

CONTRIBUTIONS FROM THE CUSHMAN
LABORATORY FOR FORAMINIFERAL RESEARCH

93. SOME RECENT FORAMINIFERA FROM OFF SAN
PEDRO, CALIFORNIA

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There is so much interest taken in the conditions under which the Pliocene deposits of California were deposited that data from Recent material is of much use. Most of the species and varieties found in these Pliocene deposits are now living off the California coast. The ecologic conditions under which the Recent forms are now living can therefore be used for an interpretation of the Pliocene conditions. Data for a number of collections of Pliocene and Recent has already been given and a list of these papers is given here. In those papers many of the species have been well figured, and in this paper we have figured mainly those species which have either not previously been figured from either the Recent or Pliocene of this area, or which are of especial interest. A few of the forms from off San Pedro are new, but are not in all cases represented by sufficient series for full description. Nearly all of them represent previously described species. To give the data with the use of the minimum amount of space, an abbreviated form of reference is given to the list of papers where the fuller synonymy and descriptions can be found. The species noted here have been compared with the types or authentic material as well as with the original figures and descriptions. All specimens are from off San Pedro, California, and the locality is not repeated. The depth at which the most abundant or most typical specimens were obtained is given. The figured specimens and others are in the Collection of the Cushman Laboratory for Foraminiferal Research at Sharon, and duplicate specimens in the collection of the junior author.

Credit is here given to the University of Southern California for sponsoring the work of the junior author in her part of working up these collections.

Literature referred to in the following notes or bearing on the present collection:

- CHURCH, C. C. 1928, A New Species of *Bolivinita* from the Lower Pliocene of California. (Journ. Pal., vol. 1, No. 4, 1928, pp. 265-268.)
- CHURCH, C. C. 1929, Some Recent Shallow Water Foraminifera Dredged near Santa Catalina Island, California. (l. c., vol. 3, 1929, pp. 302-305.)
- CUSHMAN, JOSEPH A. 1910-1917, A Monograph of the Foraminifera of the North Pacific Ocean. (Bull. 71, U. S. Nat. Mus., pt. 1, 1910, pp. i-xiv, 1-134, text figs. 1-203; pt. 2, 1911, pp. i-xii, 1-108, text figs. 1-156; pt. 3, 1913, pp. i-ix, 1-125, pls. 1-47; pt. 4, 1914, pp. i-vi, 1-46, pls. 1-19; pt. 5, 1915, pp. i-vii, 1-87, text figs. 1-62, pls. 1-31; pt. 6, 1917, pp. i-vii, 1-108, text figs. 1-52, pls. 1-39.)
- CUSHMAN, JOSEPH A. 1925 (a), Some Textulariidae from the Miocene of California. (Contr. Cushman Lab. Foram. Res., vol. 1, 1925, pp. 29-34, pl. 5.)
- CUSHMAN, JOSEPH A. 1925 (b), Recent Foraminifera from British Columbia. (l. c., vol. 1, 1925, pp. 38-45, pl. 6.)
- CUSHMAN, JOSEPH A. 1926, Some Pliocene Bolivinas from California. (l. c., vol. 2, 1926, pp. 40-45, pl. 6.)
- CUSHMAN, JOSEPH A. 1927, Recent Foraminifera from off the West Coast of America. (Bull. Scripps Inst. Oceanography, Tech. Ser., vol. 1, No. 10, 1927, pp. 119-188, pls. 1-6.)
- CUSHMAN, JOSEPH A. 1929, Pliocene Lagenas from California. (Contr. Cushman Lab. Foram. Res., vol. 5, 1929, pp. 67-72, pl. 11.)
- CUSHMAN, JOSEPH A. and DONALD D. HUGHES. 1925, Some Later Tertiary Cassidulinas of California. (l. c., vol. 1, 1925, pp. 11-17, pl. 2.)
- CUSHMAN, JOSEPH A. and BETTY KELLETT. 1929, Recent Foraminifera from the West Coast of South America. (Proc. U. S. Nat. Mus., vol. 75, Art. 25, 1929, pp. 1-16, pls. 1-5.)
- CUSHMAN, JOSEPH A. and ROSCOE E. STEWART. 1926, A New *Plectofrondicularia* from the Pliocene of California. (Contr. Cushman Lab. Foram. Res., vol. 2, 1926, p. 39, pl. 6, figs. 9-11.)
- CUSHMAN, JOSEPH A. and ROSCOE E. and KATHERINE C. STEWART. 1930, Tertiary Foraminifera from Humboldt County, California. (Trans. San Diego Soc. Nat. Hist., vol. VI, 1930, pp. 41-94, pls. 1-8.)
- CUSHMAN, JOSEPH A. and WILLIAM W. VALENTINE. 1930, Shallow-Water Foraminifera from the Channel Islands of Southern California. (Contr. Dept. Geol. Stanford Univ., vol. 1, 1930, pp. 1-51, pls. 1-10.)
- CUSHMAN, JOSEPH A. and R. T. D. WICKENDEN. 1929, Recent Foraminifera from off Juan Fernandez Islands. (Proc. U. S. Nat. Mus., vol. 75, Art. 9, 1929, pp. 1-16, pls. 1-6.)

GALLOWAY, J. J. and STANLEY G. WISSLER. 1927, Pleistocene Foraminifera from the Lomita Quarry, Palos Verdes Hills, California. (Journ. Pal., vol. 1, 1927, pp. 35-87, pls. 7-12.)

HANNA, G. D. and C. C. CHURCH. 1928, A Collection of Recent Foraminifera Taken off San Francisco Bay, California. (Journ. Pal., vol. 1, 1928, pp. 195-202.)

STEWART, ROSCOE E. and KATHERINE C. 1930, Post-Miocene Foraminifera from the Ventura Quadrangle, Ventura County, California. (l. c., vol. 4, 1930, pp. 60-72, pls. 8, 9.)

DR. BAGG'S paper on the Miocene and Pliocene of California is not referred to, as most of the illustrations of that paper are from other than California material.

1 REOPHAX SCORPIURUS Montfort

Plate 7, figure 1

CUSHMAN, 1910-1917, pt. 1, 1910, p. 83, text figs. 114-116.
35—50 fathoms.

2 REOPHAX EXCENTRICUS Cushman

CUSHMAN, 1910-1917, pt. 1, 1910, p. 92, text fig. 134; 1927, p. 133, pl. 1, fig. 3.

35—50 fathoms.

3 REOPHAX DENTALINIFORMIS H. B. Brady

Plate 7, figure 2

CUSHMAN, 1910-1917, pt. 1, 1910, p. 87, text fig. 121; 1927, p. 132.—HANNA and CHURCH, 1928, p. 200.

185 fathoms.

4 AMMODISCUS INCERTUS (d'Orbigny)

CUSHMAN, 1910-1917, pt. 1, 1910, p. 73, text figs. 95, 96; 1927, p. 133.—HANNA and CHURCH, 1928, p. 196.—CHURCH, 1929, p. 302.

35—50 fathoms. Specimens with nearly all cement and little arenaceous material.

5 HAPLOPHRAGMOIDES PLANISSIMA Cushman

Plate 7, figure 3

CUSHMAN, 1927, p. 135, pl. 1, fig. 6.

