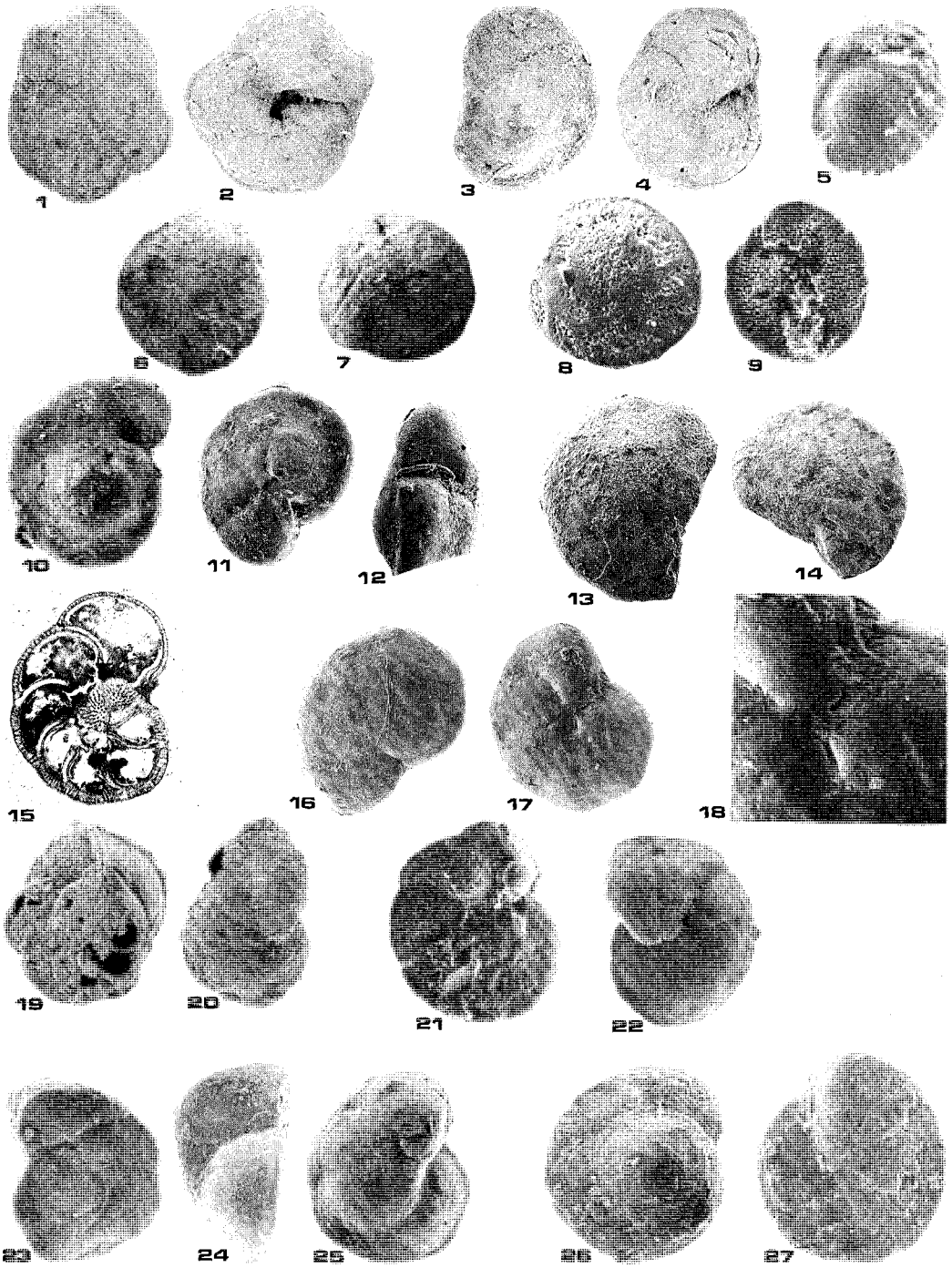

PLATE 1

PLATE 2

FIGS 1, 2 *Cibicidoides perforatus* (Karrer), Fossil Bluff; UTGD 84281, x65; (0.45 mm); from UTGD 84010b.

FIGS 3, 4 *Cibicidoides subhaidingeri* (Parr), Fossil Bluff; UTGD 84282, x85; (0.35 mm); from UTGD 84010a.

