

CONTRIBUTIONS FROM THE CUSHMAN  
LABORATORY FOR FORAMINIFERAL RESEARCH

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119. NOTES ON SOME ARENACEOUS FORAMINIFERA  
FROM THE TEMBLOR FORMATION OF CALIFORNIA

By JOSEPH A. CUSHMAN and WILLIAM F. BARBAT

An unusually complete collection of well preserved Temblor arenaceous foraminifera has been secured from a well drilled in the vicinity of Bakersfield, California. This well is known as Barnsdall No. 1, and is located in the Southwest corner of Section 20, Township 27 South, Range 28 East, Mount Diablo Base Line and Meridian. Permission to use the material from this well was kindly granted by the Barnsdall Oil Company. Mr. W. P. Winham, Mr. W. H. Corey, and Dr. H. G. Schenck have aided the writers with valuable information about the Miocene of the San Joaquin Valley, California.

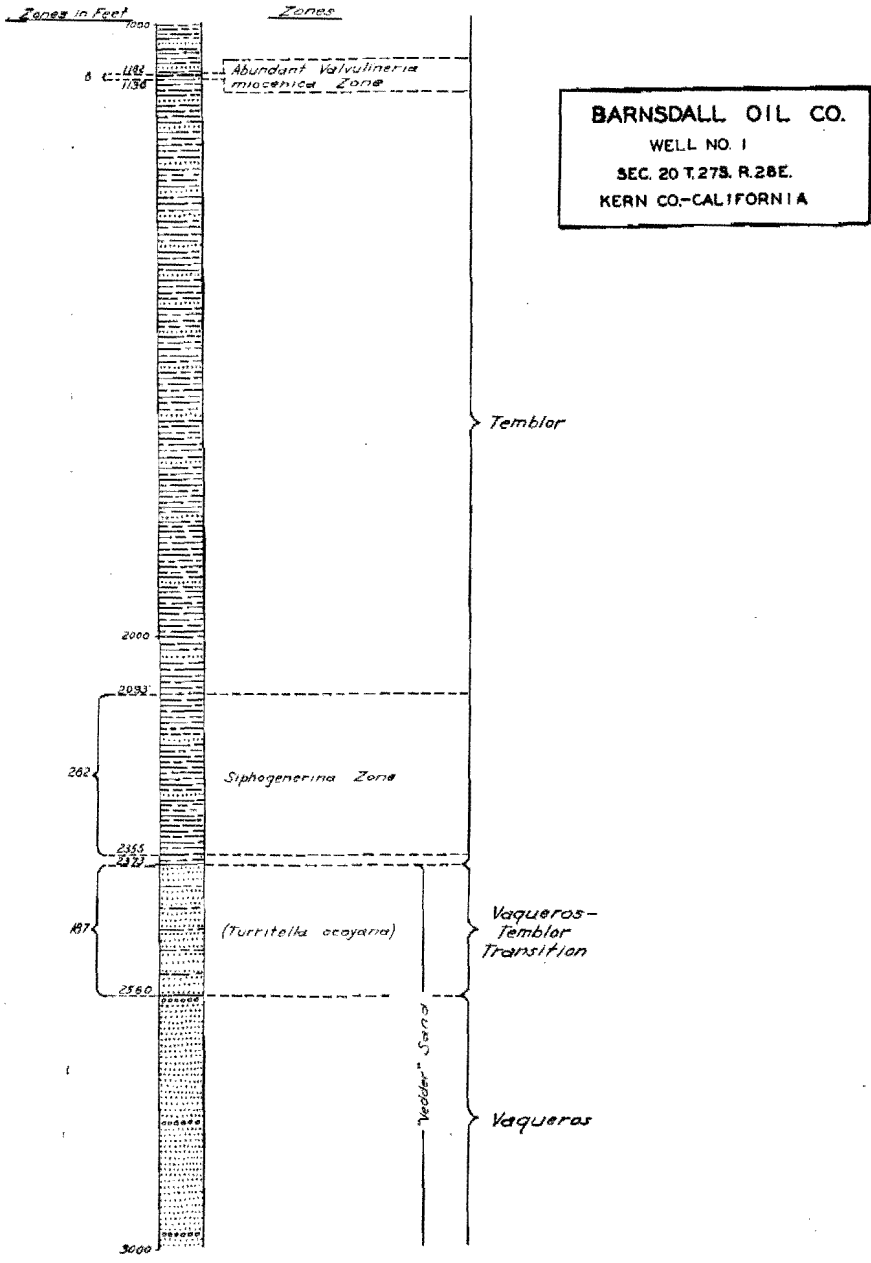
The name "Temblor" was applied to a series of sandstones and shales found stratigraphically below the Monterey shale and above so-called Tejon sandstone at Carneros Springs on the West side of the San Joaquin Valley, Kern County, California<sup>1</sup>.

