

CONTRIBUTIONS FROM THE CUSHMAN  
LABORATORY FOR FORAMINIFERAL RESEARCH

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169. NEW GENERA AND SPECIES OF FORAMINIFERA  
FROM THE EOCENE OF CUBA

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The following new genera and species represent but a few of the new foraminifera in the very rich faunas of the Eocene of Cuba, but seem worthy of being placed on record so that they may be available to students of the group.

**CHRYSALOGONIUM LAEVE** Cushman and Bermudez, n. sp. (Pl. 5, figs. 1, 2)

Test elongate, tapering, slender, slightly arcuate; early chambers in microspheric form numerous and short, increasing gradually in length as added, in the adult nearly twice as long as broad, circular in transverse section; sutures distinct, very slightly limbate, depressed except in the earliest portion; wall smooth; aperture terminal, consisting of many fine pores. Length 2.50 mm.; diameter 0.25 mm.

Holotype (Cushman Coll. No. 23092) from under Library of Havana University, Cuba (Bermudez Sta. 257). The horizon is probably middle Eocene.

The species has a much finer sieve plate at the apertural end than either of the other smooth Tertiary species, *C. elongatum* and *C. lanceolum* Cushman and Jarvis, from Trinidad, and is not likely to be confused with those Miocene species.

**CHRYSALOGONIUM TENUICOSTATUM** Cushman and Bermudez, n. sp. (Pl. 5, figs. 3-5)

Test elongate, very slightly tapering, nearly straight; chambers increasing gradually in length as added, the sides nearly straight or slightly convex; sutures distinctly limbate, slightly depressed; wall ornamented with fine, longitudinal costae, often slightly spiral, and in the adult often wanting except over the

sutures; aperture terminal, a very fine, circular sieve plate with many openings. Length up to 3.50 mm.; diameter up to 0.50 mm.

Holotype (Cushman Coll. No. 23094) from under Library of Havana University, Cuba (Bermudez Sta. 257), probably middle Eocene.

This species somewhat resembles *C. longicostatum* Cushman and Jarvis from the Miocene of Trinidad, but the Cuban species is more finely costate, and has much finer apertural openings.

**CHRYSALOGONIUM DICKERSONI** Cushman and Bermudez, n. sp. (Pl. 5, figs. 6, 7)

Test elongate, distinctly tapering, somewhat fusiform, circular in transverse section; chambers somewhat indistinct, slightly inflated in the adult; sutures indistinct, slightly depressed in the adult; wall ornamented with coarse, longitudinal costae, independent of the chambers, somewhat sinuous and bifurcating, last half of final chamber smooth; aperture terminal, with numerous small, rounded pores, the outer ring somewhat elongate and radiate. Length 2.00 mm.; diameter 0.35 mm.

Holotype (Cushman Coll. No. 23097) from upper Eocene, Alturas de Almendares quarry, Havana, Cuba (Bermudez Sta. 18).

This species somewhat resembles *C. breviloculum* Cushman and Jarvis, from the Miocene of Trinidad, but the Cuban species has finer openings in the aperture, the chambers much obscured, and the whole test fusiform.

**ELLIPSONODOSARIA ANNULIFERA** Cushman and Bermudez, n. sp. (Pl. 5, figs. 8, 9)

Test elongate, slender, very slightly if at all tapering, gently curved, initial end with a stout spine; chambers distinct, increasing gradually in height as added, circular in transverse section, very slightly inflated in the adult; sutures very distinct, strongly limbate, often forming distinct, raised bands, slightly depressed in the adult; wall smooth; aperture terminal, broadly elliptical, with a distinct tooth extending into the opening from the flattened side of the opening. Length 2.65 mm.; diameter 0.30 mm.

Holotype (Cushman Coll. No. 23099) from under Library of Havana University, Cuba (Bermudez Sta. 257). The horizon is probably middle Eocene.

The species somewhat resembles *Dentalina jacksonensis* Cushman, but its aperture shows it to belong to the Ellipsoidinidae, and the raised annular appearance of the sutures is very distinctive.

**BOLIVINA MARIELINA** Cushman and Bermudez, n. sp. (Pl. 5, figs. 10 a, b)

Test elongate, compressed, tapering from the acute initial end to the greatest width toward the apertural end, periphery subacute; chambers distinct in the adult about as high as broad, slightly overlapping, increasing gradually in size as added; sutures distinct, slightly depressed, strongly oblique, forming an angle of about 35-40° with the horizontal; wall smooth, matte; aperture elongate, very narrow, with a slight lip. Length 1.70 mm.; breadth 0.60 mm.

Holotype (Cushman Coll. No. 23101) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This somewhat remotely resembles *B. gracilis* Cushman and Applin from the upper Eocene of the southern United States, but the chambers in the Cuban species are higher, and the sutures straighter and much more oblique.

**BOLIVINA SCABRATA** Cushman and Bermudez, n. sp. (Pl. 5, figs. 11, 12)

Test about twice as long as broad, strongly tapering, initial end subacute, greatest breadth formed by the last pair of chambers, periphery broadly rounded; chambers distinct, early ones low and broad, later becoming abruptly inflated, and as high as broad, slightly overlapping; sutures fairly distinct, slightly depressed in the early portion, later strongly so, somewhat oblique, forming an angle of about 25-30° with the horizontal; wall rough with short, spinose projections; aperture broadly elliptical with a distinct, rounded lip. Length 0.90 mm.; breadth 0.45 mm.; thickness 0.30 mm.

Holotype (Cushman Coll. No. 23102) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

The species differs from *B. jacksonensis* Cushman and Applin, var. *striatella* Cushman and Applin in the much more inflated chambers, the distinction between the early chambers and the inflated later ones, and in the spinose character of the entire surface.

**BOLIVINA PALMERAE** Cushman and Bermudez, n. sp. (Pl. 5, figs. 13 a, b)

Test less than twice as long as broad, compressed, periphery serrate, rapidly tapering, greatest breadth formed by the last two chambers; chambers distinct, early ones low and broad, gradually increasing in height as added, in the adult as high as

broad, later ones inflated, each with a distinct, peripheral spine at the outer angle; sutures distinct, in the later portion depressed, oblique, forming an angle of about  $45^\circ$  with the horizontal in the adult; wall in the early portion covered with blunt spines, later ones smooth; aperture elongate, elliptical, with a distinct lip. Length 1.10 mm.; breadth 0.80 mm.; thickness 0.30 mm.

Holotype (Cushman Coll. No. 23104) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species most closely resembles the Recent *B. difformis* (Williamson), but in our form, the chambers are much higher, and the early ones are ornamented, whereas they are smooth in *B. difformis*.

*VIRGULINA MINIACEA* Cushman and Bermudez, n. sp. (Pl. 5, figs. 14 a, b)

Test elongate, somewhat fusiform, the initial portion tapering, rounded in transverse section, periphery slightly globular; chambers distinct, numerous, irregularly coiled, distinctly inflated, increasing gradually in size as added; sutures distinct, depressed; wall smooth; aperture broadly oval, in a depression of the inner portion of the last-formed chamber. Length 0.40 mm.; diameter 0.10 mm.

Holotype (Cushman Coll. No. 23107) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species may be compared with *V. californiensis* Cushman, var. *ticensis* Cushman and Kleinpell, but our species is much smaller, the chambers more irregularly arranged, and the aperture is very broad and rounded.

*VIRGULINA CYLINDRICA* Cushman and Bermudez, n. sp. (Pl. 5, figs. 15 a-c)

Test elongate, gradually tapering from the subacute, initial end to the greatest breadth formed by the last pair of chambers, nearly circular in transverse section, periphery very slightly globular; chambers distinct, slightly inflated, increasing gradually in size as added; sutures distinct, very slightly depressed; wall smooth; aperture elongate, curved, with a distinctly depressed border. Length 1.30 mm.; diameter 0.30 mm.

Holotype (Cushman Coll. No. 23108) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species may be most closely compared with *V. dibollensis* Cushman and Applin, but the Cuban species is less regular, has a broader aperture, and is less compressed.

**GONATOSPHAERA ALTERNICOSTATA** Cushman and Bermudez, n. sp. (Pl. 5, figs. 16, 17)

Test about as long as broad, circular in transverse section, consisting of a very few chambers in a rectilinear series, strongly overlapping, broadly fusiform in front view; chambers few, increasing rapidly in size as added; sutures somewhat indistinct, not depressed; wall ornamented by numerous, raised, longitudinal costae, the primary ones radiating from the initial end toward the apertural end with alternating costae coming in between these as growth proceeds, upper portion of the last-formed chamber smooth; aperture, an elongate, narrow opening, with raised lips at either side, terminal. Length 0.60 mm.; diameter 0.40 mm.