FIGS 5, 6 *Cibicidoides temperata* (Vella), Fossil Bluff; UTGD 84283, x35; (0.7 mm); from UTGD 84010b.

FIGS 7, 8 *Dyocibicides biserialis* Cushman and Valentine, Fossil Bluff; UTGD 84314, x75; (0.35 mm); from UTGD 84010b.

FIG. 9 *Planorbulina mediterranensis* d'Orbigny, Cape Grim; UTGD 84421, x50; (0.5 mm); from UTGD 84001.

FIGS 10-12 *Planorbulinella inaequilateralis* (Heron-Allen and Earland), Fossil Bluff; 10 - UTGD 84423, x25; (1.1 mm); 11,12 - UTGD 84422; Equatorial section, x22 and x160 respectively. (1.1 mm); from UTGD 84010a.

FIGS 13, 14 *Planorbulinella plana* (Heron-Allen and Earland), Marrawah; 13 - UTGD 84424, x28; (0.95 mm); from UTGD 84114. 14 - UTGD 84528 Equatorial section, x 30; (0.9 mm); from UTGD 84104.

FIG. 15 *Gypsina globulus* (Reuss), Great Musselroe Bay; UTGD 84529, x50; (0.5 mm); from UTGD 84481.

FIG. 16 *Gypsina howchini* Chapman, Cape Barren Island; UTGD 84558, x23; (1.25 mm); from UTGD 84554.

FIG. 17 *Gypsina* sp., Cape Grim; UTGD 84363, x17; (1.6 mm); from UTGD 84007.

FIGS 18, 19 *Carpenteria balaniformis* Gray, Fossil Bluff; UTGD 84572, x25; (1.4 mm); from UTGD 84010a.

FIG. 20 *Carpenteria rotaliformis* Chapman and Crespin, Great Musselroe Bay; UTGD 84267, x22; (1.2 mm); from UTGD 84483.

FIGS 21-24, 26 *Sherbornina atkinsoni* Chapman, Topotypes, Fossil Bluff; 21,22 - UTGD 84450, x21 and x 70 respectively; (1.2 mm); 23 - UTGD 121111, x 30; (1.0 mm); 24 - UTGD 84509, x35; (0.85 mm); 26 - UTGD 84508, x58; (0.95 mm); all from UTGD 84010a.

FIG. 25 *Sherbornina atkinsoni*, Brittons Swamp; UTGD 84451, x22; (1.2 mm).

