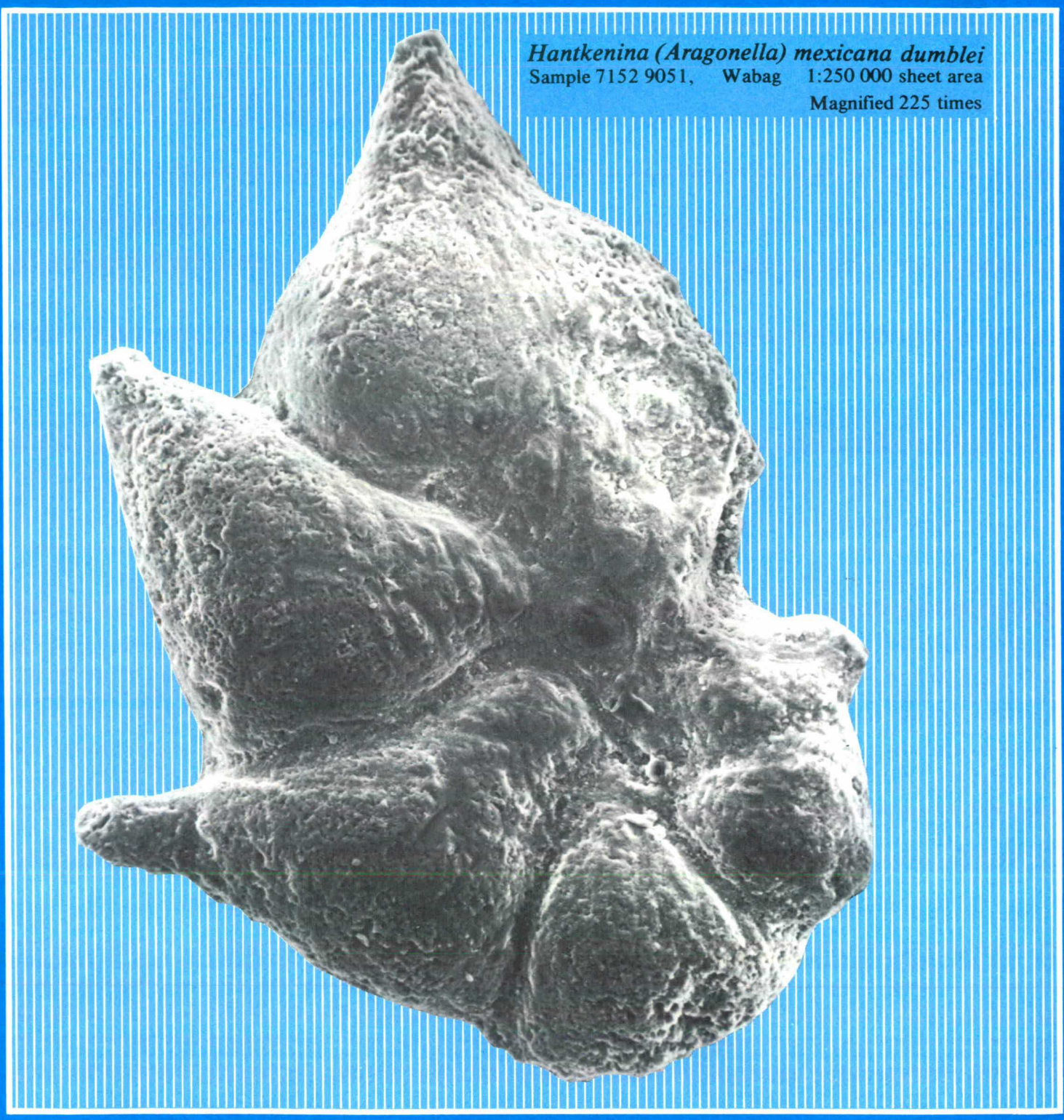
Tertiary foraminifera and age of sediments, Ok Tedi–Wabag, Papua New Guinea

D.J. Belford

BMR Bulletin
216



Hantkenina (Aragonella) mexicana dumblei
Sample 7152 9051, Wabag 1:250 000 sheet area
Magnified 225 times

DEPARTMENT OF RESOURCES & ENERGY
BUREAU OF MINERAL RESOURCES, GEOLOGY
AND GEOPHYSICS

BULLETIN 216

Tertiary foraminifera and age of sediments, Ok Tedi-Wabag, Papua New Guinea

D. J. BELFORD

AUSTRALIAN GOVERNMENT PUBLISHING SERVICE
CANBERRA 1984

DEPARTMENT OF RESOURCES & ENERGY

MINISTER: SENATOR THE HON. PETER WALSH

SECRETARY: A. J. WOODS

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

DIRECTOR: R. W. R. RUTLAND

Published for the Bureau of Mineral Resources, Geology and Geophysics
by the Australian Government Publishing Service

ISSN 0084-7089
ISBN 0 644 02887 4

Manuscript completed: 1 November 1981

Issue date: May 1984

This Bulletin was edited by J. S. Adkins

Printed by Graphic Services Pty Ltd, Northfield, S.A.

CONTENTS

Page

FIGURES

APPENDIXES

(On microfiche in pocket at back of Bulletin)

ABSTRACT

Tertiary foraminifera ranging in age from Early Paleocene to Pliocene from the area covered by the Ok Tedi and Wabag 1:250 000 Sheets, Papua New Guinea, are recorded and illustrated. An annotated check list of planktonic foraminifera is given. The faunal sequence in all available sampled sections is discussed and applied to determining ages of the sediments. In some sections, associations of larger and planktonic foraminifera suggest that the presently accepted correlation of the Te/Tf boundary of the 'letter' classification with the N.8/N.9 boundary of the planktonic foraminiferal zonal scheme requires revision. The Te/Tf boundary should be lowered in relation to the planktonic scale, possibly to within the N.6-N.7 zonal interval.

Six new taxa are described: *Globorotalia (Clavatorella) prolata, G. (Fohsella) peripheroacuta pristina, G. (F.) wabagensis, G. (G.) quasimiocenica, G. (Hirsutella) scitula planaria,* and *G. (Turborotalia) variospira.*

INTRODUCTION

The area discussed here is that covered by OK TEDI* (formerly BLUCHER RANGE) and WABAG. Samples examined were collected by the West Sepik survey party from the Bureau of Mineral Resources (BMR) in 1971–72 (sample prefix 7152), by other field parties from BMR (prefixes Ab, F, 6869, and 04NG), by the Geological Survey of Papua New Guinea (GSPNG) (prefixes P and 7629), and by M. Bik, CSIRO (prefix B). Three unnumbered samples collected by the Australasian Petroleum Company and BP Petroleum Development Australia Pty Ltd are included from OK TEDI, and one collected by Dr P. Williams, formerly of the Australian National University, from WABAG.

Age determinations resulting from examination of the foraminifera by the writer, Terpstra (1968), Binnekamp (1970), and Chaproniere (1980b) were used in compilation of geological maps and reports (Norvick, 1973; Dow & others, 1972; Davies & Norvick, 1974; Arnold & others, 1979; Davies, 1980, 1983). These reports incorporate information from unpublished reports by the Australasian Petroleum Company and BP Petroleum Development Australia Pty Ltd and should be consulted for references to earlier work.

The purpose of this Bulletin is to document the foraminiferal fauna, to give an age determination for the samples, and to describe the faunal sequence through all available sampled sections. Only those foraminifera obtained from samples examined by BMR are discussed. Additional palaeontological information is given in unpublished reports of GSPNG and of oil companies. Ages for the samples are given in terms either of the Letter Classification of the Tertiary as used in the Indo-Pacific region, or of the planktonic zonal schemes of Blow (1969; 1979).

The sample locality map of OK TEDI (Fig. 1) is based on the OK TEDI geological map compiled by Davies & Norvick (1974); that for WABAG (Fig. 7) on the WABAG geological map compiled by GSPNG (Davies, 1983).

Unless otherwise indicated, all samples have the prefix 7152. All figured specimens of foraminifera, and some unfigured paratypes of new taxa, are deposited in the Commonwealth Palaeontological Collection, BMR, Canberra, ACT, under numbers CPC 21591 to 22091.

ACKNOWLEDGEMENTS

I am indebted to Dr H. L. Davies, Dr G. C. H. Chaproniere, and Dr C. G. Adams for constructive criticism of the manuscript; Dr Davies also provided information on localities and formation names. Mr P. W. Davis assisted with photography, and Mr P. L. Griffiths drew the text figures.

PLANKTONIC FORAMINIFERA—ANNOTATED CHECK LIST

This list is prepared in alphabetical order. Reference is made only to the original description of each species; this is followed by reference to a plate and figures in this Bulletin.

Genus **Berggrenia** Parker, 1976

Type species: *Globanomalina praepumilio* Parker, 1967; by original designation.

?Berggrenia sp. [Pl. 12, figs. 5–16]

Specimens of a small planispiral form occur in fine-grained limestones at several localities in WABAG. Planktonic foraminifera from samples associated with some of the limestones give an age of zone N.3/zone N.4, Late Oligocene to Early Miocene. In the absence of free specimens of this small planispiral form, positive identification is not possible.

Genus **Chiloguembelina** Loeblich & Tappan, 1956

Type species: *Guembelina midwayensis* Cushman, 1940; by original designation.

Chiloguembelina midwayensis midwayensis (Cushman, 1940): *Guembelina midwayensis* Cushman, 1940, p. 65, pl. 11, fig. 15. [Pl. 13, figs 1–5]

Recorded rarely from samples 8084 and F.342 (localities 112 and 97 respectively, WABAG), and previously recorded (Belford, 1967) as *C. crinita*. Specimens referred to *C. midwayensis midwayensis* have a pustulose surface and vary in the rate of increase in the width of the test.

Genus **Dentoglobigerina** Blow, 1979

Type species: *Globigerina galavisi* Bermudez, 1961; by original designation.

Dentoglobigerina altispira altispira (Cushman & Jarvis, 1936); *Globigerina altispira* Cushman & Jarvis, 1936, p. 5, pl. 1, figs. 13a-c, 14. [Pl. 32, figs. 1–5]

Common in samples from the Kindan section (locality 100, WABAG), and also recorded from the Burgers Mountain section, the Maramuni River section, and sections west-southwest and southwest of Laiagam (localities 16, 17, 103, and 108, WABAG), and isolated samples (see Figures 6 and 16).

Dentoglobigerina baroemoenensis (LeRoy, 1939): *Globigerina baroemoenensis* LeRoy, 1939, p. 263, pl. 6, figs. 1–2. [Pl. 32, figs. 6–11]

Blow (1969, pl. 28, fig. 4) are referable to the *boquadrina baroemoenensis*, one said to be phylogenetically advanced and the other phylogenetically primitive. The advanced form seems to be similar to the holotype, but Blow (1969) considered his primitive form (Pl. 28, fig. 8) to compare well with LeRoy's figures; Blow's concept of *G. baroemoenensis* was that of the primitive form.

Stainforth & others (1975) considered that the holotype of *baroemoenensis* and the specimen figured by Blow (1969, pl. 28, fig. 4) are referable to the *Globoquadrina dehiscens* group. These specimens have a quadrate outline, wide umbilicus, and sharply angled apertural face.

The Papua New Guinea (PNG) specimens are similar to Blow's (1969) phylogenetically primitive form. These specimens have globose chambers, elongate

* Names of 1:250 000 Sheet areas are printed in capital letters.

on the dorsal side, and lack a distinctly angled apertural face; they can be distinguished from the *G. dehiscens* group on these features.

Specimens here referred to *Dentoglobigerina baroemoenensis* have been recorded from samples 0199 and 1810 (localities 186 and 185, OK TEDI), and comparable specimens are recorded from other localities (see Figure 6).

Dentoglobigerina langhiana (Cita & Gelati, 1960): *Globoquadrina langhiana* Cita & Gelati, 1960, p. 242, pl. 29, figs. 1–20; text-figs. 1a-c. [Pl. 32, figs. 18–23]

Stainforth & others (1975) placed *langhiana* in the *Globoquadrina dehiscens* group, referring to lack of agreement in the treatment of the genus in published papers. The specific name *langhiana* is here given to specimens very similar to the holotype, with an oval, slightly lobate outline, wide umbilicus, and with a depressed last chamber in side view, the ventral margin extending over the umbilicus. *D. langhiana* is similar to *D. baroemoenensis*, but the chambers of *langhiana* are dorsally less compressed. Blow (1969) noted that *langhiana* may be fully synonymous with, or only subspecifically distinct from, *baroemoenensis*.

D. langhiana has been recorded from a section west-southwest of Laiagam (locality 103, WABAG) and also from sample 0199 (locality 186, OK TEDI).

Dentoglobigerina sellii (Borsetti, 1959): *Globoquadrina sellii* Borsetti, 1959, p. 209, pl. 1, figs. 3a-d. [Pl. 28, figs. 14–16]

Recorded frequently from sample F.281 in a section south of Crater Lake (locality 147, WABAG) and also from several isolated samples (see Figure 16).

Dentoglobigerina tripartita tripartita (Koch, 1926): *Globigerina bulloides* d'Orbigny, var. *tripartita* Koch, p. 737, figs. 21a-b. [Pl. 28, figs. 17–21]

Recorded from two samples in the Laiagam section (locality 118, WABAG), sample F.279 in a section south of Crater Lake (locality 147, WABAG), and also from several isolated samples (see Figure 16).

Dentoglobigerina venezuelana (Hedberg, 1937): *Globigerina venezuelana* Hedberg, 1937, p. 681, pl. 92, figs. 7a-b. [Pl. 29, figs. 1–3]

Recorded from the Kindan section (locality 100) and the Maramuni River section (locality 17), both in WABAG, and from isolated samples in both WABAG and OK TEDI (see Figures 6 and 16).

Genus **Globigerina** d'Orbigny, 1826

Type species: *Globigerina bulloides* d'Orbigny, 1826; subsequent designation by Parker, Jones & Brady, 1865.

Globigerina bulloides bulloides d'Orbigny, 1826, p. 277. [Pl. 27, figs. 1–5]

Recorded from the upper part of the Kindan section (locality 100, WABAG), samples from the Burgers Mountain section (locality 16, WABAG), and from several isolated samples (see Figures 6 and 16).

Globigerina decoraperta Takayanagi & Saito, 1962: *Globigerina druryi* Akers *decoraperta* Takayanagi & Saito, 1962, p. 85, pl. 28, figs. 10a–c. [Pl. 27, figs. 6–11]

Recorded rarely from the higher beds of the Kindan section (locality 100, WABAG), and some isolated samples (see Figure 6).

Globigerina euapertura Jenkins, 1960, p. 351, pl. 1, figs. 8a-c. [Pl. 27, figs. 12–14]

Rare specimens referred to *G. euapertura* occur in sample F.280 from a section south of Crater Lake (locality 147, WABAG) and in sample F.433 at the base of the Kindan section (locality 100, WABAG). I agree with Berggren & Amdurer (1973) and Chaproniere (1981a) in placing *G. prasaepis* Blow, 1969 in the synonymy of *G. euapertura*. The holotype of *G. euapertura* does not have the small triangular lip reported by Blow (1969) in other specimens examined by him. The PNG specimens are not well preserved, but show some indication of a coarsely perforate wall with pits and strongly developed ridges.

Globigerina falconensis Blow, 1959, pl. 9, figs. 40a–c, 41. [Pl. 27, figs. 15–25]

The holotype of *falconensis* has a distinct lip, which is not shown by all unfigured paratypes in the National Museum of Natural History, Washington, D.C. Some unfigured paratypes have the last chamber partly covering the umbilicus; the PNG specimens shown in Plate 27, figs. 15 and 18 are identical to these, except that none of the present specimens has a thickened rim on the last chamber.

One PNG specimen has an elongate last chamber with a well-developed thickened lip, and probably is to be included in *G. falconensis*. It resembles *G. nepenthes delicatula* Brönnimann & Resig, 1971, but this subspecies has a higher spire, a more highly arched aperture, and is more coarsely pustulose. *G. falconensis* occurs only in sample 8049 (locality 109, WABAG).

Globigerina foliata Bolli, 1957, p. 111, pl. 24, figs. 1a–c. [Pl. 27, figs. 26–29]

Rare specimens of *G. foliata* occur in sample F.434 at the base of the Kindan section, (locality 100, WABAG). The specimens have well separated and inflated chambers; in some specimens the last chamber becomes as radially elongate as wide. The aperture is small, and is usually overhung by the inflated last chamber.

The PNG specimens are larger than the holotype, and some specimens have slightly more separated chambers. The chambers of the present specimens are also more digitate than those figured by Blow (1959). These differences are only slight, and in my opinion the PNG specimens are to be referred to *G. foliata*.

Globigerina ouachitaensis ciperoensis Bolli, 1954: *Globigerina ciperoensis* Bolli, 1954, pl. 1, text-figs. 3–6. [Pl. 27, figs. 30–34]

Recorded from samples F.279 and F.280 at the base of a section south of Crater Lake (locality 147, WABAG), sample F.937 from the Laiagam section (locality 118, WABAG), and sample 2671 (locality 168, WABAG).

Globigerina praebulloides occlusa Blow & Banner, 1962, p. 93, pl. 9, figs. U–W, text-fig. 14, I–II. [Pl. 28, figs. 1–2]

Rare specimens assigned to *G. praebulloides occlusa* occur in samples at the base of the Kindan section (locality 100, WABAG). The specimens are small and tightly coiled, with a shallow umbilicus and a small aperture lacking a lip. They are similar in coiling to *G. praebulloides leroyi*, but lack the apertural lip of this subspecies.

Globigerina praebulloides praebulloides Blow, 1959; *Globigerina praebulloides* Blow, 1959, p. 180, pl. 8, figs. 47a–c; pl. 9, fig. 48. [Pl. 28, figs. 3–7]

Blow (1959, p. 180) noted that specimens of *G. praebulloides praebulloides* are smaller in size than specimens of *G. bulloides*, but later (Blow, 1969, p. 316) stated that the difference between these two taxa is not based on a size relationship but on coiling and chamber arrangement, and the nature of the umbilicus. Specimens here referred to *G. praebulloides praebulloides* have chambers increasing more rapidly in size than those of *G. bulloides*, and also radially more elongate in relation to chamber width. The wall of specimens referred to *G. bulloides* is also more coarsely perforate than those referred to *praebulloides praebulloides*. The PNG specimens of *praebulloides praebulloides* are larger than the type specimens. They are closer to the figured and unfigured paratypes than to the holotype, which has a relatively smaller last chamber.

G. praebulloides praebulloides has been recorded only from samples at the base of the Kindan section (locality 100, WABAG) and from sample 8042 (locality 106, WABAG).

Globigerina praebulloides pseudociperoensis Blow, 1969, p. 381, pl. 17, figs. 8–9. [Pl. 28, figs. 8–13]

Abundant specimens of *G. praebulloides pseudociperoensis* occur in two samples at the base of the Kindan section (locality 100, WABAG). The specimens have five chambers in the last whorl, but only four in the penultimate whorl; the chambers increase quickly in size, and the spire opens rapidly. The PNG specimens are slightly larger than the holotype, which also has a more convex dorsal surface, but in my opinion they are referable to *G. praebulloides pseudociperoensis*.

Globigerina woodi Jenkins, 1960, p. 352, pl. 2, figs. 2a–c. [Pl. 29, figs. 4–9]

Occurs commonly in sample F.280 from a section south of Crater Lake, (locality 147, WABAG) and in sample F.457 in a section south of Laiagam (locality 136, WABAG). The specimens are very small, but have the quadrate test, radial depressed sutures, and arched aperture of the holotype.

Genus **Globigerinatheka** Brönnimann, 1952

Type species: *Globigerinatheka barri* Brönnimann, 1952; by original designation.

Bolli (1972) gave a detailed review of the genus *Globigerinatheka*, in which he included *Globigerapsis* Bolli, Loeblich & Tappan, 1957, following Proto Decima & Bolli (1970). Blow (1979) recognised these as distinct genera, on the basis of differences in wall structure, and the presence of bullae in *Globigerinatheka*. Blow (1979) also recognised the genus *Porticulasphaera* Bolli, Loeblich & Tappan, 1957, but Proto Decima & Bolli (1970) and Bolli (1972) placed in *Globigerinatheka* species which in Blow's approach are referable to *Porticulasphaera*. Bolli (1972) noted intermediate forms between the species *mexicana* Cushman (placed by Blow in *Porticulasphaera*) and *kugleri* Bolli, Loeblich & Tappan (placed by Blow in *Globigerapsis*).

The PNG specimens are not sufficiently well preserved for detailed examination of the wall structure. The approach adopted by Proto Decima & Bolli (1970) and Bolli (1972) is followed here, and species are referred to the genus *Globigerinatheka*.

Globigerinatheka mexicana barri Brönnimann, 1952: *Globigerinatheka barri* Brönnimann, 1952, p. 27, figs 3a–c, g, h. [Pl. 29, fig. 10]

Saito (1962) referred Brönnimann's figures 3d–f to *G. mexicana mexicana* and was followed in this by Bolli (1972). *G. mexicana barri* is the name given to specimens with the basic *kugleri* morphology, but also possessing bullae; specimens referred to *barri* have been found very rarely only in sample 9051 (locality 69, WABAG).

Globigerantheka mexicana kugleri (Bolli, Loeblich & Tappan, 1957): *Globigerapsis kugleri* Bolli, Loeblich & Tappan, 1957, p. 34, pl. 6, figs. 6a–c. [Pl. 29, figs. 11–16]

Specimens of *G. mexicana kugleri* have been found only in sample 9051 (locality 69, WABAG), and form the bulk of the specimens of this genus occurring in the sample. The specimens are more loosely coiled, and have more globular chambers, than does the holotype of *G. mexicana mexicana*, or other specimens referred to this subspecies by Saito (1962) and Bolli (1972).

Genus **Globigerinita** Brönnimann, 1951

Type species: *Globigerinita naparimaensis* Brönnimann, 1951; by original designation.

Globigerinita dissimilis (Cushman & Bermudez, 1937): *Globigerina dissimilis* Cushman & Bermudez, 1937, p. 25, pl. 3, figs. 4–6. [Pl. 29, fig. 17]

Found in the Laiagam section (locality 118, WABAG), in a section south of Crater Lake (locality 147, WABAG), and also in some isolated samples (see Figure 16); no distinction has been made between the subspecies *dissimilis* and *ciperoensis*.

Globigerinita incrusta Akers, 1955, p. 655, pl. 65, figs. 2a–d. [Pl. 29, figs. 18–22]

Rare specimens of this small species have been found in the upper beds of the Kindan section (locality 100, WABAG).

Globigerinita unicava unicava (Bolli, Loeblich & Tappan, 1957): *Catapsydrax unicavus* Bolli, Loeblich & Tappan, 1957, p. 37, pl. 7, figs. 9a–c. [Pl. 29, figs. 23–25]

Found in sample F.936 (locality 118, WABAG) in the Laiagam section.

Genus **Globigerinoides** Cushman, 1927

Type species: *Globigerina rubra* d'Orbigny *in* de la Sagra, 1839; by original designation.

Globigerinoides bollii Blow, 1959, p. 189, pl. 10, figs. 65a–c. [Pl. 30, figs. 1–5]

Recorded rarely from the higher beds of the Kindan section (locality 100, WABAG).

Globigerinoides obliquus extremus Bolli & Bermudez, 1965, p. 139, pl. 1, figs. 10–12. [Pl. 30, fig. 6]

Recorded rarely to frequently from the higher beds of the Kindan section (locality 100, WABAG), and in sample 1693 (locality 233, OK TEDI).

Globigerinoides obliquus obliquus Bolli, 1957: *Globigerinoides obliqua* Bolli, 1957, p. 113, pl. 25, figs. 9a–c; text-fig. 21(5). [Pl. 30, figs. 7–9]

Recorded rarely to abundantly from the higher beds of the Kindan section (locality 100, WABAG), and in sample 1846 (locality 192, OK TEDI).

Globigerinoides quadrilobatus (d'Orbigny) group

The *G. quadrilobatus* (d'Orbigny) group occurs commonly in all the samples examined. No stratigraphical significance can be given to the distribution or relative frequency of the several subspecies recognised. Specimens in many samples are too poorly preserved for definite subspecific identification; these occurrences are shown on distribution charts as '*Globigerinoides quadrilobatus* group'.

Globigerinoides quadrilobatus altiapertura Bolli, 1957: *Globigerinoides triloba altiapertura* Bolli, 1957, p. 113, text-fig. 21, 3a–b; pl. 25, figs. 7a–c, 8. [Pl. 30, figs. 10–16]

Rare specimens in sample F.436 at the base of the Kindan section (locality 100, WABAG) and in some isolated samples (see Figure 16), are referred to *altiapertura*. These specimens have a highly arched, circular primary aperture, and a large supplementary dorsal aperture. Blow (1969) gave the range of *altiapertura* as N.5 to base of N.7, but referred to specimens identified as cf. *altiapertura* occurring in the N.10 to N.12 interval. These specimens are differentiated from *altiapertura s.s.* by their looser coiling and more clearly separated chambers; the present specimens may be of this kind.

Small specimens of *G. quadrilobatus quadrilobatus* with a relatively large supplementary aperture resemble *altiapertura* very closely but may be distinguished by the oval rather than circular primary aperture.

Globigerinoides quadrilobatus immaturus, LeRoy, 1939: *Globigerinoides sacculiferus* (Brady) var. *immatura* LeRoy, 1939, p. 263, pl. 3, figs. 19–21. [Pl. 30, figs. 17–18]

Specimens referred to *immaturus* lack the elongate sac-like final chamber of *sacculifer*: they have a low elongate primary aperture and often a relatively smaller last chamber as compared to specimens of *G. quadrilobatus quadrilobatus*. This taxon has been recorded throughout the Kindan section, and is a common element in samples examined.

Globigerinoides quadrilobatus irregularus LeRoy, 1944: *Globigerinoides sacculiferus* (Brady) var. *irregularus* LeRoy, 1944, p. 40, pl. 3, figs. 42–43. [Pl. 30, fig. 19]

This subspecies, together with *G. quadrilobatus immaturus*, comprises the bulk of the *G. quadrilobatus* group in the samples examined. Specimens of *irregularus* have a smaller and often 'sac-like' last chamber, compared to other subspecies. Some specimens of *irregularus* are similar to 'primitive' forms of *G. quadrilobatus sacculifer*, but have a lower, more elongate aperture, and the last chamber is not compressed.

Globigerinoides quadrilobatus primordius Blow & Banner, 1962, p. 115, pl. 9, Dd–Ff; fig. 14: 3–8. [Pl. 30, figs. 20–23]

This subspecies has been recorded from the Laiagam section (locality 118, WABAG), from a section south of Crater Lake (locality 14, WABAG), and from isolated samples (see Figure 16). The only morphological feature used to distinguish the taxon is the single supplementary dorsal aperture.

Globigerinoides quadrilobatus quadrilobatus (d'Orbigny, 1846): *Globigerina quadrilobata* d'Orbigny, 1846, p. 164, pl. 9, figs. 7–10. [Pl. 30, figs. 24–25]

Several samples contain small specimens with large primary and supplementary apertures superficially resembling *G. quadrilobatus altiapertura*. The primary aperture of these specimens is an elongate oval opening, not circular as in *altiapertura*; they are here interpreted as small specimens of *G. quadrilobatus quadrilobatus*.

G. quadrilobatus quadrilobatus occurs commonly in many of the samples examined.

Globigerinoides quadrilobatus sacculifer (Brady, 1877): *Globigerina sacculifera* Brady, 1877, p. 535 (illustrated Brady, 1884, pl. 80, figs. 11–17). [Pl. 30, figs. 26–29]

Specimens of *sacculifer*, which is rare in the present material, are of the lectotype form, with small sac-like final chamber, and low temperatures, and not the ideotypic form figured by Brady (1884). One specimen found (Pl. 30, figs. 26–27) has a strongly compressed final chamber, but in most other specimens observed the final chamber is not compressed, and these resemble the 'primitive' forms figured by Jenkins & Orr (1972).

G. quadrilobatus sacculifer has been recorded from several localities.

Globigerinoides quadrilobatus triloba (Reuss, 1850): *Globigerina triloba* Reuss, 1850, p. 374, pl. 47, figs. 11a–e. [Pl. 31, fig. 1]

G. quadrilobatus triloba is a rare component of populations of the *G. quadrilobatus* group in numerous samples. It is characterised by the final chamber being larger than the combined earlier chambers.

Globigerinoides sp. 1, ex gr. *G. quadrilobatus* (d'Orbigny, 1846). [Pl. 31, figs. 2–9]

Included here are high-spired forms recorded from several samples in the Kindan section (locality 100, WABAG), from a section west-southwest of Laiagam (locality 103, WABAG), from sample 1789 (locality 217, OK TEDI), and also figured (Belford, 1974) from the Ilaga Valley, Nassau Range, Irian Jaya. Rare specimens have a reduced bulla-like final chamber. These specimens occur only as variants within the *G. quadrilobatus* group, probably of *G. quadrilobatus quadrilobatus*, and are not considered to warrant recognition as a separate taxon. The observed stratigraphic range of these forms is from zone N.3 (Irian Jaya) to at least zone N.17 (Kindan section).

Globigerinoides sp. 2, ex gr. *G. quadrilobatus* (d'Orbigny, 1846). [Pl. 31, figs. 10–15]

Sixteen specimens of this taxon have been found in sample F.875A, from a section west-southwest of Laiagam (locality 103, WABAG), and it occurs very rarely in sample 3344, (locality 145, OK TEDI). It is certainly close to the *G. quadrilobatus* group; characters distinguishing it from described subspecies of this group are the large primary aperture directed to one side of the test, and the coarsely pustulose rather than reticulate test surface. These differences may reflect unknown environmental influences rather than genetic control. In view of the limited number of specimens available, and the restricted occurrences, no faunal description is given at this time.

Globigerinoides subquadratus subquadratus Brönnimann, 1954, p. 680, pl. 1, figs. 5, 8a–c. [Pl. 31, figs. 17–21]

Cordey (1967) discussed the distinction between *G. subquadratus* and *G. ruber* (d'Orbigny, 1839), and gave as the main criterion the difference in numbers of chambers in the penultimate whorl. *G. subquadratus* was stated to have four chambers, and *G. ruber* three. This criterion cannot be applied consistently to the present specimens; most specimens examined have only three chambers in the penultimate whorl (Pl. 31, fig. 19). Postuma (1971) figured a specimen with three chambers in the penultimate whorl as *G. subquadratus*.

Blow (1969) mentioned differences in wall texture and structure, and in chamber shape and arrangement, between the two taxa. These features have not been examined closely in the present study, but a comparison of the present specimens with specimens of very similar gross morphology from Pliocene and Recent material suggests that a distinction on this basis may be possible.

G. subquadratus subquadratus has been recorded from the Kindan section (locality 100, WABAG), sections southwest and west-southwest of Laiagam (localities 103 and 108, WABAG), and from isolated samples (see Figures 6 and 16).

Genus **Globoquadrina** Finlay, 1947

Type species: *Globorotalia dehiscens* Chapman, Parr & Collins, 1934; by original designation.

Globoquadrina dehiscens dehiscens (Chapman, Parr & Collins, 1934): *Globorotalia dehiscens* Chapman, Parr & Collins, 1934, p. 569, pl. 11, figs. 36a–c. [Pl. 32, figs. 12–17]

Stainforth & others (1975) included several species in the '*Globoquadrina dehiscens* group', with *dehiscens* being given priority by date of publication. Some species placed by Stainforth & others (1975) in the synonymy of *dehiscens* are here recognised as distinct species; additional comments are given under the species concerned.

Specimens here referred to *G. dehiscens dehiscens* are characterised by a quadrate outline, flattened dorsal surface, and elongate chambers, particularly on the dorsal side.

G. dehiscens dehiscens has been recorded from the lower beds of the Kindan section, a section south of Crater Lake, and a section southwest of Laiagam (localities 100, 147, and 108 respectively, WABAG), and also from isolated samples (see Figures 6 and 16).

Genus **Globorotalia** Cushman, 1927

Type species: *Pulvinulina menardii* (d'Orbigny) var. *tumida* Brady, 1877; by original designation.

Blow (1979) emended the family Globorotaliidae, and within the genus *Globorotalia* recognised six subgenera. In particular, the taxon *Planorotalites* was placed in the synonymy of *Globorotalia (Globorotalia)* on the grounds that no morphological basis for distinguishing these taxa exists. Blow further noted that, although it might be thought that a phyletic basis existed for separate supraspecific distinction of Paleogene carinate globorotaliids, such a separation cannot be maintained, as Neogene/Anthropogene taxa included in *Globorotalia (Globorotalia)* are also polyphyletically produced. The inclusion of *Planorotalites* in *Globorotalia (Globorotalia)* is followed here.

Subgenus **Acarinina** Subbotina, 1953

Type species: *Acarinina acarinata* Subbotina, 1953, p. 219; by original designation.

Globorotalia (Acarinina) broedermanni broedermanni Cushman & Bermudez, 1949: *Globorotalia (Truncorotalia) broedermanni* Cushman & Bermudez, 1949, p. 40, pl. 7, figs. 22–24. [Pl. 13, figs. 6–8]

Rare specimens of this species have been found in sample 9051 (locality 69, WABAG). The specimens have seven chambers visible ventrally, with a distinct open umbilicus. The test has a low strong pustulose ornament, thickened on the umbilical shoulders. The ventral sutures are straight and radial, and the dorsal sutures slightly curved and reflexed. The aperture is low, elongate, and umbilical-extraumbilical. In terms of the discussion given by Blow (1979), the PNG specimens more closely resemble the *broedermanni* (s.s.) morphotype than the *lodoensis* morphotype.

Globorotalia (Acarinina) bullbrooki Bolli, 1957; *Globorotalia bullbrooki* Bolli, 1957, p. 167, pl. 38, figs. 4a–c, 5a–c. [Pl. 13, figs. 9–14]

The taxonomic confusion surrounding *G. (A.) bullbrooki* and other morphotypes of similar gross appearance has been referred to by Fleisher (1974), Stainforth & others (1975), and Blow (1979). Fleisher (1974) regarded *bullbrooki* and *G. (A.) densa* (Cushman, 1925) as distinct species, but Pessagno (1960), after comparing the holotypes, regarded them as identical. Berggren (1965, 1968) also regarded *G. (A.) densa* as synonymous with several species, including *G. (A.) bullbrooki* and *G. (A.) spinuloinflata* (Bandy, 1949). Blow (1979) reported that the holotype of *densa* is missing from the collection of the National Museum of Natural History, Washington, DC, if not completely lost, and considered it best that the name not be used. However, Cifelli (1972) illustrated the holotype, which was described and figured as having a weak beaded keel and as being truncate in edge view. It seems to be referable to the subgenus *Morozovella*, with a distinct muricocarina developed; Stainforth & others (1975) noted that *densa* differs from *bullbrooki* in having a well-developed keel.

The PNG specimens resemble the specimens figured by Blow (1979, pl. 171, figs. 1–3, 7–9) as *Globorotalia (Acarinina) bullbrooki*, with slight dorsal flattening, rather than the more rounded specimens shown by him on plate 155, figures 1–8.

G. (A.) bullbrooki occurs in sample 9051 (locality 69, WABAG); rare specimens compared to *bullbrooki* occur in sample 9044 (locality 61, WABAG).

Globorotalia (Acarinina) convexa convexa Subbotina, 1953: *Globorotalia convexa* Subbotina, 1953, p. 209, pl. 17, figs. 2a–c, 3a–c. [Pl. 13, figs. 15–21]

Stainforth & others (1975) placed *convexa* in synonymy with *G. (A.) broedermanni*. The type specimens of these two taxa are similar, particularly in edge view. However, *convexa* has a small, almost closed umbilicus as against the open umbilicus of *broedermanni*; *convex*a also has tangentially elongate dorsal chambers rather than the radially broad chambers of *broedermanni*. Blow (1979) regarded the two morphotypes as stages in an evolutionary series, and the distinction between them is maintained here.

G. (A.) convexa convexa occurs commonly in sample 9039 (locality 65, WABAG).

Globorotalia (*Acarinina*) *pentacamerata* Subbotina, 1947: *Globorotalia pentacamerata* Subbotina, 1947, p. 128, pl. 7, figs. 12–17; pl. 9, figs. 24–26. [Pl. 13, figs. 22–26]

The taxonomy and nomenclature of this taxon were discussed by Blow (1979). Blow's opinion that Subbotina's original (1936) proposal of the name was validated in 1947 is followed.

G. (*A.*) *pentacamerata* has been found rarely in samples 9051 and F.184 (localities 69 and 80 respectively, WABAG). The specimens are usually tightly coiled, with a small open umbilicus, but do not have the appressed chambers of the morphotype illustrated by Blow (1979, pl. 135, fig. 5). One specimen is relatively loosely coiled, with a wide umbilicus (Pl. 13, fig. 25); all specimens show the dorsal flattening referred to by Blow (1979).

Globorotalia (*Acarinina*) *praecursoria praecursoria* (Morozova, 1957): *Acarinina praecursoria* Morovova, 1957, p. 111, figs. 1a–c. [Pl. 14, figs. 1–12]

Specimens referred to *A. praecursoria* have been found only in sample 8084 (locality 112, WABAG). Berggren (1965) and Martinez-Gallego (1972) included *G.* (*A.*) *trinidadensis* Bolli, 1957 in the synonymy of *praecursoria*, but both *praecursoria* and *trinidadensis* (= *G.* (*T.*) *inconstans*) are recognised here. Following the criteria given by Blow (1979) the limit between the *inconstans* and *praecursoria* morphotypes is drawn at the point where some of the chambers of the last whorl show dorsal flattening and recurved dorsal sutures. Stainforth & others (1975) separated *G.* (*A.*) *praecursoria* from *G.* (*A.*) *trinidadensis* by its distinctly angulate initial chambers in the last whorl. A specimen of *praecursoria* from the Crimea figured by Stainforth & others (1975) is more angulate than the holotype and is close to the *Globorotalia uncinata* Bolli morphotype; *uncinata* was placed by Blow (1979) in the synonymy of *praecursoria*.

One PNG specimen (Pl. 14, figs. 7–9) has characters intermediate between *praecursoria* and *inconstans*; the chambers of the last whorl are rounded and the dorsal sutures are radial, but a muricate wall is developed. The development of muricae varies greatly in specimens observed. Some specimens here placed in *praecursoria* (see Pl. 14, figs. 1–3) have only weakly muricate walls on early chambers of the last whorl, but show flattening of the dorsal surface and have recurved dorsal sutures.

Occasional PNG specimens develop irregular coiling, in that the later chambers of the last whorl move away from the dorsal side, giving the appearance of a high-spired test.

Globorotalia (*Acarinina*) *pseudodubia piparoensis* (Brönnimann & Bermudez, 1953): *Truncorotaloides rohri* var. *piparoensis* Brönnimann & Bermudez, 1953, p. 819, pl. 87, figs. 4–6 [Pl. 14, figs. 13–18]

Specimens of the kind illustrated are referred to *G.* (*A.*) *pseudodubia piparoensis*; they occur rarely in samples 9044 and 9501 (localities 61 and 69 respectively, WABAG). The specimens have 4½–5 chambers in the last whorl with a rounded, rather than distinctly angulate, axial peripheral margin; this feature distinguishes these forms from the *Globorotalia* (*Truncorotaloides*) *rohri* group. The PNG specimens do not show the development of the muricae illustrated by Blow (1979), and supplementary dorsal apertures have not been observed.

Specimens referable to the *G.* (*A.*) *pseudodubia* group have been observed in several samples of fine-grained limestone (see Pl. 1, figs. 17, 19–22, 25–26).

Globorotalia (*Acarinina*) *wartsteinensis* Gohrbandt, 1967: *Globorotalia wartsteinensis* Gohrbandt, 1967, p. 322, pl. 1, figs. 18–24. [Pl. 14, figs. 19–26]

Rare specimens from sample 9051 (locality 69, WABAG) agree well with the description and illustrations given by Gohrbandt (1967). The dorsal surface ranges from moderately to strongly biconvex, the axial periphery is usually broadly rounded, the dorsal sutures are reflexed, and the ventral sutures radial. Blow (1979) regarded *wartsteinensis* as belonging to the plexus of forms within the *lodoensis-broedermanni* morphotype series, and considered that it would best be referred to as a subspecies of one of these taxa, depending on an examination of a topotype assemblage.

Globorotalia (*Acarinina*) *whitei* Weiss, 1955: *Globorotalia whitei* Weiss, 1955, p. 18, pl. 6, figs. 1–3. [Pl. 15, figs. 1–4]

Recorded rarely from sample F.184 (locality 80, WABAG) only. The specimens are poorly preserved, with apertural details and nature of the sutures obscured. However, the flat dorsal surface and the papillate test wall are evident. The oval periphery is broadly rounded, with no indication of an imperforate marginal keel developed.

Blow (1979) regarded *G.* (*A.*) *whitei* as a form intermediate between *G.* (*A.*) *acarinata intermedia* (Subbotina, 1953) and *G.* (*A.*) *pseudotopilensis* (Subbotina, 1953), not worthy of separate taxonomic recognition.

Subgenus **Clavatorella** Blow, 1965

Type species: *Hastigerinella bermudezi* Bolli, 1957; by original designation.

Originally described at the generic level, *Clavatorella* was regarded by Blow (1969) as a subgenus of *Globorotalia*.

Globorotalia (*Clavatorella*) *prolata* sp. nov. [Pl. 33, figs. 1–9]

See p. 15 for a full description of this species. Found only in sample F.434, Kindan section (locality 100, WABAG).

Subgenus **Fohsella** Bandy, 1972

Type species: *Globorotalia (Globorotalia) praefohsi* Blow & Banner, 1966; by original designation.

Globorotalia (*Fohsella*) *peripheroacuta peripheroacuta* Blow & Banner, 1966, p. 244, pl. 1, figs. 2a–c; pl. 2, figs. 4–5, 13. [Pl. 33, figs. 10–16]

Rare, poorly preserved specimens occur in one sample from the Kindan section (locality 100, WABAG); the range of variation is shown in the illustrations. The axial periphery of the early chambers of the last whorl is broadly rounded, and of the later chambers, is narrowly rounded to acute. The umbilicus ranges from almost closed to narrow and open. The aperture is an elongate low interiomarginal slit extending almost to the periphery; only traces of an apertural lip are preserved.

Compared with the holotype, some PNG specimens are more rounded in edge view, and others have a slightly wider umbilicus; they are considered to fall within the variation of *peripheroacuta peripheroacuta.*

Globorotalia (*Fohsella*) *peripheroacuta pristina* subsp. nov. [Pl. 33, figs. 17–26]

See p. 16 for a full description of this subspecies. Recorded only from the Kindan section (locality 100, WABAG).

Globorotalia (*Fohsella*) *peripheroronda* Blow & Banner, 1966, p. 244, pl. 1, figs. 1a–c; pl. 2, figs. 1–3. [Pl. 34, figs. 1–9]

Specimens from WABAG agree in all respects with specimens of *G.* (*F.*) *peripheroronda* from a slide in the BMR foraminiferal collection labelled 'S8040. Lower Socorro, Miocene, Eastern Falcon, Venezuela', except that the PNG specimens are much larger. Most of the PNG specimens are also larger than the holotype, which has a maximum diameter of 0.31 mm. The development of the apertural lip varies considerably and ranges from narrow and elongate (Pl. 34, figs. 4–5) to a broad imperforate flap extending from the umbilical margin of the chamber, and completely covering the umbilicus (Pl. 34, figs. 6–7). The shape of the dorsal chambers is also variable, resulting from the degree of reflexion of the dorsal intercameral sutures, which may be only slightly recurved, giving tangentially elongate dorsal chambers.

In comparison with the holotype, the PNG specimens are more regularly rounded, rather than slightly asymmetric, in edge view, and have a more convex dorsal surface.

Recorded from the Kindan section, (locality 100, WABAG) and sample 3359 (locality 137, OK TEDI).

Globorotalia (*Fohsella*) *quinifalcata* Saito & Maiya, 1973; *Globorotalia quinifalcata* Saito & Maiya, 1973, p. 119, pl. 18, figs. 5a–c, 6a–c. [Pl. 34, figs. 10–18]

Specimens of *G.* (*F.*) *quinifalcata* have been found only in two samples at the base of the Kindan section (locality 100, WABAG), in association with a fauna indicating a planktonic zone N.8 age. These specimens agree very closely with the description and figures given by Saito & Maiya (1973); some specimens develop pustules on the ventral surface of the early chambers of the last whorl. This species shows a close relationship to *G.* (*F.*) *peripheroronda* Blow & Banner, 1966; differences from this species additional to those noted by Saito & Maiya are the smaller number of chambers in the last whorl of *quinifalcata* (4–5 as against 6), and the relatively larger last chamber of *quinifalcata.*

Globorotalia (*Fohsella*) *wabagensis* sp. nov. [Pl. 34, figs. 19–28]

See p. 16 for a full description of this species. Recorded from only sample F.888 in a section west-southwest of Laiagam (locality 103, WABAG).

Subgenus **Globorotalia** Cushman, 1927

Bandy (1972) proposed the subgenus *Menardella* with *Globorotalia menardii* (d'Orbigny) the type species. As noted by Fleisher (1974), the evolutionary development of the lineages discussed by Bandy is still uncertain, and I follow Fleisher for the present in regarding *Menardella* as a synonym of *Globorotalia.*

Globorotalia (*Globorotalia*) *cultrata cultrata* (d'Orbigny, 1839): *Rotalina* (*Rotalina*) *cultrata* d'Orbigny, *in* de la Sagra, 1839, p. 76. [Pl. 35, figs. 1–5]

A group of specimens from WABAG is referred to *G.* (*G.*) *cultrata cultrata.* These are not as compressed as the neotype selected by Banner & Blow (1960), or as the hypotypes figured by Blow (1969). Most are coiled, circular in outline, with a lobate equatorial periphery, equally biconvex, and with limbate dorsal intercameral and spiral sutures, at least in the last whorl. Specimens of this kind are much more common than more loosely coiled forms, oval in outline and more strongly convex ventrally, which may be referred to *G.* (*G.*) *cultrata menardii.* Blow (1969) noted the same relative abundance in the Lengua Formation of Trinidad.

Some specimens which are less convex ventrally approach the morphological type of the subspecies *G. cultrata limbata,* but lack the 'hockey-stick' shape of the dorsal intercameral sutures; the sutures are limbate, but are smoothly curved.

G. (*G.*) *cultrata cultrata* is recorded from the Kindan section (locality 100, WABAG) and the Burgers Mountains section (locality 16, WABAG).

Globorotalia (*Globorotalia*) *cultrata menardii* (Parker, Jones & Brady, 1865): *Rotalia menardii* Parker, Jones & Brady, 1865, p. 20, pl. 3, fig. 81. [Pl. 35, figs. 6–9]

Rare specimens from two samples in the Kindan section (locality 100, WABAG) are referred to *G. cultrata menardii.* As noted in the comments under *G. cultrata cultrata,* specimens of *menardii* are rare in the fauna, and are distinguished by their looser coiling, oval outline, and more convex ventral surface.

The name *G.* (*G.*) *cultrata menardii* is used here as defined by Blow (1969). Stainforth & others (1975) have discussed the confusion in the use of this name, and have in preparation an appeal to the International Commission on Zoological Nomenclature with the purpose of resolving the problem.

Globorotalia (*Globorotalia*) *ehrenbergi* Bolli, 1957: *Globorotalia ehrenbergi* Bolli, 1957, p. 77, pl. 20, figs. 18–20. [Pl. 15, figs. 5–10]

Occurs frequently in sample 8084 (locality 112, WABAG) and very rarely in sample 9039 (locality 65, WABAG). The specimens are biconvex with a narrowly rounded axial periphery, and agree well with the original description and figures.

Globorotalia (*Globorotalia*) *merotumida* Blow & Banner, 1965, *in* Banner & Blow, 1965, p. 1352, figs. 1a–c. [Pl. 35, figs. 10–16]

G. (*G.*) *merotumida* occurs commonly throughout the upper half of the Kindan section (locality 100, WABAG). Among the stratigraphically lowest specimens are some which are almost equally biconvex rather than with a more strongly convex ventral surface, and which are relatively more compressed than specimens in younger beds (see Pl. 35, figs. 10–14). The PNG specimens generally agree well in most respects with the very detailed description given by Blow & Banner (1965); only remnants of an apertural lip have been observed. The specimen on Plate 35, figs. 10–12 is slightly more circular and more lobate than the holotype; the specimen on Plate 35, figs. 13–14 is very close to the holotype, differing only in having slightly more depressed sutures between the last three

chambers; the specimen on Plate 35, figs. 15–16 is the most tumid of the specimens referred to *G. (G.) merotumida.*

The coiling of the test appears to be the most variable feature, and some of the more loosely coiling forms could equally well be referred to *G. (G.) tumida plesiotumida* Blow & Banner, 1965. Blow (1969), discussing the differentiation of the taxa *merotumida, plesiotumida,* and *tumida,* gave a height/maximum diameter ratio for *merotumida* of the order of 1:2.2; however, this ratio for the holotype is almost exactly 1:2.0, and for a figured ideotype (Blow, 1969, Pl. 45, figs. 4 and 9), is about 1:1.80. For the PNG specimens the ratio ranges from 1:1.77 to 1:1.95.

The PNG specimens represent a development towards tumidity as reflected by the height/maximum diameter ratio falling at least in part within that of *G. (G.) merotumida.* The appearance of this taxon just above the base of zone N.16 marks the beginning of evolutionary development of tumid tests in the late Middle Miocene. The full range of variation of the height/maximum diameter ratio of *G. (G.) merotumida* in different areas and at different stratigraphical levels is not known; this feature could well be affected by the environment.

Globorotalia (Globorotalia) praemenardii archeomenardii Bolli, 1957: *Globorotalia archeomenardii* Bolli, 1957, p. 119, pl. 28, figs. 11a–c. [Pl. 35, figs. 17–19]

Recorded rarely from a section southwest of Laiagam (locality 108, WABAG). The ratio of dorsal-ventral height to maximum diameter of the test in specimens referred to the subspecies *archeomenardii* ranges from 2.1 to 2.3, as against a figure of about 2.5 given by Blow (1969). The figured specimen is slightly larger than the holotype, and is more sharply angulate on the last chamber.

Globorotalia (Globorotalia) pseudomenardii Bolli, 1957: *Globorotalia pseudomenardii* Bolli, 1957, p. 77, pl. 20, figs. 14–17. [Pl. 15, figs. 11–15]

Recorded in the present material from samples 8136, 8142, and 9039 (localities 47, 35, and 65 respectively, WABAG); previously recorded (Belford, 1967) from localities 37, 97, and 105, WABAG.

Globorotalia (Globorotalia) quasimiocenica sp. nov. [Pl. 36, figs. 1–11]

For a full description of this new taxon see p. 17. Known only from sample F.432, Kindan section (locality 100, WABAG), in beds of Late Miocene age.

Globorotalia (Globorotalia) tumida plesiotumida Blow & Banner, 1965, *in* Banner & Blow, 1965, p. 1353, figs. 2a–c. [Pl. 36, figs. 12–16]

As noted in the comments under *G. (G.) merotumida,* more loosely coiled and also less tumid specimens occur among PNG specimens; these are here referred to *G. (G.) tumida plesiotumida.* The height/maximum diameter ratio ranges from 1:2.06 to 1:2.37, as against a figure of 1:2.6, given by Blow (1969). From the illustrations, the holotype has a ratio of 1:2.36; another specimen figured by Blow (1969) has a ratio almost exactly 1:2.0. The PNG specimens differ from the holotype mainly in having a more circular outline.

G. (G.) tumida plesiotumida has been recorded from the upper beds of the Kindan section (locality 100, WABAG).

Globorotalia (Globorotalia) sp. 1 ex. gr. *G. tumida* (Brady, 1877). [Pl. 37, figs. 1–7]

Rare specimens from the upper beds of the Kindan section (locality 100, WABAG) are placed here. The dorsal surface is only slightly convex, and the ventral surface strongly convex, with usually 5 and sometimes 6 chambers visible from the ventral side. The umbilicus is wide and open; the ventral sutures are depressed and radial, and the dorsal sutures obscured. A thick keel is developed on all chambers.

The specimens resemble *G. (G.) miocenica* Palmer, 1945, but do not have the flat dorsal surface of this species, and have a wider umbilicus. Insufficient specimens are available either to determine their affinities or to justify their faunal description. They are considered to be closer to the *tumida* group than to the *cultrata* group, because of the number of chambers in the last whorl, 5, while the *cultrata* group has 6 or more. The maximum width/height ratio is also closer to that of the *tumida* group. However, the specimens also have a less restricted umbilicus than that of species of the *tumida* group. Bizon & Bizon (1971) identified as *Globorotalia* cf. *merotumida* some specimens which are similar to the PNG specimens. The PNG specimens are referable to the 'menardiform group' of Stainforth & others (1975).

Globorotalia (Globorotalia) sp. 2. [Pl. 37, figs. 8–9]

Only one specimen of this form has been found, in the upper beds of the Kindan section (locality 100, WABAG). It has a strongly biconvex test, and cannot be identified as any described species.

Subgenus **Hirsutella** Bandy, 1972

Type species: *Pulvinulina scitula* Brady, 1882; figured Brady, 1884, pl. 103, figs. 7a–c, as *Pulvinulina patagonica* (d'Orbigny); by original designation.

Globorotalia (Hirsutella) scitula planaria subsp. nov. [Pl. 37, figs. 10–17]

See p. 17 for a full description of this species. Recorded only from the Kindan section (locality 100, WABAG).

Globorotalia (Hirsutella) scitula praescitula Blow, 1959: *Globorotalia scitula praescitula* Blow, 1959, p. 221, pl. 19, figs. 128a–c. [Pl. 38, figs. 18–22]

Rare specimens occur in sample F.888 (locality 103, WABAG), in a section southwest of Laiagam. The specimen figured by Blow (1969, pl. 39, fig. 9) has a more sharply angulate axial periphery than do the PNG specimens, which closely resemble the holotype.

Globorotalia (Hirsutella) scitula scitula (Brady, 1882): *Pulvinulina scitula* Brady, 1882, p. 716; figured Brady, 1884, pl. 103, figs. 7a–c, as *Pulvinulina patagonica* (d'Orbigny). [Pl. 37, figs. 23–26]

Recorded from several samples in the upper beds of the Kindan section (locality 100, WABAG).

Globorotalia (Hirsutella) sp. 1. [Pl. 37, figs. 27–31]

Rare specimens from the upper beds of the Kindan section (locality 100, WABAG) are placed here. These specimens are biconvex and oval in outline with a lobate

equatorial periphery, and narrowly rounded axial periphery. Five chambers are visible from the ventral side, the chambers increasing rapidly in size as added.

Subgenus **Morozovella** McGowran, 1964, *in* Luterbacher, 1964

Type species: *Pulvinulina velascoensis* Cushman, 1925; original designation.

Morozovella was given generic status by Luterbacher (1964), but was placed by McGowran (1968) as a subgenus of *Truncorotaloides*. Blow (1979) emended the diagnosis and placed *Morozovella* as a subgenus of *Globorotalia*; this is followed here.

Globorotalia (*Morozovella*) *aequa aequa* Cushman & Renz, 1942: *Globorotalia crassata* (Cushman) var. *aequa* Cushman & Renz, 1942, p. 12, pl. 3, figs. 3a–c. [Pl. 1, fig. 1; Pl. 15, figs. 16–20]

G. (*M.*) *aequa aequa* has been recorded from several samples from WABAG (see Figure 16). The specimens have four chambers visible in the last whorl, and vary in the proportion of the test formed by the last chamber. The peripheral test muricocarina is not clearly observed, because of the preservation of the specimens.

Globorotalia (*Morozovella*) *angulata angulata* (White, 1928): *Globigerina angulata* White, 1928, p. 191, pl. 27, figs. 13a–c. [Pl. 15, figs. 21–23]

Recorded rarely from sample 8142 (locality 35, WABAG) only; specimens compared to *G.* (*M.*) *angulata angulata* were recorded by Belford (1967) from sample F.342 (locality 97, WABAG).

Considerable variation is shown by published figures of this species, mainly in the number of chambers per whorl, in the angularity of the axial periphery, and in the test profile which ranges from planoconvex to biconvex. Blow (1979) discussed in some detail numerous specimens referred to *angulata* and revised many determinations. The present specimens have 5 chambers visible ventrally, are sharply angled only on the later chambers of the last whorl, and have a small shallow circular umbilicus.

Globorotalia (*Morozovella*) *apanthesma* Loeblich & Tappan, 1957: *Globorotalia apanthesma* Loeblich & Tappan, 1957, p. 187, pl. 48, figs. 1a–c; pl. 55, figs. 1a–c; pl. 58, figs. 4a–c; pl. 59, figs. 1a–c. [Pl. 16, figs. 1–8]

Recorded from samples 8142 (locality 35, WABAG) and 9039 (locality 65, WABAG); specimens compared to *G.* (*M.*) *apanthesma* were recorded (Belford, 1967) from a section on the Andebare River (locality 105, WABAG).

Blow (1979) discussed in some detail the distinction between G. (*M.*) *apanthesma* and *G.* (*M.*) *angulata angulata* (White, 1928). The PNG specimens resemble the holotypic form of *G.* (*M.*) *apanthesma*; one specimen (Pl. 16, figs. 6–8) has a sharp umbilical shoulder on the last chamber, but earlier chambers have rounded shoulders and the specimen is referred to *apanthesma*.

Globorotalia (*Morozovella*) *aragonensis* Nuttall, 1930: *Globorotalia aragonensis* Nuttall, 1930, p. 288, pl. 24, figs. 6–8, 10–11. [Pl. 1, fig. 8; Pl. 16, figs. 9–16]

Recorded only from sample 9051 (locality 69, WABAG). Included here are specimens which are very similar to paratypes of *Globorotalia naussi* Martin, 1943 deposited in the National Museum of Natural History, Washington, DC. Blow (1979) noted the close similarity of *G. naussi* and *G. marksi* Martin, 1943 and the intermediate position of these morphotypes between *G.* (*M.*) *aragonensis* and *G.* (*M.*) *lensiformis*, with *marksi* being closer to *lensiformis* and *naussi* closer to *aragonensis*. The PNG specimens are closer to *aragonensis* and are included in the morphologically 'primitive' group of *aragonensis*, as distinguished by Blow (1979). These 'primitive' forms are also found in sample 9044 (locality 61, WABAG).

Globorotalia (*Morozovella*) *lehneri* Cushman & Jarvis, 1929: *Globorotalia lehneri* Cushman & Jarvis, 1929, p. 17, p. 17, pl. 3, figs. 16a–c. [Pl. 16, figs. 17–22]

Specimens referred to *G.* (*M.*) *lehneri* occur commonly in sample 9051 (locality 69, WABAG); the chambers are as radially elongate as those of the holotype, and of specimens figured by Bolli (1957c), but not as elongate as those of the specimens figured by Blow (1979). Only one PNG specimen shows the small groups of fused peripheral muricae noted by Blow (1979).

Globorotalia (*Morozovella*) *lensiformis* Subbotina, 1953: *Globorotalia lensiformis* Subbotina, 1953, p. 214, pl. 18, figs. 4a–c, 5a–c. [Pl. 17, figs. 1–5]

Recorded rarely from sample 9051 (locality 69, WABAG). The specimens are closer in form to the paratype figured by Subbotina than to the holotype; they show some variation in the ratio between the size of the last chamber and the remainder of the test. Those specimens with a large last chamber (Pl. 17, figs. 1–3) can be separated from *G.* (*M.*) *aequa aequa* by their convex dorsal surface. The specimens also resemble *G.* (*M.*) *aequa dolabrata* Jenkins, 1966 but have a more open umbilicus and a narrowly rounded axial profile.

Globorotalia (*Morozovella*) *occlusa occlusa* Loeblich & Tappan, 1957: *Globorotalia occlusa* Loeblich & Tappan, 1957, p. 191, pl. 55, figs. 3a–c; pl. 64, figs. 3a–c. [Pl. 17, figs. 6–14]

Rare specimens from sample 8136 (locality 47, WABAG) are referred to *G.* (*M.*) *occlusa occlusa*. Many specimens have a planoconvex rather than a slightly biconvex test in axial profile.

G. (*M.*) *occlusa occlusa* has been previously recorded (Belford, 1967) as *Globorotalia velascoensis occlusa* from a section and one sample from the Andebare River (localities 105 and 97, WABAG).

Globorotalia (*Morozovella*) *occlusa acutispira* Bolli & Cita, 1960: *Globorotalia acutispira* Bolli & Cita, 1960, p. 375, pl. 33, figs. 3a–c. [Pl. 17, figs. 14–21]

Specimens referred to *M. acutispira* occur abundantly in sample 9039 (locality 65, WABAG). The specimens vary in number of chambers per whorl and in the convexity of the dorsal surface. The number of chambers in the last whorl is 4 or 5, and the specimens range from equally biconvex to those with a more strongly convex dorsal surface. In most specimens the umbilicus is wider than in the holotype, which is a four-chambered specimen. Olsson (1969) discussed the variation of *G.* (*M.*) *occlusa acutispira* and figured four and five-chambered variants; the five-chambered forms have a more open umbilicus, as in the PNG specimens.

Globorotalia (*Morozovella*) *spinulosa spinulosa* Cushman, 1927: *Globorotalia spinulosa* Cushman, 1927, p. 114, pl. 23, figs. 4a–c. [Pl. 17, figs. 22–26]

Following Blow (1979), this name is used for the taxon illustrated, rather than *G.* (*M.*) *crassata* Cushman, 1925. Bandy (1964) lectotypified *G. crassata*, and Banner & Blow (1965) suggested that, as a result of this, *G. spinulosa* Cushman became a synonym of *G. crassata*. However, Blow (1979) reported the loss of the lectotype of *G.* (*M.*) *crassata*, and stated that remaining syntypes are not conspecific with the lectotype selected by Bandy. Blow therefore recommended that the name *G. spinulosa* be used in the interests of stability of nomenclature.

The PNG specimens agree well with the description and figures of *G.* (*M.*) *spinulosa*; the test is unequally biconvex with usually 5 chambers in the last whorl and a small umbilicus. The muricate peripheral margin and dorsal and ventral sutures are not observed because of poor preservation. The peripheral margin is continuous; this was noted by Blow (1979) as a feature of stratigraphically earlier specimens.

G. (*M.*) *spinulosa spinulosa* has been found only in 9051 (locality 69, WABAG).

Globorotalia (*Morozovella*) *spinulosa coronata* Blow, 1979, p. 1016, pl. 50, figs. 2–5, pl. 168, figs. 1–8; 229, figs. 5–6; pl. 230, figs. 1–6. [Pl. 18, figs. 1–3]

Blow (1969, p. 370) discussed this taxon; Berggren (1969b, p. 360) used the manuscript name *G. coronata* Blow, which is validated in Blow (1979).

Rare specimens from sample 9051 (locality 69, WABAG) are referred to this subspecies. The specimens are not well preserved, and do not show the muricae of the specimens figured by Blow (1979); a muricocarina is present, and the umbilical shoulders have thickenings which may have resulted from the development of muricae. The umbilicus is wide, and the test unequally biconvex.

Globorotalia (*Morozovella*) *subbotinae gracilis* Bolli, 1957: *Globorotalia formosa gracilis* Bolli, 1957, p. 75, pl. 18, figs. 4–8. [Pl. 1, fig. 9; Pl. 18, figs. 4–9]

Recorded only from sample 9039 (locality 65, WABAG). The specimens agree well with published descriptions and illustrations except that rare specimens (see Pl. 18, figs. 4–6) are equally biconvex. This record from Papua New Guinea is older than previously known occurrences, which have been only from the latest Paleocene to Early Eocene.

Globorotalia (*Morozovella*) *subbotinae marginodentata* Subbotina, 1953: *Globorotalia marginodentata* Subbotina, 1953, p. 212, pl. 17, figs. 14a–c, 15a–c, 16a–c; pl. 18, figs. 1a–c, 2a–c, 3a–c. [Pl. 18, figs. 10–17]

Specimens referred to *G.* (*M.*) *subbotinae marginodentata* occur only in sample 9039 (locality 65, WABAG). They agree well with the description and figures given by Subbotina (1953); the test is biconvex, often distinctly so in the central part of the dorsal surface, with 4–5 chambers visible from the ventral side. The chambers increase rapidly in size as added, and are radially elongated to different degrees; rare specimens have the final chamber smaller than the preceding chambers. The specimens show the extreme development of the peripheral test muricocarina noted by Blow (1979). The strongly biconvex specimens resemble those here referred to *G.* (*M.*) *occlusa acutispira*, but differ in the more strongly developed muricocarina.

Blow (1979) recorded *marginodentata* only from the Early Eocene, and regarded it as an extreme phenotype of the basic *gracilis* and *subbotinae* (s.s.) morphotypes. Subbotina (1953) recorded it from the Paleocene-Early Eocene, and Stainforth & others (1975) from the Late Paleocene-Early Eocene. The only recorded occurrence in Papua New Guinea is in beds of Late Paleocene age.

Globorotalia (*Morozovella*) *tadjikistanensis* Bykova, 1953: *Globorotalia tadjikistanensis* Bykova, 1953, p. 86, pl. 3, figs. 5a–c. [Pl. 18, figs. 18–23]

G. (*M.*) *tadjikistanensis* is recorded only from sample 9039 (locality 65, WABAG). The specimens are strongly biconvex, and agree well with the original description and figures of the species, as well as the figures given by Luterbacher (1964) and Samanta (1973). The specimen figured by Samanta differs only in having a sharply angled axial periphery. This feature varies considerably in the PNG specimens, ranging from broadly to narrowly rounded.

G. (*M.*) *tadjikistanensis* may be, as suggested by Blow (1979), an ecophenotypic variant of *G.* (*M.*) *angulata conicotruncata* Subbotina, 1947 but is for the present here retained as a separate species.

Globorotalia (*Morozovella*) *velascoensis velascoensis* (Cushman, 1925): *Pulvinulina velascoensis* Cushman, 1925, p. 19, pl. 3, figs. 5a–c. [Pl. 1, fig. 2; Pl. 19, figs. 1–10]

Recorded from sample 9039 (locality 69, WABAG), and previously recorded from this area (Belford, 1967) from a section on the Andebare River (locality 105, WABAG), and a section at Tibinini (locality 37, WABAG).

Globorotalia (*Morozovella*) *velascoensis acuta* Toulmin, 1941: *Globorotalia wilcoxensis* Cushman & Ponton var. *acuta* Toulmin, 1941, p. 608, pl. 82, figs. 6–8. [Pl. 19, figs. 11–15]

Recorded from samples 8136, 8142, and 9039 (localities 47, 35, and 65 respectively, WABAG).

Globorotalia (*Morozovella*) *velascoensis parva* Rey, 1955: *Globorotalia velascoensis* (Cushman) *parva* Rey, 1955, p. 209, pl. 12, figs. 1a–b. [Pl. 19, figs. 16–18]

Rare specimens from sample 8142 (locality 35, WABAG), are placed here. The specimens have a flat dorsal surface, 4–4½ chambers visible from the ventral side, a small umbilicus, and thickened shoulders.

Globorotalia (*Morozovella*) *velascoensis pasionensis* (Bermudez, 1961): *Pseudogloborotalia pasionensis* Bermudez, 1961, p. 1346, pl. 16, figs. 8a–b. [Pl. 19, figs. 19–23]

Blow (1979) noted that the specimen deposited in the National Museum of Natural History, Washington, DC, as the holotype of *Pseudogloborotalia pasionensis* Bermudez is not the specimen figured by Bermudez (1961). Blow figured a specimen said to be very similar to the holotype. The specimen figured as the holotype by Bermudez has 6 chambers in the final whorl, and the species was described as having 6-7 chambers in the last whorl. The specimen deposited as the holotype was said by Blow to have about 9 chambers in

the final whorl, and the specimen figured by Blow as very similar to the holotype has 9–10 chambers.

The PNG specimens generally have 6 chambers in the final whorl, have a wide umbilicus, and a biconvex axial profile. They are very similar to the specimen originally figured by Bermudez (1961).

Specimens referred to *G. (M.) velascoensis pasionensis* occur frequently in sample 9039 and rarely in sample 8142 (localities 65 and 35 respectively, WABAG); the species was recorded previously (Belford, 1967) from a section at Tibinini (locality 37, WABAG).

Globorotalia (Morozovella) sp. 1. [Pl. 20, figs. 4–8]

Only one specimen of this form has been found, in sample 9039 (locality 65, WABAG). It is similar to the specimen figured by Bolli (1957, pl. 17, figs. 10–12) as transitional from *Globorotalia uncinata* to *G. angulata*. Stainforth & others (1975) placed this specimen in the synonymy of *angulata*. The PNG specimen has a wider umbilicus than does *G. (M.) angulata angulata*, and has more sharply angled umbilical shoulders, particularly on the last chamber.

Globorotalia (Morozovella) sp. 2. [Pl. 20, figs. 1–3]

Only two specimens of this form have been found, both from sample 8142 (locality 35, WABAG). Each specimen is biconvex, with a thick muricocarina developed; one has 7 chambers in the final whorl and the other, 8. The umbilicus is small, open, and deep. The ventral sutures are straight, radial, and depressed, and the dorsal sutures curved and reflexed. One specimen has a raised spiral suture.

Subgenus **Truncorotaloides** Brönnimann & Bermudez, 1953

Type species: *Truncorotaloides rohri* Brönnimann & Bermudez, 1953; by original designation.

Globorotalia (Truncorotaloides) topilensis topilensis (Cushman, 1925): *Globigerina topilensis* Cushman, 1925, pl. 1, figs. 9a–c. [Pl. 1, figs. 13–15, 18; Pl. 20, figs. 9–13]

Found frequently in sample 9051 (locality 69, WABAG) only. The specimens are muricate, but lack the well-developed muricae shown on the specimens illustrated by Blow (1979). The lateral angulation of the chambers, particularly of the last chamber, is well shown; no supplementary dorsal apertures have been observed.

Specimens referred to the *G. (T.) topilensis* group have also been observed in thin sections of limestones from OK TEDI.

Subgenus **Turborotalia** Cushman & Bermudez, 1949

Type species: *Globorotalia centralis* Cushman & Bermudez, 1937; by original designation.

Globorotalia (Turborotalia) acostaensis acostaensis, Blow, 1959, p. 208, pl. 17, figs. 106a–c, 107. [Pl. 38, figs. 1–5]

Rare specimens of *G. (T.) acostaensis acostaensis* occur in the upper part of the Kindan section (locality 100, WABAG). Most specimens have the final chamber smaller than the preceding chamber, as noted by Blow (1969); similar specimens were figured by Jenkins & Orr (1972, pl. 19, fig. 9). The umbilicus of each of the present specimens is often covered by an extension of the well-developed apertural lip.

Globorotalia (Turborotalia) birnageae Blow, 1959: *Globorotalia birnageae* Blow, 1959, p. 210, pl. 17, figs. 108a–c. [Pl. 38, figs. 6–10]

Recorded from sample F.875 in a section west-southwest of Laiagam (locality 103, WABAG). The holotype has five chambers in the last whorl, with the final chamber smaller than the previous chambers and with a distinct lip. An apertural lip is shown by some, but not all, of the unfigured paratypes (USNM 625710), which also have generally six chambers in the last whorl, one specimen having 6½. One PNG specimen (Pl. 38, figs. 6–8) which is particularly close to the paratypes, shows remnants of an apertural lip.

The PNG specimens agree closely with a paratype figured by Blow (1969), and are also very similar to specimens of *G. (T.) birnageae* from the Pungo River Formation, Aurora, North Carolina, forwarded by Dr T. Gibson of the US Geological Survey, Washington, DC.

Globorotalia (Turborotalia) compressa compressa (Plummer, 1926): *Globigerina compressa* Plummer, 1926, p. 135, pl. 8, figs. 11a–c. [Pl. 20, figs. 14–21]

Recorded frequently from sample 8084 (locality 112, WABAG) only. Specimens placed here range from oval to quadrate in outline, and from being slightly to strongly convex dorsally, but all have a narrowly rounded axial periphery, radial depressed ventral sutures, and curved slightly reflexed dorsal sutures. This species is widely recorded, and is characteristic of the Early Paleocene.

Globorotalia (Turborotalia) continuosa Blow, 1959, p. 218, pl. 19, figs. 125a–c. [Pl. 38, figs. 11–16]

Rare specimens of *G. (T.) continuosa* occur in the upper part of the Kindan section (locality 100, WABAG); all have four chambers in the final whorl. A distinct apertural lip is present, and some specimens have an atypical very reduced last chamber covering the umbilicus (Pl. 38, figs. 14–16). These specimens resemble that figured by Jenkins & Orr (1972, pl. 21, fig. 1), and also resemble in gross morphology PNG specimens referred to *G. (T.) opima nana*. Specimens of *G. (T.) continuosa* have a more arched aperture.

Globorotalia (Turborotalia) haunsbergensis Gohrbandt, 1963: *Globorotalia haunsbergensis* Gohrbandt, 1963, p. 53, pl. 6, figs. 10–12. [Pl. 20, figs. 22–27]

Recorded rarely from sample 8084 (locality 112, WABAG) only. The specimens are biconvex, with a narrowly rounded axial periphery, and vary in the relative convexity of the dorsal and ventral surfaces. They agree well with the original description and figures. The dorsal sutures are curved, as in the holotype. Blow (1979) stated that in most specimens the dorsal sutures are radial.

Globorotalia (Turborotalia) inconstans (Subbotina, 1953): *Globigerina inconstans* Subbotina, 1953, p. 58, pl. 3, figs. 1a–c, 2a–c. [Pl. 21, figs. 1–12]

As noted in the discussion under *G. (Acarinina) praecursoria praecursoria*, specimens with rounded chambers and radial dorsal sutures are placed in *G. (T.) inconstans*. The opinion of Blow (1979)—that *Globorotalia trinidadensis* Bolli, 1957 is a synonym of *Globigerina inconstans*—is followed. Stainforth & others (1957) stated that *inconstans* differs from *trinidadensis* in having fewer chambers in the last whorl and in its

smoother surface. However, the type specimens of both *inconstans* and *trinidadensis* have 6 chambers visible from the ventral side; *trinidadensis* was originally described as having a smooth surface, with the early chambers often slightly rugose.

G. (T.) inconstans has been found only in sample 8084 (locality 112, WABAG). Several specimens have the final chamber of the last whorl offset from the normal progression of the spire.

Globorotalia (Turborotalia) kugleri Bolli, 1957, p. 118, pl. 28, figs. 5a–c, 6. [Pl. 38, figs. 17–19]

Recorded rarely from a section south of Crater Lake (locality 147, WABAG), the Laiagam section (locality 118, WABAG), and two isolated samples, F.239 and Ab.80 (localities 59 and 8 respectively, WABAG).

Globorotalia (Turborotalia) obesa Bolli, 1957, p. 119, pl. 29, figs. 2a–c, 3. [Pl. 38, figs. 20–22]

Recorded from several samples in the Kindan section (locality 100, WABAG), from the Burgers Mountain section (locality 16, WABAG), from the Laiagam section (locality 118, WABAG), and from numerous isolated samples (see Figures 6 and 16).

Globorotalia (Turborotalia) opima nana Bolli, 1957: *Globorotalia opima nana* Bolli, 1957, p. 118, pl. 28, figs. 3a–c. [Pl. 38, figs. 23–31]

Occurs at localities 106, 118, and 137, WABAG. The specimens are small, tightly coiled with a closed umbilicus, and 4–4½ chambers in the final whorl. The low slit-like aperture has a well-developed lip on most specimens. As noted on p. 32, some specimens are associated with a N.8 fauna; the relationships of these faunas require further investigation.

Globorotalia (Turborotalia) pseudobulloides (Plummer, 1926): *Globigerina pseudobulloides* Plummer 1926, p. 133, pl. 8, figs. 9a–c. [Pl. 21, figs. 13–16]

Recorded rarely from sample 8084 (locality 112, WABAG).

Globorotalia (Turborotalia) pusilla Bolli, 1957: *Globorotalia pusilla pusilla* Bolli, 1957, p. 78, pl. 20, figs. 8–10 [not figured]

Rare specimens of this species have been found only in sample F.342 (locality 97, WABAG); it was figured by Belford (1967).

Globorotalia (Turborotalia) siakensis (LeRoy, 1939): *Globigerina siakensis* LeRoy, 1939, p. 262, pl. 4, figs. 20–22. [Pl. 39, figs. 1–12]

Recorded from several samples throughout WABAG and OK TEDI (see Figures 6, 8, 9, 11, 12–14, 16). The specimens range in outline from circular to oval and the dorsal sutures range from radial to somewhat reflexed; some specimens (Pl. 39, figs. 5–6) show slightly curved dorsal sutures on the later chambers. The chambers are not as appressed as those of *G. (T.) mayeri*. Several specimens show strong involution of the chambers on the dorsal side.

Globorotalia (Turborotalia) subscitula Conato, 1964: *Globorotalia scitula* Brady var. *subscitula* Conato, 1964, p. 290, pl. 2, figs. 16a–c. [Pl. 39, figs. 13–19]

Rare specimens found only in the upper part of the Kindan section (locality 100, WABAG) are referred to *G. (T.) subscitula*. The holotype and paratype are oval in outline, with 5 chambers visible from the ventral side; the present specimens are more circular, with 4 to 4½ chambers visible ventrally, and compare very closely to the specimen from Jamaica figured by Blow (1969, pl. 3, figs. 1–3). Some of the PNG specimens develop a last chamber often smaller than the preceding chambers, and have an acute periphery; all specimens of this kind occur at the top of the stratigraphical range of *subscitula* as recorded in the Kindan section.

The PNG specimens are smaller and slightly less lobate than specimens from Bowden, Jamaica, in the collection of the National Museum of Natural History, Washington, DC, but are otherwise identical. *G. (T.) subscitula* of Blow (1969, pl. 39, fig. 8) has a strongly convex dorsal surface and angulate final chamber; it is similar to the PNG specimens, but is much larger.

Globorotalia (Turborotalia) variospira sp. nov. [Pl. 24, figs. 15–17; Pl. 25, figs. 1–7]

For a full description of this species see p. 18. Recorded only from sample 9039 (locality 65, WABAG).

Genus **Globorotaloides** Bolli, 1957

Type species: *Globorotaloides variabilis* Bolli, 1957; by original designation.

Globorotaloides suteri Bolli 1957, p. 117, pl. 27, figs. 9a–c, 10a–b, 11a–b, 12a–b, 13a–b. [Pl. 39, figs. 20–24]

Occurs rarely in sample F.436, near the base of the Kindan section (locality 100, WABAG).

Genus **Hantkenina** Cushman, 1925

Type species: *Hantkenina alabamensis* Cushman, 1925; by original designation.

Subgenus **Aragonella** Thalmann, 1942

Type species: *Hantkenina mexicana* Cushman var. *aragonensis* Nuttall, 1930; by original designation.

Hantkenina (Aragonella) mexicana mexicana Cushman, 1925: *Hantkenina mexicana* Cushman, 1925, p. 3, pl. 2, fig. 2. [Pl. 21, figs. 17–19]

Ramsay (1962) discussed the morphological variation of *H. mexicana* Cushman, and regarded it as probable that the variety *aragonensis* of Nuttall (1930) should be placed in synonymy. Blow (1979) followed this, but recognised subspecific differentiation within *H. mexicana* and also placed other species in the synonymy of *H. mexicana mexicana*.

The PNG specimens range in chamber shape from inflated (Pl. 21, fig. 17) to more compressed and tangential (Pl. 21, figs. 18–19). *H. mexicana mexicana* is recorded only from sample 9051 (locality 69, WABAG).

Hantkenina (Aragonella) mexicana dumblei Weinzierl & Applin, 1929: *Hantkenina dumblei* Weinzierl & Applin, 1929, p. 402, pl. 43, figs. 5a–b. [Pl. 21, figs. 20–22]

Recorded commonly from sample 9051 (locality 69, WABAG) only. The PNG specimens agree well with the illustration of the lectotype given by Bolli, Loeblich, & Tappan (1957) and with specimens figured by Blow (1979). The appressed chambers, the laterally compressed test, and the tubulospines rising from more anterior parts of the chambers are clearly shown.

Genus **Hastigerina** Thomson, 1876

Type species: *Hastigerina murrayi* Thomson, 1876; by original designation (monotypy).

Hastigerina siphonifera praesiphonifera Blow, 1969, p. 408, pl. 54, figs. 7–9. [Pl. 40, figs. 1–7]

Recorded frequently throughout the Kindan section (locality 100, WABAG). The specimens show a wide range of variation in coiling from closely to loosely coiled (see illustrations). The early trochospiral coiling is visible, and the aperture is not fully symmetrical. The chambers are not as broadly inflated as the lectotype of *H. siphonifera siphonifera* (d'Orbigny, 1839) figured by Banner & Blow (1960b).

Genus **Muricoglobigerina** Blow, 1979

Type species: *Globigerina soldadoensis* Brönnimann, 1952; by original designation.

Muricoglobigerina aquiensis (Loeblich & Tappan, 1957): *Globigerina aquiensis* Loeblich & Tappan, 1957, p. 180, pl. 51, figs. 4a–c, 5a–c; pl. 56, figs. 4a–c, 5a–c, 6a–c. [Pl. 22, figs. 1–3]

Rare specimens from sample 8142 (locality 35, WABAG) compare very closely with the type specimens of this species. They are not as high-spired as the holotype, but show the lower coil of the paratypes. Blow (1969) stated that the high-spired appearance of the holotype is more apparent than real, and is caused by the abortive end chamber not being added in the normal progression of the spire. The specimens have a four-chambered whorl, the test surface is hispid to pustulose, and the aperture is arched. The well-developed muricae illustrated by Blow (1979) have not been observed.

Muricoglobigerina mckannai (White, 1928): *Globigerina mckannai* White, 1928, p. 194, pl. 27, figs. 16a–c. [Pl. 22, figs. 4–8]

Recorded rarely only from sample 8142 (locality 35, WABAG) in the present material. Previously recorded (Belford, 1967) from sequences near the Andebare River and near Tibinini, here given locality numbers 105 and 37, respectively (WABAG).

