CONTRIBUTIONS

FROM THE

CUSHMAN LABORATORY

FOR

FORAMINIFERAL RESEARCH

VOLUME 25, PART 4
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Contents

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CUSHMAN LABORATORY
FOR FORAMINIFERAL RESEARCH

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CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

330. FORAMINIFERA FROM THE EOCENE, VERDUN FORMATION, OF PERU*

By Joseph A. Cushman and Benton Stone

Foraminifera from this formation are of interest in establishing the faunal sequence of the Eocene in northwestern Peru. Although most of the species have already been described, the fauna is important because of the relationships it demonstrates with the Eocene faunas of other areas.

Iddings and Olsson[1] proposed the Verdun formation for strata on the La Brea-Parinas Estate which they believed to be of Oligocene age. Later, Olsson[2] recognized the Eocene age of the formation, correlating it with the Saman formation of the type locality, using the name Saman and reviving the name Talara of Grzybowski[3] for the Saman formation of Iddings and Olsson *op. cit.* Wiedey and Frizzell[4] felt that this correlation might be open to question and retained the name Verdun for the better known succession of the La Brea-Parinas Estate. In the present paper the usage of Wiedey and Frizzell is followed.

The type area of the formation was originally described as "a wide belt along the northern flank of the Negritos structure, centering about High Verdun." In a company report Frizzell later designated outcrops in Square Miles 2 to 4-N-6 to 7[5] as a restricted type locality.

Lithologically, the Verdun formation consists of silty to sandy shales and sandstones. The shales are usually thin bedded, consisting of an alternation of one to three inch bands, with occasional fine grained sandstone bands. The sandstones are of variable thickness, massive, usually medium to coarse grained, sometimes conglomeratic and light

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1 Iddings, Arthur and A. A. Olsson, Geology of Northwestern Peru, Bull. Amer. Assoc. Petr. Geol., vol. 12, No. 1, 1928, pp. 20-21.

2 Olsson, A. A., Contributions to the Tertiary Paleontology of Northern Peru, Part 3, Eocene Mollusca, Bull. Amer. Pal., vol. 17, No. 62, 1930, pp. 8-9.

3 Grzybowski, J., Die Tertiarablagerungen des nordlischen Peru und ihre Mollusken-fauna, Neues Jahrb., Beilageband, Bd. 12, 1899, pp. 610-664.

4 Wiedey, L. W., and D. L. Frizzell, Revision of the Eocene Stratigraphy of northwestern Peru, Proc. 6th Sci. Congress, 1939, pp. 527-528.

5 A description of the coordinate system employed by the International Petroleum Co., Ltd., in northwestern Peru may be found in Frizzell, D. L., Upper Cretaceous Foraminifera from northwestern Peru, Journ. Pal., vol. 17, 1943, p. 335.

colored. Orbitoidal foraminifera *(Lepidocyclina)* are sparse to very abundant, particularly in the coarse sandstones in the lower part of the formation, and are an important aid to field identification of the Verdun. The Verdun formation to the south in the Lagunitos Trough area contains more shale and represents more off-shore conditions of deposition. In Parinas District of the Estate the Verdun formation attains a maximum thickness of some 2300 feet.

The Verdun has been penetrated in numerous wells on the Estate. In its type area it is transgressive and mildly unconformable with the underlying Pozo shale. The formation is more transgressive near the edge of the Lagunitos Trough where it often overlaps the Upper Cretaceous Mal Paso formation. In the same area it is overlain conformably by the Upper Eocene Chira shale.

The microfauna of the Verdun shows considerable facies variation, particularly in its more shaley development, and calcareous assemblages frequently alternate with arenaceous ones although the fauna consists principally of arenaceous forms. *Lepidocyclina peruviana* Cushman, *L. r. douvillei* Lisson and *Operculinoides lissoni* (H. Douvillé) are the more abundant foraminifera found in the Verdun. Also present are *Helicostegina soldadensis* Grimsdale, *Helicolepidina vichayalensis* (Rutten) and *Amphistegina* aff. *A. speciosa* (W. Berry).

The Verdun fauna shows close relationships with that of the Upper Eocene Cowlitz River as published by Beck.[6] It is also of considerable interest to record *Cibicides parki* Finlay in the Peruvian Upper Eocene. This form was originally described from the Upper Eocene of New Zealand and has recently been recognized in the Eocene of several South American countries. It somewhat resembles *Cibicides natlandi* Beck in the Cowlitz River fauna.

Family ASTRORHIZIDAE

Genus ASTRORHIZA Sandahl, 1858

ASTRORHIZA cf. VERMIFORMIS Goës (Pl. 13, fig. 1)

Fragmentary specimens are similar to those recorded from the Eocene of Trinidad (Cushman and Renz, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 4, pl. 1, figs. 1, 2).

Genus RHABDAMMINA M. Sars, 1869

RHABDAMMINA cf. DISCRETA H. B. Brady (Pl. 13, fig. 2)

Specimens with a rather coarsely arenaceous surface may belong to this species recorded from the Eocene of Trinidad (Cushman and Renz, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 4, pl. 1, fig. 3).

6 Beck, R. Stanley, Eocene Foraminifera from Cowlitz River, Lewis County, Washington. Journ. Pal., vol. 17, No. 6, 1943, pp. 584-614.

Genus BATHYSIPHON M. Sars, 1872

BATHYSIPHON EOCENICA Cushman and G. D. Hanna (Pl. 13, fig. 3)

Bathysiphon eocenica CUSHMAN and G. D. HANNA, Proc. Calif. Acad. Sci., ser. 4, vol. 16, 1927, p. 210, pl. 13, figs. 2, 3.—CUSHMAN and McMASTERS, Journ. Pal., vol. 10, 1936, p. 508, pl. 74, fig. 1.—CUSHMAN and SIEGFUS, Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, p. 400, pl. 15, fig. 1.—KELLEY, Bull. Amer. Assoc. Petr. Geol., vol. 27, 1943, p. 11 (list).—CURRAN, l. c., pp. 1378, 1381 (lists).—MARTIN, Stanford Univ. Publ., Univ. Ser., Geol. Sci., vol. 3, No. 3, 1943, p. 9 (list).—CUSHMAN and SIMONSON, Journ. Pal., vol. 18, 1944, p. 193, pl. 30, fig. 1.—CUSHMAN and STONE, Special Publ. 20, Cushman Lab. Foram. Res., 1947, p. 2, pl. 1, fig. 1.—CUSHMAN and R. E. and K. C. STEWART, Bull. 36, Oregon Dept. Geol. and Min. Ind., pt. 5, 1947 (1948), p. 97, pl. 12, figs. 1, 2.

This species is widely recorded in the Eocene from Oregon, California, and Peru. Specimens from the Verdun shale show some variation in the color of the surface, some being nearly black while others are much lighter.

Family SACCAMMINIDAE

Genus SACCAMMINA M. Sars, 1869

SACCAMMINA cf. SPHAERICA M. Sars (Pl. 13, figs. 4, 5)

Numerous rather poorly preserved specimens may belong to this species. Most of the specimens are much compressed and distorted in fossilization.

Family REOPHACIDAE

Genus HORMOSINA H. B. Brady, 1879

HORMOSINA cf. GLOBULIFERA H. B. Brady (Pl. 13, figs. 6, 7)

Numerous specimens may be referred with some question to this species as they are variously distorted in fossilization. Similar forms occur in the Eocene of Trinidad.

Family AMMODISCIDAE

Genus AMMODISCUS Reuss, 1861

AMMODISCUS INCERTUS (d'Orbigny) (Pl. 13, fig. 8)

Specimens very similar to ones found in the Eocene of Trinidad occur in the Verdun formation.

AMMODISCUS GLABRATUS Cushman and Jarvis (Pl. 13, fig. 9)

(For references, see Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 6, pl. 1, fig. 16.)

Small specimens with smooth and nearly transparent wall seem to be identical with this species recorded from the Upper Cretaceous and Eocene of Trinidad.

Genus GLOMOSPIRA Rzehak, 1888

GLOMOSPIRA CHAROIDES (Jones and Parker) (Pl. 13, fig. 12)

Typical specimens of this species which has a wide range occur in the Verdun shale.

Genus LITUOTUBA Rhumbler, 1895

LITUOTUBA CHIRANA Cushman and Stone (Pl. 13, figs. 10, 11)

Lituotuba chirana CUSHMAN and STONE, Special Publ. 20, Cushman Lab. Foram. Res., 1947, p. 2, pl. 1, fig. 6.

Numerous typical specimens of this species with its straight adult portion, recently described from the Chira shale of Peru, occur in the Verdun formation.

Family LITUOLIDAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

HAPLOPHRAGMOIDES CARINATUM Cushman and Renz (Pl. 13, fig. 13)

Haplophragmoides carinatum CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 17, 1941, p. 2, pl. 1, fig. 1.—CUSHMAN and STAINFORTH, Special Publ. 14, Cushman Lab. Foram. Res., 1945, p. 15, pl. 1, fig. 18.—CUSHMAN and RENZ, Special Publ. 22, 1947, p. 4, pl. 1, fig. 3; Special Publ. 24, 1948, p. 10, pl. 2, figs. 5, 6.

This species originally described from Venezuela apparently has a range from Eocene to Miocene. The Peruvian specimens seem typical.

Genus AMMOBACULITES Cushman, 1910

AMMOBACULITES cf. FOLIACEUS (H. B. Brady) (Pl. 13, fig. 14)

Very much compressed, coarsely arenaceous specimens may be referred to this species with some question. Only a few of them show the uncoiled stage.

Genus CYCLAMMINA H. B. Brady, 1876

CYCLAMMINA DEFORMIS Guppy (Pl. 13, fig. 15)

Cyclammina cancellata H. B. BRADY, var. *deformis* GUPPY, Geol. Mag., dec. 5, vol. 1, 1904, p. 3, pl. 9, fig. 3.

Cyclammina deformis CUSHMAN and RENZ, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 11, pl. 2, fig. 10.

This species has been known only from the Eocene of Trinidad. Specimens from the Verdun formation seem entirely identical.

Family TEXTULARIIDAE

Genus SPIROPLECTAMMINA Cushman, 1927

SPIROPLECTAMMINA TRINITATENSIS Cushman and Renz (Pl. 13, fig. 16)

Spiroplectammina trinitatensis CUSHMAN and RENZ, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 11, pl. 2, figs. 13, 14.

Specimens from the Verdun formation seem to be identical with this species recently described from the Eocene of Trinidad.

Genus TEXTULARIA Defrance, 1824

TEXTULARIA cf. ADALTA Cushman (Pl. 13, fig. 17)

Specimens from the Verdun formation are quite like this species which is widely recorded in the Upper Eocene. Our figured specimen shows an unusual broad early stage and is apparently microspheric. Other specimens in the series are more normal.

Genus VULVULINA d'Orbigny, 1826

VULVULINA JARVISI Cushman (Pl. 13, figs. 18, 19)

Vulvulina jarvisi CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, p. 84, pl. 10, fig. 20.—BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 12, 1938, p. 26.—CUSHMAN and STAINFORTH, Special Publ. 14, Cushman Lab. Foram. Res., 1945, p. 16, pl. 1, fig. 27.—CUSHMAN and RENZ, Special Publ. 24, 1948, p. 12, pl. 2, fig. 16.

Rather typical specimens of this species occur in the Verdun formation. It is known from the Eocene and Oligocene of Trinidad and the Eocene of Cuba.

Family VERNEUILINIDAE

Genus CLAVULINOIDES Cushman, 1936

CLAVULINOIDES EUCARINATUS Cushman and Bermudez (Pl. 13, fig. 21)

Clavulinoides eucarinatus CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 13, 1937, p. 3, pl. 1, figs. 10, 11.—CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 131, pl. 18, figs. 23, 24.—BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 12, 1938, p. 1.—CUSHMAN and STAINFORTH, Special Publ. 14, Cushman Lab. Foram. Res., 1945, p. 17, pl. 1, figs. 24, 25.—CUSHMAN, Special Publ. 7A, 1946, p. 34. —CUSHMAN and RENZ, Special Publ. 24, 1948, p. 14, pl. 3, fig. 6.

Specimens from the Verdun formation are very similar to this species described from the Eocene of Cuba and recorded from the Oligocene and Eocene of Trinidad.

CLAVULINOIDES HAVANENSIS Cushman and Bermudez (Pl. 13, fig. 20)

Clavulinoides havanensis CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 13, 1937, p. 3, pl. 1, figs. 12, 13.—CUSHMAN, Special Publ. 7, Cushman Lab. Foram. Res., 1937, p. 132, pl. 18, figs. 25, 26.—CUSHMAN and RENZ, Special Publ. 24, 1948, p. 14, pl. 3, fig. 8.

This species was described from the Eocene of Cuba and recorded from the Eocene of Trinidad. Rare specimens from the Verdun formation seem to be identical.

Family VALVULINIDAE

Genus TRITAXILINA Cushman, 1911

TRITAXILINA cf. PLEIONENSIS Cushman (Pl. 13, figs. 22, 23)

A few specimens from the Verdun formation resemble this species described from the Miocene of Bulgaria (Special Publ. 8, Cushman Lab. Foram. Res., 1937, p. 158, pl. 19, figs. 1, 2). The five-sided shape of the test is well seen in basal view.

Genus PLECTINA Marsson, 1878

PLECTINA TRINITATENSIS Cushman and Renz (Pl. 13, fig. 25)

Plectina trinitatensis CUSHMAN and RENZ, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 15, pl. 3, fig. 12.

Specimens from the Verdun formation have been compared with the types from the Eocene of Trinidad and seem to be identical.

Genus KARRERIELLA Cushman, 1933

KARRERIELLA cf. CHILOSTOMA (Reuss) (Pl. 13, fig. 24)

A few specimens from the Verdun formation seem to be somewhat like this species but are not entirely typical, having usually more chambers and a more elongate test.

Family MILIOLIDAE

Genus QUINQUELOCULINA d'Orbigny, 1826

QUINQUELOCULINA cf. LAEVIGATA d'Orbigny (Pl. 13, fig. 26)

A few specimens from the Verdun formation may be referred to this species with some question. The species has been recorded from the Upper Eocene of the United States.

Genus MASSILINA Schlumberger, 1893

MASSILINA DECORATA Cushman (Pl. 13, fig. 29)

Very rare specimens from the Verdun formation seem to be identical with this species which was described from the lower Oligocene and occurs in the Jackson Eocene of the United States.

