

CONTRIBUTIONS FROM THE CUSHMAN
LABORATORY FOR FORAMINIFERAL RESEARCH

180. FURTHER NEW SPECIES OF FORAMINIFERA
FROM THE EOCENE OF CUBA

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Continued study of the rich Eocene faunas of Cuba has resulted in the discovery of more undescribed species. These are here described and figured that they may be available for other workers.

VERNEUILINA VILLARENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 1, 2)

Test elongate, $2\frac{1}{2}$ to 3 times as long as broad, very gradually tapering from a somewhat rounded initial end, in transverse section triangular, the sides flattened or slightly convex, the angles sharp, somewhat keeled; chambers numerous, tri-serial throughout, of rather uniform shape, increasing gradually in size as added; sutures finely distinct, very slightly depressed; wall composed of sand grains of medium size with much cement, rather smoothly finished; aperture semi-circular, becoming nearly terminal in the adult. Length 1.60-1.95 mm.; breadth 0.55-0.65 mm.

Holotype (Cushman Coll. No. 23343) from the Eocene, under R. R. bridge on Central Highway located in Jicotea, Santa Clara Province, Cuba (Bermudez Sta. 92).

This species differs from *V. tricarinata* in the more slender, more tapering test and much stronger keels. In general shape it more closely resembles *Tritaxia ellisorae* Cushman from the Upper Cretaceous of Texas.

VERNEUILINA PINARENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 3, 4)

Test slightly less than twice as long as broad, distinctly tapering, greatest breadth at the apertural end, initial end subacute, triangular in transverse section, sides slightly convex in the

2 CONTRIBUTIONS FROM THE CUSHMAN LABORATORY

middle, concave toward the angles which are bluntly rounded with slight keels; chambers distinct, increasing gradually in size as added, central part of each on the flattened sides somewhat depressed, raised along the edges; sutures oblique, distinct, smooth, raised; wall arenaceous, of rather uniformly sized, fine grains, smoothly finished; aperture small, rounded or elongate, at the edge of the inner margin of the last-formed chamber. Length 1.10-1.25 mm.; diameter 0.60 mm.

Holotype (Cushman Coll. No. 23345) from the Eocene, 4.5 kms. W. of Guanajay on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

CLAVULINOIDES CUBENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 5-7)

Test elongate, 3 to 4 times as long as broad, sides nearly parallel for most of their length, tapering abruptly at either end, triangular in transverse section, sides slightly convex in the middle, concave toward the angles which are acute; chambers of the early triangular portion somewhat indistinct, later uniserial ones distinct, slightly inflated, increasing slightly in height as added; sutures of the later portion distinct, depressed, slightly curved upward toward the aperture in the middle; wall very finely arenaceous with much cement, smooth except for a few short spines on the initial end; aperture terminal, circular with a slight, rounded lip. Length 1.85-2.25 mm.; diameter 0.65 mm.

Holotype (Cushman Coll. No. 23347) from the Eocene, Tejar Consuelo (upper beds), Cerro, Havana, Cuba (Bermudez Sta. 36).

This species differs from *C. jarvisi* Cushman from the Miocene of Trinidad in its more slender form, parallel sides and greater number of uniserial chambers.

CLAVULINOIDES SUBULATUS Cushman and Bermudez, n. sp. (Pl. 1, figs. 8, 9)

Test elongate, about 3 times as long as broad, the earlier third gradually tapering, later two-thirds with sides parallel or even decreasing in diameter toward the apertural end, triangular in section, sides flattened or slightly concave, angles prominent, keeled except toward the apertural end where they are rounded; chambers indistinct, rather low, very slightly inflated in the adult; sutures indistinct; wall rather coarsely arenaceous with a small amount of cement, roughly finished; aperture terminal, rounded, with a slight lip. Length 3.00 mm.; diameter 1.00 mm.

Holotype (Cushman Coll. No. 23349) from the Eocene, under

Library of Havana University, Havana, Cuba (Bermudez Sta. 257).

This species differs from *C. alpini* Cushman in its straighter sides in the adult, more elongate and more slender form, and much larger triserial portion.

CLAVULINOIDES EUCARINATUS Cushman and Bermudez, n. sp. (Pl. 1, figs. 10, 11)

Test elongate, about $2\frac{1}{2}$ times as long as broad, sides for the most part parallel, apertural end truncate, base broadly rounded, early portion rounded, convex without angles, later uniserial portion triserial in section, sides flattened, edges strongly keeled, the keels fusing with the large rounded lip at the apertural end; chambers of the early triserial portion indistinct, later distinct, slightly inflated, few in number; sutures of the early portion indistinct, later slightly depressed; wall arenaceous, smoothly finished; aperture terminal, rounded, with distinct, rounded lip. Length 0.85-1.00 mm.; diameter 0.35-0.40 mm.

Holotype (Cushman Coll. No. 23351) from the Eocene, Avenida de los Presidentes, in street cut between Hospital "Calixto Garcia" and Havana University, Havana, Cuba (Bermudez Sta. 20).

This species differs from *C. jarvisi* Cushman in the rounded early portion and the prominent keels.

CLAVULINOIDES HAVANENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 12, 13)

Test slightly longer than broad, tapering, greatest breadth toward the apertural end, triangular in section, sides flat, angles acute; chambers rather indistinct, mostly triserial, last-formed one terminal; sutures indistinct; wall finely arenaceous with much cement, smoothly finished; aperture rounded, sub-terminal with a slight lip. Length 1.00 mm.; diameter 0.85 mm.

Holotype (Cushman Coll. No. 23353) from the Eocene, under Library of Havana University, Havana, Cuba (Bermudez Sta. 257).

This species differs from *C. jarvisi* Cushman in the shorter form, larger proportion of triserial chambers, and tapering form throughout.

CLAVULINOIDES EXCURRENS Cushman and Bermudez, n. sp. (Pl. 1, figs. 14, 15)

Test elongate, somewhat fusiform, greatest breadth near the middle, somewhat truncate at the apertural end, gradually tapering to the subacute initial end, triangular in section, sides flat-

tened or slightly concave, angles broadly rounded; chambers indistinct, usually only two uniserial ones in the adult, high; sutures indistinct; wall arenaceous with much cement, smoothly finished; aperture terminal, rounded, with a short neck and distinct lip. Length 1.35-1.50 mm.; diameter 0.55-0.65 mm.

Holotype (Cushman Coll. No. 23355) from the Eocene, under Library of the Havana University, Havana, Cuba (Bermudez Sta. 257).

This species differs from *C. jarvisi* Cushman in the fewer uniserial chambers, fusiform shape, and very broadly rounded angles.

CLAVULINOIDES MARIELINUS Cushman and Bermudez, n. sp. (Pl. 1, figs. 16, 17)

Test elongate, about $2\frac{1}{2}$ times as long as broad, early triserial portion rapidly tapering, later uniserial portion with sides nearly parallel, triangular in transverse section, sides flattened or slightly concave, angles subacute; chambers fairly distinct in the uniserial portion, very indistinct in the early triserial part, 2 or 3 uniserial ones in the adult; sutures of the early portion indistinct, later distinct and slightly depressed; wall finely arenaceous, smoothly finished; aperture terminal, rounded, with a slightly rounded lip. Length 1.50-1.75 mm.; diameter 0.65-0.80 mm.

Holotype (Cushman Coll. No. 23357) from the Eocene, 4.5 kms. W. of Guanajay on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *C. jarvisi* Cushman in the much more inflated early portion, less definite angles in the adult, and smaller aperture.

KARRERIELLA CUBENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 18, 19)

Test somewhat longer than broad, compressed, periphery of the early portion subacute, later rounded, almost entirely biserial, early chambers obscure, whole test gradually tapering from the subacute initial end to greatest breadth toward apertural end; chambers distinct, somewhat inflated, especially the last-formed adult pair which rapidly increases in size; sutures distinct, depressed, strongly oblique, straight or slightly curved; wall very finely arenaceous with much cement, smoothly finished; aperture an elongate opening somewhat above the base of the apertural face, with a distinct lip and short neck. Length 0.60 mm.; breadth 0.35-0.40 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 23359) from the Eocene, under the Library of Havana University, Havana, Cuba (Bermudez Sta. 257).

This species differs from *K. chapapotensis* (Cole) in the much greater compression, lower chambers, and more oblique sutures.

KARREKIELLA ARENASENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 20, 21)

Test elongate, about two and one-half times as long as broad, slender; tapering from the subacute initial end to the greatest breadth toward the apertural end, slightly compressed, periphery broadly rounded; chambers except in the early portion distinct, inflated, of uniform shape, increasing rather regularly in size as added; sutures distinct, depressed, straight, at right angles to the elongate axis; wall finely arenaceous, smooth, with much cement; aperture a low broad opening just above the base of the last-formed chamber. Length 0.85-1.00 mm.; breadth 0.40 mm.; thickness 0.30 mm.