It has long been recognized by Anderson<sup>2</sup> that the correlative of the Carneros Springs beds occurs on the East side of the San Joaquin Valley, near Bakersfield. In the latter locality the Temblor beds overly Vaqueros sandstone and non-marine "Walker Basin" formation<sup>3</sup>. These non-marine beds are equivalent to the Tecuya beds at the South end of the San Joaquin Valley and together they appear to correlate with the Sespe Formation of

<sup>1</sup> Anderson, F. M., "Stratigraphic Study in the Mount Diablo Range of California." Proc. Calif. Acad. Sci., 3rd series, vol. 2, No. 2, 1905.

<sup>2</sup> Anderson, F. M., "The Neocene deposits of Kern River, California, and the Temblor Basin." Proc. Calif. Acad. Sci., 4th series, vol. 3, 1911.

<sup>3</sup> Hanna, G. Dallas, "Geology of Sharktooth Hill, Kern County, California." Proc. Calif. Acad. Sci., 4th series, vol. 19, No. 7, 1930, p. 77.



Ventura County<sup>4</sup>. The sandstones above the "Walker Basin" formation contain Vaqueros molluscan fossils in the lower portion and a "transitional Vaqueros-Temblor assemblage" in the upper part<sup>5</sup>. When penetrated in wells, the top portion of this sandstone is known as the "Vedder sandstone", and is quite easily distinguished from the overlying beds.

Between 1,000 and 1,500 feet of foraminifera-bearing shales rest upon the "Vedder sandstone". The arenaceous foraminifera were secured from this portion of the section. The associated calcareous foraminiferal fauna from these beds has enabled us to correlate them with Temblor shales lying between the Carneros sandstone member<sup>6</sup> and the lower Temblor sandstone reef of Carneros Springs. A correlation is also suggested with the *Nodosaria* Division of the Salinas shales of the Salinas Valley, California, as defined by Kleinpell<sup>7</sup>.

The foraminifera-bearing shales grade upward into fossiliferous sandstones designated as Zone "B" by F. M. Anderson<sup>8</sup>. The fauna from this zone is well known and has been frequently referred to as the *Agasoma barkeriana* Zone of the Temblor. Zone "B" is exposed on both sides of Kern River and on the West side of the San Joaquin Valley near the top of the Temblor formation where it underlies shales containing a Monterey assemblage of foraminifera. The micro-fauna from these shales is chiefly marked by *Valvulineria californica* Cushman, which gives its name to the *Valvulineria californica* Zone. This faunal zone is recognized in the basal beds of the Monterey formation near the town of Monterey, California, and at Carneros Springs, Kern County, California.

The section shown in drilling Barnsdall Oil Co. Well No. 1 is graphically represented in figure 1<sup>9</sup>.

<sup>4</sup> Hoots, H. W., "Geology and Oil Resources Along the Southern Border of the San Joaquin Valley, California." Bull. 812-D, U. S. Geol. Survey, 1930, pp. 259-268.

<sup>5</sup> Corey, W. H., Personal communication. Mr. Corey and Mr. Wayne Lowell have a paper in preparation covering results of an extensive study of the stratigraphy of the Vaqueros formation.

<sup>6</sup> A name employed by H. G. Schenk for the prominent sandstone containing *Pecten miguelensis* Arnold near the middle of the Type Temblor section.

<sup>7</sup> Kleinpell, Rob't., Unpublished thesis, Leland Stanford Jr. University.

<sup>8</sup> Anderson, F. M., Proc. Calif. Acad. Sci., 4th series, vol. 3, 1911, p. 85.

<sup>9</sup> Compare—Hanna, G. D., Proc. Calif. Acad. Sci., 4th series, vol. 19, No. 7, 1930, figs. 2, 3.

## Family RHIZAMMINIDAE

Genus BATHYSIPHON M. Sars, 1872

BATHYSIPHON FILIFORMIS M. Sars (?) (Pl. 5, fig. 1)

The figured specimen represents a characteristic fragment of a species of *Bathysiphon* which may be referred to *B. filiformis*. None of the specimens represent more than a very short fragmentary portion.

Temblor Formation, Barnsdall No. 1, depth 1,894'-1,904' (Cushman Coll. No. 16105); associated with *Textularia mexicana* Cushman, *Cyclammina incisa* (Stache), *Clavulina flintiana* Cushman, and *Globobulimina pacifica* Cushman.

## Family LITUOLIDAE

Genus CYCLAMMINA H. B. Brady, 1876

CYCLAMMINA INCISA (Stache) (Pl. 5, figs. 2 a, b)

*Haplophragmium incisum* STACHE, *Novara-Exped.*, Geol. Theil, vol. 1, 1864, p. 165, pl. 21, fig. 1.

*Cyclammina incisa* CHAPMAN, New Zealand Geol. Survey, Pal. Bull. No. 11, 1926, p. 29, pl. 2, fig. 1.—CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 93, pl. 9, figs. 6 a, b.

