

The taxonomic status of the minute foraminifera *Discorbina minutissima* Chaster (1892), *D. chasteri* Heron-Allen & Earland (1913) and related species

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ABSTRACT

This study presents a revision, using type material, of the tiny foraminifera *Discorbina minutissima* Chaster, *D. chasteri* Heron-Allen & Earland (erected as a *nomen novum* for *D. minutissima* Chaster, non Seguenza) and *D. chasteri* var. *bispinosa* Heron-Allen & Earland. All are referred to the genus *Rotaliella* Grell. Heron-Allen & Earland's new name *chasteri* is shown to be only applicable as a replacement name for Chaster's species; their own material from Clare Island is a new species, named here *R. heronalleni* sp.nov. In addition, two other species — *Rotaliella* ? *simplex* (Sidebottom) and *R. antarctica* sp.nov. — have been recognised amongst the specimens labelled as *D. chasteri* in the Heron-Allen & Earland Collection in the Natural History Museum (BMNH). Lectotypes are designated for *Rotaliella chasteri* and *R. bispinosa*. *J. Micropalaeontol.*, **11** (2), 127-134 December 1992.

INTRODUCTION

While working on the minute benthic foraminifera of the Gulf of Elat and the NE Atlantic, we found a few specimens which resemble the species *Discorbina minutissima* and *D. chasteri* auctt. The original descriptions and illustrations of these tiny species, whose test diameters average only 100 microns, were made by Chaster (1892) and Heron-Allen & Earland (1913), respectively. Their drawings, however, are quite schematic and difficult to compare with the modern SEM images of our specimens. We therefore examined the relevant type material, deposited in the Natural History Museum, London (BMNH) as well as other specimens labelled as *minutissima/chasteri* in the Heron-Allen & Earland Collection of the BMNH and in the Cushman Collection of the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM). The results of the study, presented here, reveal five different species are involved. No doubt many other species have erroneously been referred to *minutissima/chasteri* in the past and await further study.

Because of its small size, *D. minutissima/chasteri* has only rarely been cited in the recent literature of benthic foraminifera (Boltovskoy & Lena, 1970; Boltovskoy *et al.*, 1980), reflecting a general lack of interest in such small sized forms in foraminiferal research. For years the limited possibilities of optical equipment made the identification of such 'microforaminifera' difficult. The advent of scanning electron microscopy, however, now makes it perfectly feasible to study in detail species smaller than 100µm. This paper is a contribution to the better understanding of this group, whose possible greater diversity is still to be discovered.

HISTORICAL REVIEW

The history of *Discorbina minutissima/chasteri* is a good example

of how confusing the determination of these tiny foraminifera can be. *D. minutissima* was described by Chaster in 1892, as a small foraminifer having a... 'test circular in outline, depressed, consisting of about two convolutions; segments few, about three in the last convolution, inflated and smooth superiorly; inferior surface deeply umbilicated in the centre, and marked with radiating lines; periphery rounded'. The species was isolated from shore mud off Southport, NW England, at a depth of 20-50m. Later it was reported from the Recent and Quaternary of Ireland by Wright (1903) and Gough (1907), the latter illustrating it with a copy of Chaster's original drawings (Fig. 1A).

In 1913, Heron-Allen & Earland in their classic work on the foraminifera of Clare Island, W Ireland, described a species which they considered conspecific with *D. minutissima* Chaster. They pointed out, however, that Chaster's name could not be used because of primary homonymy... 'the specific name *minutissima* having been used in 1880 by Seguenza for a *Discorbina* of the *orbicularis* type..., Chaster's name must lapse'. They, therefore, gave it the new name of *Discorbina chasteri*. Heron-Allen & Earland (1913) illustrated *D. chasteri* with three views (reproduced here as Fig. 1B), one of them representing a form with an oval outline. According to these authors, this oval form, in which '... the chambers are longer and set eccentrically so as to give an oval contour of the test', was identical with *Pulvinulina simplex* described by Sidebottom (1909) from Delos Island in the Mediterranean. They suggested that *chasteri* may have a circular or oval form of the test. Both occurred in the same samples, but the circular form was more abundant. *D. chasteri* was reported elsewhere by Heron-Allen & Earland, from the North Sea (1913, 1916a, 1916b) from the SE coast of Africa (1915), from the Ross Sea, Antarctica (1922) and the South Atlantic (1932).