Muricoglobigerina soldadoensis angulosa (Bolli, 1957): *Globigerina soldadoensis angulosa* Bolli, 1957, p. 71, pl. 16, figs. 4–6. [Pl. 22, figs. 9–12]

Specimens referred to *M. soldadoensis angulosa* have been found rarely only in sample 9051 (locality 69, WABAG). The specimens are 4 to 5 chambered in the last whorl, with a wide umbilicus, depressed dorsal sutures, and straight reflexed ventral sutures. Some specimens have the final chamber smaller than the previous chambers. The lateral compression and angularity of the chambers are clearly shown in ventral view; dorsally, the chambers are tangentially elongate. The well-developed muricae illustrated by Blow (1979) are not present, probably because of the preservation of the specimens.

Genus **Orbulina** d'Orbigny, 1839

Type species: *Orbulina universa* d'Orbigny, 1839; by original designation (monotypy).

Orbulina suturalis Brönnimann, 1951, p. 135, text-fig. 2, figs. 1–2, 5–8, 10; text-fig. 3, figs. 3–8, 11, 13–16, 18, 20–22; text-fig. 4, figs. 2–4, 7–12, 15–16, 19–22. [Pl. 40, figs. 8–9]

O. suturalis occurs commonly in most samples from Middle Miocene and younger beds. In the Kindan section, because of the wide sampling intervals, the precise level at which this species appeared cannot be fixed, and its development from ancestral forms, as documented from other areas, cannot be traced in detail. However, the information available shows that *Orbulina* evolved as recorded in many other areas through the sequence from *Globigerinoides sicanus* and the *Praeorbulina* group.

Orbulina universa d'Orbigny, 1839, p. 2, pl. 1, fig. 1. [Pl. 40, fig. 10]

A common element in the fauna of Middle Miocene and younger beds; appears about 300 metres above the base of the Kindan section (locality 100, WABAG), and is then found throughout the section.

Genus **Praeorbulina** Olsson, 1964

Type species: *Globigerinoides glomerosa glomerosa* Blow, 1956; by original designation.

Praeorbulina glomerosa circularis (Blow, 1956): *Globigerinoides glomerosa circularis* Blow, 1956, p. 65, text-fig. 2, figs. 3–4. [Pl. 40, figs. 11–12]

Recorded from a section southwest of Laiagam, locality 108, WABAG and also from isolated samples in OK TEDI and WABAG (see Figures 6 and 16).

Praeorbulina glomerosa curva (Blow, 1956): *Globigerinoides glomerosa curva* Blow, 1956, p. 64, text-fig. 1, figs. 9–14. [Pl. 40, figs. 14–15]

Recorded rarely at the base of the Kindan section (locality 100, WABAG), and in sections southwest and west-southwest of Laiagam (localities 108 and 103 respectively, WABAG); also recorded from isolated samples in OK TEDI and WABAG (see Figures 6 and 16).

Praeorbulina glomerosa glomerosa (Blow, 1956): *Globigerinoides glomerosa glomerosa* Blow, 1956, p. 65, text-fig. 1, 15–19; text-fig. 2, figs. 1–2. [Pl. 40, fig. 13]

Rare forms assigned to *P. glomerosa glomerosa* occur in sample F.435 at the base of the Kindan section (locality 100, WABAG) and in a section southwest of Laiagam (locality 108, WABAG); these specimens are transitional to *P. glomerosa curva*.

Specimens referable to the *Praeorbulina glomerosa* group also occur in fine-grained limestones from several localities (see Pl. 11).

Praeorbulina sicana sicana (de Stefani, 1952): *Globigerinoides sicana* de Stefani, 1952, p. 9. [Pl. 31, fig. 16]

Blow (1969) concluded that the name *Globigerinoides sicanus* had priority over the name *G. bisphericus* Todd, 1954. However, while some workers have used the name *sicanus*, others retained the usage of *bisphericus*. Jenkins & others (1981) referred to these different usages, and from an examination of the holotype of each species decided that they could be separated; *sicanus* was transferred to the genus *Praeorbulina*. The PNG specimens show the features listed by Jenkins & others (1981) for *P. sicana*.

P. sicana sicana has been recorded from several sections and isolated samples (see Figs. 6, 8, 9, 12, 13 and 16).

Praeorbulina transitoria (Blow, 1956): *Globigerinoides transitoria* Blow, 1956, p. 65, text-fig. 2, figs. 12–15. [Pl. 40, fig. 16]

Occurs abundantly in samples at the base of the Kindan section (locality 100, WABAG), and is common in sections southwest and west-southwest of Laiagam (localities 103 and 108 respectively, WABAG), in the Burgers Mountain section (locality 16, WABAG), and in isolated samples (see Figures 6 and 16).

Genus **Sphaeroidinellopsis** Banner & Blow, 1959

Type species: *Sphaeroidinella dehiscens subdehiscens* Blow, 1959; by original designation.

Sphaeroidinellopsis seminulina seminulina (Schwager, 1866): *Globigerina seminulina* Schwager, 1866, p. 256, pl. 7, fig. 112. [Pl. 40, figs. 17–18]

Occurs as a rare to abundant element of the fauna in several sections and isolated samples.

Genus **Streptochilus** Brönnimann & Resig, 1971

Type species: *Bolivina tokelauae* Boersma, 1969 (*in* Kierstead & others, 1969); by original designation.

Streptochilus globigerum (Schwager, 1866): *Textilaria globigera* Schwager, 1866, p. 252, pl. 7, fig. 100. [Pl. 40, figs. 19–23]

Specimens referred to *Streptochilus globigerum* have been found in samples from the upper beds of the Kindan section (locality 100, WABAG). Only rare specimens show the apertural collar and connection with the margin of the previous aperture; in most cases these are either removed by abrasion, or obscured by infilling of the test. The reticulate test wall similarly is shown only by few specimens.

Steptochilus sp. [Pl. 12, figs. 19–24]

Specimens placed here have been observed only in thin sections of fine-grained limestones thought to be Late Oligocene-Early Miocene in age. Only the biserial test form has been observed, and no data are available on apertural characteristics or wall texture.

Genus **Subbotina** Brotzen & Pozaryska, 1961

Type species: *Globigerina triloculinoides* Plummer, 1926; by original designation.

Subbotina frontosa frontosa (Subbotina, 1953); *Globigerina frontosa* Subbotina, 1953, p. 84, pl. 12, figs. 3a–c (fide Blow, 1979). [Pl. 22, figs. 13–18]

Occurs rarely in sample 9051 (locality 69, WABAG) only. The specimens closely resemble the holotype, with four chambers visible from the ventral side, a high arched aperture, and a convex dorsal surface.

Subbotina frontosa boweri (Bolli, 1957): *Globigerina boweri* Bolli, 1957, p. 163, pl. 36, figs. 1a–c, 2a–b. [Pl. 22, figs. 19–27]

Rare specimens assigned to this species occur in sample 9051 (locality 69, WABAG). Stainforth & others (1975) regarded *S. boweri* as a synonym of *S. frontosa*, but the distinction as recognised by Blow (1979) at the subspecific level is followed here. The PNG specimens range from forms with appressed chambers (Pl. 22, figs. 22–24) to forms with more open coiling (Pl. 22, figs. 19–21) which resemble in ventral view *S. frontosa frontosa*. However, the tests have a distinct dorsal flattening which is not shown by *S. frontosa frontosa*.

Subbotina inaequispira (Subbotina, 1953): *Globigerina inaequispira* Subbotina, 1953, p. 69, pl. 6, figs. 1a–c, 2a–c, 3a–c, 4a–c. [Pl. 23, figs. 1–8]

This species was described from the Lower and Middle Eocene beds of the Caucasus, but in the present material has been recorded from samples 8142 and 9039 (localities 35 and 65 respectively, WABAG) of Late Paleocene age, and sample 9040 (locality 64, WABAG) of Middle Eocene age. Rare, poorly preserved specimens in samples 9051 and F.184 (localities 69 and 80 respectively, WABAG) are also possibly referable to *S. inaequispira*.

None of the present specimens have radially elongate chambers, but this is not a constant feature of the species and, in the original material, is clearly shown by only one paratype. The PNG specimens from the Eocene do have a more elongate final chamber than do those from the Late Paleocene, but this is the only difference to be observed. El-Naggar (1966) figured from the Paleocene of the Esna-Idfu region, Egypt, specimens with elongate chambers which he referred to *inaequispira*; these specimens are closely comparable to *inaequispira*, as was noted by Samanta (1973). Other records of *S. inaequispira* in Paleocene beds are given by Loeblich & Tappan (1957), Olsson (1960), and Hillebrandt (1962). However, Hillebrandt (1962) and Blow (1979) considered the specimens figured by Loeblich & Tappan (1957) as *Globigerina inaequispira* not to be referable to this species. Hillebrandt (1962) also considered the identification of *G. inaequispira* by Olsson (1960) as incorrect.

Blow (1979) gave the stratigraphical range of *S. inaequispira* as the later part of the Early Eocene to the later part of the Middle Eocene. The PNG specimens from the Late Paleocene resemble very closely the original type specimens and also specimens figured by Blow (1979, pl. 180 and 185) as characteristic of the species, and are referred to *S. inaequispira*. Some of the PNG specimens have a slightly broader last chamber. *S. triangularis* (White) in the sense of Bolli (1957) is also similar to the PNG specimens, but is a more closely coiled form with a smaller umbilicus.

Subbotina linaperta (Finlay, 1939): *Globigerina linaperta* Finlay, 1939, p. 125, pl. 23, figs. 54–57. [Pl. 23, figs. 9–15]

Recorded only from samples F.174 and F.184 (localities 77 and 80, WABAG). One specimen (Pl. 23, figs. 9–11) is very close to the holotype, which was refigured by Hornibrook (1958) and by Jenkins (1971). Some specimens have a bulla-like final chamber varying greatly in size and obscuring the umbilicus. One specimen of this kind was figured by Jenkins (1971). Jenkins' specimen does not have the distinctively compressed chambers of the holotype; the PNG specimens are also less compressed.

Subbotina pseudoeocaena (Subbotina, 1953): *Globigerina pseudoeocaena* var. *pseudoeocaena* Subbotina, 1953, p. 81, pl. 4, figs. 9a–c only (fide Blow, 1979). [Pl. 23, figs. 16–21]

Rare large specimens from sample 9051 (locality 69, WABAG) agree well with the description and figures given by Subbotina (1953). Included here are forms which Blow (1979) considered to be intermediate between *S. inaequispira* and *S. pseudoeocaena*.

Subbotina triloculinoides (Plummer, 1926): *Globigerina triloculinoides* Plummer, 1926, p. 134, pl. 8, figs. 10a–b. [Pl. 24, figs. 1–5]

Recorded frequently from samples 8136, 8142, and 9039 (localities 47, 35, and 65 respectively, WABAG). Previously recorded (Belford, 1967) from localities 37, 105, and 146, WABAG.

Subbotina velascoensis (Cushman, 1925): *Globigerina velascoensis* Cushman, 1925, p. 19, pl. 3, figs. 6a–c. [Pl. 24, figs. 6–14]

Recorded from samples 8136, 8142, and 9039 (localities 47, 35, and 65 respectively, WABAG). As noted by Bolli (1957), the holotype is a poorly preserved and deformed specimen. Blow (1979) used the name *velascoensis* in the sense of the specimens figured by Bolli, and that usage is followed here. The PNG specimens agree well with the specimens illustrated by Bolli and some show a porticus bordering the aperture.

Subbotina sp. 1. [Pl. 25, figs. 8–10]

Only one specimen of this species has been found, in sample 9039 (locality 65, WABAG). The test is high-spired and closely coiled, with the chambers increasing rapidly in size as added. The umbilicus is small, and the aperture a small low arch.

Subbotina sp. 2. [Pl. 25, figs. 11–13]

Only one specimen of this high-spired form has been found, in sample 9051 (locality 69, WABAG). The test has four chambers to a whorl, the chambers being inflated and globular, separated by deeply depressed sutures. The final chamber largely covers the umbilicus, and the aperture is large and arched.

Subbotina sp. 3. [Pl. 26, figs. 1–3]

This is also a high-spired species, represented only by one specimen from sample 9051 (locality 69, WABAG). It is more tightly coiled than is *S.* sp. 2, with appressed chambers, smaller lower aperture, and with the last chamber smaller than the previous chambers.

Subbotina sp. 4 [Pl. 26, figs. 4–11]

Numerous specimens of this small form have been found in sample 9039 (locality 65, WABAG). These are tightly coiled forms with appressed, but not laterally elongate, chambers, having 3 or slightly more than 3 chambers in the last whorl. The umbilicus is small, and the aperture is bordered by a porticus.

The PNG specimens resemble a specimen of *S. linaperta* (Finlay, 1939) figured by Blow (1979, pl. 160, fig. 7) and are probably referable to this species group. The chambers are not as laterally compressed as a specimen of *S. bakeri* (Cole, 1927) figured by Blow (1979, pl. 160, fig. 5). The present specimens resemble specimens from Late Paleocene beds of the Wangerrip Group, western Victoria, referred to by McGowran (1965) as *Globigerina* aff. *linaperta*.

Subbotina sp. 5. [Pl. 26, figs. 12–16]

This is a large, high-spired species with four chambers to a whorl, found rarely in samples 9040 and 9051 (localities 64 and 69 respectively, WABAG). Most specimens have a small bulla-like last chamber, either strongly or completely covering the umbilicus.

The PNG specimens may be referable to the *Subbotina corpulenta* group. They are more high-spired than the holotype of *S. corpulenta*, but are similar to a paratype (Subbotina, 1953, pl. 10, figs. 3a–c).

DESCRIPTIONS OF NEW TAXA

Globorotalia (*Clavatorella*) *prolata* sp. nov. [Pl. 33, figs. 1–9]

Materials examined: 15 specimens, many broken.

Derivation of name: From the Latin *prolatus*, extended, elongate, referring to the elongate chambers.

Diagnosis: A species of *Clavatorella* with well-separated chambers, test surface finely reticulate, also finely hispid on some specimens. Aperture with narrow porticus, and relict aperture on penultimate chamber of some specimens.

Description: Test low, trochospiral, umbilicus wide, open, consisting of 10 to 12 chambers in two whorls, 4 or 5 chambers visible from ventral side. Chambers of first whorl tightly coiled, increasing only slowly in size, those of second whorl increasing rapidly in size and becoming radially elongate, more loosely coiled and distinctly separated. Dorsal and ventral sutures narrow, deeply depressed, radial. Wall of test perforate, surface finely reticulate, on some specimens also finely hispid. Aperture interiomarginal, umbilical-extraumbilical, arched, with imperforate umbilical extension (porticus) developed on last two chambers of some specimens; a relict aperture is present occasionally along umbilical margin of porticus of penultimate chamber.

Dimensions	*Max. diameter*	*Min. diameter*	*Height*
Holotype	0.51 mm	0.40 mm	0.25 mm
Paratype A	0.50 mm	0.40 mm	0.25 mm
Paratype B	0.44 mm	0.33 mm	0.24 mm
Paratype C	0.41 mm	0.27 mm	0.20 mm
Paratype D	0.31 mm	0.24 mm	0.17 mm

Occurrence: Holotype (CPC 21996), and paratypes A to D (CPC 21997 to 22000) from sample F.434, Kindan section, locality 100, Wabag 1:250 000 Sheet area, Papua New Guinea; known only from this sample. Unfigured paratypes are deposited under CPC 22001, and also in the ESCAP Fossil Reference Collection held at the Bureau of Mineral Resources under number E.871.

Type level: Early Miocene; planktonic zone N.8.

Remarks: The new species *prolata* is placed in the subgenus *Clavatorella* following the criterion given by Blow (1969), namely that this is a useful taxonomic category for turborotalid forms with clavate, radially elongate adult chambers. Small forms of *G.* (*C.*) *prolata* sp. nov. show its turborotaliid relationships. The test is clearly trochospiral and there is no development of an apparent biumbilicate test, as noted by Blow (1969) for *G.* (*C.*) *bermudezi*.

G. (*C.*) *prolata* sp. nov. does not have as highly arched an aperture as does the type-species of this

subgenus, *G. (C.) bermudezi* (Bolli), particularly towards the equatorial periphery. Blow (1965) suggested that the aperture originally shown for *G. (C.) bermudezi* is a misdrawing. Edge views of *bermudezi* published by Blow (1965; 1969) show that the aperture is strongly arched near the equatorial periphery, and can give the impression of elongation of the aperture into the apertural face in the plane of coiling. The aperture of *prolata* sp. nov. is uniformly arched, and is not strongly developed on small forms.

The chambers of *G. (C.) prolata* sp. nov. are more clearly separated than are those of other described species of this subgenus.

Blow (1965) noted that *Clavatorella* is the Neogene analogue of the Cretaceous genus *Clavihedbergella* Banner & Blow, 1959, but differs in that it lacks a porticus or well-marked relict apertures. On some specimens of *G. (C.) prolata* sp. nov., a relict aperture can be seen on the penultimate chamber. *G. (C.) oveyi* Buckley, 1973 is the only other described species referred to *Clavatorella* which has distinct relict apertures and portici.

Globorotalia (Fohsella) peripheroacuta pristina subsp. nov. [Pl. 33, figs. 17–26]

Material examined: 34 specimens.

Derivation of name: From the Latin *pristinus*, early, original, primitive.

Diagnosis: A subspecies of the *G. (F.) peripheroacuta* group, with five chambers in the last whorl, a relatively large last chamber, and a compressed test.

Description: Test trochoid, dorsal surface evolute, ventral surface involute, umbilicus narrow, open; oval to almost circular in outline, equatorial periphery lobate, axial periphery broadly rounded in early chambers of last whorl, becoming narrowly to acutely rounded on later chambers. Dorsal slightly convex, ventral surface strongly convex. Chambers arranged in about three whorls, five chambers forming last whorl, increasing slowly and regularly in size, with last chamber forming slightly less than one-third of test. Spiral suture and dorsal intercameral sutures smooth or very slightly depressed, strongly recurved, meeting spiral suture at angle of 90°, and periphery of test at angle of about 45°; ventral sutures narrow, strongly depressed, radial. Test wall distinctly and coarsely perforate; wall of test smooth except for small pustules near aperture and near umbilical area of first two or three chambers of last whorl. Apertural face separated from remainder of chamber wall by distinct smooth angle. Aperture interiomarginal, narrow, elongate, extending from umbilicus to small re-entrant at periphery, with narrow strong lip.

Dimensions	*Max. diameter*	*Min. diameter*	*Height*
Holotype	0.38 mm	0.32 mm	0.21 mm
Paratype A	0.42 mm	0.33 mm	0.19 mm
Paratype B	0.44 mm	0.35 mm	0.20 mm
Paratype C	0.48 mm	0.42 mm	0.22 mm

Occurrence: Holotype (CPC 22005), and paratypes A to C (CPC 22006 to 22008) from sample F.434, Kindan section, locality 100, Wabag 1:250 000 Sheet area, Papua New Guinea; found also in sample F.435 in this section. Unfigured paratypes are deposited under CPC 22009, and also in the ESCAP Fossil Reference Collection held at the Bureau of Mineral Resources under number E.872.

Type level: Early Miocene, planktonic zone N.8.

Remarks: The rounded periphery of the early chambers of the last whorl, and the narrowly rounded later chambers, indicate a relationship between the present specimens and the species described by Blow & Banner (1966) as *G. (T.) peripheroacuta*, and for this reason the new taxon is introduced at subspecific level. It differs from *G. (T.) peripheroacuta peripheroacuta* in having 5 chambers in the last whorl as against 6, in having a relatively larger last chamber, and in the more compressed test.

The full range in test shape and test profile in edge view is shown by the holotype and figured paratypes. The profile of the last chamber ranges from that of the holotype, broad and with a change in curvature near the periphery, to that of paratypes C and D, smoothly sloping throughout and more compressed. Paratype C is the largest specimen found and also has the most narrowly rounded periphery, and a circular outline.

Globorotalia (Fohsella) wabagensis sp. nov. [Pl. 34, figs. 19–28]

Material examined: 38 specimens.

Derivation of name: From the town of Wabag, Central Highlands, Papua New Guinea.

Diagnosis: A biconvex species of *Fohsella* with 4 or 5 chambers in the last whorl, broadly rounded axial periphery, pustulose ventral surface near umbilicus and interiomarginal aperture; narrow, thick apertural lip.

Description: Test trochoid, dorsal surface evolute, ventrally involute, umbilicus very narrow or closed, oval to circular in outline, equatorial periphery lobate, axial periphery rounded. Profile in edge view ranging from slightly convex dorsally and strongly convex ventrally, to equally biconvex, to more strongly convex dorsally. Chambers arranged in about 3 whorls, with usually 5 but sometimes 4 chambers in the last whorl; increasing slowly in size as added, last chamber often offset towards ventral side. Spiral suture and dorsal intercameral sutures narrow, slightly depressed, dorsal sutures curved and strongly reflexed, dorsal chambers narrow, elongate; ventral sutures narrow, depressed, radial, or slightly sinuous between last 2 or 3 chambers. Periphery of early chambers of last whorl with thickened margin of clear shell material, visible only on moistened specimens, no keel developed. Test wall finely perforate, thickened and pustulose on ventral side of early chambers of last whorl and near umbilicus; early chambers on dorsal side obscured by shell material. Aperture interiomarginal, a narrow elongate opening extending from umbilicus to periphery, with narrow heavy, well developed lip.

Dimensions	*Max. diameter*	*Min. diameter*	*Height*
Holotype	0.31 mm	0.27 mm	0.18 mm
Paratype A	0.33 mm	0.29 mm	0.19 mm
Paratype B	0.33 mm	0.28 mm	0.20 mm
Paratype C	0.31 mm	0.27 mm	0.19 mm
Paratype D	0.31 mm	0.28 mm	0.21 mm

Occurrence: Holotype (CPC 22018) and paratypes A to D (CPC 22019 to 22022) from sample F.888 in a section west-southwest of Laiagam, locality 103, Wabag 1:250 000 Sheet area, Papua New Guinea; found only in this sample. Unfigured paratypes are deposited under

CPC 22023, and also in the ESCAP Fossil Reference Collection held at the Bureau of Mineral Resources under number E.873.

Remarks: The holotype and paratypes show the full range of variation observed for *G. (T.) wabagensis*. The holotype is a five-chambered equally biconvex form with a distinct apertural lip. Paratype A is also five chambered, with a small open umbilicus and more narrowly rounded last chamber. Paratypes B and D are four chambered forms; Paratype B has a relatively large last chamber and only slightly convex dorsal side. Paratype D has a strongly convex dorsal side. Some of the four chambered forms resemble *G. (G.) miozea cibaoensis* Bermudez, 1949, but have a more broadly rounded last chamber and lack the high spire of *cibaoensis*.

Dr D. G. Jenkins has compared specimens of *G. (T.) wabagensis* with *G. (G.) miozea miozea* Finlay, 1939, and has also kindly forwarded specimens of *miozea miozea*. *G. (T.) wabagensis* is more biconvex than *miozea miozea*, has a distinct apertural lip not normally found in *miozea miozea*, and also seems to have a thinner test wall.

Globorotalia (Globorotalia) quasimiocenica sp. nov. [Pl. 36, figs. 1–11]

Material examined: 10 specimens.

Derivation of name: Prefixed by the Latin *quasi*, appearing as if, simulating, referring to the similarity with the species *miocenica*.

Diagnosis: A large, moderately compressed species of *Globorotalia* with flat or very slightly convex dorsal surface, convex ventral surface, 6–7 chambers in the last whorl, curved, raised dorsal sutures, and narrow depressed radial ventral sutures.

Description: Test large, trochoid, dorsal surface flat or only slightly convex, ventral surface strongly convex. Outline of test circular, equatorial periphery slightly lobate, axial periphery narrow with thick imperforate keel. Chambers increasing only slowly in size, usually 7 chambers visible from ventral side, some specimens with only 6 chambers. Dorsal sutures thickened and raised near periphery, becoming smooth near spiral suture, curved and reflexed; ventral sutures narrow, depressed, straight or slightly curved, radial. Test wall finely perforate, surface of test smooth. Aperture interiomarginal, umbilical-extraumbilical, an elongate low opening, on some specimens with a narrow lip.

Dimensions	*Max. diameter*	*Min. diameter*	*Height*
Holotype	0.66 mm	0.53 mm	0.30 mm
Paratype A	0.56 mm	0.46 mm	0.27 mm
Paratype B	0.56 mm	0.46 mm	0.28 mm
Paratype C	0.66 mm	0.60 mm	0.28 mm

Occurrence: Holotype (CPC 22032) and paratypes A to C (CPC 22033 to 22035) from sample F.432, Kindan section, locality 100, Wabag 1:250 000 Sheet area, Papua New Guinea; known only from this sample. Unfigured paratypes are deposited under CPC 22036, and also in the ESCAP Fossil Reference Collection held at the Bureau of Mineral Resources, under number E.874.

Type level: Late Miocene, not older than planktonic zone N.17.

Remarks: G. (G.) quasimiocenica sp. nov. resembles *G. (G.) pseudomiocenica* Bolli & Bermudez, 1965 in its flat dorsal surface, but *G. (G.) quasimiocenica* is more compressed with more chambers per whorl, and the equatorial periphery is less lobate. *G. (G.) quasimiocenica* also resembles *G. (G.) miocenica* Palmer, 1945 in its flat dorsal surface, but is more compressed, and has a more lobate equatorial periphery. *G. (G.) multicamerata* Cushman & Jarvis, 1930 is a more compressed biconvex species with a more strongly developed keel.

Globorotalia (Hirsutella) scitula planaria subsp. nov. [Pl. 37, figs. 10–17]

Material examined: 17 specimens.

Derivation of name: From the Latin *planarius*, even, flat, referring to the flat dorsal surface.

Diagnosis: A subspecies of the *G. (H.) scitula* group characterised by a flat dorsal surface.

Description: Test trochospiral, tightly coiled, umbilicus small, shallow; chambers increasing slowly in size, arranged in 2½ to 3 whorls, five chambers visible from ventral side. Plano-convex, dorsal surface flat, ventral surface convex. Circular to oval in outline, equatorial periphery lobate, axial periphery of early chambers broadly rounded, on later chambers narrowly rounded; no peripheral keel or imperforate peripheral band developed. Sutures on dorsal side depressed, curved, meeting periphery at angle of about 45°, on ventral side, depressed, straight, radial. Surface of test finely perforate, small pustules developed on early chambers of last whorl on ventral side, particularly at umbilical margins. Aperture interiomarginal, umbilical-extra-umbilical, extending to small re-entrant near periphery, with narrow, elongate lip.

Dimensions	*Max. diameter*	*Min. diameter*	*Height*
Holotype	0.35 mm	0.30 mm	0.16 mm
Paratype A	0.32 mm	0.29 mm	0.16 mm
Paratype B	0.32 mm	0.28 mm	0.15 mm

Occurrence: Holotype (CPC 22043) and paratypes A and B (CPC 22044 and 22045) from sample F.421, Kindan section, locality 100, Wabag 1:250 000 Sheet area, Papua New Guinea; known also from samples F.420 and F.432 in this section. Unfigured paratypes are deposited under CPC 22046, and also in the ESCAP Fossil Reference Collection held at the Bureau of Mineral Resources under number E.875.

Type level: Late Miocene; not older than planktonic zone N.17.

Remarks: G. (H.) scitula planaria subsp. nov. is considered to be referable to the *G. (H.) scitula* group, particularly in the nature of the coiling and the dorsal chamber shape. It differs from *G. (H.) scitula scitula* in the plano-convex rather than biconvex test, and in having a relatively smaller last chamber. *G. (H.) scitula ventriosa* Ogniben, 1958 has a flat or only slightly convex dorsal surface, but has a highly convex ventral surface and broadly rounded axial periphery. The specimens figured by Verdenius (1970) as *Globorotalia scitula ventriosa* from the Late Miocene of the western Guadalquivir Basin are much less convex dorsally than the type specimens of this species and have a narrower axial periphery. They are very similar to *G. (H.) scitula planaria* subsp. nov., and may be referable to this subspecies.

Globorotalia (*Turborotalia*) *variospira* sp. nov. [Pl. 24, figs. 15–17; Pl. 25, figs. 1–7]

Material examined: 29 specimens.

Derivation of name: From the Latin *varius*, changing, and *spira*, coil, referring to the looser coiling of the last whorl.

Diagnosis: A large species of *Globorotalia* (*Turborotalia*) with 4 or 5 chambers visible ventrally, coiling becoming looser in the final whorl; narrow, depressed, radial dorsal and ventral sutures; wall pustulose near umbilicus, aperture umbilical, low, elongate.

Description: Test large, trochoid, consisting of about 12 chambers arranged in three whorls, usually 5 but sometimes 4 chambers visible from ventral side. Equatorial periphery lobate, axial periphery rounded. Chambers increasing only slowly in size, four chambers in penultimate whorl, coiling in most specimens then becoming looser and more open, generally with five chambers in final whorl, umbilicus wide, open, shallow. Occasional specimens with final chamber directed towards umbilicus, coiling also becoming tighter, 4–4½ chambers visible from ventral side. Sutures on both dorsal and ventral sides narrow, deeply depressed, radial. Test wall perforate, with small pustules at umbilical margin of early chambers of last whorl, otherwise finely pitted. Aperture interiomarginal, umbilical-extraumbilical, low, elongate, not clearly observed.

Dimensions	*Max. diameter*	*Min. diameter*	*Height*
Holotype	0.80 mm	0.65 mm	0.53 mm
Paratype A	0.80 mm	0.63 mm	0.50 mm
Paratype B	0.71 mm	0.67 mm	0.51 mm
Paratype C	0.61 mm	0.51 mm	0.47 mm
Paratype D	0.47 mm	0.41 mm	0.46 mm

Occurrence: Holotype (CPC 21919) and paratypes A to C (CPC 21920 to 21922) from sample 7152–9039, near the Lagaip River, 14 km northwest of Laiagam, locality 65, Wabag 1:250 000 Sheet area, Papua New Guinea; known only from this sample. Unfigured paratypes are deposited under CPC 21923, and also in the ESCAP Fossil Reference Collection held at the Bureau of Mineral Resources under number E.876.

Type level: Late Paleocene (*Globorotalia* (*G.*) *pseudomenardii* Zone, P.4).

Remarks: Of the observed specimens of *G.* (*T.*) *variospira* sp. nov., 20 are dextrally coiled and 9 sinistrally coiled. The holotype and figured paratypes show the full range of variation of the species from open coiling, five-chambered forms to the more tightly coiled four chambered forms. *Globorotalia* (*Turborotalia*) *variospira* is very similar to *G.* (*T.*) sp. 2 figured by Pujol & Sigal (1979), particularly the more open coiled five-chambered forms. Pujol & Sigal did not record closely coiled specimens similar to those in the PNG material. *Globorotalia* (*T.*) *inconstans* (Subbotina, 1953) has more chambers per whorl, and the test is more strongly pustulose. *G.* (*T.*) *schachdagica* (Khalilov, 1956) also has more chambers per whorl and is more closely coiled with a smaller umbilicus.

AGES OF SEDIMENTS

OK TEDI 1:250 000 SHEET AREA (Fig. 1)

Late Paleocene

Only one sample, 0756, on the Bi River, a southern tributary of the Ok Om, is included here. It contains rare planktonic foraminifera, *Globorotalia* (*Morozovella*) spp. and globigerinids; the specimens of *Morozovella* are referred to the *G.* (*M.*) *velascoensis* group. This sample is considered to be from deep-water sediments.

Eocene

In OK TEDI, Eocene rocks are known from the north Tekin section, from near Telefomin, from northwest of Lake Kopiago, and from south of Mount Capella. In the north Tekin section, Eocene beds are represented only by material derived from the central and second thrust sheets. The samples, all of limestone (biomicrudite) are 3410, 3426, 3428, 3429, 3430, and 3431. The fauna recorded includes *Discocyclina* spp. (abundant), *Nummulites* cf. *javanus* Verbeek, *N.* sp., *Asterocyclina* sp., *?Aktinocyclina* sp., *Operculina* sp., *?Elphidium* sp., *Gypsina* sp., *Heterostegina* sp., *Lacazinella* sp. (fragments), planktonic foraminifera and indeterminable smaller benthonic foraminifera. Some specimens in sample 3431 are referred to *Palaeonummulites* as recognised by Eames & others (1962) and as used as a subgenus of *Nummulites* by Frost & Langenheim (1974). The planktonic foraminifera include *Globorotalia* (*Truncorotaloides*) spp. (including *G.* (*T.*) *topilensis*), a thick-walled globigerinid resembling *Globigerapsis senni* (Beckmann) (referred by Blow, 1979, to *Muricoglobigerina*) or *G. index* (Finlay), and rare Heterohelicidae.

These samples are placed in the Middle Eocene (zones P.12 to P.14 of the planktonic zonal scale, or Ta_3 of the 'letter' classification*). Sample 0661 is regarded as doubtfully Eocene; it is a biomicrite, with rare small planktonic foraminifera and rare probable radiolaria. The fauna consists of globigerinid specimens, small keeled forms referred to *Globorotalia* (*Morozovella*) sp., one specimen referred to *Globorotalia* (*Turborotalia*) sp., and a rare small almost planispiral form which may be referable to *Pseudohastigerina* sp. The faunal evidence for age of the sample is not conclusive, but is suggestive of Eocene (see Pl. 1, figs. 10, 23, 33 and 34).

Sample 04NG0517 and part of sample 04NG0523 are referred to the Middle to Late Eocene; the fauna includes *Nummulites* sp., *Discocyclina* sp., and *?Borelis* sp.; no planktonic foraminifera have been found.

Sample P.5016, south of Mount Capella, is also referred to the Middle to Late Eocene; it contains *Discocyclina* sp., *Aktinocyclina* sp., and *Nummulites javanus*.

* Adams (in press) has reviewed the Oligocene and Miocene parts of the Letter Classification and related them to the European stages. The lower Tf is now divided into Tf_1 and Tf_2 'stages', and some of the samples described here should be referred to the upper Te-Tf_1 interval which is mainly of Early Miocene age. The top of Tf_1 = top N9 of Blow's (1969) planktonic zonation.

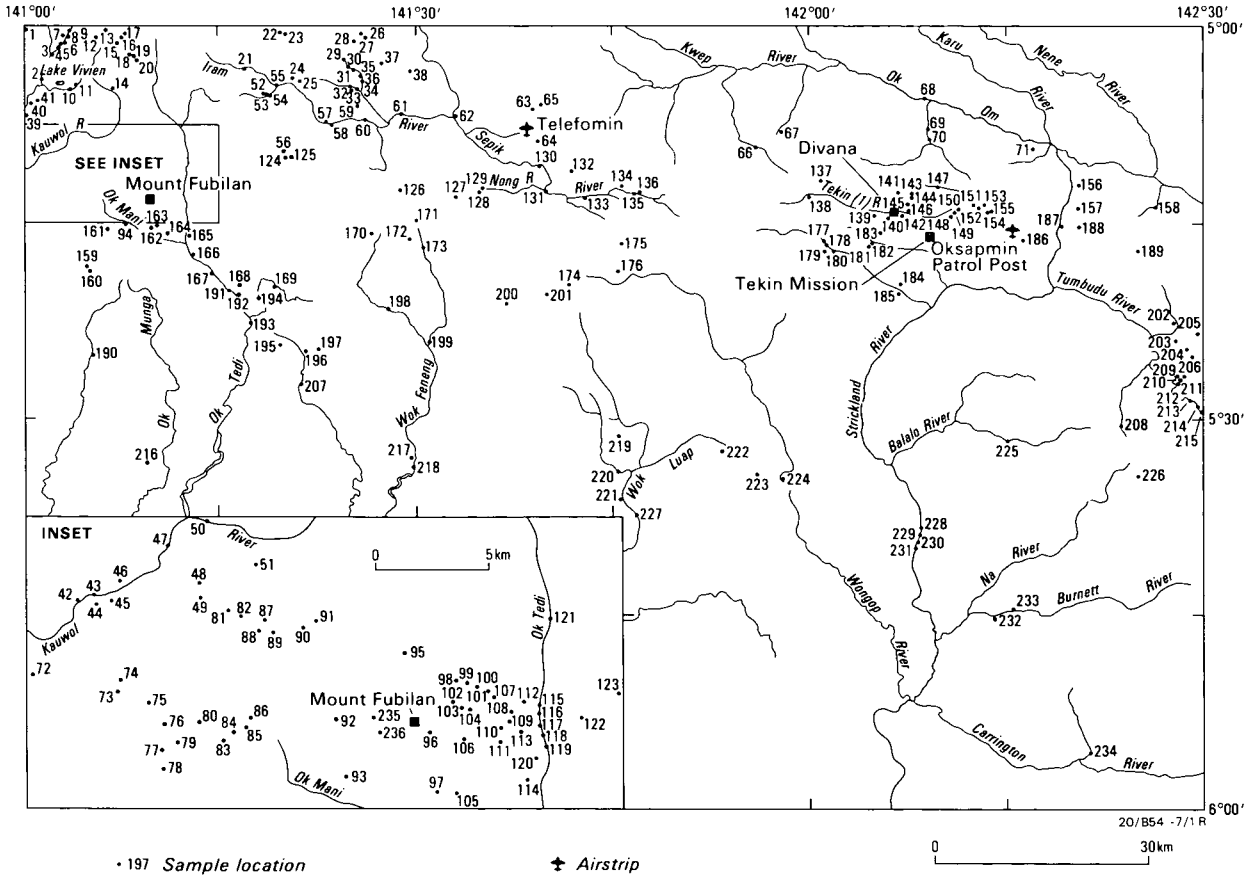


Fig. 1. Sample localities, Ok Tedi 1:250 000 Sheet area; based on Davies & Norvick (1974).

These sediments, except for those represented by 0661, are thought to have accumulated under open shelf or fore-reef shoal conditions, with warm, clear, shallow water; 0661 is regarded as being from a deep-water sediment.

Early Oligocene (Tc)

Beds of this age are represented by both outcrop and float material, all from carbonate sediments. Early Oligocene samples in the north Tekin section are 3411, 3432, 3433, 3434, 3435, and 3436; in the south Tekin section, 3337, 3338, and 3444; at the head of the Wongop River, 6052, 6053, 6054, 6055, and 6057; and at the head of the Wok Feneng, 1195. These samples are discussed in more detail in the relevant sections. The fauna recorded includes *Nummulites fichteli* Michelotti, *Borelis pygmaeus* Hanzawa, *Amphistegina* sp., *Heterostegina* sp., *Carpenteria* sp. or *Sporadotrema* sp., *Halkyardia* sp., *Gypsina* sp., *Operculina* sp., *Elphidium* sp., miliolids, and indeterminable smaller foraminifera.

Isolated samples of Early Oligocene age are: 0139, 1641, 0200, 3017, 3105, 3354, 6131K, 68691650A, 04NG0519, 04NG1013, P.4641, and P.5670. These samples, except for 1641, are biomicrudites with a fauna very similar to that given earlier; sample P.5670 also contains *Nummulites vascus* Joly & Leymerie. Sample 1641 is a conglomerate with igneous fragments and coarse sandstone pebbles, containing large mollusca, corals, bryozoa, foraminifera, algae, and echinoid spines. Foraminifera include *Nummulites fichteli* Michelotti, *Borelis* sp. (in sample 0139 referred to *B.* cf. *inflata*), *Operculina* sp., and small indeterminable rotaliids. The only definite indication of age is given by *Nummulites fichteli*; specimens are well-preserved and do not appear to have undergone prolonged abrasion and reworking. In the absence of other evidence this sample is also included in the Early Oligocene.

Part of sample 1231, which consists of samples of boulders at the foot of a cliff, contains an Early Oligocene fauna of *Nummulites fichteli*, *Operculina* sp., and *Elphidium* sp. An outcrop sample of nummulitic limestone collected by Chawner (1939) at locality 219 is probably of Early Oligocene age, as is a similar sample collected by Zehnder & de Caen (1955) at locality 220.

Sediments of Early Oligocene age are regarded as having been deposited mainly in warm, shallow water, in open-shelf or fore-reef shoal conditions. Beds represented by sample 1641 are probably of shallow water, possibly fore-reef shoal origin.

Late Oligocene–Early Miocene (Te, undifferentiated)

This group of samples, which contains a fauna not permitting finer subdivision into early or late Te, includes biomicrites, biomicrudites, biosparites, and biosparudites, from outcrop and float material.

Three samples, 0864, 0865, and 0866, from the Nong River section, are placed here; a more detailed discussion of this section is given later. Sample 1047, from float material, contains *Borelis pygmaeus* Hanzawa, *Austrotrillina striata* Todd & Post, *Gypsina globulus* Reuss, miliolids, and other indeterminable

smaller foraminifera. Sample P.5017, from outcrop south of Mount Capella, has a similar fauna.

Numerous samples referred to the Te stage are characterised by a fauna which includes *Borelis pygmaeus*, *Austrotrillina striata*, and *Sorites* sp. These samples are: 1149, 1151, and 1156 from the Strickland Gorge; 1682, 1986, 3110, 3127, 3141, 3498, 6011, and 6056; 3415 and 3417 from the north Tekin section; 68691634B; 68691636B and 68691649. Two other samples included here, 1343 and 1345, from a section on the Hindenberg Wall, are lower Te on the basis of their stratigraphic position, as are 1032, 1038, and 1041 from the Tifalmin section, and probably also 3340 from the south Tekin section.

Other samples are placed in the Te stage on the co-occurrence of *Borelis pygmaeus* and *Sorites* sp. These include 1150 and 1152 from the Strickland Gorge; 3475 to 3480 inclusive, collected from blocks at the foot of a cliff of Darai Limestone; 1193; 1644; and P.5025.

An outcrop sample at the top of the north Tekin section, 1829, contains *Lepidocyclina* (*Eulepidina*) sp., *Borelis* sp., *Heterostegina* sp., *Amphistegina* sp., *?Pararotalia* sp., and indeterminable smaller benthonic foraminifera. Sample 3114, from a landslide above Bolivip Mission, contains *Spiroclypeus margaritatus* (Schlumberger), *Lepidocyclina* (*Nephrolepidina*) sp., *Carpenteria* sp. or *Sporadotrema* sp., *Amphistegina* sp., *Cycloclypeus* sp., *Heterostegina* sp., *Elphidium* sp., rare planktonic specimens (Globigerinidae), and indeterminable smaller benthonic foraminifera.

Sample 3427, from the north Tekin section, contains *Lepidocyclina* (*Eulepidina*) sp., *L.* (*?Nephrolepidina*) sp., *Heterostegina* sp., *Borelis* sp., and indeterminable smaller foraminifera. Sample 3355 contains *Lepidocyclina* (*Eulepidina*) sp., *Heterostegina* sp., and *Operculina* sp. Another sample probably of Te age is 3347, which contains *Lepidocyclina* (*?E.*) sp. and *?Acervulina* sp.

Several samples are referred to the Te stage on the occurrence of either *Lepidocyclina* (*Eulepidina*) sp. or *Spiroclypeus* sp., or on the co-occurrence of these genera. These samples are 68691631, 68691642B, 68691644A, 68691647A, 68691651B, 04NG1008, P.4624, P.4880, P.5027, and 76294197. Two samples from the south Tekin section included here, 3442 and 3443, are lower Te in age on their stratigraphic position.

Samples from the Tifalmin section with a similar fauna which are placed here are 1033, 1034, 1036, 1037, and 1040; 1033 and 1034 also contain *Austrotrillina striata* Todd & Post. On their stratigraphic position these samples can be placed in the lower Te.

Sediments referred to the Te stage are interpreted as having accumulated under open-shelf or fore-reef shoal conditions, with warm, shallow, clear water.

Late Oligocene (lower Te)

Samples of this age, from both outcrop and float material, include biomicrites, biomicrudites, biosparites, and biosparudites.

Sample 1043 contains *Lepidocyclina* (*Eulepidina*) *ephippioides* Jones & Chapman, *Borelis* sp., *Heterostegina* sp., *Gypsina* sp., *Amphistegina* sp., *Carpenteria* sp. or *Sporadotrema* sp., and indeterminable smaller foraminifera. Sample 1338, in a section at the Hindenberg Wall, contains *Spiroclypeus margaritatus*, *Lepidocyclina* (*Nephrolepidina*) sp., *Miogypsina* (*Miogypsinoides*) *complanata/bantamensis*, *Gypsina globulus*, *Operculina* sp., and *?Heterostegina* sp. Other samples given a lower Te age based on the occurrence of *Lepidocyclina* (*E.*) *ephippioides* and/or *Miogypsina* (*Miogypsinoides*) *complanata/bantamensis*, together with *Spiroclypeus margaritatus*, *Austrotrillina striata*, and *Borelis pygmaeus*, are 1583, 3021, 3339, 3412, 3413, and 3414. Sample 1583 contains specimens of *Nummulites* (*Palaeonummulites*) sp. which in vertical section closely resemble *Operculinoides howei* Gravell & Hanna, 1937 (see Pl. 4, figs. 1 and 2).

Samples from the Tifalmin section which can be referred to the lower Te are 1040, near the base of the sequence, and 1031, near the top. The fauna of 1040 includes *Lepidocyclina* (*E.*) cf. *ephippioides* and *Spiroclypeus* sp., and of 1031, *Austrotrillina striata*, *Miogypsina* (*Miogypsinoides*) *?complanata* (Schlumberger), *Spiroclypeus* sp., and *Borelis* sp.

The fauna of sample 68691651C includes *Lepidocyclina* (*E.*) sp., *Halkyardia* sp., and *Borelis* sp. Adams (1970) gave the lower Te as the upper stratigraphic limit of the genus *Halkyardia*, and this sample is therefore referred to the lower Te. Sample P.4622, containing *Lepidocyclina* (*E.*) *ephippioides*, *Heterostegina* sp., and *Amphistegina* sp. is placed in the lower Te; P.5669 has a similar fauna. Sample P.4884, which contains specimens referred to the *Lepidocyclina* (*E.*) *ephippioides* group, is also regarded as of probable lower Te age.

Late Oligocene sediments are also considered to have accumulated under open shelf or fore-reef conditions, with warm, shallow, clear water.

Early Miocene (upper Te)

Rocks of this age include biomicrites, biomicrudites, and biosparudites. Sample 0624 is probably upper Te in age, the fauna including *Miogypsina* (*M.*) *thecideaeformis*, *M.* (*Miogypsinoides*) cf. *dehaarti*, and *Austrotrillina* cf. *striata*. From a section on the Nong River, samples 0858 and 0859 are placed in the upper Te; these samples are discussed in more detail later. Sample 3416 from the north Tekin section, 3097 from the Hindenberg Wall, and 3329, 3438, 3439, and 3440 from the south Tekin section, are also upper Te in age.

Samples which contain specimens intermediate between *Austrotrillina striata* Todd & Post and *A. howchini* (Schlumberger), some also containing *Miogypsina* (*M.*) sp. and/or *Flosculinella globulosa* or *Flosculinella* sp., are probably of upper Te age. These samples are 6018, 68691640E, 68691643B, 68691644A, 68691646A, and 68691646B.

Sample 3329 contains *Lepidocyclina* (*Nephrolepidina*) *ferreroi* Provale and one specimen of *Austrotrillina striata*. Adams (1970) queried the occurrence of *L.* (*N.*) *ferreroi* in late upper Te, but this occurrence suggests that it does appear at this level.

Sample P.4716, containing *Lepidocyclina* (*N.*) sp., *Spiroclypeus margaritatus*, and *Miogypsina* (*Miogypsinoides*) *bantamensis/dehaarti*, is placed in the upper Te, as is P.5019, with *Lepidocyclina* (*N.*) sp., *Miogypsina* (*M.*) sp., and *Austrotrillina striata*.

These sediments are interpreted as accumulating under open shelf or fore-reef shoal conditions, with warm, shallow, clear water.

Early–Middle Miocene (upper Te–lower Tf)

Many samples contain an indefinite fauna which does not enable any more precise age determination to be

made within this stratigraphic interval; these beds include biomicrites, biosparites, biomicrudites, and biosparudites. The more important elements of the fauna are *Miogypsina* (*M.*) sp., *Lepidocyclina* (*N.*) spp., including *L.* (*N.*) *ferreroi* Provale, *Austrotrillina* spp., the specimens often being poorly preserved and specifically indeterminable, *Flosculinella* sp., and *Cycloclypeus* (*Katacycloclypeus*) spp. (including *C.* (*K.*) cf. *annulatus* Martin).

Samples referred to this interval are: 0131; 1231 (part); 1335; 1602; 1631, which contains a thick-walled species of *Austrotrillina* too poorly preserved for positive identification, and is associated with 1632, which contains a planktonic foraminiferal fauna not older than Middle Miocene (zone N.9) (the relative stratigraphic position of these two samples is not known — 1631 may be lower Tf in age, but because of the uncertain specific identification of the specimens of *Austrotrillina* it is included in the upper Te–lower Tf; it is probably not older than late upper Te); 1636, 1640, 1651, 1681; 1684 1690; 1809; 1811, also associated with a sample containing a planktonic foraminiferal fauna not older than Middle Miocene (zone N.9), and probably not older than late upper Te; 3029, 3278; 3280; 3282; 3330 (lower Tf on biometric data); 3342; 3343 (lower Tf on biometric data); 3351; 3353; 3407; 3408; 3422; 3423 (lower Tf on biometric data); 3424; 3437; 5035; 5036 (lower Tf on biometric data); 5037; 6019; 6022; 6023; 6111; 7006; 68691621; 68691626A; 68691627C; 68691638B; 68691639; 68691640B; 68691640F; 68691643C; 04NG0514; 04NG0518; 04NG1010; P.4645; P.4661; P.4668; P.4670; P.4671; P.4677; P.4678; P.4679; P.4680; P.4681; P.4691; P.4699; P.4700; P.4804; P.4811; P.4814; P.4816; P.4818; P.4826; P.4828; P.4838; P.4839; P.4882; P.4883; P.4885; P.4973; P.4984; P.4986; P.5001; P.5012; P.5022; P.5023; 76294158; 76294159; 76294179; 76294183; 76294196.

Sample 7000 contains an indefinite fauna of upper Te–lower Tf age; it contains, among other species, *Lepidocyclina* (*Nephrolepidina*) sp. and *Miogypsina* (*M.*) sp., and is probably referable to the lower Tf on its stratigraphic position. Samples 1794 and 6129B contain a limited fauna including *Miogypsina* (*M.*) sp.; 1794 is probably lower Tf in age, based on its stratigraphic position, and 6129B is associated with samples containing a planktonic foraminiferal fauna indicating an age not older than Middle Miocene (zone N.9).

Sample 0459, containing *Flosculinella globulosa* (Rutten), *Austrotrillina* cf. *howchini* (Schlumberger), *Lepidocyclina* (*Nephrolepidina*) sp., and *Miogypsina* (*M.*) sp. is given a late upper Te–early lower Tf age. Adams (1970) stated that it was uncertain whether the transition from *F. globulosa* to *F. bontangensis* (Rutten) occurred just below or above the Te/Tf boundary. The fauna of sample 0459 does not give an accurate age determination; the specimens of *Austrotrillina* are poorly preserved, but show a wall structure approaching that of *A. howchini*, which appears in late upper Te.

Three samples, 0133, 0134, and 0135, from outcrop in a section on the Sepik River headwaters, overlie clastic sediments containing a planktonic foraminiferal fauna indicating a zone N.8 age (uppermost Early Miocene). The fauna recorded from these samples includes *Lepidocyclina* (*Nephrolepidina*) *ferreroi* Provale, *Cycloclypeus* (*C.*) sp., *C.* (*Katacycloclypeus*) cf. *annulatus* Martin, *Miogypsina* (*M.*) sp., *Austrotrillina* sp. (poorly preserved), *Planorbulinella* sp., *Operculina* sp., *Gypsina* sp., *Amphistegina* sp., *Carpenteria* sp. or *Sporadotrema* sp., *Elphidium* sp., and indeterminable smaller foraminifera. One sample, 0134, also contains numerous planktonic foraminifera referable to the *Praeorbulina* group. The fauna of these samples indicates a latest upper Te or lower Tf age; their relationship to the clastic sediments supports a lower Tf age; 0134 is also lower Tf on the evidence of biometric data.

As with other carbonate sediments, sediments of upper Te–lower Tf age are thought to have accumulated under open shelf or fore-reef shoal conditions.

Middle Miocene (lower Tf)

Samples of lower Tf age include biomicrites, biomicrudites, and biosparrudites. An outcrop sample placed in the lower Tf on the evidence of the planktonic foraminifera is 1688. This sample contains *Lepidocyclina* (*Nephrolepidina*) sp., *Miogypsina* (*M.*) sp., *Carpenteria* sp. or *Sporadotrema* sp., *Sorites* sp., *Gypsina* sp., *Planorbulinella* sp., *Operculina* sp., *Amphistegina* sp., and planktonic foraminifera, including *Orbulina*. This sample is associated with 1687, which contains a planktonic foraminiferal fauna indicating an age within the N.9 to N.13 zonal interval. Other samples for which reliance is placed on the planktonic foraminifera for a lower Tf age are 3261, 3264, 3269, 7001, and 68691627D.

Three float samples of lower Tf age, 1048, 1654, and 1828, contain *Flosculinella bontangensis*, *Austrotrillina howchini*, *Miogypsina* (*M.*) sp., *Sorites* sp., and *Lepidocyclina* sp. Sample 3361, also a float sample, contains planktonic foraminifera, including *Orbulina*, and also one reworked specimen of *Morozovella* cf. *velascoensis acuta* from the Late Paleocene. Specimens of *Lepidocyclina* sp. are present and may also be reworked. Sample 3361 is associated with 3359, which contains a planktonic foraminiferal fauna of zone N.8 age.

A section on the Wok Feneng, the source of samples 1786 to 1792 inclusive, consists of beds of lower Tf age. Samples 1789, 1790, and 1792 contain planktonic foraminifera including *Orbulina universa* d'Orbigny, the *Globigerinoides quadrilobatus* (d'Orbigny) group, the *Globigerina praebulloides* Blow group, *Sphaeroidinellopsis seminulina seminulina* (Schwager), and *Globorotalia* (*Turborotalia*) cf. *obesa* Bolli. Two samples, 1790 and 1792, also contain specimens of *Miogypsina*, poorly preserved and possibly reworked. Three samples from beds above these, 1786, 1787, and 1788, contain *Flosculinella bontangensis*, *Marginopora* sp., *Elphidium* sp., *Operculina* sp., and indeterminable smaller foraminifera. Sample 6120D, a float sample, contains *Lepidocyclina* (*Trybliolepidina*) sp., *L.* (*Nephrolepidina*) *ferreroi*, *Miogypsina* (*M.*) sp., *Cycloclypeus* (*C.*) sp., and *Operculina* sp., and is placed in the lower Tf. Sample 1989, from outcrop, yielded free specimens of *Lepidocyclina* (*Nephrolepidina*) referable to the *howchini* group; this sample is associated with 1990, which contains a sparse and indefinite planktonic fauna indicating an age within the interval from zone N.9 to zone N.16. Measurements of the degree of curvature for specimens of *Lepidocyclina* from sample 1989 give a range from 53% to 79%, with a mean of 62.4%. In terms of

parameter F, introduced by Chaproniere (1980a, 1981b) and applied by Belford (1981) to specimens from New Ireland, the specimens are referable mainly to category 4, with some specimens close to category 5.

Part of sample 1231, from boulders at the foot of a cliff, is of lower Tf age, containing *Flosculinella bontangensis*, *Austrotrillina* cf. *howchini*, and indeterminable smaller foraminifera. Sample 68691628, with *Lepidocyclina* (*Trybliolepidina*) *rutteni* van der Vlerk, *L.* (*Nephrolepidina*) *ferreroi*, *Miogypsina* (*M.*) sp., *Amphistegina* sp., and *Operculina* sp. is also referred to the lower Tf. East of Mount Fubilan, sample P.4812, with a fauna including *Lepidocyclina* (*Nephrolepidina*) sp., *Miogypsina* (*M.*) sp., and *Flosculinella bontangensis* is placed in the lower Tf. Sample P.4836, with *Lepidocyclina* (*N.*) sp. and *Miogypsina* (*M.*) sp., is placed in the lower Tf on the basis of the occurrence of *Orbulina* in the fauna, as is sample P.5142.

Most of the samples of Middle Miocene age are regarded as open-shelf or fore-reef shoal deposits; the occasional occurrence of planktonic foraminifera among the larger benthonic foraminifera is not of significance for palaeoenvironmental conclusions. Sample 3361, with mainly planktonic foraminifera is from a deeper-water sediment; the rare specimens of large benthonic foraminifera, if not reworked, have been washed down the slope to deeper water. Samples 1789, 1790, and 1792 contain a varied fauna of benthonic smaller foraminifera, in addition to the planktonic faunas, and also have mollusca, bryozoa, echinoids, and fish fragments. These are probably outer-shelf deposits. In this section, on the Wok Feneng, there appears to have been a shallowing of the sea with time, the higher beds containing mainly larger benthonic foraminifera, echinoids, and algae.

Early Miocene (zone N.8)

The following samples contain a planktonic foraminiferal fauna indicating a zone N.8 age: 0136, 0137, 0138, 0199, 1835, 3321, 3322, 3332–3335, 3344–3346, 3359, 5034, 5038, 6015, 6044, 6045, P.4658, P.4659, P.4663, P.4676, P.4695, P.4749, P.4756, P.4817, P.4819, P.4820, P.4825, P.4833, P.4834, P.4840, P.4919, P.4932, P.4934, P.4935, P.4948, P.4974, 76294199, 76294201, and 76294203.

The zone N.8 age is based on the occurrence of such species as *Praeorbulina transitoria* (Blow), *P. glomerosa curva* (Blow), and *P. glomerosa circularis* (Blow). The full fauna recorded from each sample is shown in Figure 6.

Sediments of N.8 age contain an abundant and varied benthonic foraminiferal fauna, and are regarded as having accumulated under oceanic conditions on outer shelf areas.

Middle Miocene or younger

Samples included in this interval contain a restricted and often poorly preserved foraminiferal fauna, which in most cases indicates only that the age is not older than Middle Miocene (zone N.9); some samples contain a fauna suggesting a general Middle or Late Miocene age. Benthonic smaller foraminifera also occur in many samples. The fauna recorded includes *Orbulina universa* d'Orbigny, *O. suturalis* Brönnimann, the *Globigerinoides quadrilobatus* (d'Orbigny) group, *Globorotalia* (*Turborotalia*) *obesa* Bolli, *Dentoglobigerina altispira altispira* (Cushman & Jarvis), *D.* cf. *langhiana* Cita & Gelati, and *Globoquadrina dehiscens dehiscens* (Chapman, Parr & Collins). Samples placed here are 1148, 1578, 1632, 1642, 1659, 1805, 1810, 1845, 1998, 2395, 2396, 2399, 7003, 7007, P.4703, P.4827, P.4992, and 76294156.

Other samples from a section on the Ok Mani, containing a similar fauna and also not older than Middle Miocene, are 6123, 6125, 6126, 6127, and 6130. Sample 6127 also contains *Globorotalia* (*Fohsella*) cf. *peripheroronda* and may be Middle Miocene in age (N.9–N.11 zonal interval).

Sample 1990 contains the *Globigerina praebulloides* group, the *Globigerinoides quadrilobatus* group, *G. subquadratus*, *Orbulina universa*, and *Globorotalia* (*Turborotalia*) *continuosa*, and can be placed in the N.9–N.16 zonal interval. This sample is associated with 1989, which contains specimens of the *Lepidocyclina* (*Nephrolepidina*) *howchini* group, and is of lower Tf age.

A general Middle Miocene (N.9–N.13 or N.14) age is given to four samples containing the following planktonic foraminifera: *Orbulina universa*, *Globigerina praebulloides* Blow group, *Globigerinoides quadrilobatus* group, *G. subquadratus* Brönnimann, *Globorotalia* (*Turborotalia*) *siakensis* (LeRoy), *G.* (*T.*) *obesa*, *Globoquadrina dehiscens dehiscens*, *Dentoglobigerina* cf. *langhiana*, and *Hastigerina siphonifera* Blow, s.l. These samples are 1530, 1643, 1687, and 6135. A sample collected by White (1972) at locality 234 is placed in the N.14–N.17 zonal interval.

Sample 1846 includes, in addition to other planktonic species already mentioned, the *Globorotalia* (*G.*) *cultrata* (d'Orbigny) group, *Sphaeroidinellopsis seminulina seminulina* (Schwager) and *Globigerinoides obliquus obliquus* Bolli, and is given a Middle Miocene (zone N.11) or younger age.

A group of samples with small planktonic foraminifera, benthonic smaller foraminifera, and some also with gastropods, bryozoa, coral fragments, ostracods, and echinoid spines is given a Late Miocene to Pliocene (N.16–N.21) age. These samples are 1693, 1804, 1853, 1854, and 3259. Planktonic species recorded are *Globigerina bulloides bulloides* d'Orbigny, *G. decoraperta* Takayanagi & Saito, *Globigerinoides quadrilobatus* group, *G. obliquus obliquus*, *Sphaeroidinellopsis seminulina seminulina*, *Globorotalia* (*Turborotalia*) *obesa*, and *Hastigerina siphonifera*, s.l.

Sample 76294157 is included here but could be older than Middle Miocene; it contains an indefinite fauna giving an age within the range N.6–N.14.

Beds of Middle Miocene or younger age also contain benthonic smaller foraminifera in addition to the planktonic fauna, and are thought to have accumulated under oceanic conditions on the outer shelf area.

Pliocene

Two samples, 1605 and 1608, are given a Pliocene age; 1605 may be younger than Pliocene. In 1605, the foraminiferal fauna is dominated by the benthonic species *Pseudorotalia schroeteriana*; gastropods and bryozoa are also present. Sample 1608 also contains *Pseudorotalia schroeteriana*; planktonic foraminifera present include the *Globigerinoides quadrilobatus* group, *G. bollii* Blow, *Globorotalia* (*Turborotalia*) *obesa*, *Globigerina bulloides bulloides*, and *Sphaeroidinellopsis seminulina seminulina*.

Samples of indefinite age

Included here are those samples containing a fauna which either does not permit an age determination, or gives an age only within a wide stratigraphic range. Many of these samples are associated with samples for which a definite age determination is possible, or are in a sequence whose age is known. In these cases, the probable age of the samples is given.

Late Eocene–Early Miocene. Sample 1776 contains *Borelis pygmaeus*, *Heterostegina* sp., *Gypsina* sp., and *Operculina* sp., and can be given an age only within the limits of Late Eocene to Early Miocene (Tb–upper Te). A similar fauna occurs in 3441, which probably can be referred to the Late Oligocene (lower Te) on its stratigraphic position.

Middle Oligocene–Early Miocene. Only one sample, 76294192, is included here; it contains *Austrotrillina striata* and *Borelis* sp., and is placed in the late middle Oligocene to Early Miocene (upper Td–Te).

Middle Oligocene–Middle Miocene (Td–lower Tf). Several samples containing *Lepidocyclina* sp. (subgenus often indeterminable), with or without *Operculina* sp., *Elphidium* sp., *Austrotrillina* sp., *Cycloclypeus* (*C.*) sp., *Borelis* sp., *Heterostegina* sp., and *Amphistegina* sp., are referred to the interval from middle Oligocene to Middle Miocene (Td–lower Tf). These samples are: 0860, 0862, and 0863 (all referable to Late Oligocene–Early Miocene, Te undifferentiated, on stratigraphic position); 1035 and 1039 (Late Oligocene, lower Te, on stratigraphic position); 1133; 1334 (possibly Early Miocene, upper Te, on stratigraphic position); 1639 (Early–Middle Miocene, upper Te–lower Tf, on association with other samples); 1655 (from an area where Middle Miocene, lower Tf, beds are known); 1658 (associated with beds not older than Middle Miocene, zone N.9; 3266 (Middle Miocene, lower Tf, on stratigraphic position); 3419 (Early Miocene, upper Te, on stratigraphic position); 68691623; P.4623 (associated with P.4622, of lower Te age); P.4674; P.4775; P.4776; P.4832; P.4916; P.5024; P.5028; and P.5080.

Late Oligocene–Middle Miocene (lower Te–lower Tf). Sample 1980, containing *Lepidocyclina* sp., *Marginopora* sp. or *Sorites* sp., *Elphidium* sp., and *Operculina* sp. can be referred to this interval.

Early Miocene or younger. Four samples, 0130, 1786, 6010, and 68691633, can be given only an Early Miocene or younger age on the basis of the observed fauna. Sample 0130 can be referred to the Early to Middle Miocene (upper Te–lower Tf) on its association with sample 0131; 1786 is probably Middle Miocene (lower Tf) based on its stratigraphic position in the Wok Feneng section; 6010 is associated with 6011, of Late Oligocene–Early Miocene, Te undifferentiated, age.

Age indefinite. Sample 0869, containing rare small planktonic foraminifera, can be given only a general Tertiary, possibly Miocene, age. Additional samples containing only planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera, or both planktonic and benthonic foraminifera, and which cannot be given any definite age are: 0132; 0856 (Late Oligocene–Early Miocene, Te undifferentiated, on stratigraphic position); 0857 (Early Miocene, upper Te, on stratigraphic position); 0861, 0867, and 0868 (all Late Oligocene–Early Miocene, Te undifferentiated, on stratigraphic position); 1147, 1157; 1336; 1337; 1341; 1342; 1344; 1653; 1683; 1694; 1807; 1981; 1988; 2394; 2610; 3096 (associated with Early Miocene, upper Te, beds) 3323; 3325, 3326, and 3327 (all probably Early Miocene, upper Te, on stratigraphic position); 3331 (associated with Early Miocene, upper Te, beds); 3350; 3409 (Early–Middle Miocene, upper Te–lower Tf, on stratigraphic position); 3418 (Early Miocene, upper Te, on stratigraphic position); 3425 (Early–Middle Miocene, upper Te–lower Tf, on stratigraphic position); 6033, 6034, 6128 (Middle Miocene, lower Tf, on stratigraphic position); and 7005.

Other samples containing a fauna which does not permit a definite age determination are: 1029, 1030, and 1042 (all probably Late Oligocene, lower Te, on stratigraphic position); 1131; 1132; 1134; 1169 (possibly Early Oligocene, Tc, on stratigraphic position); 1210, 1211; 1289; 1339 (Late Oligocene, lower Te, on stratigraphic position); 1604; 1650; 1678; 1695; 1774; 1775; 1777; 3099 (associated with Early Miocene, upper Te, samples); 3111 and 3113 (both associated with Late Oligocene–Early Miocene, Te undifferentiated, beds); 3146, 3341 (Late Oligocene, lower Te, on stratigraphic position); 3352, 3421 (Early Miocene, upper Te, on stratigraphic position); 6020; 6052; 68691630B; 68691645A–D; and 04NG0509.

A younger Tertiary (Neogene) age is given to three on stratigraphic position): 3352, 3421 (Early Miocene, lower Tf, on stratigraphic position).

A general Tertiary age is given to sample P.4660, containing planktonic foraminifera (Globigerinidae) seen only in thin section; it is associated with samples of Early Mocene (zone N.8) age.

Samples P.4644, P.4648, and P.4652 contain indefinite assemblages of planktonic foraminifera and can be given only a general Miocene or younger age. Also given this age are samples P.4689, P.4989, and 76294225, which contain small benthonic foraminifera including *Sorites* sp., *Marginopora* sp., and *Ammonia beccarii*.

North Tekin section

(localities 143 and 144, OK TEDI; Figure 2)

This section begins with a fine-grained deep-water planktonic foraminiferal limestone (Globigerinidae) also containing sponge spicules; the age is indefinite. This is followed by an open-shelf or fore-reef shoal limestone with a larger foraminiferal fauna giving only a general Early–Middle Miocene age (upper Te–lower Tf). This limestone, referred to the Darai Limestone, is followed by an interval of no exposure, probably representing the Lai Siltstone, which elsewhere is known to be of uppermost Early Miocene (zone N.8) age. This interval is terminated by a thrust fault, followed by a limestone sequence. A float sample at the base of the sequence (3410) contains *Discocyclina* spp., *Nummulites javanus*, and rare planktonic foraminifera, including *Globorotalia* (*Truncorotaloides*) types, and is regarded as Middle Eocene (Ta_3) in age. Above this is a limestone (3411) containing *Nummulites fichteli*, of Early Oligocene (Tc) age, followed by three samples (3412, 3413, and 3414) of Late Oligocene (lower Te) age, with *Lepidocyclina* (*Eulepidina*) cf. *ephippioides* and *Miogypsina* (*Miogypsinoides*) of the *complanata/bantamensis* group. No beds of Middle Oligocene (Td) age have been identified, but no break in the sequence has been observed. There is a sampling gap of about 15 metres in the section, and Middle

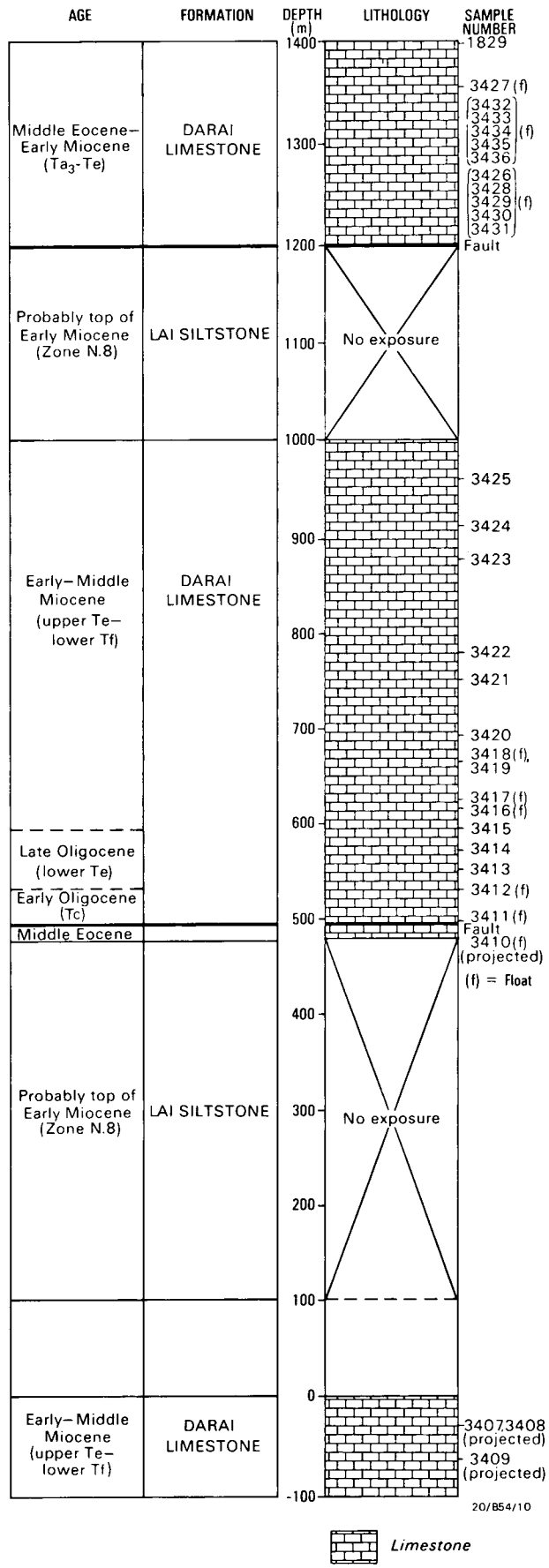


Fig. 2. North Tekin section; based on an unpublished section compiled by M. Norvick.

Oligocene beds may be represented in this interval. Adams (1970) noted that *Nummulites* and *Lepidocyclina* (*Eulepidina*) do not always occur together, and as the Middle Oligocene (Td) is defined by their association it is possible that some of the samples examined are in fact Middle Oligocene, lacking the necessary faunal content to establish this age.

The first sample in the sequence of Early Miocene (upper Te) age is 3416, with *Miogypsina* (*Miogypsinoides*) *bantamensis/dehaarti*, *Borelis pygmaeus*, *Austrotrillina striata*, and *Spiroclypeus margaritatus*. Associated with 3416 are two samples (3415, 3417) which can be given only a general Te age (Late Oligocene–Early Miocene). Samples from the sequence above this level contain an indefinite fauna, or a fauna giving only a general Early–Middle Miocene age (upper Te–lower Tf). Sample 3423 is lower Tf based on values for parameter F of Chaproniere (1980a, 1981b) applied to *Lepidocyclina*. Sample 3424, near the top of the sequence, contains *Lepidocyclina* (*Nephrolepidina*) *ferreroi*, indicating a late upper Te or lower Tf age. The highest sample, 3425, is again a deeper-water deposit with abundant planktonic foraminifera (Globigerinidae), and is of indefinite age.

Following this limestone sequence is a second interval lacking outcrop, again thought to represent the Lai Siltstone, terminated by a fault and followed by a second limestone sequence. The lower part of the sequence is represented only by float samples whose relative stratigraphic position is not known; they can be grouped only according to age. Five samples are considered to be of Middle Eocene (Ta_3) age; they contain *Discocyclina* sp., *Asterocyclina* sp., *Nummulites* sp., and planktonic foraminifera including *Morozovella* spp. and *Truncorotaloides* types. Another five samples are of Early Oligocene (Tc) age, with a fauna including *Nummulites fichteli*. The higher beds of the sequence are represented by only two samples, one float and one outcrop; each sample can be given only a general Te age, Late Oligocene to Early Miocene.

South Tekin section
(localities 145–153, OK TEDI; Figure 3)

The Darai Limestone at the base of this section is a fine-grained limestone containing planktonic and benthonic smaller foraminifera and sponge spicules, and is probably an outer shelf deposit. No definite age can be given to samples from this unit. Higher in the sequence, sample 3329 contains, among other species, *Lepidocyclina* (*N.*) *ferreroi*, *Austrotrillina striata* (one specimen), and planktonic specimens of the *Praeorbulina* group, and is placed in the late upper Te. Samples 3328 and 3330 can be given only an upper Te–lower Tf age, although 3330 is lower Tf on the basis of parameter F of Chaproniere (1980a, 1981b).

This limestone sequence is followed by 1050 metres of mudstone, silty mudstone, and silty sandstone, here referred to the Lai Siltstone. The planktonic foraminiferal fauna includes *Praeorbulina sicana*, *P. transitoria*, *P. glomerosa* group, *Globigerinoides quadrilobatus* group, and *Globoquadrina dehiscens dehiscens*, indicating a zone N.8 age; reworked Late Cretaceous and Paleocene specimens also occur. No change in age has been observed throughout the sequence, but no structural complication or repetition of the beds has been observed.

This sequence is terminated by a fault, followed by

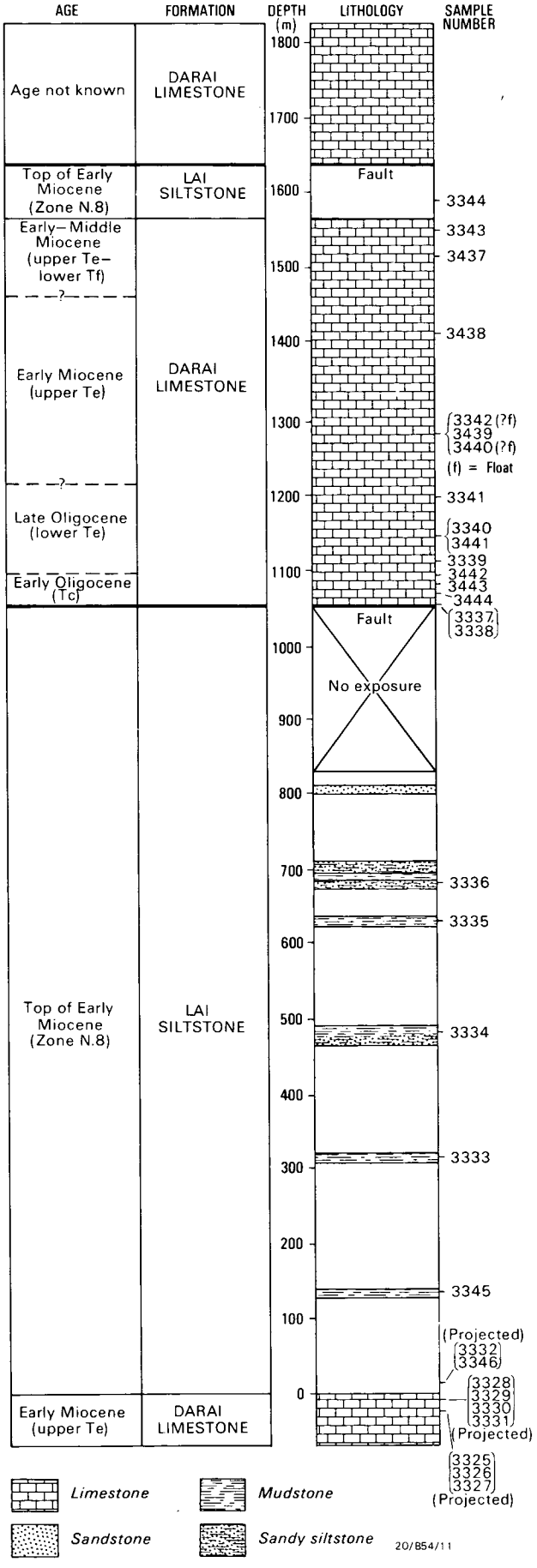


Fig. 3. South Tekin section; based on an unpublished section compiled by M. Norvick.

limestone, the lowest beds of which are Early Oligocene (Tc) in age, with *Nummulites fichteli*. Following a sample gap of about 20 metres, Late Oligocene (lower Te) beds occur; this age determination is based on the fauna of sample 3339, which includes *Lepidocyclina* (*Eulepidina*) *ephippioides*, *Austrotrillina striata*, and specimens of the *Miogypsina* (*Miogypsinoides*) *complanata/bantamensis* group. As with the north Tekin section, there is no indication of beds of Middle Oligocene (Td) age, and no break in the sequence has been observed. The upper limit of the Late Oligocene beds, and the position of the lower Te/upper Te boundary, cannot be fixed, as the succeeding samples have only a general Te fauna, with the appearance of an upper Te fauna in samples 3439, 3440, and by association 3342. The Early Miocene (upper Te) age is based on the occurrence of *Spiroclypeus margaritatus*, *Miogypsina* (*M.*) sp., and *M.* (*Miogypsinoides*) *bantamensis/dehaarti*. Beds of upper Te age continue in the section at least to sample 3438; above this sample, a fauna of Early–Middle Miocene age (upper Te–lower Tf) occurs in samples 3437 and 3343, including *Lepidocyclina* (*Nephrolepidina*) sp., *Miogypsina* (*M.*) sp., and *Cycloclypeus* (*Katacycloclypeus*) sp; 3343 is dated as lower Tf on the basis of parameter F of Chaproniere (1980a, 1981b).

The limestone sequence is followed by beds referred to the Lai Siltstone; the only sample available, 3344, again contains a planktonic foraminiferal fauna indicating a zone N.8 age. Another sequence of the Darai Limestone is in faulted contact with the mudstone, but no samples are available.

Nong River section
(localities 126–129, OK TEDI; Figure 4)

This section, measured on the northern side of the Nong River, has at the base a thickness of about 30 metres of limestone and shale projected from localities between the Nong River and Tifalmin. Three samples from the Darai Limestone (5035, 5036, and 5037) are regarded as Early to Middle Miocene (late upper Te–lower Tf) in age, based on the occurrence of specimens of *Austrotrillina howchini* and of specimens of the *Praeorbulina* group; 5036 is lower Tf based on values of parameter F of Chaproniere (1980a, 1981b). Two samples from the Lai Siltstone, immediately overlying the limestone, contain a planktonic foraminiferal fauna indicating a zone N.8 age, uppermost Early Miocene. These beds, of unknown thickness, are terminated by a thrust fault, and above this is a light grey siltstone, a sample (0869) of which contains a fauna of very small planktonic foraminifera indicating only a general Miocene age; reworked Paleocene specimens also occur. There is then a gap in outcrop, followed by a sandstone lacking foraminifera, then a second fault in the sequence, probably a minor thrust fault. Above the fault is another sequence through the Darai Limestone (samples 0856–0868); most of these samples contain an indefinite fauna, or a fauna indicating only a general Late Oligocene-Early Miocene age (Te, undifferentiated). Two samples near the top of the sequence (0858 and 0859) are Early Miocene (upper Te) in age, based on the occurrence of specimens of the *Miogypsina* (*Miogypsinoides*) *bantamensis/dehaarti* group. Part of this sequence through the Darai Limestone could be Late Oligocene (lower Te) in age, but this cannot be confirmed with the observed fauna.

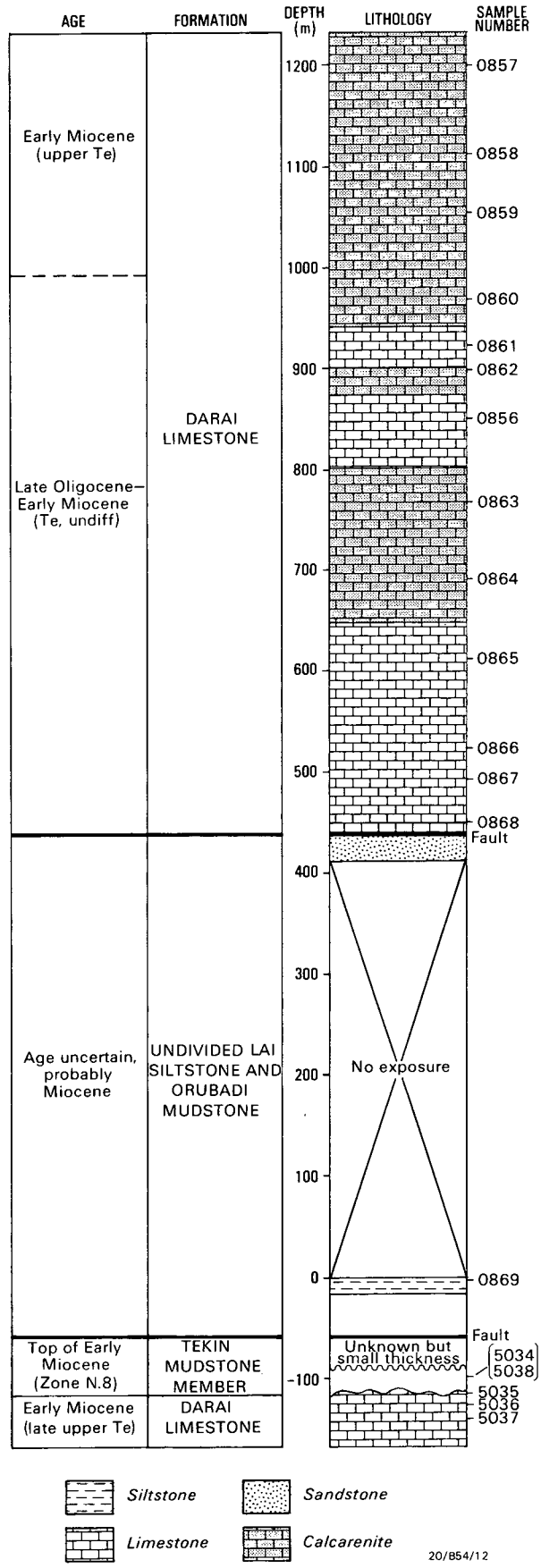


Fig. 4. Nong River section; based on an unpublished section compiled by M. Norvick.