Test much compressed, umbilicate; chambers eight or ten in the last-formed coil, somewhat irregular in size; sutures slightly depressed, slightly curved, nearly radial; wall finely arenaceous, rather smoothly finished. Diameter slightly more than 1 mm.

This species is recorded from the Tertiary of New Zealand and the Miocene of Los Sauces Creek. Our specimens from the Temblor are very similar. Our specimens are somewhat compressed, but the figured specimen is fairly well preserved.

Figured specimen (Cushman Coll. No. 16106) from Temblor Formation, Barnsdall No. 1, depth 1,730'-1,749'; associated with *Textularia laevigata* d'Orbigny, *Nonion costiferum* (Cushman), and *Uvigerinella obesa* Cushman.

## Family TEXTULARIIDAE

Genus TEXTULARIA Defrance, 1824

TEXTULARIA LAEVIGATA d'Orbigny (Pl. 5, figs. 6 a, b, 7)

*Textularia laevigata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 262, No. 2; Foram. Foss. Bass. Tert. Vienne, 1846, p. 243, pl. 14, figs. 14-16.

Test elongate, rather rapidly enlarging in the early stages but with the sides nearly parallel in the adult, periphery rounded;

chambers distinct, slightly overlapping, fairly high; sutures distinct, slightly depressed, sloping backward at an angle of about  $35^\circ$  from the horizontal; wall distinctly arenaceous, but smoothly finished; aperture narrow, at the base of the apertural face. Length up to 1.25 mm.; breadth 0.60 mm.; thickness 0.35-0.40 mm.

Specimens of this species which is known from the Miocene of Europe are well preserved in this collection from the Temblor.

Figured specimens (Cushman Coll. No. 16107, 16108) from Temblor Formation, Barnsdall No. 1, depth 1,140'-1,155'; associated with *Gaudryina trinitatensis* Nuttall, *Gaudryina triangularis* Cushman, *Bolivina advena* Cushman, *Eponides mansfieldi* Cushman, and *Nonion incisum* (Cushman).

**TEXTULARIA MEXICANA** Cushman (Pl. 5, figs. 3 a, b)

*Textularia rugosa* REUSS, var., GOËS, Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 43, pl. 5, figs. 4, 5.

*Textularia carinata* FLINT (not D'ORBIGNY), Rep't U. S. Nat. Mus., 1897 (1899), p. 284, pl. 29, fig. 1.

*Textularia mexicana* CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 17, pl. 2, fig. 9; Contr. Cushman Lab. Foram. Res., vol. 5, 1929, p. 79, pl. 12, fig. 4.

*Textularia flabelliformis* GALLOWAY and MORREY (not GÜMBEL), Bull. Amer. Pal., vol. 15, No. 55, 1929, p. 35, pl. 5, figs. 8 a, b.

Test much compressed, about  $1\frac{1}{2}$  times as long as broad in the adult, the apical end triangular, bluntly pointed, apertural end rounded or slightly angular, periphery acute, test thickest near the middle, narrowly rhomboid in end view; chambers numerous, distinct, broadest at the apertural end, thence concave toward the inferior margin; sutures depressed, above the thickened line of the margin of the previous chamber; wall coarsely arenaceous, roughened on the ridges; aperture semicircular at the base of the inner margin of the chamber. Length 1.10 mm.; breadth 0.60-0.85 mm.; thickness 0.20-0.30 mm.

This species, originally described from the Gulf of Mexico, occurs fossil in the Miocene of Ecuador and Venezuela.

Figured specimen (Cushman Coll. No. 16109) from Temblor Formation, Barnsdall No. 1, depth range 1,700'-1,904'.

## Family VERNEUILINIDAE

Genus GAUDRYINA d'Orbigny, 1839

GAUDRYINA SUBROTUNDATA Schwager (Pl. 5, figs. 8, 9 a, b)

*Gaudryina subrotundata* SCHWAGER, *Novara-Exped.*, Geol. Theil, vol. 2, 1866, p. 198, pl. 4, fig. 9.

Test elongate, early portion conical, triserial, later portion sub-cylindrical, biserial, sides nearly parallel; chambers distinct except in the early triserial portion, slightly inflated, somewhat overlapping; sutures in the biserial portion, distinct, slightly depressed, nearly at right angles to the periphery; wall finely arenaceous, smoothly finished; aperture, a low arch at the base of the inner margin of the chamber. Length up to 1.40 mm.; diameter 0.50 mm.