Holotype (Cushman Coll. No. 23361) from the Eocene, 1 km. N. of Arroyo Arenas on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *K. chapapotensis* (Cole) in the more slender form with more numerous and longer chambers.

LISTERELLA CUBANA Cushman and Bermudez, n. sp. (Pl. 1, figs. 22, 23)

Test elongate, slender, about three times as long as broad, early triangular portion larger in diameter than the later uniserial part, triangular in section, sides flattened, angles broadly rounded, later portion circular in section; chambers indistinct, 3 or 4 in the uniserial portion; sutures indistinct; wall coarsely arenaceous, roughly finished; aperture small, rounded, terminal. Length 1.00-1.25 mm.; diameter 0.35-0.45 mm.

Holotype (Cushman Coll. No. 23363) from the Eocene, "El Husillo" Quarry, (lower beds) Puentes Grandes, Havana, Cuba (Bermudez Sta. 312).

This species differs from *L. howchini* Cushman in the much rougher surface and more flattened sides in the triserial portion.

LISTERELLA PETROSA Cushman and Bermudez, n. sp. (Pl. 1, figs. 24-26)

Test elongate, slender, of rather uniform diameter throughout, early triserial portion sharply triangular in section, angles rounded, sides flattened; chambers rather indistinct except in the last-formed portion where they are somewhat inflated, 6 or 7 in

the uniserial portion in the adult; sutures indistinct except in the later uniserial portion where they are slightly depressed; wall coarsely arenaceous, roughly finished; aperture terminal, rounded, small, often with a slight neck. Length 1.50-2.25 mm.; diameter 0.40-0.50 mm.

Holotype (Cushman Coll. No. 23365) from the Eocene, Tejar Consuelo (upper beds), Cerro, Havana, Cuba (Bermudez Sta. 36).

This species differs from *L. howchini* Cushman in the much shorter triserial portion, larger number of uniserial chambers, and the much more slender test.

LISTERELLA GRACILLIMA Cushman and Bermudez, n. sp. (Pl. 1, figs. 27, 28)

Test elongate, slender, initial portion triangular, broader than the later uniserial portion, sides flattened, angles rounded, later uniserial portion with few chambers of uniform diameter; chambers of the early triserial portion indistinct, later more distinct, inflated, increasing slightly in size as added; sutures indistinct except between the later chambers where they are slightly depressed; wall rather coarsely arenaceous, somewhat roughly finished; aperture small, terminal. Length 1.50 mm.; diameter 0.45 mm.

Holotype (Cushman Coll. No. 23367) from the Eocene, under Library of Havana University, Havana, Cuba (Bermudez Sta. 257).

This species differs from *L. howchini* Cushman in the much more slender form, smaller proportion of triserial chambers, and higher uniserial ones.

LISTERELLA CARIBAEA Cushman and Bermudez, n. sp. (Pl. 1, figs. 29, 30)

Test elongate, slender, the early triserial portion broader than the remainder of the test, generally rounded, triangular in section, later portion circular and with the sides nearly parallel; chambers indistinct, later uniserial ones four or five in number, slightly inflated, increasing slightly in height as added; sutures indistinct except in the later portion where they are slightly depressed; wall coarsely arenaceous, of rounded grains, roughly finished; aperture small, rounded, terminal, without a distinct neck. Length 1.40-1.50 mm.; diameter 0.45-0.50 mm.

Holotype (Cushman Coll. No. 23369) from the Eocene, under Library of Havana University, Havana, Cuba (Bermudez Sta. 257).

This species differs from *L. howchini* Cushman in having the greatest width near the base, the triserial portion being short and rounded, and having a larger number of uniserial chambers.

TRITAXILINA CUBENSIS Cushman and Bermudez, n. sp.

Test elongate, fusiform, about twice as long as broad, greatest breadth at or a little above the middle, apertural end rounded, initial end pointed; chambers fairly distinct, with deep excavation at the base at either side, middle of chambers extending downward; sutures fairly distinct, depressed; wall coarsely arenaceous, rather smoothly finished; aperture small, narrow, at right angles to the inner margin, in a distinct depression. Length up to 1.50 mm.; diameter 0.75 mm.

Holotype (Cushman Coll. No. 23288) from lower beds of "El Husillo" Quarry, Puentes Grandes, Havana, Cuba (Bermudez Sta. 312).

This species differs from *T. hantkeni* Cushman in the very deep depressions at the sides of the base of the chambers, and the depressed sutures.

The figures of the type of this species will be found in Contr. Cushman Lab. Foram. Res., vol. 12, pl. 10, figs. 25, 26.

VALVULINA MARTII Cushman and Bermudez, n. sp.

Test elongate, about $1\frac{1}{2}$ -2 times as long as broad, triserial, triangular, the early portion with the angles subacute, later more rounded, tapering, greatest breadth toward the apertural end; chambers fairly distinct, the base at each side of the angle deeply excavated; sutures distinct, progressively more depressed toward the apertural end; wall rather coarsely arenaceous but rather smoothly finished; aperture a large opening at the inner margin of the last-formed chamber with a large, elongate, somewhat curved, valvular tooth. Length up to 1.65 mm.; breadth up to 0.95 mm.

Holotype (Cushman Coll. No. 23661) from the Eocene of Cuba (Bermudez Sta. 110).

This species differs from *V. limbata* Terquem in the more rounded periphery in the adult, narrower and more curved tooth, and the very deeply excavated sides of the chambers.

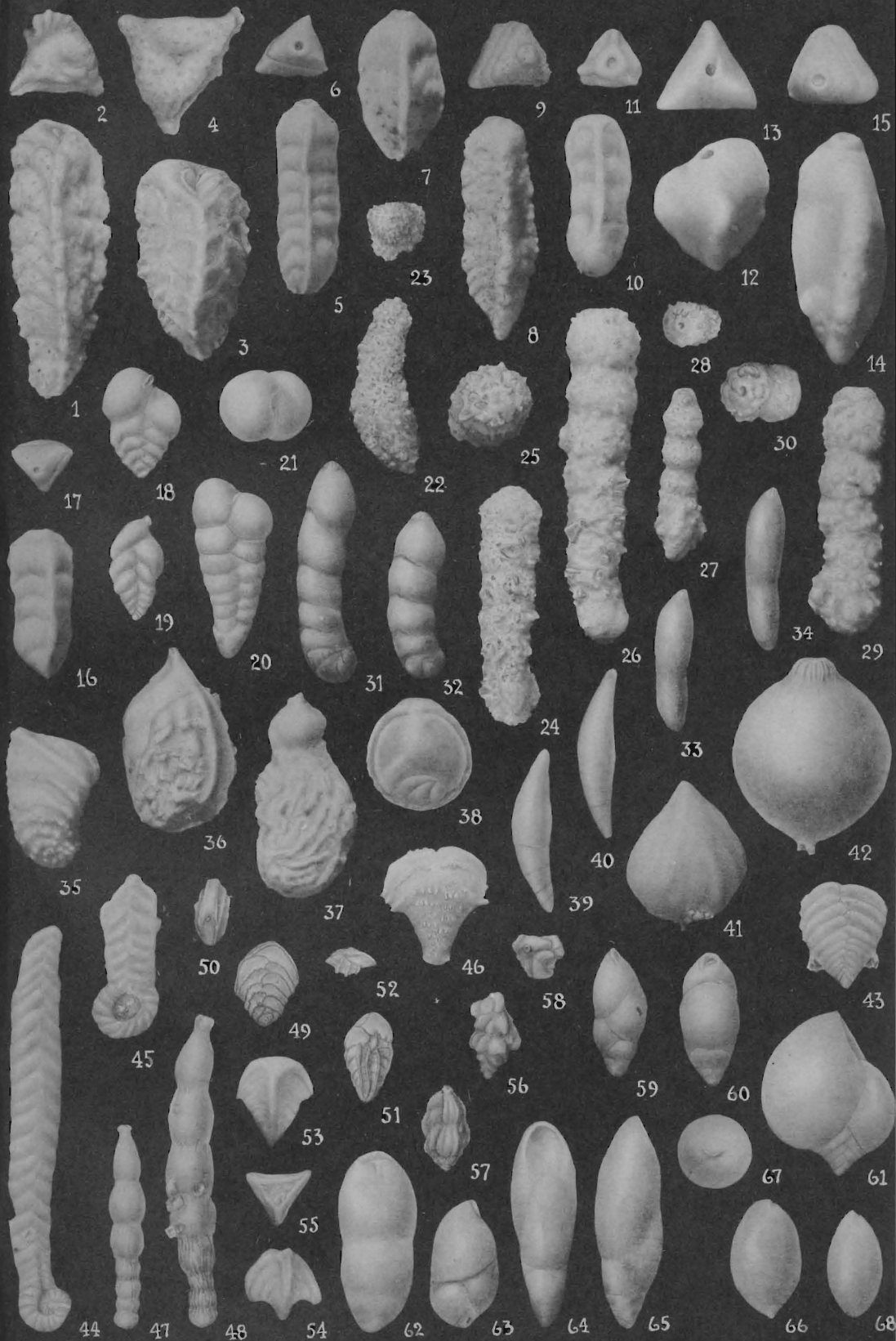
VALVULAMMINA CUBENSIS Cushman and Bermudez, n. sp.

