

# The genus *Planorbulinella* (Foraminiferida) in Indonesia

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Species of *Planorbulinella* are common in several southern European Neogene sections, as well as on recent reefs in the Indo-West Pacific. So far, they have only been recorded rarely from the Neogene of the Indo-West Pacific region. The only published records are from the Early Miocene of Papua New Guinea and New Zealand. Two new species, a new record of a known species and an as yet undescribed species from the Neogene of Indonesia are reported herein. This increases the number of known *Planorbulinella* species from Indonesia to at least five.

## Contents

Introduction .....	137
Systematic palaeontology .....	138
Discussion .....	142
Acknowledgements .....	143
References .....	143

## Introduction

Belford (1982) reviewed the genus *Planorbulinella* in the Indo-West Pacific region. Up to then there had also been records of the morphologically similar genus *Linderina* from the Miocene. That genus is now generally regarded as restricted to the Eocene. The Neogene records of *Linderina* were either referable to misidentifications or could not be confirmed because the samples or thin sections could not be traced (Belford, 1982). In the same publication Belford described a new species, *Planorbulinella solida*, from specimens found in several localities from the upper Te to Tf1 interval (Early Miocene). However, he overlooked the occurrence of *P. zelandica* Finlay, 1947, from the Early Miocene of South Island (New Zealand). Other authors merely reported the occurrence of *Planorbulinella*, but left the specimens in open nomenclature (e.g., Freudenthal, 1969; Lunt & Allan, 2004).

*Planorbulinella* has an orbitoid morphology, that is, it starts with a proloculus and a deuteroconch; these can be followed by one or more spiral chambers with only one aperture. This coil ends in a chamber with two apertures. After this, growth occurs by the simultaneous formation of a number of chambers (one at each aperture) in one plane. In many lineages showing an orbitoidal growth form, nepeonic acceleration has been demonstrated; the number of spiral chambers is less in younger populations within a lineage (Drooger, 1993).

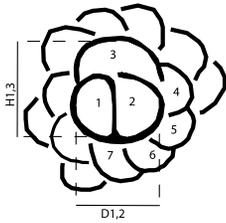


Fig. 1. Measurements used in this study. D1-2 is the diameter of the protoconch and deuteroconch together, measured along a line through their imaginary centres. H1-3 The diameter of the first three chambers together, measured along a line perpendicular to that of D1-2, and through the imaginary centre of the third chamber. Y: the number of chambers in the initial spiral, which have a single proximal stolon, starting to count with the protoconch.

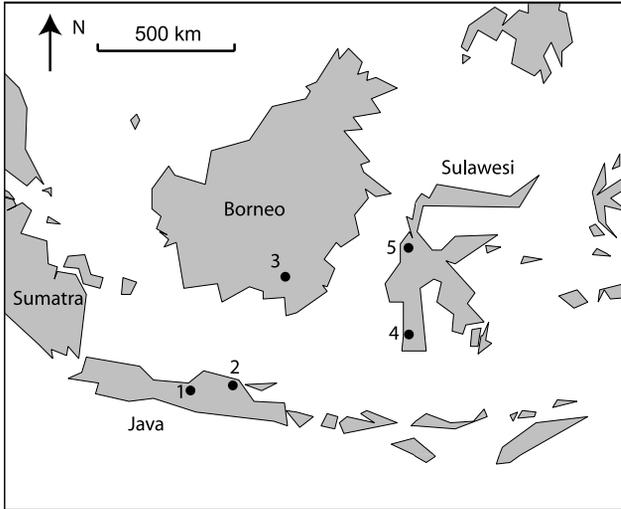


Fig. 2. Approximate distribution of the localities mentioned in the text. Key: 1 = Gegunung Kali; 2 = Krandji; 3 = Sungai Lemu; 4 = Tonasa Quarry 1; 5 = Lariang-Palu area.

In the Mediterranean area, *Planorbulinella* has been reported from the Oligocene to the end of the Miocene (Messinian), when the lineage ended (Freudenthal, 1969; Drooger, 1993). It has also been reported from the Miocene of Trinidad. *Planorbulinella* is widespread in the Indo-West Pacific Ocean and at least two species occur from as far a field as the Red Sea to Hawaii.