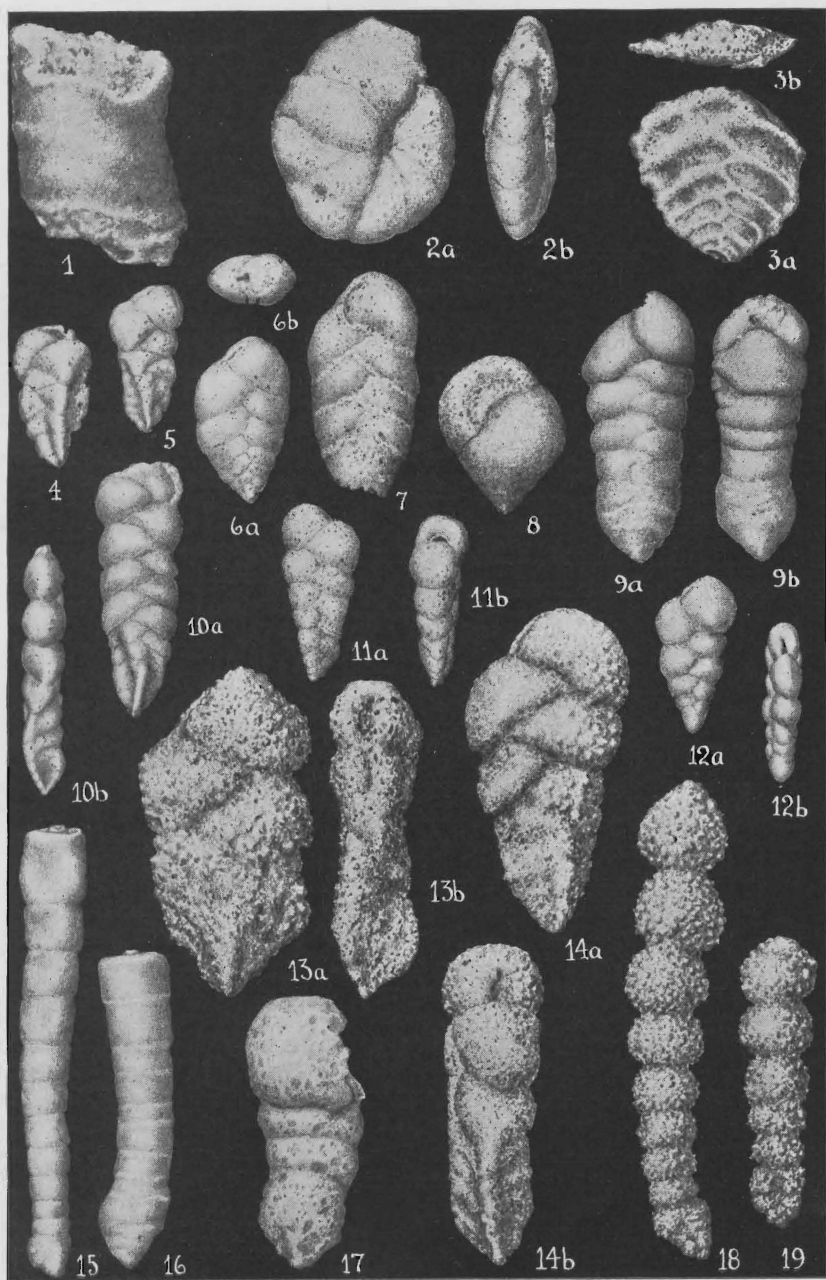
This species originally described from the Pliocene of Kar Nicobar has been recorded in the Late Tertiary of other parts of the Pacific and elsewhere. The early stage before the biserial portion is developed (Pl. 5, fig. 8) may easily be mistaken for a species of *Verneuilina*.

## EXPLANATION OF PLATE 5

All figures  $\times 25$ 

- FIG. 1. *Bathysiphon filiformis* M. Sars (?).  
 FIGS. 2 a, b. *Cyclammmina incisa* (Stache). a, side view; b, peripheral view.  
 FIGS. 3 a, b. *Textularia mexicana* Cushman. a, front view; b, apertural view.  
 FIGS. 4, 5. *Gaudryina trinitatensis* Nuttall. Early stages.  
 FIGS. 6, 7. *Textularia laevigata* d'Orbigny. Fig. 6, a, front view; b, apertural view.  
 FIGS. 8, 9. *Gaudryina subrotundata* Schwager. Fig. 8, Early triserial stage easily mistaken for *Verneuilina*. Fig. 9, a, front view; b, side view.  
 FIGS. 10 a, b. *Gaudryina trinitatensis* Nuttall. a, front view; b, side view.  
 FIGS. 11 a, b. *Gaudryina triangularis* Cushman. a, front view; b, side view. Plesiotype.  
 FIGS. 12 a, b. *Gaudryina lobatula* Cushman and Barbat, n. sp. a, front view; b, side view.  
 FIGS. 13 a, b. *Gaudryina atlantica* (Bailey), var. *asperita* Cushman and Barbat, n. var. a, front view; b, side view.  
 FIGS. 14 a, b. *Gaudryina atlantica* (Bailey). a, front view; b, side view.  
 FIGS. 15, 16. *Clavulina communis* d'Orbigny.  
 FIG. 17. *Clavulina flintiana* Cushman.  
 FIGS. 18, 19. *Clavulina humilis* H. B. Brady, var. *mexicana* Cushman.