Family TROCHAMMINIDAE

Genus TROCHAMMINA Parker and Jones, 1859

TROCHAMMINA TEASI Cushman and Ellisor (Pl. 13, figs. 27, 28)

Trochammina teasi CUSHMAN and ELLISOR, Contr. Cushman Lab. Foram. Res., vol. 7, 1931, p. 52, pl. 7, fig. 3.—ELLISOR, Bull. Amer. Assoc. Petr. Geol., vol. 17, No. 11, 1933, pl. 1, fig. 9.—CUSHMAN and ELLISOR, Journ. Pal., vol. 19, 1945, p. 552, pl. 72, fig. 20.

Numerous specimens from the Verdun material seem very close to this species described from the Upper Eocene of Texas. Two morphologically similar forms occur; one (fig. 28) with considerable cement and composed of only very fine sand grains, and the other (fig. 27), more typical of *T. teasi,* with little cement and composed of much coarser grains. The two forms often occur together but there seem to be no intergrades between them.

There are other species evidently to be referred to *Trochammina* but they are much distorted in fossilization and cannot be specifically determined.

Family LAGENIDAE

Genus ROBULUS Montfort, 1808

ROBULUS OCCIDENTALIS (Cushman), var. GLABRATUS (Cushman) (Pl. 13, fig. 30)

Cristellaria occidentalis CUSHMAN, var. *glabrata* CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 4, 1923, p. 103, pl. 25, fig. 3.

Robulus occidentalis (CUSHMAN), var. *glabratus* CUSHMAN and STAINFORTH, Special Publ. 14, Cushman Lab. Foram. Res., 1945, p. 22, pl. 3, fig. 2.—CUSHMAN and RENZ, Special Publ. 24, 1948, p. 19, pl. 4, fig. 1.

Very rare specimens in the Verdun shale may be referred to this variety recently recorded from the Eocene of Trinidad.

ROBULUS PSEUDOVORTEX Cole (Pl. 13, fig. 31)

Robulus pseudovortex COLE, Bull. Amer. Pal., vol. 14, No. 51, 1927, p. 19, pl. 1, fig. 12. —CUSHMAN and McMASTERS, Journ. Pal., vol. 10, 1936, p. 510, pl. 74, fig. 12.—CUSHMAN and SIEGFUS, Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, p. 404, pl. 15, fig. 23.

This species was described from the Eocene, Guayabal formation, of Mexico and recorded from the Eocene of California. Specimens from the Verdun formation seem to be identical.

ROBULUS cf. MACRODISCUS (Reuss) (Pl. 14, fig. 1)

A few specimens from the Verdun formation may be referred to this species. It is widely recorded, and is known from the Eocene of Trinidad.

Genus MARGINULINA d'Orbigny, 1826

MARGINULINA MEXICANA (Cushman), var. NUDICOSTATA (Cushman and G. D. Hanna) (Pl. 14, figs. 2, 3)

Cristellaria mexicana CUSHMAN, var. *nudicostata* CUSHMAN and G. D. HANNA, Proc. Calif. Acad. Sci., ser. 4, vol. 16, 1927, p. 216, pl. 14, fig. 2.

Robulus mexicanus (CUSHMAN), var. *nudicostatus* CUSHMAN and M. A. HANNA, Trans. San Diego Soc. Nat. Hist., vol. 5, 1927, p. 50, pl. 4, fig. 2.—CUSHMAN and McMASTERS, Journ. Pal., vol. 10, 1936, p. 511, pl. 74, figs. 15, 16.

This variety was described and recorded from the Eocene of California. Specimens both from California and this Verdun material have an uncoiled stage which would place it in *Marginulina*.

Genus DENTALINA d'Orbigny, 1826

DENTALINA sp. (Pl. 14, fig. 4)

Very rare specimens from the Verdun material show too much variation to warrant a specific identification.

Family BULIMINIDAE

Genus BULIMINA d'Orbigny, 1826

BULIMINA PUPOIDES d'Orbigny (Pl. 14, figs. 6, 7)

(For earlier references, see CUSHMAN and PARKER, U. S. Geol. Survey Prof. Paper 210-D, 1947, p. 105, pl. 25, figs. 3-7.)—CUSHMAN and RENZ, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 25, pl. 5, fig. 16.

From the records this species ranges from the Upper Eocene to Recent and is very widely distributed. Our specimens from the Verdun formation seem to be typical.

Genus GLOBOBULIMINA Cushman, 1927

GLOBOBULIMINA HANNAI Cushman and Ellisor (Pl. 14, fig. 8)

Globobulimina hannai CUSHMAN and ELLISOR, Journ. Pal., vol. 19, 1945, p. 562, pl. 76, fig. 1.

Specimens from the Verdun formation are very variable but the fully developed ones seem similar to the types of this species described from the Anahuac formation of Texas.

Genus UVIGERINA d'Orbigny, 1826

UVIGERINA GARZAENSIS Cushman and Siegfus (Pl. 14, fig. 10)

Uvigerina garzaensis Cushman and Siegfus, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 28, pl. 6, fig. 15; Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, p. 414, pl. 17, fig. 5.—Kelley, Bull. Amer. Assoc. Petr. Geol., vol. 27, 1943, p. 11 (list).—Curran, l. c., pp. 1378, 1381 (lists).—Cushman and Simonson, Journ. Pal., vol. 18, 1944, p. 199, pl. 32, figs. 20, 21.—Detling, l. c., vol. 20, 1946, p. 357, pl. 50, fig. 8.

This species was described from the Eocene, Kreyenhagen shale, of California and recorded from various Eocene and Oligocene formations of California and Oregon. Specimens from the Verdun formation seem to be typical.

UVIGERINA cf. FARINOSA Hantken (Pl. 14, fig. 9)

A few specimens from the Verdun formation seem to be closely related to this species described from the Upper Eocene of Hungary and widely recorded elsewhere including the upper Eocene of Louisiana.

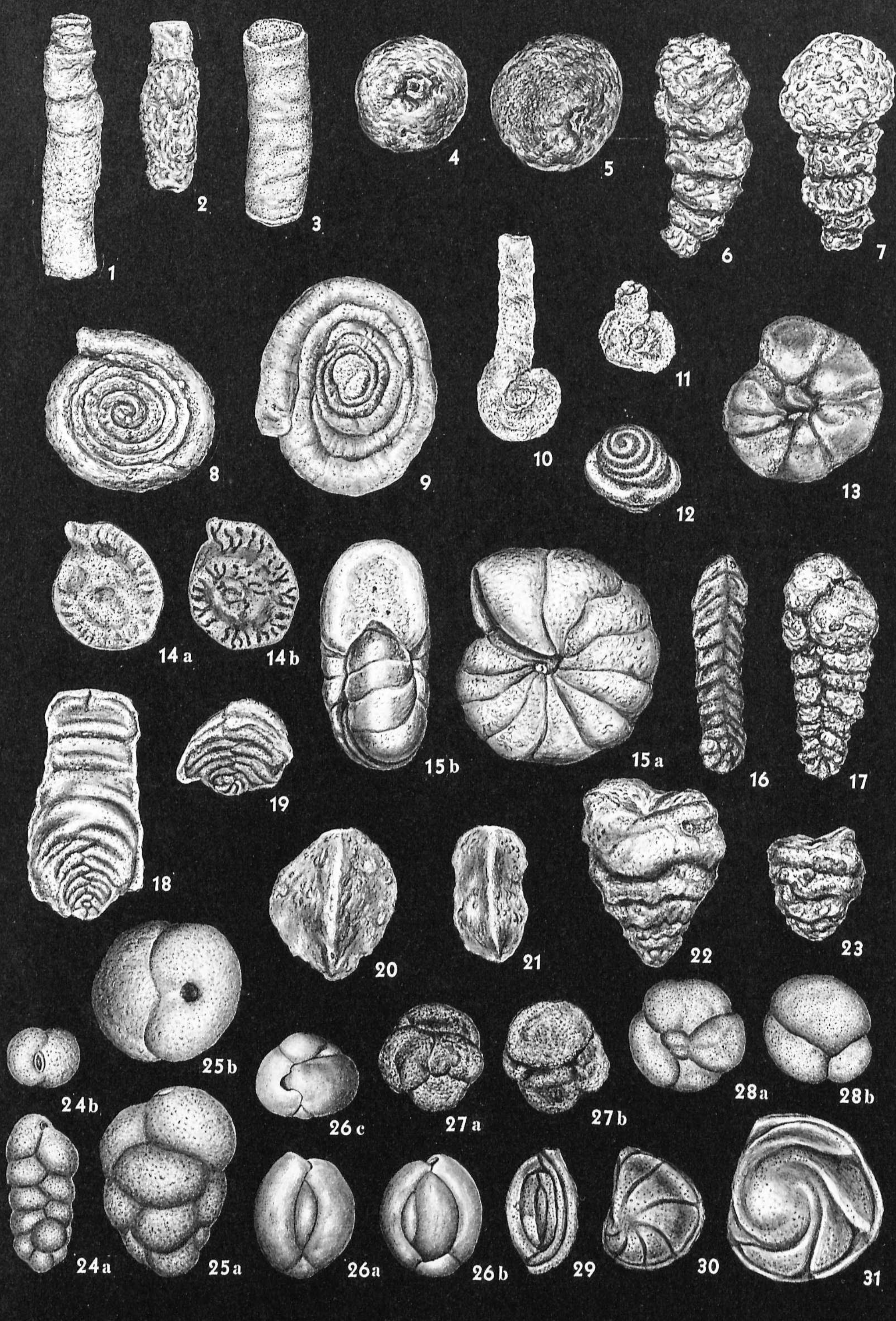
UVIGERINA JACKSONENSIS Cushman (Pl. 14, fig. 11)

(For references, see Cushman, Special Publ. 16, Cushman Lab. Foram. Res., 1946, p. 28, pl. 5, fig. 14.)

Numerous specimens of this typical upper Eocene species occur in the Verdun formation. The costae are usually not broken at the suture lines.

EXPLANATION OF PLATE 13

Fig. 1. *Astrorhiza* cf. *vermiformis* Goës. × 14. 2. *Rhabdammina* cf. *discreta* H. B. Brady. × 20. 3. *Bathysiphon eocenica* Cushman and G. D. Hanna. × 14. 4, 5. *Saccammina* cf. *sphaerica* M. Sars. × 20. 6, 7. *Hormosina* cf. *globulifera* H. B. Brady. 6, × 28. 7, × 20. 8. *Ammodiscus incertus* (d'Orbigny). × 14. 9. *A. glabratus* Cushman and Jarvis. × 40. 10, 11. *Lituotuba chirana* Cushman and Stone. × 28. 12. *Glomospira charoides* (Jones and Parker). × 40. 13. *Haplophragmoides carinatum* Cushman and Renz. × 40. 14. *Ammobaculites* cf. *foliaceus* (H. B. Brady). × 28. *a*, by reflected light; *b*, by transmitted light. 15. *Cyclammina deformis* Guppy. × 28. *a*, side view; *b*, peripheral view. 16. *Spiroplectammina trinitatensis* Cushman and Renz. × 40. 17. *Textularia* cf. *adalta* Cushman. × 40. 18, 19. *Vulvulina jarvisi* Cushman. × 28. 20. *Clavulinoides havanensis* Cushman and Bermudez. × 28. 21. *C. eucarinatus* Cushman and Bermudez. × 28. 22, 23. *Tritaxilina* cf. *pleionensis* Cushman. × 28. 24. *Karreriella* cf. *chilostoma* (Reuss). × 28. *a*, side view; *b*, end view. 25. *Plectina trinitatensis* Cushman and Renz. × 28. *a*, side view; *b*, end view. 26. *Quinqueloculina* cf. *laevigata* d'Orbigny. × 28. *a*, *b*, opposite sides; *c*, end view. 27, 28. *Trochammina teasi* Cushman and Ellisor. 27, × 28. 28, × 40. 29. *Massilina decorata* Cushman. × 40. 30. *Robulus occidentalis* (Cushman), var. *glabratus* (Cushman). × 40. 31. *R. pseudovortex* Cole. × 28.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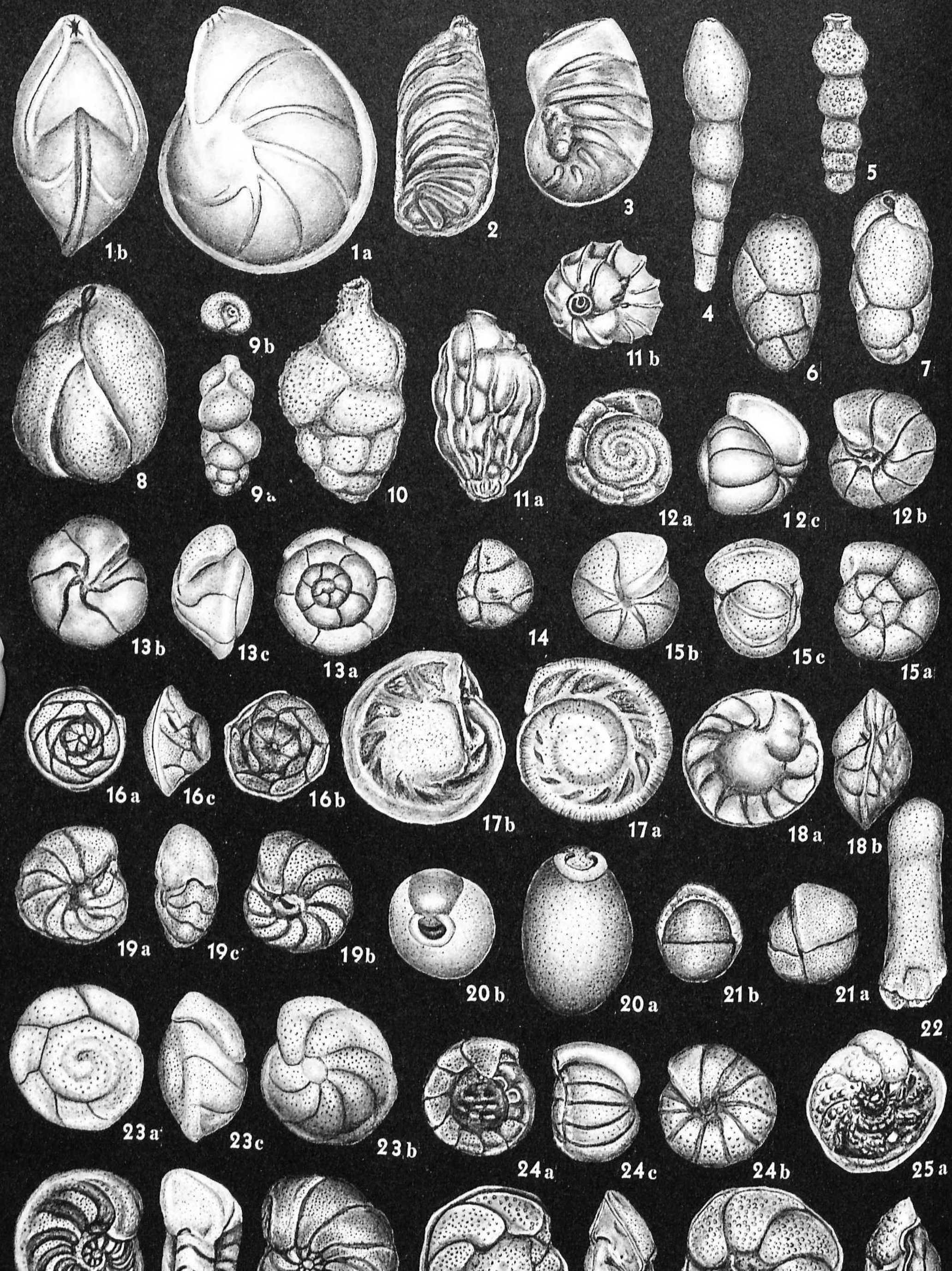
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27 c
27 b
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Family ELLIPSOIDINIDAE

Genus ELLIPSONODOSARIA A. Silvestri, 1900

ELLIPSONODOSARIA cf. SAGRINENSIS (Bagg) (Pl. 14, fig. 5)

Numerous specimens from the Verdun formation are very similar to this species recorded from the Paleocene and the Pliocene. The shape and surface characters are very typical.