Test subglobular, periphery broadly rounded, early portion with 5 or more chambers in the whorl, the adult with 4, spire low;

EXPLANATION OF PLATE 1

FIGS.

- 1, 2. *Verneuilina villarensis* Cushman and Bermudez, n. sp. $\times 40$. 1, Holotype, front view. 2, Paratype, apertural view.
- 3, 4. *Verneuilina pinarensis* Cushman and Bermudez, n. sp. $\times 40$. 3, Holotype, front view. 4, Paratype, apertural view.
- 5-7. *Clavulinoides cubensis* Cushman and Bermudez, n. sp. $\times 22$. 5, Holotype, front view. 6, 7, Paratypes; 6, apertural view; 7, front view.
- 8, 9. *Clavulinoides subulatus* Cushman and Bermudez, n. sp. $\times 18$. 8, Holotype, front view. 9, Paratype, apertural view.
- 10, 11. *Clavulinoides eucarvinatus* Cushman and Bermudez, n. sp. $\times 18$. 10, Holotype, front view. 11, Paratype, apertural view.
- 12, 13. *Clavulinoides havanensis* Cushman and Bermudez, n. sp. $\times 35$. 12, Holotype, front view. 13, Paratype, apertural view.
- 14, 15. *Clavulinoides excurrens* Cushman and Bermudez, n. sp. $\times 40$. 14, Holotype, front view. 15, Paratype, apertural view.
- 16, 17. *Clavulinoides marielinus* Cushman and Bermudez, n. sp. $\times 24$. 16, Holotype, front view. 17, Paratype, apertural view.
- 18, 19. *Karrerella cubensis* Cushman and Bermudez, n. sp. $\times 45$. 18, Holotype, front view. 19, Paratype, front view.
- 20, 21. *Karrerella arenasensis* Cushman and Bermudez, n. sp. $\times 45$. 20, Holotype, front view. 21, Paratype, apertural view.
- 22, 23. *Listerella cubana* Cushman and Bermudez, n. sp. $\times 40$. 22, Holotype, front view. 23, Paratype, apertural view.
- 24-26. *Listerella petrosa* Cushman and Bermudez, n. sp. $\times 40$. 24, Holotype, front view. 25, 26, Paratypes; 25, apertural view; 26, front view.
- 27, 28. *Listerella gracillima* Cushman and Bermudez, n. sp. $\times 30$. 27, Holotype, front view. 28, Paratype, apertural view.
- 29, 30. *Listerella caribaea* Cushman and Bermudez, n. sp. $\times 40$. 29, Holotype, front view. 30, Paratype, apertural view.
- 31, 32. *Marginulina havanensis* Cushman and Bermudez, n. sp. $\times 35$. 31, Holotype. 32, Paratype.
- 33, 34. *Marginulina laeviuscula* Cushman and Bermudez, n. sp. $\times 35$. 34, Holotype. 33, Paratype.
35. *Saracenaria ornatula* Cushman and Bermudez, n. sp. $\times 40$.
- 36, 37. *Marginulina palmerae* Cushman and Bermudez, n. sp. $\times 32$. 36, Holotype. 37, Paratype.
38. *Lingulina cubensis* Cushman and Bermudez, n. sp. $\times 33$.
- 39, 40. *Dentalina havanensis* Cushman and Bermudez, n. sp. $\times 40$. 40, Holotype. 39, Paratype.
41. *Sigmomorphina cubensis* Cushman and Bermudez, n. sp. $\times 20$.
42. *Glandulina cubensis* Cushman and Bermudez, n. sp. $\times 33$.
43. *Bolivina alata* Cushman and Bermudez, n. sp. $\times 30$.
- 44, 45. *Spiroplectoides cubensis* Cushman and Bermudez, n. sp. $\times 40$. 44, Holotype. 45, Paratype.
46. *Bolivina cubensis* Cushman and Bermudez, n. sp. $\times 33$.
- 47, 48. *Nodogenerina havanensis* Cushman and Bermudez, n. sp. $\times 40$. 48, Holotype. 47, Paratype.
- 49, 50. *Bolivina capdevilensis* Cushman and Bermudez, n. sp. $\times 35$. 49, Holotype, front view. 50, Paratype, apertural view.
- 51, 52. *Bolivina tricola* Cushman and Bermudez, n. sp. $\times 40$. 51, Holotype, front view. 52, Paratype, apertural view.
- 53-55. *Chrysaldinella cubana* Cushman and Bermudez, n. sp. $\times 40$. 53, Holotype, front view. 54, 55, Paratypes; 54, front view; 55, apertural view.
- 56-58. *Angulogerina naranjoensis* Cushman and Bermudez, n. sp. $\times 40$. 56, Holotype, front view. 57, 58, Paratypes; 57, front view; 58, apertural view.



chambers inflated, enlarging rapidly in size as added; sutures distinct, depressed; wall coarsely arenaceous, smoothly finished; aperture large, almost completely covered with an irregularly shaped, valvular tooth. Diameter 1.00 mm.; height 0.65 mm.

Holotype (Cushman Coll. No. 23664) from the Eocene of Cuba (Bermudez Sta. 110).

This species differs from *V. globularis* (d'Orbigny) in the more inflated chambers and very much larger, irregularly shaped, valvular tooth.

VALVULAMMINA AFFINIS Cushman and Bermudez, n. sp.

Test subglobular, periphery broadly rounded, spire low, the last-formed whorl making up nearly the entire surface of the test; chambers fairly distinct, slightly inflated, 6 or more in the last-formed whorl, increasing rapidly in size as added; sutures slightly depressed; wall coarsely arenaceous, rather smoothly finished; aperture large with a very broad, valvular tooth. Diameter 0.90 mm.; height 0.85 mm.

Holotype (Cushman Coll. No. 23667) from the Eocene of Cuba (Bermudez Sta. 110).

This species differs from *V. globularis* (d'Orbigny) in the greater number of chambers to the whorl, more involute chambers, and much larger, valvular tooth.

MARGINULINA HAVANENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 31, 32)

Test elongate, early portion close coiled, much compressed, later becoming uncoiled and nearly circular in section; chambers distinct, those of the uncoiled portion becoming somewhat inflated, and increasing in height as added; sutures distinct, early ones somewhat limbate, later ones becoming progressively more depressed; wall smooth, very finely perforate; aperture terminal,

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- 59, 60. *Pleurostomella naranjoensis* Cushman and Bermudez, n. sp. × 33.
60, Holotype, front view. 59, Paratype, side view.
61. *Pleurostomella obesa* Cushman and Bermudez, n. sp. × 28.
62, 63. *Pleurostomella rimosa* Cushman and Bermudez, n. sp. × 20. 62, Holotype, front view. 63, Paratype, side view.
64, 65. *Pleurostomella alazanensis* Cushman, var. *cubensis* Cushman and Bermudez, n. var. × 28. 64, Holotype, front view. 65, Paratype, side view.
66-68. *Ellipsoglandulina cubensis* Cushman and Bermudez, n. sp. × 22.
66, Holotype, side view. 67, 68, Paratypes; 67, apertural view; 68, side view.

From photographs retouched by Patricia G. Edwards.

10 CONTRIBUTIONS FROM THE CUSHMAN LABORATORY

radiate. Length 1.50-1.75 mm.; diameter 0.40 mm.

Holotype (Cushman Coll. No. 23371) from the Eocene, "El Husillo" Quarry (lower beds), Puentes Grandes, Havana, Cuba (Bermudez Sta. 312).

This species differs from *M. jacksonensis* (Cushman and Applin) in the lower and more numerous uniserial chambers, and more inflated later portion.

MARGINULINA LAEVIUSCULA Cushman and Bermudez, n. sp. (Pl. 1, figs. 33, 34)

Test elongate, slender, early portion somewhat coiled, very slightly compressed, last-formed chamber circular in section; chambers indistinct except the final one which is inflated and nearly as high as the remainder of the test, earlier chambers elongating rapidly as added; sutures indistinct except that in the base of the last-formed chamber which is slightly depressed; wall smooth, finely perforate; aperture terminal, radiate. Length 1.20-1.30 mm.; diameter 0.30 mm.

Holotype (Cushman Coll. No. 23373) from the Eocene, Avenida de los Presidentes, in road cut between hospital "Calixto Garcia" and Havana University, Havana, Cuba (Bermudez Sta. 20).