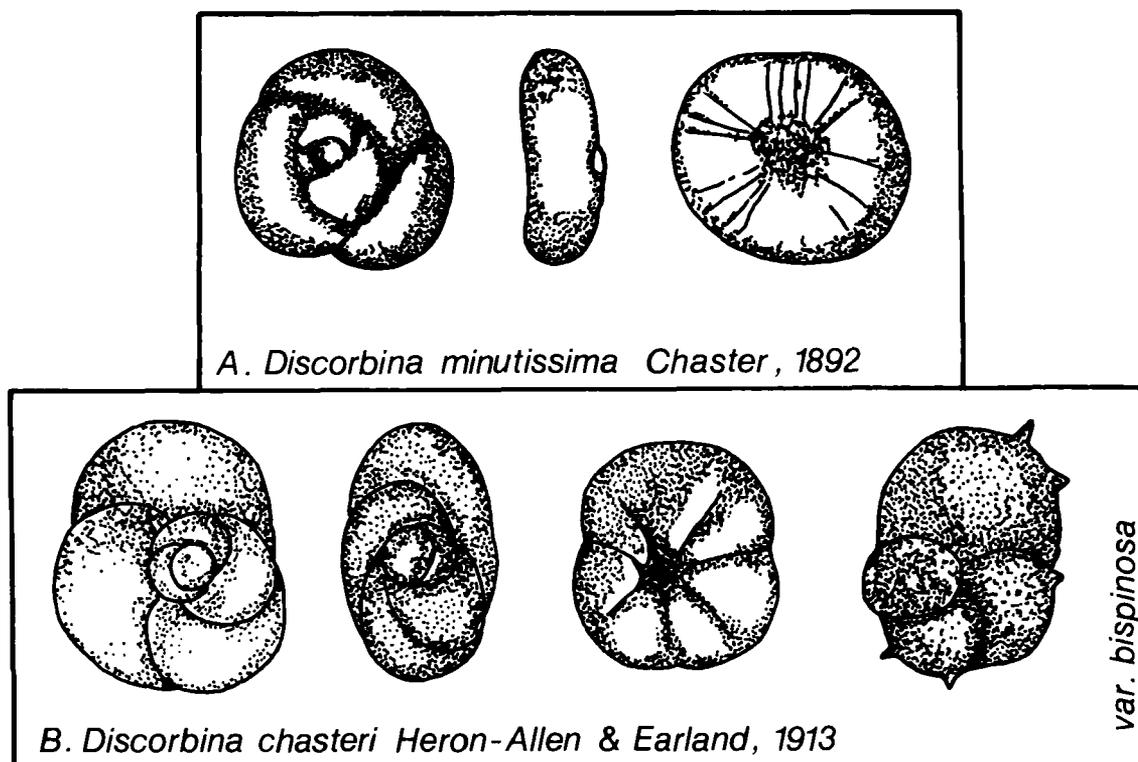


Fig. 1 Original illustrations of *Discorbina minutissima* Chaster, 1892 (Fig. 1A); and *Discorbina chasteri* Heron-Allen & Earland, 1913 and *D. chasteri*

In 1913 Heron-Allen & Earland also described a variety of this species, *D. chasteri* var. *bispinosa*, in which... 'the surface of each of the last two or three chambers is furnished with a pair of short but stout spines, projecting forwards. The spines average .01mm in length'. They observed that in this variety... 'the surface of the test is also rough compared with the highly vitreous surface of the type' (see Fig. 1B). It seems that it was relatively rare compared to the nonspinoso form and was reported from the shallow waters off the coasts of southern Cornwall, SW England (Heron-Allen & Earland, 1916a) and western Scotland (Heron-Allen & Earland, 1916b).

Subsequently, Cushman (1931) transferred *Discorbina chasteri* and *D. chasteri* var. *bispinosa* to the genus *Discorbis*. In this, his monograph of the Foraminifera of the Atlantic Ocean, he described *chasteri* and illustrated it with a copy of the original drawings by Heron-Allen & Earland (1913) and pictures of two specimens collected off the Faroe Islands, at 128 metres, sent to him by Earland. Cushman had some doubts concerning the homogeneity of the species, observing that its wide distribution, from the North Sea to the Antarctic, was quite unusual, if 'these are really all the same'. He particularly noticed that the specimen from the east coast of Australia, identified by Sidebottom (1918) as *D. chasteri* var. *bispinosa*, was quite different, being keeled rather than having a broadly rounded periphery.