Family ROTALIIDAE

Genus GYROIDINA d'Orbigny, 1826

GYROIDINA GIRARDANA (Reuss) (Pl. 14, fig. 12)

(For earlier references, see CUSHMAN and TODD, Special Publ. 15, Cushman Lab. Foram. Res., 1945, p. 58, pl. 9, fig. 2.)—CUSHMAN and RENZ, Special Publ. 22, 1947, p. 35; Special Publ. 24, 1948, p. 34.

Typical specimens occur in the Verdun formation. It is common in the Eocene of Trinidad and widely recorded elsewhere.

GYROIDINA GIRARDANA (Reuss), var. PERAMPLA Cushman and Stainforth (Pl. 14, fig. 15)

(For references, see CUSHMAN and RENZ, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 34, pl. 7, fig. 1.)

This variety known from the Oligocene and Eocene of Trinidad occurs in considerable numbers in the Verdun material.

Genus EPONIDES Montfort, 1808

EPONIDES UMBONATUS (Reuss) (Pl. 14, fig. 13)

Typical specimens of this very widely recorded species occur in the Verdun formation.

EXPLANATION OF PLATE 14

FIG. 1. *Robulus* cf. *macrodiscus* (Reuss). × 20. *a*, side view; *b*, peripheral view. 2, 3. *Marginulina mexicana* (Cushman), var. *nudicostata* (Cushman and G. D. Hanna). × 20. 4. *Dentalina* sp. × 40. 5. *Ellipsonodosaria* cf. *sagrinensis* (Bagg). × 40. 6, 7. *Bulimina pupoides* d'Orbigny. × 40. 8. *Globobulimina hannai* Cushman and Ellisor. × 40. 9. *Uvigerina* cf. *farinosa* Hantken. × 40. *a*, side view; *b*, apertural view. 10. *U. garzaensis* Cushman and Siegfus. × 80. 11. *U. jacksonensis* Cushman. × 40. *a*, side view; *b*, apertural view. 12. *Gyroidina girardana* (Reuss). × 40. 13. *Eponides umbonatus* (Reuss). × 40. 14. *Cassidulina* cf. *globosa* Hantken. × 40. 15. *Gyroidina girardana* (Reuss), var. *perampla* Cushman and Stainforth. × 40. 16. *Asterigerina crassaformis* Cushman and Siegfus. × 40. 17. *Epistomina* cf. *eocenica* Cushman and M. A. Hanna. × 28. 18. *Parrella mexicana* (Cole). × 28. *a*, ventral view; *b*, peripheral view. 19. *Cibicides venezuelanus* Nuttall. × 40. 20. *Chilostomelloides ovicula* Nuttall. × 28. *a*, side view; *b*, end view. 21. *Pullenia bulloides* (d'Orbigny). × 40. *a*, side view; *b*, peripheral view. 22. *Hastigerinella jarvisi* Cushman. × 40. Fragment of one chamber. 23. *Cibicides mexicanus* Nuttall. × 40. 24. *C. grimsdalei* Nuttall. × 28. 25. *C. parki* Finlay. × 28. *a*, ventral view; *b*, peripheral view. 26. *C. cushmani* Nuttall. × 40. 27. *C.* cf. *martinezensis* Cushman and Barksdale. × 40.

(Unless otherwise indicated, *a*, dorsal view; *b*, ventral view; *c*, peripheral view.)

Genus EPISTOMINA Terquem, 1883

EPISTOMINA cf. EOCENICA Cushman and M. A. Hanna (Pl. 14, fig. 17)

Specimens from the Verdun formation are close to this species which is widely recorded in the American Eocene. The figured specimen has more chambers in the whorl than most of the others which are more typical.

Genus PARRELLA Finlay, 1939

PARRELLA MEXICANA (Cole) (Pl. 14, fig. 18)

(For references, see CUSHMAN and RENZ, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 35, pl. 7, figs. 9, 10.)

This species described from the Eocene of Mexico is fairly common in the Verdun material. Most of the specimens are more typical than the one here figured.

Family AMPHISTEGINIDAE

Genus ASTERIGERINA d'Orbigny, 1839

ASTERIGERINA CRASSAFORMIS Cushman and Siegfus (Pl. 14, fig. 16)

Asterigerina crassaformis CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 11, 1935, p. 94, pl. 14, fig. 10; Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, p. 420, pl. 18, fig. 1.—KELLEY, Bull. Amer. Assoc. Petr. Geol., vol. 27, 1943, pp. 8, 11 (lists).—CURRAN, l. c., pp. 1378, 1381 (lists).—MARTIN, Stanford Univ. Publ., Univ. Ser., Geol. Sci., vol. 3, No. 3, 1943, p. 9 (list).

This species was described from the Eocene, Kreyenhagen shale, of California, and has been recorded from other Eocene formations of California. A few specimens from the Verdun material seem to be identical.

Family CASSIDULINIDAE

Genus CASSIDULINA d'Orbigny, 1826

CASSIDULINA cf. GLOBOSA Hantken (Pl. 14, fig. 14)

Small specimens from the Verdun formation may be referred to this species which is widely recorded, particularly in the Eocene.

Family CHILOSTOMELLIDAE

Genus CHILOSTOMELLOIDES Cushman, 1926

CHILOSTOMELLOIDES OVICULA Nuttall (Pl. 14, fig. 20)

(For references, see CUSHMAN and RENZ, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 38, pl. 7, figs. 13, 14.)

Rare specimens of this species previously known only from the Eocene and Oligocene of Trinidad occur in the Verdun formation.

Genus PULLENIA Parker and Jones, 1862

PULLENIA BULLOIDES (d'Orbigny) (Pl. 14, fig. 21)

(For earlier references, see CUSHMAN and RENZ, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 38.)

Specimens referable to this species occur very rarely in the Verdun material.

Family GLOBIGERINIDAE

Genus HASTIGERINELLA Cushman, 1927

HASTIGERINELLA JARVISI Cushman (Pl. 14, fig. 22)

Hastigerinella jarvisi CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 6, 1930, p. 18, pl. 3, figs. 8-11.—RENZ, Proc. 8th Amer. Sci. Congress, 1942, p. 541 (list).—CUSHMAN and RENZ, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 39.

Numerous fragments in the Verdun formation belong to this genus. The figured specimen might be taken for *H. eocanica* Nuttall but numerous other specimens show the later and longer form of *H. jarvisi*. It is known previously only from the Eocene of Trinidad.

Family ANOMALINIDAE

Genus CIBICIDES Montfort, 1808

CIBICIDES VENEZUELANUS Nuttall (Pl. 14, fig. 19)

Cibicides venezuelana NUTTALL, Journ. Pal., vol. 9, 1935, p. 131, pl. 15, figs. 25-27.—BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 11, 1937, p. 345.—CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 32, pl. 7, fig. 4; Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, p. 423, pl. 18, fig. 8.

This species known from the Eocene of Venezuela, Cuba, and California, occurs in the Verdun formation.

CIBICIDES GRIMSDALEI Nuttall (Pl. 14, fig. 24)

(For references, see CUSHMAN and RENZ, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 41, pl. 8, figs. 17-19.)

Specimens from the Verdun formation have been compared with the types from the Eocene, Aragon formation, of Mexico and seem typical. It was found commonly in the Eocene of Trinidad.

CIBICIDES CUSHMANI Nuttall (Pl. 14, fig. 26)

(For references, see CUSHMAN and RENZ, Special Publ. 24, Cushman Lab. Foram. Res., 1948, p. 41, pl. 8, figs. 22, 23.)

The Verdun specimens have been compared with the types from the Eocene, Aragon formation, of Mexico and seem more typical than some others that have been referred to it. It is recorded also from Trinidad and California.

CIBICIDES MEXICANUS Nuttall (Pl. 14, fig. 23)

(For earlier references, see CUSHMAN and STAINFORTH, Special Publ. 14, Cushman Lab. Foram. Res., 1945, p. 73, pl. 15, fig. 5.)—CUSHMAN and RENZ, Special Publ. 24, 1948, p. 42, pl. 8, figs. 20, 21.

This species is widely recorded in the Oligocene and Eocene of America. Specimens from the Verdun material are fairly typical.

CIBICIDES cf. MARTINEZENSIS Cushman and Barksdale (Pl. 14, fig. 27)

Specimens from the Verdun formation are very close to those referred to this species from the Eocene, Kreyenhagen shale, of California (Cushman and Siegfus, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 33, pl. 7, fig. 6). It is recorded from several Eocene formations of California.

CIBICIDES PARKI Finlay (Pl. 14, fig. 25)

Cibicides parki FINLAY, Trans. Roy. Soc. New Zealand, vol. 68, 1939, p. 528, pl. 69, fig. 1.

This species described from the Upper Eocene of New Zealand occurs in the Verdun formation. It is very rare and is present only in shaley facies of the Verdun.

331. SPECIES OF THE GENUS *CHILOSTOMELLA* AND RELATED GENERA*

BY JOSEPH A. CUSHMAN and RUTH TODD[1]

This paper is the fourth and last of a series on the species included in the foraminiferal family Chilostomellidae.[2] The present paper is concerned with the subfamilies Chilostomellinae and Seabrookiinae and two genera, *Allomorphinella* and *Chilostomellina,* of the subfamily Allomorphinellinae.

The family Chilostomellidae seems to have originated during Jurassic time. It became rather widespread and well represented in the Upper Cretaceous and has persisted to the Recent epoch. Certain genera in the family died out at various times and others appeared, so that the family is still represented in Recent seas by six genera, although specimens are not often found abundantly.

Key to the Genera of the Chilostomellidae:

I. Test trochoid throughout.		
A. Chambers evolute on the dorsal side.		
1. Three chambers to a whorl.	*Allomorphina*	**Allomorphininae**
2. Four chambers to a whorl.	*Quadrimorphina*	**Allomorphininae**
B. Chambers strongly embracing on the dorsal side.	*Sphaeroidina*	**Sphaeroidininae**
II. Test trochoid in the young, planispiral in adult.		
A. Two chambers to a whorl.		
1. Aperture at the side of the test.		
a. Aperture narrow.	*Chilostomella*	**Chilostomellinae**
b. Aperture rounded.	*Chilostomelloides*	**Chilostomellinae**
2. Aperture terminal.	*Seabrookia*	**Seabrookiinae**
B. More than two chambers to a whorl.		
1. Chambers high.		
a. Aperture simple, narrow, low.	*Allomorphinella*	**Allomorphinellinae**
b. Aperture fimbriate	*Chilostomellina*	**Allomorphinellinae**
2. Chambers low.		
a. Aperture wide, low.	*Pullenia*	**Allomorphinellinae**
b. Aperture cribrate.	*Cribropullenia*	**Allomorphinellinae**

* Published by permission of the Director, U. S. Geological Survey.

1 This paper was only partly completed at the time of Dr. Cushman's death. Therefore, the responsibility for any errors of fact or interpretation is my own. R. T.

2 Previous papers appeared in these Contributions as follows:
Pullenia, vol. 19, pt. 1.
Sphaeroidina, vol. 25, pt. 1.
Allomorphina and Quadrimorphina, vol. 25, pt. 3.

Genus CHILOSTOMELLA Reuss, 1850

Genotype, *Chilostomella ovoidea* Reuss

Chilostomella REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 379.—H. B. BRADY, Rep. Voy. *Challenger,* Zoology, vol. 9, 1884, p. 436.—RHUMBLER, Nordisches Plankton, pt. 14, Foraminiferen, 1901, p. 11.—CHAPMAN, The Foraminifera, 1902, p. 182.—CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 2; Bull. 104, pt. 5, 1924, p. 1; Smithsonian Misc. Coll., vol. 77, No. 4, 1925, p. 40; Foraminifera, 4th Ed., 1948, p. 319.

Test fusiform, ovoid, or subcylindrical, in the early stages, especially of the microspheric form, with the chambers as in *Allomorphina,* adult with two chambers completing a coil, and embracing so that but a small part of the base of the preceding chamber is visible from the ventral side; wall calcareous, perforate; aperture a narrow curved opening, at the inner margin of the ventral face of the last-formed chamber, often with a slightly upturned lip.—Upper Cretaceous to Recent.

Fifteen species and three varieties are here included in *Chilostomella.* In the following descriptions, they are arranged according to geologic age.