This species differs from *M. subrecta* Franke in the more elongate early chambers and much higher final chamber.

MARGINULINA PALMERAE Cushman and Bermudez, n. sp. (Pl. 1, figs. 36, 37)

Test slightly longer than broad, much compressed, close coiled except the last one or two chambers, periphery sharply keeled, especially on the dorsal side; chambers and sutures largely obscured by the ornamentation of the surface; wall, except for the last-formed chamber in the adult, ornamented by a raised net-work of short, oblique costae, the longer ones representing the line of the sutures with one more prominent costa nearly parallel to the dorsal side; aperture radiate, terminal. Length 1.50 mm.; breadth 0.80-0.85 mm.

Holotype (Cushman Coll. No. 23376) from the Eocene, under R. R. bridge on Central Highway, located in Jicotea, Santa Clara Province, Cuba (Bermudez Sta. 92).

This species differs from *M. fragaria* (Gümbel) in the greater amount of ornamentation forming an irregular net-work rather than a series of parallel lines, and in its shorter and broader form.

SARACENARIA ORNATULA Cushman and Bermudez, n. sp. (Pl. 1, fig. 35)

Test smooth, longer than broad, early portion coiled, later uncoiling, triangular in end view, angles acute, ventral face concave, the other two faces slightly convex; chambers fairly distinct, not inflated, increasing rather rapidly in size as added especially in the later uncoiled ones; sutures fairly distinct, raised, the earlier ones with a series of short, rounded spines, later ones forming raised costae projecting at the ventral margins into short spines; wall smooth except for the ornamentation of the sutures, finely perforate; aperture radiate at the dorsal angle. Length 1.25 mm.; breadth 0.85 mm.

Holotype (Cushman Coll. No. 23375) from the Eocene, 1 km. N. of Arroyo Arenas, on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *S. schencki* Cushman and Hobson in the ornamentation of the surface and the somewhat greater height of the chambers at the inner margin.

LINGULINA CUBENSIS Cushman and Bermudez, n. sp. (Pl. 1, fig. 38)

Test nearly circular in front view, moderately compressed, periphery with a distinct, sharp keel; chambers few, in the microspheric form with the earlier ones somewhat coiled, overlapping, the last-formed one making up a large proportion of the test; sutures distinct, very slightly depressed; wall smooth, very finely perforate; aperture terminal, elongate in the line of compression of the test, radiate. Length 0.55 mm.; breadth 0.45 mm.

Holotype (Cushman Coll. No. 23378) from the Eocene, 1 km. N. of Arroyo Arenas, on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *L. mexicana* Cole in the more circular outline, less developed keel, and larger proportion of the test made up by the final chamber.

DENTALINA HAVANENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 39, 40)

Test elongate fusiform, greatest breadth at about the middle, thence tapering nearly equally toward either end, one side convex, the other slightly concave, initial end bluntly pointed; chambers few, increasing rapidly in size as added, overlapping; sutures fairly distinct, slightly oblique, becoming less so in the later portion; wall smooth, finely perforate; aperture terminal, radiate. Length 0.75 mm.; diameter 0.18 mm.

Holotype (Cushman Coll. No. 23379) from the Eocene, under Library of Havana University, Havana, Cuba (Bermudez Sta. 257).

This species differs from *D. cooperensis* Cushman in the fewer chambers, more fusiform test, and the much longer part of the test occupied by the last-formed chamber.

SIGMOMORPHINA CUBENSIS Cushman and Bermudez, n. sp. (Pl. 1, fig. 41)

Test compressed, somewhat rhomboid in side view, the basal portion rounded, the upper portion with the sides nearly straight, base with a small spine; chambers rather indistinct, elongate, in alternating series; sutures indistinct, not depressed; wall smooth; aperture terminal, radiate. Length 1.80 mm.; breadth 1.00 mm.

Holotype (Cushman Coll. No. 23381) from the Eocene, 1 km. N. of Arroyo Arenas, on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *S. voughani* Cushman and Ozawa in the more compressed test with the rounded basal portion and straight sides above, more elongate chambers, and basal spine.

GLANDULINA CUBENSIS Cushman and Bermudez, n. sp. (Pl. 1, fig. 42)

Test globular, nearly spherical, initial end with a short, stout spine, apertural end with a distinctly projecting neck; chambers indistinct, those of the earliest portion small, biserial, the last-formed one making up much the larger portion of the test; sutures indistinct, not depressed; wall smooth, except for slightly raised costae radiating from the base of the apertural neck; aperture radiate, with a distinct neck, costate at the sides. Length 1.00 mm.; diameter 0.85 mm.

Holotype (Cushman Coll. No. 22382) from the Eocene, 1 km. N. of Arroyo Arenas, on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *G. laevigata* d'Orbigny in the more spherical form, radiate costae about the aperture, and the larger apertural neck.

BOLIVINELLA ALATA Cushman and Bermudez, n. sp. (Pl. 1, fig. 43)

Test generally triangular in front view, much compressed, greatest breadth near the apertural end, thence gradually tapering to the acute initial end, apertural end truncate, periphery with a distinct, triangular, somewhat flattened spine toward the

base on each side; chambers low, broad, biserial; sutures distinct, not depressed, slightly curved; wall smooth; aperture small, a low opening at the inner margin of the last-formed chamber. Length 0.55 mm.; breadth 0.45 mm.

Holotype (Cushman Coll. No. 22383) from the Eocene, 4.5 kms. W. of Guanajay, on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *B. folia* (Parker and Jones), var. *ornata* Cushman in the broader triangular form, lack of median longitudinal ridge and raised granular sutures, and broader and lower spines.

BOLIVINELLA CUBENSIS Cushman and Bermudez, n. sp. (Pl. 1, fig. 46)

Test compressed, initial end rounded, truncate, thence increasing to the greatest width at about the middle, later portion of about the same width, apertural end broadly rounded, sides of the early portion concave, later convex; chambers biserial, indistinct, last two pairs greatly increasing in size, each with a slight spine at the posterior angle; sutures marked by a series of raised beads, slightly longer than broad; wall ornamented by the beaded sutures. Length 0.60 mm.; breadth 0.55 mm.

Holotype (Cushman Coll. No. 23386) from the Eocene, 4.5 kms. W. of Guanajay on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *B. folia* (Parker and Jones), var. *ornata* Cushman in the lack of a longitudinal ridge, much broader later portion, and highly beaded sutures.

SPIROPLECTOIDES CUBENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 44, 45)

Test very elongate slender, compressed, early portion planispirally coiled, more or less evolute, later portion biserial, elongate, sides nearly parallel; chambers distinct, of rather uniform size in both the early planispiral and later biserial portions; sutures distinct, slightly depressed, becoming more strongly oblique in the later portion; wall smooth, coarsely perforate. Length 1.60 mm.; breadth 0.20 mm.

Holotype (Cushman Coll. No. 23384) from the Eocene of Alturas de Almendares Quarry in Reparto Kohly, W. side of Almendares River, Havana, Cuba (Bermudez Sta. 18).

This species differs from *S. curta* Cushman in the very slender, elongate test, lower chambers and more evolute early coils,

14 CONTRIBUTIONS FROM THE CUSHMAN LABORATORY

BOLIVINA CAPDEVILENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 49, 50)

Test moderately compressed, generally rhomboid in front view, initial end bluntly pointed, sides truncate in end view, slightly keeled at each side; chambers distinct, not inflated, increasing slightly in height as added; sutures distinct, raised, thin and plate-like, strongly oblique, often slightly undulate near the inner end; wall of the earliest portion spinose, later smooth between the plate-like sutures; aperture a small, low, arched opening at the inner margin of the last-formed chamber. Length 0.30-0.38 mm.; breadth 0.22-0.24 mm.; thickness 0.10-0.12 mm.

Holotype (Cushman Coll. No. 22388) from the Eocene, Tejar "Cuba," Arroyo Naranjo (lower beds), Havana Province, Cuba (Bermudez Sta. 235C).

This species differs from *B. jacksonensis* Cushman and Applin in the shorter, broader form, truncate periphery, and very strongly raised sutures.

BOLIVINA TRICOSTA Cushman and Bermudez, n. sp. (Pl. 1, figs. 51, 52)

Test compressed, thickest in the middle, thence thinning to the periphery which is sharply keeled, initial end bluntly pointed; chambers distinct, overlapping, last-formed ones nearly as high as broad, basal margin in the adult slightly crenulate; sutures distinct, slightly limbate, curved strongly toward the periphery; wall ornamented by three strongly raised, longitudinal costae, one in the median line, and one at each side of the middle; aperture a low opening in the median line at the base of the last-formed chamber. Length 0.32-0.36 mm.; breadth 0.18-0.20 mm.

Holotype (Cushman Coll. No. 23389) from the Eocene, 1 km. N. of Arroyo Arenas, on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *B. scalprata* Schwager in the much higher, coarser costae, less obliquely curved costae, and crenulate chamber margin in the adult.