Cushman (1948) also included *D. chasteri* in his monograph of the Arctic Foraminifera. He gave the same description as in 1931, but the illustrated specimen, this time, was much larger, with numerous chambers and several rows of pustules on the umbilical side. He observed that this specimen resembles

'*Discorbina obtusa* d'Orbigny' illustrated by Parker & Jones (1865) and suggested that both species were identical.

SYSTEMATIC DESCRIPTIONS

Five species are distinguished herein from material in the BMNH and USNM, labelled as *minutissima/chasteri*, including the type specimens. All are transferred to *Rotaliella* Grell (1954), a genus characterized by a minute, trochospiral test composed of few inflated chambers. The aperture is umbilical and covered by a more or less developed umbilical flap. The thin translucent wall is finely perforate on the spiral side and covered with radial grooves on the umbilical side. Tiny denticles occur around the umbilicus. A distinctive character of *Rotaliella*, furthermore, is a small, hemispherical or elongated space, situated between the proloculus and the subsequent two chambers, which is visible as a prolocular boss on the spiral side; this structure was called the 'Zwischenkammer' by Grell (1954), who suggested that this is an additional chamber formed during the embryonic stage. It seems, however, that this 'prolocular boss' is a pseudochamber, rather than a real chamber, as it never contains the cytoplasm (this is based on the original illustration of *Rotaliella heterocaryotica* Grell (1954) and our own observations of cultured species of *Rotaliella*).

Our SEM study of the syntypes of *Discorbina minutissima* and Heron-Allen & Earland's Clare Island material of *D. chasteri* clearly show there are two species involved. We have designated a lectotype from Chaster's material. This is referred to *Rotaliella chasteri* (Heron-Allen & Earland), as their *nomen novum* was erected as a replacement name for *minutissima* (*non* Seguenza, 1880). The other species, as illustrated by Heron-

Allen & Earland (1913, Pl. 13, Figs 1-3), is named *Rotaliella heronalleni* sp.nov. We propose to raise *Discorbina chasteri* var. *bispinosa* Heron-Allen & Earland to specific status, as *Rotaliella bispinosa*. The differences between the oval form of 'D. chasteri' (see above) and *Rotaliella ? simplex* (Sidebottom) are also presented. A new species, *Rotaliella antarctica*, is described from Heron-Allen & Earland material collected by the 'Terra Nova' and 'Discovery' expeditions to the Antarctic.

We have examined with the scanning electron microscope the specimens identified, as *D. chasteri*, by Sidebottom (1918) from the east coast of Australia and these can be referred to *Heronallenita dorsocostata* Seiglie & Bermúdez (1965). Cushman's (1948) specimens of *chasteri* are similar to *Discorbina arctica* Norman, 1892. As both species were only referred to the *minutissima/chasteri* group in error, they are not included further in this work.

Order Foraminiferida Eichwald, 1830

Suborder Rotaliina Delage & Hérouard, 1896

Superfamily Glabratellacea Loeblich & Tappan, 1964

Family Glabratellidae Loeblich & Tappan, 1964

Subfamily Rotaliellinae Loeblich & Tappan, 1964

Genus *Rotaliella* Grell, 1954

Typespecies. *R. heterocaryotica* Grell, 1954, original designation.

Rotaliella chasteri (Heron-Allen & Earland, 1913)

(Pl. 1, Figs 1a, b, 2)

1892 *Discorbina minutissima* Chaster: 65 (*pars*), Pl. 1, Fig. 15 (*non* Seguenza, 1880).

1903 *Discorbina minutissima* Chaster; Wright: 174, 175.

1907 *Discorbina minutissima* Chaster; Gough: 57, Pl. 1, Fig. 8.

1913 *Discorbina chasteri* Heron-Allen & Earland: 128 (name only; not Figs).

Lectotype. 1915.10.25.438, Natural History Museum (BMNH), London, herein designated. From off Southport, NW England, depth 15 fathoms (27m); G.W. Chaster Collection. Figured in Pl. 1, Figs 1a, b.