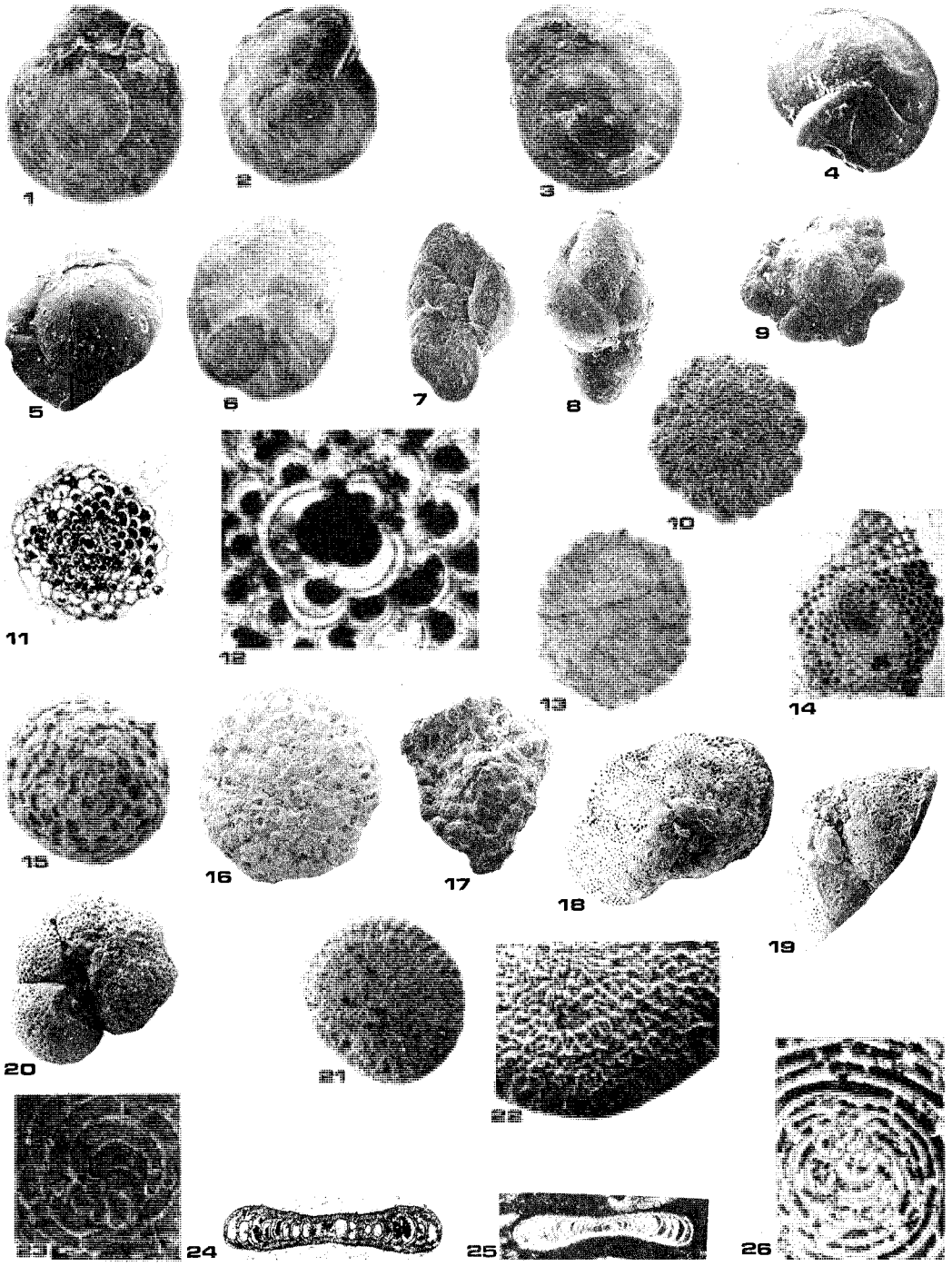

PLATE 2

PLATE 3

FIGS 1-6 *Tenisonina tasmaniae* Quilty, Cape Grim; 1-3 - Holotype, UTGD 84510; 1,2 - x23; (1.2 mm); 3 - detail of 1, x240. 4 - Paratype, UTGD 84511, equatorial section; x23, (1.2 mm); 5 - Paratype, UTGD 84512, equatorial section; x65 (0.36 mm); 6 - Paratype, UTGD 84513, vertical section, x30; (1.1 mm); all from UTGD 84005.

FIGS 7, 8 *Calcarina mackayi* (Karrer), Great Musselroe Bay; UTGD 84516, x55; (0.55 mm); from UTGD 84481.

FIGS 9, 10 *Calcarina verriculata* (Howchin and Parr), Fossil Bluff; UTGD 84263, x30; (1.1 mm); from UTGD 84010a.

FIG. 11 *Cribroelphidium poeyanum* (d'Orbigny), Fossil Bluff; UTGD 84292, x120; (0.25 mm); from UTGD 84022.

FIG. 12 *Elphidium chapmani* Cushman, Fossil Bluff; UTGD 84318, x18; (1.5 mm); from UTGD 84013.

FIG. 13 *Elphidium crassatum* Cushman, Marrawah; UTGD 84527, x45; (0.6 mm); from UTGD 84104.

FIG. 14 *Elphidium crespinae* Cushman, Great Musselroe Bay; UTGD 84319, x35; (0.8 mm); from UTGD 84482.

FIGS 15, 16 *Elphidium grimensis* Quilty, Holotype, Cape Grim; UTGD 84324, x45; (0.57 mm); from UTGD 84001.

FIGS 17, 18 *Elphidium helenae* Quilty, Holotype, Fossil Bluff; UTGD 84331, x95; (0.32 mm); from UTGD 84010b.

FIGS 19-21 *Elphidium musselroeensis* Quilty, Great Musselroe Bay; 19 - Holotype, UTGD 84332, x14; (2.0 mm); 20,21 - Paratype, UTGD 84333, equatorial section, x22 and x125 respectively; 21 - illustrates typical septal structure of *Elphidium* ; (1.2 mm); from UTGD 84483.

FIGS 22, 23 *Elphidium pseudoinflatum* Cushman, Great Musselroe Bay; UTGD 84517, x35; (0.8 mm); from UTGD 84481.

FIGS 24, 25 *Elphidium* sp. 1, Cape Grim; UTGD 84336, x95; (0.3 mm); from UTGD 84003.