All type material is deposited in Nationaal Natuurhistorisch Museum, Leiden, The Netherlands (RGM). Other specimens are in The Natural History Museum, London (BMNH). The measurements used are explained in Figure 1.

### Systematic palaeontology

#### Genus *Planorbulinella* Cushman, 1927

*Type species* — *Planorbulina larvata* Parker & Jones, 1865, by original designation.

*Diagnosis* — Test discoidal, flattened, early chambers in a trochoid spiral of variable length, later chambers orbitoidal with two anteriomarginal apertures on the periphery on either end of the chamber. Arched apertures with a small imperforate lip. Wall calcareous, perforate. Central part of the test may be thickened by lamellar additions.

***Planorbulinella adamsi* sp. nov.**

Pl. 1, figs. 1-7; Pl. 2, figs. 6-8.

*Material examined* — Several specimens from Batu Temmongong Besar, Lower Kinabatangan River, North Borneo, samples NB9023, NB9030 (deposited in BMNH).

*Type material* — Holotype, RGM 468 125; paratypes, RGM 468 126-468 136, RGM S12236.

*Type locality* — Gunung Kali sleuf A.K (Java) (Fig. 2).

*Derivatio nominis* — The species is named after the late C.G. Adams, who contributed significantly to the knowledge of large benthic foraminifera stratigraphy of the region. After submission of this manuscript I found specimens labelled '*Planorbulinella kinabatangensis* nov. spec' by Adams in the collections at The Natural History Museum, London, an unpublished name from an uncompleted typescript (Pl. 2, figs. 6, 7). These turned out to be the same species.

*Diagnosis* — A medium sized *Planorbulinella* with a flat ventral side with thickened chamber sutures and perforate chamber walls. The dorsal side is concave, with small pustules that do not fuse. There are five to seven spiral chambers.

*Description* — Test discoidal, diameter up to 1.2 mm, flat or slightly concavo-convex. Ventral surface flat, strongly pustulate, the pustules covering nearly the whole surface, except for the peripheral chambers. The pustules are ovate and do not fuse to ridges, but occasionally approach each other. On the dorsal side the chamber sutures are thickened and the chamber walls perforate.

*Measurements* — D1-2 =  $137 \pm 7.4$   $\mu\text{m}$ ; H1-3 =  $142 \pm 7.4$   $\mu\text{m}$ . Most specimens have Y = 5-7.

*Remarks* — This species can be differentiated from all other species by the presence of a long (Y = 6-8) initial spiral, and a larger D1-2 and H1-3 than species with a similar number of spiral chambers in the Mediterranean. *Planorbulinella rokae* Freudenthal, 1969, has Y = 5.35-6.49 and D1-2 averages  $73 \pm 4.9$   $\mu\text{m}$ . Additionally, most other species have coarser pustules than *P. adamsi*.

*Occurrence* — *Planorbulinella adamsi* is found at the type locality, a sample from southeast Kalimantan and from Batu Temmongong Besar (North Borneo). The type sample contains *Nephrolepidina martini* (Schlumberger), *N. radiata* (Martin), *Miogypsina thecidaeformis* (Rutten) and *Cycloclypeus carpenteri* Brady, and is of probable Tf1 or Tf2 (Burdigalian/early Langhian) age. The specimens from southeast Kalimantan come from a sample containing *Flosculinella bontangensis*, which ranges from Tf2-Tf3 (Serravallian). The Batu Temmongong Besar samples contain *Heterostegina* (*Vlerkina*) and *Tansinhokella* sp., and are thus of probable Te2-3 age (Aquitanian-Burdigalian).

***Planorbulinella lunti* sp. nov.**

Pl. 1, figs. 8-14.

2004 *Planorbulinella* sp.: Lunt & Allan, p. 95, unnumbered figure.

*Material examined* — One free specimen from h280 Krandji, East Java. Chattian (Te1); 20 free specimens Sungai Lemu 81 (RGM S10979), Te.

*Type material* — Holotype, RGM 468 116; paratypes, RGM 468 115, 468 117-468 124.

*Type locality* — Sungai Lemu, Barito Basin, southeast Kalimantan.

*Type horizon* — Beraí Limestone, sample 81. A level with *Heterostegina* (*Vlerkina*) *borneensis* Van der Vlerk and *Eulepidina* sp., thus probably of Te1 age (Chattian).