CHILOSTOMELLA PRIMITIVA Cushman and Todd, n. sp. (Pl. 15, fig. 1)

Chilostomella cf. *ovoidea* CUSHMAN and HEDBERG (not REUSS), Contr. Cushman Lab. Foram. Res., vol. 17, 1941, p. 98, pl. 23, fig. 16.—CUSHMAN, l. c., vol. 23, 1947, p. 16, pl. 4, fig. 28; U. S. Geol. Survey Prof. Paper 206, 1946, p. 146, pl. 66, fig. 14.

Test small, elongate oval, the ends broadly rounded; chambers strongly inflated, involute, the last-formed chamber making up a large proportion of the surface, a third chamber partly visible in some probably microspheric specimens; sutures fairly distinct, little if at all depressed; wall smooth; aperture a low, narrow opening extending across the basal margin of the last-formed chamber, with a distinct, overhanging, thin lip. Length 0.45-0.50 mm.; breadth 0.25-0.28 mm.

Holotype (Cushman Coll. No. 38014) from the Upper Cretaceous, Colon shale, *Pullenia cretacea* zone, Quebrada Mito Juan, Santander del Norte, Colombia. Specimens occur also in the Vidoño shale member of the Santa Anita formation, Quebrada San Juan, Venezuela.

The species differs from *C. ovoidea* Reuss in the more elongate form, straighter base to the last-formed chamber, and thinner and broader lip. This species shows rather definitely the derivation of *Chilostomella* from *Allomorphina.*

CHILOSTOMELLA TRINITATENSIS Cushman and Todd, n. sp. (Pl. 15, fig. 2)

possibly Chiloides

Chilostomella cf. *ovoidea* CUSHMAN and RENZ (not REUSS), Spec. Publ. 18, Cushman Lab. Foram. Res., 1946, p. 47, pl. 8, fig. 8.

Test fairly large, elongate, sides nearly parallel, ends broadly rounded; chambers distinct, the last-formed one making up about ⅔ of the surface of the test; sutures rather indistinct, slightly if at all depressed; wall smooth; aperture semicircular at the base of the last-formed chamber, without a distinct lip. Length of holotype, 1.40 mm.; diameter 0.53 mm.

Holotype (Cushman Coll. No. 46785) from the Upper Cretaceous, Lizard Springs marl, lower zone, Ravine Ampelu, Lizard Springs area, southeastern Trinidad, B. W. I.

This species differs from *C. ovoidea* Reuss in the elongate form with nearly parallel sides and semicircular aperture, and from *C. tenuis* Bornemann in the much larger size and semicircular aperture.

(tenuis is here made a var. of cylindroides)

CHILOSTOMELLA MEXICANA Nuttall (Pl. 15, figs. 3, 4)

Chilostomella mexicana NUTTALL, Journ. Pal., vol. 2, 1928, p. 373, pl. 50, figs. 1, 2.

"Test smooth, roughly ovoid, slightly compressed, tapering to the broadly rounded basal end. Shell widest at the aperture, this end being somewhat truncated. Test about two thirds as wide as long. Aperture situated a short distance below the upper surface, an elongate slightly curved narrow slit with a narrow lip. Average length 1 mm."—Nuttall.

The types of this species are from the Eocene of Mexico, Filisola well 82, depth 2667-2794 feet, Isthmus of Tehuantepec, Mexico.

In some respects this species resembles *Allomorphina* but an examination of the type specimens shows that they are correctly placed in *Chilostomella*.

CHILOSTOMELLA MEXICANA Nuttall, var. SERRATA Cushman and Stone (Pl. 15, fig. 5)

Chilostomella ovoidea REUSS, var. *serrata* CUSHMAN and STONE, Special Publ. 20, Cushman Lab. Foram. Res., 1947, p. 24, pl. 3, fig. 13.

Variety differing from the typical form in the serrate character of the apertural lip.

The types of this variety are from the Eocene, Chira shale, Quebrada Siches, near El Alto, 20 miles N. of Talara, Dept. of Piura, northwestern Peru.

This variety seems more closely related to *C. mexicana* Nuttall than to *C. ovoidea* Reuss, but it may be a distinct species.

CHILOSTOMELLA MEXICANA Nuttall, var. CHIRANA Cushman and Todd, n. var. (Pl. 15, fig. 6)

Chilostomella mexicana CUSHMAN and STONE (not NUTTALL), Special Publ. 20, Cushman Lab. Foram. Res., 1947, p. 24, pl. 3, fig. 12.

Variety differing from the typical form in the much lower aperture, which is nearly straight and has a thin lip.

Holotype of variety (Cushman Coll. No. 48983) from the Eocene, Chira shale, Quebrada Siches, near El Alto, 20 miles N. of Talara, Dept. of Piura, northwestern Peru.

A further comparison of the Peruvian specimens with the types of *C. mexicana* Nuttall from Mexico shows that there is a distinct difference which may be even more than a varietal difference.

CHILOSTOMELLA CHILOSTOMELLOIDES Vasicek (Pl. 15, fig. 7)

Chilostomella chilostomelloides VASICEK, Vest. Stat. Geol. Ust. Rep. Cesk., Rocnik XXII, 1947, p. 248, pl. 2, fig. 16.

possibly should be Chilostomelloides

Test elongate oval, greatest width in the middle, thence tapering to the rounded ends, height and breadth about equal, test circular in end view; chambers distinct, the last-formed one making up a large proportion of the surface; sutures fairly distinct, not depressed; wall smooth; aperture semicircular with a distinct, raised lip, at the base of the last-formed chamber. Length of holotype 0.90 mm.; breadth 0.50 mm.

The types are from the upper Eocene or lower Oligocene, Magura Flysch, Moravia.

This species in some characters resembles *C. trinitatensis* n. sp. but is much more oval in shape and has a somewhat differently shaped aperture.

CHILOSTOMELLA CYLINDROIDES Reuss (Pl. 15, figs. 8-10)

Chilostomella cylindroides REUSS, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 80, pl. 6, fig. 43.—BORNEMANN, l. c., vol. 7, 1855, p. 343, pl. 17, fig. 1.—REUSS, Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 156; Sitz. Akad. Wiss. Wien, vol. 62, pt. 1, 1870, p. 488, in VON SCHLICHT, Foram. Sept. Pietzpuhl, 1870, pl. 25, figs. 37-48.—HANTKEN, Mitth. Jahrb. K. Ungar. geol. Anstalt, vol. 4, 1875 (1881), p. 63, pl. 7, fig. 7; Math. Nat. Ber. Ungarn, vol. 2, 1884, p. 130.—ANDREAE, Abhandl. Geol. Special-Karte Elsass-Lothringen, vol. 2, 1884, p. 127.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 76, pl. 11, figs. 14, 15.—HUCKE, Ber. Nat. Ver. Dessau, Heft 2, 1930, p. 17 (list).—COLOM, Num. 2, Estudios Geologicos, Instit. Invest. Geol., 1945, p. 74, pl. 5, figs. 124-129.

Chilostomella oolina CUSHMAN (not SCHWAGER), Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, No. 10, 1927, p. 169.—CUSHMAN and MOYER, Contr. Cushman Lab. Foram. Res., vol. 6, 1930, p. 61, pl. 8, fig. 15.

Chilostomella grandis CUSHMAN and MOYER (not CUSHMAN), l. c., vol. 6, 1930, p. 61, pl. 8, fig. 14.

Test elongate, sides slightly convex, ends broadly rounded, circular in end view, slightly compressed laterally in the middle; chambers distinct, the last-formed one making up almost the entire ventral side of the test; sutures distinct when moistened, slightly if at all depressed; wall thin, smooth, polished, very finely perforate throughout and with a few large additional punctae; aperture a very narrow elongate opening at the ventral margin of the last-formed chamber, with a distinct, narrow lip. Length 0.55-0.75 mm.; breadth 0.35-0.50 mm.

The types are from the Oligocene of Hermsdorf, near Berlin, Germany. The species is recorded also from numerous localities in the Oligocene and Upper Eocene of Europe. A series of topotypes which we have examined shows some variation in the relative length of the test but the specimens are quite distinct from *C. ovoidea* Reuss from the Miocene.

Recent specimens collected off the west coast of North America seem to be identical with specimens from Septaria clay of Germany. They are all characterized by a rather widely open aperture of narrow arc extending ¼ to ⅓ of the circumference of the test.

There are numerous records of this species not accompanied by figures, and those from other than European localities may not be correctly identified. Specimens recorded as *C. cylindroides* from the upper Eocene (Jackson) of Louisiana (Howe and Wallace, Louisiana Geol. Bull. No. 2, 1932, p. 72, pl. 14, fig. 1), from the middle Eocene, Llajas formation, of California (Cushman and McMasters, Journ. Pal., vol. 10, 1936, p. 515, pl. 76, fig. 6), and from the upper Eocene (Jackson) Yazoo clay, of Mississippi (Bergquist, Bull. 49, Mississippi State Geol. Survey, 1942, p. 93, pl. 9, fig. 33) are not typical and should be studied further with more material.

CHILOSTOMELLA CYLINDROIDES Reuss, var. TENUIS Bornemann (Pl. 15, fig. 11)

Chilostomella tenuis BORNEMANN, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 343, pl. 17, fig. 2.—REUSS, Denkschr. Akad. Wiss. Wien, vol. 25, 1865, p. 156; Sitz. Akad. Wiss. Wien, vol. 62, pt. 1, 1870, p. 489, in VON SCHLICHT, Foram. Sept. Pietzpuhl, 1870, pl. 25, figs. 25-36.—HANTKEN, Mitth. Jahrb. K. Ungar. geol. Anstalt, vol. 4, 1875 (1881), p. 64.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 76, pl. 11, fig. 16.

Variety differing from the typical form in its more slender form with nearly parallel sides. Length 0.4-0.5 mm.

This form was described from the Oligocene of Hermsdorf, near Berlin, Germany, and is recorded from other localities in the Eocene of Germany. Hantken recorded it from the upper Eocene of Hungary but did not figure specimens. From a study of topotype and other material, this would seem to be a narrow variety of Reuss' species.

CHILOSTOMELLA HADLEYI Keijzer (Pl. 15, figs. 12-14)

Chilostomella sp. HADLEY, Bull. Amer. Pal., vol. 20, No. 70A, 1934, p. 24, pl. 2, figs. 20, 21.
Chilostomella hadleyi KEIJZER, Outline geol. eastern part Prov. Oriente, Cuba, Utrecht, 1945, p. 205, pl. 4, fig. 55.

"Test small, elongate, circular in transverse section, about twice as long as broad, with the greatest width at the middle of the last chamber. The earlier coils are visible from the back side. Aperture a short, elongate slit."—Keijzer.

Maximum length of specimens from type locality, 0.40 mm.; of Hadley's specimens, 0.61 mm.

The types are from the "Oligomiocene" of the eastern part of Oriente Province, Cuba. Hadley's specimens were from the upper Eocene, in cut on railroad between Nuevitas and Pastelillo, about 1½-2 km. N. of Nuevitas railway station on Nuevitas Bay, north coast of Cuba. Both Keijzer's and Hadley's figures are reproduced here.

CHILOSTOMELLA GLOBATA Galloway and Heminway (Pl. 15, fig. 15)

Chilostomella globata GALLOWAY and HEMINWAY, New York Acad. Sci., Sci. Survey Porto Rico and Virgin Ids., vol. 3, pt. 4, 1941, p. 409, pl. 28, fig. 2.

"Test small, subglobular, the last chamber considerably larger than the previous one and constituting about two-thirds of the external test; subcircular in cross section; the suture line is only slightly concave on the back of the test; wall very finely perforate; surface smooth; aperture a narrow crescentic slit, comprising about one-fourth of the circumference of the test, with large, strongly everted, slightly undulating and fimbriate lip. Length, 0.38 millimeter; diameter, 0.33 millimeter. Other specimens up to 0.8 millimeter in diameter."—Galloway and Heminway.

The types are from the upper Oligocene or lower Miocene, Ponce formation, outcrops between kilometer 254.7 and 254.9 and between kilometer 255.1 and 255.2 on Penuelas-Ponce road, Porto Rico. The species has not been recorded elsewhere.

CHILOSTOMELLA URCEOLUS Galloway and Heminway (Pl. 15, fig. 16)

Chilostomella urceolus GALLOWAY and HEMINWAY, New York Acad. Sci., Sci. Survey Porto Rico and Virgin Ids., vol. 3, pt. 4, 1941, p. 410, pl. 27, fig. 6.

"Test ovoid, circular in transverse section, broadly rounded at both apical and apertural ends, 3/5 as broad as long; greatest width more than twice that at the aperture; last chamber covering practically all of the preceding chamber, the line of contact between the two chambers being straight and at right angles to the axis of the test; wall smooth; aperture curved, at the base of the last chamber with a flaring lip. Length, 1 millimeter; diameter, 0.60 millimeter."—Galloway and Heminway.

The types are from the upper Oligocene or lower Miocene, Ponce formation, from kilometer 2.8-2.9 on Ponce-Arecibo road, Porto Rico.

"This new species resembles *C. ovoidea* Reuss in many respects, but differs in that *C. urceolus* is rounded both apically and aperturally, is more elongate, and the line of contact between the last 2 chambers is not deflected posteriorly as in *C. ovoidea*. It is smaller than *C. grandis* and the suture is without posterior deflection."—Galloway and Heminway.

CHILOSTOMELLA OVOIDEA Reuss (Pl. 15, figs. 17-19)

Chilostomella ovoidea REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 380, pl. 48, fig. 12; Sitz. Akad. Wiss. Wien, vol. 55, pt. 1, 1867, p. 96.—KARRER, l. c., vol. 58, pt. 1, 1868, p. 178.—FRANZENAU, Földt. Közlöny, vol. 11, 1881, p. 51.—SCHUBERT, Sitz. Deutsch. Nat. Med. Ver. Böhmen "Lotos," 1900, p. 96.—TOULA, Jahrb. k. k. geol. Reichs., vol. 64, 1914 (1915), p. 665.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1925, p. 74, pl. 11, fig. 1.—MACFADYEN, Geol. Survey Egypt, 1930 (1931), p. 64, pl. 2, fig. 9.—NUTTALL, Journ. Pal., vol. 6, 1932, p. 28.—TEN DAM and REINHOLD, Med. Geol. Stichting, ser. C-V, No. 2, 1942, p. 94.—LEROY, Colorado School Mines Quart., vol. 39, No. 3, pt. 1, 1944, p. 38, pl. 4, figs. 34, 35.—COLOM, Num. 3, Estudios Geologicos, Instit. Invest. Geol., 1946, p. 167, pl. 10, figs. 187-189.—CUSHMAN and RENZ, Special Publ. 22, Cushman Lab. Foram. Res., 1947, p. 39.—Mem. 32, Geol. Soc. Amer., 1948, p. 126, pl. 9, fig. 16.