FIGS 26, 27 *Elphidium* sp. 2, Cape Grim; UTGD 84317, x50; (0.57 mm); from UTGD 84008.

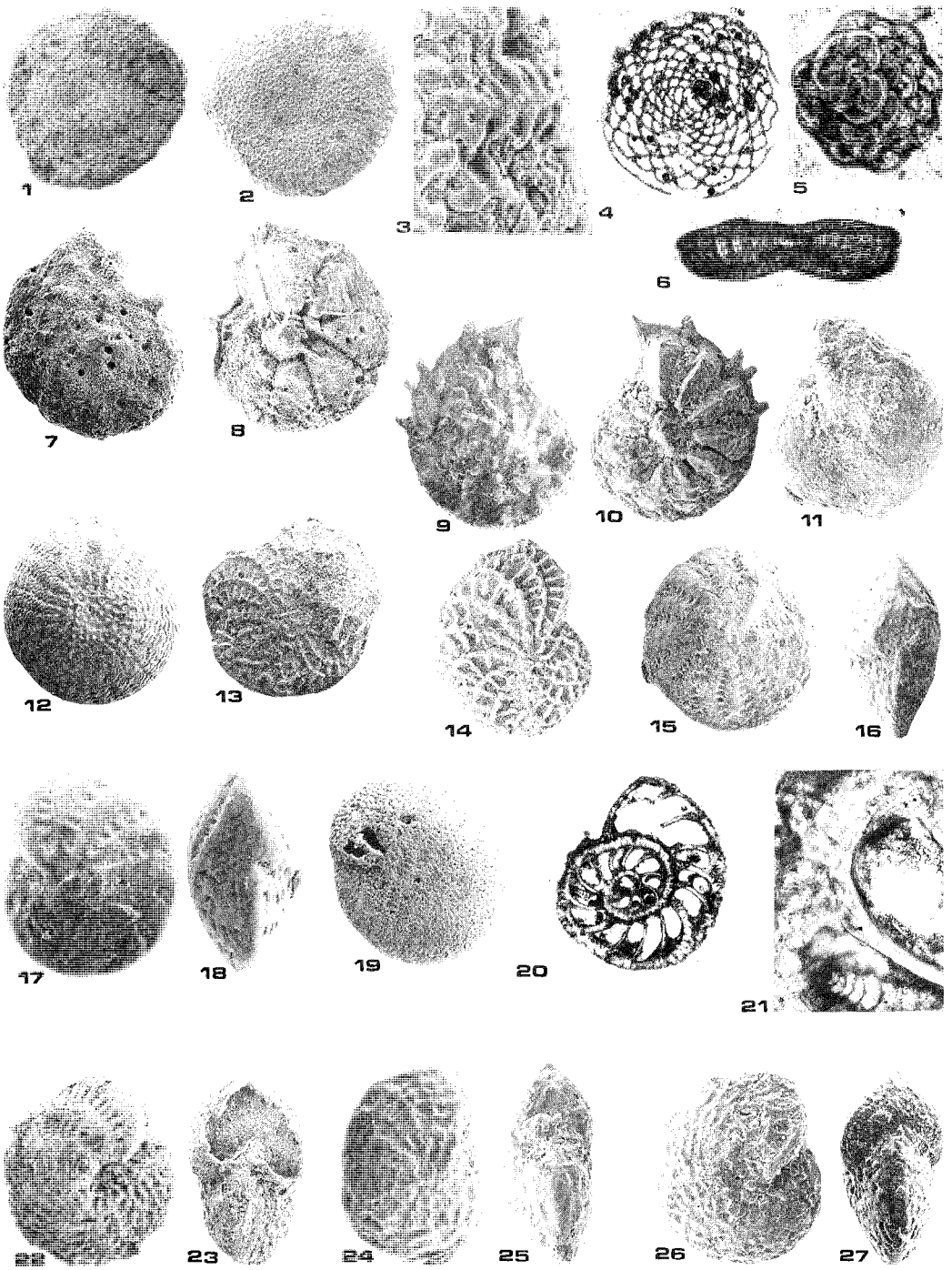

PLATE 3

PLATE 4

FIGS 1-3 *Notorotalia howchini* (Chapman, Parr and Collins), 1 - Fossil Bluff; x50, UTGD 84428; (0.6 mm); from UTGD 84010b. 2,3 - Great Musselroe Bay; UTGD 84427, x35; (0.9 mm); from UTGD 84483.