*Derivatio nominis* — For Peter Lunt, who first figured this species (*in* Lunt & Allan, 2004).

*Diagnosis* — A medium sized *Planorbulinella* with flat, finely pustulate dorsal and ventral sides. The initial spire has 10-12 chambers, more than any of the other species.

*Description* — Test discoidal, flat, diameter up to 1.2 mm. Dorsal and ventral surfaces flat, finely pustulate, also on the peripheral chambers. Normal specimens are circular in dorsal view (holotype), but the shape of the test is strongly affected by the surface to which it has grown. Up to ten spiral chambers.

*Measurements* — D1-2: 60-110  $\mu\text{m}$  (average 85  $\mu\text{m}$ ); H1-3: 100-140  $\mu\text{m}$  (average 98  $\mu\text{m}$ ); Y= 10-12.

*Remarks* — *Planorbulinella lunti* is distinguished from all other *Planorbulinella* species by the very finely pustulate ventral and dorsal sides. The chambers are more irregularly arranged than in *P. zelandica*. The specimen differs from the Mediterranean Miocene species in having more spiral chambers. The diameter of the embryonic chambers is similar to that of *P. canae* Freudenthal, 1969, but that species has only three to four spiral chambers, and no pustules on the dorsal and ventral surface.

The additionally studied samples and specimens are not included in the type material, since it is preferred to refer to a single site as type locality for this species.

*Occurrence* — *Planorbulinella lunti* is known from its type-locality in southeast Kalimantan, from a few specimens from East Java (among which is RGM 468 138), from one sample from southwest Sulawesi (Tonasa quarry 1, Tonassa Limestone), and from several specimens from Batu Temmongong Besar, Lower Kinabatangan River, North Borneo, samples NB9023, NB9030 (BMNH). All samples contained abundant *Heterostegina* (*Vlerkina*) *borneensis* Van der Vlerk, without *Tansinhokella*, and are thus probably of Te1 (Chattian) age. Additionally, Lunt & Allan (2004) figured one specimen from the Citarete Limestone, west Java, Chattian (Te1 or Te2-3).

*Planorbulinella zelandica* Finlay, 1947

Pl. 2, figs. 1-5.

1947 *Planorbulinella zelandica* Finlay, p. 280.1969 *Planorbulinella zelandica* Finlay: Freudenthal, pp. 86-90, pl. 5, figs. 3, 4, pl. 6, figs. 1, 6, pl. 12, figs. 6, 7.

*Material examined* — Twenty two free specimens from h266 Krاندji, east Java, Aquitanian (Te5, M1; Berggren *et al.* 1995); one free specimen from h6-7-7a, Prupuh, east Java, Burdigalian (Te5, M2; Berggren *et al.* 1995); 25 free specimens from Lariang-Palu area Tata Mts, east Sulawesi (RGM S11616), Tf1.

*Description* — Test discoidal, flat. Ventral surface flat, dorsal surface flat to slightly convex; ranging from 0.8-1.5 mm in diameter and 0.10 to 0.25 mm in thickness; periphery irregularly rounded, lobate. Ventral surface of test shows the thickened sutures of the underlying chambers, ornamented with small pores. The dorsal surface is ornamented with small pustules that do not form ridges. The chamber walls are occasionally visible, especially towards the periphery, and are perforated by small pores. The peripheral chambers are enlarged and show fine pores. All specimens examined were macroshpheric.

*Measurements* — The measurements are based on the specimens from H266. D1-2 = 175-214 (average 198, n= 12)  $\mu\text{m}$ ; H1-H3 = 228-265 (average 242, n= 12)  $\mu\text{m}$ ; Y=2, apart from one specimen with Y=3. The chambers are arcuate, about one and a half times as wide as high.

*Remarks* — Finlay (1947) described this species using only internal characters. Freudenthal (1969) obtained topotype material and added descriptions of the internal structure. The size of the embryonic chambers of the Javanese specimens is similar to the measurements provided by Freudenthal (1969) for *P. zelandica*, although h1-3 is slightly higher. *Planorbulinella zelandica* also shows better-developed lamellar thickening, especially in the centre of the test. Variation in test thickness is often related to water depth in many recent larger benthic foraminifera, so the Java specimens are considered to be conspecific with *P. zelandica*.