35—50 fathoms. Very typical.

6 HAPLOPHRAGMOIDES ADVENA Cushman

Plate 7, figure 4

CUSHMAN, 1925 (b), p. 38, pl. 6, fig. 1; 1927, p. 135.—HANNA and CHURCH, 1928, p. 198.—CHURCH, 1929, p. 304.—CUSHMAN and VALENTINE, 1930, p. 7, pl. 1, fig. 5.

35—50, and 185 fathoms.

7 TEXTULARIA SCHENCKI Cushman and Valentine

CUSHMAN and VALENTINE, 1930, p. 8, pl. 1, fig. 3.

35—50 fathoms.

8 VERNEUILINA ADVENA Cushman
Plate 7, figure 6

Verneuilina advena CUSHMAN, Contrib. Canadian Biol., 1921 (1922), p. 9; Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 57, pl. 9, figs. 7-9; 1927, p. 137.

18 fathoms.

9 GAUDRYINA TRIANGULARIS Cushman
Plate 7, figure 5

CUSHMAN, 1910-1917, pt. 2, 1911, p. 65, text fig. 104; 1927, p. 138.—

CUSHMAN and WICKENDEN, 1929, p. 2, pl. 1, fig. 1.—CUSHMAN, STEWART and STEWART, 1930, p. 51, pl. 1, fig. 2.

35—50 fathoms.

10 CLAVULINA FLINTII Cushman
Plate 7, figures 7-9

Clavulina flintii CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 86, pl. 15, figs. 7-9.

185 fathoms.

This is a rather primitive species and the triserial, biserial and uniserial forms are usually all associated as figured here. The immature specimens are easily mistaken for *Verneuilina* and *Gaudryina*. The species is common in water of 100—200 fathoms off the coast of Florida.

11 QUINQUELOCULINA FLEXUOSA d'Orbigny

CUSHMAN and VALENTINE, 1930, p. 11, pl. 2, figs. 3 a-c.

18 fathoms.

12 QUINQUELOCULINA LAMARCKIANA d'Orbigny

CUSHMAN and VALENTINE, 1930, p. 10, pl. 1, figs. 9 a-c, 10 a-c.

35—50 fathoms.

13 QUINQUELOCULINA SEMINULA (Linné)

HANNA and CHURCH, 1928, p. 200.—CUSHMAN and VALENTINE, 1930, p. 10, pl. 1, figs. 8 a-c.

35—50 fathoms.

14 TRILOCULINA OBLONGA (Montagu)

CUSHMAN and VALENTINE, 1930, p. 16, pl. 4, figs. 5 a-c, 6 a-c.

35—50 fathoms.

15 CORNUSPIRA FOLIACEA (Philippi)

Plate 7, figure 12

CUSHMAN, 1910-1917, pt. 6, 1917, p. 24, pl. 1, fig. 1; pl. 2, fig. 1; text figs. 4, 5.—HANNA and CHURCH, 1928, p. 197.

35—50 fathoms.

11 TROCHAMMINA GLOBIGERINIFORMIS (Parker and Jones)

Plate 7, figures 11 *a, b*CUSHMAN, 1910-1917, pt. 1, 1910, p. 125, text figs. 195 *a-c*; 1927, p. 141.
18 fathoms.

17 TROCHAMMINA TURBINATA (H. B. Brady)

Plate 7, figure 10

CUSHMAN, 1927, p. 142.
35—50 fathoms.

12 LAGENA ELONGATA (Ehrenberg)

Plate 7, figure 14

CUSHMAN, 1910-1917, pt. 3, 1913, p. 12, pl. 1, figs. 5 *a, b*; 1929, p. 67, pl. 11, fig. 1.
185 fathoms.

19 LAGENA GRACILIS Williamson

CUSHMAN, 1927, p. 144; 1929, p. 67, pl. 11, fig. 2.—HANNA and CHURCH, 1928, p. 198.

185 fathoms.

20 LAGENA HEXAGONA (Williamson), var. SCALARIFORMIS (Williamson)

CUSHMAN, 1910-1917, pt. 3, 1913, p. 17, pl. 6, fig. 4; 1929, p. 72, pl. 11, fig. 17.—CUSHMAN, STEWART and STEWART, 1930, p. 58, pl. 3, fig. 8.

35—50 fathoms.

21 LAGENA HISPIDA Reuss

Plate 7, figure 13

CUSHMAN, 1910-1917, pt. 3, 1913, p. 13, pl. 4, figs. 4, 5; pl. 5, fig. 1; 1927, p. 147; 1929, p. 71, pl. 11, fig. 13.

35—50 fathoms.

22 LAGENA LAMELLATA Sidebottom

CUSHMAN, 1927, p. 147; 1929, p. 71, pl. 11, fig. 14.

35—50 fathoms.

23 LAGENA SULCATA (Walker and Jacob), var. APICULATA Cushman

CUSHMAN, 1910-1917, pt. 3, 1913, p. 23, pl. 9, figs. 3, 4.

35—50 fathoms.

24 GUTTULINA QUINQUECOSTA Cushman and Ozawa

Plate 7, figure 15

CUSHMAN and VALENTINE, 1930, p. 19, pl. 5, figs. 6 *a-c*.

35—50 fathoms.

25 POLYMORPHINA CHARLOTTENSIS Cushman

CUSHMAN, 1925 (*b*), p. 41, pl. 6, fig. 9.—CUSHMAN, STEWART and STEWART, 1930, p. 59, pl. 4, fig. 6.

35—50 fathoms.

26 SIGMOMORPHINA TRILOCULARIS (Bagg)

Plate 7, figure 16

CUSHMAN and VALENTINE, 1930, p. 20, pl. 5, figs. 8 a-c.
12 fathoms.

27 SIGMOMORPHINA FRONDICULARIFORMIS (Galloway and Wissler)

GALLOWAY and WISSLER, 1927, p. 55, pl. 9, fig. 6.

35—50 fathoms.

28 NONION PIZARRENSIS Berry, var. BASISPINATA Cushman and Moyer, n. var.

Plate 7, figures 18 a, b

Variety differing from the typical in the later chambers which on the outer margin toward the base have a fringe of small spinose processes often very conspicuous also along the sutures.

