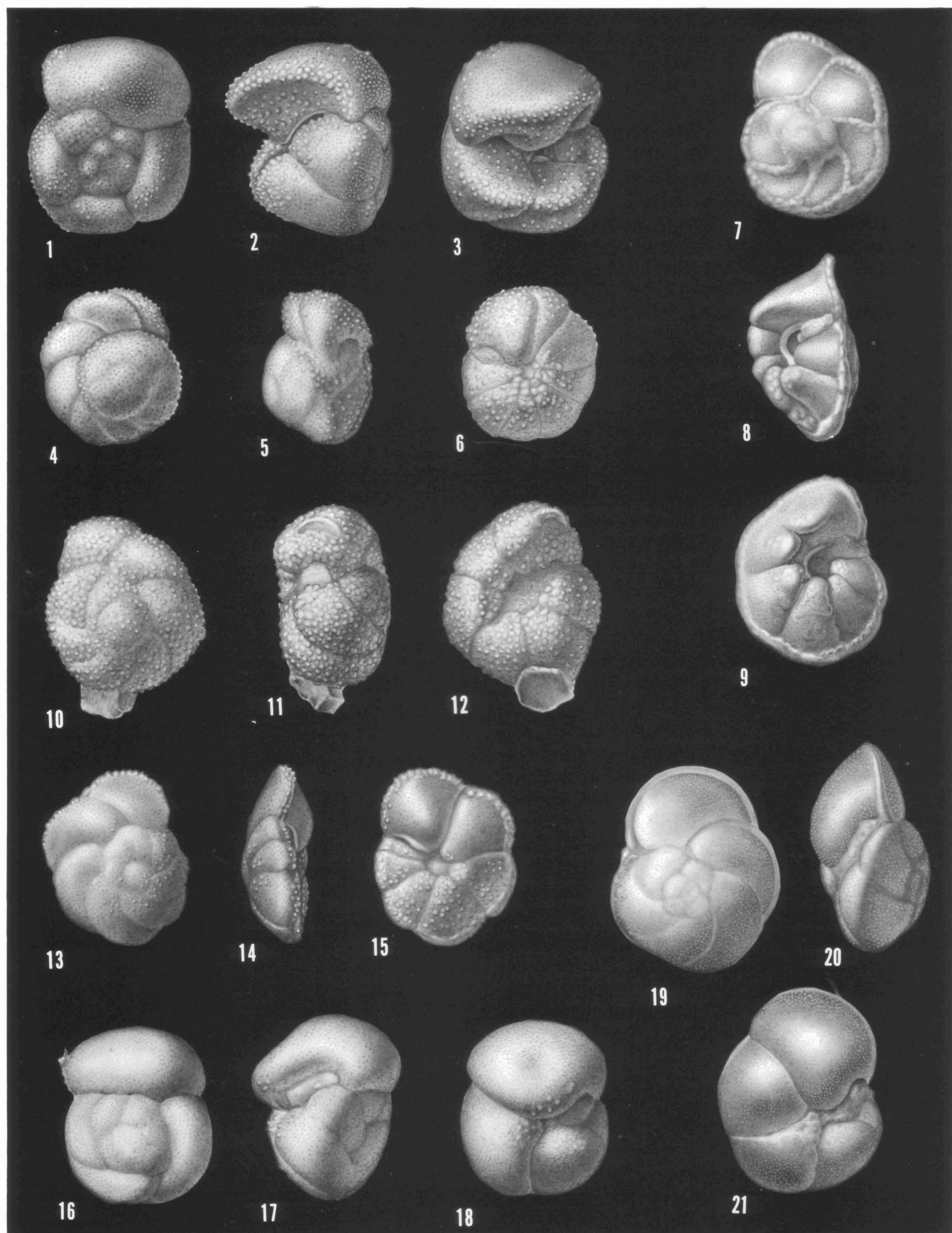




THE TYPES OF SEVERAL SPECIES OF TERTIARY PLANKTONIC FORAMINIFERA IN THE COLLECTIONS OF THE U.S. NATIONAL MUSEUM OF NATURAL HISTORY

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ABSTRACT

New figures and descriptions are given for the holotypes of *Globoquadrina quadraria* var. *advena* Bermudez, *Globorotalia albeardi* Cushman and Bermudez, *G. broedermanni* Cushman and Bermudez, *G. capdevi-*

lensis Cushman and Bermudez and *G. cibaoensis* Bermudez. A lectotype is designated for *G. aragonensis* and for *G. centralis* Cushman and Bermudez.