Hindenberg Wall
(locality 175, OK TEDI)

This section through the Darai Limestone consists largely of beds of Late Oligocene (lower Te) age, between sample 1345 at the base and sample 1338, about 320 metres topographically higher. The lower Te age for this interval is based on the fauna of sample 1338, which includes *Spiroclypeus margaritatus* and specimens of the *Miogypsina* (*Miogypsinoides*) *complanata/bantamensis* group; samples lower in the section contain either an indefinite fauna, or a fauna giving only a general Te, Late Oligocene–Early Miocene, age. The next two higher samples, 1336 and 1337, contain only planktonic foraminifera (Globigerinidae) and indeterminable smaller foraminifera, and no definite age determination is possible. Sample 1335, about 480 metres topographically above the base of the section, contains a limited fauna, including *Miogypsina* (*M.*) sp., which indicates a general upper Te–lower Tf, Early to Middle Miocene, age; these beds are probably upper Te on the basis of their stratigraphic position. The last sample in the sequence, 1334, from the top 3 metres of limestone, contains only one fragment of *Lepidocyclina* sp., and indeterminable smaller foraminifera.

In addition to these outcrop samples, four samples (3096–3099 inclusive) were collected from boulders at the base of the section. Sample 3097 contains an upper Te, Early Miocene, fauna including *Miogypsina* (*M.*) sp., *M.* (*Miogypsinoides*) *dehaarti*, and *Lepidocyclina* (*Nephrolepidina*) sp., and is from high in the sequence. The remaining three samples contain only an indefinite fauna, and it is not possible to relate them to any particular part of the sequence.

Tifalmin section
(locality 59, OK TEDI; Figure 5)

This cliff section (samples 1029–1042) passes through beds which are probably of Late Oligocene (lower Te) age. The fauna recorded from each sample is given in Appendix 1. Several samples contain an indefinite fauna, others a fauna indicating only a general Late Oligocene–Early Miocene (Te, undifferentiated) age. The only possibility of a more definite Late Oligocene (lower Te) age determination is given by specimens of *Lepidocyclina* (*Eulepidina*) cf. *ephippioides* in sample 1040, and by specimens of *Miogypsina* (*Miogypsinoides*) sp., with a long initial coil similar to *M.* (*M.*) *complanata*, in sample 1031. Sample 1040 is near the base of the sequence and 1031 near the top; these samples form the basis for regarding the entire sequence as probably Late Oligocene in age.

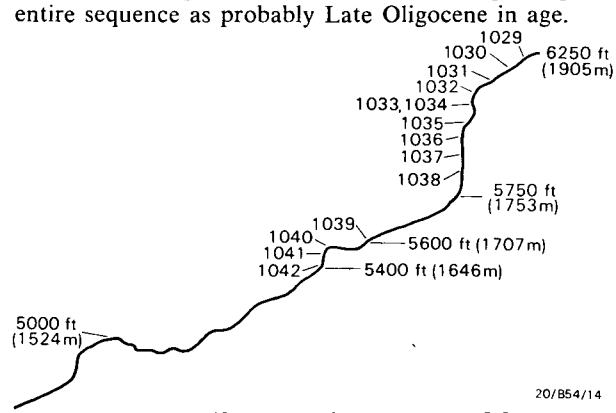


Fig. 5. Profile of Tifalmin section; based on field notes by H. L. Davies.

Sepik River headwaters, east of Feramin (localities 134–136, OK TEDI)

This is a short section through a northeast-dipping sequence; the sample interval is not known. In this area the Darai Limestone (samples 0133–0135) overlies shale referred to the Lai Siltstone (samples 0136–0138). The shale contains a planktonic foraminiferal fauna including *Praeorbulina sicana*, *P. transitoria*, and *P. glomerosa curva*, indicating a zone N.8 age. The limestone contains a fauna of top Early Miocene to Middle Miocene age, late upper Te to lower Tf, including *Lepidocyclina (Nephrolepidina) ferreroi*, *Cycloclypeus (Katacycloclypeus) annulatus*, *Miogypsina (M.)* sp., and planktonic foraminifera, either *Orbulina suturalis* or advanced specimens of the *Praeorbulina glomerosa* group. On its stratigraphic position, the limestone is most probably Middle Miocene (lower Tf) in age; sample 0134 is also lower Tf on the basis of parameter F of Chaproniere (1980a, 1981b).

Upstream from samples 0133 and 0134 in this section, stream boulders of a limestone (sample 0139) were collected, containing a fauna including *Nummulites fichteli*, *Borelis* sp., and *Halkyardia* sp., this sample is Early Oligocene (Tc) in age.

Ok Mani section (locality 164, OK TEDI)

This section is in Pnyang Formation on a northern tributary of the Ok Mani, and consists mainly of sandy siltstone, with a marly limestone near the top of the sequence; seven samples are available (in ascending order, 6123, 6125, 6126, 6127, 6128, 6129B, and 6130). The planktonic foraminifera are poorly preserved, and the fauna of most samples, which includes *Orbulina universa*, indicates only the the beds are not older than Middle Miocene (zone N.9). Sample 6127 contains one specimen of *Globorotalia (Fohsella)* cf. *peripheroronda*, suggesting that the beds may range from zone N.9 to zone N.11 in age (early Middle Miocene).

The marly limestone from the top of the section is represented by only one sample, 6129B, which contains *Miogypsina (M.)* sp., *Elphidium* sp., and *Carpenteria* sp. or *Sporadotrema* sp. This fauna gives only a general Early-Middle Miocene age, but the sample is Middle Miocene (lower Tf) in age on its stratigraphic position. The complete sampled sequence can be referred to the Middle Miocene, lower Tf, or zones N.9–N.12 of the planktonic foraminiferal zonal scheme.

Head of Wok Feneng (locality 171, OK TEDI)

At the base of this cliff section is a sequence of siltstones and silty sandstones of Ieru Formation which have not yielded foraminifera; a sample about 100 metres topographically above the base contains ostracods which suggest a general Mesozoic age (P. J. Jones, BMR, personal communication, 1975).

The first outcrop sample containing foraminifera is 1195, one of three samples collected over the top 30 metres of limestone; this sample is of Early Oligocene (Tc) age, containing *Nummulites fichteli*, *Halkyardia* sp., and *?Borelis* sp. Of the other two samples collected, 1194 lacks foraminifera, and 1196 contains an indefinite fauna. Higher beds in the section are represented by only one float sample, 1193, which contains *Borelis pygmaeus*, *Sorites* sp., *?Marginopora* sp., and *Austrotrillina* sp. (poorly preserved), and can be given only a general Te age.

The Tertiary part of this sequence, referred to the Darai Limestone, is known to consist at least of Early Oligocene, and Late Oligocene to Early Miocene beds. As with the north and south Tekin sections, there is no indication of Middle Oligocene (Td) beds, and the upper stratigraphic level of the sequence has not been established.

Wok Feneng, below limestone gorges (localities 217 and 218, OK TEDI)

This section is of Middle Miocene age; it passes through the Pnyang Formation, with limestone interbeds of the Pnyang Formation or the Warre Limestone Member. Marls, silty mudstones, and calcareous siltstones at the base contain abundant planktonic foraminifera including *Orbulina universa*, and some samples also contain specimens of *Miogypsina (M.)* sp. The fauna indicates a lower Tf, Middle Miocene age, zones N.9 to N.12 of the planktonic foraminiferal zonal scheme. This interval extends from sample 1789 to 1792. Above this is an interval represented by samples 1793, 1794, and 1786, lacking foraminifera or with an indefinite fauna; sample 1794 contains *Miogypsina (M.)* and these samples can be placed in the Middle Miocene on their stratigraphic position. Sample 1787 contains *Flosculinella bontangensis*, and the highest sample in the sequence, 1788, contains an indefinite fauna including *?Flosculinella* sp., *Operculina* sp., and *Elphidium* sp.

Head of Wongop River (locality 174, OK TEDI)

This section through the Darai Limestone, in a landslide in the headwaters of the Wongop River, consists mainly of Early Oligocene (Tc) beds. Sample 6052, at the base of the section, contains an indefinite fauna, and is followed by beds containing mainly *Nummulites fichteli*, extending to sample 6057; one sample, 6055, contains only *Halkyardia* sp., *Operculina* sp., and *?Borelis* sp., and is placed in the Early Oligocene on its stratigraphic position. Younger beds in the sequence are represented only by one float sample, 6056, which contains *Austrotrillina striata*, *Borelis pygmaeus*, *Sorites* sp., and *Gypsina globulus*, and can be given a general Late Oligocene–Early Miocene (Te) age.

WABAG 1:250 000 SHEET AREA (Fig. 7)

Early to Middle Paleocene

Only one sample, 8084, is included here. The fauna recorded is *Globorotalia (Acarinina) praecursoria praecursoria*, *G. (Turborotalia) inconstans*, *G. (T.) haunsbergensis*, *G. (T.) compressa compressa*, *G. (T.) pseudobulloides*, *G. (Globorotalia) ehrenbergi*, *Subbotina triloculinoides*, and *Chiloguembelina midwayensis midwayensis*.

Blow (1970) referred briefly to a Palaeogene zonation and, in a later publication (Blow, 1979), gave a detailed discussion of Palaeogene planktonic foraminiferal zones. Berggren (1971a, 1972), although not giving detailed definitions, showed the proposed

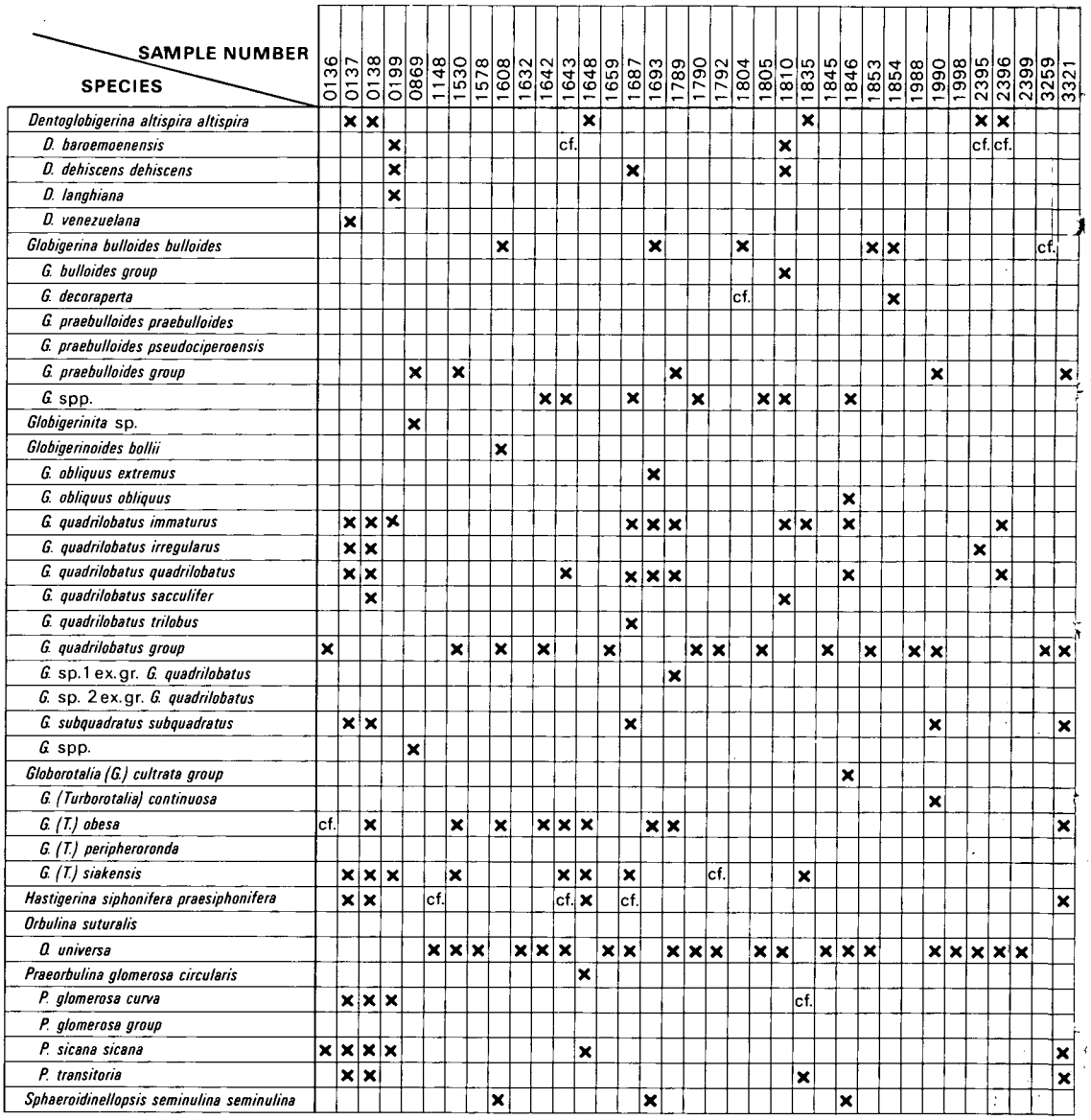


Fig. 6. Distribution of foraminifera in spot samples, Ok Tedi 1:250 000 Sheet area.

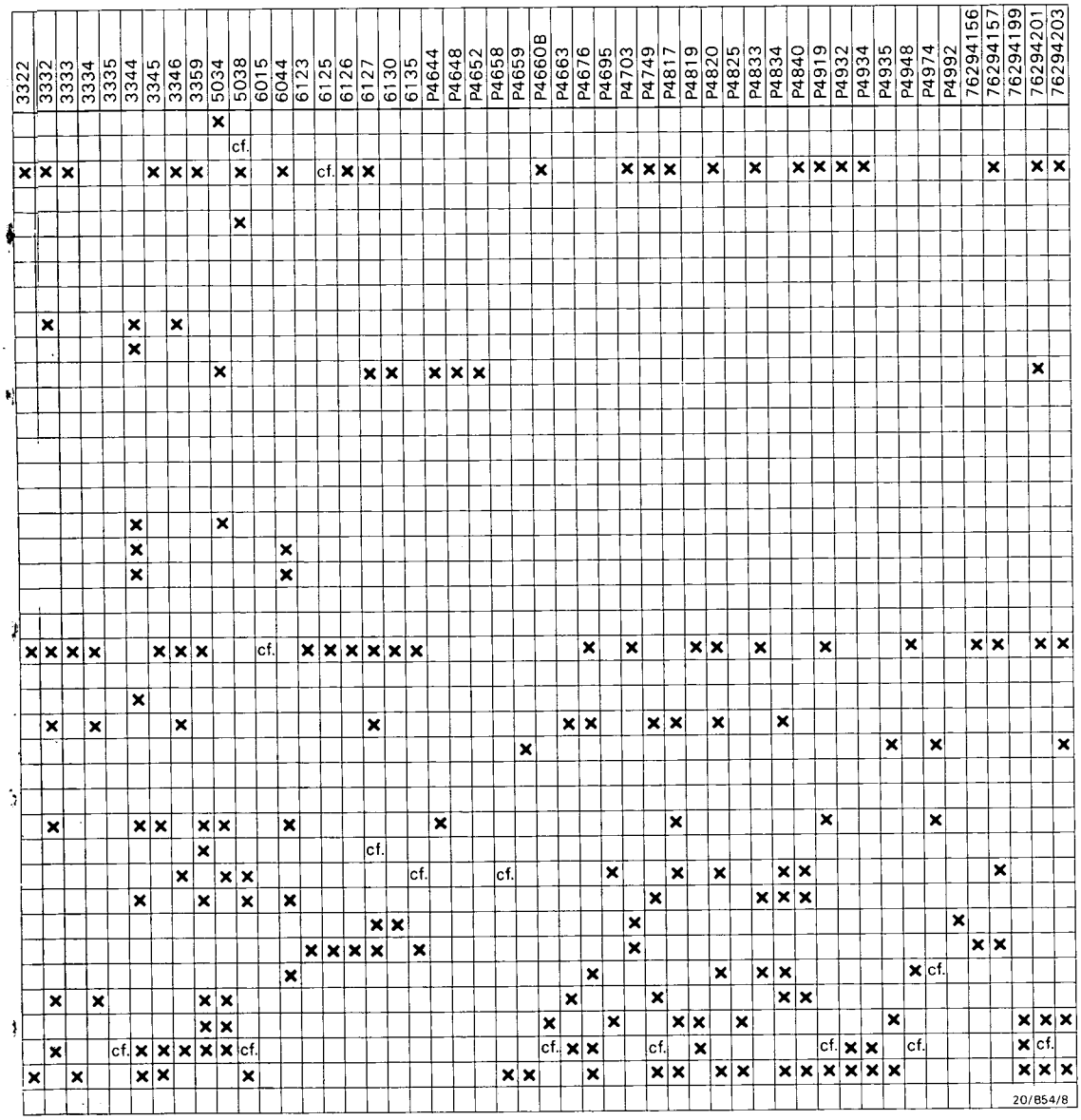
sequence of zones and related them to the chronostratigraphic scale. In terms of this zonation, sample 8084 is referred to the P.2–P.3 interval, latest Early Paleocene to middle Paleocene. One difficulty is the co-occurence of *Globorotalia* (*G.*) *ehrenbergi* and *G.* (*Turborotalia*) *inconstans*, which according to Blow (1979) do not overlap; *ehrenbergi* is given a range of P.3–P.4, and *inconstans* P.1–P.2. Other publications which discuss the occurrence of species recorded from sample 8084 are those of Beckmann (1957), Berggren (1965, 1969a, 1969b), Bolli (1957a), Bang (1969), Olsson (1970a, 1970b), Gohrbandt (1963), and Subbotina (1953).

These beds are the oldest Tertiary sediments known from OK TEDI and WABAG. An older fauna was recorded by Palmieri (1971) from Port Moresby.

Late middle to Late Paleocene

Samples of this age are 1008, 8136, 8142, 9039, 9041, 9042, 9060, F.342, F.870–F.872, F.900–F.905, and F.913–F.917. Sediments include marls, siltstones, and fine-grained limestones. Species recorded include *Globorotalia* (*G.*) *pseudomenardii*, *G.* (*Acarinina*) *convexa convexa*, *G.* (*Morozovella*) *velascoensis velascoensis*, *G.* (*M.*) *aequa aequa*, *G.* (*M.*) *tadjikistanensis*, *G.* (*M.*) *apanthesma*, *Subbotina triloculinoides*, and *Muricoglobigerina mckannai*. Sample 1008 is from a fine-grained limestone containing abundant planktonic foraminifera—*Globorotalia* (*Morozovella*) spp., including the *G.* (*M.*) *velascoensis* group and the *G.* (*M.*) *aequa* group, and Globigerinidae. These samples are regarded as late middle to Late Paleocene, zones P.4 to P.5 of Blow (1979).

Some additions and corrections are required to a paper by Belford (1967) recording Paleocene planktonic foraminifera from Papua New Guinea. One sample, F.275, is now regarded as probably Middle Eocene in age; samples F.871 and F.872 at the base of a section southwest of Laiagam, not previously included, are Late Paleocene in age. The fauna is limited, and includes only *Subbotina triloculinoides*, *S. velascoensis*, *Globorotalia* (*G.*) *pseudomenardii*, and *G.*



(*Morozovella*) cf. *pusilla laevigata*. These samples are overlain by beds of Early Miocene, zone N.8, age (see Figure 12). Dow & others (1972) show a fault at the base of this section which may separate the Paleocene and Miocene beds.

A section on the Andebare River (samples F.900–F.912), given as section 7 by both Dekker & Faulks (1964) and Belford (1967), is now considered to be inverted. Dow & others (1972) show the Andebare River section as being on the flank of a faulted and overturned anticline. Samples F.908–F.912 are now referred to the Eocene, and are discussed further later in this Bulletin.

A section at Tibinini, shown as section 5 by Belford (1967), has, at the base, a fine-grained limestone (sample F.913) of Late Paleocene age, with abundant planktonic foraminifera, including *Globorotalia* (*Morozovella*) of the *valescoensis* and *aequa* groups and small Globigerinidae; sample F.912 should be deleted from this section. Samples F.914 and F.915 are Late Paleocene in age; the two highest samples in the section, F.916 and F.917, are also now regarded as Eocene, and are discussed later.

The sediments of Paleocene age have been named the Lagaip beds, a term first used by Dekker & Faulks (1964). This was given as a new name by Dow & others (1972), but was first defined by Dow *in* Belford (1967). The later paper gave a more detailed discussion, and also designated a type section, although no section was measured. Similar Late Paleocene sediments were mapped as Moogli Mudstone and Urubea Sandstone by Jenkins & others (1969) and as 'Ta' by Davies (1983).

The limestone shown as Tibinini in section 5 of Dekker & Faulks (1964) and Belford (1967) is probably not Tibinini Limestone, but is the same limestone as that included in the Lagaip beds in section 7 of these papers (now considered to be inverted—see above). Unfortunately, no samples are available from the limestone in section 5 and no conclusions regarding its age can be given.

Late Paleocene–Early Eocene

One sample, Ab.81, with a limited and poorly preserved planktonic fauna, is placed here. The fauna includes *Globorotalia* (*Morozovella*) *aequa aequa*, *Sub-*

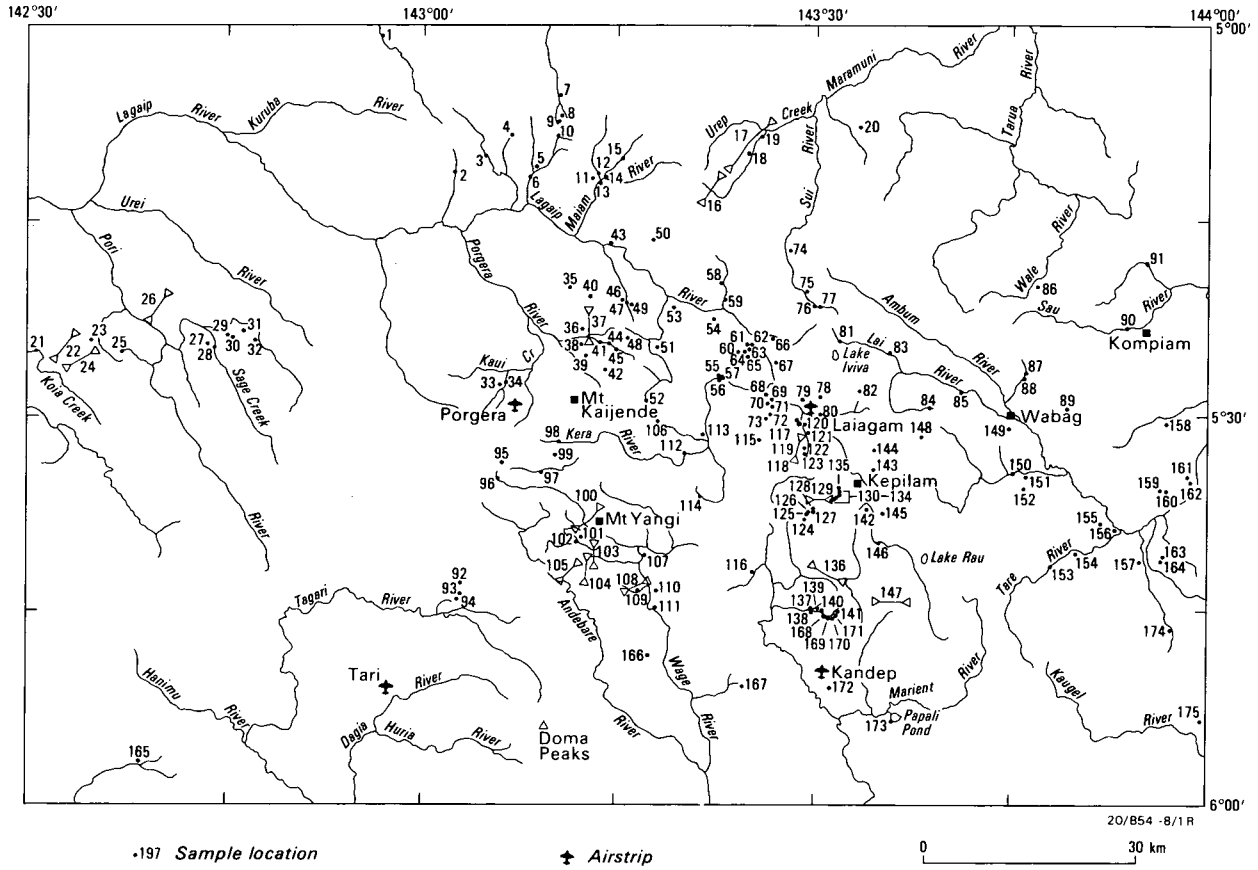


Fig. 7. Sample localities, Wabag 1:250 000 Sheet area; based on Davies (1983).

botina sp. of the *triloculinoides/linaperta* group, and *Muricoglobigerina* sp. of the *soldadoensis* group.

Early Eocene

One sample, F.184, is placed in the late part of the Early Eocene, zones P.8 to P.9. The fauna is limited and poorly preserved; species identified are *Globorotalia* (*Acarinina*) *pentacamerata*, *G.* (*A.*) *soldadoensis*, *G.* (*A.*) *whitei*, *Subbotina linaperta*, *S.* cf. *boweri*, and *S.* cf. *inaequispira*.

Middle Eocene

Sample F.174 contains small poorly preserved specimens among which are *Subbotina linaperta*, *S. frontosa boweri*, *Globorotalia* (*Acarinina*) *broedermanni*, *G.* (*Morozovella*) *lensiformis*, and *G.* (*M.*) sp. referable to the *aragonensis* group. This sample is referred to early Middle Eocene, zone P.10.

Sample 9044 contains *Subbotina frontosa frontosa*, *Globorotalia* (*Morozovella*) *lehneri*, *Globorotalia* (*Acarinina*) *pseudodubia piparoensis*, *G.* (*A.*) cf. *bullbrooki*, *G.* (*Truncorotaloides*) *topilensis*, *G.* (*M.*) *aequa aequa*, and *G.* (*M.*) *aragonensis*. The age is regarded as Middle Eocene, zone P.11; the species *aequa aequa* and *aragonensis* are possibly reworked from a slightly older Early Eocene, zone P.8 or P.9 fauna.

Several samples from fine-grained limestones containing abundant planktonic foraminifera are regarded as Middle Eocene in age. The fauna includes *Globorotalia* (*Morozovella*) spp., *Globorotalia* (*Truncorotaloides*) spp., indeterminable Globigerinidae, and rare Heterohelicidae. Species groups considered to be represented in the samples are: *Globorotalia* (*Truncorotaloides*) *rohri*, *G.* (*T.*) *topilensis*, *G.* (*Morozovella*) *aragonensis*, *G.* (*M.*) *renzi*, *G.* (*M.*) cf. *rex*, *G.* (*M.*) *spinulosa*, and a thick-walled globigerinid, closely comparable to the *Globigerinatheka index* (Finlay) group, or to *G. senni* (Beckmann); *senni* was referred by Blow (1979) to the genus *Muricoglobigerina*. *Hantkenina* sp. has also been observed rarely. Illustrations of these specimens are given in Plate 1.

Samples placed as Middle Eocene are: 0295, 1524, 1525, 1534, 1536, 8085, 8093, 8095, 8097, 8098, 8099, 8112, 8113, 8115, 8138, 8139, 8141, 8143a, 8146, B.70, B.118, B.135b, B.135h, B.138, F.41, F.231, F.275, F.868, F.908–F.912, F.916–F.917, and P.9401–P.9408.

Samples P.9401–P.9408 are not shown on the sample locality map. They are from the lower cliff, Mount Paiam, below Mount Kaijende, in the head of the Porgera Valley, east of Porgera airstrip. The outcrop from which the samples were taken is shown by Dow & others (1972, pl. 8, fig. 2). The Eocene beds in this section are referred to the Mendi Group. The only age previously available for any part of the sequence was the probable Te age given by Dow & others (1972) for beds referred by them to the Tibinini Limestone Member; these beds are placed by Davies (1983) in the Darai Limestone. There may be a continuous sequence in this area and Oligocene beds may be present higher in the cliffs at the head of the Porgera Valley.

Sample 1532 is probably Middle Eocene on its association with samples 1534 and 1536. Sample 8145 is doubtfully included here; it contains only radiolaria

and sponge spicules, but is associated as colluvial boulders with 8146, and is included for the sake of completeness in the faunal record.

The only samples collected in a sequence are F.908–F.912 and F.916–F.917. As already noted, samples F.908–F.912 are in a sequence which, as shown by Dekker & Faulks (1964) and Belford (1967), is now considered to be inverted, and the samples are now placed in the Middle Eocene and referred to the Mendi Group. The best fauna is that of sample F.908, which contains small specimens of *Discocyclina* sp., in addition to planktonic foraminifera which include *Globorotalia (Morozovella)* spp., *G. (Truncorotaloides)* spp., Globigerinidae, and indeterminable small rotaliid foraminifera. The sequence contains a high proportion of terrigenous material, and some samples have abundant specimens of small rotaliid foraminifera; planktonic foraminifera occur less frequently and consist only of Globigerinidae. Sample F.916 is from beds of this kind; sample F.917 contains abundant planktonic foraminifera, with no benthonic forms. Sample F.275, which was also placed by Belford (1967) in the Late Paleocene, has a similar but less abundant fauna.

Sample F.289 contains abundant small planktonic foraminifera and also abundant indeterminable rotaline forms. The planktonic foraminifera are small, thick-walled bullate forms, possibly referable to the *Globogerinatheka index* or *G. senni* groups; F.289 is tentatively considered to be Middle Eocene in age.

Two samples, 9040 and 9051, yielded free specimens of planktonic foraminifera (abundant in 9051). Species recorded include *Hantkenina (Aragonella) mexicana mexicana, H. (A.) mexicana dumblei, Globorotalia (Acarinina) broedermanni, G. (A.) pentacamerata, G. (A.) wartsteinensis, Globigerinatheka mexicana barri, G. mexicana kugleri, Globorotalia (Morozovella) aragonensis, G. (M.) lehneri, G. (M.) lensiformis, G. (Truncorotaloides) topilensis, G. (Acarinina) pseudodubia piparoensis, Subbotina frontosa frontosa, S. frontosa boweri,* and *S. inaequispira*; 9040 also contains rare radiolaria. These two samples are regarded as Middle Eocene in age; there are some inconsistencies in reported stratigraphic ranges, but they can be placed within the P.10 to P.12 zonal interval.

Early Oligocene (Tc)

Three samples, 0697, 2696, and Ab.43b are of Early Oligocene (Tc) age; all are biomicrudites, containing foraminifera, algae, and molluscan and coral fragments. Sample Ab.43b is from a limestone pebble in a conglomerate. Foraminifera occurring are *Nummulites fichteli, Borelis* sp., *Halkyardia* sp., *Heterostegina* sp., *Operculina* sp., *Carpenteria* sp. or *Sporadotrema* sp., miliolids, and other indeterminable smaller foraminifera.

General Oligocene age only (zones P.19–N.3)

One sample, 2672, yielded a limited fauna of planktonic species including *Dentoglobigerina tripartita tripartita, D. sellii,* and *Globigerinita dissimilis*, s. l., insufficient for a definite age determination. Two samples, P.9124 and P.9125, contain very poorly preserved foraminifera including possible *Dentoglobigerina sellii,* and cannot be dated more accurately than possible Oligocene.

Middle Oligocene–Middle Miocene (Td–lower Tf)

Two samples, 1106 and F.226, cannot be dated precisely, but are within this stratigraphic interval. The fauna includes foraminifera, algae, bryozoa, and echinoids; the foraminifera are *Lepidocyclina* sp., (no subgeneric identification possible) and *Elphidium* sp. Sample 1106 also contains *Amphistegina* sp., *Gypsina* sp., and *Planorbulina* sp.

Late Oligocene–Middle Miocene (Te–lower Tf)

Sample 2701 contains a poorly preserved fauna, including fragments of *Lepidocyclina* sp., *Sorites* sp., and *?Operculina* sp., and cannot be dated precisely within this stratigraphic interval. Another sample, P.9173, containing *?Lepidocyclina* sp. and *Borodinia septentrionalis*, is included here, but is given a general Te–Tf, Late Oligocene–Miocene, age.

Late Oligocene (lower Te)

Only one sample, 2700, is placed tentatively here. The fauna recorded is: *Lepidocyclina* spp., generally as small specimens or fragments, with one specimen resembling the species *L. (Eulepidina) ephippioides* Jones & Chapman; *Operculina* sp.; *Heterostegina* sp.; and indeterminable small foraminifera.

Late Oligocene–Early Miocene (zone N.3–zone N.4)

Samples included here are: 2648; 2650; 2671; 2675; 2679; 9054; F.279–F.281 from a section south of Crater Lake (Figure 10); F.449 and F.456–F.458 from a section south of Laiagam for which no details are available; F.936–F.938 from the Laiagam section (Figure 11); Ab.80; and Ab.82. The fauna recorded includes *Globigerinoides quadrilobatus primordius, Dentoglobigerina tripartita tripartita, D. sellii, Globigerina ouachitaensis ciperoensis, Globigerinita dissimilis, Globorotalia (T.) opima nana* and *G. (T.) kugleri.* The fauna is similar to that recorded by Belford (1974) from samples in the Ilaga Valley, Irian Jaya; nothing can be added here to the discussion given in that paper. Shafik & Chaproniere (1978) recorded these species from the Ashmore No. 1 Well, Northern Territory and commented on the delineation of the Oligocene/Miocene boundary.

Samples 2671 and 2679 do not contain *Globigerinoides* and can perhaps be regarded as Late Oligocene in age.

Probable Late Oligocene–Early Miocene

Numerous samples from fine-grained limestones containing only planktonic foraminifera are placed here. The samples are: 2651, 2674, 2676, 2678, 2680, 5195, 8087, 8096, 8100, 8101, 8105, 8107, 8108, 8111, 8114, 8133, 8143, 9030, 9036A–B, 9047, 9048, 9049, 9050, 9055, 9056, 9057, 9058, 9059, F.178, F.223, F.260, F.283, F.284, F.410, F.412, F.450, F.459, F.460, F.491, F.827, F.838, F.841, F.845, F.930, B.23, B.45, B.83, B.111, B.113, B.120, B.135f, B.136a, and B.136b.

The fauna includes Globigerinidae, small biserial forms here placed in *Streptochilus* sp., and small planispiral forms possibly referable to the genus *Berggrenia* Parker, 1976. Two samples, F.283 and F.284, occur in a section of the Crater Lake (Figure 10); planktonic foraminifera from other samples lower in the sequence indicate a Late Oligocene to Early Miocene age. Two other samples, F.450 and F.459, occur in a section south of Laiagam for which no details are available. Planktonic foraminifera from other samples in the sequence also indicate a Late Oligocene to Early Miocene age; these samples have been used as reference samples to which all other samples given a probable

Late Oligocene–Early Miocene age have been compared. Several samples occur as colluvial boulders associated with boulders of fine-grained limestone of Middle Eocene age, but this association has not been found in outcrop; it is possible that there is a stratigraphic break between Middle Eocene and Late Oligocene in the fine-grained deep-water limestones represented by these samples.

The recognition of the genera *Streptochilus* and *Berggrenia* in these samples cannot be taken as firm. *Streptochilus* has been recognised in Late Miocene samples in the Kindan section; no apertural details can be observed in thin section. The suggested reference to *Streptochilus* is based on the general test form, and the known stratigraphic range of the genus, which is Early Miocene to Recent. The genus *Berggrenia*, described from the Pliocene, is distinguished from *Pseudohastigerina* by its aperture and wall texture, neither of which can be determined in thin section; no free specimens which would permit a definite identification have been found.

Late Oligocene–Early Miocene (Te, undifferentiated)

Only one sample, 6058, is placed here; it is a biosparite, containing foraminifera, algae, and coral fragments. The foraminifera are recrystallised and poorly preserved, and include *Austrotrillina* cf. *striata, Sorites* sp., *Elphidium* sp., and miliolids.

Early Miocene

(a) *Upper Te.* Samples from carbonate sediments included here are 3299, 3386, 8041, 8042, F.43 and B.133a. The samples include biomicrudites and biosparites, with foraminifera, algae, bryozoa, molluscan fragments, and echinoid spines. The more important forms recorded are *Lepidocyclina* (*Nephrolepidina* and *Eulepidina*) spp., *Miogypsina* (*M.*) sp., M. (*Miogypsinoides*) *dehaarti*, and *Spiroclypeus margaritatus*. Samples 8041 and 8042 contain a fauna indicating an upper Te to lower Tf age; they are placed in the upper Te on the basis of the form number of specimens of *Lepidocyclina*.

Sample 8042 yielded free specimens of *Lepidocyclina* (*Nephrolepidina*) sp. The degree of curvature of specimens ranges from 18.2% to 54.3%, with a mean of 34.6%. The form number, a parameter introduced by Chaproniere (1980a, 1981b) is 1 or 2, indicating an early development stage. Free specimens of *Miogypsina* (*M.*) sp. referable to the *M.* (*M.*) *thecideaeformis* (Rutten) group also occur.

Specimens of *Lepidocyclina* from other samples examined have a form number of 3 or 4 in beds associated with a planktonic foraminiferal fauna of zone N.8 age. It is possible that the specimens of *Lepidocyclina* and *Miogypsina* in samples 8041 and 8042 are reworked, and that the age should be based on the planktonic fauna. This association is not regarded as reliable as evidence for the relationship of the larger foraminiferal and planktonic zonal schemes (see p. 40).

(b) *Planktonic zone N.8.* Samples placed here are: 2646; 8034; 8040; 8042; 8043; 8047; F.870–F.889 in a section west-southwest of Laiagam near Mount Yangi; F.433 and F.434 at the base of the Kindan section; F.399 in the Burgers Mountain section; and F.934 at the base of the Laiagam section. The fauna of these samples is given in Figures 8, 9, 12 and 16. Samples 8040, 8042, and 8043 contain specimens of the *Globigerinoides quadrilobatus* group, *Praeorbulina sicana*, *Globorotalia* (*T.*) *siakensis*, *G.* (*T.*) *birnageae*, and *G.* (*Hirsutella*) *scitula praescitula*; they are given an early N.8 age. Other samples contain *Praeorbulina transitoria* and the *P. glomerosa* group, and are given a younger N.8 age.

Also present in samples 8040, 8042, and 8043 are small, tightly coiled, four-chambered forms which in gross morphology cannot be distinguished from the *Globorotalia* (*Turborotalia*) *opima nana* morphotype (see Pl. 38, figs. 26–31). Blow (1969) referred to 4 to 5 chambered turborotaliid forms occurring in zones N.4 and N.5, differing from *G.* (*T.*) *opima nana* in apertural and umbilical characters. These distinctions cannot be applied easily to the present forms; their relationship requires further investigation. They lack the high arched aperture of *G.* (*T.*) *continuosa*, which is another form with similar gross morphology. Samples F.863 and F.1001, both fine-grained limestones examined only in thin section, contain planktonic foraminifera possibly including the *Praeorbulina glomerosa* group, and are included here as probably zone N.8 in age.

(c) *Miscellaneous* (zones N.4–N.8). Sample Ab.86 contains a planktonic foraminiferal fauna giving a zone N.4 to N.6 age.

Sample F.239, containing only *Globorotalia* (*Turborotalia*) *kugleri*, the *Globigerinoides quadrilobatus* group, and the *Globigerina praebulloides* group, is referred to the planktonic zone N.4. Samples 2658 and 2659 are referred to the N.4–N.6 zonal interval; 2658 contains the *Globigerinoides quadrilobatus* group and *Globigerinita dissimilis* (*ciperoensis* type of Blow); and 2659 contains the *Globigerinoides quadrilobatus* group, *Globigerinita unicava unicava*, and the *Globigerina praebulloides* group. A more varied fauna occurs in sample 8035, referred to the N.6–N.7 zonal interval; several subspecies of the *Globigerinoides quadrilobatus* group are present, including *altiapertura*, and also *G. subquadratus*, *Globorotalia* (*Turborotalia*) cf. *continuosa*, *Globoquadrina dehiscens dehiscens*, *Dentoglobigerina altispira altispira*, and *Hastigerina siphonifera*, s. l.

Early–Middle Miocene

(a) *Upper Te–lower Tf.* Several samples cannot be dated accurately within this interval. These samples are: 0687, 0690, 0691, 0694, 0695, 6064, 6065, 8029, 8037, 8048, 8117, F.50, F.527, F.557, F.560, Ab.78, Ab.1086a, and G.49. The main elements of the foraminiferal fauna are *Lepidocyclina* (*N.*) spp. and *Miogypsina* (*M.*) spp. Other forms are *Cycloclypeus* (*C.*) sp., *Amphistegina* sp., *Elphidium* sp., *Planorbulinella* sp., *Austrotrillina* sp., *Operculina* sp., *Gypsina* sp., *?Flosculinella* sp., and *Carpenteria* sp. or *Sporadotrema* sp.

(b) *Zones N.8–N.9.* A sequence southwest of Laiagam (samples F.442–F.448) contains a fauna referable to this zonal interval. The faunal distribution (Figure 13) reflects the position of this section across a synclinal axis (Dow & others, 1972), with a core of beds of N.9 age surrounded by beds of N.8 age.

(c) *Middle Miocene (zones N.9–N.13).* One sample, P.9171, contains a poorly preserved foraminiferal fauna indicating an age within this interval.

(d) *Miscellaneous (zones N.4–N.14).* Sample 8036 cannot be dated precisely within the N.5–N.12 zonal

interval; it contains the *Globigerinoides quadrilobatus* group, *G. subquadratus*, *Globoquadrina altispira altispira*, and *Globorotalia* (*Turborotalia*) *foliata*.

Sample Ab.83 is placed in the interval N.5–N.13; it contains only forms of the *Globigerinoides quadrilobatus* group, *G. subquadratus*, and *Dentoglobigerina ?venezuelana*.

Sample Ab.43, containing the *Globigerinoides quadrilobatus* group and *Globorotalia* (*Turborotalia*) *siakensis*, is placed in the N.4–N.14 zonal interval.

Early–Late Miocene (zone N.8 to zone N.17 or younger)

The Kindan section (F.420–F.439; see Figure 9) extends over this stratigraphic interval. It has not been possible to recognise all the zonal divisions over this interval, either because of insufficient fauna or lack of outcrop.

The Burgers Mountain section (F.398–F.405; F.451–F.455; F.461–F.471) includes beds referable to zone N.8, and to zone N.17 or younger, but no intervening zones have been recognised. The planktonic foraminifera in several samples from this section have been observed only in thin section, and in other samples are so poorly preserved as to be indeterminable. The section was measured in a structurally complex area, with overturned beds and faulting.

Middle Miocene

(a) *Lower Tf.* Four samples, F.329, F.846, P.9174, and KJ.10 (not shown on the sample locality map), are placed here. F.329, from the Marimuni River section, yielded free specimens of *Lepidocyclina* (*Nephrolepidina*) sp., referable to the *L.* (*N.*) *howchini* group. Measurement of the degree of curvature of these specimens gave a mean of 65.4%, which would place this sample high in the Middle Miocene. For parameter F (the form number), introduced by Chaproniere (1980a, 1981b), the specimens are placed in categories 3 and 4.

Sample F.846 contains, among other species, *Lepidocyclina* (*Nephrolepidina*) *ferreroi*, *Miogypsina* (*M.*) sp., and *Cycloclypeus* (*Katacycloclypeus*) sp. Sample P.9174 contains *Lepidocyclina* (*N.*) sp., *Borodinia septentrionalis*, *Marginopora vertebralis*, *?Flosculinella* sp., and *?Miogypsina* (*M.*) sp. Sample KJ.10 (collected near the summit of Mount Kaijende by Dr P. Williams, then of the Australian National University, Canberra) contains *Miogypsina* (*M.*) sp., *Austrotrillina* sp. (poorly preserved), and *Alveolinella ?quoyi*.

(b) *Zone N.9.* Four samples, 6060, 6061, 6062, and 8049, are placed here. The age determination is based on the occurrence of the species *Orbulina universa*, *O. suturalis*, *Praeorbulina glomerosa circularis*, and *P. transitoria*; the total fauna for each sample is shown in Figure 16.

Not older than Middle Miocene (zone N.9)

Several samples contain a poor fauna including only *Orbulina universa* and specimens of the *Globigerinoides quadrilobatus* group. It is not possible to date these accurately, and they are given only as not older than Middle Miocene. These samples are: 0480, 0485, 0486, 1101, 1107, 1108, 1109, 1110, 1121, 1122, 1473, 1475, 2662, 2664, 2665, 2667, 2668, 8031, 8046, 8050, 9031, 9032, F.1005, and B.117.

Beds in the Maramuni River section (see Figure 14), above sample F.313, are also not older than Middle Miocene. Faunal control of this section is limited; it is discussed in more detail on page 38.

General Miocene age only

Samples placed here contain only long-ranging species which do not permit any precise age determination within the Miocene. The fauna of each of the samples is shown in Figure 16. These samples are: 1474, 2685, 8060, 9003, F.286, F.416, F.441, F.932, F.1004, F.1006, and F.1013.

Late Miocene (zone N.17–zone N.18)

One sample, 1478, contains a limited planktonic fauna; species occurring are *Orbulina universa*, *O. suturalis*, *Globorotalia* (*G.*) cf. *tumida plesiotumida*, and *G.* (*G.*) cf. *quasimiocenica* sp. nov. In the absence of any species indicating a Pliocene age, this sample is placed in the Late Miocene. Another sample, 2653, containing *Globigerina bulloides*, the *Globigerinoides quadrilobatus* group, and *Globigerinita* sp., is of Late Miocene or younger age.

General Miocene or younger age

These samples contain an indefinite fauna of planktonic foraminifera or benthonic smaller foraminifera, seen both in thin sections and as free specimens. The planktonic foraminifera are Globigerinidae (including occasionally *Orbulina*), and the benthonic forms *Amphistegina* sp., *Elphidium* sp., *Operculina* sp., *Sorites* sp., *Marginopora* sp., *?Borelis* sp., *Ammonia* sp., *Pararotalia* sp., *Cellanthus craticulus*, and *Alveolinella* sp. Some of these samples may be Pliocene or younger in age, but no definite age determination is possible. Samples included here are: 0390, 0466, 0470, 0471, 0482, 0483, 0484, 1102, 1103, 1104, 1105, 1115, 1117, 1118, 1119, 1567, 2654, 2655, 2656, 2657, 2660, 2661, F.48, F.681, B.137a, and B.137b.

Samples of indefinite age

Last to be considered are those numerous samples which contain an indefinite fauna either not permitting any age determination or at best indicating only a general Tertiary age. The fauna of these samples may be seen from Appendix 2. Samples included here are: 0294, 0389, 0476, 0689, 1100, 1120, 2647, 2670, 6005, 6066, 8009, 8091, 8094, 8119, 8145, 9045, 9052, F.1, F.39, F.197, F.493, F.564, F. 753, B.36, B.79, B.116, B.133b, B.133d, B.133e, B.135a, B.135c, B.135d, and B.135e.

Burgers Mountain section
(locality 16, WABAG; Figure 8)

No foraminifera have been found in a coarse-grained tuffaceous sandstone at the base of the section. A grey limestone above the sandstone contains fragments of igneous material, coral fragments, and rare planktonic foraminifera insufficient for definite age determination. Sample F.452 from a tuffaceous reef bed contains rare planktonic and benthonic foraminifera, without any particular age significance. Sample F.451 near the base of a thin-bedded micaceous siltstone sequence contains abundant planktonic and benthonic smaller foraminifera, the planktonic component indicating an age not older than zone N.17. Calcareous benthonic forms are abundant, and agglutinated genera also occur. Sample F.405 contains mainly planktonic forms, with rare agglutinated genera. A similar fauna occurs up to and

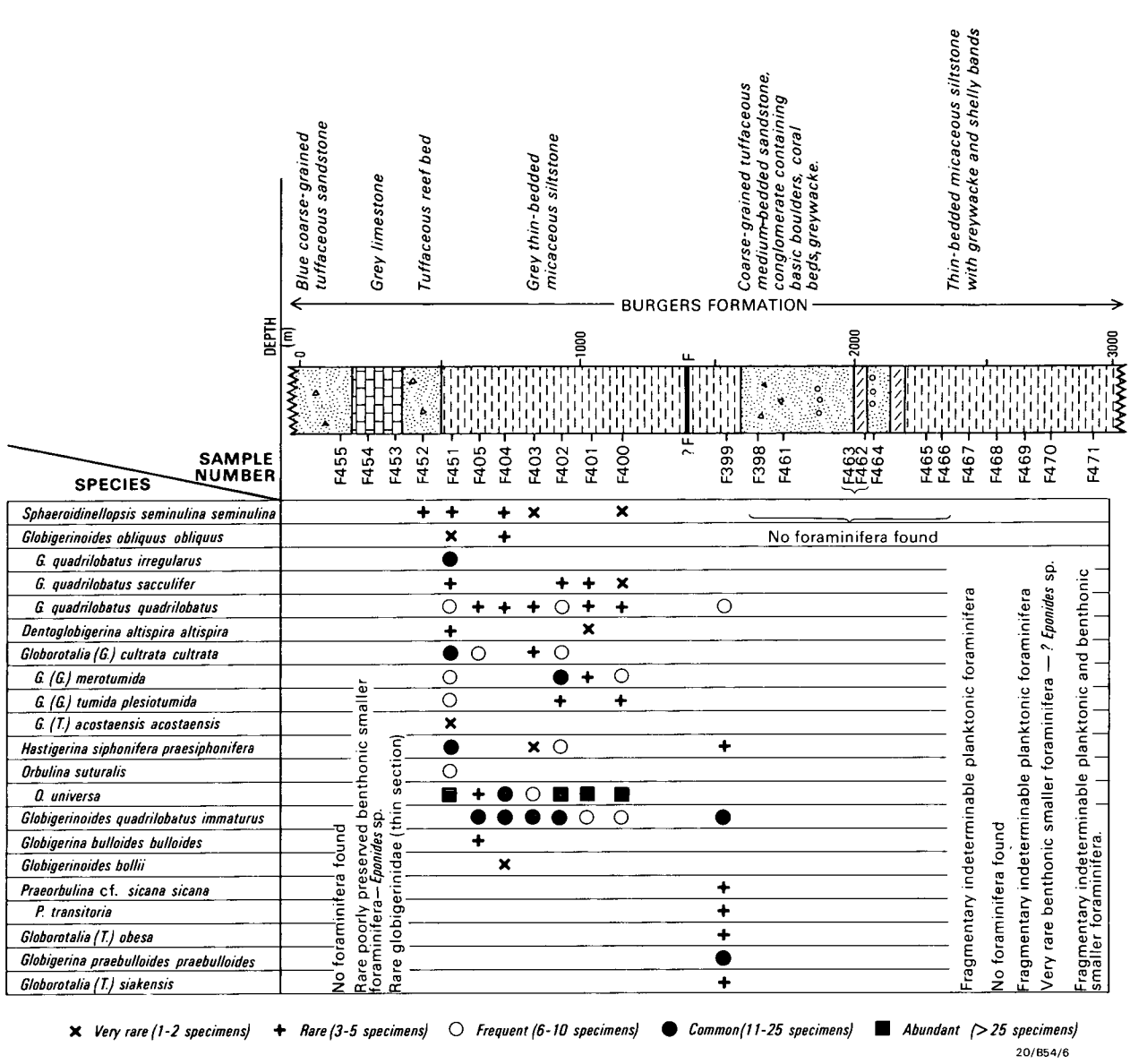


Fig. 8. Foraminiferal distribution chart, Burgers Mountain section; section from Dekker & Faulks (1964).

including sample F.403. Sample F.402 has an assemblage very similar to that of F.451, but with a less diverse calcareous benthonic element and more agglutinated forms. Samples F.401 and F.400 have mainly planktonic and agglutinated forms. In this part of the sequence there is no indication of age younger than zone N.17.

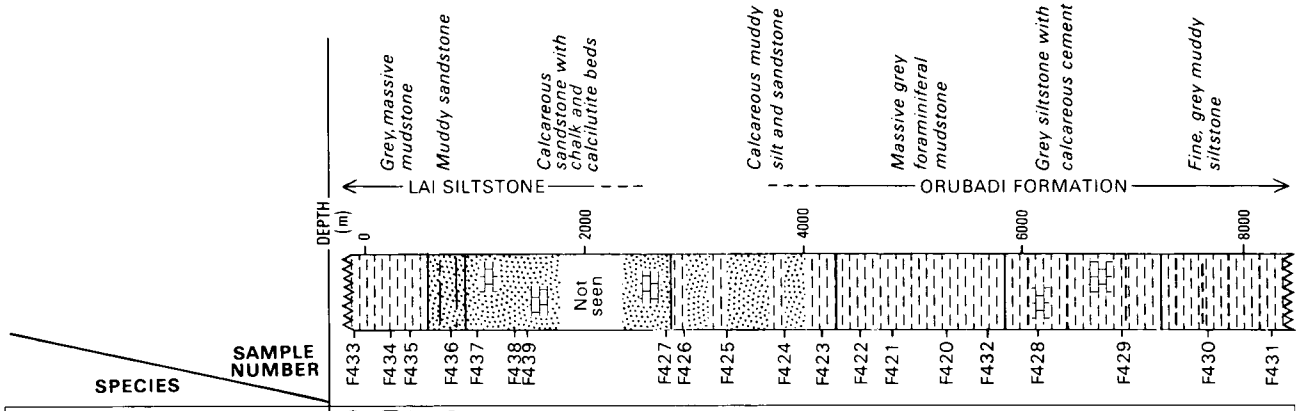
Above sample F.400 there is a large sample gap before sample F.399, which contains abundant planktonic, calcareous benthonic, and agglutinated forms, the planktonic species indicating a zone N.8 age. Above sample F.399, no faunal information is available, only fragments of possible planktonic foraminfera being observed.

The ages defined by the planktonic foraminifera imply a structural complexity in the section between samples F.400 and F.399. An inferred fault is shown on the geological map of the area by Dow & others (1972); this may have been the cause of beds of N.8 age occurring in the sequence above Late Miocene.

KINDAN SECTION
(locality 100, WABAG; Figure 9)

At the base of the section, sample F.433 contains small planktonic foraminifera, rare agglutinated genera (*Ammodiscus* sp., ?*Hyperammina* sp., *Glomospira* sp.), and rare small calcareous forms (*Gyroidina* sp. and *Heterolepa* sp.). In a mudstone above this sample is an abundant planktonic and benthonic fauna, the benthonic component including both calcareous and agglutinated forms. Calcareous genera present include *Anomalinoides*, *Gyroidina*, *Heterolepa*. *Laticarinina*, *Siphonina*, *Baggina*, *Alabamina*, *Sphaeroidina*, *Ramulina*, *Fursenkoina*, *Brizalina*, *Trifarina*, *Uvigerina*, *Bulimina*, *Nodosaria*, and *Frondicularia*; agglutinated genera include *Ammodiscus*, *Ammobaculites*, *Textularia*, *Gaudryina*, *Martinottiella*, *Hyperammina*, *Triplasia*, and *Karreriella*.

A lithological change to a calcareous sandstone is also reflected in the fauna; planktonic foraminifera, which form the bulk of the assemblage, are reduced



SPECIES \ SAMPLE NUMBER	F433	F434	F435	F436	F437	F438	F439	F427	F426	F425	F424	F423	F422	F421	F420	F432	F428	F429	F430	F431
Globigerina praebulloides praebulloides	●	■	+	○																
G. euapertura	×																			
Globigerinoides quadrilobatus immaturus	+	●	●	■								○	●	●	+	●		×		
G. sp. ex gr. *G. quadrilobatus*	×	○											+		●					
Globorotalia (F.) peripheroronda	×	■	+																	
G.(F.) quinifalcata		■		×																
G.(F.) peripheroacuta pristina, subsp.nov.		■	+																	
G.(T.) siakensis		○	+	○																
G.(T.) obesa		+	+	+									+							
G.(C.) prolata, sp. nov		●																		
Globigerina praebulloides occlusa		○	●	+																
G. praebulloides pseudociperoensis		●	○																	
G. foliata		+																		
G. falconensis		●		+									+	○	○	+				
Dentoglobigerina venezuelana		×																		
Praeorbulina sicana sicana		■	●																	
Globigerinoides quadrilobatus quadrilobatus		■	○	+									+	●	+	●				
G. quadrilobatus irregularus		■	■									+	○	○	+	○		+		
G. subquadratus subquadratus		■	○	+									+							
Praeorbulina transitoria		■	●																	
Globoquadrina dehiscens dehiscens		○		●																
Dentoglobigerina altispira altispira		■	○	●	+								●	○		●				
Hastigerina siphonifera praesiphonifera		■	●		+							+	■	■	■	■				
Globorotalia (T.) minima			●																	
Orbulina suturalis			×	■																
Praeorbulina glomerosa glomerosa			+																	
P. glomerosa curva			○																	
Globorotalia (T.) continuosa				+									+	+						
G.(T.) peripheroacuta peripheroacuta				+																
Sphaeroidinellopsis seminulina seminulina				●						■			×	○	+					
Globigerinoides quadrilobatus altiapertura				+																
Globoroteloides suteri				+																
Orbulina universa					●			+		×	○	■	■	■	■	■	×	○	○	■
Globorotalia (G.) cultrata cultrata										○		○	●	○	○	●				
Globigerinoides quadrilobatus group										○	○						×		+	
Globorotalia (G.) cultrata menardii												+	+							
G.(G.) sp. 1 ex gr. *G. tumida*												+	+			+				
G.(G.) merotumida												○	●	●	●	●		○		
G.(G.) tumida plesiotumida												○	○	●		○				
G.(T.) scitula scitula												+	+	■		■	×			
Globigerinoides bollii													×		+	+				
G. obliquus obliquus													+	●	■	■				
Globigerinita incrusta													+	+						
Globorotalia (T.) acostaensis													+	○	■	○				
Globigerina bulloides bulloides													+	●	■	○				
Globigerinoides quadrilobatus sacculifer														+	+	○				
G. obliquus extremus														+	○	○				
Globorotalia (T.) subscitula														×	+	+				
G.(T.) scitula planaria, subsp. nov.														○	●	+				
Globigerina decoraperta														+	+	+				
Globorotalia (G.) quasimiocenica, sp. nov.																○				
G.(G.) sp. 2.																×				

× *Very rare (1-2 specimens)* + *Rare (3-5 specimens)* ○ *Frequent (6-10 specimens)* ● *Common (11-25 specimens)* ■ *Abundant (>25 specimens)*

Fig. 9. Foraminiferal distribution chart, Kindan section; section from Dekker & Faulks (1964). 20/B54/7

in number, and benthonic forms are rare. This limited fauna continues up to sample F.426, which contains mainly the one benthonic species, *'Eponides' praecinctus*. Samples F.425 and F.424 have rare planktonic forms, dominated in F.425 by *Sphaeroidinellopsis seminulina*. Sample F.423, from a massive grey mudstone, shows a return to an abundant planktonic and benthonic fauna; this continues up to and including sample F.432. Above this there is again a reduced fauna in a calcareous siltstone, with both planktonic and benthonic forms rare.

Complete zonal subdivision of the Kindan section is not possible, because of the sparse fauna over much of the section. The base of the section is of zone N.8 age, and the boundary between zone N.8 and zone N.9 can be placed between samples F.434 and F.435. The evolutionary development of *Orbulina* cannot be followed in detail because of the large sampling interval, but it would appear to follow the same sequence as reported from other areas.

The next zonal boundary to be recognised is the N.9/N.10 boundary, between samples F.435 and F.436, based on the appearance of *Globorotalia* (*G.*) *cultrata cultrata*. The appearance of an abundant fauna in sample F.423, including *G.* (*G.*) *tumida plesiotumida*, marks at least zone N.17. No other zonal boundaries can be recognised in the section, and the age of the upper beds of the sequence, which contain a sparse fauna, is not known.

On a geological map published by Dow & others (1972) this section is shown as crossing a faulted and overturned anticline and syncline. No indication of either faulting or overturning is shown by the fauna, which, as far as can be observed, follows a normal sequence. There is a break in outcrop and a sparse fauna near the base of the section, which together could obscure faunal indications of structural complications. The same applies to the sparse fauna in the upper part of the section above sample F.432.

Section south of Crater Lake (Lake Rau) (locality 147, WABAG; Figure 10)

Beds at the base of this section (samples F.279–F.281) are Late Oligocene to Early Miocene (zone

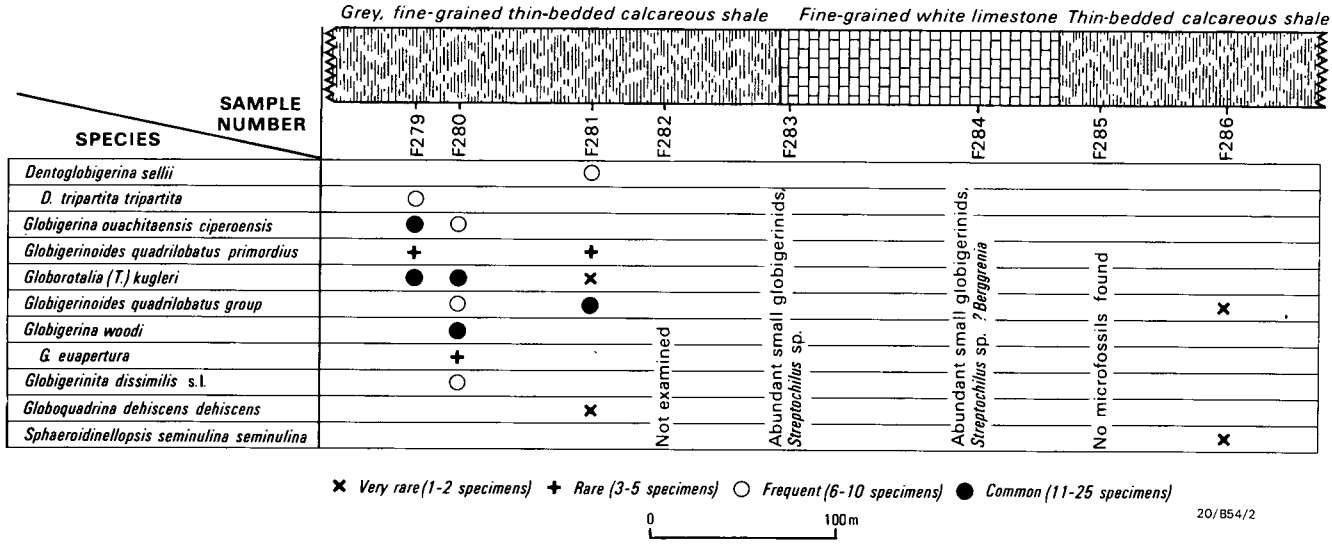


Fig. 10. Foraminiferal distribution chart, section south of Crater Lake (Lake Rau); section from Dekker & Faulks (1964).

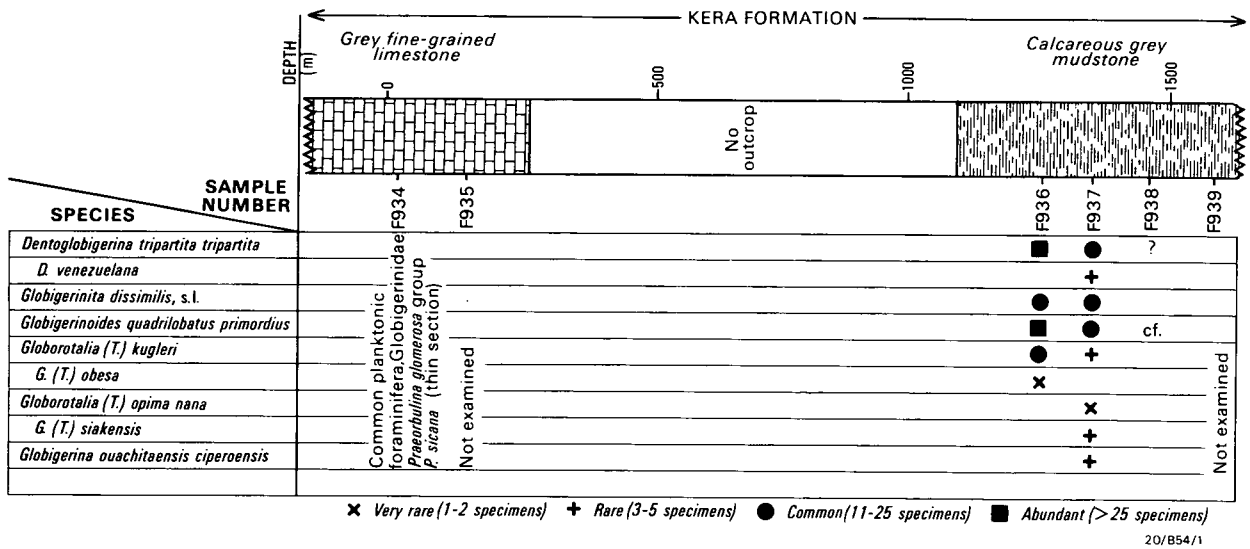


Fig. 11. Foraminiferal distribution chart, Laiagam section; section from Dekker & Faulks (1964).

N.3–zone N.4) in age, containing *Dentoglobigerina tripartita tripartita, Globigerina ouachitaensis ciperoensis, G. woodi, G. euapertura, Dentoglobigerina sellii, Globorotalia (Turborotalia) kugleri, Globigerinita dissimilis, Globigerinoides quadrilobatus primordius*, and *Globoquadrina dehiscens dehiscens.*

These beds are followed by fine-grained planktonic foraminiferal biomicrites (samples F.283 and F.284) containing abundant small Globigerinidae, rare small biserial forms referred to *Streptochilus* sp. and small planispiral forms tentatively placed in *Berggrenia.* Sample F.284 also contains sponge spicules and rare radiolaria. These samples are regarded as probably Late Oligocene–Early Miocene in age. Above this is a calcareous shale (sample F.286) containing rare specimens of the *Globigerinoides quadrilobatus* group and *Sphaeroidinellopsis seminulina seminulina*; only a general Miocene age can be given to this sample.

Laiagam section
(locality 118, WABAG; Figure 11)

A limestone at the base of this section contains abundant planktonic foraminifera (Globigerinidae); the specimens, which have been observed only in thin section, show characteristics of the *Praeorbulina glomerosa* group or *P. sicana*, and of *P. transitoria* (see illustrations in Pl. 11). The limestone is regarded as probably zone N.8 in age.

Following an interval of no outcrop, samples from a calcareous grey mudstone contain abundant planktonic foraminifera, with a limited calcareous and agglutinated benthonic fauna. Planktonic species are *Dentoglobigerina tripartita tripartita, D. venezuelana, Globigerina ouachitaensis ciperoensis, Globigerinoides quadrilobatus primordius, Globigerinita dissimilis, Globorotalia (Turborotalia) kugleri, G. (T.) siakensis*, and *G. (T.)* cf. *opima nana.* This fauna is given a Late Oligocene–Early Miocene (zone N.3–zone N.4 age).

If the limestone in this section is correctly interpreted as zone N.8 in age, then there is either structural complication of the section, or the section as shown by Dekker & Faulks (1964, section 3, pl. 4) is inverted.

Section south of Laiagam
(locality 136, WABAG)

This section is represented by samples F.449, F.450, and F.456 to F.459; no detailed information is available. The sequence begins in beds of Late Oligocene–Early Miocene age, zone N.3–zone N.4 (sample F.449). Species occurring include *Dentoglobigerina tripartita tripartita*, the *Globigerina praebulloides* group, the *Globigerinoides quadrilobatus* group, *Globigerinita dissimilis, G. unicava unicava*, and *Globoquadrina* cf. *dehiscens.* Reworked specimens of Late Cretaceous and Paleocene age also occur. An overlying fine-grained planktonic foraminiferal limestone (sample F.450) contains abundant small Globigerinidae, specifically indeterminable. Beds above the limestone (samples F.456, F.457) are also of Late Oligocene–Early Miocene age (zone N.3–zone N.4), species occurring additional to those already mentioned being *Globigerina*

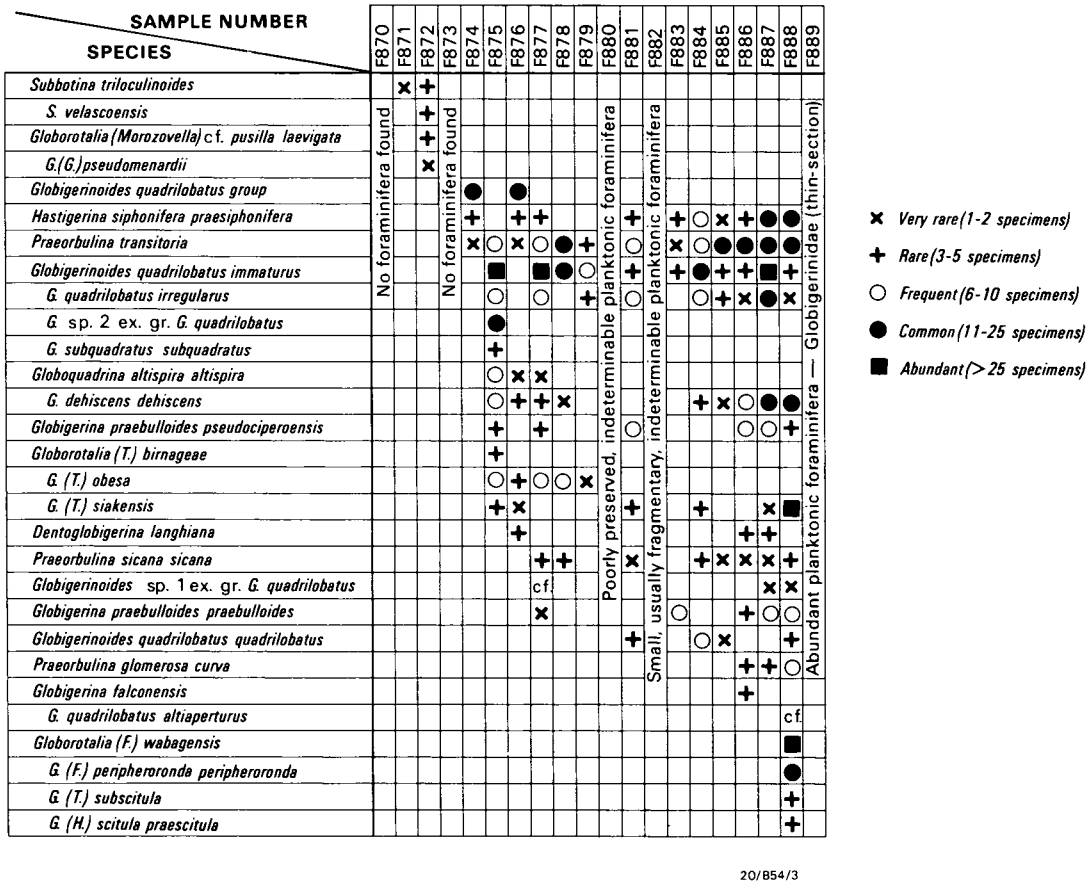


Fig. 12. Foraminiferal distribution chart, section west-southwest of Laiagam; section details not available.

ouachitaensis ciperoensis, *G. woodi*, *Globorotalia* (*Turborotalia*) *opima nana*, and *G.* (*T.*) *siakensis*; reworked Late Cretaceous and Paleocene specimens again occur in sample F.456.

Sample F.458 contains a fauna of indefinite age including *Globoquadrina* cf. *praedehiscens*, *Globigerina woodi*, *G.* cf. *ouachitaensis ciperoensis*, and the *Globigerinoides quadrilobatus* group. It is followed by a second fine-grained planktonic foraminiferal limestone (sample F.459) containing abundant small Globigerinidae and frequent small biserial forms.

Section west-southwest of Laiagam (locality 103, WABAG; Figure 12)

This section is in the Andebare River area; no stratigraphic column is available. At the base, two samples, F.871 and F.872, have a sparse, poorly preserved Late Paleocene fauna, including *Subbotina triloculinoides*, *S. velascoensis*, *Globorotalia* (*G.*) *pseudomenardii*, and *Globorotalia* (*Morozovella*) cf. *pusilla laevigata*; rare benthonic species also occur.

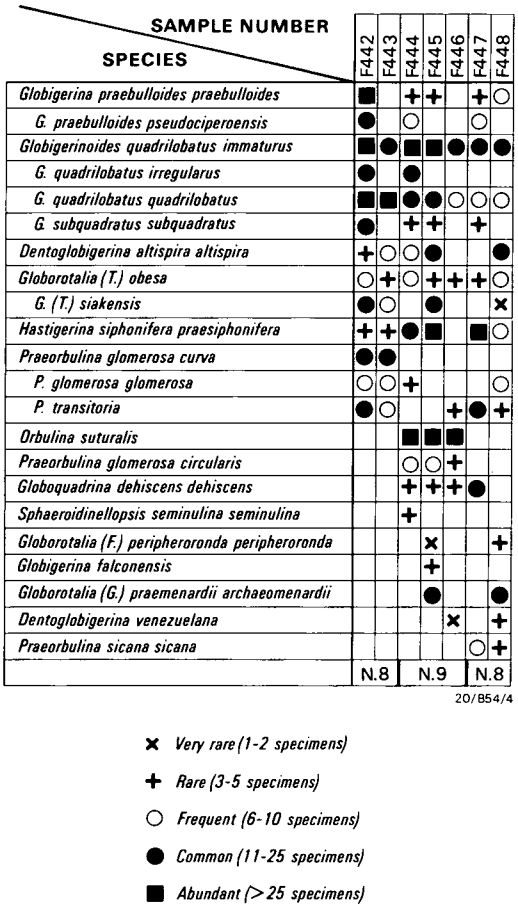


Fig. 13. Foraminiferal distribution chart, section southwest of Laiagam; section details not available.

The fauna recorded from the remainder of the sequence is zone N.8 in age; species recorded include *Praeorbulina transitoria*, *P. glomerosa curva*, *P. sicana*, the *Globigerinoides quadrilobatus* group, *Globorotalia* (*Turborotalia*) *siakensis*, *G.* (*T.*) *obesa*, *G.* (*T.*) *peripheroronda peripheroronda*, *G.* (*T.*) *birnageae*, *Globigerina praebulloides praebulloides*, *G. praebulloides pseudociperoensis*, *Dentoglobigerina altispira altispira*, *Globoquadrina dehiscens*, and *Hastigerina siphonifera praesiphonifera*. One sample, F.883, has reworked Late Cretaceous and Late Paleocene specimens.

Dow & others (1972) show this section as crossing a faulted and overturned syncline. The faulting may separate the Paleocene and Early Miocene beds, and both the faulting and overturning may explain the thickness of beds referable to one planktonic foraminiferal zone.

Section southwest of Laiagam (locality 108, WABAG; Figure 13)

This sequence, on the Wage River (samples F.442–F.448, locality 108, WABAG) was measured across a syncline; no stratigraphic column is available. These beds are referable to planktonic zones N.8 and N.9.

Maramuni River section (locality 17, WABAG; Figure 14)

This is a thick sequence of siltstone, sandstone, conglomerate, greywacke, and volcaniclastic sediments for which there is little faunal control, particularly in the lower two-thirds of the section. Details of the fauna recorded are given in Figure 14. The occurrence of *Orbulina* in sample F.313 indicates that the beds from which F.313 was taken are at least of Middle Miocene age. *Globorotalia* (*Turborotalia*) *continuosa* occurs in sample F.317, indicating only that the beds are not younger than zone N.16, the early part of the Late Miocene. Sample F.319 contains indeterminable globigerinids.

Above sample F.319 there is an interval from which foraminifera have not been recorded. Abundant foraminifera occur in sample F.329, which yielded free specimens of *Lepidocyclina* (*Nephrolepidina*) sp. referred to the *howchini* group. Measurement of the degree of curvature for these specimens gave a range from 50% to 77.8%, with a mean of 65.4%. Parameter F, the form number (see Chaproniere 1980a, 1981b), is category 4 for most specimens, with some specimens being placed in category 3. The values for degree of curvature, and the form number, place sample F.329 in the Middle Miocene (lower Tf). Also occurring are *Cycloclypeus* (*Katacycloclypeus*) *cf. annulatus*, and *Nummulites* (*Palaeonummulites*) sp., similar in median section to *Operculinoides bikiniensis* Cole.

Above sample F.329 the faunal evidence is not sufficient to enable any age determination to be made.

Fig. 14. Foraminiferal distribution chart, Maramuni River section; section from Dekker & Faulks (1964).

NOTE ON LARGER AND PLANKTONIC FORAMINIFERAL TIME SCALES

The Darai Limestone is mainly of Late Oligocene to Middle Miocene age, but Early Oligocene and Middle to Late Eocene faunas have been recorded from some beds referred to this formation. In five areas, the north and south Tekin sections (Figures 2 and 3 respectively), the Nong River section (Figure 4), a short section east of Feramin, and southeast of Mount Kaijende (Figure 15), the Darai Limestone is in contact with mudstones containing a planktonic foraminiferal fauna of zone N.8 age. The limestone is below zone N.8 beds in the Tekin sections and the Nong River section, above zone N.8 beds in the section east of Feramin, and within zone N.8 beds east of Mount Kaijende.

Findlay (1974) showed the Darai Limestone in the Iaro Syncline, south of the Kubor Range, divided into two tongues separated by terrigenous clastic rocks of the Aure Group. This relationship was investigated from the point of view of the correlation between the larger and planktonic foraminiferal zonal schemes. Because of the indefinite nature of the fauna, it is often not possible, using traditional biostratigraphic methods, to make a more definite age determination than Early to Middle Miocene (upper Te–lower Tf) for the Darai Limestone. Arnold & others (1979, part 2, p. 52) referred to the apparent contradiction implied by strata of zone N.8 age overlying lower Tf beds, and suggested that this indicated a problem with prevailing correlations of planktonic and larger foraminiferal zones. The only difference observed in the fauna of the limestone above and below zone N.8 beds is the occurrence of *Austrotrillina striata*, or specimens intermediate between *A. striata* and *A. howchini*, below zone N.8 beds.

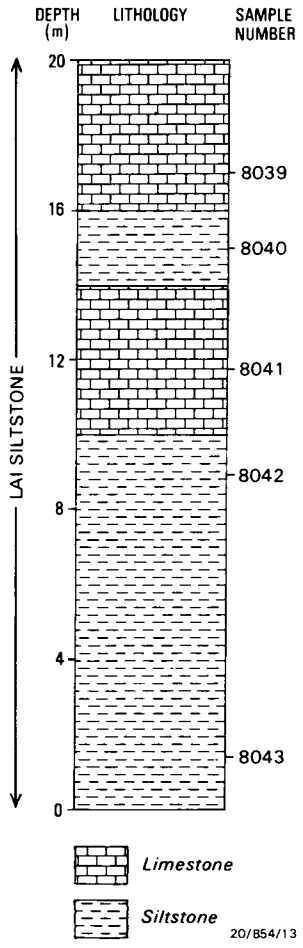


Fig. 15. Section southeast of Mount Kaijende; based on field notes by H. L. Davies.

Although it is not possible to determine a precise age for the limestone by traditional methods, a biometric method introduced by Chaproniere (1980a, 1981b) using parameter F, the form number, in the genus *Lepidocyclina*, gives a more definite indication. The F number has been determined mainly from uncentred vertical sections, using the criteria outlined by Chaproniere (1981b).

In the south Tekin section, sample 3343 contains specimens with an F number of 4; 3330, in the same section, gives an F number of 3 to 4. Other samples, 3328 and 3329, contain specimens of planktonic foraminifera referable to the *Praeorbulina* group. In the north Tekin section, sample 3423 has specimens with an F number of 3. In the Nong River section, specimens in sample 5036 have an F number of 3; this sample also contains specimens of the *Praeorbulina glomerosa* group. East of Feramin, specimens of *Lepidocyclina* in sample 0134 have an F number of 4 to 5; this sample also contains specimens of the *Praeorbulina* group. Sample 0135 has specimens with an F number ranging from 3 to 5. In the one sample, 8041, east of Mount Kaijende between beds of zone N.8 age, no value can be determined for the F number.

Studies by Chaproniere (1980a, 1981b) indicate that specimens with an F number of 3 or higher are from strata of lower Tf age. Although accurate values for parameter F cannot be obtained from random thin sections, some indication of values can be obtained. In three areas, beds of lower Tf age underlie beds with a zone N.8 planktonic fauna. In a fourth area, the lower Tf beds are above zone N.8 beds, but the limestone contains planktonic foraminifera indicating a zone N.8 age. Chaproniere (1981b) has recorded from Irian Jaya a fauna of lower Tf age containing *Flosculinella bontangensis* and overlain by beds containing a zone N.8 planktonic fauna.

These results from Papua New Guinea and Irian Jaya indicate that the presently accepted correlation of the Te/Tf boundary with the N.8/N.9 zonal boundary requires revision. Chaproniere (1981b) has discussed this problem, and from these data, and data from other areas, has concluded that the Te/Tf boundary should be placed within the N.6–7 zonal interval.