NODOGENERINA HAVANENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 47, 48)

Test elongate, slightly tapering toward either end, initial end rounded, apertural end truncate, circular in transverse section; chambers distinct, slightly overlapping, increasing very gradually in diameter but much more rapidly in height as added; sutures distinct, depressed; wall ornamented with numerous, low, longitudinal costae on the earlier chambers, in later ones becoming

obsolescent except over the sutures; aperture rounded, terminal, at the end of a definite neck, the end of which is slightly expanded into a thickened lip. Length 0.85-1.40 mm.; diameter 0.16-0.22 mm.

Holotype (Cushman Coll. No. 23391) from Eocene, Alturas de Almendares Quarry in Reparto Kohly, W. side of Almendares River, Havana, Cuba (Bermudez Sta. 18).

This species differs from *N. cooperensis* Cushman in the less tapering form, higher chambers, elongate neck, and costate wall.

NODOGENERINA LAEVIS Cushman and Bermudez, n. sp. (Pl. 2, fig. 12)

Test elongate fusiform, initial end acute; chambers comparatively few, overlapping, increasing very rapidly in size and length as added; sutures distinct, depressed, especially in the later portion; wall smooth; aperture rounded, at the end of a distinct cylindrical neck, without an expanded lip. Length 1.00 mm.; diameter 0.20 mm.

Holotype (Cushman Coll. No. 23416) from Eocene, from under Library of Havana University, Havana, Cuba (Bermudez Sta. 257).

This species differs from *N. cooperensis* Cushman in its fusiform shape, fewer and higher chambers, elongate neck, and smooth wall.

CHRYSALIDINELLA CUBANA Cushman and Bermudez, n. sp. (Pl. 1, figs. 53-55)

Test about as long as broad, triangular in end view, sides concave, initial end pointed, thence increasing gradually in width in the microspheric form, rapidly in the megalospheric, to the greatest breadth at the base of the last-formed whorl of chambers; chambers numerous, increasing rather rapidly in breadth as added, not inflated, earlier ones triserial, later ones uniserial; sutures strongly oblique, not depressed; wall smooth; aperture cribrate, in the terminal face. Length 0.40-0.50 mm.; diameter 0.30-0.40 mm.

Holotype (Cushman Coll. No. 23393) from the Eocene, 4.5 kms. W. of Guanajay, on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *C. pulchella* (Cushman) in the relatively shorter, broader test, lower and broader chambers, recurved final chambers, and very tapering test.

ANGULOGERINA NARANJOENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 56-58)

Test somewhat longer than broad, tapering toward either end, generally triangular in end view, angles broadly truncate, sides slightly concave; chambers somewhat inflated, strongly concave at the base, and overhanging previous ones, increasing rapidly in size in the earlier portion; sutures deeply depressed; wall generally smooth; aperture small, circular, terminal, with a short neck and slight lip. Length 0.25-0.30 mm.; diameter 0.15-0.20 mm.

Holotype (Cushman Coll. No. 23395) from the Eocene, Tejar "Cuba," Arroyo Naranjo (lower beds), Havana Province, Cuba (Bermudez Sta. 235C).

This species differs from *A. cooperensis* Cushman in the shorter, broader form, more inflated chambers deeply excavated on the basal portion, and smooth wall.

SIPHOGENERINA TRANSVERSA Cushman, var. **CUBENSIS** Cushman and Bermudez, n. var. (Pl. 2, figs. 8, 9)

Variety differing from the typical in the higher costae and more fusiform shape. Length 1.00-1.40 mm.; diameter 0.55-0.68 mm.

Holotype of variety (Cushman Coll. No. 23411) from the Eocene, 1 km. N. of Arroyo Arenas, on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

PLEUROSOMELLA NARANJOENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 59, 60)

Test fusiform in both front and side views, initial end bluntly pointed, circular in transverse section; chambers distinct, inflated, increasing rapidly in size as added, the last pair making up about two-thirds of the whole test; sutures distinct, slightly depressed; wall smooth; aperture subterminal, with a slight lip. Length 0.55-0.60 mm.; breadth 0.25-0.28 mm.

Holotype (Cushman Coll. No. 23397) from the Eocene, Tejar "Cuba," Arroyo Naranjo (lower beds), Havana Province, Cuba (Bermudez Sta. 235C).

This species differs from *P. incrassata* Hantken in the shorter form, less inflated and slightly higher chambers, and smaller aperture.

PLEUROSOMELLA OBESA Cushman and Bermudez, n. sp. (Pl. 1, fig. 61)

Test slightly compressed, initial end subacute, tapering, periphery of adult portion broadly rounded; chambers overlapping, increasing very greatly in size in the adult, the last pair

greatly inflated and making up almost the entire surface of the test; sutures strongly oblique, little if at all depressed; wall smooth; aperture in a broad depression of the apertural face, with a broad, bifid tooth. Length 1.00 mm.; breadth 0.85 mm.

Holotype (Cushman Coll. No. 23401) from the Eocene, 1 km. N. of Arroyo Arenas, on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *P. rapa* (Gümbel), var. *recens* Dervieux in the greater obliquity of the sutures and much more inflated later chambers.

PLEUROSOMELLA RIMOSA Cushman and Bermudez, n. sp. (Pl. 1, figs. 62, 63)

Test subcylindrical, initial end bluntly pointed, sides nearly parallel, nearly circular in transverse section; chambers few, slightly inflated, increasing very rapidly in size as added, the last three making up a very large proportion of the whole test, apertural face flattened near the apex; sutures very slightly depressed; wall smooth; aperture subterminal, with a broad tooth and broad central slit, the aperture itself low and broad in front view. Length 0.80-1.10 mm.; diameter 0.40-0.45 mm.

Holotype (Cushman Coll. No. 23402) from the Eocene, 1 km. N. of Arroyo Arenas, on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *P. incrassata* Hantken in the less inflated chambers, nearly parallel sides, and more narrow aperture.

PLEUROSOMELLA ALAZANENSIS Cushman, var. **CUBENSIS** Cushman and Bermudez, n. var. (Pl. 1, figs. 64, 65)

Variety differing from the typical in the somewhat larger size, slightly greater inflation of the chambers, somewhat higher, narrower aperture, and more oblique apertural face. Length 1.30 mm.; diameter 0.40 mm.

Holotype of variety (Cushman Coll. No. 23404) from the Eocene, under Library of Havana University, Havana, Cuba (Bermudez Sta. 257).

ELLIPSOGLANDULINA CUBENSIS Cushman and Bermudez, n. sp. (Pl. 1, figs. 66-68)

Test about twice as long as broad, elliptical in side view, circular in transverse section, initial end subacute; chambers few, earliest ones biserial, last-formed one making up a large part of the test; sutures indistinct; wall smooth; aperture subterminal, slightly curved in end view, very low in front view, the upper rim

forming a hood-like, overhanging lip. Length 0.70-0.90 mm.; diameter 0.35-0.45 mm.

Holotype (Cushman Coll. No. 23407) from the Eocene, Avenida de los Presidentes, in road cut between Hospital "Calixto Garcia" and Havana University, Havana, Cuba (Bermudez Sta. 20).

This species differs from *E. velascoensis* Cushman in the more narrowly elliptical side view, less tapering initial end, and less pointed apertural end.

ELLIPSOGLANDULINA PRINCIPIENSIS Cushman and Bermudez, n. sp. (Pl. 2, figs. 1-3)

Test fusiform, once and a half to twice as long as broad, initial end bluntly pointed, circular in transverse section; chambers few, earlier ones biserial, later ones inflated, last-formed one making up about half the test, somewhat overlapping; sutures distinct, earlier ones slightly oblique, later ones slightly depressed; wall smooth; aperture subterminal, low, arched, with a broad, flattened tooth. Length 0.60-0.80 mm.; diameter 0.30-0.50 mm.

Holotype (Cushman Coll. No. 23408) from the Eocene, Avenida de los Presidentes, in road cut between Hospital "Calixto Garcia" and Havana University, Havana, Cuba (Bermudez Sta. 20).

This species differs from *E. exponens* (H. B. Brady) in the smaller, lower aperture and less depressed sutures.

NODOSARELLA CONSTRICTA Cushman and Bermudez, n. sp. (Pl. 2, figs. 4-7)

Test three to five times as long as broad, circular in transverse section, tapering from the subacute or rounded initial end to the greatest breadth formed by the last chamber; chambers distinct, inflated, particularly the later ones, increasing rapidly in size and height as added, earlier ones much overlapping, later ones less and less so; sutures slightly depressed in the earlier portion, strongly so in the adult; wall smooth; aperture nearly terminal, with a slightly overhanging, hood-like lip and a flattened, bifid tooth. Length 0.60-1.60 mm.; diameter 0.32-0.36 mm.