INTRODUCTION

In this paper our purpose is to clarify the types of seven Tertiary planktonic foraminiferal species in the collections of the U.S. National Museum of Natural History. Five of the species have designated holotypes, but those specimens were figured only in a single view. In light of current refinement of planktonic foraminifera this does not seem fully adequate for comparison with other species. Therefore, those holotypes are

re-illustrated and described. One species, *Globorotalia centralis*, had a designated holotype but the specimen is lost; a lectotype is designated from the original suite of paratypes. The remaining species, *Globorotalia aragonensis*, had no designated holotype, and was described from a suite of cotypes. One of those cotypes is designated as the lectotype.

DESCRIPTIONS

Globoquadrina quadraria var. *advena* Bermudez
Pl. 1, Figs. 1–3

Globoquadrina quadraria var. *advena* Bermudez, 1949, p. 287, Pl. 22, Fig. 38.

PLATE 1

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- 1–3 *Globoquadrina quadraria* var. *advena*. Holotype. 1. Spiral view. 2. Edge view. 3. Umbilical view. $\times 65$. Cushman Coll. no. 63245.
4–6 *Globorotalia albeardi*. Holotype. 4. Spiral view. 5. Edge view. 6. Umbilical view. $\times 100$. Cushman Coll. no. 47413.
7–9 *Globorotalia aragonensis*. Lectotype. 7. Spiral view. 8. Edge view. 9. Umbilical view. $\times 65$. Cushman Coll. no. 64893.
10–12 *Globorotalia broedermanni*. Holotype. 10. Spiral view.

11. Edge view. 12. Umbilical view. $\times 100$. Cushman Coll. no. 47407.
13–15 *Globorotalia capdevilensis*. Holotype. 13. Spiral view. 14. Edge view. 15. Umbilical view. $\times 160$. Cushman Coll. no. 47405.
16–18 *Globorotalia centralis*. Lectotype. 16. Spiral view. 17. Edge view. 18. Umbilical view. $\times 65$. Cushman Coll. no. 64894.
19–21 *Globorotalia cibaoensis*. Holotype. 19. Spiral view. 20. Edge view. 21. Umbilical view. $\times 65$. Cushman Coll. no. 63458.

Bermudez described this form from the Middle Miocene Gurabo Formation, Puerto Plata Province, Dominican Republic. The holotype slide originally contained the two figured paratypes as well as the holotype. Each specimen was figured in a single view, with the holotype shown on the spiral side. The holotype has been separated from the paratypes and is figured here in all three views.

Description of holotype. Test trochoid, plano-convex, with deep open umbilicus; spiral side flat, evolute; umbilical side strongly convex, involute, with four chambers visible, increasing rapidly in size as added; test quadrate in outline, subrounded in edge view; chambers on spiral side narrow, elongate, with radial sutures; chambers on umbilical side subangular with narrow, curved sutures slightly inclined to direction of coiling; wall finely perforate, smooth on spiral side, slightly pustulose on umbilical side, distinctly pustulose on umbilical shoulders; apertural face broad, finely pustulose, sloping sharply into umbilicus; aperture interiomarginal, umbilical, with distinct narrow lip remaining open on all chambers on umbilical side.