Larger foraminifera and planktonic foraminifera occur together in samples 9041 and 8042 (locality 106, WABAG). However, in this case there is a possibility that the larger foraminifera are reworked, and this occurrence is regarded as unreliable for the purpose of relating the larger and planktonic foraminiferal scales.

SAMPLES LISTED ACCORDING TO AGE, OK TEDI 1:250 000 SHEET AREA

Samples of indefinite age, or with a fauna giving an age over a wide stratigraphic interval, are not listed here but are discussed in the text, and the faunas are listed in Appendix 1. The locality number is given in brackets after the sample number.

Late Paleocene
0756 (67)

Eocene
0661 (65)
3410 (143)
3426 (144)
3428 (144)
3429 (144)
3430 (144)
3431 (144)
04NG0517 (157)
04NG0523, part (68)
P.5016 (17)

Early Oligocene (Tc)
0139 (136)
0200 (187)
1195 (171)
1641 (72)
3017 (70)
3105 (176)
3337 (145)
3338 (145)
3354 (138)
3411 (143)
3432 (144)
3433 (144)
3434 (144)
3435 (144)
3436 (144)
3444 (145)
6052 (174)
6053 (174)
6054 (174)
6055 (174)
6057 (174)
6131K (96)
68691650A (123)
04NG0519 (71)
04NG1013 (132)
P.4641 (56)
P.5670 (61)
Sample collected by Chawner (1939); (219)
Sample collected by Zehnder & de Caen (1955); (220)

Late Oligocene-Early Miocene (Te, undifferentiated)
0864 (129)
0865 (129)
0866 (129)
1032 (59)
1033 (59)
1034 (59)
1036 (59)
1037 (59)
1038 (59)
1040 (59)
1041 (59)
1047 (27)
1149 (229)
1150 (229)
1151 (229)
1152 (229)
1156 (228)
1193 (171)
1343 (175)
1345 (175)
1644 (90)
1682 (110)
1829 (141)
1986 (106)
3110 (201)
3114 (201)
3127 (200)
3141 (199)
3340 (145)
3347 (140)
3355 (138)
3415 (143)
3417 (143)
3427 (144)
3442 (145)
3443 (145)
3475–3480 (222)
3498 (222)
6011 (183)
6056 (174)
68691631 (113)
68691634B (173)
68691636B (169)
68691642B (28)
68691644A (3)
68691647A (14)
68691649 (123)
68691651B (121)
04NG1008 (63)
04NG1009 (64)
76294197 (21)
P.4624 (38)
P.4880 (9)
P.5017 (16)
P.5025 (34)
P.5027 (32)

Late Oligocene (lower Te)
1031 (59)
1040 (59)
1043 (60)
1338 (175)
1583 (24)
3021 (70)
3339 (145)
3412 (143)
3413 (143)
3414 (143)
68691651C (121)
P.4622 (38)
P.4884 (7)
P.5669 (62)

Early Miocene (upper Te)
0624 (37)
0858 (129)
0859 (129)
3097 (175)
3329 (151)
3416 (143)
3438 (145)
3439 (145)
3440 (145)
6018 (181)
6869164OE (50)
68691643B (8)
68691644A (3)
68691646A, B (114)
P.4716 (195)
P.5019 (15)

Early-Middle Miocene (upper Te-lower Tf)
0131 (138)
0133 (136)
0134 (136)
0135 (136)
0459 (158)
1231, part (170)
1335 (175)
1602 (226)
1631 (47)
1636 (72)
1640 (72)
1651 (77)
1681 (92)
1684 (110)
1690 (196)
1794 (217)
1809 (184)
1811 (185)
3029 (69)
3278 (205)
3280 (205)
3282 (205)
3328 (151)
3330 (150)
3342 (145)
3343 (145)
3351 (138)
3353 (138)
3407 (147)
3408 (147)
3422 (143)
3423 (143)
3424 (143)
3437 (145)
5035 (126)
5036 (126)
5037 (127)
6019 (181)
6022 (181)
6023 (181)
6111 (235)
6129B (164)
7000 (211)
7006 (214)
68691621 (95)
68691626A (93)
68691627C (94)
68691638B (79)
68691639 (46)
68691640B (50)
68691640F (50)
68691643C (8)
04NG0514 (188)
04NG0518 (156)
04NG1010 (133)
P.4645 (125)
P.4661 (11)
P.4668 (51)
P.4670 (88)
P.4671 (88)
P.4677 (82)
P.4678 (82)
P.4679 (82)
P.4680 (82)
P.4681 (81)
P.4691 (48)
P.4699 (44)
P.4700 (43)
P.4804 (98)
P.4811 (99)
P.4814 (101)
P.4816 (108)
P.4818 (108)
P.4826 (103)
P.4828 (112)
P.4838 (120)
P.4839 (115)
P.4882 (6)
P.4883 (5)
P.4885 (4)
P.4973 (73)
P.4984 (83)
P.4986 (84)
P.5001 (13)
P.5012 (26)
P.5022 (18)
P.5023 (19)
76294158 (97)
76294159 (105)
76294179 (193)
76294183 (80)
76294196 (54)

Middle Miocene (lower Tf)
1048 (27)
1231, part (170)
1654 (76)
1688 (196)
1786–1792 (217, 218)
1828 (66)
1989 (207)
3261 (210)
3264 (210)
3269 (211)
3361 (137)
6120D (236)
7001 (211)
68691627D (94)
68691628 (94)
P.4812 (100)
P.4836 (119)
P.5142 (194)

Early Miocene (zone N.8)
0136–0138 (136)
0199 (186)
1835 (131)
3321 (155)
3322 (155)
3332 (148)
3333–3335 (146)
3344 (145)
3345 (146)
3346 (142)
3359 (137)
5034 (126)
5038 (128)
6015 (182)
6044 (179)
6045 (180)
P.4658 (11)
P.4659 (11)
P.4663 (11)
P.4676 (82)
P.4695 (45)
P.4749 (23)

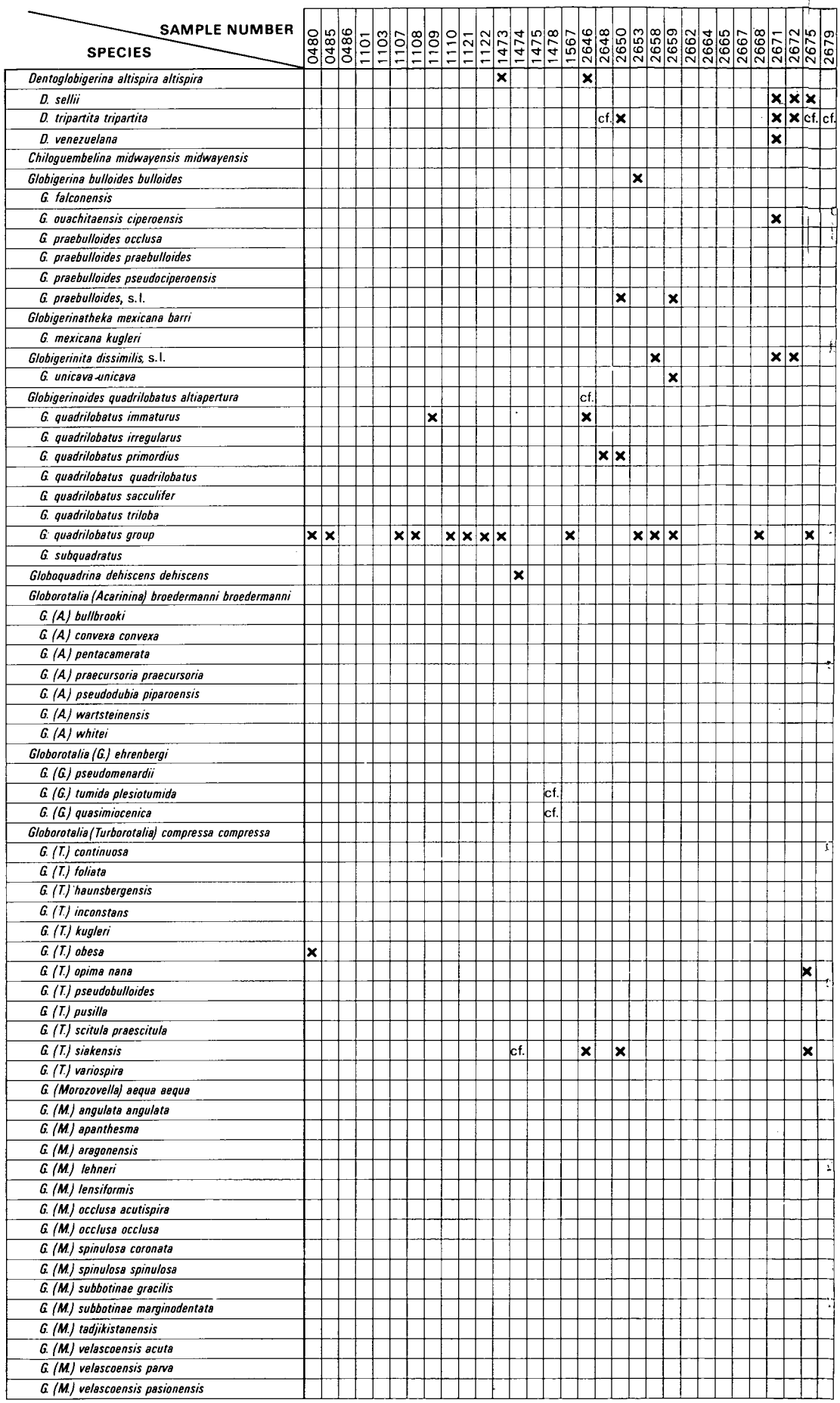
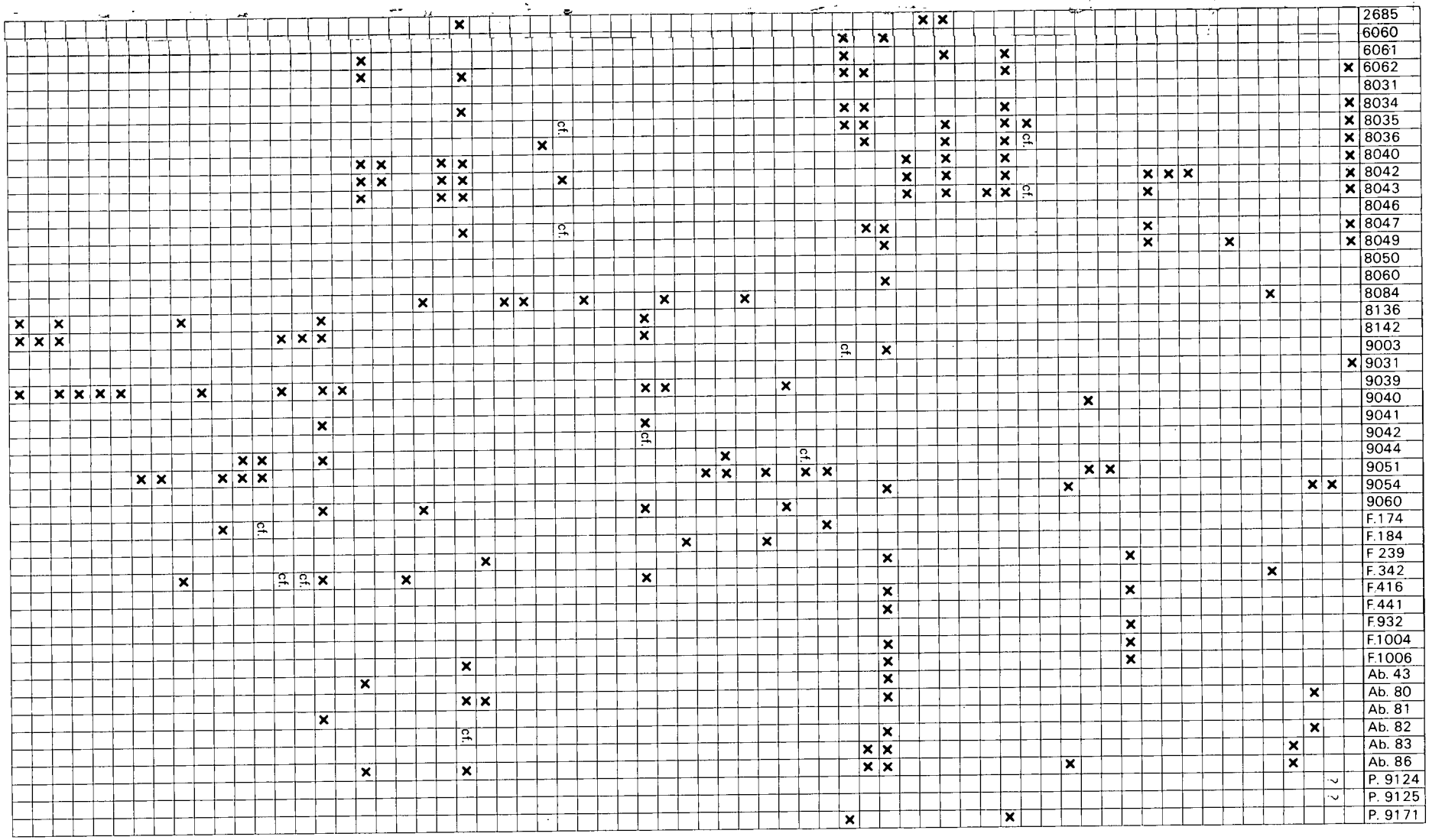


Fig. 16. Distribution of foraminifera in spot samples, Wabag 1:250 000 Sheet area (continued on pp. 44 and 45).


2685
6060
6061
6062
8031
8034
8035
8036
8040
8042
8043
8046
8047
8049
8050
8060
8084
8136
8142
9003
9031
9039
9040
9041
9042
9044
9051
9054
9060
F.174
F.184
F 239
F.342
F.416
F.441
F.932
F.1004
F.1006
Ab. 43
Ab. 80
Ab. 81
Ab. 82
Ab. 83
Ab. 86
P. 9124
P. 9125
P. 9171
cf.
?

SPECIES \ SAMPLE NUMBER	0480	0485	0486	1101	1103	1107	1108	1109	1110	1121	1122	1473	1474	1475	1478	1567	2646	2648	2650	2653	2658	2659	2662	2664	2665	2667	2668	2671	2672	2675	2679
G. (M.) velascoensis velascoensis									×								×														
G. (M.) sp. 1																															
G. (M.) sp. 2																															
Hantkenina (Aragonella) mexicana mexicana																															
H. (A.) mexicana dumblei																															
Hastigerina siphonifera s. l.																															
Muricoglobigerina aquiensis																															
M. mckannai																															
M. soldadoensis angulosa																															
Orbulina suturalis															×																
O. universa	×	×	×	×	×	×	×	×	×	×	×	×			×	×								×	×	×	×	×			
Praeorbulina glomerosa circularis																															
P. glomerosa curva																															
P. sicana sicana																	×														
P. transitoria																															
Sphaeroidinellopsis seminulina seminulina																											×				
Subbotina frontosa boweri																															
S. frontosa frontosa																															
S. inaequispira																															
S. linaperta																															
S. pseudoeocaena																															
S. triloculinoides																															
S. velascoensis																															
S. sp. 1																															
S. sp. 2																															
S. sp. 3																															
S. sp. 4																															
S. sp. 5																															
Truncorotaloides topilensis																															

P.4756 (22)
P.4817 (108)
P.4819 (108)
P.4820 (108)
P.4825 (104)
P.4833 (117)
P.4834 (118)
P.4840 (115)
P.4919 (29)
P.4932 (31)
P.4934 (35)
P.4935 (36)
P.4948 (91)
P.4974 (74)
76294199 (55)
76294201 (53)
76294203 (52)

Early-Middle Miocene (zone N.6–N.14)
76294157 (162)

Middle Miocene or younger (zone N.9 or younger)
1148 (230)
1578 (208)
1632 (47)
1642 (90)
1659 (75)
1805 (176)
1810 (185)
1845 (192)
1846 (192)
1990 (207)
1998 (165)
2395 (203)
2396 (203)
2399 (204)
6123 (164)
6125 (164)
6126 (164)
6127 (164)
6130 (164)
7003 (212)
7007 (215)
P.4703 (197)
P.4827 (102)
P.4992 (86)
76294156 (163)
Sample collected by White (1972); (234)

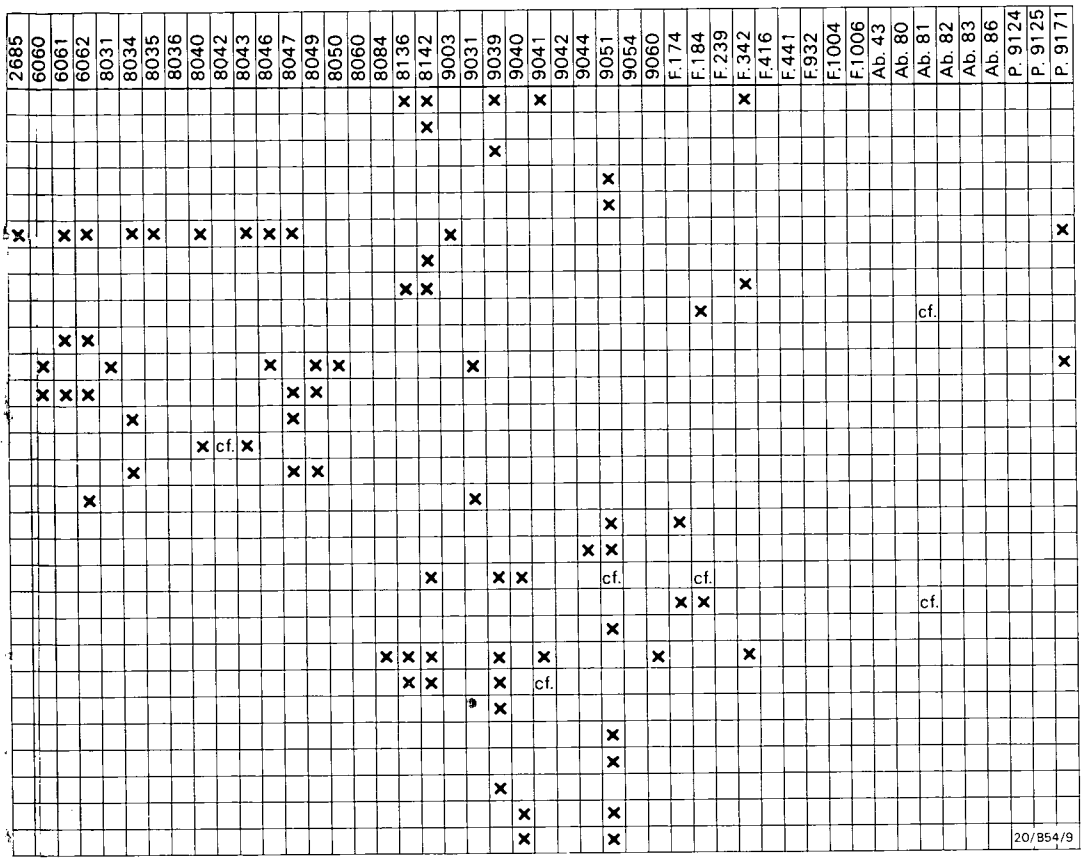
Middle Miocene (zone N.9–N.14)
1530 (130)
1643 (90)
1687 (196)
6135 (107)

Late Miocene-Pliocene (zone N16–N.21)
1693 (233)
1804 (191)
1853 (168)
1854 (168)
3259 (209)

Pliocene
1605 (232)
1608 (232)

LIST OF LOCALITY NUMBERS WITH CORRESPONDING SAMPLE NUMBERS, OK TEDI 1:250 000 SHEET AREA

Locality	*Sample(s)*	*Locality*	*Sample(s)*	*Locality*	*Sample(s)*	*Locality*	*Sample(s)*
1	1980	18	P.5022	35	P.4934	52	76294203
2	P.5080	19	P.5023	36	P.4935	53	76294201
3	68691644 A, B	20	P.5024	37	0624	54	76294196
4	P.4885	21	76294197	38	P.4622–P.4624	55	76294199
5	P.4883	22	P.4756	39	1981	56	P.4641
6	P.4882	23	P.4749	40	P.4648	57	P.4776
7	P.4884	24	1583	41	P.4652	58	P.4775
8	6869143 B, C	25	76294192	42	1648	59	1029–1042
9	P.4880	26	P.5012	43	P.4700	60	1043
10	68691645 A–D	27	1047–1048	44	P.4699	61	P.5670
11	P.4658–P.6443	28	68691642 B	45	P.4695	62	P.5669
12	1289	29	P.4919	46	68691639	63	04NG1008
13	P.5001	30	P.4916	47	1631–1632	64	04NG1009
14	68691647 A	31	P.4932	48	P.4691	65	0661
15	P.5019	32	P.5027	49	P.4689	66	1828
16	P.5017	33	P.5028	50	68691640 B, E, F	67	0756
17	P.5016	34	P.5025	51	P.4668	68	04NG0523



69	3029	103	P.4826	137	3359, 3361	171	1193, 1195, 1196
70	3017, 3021	104	P.4825	138	3351–3355	172	1217
71	04NG0519	105	72694159	139	3350	173	68691634 B
72	1636, 1639–1641	106	1986	140	3347	174	6052–6057
73	P.4973	107	6135	141	1829	175	1334–1345, 3096–3099
74	P.4974	108	P.4816–P.4820	142	3346		
75	1658–1659	109	68691622 B, C	143	3410–3425	176	3105
76	1653–1655	110	1682–1684	144	3426–3436	177	6034
77	1651	111	68691623	145	3337–3344, 3437–3444	178	6033
78	1650	112	P.4828			179	6044
79	68691638 B	113	68691631	146	3333–3335, 3345	180	6045
80	76294183	114	68691646 A, B	147	3407–3409	181	6018–6023
81	P.4681	115	P.4839–P.4840	148	3332	182	6015
82	P.4676–P.4680	116	P.4832	149	3331	183	6010–6011
83	P.4984	117	P.4833	150	3330	184	1809
84	P.4986	118	P.4834	151	3328–3329	185	1810–1811
85	P.4989	119	P.4836	152	3325–3326	186	0199
86	P.4992	120	P.4838	153	3327	187	0200
87	P.4674	121	68691651 B, C	154	3323	188	04NG0514
88	P.4670–P.4671	122	2610	155	3321–3322	189	04NG0509
89	P.4669	123	68691649, 68691650 A	156	04NG0518	190	1678–1679
90	1642–1644			157	04NG0517	191	1804
91	P.4948	124	P.4644	158	0459	192	1845–1846
92	1681	125	P.4645	159	76294225	193	76294179
93	68691626 A	126	5034–5036	160	1667	194	P.5142
94	686971627 C, D; 68691628	127	5037	161	68691630 B	195	P.4716
		128	5038	162	76294157	196	1688, 1690
95	68691621	129	0856–0869	163	76294156	197	P.4703
96	6131 K	130	1530	164	6123-6130	198	68691633
97	7629, 158	131	1835	165	1998	199	3141, 3146
98	P.4804	132	04NG1013	166	1805	200	3127
99	P.4811	133	04NG1010	167	1807	201	3110–3111, 3113–3114
100	P.4812	134	0133–0139	168	1853–1854		
101	P.4814	135	0132	169	68691636 B	202	04NG0501
102	P.4827	136	0130–0131	170	1231	203	2395–2396

Locality	Sample(s)
204	2399
205	3278, 3280, 3282
206	2394
207	1989–1990
208	1578
209	3259
210	3261, 3264
211	3266, 3269, 7000–7001
212	7003
213	7005
214	7006
215	7007
216	1988
217	1788–1794
218	1786–1787
219	Sample collected by Chawner (1939)
220	Sample collected by Zehnder & de Caen (1955)
221	1777
222	3475–80; 3498
223	1774–1776
224	1131–1134
225	1604
226	1602
227	1210–1211
228	1156–1157
229	1149–1152
230	1148
231	1147
232	1605, 1608
233	1693–1695
234	Sample collected by White (1972)
235	6111
236	6120 D

SAMPLES LISTED ACCORDING TO AGE, WABAG 1:250 000 SHEET AREA

Samples of indefinite age are not listed, but are discussed in the text, and the faunas are listed in Appendix 2. The locality number is given in brackets after the sample number.

Early Paleocene
8084 (112)

Late middle to Late Paleocene
1008 (2)
8136 (47)
8142 (35)
9039 (65)
9041 (63)
9042 (62)
9060 (153)
F.342 (97)
F.870–F.872 (103)
F.900–F.905 (105)
F.913–F.917 (37)

Early Eocene
F.184 (80)

Middle Eocene
0295 (3)
1524 (1)
1525 (1)
1532 (43)
1534 (43)
1536 (43)
8085 (113)
8093 (4)
8095 (4)
8097 (5)
8098 (5)
8099 (5)
8112 (50)
8113 (50)
8115 (158)
8138 (47)
8139 (46)
8141 (46)
8143a (35)
8145–8146 (49)
9040 (64)
9044 (61)
9051 (69)
B.70 (81)
B.118 (107)
B.135b (44)
B.135h (44)
B.138 (45)
F.41 (151)
F.174 (77)
F.231 (54)
F.275 (146)
F.289 (116)
F.868 (101)
F.908–F.912 (105)
F.916–F.917 (37)
P.9401–P9408 (not shown; see text)

Early Oligocene (Tc)
0697 (32)
2696 (92)
Ab.43b (91)

Middle Oligocene-Middle Miocene (Td-lower Tf)
F.226 (51)

Late Oligocene-Middle Miocene (Te-lower Tf)
2701 (93)

Late Oligocene (lower Te)
2700 (94)

Late Oligocene-Early Miocene (zones N3-N.4)
2648 (120)
2650 (129)
2671 (168)
2675 (137)
2679 (125)
9054 (56)
F.279-F.281 (147)
F.449 (136)
F.456-F.459 (136)
F.936-F.938 (118)

Probably Late Oligocene-Early Miocene (see text)
2651 (129)
2674 (139)
2676 (128)
2678 (126)
2680 (124)
5195 (6)
8087 (67)
8096 (5)
8100 (5)
8101 (5)
8105 (11)
8107 (14)
8108 (14)
8111 (50)
8114 (50)
8133 (154)
8143 (35)
9030 (143)
9036A, B (60)
9047 (73)
9048 (72)
9049 (71)
9050 (70)
9055 (57)
9056 (57)
9057 (57)
9058 (57)
9059 (57)
F.178 (82)
F.223 (53)
F.260 (144)
F.283 (147)
F.284 (147)
F.410 (55)
F.412 (68)
F.450 (136)
F.459 (136)
F.460 (138)
F.491 (79)
F.827 (40)
F.838 (48)
F.841 (38)
F.845 (36)
F.930 (119)
B.23 (156)
B.45 (85)
B.83 (145)
B.111 (173)
B.113 (172)
B.120 (114)
B.135f (44)
B.136a–B.136b (41)

General Oligocene age only (P.19-N.3)
2672 (140)

Late Oligocene-Early Miocene (Te, undifferentiated)
6058 (22)

Early Miocene (upper Te)
3299 (34)
3386 (21)
8041 (106)
8042 (106)
F.43 (150)
B.133a (44)

Early Miocene (zone N.8)
2646 (123)
8034 (99)
8040 (106)
8042 (106)
8043 (106)
8047 (110)
F.399 (16)
F.863 (95)
F.870–F.889 (103)
F.934 (118)
F.1001 (96)

General Early Miocene age (zones N.4-N.8)
2658 (131)
2659 (132)
8035 (98)
F.239 (59)
Ab.86 (13)

Early-Middle Miocene (upper Te-lower Tf)
0687 (28)
0690 (30)
0691 (30)
0694 (31)
0695 (31)
1106 (26)
6064 (22)
6065 (22)
8029 (86)
8037 (52)
8048 (110)
8117 (162)
F.50 (161)
F.527 (155)
F.557 (164)
F.560 (163)
Ab.78 (7)
Ab.1086a (20)
G.49 (90)

Zones N.8-N.9
F.442–F.448 (108)

Zones N.4-N.14
8036 (98)
Ab.43 (91)
Ab.83 (12)

Zones N.8-N.17
F.420–F.439 (100)
F.398–F.405 (16)
F.451–F.455 (16)
F.461–F.471 (16)
F.329 (17)

Middle Miocene (lower Tf)
F.329 (17)
F.846 (39)
KJ.10 (not shown; see text)

Zone N.9
6060 (22)
6061 (22)
6062 (22)
8049 (109)

Not older than Middle Miocene (zone N.9)
0480 (25)
0485 (25)
0486 (25)
1101 (26)
1107 (26)
1108 (26)
1109 (26)
1110 (26)
1121 (26)
1122 (26)
1473 (76)
1475 (76)
2662 (135)
2664 (141)
2665 (141)
2667 (171)
2668 (170)
8031 (86)
8046 (111)
8050 (109)
9031 (148)
9032 (148)
F.1005 (104)
B.117 (166)

General Miocene age only
1474 (76)
2685 (84)
8060 (175)
9003 (58)
F.286 (147)
F.416 (78)
F.441 (102)
F.932 (119)
F.1004 (104)
F.1006 (104)
F.1013 (33)

Late Miocene (zones N.17-N.18)
1478 (75)
2653 (129)

General Miocene or younger age
0390 (23)
0466 (24)
0470 (25)
0471 (25)
0482 (25)
0483 (25)
0484 (25)
1102 (26)
1103 (26)
1104 (26)
1105 (26)
1115 (26)
1117 (26)
1118 (26)
1119 (26)
1567 (165)
2654 (129)
2655 (129)
2656 (129)
2657 (130)
2660 (133)
2661 (134)
F.48 (160)
F.681 (89)
B.137a (42)
B.137b (42)

LIST OF LOCALITY NUMBERS WITH CORRESPONDING SAMPLE NUMBERS, WABAG 1:250 000 SHEET AREA

Locality	*Sample(s)*	*Locality*	*Sample(s)*	*Locality*	*Sample(s)*	*Locality*	*Sample(s)*
1	1524–1525	41	B.136 A, B	87	P.9171	133	2660
2	1008	42	B.137 A, B	88	P.9173–P.9174	134	2661
3	0294–0295	43	1532, 1534, 1536	89	F.681	135	2662
4	8091, 8093–8095	44	B.133 A, B, D, E;	90	G.49	136	F.449–F.450,
5	8096–8101		B.135 A–H	91	Ab.43, Ab.43b		F.456–F459
6	5195	45	B.138	92	2696	137	2675
7	Ab.78	46	8139, 8141	93	2701	138	F.460
8	Ab.80	47	8136, 8138	94	2700	139	2674
9	Ab.81	48	F.838	95	F.863	140	2672
10	Ab.82	49	8145–8146	96	F.1001	141	2664–2665
11	8105	50	8111–8114	97	F.342	142	B.79
12	Ab.83	51	F.226	98	8035–8036	143	9030
13	Ab.86	52	8037	99	8034	144	F.260
14	8107–8108	53	F.223	100	F.420–F.439	145	B.83
15	6005	54	F.231	101	F.868	146	F.275
16	F.398–F.405,	55	F.410	102	F.441	147	F.279–F.286
	F.451–F.455;	56	9054	103	F.870–889	148	9031–9032
	F.461–F.471	57	9055–9059	104	F.1004-F.1006	149	B.36
17	F.300–F.340	58	9003	105	F.900–F.912	150	F.43
18	P.9124	59	F.239	106	8039–8043	151	F.41
19	P.9125	60	9036 A, B	107	B.118	152	F.39
20	Ab.1086 A	61	9044	108	F.442–F.448	153	9060
21	3386	62	9042	109	8049–8050	154	8133
22	6058, 6060–6062,	63	9041	110	8047–8048	155	F.527
	6064–6066	64	9040	111	8046	156	B.23
23	0389–0391	65	9039	112	8084	157	F.564
24	0466, 0469–0471,	66	F.197	113	8085	158	8115
	0476, 0480,	67	8087	114	B.120	159	8119
	0482–0486	68	F.412	115	9045	160	F.48
25	8009	69	9051	116	F.289	161	F.50
26	1100–1110,	70	9050	117	9052	162	8117
	1115–1122	71	9049	118	F.934–F.938	163	F.560
27	0686	72	9048	119	F.930, F.932	164	F.557
28	0687	73	9047	120	2648	165	1567
29	0689	74	1478	121	8135	166	B.117
30	0690–0691	75	1475	122	2647	167	B.116
31	0694–0695	76	1473–1474	123	2646	168	2671
32	0697	77	F.174	124	2680	169	2670
33	F.1013	78	F.416	125	2679	170	2668
34	3299	79	F.491	126	2678	171	2667
35	8142, 8143,	80	F.184	127	2677	172	B.113
	8143 A	81	B.70 A, B	128	2676	173	B.111
36	F.845	82	F.178	129	2650–2651,	174	F.1
37	F.913–F.917	83	F.753		2653–2656	175	8060
38	F.841	84	2685	130	2657		
39	F.846	85	B.45	131	2658		
40	F.827	86	8029, 8031	132	2659		

REFERENCES

ADAMS, C. G., 1970—A reconsideration of the East Indian letter classification of the Tertiary. *Bulletin of the British Museum (Natural History),* 19(3), 87-137.

ADAMS, C. G., in press—Neogene larger foraminifera, evolutionary and geological events in the context of Indo-Pacific datum planes. *In* IGCP Project 114—Biostratigraphic datum-planes of the Pacific Neogene. Final Report.

AKERS, W. H., 1955—Some planktonic foraminifera of the American Gulf Coast and suggested correlations with the Caribbean Tertiary. *Journal of Paleontology,* 29(4), 647-664.

ARNOLD, G. O., GRIFFIN, T. J., & HODGE, C. C., 1979—Geology of the Ok Tedi and southern Atbalmin 1:100 000 sheet. *Geological Survey of Papua New Guinea, Report* 79/3, parts 1-3 (unpublished).

BANDY, O. L., 1949—Eocene and Oligocene foraminifera from Little Stave Creek, Clarke County, Alabama. *Bulletins of American Paleontology,* 32(131), 1-211.

BANDY, O. L., 1964—The type of *Globorotalia crassata* (Cushman). *Contributions from the Cushman Foundation for Foraminiferal Research,* 15(1), 34-35.

BANDY, O. L., 1972—Origin and development of *Globorotalia (Turborotalia) pachyderma* (Ehrenberg). *Micropaleontology,* 18(3), 294-318.

BANG, I., 1969—Planktonic foraminifera and biostratigraphy of the type Danian. *In* Proceedings of the First International Conference on Planktonic Microfossils, Geneva, 1967. *E. J. Brill, Leiden,* 1, 58-65.

BANNER, F. T., & BLOW, W. H., 1959—The classification and stratigraphical distribution of the Globigerinaceae. *Palaeontology,* 2(1), 1-27.

BANNER, F. T., & BLOW, W. H., 1960a—Some primary types of species belonging to the superfamily Globigerinaceae. *Contributions from the Cushman Foundation for Foraminiferal Research,* 11(1), 1-41.

BANNER, F. T., & BLOW, W. H., 1960b—The taxonomy, morphology and affinities of the genera included in the subfamily Hastigerininae. *Micropaleontology,* 6(1), 19-31.

BANNER, F. T., & BLOW, W. H., 1965—Two new taxa of the Globorotaliinae (Globigerinacea, Foraminifera) assisting determination of the late Miocene/Middle Miocene boundary. *Nature,* 207 (5004), 1351-1354.

BECKMANN, J. P., 1957—*Chiloguembelina* Loeblich and Tappan and related foraminifera from the lower Tertiary of Trinidad, B.W.I. *United States National Museum, Bulletin,* 215, 83-95.

BELFORD, D. J., 1967—Paleocene planktonic foraminifera from Papua and New Guinea. *Bureau of Mineral Resources, Australia, Bulletin* 92, 1-33.

BELFORD, D. J., 1974—Foraminifera from the Ilaga Valley, Nassau Range, Irian Jaya. *Bureau of Mineral Resources, Australia, Bulletin* 150, 1-26.

BELFORD, D. J., 1981—Co-occurrence of middle Miocene larger and planktic smaller foraminifera, New Ireland, Papua New Guinea. *Bureau of Mineral Resources, Australia, Bulletin* 209, iii, 1-21.

BERGGREN, W. A., 1965—Some problems of Paleocene-lower Eocene planktonic foraminiferal correlations. *Micropaleontology,* 11(3), 278-300.

BERGGREN, W. A., 1968—Phylogenetic and taxonomic problems of some Tertiary planktonic foraminiferal lineages. *Tulane University Studies in Geology,* 6(1), 1-22.

BERGGREN, W. A., 1969a—Paleogene biostratigraphy and planktonic foraminifera of northern Europe. *In* Proceedings of the First International Conference on Planktonic Microfossils. *E. J. Brill, Leiden,* 1, 121-161.

BERGGREN, W. A., 1969b—Rates of evolution in some Cenozoic planktonic foraminifera. *Micropaleontology,* 15(3), 351-365.

BERGGREN, W. A., 1971a—Tertiary boundaries and correlations. *In* FUNNEL, B. F., & RIEDEL, W. R. (Editors)—MICROPALEONTOLOGY OF THE OCEAN. *University Press, Cambridge,* 693-809.

BERGGREN, W. A., 1971b—Multiple phylogenetic zonations of the Cenozoic based on planktonic foraminifera. *In* Proceedings of the 2nd Planktonic Conference, Rome, 1970. *Edizioni Tecnoscienza, Rome,* 1, 41-56.

BERGGREN, W. A., 1972—A Cenozoic time-scale—some implications for regional geology and paleobiogeography. *Lethaia,* 5, 195-215.

BERGGREN, W. A., & AMDURER, M., 1973—Late Paleogene (Oligocene) and Neogene planktonic foraminiferal biostratigraphy of the Atlantic Ocean (Lat. 30°N to Lat. 30°S). *Rivista Italiana di Paleontologia e Stratigrafia,* 79 (3), 337-392.

BERGGREN, W. A., OLSSON, R. K., & REYMENT, R. A., 1967—Origin and development of the foraminiferal genus *Pseudohastigerina* Banner & Blow, 1959. *Micropaleontology,* 13(3), 265-288.

BERMUDEZ, P. J., 1949—Tertiary smaller foraminifera of the Dominican Republic. *Cushman Laboratory for Foraminiferal Research, Special Publication* 25, I-IV, 1-322.

BERMUDEZ, P. J., 1961—Contribucion al estudio de las Globigerinidea de la region Caribe-Antillana. *Memoria del III Congreso Geologico Venezolano—vol. III Boletin de Geologia—Publicacion especial* 3, 1.119-1.393.

BINNEKAMP, J. G., 1970—Foraminifera and age of samples from the Star Mountains, Territory of Papua and New Guinea. *Bureau of Mineral Resources, Australia, Record* 1970/14.

BIZON, G., & BIZON, J. J., 1971—Observations sur l'evolution de *Globorotalia 'menardi'* dans le Miocene moyen et superieur d'Espagne meridionale. *In* Proceedings of the 2nd Planktonic Conference, Rome, 1970. *Edizioni Tecnoscienza, Rome,* 1, 85-93.

BLOW, W. H., 1956—Origin and evolution of the foraminiferal genus *Orbulina* d'Orbigny. *Micropaleontology,* 2(1), 57-70.

BLOW, W. H., 1959—Age, correlation and biostratigraphy of the upper Tocuyo (San Lorenzo) and Pozon Formations, eastern Falcon, Venezuela. *Bulletins of American Paleontology,* 39(178), 67-251.

BLOW, W. H., 1965—*Clavatorella,* a new genus of the Globorotaliidae. *Micropaleontology,* 11(3), 365-368.

BLOW, W. H., 1969—Late middle Eocene to Recent planktonic foraminiferal biostratigraphy. *In* Proceedings of the First International Conference on Planktonic Microfossils, Geneva, 1967. *E. J. Brill, Leiden,* 1, 199-422.

BLOW, W. H., 1970—Deep-Sea Drilling Project, Leg 3, Foraminifera from selected samples. *In* MAXWELL, A. E., & OTHERS—Initial reports of the Deep Sea Drilling Project. *Washington, US Government Printing Office,* 3, 589-611.

BLOW, W. H., 1979—THE CAINOZOIC GLOBIGERINIDA, Volumes I-III. *E. J. Brill, Leiden.*

BLOW, W. H., & BANNER, F. T., 1962—The Mid-Tertiary (Upper Eocene to Aquitanian) Globigerinaceae. *In* EAMES, F. E., BANNER, F. T., BLOW, W. H., & CLARKE, W., 1962—FUNDAMENTALS OF MID-TERTIARY STRATIGRAPHICAL CORRELATION. *Cambridge University Press, London,* 61-147.

BLOW, W. H., & BANNER, F. T., 1966—The morphology, taxonomy and biostratigraphy of *Globorotalia barisanensis* LeRoy, *Globorotalia fohsi* Cushman and Ellisor and related taxa. *Micropaleontology,* 12(3), 286-302.

BOLLI, H. M., 1954—Note on *Globigerina concinna* Reuss, 1850. *Contributions from the Cushman Foundation for Foraminiferal Research,* 5(1), 1-3.

BOLLI, H. M., 1957a—The genera *Globigerina* and *Globorotalia* in the Paleocene-lower Eocene Lizard Springs Formation of Trinidad, B.W.I. *United States National Museum, Bulletin,* 215, 61-81.

BOLLI, H. M., 1957b—Planktonic foraminifera from the Oligocene-Miocene Cipero and Lengua Formations of Trinidad, B.W.I. *United States National Museum, Bulletin* 215, 97-123.

BOLLI, H. M., 1957c—Planktonic foraminifera from the Eocene Navet and San Fernando Formations of Trinidad, B.W.I. *United States National Museum, Bulletin* 215, 155-172.

BOLLI, H. M., 1972a—The genus *Globigerinatheka* Brönnimann. *Journal of Foraminiferal Research,* 2(3), 109-136.

BOLLI, H. M., & BERMUDEZ, P. J., 1965—Zonation based on planktonic foraminifera of middle Miocene to Pliocene warm-water sediments. *Boletin Informativo Asociacion Venezolano de Geologia, Mineria y Petroleo,* 8(5), 121-149.

BOLLI, H. M., & CITA, MARIA BIANCA, 1960—Globigerine e Globorotalie del Paleocene di Paderno d'Adda (Italia). *Rivista Italiana di Paleontologia e Stratigrafia,* 66(3), 1-42.

BOLLI, H. M., LOEBLICH, A. R. JR, & TAPPAN, HELEN, 1957—Planktonic foraminiferal families Hantkeninidae, Orbulinidae, Globorotaliidae and Globotruncanidae. *United States National Museum, Bulletin,* 215, 3-50.

BOLTOVSKOY, E., 1974—Neogene planktonic foraminifera of the Indian Ocean. *In* DAVIES, T. A., LUYENDYK, B. P., & OTHERS—Initial reports of the Deep Sea Drilling Project. *US Government Printing Office, Washington,* 26, 675-741.

BORSETTI, ANNA MARIA, 1959—Tre nuovi foraminiferi planctonici dell' Oligocene Piacentino. *Giornale di Geologia,* ser. 2a, 27, 205-212.

BRADY, H. B., 1877—Supplementary note on the foraminifera of the chalk (?) of the New Britain Group. *Geological Magazine,* new series, decade 2, volume 4, 534-536.

BRADY. H. B., 1882—Report on the foraminifera. *In* TIZARD & MURRAY, J.—Exploration of the Faroe Channel during the summer of 1880, in H.M.S. 'Knight Errant', with subsidiary reports. *Proceedings of the Royal Society of Edinburgh,* 11(111), 708-717.

BRADY, H. B., 1884—Report on the foraminifera dredged by H.M.S. Challenger during the years 1873-76. *In* REPORT ON THE SCIENTIFIC RESULTS OF THE VOYAGE OF H.M.S. CHALLENGER DURING THE YEARS 1873-76. ZOOLOGY —VOL. IX. *HMSO, London.*

BRÖNNIMANN, P., 1951a—The genus *Orbulina* d'Orbigny in the Oligo-Miocene of Trinidad, B.W.I. *Contributions from the Cushman Foundation for Foraminiferal Research,* 2 (4), 132-138.

BRÖNNIMANN, P., 1951b—*Globigerinita naparimaensis,* n. gen., n.sp., from the Miocene of Trinidad, B.W.I. *Contributions from the Cushman Foundation for Foraminiferal Research,* 2(1), 16-18.

BRÖNNIMANN, P., 1952a—*Globigerinoita* and *Globigerinatheka,* new genera from the Tertiary of Trinidad, B.W.I. *Contributions from the Cushman Foundation for Foraminiferal Research,* 3(1), 25-28.

BRÖNNIMANN, P., 1952b—Trinidad Paleocene and lower Eocene Globigerinidae. *Bulletins of American Paleontology,* 34(143), 5-34.

BRÖNNIMANN, P., 1954 *in* TODD, RUTH, CLOUD, P. E. JR., LOW, DORIS, & SCHMIDT, R. G.—Probable occurrence of Oligocene on Saipan. *American Journal of Science,* 252, 673-682.

BRÖNNIMANN, P., & BERMUDEZ, P. J., 1953—*Truncorotaloides,* a new foraminiferal genus from the Eocene of Trinidad, B.W.I. *Journal of Paleontology,* 27(6), 817-820.

BRÖNNIMANN, P., & RESIG, J., 1971—A Neogene globigerinacean biochronologic time-scale of the southwestern Pacific. *In* WINTERER, E. L., & OTHERS—Initial Reports of the Deep Sea Drilling Project. *US Government Printing Office, Washington,* 7, 1235-1469.

BROTZEN, F., & POZARYSKA, K., 1961—Foraminifères du Paléocène et de l'Éocène inférieur en Pologne Septentrionale remarques paléogéographiques. *Revue de Micropaléontologie,* 4(3), 155-166.

BUCKLEY, H. A., 1973—*Globorotalia (Clavatorella) oveyi* n. sp., première mention Recente d'un sous-genre de Foraminifère du Neogene. *Revue de Micropaléontologie,* 16 (3), 168-172.

BYKOVA, N. K., 1953—Foraminifera from the Suzak stage of the Tadzhisk depression. (In Russian.) *Mikrofauna SSSR,* 6, 5-15.

CHAPMAN, F., PARR, W. J., & COLLINS, A. C., 1934—Tertiary foraminifera of Victoria, Australia—the Balcombian deposits of Port Phillip; part III. *Journal of the Linneian Society of London, Zoology,* 38(262), 553-577.

CHAPRONIERE, G. C. H., 1975—Palaeoecology of Oligo-Miocene larger Foraminiferida, Australia. *Alcheringa,* 1, 37-58.

CHAPRONIERE, G. C. H., 1977—Studies on foraminifera from Oligo-Miocene sediments, northwest Western Australia (2 volumes). *Ph.D. thesis, University of Western Australia* (unpublished).

CHAPRONIERE, G. C. H., 1980a—Biometrical studies of Early Neogene larger Foraminiferida from Australia and New Zealand. *Alcheringa,* 4(3), 153-181.

CHAPRONIERE, G. C. H., 1980b—Foraminiferal faunas in samples from the Wabag 1:250 000 Sheet area, Papua New Guinea. *Bureau of Mineral Resources, Australia, Professional Opinion Geol.* 80.003 (unpublished).

CHAPRONIERE, G. C. H., 1981a—Late Oligocene to early Miocene planktic Foraminiferida from Ashmore Reef No. 1 well, northwest Australia. *Alcheringa,* 5(2), 103-131.

CHAPRONIERE, G. C. H., 1981b—Australasian mid-Tertiary larger foraminiferal associations and their bearing on the East Indian Letter Classification. *BMR Journal of Australian Geology & Geophysics,* 6, 145-151.

CHAWNER, W. D., 1939—Report on geological reconnaissance in Permit 4 area during 1937 and 1938. *Island Exploration Company Pty Ltd, Report* JA (unpublished).

CIFELLI, R., 1972—The holotypes of *Pulvinulina crassata* var. *densa* Cushman and *Globigerina spinuloinflata* Bandy. *Journal of Foraminiferal Research,* 2(3), 157-159.

CITA, M. B., & GELATI, R., 1960—*Globoquadrina langhiana* n.sp. del Langhiano tipo. *Rivista Italiana di Paleontologia e Stratigrafia,* 66(2).

COLE, W. S., 1927—A foraminiferal fauna from the Guayabal Formation in Mexico. *Bulletins of American Paleontology,* 14(51), 1-46.

CORDEY, W. G., 1967—The development of *Globigerinoides ruber* (d'Orbigny, 1839) from the Miocene to Recent. *Paleontology,* 10(4), 647-659.

CONATO, V., 1964—Alcuni Foraminiferi nuovi nel Pliocene nordappenninico Contributo 1. *Geologia Romana,* 3, 279-302.

CUSHMAN, J. A., 1925a—A new genus of Eocene foraminifera. *Proceedings of the United States National Museum,* 66 (1924), 2567, art. 30, 1-4.

CUSHMAN, J. A., 1925b—New Foraminifera from the Upper Eocene of Mexico. *Contributions from the Cushman Laboratory for Foraminiferal Research,* 1(1), 4-10.

CUSHMAN, J. A., 1925c—Some new Foraminifera from the Velasco Shale of Mexico. *Contributions from the Cushman Laboratory for Foraminiferal Research,* 1(1), 18-23.

CUSHMAN, J. A., 1925d—An Eocene fauna from the Moctezuma River, Mexico. *Bulletin of the American Association of Petroleum Geologists,* 9(2), 298-303.

CUSHMAN, J. A., 1927a—An outline of a reclassification of the Foraminifera. *Contributions from the Cushman Laboratory for Foraminiferal Research,* 3(1), 1-105.

CUSHMAN, J. A., 1927b—New and interesting foraminifera from Mexico and Texas. *Contributions from the Cushman Laboratory for Foraminiferal Research,* 3(2), 111-116.

CUSHMAN, J. A., 1940—Midway foraminifera from Alabama. *Contributions from the Cushman Laboratory for Foraminiferal Research,* 16(3), 51-73.

CUSHMAN, J. A., & BERMUDEZ, P., 1937—Further new species of foraminifera from the Eocene of Cuba. *Contributions from the Cushman Laboratory for Foraminiferal Research,* 13(1), 1-29.

CUSHMAN, J. A., & BERMUDEZ, P. J., 1949—Some Cuban species of *Globorotalia. Contributions from the Cushman Laboratory for Foraminiferal Research,* 25(2), 26-45.

CUSHMAN, J. A., & ELLISOR, A. C., 1939—New species of foraminifera from the Oligocene and Miocene. *Contributions from the Cushman Laboratory for Foraminiferal Research*, 15(1), 1-14.

CUSHMAN, J. A., & JARVIS, P. W., 1929—New Foraminifera from Trinidad. *Contributions from the Cushman Laboratory for Foraminiferal Research*, 5(1), 6-17.

CUSHMAN, J. A., & JARVIS, P. W., 1930—Miocene foraminifera from Buff Bay, Jamaica. *Journal of Paleontology*, 4(4), 353-368.

CUSHMAN, J. A., & JARVIS, P. W., 1936—Three new foraminifera from the Miocene, Bowden Marl, of Jamaica. *Contributions from the Cushman Laboratory for Foraminiferal Research*, 12(1), 3-5.

CUSHMAN, J. A., & RENZ, H. H., 1942—Eocene, Midway, Foraminifera from Soldado Rock, Trinidad. *Contributions from the Cushman Laboratory for Foraminiferal Research*, 18(1), 1-20.

DAVIES, H. L., 1980—Palaeontological data for the Wabag 1:250 000 Sheet area. *Geological Survey of Papua New Guinea, Report* 80/30 (unpublished).

DAVIES, H. L., 1983—Wabag—1:250 000 Geological Series. *Geological Survey of Papua New Guinea, Explanatory Notes* SB/54-8.

DAVIES, H. L., & NORVICK, M., 1974—Blucher Range, New Guinea—1:250 000 Geological Series. *Bureau of Mineral Resources, Australia, Explanatory Notes*, SB/54-7.

DEKKER, F. E., & FAULKS, I. G., 1964—The geology of the Wabag area, New Guinea. *Bureau of Mineral Resources, Australia, Record* 1964/137.

DOW, D. B., SMIT, J. A. J., BAIN, J. H. C., & RYBURN, R. J., 1972—Geology of the south Sepik region, New Guinea. *Bureau of Mineral Resources, Australia, Bulletin* 133.

EAMES, F. E., BANNER, F. T., BLOW, W. H., & CLARKE, W. J., 1962—FUNDAMENTALS OF MID-TERTIARY STRATIGRAPHICAL CORRELATION. *University Press, Cambridge.*

ELLIS, B. F., & MESSINA, ANGELINA R., 1940 et seq—Catalogue of Foraminifera. *American Museum of Natural History, Special Publication.*

EL-NAGGAR, Z. R., 1966—Stratigraphy and planktonic foraminifera of the Upper Cretaceous-Lower Tertiary succession in the Esna-Idfu region, Nile Valley, Egypt, U.A.R. *Bulletin of the British Museum (Natural History), Geology, Supplement* 2, 1-291.

EL-NAGGAR, Z. R., 1969—New suggestions for the division and correlation of Paleocene strata by the use of planktonic foraminifera. *In* Proceedings of the First International Conference on Planktonic Microfossils, Geneva, 1967. *E. J. Brill, Leiden*, 2, 182-201.

EL-NAGGAR, Z. R., 1971—On the classification, evolution and stratigraphical distribution of the Globigerinacea. *In* Proceedings of the 2nd Planktonic Conference, Rome, 1970. *Edizioni Tecnoscienza, Rome*, 1, 421-476.

EL-NAGGAR, Z. R., & AL MEER, A. Y., 1973—Position taxonomique du genre *Globanomalina* Hague 1956 et remarques sur les Hantkenininae (Foraminifères). *Revue de Micropaléontologie*, 16(2), 65-72.

FINDLAY, A. L., 1974—The structure of foothills south of the Kubor Range, Papua New Guinea. *The APEA Journal*, 14(1), 14-20.

FINLAY, H. J., 1939a—New Zealand Foraminifera: key species in stratigraphy—No. 2. *Transactions of the Royal Society of New Zealand*, 69(1), 89-128.

FINLAY, H. J., 1939b—N.Z. Foraminifera: key species in stratigraphy—No. 3. *Transactions of the Royal Society of New Zealand*, 69(3), 309-329.

FINLAY, H. J., 1947—New Zealand foraminifera: key species in stratigraphy, No. 5. *New Zealand Journal of Science and Technology*, sec. B, 28(5), 259-292.

FLEISHER, R. L., 1974—Cenozoic planktonic foraminifera and biostratigraphy, Arabian Sea Deep Sea Drilling Project, leg 23A. *In* WHITMARSH, R. B., WESER, O. E., ROSS, D. A., & OTHERS—Initial Reports of the Deep Sea Drilling Project. *US Government Printing Office, Washington*, 23, 1001-1072.

FROST, S. H., & LANGENHEIM, R. L., 1974—CENOZOIC REEF BIOFACIES. *Northern Illinois University Press, Illinois.*

GLAESSNER, M. F., 1937a—Planktonforaminiferen aus der Kreide und dem Eozän und ihre stratigraphische Bedeutung. (German with Russian summary.) *Moscow University Palaeontological Laboratory, Studies in Micropaleontology*, 1(1), 27-46.

GLAESSNER, M. F., 1937b—Studien über Foraminiferen aus der Kreide und dem Tertiär des Kaukasus; I. Die Foraminiferen der ältesten Tertiarschichten des Nordwestkaukasus. *Moscow University Palaeontological Laboratory, Problems in Paleontology*, 2-3, 349-410.

GOHRBANDT, K., 1963—Zur Gliederung der Paläogen im Helvetikum nördlich Salzburg nach planktonischen Foraminiferen. 1. Tiel Paleozän und tiefstes Untereozän. *Mitteilungen der Geologischen Gesellschaft in Wien*, 56 (1), 1-116.

GOHRBANDT, K. H. A., 1967—Some new planktonic foraminiferal species from the Austrian Eocene. *Micropaleontology*, 13(3), 319-326.

GRAVELL, D. W., & HANNA, M. A., 1937—The *Lepidocyclina texana* horizon in the *Heterostegina* zone, Upper Oligocene, of Texas and Louisiana. *Journal of Paleontology*, 11, 517-529.

HAQUE, A. F. M. M., 1956—The smaller foraminifera of the Ranikot and Laki of the Nammal Gorge, Salt Range. *Memoir Pakistan Geological Survey, Palaeontologica Pakistanica*, 1, 1-300.

HEDBERG, H. D., 1937—Foraminifera of the middle Tertiary Carapita Formation of northeastern Venezuela. *Journal of Paleontology*, 11(8), 661-697.

HILLEBRANDT, A. VON, 1962—Das Paleozän und seine Foraminiferen fauna im Becken von Reichenhall und Salzburg. *Bayerische Akadamie der Wissenschaften Mathematisch-Naturwissenschaftliche Klasse, Abhandlungen*, N.F., 108, 1-182.

HORNIBROOK, N. DE B., 1958—New Zealand Upper Cretaceous and Tertiary foraminiferal zones and some overseas correlations. *Micropaleontology*, 4(1), 25-38.

JENKINS, D. G., 1960—Planktonic foraminifera from the Lakes Entrance oil shaft, Victoria, Australia. *Micropaleontology*, 6(4), 345-371.

JENKINS, D. G., 1966—Planktonic foraminiferal zones and new taxa from the Danian to lower Miocene of New Zealand. *New Zealand Journal of Geology and Geophysics*, 8(6), 1088-1126.

JENKINS, D. G., 1971—New Zealand Cenozoic planktonic foraminifera. *New Zealand Geological Survey, Palaeontological Bulletin*, 42.

JENKINS, D. G., & ORR, W. N., 1972—Planktonic foraminiferal biostratigraphy of the eastern equatorial Pacific—DSDP Leg 9. *In* HOLLISTER, C. D., & OTHERS—Initial reports of the Deep Sea Drilling Project. *US Government Printing Office, Washington*, 9, 1059-1193.

JENKINS, D. G., SAUNDERS, J. B., & CIFELLI, R., 1981—The relationship of *Globigerinoides bisphericus* Todd 1954 to *Praeorbulina sicana* (de Stefani) 1952. *Journal of Foraminiferal Research*, 11(4), 262-267.

JENKINS, D. A. L., FINDLAY, A. L., & ROBINSON, G. P., 1969—Mendi Geological Survey, Permits 46, 27 Papua. *BP Petroleum Development Australia Pty Ltd, Report* 84 (unpublished).

KHALILOV, D. M., 1956—The pelagic foraminiferal fauna of the Paleogene deposits of Azerbaijan. (In Russian.) *Akademia Nauk Azerbaijan SSR, Institute Geology, Trudy*, 17, 234-255.

KIERSTEAD, CAROLINE H., LEIDY, ROSANNE R. D., FLEISHER, R. L., & BOERSMA, ANN, 1969—Neogene zonation of tropical Pacific cores. *In* Proceedings of the First International Conference on Planktonic Microfossils, Geneva, 1967. *E. J. Brill, Leiden*, 2, 328-338.

KOCH, F., 1926—Mitteltertiare Foraminiferen aus Bulongan, Ost-Borneo. *Eclogae Geologicae Helvetiae*, 19(3), 722-751.

LAMB, J. L., & BEARD, J. H., 1972—Late Neogene planktonic foraminifers in the Caribbean, Gulf of Mexico, and Italian stratotypes. *University of Kansas, Palaeontological Contribution,* Art. 57, 1-67.

LEROY, L. W., 1939—Some small Foraminifera, ostracoda and otoliths from the Neogene ('Miocene') of the Rokan-Tapanoeli area, Central Sumatra. *Natuurkundig tijdschrift voor Nederlandsch-Indie,* 99(6), 215-296.

LEROY, L. W., 1944—Miocene Foraminifera of central Sumatra, Netherlands East Indies. *Quarterly of the Colorado School of Mines,* 39(3), 7-69.

LEROY, L. W., 1953—Biostratigraphy of the Maqfi section, Egypt. *The Geological Society of America, Memoir* 54, i-vii, 1-73.

LOEBLICH, A. R. JR., & TAPPAN, HELEN, 1956—*Chiloguembelina,* a new Tertiary genus of the Heterohelicidae (Foraminifera). *Journal of the Washington Academy of Science,* 46(11).

LOEBLICH, A. R. JR., & TAPPAN, HELEN, 1957—Planktonic foraminifera of Paleocene and early Eocene age from the Gulf and Atlantic Coastal Plains. *United States National Museum, Bulletin,* 215, 173-198.

LOEBLICH, A. R. JR., & TAPPAN, HELEN, 1964—Part C, Protista 2, chiefly 'Thecamoebians' and Foraminiferida. *In* MOORE, R. C. (Editor)—TREATISE ON INVERTEBRATE PALEONTOLOGY. *University of Kansas Press and the Geological Society of America.*

LUTERBACHER, H. P., 1964—Studies in some *Globorotalia* from the Paleocene and lower Eocene of the central Apennines. *Eclogae Geologicae Helvetiae,* 57(2), 631-730.

MARTINEZ-GALLEGO, J., 1972—Bioestratigrafia de la zona de *Globorotalia pseudomenardii* (base del Paleoceno superior) en el sector de Alamedilla (Provincia de Granada). *Revista Espanola de Micropaleontologia, Numero Extraordinaria,* 30th Anniversary E.N. Adaro, 131-141.

MCGOWRAN, B., 1964—Foraminiferal evidence for the Paleocene age of the King's Park Shale (Perth Basin, Western Australia.) *Journal of the Royal Society of Western Australia,* 47(3), 81-86.

MCGOWRAN, B., 1965—Two Paleocene foraminiferal faunas from the Wangerrip Group, Pebble Point coastal section, Western Victoria. *Proceedings of the Royal Society of Victoria,* 79(1), 9-74.

MCGOWRAN, B., 1968—Reclassification of early Tertiary *Globorotalia. Micropaleontology,* 14(2), 179-198.

MARTIN, L. T., 1943—Eocene foraminifera from the type Lodo Formation, Fresno County, California. *Stanford University Publications in Geological Science,* 3(3), 93-125.

MOROZOVA, V. G., 1957—The foraminiferal superfamily Globigerinidae and some of its representatives. (In Russian.) *Doklady Akademia Nauk SSSR* 114/5, 1109-1112.

MOROZOVA, V. G., 1961—Planktonic foraminifera from the Danian-Montian of the southern USSR. (In Russian.) *Paleontological Journal Akademia Nauk USSR,* 1/2, 8-19.

NORVICK, M., 1973—Results of palaeontological work, Blucher Range 1:250 000 Sheet area, Papua New Guinea. *Bureau of Mineral Resources, Australia, Record* 1973/101 (unpublished).

NUTTALL, W. L. F., 1930—Eocene foraminifera from Mexico. *Journal of Paleontology,* 4(3), 271-293.

OGNIBEN, L., 1958—Stratigrafia e microfaune del Terziario della zona di Caiazzo (Caserta). *Rivista Italiana di Paleontologia e Stratigrafia,* 64(3), 199-286.

OLSSON, R. K., 1960—Foraminifera of latest Cretaceous and earliest Tertiary age in the New Jersey coastal plain. *Journal of Paleontology,* 34, 1-58.

OLSSON, R. K., 1964—*Praeorbulina* Olsson, a new foraminiferal genus. *Journal of Paleontology,* 38(4), 770-771.

OLSSON, R. K., 1969—Early Tertiary planktonic foraminiferal zonation of New Jersey. *In* Proceedings of the First International Conference on Planktonic Microfossils, Geneva, 1967. *E. J. Brill, Leiden,* 2, 493-504.

OLSSON, R. K., 1970a—Paleocene planktonic foraminiferal biostratigraphy and paleozoogeography of New Jersey. *Journal of Paleontology,* 44(4), 589-597.

OLSSON, R. K., 1970b—Planktonic foraminifera from base of Tertiary, Millers Ferry, Alabama. *Journal of Paleontology,* 44(4), 598-604.

ORBIGNY, A. D', 1826—Tableau methodique de la classe des Cephalopodes. *Annales des Sciences Naturelles Paris,* series 1, 7, 96-314.

ORBIGNY, A. D', 1839—Foraminiferes. *In* SAGRA, R. DE LA—HISTOIRE PHYSIQUE, POLITIQUE ET NATURELLE DE L'ILE DE CUBA. *A. Bertrand, Paris.*

ORBIGNY, A. D', 1846—FORAMINIFERES FOSSILES DU BASSIN TERTIARE DE VIENNE (AUTRICHE). *Gide et Comp., Paris.*

PALMER, DOROTHY K., 1945—Notes on the foraminifera from Bowden, Jamaica. *Bulletins of American Paleontology,* 29(115), 5-82.

PALMIERI, V., 1971—Occurrence of Danian at Port Moresby. *Geological Survey of Queensland, Report,* 63, 1-8.

PARKER, FRANCES L., 1967—Late Tertiary biostratigraphy (planktonic foraminifera) of tropical Indo-Pacific deep-sea cores. *Bulletins of American Paleontology,* 52(235), 115-208.

PARKER, FRANCES L., 1976—Taxonomic notes on some planktonic foraminifera. *In* TAKAYANAGI, Y., & SAITO, T. (Editors)—PROGRESS IN MICROPALEONTOLOGY. *Micropaleontology Press and American Museum of Natural History, Special Publication,* 258-262.

PARKER, W. K., JONES, T. R., & BRADY, H. B., 1865—On the nomenclature of the foraminifera. Pt. 12. The species enumerated by d'Orbigny in the 'Annales des Sciences Naturelles', vol. 7, 1826. *Annals and Magazine of Natural History,* series 3, 16, 15-41.

PESSAGNO, E. A. JR., 1960—Stratigraphy and micropaleontology of the Cretaceous and Lower Tertiary of Puerto Rico. *Micropaleontology,* 6(1), 87-110.

PLUMMER, H. J., 1926—Foraminifera on the Midway Formation in Texas. *Bulletin of the University of Texas,* 2644, 1-206.

POSTUMA, J. A., 1971—MANUAL OF PLANKTONIC FORAMINIFERA. *Elsevier Publishing Company, Amsterdam.*

PROTO DECIMA, FRANCA, & BOLLI, H. M., 1970—Evolution and variability of *Orbulinoides beckmanni* (Saito). *Eclogae Geologicae Helvetiae,* 63(3), 883-905.

PUJOL, C., & SIGAL, J., 1979—Les foraminifères planctoniques Paléogènes du Site 245 (Bassin de Madagascar)—Biostratigraphie. (D.S.D.P. Leg 25.) *Centre National de la Recherche Scientifique, Paris, Editions du C.N.R.S.,* 1-105.

RAMSAY, W. R., 1962—Hantkenininae in the Tertiary rocks of Tanganyika. *Contributions from the Cushman Foundation for Foraminiferal Research,* 13(3), 79-89.

REUSS, A. E., 1850—Neues Foraminiferen aus den Schichten des Osterreichischen Tertiarbeckens. *Kaiserlichen Akademie der Wissenschaften Wien, Mathematisch-Naturwissenschaftliche Classe, Denkschriften,* 1, 365-390.

REY, M., 1955—Description de quelques espécies nouvelles de foraminifères dans le Nummulitique nord-marocain. *Bullétin Société Géologique France,* séries 6, 4(4-6), 209-211.

SAITO, T., 1962—Eocene planktonic foraminifera from Hahapima (Hillsborough Island). *Transactions and Proceedings of the Palaeontological Society of Japan,* 45, 209-225.

SAITO, T., & MAIYA, S., 1973—Planktonic foraminifera of the Nishikurosawa Formation, northeast Honshu, Japan. *Transactions and Proceedings of the Palaeontological Society of Japan,* 91, 113-125.

SAMANTA, B. K., 1973—Planktonic foraminifera from the Paleocene-Eocene succession in the Rakhi Nala, Sulaiman Range, Pakistan. *Bulletin of the British Museum (Natural History), Geology,* 22(6), 423-482.

SCHWAGER, C., 1866—Fossile Foraminiferen von Kar Nikobar. *Novara Expedition, 1857-1859, Wien, Osterreich, Geologischen Theil,* 2(2), 187-268.

SCHWAGER, C., 1883—Die Foraminiferen aus den Eocaenablagerungen der Lybischen Wuste und Agyptens. *Paleontographica,* 30, 79-154.

SHAFIK, S., & CHAPRONIERE, G. C. H., 1978—Nannofossil and planktic foraminiferal biostratigraphy across the Oligocene-Miocene boundary in parts of the Indo-Pacific region. *BMR Journal of Australian Geology & Geophysics,* 3(2), 135-151.

STAINFORTH, R. M., LAMB, J. L., LUTERBACHER, H., BEARD, J. H., & JEFFORDS, R. M., 1975—Cenozoic planktonic foraminiferal zonation and characteristics of index forms. Appendix. *University of Kansas, Paleontological Contributions, Article* 62, 163-425.

STEFANI, T. DE, 1952—Su alcune manifestazioni di idrocaburi in provincia di Palermo e descrizione di foraminiferi nuovi. *Plinia, Palermo, Italy,* 3, nota 4, 1-12.

SUBBOTINA, N. N., 1947—Foraminifera of the Danian and Paleogene deposits of the northern Caucasus. *In* Microfauna of the oil fields of the Caucasus, Emba and Central Asia, volume 1. *VNIGRI,* 39-160. (In Russian.)

SUBBOTINA, N. N., 1953—Fossil Foraminifera of the USSR: Globigerinidae, Hantkeninidae and Globorotaliidae. (In Russian.) *VNIGRI, Trudy,* new series, 76, 1-296. (Translated into English by E. Lees, 1971; Collets, London & Wellingborough.)

TAKAYANAGI, Y., & SAITO, T., 1962—Planktonic Foraminifera from the Nobori Formation, Shikoku, Japan. *Science Reports of the Tohoku University,* second series (Geology), Special Volume, 5, 67-106.

TERPSTRA, G. R. J., 1968—Micropalaeontological examination of samples from Papua New Guinea. *Bureau of Mineral Resources, Australia, Record* 1968/33.

THALMANN, H. E., 1942—Foraminiferal genus *Hantkenina* and its subgenera. *American Journal of Science,* 240, 809-820.

THOMSON, W., 1876—*In* MURRAY, J.—Preliminary reports to Professor Wyville Thomson, F.R.S., director of the Civilian Scientific Staff, on work done on board the 'Challenger'. *Proceedings of the Royal Society of London,* 24, 417-544.

TODD, RUTH, 1954—Descriptions of new species. *In* TODD, RUTH, CLOUD, P. E. JR., LOW, DORIS, & SCHMIDT, R. G. —Probable occurrences of Oligocene on Saipan. *American Journal of Science,* 252(11), 673-682.

TOULMIN, L. D., 1941—Eocene smaller foraminifera from the Salt Mountain limestone of Alabama. *Journal of Paleontology,* 15(6), 567-611.

VERDENIUS, J. G., 1970—Neogene stratigraphy of the western Guadalquivir Basin (northern Spain). *Utrecht Micropaleontological Bulletins,* 3, 1-109.

WEINZIERL, LAURA L., & APPLIN, ESTHER R., 1929—The Claiborne formation on the coastal domes. *Journal of Paleontology,* 3, 384-410.

WEISS, L., 1955—Foraminifera from the Paleocene Pale Greda Formation of Peru. *Journal of Paleontology,* 29 (1), 1-21.

WHITE, M. F., 1972—Report on the Muller Range geological survey. *BP Petroleum Development Australia Pty Ltd, Report* 101 (unpublished).

WHITE, M. P., 1928—Some index foraminifera of the Tampico embayment area of Mexico. *Journal of Paleontology,* 2(3), 177-215.

ZEHNDER, J. O., & DE CAEN, R. F. B., 1955—Report on the Palmer River reconnaissance survey. *Australasian Petroleum Company Pty Ltd, Report* JK (unpublished).

PLATE 1

(All figures ×80 unless otherwise indicated)

Figs.

1 **Globorotalia (Morozovella) aequa aequa** Cushman & Renz
CPC 21591, sample 71521008.

2 **Globorotalia (Morozovella) velascoensis velascoensis** (Cushman)
CPC 21592, sample 71521008.

3, 4 **Globorotalia (Morozovella)** spp.
CPC 21593 and 21594, sample 71520756.

5 **Globorotalia (Morozovella)** sp.
CPC 21595, sample 71528138.

6 **Globorotalia (Morozovella)** sp.
CPC 21596, sample 71523410.

7 **Globorotalia (Morozovella)** cf. **rex** Martin
CPC 21597, sample 71521536.

8 **Globorotalia (Morozovella) aragonensis** Nuttall
CPC 21598, sample 71521524.

9 **Globorotalia (Morozovella) subbotinae gracilis** Bolli
CPC 21599, sample 71528085.

10 **Globorotalia (Morozovella)** sp.
CPC 21600, sample 71520661.

11 **Globorotalia (Morozovella) renzi** Bolli
CPC 21601, sample 71521524.

12 **Globorotalia (Morozovella)** sp.
CPC 21602, sample P.9403.

13 **Globorotalia (Truncorotaloides) topilensis topilensis** (Cushman)
CPC 21603, sample P.9402.

14 **Globorotalia (Truncorotaloides) topilensis topilensis** (Cushman)
CPC 21604, sample B.138.

15 **Globorotalia (Truncorotaloides) topilensis topilensis** (Cushman)
CPC 21605, sample 71528085.

16 **Globorotalia (Truncorotaloides)** cf. **topilensis topilensis** (Cushman)
CPC 21606, sample 71523431.

17 **Globorotalia (Acarinina) pseudodubia** (Bandy) group
CPC 21607, sample 71523426.

18 **Globorotalia (Truncorotaloides) topilensis topilensis** (Cushman)
CPC 21608, sample 71520295.

19, 20 **Globorotalia (Acarinina) pseudodubia** (Bandy) group
CPC 21609 and 21610, sample 71521536.

21 **?Globorotalia (Acarinina) pseudodubia** (Bandy) group
CPC 21611, sample 71520756.

22 **Globorotalia (Acarinina)** cf. **pseudodubia** (Bandy) group
CPC 21612, sample 71523428.

23 **Globorotalia (Turborotalia)** sp.
CPC 21613, sample 71520661.

24 **Globorotalia (Truncorotaloides)** cf. **topilensis topilensis** (Cushman)
CPC 21614, sample P.9402.

25, 26 **Globorotalia (Acarinina)** cf. **pseudodubia** (Bandy) group
CPC 21615 and 21616, sample P.9402.

27–29 **Globigerinatheka senni** (Beckmann) group
CPC 21617 to 21619, sample 71528085.

30 **?Chiloguembelina** sp.
CPC 21620, sample 71523429; ×180.

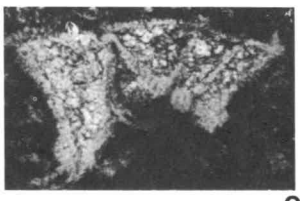
31 **?Chiloguembelina** sp.
CPC 21621, sample 71523410; ×180.

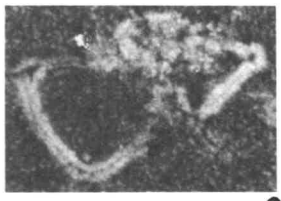
32 **?Chiloguembelina** sp.
CPC 21622, sample 71521536.

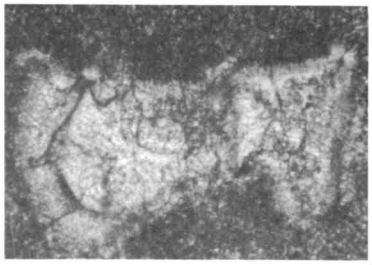
33, 34 **?Pseudohastigerina** sp.
CPC 21623 and 21624, sample 71520661.

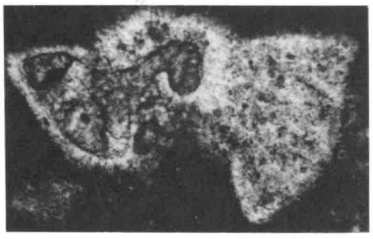
35 Radiolarian
CPC 21625, sample 71528138.

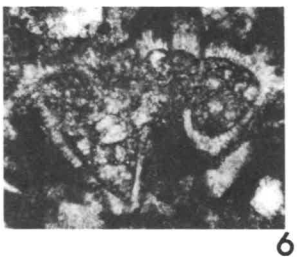

1

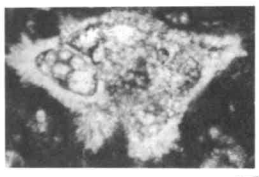

2

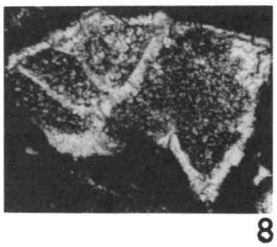

3

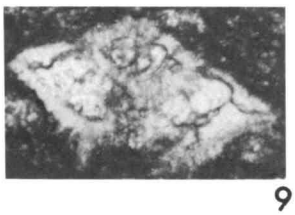

4

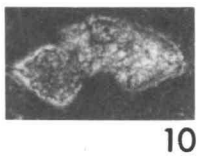

5


6

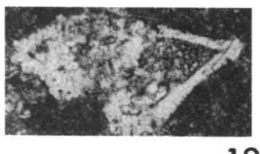

7


8


9

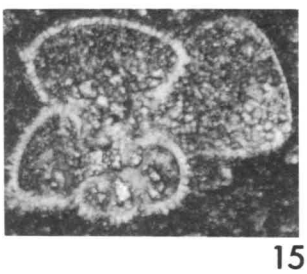

10


11


12

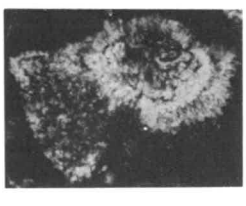

13

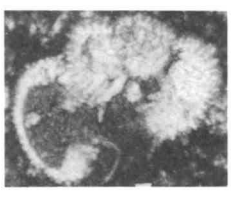

14

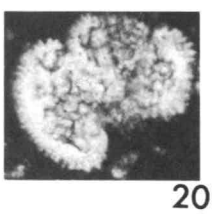

15

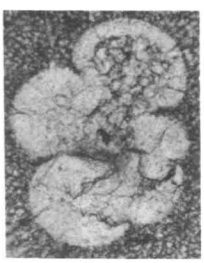

16


17

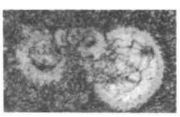

18

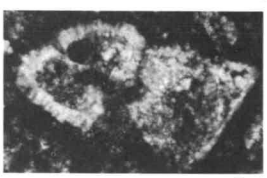

19

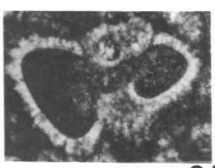

20

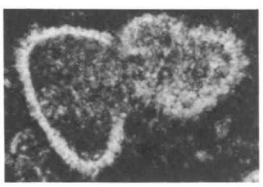

21


22


23


24

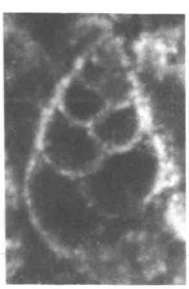

25


26


27


28


29


30


31


32


33


34

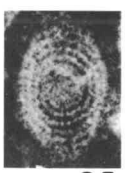

35

PLATE 2

Figs.

1, 2 **Nummulites** cf. **javanus** Verbeek
CPC 21626 and 21627, sample 71523410; ×20.

3 **Nummulites** cf. **javanus** Verbeek
CPC 21628, sample 71523428; ×40.

4, 5 **Lacazinella** sp.
CPC 21629 and 21630, sample 71523431; ×40.

6 **Gypsina** sp.
CPC 21631, sample 71523431; ×30.

7, 9 **Discocyclina (D.)** sp.
CPC 21632 and 21633, sample 71523431; ×30.

8 **?Asterocyclina** sp.
CPC 21634, sample 71523428; ×30.

10 **?Asterocyclina** sp.
CPC 21635, sample 71523426; ×30.

11 **Discocyclina (Aktinocyclina)** sp.
CPC 21636, sample 71523431; ×20.

12–14 **Nummulites (Palaeonummulites)** sp.
CPC 21637 to 21639, sample 71523431; ×30.

15 **Heterostegina** sp.
CPC 21640, sample 71523431; ×35.

16 **Heterostegina** sp.
CPC 21641, sample 71523439; ×35.

17, 18 **Nummulites fichteli** Michelotti
CPC 21642 and 21643, sample 71523337; 17, ×10; 18, ×30.

19 **Nummulites fichteli** Michelotti
CPC 21644, sample 71520139; ×40.