FIGS 4, 5 *Polystomellina miocenica* Cushman, Marrawah; UTGD 84426, x50, x60 respectively; (0.55 mm); from UTGD 84104.

FIGS 6, 7 *Operculina victoriensis* Chapman and Parr, Marrawah; 6 - UTGD 84519, equatorial section, x15; (2.2 mm); 7 - UTGD 84518, vertical section, x35; (1.1 mm); from UTGD 84104.

FIG. 8 *Lepidocyclina howchini* Chapman and Crespin, Marrawah; UTGD 84404, equatorial section, x13; (2.5 mm); from UTGD 84114.

FIG. 9 *Annulopatellina annularis* (Parker and Jones), Fossil Bluff; UTGD 84573, x65; (0.45 mm); from UTGD 84010a.

FIGS 10, 11 *Cassidulina laevigata* d'Orbigny, Brittons Swamp; UTGD 84533; 10 - x95; 11 - detail of aperture, x190; (0.3 mm); from UTGD 84480.

FIG. 12 *Cassidulina neocarinata* Thalmann, Fossil Bluff; UTGD 84269, x140; (0.21 mm); from UTGD 84025a.

FIGS 13, 14 *Cassidulina translucens* Cushman and Hughes, Cape Grim; UTGD 84270, x90; (0.32 mm); from UTGD 84008.

FIGS 15-17 *Cassidulinoides campana* Carter, Cape Grim; 15 - UTGD 84273, x75; (0.4 mm); 16, 17 - thin section in plane polarised light and under crossed polars respectively, UTGD 84274, x65; (0.4 mm); 15 - from UTGD 84008; 16, 17 - from UTGD 84006.

FIG. 18 *Cassidulinoides chapmani* Parr, Cape Grim; UTGD 84275, x90; (0.32 mm); from UTGD 84006.

FIGS 19, 20 *Ehrenbergina healyi* Finlay, Marrawah; UTGD 84315, x75; (0.4 mm); from UTGD 84106.

FIGS 21, 22 *Ehrenbergina serrata* Reuss, Great Musselroe Bay; UTGD 84316, x60; (0.55 mm); from UTGD 84483.

FIGS 23, 24 *Globocassidulina globosa* (Brady), King Island; UTGD 84360, x75; (0.40 mm); from UTGD 84097.