Holotype (Cushman Coll. No. 23105) from under Library of Havana University, Cuba (Bermudez Sta. 257), probably middle Eocene.

This species is somewhat similar to *G. prolata* Guppy, but has more closely set chambers, and a highly developed ornamentation, whereas *G. prolata* is smooth.

**Genus RECTOEPONIDES** Cushman and Bermudez, n. gen.

Genoholotype, *Rectoeponides cubensis* CUSHMAN and BERMUDEZ, n. sp.

Test in the early portion trochoid, *Eponides*-like, later portion becoming uniserial and rectilinear; wall calcareous, finely perforate; aperture, an elongate, narrow opening, slightly on the ventral side of the terminal face of the last-formed chamber in a distinct depression, without a distinct lip.

**RECTOEPONIDES CUBENSIS** Cushman and Bermudez, n. sp. (Pl. 5, figs. 18 a-c)

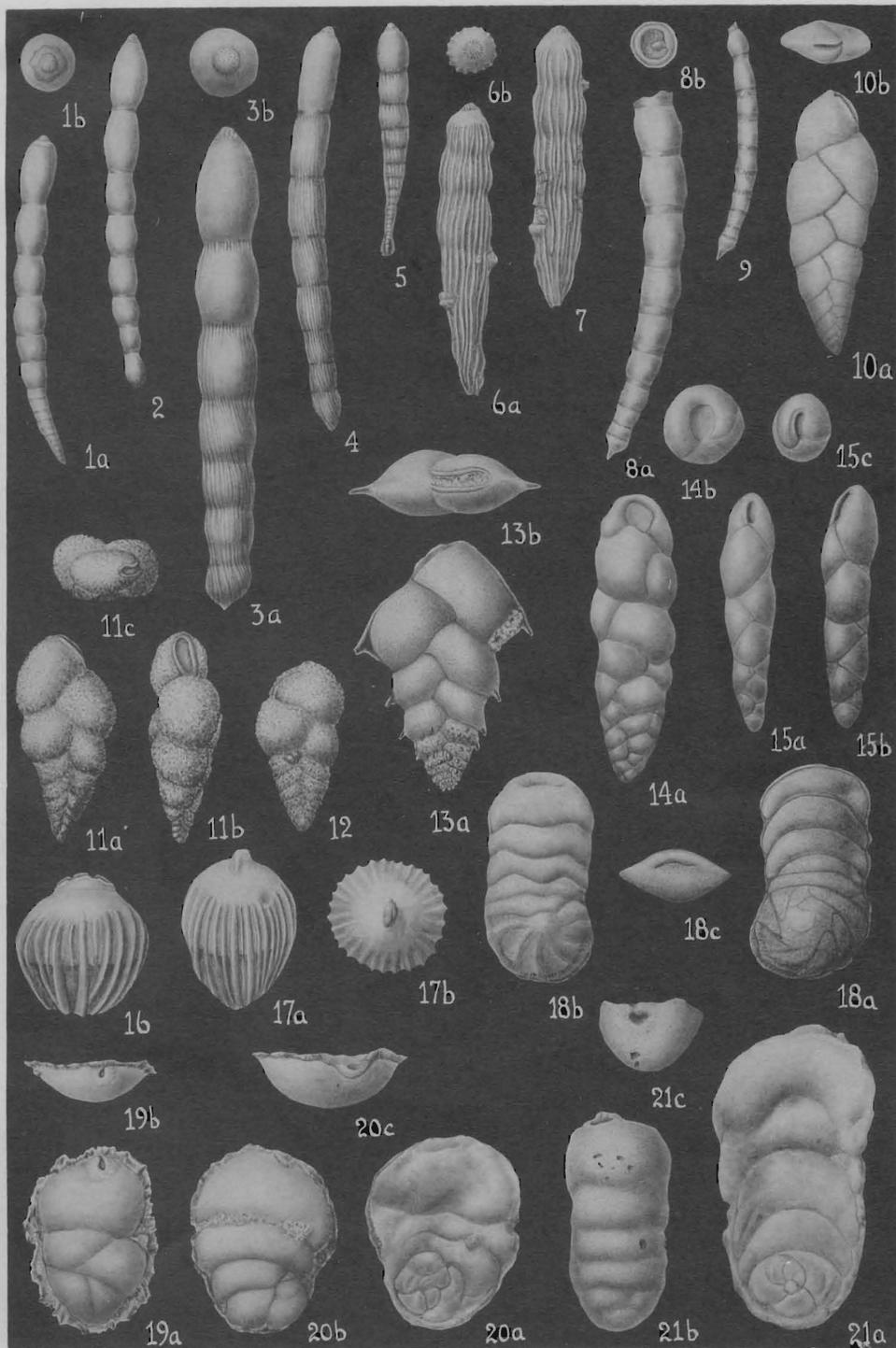
Test elongate, about twice as long as broad, the earlier portion trochoid, *Eponides*-like with the aperture at the inner margin of the last-formed chamber on the ventral side, the later chambers in a rectilinear series, periphery acute, very slightly curved; chambers distinct, those of the early portion close coiled, increasing very gradually in size as added, later rectilinear ones much broader than high, of rather uniform size and shape, very slightly inflated on the ventral side; sutures distinct, slightly limbate, strongly oblique in the early portion, on the dorsal side nearly

radiate, curved on the ventral side, in the rectilinear portion strongly convex on the dorsal side, sinuous on the ventral side; wall calcareous, finely perforate, smooth; aperture in the early stage *Eponides*-like, in the adult an elongate, narrow opening, slightly on the ventral side of the terminal face of the last-

## EXPLANATION OF PLATE 5

- FIGS. 1, 2. *Chrysalogonium laeve* Cushman and Bermudez, n. sp. Fig. 1, Holotype. *a*, front view,  $\times 20$ ; *b*, apertural view,  $\times 40$ . Microspheric form. Fig. 2, Paratype. Megalospheric form.  $\times 20$ .
- FIGS. 3-5. *Chrysalogonium tenuicostatum* Cushman and Bermudez, n. sp.  $\times 20$ . Fig. 3, Holotype. *a*, front view; *b*, apertural view. Figs. 4, 5, Paratypes showing variation.
- FIGS. 6, 7. *Chrysalogonium dickersoni* Cushman and Bermudez, n. sp.  $\times 22$ . Fig. 6, Holotype. *a*, front view; *b*, apertural view. Fig. 7, Paratype.
- FIGS. 8, 9. *Ellipsonodosaria annulifera* Cushman and Bermudez, n. sp.  $\times 20$ . Fig. 8, Holotype. *a*, front view; *b*, apertural view. Fig. 9, Paratype.
- FIG. 10. *Bolivina marielina* Cushman and Bermudez, n. sp.  $\times 22$ . *a*, front view; *b*, apertural view.
- FIGS. 11, 12. *Bolivina scabrata* Cushman and Bermudez, n. sp.  $\times 33$ . Fig. 11, Holotype. *a*, front view; *b*, side view; *c*, apertural view. Fig. 12, Paratype.
- FIG. 13. *Bolivina palmerae* Cushman and Bermudez, n. sp.  $\times 33$ . *a*, front view; *b*, apertural view.
- FIG. 14. *Virgulina miniacea* Cushman and Bermudez, n. sp.  $\times 100$ . *a*, front view; *b*, apertural view.
- FIG. 15. *Virgulina cylindrica* Cushman and Bermudez, n. sp.  $\times 28$ . *a*, front view; *b*, side view; *c*, apertural view.
- FIGS. 16, 17. *Gonatosphaera alternicostata* Cushman and Bermudez, n. sp. Fig. 16, Paratype. Front view.  $\times 80$ . Fig. 17, Holotype. *a*, side view; *b*, apertural view.  $\times 40$ .
- FIG. 18. *Rectoeponides cubensis* Cushman and Bermudez, n. gen. and n. sp.  $\times 33$ . *a*, dorsal view; *b*, ventral view; *c*, apertural view.
- FIGS. 19-21. *Stichocibicides cubensis* Cushman and Bermudez, n. gen. and n. sp. Fig. 20 *a-c*, Holotype.  $\times 33$ . *a*, dorsal view; *b*, ventral view; *c*, apertural view. Figs. 19, 21, Paratypes. Fig. 19, *a*, ventral view; *b*, apertural view.  $\times 22$ . Fig. 20, *a*, dorsal view,  $\times 40$ ; *b*, ventral view,  $\times 25$ ; *c*, apertural view,  $\times 25$ .