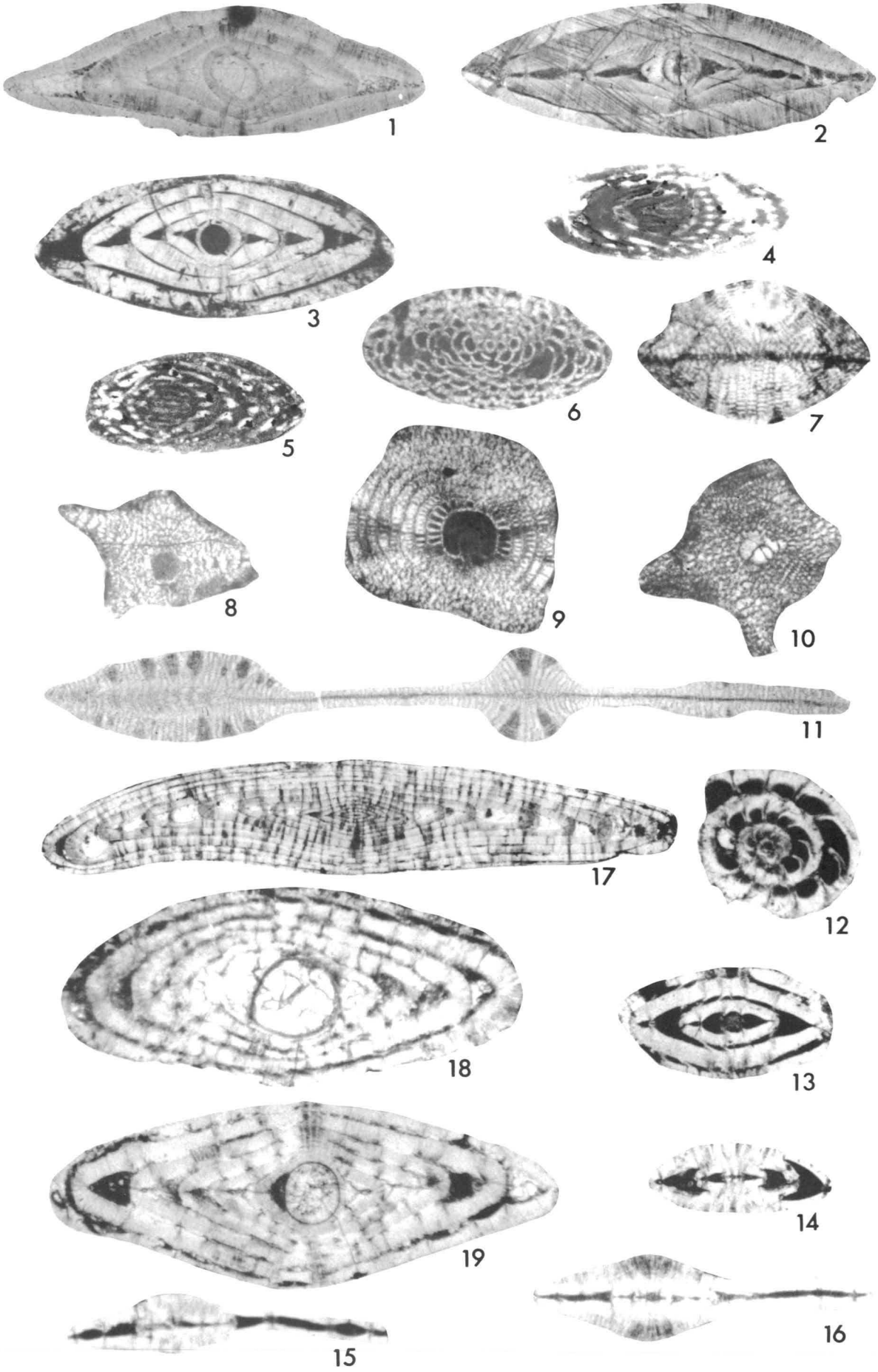

1
2
3
4
5
6
7
8
9
10
11
17
12
18
13
19
14
15
16

PLATE 3

Figs.

1 **Borelis** cf. **inflata** (Adams)
CPC 21645, sample 71520139; ×75.

2, 3 **Borelis** sp.
CPC 21646 and 21647, sample 71523433; ×30.

4 **Halkyardia** sp.
CPC 21648, sample 71526055; ×80.

5 **Halkyardia** sp.
CPC 21649, sample 71521195; ×90.

6 **Halkyardia** sp.
CPC 21650, sample 71520139; ×90.

7 **Halkyardia** sp.
CPC 21651, sample 71523435; ×80.

8, 9 **Sporadotrema** cf. **cylindricum** (Carter)
CPC 21652 and 21653, sample 04NG0519; ×30.

10–13 **Heterostegina** sp.
CPC 21654 to 21657, sample 71523444; 10 & 11, ×30; 12 & 13, ×40.

14 **Heterostegina** sp.
CPC 21658, sample 71523433; ×30.

15 **Heterostegina** sp.
CPC 21659, sample 71526055; ×30.

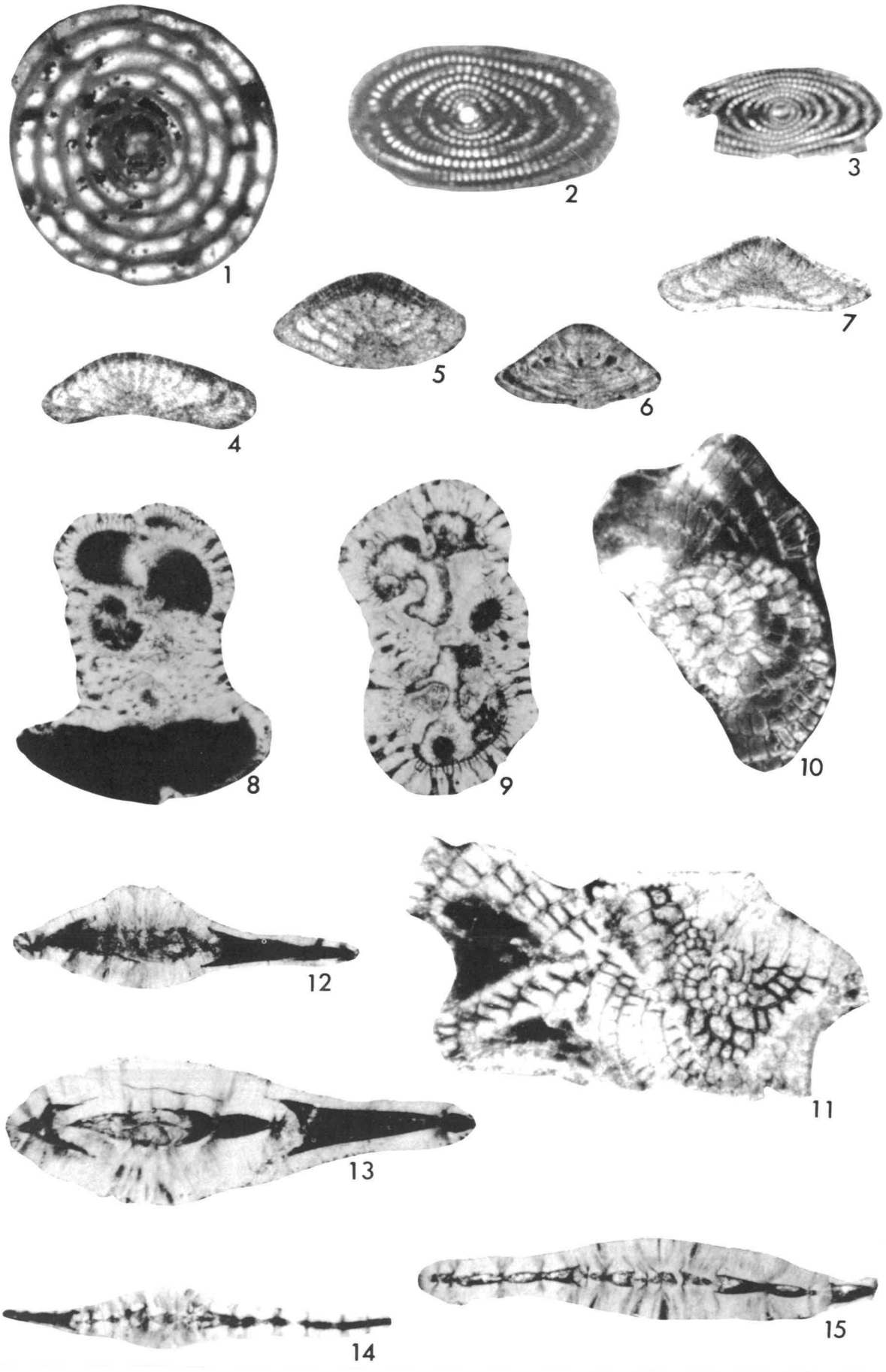

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

PLATE 4

Figs.

1, 2 **Nummulites (Palaeonummulites)** sp.
CPC 21660 and 21661, sample 71521583; ×30.

3–5 **Heterostegina** sp.
CPC 21662 to 21664, sample 71521043; ×30.

6–8 **Miogypsina (Miogypsinoides) complanata** (Schlumberger)
CPC 21665 to 21667, sample 71523339; ×60.

9 **Miogypsina (Miogypsinoides) complanata** (Schlumberger)
CPC 21668, sample 71521338; ×60.

10 **Miogypsina (Miogypsinoides) complanata** (Schlumberger)
CPC 21669, sample 71523339; ×30.

11 **Miogypsina (Miogypsinoides) complanata** (Schlumberger)
CPC 21670, sample 71521031; ×40.

12 **Elphidium** sp.
CPC 21671, sample 71521503; ×50.

13 **Lepidocyclina (Eulepidina) ephippioides** Jones & Chapman
CPC 21672, sample 71521583; ×10.

14, 15 **Lepidocyclina (Eulepidina) ephippioides** Jones & Chapman
CPC 21673 and 21674, sample 71521043; ×10.

16 **Archaias cf. angulatus** (Fichtel & Moll)
CPC 21675, sample 71523113; ×40.

17 **Archaias** cf. **angulatus** (Fichtel & Moll)
CPC 21676, sample 71521032; ×40.

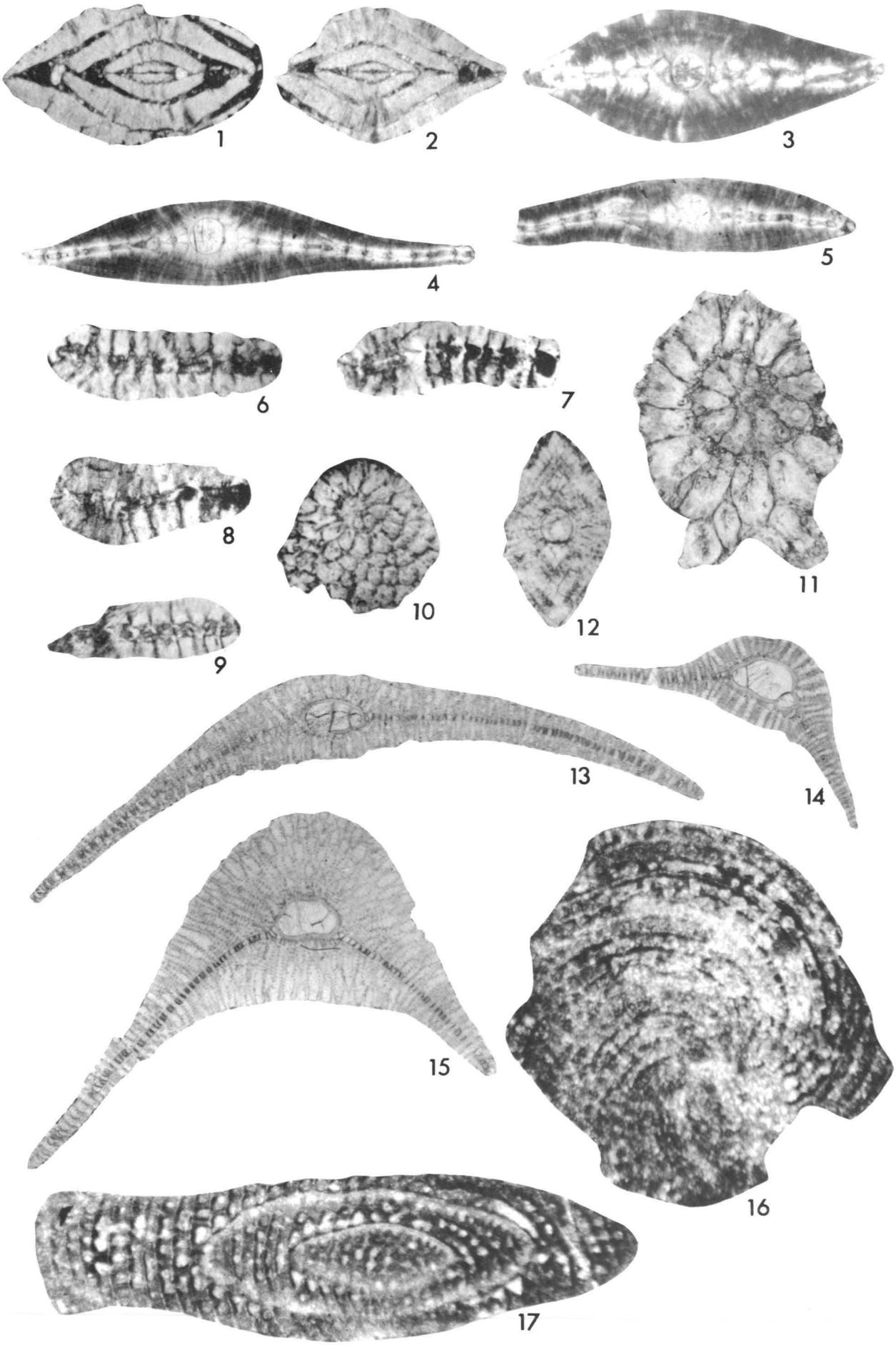

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

PLATE 5

Figs.

1 **Spiroclypeus margaritatus** (Schlumberger)
CPC 26177, sample 04NG1008; ×30.

2, 3 **Austrotrillina striata** Todd & Post
CPC 21678 and 21679, sample 71521149; ×40.

4, 5 **Amphistegina** sp.
CPC 21680 and 21681, sample 71523114; ×40.

6 **Heterostegina** sp.
CPC 21682, sample 71521037; ×30.

7 **Heterostegina** sp.
CPC 21683, sample 71523114; ×30.

8 **Sporadotrema** cf. **cylindricum** (Carter)
CPC 21684, sample 71523330; ×20.

9 **Borelis pygmaeus** Hanzawa
CPC 21685, sample 71521047; ×30.

10 **Borelis pygmaeus** Hanzawa
CPC 21686, sample 71521151; ×30.

11 **Austrotrillina striata** Todd & Post
CPC 21687, sample 71523416; ×40.

12–15 **Miogypsina (Miogypsinoides) bantamensis/dehaarti**
CPC 21688 to 21691, sample 71520859; ×40.

16 **Miogypsina (Miogypsinoides) bantamensis/dehaarti**
CPC 21692, sample 71523416; ×40.

17, 18 **Miogypsina (Miogypsinoides)** cf. **dehaarti** van der Vlerk
CPC 21693 and 21694, sample 71520624; ×40.

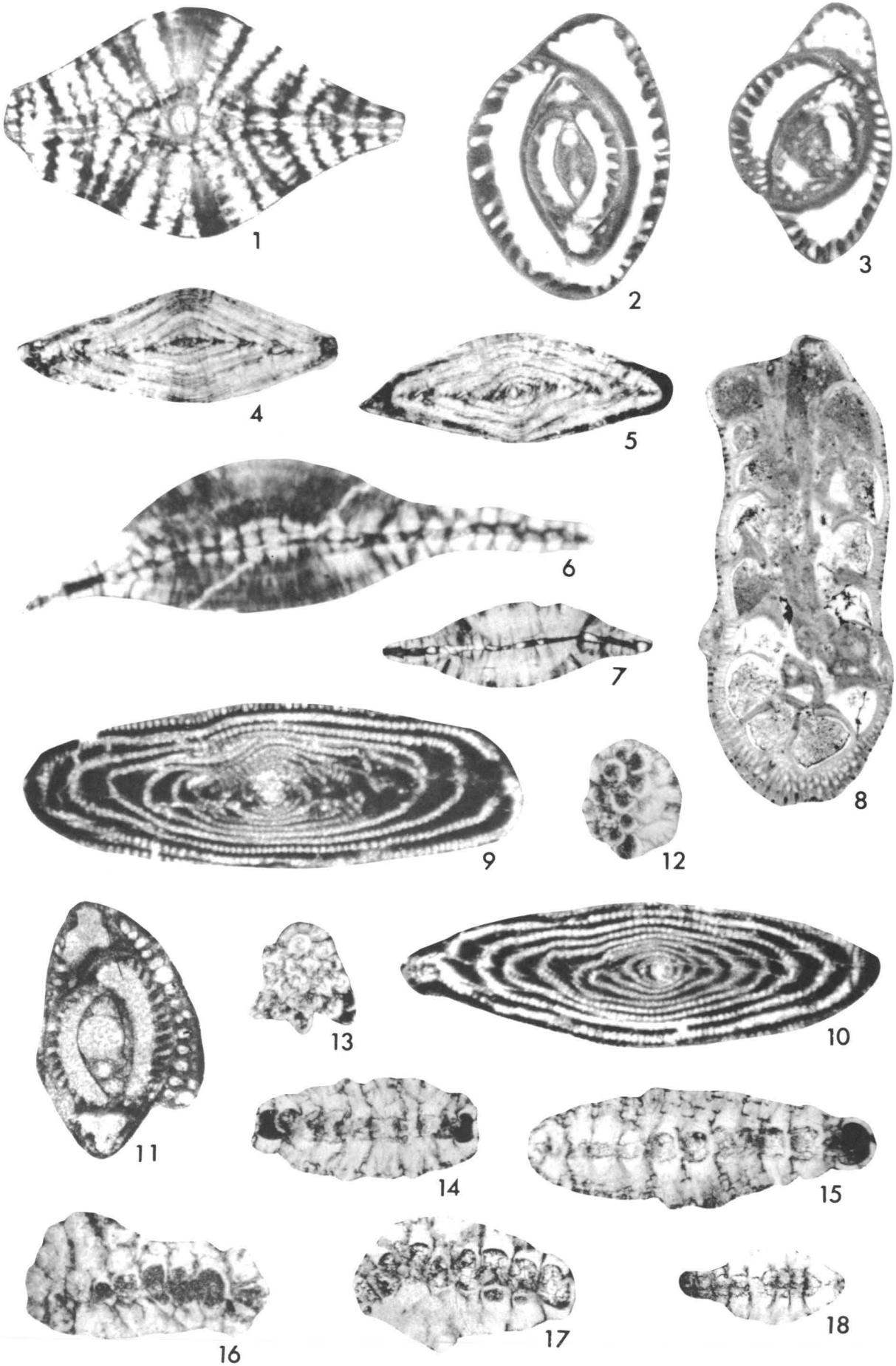

1
2
3
4
5
6
7
8
9
12
10
13
11
14
15
16
17
18

PLATE 6

Figs.

1 **Carpenteria** sp. or **Sporadotrema** sp.
CPC 21695, sample 71520624; ×30.

2, 3 **Elphidium** sp.
CPC 21696 and 21697, sample 71520859; ×40.

4, 5 **Elphidium** sp.
CPC 21698 and 21699, sample 71520624; ×40.

6 **Lepidocyclina (Nephrolepidina)** cf. **parva** Oppenoorth
CPC 21700, sample 71523097; ×40.

7 **Miogypsina (M.) thecideaeformis** (Rutten)
CPC 21701, sample 71523438; ×40.

8 **Miogypsina (M.)** cf. **kotoi** Hanzawa
CPC 21702, sample 71520624; ×30.

9, 10 **Miogypsina (M.)** sp.
CPC 21703 and 21704, sample 71520858; ×40.

11 **Elphidium** sp.
CPC 21705, sample 71520624; ×40.

12 **Heterostegina** sp.
CPC 21706, sample 71528048; ×20.

13, 14 **Archaias** cf. **angulatus** (Fichtel & Moll)
CPC 21707 and 21708, sample 71520624; ×40.

15 **Flosculinella globulosa** Rutten
CPC 21709, sample 68691643B; ×40.

16, 17 **Borelis pygmaeus** Hanzawa
CPC 21710 and 21711, sample 71521032; ×40.

18 **Austrotrillina** cf. **striata** Todd & Post
CPC 21712, sample 71521032; ×40.

19 **Austrotrillina howchini** (Schlumberger)
CPC 21713, sample 71525035; ×40.

20 **Lepidocyclina (Nephrolepidina)** cf. **inflata** Provale
CPC 21714, sample 71523408; ×35.

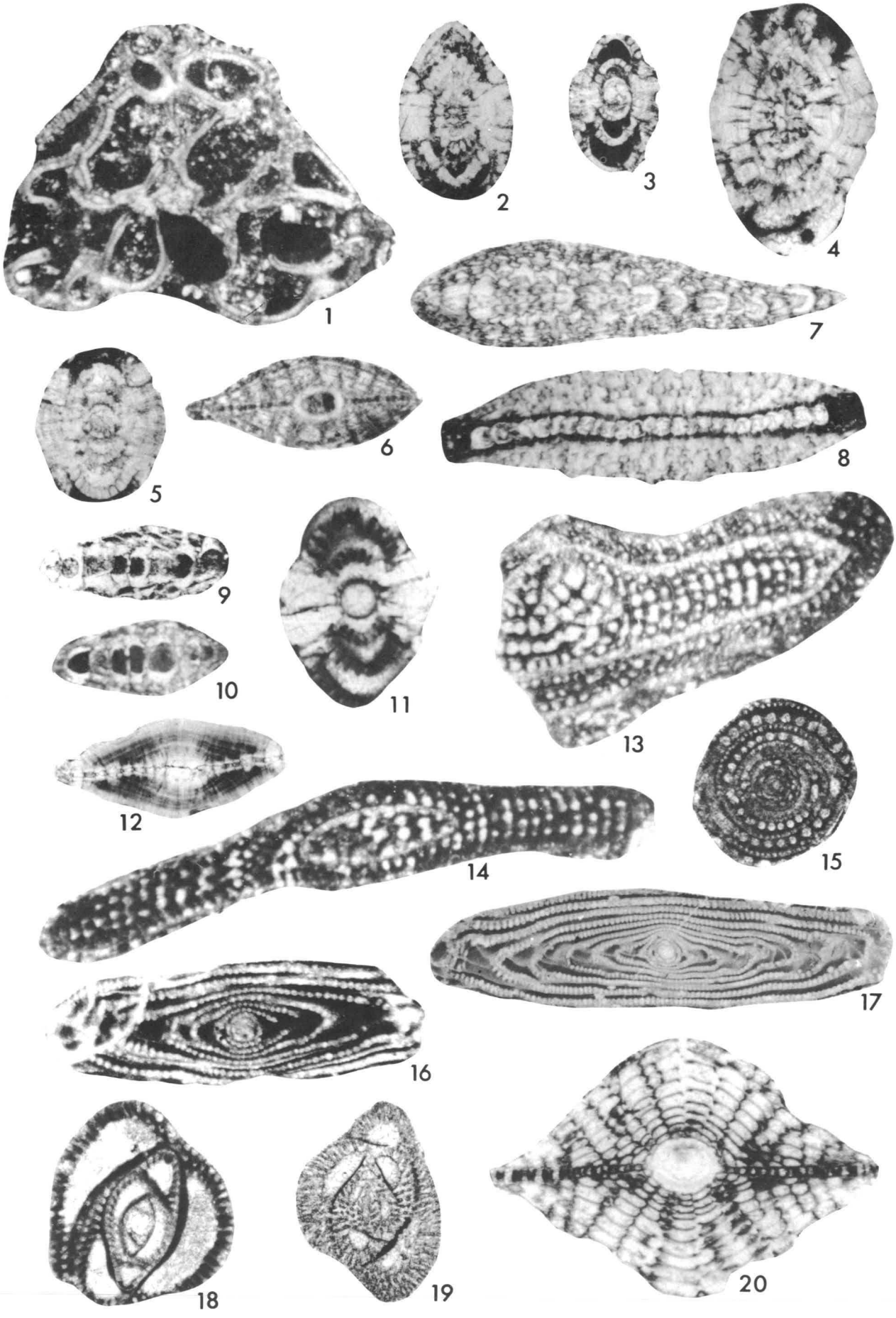

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

PLATE 7

Figs.

1 **Cycloclypeus (Katacycloclypeus)** cf. **annulatus** Martin
CPC 21715, sample 71525036; ×20.

2 **Flosculinella globulosa** Rutten
CPC 21716, sample 71520459; ×50.

3, 4 **Planorbulinella** sp.
CPC 21717 and 21718, sample 71520687; ×50.

5–7 **Miogypsina (M.)** sp.
CPC 21719 to 21721, sample 71521335; ×60.

8, 10 **Elphidium** sp.
CPC 21722 and 21723, sample 71521640; ×40.

9 **Elphidium** sp.
CPC 21724, sample 71521602; ×40.

11 **Lepidocyclina (Nephrolepidina)** cf. **parva** Oppenoorth
CPC 21725, sample 71523437; ×40.

12 **Lepidocyclina (Nephrolepidina)** cf. **parva** Oppenoorth
CPC 21726, sample 04NG0514; ×40.

13 **Amphistegina** sp.
CPC 21727, sample 71520134; ×40.

14 **Miogypsina (M.) thecideaeformis** (Rutten)
CPC 21728, sample 71528048; ×20.

15–17 **Miogypsina (M.) thecideaeformis** (Rutten)
CPC 21729 and 21730, sample 71520694; 15, 16, ×20; 17, same specimen as fig. 16, ×65.

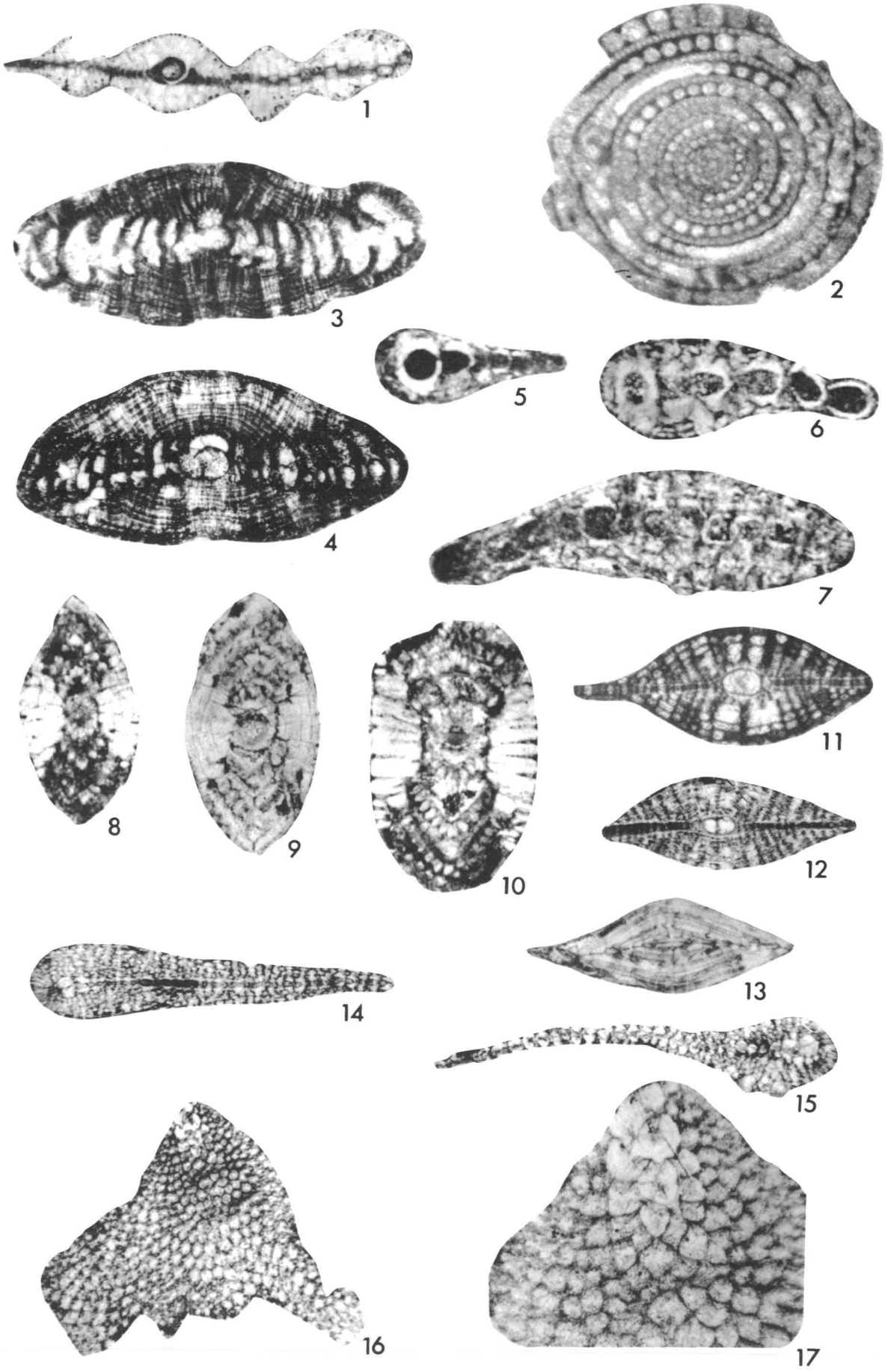

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

PLATE 8

Figs.

1 **Cycloclypeus (C.)** sp.
CPC 21731, sample 71520135; ×20.

2 **Lepidocyclina (Nephrolepidina) ferreroi** Provale
CPC 21732, sample F.846; ×20.

3 **Lepidocyclina (N.) ferreroi** Provale
CPC 21733, sample 71526120D; ×20.

4 **Lepidocyclina (N.) ferreroi** Provale
CPC 21734, sample 71520131; ×40.

5, 6 **Austrotrillina howchini** (Schlumberger)
CPC 21735 and 21736, sample 71521048; ×55.

7 **Cycloclypeus (Katacycloclypeus)** sp.
CPC 21737, sample F.846; ×20.

8 **Cycloclypeus (K.)** cf. **annulatus** Martin
CPC 21738, sample 71520135; ×20.

9 **Cycloclypeus (K.)** cf. **annulatus** Martin
CPC 21739, sample 71528048; ×20.

10–12 **Cycloclypeus (K.)** cf. **annulatus** Martin
CPC 21740 to 21742, sample F.329; ×20.

13 **Sorites** sp.
CPC 21743, sample 71521048; ×25.

14 **Flosculinella bontangensis** (Rutten)
CPC 21744, sample 71521048; ×50.

15 **Amphistegina** sp.
CPC 21745, sample 71523261; ×40.

16 **Elphidium** sp.
CPC 21746, sample F.329; ×40.

17 **Alveolinella quoyi** d'Orbigny
CPC 21747, sample B.137a; ×20.

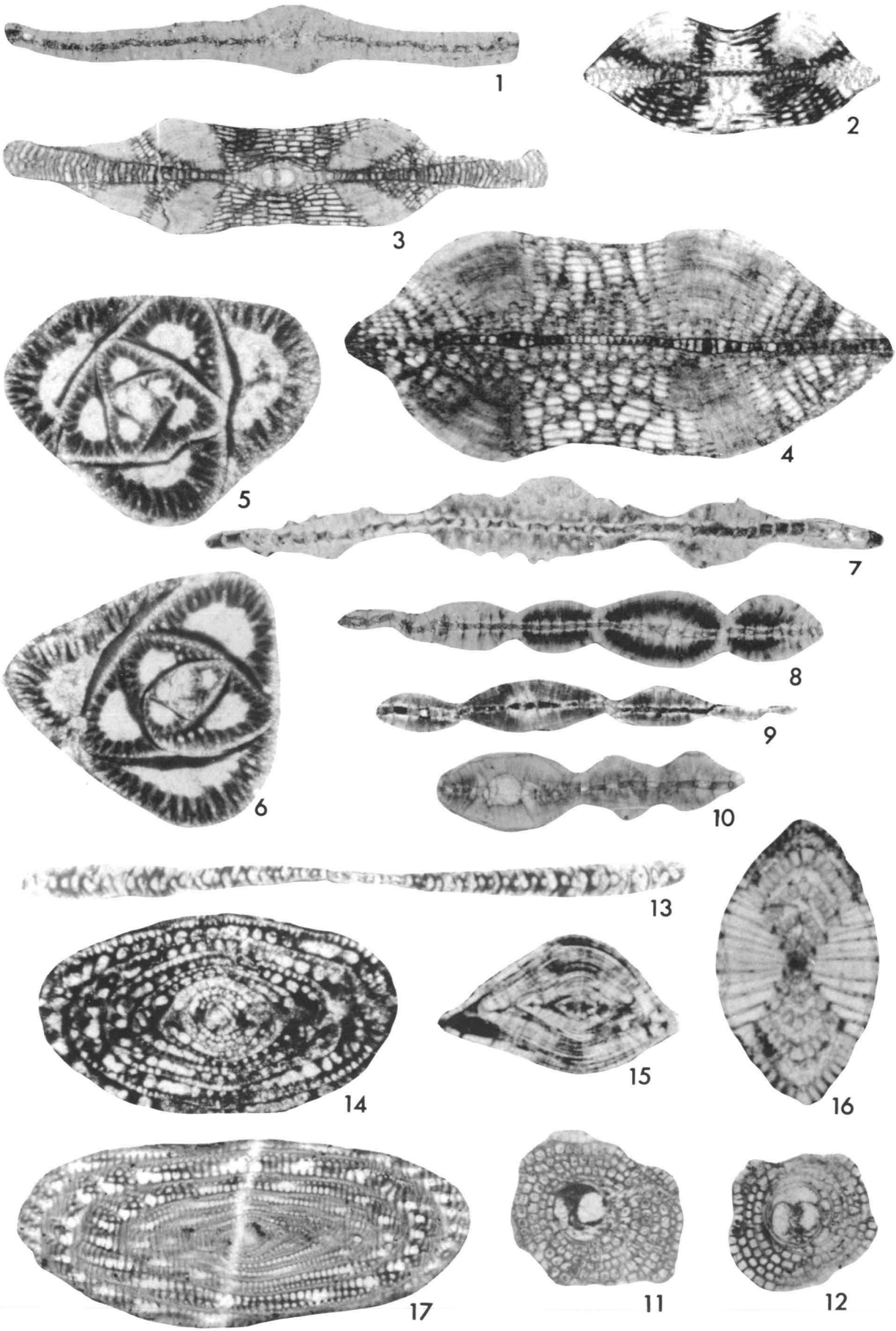
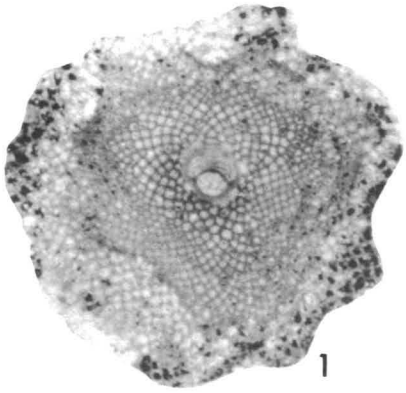


PLATE 9

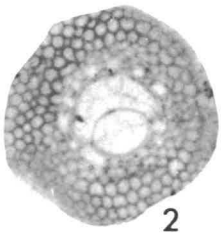
Figs.

1–8 **Lepidocyclina (Nephrolepidina)** sp.
CPC 21748 to 21751, sample 71528042; 1–4, ×30; 5–8, same specimens as figures 1–4 respectively, ×80.

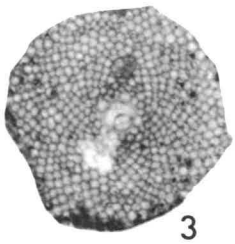
9–13 **Lepidocyclina (N.) howchini** Chapman & Crespin group
CPC 21752 to 21754, sample 71521989; 9–11, ×30; 12, 13, same specimens as figures 9, 10 respectively, ×80.



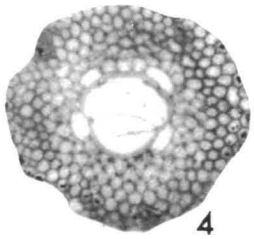
1



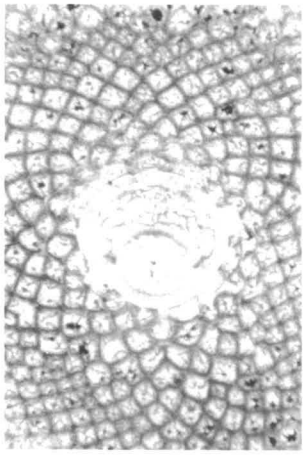
2



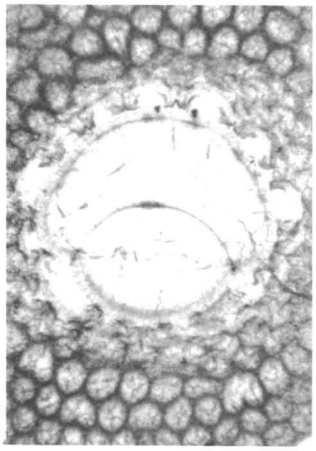
3



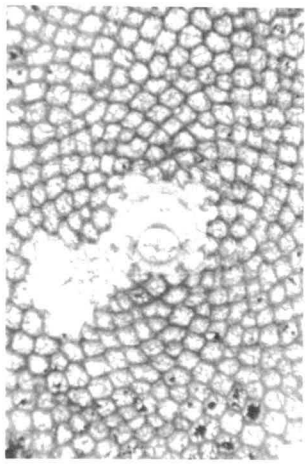
4



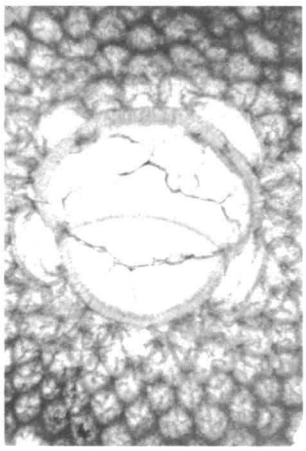
5



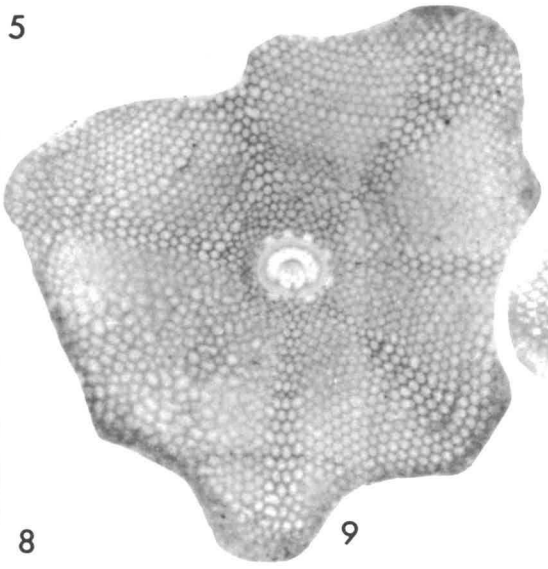
6



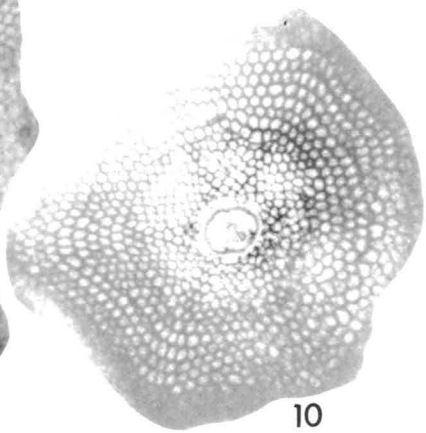
7



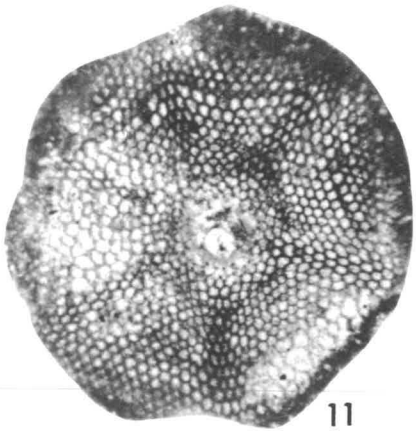
8



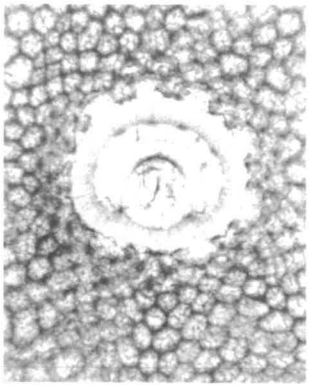
9



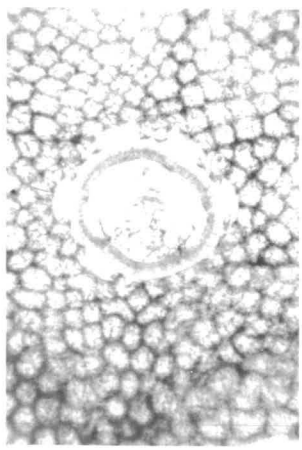
10



11



12



13

PLATE 10

Figs.

1–2 **Lepidocyclina (Nephrolepidina) howchini** Chapman & Crespin group
CPC 21755 and 21756, sample 71521989; ×30.

3–9 **Lepidocyclina (N.) howchini** Chapman & Crespin group
CPC 21757 to 21760, sample F.329; 3–5, 9, ×30; 6–8, same specimens as figures 3–5 respectively, ×80.

10–15 **Nummulites (Palaeonummulites)** sp.
CPC 21761 to 21766, sample F.329; ×20.

16 **Operculina complanata** (Defrance)
CPC 21767, sample F.329; ×20.

17–20 **Miogypsina (M.) thecideaeformis** (Rutten)
CPC 21768 and 21769, sample 71528042; 17, 19, ×40; 18, 20, same specimens as figures 17, 19 respectively, ×80.

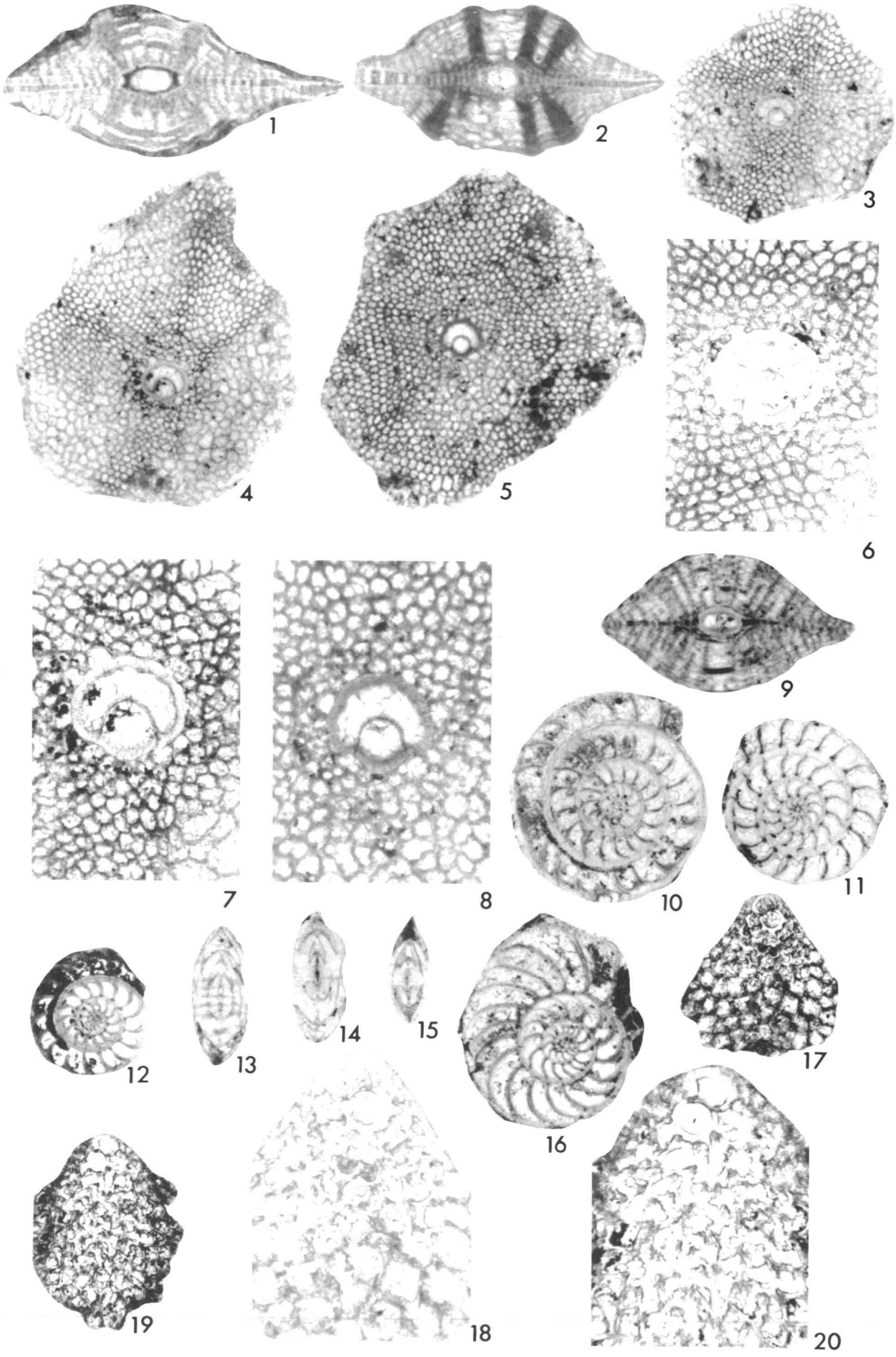

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

PLATE 11

(All figures ×80 unless otherwise indicated.)

Figs.

1–3 **Lepidocyclina (Nephrolepidina)** cf. **angulosa** Provale
CPC 21770 to 21772, sample 68691628; 1–2, ×40; 3, ×30.

4–5 **Orbulina suturalis** Brönnimann
CPC 21773 and 21774, sample 71523164.

6 **Praeorbulina glomerosa** (Blow) group
CPC 21775, sample 71523330.

7 **Praeorbulina transitoria** (Blow)
CPC 21776, sample F.889.

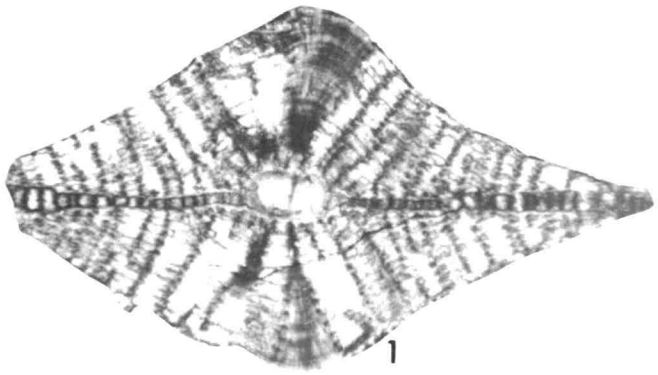
8, 9 **Praeorbulina glomerosa** (Blow) group
CPC 21777 and 21778, sample F.889.

10, 11 **Praeorbulina glomerosa** (Blow) group
CPC 21779 and 21780, sample 71525036.

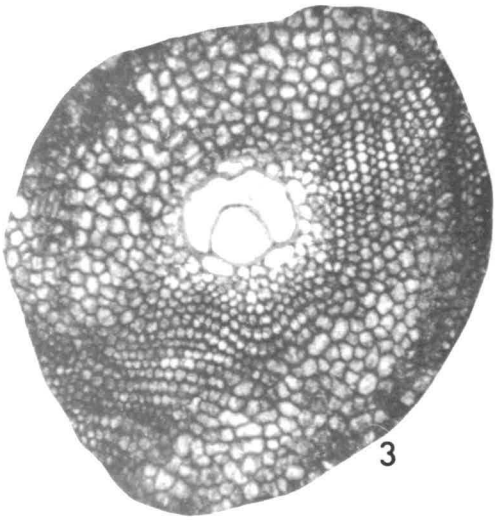
12, 13 **Praeorbulina transitoria** (Blow)
CPC 21781 and 21782, sample 71520134.

14 **Praeorbulina glomerosa** (Blow) group
CPC 21783, sample 71520134.

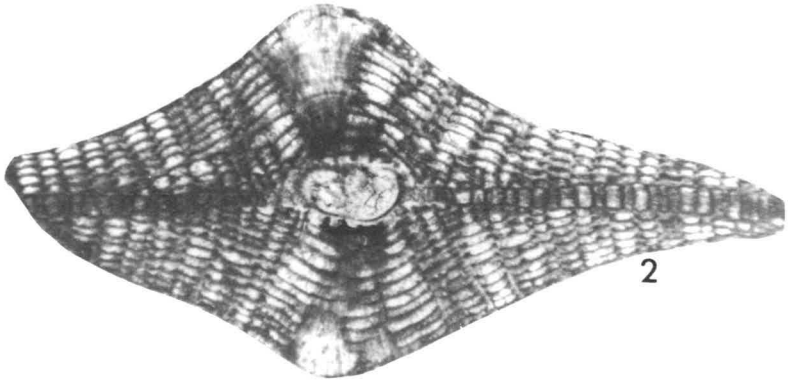
15 **Globigerina** sp.
CPC 21784, sample F.260.



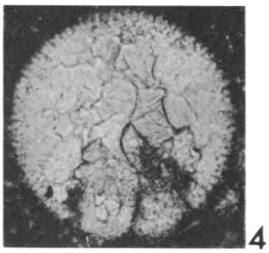
1



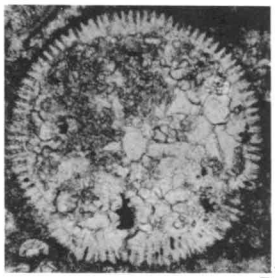
3



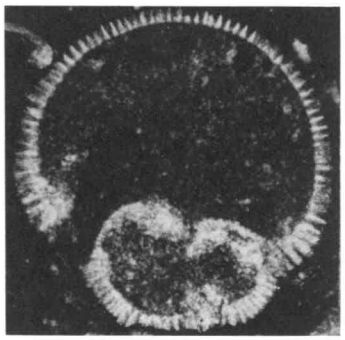
2



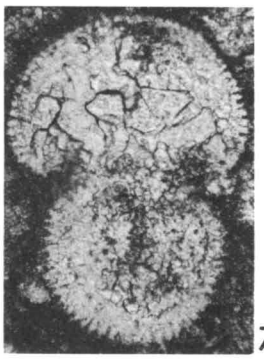
4



5

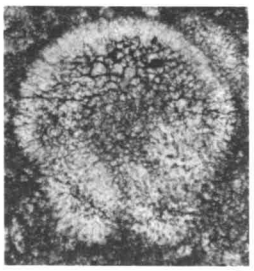


6

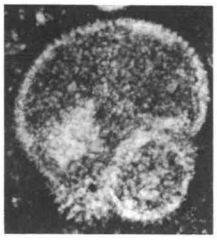


7

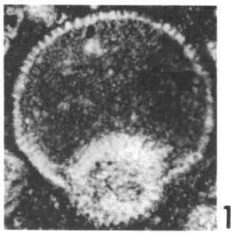
8



9



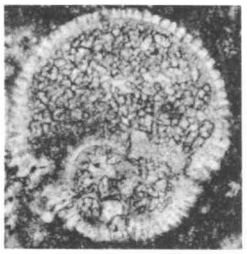
10



11

12

13



14

15

PLATE 12

Figs.

1 **Praeorbulina glomerosa** (Blow) group
CPC 21785, sample 71529055; ×80.

2 **?Globigerinatheka** sp.
CPC 21786, sample 71529055; ×80.

3 **Globigerina** sp.
CPC 21787, sample F.260; ×80.

4 **Globoquadrina dehiscens** Chapman, Parr & Collins group
CPC 21788, sample F.934; ×80.

5 **?Berggrenia** sp.
CPC 21789, sample F.410; ×160.

6, 7 **?Berggrenia** sp.
CPC 21790 and 21791, sample F.838; ×80.

8, 9 **?Berggrenia** sp.
CPC 21792 and 21793, sample F.223; ×80.

10 **?Berggrenia** sp.
CPC 21794, sample F.260; ×160.

11, 12 **?Berggrenia** sp.
CPC 21795 and 21796, sample F.410; ×160.

13–15 **?Berggrenia** sp.
CPC 21797 to 21799, sample F.827; ×160.

16 **?Breggrenia** sp.
CPC 21800, sample 71529055; ×160.

17 **?Sphaeroidinellopsis** sp.
CPC 21801, sample F.450; ×80.

18 **?Sphaeroidinellopsis** sp.
CPC 21802, sample F.410; ×80.

19, 20 **Streptochilus** sp.
CPC 21803 and 21804, sample F.838; ×160.

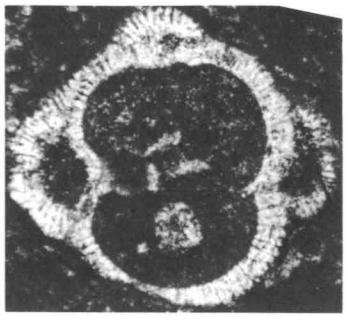
21 **Streptochilus** sp.
CPC 21805, sample F.410; ×160.

22 **Streptochilus** sp.
CPC 21806, sample F.459; ×160.

23 **Streptochilus** sp.
CPC 21807, sample F.260; ×160.

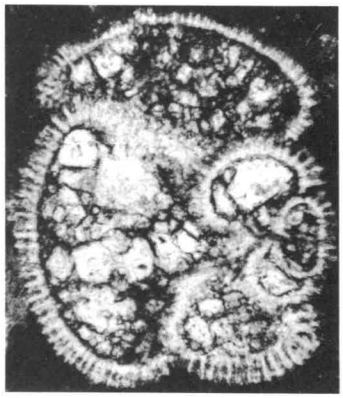
24 **Streptochilus** sp.
CPC 21808, sample F.410; ×160.

1

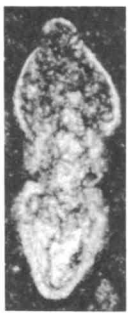


2

3



4



5

6

7

8

9

10

11

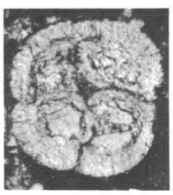
12

13

14

15

16

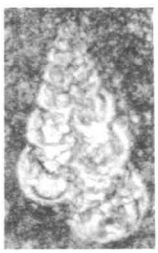


17

18

19

20



21

22

23

24

PLATE 13

(All figures ×80 unless otherwise indicated.)

Figs.

1–5 **Chiloguembelina midwayensis midwayensis** (Cushman)
1, CPC 21809, sample 71528085.
2, 3 CPC 21810, same sample.
4, 5 CPC 21811, same sample; Figs. 3, 5 ×175.

6–8 **Globorotalia (Acarinina) broedermanni broedermanni** Cushman & Bermudez
CPC 21812, sample 71529051; 6, ventral view; 7, dorsal view; 8, edge view

9–14 **Globorotalia (Acarinina) bullbrooki** Bolli
9–11, CPC 21813, sample 71529051; 9, ventral view; 10, dorsal view; 11, edge view.
12–14, CPC 21814, same sample; 12, ventral view; 13, dorsal view; 14, edge view.

15–21 **Globorotalia (Acarinina) convexa convexa** Subbotina
15–17, CPC 21815, sample 71529039; 15, ventral view; 16, dorsal view; 17, edge view.
18–20, CPC 21816, same sample; 18, ventral view; 19, dorsal view; 20, edge view.
21, CPC 21817, sample 71529060, edge view.

22–26 **Globorotalia (Acarinina) pentacamerata** Subbotina
22–24, CPC 21818, sample 71529051. 22, ventral view; 23, dorsal view; 24, edge view.
25, 26, CPC 21819, same sample; 25, ventral view; 26, edge view.

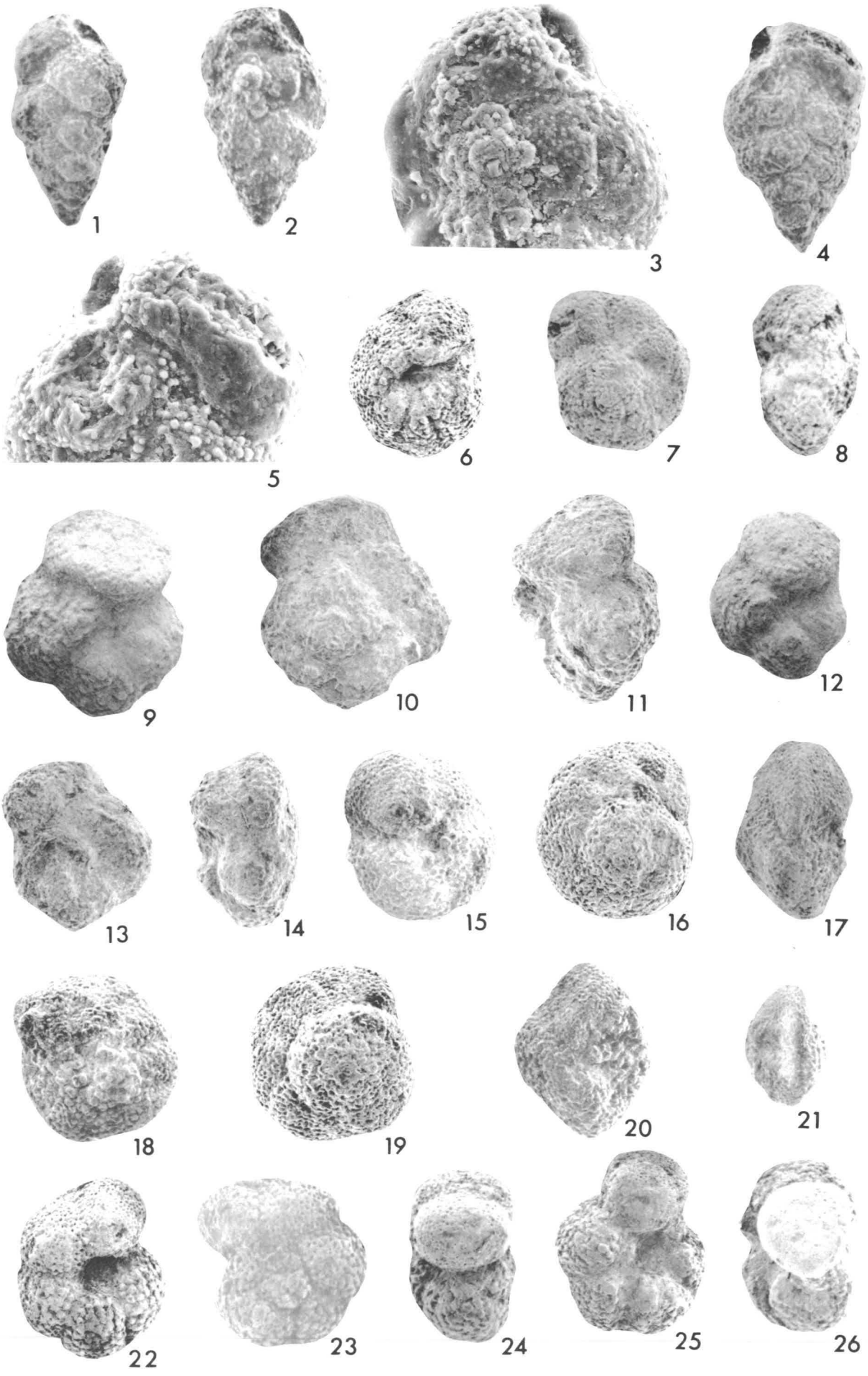

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

PLATE 14

(All figures ×80.)

Figs.

1–12 **Globorotalia (Acarinina) praecursoria praecursoria** (Morozova)
1–3, CPC 21820, sample 71528084; 1, ventral view; 2, dorsal view; 3, edge view.
4–6, CPC 21821, same sample; 4, ventral view; 5, dorsal view; 6, edge view.
7–9, CPC 21822, same sample; 7, ventral view; 8, dorsal view; 9, edge view.
10–12, CPC 21823, same sample; 10, ventral view; 11, dorsal view; 12, edge view.

13–18 **Globorotalia (Acarinina) pseudodubia piparoensis** (Brönnimann & Bermudez)
13–15, CPC 21824, sample 71529051; 13, ventral view; 14, dorsal view; 15, edge view.
16–18, CPC 21825, same sample; 16, ventral view; 17, dorsal view; 18, edge view.

19–26 **Globorotalia (Acarinina) wartsteinensis** Gohrbandt
19–21, CPC 21826, sample 71529051; 19, ventral view; 20, dorsal view; 21, edge view.
22–24, CPC 21827, same sample; 22, ventral view; 23, dorsal view; 24, edge view.
25, 26, CPC 21828, same sample; 25, ventral view; 26, edge view.

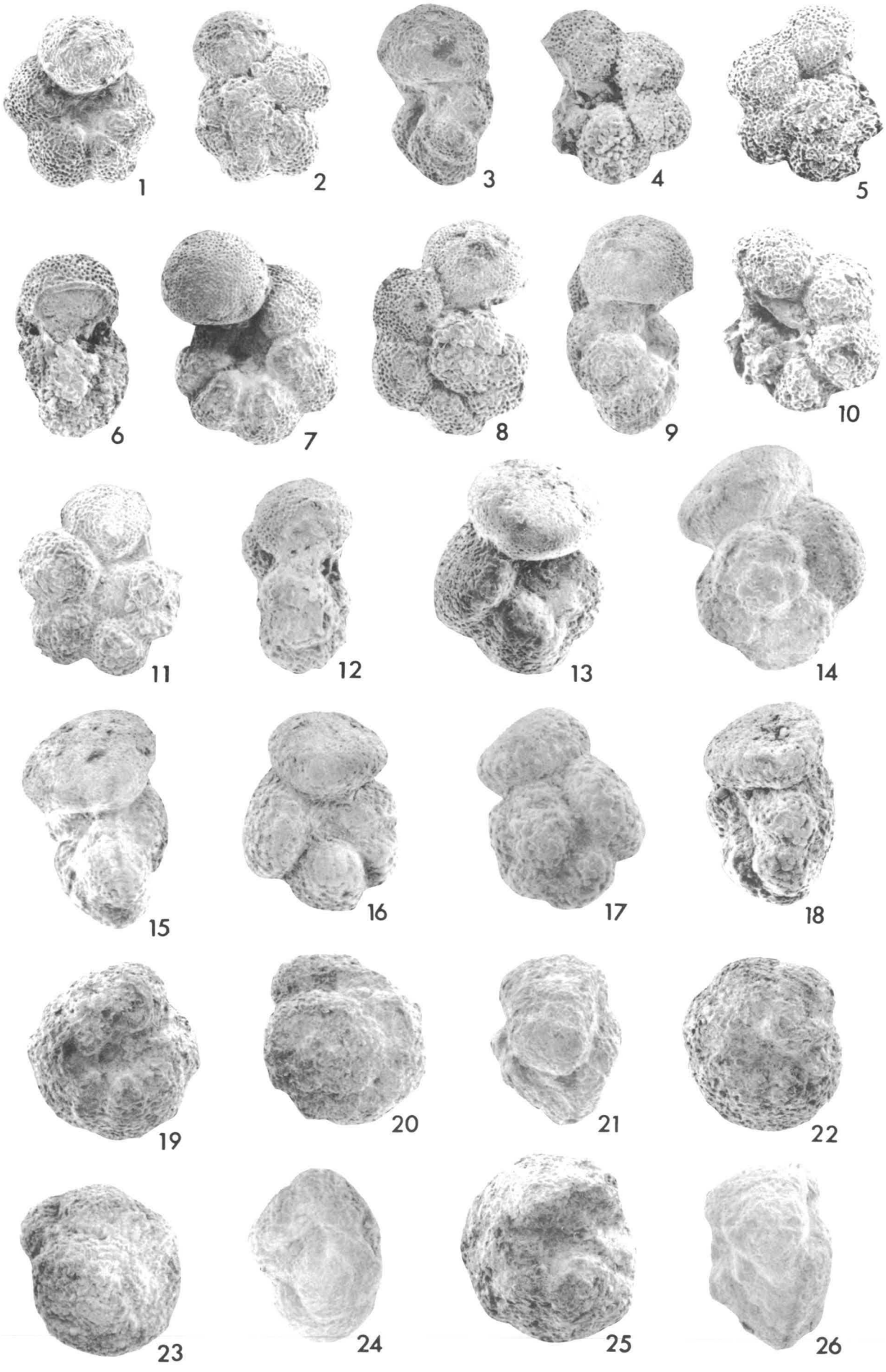


PLATE 15

(All figures ×80.)

Figs.

1–4 **Globorotalia (Acarinina) whitei** Weiss
1–3, CPC 21829, sample F.184; 1, ventral view; 2, dorsal view; 3, edge view.
4, CPC 21830, same sample, ventral view.

5–10 **Globorotalia (Globorotalia) ehrenbergi** Bolli
5–7, CPC 21831, sample 71528084; 5, ventral view; 6, dorsal view; 7, edge view.
8–10, CPC 21832, same sample; 8, ventral view; 9, dorsal view; 10, edge view.

11–15 **Globorotalia (Globorotalia) pseudomenardii** Bolli
11–13, CPC 21833, sample 71528142; 11, ventral view; 12, dorsal view; 13, edge view.
14, 15, CPC 21834, same sample; 14, ventral view; 15, edge view.

16–20 **Globorotalia (Morozovella) aequa aequa** Cushman & Renz
16–18, CPC 21835, sample 71528136; 16, ventral view; 17, dorsal view; 18, edge view.
19, 20, CPC 21836, same sample; 19, ventral view; 20, edge view.

21–23 **Globorotalia (Morozovella) angulata angulata** (White)
CPC 21837, sample 71528142; 21, ventral view; 22, dorsal view; 23, edge view.

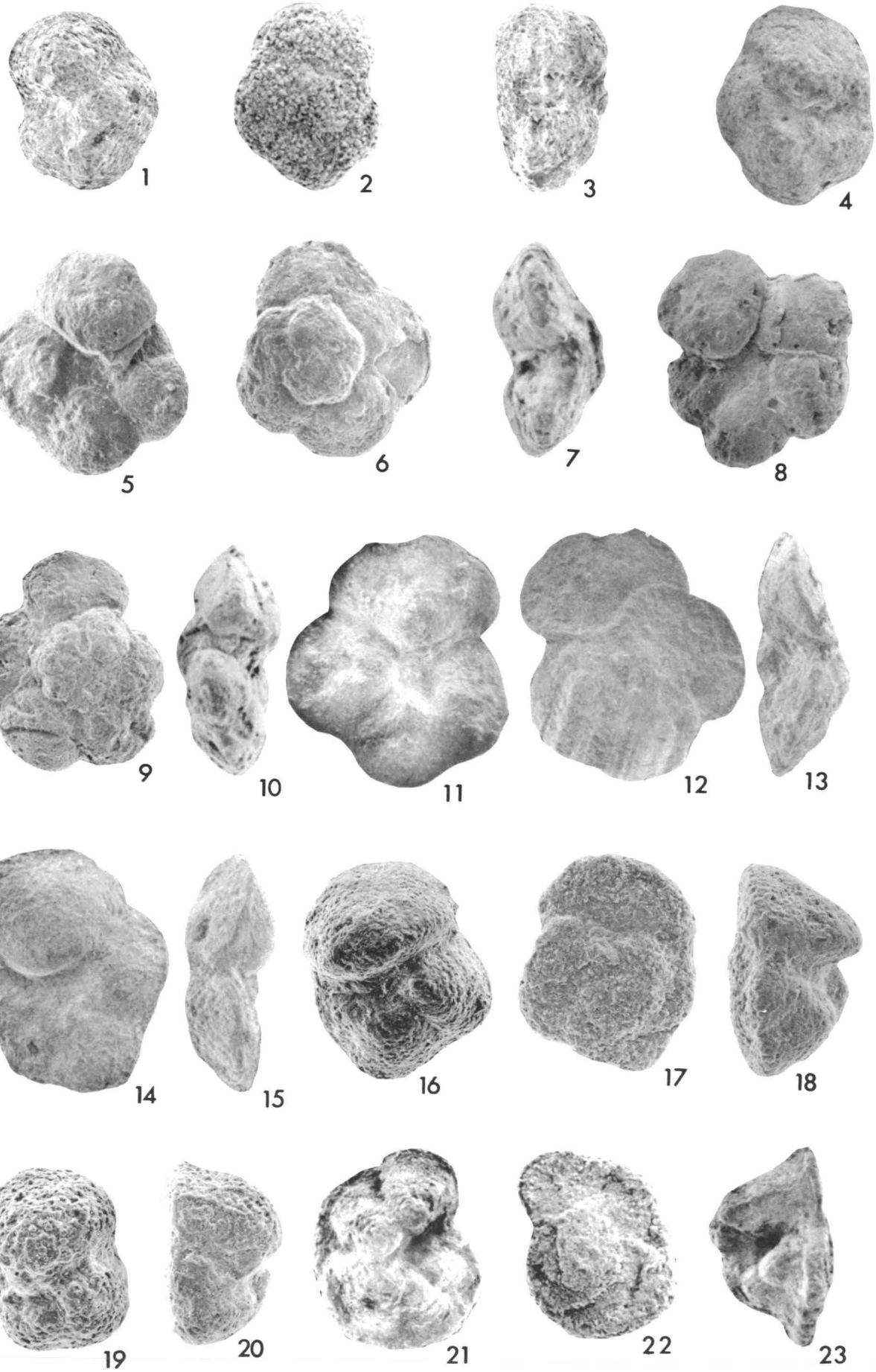

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

PLATE 16

(All figures ×80.)

Figs.

1–8 **Globorotalia (Morozovella) apanthesma** Loeblich & Tappan
1–3, CPC 21838, sample 71528142; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, CPC 21839, same sample; 4, ventral view; 5, edge view.
6–8, CPC 21840, sample 71529039; 6, ventral view; 7, dorsal view; 8, edge view.

9–16 **Globorotalia (Morozovella) aragonensis** (Nuttall)
9–11, CPC 21841, sample 71529051; 9, ventral view; 10, dorsal view; 11, edge view.
12, 13, CPC 21842, same sample; 12, ventral view; 13, edge view.
14–16, CPC 21843, same sample; 14, ventral view; 15, dorsal view; 16, edge view.

17–22 **Globorotalia (Morozovella) lehneri** Cushman & Jarvis.
17–19, CPC 21844, sample 71529051; 17, ventral view; 18, dorsal view; 19, edge view.
20, 21, CPC 21845, same sample; 20, ventral view; 21, edge view.
22, CPC 21846, same sample, ventral view.

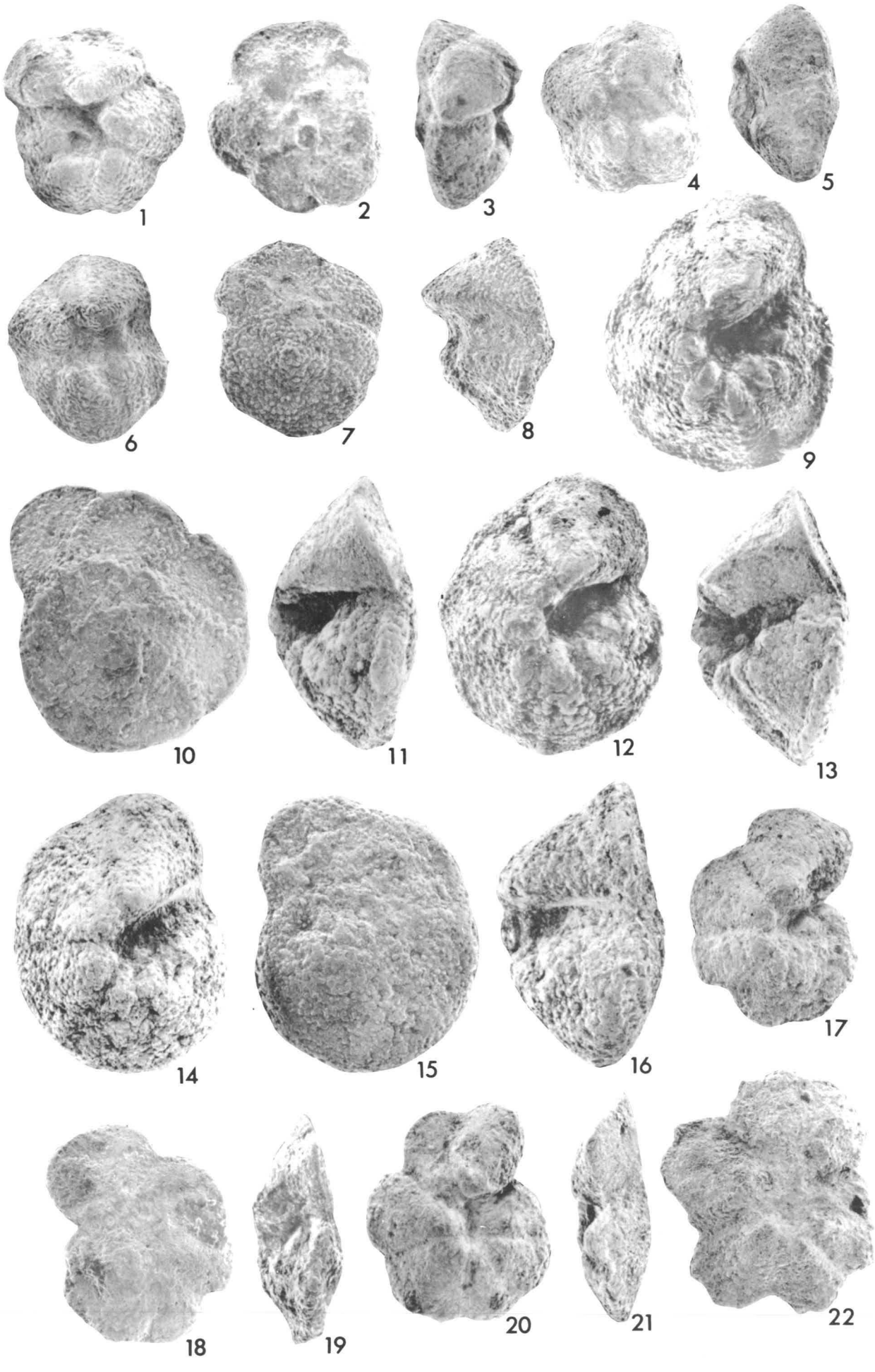

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

PLATE 17

(All figures ×80.)

Figs.

1–5 **Globorotalia (Morozovella) lensiformis** Subbotina
1–3, CPC 21847, sample 71529051; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, CPC 21848, same sample; 4, ventral view; 5, dorsal view.

6–13 **Globorotalia (Morozovella) occlusa occlusa** Loeblich & Tappan
6–8, CPC 21849, sample 71528136; 6, ventral view; 7, dorsal view; 8, edge view.
9–11, CPC 21850, sample 71528142; 9, ventral view; 10, dorsal view; 11, edge view.
12, 13, CPC 21851, same sample; 12, ventral view; 13, edge view.

14–21 **Globorotalia (Morozovella) occlusa acutispira** Bolli & Cita
14–16, CPC 21852, sample 71529039; 14, ventral view; 15, dorsal view; 16, edge view.
17, 18, CPC 21853, same sample; 17, ventral view; 18, edge view.
19, 20, CPC 21854, same sample; 19, ventral view; 20, edge view.
21, CPC 21855, same sample, edge view.

22–26 **Globorotalia (Morozovella) spinulosa spinulosa** Cushman
22–24, CPC 21856, sample 71529051; 22, ventral view; 23, dorsal view; 24, edge view.
25, 26, CPC 21857, same sample; 25, ventral view; 26, edge view.

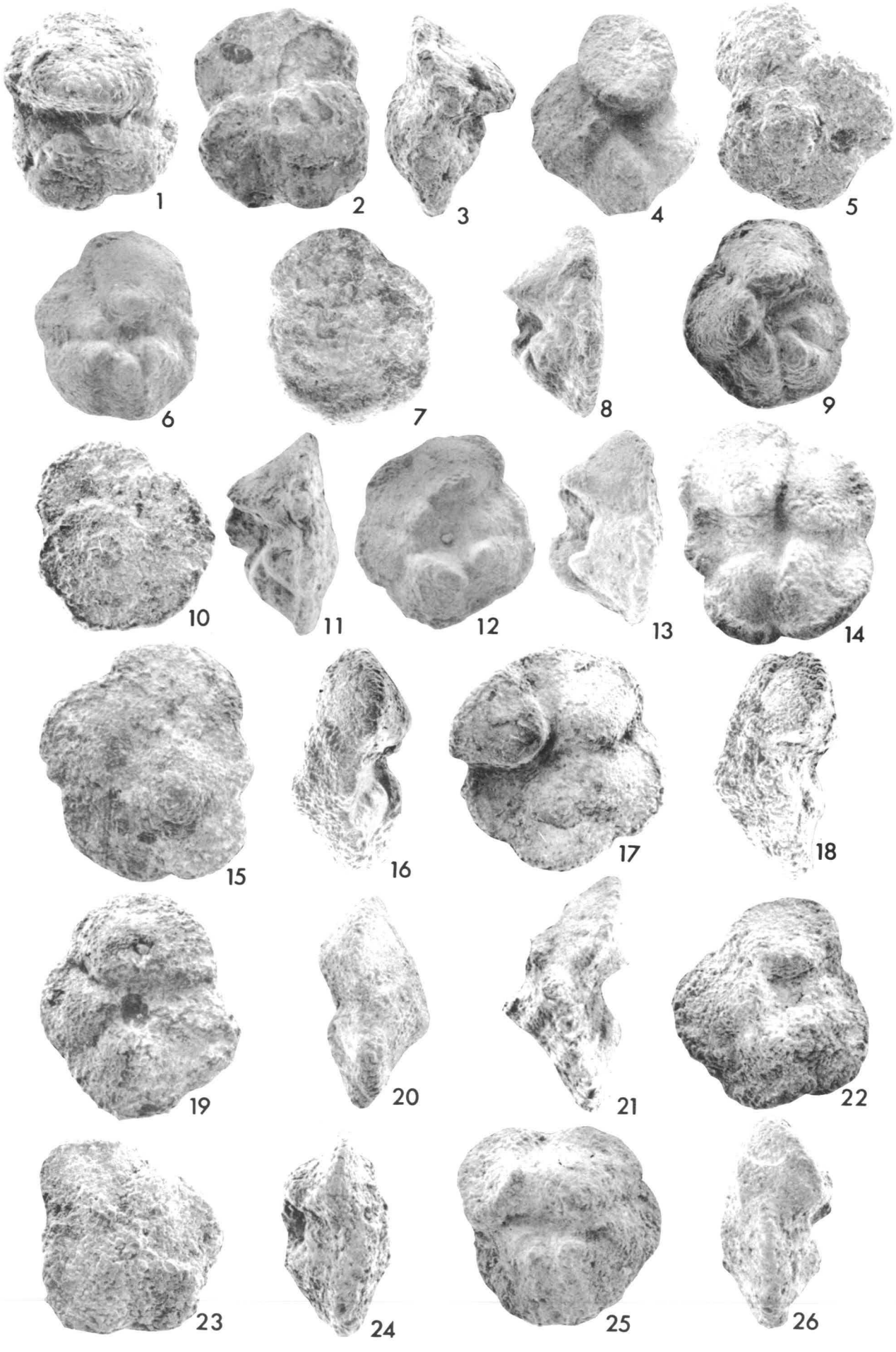

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

PLATE 18

(All figures ×80.)

Figs.

1–3 **Globorotalia (Morozovella) spinulosa coronata** Blow
CPC 21858, sample 71529051; 1, ventral view; 2, dorsal view; 3, edge view.

4–9 **Globorotalia (Morozovella) subbotinae gracilis** Bolli
4–6, CPC 21859, sample 71529039; 4, ventral view; 5, dorsal view; 6, edge view.
7–9, CPC 21860, same sample; 7, ventral view; 8, dorsal view; 9, edge view.

10–17 **Globorotalia (Morozovella) subbotinae marginodentata** Subbotina
10–12, CPC 21861, sample 71529039; 10, ventral view; 11, dorsal view; 12, edge view.
13, 14, CPC 21862, same sample; 13, ventral view; 14, edge view.
15–17, CPC 21863, same sample; 15, ventral view; 16, dorsal view; 17, edge view.

18–23 **Globorotalia (Morozovella) tadjikistanensis** Bykova
18–20, CPC 21864, sample 71529039; 18, ventral view; 19, dorsal view; 20, edge view.
21–23, CPC 21865, same sample; 21, ventral view; 22, dorsal view; 23, edge view.

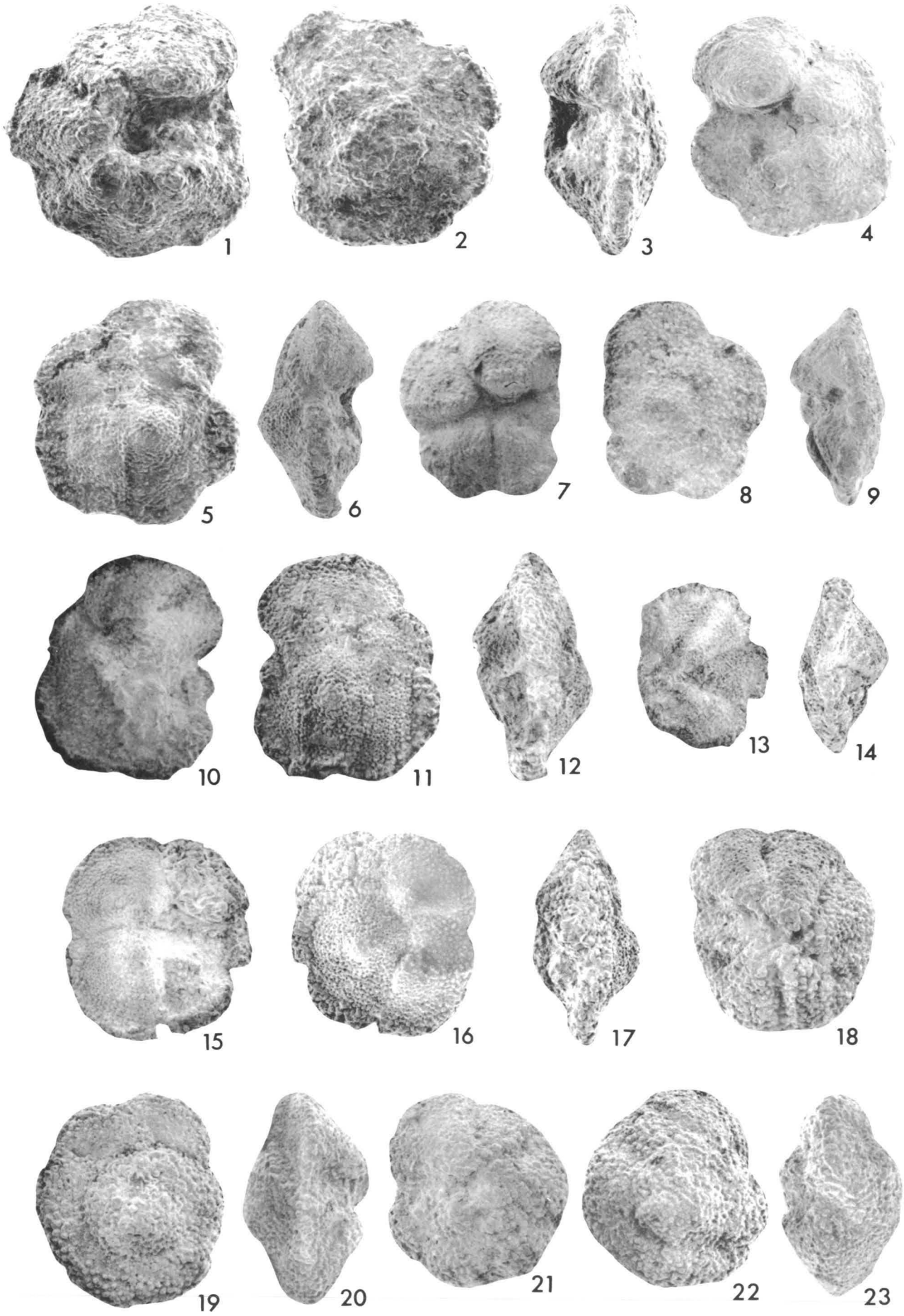

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

PLATE 19

(All figures ×80.)