Description (lectotype). Test minute (approximately 115µm maximum diameter), trochospiral, circular in outline; proloculus oval followed by 5 inflated, crescentic chambers, 3 in the last whorl; periphery broadly rounded; sutures slightly depressed, curved on the spiral side, nearly radial on the umbilical side; umbilicus deep and open, aperture not directly observed, covered by an umbilical flap; wall translucent, smooth, finely perforate on the spiral side, umbilical side imperforate, with numerous denticles at the umbilical margin and with fine grooves radiating from umbilicus towards periphery, the longest ones just visible on the spiral side.

Remarks. The remaining syntypes in Chaster's original slides from off Southport (1915.10.25.438 and 1915.4.1.620), and a slide in the Heron-Allen Students Collection, collected by Wright from Strangford Lough, Northern Ireland, were examined. Of the syntypes, 2 have a circular, slightly lobate test with numerous radial grooves on the umbilical side, as illustrated by Chaster (1892); one of them is chosen as lectotype. Two others have an oval test, smaller and less arcuate chambers, and a smaller umbilicus, and are conspecific with the specimens illustrated from Clare Island by Heron-Allen & Earland (1913). They were either unaware that two species were involved or,

more likely, as followers of the 'English School', they had a wide concept of the species in general. To them, they would have no hesitation in synonymising the two forms, in spite of the fact that the original illustrations are quite different (see Fig. 1). As we have now shown that they are distinct, the *nomen novum chasteri* must apply only to Chaster's species, as lectotypified by us. The other is named *Rotaliella heronalleni* sp.nov. (see below).

Amongst the other species belonging to *Rotaliella*, *R. chasteri* most resembles the type species, *R. heterocaryotica* Grell. The latter, however, is much smaller, with a more lobate periphery, more elevated spiral face and 2, instead of 3-4 radial grooves on the umbilical side. Because of the fact that the number of the umbilical grooves is constant in cultured species of *Rotaliella* (from observations of slides kindly sent to us by Professor K. Grell and from our own cultured material), this character seems to be a valuable taxonomic criterion.

Rotaliella heronalleni sp.nov.

(Pl. 1, Figs 3a, b, 4a, b)

1913 *Discorbina chasteri* Heron-Allen & Earland: 128 (*pars*; not name), Pl. 13, Figs 1-3.

1931 *Discorbis chasteri* (Heron-Allen & Earland; Cushman: 20, Pl. 4, Figs 1-3).

1980 *Glabratella chasteri* (Heron-Allen & Earland); Boltovskoy *et al.*: 33, Pl. 17, Figs 1-4.

Derivation of name. In honour of Edward Heron-Allen (1861-1943).

Diagnosis. Test minute, oval to elongate-ovate in shape, with 3-4 chambers in the final whorl. Umbilicus small, with a relatively small number of denticles; umbilical side with about 8 long radial grooves.

Holotype. ZF 4930, Natural History Museum (BMNH), London. From Clare Island Survey, station 23, near the island of Inishturk, Clew Bay, Co. Mayo, W Ireland, dredged by the S.S. Helga, 20.8.1911, in 11 fathoms (20m); Heron-Allen & Earland Collection. Figured in Pl. 1, Figs 3a, b.

Description (holotype). Test minute (maximum diameter 110µm), trochospiral, oval in outline; proloculus oval, followed by small deuteroecolus and 4 subglobular, inflated chambers, arranged in one whorl; periphery broadly rounded, sutures flush, slightly curved on the spiral side, radial on the umbilical side; umbilicus small, deep and open, aperture umbilical; wall translucent, smooth, spiral side and periphery finely perforate, umbilical side imperforate, each chamber marked with 2 long radial grooves, umbilical border denticulate.

Measurements. 19 specimens collected off the Faroe Islands by Earland, deposited in the Cushman Collection (USNM), were measured.