Figures drawn by Patricia G. Edwards.



formed chamber in a distinct depression, without a distinct lip. Length 1.00 mm.; breadth 0.45 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 23109) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species is evidently derived from an *Eponides*-like ancestor.

Genus *STICHOCIBICIDES* Cushman and Bermudez, n. gen.

Genoholotype, *Stichocibicides cubensis* CUSHMAN and BERMUDEZ, n. sp.

Test attached by the dorsal side, in the early stages close coiled, trochoid, the dorsal side flattened, ventral side convex, later followed by a series of uniserial chambers; wall calcareous, finely perforate; aperture, a generally rounded or elliptical opening on the middle of the ventral side of the last-formed chamber, near the periphery, without a distinct lip.

*STICHOCIBICIDES CUBENSIS* Cushman and Bermudez, n. sp. (Pl. 5, figs. 19-21)

Test attached by the dorsal side which is flattened, the ventral side convex and involute, later portion uniserial, rectilinear, the chambers of the early portion increasing rapidly in size as added, later ones also increasing in size, but less rapidly, periphery subacute or keeled; sutures distinct, slightly depressed on the dorsal side, more strongly so on the ventral, in the uniserial portion nearly straight on the ventral side, strongly convex on the dorsal; wall smooth, finely perforate; aperture single, nearly terminal in the adult, near the periphery in the border of the last-formed chamber on the ventral side, sometimes with a slight lip. Length 1.10 mm.; breadth 0.60 mm.; thickness 0.15-0.25 mm.

Holotype (Cushman Coll. No. 23110) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A). Paratype (Pl. 5, figs. 19 a, b) from 1 km. N. of Arroyo Arenas on the road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31). Paratype (Pl. 5, figs. 21 a-c) from upper Eocene, 1 km. S. of Ingenio Saratoga, Matanzas Province, Cuba (Bermudez Sta. 322).

This species is evidently derived from *Eponides* by the addition of a rectilinear series of chambers. It may be distinguished from *Rectocibicides* by the single aperture.

## VALVULINERIA CUBANA Cushman and Bermudez, n. sp. (Pl. 6, figs. 1, 2)

Test coiled, trochoid, ventral side completely involute, periphery broadly rounded, dorsally the early coils depressed below the final one; chambers distinct, inflated, five or six in the final whorl, rapidly increasing in size; sutures distinct, somewhat depressed, strongly oblique on the dorsal side, nearly radial on the ventral side; wall smooth, distinctly perforate; aperture elongate; at the umbilical margin of the chamber which extends over it in a series of tooth-like processes. Length 0.70 mm.; breadth 0.60 mm.; thickness 0.50 mm.

Holotype (Cushman Coll. No. 23113) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

The species differs from *V. texana* Cushman and Ellisor in the greater inflation of the chambers, more depressed spire, and the peculiar filamentous character of the inner end of the ventral side of the chamber.

## Genus NEOCARPENTERIA Cushman and Bermudez, n. gen.

Genoholotype, *Neocarpenteria cubana* CUSHMAN and BERMUDEZ, n. sp.

Test attached by the dorsal side, close coiled, trochoid, dorsal side flattened, ventral side convex; wall calcareous, perforate; aperture large, semicircular, on the margin of the ventral side of the chamber, with a distinct lip.

There seems to be a tendency to grow upward slightly on the ventral side, suggesting the type of development seen in *Carpenteria*.

## NEOCARPENTERIA CUBANA Cushman and Bermudez, n. sp. (Pl. 6, figs. 3-5)

Test attached by the dorsal side, close coiled, trochoid, periphery with a distinct keel, ventral side strongly convex; chambers distinct, increasing rather rapidly but uniformly in size as added, those of the ventral side becoming involute and inflated; sutures distinct, very strongly oblique on the dorsal side, nearly radial and depressed ventrally; wall finely perforate; aperture at the margin of the chamber on the dorsal side, large, semicircular, with a distinct lip. Diameter 1.00 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 23115) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This is a very unique species, the ventral side especially pre-

senting a peculiar appearance with the keel of each chamber showing as an oblique area the slightly inflated chambers between.

**PULVINULINELLA CANCELLATA** Cushman and Bermudez, n. sp. (Pl. 6, figs. 7 a, b)

Test trochoid, close coiled, nearly equally biconvex, periphery keeled; chambers indistinct, five or six in the final whorl; sutures indistinct, oblique, slightly curved; wall except the last chamber with a cancellated surface consisting of an irregularly polygonal, raised meshwork; aperture, an elongate, elliptical opening slightly on the ventral side of the periphery. Diameter 1.00 mm.; thickness 0.50 mm.

Holotype (Cushman Coll. No. 23118) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *P. interrupta* Cushman from the Alazan of Mexico in the more strongly biconvex character, and particularly the surface ornamentation.

**CASSIDULINA CRISPULA** Cushman and Bermudez, n. sp. (Pl. 6, figs. 8, 9)

Test with height, breadth and thickness about equal, generally rounded in transverse section; chambers fairly distinct, later ones somewhat inflated; sutures of the later portion distinct, slightly depressed, earlier ones obscured; wall ornamented along the periphery of the chambers which are crenulated but not distinctly spinose; aperture elongate, arcuate. Length 0.60 mm.; breadth 0.60 mm.; thickness 0.60 mm.

Holotype (Cushman Coll. No. 23119) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from the common Eocene *C. globosa* Hantken in the crenulate ornamentation of the chamber margins.

**CASSIDULINA CONSTELLATA** Cushman and Bermudez, n. sp. (Pl. 6, figs. 10 a, b)

Test slightly longer than broad, nearly circular in transverse section; chambers in the later portion distinct and inflated, earlier ones obscure; sutures of the later portion distinct and depressed, earlier ones obscured by the ornamentation; wall in the earlier chambers ornamented by large, coarse spines, somewhat radiate, giving a stellate appearance, later chambers smooth; aperture elongate, slightly curved. Length 0.40 mm.; diameter 0.35 mm.

Holotype (Cushman Coll. No. 23121) from upper Eocene, 1 km. S. of Ingenio Saratoga, Matanzas Province, Cuba (Bermudez Sta. 322).

This species differs from *C. globosa* and *C. crispula* in the ornamentation of very large, stout spines. It remotely resembles *Ehrenbergina hystrix* H. B. Brady, but the chambers show it to be a *Cassidulina*.