Remarks. This form was designated *Globoquadrina dehiscens advena* by Blow (1959; 1969), who considered *G. quadraria* (Cushman and Ellisor) a junior synonym of *G. dehiscens* (Chapman, Parr and Collins). *G. dehiscens advena* was retained as a subspecies by Blow partly because of a supposed almost closed umbilicus. However, the holotype shows an open umbilicus, certainly no more restricted than that of the figured and unfigured hypotypes of *G. dehiscens dehiscens* given by Blow. Also, the umbilicus of the holotype is more open than that of specimens in the U.S.N.M. collections of *G. dehiscens* from Victoria, Australia, the type region of this species. It is doubtful that *G. quadraria advena* can be distinguished from *G. dehiscens*.

***Globorotalia albeari* Cushman and Bermudez**
Pl. 1, Figs. 4–6

Globorotalia albeari Cushman and Bermudez, 1949, p. 33, Pl. 6, Fig. 6.

This species was described from the Paleocene, Madrugá Formation, Habana Province, Cuba. The type material consists of a holotype and two paratypes, all mounted together on the holotype slide. Along with the original description of the species, one view was figured for each of the specimens, with the holotype shown in spiral view. The holotype has been

separated from the paratypes and is figured here in three views.

Description of holotype. Test small, trochoid, tightly coiled, equally biconvex, periphery narrowly rounded; evolute on spiral side, involute on umbilical side, with eight chambers visible on umbilical side, increasing very slowly in size as added; almost circular in outline, with final three chambers slightly lobulate; surface rugose, somewhat obscuring early chambers on both spiral and umbilical sides; later chambers on spiral side narrow, elongate with sutures smooth or slightly depressed, curved and strongly reflexed; chambers on umbilical side indistinct in early part of whorl, later narrow, elongate, with slightly depressed radial sutures; umbilical surface ornamented by fine pustules; aperture interiomarginal, but obscured by sedimentary matrix.

Remarks. The aperture on the holotype can be seen to be interiomarginal, but is not fully visible. On the paratypes the aperture is umbilical-extraumbilical, terminating in a small re-entrant near the test margin.

Globorotalia albeari is probably best placed in *Acarinina* because of its narrowly rounded periphery, rugose surface and pustulose ornamentation. It is one of a number of species which form a distinct morphological group within the late Paleocene-middle Eocene. Other species of this group include *Globorotalia mattsensis* Gohrbandt, *G. wartsteinensis* Gohrbandt, *G. salisburgensis* Gohrbandt, *G. convexa* Subbotina, *G. broedermanni* Cushman and Bermudez, and the *G. pusilla* Bolli group.

There is at least a superficial resemblance between some species of this group and species described as benthonic forms, for example *Eponides toulmini* Brotzen, 1948. The possible relationships of these forms may be worthy of investigation, but are beyond the scope of this paper.

***Globorotalia aragonensis* Nuttall**
Pl. 1, Figs. 7–9

Globorotalia aragonensis Nuttall, 1930, p. 288, Pl. 24, Figs. 6–8, 10, 11.

This species was described from the Lower Eocene Aragon and Chapapote Formations, Tampico embayment, Mexico. Nuttall (1930) did not designate a holotype in his description of this species. The type material consists of five cotypes that were figured in the original description and another group of cotypes that were unfigured. One of the figured cotypes has been separated and is here designated as the lectotype.

Description of lectotype. Test trochoid, spiral side slightly convex, umbilical side strongly convex, truncate, with wide, deep umbilicus; evolute on spiral side, involute on umbilical side, with six chambers visible, increasing slowly in size as added; oval in outline, with smooth periphery and thick imperforate margin throughout; narrowly rounded in edge view of early chambers of last whorl, last chamber sharply angulate, sutures on spiral side limbate, slightly curved, reflexed; sutures on umbilical side narrow, deeply depressed, radial; surface finely perforate, with early chambers on umbilical side pustulose, otherwise smooth; umbilical shoulders rounded, imperforate; apertural face broad, elongate sloping sharply towards umbilicus; aperture interiomarginal, umbilical-extraumbilical, a narrow elongate opening extending close to periphery, with thick lip visible on last three chambers.