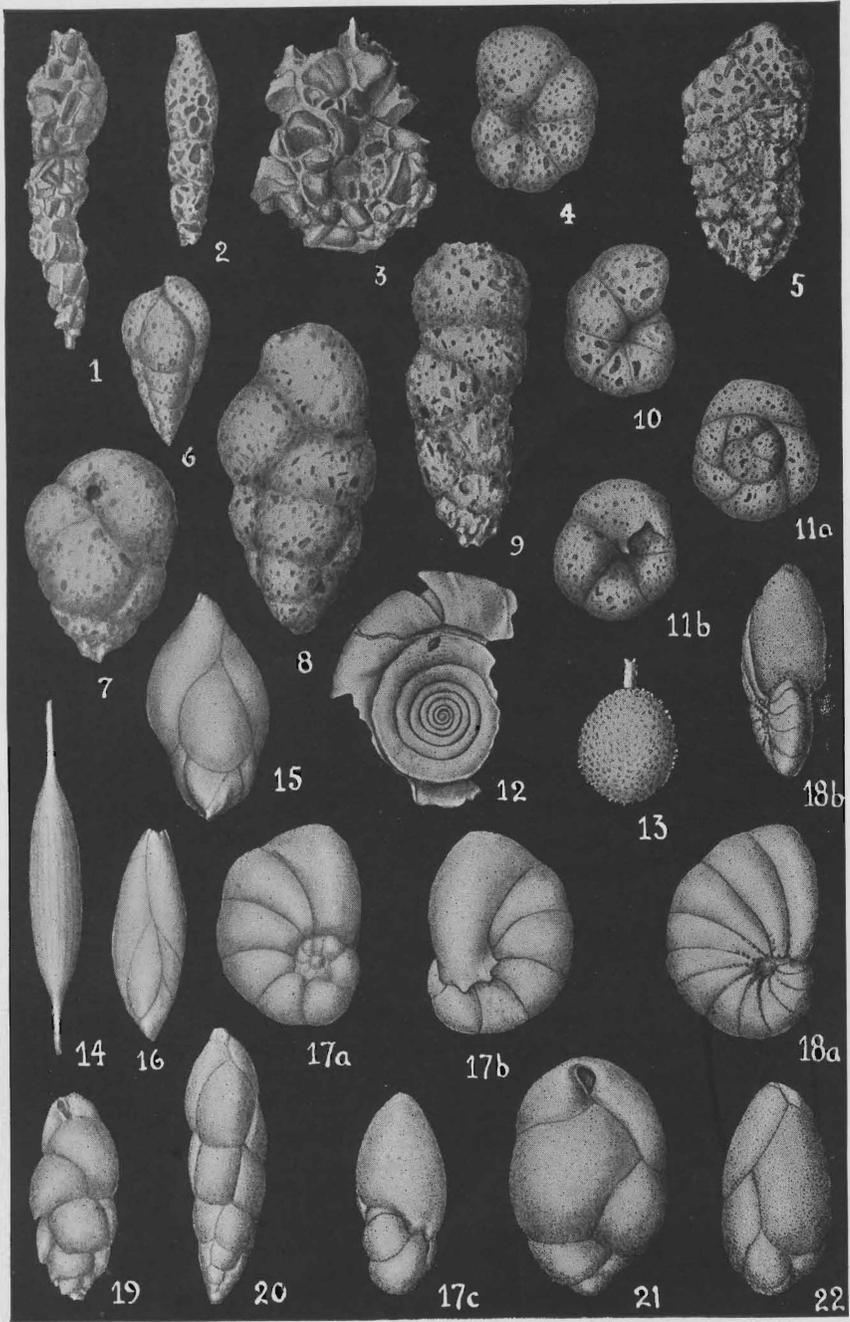
Holotype of variety (Cushman Coll. No. 13950) from 35—50 fathoms, off San Pedro, California.

The type form is described as smooth, and the Peruvian material examined keeps this characteristic.

EXPLANATION OF PLATE 7

- FIG. 1. *Reophax scorpiurus* Montfort. $\times 35$.
 FIG. 2. *Reophax dentaliniformis* H. B. Brady. $\times 55$.
 FIG. 3. *Haplophragmoides planissima* Cushman. $\times 35$.
 FIG. 4. *Haplophragmoides advena* Cushman. $\times 35$.
 FIG. 5. *Gaudryina triangularis* Cushman. $\times 35$.
 FIG. 6. *Verneuilina advena* Cushman. $\times 100$.
 FIGS. 7-9. *Clavulina flintii* Cushman. $\times 30$. Fig. 7, Triserial *Verneuilina* stage. Fig. 8, Biserial *Gaudryina* stage.
 FIG. 10. *Trochammina turbinata* (H. B. Brady). $\times 75$.
 FIGS. 11 a, b. *Trochammina globigeriniformis* (Parker and Jones). $\times 40$. a, dorsal view; b, ventral view.
 FIG. 12. *Cornuspira foliacea* (Philippi). $\times 55$.
 FIG. 13. *Lagena hispida* Reuss. $\times 75$.
 FIG. 14. *Lagena elongata* (Ehrenberg). $\times 75$.
 FIG. 15. *Guttulina quinquecosta* Cushman and Ozawa. $\times 40$.
 FIG. 16. *Sigmomorphina trilocularis* (Bagg). $\times 40$.
 FIGS. 17 a-c. *Nonionella miocenica* Cushman, var. *stella* Cushman and Moyer, n. var. $\times 75$. a, dorsal view; b, ventral view; c, peripheral view.
 FIGS. 18 a, b. *Nonion pizarrensis* Berry, var. *basispinata* Cushman and Moyer, n. var. $\times 40$. a, side view; b, peripheral view.
 FIG. 19. *Bulimina pulchella* d'Orbigny. $\times 75$.
 FIG. 20. *Buliminella subfusiformis* Cushman. $\times 75$.
 FIG. 21. *Bulimina ovula* d'Orbigny. $\times 40$.
 FIG. 22. *Bulimina ovata* d'Orbigny. $\times 40$.

Figures drawn by Margaret S. Moore



29 *NONIONELLA MIOCENICA* Cushman, var. *STELLA* Cushman and Moyer, n. var.
Plate 7, figures 17 a-c

Variety differing from the typical in the stellate character of the inner end of the last-formed chamber on the ventral side which develops short finger-like processes over the previous sutures.

Holotype of variety (Cushman Coll. No. 13953) from 35—50 fathoms, off San Pedro, California.

The finger-like processes become very marked in some of the Recent material, but this seems to be only a varietal character.

30 *ELPHIDIUM SPINATUM* Cushman and Valentine
CUSHMAN and VALENTINE, 1930, p. 21, pl. 6, figs. 1 a, b, 2.

12 fathoms.

The young specimens and those partially developed do not show the spines, but the adults develop them to a greater or lesser degree, and the other characters of retral processes and perforations are constant.

31 *BULIMINELLA SUBFUSIFORMIS* Cushman
Plate 7, figure 20

CUSHMAN, 1925 (a), p. 33, pl. 5, fig. 12.—CUSHMAN, STEWART and STEWART, 1930, p. 64, pl. 4, figs. 8 a, b.

400 fathoms.

32 *BULIMINA OVULA* d'Orbigny
Plate 7, figure 21

CUSHMAN, 1927, p. 150, pl. 2, fig. 10.

400 fathoms.

The figured specimen is a megalospheric one, and shows the broad base compared to the pointed base in the microspheric form.

33 *BULIMINA OVATA* d'Orbigny
Plate 7, figure 22

CUSHMAN, 1910-1917, pt. 2, 1911, p. 77, text figs. 125 a-c; 1927, p. 150.

185 fathoms.

This is variable in its form, but is generally fusiform.

34 *BULIMINA PULCHELLA* d'Orbigny
Plate 7, figure 19

CUSHMAN, 1927, p. 152, pl. 2, fig. 13.

35—50 fathoms.