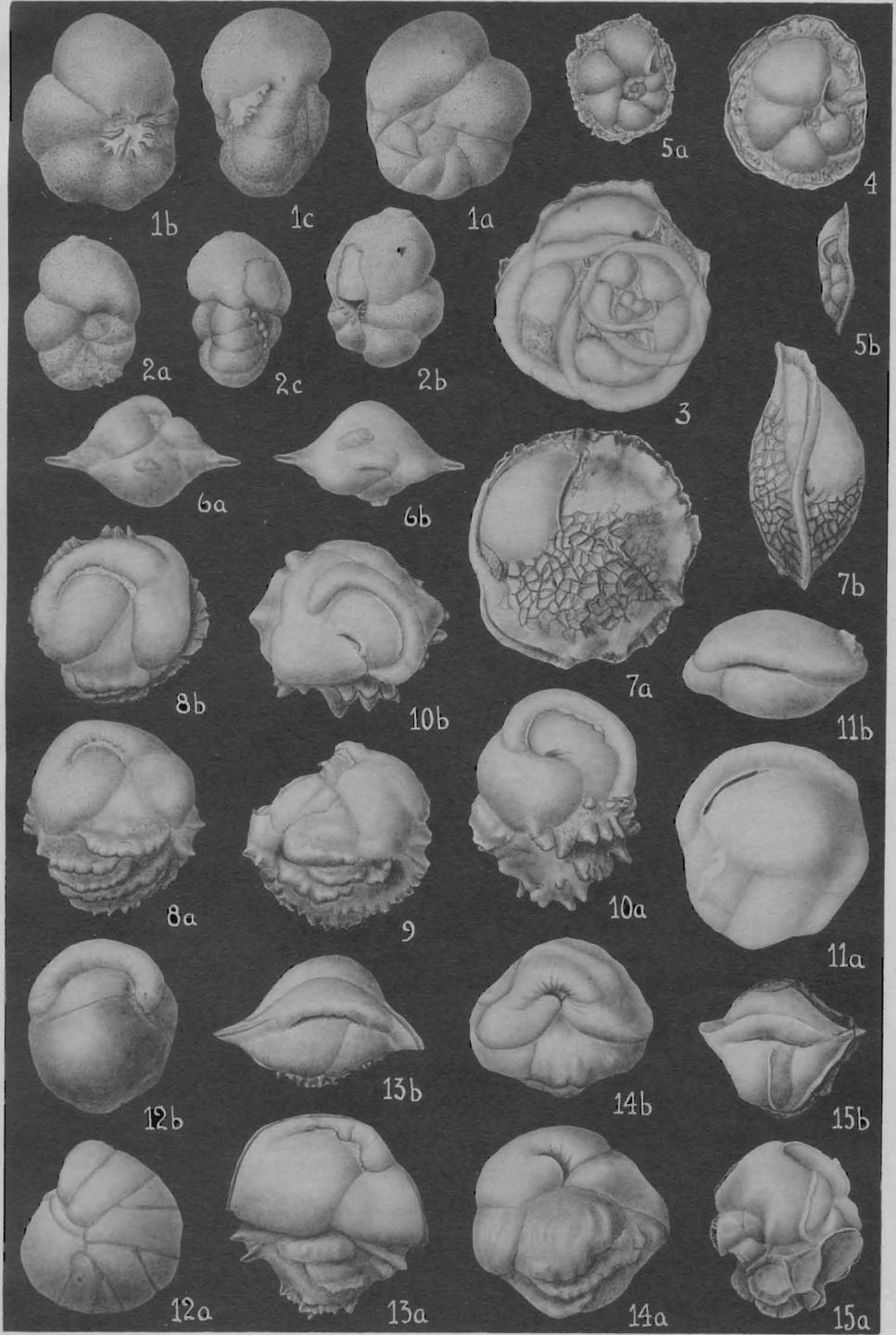
CASSIDULINA HAVANENSIS Cushman and Bermudez, n. sp. (Pl. 6, figs. 11 a, b)

Test strongly compressed in peripheral view, nearly circular in front view, periphery very slightly lobulate; chambers few, with three pairs in the last whorl, increasing rapidly in size as added, very slightly inflated; sutures fairly distinct, very slightly depressed, nearly straight; wall smooth; aperture very narrow,

#### EXPLANATION OF PLATE 6

- FIGS. 1, 2. *Valvulineria cubana* Cushman and Bermudez, n. sp. Fig. 1, Holotype,  $\times 40$ . Fig. 2, Paratype,  $\times 33$ . a, a, dorsal views; b, b, ventral views; c, c, peripheral views.
- FIGS. 3-5. *Neocarpenteria cubana* Cushman and Bermudez, n. gen. and n. sp.  $\times 33$ . Fig. 3, Holotype, dorsal view. Figs. 4, 5, Paratypes. 4 a, ventral view; b, peripheral view.
- FIG. 6. *Ehrenbergina bicornis* H. B. Brady, var. *eocenica* Cushman and Bermudez, n. var.  $\times 55$ . a, front view; b, apertural view.
- FIG. 7. *Pulvinulinella cancellata* Cushman and Bermudez, n. sp.  $\times 33$ . a, side view; b, peripheral view.
- FIGS. 8, 9. *Cassidulina crispula* Cushman and Bermudez, n. sp.  $\times 50$ . Fig. 8, Holotype. a, front view; b, apertural view. Fig. 9, Paratype.
- FIG. 10. *Cassidulina constellata* Cushman and Bermudez, n. sp.  $\times 80$ . a, front view; b, apertural view.
- FIG. 11. *Cassidulina havanensis* Cushman and Bermudez, n. sp.  $\times 33$ . a, front view; b, apertural view.
- FIG. 12. *Cassidulina labiata* Cushman and Bermudez, n. sp.  $\times 50$ . a, side view; b, apertural view.
- FIG. 13. *Ehrenbergina cubensis* Cushman and Bermudez, n. sp.  $\times 80$ . a, front view; b, apertural view.
- FIG. 14. *Cassidulina arenasensis* Cushman and Bermudez, n. sp.  $\times 50$ . a, front view; b, apertural view.
- FIG. 15. *Ehrenbergina cristata* Cushman and Bermudez, n. sp.  $\times 80$ . a, front view; b, apertural view.

Figures drawn by Patricia G. Edwards.



elongate, at the base of the last-formed chamber. Diameter 0.80 mm.; thickness 0.45 mm.

Holotype (Cushman Coll. No. 23122) from upper Eocene, 1 km. N. of Arroyo Arenas on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

In the number of chambers this species resembles *C. globosa*, but *C. havanensis* is very much compressed, and the aperture is very narrow and elongate.

**CASSIDULINA LABIATA** Cushman and Bermudez, n. sp. (Pl. 6, figs. 12 a, b)

Test generally rounded in both front and side views, periphery not lobulate but entire; chambers numerous, six or seven pairs in the final whorl, the sides parallel, those of the opposite side appearing as broad triangles, increasing very slightly in size as added; sutures slightly limbate, straight, not depressed; wall smooth; aperture narrow, elongate, curved. Length 0.60 mm.; breadth 0.60 mm.; thickness 0.45 mm.

Holotype (Cushman Coll. No. 23123) from upper Eocene, 1 km. N. of Arroyo Arenas on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *C. globosa* in having nearly double the number of chambers in the final whorl, the entire periphery, and the straight, non-depressed sutures.

**CASSIDULINA ARENASENSIS** Cushman and Bermudez, n. sp. (Pl. 6, figs. 14 a, b)

Test slightly broader than high, irregularly polygonal in end view, periphery rounded; chambers fairly distinct, somewhat inflated, about three pairs in the final whorl; sutures of the later portion distinct and depressed, straight, earlier ones obscure; wall with low, rounded, longitudinal costae or plications, periphery of earlier chambers slightly crenulate; aperture elongate, curved, with fine radiate costae about the opening. Length 0.50 mm.; breadth 0.55 mm.; thickness 0.45 mm.

Holotype (Cushman Coll. No. 23124) from upper Eocene, 1 km. N. of Arroyo Arenas on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *C. globosa* in the polygonal shape, crenulate margins and plicate chambers.

**EHRENBERGINA BICORNIS** H. B. Brady, var. *EOCENICA* Cushman and Bermudez, n. var. (Pl. 6, figs. 6 a, b)

Variety differing from the typical in having fewer chambers in

the final whorl; chambers lower, the outline of the test more elongate, fusiform, and the spines more slender.

Holotype of variety (Cushman Coll. No. 23125) from upper Eocene, 4.5 kms. N. of Guanajay on the road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

*EHRENBERGINA CUBENSIS* Cushman and Bermudez, n. sp. (Pl. 6, figs. 13 a, b)

Test slightly broader than high in front view, somewhat compressed, periphery acute in end view; chambers distinct, later ones inflated and the last pair occupying more than half the surface of the test in front view; sutures distinct, depressed; wall of the last chambers smooth, earlier ones with slight longitudinal plications of the surface, and the periphery slightly spinose in the earlier ones, with a few strong spines in the chambers just previous to the last pair; aperture elongate, slightly curved. Length 0.40 mm.; breadth 0.45 mm.; thickness 0.25 mm.

Holotype (Cushman Coll. No. 23126) from upper Eocene, 1 km. N. of Arroyo Arenas on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species somewhat resembles *E. semmesi* Cushman from the Alazan of Mexico, but the Cuban species has higher chambers in the adult, less well developed spines, the earlier portion with fine spines, and the surface somewhat plicate.

*EHRENBERGINA CRISTATA* Cushman and Bermudez, n. sp. (Pl. 6, figs. 15 a, b)

Test somewhat longer than broad, broadly elliptical in front view, strongly biconvex in end view, periphery acute, keeled; chambers and sutures largely obscured by the ornamentation; wall ornamented by a very coarse, reticulate pattern made by high, plate-like projections with irregular, depressed, polygonal areas between; aperture elongate, narrow. Length 0.30 mm.; breadth 0.25 mm.; thickness 0.25 mm.

Holotype (Cushman Coll. No. 23127) from upper Eocene, 1 km. N. of Arroyo Arenas on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

The only other species with a reticulate ornamentation is *E. reticulata* Cushman from the Tropical Pacific. That species has a very finely reticulate surface, entirely different from our Eocene species.