*Planorbulinella solida* Belford, 1982, also has large, though slightly smaller embryonic chambers. It differs from the Javan specimens described here in being asymmetrical and having strongly laminated lateral sides with elongate pores running through them.

The external morphology of *P. zelandica* is similar to the extant *P. larvata* (Parker & Jones, 1865). The internal morphology differs in having more regularly arranged chambers and the embryonic chambers are smaller.

*Occurrence* — This is the first report of this species outside New Zealand. Within Indonesia it has been found at localities in Java, Kalimantan and Sulawesi. The age of the Indonesian specimens is similar to that of those from New Zealand, which are, according to Freudenthal (1969), Burdigalian, which equals Te5-Tf1 in the Indonesian letter classification (Renema, 2002).

### *Planorbulinella* sp.

1949 *Planorbulinella larvata* (Parker & Jones): Boomgaart, p. 152.

1969 *Planorbulinella* cf. *canae*: Freudenthal, pp. 84-87.

1993 *Planorbulinella* sp.: Drooger, p. 58.

*Description* — (After Freudenthal, 1969, p. 85.) “Test discoidal, diameter up to 1.5 mm, flat or slightly concavo-convex. Both sides are strongly pustulate, the pustules covering nearly the whole surface, except for the peripheral chambers. The pustules are rounded to subrounded and do not fuse to ridges. The initial chambers are visible from the outside in a few specimens only, since calcareous laminae and pustules generally thicken towards the centre. The apertures are median low arches, two to each chamber, and provided with a small imperforate lip.”

*Measurements* — D1-2 =  $137 \pm 8.6 \mu\text{m}$ ; H1-3 =  $142 \pm 7.4 \mu\text{m}$ ; Y=3-4, but there is a common recurrence of the one aperture configuration in the orbitoidal growth stage.

*Remarks* — Although the spiral configuration is similar to *P. canae*, the initial chambers are much larger. Also, the external morphology with pustules is not seen in *P. canae*, which has finely perforate chamber walls, and the internal structure is visible from outside.

According to Drooger (1993), the internal morphology is comparable with recent specimens from the Maldives. Previous records of this species were not figured by any of the authors and material was not available to produce a formal description.

*Occurrence* — This species has only been observed in the Bodjonegoro I drill hole at Java. The exact age is unclear. Boomgaart (1949) considered this horizon to be Pliocene, but Bolli (1966) gave a Middle Miocene age. Freudenthal (1969) noted that Bolli (1966) might be erroneous and suggested a Late Miocene or Early Pliocene age for the samples. Van Gorsel & Troelstra (1981) correlated the Bodjonegoro I drill hole with the Solo river section and came to a N17, or Late Pliocene, age for the considered interval.

### Discussion

Although widely distributed in the Recent of the Indo-West Pacific there are only a few Cenozoic records of *Planorbulinella* from that region. However, the genus was included in several range charts. Records of identified species came from the Early Miocene. Further records from the Chattian-Burdigalian have been added in this publication. The only species recorded from Indonesia were *P. solida* Belford in Lunt & Allan (2004) and *P. larvata* Parker & Jones in Boomgaart (1949), identified as *P. cf. canae* by Freudenthal (1969). Because of the large initial chambers, Drooger (1993) thought that these specimens were more similar to an as yet undescribed, Recent form documented from the Maldives.

Two additional species are added for the Indonesian fauna herein, showing that there were at least five species of *Planorbulinella*. Based on internal and external mor-

phology, and assuming that in lineages of orbitoidal foraminifera there is a tendency to reduce the number of spiral chambers, and increase the initial chambers, *P. adamsi* could be a predecessor of *Planorbulinella* sp., and *P. lunti* could be the predecessor of *P. larvata*. *Planorbulinella zelandica* Finlay, 1947, and *P. solida* Belford, 1982, both represent separate lineages, without known extant members.

### Acknowledgements

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**Plate 1**

Figs. 1-7. *Planorbulinella adamsi* sp. nov.

Figs. 1, 5. RGM 468 126, paratype. (1) Dorsal view. (5) Ventral view.