Chilostomella cylindroides REUSS, var. *ovoidea* REUSS, Sitz. Akad. Wiss. Wien, vol. 62, pt. 1, 1870, p. 488, in VON SCHLICHT, Foram. Sept. Pietzpuhl, 1870, pl. 25, figs. 17-22.

Test slightly longer than broad, widest in the middle, thence tapering toward the ends, one of which is broadly rounded, the other more contracted, circular in end view; chambers distinct, the last-formed one making up about three-fourths of the surface of the test; sutures distinct, slightly depressed; wall smooth; aperture a low, narrow opening at the inner margin of the ventral side of the last-formed chamber with a distinct but narrow lip. Length 0.50-0.75 mm.; breadth 0.40-0.55 mm.

The types are from the Miocene of Grinzing, near Vienna, Austria. Our specimens from the Vienna Basin correspond very well to the type figures given by Reuss. Other forms from deposits of Upper Cretaceous to Recent age have been referred to this species, but an inspection of those figured makes it evident that most of them are not the same as the Miocene types from the Vienna Basin. There are also many records for the species without figured specimens, and it is impossible to verify these identifications without seeing the specimens. A single specimen from 159 fathoms, off Sombrero Id. in the Philippines (*Albatross* D 5113), seems to be identical with the Miocene specimens.

This species differs from *C. grandis* Cushman in having a definite raised lip around the rather widely open aperture.

CHILOSTOMELLA CZIZEKI Reuss (Pl. 15, figs. 20-22)

Chilostomella czizeki REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 380, pl. 48, fig. 13.—RZEHAK, Verh. Nat. Ver. Brünn, vol. 14, pt. 1, 1885, pp. 81, 90.—CLODIUS, Archiv. Ver. Freunde Nat. Mecklenburg, 75 Jahr., 1922, p. 104.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 74, pl. 11, fig. 2.—GALLOWAY and HEMINWAY, New York Acad. Sci., Sci. Survey Porto Rico and Virgin Ids., vol. 3, pt. 4, 1941, p. 409, pl. 28, fig. 3.—CORYELL and MOSSMAN, Journ. Pal., vol. 16, 1942, p. 237, pl. 36, figs. 24, 25.—PALMER, Bull. Amer. Pal., vol. 29, No. 115, 1945, p. 67.—CUSHMAN and TODD, Special Publ. 15, Cushman Lab. Foram. Res., 1945, p. 64, pl. 11, fig. 4. —CUSHMAN and RENZ, l. c., Special Publ. 22, 1947, p. 39.

Chilostomella oolina HEDBERG (not SCHWAGER), Journ. Pal., vol. 11, 1937, p. 680, pl. 92, fig. 3.—FRANKLIN, l. c., vol. 18, 1944, p. 317, pl. 48, fig. 2.

Test typically about twice as long as broad, greatest width in the middle, thence tapering gradually to the broadly rounded ends, circular in end view; chambers distinct, inflated, the last-formed one making up a very large part of the ventral surface; sutures distinct, very slightly depressed; wall smooth; aperture a low narrow opening at the ventral margin of the last-formed chamber with a narrow but very distinct lip, the inner edge marked by a distinct depression. Length 0.50-0.70 mm.; breadth 0.30-0.40 mm.

The types are from the Miocene of the Vienna Basin, recorded by Reuss from Baden and Möllersdorf. Similar specimens occur in the Miocene of Porto Rico and Jamaica, the Pliocene Charco Azul formation of

Panama, the Oligocene Carapita formation of Venezuela, and the upper Oligocene Ste. Croix formation of Trinidad.

The species shows a considerable range of variation, especially of relative breadth of the test, in the same sample. Some specimens are very close to *C. cylindroides* Reuss, and it is possible that *C. czizeki* and *C. cylindroides* are variants of a single species.

A few specimens from 48 fathoms, North Pacific off Alaska (*Albatross* D 2555), seem to be closer to this than to any other species.

CHILOSTOMELLA OOLINA Schwager (Pl. 15, figs. 23, 24)

Chilostomella oolina SCHWAGER, Boll. Com. geol. Ital., vol. 9, 1878, p. 527, pl. 1, fig. 16. CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 74, pl. 11, figs. 3-10; Bull. 4, Florida State Geol. Survey, 1930, p. 59.—CUSHMAN and PONTON, l. c., Bull. 9, 1932, p. 98.—HOFKER, Publ. Sta. Zool. Napoli, vol. 12, pt. 1, 1932, p. 133, text fig. 42.—CUSHMAN and CAHILL, U. S. Geol. Survey Prof. Paper 175-A, 1933, p. 33.—CUSHMAN, Special Publ. 4, Cushman Lab. Foram. Res., 1933, pl. 26, fig. 8; Bull. 119, Bernice P. Bishop Mus., 1934, p. 133, pl. 17, fig. 3.—LEROY, Nat. Tijdschr. Nederl.-Indie, vol. 99, 1939, p. 261, pl. 5, figs. 29, 30; Colorado School Mines Quart., vol. 39, No. 3, pt. 1, 1944, p. 38, pl. 4, figs. 36-39; pl. 5, figs. 20-23.

Chilostomella ovoidea H. B. BRADY (part) (not REUSS), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 436.—EGGER, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 305, pl. 9, figs. 1, 2.—GOËS, Kongl. Svensk. Vet.-Akad. Handl., vol. 25, No. 9, 1894, p. 53, pl. 9, figs. 512-516.—RHUMBLER, Nordisches Plankton, pt. 14, Foraminiferen, 1901, p. 11, text figs. 1-3.—CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 5, 1924, p. 2, pl. 1, figs. 8-10 (not figs. 1-7).—CUSHMAN and HENBEST, U. S. Geol. Survey Prof. Paper 196-A, 1940, pl. 10, fig. 11.—CUSHMAN, Amer. Journ. Sci., vol. 239, 1941, p. 138, pl. 5, fig. 15.—PARKER, Bull. Mus. Comp. Zoöl., vol. 100, 1948, p. 237 (list), pl. 3, fig. 15.

Test elongate, about 3 times as long as wide, both ends broadly rounded, circular in end view, sides nearly parallel for most of their length; chambers distinct, the last-formed one making up about three-fourths of the surface of the ventral side; sutures distinct, very slightly if at all depressed; wall smooth; aperture very low, elongate, at the base of the ventral margin of the last-formed chamber with a narrow but distinct lip. Length 0.70-1.00 mm.; breadth 0.25-0.37 mm.

The types are from the Tertiary of Stretto in Sicily. It is widely recorded from Miocene to Recent, and specimens from the Western Atlantic seem to be typical. It is a much more slender species than *C. ovoidea* Reuss.

The figured specimen referred to this species from the Oligocene, Anahuac formation, of Texas (Cushman and Ellisor, Journ. Pal., vol. 19, 1945, p. 570, pl. 78, fig. 4) is not typical, but some of the other specimens are more nearly like the typical form.

CHILOSTOMELLA MEDITERRANENSIS Cushman and Todd, n. sp. (Pl. 15, figs. 25, 26)

Test of medium size, about twice as long as broad, tapering with both ends rather sharply rounded, outline irregular due to the slightly projecting earliest chambers and the projecting apertural lip; chambers inflated, strongly embracing ventrally so that only a fifth to a seventh of the ventral surface is formed by the penultimate chamber, rapidly increasing in size as added; sutures faint, slightly depressed; wall thin, translucent, very finely punctate, with a few large evenly spaced punctae, aperture widely open but short in arc, about 3 times as long as wide, protected by an erect, slightly flaring lip, the aperture making a distinct break in the outline of the test. Length 0.40-0.55 mm.; diameter 0.20-0.30 mm.

Holotype (Cushman Coll. No. 59531) from 2471 meters, Straits of Sicily, 35° 59′ N., 00° 53′ W. (*Atlantis* 4732). The specimens were received through the courtesy of Miss Frances L. Parker, who recognized them as undescribed.

This species differs from *C. oolina* Schwager in its fusiform instead of cylindrical shape and in its short but wide aperture, which make a distinct break in the outline of the test. In its short aperture it resembles *C. cylindroides* Reuss more than any other species, but in Reuss' species the aperture does not have such a high and outwardly flaring lip.

This Recent species seems to form the closest link with the genus *Chilostomelloides,* which appears to have died out in late Tertiary.

CHILOSTOMELLA GRANDIS Cushman (Pl. 16, figs. 1, 2, 6)

Chilostomella grandis CUSHMAN, Proc. U. S. Nat. Mus., vol. 51, 1917, p. 662; Bull. 100, vol. 4, 1921, p. 283, pl. 57, fig. 5; Smithsonian Misc. Coll., vol. 77, No. 4, 1925, pl. 8, fig. 6; Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 75, pl. 11, fig. 12.

Test large, broadly elliptical in side view, circular in end view; chambers distinct, inflated, the last-formed one making up almost the entire surface of the ventral side of the test; sutures distinct, slightly if at all depressed; wall smooth, thick; aperture elongate, curved, semicircular in end view, with a flangelike truncated lip at the ventral margin of the last-formed chamber. Length as much as 4.00 mm. or more. (We have seen no specimens larger than 2 mm.; and the type specimen, according to its magnification, was only 2.05 mm. in length.)

The types are from 300 fathoms, east coast of Luzon, between San Bernardino Strait and San Miguel Bay, Philippines (*Albatross* D 5449), and it occurs at several other stations off the Philippines.

This is by far the largest species of the genus. None of our available specimens is as stout as the type. In young specimens of this as well as other species the penultimate chamber appears to project outward at an angle (see pl. 16, fig. 6).

CHILOSTOMELLA MILLETTI Cushman (Pl. 16, fig. 3)

Chilostomella ovoidea MILLETT (part) (not REUSS), Journ. Roy. Micr. Soc., 1901, p. 2, pl. 1, fig. 2 (not fig. 3).

Chilostomella milletti CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 76, pl. 11, fig. 13.

Test ovate in outline, broadest below the middle, two thirds as broad as long, only the very base of the penultimate chamber visible, the last-formed chamber almost completely covering it on the ventral side; sutures slightly depressed; wall thick and opaque with a granular surface; aperture a low, curved opening nearly at the tip of the test. Length 0.50 mm.; breadth 0.32 mm.

The types are from Recent material from the Malay region. Heron-Allen and Earland (British Antarctic Exped., Zoology, vol. 6, 1922, p. 142) identified some of their Antarctic material with Millett's figure.

This is the only species of *Chilostomella* that has a definite ornamentation. We have not seen any material.

CHILOSTOMELLA CUSHMANI Chapman (Pl. 16, figs. 4, 5, 11, 12)

Chilostomella cushmani CHAPMAN, Trans. Roy. Soc. So. Australia, vol. 65, 1941, p. 177, pl. 8, fig. 9; pl. 9, fig. 6.

Chilostomella ovoidea CUSHMAN (not REUSS), Proc. U. S. Nat. Mus., vol. 56, 1919, p. 621.

Chilostomella oolina HERON-ALLEN and EARLAND (not SCHWAGER), *Discovery* Reports, vol. 4, 1932, p. 360, pl. 9, figs. 38, 39.

"*Description*—Test large, ovoid, about twice as long as broad; sides evenly and fully curved; aperture sub-terminal, with an elevated rim (stand-up-collar shape) and a widely open mouth. No internal segmentation visible from outside. Surface of test smooth to polished, with numerous scattered puncta. Length, 1.08 mm.; breadth 0.65 mm. This is probably Form A, [our plate 16, fig. 12].

"Test small, more narrowly ovoid and thinner than in Form A, more pointed at oral end, with sides slightly more convex in proportion to Form A. Aperture slit-like, closely adpressed to surface of test and without a rim-like margin as in Form A. Surface smooth, less punctate and with internal chambers alternating on a transverse axis, the edges of which are seen through the transparent test. Length, 0.57 mm.; breadth, 0.27 mm. This is probably Form B, [our plate 16, fig. 11]."—Chapman.

The types are from dredgings along the continental shelf of the south-eastern coast of Australia. The other specimens referred to the species are from off New Zealand (Cushman) and from off the Falkland Islands (Heron-Allen and Earland).

Genus CHILOSTOMELLOIDES Cushman, 1926

Genotype, *Lagena (Obliquina) oviformis* Sherborn and Chapman

Chilostomelloides CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 77; vol. 3, 1927, p. 85; Journ. Pal., vol. 1, 1927, p. 167; Foraminifera, 4th Ed., 1948, p. 319.

Lagena (Obliquina) SHERBORN and CHAPMAN, 1886 (not SEGUENZA).

Chilostomella (part) of authors.

Test similar in general structure to *Chilostomella*, but the aperture rounded and somewhat offset from the general contour of the test, with a slight neck in some species and a slightly developed lip.—Upper Cretaceous to Pliocene (?).

Four named species have been recognized.

CHILOSTOMELLOIDES EOCENICA Cushman (Pl. 16, fig. 10)

Chilostomelloides eocenica CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 78, pl. 11, fig. 20.—PLUMMER, Univ. Texas Bull. 2644, 1927, p. 129, pl. 8, fig. 8.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 16, 1940, p. 72, pl. 12, fig. 11. —KLINE, Bull. 53, Mississippi State Geol. Survey, 1943, p. 57, pl. 6, fig. 8.

Test elongate, about 2½ times as long as broad, ends rounded, sides gently convex, tapering toward either end; chambers distinct, inflated, the last-formed one making up about three-fourths of the ventral side; sutures distinct, slightly depressed; wall smooth; aperture semicircular to nearly circular, standing out at an angle from the contour of the test, with a distinct, slightly thickened lip. Length 0.50-1.20 mm.; breadth 0.25-0.60 mm.

The types are from the Paleocene of the Mexia Oil Field, Mexia, Texas. The species is recorded also from the Paleocene of Alabama and Mississippi.

It differs from *C. oviformis* (Sherborn and Chapman) in having a more tapering form and an aperture not wholly free from the preceding chamber, the latter character indicating an intermediate stage in the development of the genus from *Chilostomella.*

CHILOSTOMELLOIDES OVIFORMIS (Sherborn and Chapman) (Pl. 16, figs. 7-9)

Lagena (Obliquina) oviformis SHERBORN and CHAPMAN, Journ. Roy. Micr. Soc., 1886, p. 745, pl. 14, fig. 19.