Figures drawn by Margaret S. Moore.



Figured specimens (Cushman Coll. No. 16110, 16111) from Temblor Formation, Barnsdall No. 1, depth 2,093'-2,103'; associated with *Epistomina elegans* (d'Orbigny), *Globobulimina pacifica* Cushman, *Gyroidina soldanii* d'Orbigny, *Robulus nikobarensis* (Schwager), and *Siphogenerina transversa* Cushman.

GAUDRYINA TRINITATENSIS Nuttall (Pl. 5, figs. 4, 5, 10 a, b)

*Gaudryina trinitatensis* NUTTALL, Quart. Journ. Geol. Soc., vol. 84, 1928, p. 76, pl. 3, figs. 15, 16.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 5, 1929, p. 80, pl. 12, fig. 7.

Test elongate, slender, the early triserial portion triangular in section with the sides somewhat concave, biserial portion somewhat compressed, periphery lobulated, sides nearly parallel; chambers distinct, those of the biserial portion somewhat inflated; sutures distinct, early triserial portion flush with the surface, later ones somewhat depressed, forming an angle of 20°-30° with the horizontal; aperture semi-elliptical with a slight tooth. Length 1.35 mm.; breadth 0.45 mm.

This species described by Nuttall from the Tertiary of Trinidad also occurs in the Miocene of Ecuador, and probably is widely distributed in the American Miocene. The triserial stage is unusually prolonged.

Figured specimens (Cushman Coll. No. 16113-16115) from Temblor Formation, Barnsdall No. 1, depth range of species 1,140'-2,118'.

GAUDRYINA TRIANGULARIS Cushman (Pl. 5, figs. 11 a, b)

*Gaudryina triangularis* CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 65, figs. 104 a-c (in text); Bull. 103, U. S. Nat. Mus., 1918, p. 56, pl. 20, fig. 3; Proc. U. S. Nat. Mus., vol. 56, 1919, p. 604; Publ. 291, Carnegie Instit. Washington, 1919, p. 35; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 148; Prof. Paper 129-F, U. S. Geol. Survey, 1922, p. 127; Prof. Paper 133, 1923, p. 21, pl. 3, fig. 5; Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, 1927, p. 138.—CUSHMAN and WICKENDEN, Proc. U. S. Nat. Mus., vol. 75, Art. 3, 1929, p. 2, pl. 1, figs. 1 a, b.—CUSHMAN, R. E. and K. C. STEWART, Trans. San Diego Soc. Nat. Hist., vol. 6, 1930, p. 51, pl. 1, fig. 2.—CUSHMAN and PARKER, Contr. Cushman Lab. Foram. Res., vol. 7, 1931, p. 2, pl. 1, fig. 1.—CUSHMAN and LAI-MING, Journ. Pal., vol. 5, 1931, p. 95, pl. 9, figs. 8, 9.

Test somewhat longer than broad, for the most part triangular, the angles subacute; early chambers triserially arranged, later ones biserial, few, slightly inflated; sutures distinct, those of the



biserial portion nearly at right angles to the periphery, slightly depressed; wall coarsely arenaceous, smoothly finished; aperture, a narrow slit at the base of the inner face of the last-formed chamber. Length 0.90 mm.; breadth 0.40-0.50 mm.; thickness 0.25 mm.

This species is recorded from the Pacific and in the Pliocene, Miocene and Oligocene of the United States, Cuba and Panama. It is subject to considerable variation in shape according to the number of chambers developed in the biserial portion, this in turn being somewhat dependent on the microspheric and megalospheric forms.

Figured specimen (Cushman Coll. No. 16116) from Temblor Formation, Barnsdall No. 1, depth 1,140'-1,155'.

GAUDRYINA ATLANTICA (Bailey) (Pl. 5, figs. 14 a, b)

*Textularia atlantica* BAILEY, Smithsonian Contrib., vol. 2, art 3, 1851, p. 12, pl., figs. 38-43.

*Gaudryina atlantica* CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 70, pl. 13, figs. 1-3.

*Gaudryina rugosa* FLINT, Rep't U. S. Nat. Mus., 1897 (1899), p. 288, pl. 33, fig. 3.

*Verneuilina triquetra* GOËS (not MÜNSTER), Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 38.

Test elongate, triangular in section, the angles acute, triserial portion short, biserial portion mostly triangular, the last-formed chambers often rounded, tapering gradually from the blunt initial end to the broadly rounded apertural end; chambers distinct, only the last-formed ones showing inflation; sutures distinct, those of the biserial portion forming an angle of about 35° with the horizontal; wall coarsely arenaceous but rather smoothly finished; aperture elongate, slightly arched, in a deep reëntrant at the base of the inner border of the chamber. Length 1.75 mm.; breadth 0.80 mm.; thickness 0.50 mm.