	Mean	Standard Deviation	Range
Maximum test diameter	130µm	16.2	110-150µm
Maximum test width	100µm	14.7	80-130µm
Proloculus diameter	20µm		
Number of chambers	3-4		

Remarks. Apart from the holotype, 14 paratypes from the

Clare Island Survey material and 4 specimens collected off the Faroe Islands, sent to Cushman by Earland, were examined by SEM. Most of the specimens fit well with the description and illustrations of Heron-Allen & Earland (1913). They differ from *R. chasteri* (Heron-Allen & Earland), as lectotypified by us, in having an oval, rather than a circular form of test, usually 4 instead of 3 chambers in the last whorl, more highly arched and less embracing chambers, a smaller umbilicus, a smoother wall, and less numerous grooves and denticles. In some paratypes the last chambers are quite long, giving an elongated test (Pl. 1, Figs 4a, b). The difference between this form and the species described as *Pulvinulina simplex* by Sidebottom (1909) are given below.

Rotaliella bispinosa (Heron-Allen & Earland, 1913)
(Pl. 1, Figs 5a, b)

1913 *Discorbina chasteri* var. *bispinosa* Heron-Allen & Earland: 129, Pl. 13, Fig. 4.

1931 *Discorbina chasteri* var. *bispinosa* Heron-Allen & Earland; Cushman: 20, Pl. 4 Figs 5, 6.

Lectotype. ZF 4932, Natural History Museum (BMNH), London; herein designated. From Clare Island Survey, station 23, near the island of Inishturk, Clew Bay, Co. Mayo, W Ireland, dredged by the SS 'Helga', on 20.8.1911, in 11 fathoms (20m); Heron-Allen & Earland Collection. Figured in Pl. 1, Figs 5a, b.
Description (lectotype). Test minute (100µm maximum diameter), trochospiral, ovate-rectangular in outline with broadly rounded periphery, proloculus oval, followed by hemispherical deuterolocus and 4 flattened inflated chambers, embryonic pseudochamber visible only in transmitted light; spiral sutures large, curved, umbilical sutures deep, radial; umbilicus open, with short, large denticles at umbilical margin; aperture umbilical, covered with denticulate umbilical flap; wall calcareous, translucent, relatively thick and rugose, the spiral side, except proloculus, perforate, with a few short spines on periphery; umbilical side imperforate, marked with long radial grooves, which reach the periphery and are just visible on the spiral side in the form of 'drip-point' terminations, the long grooves are separated by short, secondary grooves.

Remarks. *R. bispinosa* was first described by Heron-Allen & Earland (1913) as a variety of *D. chasteri*. It is raised here to species level because of the relatively thick, rugose wall, deep, umbilical grooves whose terminations are just visible on the spiral side, and the short, peripherally situated spines. The spines, however, are not always present. Two such specimens, but with the thickly calcified wall, distinctive spiral side, and the 'drip-point' terminations of the umbilical grooves, so characteristic of *bispinosa*, were observed in the Clare Island material.

The species *Glabratella arctica* Scott & Vilks (1991) which also often has (but not always) spines around the periphery, differs from *R. bispinosa* in having more arcuate chambers and more numerous umbilical grooves. Another spinose form *R. keigwini* Pawlowski (1991), differs from *bispinosa* in having dorsal, rather than peripheral spines, angular, rather than globular chambers, a semicircular protuberance on the first chamber, and in being smaller; neither, moreover, appear to have the test rugosity of *bispinosa*.

Rotaliella simplex (Sidebottom, 1909)
(Pl. 2, Figs 4a, b)

1909 *Pulvinulina simplex* Sidebottom: 9, Pl. 4, Figs 4, 5.

Remarks. One specimen of this type was found on a Clare Island Survey slide from station 13, Inishgowla Harbour, Clew Bay, Co. Mayo; dredged by the SS 'Helga' in 4 fathoms (7m). It was in the Heron-Allen & Earland Collection and had been identified by them as the 'oval form' of *chasteri*, for which they considered *P. simplex* Sidebottom to be one and the same. However, a SEM study of the syntypes of Sidebottom's species, from Delos (in the BMNH), shows that there are differences between the two in the form of the chambers and position of the umbilicus. *R. simplex* has rapidly enlarged chambers, with the last chamber particularly large and strongly inflated on the umbilical side, making the position of the umbilicus eccentric.

The generic position of this species is unclear. It resembles other *Rotaliella* in having umbilical grooves and denticles. The prolocular pseudochamber, which is characteristic of this genus, was not observed in this specimen.