Remarks. This species is an excellent example of a well developed Paleogene keeled globorotalid that has no direct relationship with Miocene to Recent *Globorotalia*. It is best referred to *Truncorotaloides* (*Morozovella*) as defined by McGowran (1968; in Luterbacher, 1964).

Globorotalia* (*Truncorotalia*) *broedermanni

Cushman and Bermudez

Pl. 1, Figs. 10–12

Globorotalia (*Truncorotalia*) *broedermanni* Cushman and Bermudez, 1949, p. 40, Pl. 7, Fig. 24.

This species was described from the Lower Eocene Capdevila Formation, Habana Province, Cuba. The holotype slide originally contained the two figured paratypes as well as the holotype. Each specimen was figured in a single view, with the holotype shown on the spiral side. The holotype has been separated from the paratypes and is figured here in all three views.

Description of holotype. Test small, tightly coiled, slightly biconvex, with open umbilicus, rounded in edge view; evolute on spiral side, involute on umbilical side, chambers increasing gradually in size as added, with six chambers visible on umbilical side; circular in outline with slight inflation of final chamber, early chambers obscured by shell thickness, later chambers on spiral side with slightly depressed, curved, reflexed sutures; on umbilical side sutures depressed, radial; surface rugose, ornamented by short, blunt pustules; aperture an elongate umbilical-extraumbilical slit.

Remarks. *Globorotalia broedermanni* ranges from broadly rounded in the holotype to narrowly rounded in the paratype figured by Cushman and Bermudez

(1949, Pl. 7, Fig. 23). Cushman and Bermudez noted that *G. broedermanni* resembles *G. albeari*, particularly in dorsal view. However, *G. albeari* has more chambers per whorl, the dorsal chambers being more elongate and the sutures more reflexed. *G. broedermanni* also has a more strongly pustulose surface than does *G. albeari*.

Globorotalia mattseensis Gohrbandt closely resembles *G. broedermanni* and may not warrant more than subspecific distinction. *Globorotalia broedermanni* is considered to be referable to *Acarinina*, a subgenus of *Truncorotalites* in the scheme McGowran (1968).

Globorotalia* (*Globorotalia*) *capdevilensis

Cushman and Bermudez

Pl. 1, Figs. 13–15

Globorotalia (*Globorotalia*) *capdevilensis* Cushman and Bermudez, 1949, p. 32, Pl. 6, Fig. 11.

Cushman and Bermudez described this species from the Lower Eocene Capdevila Formation, Habana Province, Cuba. The holotype slide originally contained the two figured paratypes as well as the holotype. Each specimen was figured in a single view, with the holotype shown on the spiral side. The holotype has been separated from the paratypes and is figured here in all three views.

Description of holotype. Test small, trochoid, almost equally biconvex; evolute on spiral side, involute on umbilical side, with small umbilicus; chambers increasing gradually in size as added, with six and one-half chambers visible on umbilical side; circular and lobulate in outline, narrowly rounded in edge view, with pustulose, imperforate keel; chambers on spiral side with smooth, curved sutures, on umbilical side with depressed, straight, radial sutures; surface perforate, with granular appearance and pustulose on early chambers on umbilical side; aperture interiomarginal, umbilical-extraumbilical, extending to near periphery, with distinct narrow lip.

Remarks. In the original description it was stated that this species is not keeled. However, the holotype shows a finely pustulose, imperforate margin which we would regard as a developed keel. Also, the surface is pustulose, and not smooth as shown in the original figure. This species is probably best placed in the genus *Planorotalites* Morozova, as defined by McGowran (1968); it is referable to the group "with slight inflational thickening producing a weak keel" (McGowran, op. cit.).

Globorotalia centralis Cushman and Bermudez
Pl. 1, Figs. 16–18

Globorotalia centralis Cushman and Bermudez, 1937, p. 26,
Pl. 2, Figs. 62–65.

This species was described from the Eocene, Santa Clara Province, Cuba.

