CONTRIBUTIONS
FROM THE
CUSHMAN LABORATORY
FOR
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Contents

No. 315. *Pseudoparrella*, A New Generic Name, and A New Species of *Parrella* .......... 49
No. 316. A Miocene Foraminiferal Fauna from Ecuador ........................................... 50
No. 317. Some Paleocene Foraminifera from the Madruga Formation of Cuba ................. 68
No. 318. Three New Names for Recent Pacific Foraminifera .................................... 76
No. 319. Anomalina tenuissima (Reuss), var. evoluta van Bellen, a Homonym ............... 76
Recent Literature on the Foraminifera ................................................................. 77

SHARON, MASSACHUSETTS, U. S. A.
1948
This species, described from the Miocene Agua Salada formation of Venezuela, is recorded from the Brasso formation of Trinidad and the Anahuac formation of Texas. It was found in samples 21749, 21818, and 21860.

317. SOME PALEOCENE FORAMINIFERA FROM THE MADRUGA FORMATION OF CUBA

By Joseph A. Cushman and Pedro J. Bermudez

Outcrops with typically Paleocene faunas have been observed in various parts of Cuba. The shales, sandy shales, and fine radiolarian sandstones, named Madruga formation, are well exposed in the vicinity of Madruga village and in other localities in the provinces of Pinar del Rio, Habana, and Oriente. In Las Villas and Camagüey provinces the Paleocene consists of a very hard, white, dense, and compact limestone with a fauna of shallow water facies predominating, such as some species of *Borelis* (*B. jamaicensis* Vaughan, *B. gunteri* Cole, *B. matleyi* Vaughan) and some unidentified species of *Textularia*, *Cuneolina*, *Lockhartia*, and the Miliolidae. This hard limestone is named Remedios limestone and is very similar to the Cedar Keys limestone of Florida (Cole, Florida Dept. Conservation, Geol. Bull. 26, 1944, pp. 27, 28) and is apparently in part equivalent to the Madruga formation. Both the Madruga formation and the Remedios limestone are Midwayan in age. They are being formally described by the junior author in an article to be published soon: “Contribution al Estudio del Cenozoico Cubano.”

The species here recorded originate from the Madruga formation at two localities as follows:
Bermudez sta. 76b: Under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.
Bermudez sta. C-24: San Juan y Martinez, Pinar del Rio Province, Cuba.

We are indebted to Caridad V. Bermudez, wife of the junior author, who made the drawings illustrating the species.

Family VALVULINIDAE

Genus VALVULAMMINA Cushman, 1933

*VALVULAMMINA NASSAUENSIS* Apollin and Jordan, var. CUBANA Cushman and Bermudez, n. var. (Pl. 11, fig. 1)

Variety differing from the typical form in the larger size, more taper-
ing form and more pointed initial end. Length of holotype 1.17 mm.; breadth 0.87 mm.

Holotype of variety (Cushman Coll. No. 57966) from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

Family LAGENIDAE

Genus MARGINULINA d'Orbigny, 1826

MARGINULINA UISTINC'TA Cushman and Bermudez, n. sp. (Pl. 11, fig. 2)

Test elongate, early portion close coiled, becoming uncoiled in the adult portion, axis slightly curved, early portion somewhat compressed, adult portion circular in transverse section; chambers distinct, early ones not inflated, adult ones distinctly inflated, increasing in size rapidly as added, the last three making up a large proportion of the test; sutures distinct, earlier ones slightly raised, later ones depressed; wall ornamented with numerous, fine, longitudinal costae, those of the later portion independent of the sutures; aperture radiate, at the peripheral angle, somewhat projecting. Length of holotype 0.80 mm.; diameter 0.30 mm.

Holotype (Cushman Coll. No. 57967) from the Paleocene, Madruga formation, highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

This species differs from M. havanensis Cushman and Bermudez in the shorter and stouter form, more strongly oblique sutures, and the costate ornamentation.

MARGINULINA TUBERCULATA (Plummer) (Pl. 11, fig. 5)

Cristellaria subaculeata Cushman, var. tuberculata Plummer, Univ. Texas Bull. 2644, 1926 (1927), p. 101, pl. 7, fig. 2; pl. 14, fig. 1.

Hemicristellaria subaculeata Cushman, var. tuberculata Kline, Bull. 53, Mississippi State Geol. Survey, 1943, p. 22, pl. 1, fig. 11.