Holotype (Cushman Coll. No. 23412) from the Eocene, Avenida de los Presidentes, in road cut between Hospital "Calixto Garcia" and Havana University, Havana, Cuba (Bermudez Sta. 20).

This species differs from *N. subnodosa* (Guppy) in the more rapidly tapering form, more separated and somewhat higher chambers in the adult, and the more pointed initial and apertural ends.

NODOSARELLA ACUS Cushman and Bermudez, n. sp. (Pl. 2, figs. 10, 11)

Test elongate, fusiform, about four times as long as broad, ends subacute, circular in transverse section; chambers few, distinct but not inflated, somewhat overlapping, increasing gradually in size as added; sutures not depressed, usually irregularly oblique; wall smooth; aperture subterminal, very narrow, nearly filled by the flattened tooth. Length 0.68-0.75 mm.; diameter 0.18 mm.

Holotype (Cushman Coll. No. 23414) from Eocene, under Library of Havana University, Havana, Cuba (Bermudez Sta. 257).

This species differs from *N. subnodosa* (Guppy) in the fusiform shape, irregularly oblique and not depressed sutures, and the non-inflated chambers.

NONION HAVANENSE Cushman and Bermudez, n. sp. (Pl. 2, figs. 13, 14)

Test somewhat compressed, slightly depressed in the umbilical regions, completely involute, periphery rounded, 8 to 10 chambers in the adult coil, of uniform shape, increasing very slightly in size as added; sutures distinct, very slightly limbate, not depressed, gently curved; wall smooth; aperture low. Length 0.55 mm.; breadth 0.48 mm.; thickness 0.28 mm.

Holotype (Cushman Coll. No. 23417) from the Eocene, Tejar Consuelo (upper beds), Cerro, Havana, Cuba (Bermudez Sta. 36).

This species differs from *N. advenum* (Cushman) in the depressed umbilical regions without a raised boss, less limbate and not depressed sutures, and less compressed test.

DISCORBIS HAVANENSIS Cushman and Bermudez, n. sp. (Pl. 2, figs. 15, 16)

Test much compressed, dorsal side slightly convex, ventral side flattened or slightly convex, periphery acute, with a thin keel; chambers very distinct, 4 to 5 in the adult whorl, of uniform shape, increasing regularly in size as added, very slightly inflated; sutures distinct, strongly curved on both sides, slightly depressed on the ventral side; wall smooth, finely perforate; aperture a low opening at the ventral border beneath a distinct, overhanging lip which forms a lobe on the inner portion of the chamber. Length 0.65-0.70 mm.; breadth 0.55 mm.; thickness 0.15-0.18 mm.

Holotype (Cushman Coll. No. 23431) from the Eocene, under Library of Havana University, Havana, Cuba (Bermudez Sta. 257).

This species differs from *D. assulata* Cushman in the fewer

EXPLANATION OF PLATE 2

FIGS.

- 1-3. *Ellipsoglandulina principiensis* Cushman and Bermudez, n. sp. $\times 28$. 1, Holotype, side view. 2, 3, Paratypes; 2, side view; 3, apertural view.
- 4-7. *Nodosarella constricta* Cushman and Bermudez, n. sp. $\times 35$. 4, Holotype, side view. 5-7, Paratypes; 5, 6, side views; 7, apertural view.
- 8, 9. *Siphogenerina transversa* Cushman, var. *cubensis* Cushman and Bermudez, n. var. $\times 28$. 8, Holotype. 9, Paratype.
- 10, 11. *Nodosarella acus* Cushman and Bermudez, n. sp. $\times 30$. 10, Holotype. 11, Paratype.
12. *Nodogenerina laevis* Cushman and Bermudez, n. sp. $\times 30$.
- 13, 14. *Nonion havanense* Cushman and Bermudez, n. sp. $\times 40$. 13, Holotype, side view. 14, Paratype, apertural view.
- 15, 16. *Discorbis havanensis* Cushman and Bermudez, n. sp. $\times 28$. 15, Holotype, dorsal view. 16, Paratype, ventral view.
- 17, 18. *Discorbis incrustatus* Cushman and Bermudez, n. sp. $\times 28$. 17, Holotype, dorsal view. 18, Paratype, ventral view.
- 19, 20. *Siphonina advena* Cushman, var. *cubensis* Cushman and Bermudez, n. var. $\times 28$. 20, Holotype, dorsal view. 19, Paratype, ventral view.
- 21-23. *Baggina marielina* Cushman and Bermudez, n. sp. $\times 28$. 23, Holotype, ventral view. 21, 22, Paratypes; 21, dorsal view; 22, peripheral view.
- 24-26. *Lamarckina torrei* Cushman and Bermudez, n. sp. $\times 20$. 25, Holotype, dorsal view. 24, 26, Paratypes; 24, dorsal view; 26, peripheral view.
- 27-29. *Eponides marielensis* Cushman and Bermudez, n. sp. $\times 25$. 27, Holotype, dorsal view. 28, 29, Paratypes; 28, ventral view; 29, peripheral view.
- 30-32. *Eponides principiensis* Cushman and Bermudez, n. sp. $\times 22$. 30, Holotype, dorsal view. 31, 32, Paratypes; 31, ventral view; 32, peripheral view.
- 33-35. *Eponides rutteni* Cushman and Bermudez, n. sp. $\times 28$. 33, Holotype, dorsal view. 34, 35, Paratypes; 34, ventral view; 35, peripheral view.
- 36-38. *Gyroidina elongata* Cushman and Bermudez, n. sp. $\times 22$. 36, Holotype, peripheral view. 37, 38, Paratypes; 37, dorsal view; 38, ventral view.
- 39-41. *Gyroidina protea* Cushman and Bermudez, n. sp. $\times 18$. 39, Holotype, ventral view. 40, 41, Paratypes; 40, dorsal view; 41, peripheral view.
- 42-44. *Gyroidina plummerae* Cushman and Bermudez, n. sp. $\times 30$. 42, Holotype, ventral view. 43, 44, Paratypes, dorsal views.
- 45-47. *Planulina simplex* Cushman and Bermudez, n. sp. $\times 35$. 46, Holotype, side view. 45, 47, Paratypes; 45, side view; 47, peripheral view.
- 48-50. *Cancris cubensis* Cushman and Bermudez, n. sp. $\times 22$. 48, Holotype, dorsal view. 49, 50, Paratypes; 49, ventral view; 50, peripheral view.
- 51-53. *Globorotalia palmerae* Cushman and Bermudez, n. sp. $\times 40$. 52, Holotype, dorsal view. 51, 53, Paratypes; 51, ventral view; 53, peripheral view.
- 54-56. *Planulina suturata* Cushman and Bermudez, n. sp. $\times 28$. 54, Holotype, dorsal view. 55, 56, Paratypes; 55, ventral view; 56, peripheral view.
- 57-59. *Anomalina corrugata* Cushman and Bermudez, n. sp. $\times 20$. 57, Holotype, dorsal view. 58, 59, Paratypes; 58, ventral view; 59, peripheral view.
- 60, 61. *Anomalina almendarensis* Cushman and Bermudez, n. sp. $\times 28$. 60, Holotype, ventral view. 61, Paratype, dorsal view.
- 62-65. *Globorotalia centralis* Cushman and Bermudez, n. sp. $\times 28$. 65, Holotype, peripheral view. 62-64, Paratypes; 62, ventral view; 63, peripheral view; 64, dorsal view.

From photographs retouched by Patricia G. Edwards.



chambers, wider keel, and more pronounced lobe above the aperture.

DISCORBIS INCRUSTATUS Cushman and Bermudez, n. sp. (Pl. 2, figs. 17, 18)

Test nearly circular in dorsal view, much compressed, dorsal side with the central portion of the spire convex, then flattening out or even becoming concave toward the periphery, ventral side slightly concave, periphery subacute, not definitely keeled; chambers numerous, about 7 in the adult whorl, distinct, of rather uniform shape, increasing very gradually in size as added, ventrally, chambers somewhat indistinct, the inner end slightly contracted, dorsally the margin raised; sutures on the dorsal side strongly curved and oblique, ventrally depressed, nearly radiate; wall unornamented except for the raised margins on the dorsal side; aperture ventral, low. Diameter 1.00 mm.; thickness 0.40 mm.

Holotype (Cushman Coll. No. 23433) from the Eocene, 4.5 kms. W. of Guanajay on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *D. assulata* Cushman in the very oblique chambers with raised borders on the ventral side, radial sutures on the ventral side, and lack of a definite keel.