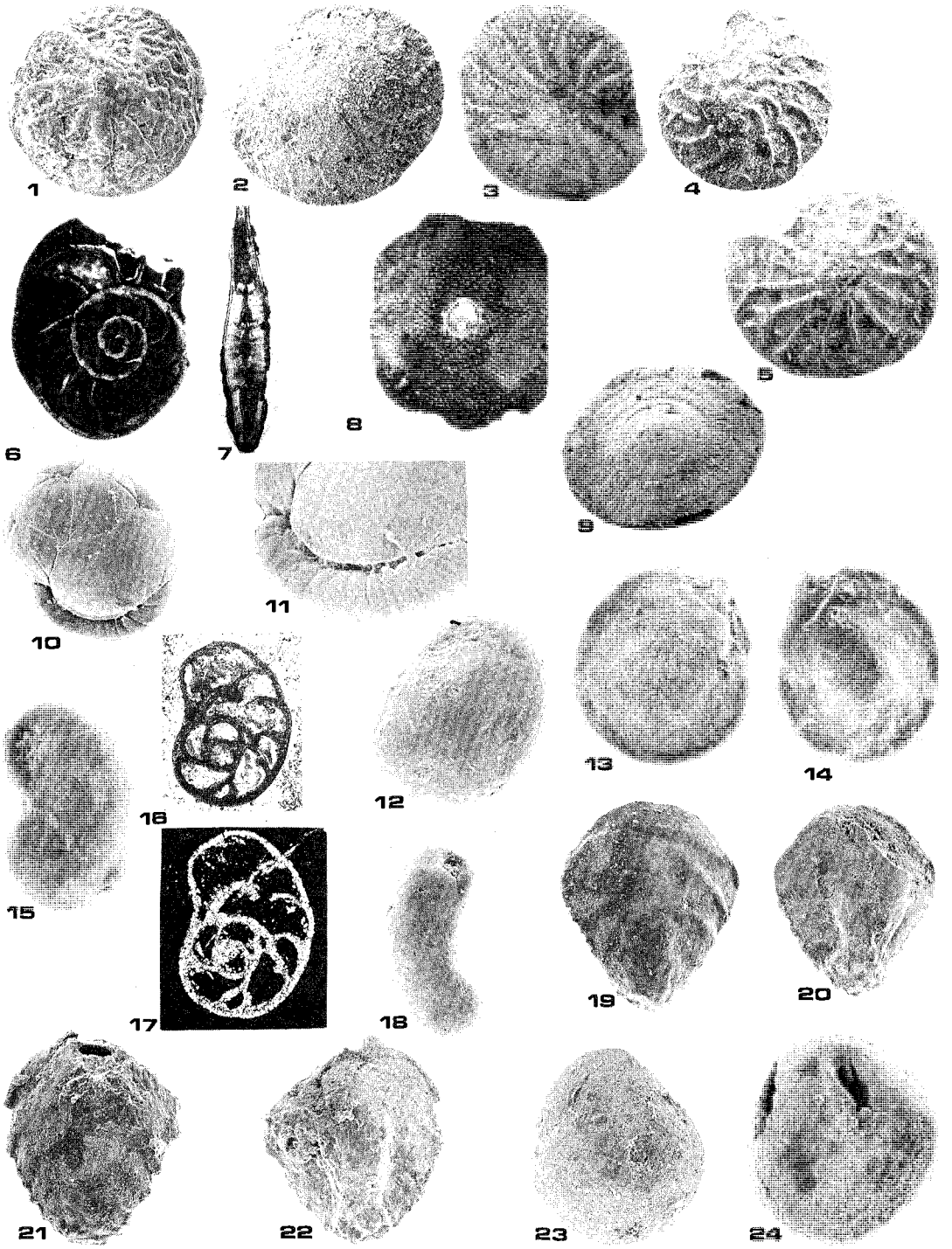

PLATE 4

PLATE 5

FIG. 1 *Astrononion australe* Cushman and Edwards, Cape Grim; UTGD 84254, x110; (0.25 mm); from UTGD 84001.

FIGS 2, 3 *Astrononion centroplax* Carter, Fossil Bluff; UTGD 84255; 2 - x60; (0.45 mm); from UTGD 84010b. 3 - detail of 2, x250.

FIGS 4, 5 *Astrononion tasmaniensis* Carter, Fossil Bluff; UTGD 84256, x75; (0.4 mm); from UTGD 84010b. 5 - detail of 4, x750.

FIG. 6 *Florilus victoriensis* (Cushman), Fossil Bluff; UTGD 84343, x60; (0.5 mm); from UTGD 84010b.

FIGS 7, 8 *Pullenia miocenica* Kleinpell, Mt Cameron West; UTGD 84436, x120; (0.25 mm); from UTGD 84120.

FIG. 9 *Pullenia quinqueloba* (Reuss), Fossil Bluff; UTGD 84437, x85; (0.35 mm); from UTGD 84010b.

FIG. 10 *Pullenia salisburyi* R.E. and K.C. Stewart, Fossil Bluff; UTGD 84438, x125; (0.25 mm); from UTGD 84010b.

FIGS 11, 12 *Alabamina tenuimarginata* (Chapman, Parr and Collins), Cape Grim; UTGD 84350, x45; (0.6 mm); from UTGD 84006.

FIGS 13-18 *Gyroidina allani* Finlay, Cape Grim; 13 to 15 - UTGD 84364, x90; (0.30 mm); from UTGD 84008. 16 to 18 - UTGD 84365, x55; (0.5 mm); from UTGD 84006.

FIGS 19, 20 *Gyroidina prominula* (Stache), Marrawah; UTGD 84569, x115; (0.27 mm); from UTGD 84561.

FIGS 21-23 *Gyroidina neosoldanii* Brotzen, Marrawah; UTGD 84571, x90; (0.35 mm); from UTGD 84561.