Chilostomella oviformis SHERBORN and CHAPMAN, l. c., 1889, p. 485, pl. 11, fig. 13.—SELLI, Ann. Mus. Geol. Bologna, ser. 2, vol. 17, 1943-44 (1944), p. 71.

Chilostomelloides oviformis CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 77, pl. 11, figs. 17, 21; Journ. Pal., vol. 1, 1927, p. 168, pl. 26, fig. 10.—COLE, Bull. Amer. Pal., vol. 14, No. 53, 1928, p. 216 (16).—NUTTALL, Journ. Pal., vol. 4, 1930, p. 289; vol. 6, 1932, p. 28.—HOWE and WALLACE, Louisiana Geol. Bull. No. 2, 1932, p. 73, pl. 15, fig. 5.—CUSHMAN, Special Publ. 4, Cushman Lab. Foram. Res., 1933, pl. 26, fig. 9; Special Publ. 5, 1933, pl. 33, figs. 12, 13.—BERGQUIST, Bull. 49, Mississippi State Geol. Survey, 1942, p. 94, pl. 9, fig. 31.—COLOM, Num. 2 Estudios Geologicos, Instit. Invest. Geol., 1945, p. 74, pl. 5, figs. 135-139.

Chilostomella ovoidea SHERBORN and CHAPMAN (not REUSS), Journ. Roy. Micr. Soc., 1889, p. 3, pl. 11, fig. 12.

Chilostomella eximia FRANZENAU, Termesz. Füzetek, vol. 11, 1889, pp. 147, 206, woodcut; Math. termesz. ertesito, vol. 7, 1889, p. 248, pl. 4, fig. 3; Math. Nat. Ber. Ungarn, vol. 7, 1889, p. 67, pl. 3, fig. 3.

Chilostomelloides eximia CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 77, pl. 11, fig. 18.

Test oval in ventral view, greatest breadth slightly nearer apical than apertural end, sides curved, ends rounded, in side view with the aperture projecting; chambers distinct, inflated, the last-formed one making up almost the entire ventral surface of the test; sutures distinct, slightly depressed; wall smooth; aperture circular, with a slight neck, at the ventral end of the last-formed chamber. Length as much as 1.00 mm.

The types of this species are from the Eocene, London clay, of England, and it is widely recorded from the Eocene and Oligocene of Europe and America. We have typical specimens from the Alazan clay of Mexico.

The species described by Franzenau from the upper Eocene or lower Oligocene of Hungary is apparently to be included in *C. oviformis.*

CHILOSTOMELLOIDES n. sp. of Rutgers (Pl. 16, figs. 13, 14)

Chilostomelloides n. sp. RUTGERS, Geol. Pal. Südöst. Teiles Biokovo und Seines Hinterlandes (Dalmatien), Utrecht, 1942, p. 31, pl. 1, figs. 28, 29.

Test oviform; chambers so completely involute that only two chambers are visible; wall thick and opaque; aperture round and the border more contracted than in other known species of the genus. Length 1.80 mm.; breadth 1.60 mm.; thickness 0.50 mm.—Translation.

This species from the Eocene, Flysch, of Dalmatia has not been named, although it seems to be a distinct species.

CHILOSTOMELLOIDES? sp. Frizzell

Chilostomelloides? sp. FRIZZELL, Journ. Pal., vol. 17, 1943, p. 352, pl. 57, fig. 13.

A very poorly preserved form was figured from the Upper Cretaceous, Mal Paso shale, of northwestern Peru. From an examination of the figured specimen it is very doubtful whether it belongs to this genus.

CHILOSTOMELLOIDES OVICULA Nuttall (Pl. 16, figs. 15, 16)

Chilostomelloides ovicula NUTTALL, Quart. Journ. Geol. Soc., vol. 84, 1928, p. 78, pl. 3, figs. 20, 21; text fig. 2.—CUSHMAN and STAINFORTH, Special Publ. 14, Cushman Lab. Foram. Res., 1945, p. 66, pl. 12, fig. 7.—CUSHMAN and RENZ, l. c., Special Publ. 22, 1947, p. 39; Special Publ. 24, 1948, p. 38, pl. 7, figs. 13, 14.

"Test short or long ovoid, circular in transverse section; at each end rounded and tapering. Surface smooth and glossy. Aperture broad, crescentic, semicircular, or nearly a complete circle with a distinct lip. The aperture is situated close to one end of the test, or as much as a quarter of the length of the test down one side; it does not stand out beyond the point of maximum thickness of the test, and is curved downwards on its exterior flank. Maximum length 1.2 mm."—Nuttall.

The types are from the Tertiary of Trinidad. The species has been recorded also from the Oligocene, Cipero and Ste. Croix formations, and the Eocene, Hospital Hill formation, of Trinidad.

CHILOSTOMELLOIDES CYCLOSTOMA (Rzehak) (Pl. 16, fig. 17)

Chilostomella cyclostoma RZEHAK, Ann. k. k. Nat. Hofmuseums, vol. 3, 1888, p. 258, pl. 11, fig. 1.

Chilostomelloides cyclostoma CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 78, pl. 11, fig. 19.

Test broadly oval in front view, the ends broadly rounded; chambers inflated, the last-formed one making up a large part of the ventral side; sutures distinct, slightly if at all depressed; wall smooth; aperture semicircular, somewhat protruding in side view, at the base of the ventral margin of the last-formed chamber, with a slight lip. Length 1.20 mm.

The types are from a well sample in the Tertiary of Nieder-Hollabrunn, Austria, and the species is recorded also from the lower Bartonian of Bruderndorf. We have had no specimens of this species.

The late Miocene or early Pliocene of the Sangkoelirang Bay area of East Borneo contains a rare form recorded as "*Chilostomella oolina* Schwager" (LeRoy, Colorado School Mines Quart., vol. 36, No. 1, pt. 1, 1941, p. 43, pl. 1, figs. 14-16) that seems to be more properly included under *Chilostomelloides*. If placed here, this species represents the latest known occurrence of the genus. Further specimens of *Chilostomelloides* should be looked for in late Tertiary sediments.

Genus SEABROOKIA H. B. Brady, 1890

Genotype, *Seabrookia pellucida* H. B. Brady

Seabrookia H .B. BRADY, Journ. Roy. Micr. Soc., 1890, p. 570.—J. WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 476.—CHAPMAN, The Foraminifera, 1902, p. 182. CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 5, 1924, p. 4; Smithsonian Misc. Coll., vol. 77, No. 4, 1925, p. 41; Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 86; Foraminifera, 4th Ed., 1948, p. 319.

Milletia J. WRIGHT, 1889.

Test essentially trochoid, three earliest chambers making up the first whorl, later chambers two to a whorl and completely involute; wall calcareous, thin, perforate; aperture elliptical, at the periphery of the more acute end of the chamber.—Upper Cretaceous to Recent.

This is a very rare genus but apparently it has a long geologic range and a wide geographic distribution. The five known species are very small, none is over 0.30 mm. in length.

SEABROOKIA CRETACICA Bermudez (Pl. 16, figs. 18-20)

Seabrookia cretacica BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 12, 1938, p. 164, text figs. 1-3.

Test very small, oval, compressed, with a keel completely surrounding the test, biconvex, slightly more convex on the ventral side, the dorsal side much less convex; last chamber very large, forming nearly the whole of the test; sutures indistinct, in a slight depression at one side; aperture terminal, elliptical, with a distinct, thickened and somewhat everted lip. Length 0.30 mm.; thickness 0.08 mm.

The types are from the Upper Cretaceous of Santa Clara Province, Cuba.

As it is difficult to determine the characters of the early stages from the type specimen, the generic position of this species is somewhat uncertain.

SEABROOKIA LAGENOIDES ten Dam (Pl. 16, fig. 21)

Seabrookia lagenoides TEN DAM, Med. Geol. Stichting, ser. C-V, No. 3, 1944, p. 127, pl. 3, fig. 18.

Test somewhat compressed, nearly equally biconvex, periphery acute at the base, slightly keeled, apertural end contracted, early chambers trochoid, last whorl with two chambers; aperture narrow, terminal, with a slight lip. Diameter 0.20 mm.

The types are from the Bartonian Eocene of the Netherlands.

SEABROOKIA CUBANA Palmer and Bermudez (Pl. 16, figs. 22, 23)

Seabrookia cubana PALMER and BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 10, 1936, p. 308, pl. 13, figs. 15, 16.

"Test very small and glassy; ovate in outline, the apertural end narrowly rounded; periphery sharp, completely surrounded by a narrow keel; biconvex but more inflated dorsally. Dorsal side gently depressed along the suture of early chamber. Aperture elliptical, slightly oblique and surrounded by a narrow lip. Length to 0.3 mm.; thickness 0.08 mm. Very rare."—Palmer and Bermudez.

The types are from the Oligocene of Cuba.

SEABROOKIA PELLUCIDA H. B. Brady (Pl. 16, figs. 24, 25)

Seabrookia pellucida H. B. BRADY, Trans. Roy. Micr. Soc., 1890, p. 570, text fig. 60.—WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 476, pl. 20, fig. 5.—MILLETT, Journ. Roy. Micr. Soc., 1901, p. 3, pl. 1, fig. 4.—CHAPMAN, Journ. Linn. Soc., Zool., vol. 30, 1910, p. 406.—HERON-ALLEN and EARLAND, British Antarctic Exped., Zoology, vol. 6, 1922, p. 141.—CUSHMAN, Special Publ. 4, Cushman Lab. Foram. Res., 1933, pl. 26, fig. 10; Special Publ. 5, 1933, pl. 33, figs. 14, 15.

"Test oval, depressed, the two sides unequally convex, sometimes almost plano-convex; aboral end broad and rounded, oral end somewhat drawn out; peripheral edge acute or subcarinate, in large specimens serrate. Composed of a number of segments, the later chambers of the adult shell each inclosing, partially or entirely, those preceding it, a portion of the penultimate segment visible externally on the gibbous face of the test. Walls thin and transparent, smooth, or nearly so, externally, minutely perforated. Aperture simple, terminal, taking the form of a linear or elongate-oval slit with thickened lip. Length 1/100 in. (0.25 mm.) or less."—H. B. Brady.

The types are from dredgings in 45 fathoms from the Java Sea. It is recorded also from off Cebu at 120 fathoms, from the Malay Archipelago at 1215 fathoms, off Funafuti, and off New Zealand.

SEABROOKIA EARLANDI (J. Wright) (Pl. 16, figs. 26, 27)

Milletia earlandi J. WRIGHT, Ann. Mag. Nat. Hist., ser. 6, vol. 4, 1889, p. 448.—H. B. BRADY, Trans. Roy. Micr. Soc., 1890, p. 571.

Seabrookia earlandi J. WRIGHT, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 477, pl. 20, figs. 6, 7.—HERON-ALLEN and EARLAND, l. c., vol. 31, pt. 64, 1913, p. 72, pl. 5, figs. 10-12.—SIDEBOTTOM, Journ. Roy. Micr. Soc., 1918, p. 129.—HERON-ALLEN and EARLAND, British Antarctic Exped., Zoology, vol. 6, 1922, p. 141.—CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 5, 1924, p. 5, pl. 1, figs. 14-16.—HERON-ALLEN and EARLAND, *Discovery* Reports, vol. 4, 1932, p. 360, pl. 10, figs. 1-3.—EARLAND, l. c., vol. 7, 1933, p. 107; vol. 10, 1934, p. 140.

"Test thin and hyaline; segments nearly embracing, protruding a little near the oral end, ovate, somewhat irregular in shape, slightly carinate, unequally convex on the upper and under sides; aperture a fissure extending the entire width of the narrow end of the segment; chambers usually five in number."—J. Wright.

The types are from 345 fathoms off southwestern Ireland. It is recorded from various localities in the North Atlantic, off Ireland and Norway, off the east coast of Australia at 465 fathoms, and in the Antarctic off the Falklands and South Georgia.

Genus ALLOMORPHINELLA Cushman, 1927

Genotype, *Allomorphina contraria* Reuss

Allomorphinella CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, 1927, p. 86; Foraminifera, 4th Ed., 1948, p. 320.

Allomorphina (part) of authors.

Test with the adult chambers in a planispiral coil; the chambers involute, rapidly increasing in size as added, and embracing; wall calcareous, perforate; aperture elongate, narrow, at the periphery of the chamber at the median line.—Upper Cretaceous.

Apparently the only difference between this genus and *Pullenia* is the much greater increase in size of chambers as added. The genus is represented by a single species.

ALLOMORPHINA CONTRARIA (Reuss) (Pl. 16, fig. 28)

Allomorphina contraria REUSS, Haidinger's Nat. Abhandl., vol. 4, pt. 1, 1851, p. 43, pl. 4, fig. 7.—OLSZEWSKI, Sprawozd. Kom. Fizyj. Akad. umiej. Krakowie, vol. 9, 1875, p. 122.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 12, 1936, p. 72.

Allomorphinella contraria CUSHMAN, Special Publ. 1, Cushman Lab. Foram. Res., 1928, pl. 45, fig. 14; pl. 46, fig. 11; Special Publ. 4, 1933, pl. 26, fig. 11; Special Publ. 5, 1933, pl. 33, fig. 16; l. c., Contr., vol. 12, 1936, p. 73.

Test in the early stages triserial and trochoid, in the adult planispiral;

periphery rounded, more broadly so in the later portion; chambers distinct, three in the final whorl, increasing very rapidly in size as added, the last-formed one making up at least half the surface of the test; sutures distinct, slightly depressed; wall smooth; aperture a low, elongate opening at the peripheral base of the last-formed chamber, with a very slight lip. Length 0.26-0.50 mm.; breadth 0.20-0.40 mm.

The types of this species are from the Upper Cretaceous of Lemberg, Bavaria, Germany. It is recorded also from the Upper Cretaceous of Hungary by Olszewski, and we have specimens from the Upper Cretaceous of Höllgraben, near Adholzen in the vicinity of Siegsdorf, Upper Bavaria, Germany. Its geographic range seems to be restricted to Central Europe.

Genus CHILOSTOMELLINA Cushman, 1926

Genotype, *Chilostomellina fimbriata* Cushman

Chilostomellina Cushman, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 78; vol. 3, 1927, p. 86; Foraminifera, 4th Ed., 1948, p. 320.