LAMARCKINA TORREI Cushman and Bermudez, n. sp. (Pl. 2, figs. 24-26)

Test plano-convex, dorsal side with a low, rounded spire, ventral side flattened, slightly umbilicate, periphery subacute, with a rounded keel; chambers 5 or 6 in the adult whorl increasing rather rapidly in size as added, but of uniform shape, periphery on the dorsal side strongly raised, ventrally ending in a point at the inner end; sutures strongly curved dorsally, ventrally straight and radiate, slightly depressed; wall of the dorsal side with the periphery and sutures strongly raised, and in the central umbo further thickened to obscure the earlier chambers; aperture a low opening at the ventral border of the last-formed chamber. Length 1.30-1.65 mm.; width 1.10-1.45 mm.; thickness 0.60-0.75 mm.

Holotype (Cushman Coll. No. 23439) from the Eocene, 4.5 kms. W. of Guanajay on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *L. jacksonensis* Cushman in the more strongly developed ornamentation of the dorsal side, straight and radial sutures of the ventral side, and more convex dorsal side.

GYROIDINA ELONGATA Cushman and Bermudez, n. sp. (Pl. 2, figs. 33-35)

Test strongly plano-convex, dorsal side flattened or even slightly concave, ventrally very strongly convex, the growing edge convex, the opposite side concave in peripheral view, not truly umbilicate, periphery subacute, with a thickened border; chambers fairly distinct, 7 or 8 in the adult whorl, increasing rather rapidly in size as added; sutures indistinct, those of the dorsal side nearly radiate, straight; wall smooth; aperture a low, narrow, arched opening about midway of the ventral margin of the last-formed chamber. Diameter 1.15-1.20 mm.; thickness 0.85 mm.

Holotype (Cushman Coll. No. 23447) from the Eocene, 4.5 kms. W. of Guanajay, on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *G. orbicularis* d'Orbigny, var. *planata* Cushman in the much more convex ventral side and more pointed form in peripheral view, more strongly developed peripheral margin and less well developed umbilicus.

GYROIDINA PROTEA Cushman and Bermudez, n. sp. (Pl. 2, figs. 39-41)

Test plano-convex, dorsal side flattened or slightly concave, ventral side convex, periphery subacute without a keel, umbilicus not strongly developed; chambers on the dorsal side triangular, increasing very gradually in size as added, ventrally indistinct, 12 to 14 in the adult whorl; sutures of the dorsal side fairly distinct, straight, tangential, slightly depressed, those of the ventral side radial, very strongly limbate and broad, very slightly raised and rounded; wall smooth; aperture a low, narrow opening at the margin of the ventral side of the last-formed chamber, somewhat nearer the umbilical than the peripheral end.

Holotype (Cushman Coll. No. 23449) from the Eocene, 4.5 kms. W. of Guanajay, on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *G. orbicularis* d'Orbigny, var. *planata* Cushman in the depressed sutures of the dorsal side, the slightly raised, very broadly limbate sutures of the ventral side, and the much greater number of chambers.

GYROIDINA PLUMMERAE Cushman and Bermudez, n. sp. (Pl. 2, figs. 42-44)

Test strongly plano-convex, dorsal side flattened or even somewhat concave, ventral side very strongly convex, periphery broadly rounded, umbilicate; chambers much inflated, 5 in the adult

whorl, of uniform shape, increasing regularly in size as added, slightly involute on the dorsal side; sutures slightly depressed; wall smooth; aperture a low opening near the umbilical end of the ventral border of the last-formed chamber. Diameter 0.60-0.70 mm.; thickness 0.55 mm.

Holotype (Cushman Coll. No. 23451) from the Eocene, 1 km. N. of Arroyo Arenas, on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *G. soldanii* d'Orbigny, var. *octocamerata* Cushman and G. D. Hanna in the fewer chambers to the whorl, more involute on the dorsal side, and more convex ventral side.

EPONIDES MARIELENSIS Cushman and Bermudez, n. sp. (Pl. 2, figs. 27-29)

Test biconvex, dorsal side strongly convex, ventral side much less so, periphery bluntly angled, umbilical region filled with a solid mass of translucent, secondary shell material; chambers about 10 in the adult whorl, of uniform shape, increasing very gradually and regularly in size as added, slightly if at all inflated; sutures on the dorsal side strongly oblique, slightly curved, strongly limbate and slightly raised, ventrally nearly radiate, very slightly depressed; wall smooth; aperture a low elongate opening at the margin of the ventral side of the last-formed chamber. Length 1.20 mm.; breadth 1.05 mm.; thickness 0.70 mm.

Holotype (Cushman Coll. No. 23443) from the Eocene, 4.5 kms. W. of Guanajay, on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *E. jacksonensis* (Cushman and Applin) in the larger number of chambers, more limbate and raised sutures, and larger umbilical mass of secondary shell material.

EPONIDES PRINCIPIENSIS Cushman and Bermudez, n. sp. (Pl. 2, figs. 30-32)

Test plano-convex, dorsal side very strongly convex in a high spire, ventrally flattened, periphery with a rounded, keel-like border, subacute; chambers 5 or 6 in the adult whorl, somewhat obscure on the dorsal side, ventrally very distinct and triangular, increasing very slowly in size as added, the inner end slightly tumid and thickened; sutures of the dorsal side strongly oblique, somewhat limbate and very slightly raised, ventrally nearly radiate, slightly depressed; wall smooth; aperture a low opening on

the ventral side beneath the slightly lobed inner end of the last-formed chamber. Diameter 0.80 mm.; thickness 0.55 mm.

Holotype (Cushman Coll. No. 23441) from the Eocene, Avenida de los Presidentes, in road cut between Hospital "Calixto Garcia" and Havana University, Havana, Cuba (Bermudez Sta. 20).

This species differs from *E. jacksonensis* (Cushman and Applin) in the small size, much higher spire and convex dorsal side, fewer chambers in the whorl, and more expanded inner end of the chambers on the ventral side.

EPONIDES RUTTENI Cushman and Bermudez, n. sp. (Pl. 2, figs. 32-35)

Test biconvex, dorsal side very slightly convex, ventral side very strongly so, periphery rounded; chambers 6 or 7 in the adult whorl, of uniform shape and increasing very gradually in size as added, very little if at all inflated; sutures distinct, dorsally nearly straight, very oblique, very slightly depressed, ventrally nearly radiate, slightly curved, very slightly limbate; wall smooth; aperture fairly large, running from near the umbilicus nearly to the periphery along the ventral border of the last-formed chamber which forms a sort of thickened lip. Diameter 0.80-0.90 mm.; thickness 0.65 mm.

Holotype (Cushman Coll. No. 23445) from the Eocene, 4.5 kms. W. of Guanajay on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *E. jacksonensis* (Cushman and Applin) in the lower dorsal and much more convex ventral side, more rounded periphery, and more definitely thickened lip.

SIPHONINA ADVENA Cushman, var. **CUBENSIS** Cushman and Bermudez, n. var.
(Pl. 2, figs. 19, 20)

Variety differing from the typical in the fimbriate periphery and more highly developed apertural neck and lip. Length 0.55 mm.; breadth 0.50 mm.; thickness 0.28 mm.

Holotype of variety (Cushman Coll. No. 23435) from the Eocene, 4.5 kms. W. of Guanajay, on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

In some respects this variety resembles *S. jacksonensis* Cushman and Applin, but the shape of the chambers and general characters are more like *S. advena* Cushman.

CANCRIS CUBENSIS Cushman and Bermudez, n. sp. (Pl. 2, figs. 48-50)

Test nearly equally biconvex, periphery acute, with a slight keel; chambers few, five in the final whorl, overlapping, of rather uniform shape but increasing very rapidly in size as added; the last chamber making up nearly half the surface of the test, slightly inflated; sutures slightly depressed, on the dorsal side gently curved, ventrally nearly radial; wall smooth; aperture ventral, a low, elongate opening, near the umbilical end of the last-formed chamber. Length 0.75 mm.; breadth 0.55 mm.; thickness 0.40 mm.

Holotype (Cushman Coll. No. 23453) from the Eocene, 4.5 kms. W. of Guanajay, on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *C. brongniartii* (d'Orbigny) in the fewer, more overlapping chambers, larger proportion of the test made up by the final chamber and acute, keeled periphery.

BAGGINA MARIELINA Cushman and Bermudez, n. sp. (Pl. 2, figs. 21-23)

Test only slightly compressed, dorsal side somewhat flattened, ventral side strongly convex and somewhat umbilicate, periphery broadly rounded, spire depressed and covered by the last whorl; chambers few, about 4 or 5 in the final whorl, much inflated, increasingly rapidly in size as added, becoming involute on the dorsal side, ventrally ending in a truncate lobe at the inner end; sutures of the dorsal side slightly depressed, nearly straight, strongly oblique, ventrally strongly depressed, slightly curved, nearly radial; wall smooth; aperture an elongate opening in the umbilical region of the ventral side. Length 0.75 mm.; breadth 0.65 mm.; thickness 0.60 mm.

Holotype (Cushman Coll. No. 23437) from the Eocene, 4.5 kms. W. of Guanajay on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *B. californica* Cushman in the more inflated chambers on the ventral side, more largely covered spire dorsally, and the lobular character of the ventral ends of the chambers.