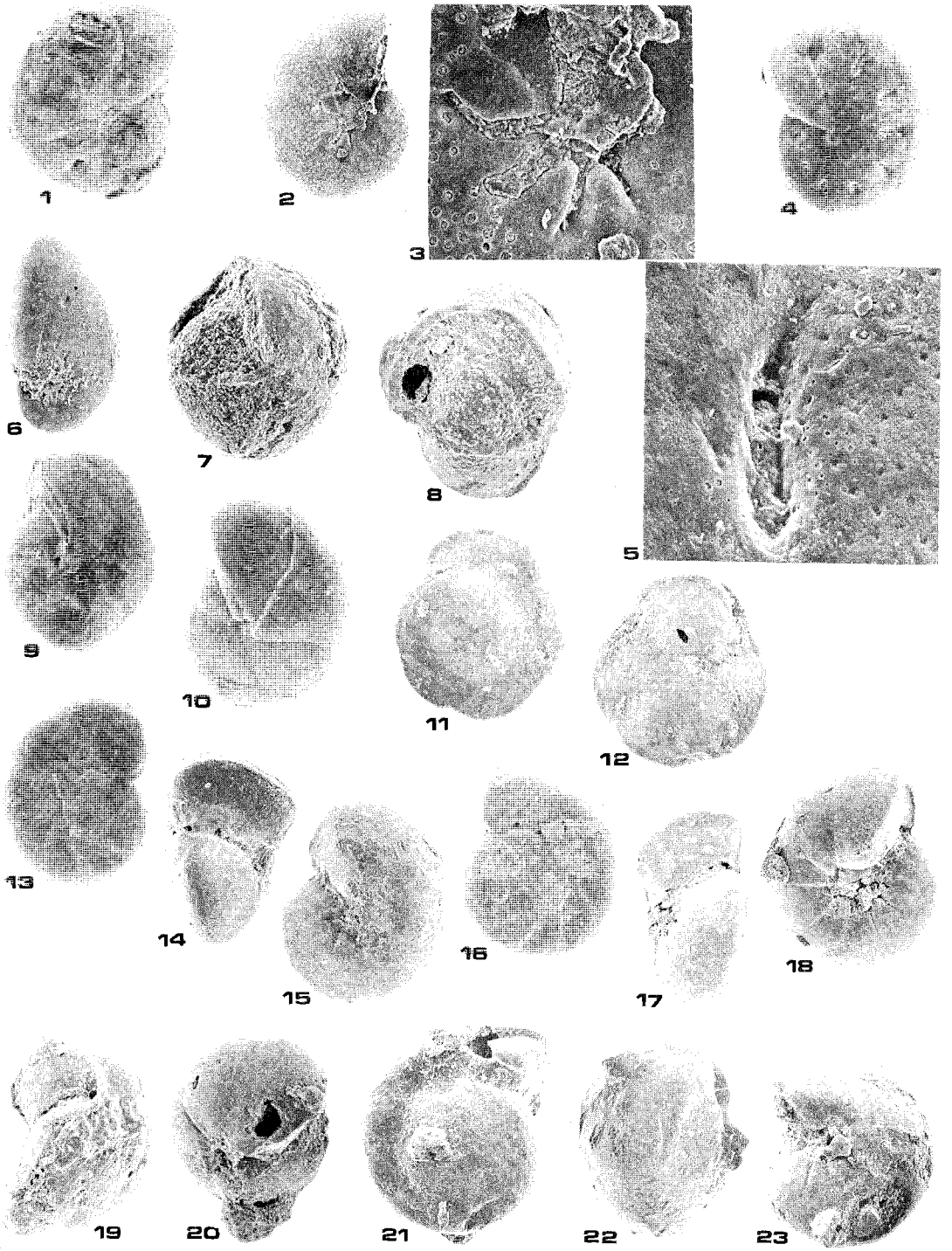

PLATE 5

PLATE 6

FIGS 1-3 *Gyroidina zelandica* Finlay, Marrawah; UTGD 84534, x95; (0.3 mm); from UTGD 84104.

FIGS 4, 5 *Anomalina* (?) cf. *humilis* (Brady), Cape Grim; UTGD 84249, x90; (0.35 mm); from UTGD 84008.

FIGS 6-8 *Anomalina* sp.1, Marrawah; UTGD 84358, x85; (0.35 mm); from UTGD 84113.

FIGS 9, 10 *Anomalinoides macraglabrus* (Finlay), Fossil Bluff; UTGD 84250, x95; (0.3 mm); from UTGD 84010b.

FIGS 11-13 *Anomalinoides nonionoides* (Parr), Cape Grim; UTGD 84251, x70; (0.4 mm); from UTGD 84006.

FIGS 14, 15 *A.* cf. *planulatus* Carter, Redpa; UTGD 84252, x55; (0.5 mm); from UTGD 84095.

FIGS 16, 17 *Anomalinoides subnonionoides* (Finlay), Cape Barren Island; UTGD 84551, x33; (0.9 mm); from UTGD 84554.