## 170. SOME AMERICAN EOCENE BULIMINAS

By JOSEPH A. CUSHMAN and FRANCES L. PARKER

In our studies of the genus *Bulimina*, the following forms seem to be distinct and undescribed. They have been compared with type and topotype material of known species. It is not always easy to show the differences either by drawings or photographs, as actual specimens must be available to make them clear. This is particularly true of the older species which are often very inadequately illustrated, and a study of the actual types, or when these are not available, of topotypes, is necessary. We are indebted to Mr. Bradford C. Adams for much of the material described here.

**BULIMINA JARVISI** Cushman and Parker, n. sp. (Pl. 7, figs. 1 a-c)

Test large, more than twice as long as broad, tapering throughout; chambers numerous, 6-7 whorls, inflated; sutures distinct, depressed; wall of the lower one-half to two-thirds of the test covered with fine, irregular costae, the upper half very coarsely perforate, giving the surface a very rough appearance; aperture loop-shaped with a slight lip. Length 0.80-0.96 mm.; diameter 0.30-0.40 mm.

Holotype (Cushman Coll. No. 23128) from the "Lower Marl" Cipero Sect. Sta. No. 10, Trinidad, B. W. I.

This species resembles *B. semicostata* Nuttall, but differs from it in its much greater size, more numerous and more strongly inflated chambers, and the much roughened surface of the test. Our specimens are all from the Eocene of Trinidad, collected by Mr. P. W. Jarvis.

**BULIMINA MICROCOSTATA** Cushman and Parker, n. sp. (Pl. 7, figs. 2 a-c)

Test medium, more than twice as long as broad; chambers numerous, 6-8 whorls, the last-formed whorl forming a third or more of the test, the chambers toward the initial end being increasingly narrower, arranged in series with a slight, offset twist and with adjacent series joined in a zigzag line, very slightly inflated; sutures distinct, slightly depressed; wall of the lower part of the test covered with very fine costae, the upper part smooth, finely perforate; aperture a long, narrow loop with a

slight lip. Length 0.34-0.48 mm.; diameter 0.19-0.24 mm.

Holotype (Cushman Coll. No. 23129) from NE  $\frac{1}{4}$  Sec. 2, T 1 N, R 1 E, in center of exposure in abandoned shale quarry,  $1\frac{1}{2}$  miles NE of Sommersville, Contra Costa Co., California.

This form differs from *B. semicostata* Nuttall in the regularity and angled character of the more numerous chambers with much finer costae, and from *B. cacumenata* in its much greater size, more inflated chambers, more uniform width and finer costae.

Our specimens are all from the type locality.

*BULIMINA CACUMENATA* Cushman and Parker, n. sp. (Pl. 7, figs. 3 a-c)

Test small, somewhat fusiform, greatest width slightly above the middle, gradually tapering to a long, subacute point; chambers numerous, 6-7 whorls, those of the last whorl somewhat inflated, arranged in a slightly twisted series, those of adjacent series meeting in a zigzag line; sutures distinct in the upper part, obscure in the lower part of the test, very slightly depressed; wall, except for the last whorl and occasionally for the next to the last, covered with irregular, low, closely set costae, last whorl smooth, coarsely perforate; aperture loop-shaped, with a slight lip. Length 0.20-0.23 mm.; diameter 0.10-0.11 mm.

Holotype (Cushman Coll. No. 23130) from the Midway, 3+ miles above bridge over Cedar Creek on Austin-Red Rock road, Bastrop Co., Texas.

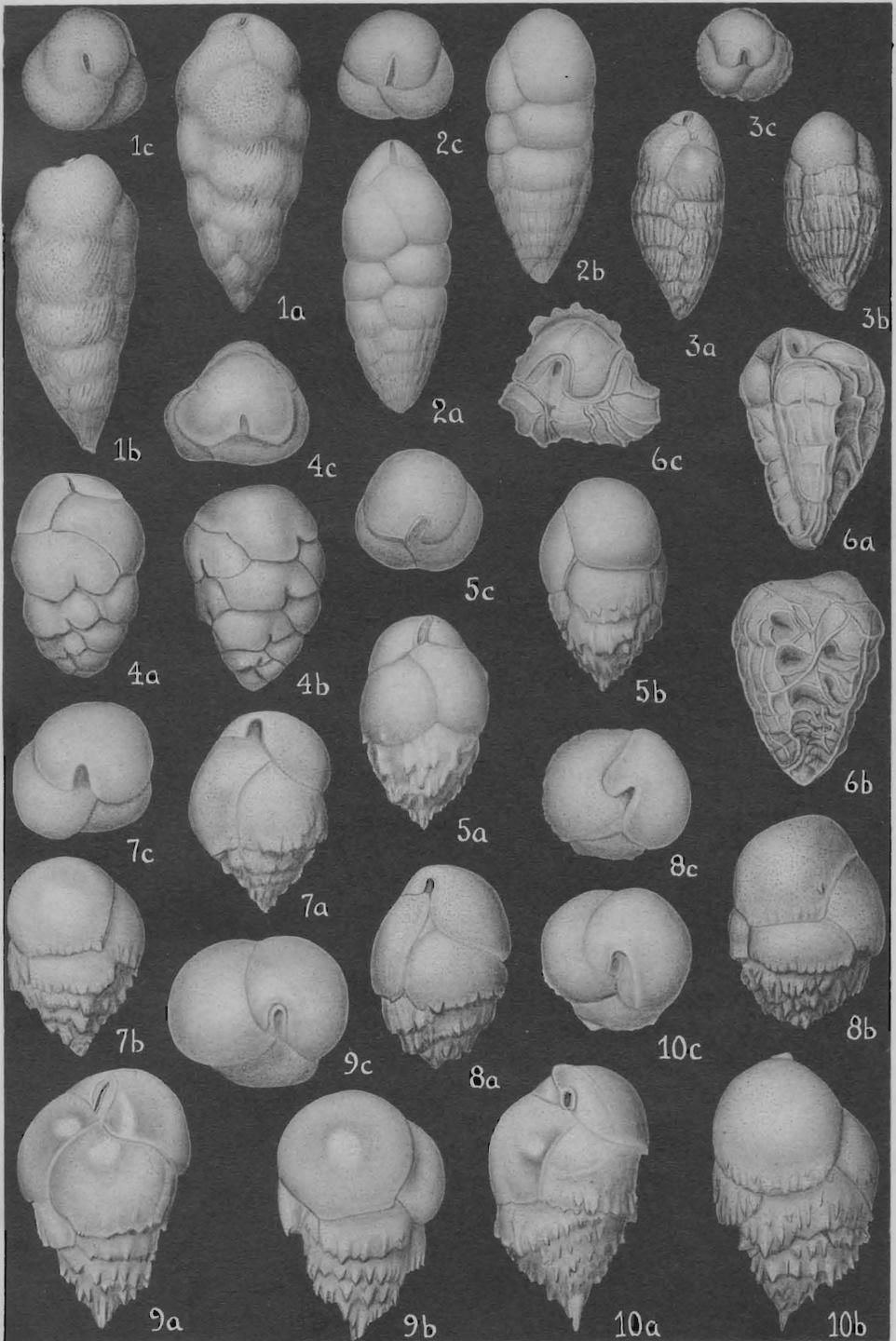
This species differs from *B. semicostata* Nuttall in the much smaller, narrower test, the more inflated chambers, and the

EXPLANATION OF PLATE 7

- FIG. 1. *Bulimina jarvisi* Cushman and Parker, n. sp.  $\times 50$ .  
 FIG. 2. *Bulimina microcostata* Cushman and Parker, n. sp.  $\times 80$ .  
 FIG. 3. *Bulimina cacumenata* Cushman and Parker, n. sp.  $\times 120$ .  
 FIG. 4. *Bulimina excavata* Cushman and Parker, n. sp.  $\times 80$ .  
 FIG. 5. *Bulimina stalacta* Cushman and Parker, n. sp.  $\times 100$ .  
 FIG. 6. *Bulimina adamsi* Cushman and Parker, n. sp.  $\times 80$ .  
 FIGS. 7, 8. *Bulimina denticulata* Cushman and Parker, n. sp.  $\times 80$ . Fig. 7, Holotype. Fig. 8, Paratype.  
 FIGS. 9, 10. *Bulimina arkadelphiana* Cushman and Parker, var. *midwayensis* Cushman and Parker, n. var.  $\times 100$ . Fig. 9, Holotype. Fig. 10, Paratype.

In all specimens: a, front view; b, rear view; c, apertural view.