35 *GLOBOBULIMINA PACIFICA* Cushman

CUSHMAN, 1927, p. 153, pl. 3, fig. 1.—GALLOWAY and WISSLER, 1927, p. 74, pl. 11, fig. 18.—CUSHMAN, STEWART and STEWART, 1930, p. 66, pl. 5, fig. 4.

185 fathoms.

36 *VIRGULINA CORNUTA* Cushman

Plate 8, figure 1

CUSHMAN, 1927, p. 154, pl. 3, fig. 2.

400 fathoms.

37 *VIRGULINA BRAMLETTI* Galloway and Morrey

Plate 8, figure 2

This is very close to the Miocene species described from Ecuador (Bull. Amer. Pal., vol. 15, 1929, p. 37, pl. 5, fig. 14). It was also recorded from the Miocene of Venezuela (Contr. Cushman Lab. Foramin. Res., vol. 5, 1929, p. 94, pl. 13, fig. 30).

400 fathoms.

38 *BOLIVINA ARGENTEA* Cushman

Plate 8, figure 3

CUSHMAN, 1926, p. 42, pl. 16, fig. 5; 1927, p. 155, pl. 3, fig. 5.

185 and 250 fathoms.

39 *BOLIVINA COSTATA* d'Orbigny, var. *BICOSTATA* Cushman

CUSHMAN, 1926, p. 42.

185 and 400 fathoms.

40 *BOLIVINA COSTATA* d'Orbigny, var. *INTERJUNCTA* Cushman

CUSHMAN, 1926, p. 41, pl. 6, fig. 3.—GALLOWAY and WISSLER, 1927, p. 70, pl. 11, figs. 10-13.

185 fathoms.

41 *BOLIVINA PYGMAEA* H. B. Brady

Plate 8, figure 4

CUSHMAN, 1927, p. 156, pl. 3, fig. 9.

185 fathoms.

42 *BOLIVINA SEMINUDA* Cushman

CUSHMAN, 1910-1917, pt. 2, 1911, p. 34, text fig. 55; 1926, p. 43; 1927, p. 157, pl. 3, fig. 6.

185 fathoms.

43 *BOLIVINA SUBADVENA* Cushman

CUSHMAN, 1926, p. 44, pl. 6, figs. 6 a, b; 1927, p. 156.—CUSHMAN, STEWART and STEWART, 1930, p. 67, pl. 5, fig. 5.

185 fathoms.

⁴⁴ *BOLIVINA SUBADVENA* Cushman, var. *SPISSA* Cushman
CUSHMAN, 1926, p. 45, pl. 6, figs. 8 *a, b*; 1927, p. 157, pl. 3, fig. 10.—GALLOWAY and WISSLER, 1927, p. 72, pl. 11, figs. 14-16.—CUSHMAN, STEWART and STEWART, 1930, p. 67, pl. 5, fig. 7.

400 fathoms.

⁴⁵ *BOLIVINA PSEUDOBeyRICHII* Cushman
Plate 8, figure 5

CUSHMAN, 1926, p. 45; 1927, p. 156, pl. 3, fig. 7.

400 fathoms.

⁴⁶ *BOLIVINA ADVENA* Cushman, var. *STRIATELLA* Cushman
Plate 8, figure 6

CUSHMAN, 1925 (*a*), p. 30, pl. 5, figs. 3 *a, b*; 1926, p. 54.—CUSHMAN, STEWART and STEWART, 1930, p. 68.

35—50 fathoms.

This Recent form seems to be identical with the Miocene one.

⁴⁷ *UVIGERINA SENTICOSA* Cushman

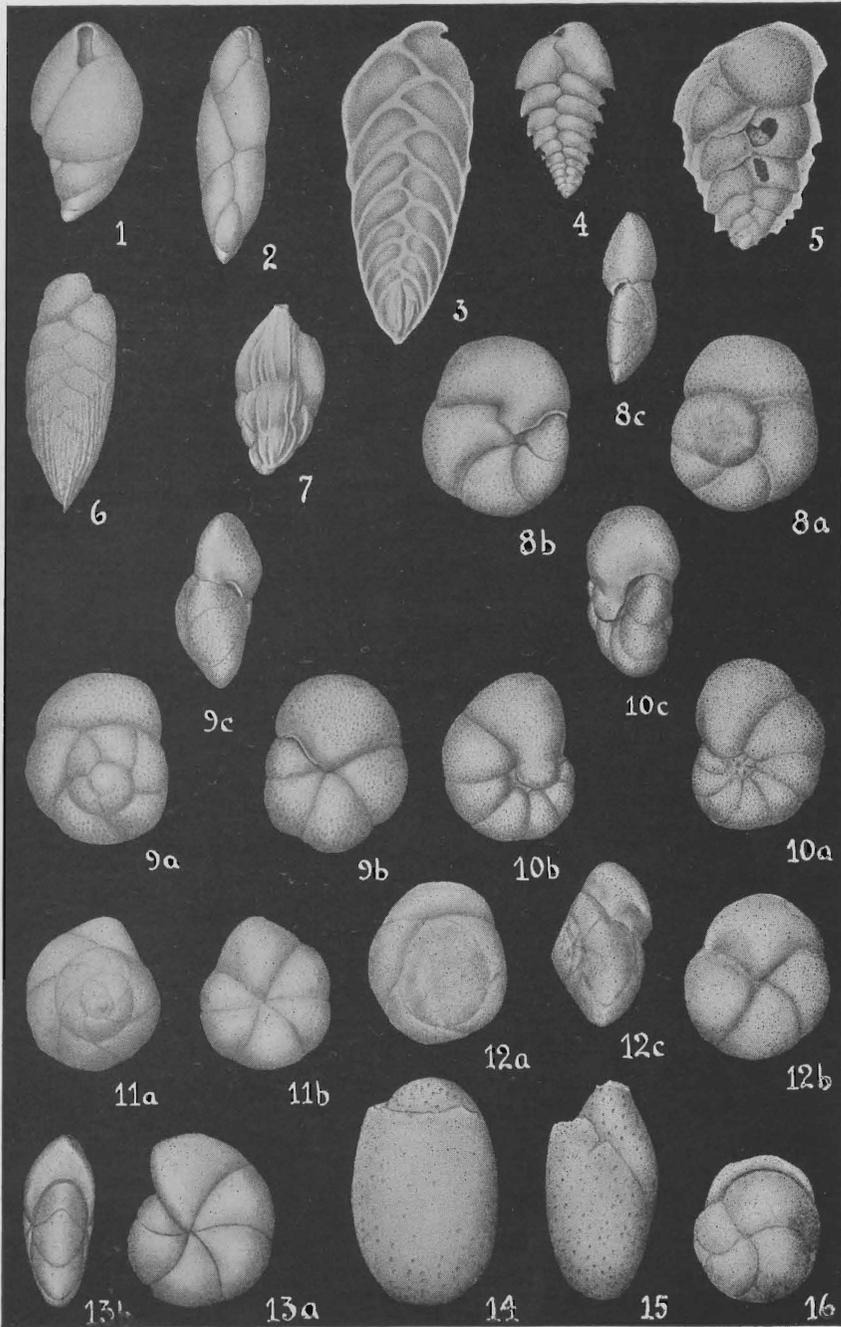
CUSHMAN, 1927, p. 159, pl. 3, fig. 14.—CUSHMAN, STEWART and STEWART, 1930, p. 68, pl. 5, fig. 9.