Figs. 2, 6. RGM 468 125, holotype. (2) Dorsal view. (6) Ventral view.

Figs. 3, 7. RGM 468 128, paratype. (3) Dorsal view. (7) Ventral view.

Fig. 4. RGM 468 141, paratype, thin section.

Figs. 8-14. *Planorbulinella lunti* sp. nov.

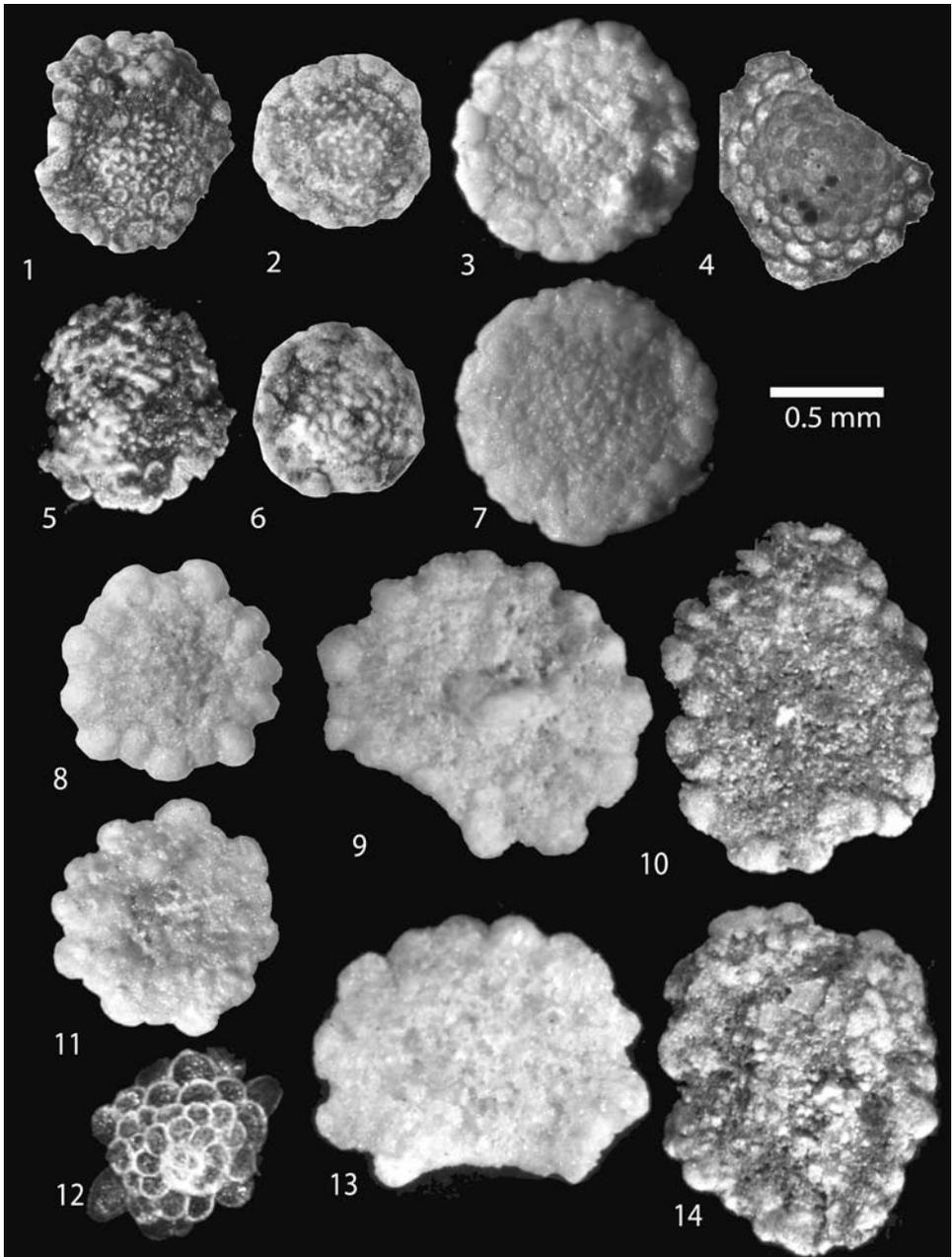
Figs. 8, 11. RGM 468 116, holotype. (8) Dorsal view. (11) Ventral view.