Rotaliella antarctica sp.nov.
(Pl. 2, Figs 1a, b; 2a, b; 3, a b)

1922 *Discorbina chasteri* Heron-Allen & Earland; Heron-Allen & Earland: 202 (*non*) Heron-Allen & Earland, 1913).

1931 *Discorbis chasteri* (Heron-Allen & Earland); Heron-Allen & Earland: 416.

Derivation of name. From its occurrence in Antarctic seas.

Diagnosis. Test small, with 3-4 arcuate inflated chambers and a largely open umbilicus, with abundant denticles around the rim; umbilical side with about 15-20 long radial grooves.

Holotype. ZF 4933, Natural History Museum (BMNH), London. From R.R.S. 'William Scoresby' station 33, off South Georgia, collected 21.12.1926, in 135m. From Heron-Allen & Earland Type Slide 568B. Figured in Pl. 2, Figs 1a, b.

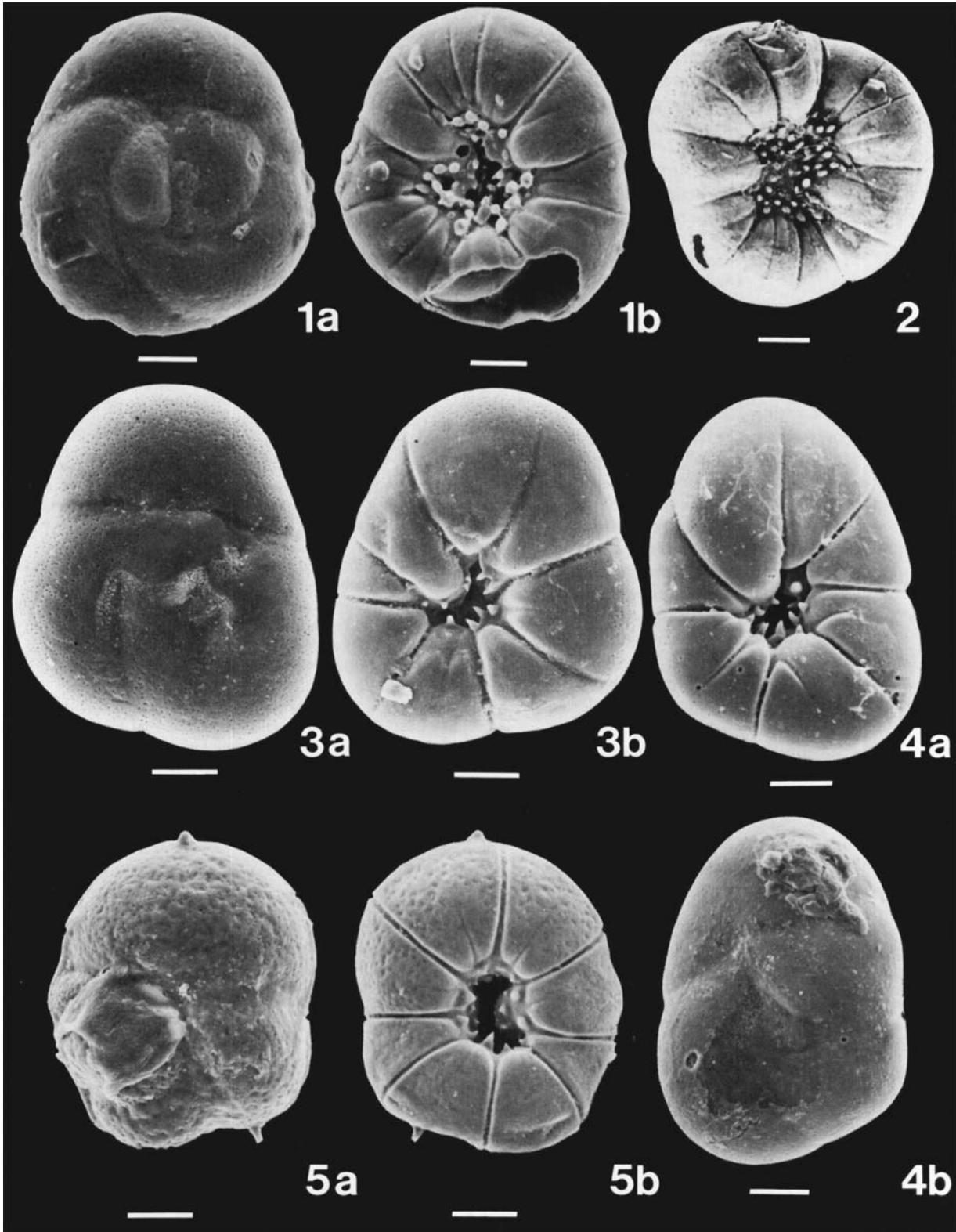
Description (holotype). Test small (approximately 185µm maximum in diameter), trochospiral, circular and slightly oblate in outline, composed of an oval proloculus followed by a small deuterolocus and 4 crescentic chambers; embryonic pseudochamber hardly visible on the spiral side; periphery