This is a fine, large species. These fossil specimens seem to be identical with the Recent ones, although there is a tendency for the later chambers to become somewhat more inflated.

Figured specimen (Cushman Coll. No. 16117) from Temblor formation, Barnsdall No. 1, depth 2,093'-2,103'.

GAUDRYINA ATLANTICA (Bailey), var. ASPERITA Cushman and Barbat, n. var.

(Pl. 5, figs. 13 a, b)

Variety differing from the typical in the greater compression of the biserial portion of the test, and the much rougher surface.

Holotype of variety (Cushman Coll. No. 16118) from Temblor formation, Barnsdall No. 1, depth 2,093'-2,103'.

This variety occurs in the collection with the typical, but seems to be easily distinguished in this material.

GAUDRYINA LOBATULA Cushman and Barbat, n. sp. (Pl. 5, figs. 12 a, b)

Test of medium size, tapering from the bluntly pointed initial end to the greatest width formed by the last two chambers, strongly compressed, periphery rounded, lobulated in outline; chambers distinct, inflated, very slightly overlapping; sutures distinct, depressed, nearly horizontal; wall finely arenaceous, smoothly finished; aperture elongate, narrow, extending nearly halfway up the apertural face. Length 0.80 mm.; breadth 0.40 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 16119) from Miocene, Temblor formation, Barnsdall No. 1, depth 1,685'-1,700'; associated with *Cibicides floridanus* (Cushman), *Globobulimina pacifica* Cushman, *Nodosaria parexilis* var. *sentifera* Cushman and Parker, *Plectofrondicularia miocenica* Cushman, and *Uvigerinella obesa* Cushman.

This is a distinctive species with strongly inflated chambers, horizontal sutures, smoothly finished wall and very high, narrow aperture.

#### Genus CLAVULINA d'Orbigny, 1826

CLAVULINA COMMUNIS d'Orbigny (Pl. 5, figs. 15, 16)

*Clavulina communis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 268; Foram. Foss. Bass. Tert. Vienne, 1846, p. 196, pl. 12, figs. 1, 2.

Test elongate, subcylindrical, usually in the microspheric form broadest at the triserial stage, in the megalospheric form slightly increasing in diameter toward the apertural end, early portion triserial, later and much the larger portion, uniserial, circular in transverse section; chambers numerous, earlier ones indistinct; sutures distinct except in the early portion, very slightly if at all depressed; wall arenaceous, but smoothly finished; aperture in the early stages verneuiline, later becoming rounded and terminal with a slight neck. Length 1.00 mm. or more; diameter 0.15-0.18 mm.

The specimens from this Temblor collection are very typical and similar to those found in the Miocene of northern South America.

Figured specimens (Cushman Coll. No. 16120, 16121) from Barnsdall No. 1, depth 2,093'-2,103'.

## CLAVULINA FLINTIANA Cushman (Pl. 5, fig. 17)

*Valvulina triangularis* D'ORBIGNY, var. *eocaena* GOËS, Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, p. 88, pl. 11, figs. 401-403.

*Clavulina eocaena* GOËS (not GÜMBEL), Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 41, pl. 8, figs. 368-377; Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 36, pl. 4, figs. 16-25.—FLINT, Rep't U. S. Nat. Mus., 1897 (1899), p. 289, pl. 35, fig. 1.

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

*Clavulina flintii* CUSHMAN and MOYER, Contr. Cushman Lab. Foram. Res., vol. 6, 1930, p. 52, pl. 7, figs. 7-9.—CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 95, pl. 9, figs. 11 a, b.

Test cylindrical, the triserial portion short, the uniserial portion also short with only three or four chambers, transverse section rounded; chambers of the uniserial portion distinct, overlapping, somewhat inflated; sutures of the triserial portion indistinct, of the uniserial portion distinct and slightly depressed; wall coarsely arenaceous but the exterior smoothly finished; aperture, a simple rounded opening in the center of the end wall of the chamber. Length up to 1.45 mm.

This species is known from the western Atlantic and off the coast of California, and so it is not surprising to find it in the Miocene of California.

Figured specimen (Cushman Coll. No. 16122) from Temblor formation, Barnsdall No. 1, depth 1,894'-1,904'.

## CLAVULINA HUMILIS H. B. Brady, var. MEXICANA Cushman (Pl. 5, figs. 18, 19)

*Clavulina parisiensis* D'ORBIGNY, var. *humilis* FLINT (not H. B. BRADY), Rep't U. S. Nat. Mus., 1897 (1899), p. 289, pl. 36, fig. 1.

*Clavulina humilis* H. B. BRADY, var. *mexicana* CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 3, 1922, p. 83, pl. 16, figs. 1-3.