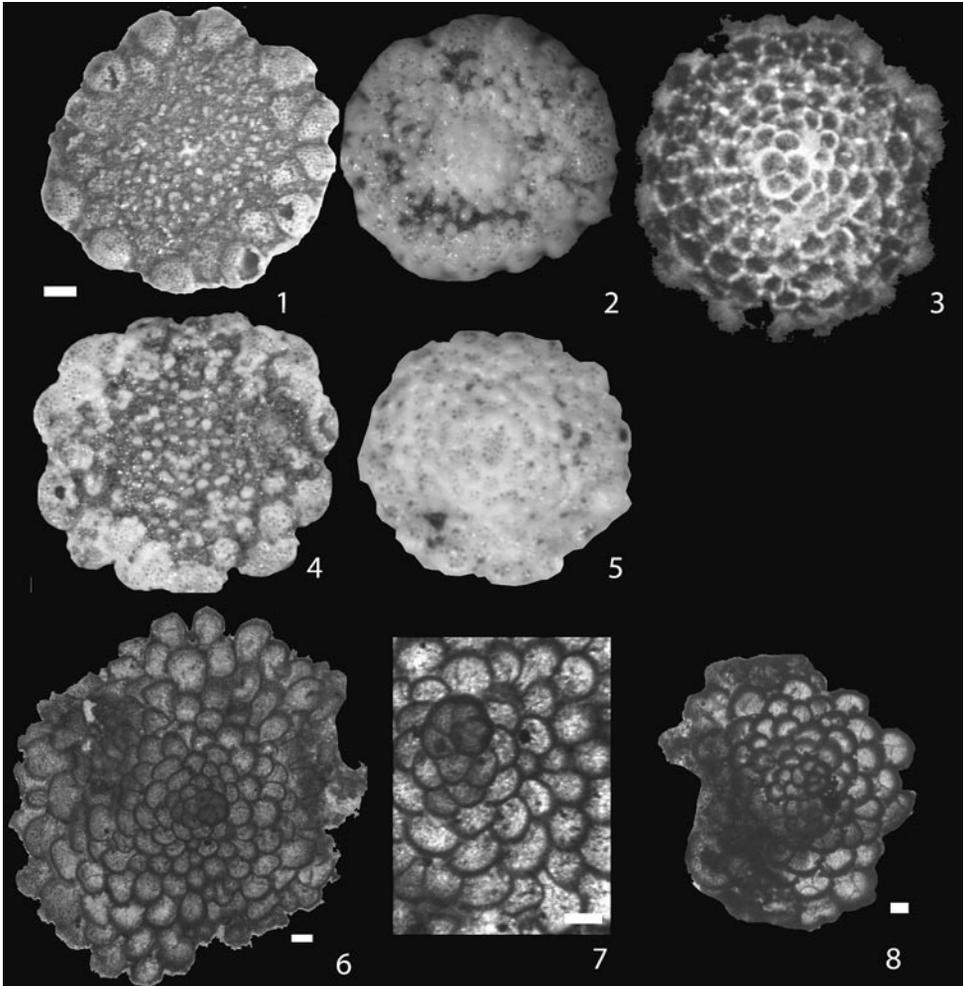
Figs. 9, 13. RGM 468 115, paratype. (9) Dorsal view. (13) Ventral view.

Figs. 10, 14. RGM 468 117, paratype. (10) Dorsal view. (14) Ventral view.

Fig. 12. RGM 468 138, paratype, X-ray photograph of the internal structure.

Scale bar represents 0.5 mm.





**Plate 2**

Figs 1-5. *Planorbulinella zelandica* Finlay, 1947.

Figs. 1, 4. RGM 468 140. (1) Dorsal view. (4) Ventral view.

Fig. 2. RGM 468 139, dorsal view.

Fig. 3. RGM 468 137, X-ray photograph of the internal structure.

Fig. 5. RGM 468 141, ventral view.

Figs. 6-8. *Planorbulinella adamsi* sp. nov. All thin sections.

Figs. 6, 7. BMNH PF67225. (6) Horizontal section. (7) Details of embryonic chambers.

Fig. 8. RGM 512 236, horizontal section.

Scale bar represents 0.1 mm.