The holotype of *G. centralis* was originally illustrated only in edge view; Bolli, Loeblich and Tappan (1957) gave illustrations of spiral, umbilical and edge views of the Cushman and Bermudez holotype. The holotype slide in the U.S. National Museum collection is empty; a paratype slide contains the three figured paratypes. The loss of the holotype was mentioned by Beckman (*in* Toumarkine and Bolli, 1970), and was also cited by Samanta (1973). As noted by Samanta, the holotype was referred to by Blow (1969); this seems to have been the last published reference to the holotype, which can be presumed lost. A lectotype is therefore designated here, selected from the three figured paratypes; the specimen selected is that which appears to be morphologically the closest to the holotype.

Description of lectotype. Test trochoid, spiral side slightly convex, umbilical side strongly convex; evolute on spiral side, involute on umbilical side; four chambers visible from umbilical side, increasing rapidly in size; umbilical area slightly indented but closed; quadrate, slightly lobulate in outline, broadly rounded in edge view; chambers on spiral side narrow, elongate, with depressed, slightly curved sutures; on umbilical side sutures depressed, straight or slightly curved, radial; surface finely perforate, smooth; aperture interiomarginal, umbilical-extraumbilical, extending to near periphery.

Remarks. *Globorotalia centralis* was selected by Cushman and Bermudez (1949) as the type species for the genus *Turborotalia*.

The relationship between *G. centralis*, *G. cerroazulensis* (Cole) and *G. cocoaensis* Cushman has been discussed by several workers; a summary was given by Samanta (1973). We have not examined the holotype of *G. cerroazulensis* (Cole), but the lectotype of *G. centralis* is more broadly rounded in edge view, and has a more open umbilicus. One of the remaining paratypes of *G. centralis*, that figured by Cushman and Bermudez in edge view as figure 63, is transitional to *G. cerroazulensis*; Blow and Banner (1962) documented the transition from *G. centralis* to *G. cerroazulensis*. Bolli (1957) also noted that there is a change in chamber shape from rounded towards subangular in specimens of *G. centralis* during evolution

of the species; he regarded the subangular specimens as transitional towards *G. cocoaensis*, which is now considered to be a synonym of *G. cerroazulensis*.

Globorotalia cibaoensis Bermudez
Pl. 1, Figs. 19–21

Globorotalia cibaoensis Bermudez, 1949, p. 285, Pl. 22, Figs. 21–23.

Bermudez described this species from the Upper Miocene Mao Formation, Cibao Valley, Santiago Province, Dominican Republic. The holotype slide originally contained the two figured paratypes as well as the holotype. Each specimen was figured in a single view, with the holotype shown on the spiral side. The holotype has been separated from the paratypes and is figured here in all three views.

Description of holotype. Test trochoid, equally bi-convex, evolute on spiral side, involute on umbilical side, with small umbilicus; chambers increasing rapidly in size as added, with four and a half chambers visible on umbilical side; oval in shape, lobulate in outline; early chambers narrowly rounded in edge view, later chambers subangular, with narrow, imperforate margin on last two chambers; early chambers on spiral side partly obscured by wall thickening, later chambers with narrow, strongly curved, depressed sutures; sutures on umbilical side depressed, slightly curved, radial; surface smooth, finely perforate, but pustulose around umbilicus on early chambers of last whorl; aperture interiomarginal, partly obscured by sedimentary matrix.

Remarks. The aperture on the holotype is not fully visible but on the paratypes it can be seen as a narrow, elongate umbilical-extraumbilical opening that extends to a distinct indentation near the periphery. In the original description, no mention was made of a keel. However, on the holotype a narrow imperforate peripheral margin is developed on the last two chambers. On the criteria given by Banner and Blow (1959), this species is therefore referable to the subgenus *Globorotalia*.

Blow (1969) discussed *G. cibaoensis*, figuring a topotype and other specimens, and regarded this species as a subspecies of *G. miozea* Finlay.

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