Test elongate, early portion sharply triangular, with a subacute apical end, later portion subcylindrical, slightly tapering; chambers of the early portion becoming somewhat more separate and distinct as added, those of the last-formed portion pyriform with a neck; sutures rather indistinct in the triserial portion, those of the later portion becoming distinct and depressed; wall coarsely arenaceous, the surface roughened; aperture terminal, central, at the end of the short tubular neck. Length up to 2.5 mm.; diameter 0.50 mm.

This is a common form in the Gulf of Mexico, and this Temblor material seems to be identical.

Figured specimens (Cushman Coll. Nos. 16123, 16124) from

Temblor formation, Barnsdall No. 1, depth 1,989'-2,005'; associated with *Buliminella subfusiformis* Cushman, *Gyroidina soldanii* d'Orbigny, *Lagena sulcata* Walker and Jacob, *Nonion costiferum* (Cushman), *Plectofrondicularia miocenica* Cushman, *Nodosaria koina* Schwager, *Uvigerinella obesa* Cushman.

## 120. ADDITIONAL NEW EOCENE FORAMINIFERA

By JOSEPH A. CUSHMAN and ALVA C. ELLISOR

A number of descriptions of new Tertiary foraminifera from Texas were published by the authors (Some New Tertiary Foraminifera from Texas. Contr. Cushman Lab. Foram. Res., vol. 7, 1931, pp. 51-59, pl. 7.) The notes and descriptions given below are of six new species and varieties from the Upper Eocene (Jackson) of Texas and Louisiana. Some of these are closely related to other species of the Eocene and Oligocene, but seem to be rather strictly limited in their vertical distribution, and, therefore, are of value as distinct markers in the Upper Eocene of the Gulf Coastal Plain region. The characters given in the descriptions and the illustrations should make these forms available for close stratigraphic work in this region.

**MASSILINA HUMBLEI** Cushman and Ellisor, n. sp. (Pl. 6, figs. 1 a-c)

Test much compressed, elongate, about twice as long as broad in side view, the apertural end somewhat projecting, periphery rounded; chambers distinct, in the adult with about five chambers visible on either side, of rather uniform shape, slightly projecting at either end and of nearly uniform width, occasionally slightly broader toward the base, early chambers of the quinqueloculine stage projecting slightly above the general surface of the adult; sutures distinct, slightly depressed; wall fairly smooth but marked by short, incised, longitudinal lines, and the chambers themselves slightly wrinkled transversely; aperture projecting, with a very slight lip, rounded, with a short, slightly bifid tooth. Length 1.40 mm.; breadth 0.70 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 16142) from the Eocene (Jackson) 4,468'-4,477' Humble Oil and Refining Co.'s No. 1 Oats, Humble Field, Harris County, Texas.

This species is rather widely distributed in the Upper Eocene of the Coastal Plain region, and is apparently characteristic of the Fayette division of the Jackson.

The transverse wrinkling of the test seems to be rather characteristic of the adult condition, but it is often not distinctly present in the younger stages. The incised lines of the wall, however, are found at all stages.

**NONION SCAPHUM** (Fichtel and Moll), var. **INFLATUM** Cushman and Ellisor, n. var.  
(Pl. 6, figs. 2 a, b)

Variety differing from the typical in the more rounded form, somewhat inflated chambers, in the adult rather deeply incised sutures, umbilical region often with numerous small papillae, earlier sutures slightly limbate; aperture an elongate, low, curved slit at the base of the apertural face of the last-formed chamber between it and the previous coil. Length 0.45 mm.; breadth 0.40 mm.; thickness 0.20 mm.

Holotype of variety (Cushman Coll. No. 16148) from the Eocene (Jackson), E. bank of Toro Bayou, S.E.  $\frac{1}{4}$  of N.W.  $\frac{1}{4}$  Sec. 6, T 3 N., R 11 W., Vernon Parish, Louisiana.

This variety seems to be a distinct marker of the Fayette portion of the Jackson. It is more circular in outline than the typical form of the species, and the last chambers particularly are more inflated. The suture lines are nearly straight. The type is perhaps slightly more circular than some of the specimens from the same locality, but is characteristic of the variety as a whole.

**NONION HANTKENI** (Cushman and Applin), var. **FAYETTEI** Cushman and Ellisor, n. var.  
(Pl. 6, figs. 3 a, b)

Test elongate, much compressed, slightly umbilicate, periphery rounded; chambers distinct, numerous, 10-12 in the last-formed whorl in the adult, increasing somewhat in length as added but changing very little in height; sutures distinct, slightly curved, those of the early portion limbate and often slightly raised, later ones becoming flush with the surface and the limbate character disappearing; wall smooth except for the slightly raised limbate sutures in the earlier portion, very finely perforate; aperture a narrow slit at the base of the apertural face of the last-formed chamber between it and the preceding coil. Length 0.50 mm.; breadth 0.35 mm.; thickness 0.15 mm.