Test composed of a few inflated chambers, the last-formed one almost completely enveloping the preceding ones, and the chambers rapidly increasing in size as added; wall calcareous, thin, finely perforate; aperture small, crescentiform, the sides of the chamber having a series of reëntrants at each side.

This genus seems to be highly specialized and its distribution very restricted.

CHILOSTOMELLINA FIMBRIATA Cushman (Pl. 16, fig. 29)

Chilostomellina fimbriata Cushman, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 4, 1926, p. 78, pl. 11, fig. 22; Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, No. 10, 1927, p. 170, pl. 6, fig. 9; Special Publ. 4, Cushman Lab. Foram. Res., 1933, pl. 26, fig. 12; Special Publ. 5, 1933, pl. 33, fig. 17.

Test composed of a few inflated chambers, the last ones planispiral, the last-formed one almost completely enveloping the preceding ones; wall thin, finely perforate; aperture small, crescentiform, the sides of the chamber next to the aperture markedly fimbriate. Length of holotype 0.45 mm.; breadth 0.35 mm.

The types are from the Bering Sea, in 276 fathoms (*Albatross* D 3608), and the species occurs also at a number of stations along the west coast of America, but in cold water.

Specimens from the Pliocene of Totomi, Japan, have been referred to this species (Makiyama, Mem. College Sci., Kyoto Imper. Univ., ser. B, vol. 7, No. 1 (Art. 1), 1931, p. 42 (list)).

332. HOMONYMS IN FORAMINIFERA ERECTED DURING 1948 and 1949

By Hans E. Thalmann

The following homonyms in Foraminifera have been recorded from the literature on Foraminifera published during 1948 and 1949 (up to October 1st). Living authors are urgently requested, in accordance with the "Code of Ethics" as stipulated during the International Zoological Congress in Monaco, 1913, to select and publish without delay new names for their homonyms.

During 1948 the following four homonyms are cited, of which two have since been renamed:

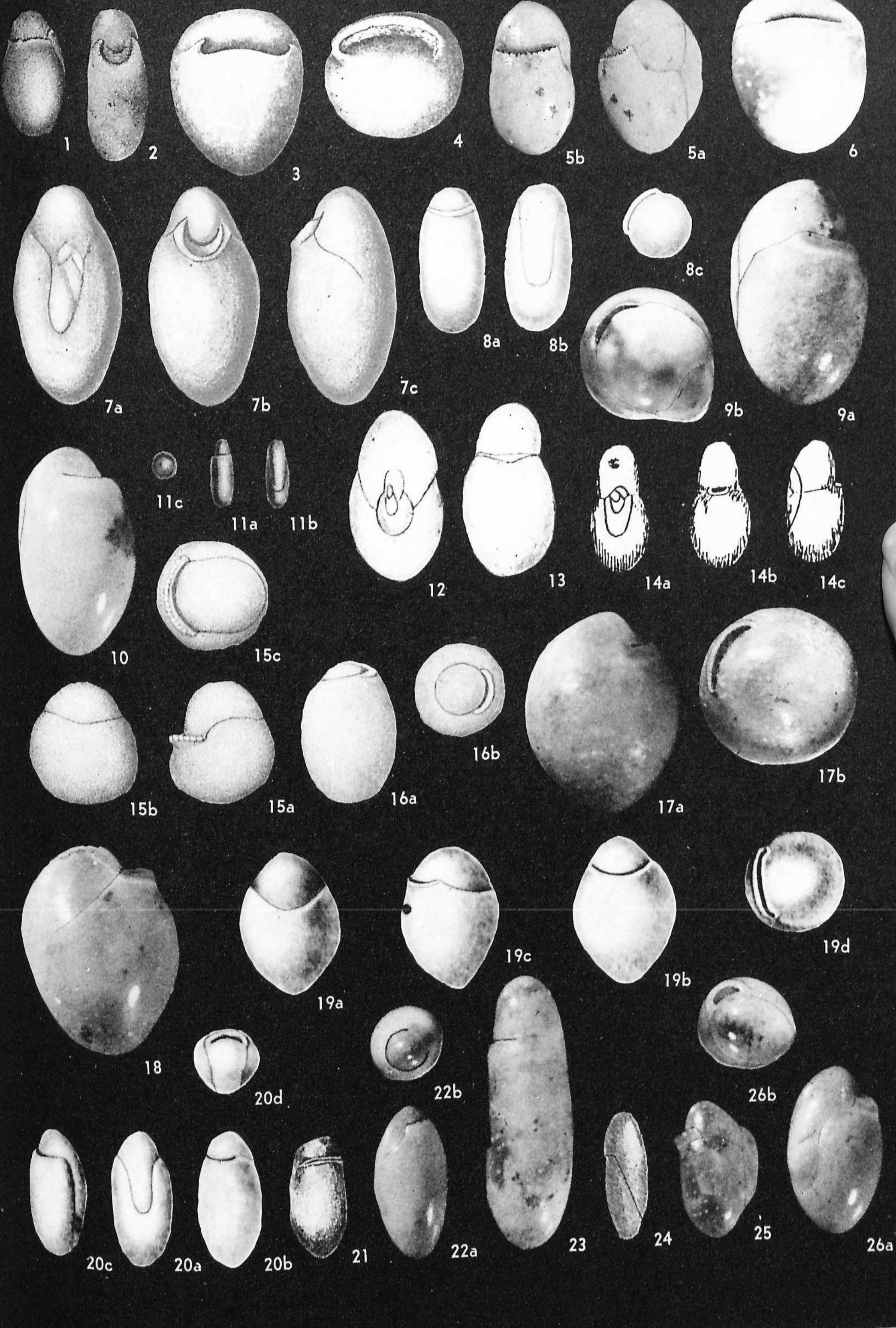
Bolivina astoriensis Rau, 1948 (not Cushman, R. E. and K. C. Stewart, 1948) has been renamed *Bolivina chehalisensis* Rau, 1949, nom. nov., Jour. Paleont., vol. 23, No. 4, July 1949, p. 441.

Eponides abatissae (Selli, 1944) var. *multicameratus* Petters and Gandolfi, 1948, Riv. Ital. Paleont. e Strat., Anno 54, fasc. 3, p. 7, pl. I, fig. 3, from the Oligocene of Italy, is preoccupied by *Eponides multicameratus* Kleinpell, 1938, Mioc. Strat. California, Am. Assoc. Petr. Geol., Tulsa, p. 320, pl. 19, figs. 2, 3, and 7, from the Upper Miocene of California. Dr. Victor Petters (Bogota), has been informed by the writer's letter, dated March 22nd, 1949.

Nummulites (Nummulites) antillea (Hanzawa) in de Cizancourt, 1948, Bull. Soc. geol. France, (5), vol. XVIII, fasc. 8-9, (published September 1949), p. 667, becomes a secondary homonym of *Nummulites antillea* Cushman, 1919, Carnegie Inst. Washington, Publ. 291, p. 51, pl. 4, figs. 1, 2; Upper Eocene, St. Bartholomew, Leeward Islands.

EXPLANATION OF PLATE 15

Fig. 1. *Chilostomella primitiva* Cushman and Todd, n. sp. Holotype. × 45. (After Cushman and Hedberg). **2.** *C. trinitatensis* Cushman and Todd, n. sp. Holotype. × 18. (After Cushman and Renz). **3, 4.** *C. mexicana* Nuttall. × 23. 3, Front view. 4, End view. (After Nuttall). **5.** *C. mexicana* Nuttall, var. *serrata* Cushman and Stone. Holotype. × 28. *a,* front view; *b,* side view. **6.** *C. mexicana* Nuttall, var. *chirana* Cushman and Todd, n. var. Holotype. × 30. **7.** *C. chilostomelloides* Vasicek. × 38. *a,* rear view; *b,* front view; *c,* side view. (After Vasicek). **8-10.** *C. cylindroides* Reuss. 8, (After Reuss). *a,* front view; *b,* rear view; *c,* end view. 9, 10, × 50. 9, Oligocene, Septaria clay, Germany. *a,* side view; *b,* end view. 10, Recent, Pacific. **11.** *C. cylindroides* Reuss, var. *tenuis* Bornemann. Approximately × 25. *a,* front view; *b,* rear view; *c,* end view. (After Bornemann). **12-14.** *C. hadleyi* Keijzer. 12, 13, × 44. (After Hadley). 14, × 48. (After Keijzer). 12, 14*a*, Rear views. 13, 14*b*, Front views. 14*c*, Side view. **15.** *C. globata* Galloway and Heminway. × 53. *a,* side view; *b,* rear view; *c,* end view. (After Galloway and Heminway). **16..** *C. urceolus* Galloway and Heminway. × 22. *a,* side view; *b,* end view. (After Galloway and Heminway). **17-19.** *C. ovoidea* Reuss. 17, Miocene, Möllersdorf, Austria. × 50. *a,* side view; *b,* end view. 18, Recent, Philippines. × 50. 19, Approximately × 40. *a,* rear view; *b,* side view; *c,* front view; *d,* end view. (After Reuss). **20-22.** *C. czizeki* Reuss. 20, Approximately × 35. *a,* rear view; *b, c,* side views; *d,* end view. (After Reuss). 21, Oligocene, Carapita formation, Venezuela. × 35. (After Franklin). 22, Recent, North Pacific. × 50. *a,* side view; *b,* end view. **23, 24.** *C. oolina* Schwager. 23, Recent, Atlantic. × 50. 24, × 40. (After Schwager). **25, 26.** *C. mediterranensis* Cushman and Todd, n. sp. × 50. 25, Paratype. 26, Holotype. *a,* side view; *b,* end view.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Planulina limbata Brotzen, 1948 (not Natland, 1938), has been renamed *Planulina scanica* nom. nov. Brotzen, 1948, The Micropaleont., vol. 2, No. 4, p. 13, 1948.

During the year 1949, as far as the foraminiferal literature was available to the writer, the following homonyms were noted:

Bolivina robusta Brady var. *pacifica* Boomgaart, 1949, Thesis Univ. Utrecht, p. 112, pl. 12, fig. 3, from the Pliocene of Java, is preoccupied by *Bolivina acerosa* Cushman, 1936, var. *pacifica* Cushman and McCulloch, 1942, Allan Hancock Pacif. Exped., vol. 6, No. 4, p. 185, pl. 21, figs. 2, 3, Recent, off Mexico, Gulf of California.

Cassidulina parva Hussey, Jour. Paleont., vol. 23, No. 2, p. 140, pl. 28, figs. 4, 5, from the Middle Eocene of Louisiana, is preoccupied by *Cassidulina subglobosa* Brady, 1881, var. *parva* Asano and Nakamura, 1937, Japan. Jour. Geol. and Geogr., vol. 14, p. 148, pl. 13, fig. 5, from Pliocene of Japan. (According to a letter, dated May 11, 1949, Hussey intends to change this homonym to: *Cassidulina inconspicua* nom. nov.)

Cibicides umbilicatus Hussey, ibid., vol. 23, No. 2, p. 142, pl. 29, figs. 18, 19, Middle Eocene, Louisiana, is preoccupied by Brotzen, 1948, Sverig. Geol. Unders., Series C, No. 493, Arsbok 42, No. 2, p. 84, pl. 13, fig. 6, Paleocene, Sweden. (Hussey intends to change this homonym to: *Cibicides RHsmithi* nom. nov., in honor of Robert Hendee Smith, a new name which, however, will not conform with the International Rules of Zoological Nomenclature).

Eponides simplex Hussey, ibid., vol. 23, No. 2, p. 137, pl. 28, figs. 17, 18, Middle Eocene, Louisiana, is a secondary or subjective homonym of *Eponides simplex* (White, 1928, *Gyroidina*), *fide* Cushman, 1946, U. S. Geol. Surv., Prof. Pap. 206, p. 142, pl. 57, fig. 15, Upper Cretaceous of Mexico. (Proposed new name by Hussey: *Eponides inornata* nom. nov.)

Lagena elliptica Bandy, 1949, (non Reuss, 1863, non Cushman, 1923) has been re-

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EXPLANATION OF PLATE 16

FIGS. **1, 2, 6.** *Chilostomella grandis* Cushman. 1, Holotype. × 15. *a*, front view; *b*, side view; *c*, end view. (After Cushman). 2, 6, Recent, Philippines. × 28. 2, Adult. *a*, side view; *b*, end view. 6, Young. **3.** *C. milletti* Cushman. × 45. *a*, view with wall broken away to show position of penultimate chamber. (After Millett). **4, 5, 11, 12.** *C. cushmani* Chapman. 4, Recent, Philippines. × 28. 5, Recent, New Zealand. × 28. *a*, side view; *b*, end view. 11, 12, (After Chapman). 11, Rear view. × 44. 12, Front view. × 22. **7-9.** *Chilostomelloides oviformis* (Sherborn and Chapman). 7, Oligocene, Alazan clay, Mexico. × 50. *a*, side view; *b*, end view. 8, × 20. (After Sherborn and Chapman). *a, b*, side views; *c, d*, enlarged views of aperture. 9, "*Chilostomella eximia* Franzenau." × 35. *a*, front view; *b*, side view; *c*, end view. (After Franzenau). **10.** *C. eocenica* Cushman. × 35. *a*, front view; *b*, side view; *c*, end view. (After Cushman). **13, 14.** *C.* n. sp. of Rutgers. × 12. 13, Side view. 14, Peripheral view. (After Rutgers). **15, 16.** *C. ovicula* Nuttall. × 26. (After Nuttall). **17.** *C. cyclostoma* (Rzehak). × 17. *a*, rear view; *b*, front view; *c*, side view. (After Rzehak). **18-20.** *Seabrookia cretacica* Bermudez. × 44. 18, 20, Side views. 19, End view. (After Bermudez). **21.** *S. lagenoides* ten Dam. × 112. *a*, side view; *b*, end view. (After ten Dam). **22, 23.** *S. cubana* Palmer and Bermudez. × 60. 22, Side view. 23, End view. (After Palmer and Bermudez). **24, 25.** *S. pellucida* H. B. Brady. × 130. 24, Specimen in Canada balsam and viewed by transmitted light, showing previous chambers. 25*a*, side view; *b*, end view. (After H. B. Brady). **26, 27.** *S. earlandi* (J. Wright). × 93. 26*a*, Side view; *b*, end view. 27, By transmitted light. (After J. Wright). **28.** *Allomorphinella contraria* (Reuss). Approximately × 40. *a*, side view; *b*, end view. (After Reuss). **29.** *Chilostomellina fimbriata* Cushman. × 40. *a*, dorsal view; *b*, end view; *c*, ventral view. (After Cushman).

named: *Lagena parvulipora* nom. nov. Bandy, 1949, Jour. Paleont., vol. 23, No. 4, 1949, p. 440.