Figures drawn by Ann Shepard.



shape of the chambers which are distinctly angled. It is much smaller and more coarsely costate than *B. microcostata*. This form was found at two stations in the Midway.

*BULIMINA EXCAVATA* Cushman and Parker, n. sp. (Pl. 7, figs. 4 a-c)

Test of medium size, somewhat triangular in transverse section, about  $1\frac{1}{2}$  times as long as broad; chambers fairly distinct, of about 5 whorls, inflated; sutures distinct, depressed, with small depressions extending from them upward into the chambers, usually one to each chamber; wall smooth, finely perforate; aperture loop-shaped. Length 0.26-0.34 mm.; diameter 0.21-0.22 mm.

Holotype (Cushman Coll. No. 23131) from about 3 miles N 45° E of town of Santa Susana, in Poison Oak Canyon, north of Simi Valley, Ventura Co., California.

This species resembles the Mexican Cretaceous species *B. incisa* Cushman, but differs from it in the more angled character of the test, the depressed sutures, and the inflation of the chambers. It was found at one station in the lower Eocene of California.

*BULIMINA ADAMSI* Cushman and Parker, n. sp. (Pl. 7, figs. 6 a-c)

Test small, triangular in section, the angles truncated, not more than  $1\frac{1}{2}$  times as long as broad; chambers somewhat obscured by the surface ornamentation, about 5 whorls, adjacent series meeting in a very sharply angled, zigzag line; sutures depressed except at the initial end; wall ornamented with three irregular, elongate costae at each corner of the triangular test, extending the whole length, the flat sides of the test ornamented with irregular costae, giving a reticulated appearance, coarsely perforate; aperture loop-shaped, with a distinct lip, on the flattened top of the test. Length 0.24-0.34 mm.; width of one side 0.20-0.24 mm.

Holotype (Cushman Coll. No. 23132) from 225 feet stratigraphically below Domengine sandstone, in Oil Canyon, just east of Oil City, Fresno Co., California.

This species is not to be confused with any of the smaller costate types like *B. truncana* Gumbel or *B. rostrata* H. B. Brady owing to the triangular shape of the test and the irregular reticulation of the costae. It is named for Mr. Bradford C. Adams, who supplied us with much of the material used in this paper.

**BULIMINA STALACTA** Cushman and Parker, n. sp. (Pl. 7, figs. 5 a-c)

Test large, about  $1\frac{1}{2}$  times as long as broad, gradually tapering, terminated by a spine; chambers distinct in upper part of test, very slightly inflated; sutures distinct, somewhat depressed; wall of last-formed whorl smooth, finely perforate, lower part ornamented by blunt spines often aligned and appearing as remnants of jagged costae, some specimens having costae as well as spines; aperture loop-shaped with a slight lip. Length of holotype 0.58 mm.; diameter 0.33 mm.

Holotype (Cushman Coll. No. 23133) from small canyon, 50 feet stratigraphically above the top of a massive sandstone on the south slope of hill 2217 (Cholame quadrangle topographic sheet, U. S. Geol. Survey) about  $\frac{1}{2}$  mile E of Tar Canyon, Reef Ridge, Kings Co., California.

This species differs from *B. aculeata* d'Orbigny (specimens of which in our collection are based on d'Orbigny's figure published by Fornasini in 1901) in the different shape and lack of inflation of the chambers, more numerous spines, and the presence of occasional costae.

**BULIMINA ARKADELPHIANA** Cushman and Parker, var. **MIDWAYENSIS** Cushman and Parker, n. var. (Pl. 7, figs. 9, 10)

*Bulimina aculeata* PLUMMER (not D'ORBIGNY), Univ. Texas Bull. 2644, 1926, p. 73, pl. 4, fig. 3.

Test small, about  $1\frac{1}{2}$  times as long as broad, tapering, usually with a well defined basal spine; chambers distinct, undercut at base, giving a "collared" effect, about 5 whorls, last-formed chambers inflated; sutures distinct, depressed; wall of all but the last-formed whorl, covered with sharp, fine spines, usually extending from the lower edges of the chambers, last-formed whorl smooth, finely perforate; aperture loop-shaped with a well-defined lip. Length 0.26-0.38 mm.; diameter 0.16-0.25 mm.

Holotype of variety (Cushman Coll. No. 23136) from the Midway, road cut S of Reservoir  $3\frac{1}{2}$  miles SE of Corsicana, Texas.

This variety differs from the typical in the more inflated and higher last-formed whorl, and in the presence of a basal spine. It differs from *B. stalacta* in its smaller size, and in having much sharper spines. Specimens were found in several stations of the Midway.

**BULIMINA DENTICULATA** Cushman and Parker, n. sp. (Pl. 7, figs. 7, 8)

Test of medium size, usually less than  $1\frac{1}{2}$  times as long as broad, rapidly tapering; chambers fairly distinct, slightly under-

cut at base, of about 4 whorls, adult whorl forming  $\frac{1}{2}$  to  $\frac{3}{4}$  of the test, and much inflated; sutures in last-formed whorl distinct, depressed, obscured in earlier portion of test; wall of last whorl smooth, perforate, the margins of the chambers cut into more or less regular flutings or scallops which apparently cover the whole of the bottom of the test owing to the very narrow chambers, the marginal character of the flutings being plain, however, in the last-formed whorl and often in the preceding one; aperture loop-shaped. Length 0.24-0.38 mm.; diameter 0.20-0.34 mm.

Holotype (Cushman Coll. No. 23134) from about 3 miles N 45° E of town of Santa Susana, in Poison Oak Canyon, N of Simi Valley, Ventura Co., California, from brown shale 2710 feet stratigraphically above the Cretaceous contact, in strata mapped as Martinez.

This form resembles most closely *B. spinata* Cushman and Campbell from the Moreno shale, but is much smaller and has the fluted margins of the chambers much more sharply defined and coarser. It seems probable that *B. spinata* may be the ancestral form.

**BULIMINA GUAYABALENSIS** Cole, var. **AMPLA** Cushman and Parker, n. var.  
(Pl. 8, figs. 1 a-c)

Variety differing from the typical in the larger test, much broader in proportion to its width. The chambers are more inflated than those of Cole's species. Length 0.40-0.61 mm.; diameter 0.30-0.45 mm.

Holotype of variety (Cushman Coll. No. 23138) from NE  $\frac{1}{4}$  Sec. 2, T 1 N, R 1 E, in center of exposure in abandoned shale quarry,  $1\frac{1}{2}$  miles NE of Sommersville, Contra Costa Co., California.

**BULIMINA LIRATA** Cushman and Parker, n. sp. (Pl. 8, figs. 2 a-c)

Test large, usually less than  $1\frac{1}{2}$  times as long as broad, rapidly tapering; chambers indistinct except in the last-formed whorl, about 4 whorls, last-formed chambers inflated, forming about one-half the test; sutures depressed; wall of last-formed chambers mostly smooth, finely perforate, remainder of test coarsely costate, with thin, plate-like, low costae, eleven or more in number, sometimes extending part way onto chambers of last-formed coil, continuous throughout; aperture loop-shaped, with a slight lip. Length of holotype 0.57 mm.; diameter 0.40 mm.

Holotype (Cushman Coll. No. 23139) from gray clay shale, 450 feet stratigraphically above the Avenal sandstone, in Coal Mine Canyon, Sec. 26, T 20 S, R 14 E, Fresno Co., California.

This species differs from *B. stalacta* in having only costae, from *B. instabilis*, n. sp., in the shorter, broader shape of the test, the less numerous chambers, and the shape of the chambers, and from *B. jacksonensis* Cushman in the shape of the test and the more numerous, lower costae.