185 fathoms.

EXPLANATION OF PLATE 8

- FIG. 1. *Virgulina cornuta* Cushman. $\times 55$.
 FIG. 2. *Virgulina bramletti* Galloway and Morrey. $\times 40$.
 FIG. 3. *Bolivina argentea* Cushman. $\times 40$.
 FIG. 4. *Bolivina pygmaea* H. B. Brady. $\times 75$.
 FIG. 5. *Bolivina pseudobeyrichii* Cushman. $\times 40$.
 FIG. 6. *Bolivina advena* Cushman, var. *striatella* Cushman. $\times 75$.
 FIG. 7. *Angulogerina angulosa* (Williamson). $\times 75$.
 FIGS. 8 *a-c*. *Discorbis isabelleana* (d'Orbigny). $\times 100$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
 FIGS. 9 *a-c*. *Valvulineria vilardeboana* (d'Orbigny), var. *glabra* Cushman. $\times 40$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
 FIGS. 10 *a-c*. *Valvulineria araucana* (d'Orbigny). $\times 40$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
 FIGS. 11 *a, b*. *Eponides exigua* (H. B. Brady) (?). $\times 100$. *a*, dorsal view; *b*, ventral view.
 FIGS. 12 *a-c*. *Eponides ornata* (d'Orbigny). $\times 55$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
 FIGS. 13 *a, b*. *Pullenia salisburyi* R. E. and K. C. Stewart. $\times 55$. *a*, side view; *b*, apertural view.
 FIG. 14. *Chilostomella grandis* Cushman. $\times 40$.
 FIG. 15. *Chilostomella oolina* Schwager. $\times 40$.
 FIG. 16. *Cassidulina delicata* Cushman. $\times 100$.

Figures drawn by Margaret S. Moore



48 UVIGERINA PIGMEA d'Orbigny, var. CURTICOSTATA Cushman
CUSHMAN, 1927, p. 157, pl. 4, fig. 1.

250 fathoms.

49 ANGULOGERINA ANGULOSA (Williamson)
Plate 8, figure 7

CUSHMAN, 1910-1917, pt. 3, 1913, p. 98, pl. 44, fig. 4.

35—50 fathoms.

This form is rare, but seems to be referable to Williamson's species which is widely distributed in cool waters.

50 DISCORBIS ISABELLEANA (d'Orbigny)
Plate 8, figures 8 a-c

CUSHMAN, 1927, p. 160, pl. 4, fig. 4.—CUSHMAN and KELLETT, 1929, p. 9,
pl. 3, figs. 12 a-c.—CUSHMAN and VALENTINE, 1930, p. 23, pl. 6, figs. 6,
7 a-c, 8 a-c.

35—50 fathoms.

51 VALVULINERIA ARAUCANA (d'Orbigny)
Plate 8, figures 10 a-c

CUSHMAN, 1927, p. 160, pl. 4, figs. 7, 8.—CUSHMAN, STEWART and STEW-
ART, 1930, p. 71, pl. 6, figs. 4 a-c.

400 fathoms.

52 VALVULINERIA VILARDEBOANA (d'Orbigny), var. GLABRA Cushman
Plate 8, figures 9 a-c

CUSHMAN, 1927, p. 161, pl. 4, figs. 5, 6.

185 fathoms.

53 EPONIDES EXIGUA (H. B. Brady) (?)
Plate 8, figures 11 a, b

35—50 fathoms.

54 EPONIDES ORNATA (d'Orbigny)
Plate 8, figures 12 a-c

CUSHMAN, STEWART and STEWART, 1930, p. 72, pl. 6, figs. 2 a-c.

12 fathoms.

55 PULVINULINELLA SMITHI R. E. and K. C. Stewart
R. E. and K. C. STEWART, 1930, p. 70, pl. 9, figs. 4 a-c.

400 fathoms.

Our specimens are very close to this species recently described from the Pliocene of California.

56 CASSIDULINA TRANSLUCENS Cushman and Hughes
CUSHMAN and HUGHES, 1925, p. 15, pl. 2, figs. 5 a-c.—GALLOWAY and
WISSLER, 1927, p. 80, pl. 12, fig. 11.—CHURCH, 1928, p. 266,

400 fathoms.

57 CASSIDULINA LAEVIKATA d'Orbigny

CUSHMAN, 1910-1917, pt. 2, 1911, p. 96, text figs. 150 *a, b*.

400 fathoms.

This is not a common species in California waters, but this material seems very typical.

58 CASSIDULINA LIMBATA Cushman and Hughes

CUSHMAN and HUGHES, 1925, p. 12, pl. 2, figs. 2 *a-c*.—CUSHMAN, 1927, p. 166, pl. 6, fig. 4.—GALLOWAY and WISSLER, 1927, p. 78, pl. 12, fig. 12.

—CUSHMAN, STEWART and STEWART, 1930, p. 74, pl. 6, figs. 7 *a, b*.

185 fathoms.

59 CASSIDULINA DELICATA Cushman

Plate 8, figure 16

CUSHMAN, 1927, p. 168, pl. 6, fig. 5.

400 fathoms.

60 CHILOSTOMELLA GRANDIS Cushman

Plate 8, figure 14

Chilostomella grandis CUSHMAN, Proc. U. S. Nat. Mus., vol. 51, 1917, p. 662; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 283, pl. 57, figs. 5 *a-c*;

Contr. Cushman Lab. Foram. Res., vol. 1, 1926, p. 75, pl. 11, figs. 12 *a-c*.

400 fathoms.

This large, very broad species was originally described from the Philippine regions, and occurs in various parts of the Pacific.

61 CHILOSTOMELLA OOLINA Schwager

Plate 8, figure 15

CUSHMAN, 1927, p. 169.

400 fathoms.

62 PULLENIA SALISBURYI R. E. and K. C. Stewart

Plate 8, figures 13 *a, b*

R. E. and K. C. STEWART, 1930, p. 72, pl. 8, figs. 2 *a, b*.

18 fathoms.

This species recently described from the Pliocene of California also is living off the coast.

63 GLOBIGERINA CONGLOMERATA Schwager

CUSHMAN, 1927, p. 172.—CUSHMAN and WICKENDEN, 1929, p. 12, pl. 5, figs. 6 *a-c*.—CUSHMAN and KELLETT, 1929, p. 14.—CUSHMAN, STEWART and STEWART, 1930, p. 76.—CUSHMAN and VALENTINE, 1930, p. 27.

35—50 fathoms.

Various stages of this common Pacific species occur. With this and the two following pelagic forms, the depth of occurrence has little meaning.

^{b2} ORBULINA UNIVERSA d'Orbigny

CUSHMAN, 1910-1917, pt. 4, 1914, p. 14, pl. 6; pl. 7; pl. 11, fig. 3; 1927, p. 174.—GALLOWAY and WISSLER, 1927, p. 45, pl. 8, fig. 3.—CHURCH, 1928, p. 267.—CUSHMAN and VALENTINE, 1930, p. 28.—CUSHMAN, STEWART and STEWART, 1930, p. 77, pl. 7, fig. 4.