Nodosaria bradyi Boomgaart, (nom. nov.), Thesis, Univ. Utrecht, p. 79, pl. 6, fig. 11, Pliocene of Java, is a secondary or subjective homonym of *Nodosaria (Dentalina) bradyi* (Spandel, 1901), Festschr. Saecular-Feier Naturf. Ges. Nürnberg, p. 179, text fig. 9, Permo-Carboniferous, Kansas.

Nodosaria pyriformis Hussey, loc. cit., vol. 23, No. 2, p. 127, pl. 26, fig. 25, Middle Eocene, Louisiana, is a secondary homonym of *Dentalina (Nodosaria) pyriformis* Terquem, 1858, Mem. Acad. Imp. Metz, annee 39, p. 608, pl. 2, fig. 22, Middle Liassic, France. (If homonymy is established, Hussey intends to rename the form: *Nodosaria tryloniformis* nom. nov.)

Palmula decorata Hussey, loc. cit., vol. 23, No. 2, p. 128, pl. 26, fig. 26, Middle Eocene, Louisiana, is preoccupied by: Leoblich and Tappan, 1941, Bull. Amer. Paleont., vol. 26, No. 99, p. 8, pl. 1, fig. 5, Lower Cretaceous, Texas. (Hussey intends to rename it: *Palmula elegantissima* nom. nov.)

Robulus limbatus Hussey, loc. cit., vol. 23, No. 2, p. 124, pl. 25, fig. 13, Middle Eocene, Louisiana, is preoccupied by *Robulina limbata* Bornemann, 1855, Zeitschr. Deutsch. geol. Ges., vol. 7, p. 335, pl. 15, figs. 4-6, Oligocene of Germany, and may also be a secondary homonym of: *Cristellaria limbata* Reuss, 1845, and of: *Cristellaria limbata* Flint, 1899. (Hussey proposes to change the name to: *Robulus pachysuturalis* nom. nov., an etymologically unfortunate specific name).

Robulus translucidus Hussey, loc. cit., vol. 23, No. 2, p. 125, pl. 25, fig. 6, Middle Eocene of Louisiana, is a possible secondary homonym of: *Cristellaria translucida* d'Orbigny, 1826, teste Fornasini, 1902, Mem. Sci. Nat. R. Accad. Sci. Ist. Bologna, series 5, vol. 10, p. 41, text fig. 40, in which case Hussey intends to rename the homonym: *Robulus claratus* nom. nov.

Robulus umbonatus Hussey, loc. cit., vol. 23, No. 2, p. 124, pl. 25, fig. 12, Middle Eocene, Louisiana, is a primary or objective homonym of: *Robulina umbonata* Reuss, 1851, Zeitschr. Deutsch. geol. Ges., vol. 3, p. 68, pl. 4, fig. 24, Oligocene of Germany; and a possible secondary or subjective homonym of: *Cristellaria josephina* d'Orbigny, 1846, var. *umbonata* Schubert, 1904; and of: *Cristellaria rotulata* (Lamarck) var. *umbonata* Cushman, 1917. (Hussey intends to rename the species in question: *Robulus vitrealis* nom. nov.)

Robulus virginianus Cushman and Cederstrom, 1949, Virginia Geol. Surv. Bull. 67, 1945, p. 10, pl. 1, fig. 3 (published April 15, 1949) is preoccupied by: *Robulus midwayensis* (Plummer) var. *virginianus* Shifflett, 1948, Maryland Board Nat. Res., Dept. Geol. etc., Bull. 3, p. 48, pl. 1, figs. 15, 16.

Triloculina subrotunda Bandy, 1949 (non *Vermiculum (Triloculina) subrotundum* Montagu, 1803) has been renamed by its author: *Triloculina pinguis* Bandy, 1949, nom. nov., Jour. Paleont., vol. 23, No. 4, p. 440.

On account of reallocation of the genus *Rotamorphina* Finlay, 1939, to the genus *Valvulineria* Cushman, 1926, by Cushman and Todd, 1949, Contr. Cushman Lab. Foram. Research, vol. 25, p. 71-72, *Rotamorphina cushmani* Finlay, 1939, Trans. Roy. Soc. New Zealand, vol. 69, pt. 3, p. 325, pl. 28, figs. 130-133, Campanian, New Zealand, becomes a secondary homonym of: *Valvulineria cushmani* Coryell and Embich, 1937, Jour. Paleont., vol. 11, p. 300, pl. 43, fig. 3, Upper Eocene of Panama.

All foraminiferologists, who intend to describe new genera and species of Foraminifera should strongly be advised to study carefully the splendidly written "Einführung in die Zoologische Nomenklatur durch Erläuterung der Internationalen Regeln" (2nd edition), by Dr. Rudolf Richter, Frankfurt am Main, 1948 (Senckenberg-Buch 15) in order to avoid, or reduce to a minimum, future nomenclatural and zoological changes of names.

This is, unfortunately, the last contribution by the writer to the late Dr. Cushman's "Contributions from the Cushman Laboratory for Foraminiferal Research" — this scientific publication exclusively devoted to the Recent and Fossil Foraminifera. The writer sincerely hopes that some means may be found to continue this professional journal in a form, which will perpetuate the name of the man and scientist who contributed more than anybody else before him to the knowledge, understanding, and practical application of the Foraminifera: Dr. Joseph A. Cushman!

Caracas,
October 27, 1949 HANS E. THALMANN

RECENT LITERATURE ON THE FORAMINIFERA

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

Silvestri, A. Foraminiferi dell'Eocene della Somalia, Pt. III, Fasc. 2.—Pal. Ital., Raccolta di Monografie Paleont., vol. 32, suppl. 6, 1948, pp. 1-56 (277-332), pls. 1-5 (32-36).—A continuation, dealing with the Orbitoididae, concluding the work which has appeared in 4 volumes. Thirteen species and varieties are described and figured, three new. Complete synonymies are given.

Phleger, Fred B, Jr. Foraminifera of a submarine core from the Caribbean Sea.—Meddelanden från Oceanografiska Institutet I Göteborg. 16 (Göteborgs Kungl. Vetenskaps- och Vitterhets-Samhälles Handlingar. Sjätte Följden. ser. B, Band 5, No. 14), Oct. 27, 1948, pp. 1-9, plate 1 [graph], table 1.—Percentages of the planktonic species are studied in relation to warmer and cooler conditions (substages of the glacial epochs).

Bandy, Orville L. Eocene and Oligocene Foraminifera from Little Stave Creek, Clarke County, Alabama.—Bull. Amer. Pal., vol. 32, No. 131, March 4, 1949, pp. 1-211 (31-241), pls. 1-27 (5-31), text figs. 1, 2, table 1.—Two hundred and eighty-three species and varieties, 102 new, and 3 new genera, *Cibicidina* (genotype *C. walli* n. sp.), *Discorbitura* (genotype *D. dignata* n. sp.), and *Asterigerinella* (genotype *A. gallowayi* n. sp.), are described and figured.

Cushman, Joseph A. Recent Belgian Foraminifera.—Mém. No. 111, Instit. Royal Sci. Nat. Belgique, June 30, 1949, pp. 1-59, pls. 1-10, distribution table.—One hundred twenty-eight species and varieties, one new, are recorded and most of them figured.

The Foraminiferal Fauna of the Arkadelphia Marl of Arkansas.—U. S. Geol. Survey Prof. Paper 221-A, 1949, pp. 1-10, pls. 1-4.—One hundred sixteen species and varieties, one variety new, are recorded and most of them figured.

Stainforth, R. M. Nomenclatural notes on *Pullenia* and *Cibicides*.—Journ. Pal., vol. 23, No. 4, July, 1949, pp. 436-438.—A new name, *Pullenia duplicata*, is proposed and the gender of *Cibicides* is discussed.

Asano, Kiyoshi. New Miocene Foraminifera from Japan.—L. c., pp. 423-430, text figs. 1, 2 [plates].—Sixty-eight species, 10 new, are recorded, many described and figured, from the Kokozura formation.

Hofker, J. On *Hagenowella* and a new species.—L. c., pp. 431-434, text figs. 1-3.—*H. paleocenica* is described and figured. Structure of the genus is re-studied.

Bandy, Orville L. New names for two species of Foraminifera from Little Stave Creek, Clarke County, Alabama.—L. c., p. 440.

Stetson, Henry C. The Sediments and Stratigraphy of the East Coast Continental Margin; Georges Bank to Norfolk Canyon, with Appendex A, Foraminifera from Canyon Tows in Semi-Consolidated Sediments, by **Fred B Phleger.**—Papers in Physical Oceanography and Meteorology, vol. 11, No. 2, and Contribution No. 487 from the Woods Hole Oceanographic Institution, August, 1949, pp. 1-60, text figs. 1-5, tables 1-7.—Mentions and lists foraminifera.

Guzmán, Eduardo J. New Petroleum Development by Petróleos Mexicanos in Northeastern Mexico.—Bull. Amer. Assoc. Petr. Geol., vol. 33, No. 8, August 1949, pp. 1351-1384, text figs. 1-14, table 1.—Lists foraminifera.

Salas, Guillermo P. Geology and Development of Poza Rica Oil Field, Veracruz, Mexico.—L. c., pp. 1385-1409, text figs. 1-15, tables 1, 2.—Lists foraminifera.

Glaessner, Martin F. Foraminifera of Franciscan (California).—L. c., No. 9, Sept. 1949, pp. 1615, 1616.—Gives reasons for considering the fauna (described in these Contributions, vol. 24, pt. 4, 1948) of Albian age.

Asano, Kiyoshi. Foraminifera from the Asagai formation (Tertiary) of Fukushima prefecture, Japan.—Journ. Pal., vol. 23, No. 5, Sept. 1949, pp. 473-478, text figs. 1, 2 [plates].—Eleven species, five new, are described and figured.

The Foraminiferal Genus *Cruciloculina* d'Orbigny, 1839.—L. c., pp. 479, 480, pl. 80. —Study of additional material indicates the genus is valid. A new species is described and figured from the Pliocene of Japan.

Frizzell, Don L. Rotaliid Foraminifera of the Chapmanininae: their natural distinction and parallelism to the *Dictyoconus* lineage.—L. c., pp. 481-495, text figs. 1-20. —A new subfamily of the Rotaliidae, Chapmanininae, is proposed, including three genera: *Ferayina* n. gen. (genotype *F. coralliformis* n. sp.), *Preverina* n. gen. (genotype *Chapmania galea* Silvestri), and *Chapmanina*. Complete descriptions and synonymies are included, and the relationships are discussed.

de Cizancourt, Maria, and **Don L. Frizzell.** *Ferayina* in the middle Eocene of Venezuela (Foraminifera, Rotaliidae, Chapmanininae).—L. c., pp. 496, 497, pl. 81.

Thalmann, Hans E. Bibliography and index to Foraminifera (Supplements and corrections for the period 1931 to 1947).—L. c., pp. 498-506.

Redmond, C. D. What is the Genus *Eponides*?—The Micropaleontologist, vol. 3, No. 4, Oct., 1949, pp. 18-21, figures.—Re-study of the original descriptions of *Nautilus* *repandus* and *Eponides repandus* indicates they are not the same as what is now regarded as *Eponides*.

Le Calvez, Yolande. Révision des Foraminifères Lutétiens du Bassin de Paris, II. Rotaliidae et Familles Affines. Mémoires pour servir à l'explication de la carte géologique détaillée de la France, Paris, 1949, pp. 1-54, pls. I-VI.—A continuation of Part I (1947). Sixty-four species, 17 new, and 2 new genera, *Gyroidinella* (genoholotype *G. magna* n. sp.) and *Pararotalia* (genoholotype *Rotalina inermis* Terquem), are noted and most of them described and figured.

Tasman, (Mrs.) Mehlika Izgi. Foraminifera from Test Wells in Adana, Turkey.—Publications of Mining Research and Exploration Institute of Turkey, Ser. B, No. 15, 1949, pp. 1-42, pls. I-VI, map.—Forty-two species and varieties, 6 new (as Izgi, n. sp.), are described from Miocene beds in a test well.

Thalmann, Hans E. Bibliography and index to new genera, species, and varieties of Foraminifera for the year 1948.—Journ. Pal., vol. 23, No. 6, November, 1949, pp. 641-668.

Bartenstein, H., and E. Brand. New Genera of Foraminifera from the Lower Cretaceous of Germany and England.—L. c., pp. 669-672, text figs. 1-10.—Five species, 3 new, included within 4 new genera: *Hechtina* (genotype *H. praeantiqua* n. sp.), *Pseudonubeculina* (genotype *Nubeculina nodulosa* Chapman), *Falsoguttulina* (genotype *F. wolburgi* n. sp.), and *Tetraplasia* (genotype *T. georgdorfensis* n. sp.), are described and figured.

Bermudez, Pedro J. Tertiary Smaller Foraminifera of the Dominican Republic.—Special Publ. No. 25, Cushman Lab. Foram. Res., Dec. 21, 1949, pp. i-iv, 1-322, pls. 1-26, text figs. 1-6 (maps), 2 charts, distribution tables.—Eight hundred thirty-three species and varieties are recorded and most of them figured. Two hundred forty-three species and varieties and 6 genera: *Olssonina* (genoholotype *O. cribrosa* n. sp.), *Acostina* (genotype *Chrysalogonium pyramidale* Acosta), *Compressigerina* (genotype *Uvigerina coartata* D. K. Palmer), *Neogyroidina* (genotype *Gyroidina protea* Cushman and Bermudez), *Asterigerinata* (genoholotype *A. dominicana* n. sp.), and *Carpenterella* (genotype *C. truncata* n. sp.) are new.

Said, Rushdi. Foraminifera of the Northern Red Sea.—L. c., Special Publ. No. 26, Dec. 21, 1949, pp. 1-44, pls. 1-4.—One hundred forty-eight species and varieties, with 21 new and 3 new names, are recorded and mostly figured.

R. T.