FIGS 18, 19 *Anomalinoides* cf. *spherícus* (Finlay), King Island; UTGD 84253, x100; (0.3 mm); from UTGD 84085.

FIGS 20, 21 *Hanzawaia procolligera* (Carter), Fossil Bluff; UTGD 84366, x90; (0.35 mm); from UTGD 84011.

FIGS 22, 23 *Karreria maoria* (Finlay), Marrawah; UTGD 84370, x70, x65 respectively; (0.45 mm); from UTGD 84104.

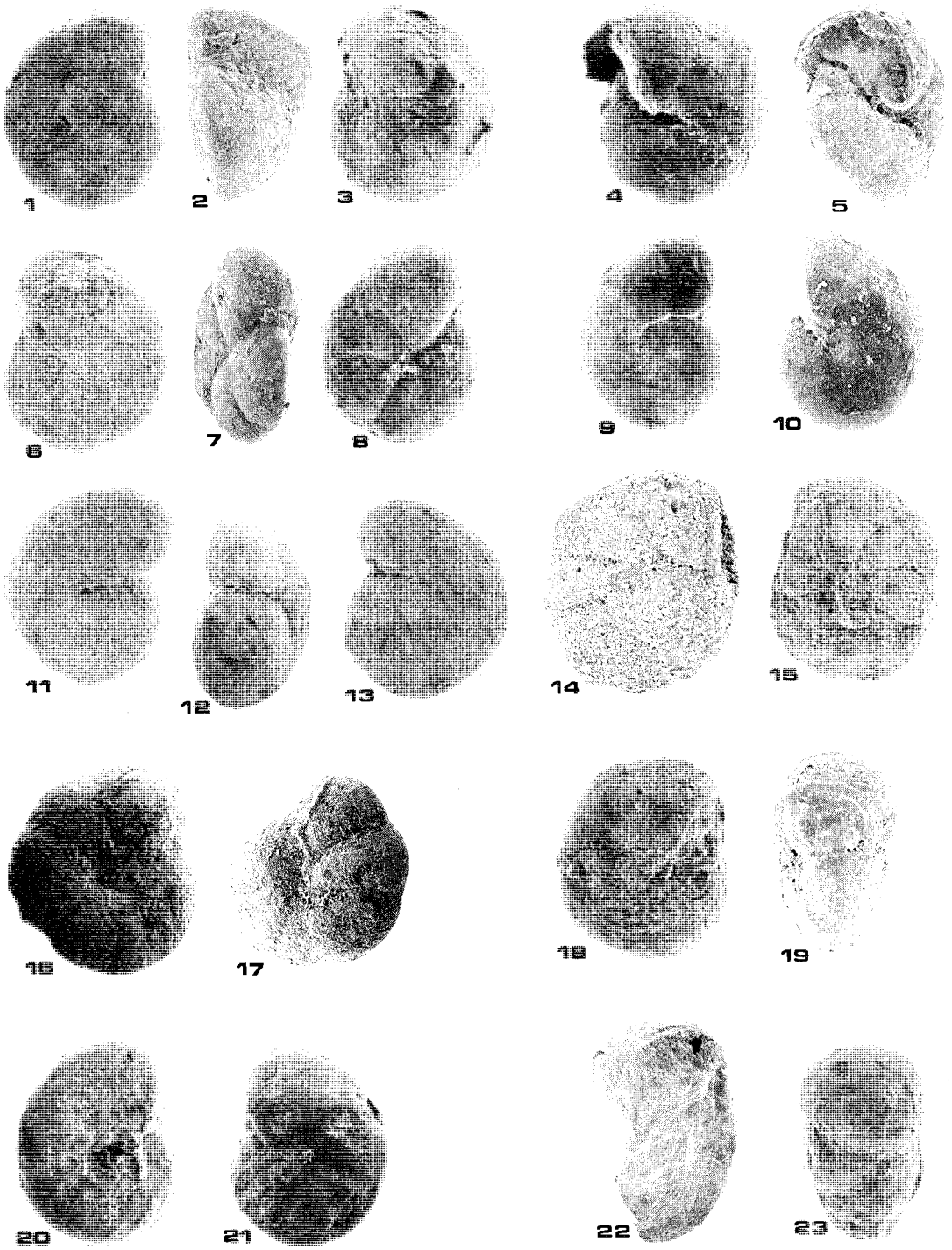

PLATE 6

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