185 fathoms.

^{b5} GLOBOROTALIA TRUNCATULINOIDES (d'Orbigny)

CUSHMAN, 1927, p. 176.—CUSHMAN and WICKENDEN, 1929, p. 14, pl. 6, figs. 3 a-c.

35—50 fathoms.

^{b6} CIBICIDES UNGERIANA (d'Orbigny)

CUSHMAN, 1927, p. 177.—HANNA and CHURCH, 1928, p. 201.

35—50 fathoms.

^{b7} CIBICIDES GALLOWAYI Cushman and Valentine

GALLOWAY and WISSLER, 1927, p. 66, pl. 10, figs. 10 a-c.—CUSHMAN and VALENTINE, 1930, p. 30, pl. 10, figs. 4 a-c.

35—50 fathoms.

^{b8} PLANULINA ORNATA (d'Orbigny)

CUSHMAN, 1927, p. 176, pl. 6, fig. 12.—CUSHMAN, STEWART and STEWART, 1930, p. 78, pl. 7, figs. 6 a, b.—CUSHMAN and VALENTINE, 1930, p. 29, pl. 9, figs. 2 a-c, 4 a-c.

35—50 fathoms.

94. ON UVIGERINA PIGMEA D'ORBIGNY

By JOSEPH A. CUSHMAN

To this species of d'Orbigny various forms of costate *Uvigerinae* have been referred, including Recent, Tertiary and Cretaceous forms. A glance through the literature will show what a wide range of forms have been assigned to this name.

The entire data as given by d'Orbigny in 1826 (Ann. Sci. Nat., vol. 7, 1826, p. 269, pl. 12, figs. 8, 9) reads as follows:

"2. pigmea, Nob., pl. 12, fig. 8, 9; Modèles, n° 67, iii^e livraison.

Polyphormium pineiformium, Sold., 2, p. 119, tab. 130, fig. ss, tt. Hab. . . fossile aux environs de Sienne."

The figures given by Soldani and referred to by d'Orbigny are not well drawn, but show apparently a somewhat thicker, coarser test with fewer and heavier costae, evidently the form now fairly common at Rimini on the Adriatic. Fortunately, d'Orbigny gives

figures as well as a Model of his species. The figures from the 1826 reference are copied here (Pl. 9, figs. 14, 15), and a drawing of the Model in the collection of the Cushman Laboratory is also given (Pl. 9, fig. 16).

The type locality may be taken as the clay pits in gray Pliocene clays at Coroncina, near Siena, Italy. I collected abundant material there in 1927, and the washed samples show numerous specimens of typical *U. pigmea*, which is by far the most common species of the genus in the material. Four specimens are here figured showing the characters. The test is fairly small, elongate, with the width of the initial end varying much in the microspheric and megalospheric forms. All but the last one or two chambers have rather sharp longitudinal costae, those of each chamber usually independent of one another and numerous. The last one or two chambers lose the costae and become nearly smooth, but have numerous short spines. The apertural end has a distinct neck, elongate and slender, and in well preserved specimens there is a distinct lip. That this species is distinct from many of the forms assigned to it will be at once apparent from a study of the figures given here. The plaster model has the last two chambers smooth as it would obviously be impossible to represent the fine spines in this medium.

d'Orbigny later, in 1846, referred to his species specimens from the Miocene of the Vienna Basin. While many of the species of these two areas are identical, these two do not seem to be from a study of the figures and abundant material from the type locality in the Vienna Basin.

Brady's figures in the *Challenger* Report referred to this species are of two distinct species, neither of which is typical *U. pigmea* of d'Orbigny. Evidently many later authors have referred back only to these figures of Brady.

From the above it would seem advisable for workers identifying specimens as *U. pigmea* d'Orbigny to refer to the figures given here of toptype material, as well as the copies of d'Orbigny's figures and model.

95. NOTES ON SOME FORAMINIFERA FROM
VENEZUELA AND COLOMBIA

By JOSEPH A. CUSHMAN and HOLLIS D. HEDBERG*

There is so little known concerning the fossil foraminifera of South America that a few notes on some interesting species may not be out of place. The Cretaceous of Venezuela and Colombia is similar in its general characters and in many of its species to the Cretaceous of Europe and of the Coastal Plain region of the United States. A few of the species from the Colon shale of Venezuela have already been noted in these "Contributions" (Volume 5, part 3, September, 1929). A few of the following species are new, and others seem to be worthy of at least recording.

ELPHIDIUM SUBSPHAERICUM Cushman and Hedberg, n. sp.

Plate 9, figures 1, 2

Test subspherical, the periphery very broadly rounded and the axis of coiling often broader than the height of the test; chambers distinct, slightly inflated, typically 8 or 9 in number; sutures slightly depressed, marked by the retral processes which number 12—16; wall smooth, coarsely perforate; aperture represented by numerous circular openings at the base of the apertural face of the last-formed chamber. Height 0.30-0.40 mm.; diameter 0.30-0.40 mm.

Holotype (Cushman Coll. No. 14,012) from Middle Miocene, Urumaco formation, District of Democracia, State of Falcon, Venezuela.

This is a very thick, rounded species with its nearest relative typical *Elphidium striato-punctatum* of the Red Sea, but from which it differs in the much smaller size and in the much fewer chambers, and the greater inflation of the chambers. This species apparently has a rather limited stratigraphic range in the Urumaco formation (Middle Miocene) of northern Falcon. The described specimens are from well samples which to the extent of present knowledge show the occurrences of this species to be limited to a zone only a few hundred feet thick. Other species of *Elphidium* are fairly common throughout the whole formation which is several thousand feet thick.

* Published by permission of the Venezuela Gulf Oil Co.

The following Venezuelan species are from a sample from the basal part of the Colon shale (Upper Cretaceous) of the District of Esuque, State of Trujillo, Venezuela. The worn appearance of the specimens is doubtless due to abrasion occurring on the sea floor at the time of deposition of the enclosing sediments. These specimens are rather certainly indigenous to the Colon formation. It is noteworthy that the non-marine Lower Tertiary sediments on the Colombian side of the Eastern Andean Cordillera frequently carry worn detrital specimens of Upper Cretaceous foraminifera among which are Upper Cretaceous Buliminidae including these species of *Bolivina* noted below.

KYPHOPYXA CHRISTNERI (Carsey)

Plate 9, figure 5

Frondicularia christneri CARSEY, Univ. Texas Bull. 2612, 1926, p. 41, pl. 6, fig. 7.

Kyphopyxa christneri CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 5, 1929, p. 1, pl. 1, figs. 1-7; vol. 6, 1930, p. 33, pl. 4, fig. 20.

One of the interesting species in the Colon shale is this species of *Kyphopyxa* which was evidently widely distributed in the Cretaceous sea about the Gulf of Mexico and Caribbean region. There is some doubt as to the California record of this species. So far as the specimens from Venezuela show, they are identical with specimens from Texas, Arkansas, and Florida.

BULIMINELLA D'ORBIGNYI (Reuss)

Plate 9, figure 3

Bulimina d'Orbigny REUSS, Verstein. Böhm. Kreide, 1845-6, pt. 1, p. 38, pl. 13, fig. 74.