Explanation of Plate 1

Figs 1, 2. *Rotaliella chasteri* (Heron-Allen & Earland). **Figs 1a, b,** Lectotype, BMNH no. 1918.10.25.438, spiral and umbilical views; **Fig. 2,** Paralectotype, BMNH no. 1915.4.1.620, umbilical view. Both from off Southport, NW England, depth 27m; Chaster Collection.

Figs 3, 4. *Rotaliella heronalleni* sp.nov. **Figs 3a, b,** Holotype, BMNH no. ZF 4930, spiral and umbilical views; **Figs 4a, b,** Paratype, BMNH no. ZF 4931, umbilical and spiral views of 'oval form' of Heron-Allen & Earland (1913). Both from Clare Island Survey station 23, near Inishturk, Clew Bay, W Ireland, depth 20m; Heron-Allen & Earland Collection.

Figs 5a, b. *Rotaliella bispinosa* (Heron-Allen & Earland). Lectotype, BMNH no. ZF 4932, spiral and umbilical views. From Clare Island, Survey station 23, near Inishturk, Clew Bay, W Ireland, depth 20m; Heron-Allen & Earland Collection. Scale bar = 0.020mm/20µm.



broadly rounded, sutures slightly depressed, curved on the spiral side, and radial on the umbilical side; umbilicus large, partly obscured by numerous denticles around the margin, aperture umbilical, covered with an umbilical flap; wall translucent, smooth, with a few fine perforations on the spiral side, umbilical side imperforate, with numerous fine grooves radiating from umbilicus towards periphery, without reaching peripheral border.

Measurements. 15 specimens from British Antarctic ('Terra Nova') Expedition station 220 (38), in the Ross Sea (off Cape Adare) (Heron-Allen & Earland, 1922) were measured.

	Mean	Standard Deviation	Range
Maximum test diameter	125µm	32.2	75-192µm
Proloculus diameter	42.9µm	13.5	28.8-80µm
Number of chambers	3.5	1.1	1-5

Remarks. With its test approaching 200µm in diameter, *R. antarctica* is the largest known species in the Rotaliellinae. It differs from the other species of *Rotaliella* in having an abundantly ornamented umbilical side (often in excess of 15 long grooves) and large embracing chambers. Some specimens have a large proloculus followed by the deuterolocus and only one true chamber (Pl. 2, Figs 3a, b), but their size is only slightly smaller than that of the larger multilocular specimens. It is possible that these specimens are the gamonts of the species, which reach maturity at the one-chamber stage, as this phenomenon has already been observed in another, unpublished species of *Rotaliella* (Pawlowski & Lee, in press).

About 40 specimens have been studied in detail from the Heron-Allen & Earland Collection in the BMNH. Recorded as *Discorbina* (or *Discorbis*) *chasteri* (see synonymy for change in generic combination), it is found in the South Atlantic and Antarctica, in the following localities: the Ross Sea (Heron-Allen & Earland, 1922), the Falkland Islands (Heron-Allen & Earland, 1932; Earland, 1934) and South Georgia (Earland, 1933). It was most abundant at 'Terra Nova' station 220, off Cape Adare, depth 80-90m, in sediments composed mostly of organic debris, hydrozoan fragments, diatoms, sponge spicules and mineral particles.