The types of this species are from the Paleocene, Mexia clay of Texas and it is recorded from the Paleocene, Porters Creek clay, of Mississippi. Specimens occur in the Madruga formation, San Juan y Martinez, Pinar del Rio Province, Cuba.

Genus DENTALINA d'Orbigny, 1826

DENTALINA GARDNERAE (Plummer) (Pl. 11, fig. 3)

Marginulina gardnerae Plummer, Univ. Texas Bull. 2644, 1926 (1927), p. 106, pl. 5, fig. 11.

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The types of this species are from the Paleocene of Texas and it is widely recorded in the Paleocene. Typical specimens occur in the Madruga formation of Cuba.

Genus PSEUDOGLANDULINA Cushman, 1929

PSEUDOGLANDULINA MADRUGAENSIS Cushman and Bermudez, n. sp. (Pl. 11, fig. 7)

Test elongate, circular in transverse section, rectilinear; chambers distinct, inflated, increasing very gradually in size as added; sutures distinct, depressed; wall ornamented with very fine longitudinal costae; aperture terminal, radiate. Length of holotype 1.05 mm.; diameter 0.40 mm.

Holotype (Cushman Coll. No. 57968) from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

This species differs from P. manifesta (Reuss) in the slightly higher chambers, deeper sutures, and finely costate surface.

Genus VAGINULINA d'Orbigny, 1826

VAGINULINA LONGIFORMA (Plummer) (Pl. 11, fig. 4)

Cristellaria longiforma Plummer, Univ. Texas Bull. 2644, 1926 (1927), p. 102, pl. 13, fig. 4.


This is a good index fossil for the Paleocene and has been recorded from Texas, Arkansas, and Alabama. Typical specimens occur in the Paleocene, Madruga formation, of Cuba.

VAGINULINA SEMILAEVIS Cushman and Bermudez, n. sp. (Pl. 11, fig. 6)

Test elongate, somewhat compressed, slender, increasing in width to the last-formed chamber, initial end acute with a slight spine, periphery slightly rounded; chambers of the early portion rather indistinct, later ones distinct and very slightly inflated, increasing rather evenly in size as added; sutures of the early portion indistinct, later ones distinct and slightly depressed, strongly oblique; wall of the early portion nearly smooth, later portion with longitudinal costae independent of the sutures; aperture terminal, radiate. Length of holotype 2.30 mm.; breadth 0.30 mm.

Holotype (Cushman Coll. No. 57988) from the Paleocene, Madruga formation, San Juan y Martinez, Pinar del Rio Province, Cuba.

This species differs from V. plumoides Plummer in the more slender, elongate form, higher chambers, and smooth early portion.
FOR FORAMINIFERAL RESEARCH

Family POLYMORPHINIDAE

Genus BULLOPOURA Quenstedt, 1856

**BULLOPOURA CHAPMANI** (Plummer) (Pl. 11, fig. 8)

*Vitrewebbina chapmani* Plummer, Univ. Texas Bull. 2644, 1926 (1927), p. 128, pl. 8, fig. 2.


This species is known from the Paleocene of Texas, Arkansas, Mississippi, and Alabama. Specimens occur in the Paleocene, Madruga formation, of Cuba.

Family HETEROHELICIDAE

Genus SIPHOGENERINOIDES Cushman, 1927

**SIPHOGENERINOIDES ELEGANTA** (Plummer) (Pl. 11, fig. 9)

(For references, see these Contributions, vol. 22, 1946, p. 59, pl. 10, fig. 18.)

This species seems to be an index fossil for the Paleocene, occurring in Texas, Arkansas, Illinois, Alabama, and Trinidad. Typical specimens occur in the Madruga formation of Cuba.

Family BULIMINIDAE

Genus LOXOSTOMUM Ehrenberg, 1854

**LOXOSTOMUM APPINAE** (Plummer) (Pl. 11, fig. 10)

(For references, see these Contributions, vol. 22, 1946, p. 60, pl. 10, fig. 22.)

This species is known from the Paleocene of Texas and Arkansas. Specimens from other Cretaceous and Tertiary records do not seem to be identical. Rather typical specimens occur in the Paleocene, Madruga formation, of Cuba.

Family ROTALIIDAE

Genus EPONIDES Montfort, 1808

**EPONIDES VANBELLENI** (van den Bold) (Pl. 12, figs. 1-3)

*Cibicides vanbelleni* van den Bold, Thesis Univ. Utrecht, Amsterdam, 1946, p. 125, pl. 18, fig. 8.