From Reuss's original figure quoted above, this species apparently has four chambers in the last-formed coil similar to that shown here. Later authors have used this name for a typical tri-serial *Bulimina*, but it seems from the original references that it be applied to this form which is a *Buliminella*.

BULIMINELLA COLONENSIS Cushman and Hedberg, n. sp.

Plate 9, figures 6, 7

Test with comparatively few coils, nearly as broad as long, at least in the microspheric form, the initial end pointed, apertural end broadly rounded; chambers 5 or 6 in the last-formed coil, elongate, rather uniformly increasing in size as added, very slightly inflated; sutures distinct, very slightly depressed; wall smooth; aperture broadly comma-shaped, the greatest breadth at the inner end of the aperture. Length up to 0.40 mm.; diameter 0.35 mm.

Holotype (Cushman Coll. No. 14,025) from Upper Cretaceous, Colon shale, Department of Esuque, State of Trujillo, Venezuela.

This is a really unique species in its very broad form with the last-formed coil occupying most of the area of the test. The megalospheric form figured seems to be the same species, but has a more narrow form and is more tapering. In some respects the species resembles *Rotaliatina*, and the more slender form suggests *Robertina*, but the chambers are not truly in two series in the same coil.

BOLIVINA EXPLICATA Cushman and Hedberg, n. sp.
Plate 9, figures 8, 9

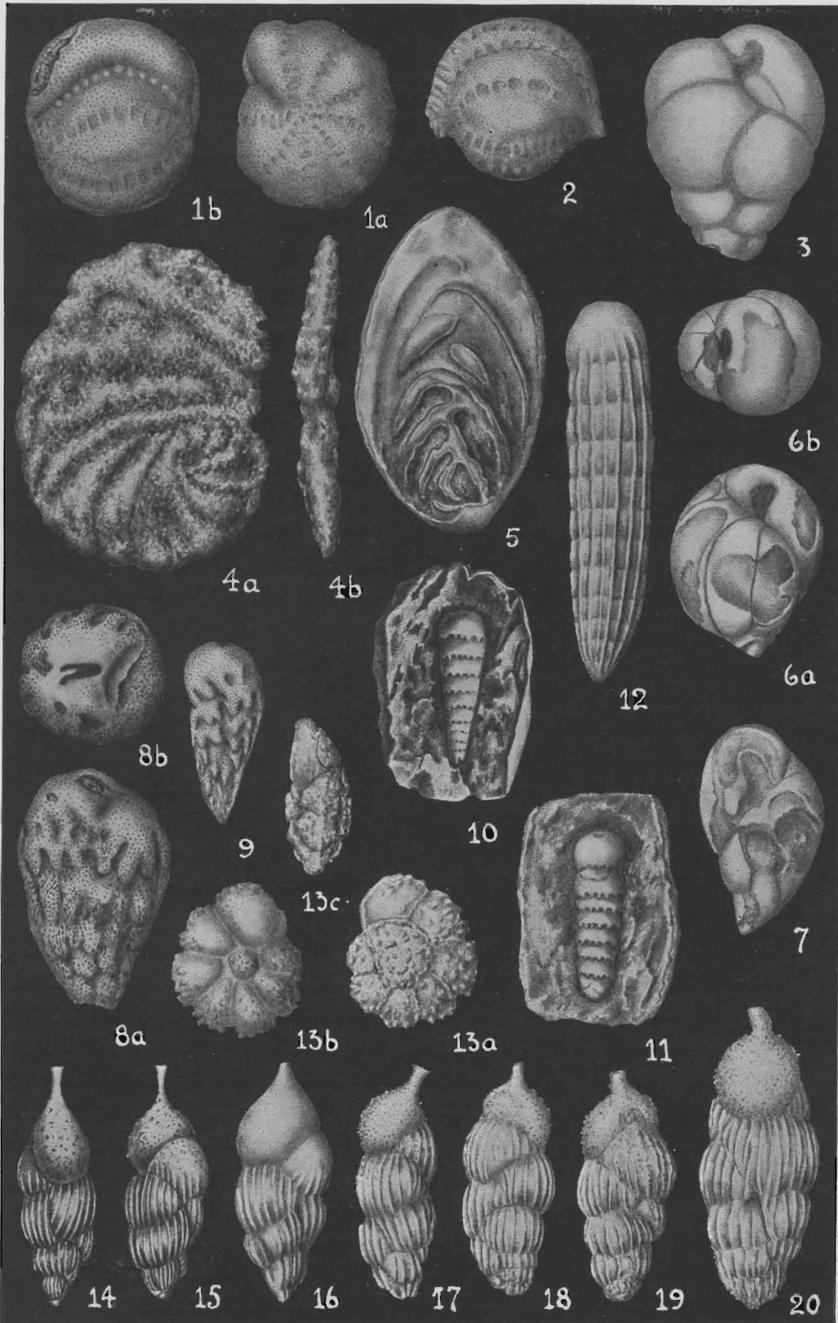
Test very stout, greatest breadth near the apertural end, thence gradually tapering to the initial end, in end view nearly circular; chambers fairly distinct, biserial, with the basal portion extended into numerous finger-like processes with deep depressions between, apertural face somewhat smooth; sutures fairly distinct, following the line of the depressions and passing under the finger-like processes; wall very coarsely perforated; aperture at the base of the apertural face, but in adults becoming somewhat terminal. Length 0.80 mm.; diameter 0.50 mm.

Holotype (Cushman Coll. No. 14,017) from Upper Cretaceous, Colon shale, Department of Esuque, State of Trujillo, Venezuela.

EXPLANATION OF PLATE 9

- FIGS. 1, 2. *Elphidium subsphaericum* Cushman and Hedberg, n. sp. $\times 75$. a, side view; b, apertural view.
 FIG. 3. *Buliminella d'orbignyi* (Reuss). $\times 75$.
 FIGS. 4 a, b. *Ammobaculites colombiana* Cushman and Hedberg, n. sp. $\times 40$. a, side view; b, peripheral view.
 FIG. 5. *Kyphopyxa christneri* (Carsey). $\times 40$.
 FIGS. 6, 7. *Buliminella colonensis* Cushman and Hedberg, n. sp. $\times 75$. Fig. 6, Holotype. a, side view; b, apertural view.
 FIGS. 8, 9. *Bolivina explicata* Cushman and Hedberg, n. sp. $\times 40$. Fig. 8, Holotype. a, front view; b, apertural view.
 FIGS. 10-12. *Siphogenerinoides ewaldi* (Karsten). Fig. 10, After type figure of Karsten. Fig. 11, Venezuela specimen. $\times 25$. Cast of interior. Fig. 12, Drawn from wax cast of exterior. $\times 50$.
 FIGS. 13 a-c. *Rotalia fimbriatula* Cushman and Hedberg, n. sp. $\times 75$. a, dorsal view; b, ventral view; c, peripheral view.
 FIGS. 14-20. *Uvigerina pigmea* d'Orbigny. Figs. 14, 15, After d'Orbigny's type figures. Fig. 16, After d'Orbigny's model. Figs. 17-20, Topotype specimens. $\times 55$.