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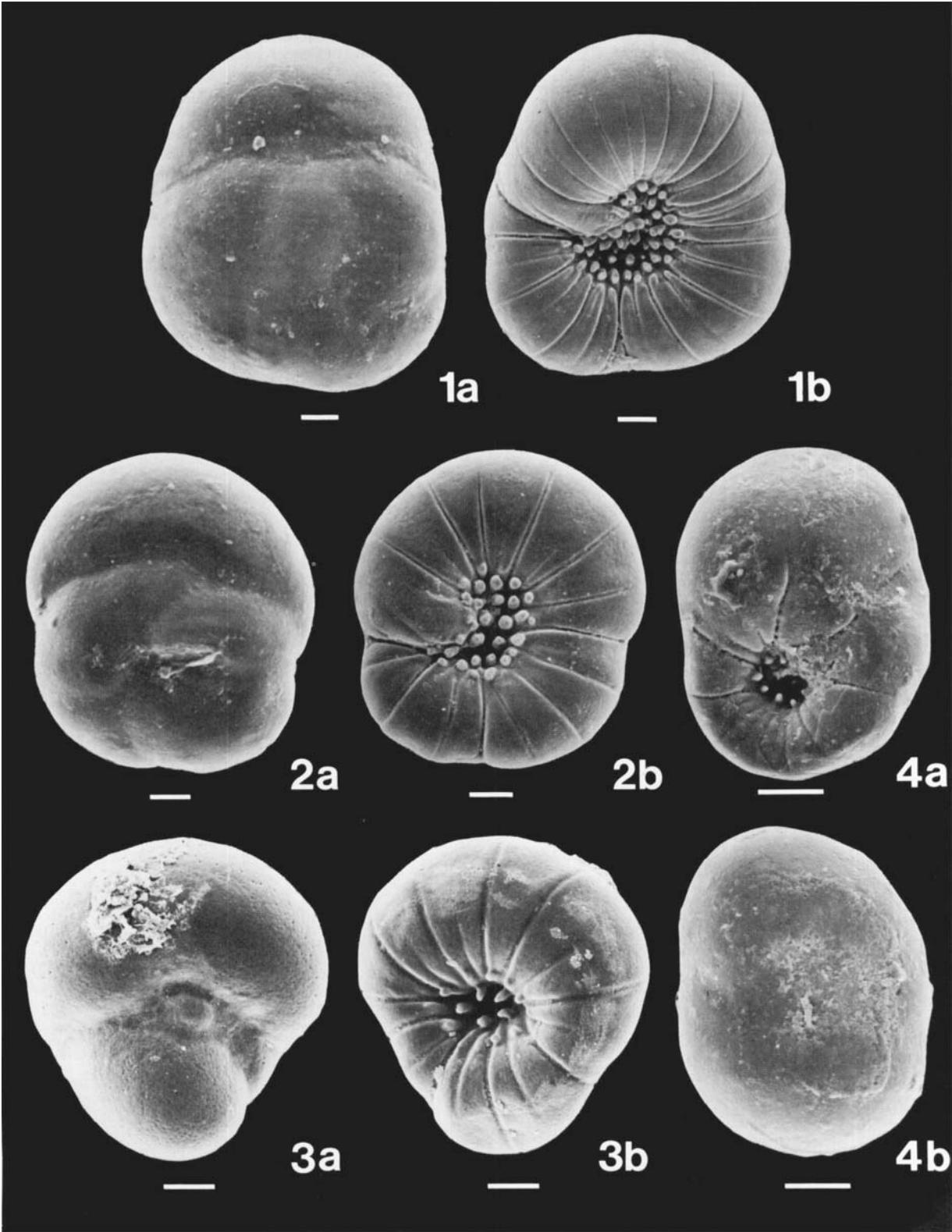
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Explanation of Plate 2

Figs 1-3. *Rotaliella antarctica* sp.nov. **Figs 1a, b**, Holotype, BMNH no ZF 4933, spiral and umbilical views; from 'William Scoresby' station 33, off South Georgia, depth 135m. **Figs 2a, b**, Paratype, BMNH no. ZF 4934, spiral and umbilical views; also from 'Terra Nova' Expedition station 220. All from Heron-Allen & Earland Collection.

Figs 4a, b. *Rotaliella ? simplex* (Sidebottom). BMNH no. ZF 4936, umbilical and spiral views. From Clare Island Survey station 13, Inishgowla Harbour, Clew Bay, W Ireland, depth 7m; Heron-Allen & Earland Collection.

Scale bar = 0.020mm/20µm.



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