**BULIMINA INSTABILIS** Cushman and Parker, n. sp. (Pl. 8, figs. 3 a-c)

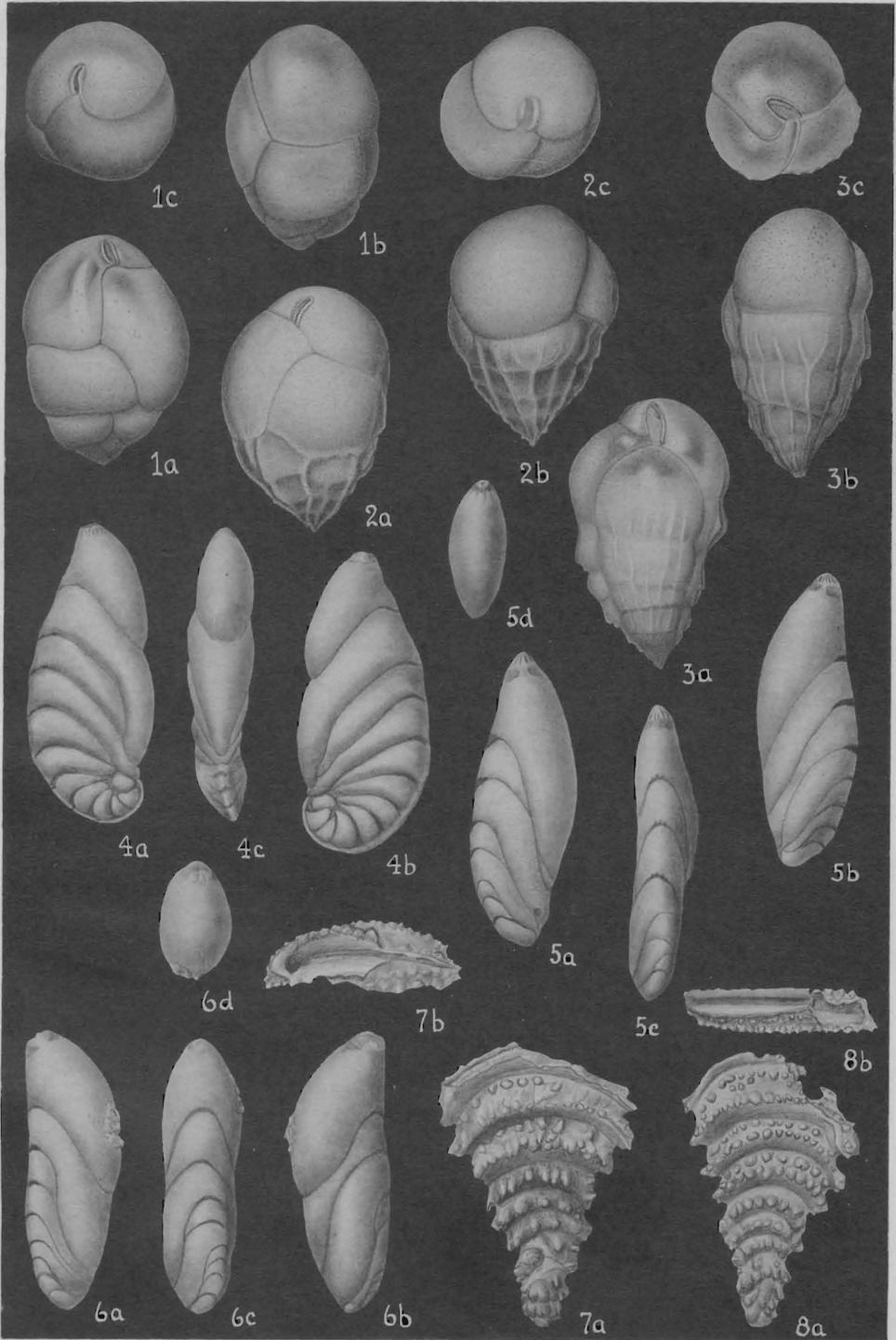
Test large, about  $1\frac{1}{2}$  times as long as broad; chambers distinct, 6-8 whorls, last-formed chambers inflated, arranged in fairly regular series; sutures distinct, very slightly depressed; wall in the adult with several thin, plate-like, somewhat jagged costae with low costae between extending up to the last-formed whorl, in young forms the costae not well developed, sometimes resembling spines, and again almost entirely absent, last-formed chambers smooth, coarsely perforate; aperture loop-shaped with a slight lip. Length of holotype 0.71 mm; diameter 0.43 mm.

Holotype (Cushman Coll. No. 23140) from 2068 feet depth of Lillis Welch well No. 1, drilled by Western Gulf Oil Company, located 680 feet N and 990 feet E of SW corner Sec. 26, T 15 S, R 12 E, Fresno Co., California.

EXPLANATION OF PLATE 8

- FIG. 1. *Bulimina guayabalensis* Cole, var. *ampla* Cushman and Parker, n. var.  $\times 55$ . a, front view; b, rear view; c, apertural view.
- FIG. 2. *Bulimina lirata* Cushman and Parker, n. sp.  $\times 60$ . a, front view; b, rear view; c, apertural view.
- FIG. 3. *Bulimina instabilis* Cushman and Parker, n. sp.  $\times 55$ . a, front view; b, rear view; c, apertural view.
- FIG. 4. *Polymorphinoides spiralis* Cushman and Hanzawa, n. gen. and n. sp.  $\times 33$ . a, b, opposite sides; c, ventral view.
- FIG. 5. *Polymorphinella vaginulinaeformis* Cushman and Hanzawa, n. gen. and n. sp.  $\times 50$ . a, b, opposite sides; c, ventral view; d, end view.
- FIG. 6. *Polymorphinella compressa* Cushman and Hanzawa, n. gen. and n. sp.  $\times 28$ . a, b, opposite sides; c, ventral view; d, end view.
- FIGS. 7, 8. *Bifarinella ryukyensis* Cushman and Hanzawa, n. gen. and n. sp.  $\times 33$ . a, a, front views; b, b, end views. Fig. 7, Paratype. Fig. 8, Holotype.

Figs. 1-3 drawn by Ann Shepard. Figs. 4-8 drawn by Patricia G. Edwards.



This form is apparently very variable. All of our specimens are from the same locality in California. In some the costae are well developed, while in others they appear only intermittently, or are even entirely lacking; the arrangement of the chambers is, however, identically the same throughout, and there seems to be no way to logically divide the species. The species differs from *B. buchiana* d'Orbigny in having many more chambers and much lower costae. It is longer and more slender than *B. lirata*, n. sp. and has more and differently shaped chambers.

**BULIMINA RUDITA** Cushman and Parker, new name

*Bulimina ornata* CUSHMAN and PARKER (not EGGER), Contr. Cushman Lab. Foram. Res., vol. 11, 1935, p. 97, pl. 15, figs. 4 a, b.

Our attention has been called to the fact that the name *Bulimina ornata* which we gave to this species is preoccupied. Therefore the above name is proposed for this very distinct species.

## 171. NEW GENERA AND SPECIES OF FORAMINIFERA OF THE LATE TERTIARY OF THE PACIFIC

By JOSEPH A. CUSHMAN and SHOSHIRO HANZAWA

The following new forms are from the Ryukyu limestone, a full description of which has been given by Hanzawa, Topography and Geology of the Riukiu Islands (Sci. Rep. Tohoku Imperial Univ., ser. 2 [Geol.] vol. XVII, 1935, pp. 22-25). All the forms here described apparently represent specialized forms developed in the late Tertiary and at least some of which are still living in the Pacific.

**Genus BIFARINELLA** Cushman and Hanzawa, n. gen.

Genoholotype, *Bifarinella ryukyuensis* CUSHMAN and HANZAWA, n. sp.

Test free, elongate, compressed, tapering, with the greatest width at the apertural end, in the young stage biserial, becoming uniserial in the adult; the early chambers generally triangular in front view with strongly oblique sutures, later chambers with the sutures nearly at right angles to the elongate axis of the

test; wall calcareous, finely perforate; aperture in the adult narrow, elongate, with a distinct, everted lip at each side.

At present only one species, that here described, is known, although some of the Pacific forms figured in the literature may be found to belong here.

**BIFARINELLA RYUKYUENSIS** Cushman and Hanzawa, n. sp. (Pl. 8, figs. 7, 8)

Test elongate about  $1\frac{1}{2}$  times as long as broad, much compressed, tapering throughout, with the greatest breadth at the apertural end, earlier portion subcylindrical, slightly twisted, biserial, adult much compressed, fan-shaped, periphery serrate, composed of about five trapezoid chambers linearly superimposed, only slightly overlapping; sutures of early portion strongly oblique, later nearly at right angles to the elongate axis, slightly curved, not depressed; wall ornamented by a row of tubercles or short spines, the main wall of the chamber with one or more rows of rounded tubercles; aperture elongate, narrow, terminal, with a distinctly everted lip. Length 0.75 mm.; breadth 0.55 mm.; thickness 0.15-0.20 mm.

Holotype (Cushman Coll. No. 23141) Pleistocene ? Ryukyu limestone, 500 meters N of Kamikatetsu, Kikar-jima, Ryukyu Islands.