Figs.

1–10 **Globorotalia (Morozovella) velascoensis velascoensis** (Cushman)
1–3, CPC 21866, sample 71529039; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, CPC 21867, sample 71528142; 4, ventral view; 5, edge view.
6–8, CPC 21868, sample 71529039; 6, ventral view; 7, dorsal view; 8, edge view.
9, 10, CPC 21869, sample 71528142; 9, ventral view; 10, edge view.

11–15 **Globorotalia (Morozovella) velascoensis acuta** Toulmin
11–13, CPC 21870, sample 71529039; 11, ventral view; 12, dorsal view; 13, edge view.
14, 15, CPC 21871, same sample; 14, ventral view; 15, edge view.

16–18 **Globorotalia (Morozovella) velascoensis parva** Rey
CPC 21872, sample 71528142; 16, ventral view; 17, dorsal view; 18, edge view.

19–23 **Globorotalia (Morozovella) velascoensis pasionensis** (Bermudez)
19–21, CPC 21873, sample 71529039; 19, ventral view; 20, dorsal view; 21, edge view.
22, 23, CPC 21874, same sample; 22, ventral view; 23, edge view.

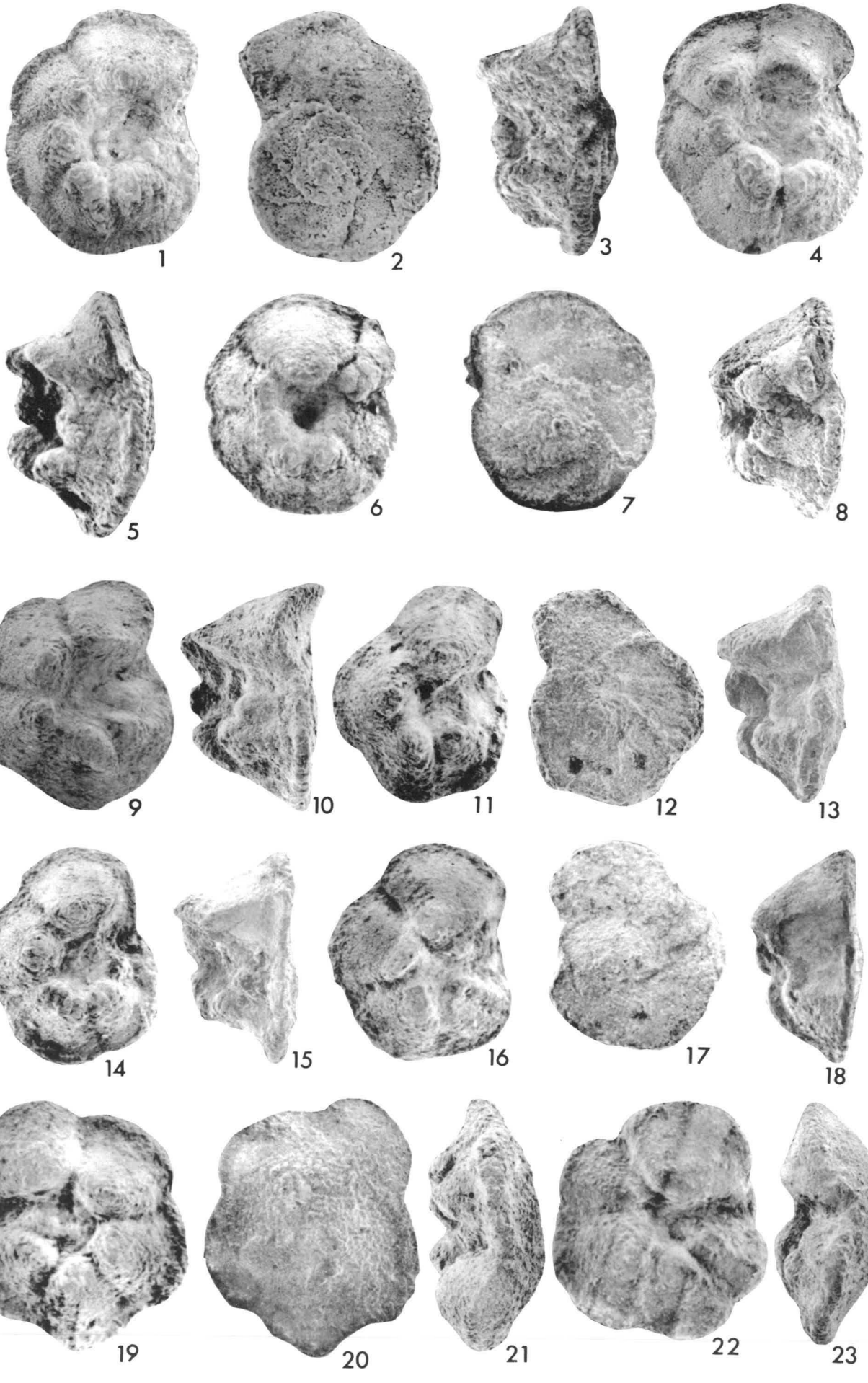

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

PLATE 20

(All figures ×80.)

Figs.

1–3 **Globorotalia (Morozovella)** sp. 1
CPC 21875, sample 71529039; 1, ventral view; 2, dorsal view; 3, edge view.

4–8 **Globorotalia (Morozovella)** sp. 2
4–6, CPC 21876, sample 71528142; 4, ventral view; 5, dorsal view; 6, edge view.
7, 8, CPC 21877, same sample; 7, ventral view; 8, edge view.

9–13 **Globorotalia (Truncorotaloides) topilensis topilensis** (Cushman)
9–11, CPC 21878, sample 71529051; 9, ventral view; 10, dorsal view; 11, edge view.
12, 13, CPC 21879, same sample; 12, ventral view; 13, dorsal view.

14–21 **Globorotalia (Turborotalia) compressa compressa** (Plummer)
14–16, CPC 21880, sample 71528084; 14, ventral view; 15, dorsal view; 16, edge view.
17–19, CPC 21881, same sample; 17, ventral view; 18, dorsal view; 19, edge view.
20, 21, CPC 21882, same sample; 20, ventral view; 21, edge view.

22–27 **Globorotalia (Turborotalia) haunsbergensis** Gohrbandt
22–24, CPC 21883, sample 71528084; 22, ventral view; 23, dorsal view; 24, edge view.
25–27, CPC 21884, same sample; 25, ventral view; 26, dorsal view; 27, edge view.

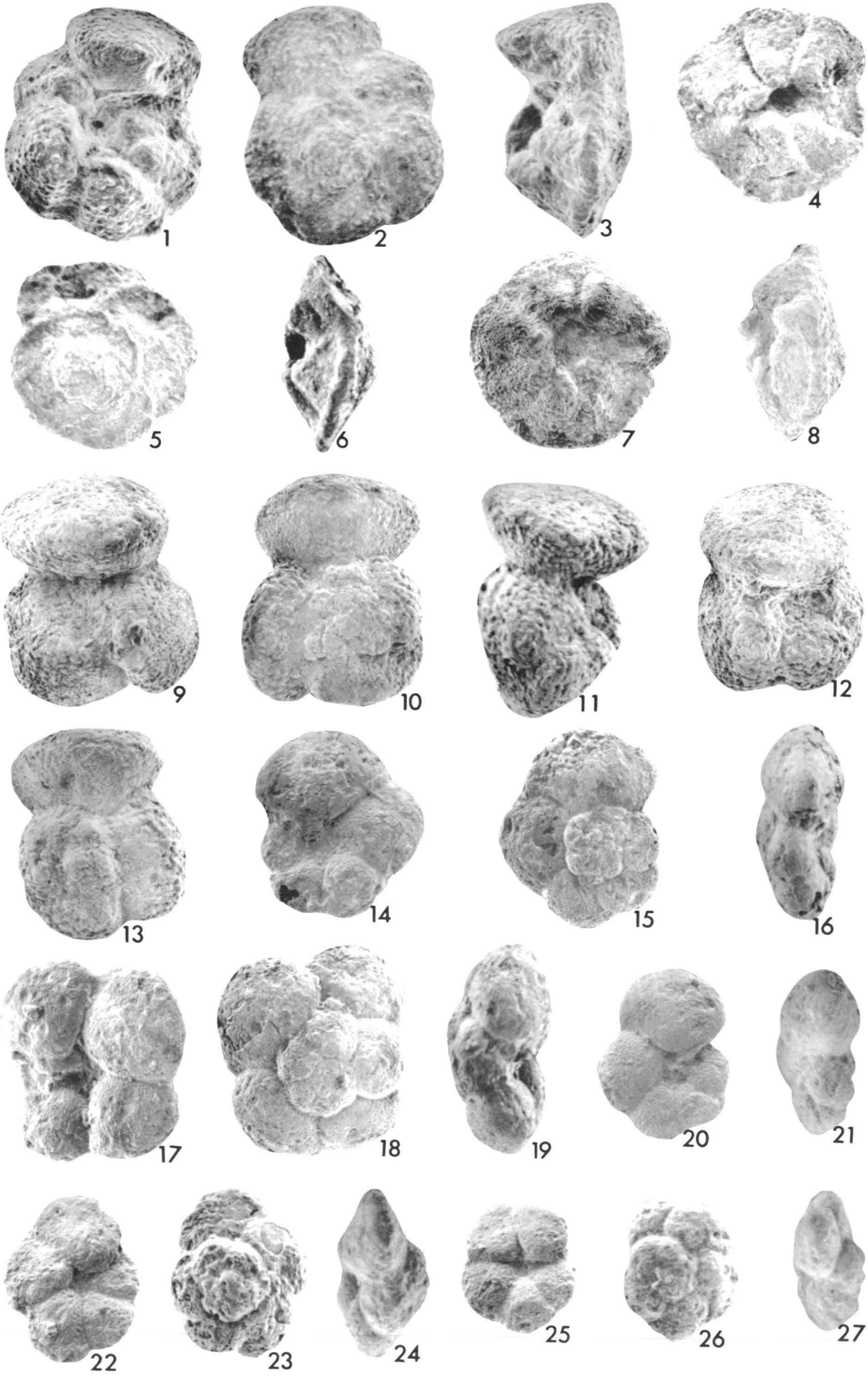

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27

PLATE 21

(All figures ×80.)

Figs.

1–12 **Globorotalia (Turborotalia) inconstans** (Subbotina)
1–3, CPC 21885, sample 71528084; 1, ventral view; 2, dorsal view; 3, edge view.
4–6, CPC 21886, same sample; 4, ventral view; 5, dorsal view; 6, edge view.
7–9, CPC 21887, same sample; 7, ventral view; 8, dorsal view; 9, edge view.
10–12, CPC 21888, same sample; 10, ventral view; 11, dorsal view; 12, edge view.

13–16 **Globorotalia (Turborotalia) pseudobulloides** (Plummer)
13–15, CPC 21889, sample 71528084; 13, ventral view; 14, dorsal view; 15, edge view.
16, CPC 21890, same sample, ventral view.

17–19 **Hantkenina (Aragonella) mexicana mexicana** Cushman
17, CPC 21891, sample 71529051, side view.
18, 19, CPC 21892, same sample; 18, side view; 19, edge view.

20–22 **Hantkenina (Aragonella) mexicana dumblei** Weinzierl & Applin
20, 21, CPC 21893, sample 71529051; 20, side view; 21, edge view.
22, CPC 21894, same sample, side view.

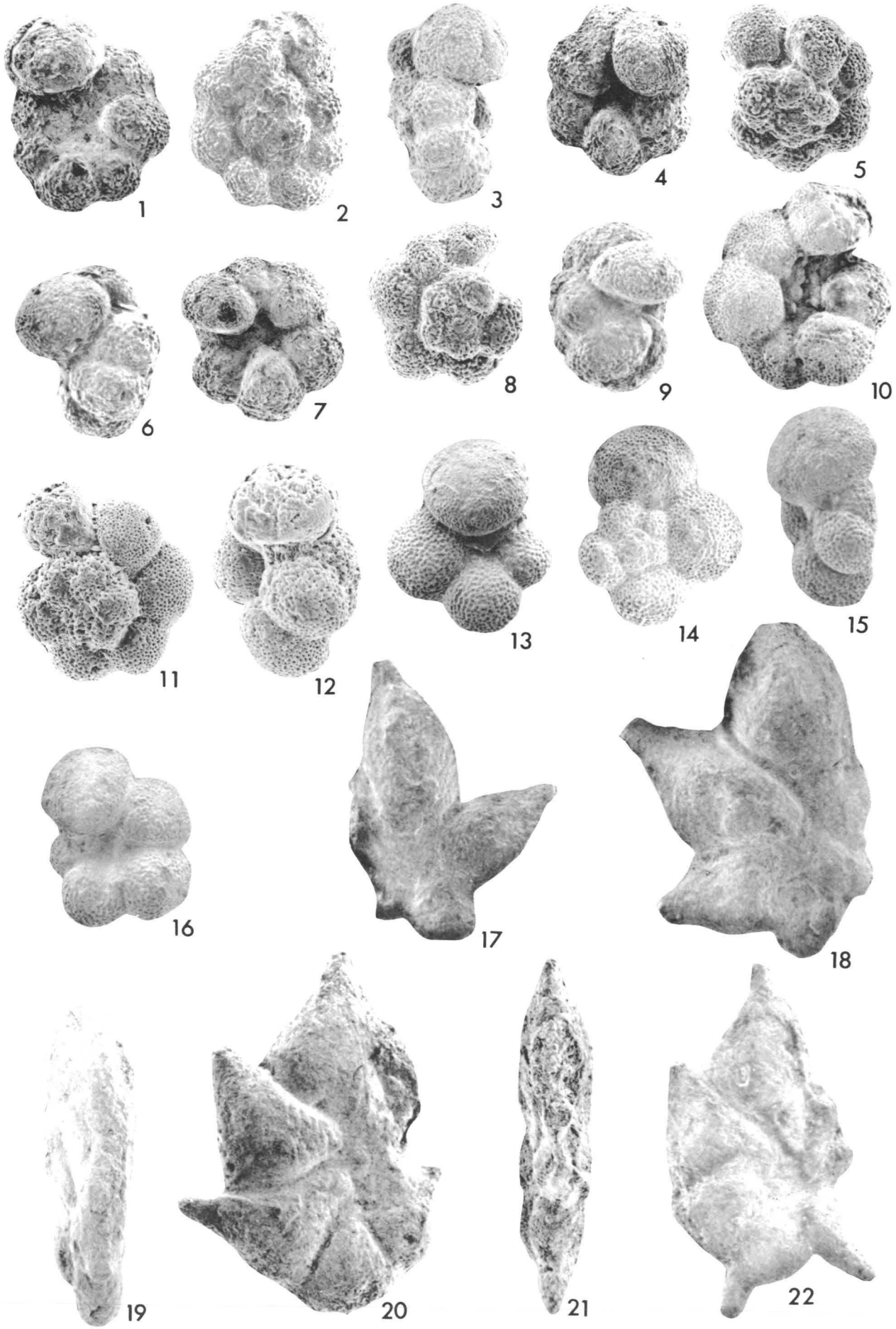

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

PLATE 22

(All figures ×80.)

Figs.

1–3 **Muricoglobigerina aquiensis** (Loeblich & Tappan)
CPC 21895, sample 71528142; 1, ventral view; 2, dorsal view; 3, edge view.

4–8 **Muricoglobigerina mckannai** (White)
4–6, CPC 21896, sample 71528142; 4, ventral view; 5, dorsal view; 6, edge view.
7, 8, CPC 21897, same sample; 7, ventral view; 8, edge view.

9–12 **Muricoglobigerina soldadoensis angulosa** (Bolli)
9–11, CPC 21898, sample F.184; 9, ventral view; 10, dorsal view; 11, edge view.
12, CPC 21899, same sample, ventral view.

13–18 **Subbotina frontosa frontosa** (Subbotina)
13–15, CPC 21900, sample 71529051; 13, ventral view; 14, dorsal view; 15, edge view.
16, 17, CPC 21901, same sample; 16, ventral view; 17, dorsal view.

19–27 **Subbotina frontosa boweri** (Bolli)
19–21, CPC 21902, sample 71529051; 19, ventral view; 20, dorsal view; 21, edge view.
22–24, CPC 21903, same sample; 22, ventral view; 23, dorsal view; 24, edge view.
25–27, CPC 21904, same sample; 25, ventral view; 26, dorsal view; 27, edge view.

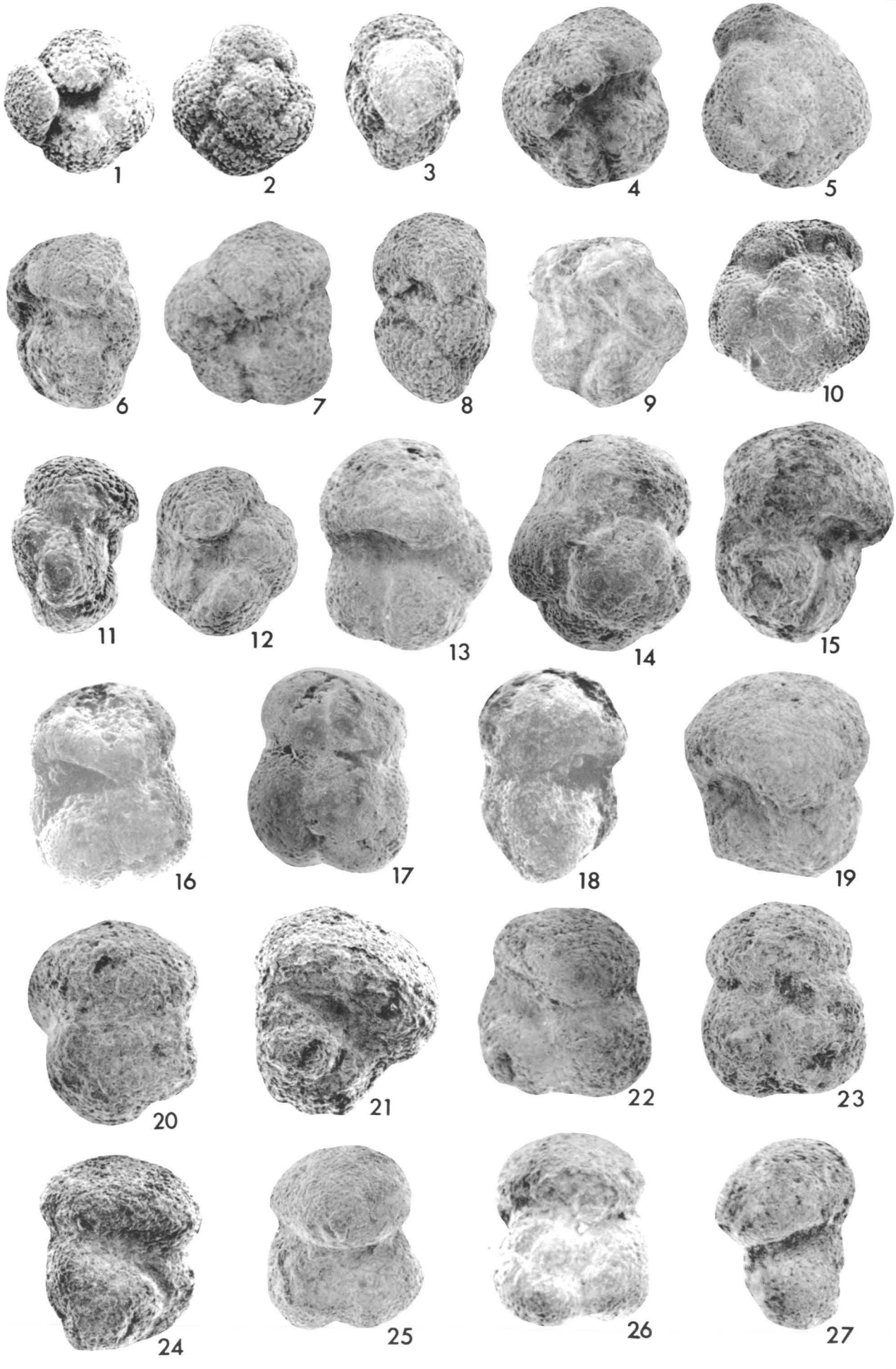

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27

PLATE 23

(All figures ×80.)

Figs.

1–8 **Subbotina inaequispira** (Subbotina)
1–3, CPC 21905, sample 71529039; 1, ventral view; 2, dorsal view; 3, edge view.
4–6, CPC 21906, same sample; 4, ventral view; 5, dorsal view; 6, edge view.
7, 8, CPC 21907, same sample; 7, ventral view; 8, edge view.

9–15 **Subbotina linaperta** (Finlay)
9–11, CPC 21908, sample F.184; 9, ventral view; 10, dorsal view; 11, edge view.
12–14, CPC 21909, same sample; 12, ventral view; 13, dorsal view; 14, edge view.
15, CPC 21910, same sample, ventral view.

16–21 **Subbotina pseudoeocaena** (Subbotina)
16–18, CPC 21911, sample 71529051; 16, ventral view; 17, dorsal view; 18, edge view.
19–20, CPC 21912, same sample; 19, ventral view; 20, edge view.
21, CPC 21913, same sample, ventral view.

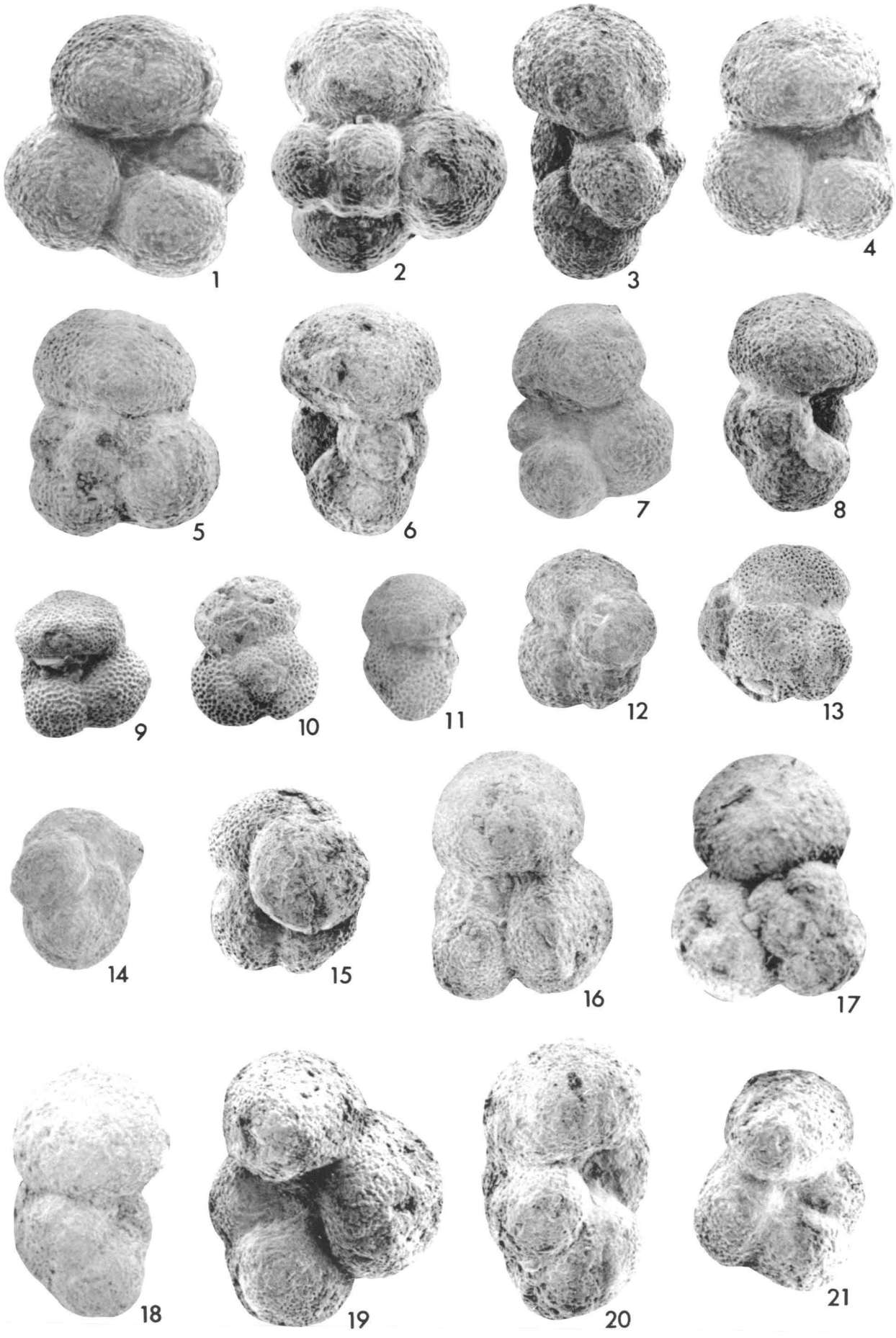

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21

PLATE 24

(All figures ×80.)

Figs.

1–5 **Subbotina triloculinoides** (Plummer)
1–3, CPC 21914, sample 71528084; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, CPC 21915, sample 71529039; 4, ventral view; 5, edge view.

6–14 **Subbotina velascoensis** (Cushman)
6–8, CPC 21916, sample 71529039; 6, ventral view; 7, dorsal view; 8, edge view.
9–11, CPC 21917, same sample; 9, ventral view; 10, dorsal view; 11, edge view.
12–14, CPC 21918, same sample; 12, ventral view; 13, dorsal view; 14, edge view.

15–17 **Globorotalia (Turborotalia) variospira** sp. nov.
Holotype, CPC 21919, sample 71529039; 15, ventral view; 16, dorsal view; 17, edge view.

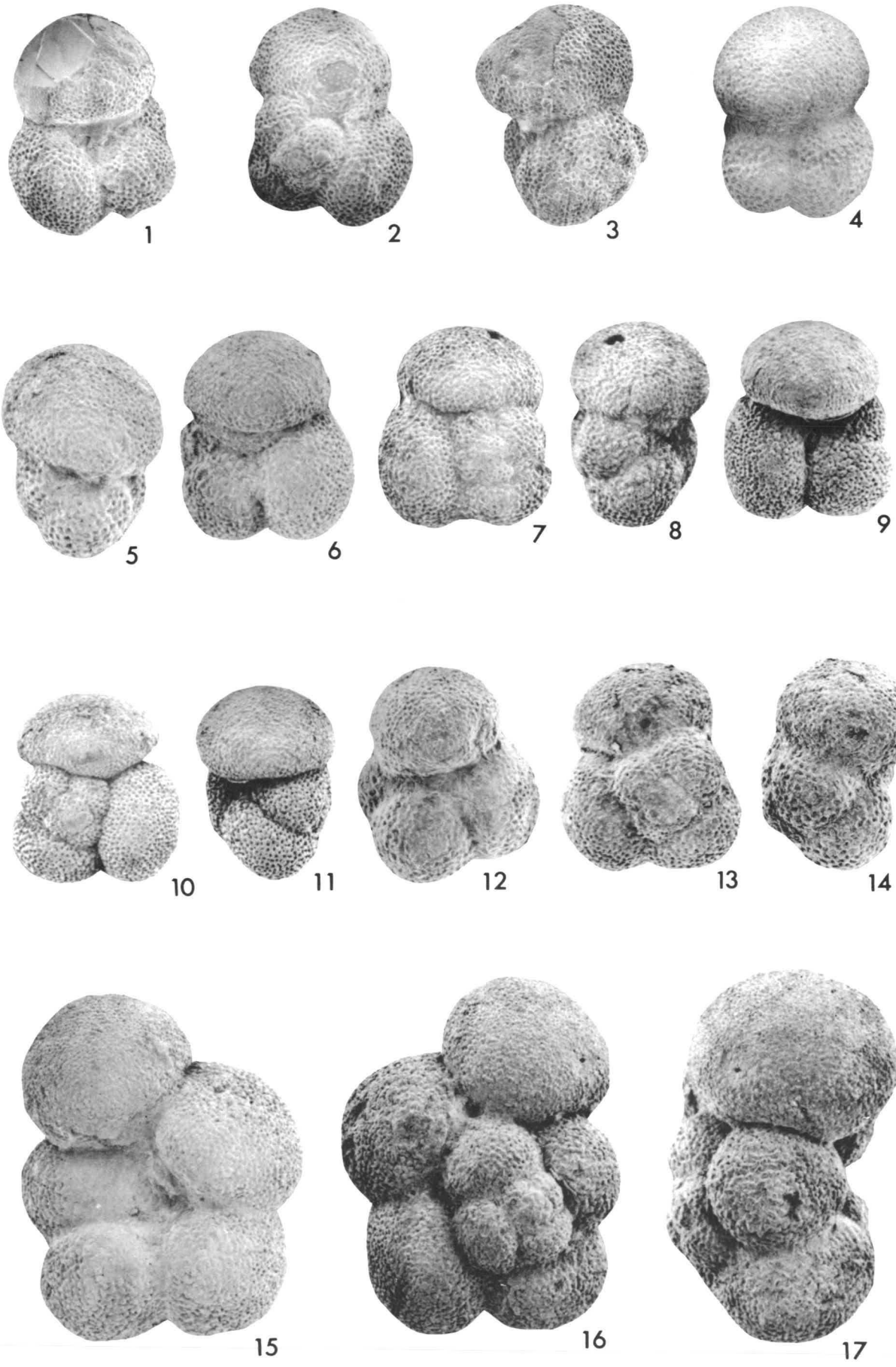

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

PLATE 25

(All figures ×80.)

Figs.

1–7 **Globorotalia (Turborotalia) variospira** sp. nov.
1–3, paratype A, CPC 21920, sample 71529039; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, paratype B, CPC 21921, same sample; 4, ventral view; 5, edge view.
6, 7, paratype C, CPC 21922, same sample; 6, ventral view; 7, dorsal view.

8–10 **Subbotina** sp. 1
CPC 21924, sample 71529039; 8, ventral view; 9, dorsal view; 10, edge view.

11–13 **Subbotina** sp. 2
CPC 21925, sample 71529015; 11, ventral view; 12, dorsal view; 13, edge view.

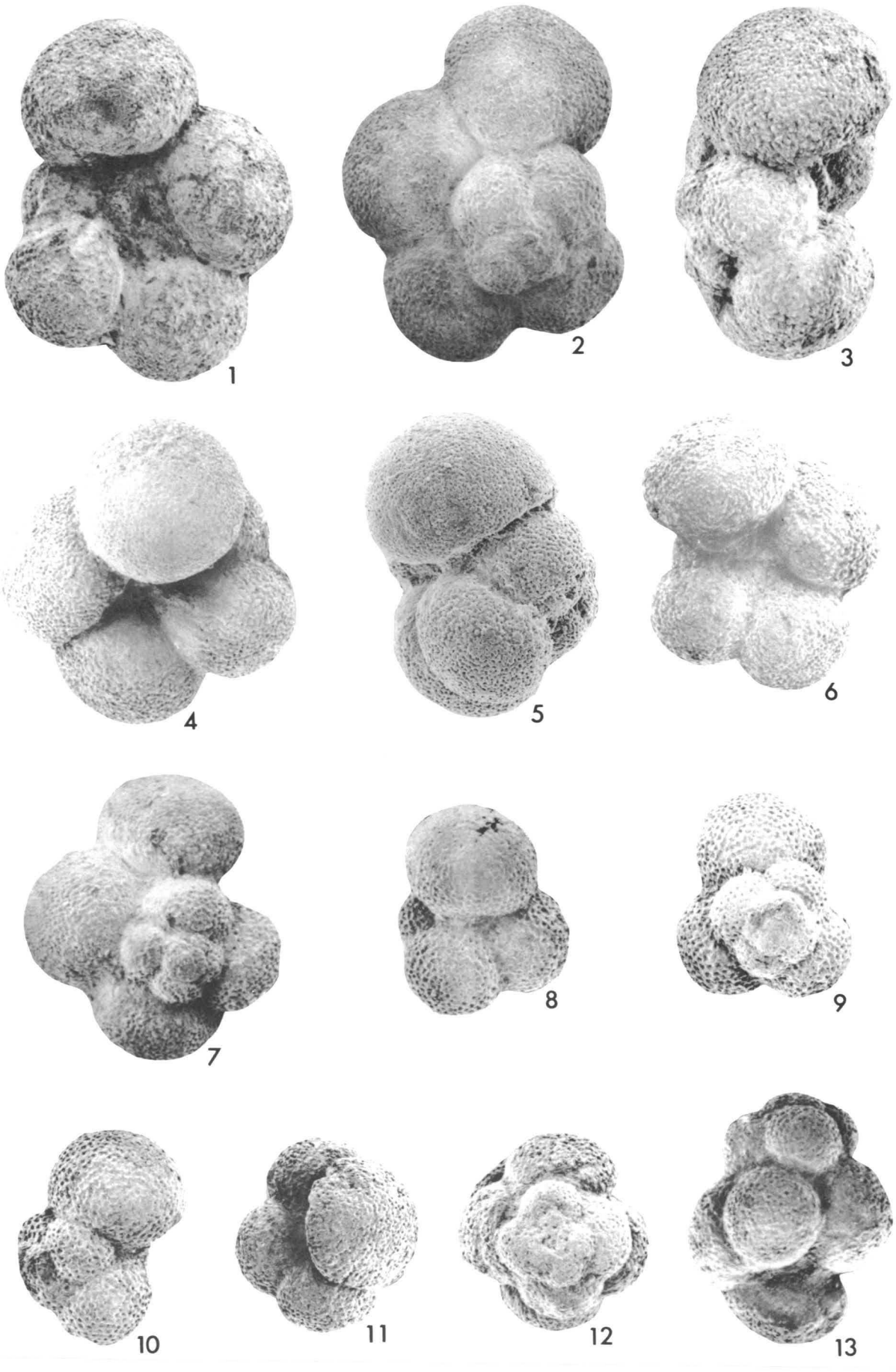


PLATE 26

(All figures ×80.)

Figs.

1–3 **Subbotina** sp. 3
CPC 21926, sample 71529051; 1, ventral view; 2, dorsal view; 3, edge view.

4–11 **Subbotina** sp. 4
4–6, CPC 21927, sample 71529039; 4, ventral view; 5, dorsal view; 6, edge view.
7–9, CPC 21928, same sample; 7, ventral view; 8, dorsal view; 9, edge view.
10, 11, CPC 21929, same sample; 10, ventral view; 11, edge view.

12–16 **Subbotina** sp. 5
12, 13, CPC 21930, sample 71529051; 12, ventral view; 13, edge view.
14–16, CPC 21931, same sample; 14, ventral view; 15, dorsal view; 16, edge view.

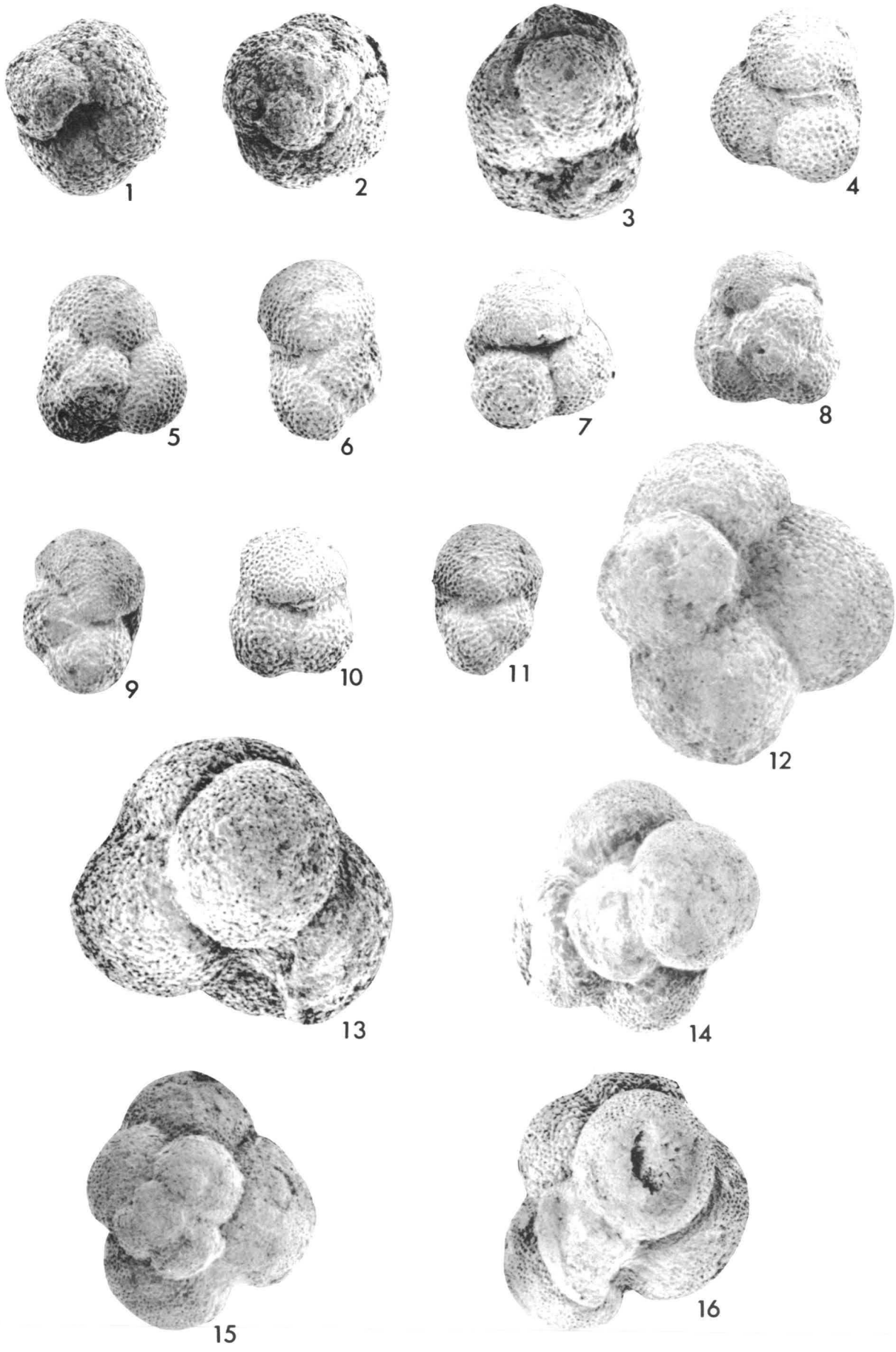

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

PLATE 27

(All figures ×80.)

Figs.

1–5 **Globigerina bulloides bulloides** d'Orbigny
1–3, CPC 21932, sample F.432; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, CPC 21933, sample F.420; 4, ventral view; 5, edge view.

6–11 **Globigerina decoraperta** Takayanagi & Saito
6–8, CPC 21934, sample F.421; 6, ventral view; 7, dorsal view; 8, edge view.
9–11, CPC 21935, same sample; 9, ventral view; 10, dorsal view; 11, edge view.

12–14 **Globigerina euapertura** Jenkins
CPC 21936, sample F.280; 12, ventral view; 13, dorsal view; 14, edge view.

15–25 **Globigerina falconensis** Blow
15–17, CPC 21937, sample F.434; 15, ventral view; 16 dorsal view; 17, edge view.
18–19, CPC 21938, sample F.432; 18, ventral view; 19, edge view.
20–22, CPC 21939, sample F.434; 20, ventral view; 21, dorsal view; 22, edge view.
23–25, CPC 21940, same sample; 23, ventral view, 24, dorsal view; 25, edge view.

26–29 **Globigerina foliata** Bolli
26–28, CPC 21941, sample F.434; 26, ventral view; 27, dorsal view; 28, edge view.
29, CPC 21942, same sample, ventral view.

30–34 **Globigerina ouachitaensis ciperoensis** Bolli
30–32, CPC 21943, sample F.279; 30, ventral view; 31, dorsal view; 32, edge view.
33, 34, CPC 21944, same sample; 33, ventral view; 34, dorsal view.

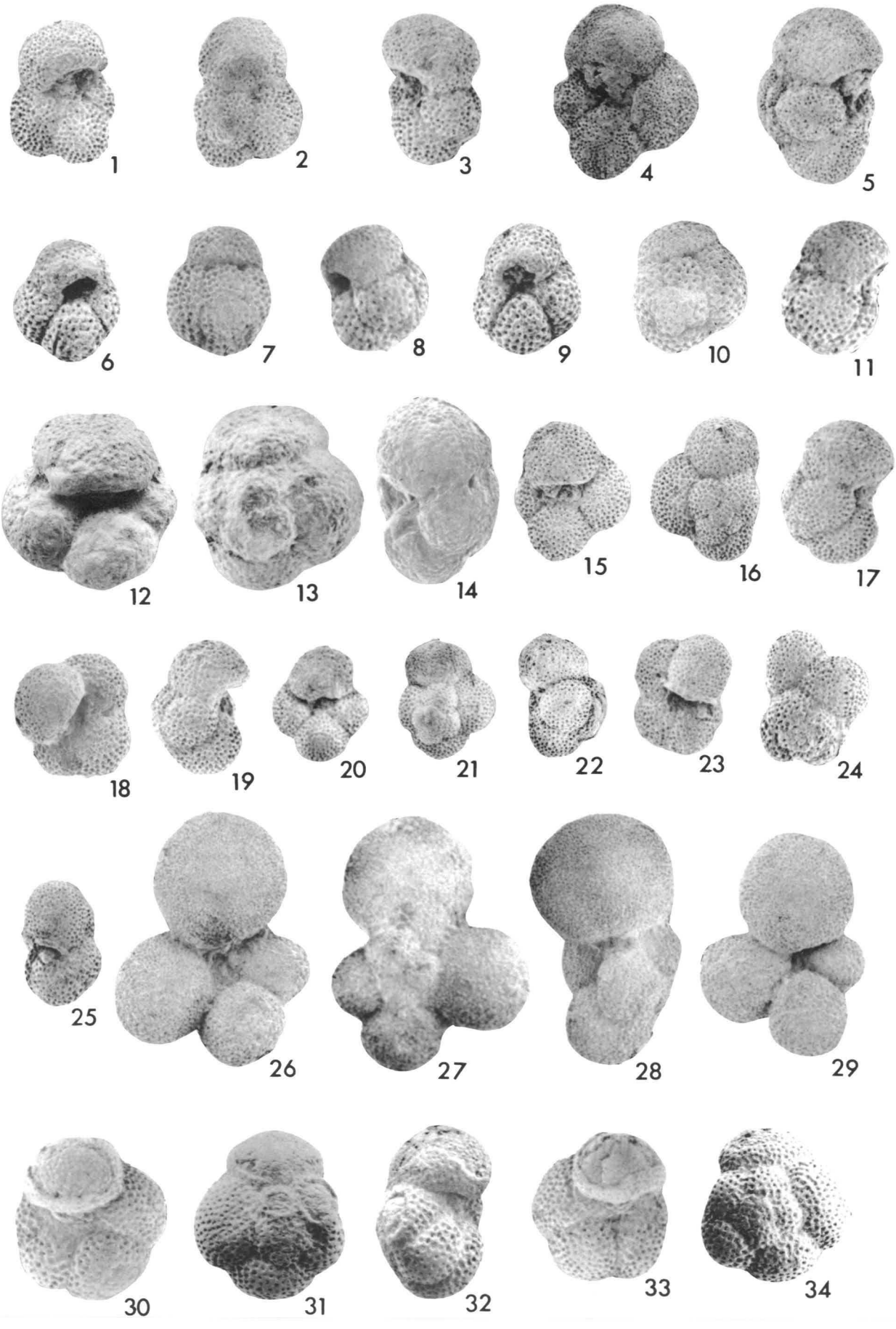

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34

PLATE 28

(All figures ×80.)

Figs.

1–2 **Globigerina praebulloides occlusa** Blow & Banner
1, CPC 21945, sample F.436, ventral view.
2, CPC 21946, sample F.434, ventral view.

3–7 **Globigerina praebulloides praebulloides** Blow
3–5, CPC 21947, sample F.434; 3, ventral view; 4, dorsal view; 5, edge view.
6,7, CPC 21948, same sample; 6, ventral view; 7, edge view.

8–13 **Globigerina praebulloides pseudociperoensis** Blow
8–10, CPC 21949, sample F.434; 8, ventral view; 9, dorsal view; 10, edge view.
11–13, CPC 21950, same sample; 11, ventral view; 12, dorsal view; 13, edge view.

14–16 **Dentoglobigerina sellii** (Borsetti)
CPC 21951, sample F.281; 14, ventral view; 15, dorsal view; 16, edge view.

17–21 **Dentoglobigerina tripartita tripartita** (Koch)
17–19, CPC 21952, sample F.279; 17, ventral view; 18, dorsal view; 19, edge view.
20, 21, CPC 21953, sample F.396; 20, ventral view; 21, dorsal view.

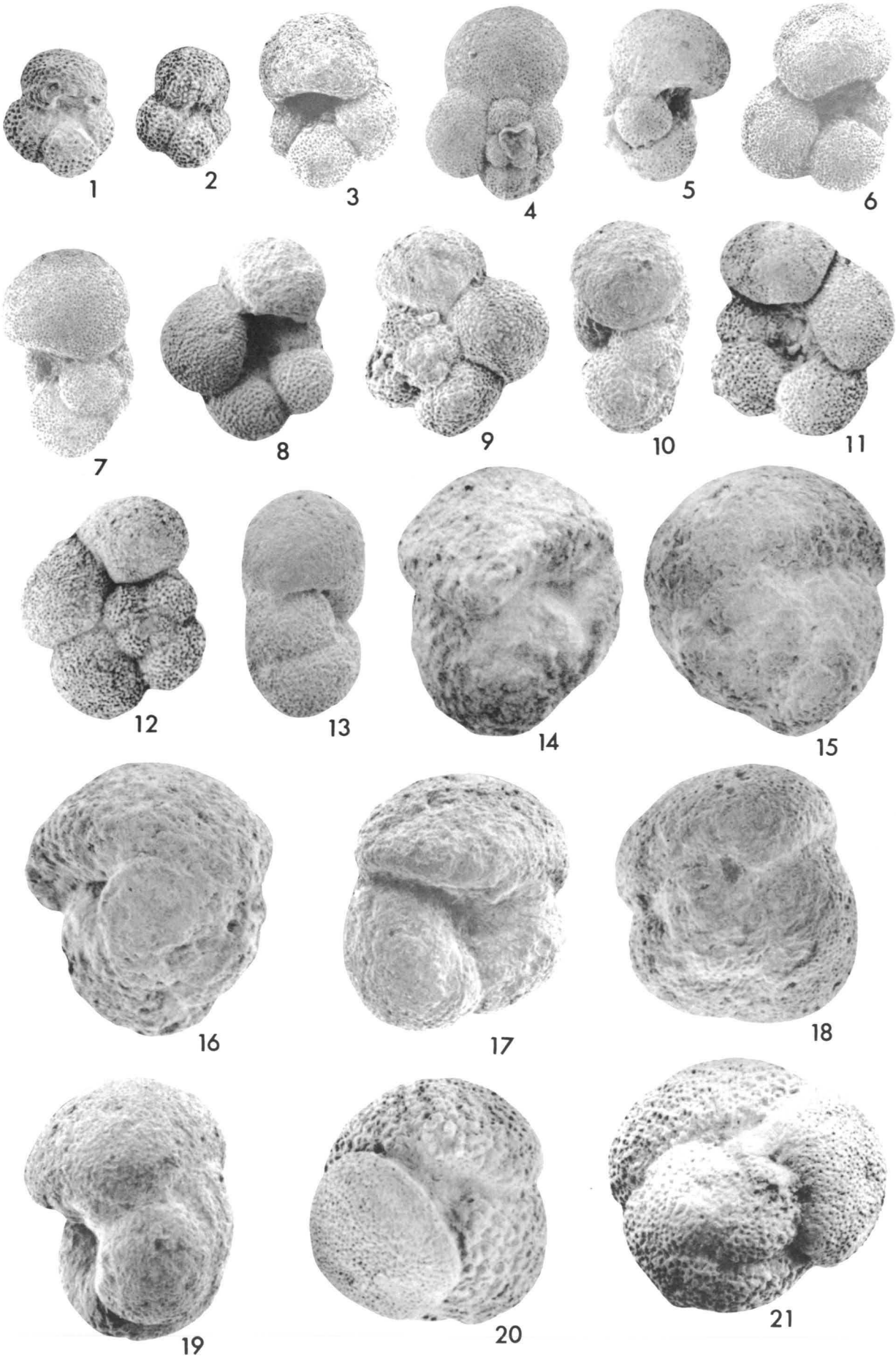

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21

PLATE 29

(All figures ×80.)

Figs.

1–3 **Dentoglobigerina venezuelana** (Hedberg)
CPC 21954, sample F.434; 1, ventral view; 2, dorsal view; 3, edge view.

4–9 **Globigerina woodi** Jenkins
4–6, CPC 21955, sample F.280; 4, ventral view; 5, dorsal view; 6, edge view.
7–9, CPC 21956, same sample; 7, ventral view; 8, dorsal view; 9, edge view.

10 **Globigerinatheka mexicana barri** Brönnimann
CPC 21957, sample 71529051, ventral view.

11–16 **Globigerinatheka mexicana kugleri** (Bolli, Loeblich & Tappan)
11–13, CPC 21958, sample 71529051; 11, ventral view; 12, dorsal view; 13, edge view.
14–16, CPC 21959, same sample; 14, ventral view; 15, dorsal view; 16, edge view.

17 **Globigerinita dissimilis** (Cushman & Bermudez)
CPC 21960, sample F.936, ventral view.

18–22 **Globigerinita incrusta** Akers
18–20, CPC 21961, sample F.420; 18, ventral view; 19, dorsal view; 20, edge view.
21, 22, CPC 21962, same sample; 21, ventral view; 22, edge view.

23–25 **Globigerinita unicava unicava** (Bolli, Loeblich & Tappan)
CPC 21963, sample F.936; 23, ventral view; 24, dorsal view; 25, edge view.

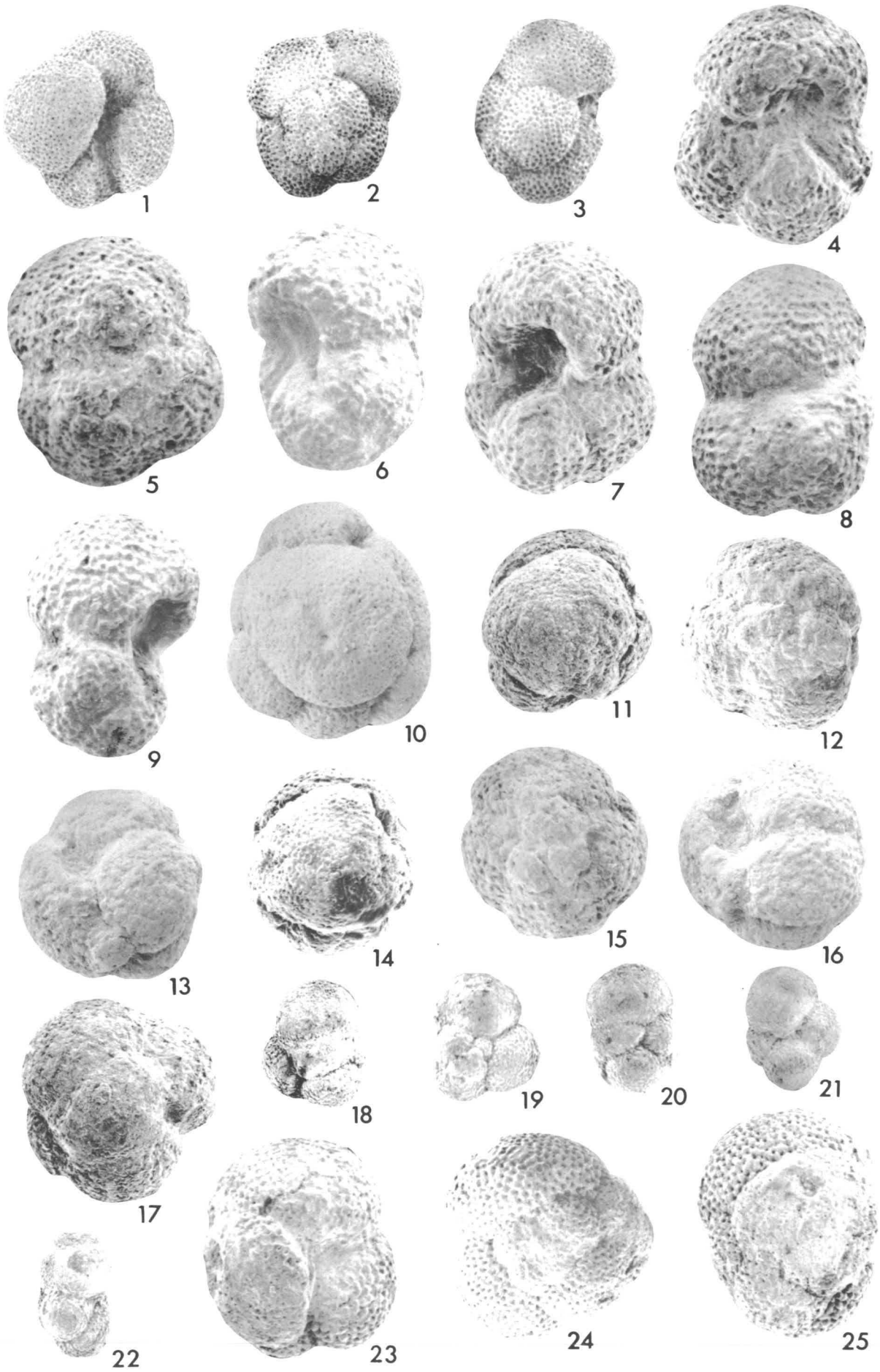

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

PLATE 30

(All figures ×80.)

Figs.

1–5 **Globigerinoides bollii** Blow
1–3, CPC 21964, sample F.420; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, CPC 21965, same sample; 4, ventral view, 5, dorsal view.

6 **Globigerinoides obliquus extremus** Bolli & Bermudez
CPC 21966, sample 71526193, ventral view.

7–9 **Globigerinoides obliquus obliquus** Bolli
CPC 21967, sample F.420; 7, ventral view; 8, dorsal view; 9, edge view.

10–16 **Globigerinoides quadrilobatus altiapertura** Bolli
10–12, CPC 21968, sample F.436; 10, ventral view; 11, dorsal view; 12, edge view.
13–15, CPC 21969, sample 71522646; 13, ventral view; 14, dorsal view; 15, edge view.
16, CPC 21970, sample F.436, ventral view.

17–18 **Globigerinoides quadrilobatus immaturus** LeRoy
CPC 21971, sample F.434; 17, ventral view; 18, dorsal view.

19 **Globigerinoides quadrilobatus irregularus** LeRoy
CPC 21972, sample F.432, ventral view.

20–23 **Globigerinoides quadrilobatus primordius** Blow & Banner
20, 21, CPC 21973, sample F.936; 20, ventral view; 21, dorsal view.
22, 23, CPC 21974, same sample; 22, ventral view; 23, dorsal view.

24–25 **Globigerinoides quadrilobatus quadrilobatus** (d'Orbigny)
CPC 21975, sample F.434; 24, ventral view; 25, dorsal view.

26–29 **Globigerinoides quadrilobatus sacculifer** (Brady)
26, 27, CPC 21976, sample F.421; 26, ventral view; 27, edge view.
28, 29, CPC 21977, sample F.432; 28, ventral view; 29, edge view.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29

PLATE 31

(All figures ×80.)

Figs.

1 **Globigerinoides quadrilobatus triloba** (Reuss)
CPC 21978, sample 71523359, ventral view.

2–9 **Globigerinoides** sp. 1, ex. gr. **G. quadrilobatus** (d'Orbigny)
2–4, CPC 21979, sample F.434; 2, ventral view; 3, dorsal view; 4, edge view.
5–7, CPC 21980, same sample; 5, ventral view; 6, dorsal view; 7, edge view.
8, 9, CPC 21981, same sample; 8, ventral view; 9, edge view.

10–15 **Globigerinoides** sp. 2, ex. gr. **G. quadrilobatus** (d'Orbigny)
10–12, CPC 21982, sample F.875A; 10, ventral view; 11, dorsal view; 12, edge view.
13–15, CPC 21983, same sample; 13, ventral view; 14, dorsal view; 15, edge view.

16 **Praeorbulina sicana sicana** (de Stefani)
CPC 21984, sample F.434, ventral view.

17–21 **Globigerinoides subquadratus** Brönnimann
17–19, CPC 21985, sample F.434; 17, ventral view; 18, edge view; 19, dorsal view.
20, 21, CPC 21986, same sample; 20, edge view; 21, dorsal view.

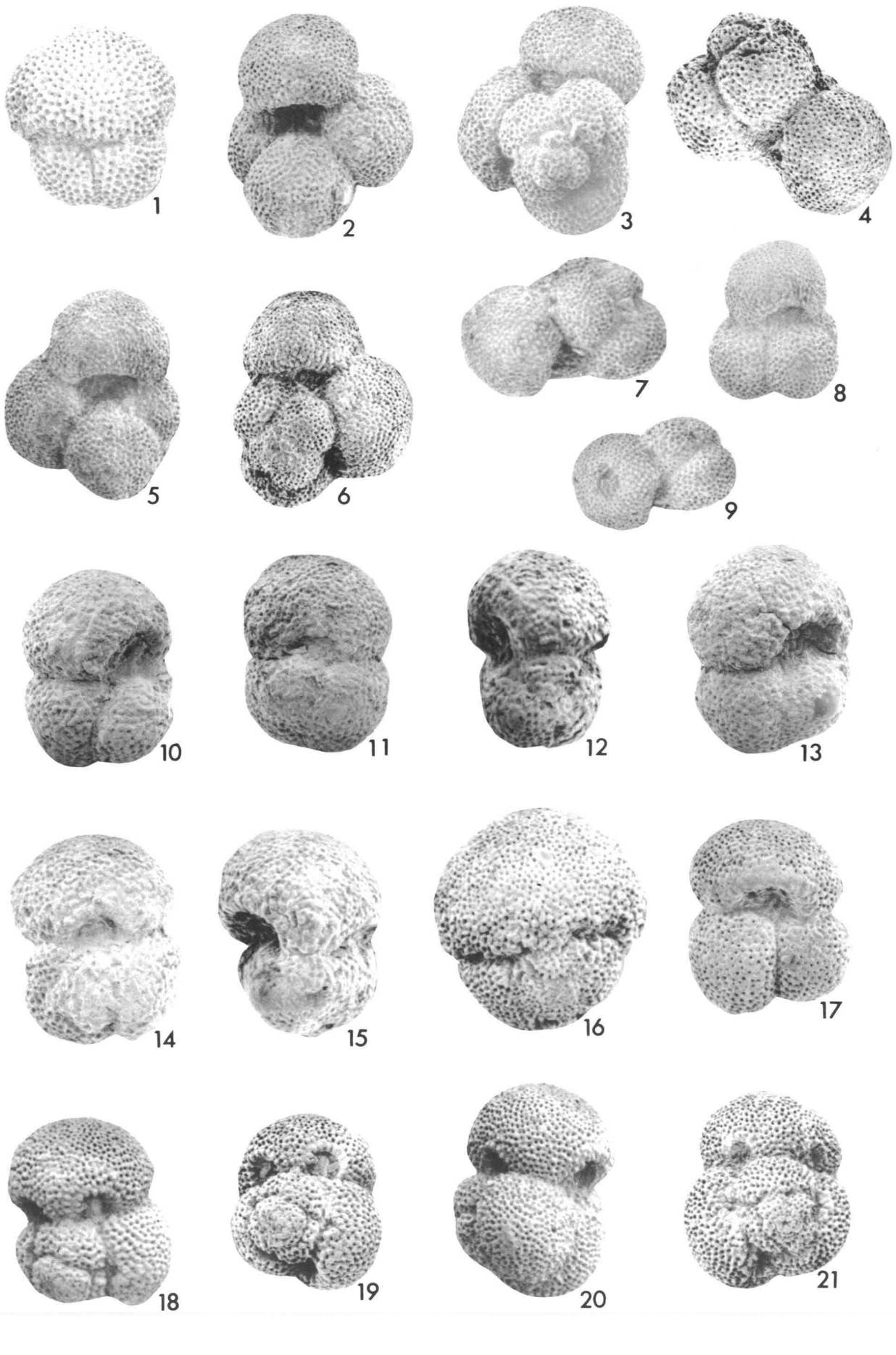

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21

PLATE 32

(All figures ×80.)

Figs.

1–5 **Dentoglobigerina altispira altispira** (Cushman & Jarvis)
1–3, CPC 21987, sample F.434; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, CPC 21988, same sample; 4, ventral view; 5, edge view.

6–11 **Dentoglobigerina baroemoenensis** (LeRoy)
6–8, CPC 21989, sample 71520199; 6, ventral view; 7, dorsal view; 8, edge view.
9–11, CPC 21990, same sample; 9, ventral view; 10, dorsal view; 11, edge view.

12–17 **Globoquadrina dehiscens dehiscens** (Chapman, Parr & Collins)
12–14, CPC 21991, sample F.434; 12, ventral view; 13, dorsal view; 14, edge view.
15, CPC 21992, same sample; ventral view.
16, 17, CPC 21993, same sample; 16, ventral view; 17, edge view.

18–23 **Dentoglobigerina langhiana** (Cita & Gelati)
18–20, CPC 21994, sample F.876; 18, ventral view; 19, dorsal view; 20, edge view.
21–23, CPC 21995, sample F.886; 21, ventral view; 22, dorsal view; 23, edge view.

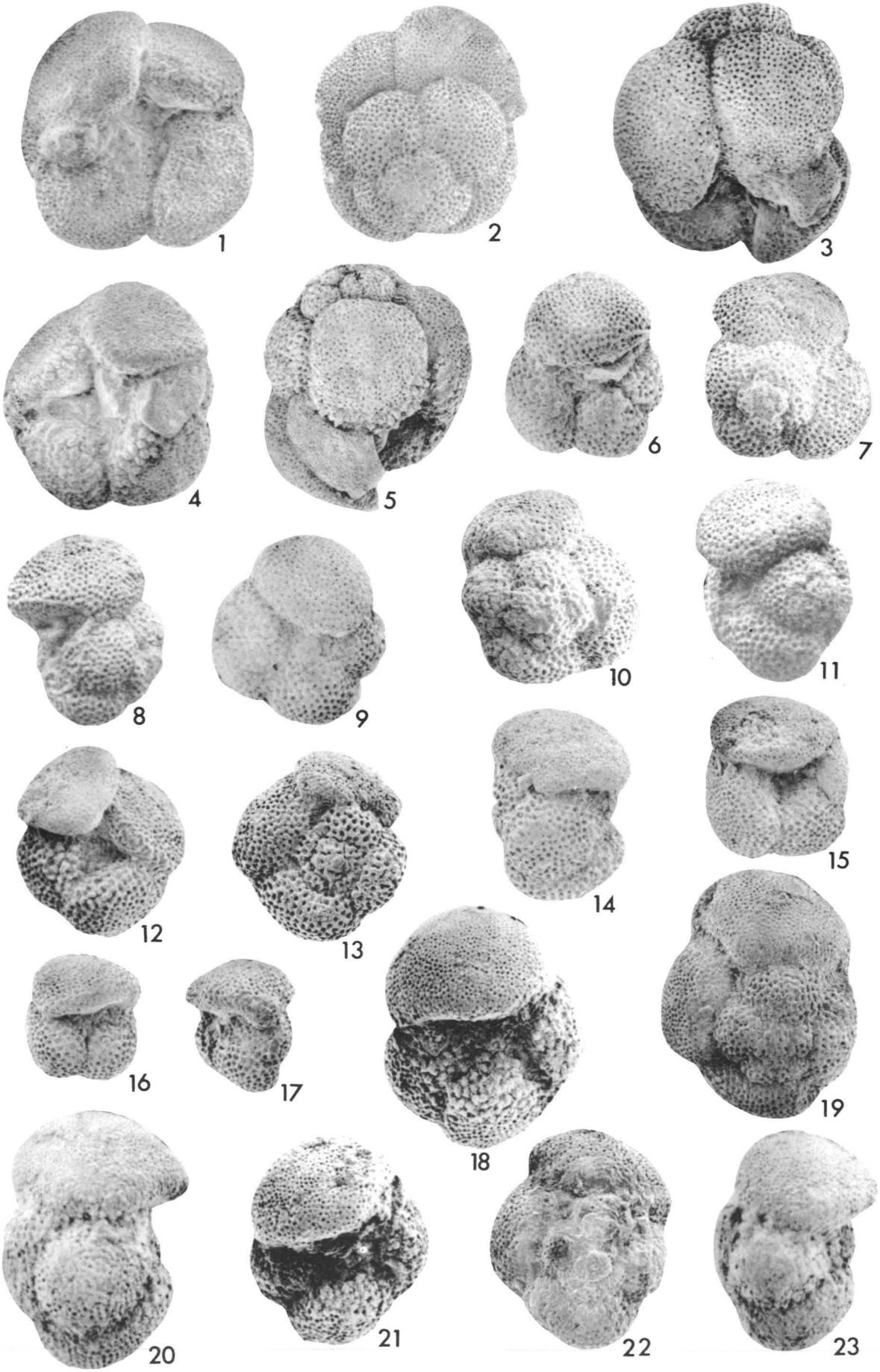

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

PLATE 33

(All figures ×80.)

Figs.

1–9 **Globorotalia (Clavatorella) prolata** sp. nov.
1–3, holotype, CPC 21996, sample F.434; 1, ventral view; 2, dorsal view; 3, edge view.
4–6, paratype A, CPC 21997, same sample; 4, ventral view; 5, edge view; 6, dorsal view.
7, paratype B, CPC 21998, same sample; ventral view.
8, paratype C, CPC 21999, same sample; ventral view.
9, paratype D, CPC 22000, same sample; ventral view.

10–16 **Globorotalia (Fohsella) peripheroacuta peripheroacuta** Blow & Banner
10–12, CPC 22002, sample F.436; 10, ventral view; 11, dorsal view; 12, edge view.
13, 14, CPC 22003, same sample; 13, ventral view; 14, edge view.
15, 16, CPC 22004, same sample; 15, ventral view; 16, edge view.

17–26 **Globorotalia (Fohsella) peripheroacuta pristina** subsp. nov.
17–19, holotype, CPC 22005, sample F.434.
17, ventral view; 18, dorsal view; 19, edge view.
20–22, paratype A, CPC 22006, same sample; 20, ventral view; 21, dorsal view; 22, edge view.
23, 24, paratype B, CPC 22007; same sample; 23, ventral view; 24, edge view.
25, 26, paratype C, CPC 22008, same sample; 25, ventral view; 26, edge view.

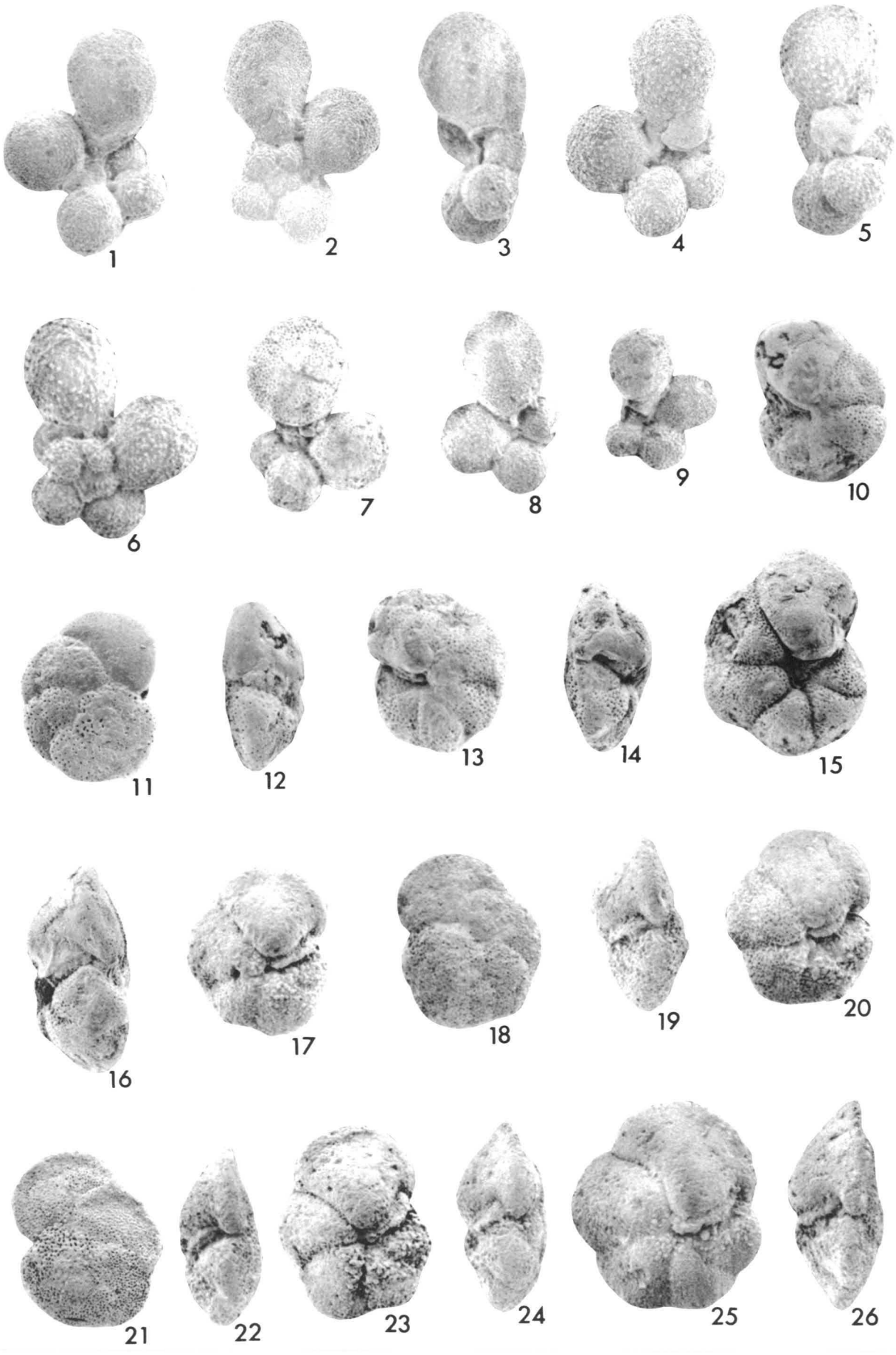

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

PLATE 34

(All figures ×80.)

Figs.

1–9 **Globorotalia (Fohsella) peripheroronda** Blow & Banner
1–3, CPC 22010, sample F.434; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, CPC 22011, same sample; 4, ventral view; 5, edge view.
6, 7, CPC 22012, same sample; 6, ventral view; 7, edge view.
8, 9, CPC 22013, sample F.436; 8, ventral view; 9, edge view.

10–18 **Globorotalia (Fohsella) quinifalcata** Saito & Maiya
10–12, CPC 22014, sample F.434; 10, ventral view; 11, dorsal view; 12, edge view.
13, 14, CPC 22015, same sample; 13, ventral view; 14, edge view.
15, 16, CPC 22016, same sample; 15, ventral view; 16, edge view.
17, 18, CPC 22017, same sample; 17, ventral view; 18, edge view.

19–28 **Globorotalia (Fohsella) wabagensis** sp. nov.
19–21, holotype, CPC 22018, sample F.888; 19, ventral view; 20, dorsal view; 21, edge view.
22, 23, paratype A, CPC 22019, same sample; 22, ventral view; 23, dorsal view.
24, 25, paratype B, CPC 22020, same sample; 24, ventral view; 25, edge view.
26, 27, paratype CPC 22021, same sample; 26, ventral view; 27, edge view.
28, paratype D, CPC 22022, same sample; ventral view.

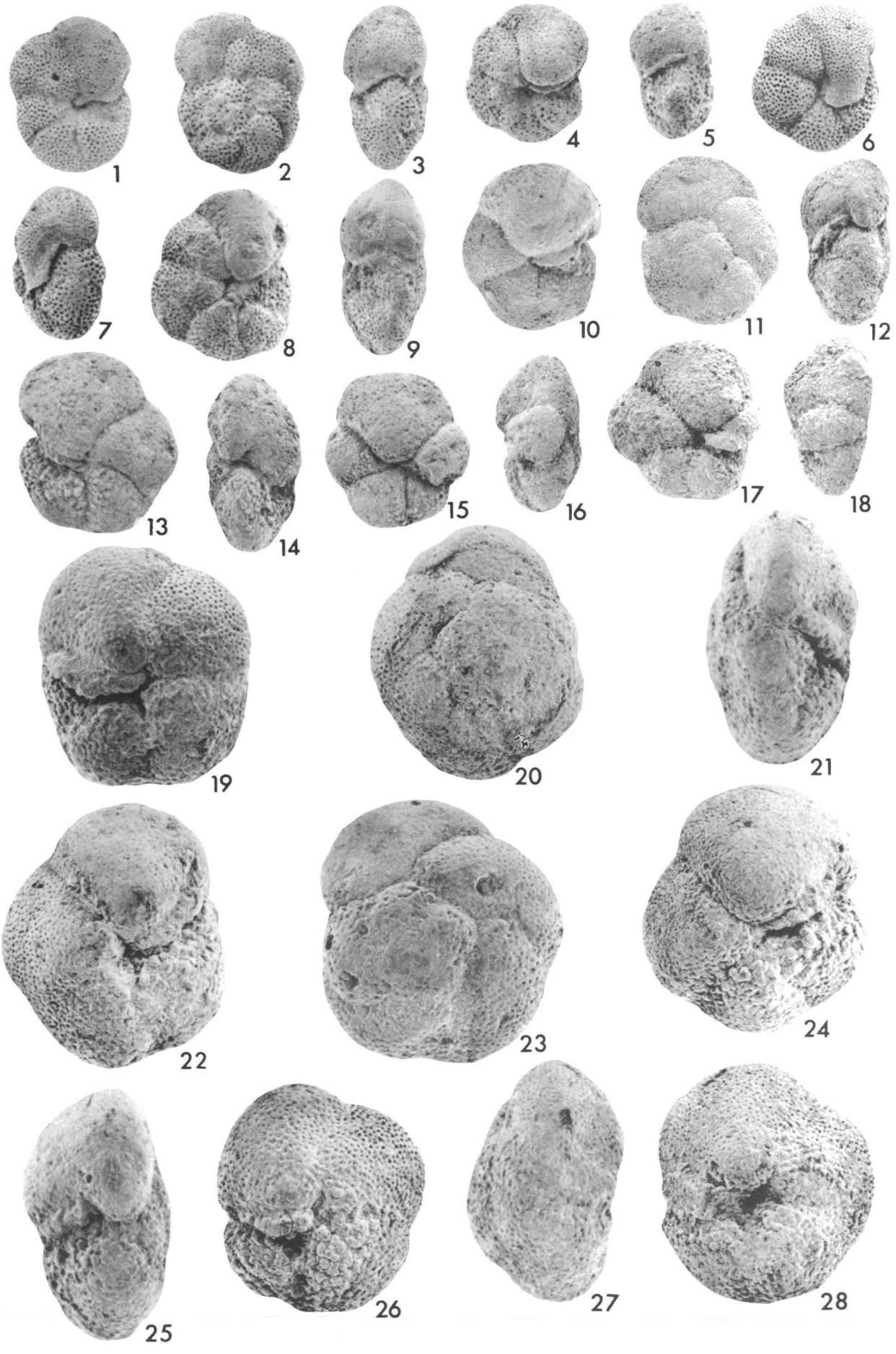

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28

PLATE 35

(All figures ×80.)

Figs.

1–5 **Globorotalia (Globorotalia) cultrata cultrata** (d'Orbigny)
1–3, CPC 22024, sample F.421; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, CPC 22025, sample F.423; 4, ventral view; 5, edge view.

6–9 **Globorotalia (Globorotalia) cultrata menardii** (Parker, Jones & Brady)
6–8, CPC 22026, sample F.423; 6, ventral view; 7, dorsal view; 8, edge view.
9, CPC 22027, same sample; ventral view.

10–16 **Globorotalia (Globorotalia) merotumida** Blow & Banner
10–12, CPC 22028, sample F.423; 10, ventral view; 11, dorsal view; 12, edge view.
13, 14, CPC 22029, same sample; 13, ventral view; 14, edge view.
15, 16, CPC 22030, sample F.422; 15, ventral view; 16, edge view.

17–19 **Globorotalia (Globorotalia) praemenardii archeomenardii** Bolli
CPC 22031, sample F.445; 17, ventral view; 18, dorsal view; 19, edge view.

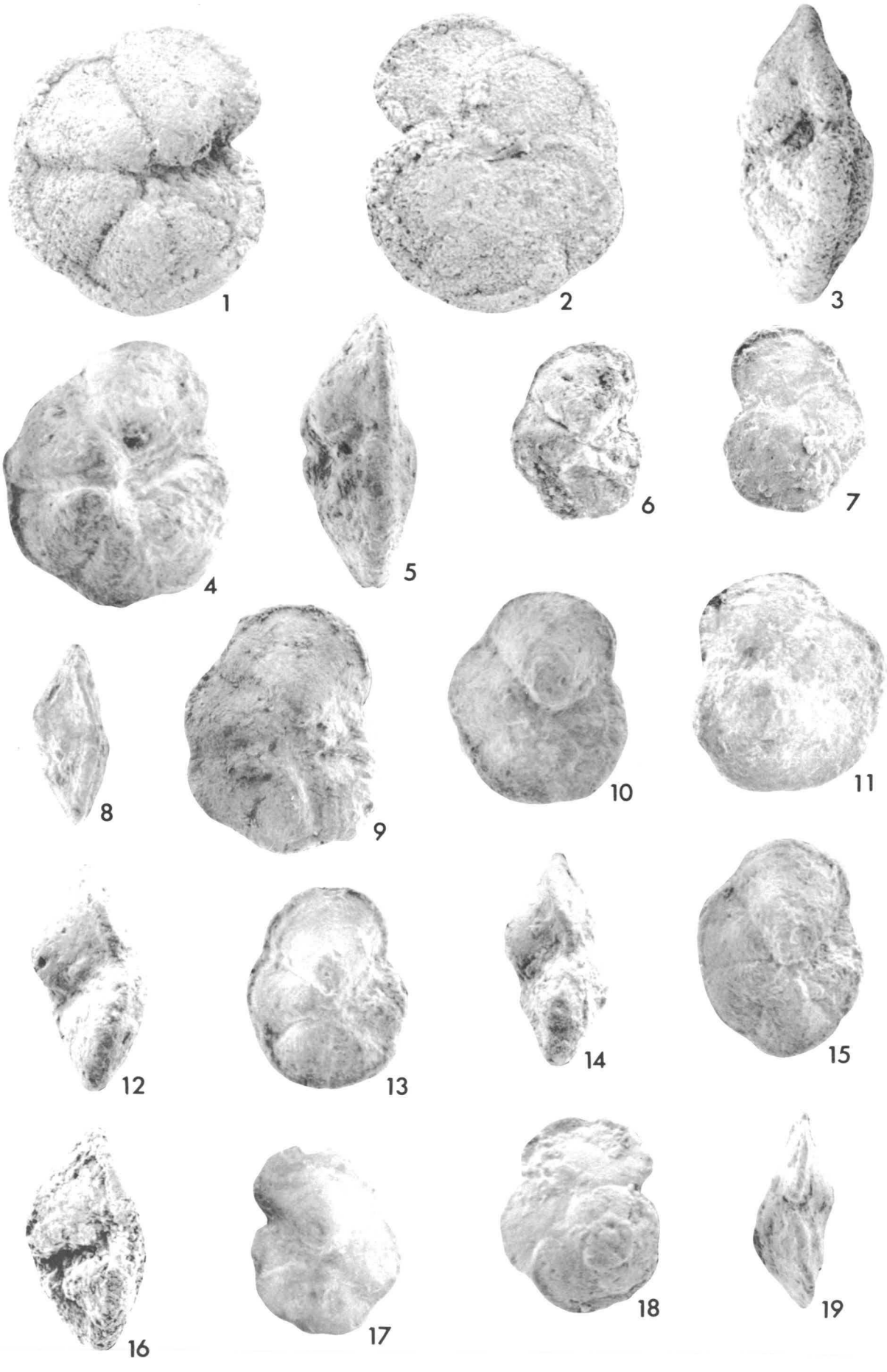

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

PLATE 36

(All figures ×80.)

Figs.

1–11 **Globorotalia (Globorotalia) quasimiocenica** sp. nov.
1–3, holotype, CPC 22032, sample F.432; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, paratype A, CPC 22033, same sample; 4, ventral view; 5, edge view.
6–8, paratype B, CPC 22034, same sample; 6, ventral view; 7, dorsal view; 8, edge view.
9–11, paratype C, CPC 22035, same sample; 9, ventral view; 10, dorsal view; 11, edge view.

12–16 **Globorotalia (Globorotalia) tumida plesiotumida** Blow & Banner
12–14, CPC 22037, sample F.422; 12, ventral view; 13, dorsal view; 14, edge view.
15, 16, CPC 22038, sample F.423; 15, ventral view; 16, edge view.