This species was described from the lower Eocene of Guatemala and British Honduras. Specimens from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba, seem to be identical and indicate that, from the position of the aperture, the species should be placed in *Eponides*.

**EPONIDES GRATIOSUS** Cushman and Bermudez, n. sp. (Pl. 11, fig. 14)

Test trochoid, unequally biconvex, the ventral side very strongly convex, dorsal side much less so, periphery acute; chambers fairly distinct on the ventral side, those of the last-formed whorl on the dorsal side fairly distinct, earlier whorls obscured by the surface ornamentation; sutures
mostly indistinct, ventrally slightly curved, dorsally strongly oblique; wall of the ventral side somewhat roughened but not definitely papillate, dorsal side finely but distinctly papillate except over the last few chambers which are fairly smooth; aperture ventral, a low elongate opening at the margin of the last-formed chamber. Diameter of holotype 0.63 mm.; thickness 0.38 mm.

Holotype (Cushman Coll. No. 57970) from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

The species differs from *E. von bellei* (van den Bold) in the acute periphery, smoother ventral side, and nearly straight ventral sides in edge view.

**Genus VALVULINERIA Cushman, 1926**

**VALVULINERIA EXTENSA** Cushman and Bermudez, n. sp. (Pl. 12, figs. 7-9)

Test trochoid, the dorsal side very slightly convex, ventral side increasing rapidly in thickness in the adult, periphery subacute to slightly rounded; chambers distinct, numerous, 10 or more in the adult whorl, increasing very gradually in size as added, with a ventral lobe over the umbilical area in the early stages becoming high and extending outward in the later portion; sutures distinct, slightly depressed, curved; wall smooth, distinctly perforate; aperture extending from the periphery along the ventral margin of the last-formed chamber. Length 0.45-0.50 mm.; breadth 0.35-0.40 mm.; thickness 0.28-0.32 mm.

Holotype (Cushman Coll. No. 57971) from the Paleocene, Madruga formation, under highway bridge, Central San Antonio, Madruga, Habana Province, Cuba.

This species differs from *V. herricki* (Hadley) in the larger number of chambers, more concave periphery, and more open umbilical region.

**EXPLANATION OF PLATE 11**

Valvulineria madrugaensis Cushman and Bermúdez, n. sp. (Pl. 12, fig. 10)

Test trochoid, with the dorsal side much less convex than the ventral, periphery rounded, becoming more acute in the later portion; chambers distinct in the later portion, slightly inflated, numerous, earlier ones indistinct, not inflated, increasing very gradually in size as added, with a narrow, ventral lobe over the umbilical area; sutures distinct in the later portion and slightly depressed, earlier ones indistinct; wall smooth; aperture extending from the periphery along the ventral margin of the last-formed chamber. Length of holotype 0.65 mm.; breadth 0.50 mm.; thickness 0.35 mm.

Holotype (Cushman Coll. No. 57973) from the Paleocene, Madruga formation, under highway bridge, Central San Antonio, Madruga, Habana Province, Cuba.

This species differs from V. extensa n. sp. in the somewhat larger size, tendency for the last-formed chambers to not reach the periphery on the dorsal side, and the less projecting ventral lobe.

Genus Pseudoparrella Cushman and ten Dam, 1948

Pseudoparrella madrugaensis Cushman and Bermúdez, n. sp. (Pl. 12, figs. 11-13)

Test trochoid, nearly equally biconvex, ventral side slightly more convex, periphery acute, slightly keeled; chambers distinct, very slightly inflated, about 5 in the adult whorl, increasing rather evenly in size as added; sutures distinct, dorsally strongly curved, ventrally nearly radial; wall smooth, distinctly perforate; aperture at the ventral margin of the last-formed chamber and extending outward parallel to the periphery, narrow and with a distinct lip. Diameter 0.35-0.40 mm.; thickness 0.15-0.18 mm.

Holotype (Cushman Coll. No. 57974) from the Paleocene, Madruga formation, under highway bridge, Central San Antonio, Habana Province, Cuba.

This species differs from P. obtusa (Burrows and Holland) in the definite keel, curved dorsal sutures, and less extended aperture.
Family ANOMALINIDAE

Genus ANOMALINA d'Orbigny, 1826

ANOMALINA MArtinezensis Cushman and Bermudez, n. sp. (Pl. 12, figs. 14-16)

Test trochoid, biconvex, both dorsal and ventral sides depressed in the median portion, periphery broadly rounded, tending to become slightly angular in the adult; chambers distinct, somewhat inflated, about 8 in the adult whorl, increasing very gradually in size as added; sutures distinct, limbate and slightly raised, dorsally oblique and somewhat curved, ventrally nearly radial; wall very coarsely perforate; aperture at the peripheral margin extending onto the ventral side at the base of the last-formed chamber, with a distinct lip. Diameter 0.65-0.80 mm.; thickness 0.32-0.40 mm.