This species is apparently closely related to *Bifarina mackinnonii* Millett from the Malay Archipelago (Journ. Roy. Micr. Soc., 1900, p. 281, pl. 2, fig. 15) and also to *B. mackinnonii*, var. *robusta* Sidebottom from off the east coast of Australia (l. c., 1918, p. 125, pl. 3, figs. 17, 18). These forms, however, are less advanced in their development, and it is quite probable that our species developed from a similar ancestry with a much smaller aperture.

**Genus POLYMORPHINELLA** Cushman and Hanzawa, n. gen.

Genoholotype, *Polymorphinella vaginulinaeformis* CUSHMAN and HANZAWA, n. sp.

Test free, compressed, elongate, with one margin straight or slightly convex, the other strongly convex, in the young stage biserial, later becoming more nearly uniserial; wall calcareous, very finely perforate; aperture radiate, with an apertural chamberlet at the dorsal angle.

This genus is apparently developed only in the Pacific, there being found both Recent and fossil forms. It appears to be re-

lated to *Polymorphina* in the biserial character of the early stages. It also, in its general shape, resembles some of the species which have been referred to *Vaginulina*. The latter, however, does not have a biserial arrangement of the chambers.

In the *Challenger* Report, Brady figured a form (Pl. LXVII, fig. 8) which he questionably referred to *Cristellaria schloenbachi* Reuss. This figure was later referred by Dr. Thalmann to the genus "*Astacolus*," but it obviously belongs to the present genus. We propose for this the new specific name *Polymorphinella pacifica* Cushman and Hanzawa.

**POLYMORPHINELLA VAGINULINAEFORMIS** Cushman and Hanzawa, n. sp.  
(Pl. 8, figs. 5 a-d)

Test compressed, with the dorsal margin slightly convex, ventral margin more strongly so, elongate, elliptical in transverse section, periphery rounded; chambers comparatively few, biserial, particularly in the early stages, becoming uniserial in the adult, chambers less overlapping, distinct, very slightly if at all inflated, increasing rather regularly in size as added, each chamber visible in its full length on one lateral face of the test, and only its upper portion on the opposite side; sutures distinct, somewhat limbate, sigmoid; walls smooth, very finely perforate; aperture radiate, in the angle of the chamber along the dorsal margin. Length 0.90 mm.; breadth 0.30 mm.; thickness 0.18 mm.

Holotype (Cushman Coll. No. 23143) from Pleistocene ? Ryukyu limestone, 500 meters N of Kamikatetsu, Kikar-jima, Ryukyu Islands.

**POLYMORPHINELLA COMPRESSA** Cushman and Hanzawa, n. sp. (Pl. 8, figs. 6 a-d)

Test elongate, somewhat compressed, dorsal margin nearly straight, ventral margin strongly convex, elliptical in transverse section, periphery rounded; chambers biserial, distinct, gradually increasing in size as added, very slightly, if at all, inflated, last two chambers nearly uniserial, their surface making up a very large portion of the test; sutures distinct, slightly curved, somewhat sigmoid, slightly, if at all, depressed; walls finely perforate; aperture at the dorsal angle, radiate. Length 1.50 mm.; breadth 0.55 mm.; thickness 0.45 mm.

Holotype (Cushman Coll. No. 23144) Pleistocene ? Ryukyu limestone, 500 meters N of Kamikatetsu, Kikar-jima, Ryukyu Islands.

## Genus POLYMORPHINOIDES Cushman and Hanzawa, n. gen.

Genoholotype, *Polymorphinoides spiralis* CUSHMAN and HANZAWA, n. sp.

Test free, compressed, elongate, early portion coiled, evolute, but bilaterally asymmetrical in the sagittal plane, convex on one side, slightly umbilicate on the other, later portion becoming uncoiled and biserial as in *Polymorphinella*; wall calcareous, finely perforate, aperture radiate at the peripheral angle.

This genus resembles "*Astacolas*" and also *Polymorphinella*, distinguished from the first by being biserial in the adult, and from the second by being definitely coiled in the early stages.

## POLYMORPHINOIDES SPIRALIS Cushman and Hanzawa, n. sp. (Pl. 8, figs. 4 a-c)

Test compressed, elongate, early portion consisting of several coiled chambers, all visible on both lateral faces of the test, but convex on one side, and slightly umbilicate on the other, not entirely bilaterally symmetrical, periphery carinate, later portion becoming uncoiled, consisting of several biserially placed chambers as in *Polymorphinella*, but less overlapping, periphery in the adult rounded, dorsal margin entire, ventral margin lobulate; sutures distinct, in the early portion flush with the surface, later slightly depressed, curved; walls smooth, finely perforate; aperture peripherally radiate. Length 1.30 mm.; breadth 0.55 mm.; thickness 0.30 mm.

Holotype (Cushman Coll. No. 23145) Pleistocene ? Ryukyu limestone, 500 meters N of Kamikatetsu, Kikar-jima, Ryukyu Islands.

This species is a peculiar one, and a complete understanding of the species requires the finding of the microspheric form.

## RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the foraminifera that have come to hand.

- Thalman, Hans E.** Die miozäne Tuxpan-Stufe im Gebiete Zwischen Rio Tuxpan und Rio Tecolutla (Staat Veracruz, Ost-Mexico).—*Eclogae geologicae Helvetiae*, vol. 28, No. 2, 1935, pp. 543-546.  
Mitteilungen über Foraminiferen II.—l. c., pp. 592-606, 2 text figs.—Two new species, *Rotalia indopacifica* and *Operculina tuxpanensis*.
- Van Emmichoven, C. P. A. Zeylman.** Remarks on the Supposed Lower Cretaceous Age of Orbitolinae in Japan and the Netherlands Indies.—*Mijn. en Geol., "De Mijningenieur"* 3 J g, No. 2, Feb., 1936, pp. 24-29.
- Plummer, Helen Jeanne.** Microscopical Evidence of the Navarro-Taylor Contact in Subsurface Sections in Central Texas.—*Univ. Texas Bull.* 3501, Feb., 1936, pp. 281-292, pl. 5.
- Dunbar, Carl O., John W. Skinner and Robert E. King.** Dimorphism in Permian Fusulines.—l. c., pp. 173-190, pls. 1-3, text fig. 30.—Besides notes on dimorphism, three new species are described by Dunbar and Skinner: *Parafusulina deliciosensis*, *P. rothi*, and *P. kingorum*.
- Schenck, Hubert G. and Robert M. Kleinpell.** Refugian Stage of Pacific Coast Tertiary.—*Bull. Amer. Assoc. Petr. Geol.*, vol. 20, No. 2, Feb., 1936, pp. 215-225.
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- Stshedrins, Z.** Zur Kenntnis der Foraminiferenfauna der Arktischen Meere der U. S. S. R.—*Trans. Arctic Inst.*, vol. XXXIII, 1936, pp. 51-64.
- Plummer, Helen Jeanne.** Structure of Ceratobulimina.—*Amer. Midland Nat.*, vol. 17, No. 2, March, 1936, pp. 460-463, 1 pl.
- Ladd, Harry S.** Globigerina Beds as Depth Indicators in the Tertiary Sediments of Fiji.—*Science*, n. ser., vol. 83, No. 2152, March 27, 1936, pp. 301, 302.
- Cushman, Joseph A.** Geology and Paleontology of the Georges Bank Canyons. Part IV. Cretaceous and Late Tertiary Foraminifera.—*Bull. Geol. Soc. Amer.*, vol. 47, March 31, 1936, pp. 413-440, pls. 1-5.
- Hayasaka, Ichiro.** A Twinned or Double Fossil Shell of *Rotalia*.—*Trans. Pal. Soc. Japan*, No. 7, 1936 (*Journ. Geol. Soc. Japan*, vol. 43, No. 508, 1936), pp. 5-7, text figs. 1 a-c.  
A *Discocyclina*-Limestone Exposed near the Peak of Minami-Daibu in Takoa Prefecture, Taiwan.—*Proc. Imp. Acad. Tokyo*, vol. XI, 1936, pp. 329, 330, figs. 1, 2.
- Thompson, M. L.** The Fusulinid Genus *Verbeekina*.—*Journ. Pal.*, vol. 10, No. 3, April, 1936, pp. 193-201, pl. 24.
- Wright Barker, Reginald.** Micropaleontology in Mexico with Special Reference to the Tampico Embayment.—*Bull. Amer. Assoc. Petr. Geol.*, vol. 20, No. 4, April, 1936, pp. 433-456, text figs. 1, 2.—Gives an excellent bibliography and table showing vertical distributions for this region.

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