GLOBIGERINA DISSIMILIS Cushman and Bermudez, n. sp. (Pl. 3, figs. 4-6)

Test subglobular, spire low, periphery broadly rounded; chambers few, four in the adult whorl, inflated, subglobular, ventrally with the last-formed chamber smaller, nearly covering the um-

bilicus, quadrangular in side view; sutures strongly depressed; wall coarsely cancellated except that of the peculiar last chamber which is much smoother; aperture rounded, opening into the umbilical area below the last chamber. Diameter 0.50-0.55 mm.; thickness 0.45 mm.

Holotype (Cushman Coll. No. 23430) from the Eocene, 1 km. N. of Arroyo Arenas on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *G. eocaena* Gümbel in the more compact form, less lobulate periphery, and the peculiarly shaped and smoother last chamber.

GLOBOROTALIA PALMERAE Cushman and Bermudez, n. sp. (Pl. 2, figs. 51-53)

Test about equally plano-convex, compressed, periphery with prominent, slightly flattened spines, and slightly keeled; chambers six or seven in the adult whorl, increasing rather evenly in size as added, inflated, the periphery of each in the adult usually ending in a somewhat tangentially pointing spine; sutures distinct, particularly on the dorsal side, slightly curved, ventrally nearly radial, strongly depressed; wall smooth, rather coarsely perforate, especially on the ventral side; aperture a low opening near the umbilical end of the ventral margin of the last-formed chamber. Length with spines 0.40-0.60 mm., without spines 0.28-0.35 mm.; breadth with spines 0.36-0.46 mm., without spines 0.24-0.30 mm.; thickness 0.10-0.12 mm.

Holotype (Cushman Coll. No. 23423) from the Eocene, Tejar "Cuba," Arroyo Naranjo (lower beds), Havana Province, Cuba (Bermudez Sta. 235C).

This species differs from *G. lehneri* Cushman and Jarvis in the smoother surface, less inflated chambers, and the periphery with a single large spine on each chamber instead of several small spines.

GLOBOROTALIA CENTRALIS Cushman and Bermudez, n. sp. (Pl. 2, figs. 62-65)

Test unequally biconvex, dorsal side only slightly so, ventrally very strongly convex, periphery rounded; chambers few, about 4 in the adult whorl, inflated, increasingly rapidly in size as added; sutures distinct, depressed, on the dorsal side strongly oblique, gently curved or nearly straight, ventrally radial; wall smooth, distinctly perforate; aperture an elongate, low, arched opening

about midway of the ventral side from periphery to umbilicus. Diameter 0.45-0.55 mm.; thickness 0.35-0.45 mm.

Holotype (Cushman Coll. No. 23425) from the Eocene, under R. R. bridge on Central Highway located in Jicotea, Santa Clara Province, Cuba (Bermudez Sta. 92).

This species differs from *G. cocoaensis* Cushman in the more inflated form, more convex ventral side, and more rounded periphery.

ANOMALINA CORRUGATA Cushman and Bermudez, n. sp. (Pl. 2, figs. 57-59)

Test plano-convex, dorsal side flattened to even somewhat concave, ventral side strongly convex, periphery in the early portion subacute, in the later portion broadly rounded; chambers 6 or 7 in the last-formed whorl, inflated on the ventral side throughout, last ones on the dorsal side strongly inflated, increasing rapidly in size as added, the last two making up nearly half the surface of the test; sutures somewhat indistinct, slightly depressed, ventrally nearly radial, dorsally somewhat curved; wall very coarsely pitted; aperture an arched opening at the base of the last-formed chamber at the periphery. Diameter 0.80-1.25 mm.; thickness 0.40-0.85 mm.

Holotype (Cushman Coll. No. 23419) from the Eocene, 4.5 kms. W. of Guanajay, on road to Mariel, Pinar del Rio Province, Cuba (Bermudez Sta. 337A).

This species differs from *Anomalina cocoaensis* Cushman in the fewer chambers, which are much more inflated, lack of central umbo, non-limbate chambers, and coarsely pitted surface.

ANOMALINA ALMENDARENSIS Cushman and Bermudez, n. sp. (Pl. 2, figs. 60, 61)

Test plano-convex, dorsal side gently convex, ventral side flattened or slightly concave; periphery subacute, with a rounded keel; chambers about 7 in the adult whorl, rather rapidly increasing in size as added, slightly inflated; sutures strongly curved, limbate, raised; wall of dorsal side distinctly perforate, ventral side more coarsely so, with numerous, irregularly scattered, rounded, or elongate, raised bosses; aperture at the periphery, small, arched, slightly extending to the ventral side. Diameter 0.90-0.95 mm.; thickness 0.45 mm.

Holotype (Cushman Coll. No. 23421) from the Eocene, Alturas de Almendares Quarry in Reparto Kohly, W. side of Almendares River, Havana, Cuba (Bermudez Sta. 18).

This species differs from *A. bilateralis* Cushman in the fewer and higher chambers, flatter ventral side, more strongly curved sutures, and ornamentation of the surface.

CIBICIDES HAVANENSIS Cushman and Bermudez, n. sp. (Pl. 3, figs. 1-3)

Test biconvex, dorsal side more strongly convex than the ventral, periphery subacute, with a bluntly-angled keel, umbilical region filled with a mass of secondary material; chambers numerous, about 12 in the adult whorl, of uniform shape, increasing very gradually in size as added, those of the earlier whorls on the dorsal side nearly obscured by secondary shell growth; sutures on the dorsal side, strongly oblique, nearly straight, limbate, ventrally gently curved, not depressed; wall smooth, except for the secondary layer over the spire; aperture, a small opening at the peripheral margin, extending to the dorsal side under a peculiar, projecting lobe of the chamber border. Diameter 0.65-0.75 mm.; thickness 0.40 mm.

Holotype (Cushman Coll. No. 23427) from the Eocene, Tejar "Cuba," Arroyo Naranjo (lower beds), Havana Province, Cuba (Bermudez Sta. 235C).

This species differs from *C. pseudoungerianus* (Cushman) in the high spire, strongly convex dorsal side, larger number of chambers, and strongly lobed final chamber.

PLANULINA SIMPLEX Cushman and Bermudez, n. sp. (Pl. 2, figs. 45-47)

Test small, much compressed, biconvex, highest in the middle, thence sloping to the subacute, somewhat carinate periphery, involute on both sides; chambers very distinct, strongly overlapping, of uniform shape, increasing very gradually in size as added; sutures very much curved, strongly limbate, slightly raised; wall smooth; aperture at the base of the apertural face, extending over onto the dorsal side, with a somewhat overhanging extension at the base of the last-formed chamber. Diameter 0.30-0.35 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 23457) from the Eocene, under Library of Havana University, Havana, Cuba (Bermudez Sta. 257).

This species differs from *P. cocodaensis* Cushman in the much smaller size, completely involute final whorl, and more strongly curved and limbate sutures.

PLANULINA SUTURATA Cushman and Bermudez, n. sp. (Pl. 2, figs. 54-56)

Test much compressed, dorsal side very slightly convex, ventral side slightly concave, umbilicate, periphery with a distinct, rounded keel; chambers 6 or 7 in the adult whorl, of uniform shape, increasing regularly in size as added, slightly inflated, on the ventral side with a distinct lobe at the umbilical end; sutures distinct, depressed, curved, more strongly so on the ventral side, limbate dorsally; wall smooth, coarsely perforate; aperture extending from the periphery slightly to the ventral side. Length 0.60-0.85 mm.; breadth 0.50-0.60 mm.; thickness 0.15-0.25 mm.

Holotype (Cushman Coll. No. 23455) from the Eocene, 1 km. N. of Arroyo Arenas, on road to Jaimanitas (water well), Havana Province, Cuba (Bermudez Sta. 31).

This species differs from *P. cocoaensis* Cushman in the fewer chambers, more evolute test, open umbilical region, and less compressed form.

181. ASTRONONION, A NEW GENUS OF THE FORAMINIFERA, AND ITS SPECIES

By JOSEPH A. CUSHMAN and PATRICIA G. EDWARDS

A study of material usually referred to "*Nonionina stelligera* d'Orbigny," both fossil and recent, from various parts of the world, has revealed very interesting structures. There are at least two distinct lines of development which apparently have definite relationships. In all the specimens there are developed supplementary chambers, alternating with the main chambers of the test in the region toward the umbilicus. In one, and apparently the earliest development, these supplementary chambers are in the form of narrow, tubular structures, reaching from the umbilicus, along the sutures, part way to the periphery, where they open to the surface. In the second group, the earliest chambers are of the same general form as already noted, but this is followed by more or less rhomboid chambers, occupying the same relative position, but with the opening at the outer posterior side. In addition, there are, apparently in certain species, supple-