Figures drawn by Margaret S. Moore



In some respects this species resembles *Loxostomum*, and perhaps should be included there, as the aperture in the largest forms becomes somewhat terminal. It also resembles *Bolivinooides* in the thickened last chamber, but the early chambers are not distinct enough to show its full development. It is related to some of the large Cretaceous forms of the Upper Cretaceous of Texas, but is much more highly developed than any of these.

Besides these species already noted, this sample of Colon shale contains *Gyroidina depressa* (Alth) and numerous other species.

SIPHOGENERINOIDES EWALDI (Karsten)

Plate 9, figures 10-12

In the previous paper mentioned the species *S. ewaldi* (Karsten) was noted. We have a specimen of the Colon shale containing great numbers of a species which is probably that of Karsten. These, like the original figure, are all represented by internal casts. The molds of the exterior are very perfectly preserved in many cases. Impressions of these were taken with wax, and one of these is here figured (Pl. 9, fig. 12) to give the appearance of the exterior as well as one of the specimens showing the appearance of the specimen in the matrix. These show the costae rather higher and sharper than in either *Siphogenerinooides parva* Cushman or *S. cretacea* Cushman. A drawing of Karsten's original figure is given for comparison (Pl. 9, fig. 10).

The following two species are from the Upper Cretaceous of Colombia, and both appear to be new.

AMMOBACULITES COLOMBIANA Cushman and Hedberg, n. sp.

Plate 9, figures 4 a, b

Test comparatively large, very much compressed, only the last 2 or 3 chambers uncoiled, the rest forming a close coiled planispiral young; chambers fairly distinct, numerous, 8—10 in the last whorl of the coiled portion, very slightly inflated in the adult; sutures fairly distinct, slightly depressed; wall rather coarsely arenaceous with considerable cement and rather smoothly finished; aperture elliptical, terminal. Length of holotype 1.10 mm.; breadth 0.90 mm.

Holotype (Cushman Coll. No. 14,030) from the Upper Cretaceous, Rio Lebrija, Department of Santander, Colombia.

This is a very fine species, somewhat resembling certain of those of the Cretaceous of Europe but distinct from any of those described.

ROTALIA FIMBRIATULA Cushman and Hedberg, n. sp.

Plate 9, figures 13 a-c

Test with the ventral side nearly flat, dorsal side strongly convex, periphery subacute, lobed, ventral side with a large central plug; chambers 8—10 in number in the last whorl, somewhat inflated, distinct on the ventral side, less so on the dorsal; sutures on the dorsal side indistinct, nearly radial, on the ventral side distinct, radial; wall of the dorsal side very strongly papillate, with fairly large papillae, ventrally more nearly smooth; aperture, a low opening at the margin of the last-formed chamber on the ventral side between the periphery and the ventral plug. Diameter 0.30 mm.; height 0.15 mm.

Holotype (Cushman Coll. No. 14,037) from the Upper Cretaceous of the Rio Lebrija about 1½ kilometers W. of Chichira, Department of Santander, Eastern Colombia.

This highly ornamented species is widespread throughout the Upper Cretaceous of the Department of Santander, Colombia, and is also known from the Upper Cretaceous of the State of Tachira, Venezuela.

RECENT LITERATURE ON THE FORAMINIFERA

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

Viennot, P.

Sur la valeur paleontologique et stratigraphique d'*Orbitolina subconca* Leymerie.

(Comptes Rendus Soc. Geol. France, No. 6, 1929, pp. 75-77.)
Paris.

The author makes *O. subconca* a simple variety of *O. conoidea*, and discusses the occurrences of several species.

Böckh, H. de and P. Viennot.

Sur la Geologie de l'Irak.

(Comptes Rendus seances Acad. Sci. Paris, vol. 189, 1929, pp. 1000-1002.)
Paris.

Discusses the stratigraphy of Irak with characteristic foraminifera.

Lacroix, Eugene.

Textularia sagittula ou *Spiroplecta Wrightii*?

(Bull. Instit. Oceanographique, No. 532, Jan. 25, 1929, pp. 1-12, text figs. 1-12.)
Monaco.

Discusses the relationships of these two forms and unites them.

Lacroix, Eugene.

Les *Astrorhizides* du littoral méditerranéen entre Saint-Raphaël et Monaco.

(l. c., Bull. 545, Oct. 25, 1929, pp. 1-22, text figs. 1-32.)
Monaco.

Nineteen species and varieties discussed and figured, none new.

Lacroix, Eugene.

Les *Lituolidés* du plateau continental méditerranéen entre Saint-Raphaël et Monaco.

(l. c., Bull. 549, Feb. 20, 1930, pp. 1-16, text figs. 1-21.)
Monaco.

Sixteen species and varieties described and figured, five new.

Hofker, J.

The Foraminifera of the Siboga Expedition, Part II. Families Astrorhizidae, Rhizamminidae, Reophacidae, Anomalinidae, Peneroplidae. With an Introduction of the Life Cycle of the Foraminifera.

(Siboga-Exped., Mon. IV. a, January, 1930, pp. 79-170, pls. xxxix-lxiv, text figs. 12-33.) *Leiden.*

Many beautiful plates with illustrations of Trimorphism. A detailed account of the life history of various forms, with relations to season, temperature, etc.

Chapman, Frederick, and Irene Crespin.

Rare Foraminifera from Deep Borings in the Victorian Tertiaries—*Victoriella*, gen. nov., *Cyclocypeus communis* Martin, and *Lepidocyclina borneensis* Provale.

(Proc. Roy. Soc. Victoria, vol. 42, pt. 2, March 10, 1930, pp. 110-115, pls. VII, VIII.) *Melbourne.*

Includes a new family, *Victoriellidae*, containing *Eoruperia* and the new genus, *Victoriella*.

Silvestri, A.

Forme insufficientemente o poco conosciute del Devoniano, del Carbonifero e del Permiano.

(Mem. Pont. Accad. Sci. Nuovi Lincei, ser. 2, vol. 14, 1930, pp. 1-24, pls. 1, 2, text figs. 8-12.) *Rome.*

Includes *Schwagerina craticulifera* Schwager from Dalmatia.

Cushman, Joseph A.

The Foraminifera of the Choctawhatchee Formation of Florida. (Florida State Geol. Survey, Bull. 4, 1930, pp. 1-89, pls. 1-12.)

Tallahassee.

Gives descriptions of 116 species and varieties (13 new), and figures nearly all.

Norton, Richard D.

Ecologic Relations of Some Foraminifera.

(Bull. Scripps Instit. Oceanography, Tech. Ser., Vol. 2, No. 9, 1930, pp. 331-388.) *Berkeley.*

Discusses depth and temperature control of various families and species.

Davies, L. M.

The Genus *Dictyoconus* and Its Allies: A Review of the Group, Together with a Description of Three New Species from the Lower Eocene Beds of Northern Baluchistan.

(Trans. Roy. Soc. Edinburgh, vol. 56, pt. 2, No. 20, 1930, pp. 485-505, pls. I, II.)

Edinburgh.

Detailed discussion of the relationships of the genera and their structure, with excellent plates.