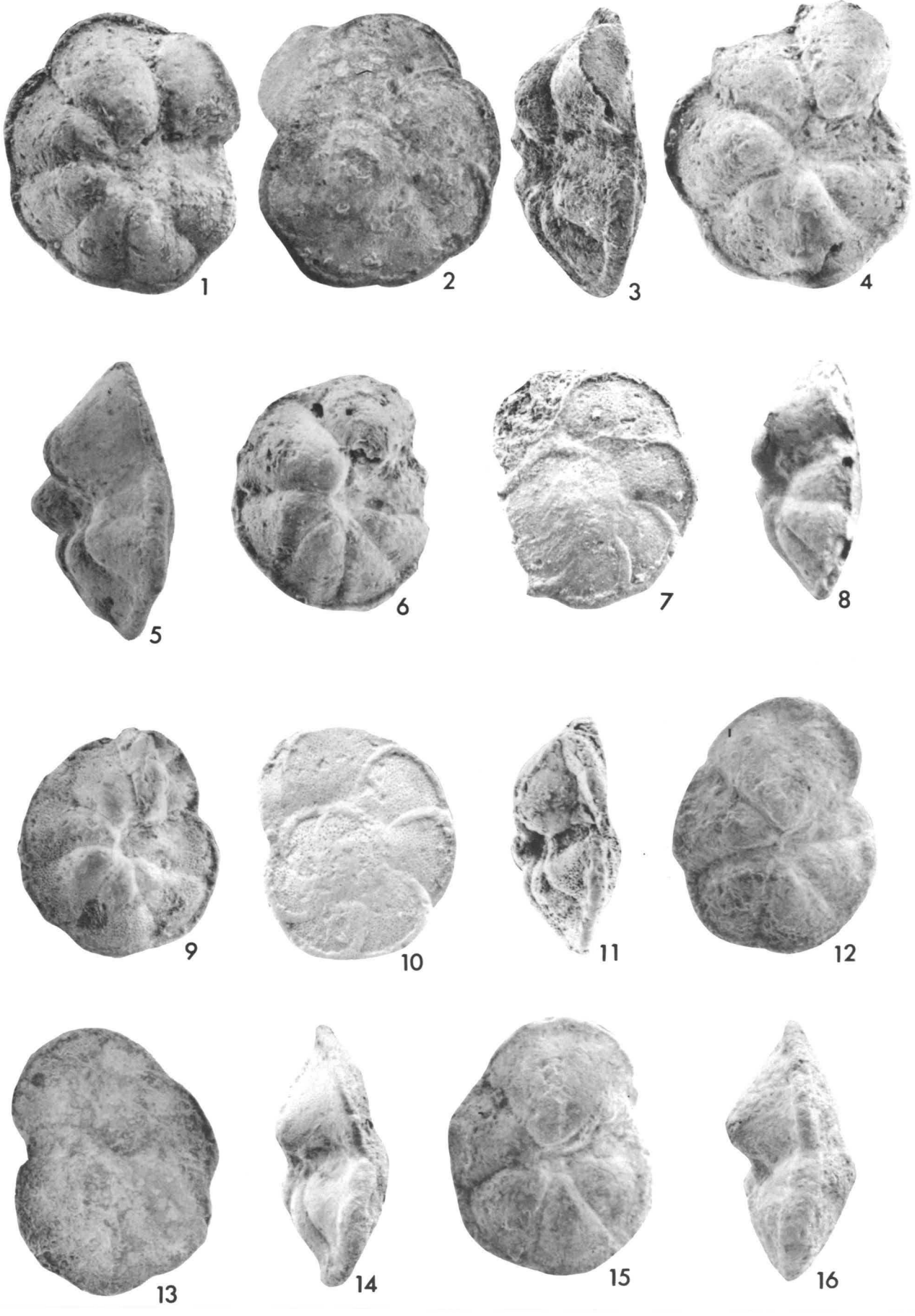

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

PLATE 37

(All figures ×80.)

Figs.

1–7 **Globorotalia (Globorotalia)** sp. 1 ex. gr. **G. (G.) tumida** (Brady)
1–3, CPC 22039, sample F.422; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, CPC 22040, same sample; 4, ventral view; 5, edge view.
6, 7, CPC 22041, same sample; 6, ventral view; 7, edge view.

8–9 **Globorotalia (Globorotalia)** sp. 2
CPC 22042, sample F.432; 8, ventral view; 9, edge view.

10–17 **Globorotalia (Hirsutella) scitula planaria** subsp. nov.
10–12, holotype, CPC 22043, sample F.421; 10, ventral view; 11, dorsal view; 12, edge view.
13, 14, paratype A, CPC 22044, same sample; 13, ventral view; 14, dorsal view.
15–17, paratype B, CPC 22045, same sample; 15, ventral view; 16, dorsal view; 17, edge view.

18–22 **Globorotalia (Hirsutella) scitula praescitula** Blow
18–20, CPC 22047, sample F.888; 18, ventral view; 19, dorsal view; 20, edge view.
21, 22, CPC 22048, same sample; 21, ventral view; 22, edge view.

23–26 **Globorotalia (Hirsutella) scitula scitula** (Brady)
23–25, CPC 22049, sample F.422; 23, ventral view; 24, dorsal view; 25, edge view.
26, CPC 22050, sample F.421; ventral view.

27–31 **Globorotalia (Hirsutella)** sp. 1
27–29, CPC 22051, sample F.435; 27, ventral view; 28, dorsal view; 29, edge view.
30, 31, CPC 22052, same sample; 30, ventral view; 31, edge view.

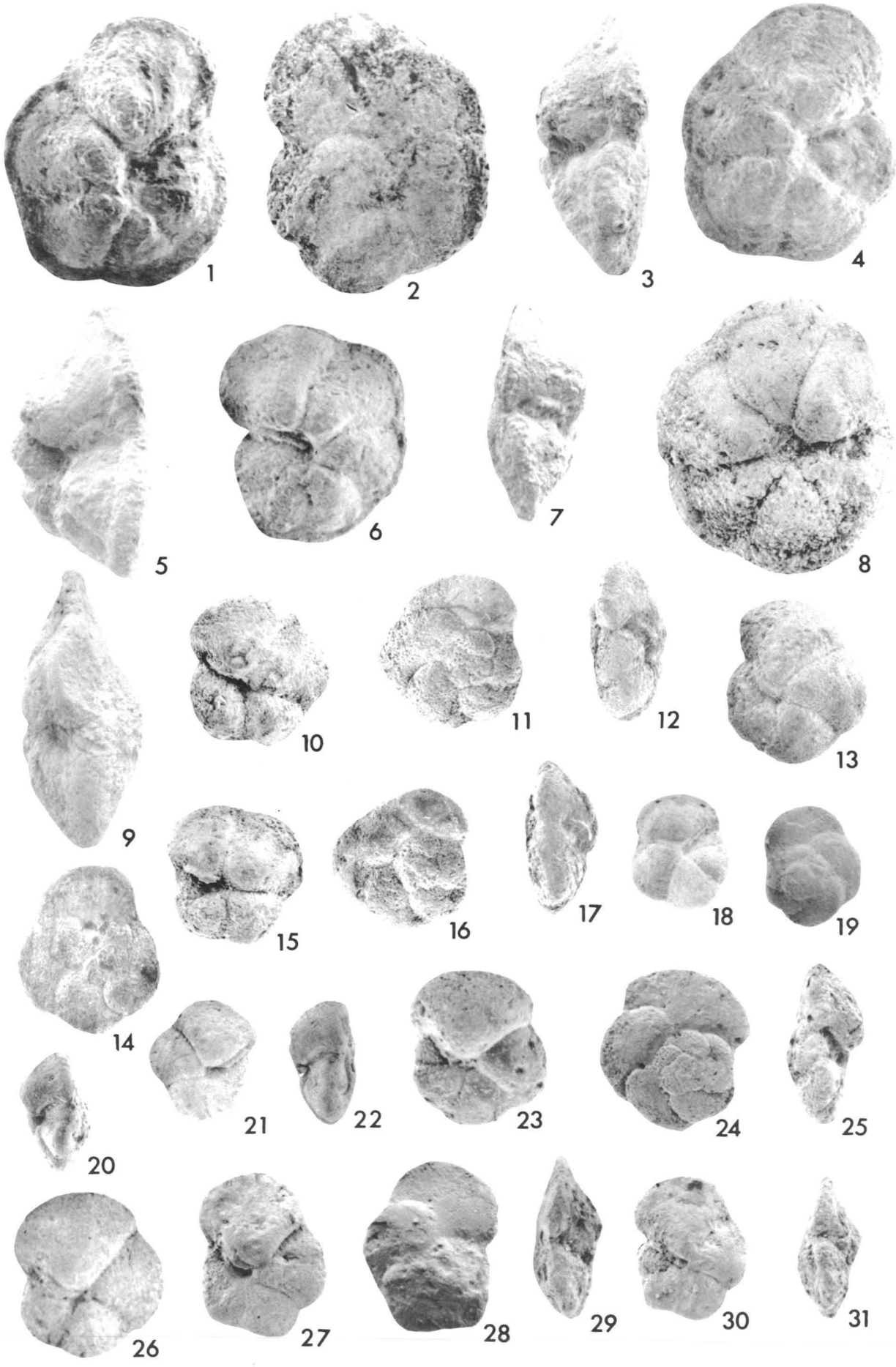

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31

PLATE 38

(All figures ×80.)

Figs.

1–5 **Globorotalia (Turborotalia) acostaensis acostaensis** Blow
1–3, CPC 22053, sample F.421; 1, ventral view; 2, dorsal view; 3, edge view.
4, 5, CPC 22054, sample F.420; 4, ventral view; 5, dorsal view.

6–10 **Globorotalia (Turborotalia) birnageae** Blow
6–8, CPC 22055, sample F.888; 6, ventral view; 7, dorsal view; 8, edge view.
9, 10, CPC 22056, same sample; 9, ventral view; 10, edge view.

11–16 **Globorotalia (Turborotalia) continuosa** Blow
11–13, CPC 22057, sample F.421; 11, ventral view; 12, dorsal view; 13, edge view.
14–16, CPC 22058, same sample; 14, ventral view; 15, dorsal view; 16, edge view.

17–19 **Globorotalia (Turborotalia) kugleri** Bolli
CPC 22059, sample F.280; 17, ventral view; 18, dorsal view; 19, edge view.

20–22 **Globorotalia (Turborotalia) obesa** Bolli
CPC 22060, sample F.434; 20, ventral view; 21, dorsal view; 22, edge view.

23–31 **Globorotalia (Turborotalia) opima nana** Bolli
23–25, CPC 22061, sample F.937; 23, ventral view; 24, dorsal view; 25, edge view.
26–28, CPC 22062, sample 71528043; 26, ventral view; 27, dorsal view; 28, edge view.
29–31, CPC 22063, same sample; 29, ventral view; 30, dorsal view; 31, edge view.

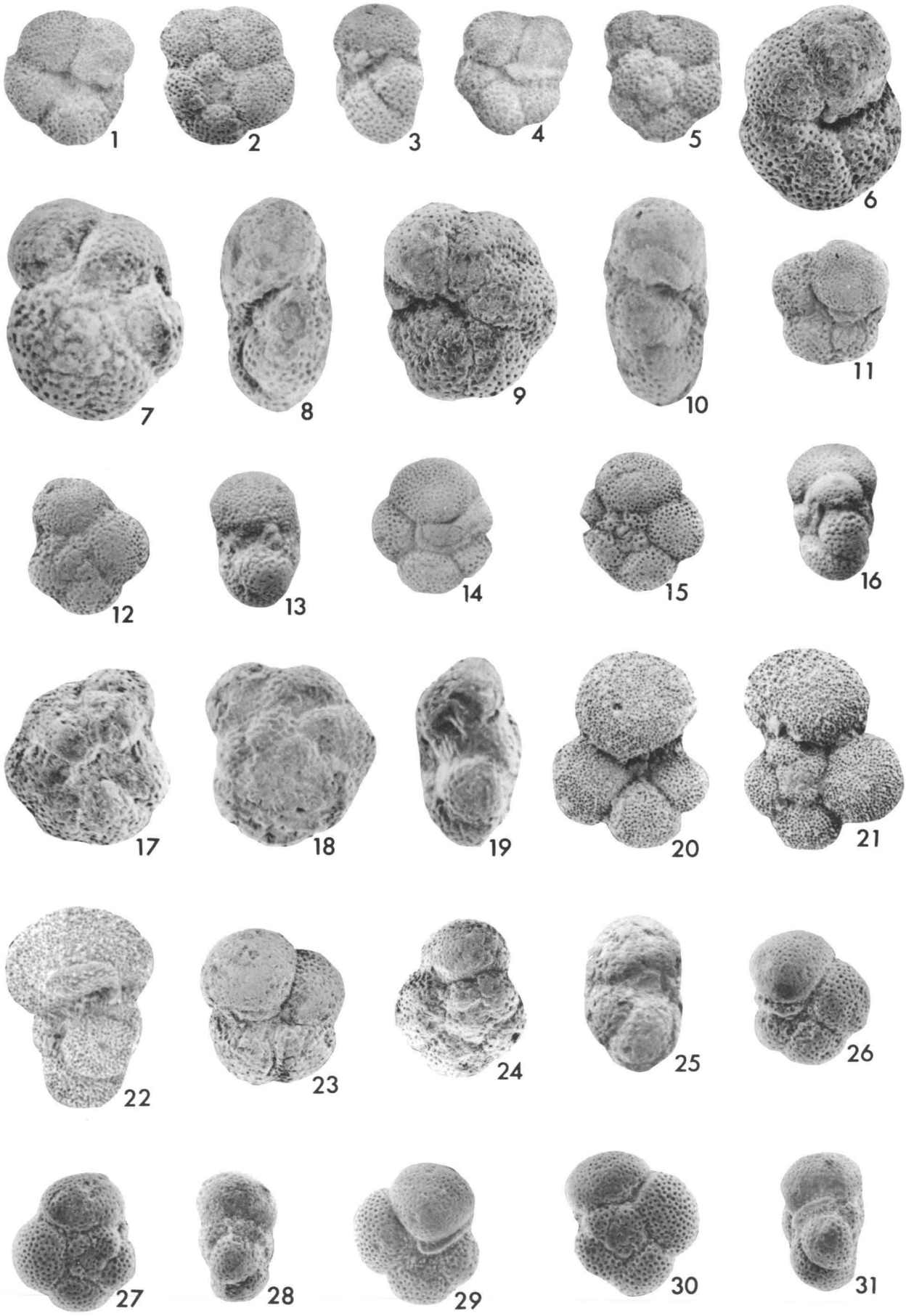

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31

PLATE 39

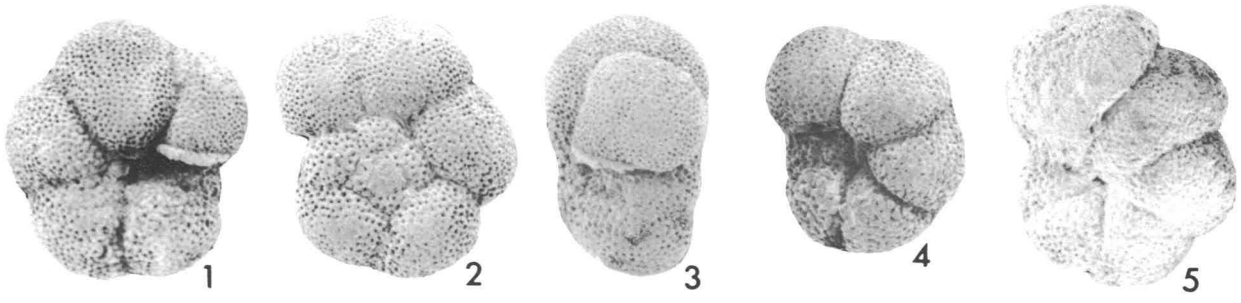
(All figures ×80 unless otherwise indicated.)

Figs.

1–12 **Globorotalia (Turborotalia) siakensis** (LeRoy)
1–3, CPC 22064, sample F.434; 1, ventral view; 2, dorsal view; 3, edge view.
4, CPC 22065, same sample; ventral view.
5, 6, CPC 22066, sample 71520137; 5, ventral view; 6, dorsal view.
7–9, CPC 22067, sample 71528042; 7, ventral view; 8, dorsal view; 9, edge view.
10–12, CPC 22068, same sample; 10, ventral view; 11, dorsal view; 12, edge view.

13–19 **Globorotalia (Turborotalia) subscitula** Conato
13–15, CPC 22069, sample F.421; 13, ventral view; 14, dorsal view; 15, edge view; all ×160.
16, 17, CPC 22070, same sample; 16, ventral view; 17, edge view; both ×160.
18, 19, CPC 22071, sample F.432; 18, ventral view; 19, edge view; both ×160.

20–24 **Globorotalia suteri** Bolli
20–22, CPC 22072, sample F.436; 20, ventral view; 21, dorsal view; 22, edge view.
23, 24, CPC 22073, same sample; 23, ventral view; 24, edge view.


1
2
3
4
5

6
7
8
9
10

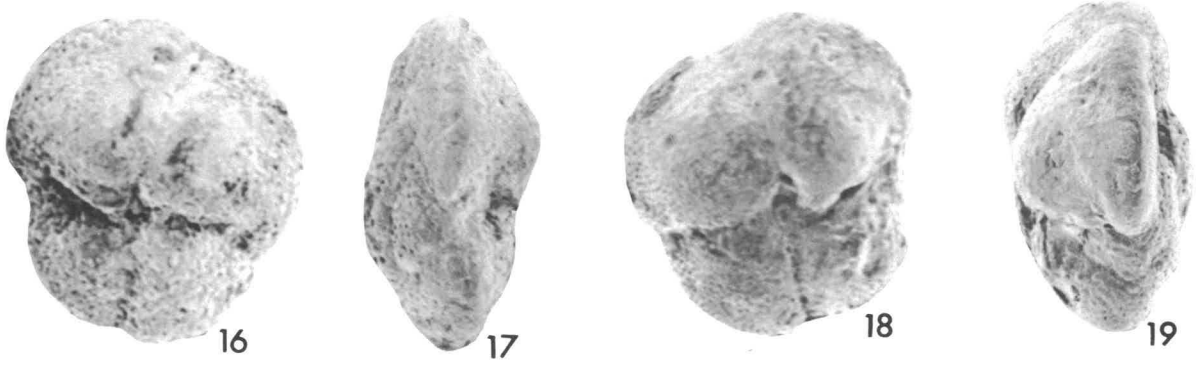
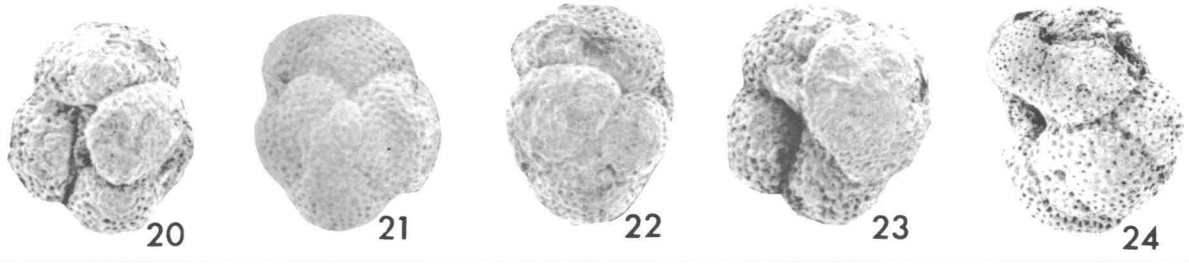
11
12
13
14
15

16
17
18
19

20
21
22
23
24

PLATE 40

(All figures ×80 unless otherwise indicated.)

Figs.

1–7 **Hastigerina siphonifera praesiphonifera** Blow
1–3, CPC 22074, sample F.434; 1, 2, opposite sides; 3, edge view.
4, CPC 22075, same sample; side view.
5, CPC 22076, same sample; side view.
6, 7, CPC 22077, same sample; 6, side view; 7, edge view.

8–9 **Orbulina suturalis** Brönnimann
8, CPC 22078, sample F.445.
9, CPC 22079, sample F.436.

10 **Orbulina universa** d'Orbigny
CPC 22080, sample F.420.

11–12 **Praeorbulina glomerosa circularis** (Blow)
11, CPC 22081, sample F.444.
12, CPC 22082, same sample.

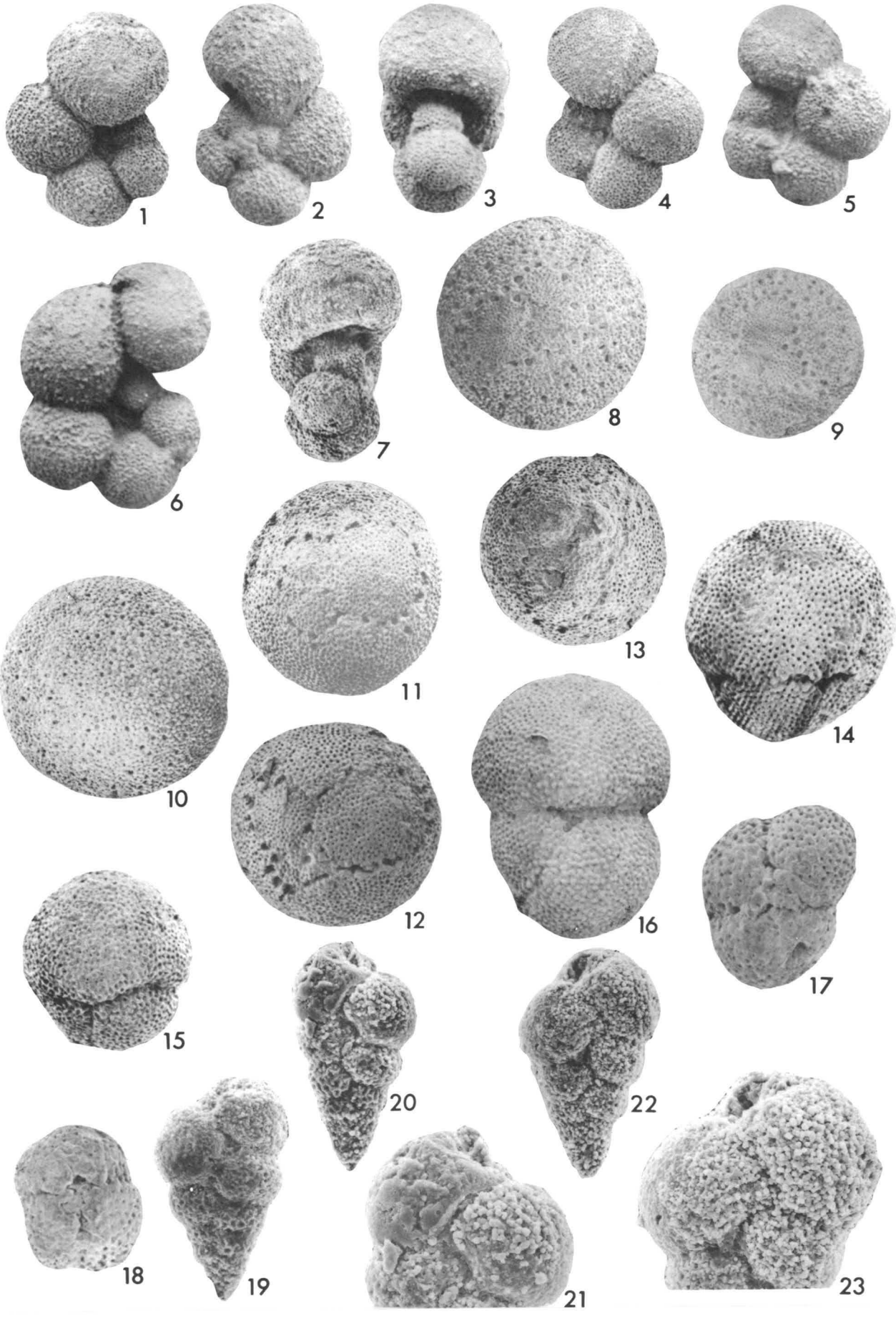
13 **Praeorbulina glomerosa glomerosa** (Blow)
CPC 22083, sample F.444.

14–15 **Praeorbulina glomerosa curva** (Blow)
14, CPC 22084, sample F.442.
15, CPC 22085, sample 71520137.

16 **Praeorbulina transitoria** (Blow)
CPC 22086, sample F.434.

17–18 **Sphaeroidinellopsis seminulina seminulina** (Schwager)
17, CPC 22087, sample F.436.
18, CPC 22088, same sample.

19–23 **Streptochilus globigerum** (Schwager)
19, CPC 22089, sample F.420; side view; ×190.
20, 21, CPC 22090, same sample; side view; 20, ×190; 21, ×300.
22, 23, CPC 22091, same sample; side view; 22, ×190; 23, ×300.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

BULLETIN 216

TERTIARY FORAMINIFERA AND AGE OF SEDIMENTS, OK TEDI-WABAG, PAPUA NEW GUINEA

by

D.J. Belford

MICROFICHE APPENDIXES

(BMR MICROFORM MF 194)

FAUNAL LIST OF SAMPLES FROM THE OK TEDI AND WABAG 1:250 000 SHEET AREAS

APPENDIX 1

FAUNAL LIST OF SAMPLES FROM

OK TEDI 1:250 000 SHEET A

LEGEND

KTf	=	Feing Gr)
Tma	=	Wai Asl ds
Tmi	=	Iwoer F ation
Tmp)	=	Pnyang l mation
Tmp1)	=	Limes ne interbeds
Tmr)	=	Warre imestone Member
Tmt) Tmtz)	=	undivide Lai & Orubadi Formations
Tpb	=	Birim F mation
Tpw	=	Wongop Sandstone
Tr)	=	Darai Limestone
Tr1)	=	slumped limestone slab
TS	=	Thin section
WR	=	Washed residue
Oc	=	Outcrop
Fl	=	Float
Cl	=	Float close to outcrop

FAUNAL LIST OF SAMPLES FROM THE OK TEDI 1:250 000 SHEET AREA

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
0130	Oc	Tmtz	136	WR	Sepik River headwaters, east of Feramin	Marginopora sp., Elphidium sp., Operculina sp., Globigerinoides quadrilobatus group	Indefinite; Early Miocene or younger age only; associated with 0131
0131	Oc	Tmtz	136	WR	Sepik River headwaters, east of Feramin	Miogypsina (M.) sp., Elphidium sp., Operculina sp.	Early-Middle Miocene (upper Te-lower Tf)
0132	Oc	Tr	135	TS	Sepik River headwaters, east of Feramin	Small planktonic foraminifera (Globigerinidae)	Indefinite; general Tertiary age only
0133	Oc	Tr	134	TS	Sepik River headwaters, east of Feramin	Lepidocyclina (N.) ferreroi, Miogypsina (M.) sp., Planorbulina sp., Cycloclypeus (C.) sp., Elphidium sp., Amphistegina sp., Carpenteria sp. or Sporadotrema sp., Austrotrillina sp., rare planktonic foraminifera, indeterminable smaller foraminifera	Early-middle Miocene (late upper Te-lower Tf)
0134	Oc	Tr	134	TS	Sepik River headwaters, east of Feramin	Lepidocyclina (N.) ferreroi, L. (N.) sp., Miogypsina (M.) sp., Cycloclypeus (C.) sp., C.(Katacycloclypeus) ?annulatus, Planorbulina sp., Amphistegina sp., planktonic foraminifera, including Praeorbulina group, indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf), lower Tf on parameter F (see text)
0135	Oc	Tr	134	TS	Sepik River headwaters, east of Feramin	Lepidocyclina (N.) ferreroi, Cycloclypeus (Katacycloclypeus) cf. annulatus, Miogypsina (M.) sp., Operculina sp., Gypsina sp., Amphistegina sp., Planorbulina sp., indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf); lower Tf on parameter F (see text)
0136	Oc	Tmt	134	WR TS	Sepik River headwaters, east of Feramin	In section, small planktonic foraminifera not determinable; in washed residue, Globigerinoides quadrilobatus, Praeorbulina sicana, Globorotalia (T.) cf. obesa (see Fig. 6)	Top of Early Miocene (Zone N.8)
0137	Oc	Tmt	134	WR	Sepik River headwaters, east of Feramin	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
0138	Oc	Tmt	134	WR	Sepik River headwaters, east of Feramin	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
0139	Fl	Tr	134	TS	Sepik River headwaters, east of Feramin	Nummulites fichteli, Borelis cf. inflata, Halkyardia sp., Operculina sp., Amphistegina sp., Elphidium sp., miliolids and other indeterminable smaller foraminifera	Early Oligocene (Tc)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
0199	Oc	Tmt	186	WR	6 km SE of Oksapmin	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
0200	Fl	Tr1	187	TS	'Ellis Rock', upper Strickland Gorge	Nummulites fichteli, Operculina sp., Heterostegina sp., Elphidium sp.	Early Oligocene (Tc)
0459	.	Tr	158	TS	Sabum Creek, southern tributary of Lagaip River	Flosculinella globulosa, Austrotrillina cf. howchini, Lepidocyclina (N.) sp., Miogypsina (M.) sp., ?Borelis sp., Elphidium sp., Sorites sp.	Early-Middle Miocene (late upper Te -lower Tf)
0624	Cl	Tr	37	TS	Silk River, 23 km WNW of Telefomin	Lepidocyclina (N.) sp., Miogypsina (M.) cf. kotoi, M. (Miogypsinoides) cf. dehaarti, ?Sorites sp. ?Borelis sp., Austrotrillina cf.striata, Elphidium sp., Archaias sp., Carpenteria sp. or Sporodotrema sp., miliolids and other indeterminable smaller foraminifera	Early Miocene (upper Te)
0661	Cl	KTf	65	TS	4 km NNE of Telefomin	Planktonic foraminifera including keeled Globorotaliidae (?Planorotalites); also ?Pseudohastigerina sp.	Probably Eocene
0756	Oc	KTf	67	TS	Bi River, south tributary of Ok Om	Planktonic foraminifera (Morozovella spp., Globigerinidae)	Late Paleocene
0856	Oc	Tr	129	TS	In section on north side of Nong River	?Elphidium sp., miliolids	Indefinite; Te undifferentiated on stratigraphic position
0857	Oc	Tr	119	TS	In section on north side of Nong River	Small planktonic foraminifera (Globigerinidae); indeterminable smaller foraminifera	Indefinite; Early Miocene (upper Te) on stratigraphic position
0858	Oc	Tr	129	TS	In section on north side of Nong River	Lepidocyclina (N.) sp., Miogyspina (M.) sp., Miogypsina (Miogypsinoides) bantamensis/dehaarti, Amphistegina sp., Carpenteria sp. or Sporadotrema sp., indeterminable smaller foraminifera	Early Miocene (upper Te)
0859	Oc	Tr	129	TS	In section on north side of Nong River	Spiroclypeus margaritatus, Lepidocyclina (N.) sp., Miogypsina (Miogypsinoides) bantamensis/dehaarti, Elphidium sp., Operculina sp., Carpenteria sp. or Sporadotrema sp.	Early Miocene (upper Te)
0860	Oc	Tr	129	TS	In section on north side of Nong River	Lepidocyclina sp. (fragments), indeterminable smaller foraminifera	General middle Oligocene-Middle Miocene age (Td-lower Tf) only: Te undifferentiated on stratigraphic position
0861	Oc	Tr	129	TS	In section on north side of Nong River	Small planktonic foraminifera	Indefinite; Te undifferentiated on stratigraphic position

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
0862	Oc	Tr	129	TS	In section on north side of Nong River	Lepidocyclina (?N.) sp., Operculina sp., Elphidium sp., indeterminable smaller foraminifera	General middle Oligocene-Middle Miocene (Td-lower Tf) age only; Te undifferentiated on stratigraphic position
0863	Oc	Tr	129	TS	In section on north side of Nong River	Lepidocyclina (N.) sp., ?Elphidium sp., indeterminable smaller foraminifera	General middle Oligocene-Middle Miocene (Td-lower Tf) age only; Te undifferentiated on stratigraphic position
0864	Oc	Tr	129	TS	In section on north side of Nong River	Austrotrillina cf. striata, Borelis sp., Sorites sp., miliolids	Late Oligocene-Early Miocene (Te, undifferentiated)
0865	Oc	Tr	129	TS	In section on north side of Nong River	Lepidocyclina sp., Borelis sp., Sorites sp., Operculina sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
0866	Oc	Tr	129	TS	In section on north side of Nong River	Lepidocyclina (E.) sp., Spiroclypeus sp., Heterostegina sp., Gypsina globulus, Operculina sp., Elphidium sp., indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
0867	Oc	Tr	129	TS	In section on north side of Nong River	Rare smaller foraminifera, indeterminable	Indefinite; Te, undifferentiated on stratigraphic position
0868	Oc	Tr	129	TS	In section on north side of Nong River	Miliolids and other indeterminable smaller foraminifera	Indefinite; Te, undifferentiated on stratigraphic position
0869	Oc	?Tmt	129	WR	In section on north side of Nong River	Small planktonic foraminifera (see Fig. 6)	General Tertiary age only (possibly Miocene)
1029	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Operculina sp., Elphidium sp., indeterminable small foraminifera	Indefinite; lower Te on stratigraphic position
1030	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Borelis sp., Sorites sp., Elphidium sp., Planorbulinella sp., miliolids and other indeterminable smaller foraminifera	Indefinite; lower Te on stratigraphic position
1031	Oc	Tr	31	TS	Section on north side of Tifalmin Valley	Spiroclypeus sp., Austrotrillina striata, Miogypsina (Miogypsinoides) ?complanata, Borelis sp., Sorites sp. Elphidium sp., Operculina sp., miliolids and other indeterminable smaller foraminifera	Probably Late Oligocene (lower Te)
1032	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Austrotrillina cf. striata, Borelis pygmaeus, Archaias sp., ?Sorites sp., Elphidium sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1033	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Austrotrillina cf. striata, Borelis pygmaeus, Archaias sp., ?Sorites sp., Elphidium sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position
1034	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Lepidocyclina (E.) sp., Austrotrillina striata, Borelis sp., Sorites sp., Carpenteria sp. or Sporadotrema sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position
1035	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Lepidocyclina (?N.), sp., Operculina sp., Elphidium sp.	General middle Oligocene-Middle Miocene age only (Td-lower Tf); lower Te on stratigraphic position
1036	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Spiroclypeus sp., Borelis pygmaeus, Elphidium sp., Sorites sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position
1037	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Spiroclypeus margaritatus, Heterostegina sp., Planorbulinella sp., Gypsina globulus, Operculina sp., indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position
1038	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Austrotrillina cf. striata, Borelis sp., Sorites sp., Gypsina globulus, miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position
1039	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Lepidocyclina sp., Elphidium sp., Carpenteria sp. or Sporadotrema sp., indeterminable smaller foraminifera	General middle Oligocene-Middle Miocene age only (Td-lower Tf); lower Te on stratigraphic position
1040	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Lepidocyclina (E.) cf. ephippioides, Spiroclypeus margaritatus, Heterostegina sp., Cycloclypeus (C.) sp., Borelis sp., miliolids and other indeterminable smaller foraminifera	Probably Late Oligocene (lower Te)
1041	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Austrotrillina cf. striata, Borelis pygmaeus, Sorites sp., indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position
1042	Oc	Tr	59	TS	Section on north side of Tifalmin Valley	Gypsina globulus, Heterostegina sp., Amphistegina sp., planktonic foraminifera, miliolids and other indeterminable smaller foraminifera	Indefinite; general Tertiary age only; probably lower Te on stratigraphic position
1043	Fl	Tr	60	TS	Iram River near Tifalmin	Lepidocyclina (E.) ephippioides, Borelis sp., Heterostegina sp., Gypsina sp., Amphistegina sp., Carpenteria sp. or Sporadotrema sp., Elphidium sp.	Probably Late Oligocene (lower Te)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1047	Fl	Tr	27	TS	Digiam landslide, 28 km WNW of Telefomin	Borelis pygmaeus, Austrotrillina striata, Gypsina globulus, miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
1048	Fl	Tr	27	TS	Digiam landslide, 28 km WNW of Telefomin	Flosculinella bontangensis, Austrotrillina howchini, Miogypsina (M). thecideaeformis, Sorites sp., miliolids	Middle Miocene (lower Tf)
1131	Oc	Tr	224	TS	Wongop River, north of Blucher Range	Operculina sp., Heterostegina sp.	Indefinite; general Tertiary age only
1132	Oc	Tr	224	TS	Wongop River, north of Blucher Range	Operculina sp., Elphidium sp. ?Sorites sp., miliolids	Indefinite; general Tertiary age only
1133	Oc	Tr	224	TS	Wongop River, north of Blucher Range	Lepidocyclina sp. (fragment), Operculina sp., miliolids and other indeterminable smaller foraminifera	General middle Oligocene-Middle Miocene age only (Td-lower Tf)
1134	Oc	Tr	224	TS	Wongop River, north of Blucher Range	Operculina sp., miliolids and other indeterminable smaller foraminifera	Indefinite; general Tertiary age only
1147	Oc	Tr	231	TS	Strickland Gorge	Miliolids	Indefinite
1148	Oc	?Tmi	230	WR	Strickland Gorge	Planktonic foraminifera (see Fig. 6)	Not older than Middle Miocene, Zone N.9
1149	Oc	Tr	229	TS	Strickland Gorge	Borelis pygmaeus, Austrotrillina striata, Sorites sp., miliolids	Late Oligocene-Early Miocene (Te, undifferentiated)
1150	Oc	Tr	229	TS	Strickland Gorge	Borelis pygmaeus, Heterostegina sp., Sorites sp., Gypsina sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
1151	Oc	Tr	229	TS	Strickland Gorge	Borelis pygmaeus, Sorites sp., Gypsina sp., Austrotrillina cf. striata, miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
1152	Oc	Tr	229	TS	Strickland Gorge	Borelis pygmaeus, Sorites sp., Gypsina sp., Amphistegina sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
1156	Fl	Tr	228	TS	Strickland Gorge	Borelis pygmaeus, Austrotrillina striata, Sorites sp., Gypsina sp., Operculina sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
1157	Oc	Tr	228	TS	Strickland Gorge	Indeterminable smaller foraminifera	Indefinite
1193	Fl	Tr	171	TS	Section at head of Wok Feneng, below Hindenberg Wall	Borelis pygmaeus, Sorites sp., ?Marginopora sp., Austrotrillina sp.	Late Oligocene-Early Miocene (Te, undifferentiated)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1195	Oc	Tr	171	TS	Section at head of Wok Feneng, below Hindenberg Wall	Nummulites fichteli, Borelis sp., Halkyardia sp., Operculina sp., Amphistegina sp., Indeterminable smaller foraminifera	Early Oligocene (Tc)
1196	Oc	Tr	171	TS	Section at head of Wok Feneng, below Hindenberg Wall	Borelis sp., Operculina sp., miliolids and other indeterminable smaller foraminifera	Indefinite; general Tertiary age only; possibly Early Oligocene (Tc) on stratigraphic position
1210	Oc	Tr	227	WR	Outcrop in landslide below limestone cliff	Poorly preserved benthonic smaller foraminifera, including Elphidium sp.	Indefinite; general Tertiary age only
1211	Oc	Tr	227	TS	Outcrop in landslide below limestone cliff	Carpenteria sp. or Sporadotrema sp., indeterminable smaller foraminifera	Indefinite; general Tertiary age only
1217	Fl	Tr	172	WR	Head of Wok Feneng	Quinqueloculina sp., Triloculina sp., Discorbis sp.	Indefinite; general younger Tertiary (Miocene or younger) age only
1231	Fl	Tr	170	TS	Hindenberg Wall at head of Wok Wunik	a) Nummulites fichteli, Operculina sp., Elphidium sp., indeterminable smaller foraminifera b) Miogypsina (M.) sp., Elphidium sp. c) Flosculinella bontangensis, Austrotrillina cf. howchini, indeterminable small foraminifera	Early Oligocene (Tc), Early-Middle Miocene (upper Te-lower Tf), and Middle Miocene (lower Tf); boulders from foot of cliff
1289	Oc	Tr	12	TS	Southern flank of Mount Capella	Elphidium sp.	Indefinite; general Tertiary age only
1334	Oc	Tr	175	TS	Hindenberg Wall SW of Feramin	Lepidocyclina sp. (fragment only), indeterminable smaller foraminifera	Middle Oligocene-Middle Miocene (Td-lower Tf); possibly upper Te on stratigraphic position
1335	Oc	Tr	175	TS	Hindenberg Wall SW of Feramin	Miogypsina (M.) sp., Operculina sp., Elphidium sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf); possibly upper Te on stratigraphic position
1336	Oc	Tr	175	TS	Hindenberg Wall SW of Feramin	Planktonic foraminifera and indeterminable smaller foraminifera	Indefinite
1337	Oc	Tr	175	TS	Hindenberg Wall SW of Feramin	Planktonic foraminifera (Globigerinidae) and indeterminable smaller foraminifera	Indefinite
1338	Oc	Tr	175	TS	Hindenberg Wall SW of Feramin	Spiroclypeus margaritatus, Lepidocyclina (?N.) sp., Miogypsina (Miogypsinoides) complanata, Gypsina globulus, Operculina sp., ?Heterostegina sp.	Late Oligocene (lower Te)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1339	Oc	Tr	175	TS	Hindenberg Wall, SW of Feramin	Operculina sp., indeterminable smaller foraminifera	Indefinite; lower Te on stratigraphic position
1340	Oc	Tr	175	TS	Hindenberg Wall, SW of Feramin	Lepidocyclina (?N.) sp.	Middle Oligocene-Middle Miocene (Td-lower Tf); lower Te on stratigraphic position
1341	Oc	Tr	175	TS	Hindenberg Wall, SW of Feramin	Indeterminable smaller foraminifera	Indefinite
1342	Oc	Tr	175	TS	Hindenberg Wall, SW of Feramin	?Gypsina sp., indeterminable smaller foraminifera	Indefinite
1343	Oc	Tr	175	TS	Hindenberg Wall, SW of Feramin	Borelis pygmaeus, Austrotrillina cf. striata, Sorites sp., Elphidium sp., miliolids	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position
1344	Oc	Tr	175	TS	Hindenberg Wall, SW of Feramin	?Amphistegina sp., miliolids and other indeterminable smaller foraminifera	Indefinite
1345	Oc	Tr	175	TS	Hindenberg Wall, SW of Feramin	Borelis pygmaeus, Austrotrillina cf. striata, Sorites sp., Gypsina globulus, Elphidium sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position
1530	Oc	Tmt	130	WR	Sepik River, SSW of Telefomin	Planktonic foraminifera (see Fig. 6)	Middle Miocene (Zone N.9-Zone N.14)
1578	Oc	?Tmtz	208	WR	Headwaters of Tumbudu River	Planktonic foraminifera, including Orbulina universa (see Fig. 6)	Not older than Middle Miocene (Zone N.9)
1583	Oc	Tr	24	TS	Diamond-drillhole, Tifalmin copper prospect	Lepidocyclina (E.) ephippioides, Nummulites (Palaeonummulites) sp., Heterostegina sp., Elphidium sp.	Late Oligocene (lower Te)
1602	Oc	Tr	226	TS	Mueller Range, 19 km NNW of Mount Karoma	Miogypsina (M.) sp., Lepidocyclina (?N.) sp., Elphidium sp.	Early-Middle Miocene (upper Te-lower Tf)
1604	Oc	Tr	225	TS	Base of limestone cliff in Mueller Range; 5°34'S, 142°17'E	Borelis sp., ?Amphistegina sp.	Indefinite; general Tertiary age only
1605	Oc	Tpw	232	WR	Burnett River	Rare benthonic smaller foraminifera, including Pseudorotalia schroeteriana	Pliocene or younger
1608	Oc	Tpw	232	WR	Burnett River	Planktonic and benthonic smaller foraminifera, including Pseudorotalia schroeteriana (see Fig. 6)	Pliocene

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1631	Cl	Tr	47	TS	Kauwol River	Miogypsina (M.) sp., Austrotrillina sp., Marginopora sp. or Sorites sp., Elphidium sp., Acervulina sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf); associated with 1632
1632	Oc	Tmi	47	WR	Kauwol River	Planktonic foraminifera (see Fig. 6)	Not older than Middle Miocene (Zone N.9)
1636	Cl	Tr	72	TS	Kauwol River	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Elphidium sp., indeterminable smaller foraminifera	Middle Oligocene-Middle Miocene (Td-lower Tf)
1639	Cl	Tr	72	TS	Kauwol River	Lepidocyclina sp., Elphidium sp., indeterminable smaller foraminifera	Middle Oligocene-Middle Miocene (Td-lower Tf); upper Te-lower Tf on field association
1640	Cl	Tr	72	TS	Kauwol River	Lepidocyclina sp., Miogypsina (M.) sp., Operculina sp., Elphidium sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
1641	Fl	Tr	72	TS	Kauwol River	Nummulites fichteli, Borelis sp., Operculina sp., ?Heterostegina sp., indeterminable smaller foraminifera	Early Oligocene (Tc)
1642	Oc	Tmi	90	WR	SW of Mount Ian	Planktonic foraminifera (see Fig. 6)	Not older than Middle Miocene (Zone N.9)
1643	Oc	Tmi	90	WR	SW of Mount Ian	Planktonic foraminifera (see Fig. 6)	Middle Miocene (Zone N.9-Zone N.13)
1644	Fl	Tr	90	TS	SW of Mount Ian	Austrotrillina striata, Borelis sp., Sorites sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
1648	Oc	Tmi	42	WR	Kauwol River	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
1650	Oc	Tmt	78	WR	South side of Kwirok River	Poorly preserved benthonic smaller foraminifera, including Elphidium sp.	Indefinite; general Tertiary age only
1651	Cl	Tmt	77	TS	South side of Kwirok River	Lepidocyclina (N.) cf. ferreroi, Miogypsina (M.) sp., Operculina sp., Elphidium sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
1653	Fl	?Tr	76	TS	South side of Kwirok River	Indeterminable smaller foraminifera	Indefinite
1654	Fl	?Tr	76	TS	Kwirok River, west of Tabubil	Flosculinella bontangensis, Austrotrillina howchini, Miogypsina (M.) sp., Sorites sp., indeterminable smaller foraminifera	Middle Miocene (lower Tf)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1695	Cl	?Tpw	233	TS	Burnett River	?Borelis sp. (fragments), Gypsina sp., Amphistegina sp., Carpenteria sp. or Sporadotrema sp., Elphidium sp., soritid genus indeterminable, and indeterminable smaller foraminifera	Indefinite; general Tertiary age only
1774	Cl	Tr	223	TS	Cliff west of Wongop River	Heterostegina sp., Gypsina sp., indeterminable smaller foraminifera	Indefinite; general Tertiary age only
1775	Cl	Tr	223	TS	Cliff west of Wongop River	Heterostegina sp., Gypsina sp., indeterminable smaller foraminifera	Indefinite; general Tertiary age only
1776	Cl	Tr	223	TS	Cliff west of Wongop River	Borelis pygmaeus, Heterostegina sp., Gypsina sp., Operculina sp., indeterminable smaller foraminifera	Late Eocene-Early Miocene (Tb-upper Te)
1777	Oc	Tr	221	TS	Wok Luap Gorge	Heterostegina sp., Operculina sp., ?Gypsina sp., indeterminable smaller foraminifera	Indefinite; general Tertiary age only
1786	Oc	Tmr	218	TS	Wok Feneng below limestone gorges	Marginopora sp., Elphidium sp., indeterminable	Indefinite; Early Miocene or younger age only; probably Middle Miocene on stratigraphic position
1787	Oc	Tmr	218	TS	Wok Feneng below limestone gorges	Flosculinella bontangensis, Marginopora sp., Elphidium sp., miliolids	Middle Miocene (lower Tf)
1788	Oc	Tmr	217	TS	Wok Feneng below limestone gorges	?Flosculinella sp., Elphidium sp., Operculina sp.	Indefinite; general Neogene age only; Middle Miocene on stratigraphic position
1789	Oc	Tmp	217	WR	Wok Feneng below limestone gorges	Planktonic foraminifera (see Fig. 6)	Probably Middle Miocene (Zone N.9-Zone N.12)
1790	Oc	Tmp	217	WR	Wok Feneng below limestone gorges	Planktonic foraminifera (see Fig. 6); Miogypsina (M.) sp., and benthonic smaller foraminifera	Middle Miocene (lower Tf) Zone N.9-Zone N.12.
1791	Oc	Tmp	217	WR	Wok Feneng below limestone gorges	Benthonic smaller foraminifera, including Ammonia; indeterminable planktonic foraminifera	General Neogene age only; Middle Miocene on stratigraphic position
1792	Oc	Tmp	217	WR	Wok Feneng below limestone gorges	Planktonic foraminifera (see Fig. 6); Miogypsina (M.) sp., and benthonic smaller foraminifera	Middle Miocene (lower Tf) Zone N.9-Zone N.12.)
1794	Oc	Tmpl	217	WR TS	Wok Feneng below limestone gorges	Miogypsina (M.) sp., ?Marginopora sp., Elphidium sp., Ammonia sp.	Early-Middle Miocene (upper Te-lower Tf); Middle Miocene on stratigraphic position
1804	Oc	Tmr	191	WR	Ok Tedi, upstream	Small planktonic foraminifera (see Fig. 6); benthonic smaller foraminifera	Middle Miocene-Pliocene (Zone N.16-Zone N.21)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1655	Fl	?Tr	76	TS	Kwirok River, west of Tabubil	Lepidocyclina sp. (fragment), Austrotrillina sp.	Middle Oligocene-Middle Miocene (Td-lower Tf); lower Tf on association with 1654
1658	Fl	?Tr	75	TS	Northern tributary of Kwirok River	Lepidocyclina sp., Gypsina globulus	Middle Oligocene-Middle Miocene (Td-lower Tf); lower Tf on association with 1659
1659	Fl	Tmp	75	WR	Northern tributary of Kwirok River	Planktonic foraminifera (see Fig. 6)	Not older than Middle Miocene (Zone N.9)
1667	Oc	Tr	160	TS	Anju Gorge	Marginopora sp. or Sorites sp., miliolids and other indeterminable smaller foraminifera	Early Miocene or younger age only
1668	Oc	Tr	190	TS	Ok Awut, western tributary of Alice River	Operculina sp.	Indefinite; general Tertiary age only
1679	Oc	Tmp	190	WR	Ok Awut, western tributary of Alice River	Benthonic smaller foraminifera, including Ammonia, Elphidium, Bolivina, Textularia	Indefinite; general Neogene age only
1681	Cl	Tr	92	TS	West of Fubilan	Miogypsina (M.) sp., ?Sorites sp.	Early-Middle Miocene (upper Te-lower Tf)
1682	Fl	Tr	10	TS	Old Ok Tedi Base Camp	Borelis pygmaeus, Austrotrillina cf. striata, Sorites sp. or Marginopora sp., Gypsina sp., Elphidium sp., indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
1683	Fl	Tr	110	TS	Old Ok Tedi Base Camp	Indeterminable smaller foraminifera	Indefinite
1684	Fl	Tr	110	TS	Old Ok Tedi Base Camp	Miogypsina (M.) sp., Gypsina globulus, Operculina sp., ?Borelis sp.	Early-Middle Miocene (upper Te-lower Tf)
1687	Oc	Tmp	196	WR	Ok Gamik, west of Amdi Range	Planktonic foraminifera (see Fig. 6)	Middle Miocene (Zone N.9-Zone N.13)
1688	Oc	Tmp	196	TS	Ok Gamik, west of Amdi Range	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Carpenteria sp. or Sporadotrema sp., Sorites sp., Gypsina sp., Planorbulinella sp., Operculina sp., Amphistegina sp., planktonic foraminifera, including Orbulina	Middle Miocene (lower Tf)
1690	Fl	?Tr	196	TS	Ok Gamik, west of Amdi Range	Miogypsina (M.) sp., Elphidium sp., Lepidocyclina sp., Operculina sp.	Early-Middle Miocene (upper Te-lower Tf)
1693	Oc	Tma	233	WR	Burnett River	Planktonic and benthonic smaller foraminifera (see Fig. 6)	Late Miocene-Pliocene (Zone N.16-Zone N.21)
1694	Oc	?Tpw	233	TS	Burnett River	Planktonic foraminifera (Globigerinidae), miliolids and other indeterminable smaller foraminifera	Indefinite; general Tertiary age only

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1805	Oc	Tmr	166	WR	Ok Tedi, south of Tabubil	Planktonic foraminifera (see Fig. 6); abundant benthonic smaller foraminifera	Not older than Middle Miocene (Zone N.9)
1807	Oc	Tmr	167	TS	Ok Tedi, SE of Tabubil	Small planktonic foraminifera (Globigerinidae)	Indefinite; general Tertiary age only
1809	Oc	Tmt	184	WR	Tukin Valley below Bimin	Miogypsina (M.) sp., Elphidium sp., Operculina sp.,	Early-Middle Miocene (upper Te-lower Tf)
1810	Oc	Tmt	185	WR	Tukin Valley below Bimin	Planktonic foraminifera (see Fig. 6); benthonic smaller foraminifera	Not older than Middle Miocene (Zone N.9)
1811	Oc	Tr	185	TS	Tukin Valley below Bimin	Lepidocyclina (N.) cf. ferreroi, L. sp., Miogypsina (M.) sp., Heterostegina sp., Operculina sp., Amphistegina sp.	Early-Middle Miocene (late upper Te-lower Tf)
1828	Fl	Tr	66	TS	Southern tributary of Ok Om	Lepidocyclina sp. (very small, rare), Flosculinella bontangensis, Sorites, sp., Miogypsina (M.) sp., indeterminable smaller foraminifera.	Middle Miocene (lower Tf)
1829	Oc	Tr	141	TS	Top of central Tekin thrust sheet	Lepidocyclina (E.) sp., Borelis sp., Heterostegina sp., Amphistegina sp.	Late Oligocene-Early Miocene (Te, undifferentiated).
1835	Oc	Tmt	131	WR	Sepik River below Foramin	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
1845	Oc	Tmr	192	WR	Ok Tedi, SE of Tabubil	Planktonic foraminifera (see Fig. 6); benthonic smaller foraminifera	Not older than Middle Miocene (Zone N.9)
1846	Oc	Tmr	192	WR	Ok Tedi, SE of Tabubil	Planktonic foraminifera (see Fig. 6); benthonic smaller foraminifera	Middle Miocene (Zone N.11) or younger
1853	Oc	Tmp	168	WR	10 km SE of Tabubil	Planktonic foraminifera (see Fig. 6); benthonic smaller foraminifera	Late Miocene (Zone N.16) or younger
1854	Oc	Tmp	168	WR	10 km SE of Tabubil	Planktonic foraminifera (see Fig. 6); benthonic smaller foraminifera	Late Miocene or Pliocene (Zone N.16-Zone N.21)
1980	Fl	Tr	1	TS	Headwaters of Fatik River, Star Mountains	Lepidocyclina sp., Sorites sp. or Marginopora sp., Elphidium sp., Operculina sp.	Late Oligocene-Middle Miocene (Te-lower Tf)
1981	Oc	Tmi	39	WR	Bun River, Star Mountains	Small poorly preserved planktonic foraminifera; benthonic smaller foraminifera	Indefinite; general Tertiary age only
1986	Fl	Tr	106	TS	South of 'Yass' helipad, Fubilan	Borelis pygmaeus, Sorites sp., Austrotrillina striata, Gypsina sp., miliolids	Late Oligocene-Early Miocene (Te, undifferentiated)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1988	Oc	Tpb	216	WR	Korebon, north of Ningerum	Rare planktonic foraminifera (see Fig. 6)	Indefinite; general Tertiary age only
1989	Oc	Tmr	207	WR	Ok Gamik, SW of Amdi Range	Lepidocyclina (N.) howchini group (free specimens)	Middle Miocene (lower Tf)
1990	Oc	Tmp	207	WR	Ok Gamik, SW of Amdi Range	Planktonic foraminifera (see Fig. 6)	Not older than middle Miocene; possibly Zone N.9-Zone N.16
1998	Oc	Tmp	165	WR	West of Tabubil in Ok Tedi	Rare planktonic foraminifera (see Fig. 6); benthonic smaller foraminifera	Not older than Middle Miocene (Zone N.9)
2394	Fl	Tmtz	206	TS	1 km west of Lake Kopiago	Elphidium sp., rare planktonic foraminifera (Globigerinidae); indeterminable smaller foraminifera	Indefinite; general Tertiary age only
2395	Oc	Tmtz	203	WR	4 km west of Lake Kopiago	Planktonic foraminifera (see Fig. 6)	Not older than Middle Miocene (Zone N.9)
2396	Oc	Tmtz	203	WR	4 km west of Lake Kopiago	Planktonic foraminifera (see Fig. 6)	Not older than Middle Miocene (Zone N.9)
2399	Oc	Tmtz	204	WR	3 km WNW of Lake Kopiago	Very rare planktonic foraminifera including Orbulina (see Fig. 6). Benthonic smaller foraminifera	Not older than Middle Miocene (Zone N.9)
2610	Oc	?Tr	122	TS WR	Southern tributary of Ok Kam	Miliolids and other indeterminable smaller foraminifera	Indefinite
3017	Fl	Tr	70	TS	Kutik River, southern tributary of Ok Om	Nummulites fichteli, Borelis pygmaeus, Operculina sp., Amphistegina sp., Gypsina sp., miliolids and other indeterminable smaller foraminifera	Early Oligocene (Tc)
3021	Fl	Tr	70	TS	Kutik River, southern tributary of Ok Om	Spiroclypeus margaritatus, Miogypsina (Miogypsinoides) complanata/bantamensis, Lepidocyclina sp., Gypsina globulus, miliolids	Late Oligocene (lower (Te)
3029	Fl	Tr	69	TS	Kutik River, southern tributary of Ok Om	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Elphidium sp.	Early-Middle Miocene (upper Te-lower Tf)
3096	Fl	Tr	175	TS	Hindenberg Wall, SW of Feramin	?Operculina sp., small planktonic foraminifera (Globigerinidae); also contains ?radiolaria and sponge spicules	Indefinite; associated with upper Te sample; float from base of cliff
3097	Fl	Tr	175	TS	Hindenberg Wall, SW of Feramin	Lepidocyclina (N.) cf. parva, Miogypsina (M.) sp., M. (Miogypsinoides) dehaarti, Heterostegina sp., Amphistegina sp., indeterminable smaller foraminifera	Early Miocene (upper Te); float from base of cliff

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
3098	Fl	Tr	175	TS	Hindenberg Wall, SW of Feramin	Borelis cf. pygmaeus, Heterostegina sp., Operculina sp., Gypsina globulus, Planorbulinella sp., miliolids and other indeterminable smaller foraminifera	Middle Oligocene-Early Miocene (Td-upper Te); associated with upper Te sample; float from base of cliff
3099	Fl	Tr	175	TS	Hindenberg Wall, SW of Feramin	Operculina sp.	Indefinite, associated with upper Te sample; float from base of cliff
3105	Fl	Tr	176	TS	Base of Hindenberg Wall, Ogop River tributary	Nummulites fichteli, Operculina sp., Elphidium sp.	Early Oligocene (Tc)
3110	Oc	Tr	201	TS	Landslide above Bolivip Mission	Borelis pygmaeus, Austrotrillina striata, Sorites sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
3111	Fl	Tr	201	TS	Landslide above Bolivip Mission	Operculina sp., indeterminable smaller foraminifera	Indefinite; associated with Late Oligocene-Early Miocene (Te, undifferentiated)
3114	Fl	Tr	201	TS	Landslide above Bolivip Mission	Spiroclypeus margaritatus, Lepidocyclina (N.) sp., Carpenteria sp. or Sporadotrema sp., Heterostegina sp., Amphistegina sp., Elphidium sp., rare planktonic foraminifera and indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
3127	Fl	Tr	200	TS	West of Bolivip	Austrotrillina striata, Borelis sp., Sorites sp., miliolids	Late Oligocene-Early Miocene (Te, undifferentiated)
3141	Fl	Tr	199	TS	Wok Feneng-Wok Wunik junction, south of Olsobip	Austrotrillina cf. striata, Borelis sp., ?Sorites sp.	Late Oligocene-Early Miocene (Te, undifferentiated)
3146	Fl	Tr	199	TS	Wok Feneng-Wok Wunik junction, south of Olsobip	Borelis sp., Operculina sp., Carpenteria sp. or Sporadotrema sp., indeterminable smaller foraminifera	Indefinite; general Tertiary age only
3259	Oc	Tmtz	209	WR	Lake Kopiago to Tumbudu road	Planktonic foraminifera (see Fig. 6)	Late Miocene (Zone N.16), or younger
3261	Oc	Tr	210	TS	Lake Kopiago to Tumbudu road	Lepidocyclina sp., Miogypsina (M.) sp., Cycloclypeus sp., Carpenteria sp. or Sporadotrema sp., Amphistegina sp., Planorbulinella sp., planktonic foraminifera (Globigerinidae, including Orbulina), indeterminable smaller foraminifera	Middle Miocene (lower Tf)
3264	Oc	Tr	210	TS	Lake Kopiago to Tumbudu road	Lepidocyclina sp. (one small specimen), planktonic foraminifera including Orbulina, indeterminable smaller foraminifera	Middle Miocene (lower Tf); Zones N.9-N.12

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
3266	Oc	Tr	211	TS	Lake Kopiago to Tumbudu road	Lepidocyclina (?N.) sp. (small specimens), Operculina sp., Indeterminable smaller foraminifera	Middle Oligocene-Middle Miocene (Td-lower Tf); lower Tf on stratigraphic position
3269	Oc	Tr	211	TS	Lake Kopiago to Tumbudu road	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Amphistegina sp., Elphidium sp., Cycloclypeus sp., planktonic foraminifera including Orbulina	Middle Miocene (lower Tf); Zone N.9-Zone N.12
3278	Fl	Tr	205	TS	2 km NW of Lake Kopiago	Miogypsina (M.) sp., Gypsina sp., Carpenteria sp. or Sporadotrema sp., Indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
3280	Fl	Tr	205	TS	2 km NW of Lake Kopiago	Miogypsina (M.) sp., Sorites sp., Amphistegina sp.	Early-Middle Miocene (upper Te-lower Tf)
3282	Fl	Tr	205	TS	2 km NW of Lake Kopiago	Lepidocyclina sp., Austrotrillina cf. howchini, Miogypsina (M.) sp., Elphidium sp.	Probably Middle Miocene (lower Tf)
3321	Oc	Tmt (base)	155	WR	Near Oksapmin	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8).
3322	Oc	Tmt (base)	155	WR	Near Oksapmin	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
3323	Oc	Tmt	154	TS	Near Oksapmin	Indeterminable smaller foraminifera; also sponge spicules	Indefinite
3325	Oc	Tr	152	TS	South Tekin section, 2nd thrust sheet	Indeterminable smaller foraminifera	Indefinite; probably upper Te on stratigraphic position
3326	Oc	Tr	153	TS	South Tekin section, 2nd thrust sheet	Indeterminable smaller foraminifera; also sponge spicules	Indefinite; probably upper Te on stratigraphic position
3327	Oc	Tr	153	TS	South Tekin section, 2nd thrust sheet	Indeterminable smaller foraminifora	Indefinite; probably upper Te on stratigraphic position
3328	Oc	Tr	151	TS	Oksapmin-Tekin road; projected to south Tekin section, 2nd thrust sheet	Lepidocyclina sp. (fragments), Miogypsina (M.) sp., Amphistegina sp., Carpenteria sp. or Sporadotrema sp., Heterostegina sp., Planorbulinella sp., rare planktonic foraminifera including Praeorbulina types, indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
3329	Oc	Tr	151	TS	Oksapmin-Tekin road; projected to south Tekin section, 2nd thrust sheet	Lepidocyclina (N.) ferreroi, L.(N.) sp., Miogypsina (M.) sp., Austrotrillina striata (one specimen), Amphistegina sp., Carpenteria sp. or Sporadotrema sp., Gypsina sp., planktonic foraminifera including Praeorbulina types, indeterminable smaller foraminifera	Early Miocene (late upper Te)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
3330	Oc	Tr (top)	150	TS	Oksapmin-Tekin road; projected to South Tekin section, 2nd thrust sheet	Lepidocyclina (N.) ferreroi, L. sp., Miogypsina (M.) sp., Sporadotrema cf. cylindricum, Planorbulinella sp., Operculina sp., Amphistegina sp., Elphidium sp., planktonic foraminifera including Praeorbulina glomerosa group, miliolids and other indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf)
3331	Oc	Tr	149	TS	Oksapmin-Tekin road; projected to South Tekin section, 2nd thrust sheet	Planktonic foraminifera, indeterminable smaller foraminifera, possible miogypsinid fragment	Indefinite; associated with upper Te-lower Tf samples
3332	Oc	Tmt (base)	148	WR	Oksapmin-Tekin road; projected to South Tekin section, 2nd thrust sheet	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
3333	Oc	Tmt	146	WR	South Tekin section	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
3334	Oc	Tmt	146	WR	South Tekin section	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
3335	Oc	Tmt	146	WR	South Tekin section	Planktonic foraminifera (see Fig. 6); Operculina sp., Elphidium sp.	Top of Early Miocene (Zone N.8)
3337	Oc	Tr	145	TS	South Tekin section; 2nd thrust sheet	Nummulites fichteli, Borelis sp., Gypsina sp., Operculina sp., Amphistegina sp., Planorbulina sp., Elphidium sp., indeterminable smaller foraminifera	Early Oligocene (Tc)
3338	Oc	Tr	145	TS	South Tekin section; 2nd thrust sheet	Nummulites fichteli, Borelis sp., Heterostegina sp., Operculina sp., miliolids and other indeterminable smaller foraminifera	Early Oligocene (Tc)
3339	Oc	Tr	145	TS	South Tekin section; 2nd thrust sheet	Lepidocyclina (E.) cf. ephippioides, L. (N.) sp., Borelis pygmaeus, Miogypsina (Miogypsinoides) complanata, Spiroclypeus margaritatus, Elphidium sp., indeterminable smaller foraminifera	Late Oligocene (lower Te)
3340	Oc	Tr	145	TS	South Tekin section; 2nd thrust sheet	Borelis pygmaeus, Sorites sp. or Marginopora sp., (fragment), Austrotrillina cf. striata, miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position
3341	Oc	Tr	145	TS	South Tekin section; 2nd thrust sheet	?Borelis sp., soritid genus indet., Planorbulinella sp., miliolids and other indeterminable smaller foraminifera	Indefinite; general Tertiary age only; lower Te on stratigraphic position
3342	Oc	Tr	145	TS	South Tekin section; 2nd thrust sheet	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Carpenteria sp. or Sporadotrema sp.	Early-Middle Miocene (upper Te-lower Tf); upper Te on stratigraphic position

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
3343	Oc	Tr	145	TS	South Tekin section; 2nd thrust sheet	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Sorites sp., Gypsina sp., Cycloclypeus (C.) sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf); lower Tf on parameter F (see text)
3344	Oc	Tmt	145	WR	South Tekin section; 2nd thrust sheet	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
3345	Oc	Tmt	146	WR	South Tekin section	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
3346	Oc	Tmt	142	WR	Between Divana and Tomiana, Tekin Valley; projected to South Tekin section	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
3347	Fl	Tr	140	TS	Between Tekap and Divana, Tekin Valley	Lepidocyclina (?E.) sp., ?Acervulina sp., planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Probably Late Oligocene-Early Miocene (Te, undifferentiated)
3350	Fl	Tmt	139	TS	Tekin Syncline, near Tekap	Indeterminable smaller foraminifera	Indefinite
3351	Fl	Tr	138	TS	Tekin River, 8 km WNW of Tekap	Lepidocyclina (?N.) sp., Miogypsina (M.) sp., Gypsina sp., Elphidium sp., Operculina sp., Amphistegina sp., miliolids and other indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
3352	Fl	Tr	138	TS	Tekin River, 8 km WNW of Tekap	Borelis sp., Elphidium sp., Amphistegina sp., miliolids and other indeterminable smaller foraminifera	Indefinite; general Tertiary age only
3353	Fl	Tr	138	TS	Tekin River, 8 km WNW of Tekap	Lepidocyclina (?N.) sp., Miogypsina (M.), Elphidium sp., Amphistegina sp., Planorbulinella sp., Operculina sp.	Early-Middle Miocene (upper Te-lower Tf)
3354	Fl	Tr	138	TS	Tekin River, 8 km WNW of Tekap	Nummulites fichteli	Early Oligocene (Tc)
3355	Fl	Tr	138	TS	Tekin River, 8 km WNW of Tekap	Lepidocyclina (E.) sp., Heterostegina sp., Operculina sp., Elphidium sp.	Late Oligocene-Early Miocene (Te, undifferentiated)
3359	Oc	Tmt	137	WR	Yama Creek, west of Tekin	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
3361	Fl	Tr	137	TS	Yama Creek, west of Tekin	Lepidocyclina sp., Carpenteria sp. or Sporadotrema sp., Amphistegina sp., abundant planktonic foraminifera probably including Orbulina	Probably Middle Miocene (lower Tf); associated with sample 3359

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
3407	Fl	Tr	147	TS	North side of Ariga River, north Tekin Valley; projected to South Tekin section	Lepidocyclina (N.) ferreroi, Miogypsina (M.) sp., Cycloclypeus (C.) sp., Sorites sp., Heterostegina sp., Carpenteria sp. or Sporadotrema sp., ?Acervulina sp., indeterminable smaller foraminifera, planktonic foraminifera including Praeorbulina types	Early-Middle Miocene (late upper Te-lower Tf)
3408	Oc	Tr	147	TS	North side of Ariga River, north Tekin Valley; projected to South Tekin section	Lepidocyclina (N.) cf. inflata, Miogypsina (M.) sp., Heterostegina sp., Amphistegina sp., Carpenteria sp. or Sporadotrema sp., Planorbulinella sp., rare planktonic foraminifera (Globigerinidae, including Praeorbulina types), indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
3409	Oc	Tr	147	TS	North side of Ariga River, north Tekin Valley; projected to South Tekin section	Small planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Indefinite; upper Te on stratigraphic position
3410	Fl	Tr	143	TS	North Tekin section, 2nd thrust sheet	Discocyclina spp., Nummulites cf. javanus, planktonic foraminifera	Middle Eocene (Ta3)
3411	Oc	Tr	143	TS	North Tekin section, 2nd thrust sheet	Nummulites fichteli, Borelis sp., indeterminable smaller foraminifera	Early Oligocene (Tc)
3412	Oc	Tr	143	TS	North Tekin section, 2nd thrust sheet	Lepidocyclina (E.) cf. ephippioides, Miogypsina (Miogypsinoides) complanta/bantamensis, Heterostegina sp., Operculina sp., Elphidium sp.	Late Oligocene (lower Te)
3413	Oc	Tr	143	TS	North Tekin section, 2nd thrust sheet	Lepidocyclina (E.) cf. ephippioides, Operculina sp., Heterostegina sp., Elphidium sp.	Late Oligocene (lower Te)
3414	Oc	Tr	143	TS	North Tekin section, 2nd thrust sheet	Lepidocyclina (E.) cf. ephippioides, Operculina sp., Heterostegina sp., Elphidium sp.	Late Oligocene (lower Te)
3415	Cl	Tr	143	TS	North Tekin section, 2nd thrust sheet	Borelis cf. pygmaeus, Heterostegina sp., Carpenteria sp. or Sporadotrema sp., Acervulina sp., indeterminable smaller foraminifera. In lithoclast: Austrotrillina striata, Sorites sp., miliolids	Late Oligocene-Early Miocene (Te, undifferentiated)
3416	Cl	Tr	143	TS	North Tekin section 2nd thrust sheet	Lepidocyclina (?N.) sp., Austrotrillina striata, Borelis pygmaeus, Miogypsina (Miogypsinoides) bantamensis/dehaarti, Spiroclypeus margaritatus, Elphidium sp., Sorites sp., Carpenteria sp. or Sporadotrema sp., miliolids and other indeterminable smaller foraminifera	Early Miocene (upper Te)
3417	Oc	Tr	143	TS	North Tekin section 2nd thrust sheet	Austrotrillina cf. striata, Borelis pygmaeus, Sorites sp., indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
3418	Fl	Tr	143	TS	North Tekin section, 2nd thrust sheet	Indeterminable smaller foraminifera	Indefinite; upper Te on stratigraphic position
3419	Oc	Tr	143	TS	North Tekin section, 2nd thrust sheet	Lepidocyclina (?N.) sp., Cycloclypeus sp., Indeterminable smaller foraminifera	Middle Oligocene-Middle Miocene (Td-lower Tf); upper Te on stratigraphic position
3421	Oc	Tr	143	TS	North Tekin section, 2nd thrust sheet	?Borelis sp., miliolids and other indeterminable smaller foraminifera	Indefinite; upper Te on stratigraphic position
3422	Oc	Tr	143	TS	North Tekin section, 2nd thrust sheet	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Cycloclypeus (C.) sp., Carpenteria sp., or Sporadotrema sp., Acervulina sp., Amphistegina sp.	Early-Middle Miocene (upper Te-lower Tf)
3423	Oc	Tr	143	TS	North Tekin section, 2nd thrust sheet	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Cycloclypeus (C.) sp., Planorbulinella sp., Carpenteria sp. or Sporadotrema sp., Indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf); lower Tf on parameter F (see text)
3424	Oc	Tr	143	TS	North Tekin section, 2nd thrust sheet	Planktonic foraminifera (Globigerinidae)	Indefinite; Early Miocene (upper Te) on stratigraphic position
3426	Fl	Tr	144	TS	Derived from central Tekin thrust sheet	Discocyclina sp., Asterocyclina sp., Operculina sp., planktonic foraminifera	Middle Eocene (Ta3)
3427	Fl	Tr	144	TS	Derived from central Tekin thrust sheet	Lepidocyclina (E.) sp., Borelis sp., Heterostegina sp., Indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
3428	Fl	Tr	144	TS	Derived from central Tekin thrust sheet	Discocyclina sp., Asterocyclina sp., Nummulites cf. javanus, planktonic foraminifera, indeterminable smaller foraminifera	Middle Eocene (Ta3)
3429	Fl	Tr	144	TS	Derived from central Tekin thrust sheet	Discocyclina sp., Asterocyclina sp., Nummulites sp., Operculina sp., planktonic foraminifera, indeterminable smaller foraminifera	Middle Eocene (Ta3)
3430	Fl	Tr	144	TS	Derived from central Tekin thrust sheet	Discocyclina sp., Asterocyclina sp., Operculina sp., ?Elphidium sp.	Middle-Late Eocene (Ta3-Tb)
3431	Fl	Tr	144	TS	Derived from central Tekin thrust sheet	Discocyclina sp., Nummulites sp., Lacazinella sp., Gypsina sp., planktonic foraminifera	Middle Eocene (Ta3)
3432	Fl	Tr	144	TS	Derived from central Tekin thrust sheet	Nummulites (Palaeonummulites) sp., Nummulites fichteli, Borelis sp., Amphistegina sp., indeterminable smaller foraminifera	Early Oligocene (Tc)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
3433	Fl	Tr	144	TS	Derived from central Tekin thrust sheet	Nummulites fichteli, Borelis pygmaeus, Heterostegina sp., Carpenteria sp. or Sporadotrema sp.	Early Oligocene (Tc)
3434	Fl	Tr	144	TS	Derived from central Tekin thrust sheet	Nummulites fichteli, Borelis sp., miliolids and other indeterminable smaller foraminifera	Early Oligocene (Tc)
3435	Fl	Tr	144	TS	Derived from central Tekin thrust sheet	Nummulites fichteli, Borelis sp., Halkyardia sp., Gypsina sp., Carpenteria sp. or Sporadotrema sp., miliolids	Early Oligocene (Tc)
3436	Fl	Tr	144	TS	Derived from central Tekin thrust sheet	Nummulites fichteli, Borelis pygmaeus, Heterostegina sp., Amphistegina sp., miliolids and other indeterminable smaller foraminifera	Early Oligocene (Tc)
3437	Oc	Tr	145	TS	South Tekin section, 2nd thrust sheet	Lepidocyclina (N.) cf. parva, Miogypsina (M.) sp., Cycloclypeus (Katacycloclypeus) sp., Elphidium sp., indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf)
3438	Oc	Tr	145	TS	South Tekin section, 2nd thrust sheet	Lepidocyclina (N.) cf. parva, Miogypsina (M.) thecideaeformis, Cycloclypeus (C.) sp., Austrotrillina striata/howchini, Sorites sp., Elphidium sp., Carpenteria sp. or Sporadotrema sp., Borelis sp.	Early Miocene (late upper Te)
3439	Oc	Tr	145	TS	South Tekin section, 2nd thrust sheet	Spiroclypeus margaritatus, Miogypsina (M.) sp., M. (Miogypsinoides) bantamensis/dehaarti, Lepidocyclina sp., Amphistegina sp., Elphidium sp., Carpenteria sp. or Sporadotrema sp.	Early Miocene (upper Te)
3440	Cl	Tr	145	TS	South Tekin section, 2nd thrust sheet	Spiroclypeus margaritatus, Lepidocyclina sp., Miogypsina (Miogypsinoides) bantamensis/dehaarti, M.(M) sp., Gypsina sp.	Early Miocene (upper Te)
3441	Oc	Tr	145	TS	South Tekin section, 2nd thrust sheet	Borelis pygmaeus, Heterostegina sp., miliolids and other indeterminable smaller foraminifera	Late Eocene-Early Miocene (Tb-upper Te); lower Te on stratigraphic position
3442	Oc	Tr	145	TS	South Tekin section, 2nd thrust sheet	Lepidocyclina (E.) sp., Heterostegina sp., Gypsina sp., Elphidium sp., indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position
3443	Oc	Tr	145	TS	South Tekin section, 2nd thrust sheet	Lepidocyclina (E.) sp., Heterostegina sp., Operculina sp., indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated); lower Te on stratigraphic position
3444	Oc	Tr	145	TS	South Tekin section, 2nd thrust sheet	Nummulites fichteli, Heterostegina sp., Borelis sp., ?Gypsina sp., Amphistegina sp., Operculina sp.	Early Oligocene (Tc)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
3475	Fl	Tr	222	TS	Blocks at base of Blucher Range section	Borelis pygmaeus, Sorites sp., Gypsina globulus	Late Oligocene-Early Miocene (Te, undifferentiated)
3476	Fl	Tr	222	TS	Blocks at base of Blucher Range section	Borelis pygmaeus, Sorites sp., miliolids	Late Oligocene-Early Miocene (Te, undifferentiated)
3477	Fl	Tr	222	TS	Blocks at base of Blucher Range section	Borelis pygmaeus, Sorites sp., Gypsina globulus	Late Oligocene-Early Miocene (Te, undifferentiated)
3478	Fl	Tr	222	TS	Blocks at base of Blucher Range section	Borelis pygmaeus, Sorites sp., Gypsina globulus, Operculina sp.	Late Oligocene-Early Miocene (Te, undifferentiated)
3479	Fl	Tr	222	TS	Blocks at base of Blucher Range section	Borelis pygmaeus, Sorites sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
3480	Fl	Tr	222	TS	Blocks at base of Blucher Range section	Borelis pygmaeus, Elphidium sp., miliolids	Late Oligocene-Early Miocene (Te, undifferentiated)
3498	Fl	Tr	222	TS	Float from landslide debris, Blucher Range section	Borelis pygmaeus, Austrotrillina striata, Sorites sp., Gypsina globulus,, Operculina sp., Elphidium sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
5034	Oc	Tmt	126	WR	Between Nong River and Tifalmin	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
5035	Oc	Tmt	126	TS	Between Nong River and Tifalmin	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Austrotrillina howchini, ?Borelis sp., Elphidium sp., Acervulina sp., Operculina sp., miliolids and indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf)
5036	Oc	Tr	126	TS	Between Nong River and Tifalmin	Lepidocyclina sp., Miogypsina (M.) sp., Carpenteria sp. or Sporadotrema sp., Cycloclypeus (Katacycloclypeus) cf. annulatus, planktonic foraminifera including Praeorbulina glomerosa group	Early-Middle Miocene (late upper Te-lower Tf); lower Tf on parameter F (see text)
5037	Oc	Tr	127	TS	Between Nong River and Tifalmin	Lepidocyclina sp., Miogypsina (M.) sp., Elphidium sp., Amphistegina sp., Carpenteria sp. or Sporadotrema sp.	Early-Middle Miocene (upper Te-lower Tf)
5038	Oc	Tmt	128	WR	Headwaters of Nong River	Planktonic foraminifera (see Fig. 6); benthonic smaller foraminifera	Top of Early Miocene (Zone N.8)
6010	Oc	Tr	183	TS	Ridge between Tekin and Bak Valleys	Marginopora sp. or Sorites sp., planktonic foraminifera, indeterminable smaller foraminifera	Early Miocene or younger age only
6011	Oc	Tr	183	TS	Ridge between Tekin and Bak Valleys	Austrotrillina striata, Borelis sp., Sorites sp., Heterostegina sp., miliolids	Late Oligocene-Early Miocene (Te, undifferentiated)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
6015	Oc	Tmt	182	WR	Bak Valley near Kwektanap	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
6018	Cl	Tr	181	TS	Ridge between Tekin and Bak Valleys	Miogypsina (M.) sp., Austrotrillina striata/howchini, Sorites sp., Gypsina sp., Acervulina sp., Carpenteria sp. or Sporadotrema sp.	Probably Early Miocene (late upper Te)
6019	Cl	Tr	181	TS	Ridge between Tekin and Bak Valleys	Lepidocyclina (N.) sp., Austrotrillina cf. howchini, Miogypsina (M.) sp., Gypsina globulus, Carpenteria sp. or Sporadotrema sp., Elphidium sp., Acervulina sp., Sorites sp., Operculina sp., miliolids and other indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf)
6020	Cl	Tr	181	TS	Ridge between Tekin and Bak Valleys	Elphidium sp., Operculina sp., indeterminable smaller foraminifera	Indefinite; general Tertiary age only
6022	Cl	Tr	181	TS	Ridge between Tekin and Bak Valleys	Lepidocyclina (?N.) sp., indeterminable smaller foraminifera	Middle Oligocene-Middle Miocene (Td-lower Tf)
6023	Cl	Tr	181	TS	Ridge between Tekin and Bak Valleys	Sorites sp., Flosculinella sp.	Early-Middle Miocene (upper Te-lower Tf)
6033	Oc	Tr	178	TS	Tukin River upstream	Indeterminable smaller foraminifera	Indefinite
6034	Oc	Tr	177	TS	Tukin River upstream	Miliolids and other indeterminable smaller foraminifera	Indefinite
6044	Oc	Tmt	179	WR	Kuskusmin, Tukin River, SW of Oksapmin	Planktonic foraminifera (Fig. 6)	Top of Early Miocene (Zone N.8)
6045	Oc	Tmt	180	WR	Bimin Village, Tukin Valley	Planktonic foraminifera	Top of Early Miocene (Zone N.8)
6052	Oc	Tr	174	TS	Landslide at head of Wongop River, 4 km ENE of Bolivip Mission	Operculina sp., Elphidium sp., indeterminable smaller foraminifera	Indefinite: general Tertiary age only; at base of sequence of Early Oligocene (Tc) beds
6053	Oc	Tr	174	TS	Landslide at head of Wongop River, 4 km ENE of Bolivip Mission	Nummulites fichteli, Borelis sp., ?Pararotalia sp., indeterminable smaller foraminifera	Early Oligocene (Tc)
6054	Oc	Tr	174	TS	Landslide at head of Wongop River, 4 km ENE of Bolivip Mission	Nummulites fichteli, indeterminable smaller foraminifera	Early Oligocene (Tc)
6055	Oc	Tr	174	TS	Landslide at head of Wongop River, 4 km ENE of Bolivip Mission	Halkyardia sp., Operculina sp., ?Borelis sp., indeterminate smaller foraminifera	Middle Eocene-Late Oligocene (Ta3-lower Te); Early Oligocene (Tc) on stratigraphic position