Holotype (Cushman Coll. No. 57992) from the Paleocene, San Juan y Martinez, Pinar del Rio Province, Cuba.

This species resembles A. midwayensis (Plummer) but differs in the more coarsely perforate wall, larger size, and much rougher surface. It also resembles Cibicides vulgaris (Plummer).

ANOMALINA CLEMENTIANA (d'Orbigny), var. ASSIMILIS Cushman and Bermudez, n. var. (Pl. 12, fig. 17)

Variety differing from the typical form in the slightly narrower chambers and slightly thicker test.

Holotype of variety (Cushman Coll. No. 57977) from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

This variety is very closely related to this Upper Cretaceous species.

Genus BOLDIA van Bellen, 1946

BOLDIA CUBENSES Cushman and Bermudez, n. sp. (Pl. 11, figs. 15, 16)

Test in the early stages trochoid, in the adult becoming nearly planispiral, periphery in the adult becoming truncate, earlier portion with a narrowly rounded border, both dorsal and ventral sides somewhat concave; chambers fairly distinct, about 6 in the adult whorl, slightly inflated, increasing very gradually in size as added; sutures rather indistinct, curved, little if at all depressed; wall smooth except for the umbilical area of the dorsal side which has a stellate thickening; aperture a low opening at the peripheral margin, extending over on the dorsal side, with a slight lip. Diameter of holotype 0.70 mm.; thickness 0.45 mm.

Holotype (Cushman Coll. No. 57978) from the Paleocene, Madruga formation, under highway bridge on Central San Antonio, Madruga, Habana Province, Cuba.

The species differs from B. vandersluiisi van den Bold in the smaller
FOR FORAMINIFERAL RESEARCH

size, less truncate periphery, and the more curved sutures. The original
description of the genus gives the aperture as ventral but in this and the
following species it is largely peripheral.

**BOLDIA MADRUGAE N SIS** Cushman and Bermudez, n. sp. (Pl. 12, figs. 4-6)

Test trochoid in the young, nearly planispiral in the adult, periphery
in the adult becoming somewhat truncate in the last portion, earlier
portion rounded, both dorsal and ventral sides somewhat concave, ven­
tral side somewhat umbilicate; chambers fairly distinct, 7 or 8 in the
adult whorl, distinctly inflated on the ventral side; sutures distinct and
depressed ventrally, slightly curved, nearly radial, dorsally indistinct;
wall coarsely perforate, smooth on the ventral side, dorsal side with
numerous irregular raised portions radiating out toward the periphery;
aperture peripheral and extending over onto the dorsal side as a narrow
slit at the inner margin of the last-formed chamber with a distinct lip.
Diameter 0.45-0.65 mm.; thickness 0.30-0.45 mm.

Holotype (Cushman Coll. No. 57981) from the Paleocene, Madruga
formation, under highway bridge on Central San Antonio, Madruga,
Habana Province, Cuba.

This species differs from *B. vandersluisi* van den Bold in the much
smaller size, less truncate border, umbilicate ventral side, and irregularly
papillate dorsal side.

**BOLDIA CARINATA** Cushman and Bermudez, n. sp. (Pl. 11, figs. 11-13)

Test trochoid in the early stages, becoming planispiral in the adult,
periphery in the adult truncate with a median depression, the dorsal
angle carinate, both dorsal and ventral sides concave in the adult, ventral
side somewhat umbilicate; chambers fairly distinct, inflated ventrally,
very slightly so dorsally, usually 8 chambers in the adult whorl; sutures
indistinct dorsally, ventrally distinct and depressed, somewhat sinuous;
wall coarsely perforate, slightly roughened, not papillate, dorsal side with
a slight stellate appearance due to the lip above the aperture; aperture
extending from the periphery along the dorsal margin of the last-formed
chamber, with a slight lip. Diameter 0.50-0.60 mm.; thickness 0.38-
0.43 mm.

Holotype (Cushman Coll. No. 57982) from the Paleocene, Madruga
formation, under highway bridge, Central San Antonio, Habana Pro­
vince, Cuba.

This species differs from *B. vandersluisi* van den Bold in the smaller
size, more definitely keeled and more concave periphery.