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
6056	Cl	Tr	174	TS	Landslide at head of Wongop River, 4 km ENE of Bolivip Mission	Austrotrillina striata, Borelis pygmaeus, Sorites sp., Gypsina globulus, miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
6057	Cl	Tr	174	TS	Landslide at head of Wongop River, 4 km ENE of Bolivip Mission	Nummulites fichteli, indeterminable smaller foraminifera	Early Oligocene (Tc)
6111	Fl	Tr	235	TS	Magnetite Creek, Fubilan	Lepidocyclina sp., Miogypsina (M.) sp., Gypsina sp., Sorites sp., Elphidium sp., Planorbulinella sp., miliolids	Early-Middle Miocene (upper Te-lower Tf)
6120	Fl	Tr	236	TS	Magnetite Creek, Fubilan	Lepidocyclina (N.) ferreroi, L. (T.) sp., L. sp., Miogypsina (M.) sp., Cycloclypeus sp., Operculina sp.	Middle Miocene (lower Tf)
6123	Oc	Tmp	163	WR	Northern tributary of Ok Mani, west of Tabubil	Planktonic foraminifera (see Fig. 6)	Not older than Middle Miocene (Zone N.9)
6125	Oc	Tmp	164	WR	Northern tributary of Ok Mani, west of Tabubil	Planktonic foraminifera (see Fig. 6)	Not older than Middle Miocene (Zone N.9)
6126	Oc	Tmp	164	WR	Northern tributary of Ok Mani, west of Tabubil	Planktonic foraminifera (see Fig. 6)	Not older than Middle Miocene (Zone N.9)
6127	Oc	Tmp	164	WR	Northern tributary of Ok Mani, west of Tabubil	Planktonic foraminifera (see Fig. 6)	Not older than Middle Miocene; (Zone N.9)
6128	Oc	Tmp	164	WR	Northern tributary of Ok Mani, west of Tabubil	Very small indeterminable globigerinids; rare benthonic smaller foraminifera	Indefinite; Middle Miocene on stratigraphic position
6129 B	Oc	Tmp	164	TS	Northern tributary of Ok Mani, west of Tabubil	Miogypsina (M.) sp., Elphidium sp., Carpenteria sp. or Sporadotrema sp., miliolids	Early-Middle Miocene (upper Te-lower Tf); lower Tf on stratigraphic position
6130	Oc	Tmp	164	WR	Northern tributary of Ok Mani, west of Tabubil	Planktonic foraminifera (see Fig. 6)	Not older than Middle Miocene (Zone N.9)
6131	Cl	Tr	96	TS	SE side of hill of Gundagai helipad, Fubilan	Nummulites fichteli, Borelis sp.	Early Oligocene (Tc)
6135	Fl	Tmp	107	WR	Sulphide Creek, east of Fubilan	Planktonic foraminifera (see Fig. 6)	Middle Miocene (Zone N.9-Zone N.14)
7000	Oc	Tr	211	TS	Lake Kopiago-Tumbudu road	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Cycloclypeus (?Katacycloclypeus) sp., Elphidium sp., Amphistegina sp., Acervulina sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Td-lower Tf); lower Tf on stratigraphic position

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
7001	Oc	Tr	211	TS	Lake Kopiago-Tumbudu road	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Cycloclypeus (C.) sp., Gypsina sp., Operculina sp., Carpenteria sp. or Sporadotrema sp., ?Heterostegina sp., planktonic foraminifera including Orbulina	Middle Miocene (lower Tf)
7003	Oc	Tmtz	212	TS	Tumbudu Valley, SW of Lake Kopiago	Planktonic foraminifera including Orbulina, indeterminable smaller benthonic foraminifera	Not older than Middle Miocene (Zone N.9)
7005	Oc	Tmtz	213	TS	Tumbudu Valley, SW of Lake Kopiago	Planktonic foraminifera (Globigerinidae)	Indefinite; general Tertiary age only
7006	Oc	Tr	214	TS	Tumbudu Valley, south of Lake Kopiago	Miogypsina (M.) sp., Amphistegina sp., Elphidium sp.	Early-Middle Miocene (upper Te-lower Tf)
7007	Oc	Tr	215	TS	Tumbudu Valley, south of Lake Kopiago	Planktonic foraminifera including Orbulina	Not older than Middle Miocene (Zone N.9)
68691621	Oc	Tmp	95	TS	Headwaters of Ok Gilor, 12 km NW of Tabubil	Lepidocyclina (N.) ferreroi, L. sp., Miogypsina (M.) sp., Amphistegina sp., Elphidium sp., Operculina sp., Gypsina sp.	Middle Miocene (lower Tf)
68691622 B & C	Fl	Tr	109	TS	OK Ningi, near OK Tedi junction	Spiroclypeus margaritatus, Miogypsina (Miogypsinoides) complanata/bantamensis, Heterostegina sp., Lepidocyclina (N.) spp., L.(E.) sp., Elphidium sp.	Late Oligocene (lower Te)
68691623	?	Tr	111	TS	Small tributary of Ok Ningi, west of sample 68691622	Lepidocyclina sp., Borelis sp., Operculina sp., Carpenteria sp. or Sporadotrema sp.	Middle Oligocene-Middle Miocene (Td-lower Tf)
68691626A	?	Tr	93	TS	Not available	Lepidocyclina sp., Miogypsina (M.) sp., Operculina sp., Carpenteria sp. or Sporadotrema sp.	Early-Middle Miocene (upper Te-lower Tf)
68691627 C	?Oc	Tmp	94	TS	Ok Mari headwaters, west of Tabubil	Miogypsina (M.) sp., Elphidium sp., Operculina sp.	Early-Middle Miocene (upper Te-lower Tf)
68691627 D	?Oc	Tmp	94	TS	Ok Mari headwaters, west of Tabubil	Lepidocyclina sp., Planorbulina sp., planktonic foraminifera including Orbulina, indeterminable smaller foraminifera	Middle Miocene (lower Tf)
68691628	?Oc	Tmp	94	TS	Ok Mari headwaters, west of Tabubil	Lepidocyclina (N.) angulosa, L.(N.) ferreroi, Miogypsina (M.) spp., Amphistegina sp.,	Middle Miocene (lower Tf)
68691630 B	Oc		161	TS	West of Olsobip	Planorbulinella sp., planktonic foraminifera (Globigerinidae)	Indefinite; general Tertiary age only
68691631	?	?Tr	113	TS	West of Olsobip	Spiroclypeus sp., Borelis pygmaeus, Operculina sp., Gypsina sp., Heterostegina sp., Carpenteria sp. or Sporadotrema sp., indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
68691633		?Tr	198	TS	West of Olsobip	?Borelis sp., Marginopora sp. or Sorites sp., miliolids and other indeterminable smaller foraminifera	Indefinite; general Early Miocene or younger age only
68691634 B	Fl	?Tr	173	TS	Head of Wok Feneng	Austrotrillina cf. striata, Borelis pygmaeus, Gypsina sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
68691638B	Oc	Tmp	79	TS	Kwirok River	Miogypsina (M.) sp., Elphidium sp., Amphistegina sp.	Early-Middle Miocene (upper Te-lower Tf)
68691639	Oc	Tmi	46	TS	Kauwol River	Miogypsina (M.) sp., Gypsina sp., Elphidium sp., Carpenteria sp. or Sporadotrema sp., ?Acervulina sp.	Early-Middle Miocene (upper Te-lower Tf)
68691640 B	?Fl	?Tr	50	TS	Kauwol River	Lepidocyclina sp., Miogypsina (M.) sp., Elphidium sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
68691640 E	?Fl	?Tr	50	TS	Kauwol River	Austrotrillina striata/howchini, Miogypsina (M.) sp., soritid gen. indet., alveolinid gen. indet., Elphidium sp.	Early Miocene (late upper Te)
68691640 F	?Fl	?Tr	50	TS	Kauwol River	Austrotrillina sp., Miogypsina (M.) sp., sorited gen. indet., alveolinid gen. indet., Elphidium sp., miliolids	Early-Middle Miocene (upper Te-lower Tf)
68691642 B	Oc	Tr	28	TS	Bun River, Star Mountains	Lepidocyclina (E.) sp., Operculina sp., Heterostegina sp., Carpenteria sp., or Sporadotrema sp. (fragments)	Late Oligocene-Early Miocene (Te, undifferentiated)
68691643 B	Oc	Tr	8	TS	Bun River, Star Mountains	Lepidocyclina (N.) spp., Flosculinella globulosa, Austrotrillina striata/howchini, Miogypsina (M.) sp., Heterostegina sp., Elphidium sp., miliolids	Probably Early Miocene (late upper Te)
68691643 C	Oc	Tr	8	TS	Bun River, Star Mountains	Lepidocyclina sp., Miogypsina (M.) sp., Heterostegina sp., Operculina sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
68691644 A	Oc	Tr	3	TS	Bun River, Star Mountains	Lepidocyclina (E.) sp., Spiroclypeus sp., Elphidium sp.	Late Oligocene-Early Miocene (Te, undifferentiated)
68691644 B	Oc	Tr	3	TS	Bun River, Star Mountains	Austrotrillina striata/howchini, Flosculinella sp., ?Sorites sp., Elphidium sp., miliolids	Probably Early Miocene (late upper Te)
68691645 A-D	Oc	Tr	10	TS	Krom Creek	?Borelis sp., Heterostegina sp., soritid gen. indet., indeterminable smaller foraminifera	Indefinite; general Tertiary age only

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
68691646 A & B		Tr	114	TS	Not available	Austrotrillina striata/howchini, Borelis pygmaeus, Sorites sp., ?Flosculinella sp., indeterminable smaller foraminifera	Probably Early Miocene (late upper Te)
68691647 A	Fl	Tr	14	TS	Headwaters of Kauwol River	Lepidocyclina (E.) sp., Heterostegina sp., Elphidium sp., Carpenteria sp., or Sporadotrema sp., Operculina sp.	Late Oligocene-Early Miocene (Te, undifferentiated)
68691649	Fl	?Tr	123	TS	Kam River, headwaters of Ok Tedi	Borelis pygmaeus, Austrotrillina cf. striata, Elphidium sp., soritid genus (?Sorites) miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
68691650 A	Fl	?Tr	123	TS	Kam River, headwaters of Ok Tedi	Nummulites fichteli, Operculina sp., Amphistegina sp., Elphidium sp., ?Borelis sp., Heterostegina sp., miliolids	Early Oligocene (Tc)
68691651 B	Fl	?Tr	121	TS	Headwaters of Ok Tedi	Lepidocyclina (E.) cf. ephippioides, ?Borelis sp., Heterostegina sp., Elphidium sp., indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
68691651 C	Fl	?Tr	121	TS	Headwaters of Ok Tedi	Lepidocyclina (E.) sp., Borelis sp., Halkyardia sp., Heterostegina sp., Elphidium sp., Operculina sp.	Probably late Oligocene (lower Te)
04NG0501		Tr	204	TS	1 mile SW of Lake Kopiago field station	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Elphidium sp., miliolids, indeterminable smaller foraminifera	Early-middle Miocene (upper Te-lower Tf)
04NG0509	Oc	?Tr	189	TS	13 km west of Lake Kopiago	Amphistegina sp., Elphidium sp.	Indefinite; general Tertiary age only
04NG0514	Oc	?Tr	188	TS	13 km WNW of Lake Kopiago	Lepidocyclina (N.) ferreroi, L (N.) cf. parva, Miogypsina (M.) sp., Cycloclypeus sp., Elphidium sp., Amphistegina sp., indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf)
04NG0517	Fl	?Tr	157	TS	11 km WNW of Lake Kopiago	Nummulites sp., Discocyclina sp. (fragments), ?Borelis sp., ?Pararotalia sp. (abundant)	Early-Middle Eocene (Ta3-Tb)
04NG0518	Oc	?Tr	156	TS	12 km WNW of Lake Kopiago	Lepidocyclina (N.) cf. ferreroi, Miogypsina (M.) sp., Heterostegina sp., Gypsina sp., indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf)
04NG0519	Fl	?Tr	71	TS	Tributary of Om River, 20 km WNW of Lake Kopiago	Nummulites fichteli, Borelis sp., Heterostegina sp., Sporadotrema cf. cylindricum, indeterminable smaller foraminifera	Early Oligocene (Tc)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
04NG0523	Fl	?Tr	68	TS	Pebbles along Om River 24 km NW of Lake Kopiago	(a) Nummulites sp., Discocyclina sp. (b) Lepidocyclina (E.) cf. ephippioides, Spiroclypeus margaritatus, Miogypsina (Miogypsinoides) bantamensis/complanata	(a) Middle-Late Eocene (Ta3-Tb) (b) Late Oligocene (lower Te)
04NG1008	?	Tr	63	TS	3 km north of Telefomin	Spiroclypeus margaritatus, Lepidocyclina (E.) sp., Elphidium sp., Operculina sp., Carpenteria sp. or Sporadotrema sp., indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
04NG1009	?	Tr	64	TS	Sol River at Telefomin	Spiroclypeus margaritatus, Lepidocyclina (N.) sp., Operculina sp., Carpenteria sp. or Sporadotrema sp., miliolids and other indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
04NG1010	?	?Tmt	133	TS	2 km east of Feramin	Lepidocyclina sp., Miogypsina (M.) sp., Operculina sp., Carpenteria sp. or Sporadotrema sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
04NG1013	?	?Tmt	132	TS	8 km SE of Telefomin	Nummulites fichteli, Borelis sp., indeterminable smaller foraminifera	Early Oligocene (Tc)
--------	Oc	Tr	219	TS	Northern slopes of Mount Mabiom	Nummulitic limestone	Probably Early Oligocene (Tc) (Chawner, 1939)
--------	Oc	Tr	220	TS	NW slopes of Mount Karik	Nummulitic limestone	Probably Early Oligocene (Tc) (Zehnder & de Caen, 1955)
--------	Oc	Tma	234	WR	Headwaters of Carrington River	Planktonic foraminifera	Late Miocene (Zone N.16?-Zone N.18) (White, 1972)
P.4622	Oc	Tr	38	TS	Sik Creek	Lepidocyclina (E.) ephippioides, Heterostegina sp., Amphistegina sp., indeterminable smaller foraminifera	Late Oligocene (lower Te)
P.4623	Oc	Tr	38	TS	Sik Creek	Lepidocyclina sp. (subgen. indet.), Heterostegina sp., Amphistegina sp., indeterminable smaller foraminifera	General Middle Oligocene-Middle Miocene age only (Td-lower Tf)
P.4624	Oc	Tr	38	TS	Sik Creek	Lepidocyclina (E.) sp., Heterostegina sp.	Late Oligocene-Early Miocene (Te, undifferentiated)
P.4641	Fl	Tr	56	TS	12 km SW of Tifalmin	Nummulites fichteli, Operculina sp.	Early Oligocene (Tc)
P.4644	Fl	Tmt	124	WR	12 km SW of Tifalmin	Planktonic foraminifera (see Fig. 6)	General Miocene or younger age only

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
P.4645	Oc	Tr	125	TS	12 km SW of Tifalmin	Austrotrillina striata/howchini, Gypsina globulus, Borelis pygmaeus, Carpenteria sp. or Sporadotrema sp., ?Sorites sp., indeterminable smaller foraminifera	Top Early Miocene-Middle Miocene (late upper Te-lower Tf)
P.4648	Oc	Tmp	40	WR	Kulkul Creek	Planktonic foraminifera (see Fig. 6); Ammonia beccarii, Elphidium spp., Lagena sp.	General Miocene or younger age only
P.4652	Oc	Tmp	41	WR	Kulkul Creek	Planktonic foraminifera (see Fig. 6); Ammonia beccarii group	General Miocene or younger age only
P.4658	Oc	Tmt	11	WR	Lake Vivien	Praeorbulina transitoria, Globorotalia (T.) cf. siakensis (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4659	Oc	Tmt	11	WR	Lake Vivien	Praeorbulina transitoria, Globigerinoides spp. (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4660 B	Oc	Tmt	11	TS	Lake Vivien	Planktonic foraminifera including Praeorbulina glomerosa group, P. cf. sicana (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4661	Fl	Tr	11	TS	Lake Vivien	Lepidocyclina spp. (subgen. indet.), Miogypsina (M.) sp., Heterostegina sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4663	Oc	Tmt	11	WR	Lake Vivien	Praeorbulina glomerosa curva, P. sicana, Globigerinoides subquadratus (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4668	Fl	Tr	S1	TS	Ok Harom	Miogypsina (M.) sp., ?Flosculinella sp., Elphidium sp., Carpenteria sp. or Sporadotrema sp., miliolids, indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4669	Oc	Tr	89	TS	Ok Harom	Lepidocyclina sp. (subgen. indet.), Miogypsina (M.) sp., Elphidium sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4670	Oc	Tr	88	TS	Ok Harom	Miogypsina (M.) sp., Elphidium sp., Acervulina sp., Operculina sp., Amphistegina sp., Carpenteria sp. or Sporadotrema sp.	Early-Middle Miocene (upper Te-lower Tf)
P.4671	Oc	Tmp	88	TS	Ok Harom	Lepidocyclina sp. (subgen. indet.), Miogypsina (M.) sp., planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4674	Oc	Tr	87	TS	Ok Harom	Lepidocyclina (N.) sp., Elphidium, sp., indeterminable smaller foraminifera	Middle Oligocene-Middle Miocene (Td-lower Tf)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
P.4676	Oc	Tmp	82	WR	Ok Harom	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4677	Oc	Tmp	82	TS	Ok Harom	Lepidocyclina (N.) ferreroi, L. (N.) spp., Miogypsina (M.) sp., Amphistegina sp., Elphidium sp., Carpenteria sp. or Sporadotrema sp., planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf)
P.4678	Oc	Tr	82	TS	Ok Harom	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Planorbulina sp., Cycloclypeus (C.) sp., planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4679	Oc	Tr	82	TS	Ok Harom	Lepidocyclina sp. (subgen. indet.), Miogypsina (M.) sp., planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4680	Oc	Tr	82	TS	Ok Harom	Miogypsina (M.) sp., miliolids	Early-Middle Miocene (upper Te-lower Tf)
P.4681	Oc	Tr	81	TS	Ok Harom	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Elphidium sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4689	Oc	Tr	49	TS	Ok Harom	Sorites sp., miliolids, indeterminable smaller foraminifera	General Miocene or younger age only
P.4691	Fl	Tr	48	TS	Ok Harom	Miogypsina (M.) sp., Elphidium sp., Planorbulina sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4695	Oc	Tmp	45	WR	Ok Harom	Planktonic foraminifera (see Fig. 6)	Probably top of Early Miocene (Zone N.8)
P.4699	Oc	Tr	44	TS	Ok Harom	Lepidocyclina sp. (subgen. indet.), Miogypsina (M.) sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4700	Oc	Tr	43	TS	Ok Harom	Lepidocyclina (N.) ferreroi, L. sp., indeterminable smaller foraminifera	?Top Early Miocene-Middle Miocene (?late upper Te-lower Tf)
P.4703	Oc	Tmp	197	WR	Ok Gamik	Planktonic foraminifera (see Fig. 6)	Middle Miocene or younger (Zone N.9 or younger)
P.4716	Oc	Tpb	195	TS	Ok Gamik	Lepidocyclina (N.) sp., Spiroclypeus margaritatus, Miogypsina (Miogypsinoides) bantamensis/dehaarti, Amphistegina sp., Elphidium sp.	Early Miocene (upper Te)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
P.4749	Oc	Tmt	23	WR	North of Kumkom	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4756	Oc	Tmt	22	WR	North of Kumkom	cf. Praeorbulina transitoria	Probably top of Early Miocene (Zone N.8)
P.4775	Oc	Tr	58	TS	Tifalmin Valley	Lepidocyclina sp. (subgen. indet.); planktonic foraminifera (Globigerinidae)	Middle Oligocene-Middle Miocene (Td-lower Tf)
P.4776	Oc	Tr	57	TS	Tifalmin Valley	Lepidocyclina (N.) sp., Heterostegina sp., indeterminable smaller foraminifera	Middle Oligocene-Middle Miocene (Td-lower Tf)
P.4804	Oc	Tr	98	TS	East of Mount Fubilan	Miogypsina (M.) sp., Operculina sp., Elphidium sp.	Early-Middle Miocene (upper Te-lower Tf)
P.4811	Oc	Tr	99	TS	East of Mount Fubilan	Lepidocyclina sp. (subgen. indet.), Miogypsina (M.) sp., Operculina sp., Carpenteria sp. or Sporadotrema sp.	Early-Middle Miocene (upper Te-lower Tf)
P.4812	Oc	Tr	100	TS	East of Mount Fubilan	Lepidocyclina (N.) sp. or Miogypsina (M.) sp., Flosculinella bontangensis, Acervulina sp., Elphidium sp., indeterminable smaller foraminifera	Middle Miocene (lower Tf)
P.4814	Oc	Tr	101	TS	East of Mount Fubilan	Lepidocyclina sp. (subgen. indet.), Sorites sp., ?Borelis sp., Elphidium sp., miliolids	Late Oligocene-Middle Miocene (Te-lower Tf)
P.4816	Oc	Tr	108	TS	East of Mount Fubilan	Miogypsina (M.) sp., Operculina sp., rare planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4817	Oc	Tmp	108	WR	East of Mount Fubilan	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4818	Oc	Tr	108	TS	East of Mount Fubilan	Miogypsina (M.) sp., Planorbulina sp., Gypsina globulus, Operculina sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4819	Oc	Tmp	108	WR	East of Mount Fubilan	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N. 8)
P.4820	Oc	Tmp	108	WR	East of Mount Fubilan	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4825	Oc		104	WR	East of Mount Fubilan	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
P.4826	Oc	Tr	103	TS	East of Mount Fubilan	Miogypsina (M.) sp., Operculina sp., Elphidium sp., Amphistegina sp., Planorbulina sp.	Early-Middle Miocene (upper Te-lower Tf)
P.4827	Oc		102	TS	East of Mount Fubilan	Planktonic foraminifera (Globigerinidae, including Orbulina)	Middle Miocene or younger (Zone N.9 or younger)
P.4828	Oc	Tr	112	TS	East of Mount Fubilan	Miogypsina (M.) sp., Planorbulina sp., Amphistegina sp., Elphidium sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4832	Oc	Tr	116	TS	Ok Tedi	Lepidocyclina sp. (subgen. indet.), Elphidium sp., Amphistegina sp.	Middle Oligocene-Middle Miocene (Td-lower Tf)
P.4833	Oc	Tmt	117	WR	Ok Tedi	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N. 8)
P.4834	Oc	Tmt	118	WR	Ok Tedi	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N. 8)
P.4836	Oc	Tr	119	TS	Ok Tedi	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Amphistegina sp., planktonic foraminifera including Orbulina, indeterminable smaller foraminifera	Middle Miocene (lower Tf)
P.4838	Oc	Tr	120	TS	Ok Tedi	Lepidocyclina (N.) ferreroi, L. (N.) sp., Miogypsina (M.) sp., Carpenteria sp. or Sporadotrema sp., Cycloclypeus (Katacycloclypeus) sp., Amphistegina sp., Sorites sp., indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf)
P.4839	Oc	Tr	115	TS	Ok Tedi	Lepidocyclina (N.) ferreroi, L. (N.) sp., Miogypsina (M.) sp., Planorbulina sp., Operculina sp., Amphistegina sp., Elphidium sp., indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf)
P.4840	Oc	Tmp	115	WR	Ok Tedi	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4880	Oc	Tr	9	TS	Upper Bun River	Lepidocyclina (E.) sp., Spiroclypeus sp., Heterostegina sp.	Late Oligocene-Early Miocene (Te, undifferentiated)
P.4882	Oc	Tr	6	TS	Upper Bun River	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Elphidium sp., Operculina sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4883	Oc	Tr	5	TS	Upper Bun River	Miogypsina (M.) sp., ?Borelis sp., Austrotrillina cf. striata, Elphidium sp., Sorites sp.	Early-Middle Miocene (upper Te-lower Tf)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
P.4884	Oc	Tr	7	TS	Upper Bun River	Lepidocyclina (E.) ephippioides group	Probably Late Oligocene (lower Te)
P.4885	Oc	Tr	4	TS	Upper Bun River	Lepidocyclina sp. (subgen. indet.), Miogypsina (M.) sp., Elphidium sp., Amphistegina sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4916	Oc	Tr	30	TS	Unfin River	?Lepidocyclina sp. (subgen. indet.), Operculina sp., Elphidium sp.	Middle Oligocene-Middle Miocene (Td-lower Tf)
P.4919	Oc	Tmt	29	TS	Unfin River	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4932	Oc	Tmt	31	WR	Unfin River	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4934	Oc	Tmt	35	WR	Unfin River	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4935	Oc	Tmt	36	WR	Unfin River	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4948	Oc	Tmt	91	WR	Ok Harom	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
P.4973	Oc	Tmp	73	TS	6 km north of Mount Frew	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Sorites sp., Elphidium sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4974	Oc	Tmp	74	WR	6 km north of Mount Frew	Planktonic foraminifera (see Fig. 6)	Probably top of Early Miocene (Zone N.8)
P.4984	Oc	Tmp	83	TS	Upper Kwirok River	Miogypsina (M.) sp., Carpenteria sp. or Sporadotrema sp., miliolids, indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4986	Oc	Tmp	84	TS	Upper Kwirok River	Miogypsina (M.) sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.4989	Oc	Tmp	85	WR	Upper Kwirok River	Ammonia beccarii, indeterminable agglutinated foraminifera	General Miocene or younger age only
P.4992	Oc	Tmp	86	WR	Upper Kwirok River	Rare planktonic foraminifera (see Fig. 6)	Midddle Miocene or younger (Zone N.9 or younger)
P.5001	Oc	Tr	13	TS	Mount Capella	Lepidocyclina sp. (subgen. indet.), ?Miogypsina (M.) sp., Elphidium sp., miliolids, indeterminable smaller foraminifera	Probably Early to Middle Miocene (upper Te-lower Tf)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
P.5012	Oc	KTf	26	TS	Digiam River	Miogypsina (M.) sp., Austrotrillina striata/ howchini, Flosculinella sp., Sorites sp., Elphidium sp., miliolids	Top Early Miocene-Middle Miocene (late upper Te-lower Tf)
P.5016	Oc	Tr	17	TS	South of Mount Capella	Discocyclina sp., Aktinocyclina sp., Nummulites javanus, ?Operculina sp., rare planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Middle-Late Eocene (Ta3-Tb)
P.5017	Oc	Tr	16	TS	South of Mount Capella	Borelis pygmaeus, Austrotrillina striata, Gypsina globulus, Heterostegina sp., Elphidium sp., Operculina sp., miliolids	Late Oligocene-Early Miocene (Te, undifferentiated)
P.5019	Oc	Tr	15	TS	South of Mount Capella	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Amphistegina sp., Austrotrillina striata, Carpenteria sp. or Sporadotrema sp., Elphidium sp.	Early Miocene (upper Te)
P.5022	Oc	Tr	18	TS	South of Mount Capella	Miogypsina (M.) sp., Operculina sp., Carpenteria sp., or Sporadotrema sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.5023	Oc	Tr	19	TS	South of Mount Capella	Lepidocyclina sp. (subgen. indet.), Miogypsina (M.) sp., Operculina sp., planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	(Early-Middle Miocene (upper Te-lower Tf)
P.5024	Oc	Tr	20	TS	South of Mount Capella	Lepidocyclina sp. (subgen. indet.), Carpenteria sp. or Sporadotrema sp., ?Elphidium sp.	Middle Oligocene-Middle Miocene (Td-lower Tf)
P.5025	Oc	Tr	34	TS	Sukun River	Borelis pygmaeus, Cycloclypeus (C.) sp., Sorites sp., Heterostegina sp., rare planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
P.5027	Oc	Tr	32	TS	Sukun River	Spiroclypeus margaritatus, Borelis sp., Sorites sp., planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
P.5028	Oc	Tr	33	TS	Sukun River	Lepidocyclina (N.) sp., Operculina sp., Borelis sp., miliolids, indeterminable smaller foraminifera	Middle Oligocene-Middle Miocene (Td-lower Tf)
P.5080	Oc	Tr	2	TS	Bun River	Lepidocyclina sp. (subgen. indet.), Elphidium sp.	Middle Oligocene-Middle Miocene (Td-lower Tf)
P.5142	Oc	Tr	194	TS	Ok Menga	Lepidocyclina (N.) sp., planktonic foraminifera (Globigerinidae), including Orbulina, indeterminable smaller foraminifera	Middle Miocene (lower Tf)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
P.5669	Oc	Tr	62	TS	Sepik Gorge, downstream from the Sepik-Elam confluence	Lepidocyclina (E.) ephippioides, Heterostegina sp., Gypsina globulus, Elphidium sp., indeterminable smaller foraminifera	Oligocene (lower Te)
P.5670	Oc	Tr	61	TS	Just downstream from the Elam-Anfin confluence	Nummulites fichteli (abundant), Operculina sp., very rare planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Early Oligocene (Tc)
76294156	Oc	Tmp	163	WR	Northern tributary of Ok Mani near Mount Robinson	Planktonic foraminifera (see Fig. 6)	Middle Miocene or younger (Zone N.9 or younger)
76294157	Oc	Tmp	162	WR	Northern tributary of Ok Mani near Mount Robinson	Planktonic foraminifera (see Fig. 6)	Early-Middle Miocene (Zone N.6 - Zone N.14)
76294158	Oc	Tr	97	TS	Northern tributary of Ok Mani near Mount Robinson	Lepidocyclina (N.) sp., Cycloclypeus (C.) sp., Miogypsina (M.) sp., Amphistegina sp., Carpenteria sp. or Sporadotrema sp.	Early-Middle Miocene (upper Te-lower Tf)
76294159	Oc	Tr	105	TS	Northern tributary of Ok Mani near Mount Robinson	Lepidocyclina (N.) sp., Miogypsina (M.) sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
76294179	Oc	Tr	193	TS	Ok Menga Gorge	Lepidocyclina (N.) ferreroi, L. (N.) sp., Miogypsina (M.) sp., Cycloclypeus (C.) sp., Elphidium sp., Carpenteria sp. or Sporadotrema sp., planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Early-Middle Miocene (late upper Te-lower Tf)
76294183	Oc	Tmp	80	TS	Northerly tributary of Kwirok River	Lepidocyclina sp. (subgen. indet.), ?Miogypsina (M.) sp., Amphistegina sp., planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Probably Early-Middle Miocene (upper Te-lower Tf)
76294192	Oc	Tr	25	TS	Futik River	Austrotrillina striata, Borelis sp., indeterminable smaller foraminifera	Late middle Oligocene-Early Miocene (upper Td-Te)
76294196	Oc	Tr	54	TS	Felim River	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Operculina sp., Elphidium sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
76294197	Oc	Tr	21	TS	Elam River	Spiroclypeus margaritatus, Lepidocyclina sp. (subgen. indet.), Carpenteria sp. or Sporadotrema sp., alveolinid genus indet., miliolids, indeterminable smaller foraminifera	Late Oligocene-Early Miocene (Te, undifferentiated)
76294199	Oc	Tmt	55	WR	Elam River	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
76294201	Oc	Tmt	53	WR	Felim River	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
76294203	Oc	Tmt	52	WR	Felim River	Planktonic foraminifera (see Fig. 6)	Top of Early Miocene (Zone N.8)
76294225	Oc	Tmr	159	WR	Headwaters of Ok Tarim	Cellanthus craticulatus, Marginopora sp., Sigmoidella elegantissima, Ammonia sp., Planorbulina sp.	General Miocene or younger age only

APPENDIX 2

FAUNAL LIST OF SAMPLES FROM THE

WABAG 1:250 000 SHEET AREA

LEGEND

Tma	=	Aure Group
Tmb	=	Burgers Formation
Tmc	=	Laialam Limestone
Tmt	=	Tarua Volcanics
Tmo	=	Orubadi Formation
Tmm	=	Mala Limestone
Tml	=	Lai Siltstone
Tomc) Toms)	=	Kera Formation
Tr	=	Darai Limestone
Tem	=	Mendi Group
Ten	=	Nebilyer Limestone
Tet	=	Tongul Calcilutite
Tev	=	Salumei Formation, part
Ta	=	unnamed Late Paleocene
KTsm	=	Salumei Formation
KTq	=	unnamed Late Cretaceous to Late Eocene
Kuc	=	Chim Formation
TS	=	Thin section
WR	=	Washed residue
Oc	=	Outcrop
Fl	=	Float
Cl	=	Float close to outcrop

FAUNAL LIST OF SAMPLES FROM THE WABAG 1:250 000 SHEET AREA

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
0294	Fl	KTsm	3	TS	Northern tributary of Lagaip River, NNW of Porgera	Rare agglutinated smaller foraminifera; abundant radiolaria	Indefinite
0295	Fl	KTsm	3	TS	Northern tributary of Lagaip River, NNW of Porgera	Abundant planktonic foraminifera - Morozovella spp., Truncorotaloides spp.	Middle Eocene
0389	Fl	Tml	23	TS	Creek east of Lake Kopiago airstrip	Very small indeterminable benthonic foraminifera	Indefinite
0390	Fl	Tml	23	TS	Creek east of Lake Kopiago airstrip	Soritid gen. indet., Elphidium sp., ?Anomalinella sp., miliolids, small planktonic foraminifera (Globigerinidae), and other indeterminable smaller foraminifera	Miocene or younger age only
0391	Fl	Tml	23	TS	Creek east of Lake Kopiago airstrip	Rare planktonic foraminifera (Globigerinidae); rare indeterminable benthonic smaller foraminifera	Indefinite; general Tertiary age only
0466	Oc	Tml	24	TS	Creek east of Lake Kopiago airstrip	Cellanthus sp., Operculina sp., indeterminable smaller foraminifera	Miocene or younger age only
0469	Oc	Tml	24	TS	Creek east of Lake Kopiago airstrip	Rare planktonic foraminifera (Globigerinidae); rare indeterminable benthonic smaller foraminifera	Indefinite; general Tertiary age only
0470	Oc	Tml	24	WR	Creek east of Lake Kopiago airstrip	Cellanthus craticulatus, Operculina sp.	Miocene or younger age only (?Pliocene or younger)
0471	Oc	Tml	24	WR	Creek east of Lake Kopiago airstrip	Cellanthus craticulatus, Operculina sp.	Miocene or younger age only (?Pliocene or younger)
0476	Oc	Tml	24	WR	Creek east of Lake Kopiago airstrip	?Ammonia sp.	Indefinite
0480	Oc	Tml	24	WR	Creek east of Lake Kopiago airstrip	Planktonic foraminifera, including Orbulina (see Fig. 16); benthonic smaller foraminifera	Not older than Middle Miocene (Zone N.9)
0482	Oc	Tml	24	WR	Creek east of Lake Kopiago airstrip	Elphidium sp., ?Ammonia sp.	Miocene or younger age only
0483	Oc	Tml	24	WR	Creek east of Lake Kopiago airstrip	Elphidium sp., ?Marginopora sp. (fragment)	Miocene or younger age only
0484	Oc	Tml	24	TS	Creek east of Lake Kopiago airstrip	Pyrgo sp., Triloculina cf. tricarinata	Miocene or younger age only
0485	Oc	Tml	24	WR	Creek east of Lake Kopiago airstrip	Planktonic foraminifera, including Orbulina (see Fig. 16); benthonic smaller foraminifera	Not older than Middle Miocene (Zone N.9)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
0486	Oc	Tml	24	WR	Creek east of Lake Kopiago airstrip	Planktonic foraminifera, including Orbulina (see Fig. 16); benthonic smaller foraminifera	Not older than Middle Miocene (Zone N.9)
0686	Oc	Tr	27	TS	Yerinda area, south of Logaiyu River	(a) Lepidocyclina (N.) sp., Miogypsina (M.) sp., Borelis sp., Austrotrillina cf. striata, Elphidium sp., Planorbulinella sp., Carpenteria sp., or Sporadotrema sp., Amphistegena sp., rare planktonic foraminifera (Globigerinidae), indeterminable benthonic smaller foraminifera (b) Lepidocyclina (?N.) sp., soritid genus indeterminable, Amphistegina sp., rare planktonic foraminifera (Globigerinidae), indeterminable benthonic smaller foraminifera	(a) Early Miocene (upper Te) (b) Probably Early-Middle Miocene (upper Te-lower Tf)
0687	Oc	Tr	28	TS	Yerinda area, south of Logaiyu River	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Planorbulinella sp., Amphistegina sp., Elphidium sp.	Early-Middle Miocene (upper Te-lower Tf)
0689	Oc	Tr	29	TS	Yerinda area, south of Logaiyu River	Amphistegina sp., ?Borelis sp.	Indefinite
0690	Fl	Tr	30	TS	Yerinda area, south of Logaiyu River	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Cycloclypeus sp., Elphidium sp., Amphistegina sp.	Early-Middle Miocene (upper Te-lower Tf)
0691	Oc	Tr	30	TS	Yerinda area, south of Logaiyu River	Lepidocyclina sp., Miogypsina (M.) sp., Amphistegina sp., Elphidium sp., Planorbulinella sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
0694	Oc	Tr	31	TS	Yerinda area, south of Logaiyu River	Lepidocyclina (N.) sp., Austrotrillina sp., Miogypsina (M.) thecideaeformis, Operculina sp.	Early-Middle Miocene (upper Te-lower Tf)
0695	Oc	Tr	31	TS	Yerinda area, south of Logaiyu River	Lepidocyclina sp., Miogypsina (M.) sp., Operculina sp.	Early-middle Miocene (upper Te-lower Tf)
0697	Oc	Tr	32	TS	Yerinda area, south of Logaiyu River	Nummulites fichteli, Borelis sp., Halkyardia sp., miliolids and other indeterminable smaller foraminifera	Early Oligocene (Tc)
1008	Fl	Ktsm	2	TS	North tributary of Lagaip River north-northwest of Porgera	Abundant planktonic foraminifera (Globigerinidae, Morozovella spp.)	Late middle to Late Paleocene (P.4-P.5).
1100	Oc	Tmo	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Rare, poorly preserved benthonic smaller foraminifera; Neoeponides sp., Lenticulina sp.	General younger Tertiary age only
1101	Oc	Tmo	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Rare planktonic foraminifera including Orbulina universa; rare benthonic smaller foraminifera	Not older than Middle Miocene (Zone N.9)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1102	Oc	Tmo	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Rare poorly preserved benthonic smaller foraminifera; Ammonia sp., Cellanthus sp.	Miocene or younger age only (?Pliocene or younger)
1103	Oc	Tmo	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Rare planktonic foraminifera, including Orbulina (see Fig. 16). Benthonic smaller foraminifera - Ammonia sp., Cellanthus craticulatus, ?Sorites sp.	Miocene or younger age only (?Pliocene or younger)
1104	Oc	Tmo	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Rare, poorly preserved benthonic smaller foraminifera; Ammonia sp., Cellanthus sp.	Miocene or younger age only (?Pliocene or younger)
1105	Oc	Tmo	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Rare poorly preserved benthonic smaller foraminifera; Cellanthus craticulatus, Ammonia sp.	Miocene or younger age only (?Pliocene or younger)
1106	Oc	Tmm	26	TS	Section on tributary of Pori River, east-northeast of Lake Kopiago	Lepidocyclina sp., Elphidium sp., Amphistegina sp., Gypsina sp. Planorbulina sp., rare planktonic foraminifera (Globigerinidae)	Middle Oligocene-Middle Miocene (Td-lower Tf)
1107	Oc	Tmm	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Planktonic foraminifera, including Orbulina (see Fig. 16); also Cellanthus craticulatus and Operculina sp.	Not older than Middle Miocene (possibly Pliocene or younger)
1108	Oc	Tmo	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Planktonic foraminifera, including Orbulina (see Fig. 16)	Not older than Middle Miocene (Zone N.9)
1109	Oc	Tmo	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Planktonic foraminifera, including Orbulina (see Fig. 16)	Not older than Middle Miocene (Zone N.9)
1110	Oc	Tmo	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Planktonic foraminifera, including Orbulina (see Fig. 16)	Not older than Middle Miocene (Zone N.9)
1115	Oc	Tmm	26	TS	Section on tributary of Pori River, east-northeast of Lake Kopiago	Elphidium sp., Amphistegina sp., soritid gen. indet., miliolids	General Miocene or younger age only
1116	Oc	Tmm	26	TS	Section on tributary of Pori River, east-northeast of Lake Kopiago	Elphidium sp., indeterminable benthonic smaller foraminifera	Indefinite
1117	Oc	Tmm	26	TS	Section on tributary of Pori River, east-northeast of Lake Kopiago	Operculina sp., Elphidium sp., indeterminable benthonic smaller foraminifera	Indefinite

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1118	Oc	Tmm	26	TS	Section on tributary of Pori River, east-northeast of Lake Kopiago	Operculina sp., Sorites sp., Elphidium sp., alveolinid genus (?Borelis)	General Miocene or younger ag only
1119	Oc	Tml	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Benthonic smaller foraminifera; Operculina sp., Elphidium sp.	General Miocene or younger ag only
1120	Oc	Tml	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Rare benthonic foraminifera; Operculina sp.	Indefinite; general Tertiary age only
1121	Oc	Tml	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Planktonic foraminifera, including Orbulina (see Fig. 16)	Not older than Middle Miocene (Zone N.9)
1122	Oc	Tml	26	WR	Section on tributary of Pori River, east-northeast of Lake Kopiago	Planktonic foraminifera, including Orbulina (see Fig. 16)	Not older than Middle Miocene (Zone N.9)
1473	Oc	Tmb	76	WR	Sul River	Planktonic foraminifera, including Orbulina (see Fig. 16)	Not older than Middle Miocene (Zone N.9)
1474	Oc	Tmb	76	WR	Sul River	Planktonic foraminifera (see Fig. 16)	General Miocene age only
1475	Oc	Tmb	75	WR	Sul River	Planktonic foraminifera, including Orbulina (see Fig. 16)	Not older than middle Miocene (Zone N.9)
1478	Oc	Tmb	74	WR	Sul River, north of Laiagam	Planktonic foraminifera (see Fig. 16)	Late Miocene (Zone N.17-Zone N.18)
1524	Fl	KTsm	1	TS	Western tributary, Salumei River, 5°01'S, 142°55'E	Abundant planktonic foraminifera (Globigerinidae, rare keeled Globorotaliidae (?Morozovella spp.))	Middle Eocene
1525	Fl	KTsm	1	TS	Western tributary, Salumei River, 5°01'S, 142°55'E	Planktonic foraminifera (Truncorotaloides spp., ?Globigerapsis sp.)	Middle Eocene
1532	Oc	Tet	43	TS	Mount Tongul, 5°18'S, 143°12'E	Planktonic foraminifera, mainly globigerinid fragments	Indefinite; Middle Eocene on association with 1534, 1536
1534	Oc	Tet	43	TS	Mount Tongul, 5°18'S,, 143°12'E	Abundant planktonic foraminifera (Truncorotaloides spp., ?Globigerapsis sp.)	Middle Eocene
1536	Oc	Tet	43	TS	Mount Tongul, 5°18'S, 143°12'E	Abundant planktonic foraminifera (Truncorotaloides spp., Morozovella spp., Globigerinidae)	Middle Eocene

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
1567	Oc	Tmo	165	WR	Cecilia River headwaters	Planktonic foraminifera (see Fig. 16)	Miocene or younger age only
2646	Oc	Tma	123	WR	South of Laiagam	Planktonic foraminifera (see Fig. 16)	Early Miocene (Zone N.8)
2647	Oc	Tomc?	122	TS	South of Laiagam	Globigerinidae, Heterohelicidae	Indefinite
2648	Oc	Toms	120	WR	South of Laiagam	Planktonic foraminifera (see Fig. 16)	Late Oligocene-Early Miocene (late Zone N.3-Zone N.4.)
2650	Oc	Toms	129	TS	South of Laiagam	Abundant planktonic foraminifera (see Fig. 16)	Late Oligocene-Early Miocene (late Zone N.3-Zone N.4)
2651	Oc	Tomc	129	TS	South of Laiagam	Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
2653	Oc	Tma	129	WR	South of Laiagam	Small planktonic foraminifera (see Fig. 16)	Late Miocene or younger age only
2654	Oc	Tma	129	WR	South of Laiagam	Planktonic foraminifera (Globigerinidae, unidentifiable)	General Miocene or younger age only
2655	Oc	Tma	129	WR	South of Laiagam	Planktonic foraminifera (Globigerinidae, unidentifiable)	General Miocene or younger age only
2656	Oc	Tma	129	TS	South of Laiagam	Planktonic foraminifera (Globigerinidae, unidentifiable)	General Miocene or younger age only
2657	Oc	Tma	130	TS	South of Laiagam	Abundant small planktonic foraminifera (Globigerinidae, unidentifiable)	General Miocene or younger age only
2658	Oc	Tomc	131	WR	South of Laiagam	Planktonic foraminifera (see Fig. 16)	Early Miocene (Zone No.4-Zone N.6)
2659	Oc	Tomc	132	WR	South of Laiagam	Planktonic foraminifera (see Fig. 16)	Early Miocene (Zone No.4-Zone N.6)
2660	Oc	Tomc?	133	WR	South of Laiagam	Planktonic foraminifera (Globigerinidae, unidentifiable)	General Miocene or younger age only
2661	Oc	Tma	134	WR	South of Laiagam	Planktonic foraminifera (Globigerinidae, unidentifiable)	General Miocene or younger age only
2662	Oc	Tma	135	WR	South of Laiagam	Rare planktonic foraminifera, including Orbulina	Not older than Middle Miocene (Zone N.9)
2664	Oc	Tma	141	WR	East tributary of Lai River NE of Kandep	Rare planktonic foraminifera, including Orbulina	Not older than Middle Miocene (Zone N.9)
2665	Oc	Tma	141	WR	East tributary of Lai River NE of Kandep	Rare planktonic foraminifera, including Orbulina	Not older than Middle Miocene (Zone N.9)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
2668	Oc	Tma	170	WR	East tributary of Lai River NE of Kandep	Planktonic foraminifera, including Orbulina (see Fig. 16)	Not older than Middle Miocene (Zone N.9)
2670	Oc	Tma	169	TS	East tributary of Lai River NE of Kandep	Abundant planktonic foraminifera (Globigerinidae, unidentifiable)	Indefinite; fauna not diagnostic
2671	Oc	Toms	168	WR	East tributary of Lai River NE of Kandep	Planktonic foraminifera (see Fig. 16)	Late Oligocene-Early Miocene (Zone N.3-Zone N.4)
2672	Oc	Toms	140	WR	East tributary of Lai River NE of Kandep	Planktonic foraminifera (see Fig. 16)	General Oligocene age only (Zone P.19-Zone N.3)
2674	Oc	Toms	139	TS	East tributary of Lai River NE of Kandep	Planktonic foraminifera (small Globigerinidae and Heterohelicidae)	Probably Late Oligocene-Early Miocene
2675	Oc	Tomc	137	TS	East tributary of Lai River NE of Kandep	Planktonic foraminifera (see Fig. 16)	Probably Late Oligocene-Early Miocene (Zone N.3 - Zone N.4)
2676	Oc	Tomc	128	TS	More northerly tributary of Lai River, north of Kandep	Planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
2677	Oc	Tomc	127	TS	More northerly tributary of Lai River, north of Kandep	Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
2678	Oc	Tomc	126	TS	More northerly tributary of Lai River north of Kandep	Abundant planktonic foraminifera (Globigerinidae)	Probably Late Oligocene-Early Miocene
2679	Oc	Tomc	125	WR	More northerly tributary of Lai River north of Kandep	Planktonic foraminifera (see Fig. 16).	Late Oligocene-Early Miocene (Zone N.3-Zone N.4)
2680	Oc	Tomc	124	TS	More northerly tributary of Lai River north of Kandep	Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
2685	Oc	Tma	84	WR	SE of Lake Inim	Planktonic foraminifera (see Fig. 16)	General Miocene age only
2696	Fl	Tr	92	TS		Nummulites fichteli, Borelis sp., Operculina sp., Carpenteria sp. or Sporadotrema sp., miliolids	Early Oligocene (Tc)
2700	Fl	Tr	94	TS		Lepidocyclina cf. ephippioides, Operculina sp., Heterostegina sp., indeterminable smaller foraminifera	Probably Late Oligocene (lower Te)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
2701	Fl	Tr	93	TS		Lepidocyclina sp., Sorites sp., ?Operculina sp.	Late Oligocene-Middle Miocene (Te-lower Tf)
3299	Fl	Tr	34	TS		Lepidocyclina (E.) sp., Spiroclypeus margaritatus, Miogypsina (M.) sp., M. (Miogypsinoides) dehaarti, Heterostegina sp., Elphidium sp., Amphistegina sp., Cycloclypeus (C.) sp., Carpenteria sp. or Sporadotrema sp., Planorbulinella sp.	Early Miocene (upper Te)
3386	Oc	Tr	21	TS	Ridge east of Lake Kopiago	Lepidocyclina sp., Miogypsina (M.) sp., Austrotrillina striata/howchini, Flosculinella sp., Sorites sp., Heterostegina sp., miliolids	Early Miocene (late upper Te)
5195	Fl	Tomc	6	TS	South side of Burgers Mountain	Planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
6005	Oc	Tmb	15	WR	4 km NE of Yeim Village	Operculina sp.	Indefinite; general Tertiary age only
6058	Oc	Tr	22	TS	North side of limestone ridge, east of Lake Kopiago, 5°23'S, 142°31'E	Austrotrillina cf. striata, Sorites sp., Elphidium sp., miliolids	Late Oligocene-Early Miocene (Te, undifferentiated)
6060	Oc	Tml	22	WR	North side of limestone ridge, east of Lake Kopiago, 5°23'S, 142°31'E	Planktonic foraminifera (see Fig. 16)	Early Middle Miocene (Zone N.9)
6061	Oc	Tml	22	WR	North side of limestone ridge, east of Lake Kopiago, 5°23'S, 142°31'E	Planktonic foraminifera (see Fig. 16)	Early Middle Miocene (Zone N.9)
6062	Oc	Tml?	22	WR	North side of limestone ridge, east of Lake Kopiago, 5°23'S, 142°31'E	Planktonic foraminifera (see Fig. 16)	Early Middle Miocene (Zone N.9)
6064	Oc	Tr	22	TS	North side of limestone ridge, east of Lake Kopiago, 5°23'S, 142°31'E	Lepidocyclina (?N.) sp. Miogypsina (M.) sp., Amphistegina sp., planktonic foraminifera (Globigerinidae) and indeterminable benthonic smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
6065	Oc	Tr	22	TS	South side of ridge east of Lake Kopiago	Lepidocyclina sp., Miogypsina (M.) sp., Elphidium sp., Operculina sp.	Early-Middle Miocene (upper Te-lower Tf)
6066	Oc	Tr	22	TS	South side of ridge east of Lake Kopiago	Elphidium sp., ?Planorbulina sp., indeterminable smaller foraminifera	General Tertiary age only
8009	Oc	Tmc	25	WR	Kundupwa Creek, east of Lake Kopiago	Elphidium sp., ?Pararotalia sp., "Eponides" sp.	General Tertiary age only

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
8029	Oc	Tmc	86	TS	Headwaters of Wali Creek	Miogypsina (M.) sp., Carpenteria sp. or Sporadotrema sp.	Early-Middle Miocene (upper Te-lower Tf)
8031	Fl	Tmt	86	WR	Headwaters of Wali Creek	Planktonic foraminifera, including Orbulina	Not older than Middle Miocene (Zone N.9)
8034	Oc	Tml	99	WR		Planktonic foraminifera (see Fig. 16)	Early Miocene (Zone N.8)
8035	Oc	Tml	98	WR		Planktonic foraminifera (see Fig. 16)	Early Miocene (Zone N.6-Zone N.7)
8036	Oc	Tml	98	WR		Planktonic foraminifera (see Fig. 16)	Early-Middle Miocene (Zone N.5-Zone N.12)
8037	Oc	Tr	52	TS	East of Mount Kaijende	Sorites sp., Elphidium sp., ?Flosculinella sp.	Early-Middle Miocene (upper Te-lower Tf)
8039	Oc	Tml	106	TS	Section of limestone and shale interbeds, SE of Mount Kaijende	Planktonic foraminifera (Globigerinidae); benthonic smaller foraminifera	General Miocene age only
8040	Oc	Tml	106	WR	Section of limestone and shale interbeds, SE of Mount Kaijende	Miogypsina (M.) sp., planktonic foraminifera (see Fig. 16); benthonic smaller foraminifera	Early Miocene (Zone N.8)
8041	Oc	Tml	106	TS	Section of limestone and shale interbeds, SE of Mount Kaijende	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Planorbulina sp., Amphistegina sp., planktonic foraminifera (Globigerinidae); indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
8042	Oc	Tml	106	WR	Section of limestone and shale interbeds, SE of Mount Kaijende	Lepidocyclina (N.) howchini group, Miogypsina (M.) sp., planktonic foraminifera (see Fig. 16)	Early Miocene (Zone N.8); upper Te-lower Tf (?larger foraminiferal fauna reworked)
8043	Oc	Tml	106	WR	Section of limestone and shale interbeds, SE of Mount Kaijende	Planktonic foraminifera (see Fig. 16)	Early Miocene (Zone N.8)
8046	Oc	Tml	111	WR	Wage River	Planktonic foraminifera (see Fig. 16)	Not older than Middle Miocene (Zone N.9)
8047	Oc	Tml	110	WR	Wage River	Planktonic foraminifera (see Fig. 16)	Early Miocene (Zone N.8)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
8048	Oc	Tr	110	TS	Wage River	Lepidocyclina (N.) spp., Miogypsina (M.) sp., Cycloclypeus (Katacycloclypeus) cf. annulatus, Carpenteria sp. or Sporadotrema sp., Elphidium sp., Sorites sp., Operculina sp., planktonic foraminifera (Globigerinidae), indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
8049	Oc	Tml	109	WR	Wage River	Planktonic foraminifera (see Fig. 16)	Early Middle Miocene (basal Zone N.9)
8050	Oc	Tml	109	WR	Wage River	Planktonic foraminifera, including Orbulina	Not older than Middle Miocene (Zone N.9)
8060	Oc	Tma	175	WR	East of Tambul	Planktonic foraminifera (see Fig. 16)	General Miocene age only
8084	Oc	Kuc	112	WR	Kera River	Planktonic foraminifera (see Fig. 16)	Early Paleocene (P.2-P.3)
8085	Oc	Tem	113	TS	Kera River	Planktonic foraminifera (Truncorotaloides spp., Morozovella spp., cf. Globigerinatheka sp.)	Middle Eocene
8087	Oc	Tomc	67	TS	Ridge NW of Laiagam	Planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
P.1	Cl	Tev	4	TS	East of Mount Tangoro Central Range	Planktonic foraminifera (Globigerinidae)	Indefinite
8093	Cl	Tev	4	TS	East of Mount Tangoro Central Range	Planktonic foraminifera (Morozovella spp., ?Truncorotaloides spp.)	Middle Eocene
8094	Cl	Tev	4	TS	East of Mount Tangoro Central Range	Planktonic foraminifera (Globigerinidae)	Indefinite
8095	Cl	Tev	4	TS	East of Mount Tangoro Central Range	Planktonic foraminifera (Morozovella spp., Truncorotaloides spp., cf. Globigerinatheka sp.)	Middle Eocene
8096	Cl	KTq	5	TS	Tonopa Creek, NW of Laiagam	Abundant, usually small planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
8097	Cl	KTq	5	TS	Tonopa Creek, NW of Laiagam	Abundant planktonic foraminifera (Morozovella spp., cf. Truncorotaloides sp., Globigerinidae)	Middle Eocene
8098	Cl	KTq	5	TS	Tonopa Creek, NW of Laiagam	Abundant planktonic foraminifera (Truncorotaloides spp., cf. Morozovella sp. (very rare), Globigerinidae)	Middle Eocene
8099	Cl	KTq	5	TS	Tonopa Creek, NW of Laiagam	Abundant planktonic foraminifera (Truncorotaloides spp., Globigerinidae)	Middle Eocene

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
8100	Cl	KTq	5	TS	Tonopa Creek, NW of Laiagam	Abundant, usually small, planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
8101	Cl	KTq	5	TS	Tonopa Creek, NW of Laiagam	Abundant, usually small, planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
8105	Cl	Tomc	11	TS	Landslide west of Yeim	Abundant small planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
8107	Fl	Tomc	14	TS	South of Yeim, north of Mount Tongul	Abundant usually small planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
8108	Fl	Tomc	14	TS	South of Yeim, north of Mount Tongul	Abundant usually small planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
8111	Oc	Tomc	50	TS	Knob east of Mount Tongul	Abundant small planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
8112	Oc	Tet	50	TS	Knob east of Mount Tongul	Abundant planktonic foraminifera (Morozovella spp., Truncorotaloides sp., cf. Globigerinatheka)	Middle Eocene
8113	Oc	Tet	50	TS	Knob east of Mount Tongul	Abundant planktonic foraminifera (Morozovella spp., Truncorotaloides spp.)	Middle Eocene
8114	Oc	Tomc	50	TS	Knob east of Mount Tongul	Abundant usually small planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
8115	Oc	Ten	158	TS	Near Pawari	Abundant planktonic foraminifera, poorly preserved (cf. Morozovella, Globigerinidae)	Middle Eocene
8117	Oc	Tmc	162	TS	NE of Wapenamanda	Miogypsina (M.) sp., Elphidium sp., Carpenteria sp. or Sporadotrema sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
8119	Fl	Tmb	159	WR	NE of Wapenamanda	Elphidium spp.	General Tertiary age only
8133	Oc	Tomc	154	TS	Tsak Valley limestone ridge	Abundant, usually small, planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
8135	Oc	Toms	121	TS	Ridge south of Laiagam	Planktonic foraminifera, poorly preserved (possible Truncorotaloides types)	Indefinite; possibly Middle Eocene
8136	Cl	Tem	47	WR	Pendelip Creek	Planktonic foraminifera (see Fig. 16)	Late middle-Late Paleocene (P.4-P.5)
8138	Cl	Tem	47	TS	Pendelip Creek	Abundant planktonic foraminifera (Morozovella spp., Truncorotaloides spp., Heterohelicidae (very rare))	Middle Eocene
8139	Cl	Tem	46	TS	Pendelip Creek	Abundant planktonic foraminifera (Morozovella spp., Truncorotaloides spp., cf. Globigerinatheka)	Middle Eocene

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
8141	Cl	Tem	46	TS	Pendelip Creek	Abundant planktonic foraminifera (Morozovella spp., Truncorotaloides spp.)	Middle Eocene
8142	Cl	Tem	35	WR	East tributary of Porgera River	Abundant planktonic foraminifera (see Fig. 16)	Late middle-Late Paleocene (P.4-P.5)
8143	Cl	Tomc	35	TS	East tributary of Porgera River	Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
8143A	Cl	Tem	35	TS	Pendelip Creek	Abundant planktonic foraminifera (Morozovella spp., Truncorotaloides spp.)	Middle Eocene
8145	Fl	Tem	49	TS	Pendelip Creek	No foraminifera found; bands with abundant radiolaria and sponge spicules only	?Middle Eocene
8146	Fl	Tem	49	TS	Pendelip Creek	Abundant planktonic foraminifera (Morozovella spp., Truncorotaloides spp.)	Middle Eocene
9003	Fl	Tmb	58	WR	Pendelip Creek	Planktonic foraminifera (see Fig. 16)	General Miocene age only
9030	Fl	Tomc	143	TS	Headwaters of Lagaip River, 2 km NE of Kepilam	Abundant, usually small, planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
9031	Oc	Tma	148	WR		Planktonic foraminifera (see Fig. 16)	Not older than Middle Miocene (Zone N.9).
9032	Oc	Tma	148	TS		Planktonic foraminifera, including Orbulina	Not older than Middle Miocene (Zone N.9).
9036A-B	Oc	Tomc	60	TS	Tributary of Lagaip River, 11 km NW of Laiagam	Abundant, usually small, planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
9039	Oc	Ta	65	WR		Planktonic foraminifera (see Fig. 16)	Late middle-Late Paleocene (P.4-P.5)
9040	Oc	Tem	64	WR		Planktonic foraminifera (see Fig. 16)	Middle Eocene
9041	Oc	Ta	63	WR		Planktonic foraminifera (see Fig. 16)	Late middle-Late Paleocene (P.4-P.5)
9042	Oc	Ta	62	WR		Planktonic foraminifera (see Fig. 16)	Late middle-Late Paleocene (P.4-P.5)
9044	Oc		61	WR		Planktonic foraminifera (see Fig. 16)	Middle Eocene (P.11)
9045	Oc	Tomc	115	TS	South of Laiagam	Abundant planktonic foraminifera (Globigerinidae)	Indefinite
9047	Oc	Tomc	73	TS	5 km west of Laiagam	Abundant, usually small, planktonic foraminifera (Globigerinidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
9048	Oc	Tomc	72	TS	5 km west of Laiagam	Abundant, usually small, planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia); radiolaria present	Probably Late Oligocene-Early Miocene
9049	Oc	Tomc	71	TS	4 km west of Laiagam	Abundant, usually small, planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
9050	Oc	Tomc	70	TS	4 km west of Laiagam	Abundant, usually small, planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia); rare radiolaria	Probably Late Oligocene-Early Miocene
9051	Oc	Tem	69	WR		Abundant planktonic foraminifera (see Fig. 16)	Middle Eocene (P.10-P.11)
9052	Oc	Tomc?	117	TS	1.5 km west of Laiagam	Abundant small planktonic foraminifera (Globigerinidae)	Indefinite
9054	Oc	Tomc	56	WR		Planktonic foraminifera (see Fig. 16)	Late Oligocene-Early Miocene (Zone N.3-Zone N.4)
9055	Oc	Tomc	57	TS	Lower Kera River, 12 km WNW of Laiagam	Abundant planktonic foraminifera (Globigerinidae (incl. ?Globigerinatheka or ?Globigerinoita); ?Berggrenia)	Probably Late Oligocene-Early Miocene
9056	Oc	Tomc	57	TS	Lower Kera River, 12 km WNW of Laiagam	Abundant small planktonic foraminifera (Globigerinidae, ?Berggrenia); rare radiolaria	Probably Late Oligocene-Early Miocene
9057	Oc	Tomc	57	TS	Lower Kera River, 12 km WNW of Laiagam	Abundant small planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
9058	Oc	Tomc	57	TS	Lower Kera River, 12 km WNW of Laiagam	Abundant small planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
9059	Oc	Tomc	57	TS	Lower Kera River, 12 km WNW of Laiagam	Abundant small planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
9060	Oc	Tem	153	WR		Planktonic foraminifera (see Fig. 16)	Late middle to Late Paleocene (P.4-P.5)
F.1	Oc	Tomc	174	TS		Abundant small planktonic foraminifera (Globigerinidae)	Indefinite
F.39	Oc	Tma	152	TS		Abundant planktonic foraminifera (Globigerinidae)	General Miocene age only
F.41	Oc	Tma	151	TS		Abundant planktonic foraminifera (Globigerinidae)	General Miocene age only
F.43	Oc	Tma	150	TS		Lepidocyclina (N.) sp., Miogypsina (M.) sp., M. (Miogypsinoides) dehaarti, Spiroclypeus margaritatus, Heterostegina sp., Carpenteria sp. or Sporadotrema sp.	Early Miocene (upper Te)
F.48	Oc	Tmb	160	TS		Cellanthus sp., Planorbulinella sp.	Miocene or younger age only

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
F.50	Oc	Tmc	161	TS		Miogypsina (M.) sp., Elphidium sp., Carpenteria sp. or Sporadotrema sp., indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
F.174	Oc	Tem	77	WR		Planktonic foraminifera (see Fig. 16)	Middle Eocene (P.10)
F.178	Oc	Tomc	82	TS		Abundant planktonic foraminifera (Globigerinidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
F.184	Oc	Tem?	80	WR		Planktonic foraminifera (see Fig. 16)	Early Eocene (P.8-P.9)
F.197	Oc	Tmc?	66	TS		Planktonic foraminifera (Globigerinidae, poorly preserved)	Indefinite
F.223	Oc	Tomc	53	TS		Abundant, usually small, planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
F.226	Oc	Tomc	51	TS		Lepidocyclina sp., Elphidium sp.	Middle Oligocene-Middle Miocene (Td-lower Tf)
F.231	Oc	Tem	54	TS		Rare planktonic foraminifera (small Globigerinidae, Truncorotaloides, Morozovella sp.); indeterminable small rotaline forms	Middle Eocene
F.239	Oc	Toms	59	WR		Planktonic foraminifera (see Fig. 16)	Early Miocene (Zone N.4)
F.260	Oc	Tomc	144	TS		Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
F.275	Oc	Tem	146	TS		Planktonic foraminifera (small Globigerinidae, Morozovella spp., Truncorotaloides spp.)	Middle Eocene
F.279-F.286	Oc	Tomc	147	WR	Section south of Crater Lake	Planktonic foraminifera (see Fig. 10)	Late Oligocene-Early Miocene (Zone N.3-Zone N.4)
F.289	Oc	Tem?	116	TS		Planktonic foraminifera, small bullate forms (?Globigerinatheka); indeterminable small rotaline forms	?Middle Eocene
F.398-F.405) F.451-F.455) F.461-F.471)	Oc	Tmb	16	WR TS	Burgers Mount in section	Planktonic foraminifera (see Fig. 8)	
F.300-F.340	Oc	Toms-Tmb	17	WR	Maramuni River section	Planktonic foraminifera, benthonic smaller foraminifera, larger foraminifera (see Fig. 14)	Most of section is Middle Miocene
F.342	Oc	Ta	97	WR	About 10 km SSW of Mount Kaijende	Planktonic foraminifera (see Fig. 16)	Late Paleocene
F.410	Oc	Tomc	55	TS		Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
F.412	Oc	Tomc	68	TS		Abundant planktonic foraminifera (Globigerinidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
F.415	Oc	To[illegible]	78	WR		Planktonic foraminifera, poorly preserved (see Fig. 16)	General Miocene age only
F.420-F.439	Oc	Tml, Tmm, Tmo	100	WR	Kindan section	Planktonic foraminifera (see Fig. 9)	Top of Early Miocene-Late Miocene (Zone N.8-Zone N.17 or younger)
F.441	Oc	Tml	102	WR		Rare planktonic foraminifera (see Fig. 16)	General Miocene age only
F.442-F.448	Oc		108	WR	Section southwest of Laiagam, southeast of Mount Yangi	Planktonic foraminifera (see Fig. 13)	Early-Middle Miocene (Zone N.8-lower Zone N.9)
F.449-F.450) F.456-F.459)	Oc	Toms, Tomc	136	WR TS	Section south of Laiagam, west of Crater Lake	Planktonic foraminifera; thin sections contain Heterohelicidae	Late Oligocene-Early Miocene (Zone N.3-Zone N.4)
F.460	Oc	Tomc	138	TS		Abundant planktonic foraminifera, (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
F.491	Oc	Tomc	79	TS		Abundant planktonic foraminifera, (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
F.527	Oc	Tmc	155	TS		Operculina sp., Elphidium sp., ?Miogypsina (M.) sp.	Early-Middle Miocene (upper Te-lower Tf)
F.557	Oc	Tmc	164	TS		Miogypsina (M.) sp., Carpenteria sp. or Sporadotrema sp., miliolids, indeterminable smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
F.560	Oc	Tmc	163	TS		Miogypsina (M.) sp., Carpenteria sp. or Sporadotrema sp., Acervulina sp.	Early-Middle Miocene (upper Te-lower Tf)
F.564	Oc	Tma	157	TS		Operculina sp., fragments c planktonic foraminifera	Indefinite
F.681	Oc	Tmb	89	TS		Operculina sp., Elphidium sp.	General Miocene or younger age only
F.753	Oc	Tmb	83	TS		Planktonic foraminifera (small Globigerinidae); indeterminable smaller foraminifera	Indefinite, possibly Miocene
F.827	Oc	Tomc	40	TS		Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
F.838	Oc	Tomc	48	TS		Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
F.841	Oc	Tomc	38	TS		Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
F.845	Oc	Tomc	36	TS		Abundant planktonic foraminifera (Globigerinidae, possibly including Praeorbulina group; ?Berggrenia)	Probably Late Oligocene-Early Miocene
F.846	Oc	Tr	39	TS		Lepidocyclina (N.) terreroi, Miogypsina (M.) sp., Cycloclypeus (C.) sp., C. (Katacycloclypeus) sp., Amphistegina sp., Carpenteria sp. or Sporadotrema sp.	Middle Miocene (lower Tf)
F.863	Oc	Tr	95	TS		Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae; possibly including Praeorbulina group)	Probably Early Miocene
F.868	Oc	Tem	101	TS		Planktonic foraminifera (Morozovella spp., Truncorotaloides spp); indeterminable small rotaliid foraminifera	Middle Eocene
F.870-F.889	Oc	Ta,Tr	103	WR	Section WSW of Laiagam, near Mount Yangi	Planktonic foraminifera (see Fig. 12)	Late Paleocene and top of Early Miocene (Zone N.8)
F.900-F.912	Oc	Ta,Tem	105	WR	Section on Andebare River	Planktonic foraminifera (see Belford, 1967)	Late Paleocene-Middle Eocene
F.913-F.917	Oc	Ta,Tem	37	WR TS	Section at Tibinini	Planktonic foraminifera (see Belford, 1967)	Late Paleocene-Middle Eocene
F.930	Oc	Tomc	119	TS		Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae, ?Berggrenia)	Probably Late Oligocene-Early Miocene
F.932	Oc	Toms	119	WR		Planktonic foraminifera (small Globigerinidae; see Fig. 16)	General Miocene age only
F.934-F.938	Oc	Toms	118	WR	Laiagam section	Planktonic foraminifera (see Fig. 11)	Late Oligocene-Early Miocene (Zone N.3-Zone N.4)
F.1001	Oc	Tr	96	TS		Abundant planktonic foraminifera (Globigerinidae; probably including Praeorbulina group)	Probably Early Miocene
F.1004	Oc	Tml	104	WR		Planktonic foraminifera (see Fig. 16)	General Miocene age only
F.1005	Oc	Tr or Tmm	104	TS		Planktonic foraminifera, including Orbulina	Not older than Middle Miocene (Zone N.9)
F.1006	Oc	Tml	104	WR		Planktonic foraminifera (see Fig. 16)	General Miocene age only
F.1013	Oc	Tr	33	TS		Abundant planktonic foraminifera (Globigerinidae); indeterminable benthonic smaller foraminifera	General Miocene age only; associated with 7152-3299
B.23	Fl	Tomc	156	TS	Ischak Valley, 916 metres west of Yogos Rest House, at foot of cliff	Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
B.36	Oc	Tomc?	149	TS	Ridge SW of Wabag	Abundant planktonic foraminifera (Globigerinidae)	Indefinite; general Tertiary age only
B.45	Oc	Tomc	85	TS	Upper Lai Valley, at 2046 metres	Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
B.70 a,b	Oc	Tem	81	TS	North of Sirunki Rest House along Lai River, where the Londol track crosses	Abundant planktonic foraminifera (Morozovella spp., Truncorotaloides spp.)	Middle Eocene
B.79	Oc	Tomc	142	TS	Ridge directly south of Kepilam Rest House Lagaip Valley	Rare small planktonic foraminifera, radiolaria, ?sponge spicules	Indefinite; General Tertiary age only
B.83	Oc	Tomc	145	TS	Western rim of Yobobos grassland basin	Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
B.111	Oc	Tomc	173	TS	Near Kaimbia, Kundep	Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
B.113	Oc	Tomc	172	TS	From ridge immediately adjoining Kundep patrol post on east side	Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
B.116	Oc	Tr	167	TS	West side of Kundep Valley	Planktonic foraminifera (Globigerinidae)	Indefinite; general Tertiary age only
B.117	Fl	Tr or Tmm	166	TS	Imapyak, upper Wage Valley	Planktonic foraminifera (Globigerinidae, including Orbulina, ?Praeorbulina transitoria	Not older than Middle Miocene (Zone N.9); possibly basal Zone N.9
B.118	Oc	Tem	107	TS	West of Karikari Rest House, 2595 metres	Discocyclina spp., planktonic foraminifera (Morozovella spp., Truncorotaloides spp.)	Eocene, probably Middle Eocene
B.120	Oc	Tomc	114	TS	Kindarep, in cliff just north of Kindarep Rest House	Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae)	Probably Late Oligocene-Early Miocene
B.133a	Fl	Tr	44	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley about 1.6 km NE of Tibinini	Lepidocyclina (E.) sp., L. (N.) sp., Miogypsina (Miogypsinoides) complanata/dehaarti group, Miogypsina (M.) sp., Amphistegina sp., planktonic foraminifera, indeterminable smaller foraminifera	Early Miocene (upper Te)
B.133b	Fl	Tr?	44	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley about 1.6 km NE of Tibinini	Abundant planktonic foraminifera (Globigerinidae)	Indefinite; general Tertiary age only

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
B.133d	FI	Tr?	11	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley about 1.6 km NE of Tibinini	Abundant small planktonic foraminifera and foraminiferal fragments (Globigerinidae, small planispiral forms)	Indefinite; general Tertiary age only
B.133e	FI	Tomc	11	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley about 1.6 km NE of Tibinini	Abundant small planktonic foraminifera (mainly Globigerinidae, rare planispiral forms); sponge spicules	Indefinite; general Tertiary age only
B.135a	FI	Tomc	44	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley, in tha Tuba River, where a track branching north from Taylor's Camp-Tibinini track crosses river at 1740 metres	Abundant small, rare large, planktonic foraminifera (Globigerinidae; rare planispiral forms; rare biserial specimens, probably Heterohalicidae)	Probably Late Oligocene-Early Miocene
B.135b	FI	Tem	11	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley, in the Tuba River, where a track branching north from Taylor's Camp-Tibinini track crosses river at 1740 metres	Frequent planktonic foraminifera (Morozovella spp., Truncorotaloides spp.)	Eocene, probably Middle Eocene
B135c	FI	Tr?	11	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley, in the Tuba River, where a track branching north from Taylor's Camp-Tibinini track crosses river at 1740 metres	Abundant planktonic foraminifera (Globigerinidae)	Indefinite; general Tertiary age only
B.135d	FI	Tr?	11	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley, in the Tuba River, where a track branching north from Taylor's Camp-Tibinini track crosses river at 1740 metres	Elphidium sp., indeterminable soritid genus, miliolids, indeterminable benthonic smaller foraminifera	Indefinite; general Tertiary age only

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
B.135e	Fl	Tr?	11	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley, in the Tuba River, where a track branching north from Taylor's Camp-Tibinini track crosses river at 1740 metres	Abundant small poorly preserved planktonic foraminifera (Globigerinidae)	Indefinite; general Tertiary age only
B.135f	Fl	Tomc	11	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley, in the Tuba River, where a track branching north from Taylor's Camp-Tibinini track crosses river at 1740 metres	Abundant planktonic foraminifera (Globigerinidae, Heterohelicidae, rare ?Berggrenia)	Probably Late Oligocene-Early Miocene
B.135g	Fl	Tr?	11	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley, in the Tuba River, where a track branching north from Taylor's Camp-Tibinini track crosses river at 1740 metres	Rare planktonic foraminifera (Globigerinidae; rare indeterminable smaller foraminifera)	Indefinite
B.135h	Fl	Tem	11	TS	Colluvial slope below cliffs of Mount Kaijende, Tilia Valley, in the Tuba River, where a track branching north from Taylor's Camp-Tibinini track crosses river at 1740 metres	Abundant planktonic foraminifera (Morozovella spp., Truncorotaloides spp.)	Eocene, probably Middle Eocene
B.136a	Fl	Tomc	41	TS	Colluvial debris, north of Tuba River, about 1374 metres up slope from river crossing of B.135	Abundant planktonic foraminifera (Globigerinidae; rare Heterohelicidae)	Probably Late Oligocene-Early Miocene
B.136b	Fl	Tomc	41	TS	Colluvial debris, north of Tuba River, about 1374 metres up slope from river crossing of B.135	Abundant planktonic foraminifera (Globigerinidae; rare Heterohelicidae)	Probably Late Oligocene-Early Miocene
B.137a	?Oc	Tr	42	TS	Cliff face south of Tibinini	Alveolinella quoyi, Sorites sp., Operculina sp., Peneroplis sp., miliolids and other indeterminable benthonic smaller foraminifera	Late Miocene or younger age only

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
B.137b	?Oc	Tr	42	TS	Cliff face south of Tibinini	Alveolinella sp., Elphidium sp., ?Sorites sp., indeterminable benthonic smaller foraminifera.	Late Miocene or younger age only
B.138	Oc	Tem	45	TS	Creek bed at 2565 metres, below and east of Taylor's Camp	Abundant planktonic foraminifera (Morozovella spp., Truncorotaloides spp., ?Hantkenina sp.)	Eocene, probably Middle Eocene
Ab.43	Fl	Tmt or Toms	91	WR	Timun River	Planktonic foraminifera (see Fig. 16)	General Early-Middle Miocene age only
Ab.43b	Fl	clast in Tmt conglomerate	91	TS	Timun River	Nummulites fichteli, Heterostegina sp., Operculina sp., miliolids and other indeterminable smaller foraminifera	Early Oligocene (Tc)
Ab.78	?Oc	Tmb?	7	TS	Near Kasagari village	Lepidocyclina (N.) sp., Cycloclypeus (C.) sp., Miogypsina (M.) sp., Amphistegina sp., planktonic foraminifera (Globigerinidae), indeterminable benthonic smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
Ab.80	Oc	Toms	8	WR	Creek NW of Yeim	Planktonic foraminifera (see Fig. 16)	Late Oligocene-Early Miocene (Zone N.3-Zone N.4)
Ab.81	Oc	KTsm	9	WR	Creek NW of Yeim	Planktonic foraminifera (see Fig. 16)	Late Paleocene or or Early Eocene
Ab.82	Oc	Toms	10	WR	Creek NW of Yeim	Planktonic foraminifera (see Fig. 16)	Late Oligocene-Early Miocene (Zone N.3-Zone N.4)
Ab.33	Oc	Tmb	12	WR	Laiam Creek, NW of Yeim	Planktonic foraminifera (see Fig. 16)	Early-Middle Miocene (Zone N.5-Zone N.13)
Ab.86	Oc	Toms?	13	WR	South of Yeim	Planktonic foraminifera (see Fig. 16)	Early Miocene (Zone N.6)
Ab.1086A	Oc	Tmb	20	TS	Maramuni River	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Amphistegina sp., planktonic foraminifera (Globigerinidae), indeterminable benthonic smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
G.49	Oc	Tmc	90	TS	Sau River, west of Kompiam	Lepidocyclina (N.) sp., Miogypsina (M.) sp., Elphidium sp., miliolids and other indeterminable benthonic smaller foraminifera	Early-Middle Miocene (upper Te-lower Tf)
P.9401-08	Oc	Tem		TS	Head of Porgera Valley	Planktonic foraminifera (Truncorotaloides spp., Morozovella spp.)	Middle Eocene
KJ.10	Oc	Tr		TS	Near the summit of Mount Kaijende	Miogypsina (M.) sp., Alveolinella ?quoyi, Elphidium sp., Austrotrillina sp. (very poorly preserved)	Middle Miocene (lower Tf)

Sample no.	Sample type	Formation	Locality no.	Method of study	Locality description	Foraminiferal fauna	Age
P.9124	Oc	Toms	18	WR		Very poorly preserved foraminiferids ?Globoquadrina selli	Possible Oligocene (Zones P.19-N.3/4)
P.9125	Oc	Toms	19	WR		Very poorly preserved foraminiferids ?Globoquadrina selli	Possible Oligocene (Zones P.19-N.3/4)
P.9171	Oc	Tmb	87	WR		Very poorly preserved foraminifera, including planktonic species (see Fig. 16)	Middle Miocene (Zones N.9-N.13)
P.9173	Oc	Tmb	88	TS		?Lepidocyclina sp., Borodinia septentrionalis	General Late Oligocene-Miocene age only (Te-Tf)
P.9174	Oc	Tmb	88	TS		Lepidocyclina (N.) sp., Borodinia septentrionalis, Marginopora vertebralis, ?Flosculinella sp., ?Miogypsina (M.) sp.	Middle Miocene (lower Tf)