Holotype of variety (Cushman Coll. No. 16144) from the Eocene (Jackson), E. bank of Toro Bayou, S.E.  $\frac{1}{4}$  of N.W.  $\frac{1}{4}$  Sec. 6, T 3 N., R 11 W., Vernon Parish, Louisiana.

This variety seems to be a definite marker for the Fayette division of the Upper Eocene. The limbate suture lines and the very considerable compression with the sides almost parallel will distinguish the variety. The last-formed chamber seems to be very delicate, and is usually broken away leaving a sharp line about the peripheral face as shown in our figure.

**TUBULOGENERINA EOCENICA** Cushman and Ellisor, n. sp. (Pl. 6, figs. 4 a, b)

Test elongate, usually nearly twice as long as broad, somewhat compressed, periphery broadly rounded, earlier portion triserial, later adult portion biserial and tending in the larger specimens to become uniserial; chambers fairly distinct, those of the later biserial portion more distinct and depressed; wall calcareous, ornamented with numerous, short, blunt, spinose projections rather evenly covering the entire surface; aperture in the adult elliptical, terminal, slightly projecting above the surface, with a slight lip. Length 0.30 mm.; breadth 0.20 mm.; thickness 0.10 mm.

Holotype (Cushman Coll. No. 16146) from the Eocene (Jackson) of Texas Co.'s No. 46, Fell 4,395'-4,402', Humble Field, Harris County, Texas.

This species is somewhat related to *Tubulogenerina aperta* Cushman described from the Lower Oligocene of the Byram calcareous marl, Byram, Mississippi. This genus is also known from the Eocene of Europe and the Miocene of Australia. The Eocene specimen seems to be somewhat more primitive, and is probably the ancestral form of the Lower Oligocene one. The triserial portion is more marked, and the tendency to become uniserial is not nearly as distinctive as in the Oligocene form.

**SIPHONINA CARLTONI** Cushman and Ellisor, n. sp. (Pl. 6, figs. 5 a-c)

Test very much compressed, usually plano-convex, the dorsal side flat or even slightly concave, ventral side gently convex and slightly umbilicate, periphery with a slight keel, usually somewhat serrate; chambers distinct, usually five in the last-formed whorl, all visible from the dorsal side, those on the ventral side slightly inflated, but in the last-formed coil not entirely reaching the center so that there is a small umbilical region; sutures distinct, on the dorsal side slightly limbate and strongly tangential, very slightly curved, on the ventral side slightly depressed, nearly

radial; wall smooth, very coarsely perforate, the perforations rather evenly scattered over the entire surface, periphery keeled and somewhat tubular; aperture an elongate, narrow, elliptical opening at the peripheral margin of the last-formed chamber, with a distinct lip. Diameter 0.55 mm.; thickness 0.10-0.12 mm.

Holotype (Cushman Coll. No. 16140) from the Eocene (Jackson), E. bank of Toro Bayou, S.E.  $\frac{1}{4}$  of N.W.  $\frac{1}{4}$  Sec. 6, T 3 N., R 11 W., Vernon Parish, Louisiana.

This species is distinct from the others already described from the Jackson formation. It may be distinguished by its very coarsely perforate surface, plano-convex test, and the slightly umbilicate ventral side, as well as the somewhat limbate character of the sutures on the dorsal side. It seems to be a distinctive marker for the Fayette division of the Jackson.

**DISCORBIS FARISHI** Cushman and Ellisor, n. sp. (Pl. 6, figs. 6 a-c)

Test plano-convex, the dorsal side slightly convex, ventral side nearly flat, periphery with a slight keel especially marked on the dorsal side, bluntly rounded, dorsal side with the chambers all visible, those on the ventral side continuing in to the umbilical area; chambers distinct, 7 or 8 in the last-formed whorl, increasing rather evenly in size as added, the last-formed ones increasing slightly more rapidly in the adult; sutures distinct, slightly limbate, those of the dorsal side strongly curved, not depressed, ventrally slightly depressed, strongly curved, opening into the umbilical region to form a stellate pattern; wall on the dorsal side very smooth, finely perforate, on the ventral side with numerous, elongate, raised areas on each chamber, in general radiate; aperture an elongate, narrow slit on the ventral side of the last-formed chamber extending from the umbilicus toward the periphery, and often with a slight lip. Diameter 0.35 mm.; thickness 0.08 mm.

Holotype (Cushman Coll. No. 16150) from the Eocene (Jackson), Caney Creek, back of Wooley house, Sec. 4, T 3 N., R 12 W., Sabine Parish, Louisiana.

This species is a very distinctive one in the smooth dorsal surface and variably ornamented ventral side. In the series of specimens we have, the ventral side shows a considerable diversity of ornamentation, but the general pattern is that already described, a series of elongate raised areas in general with their axis in a radial position.

121. SOME RECENT ANGULOGERINAS FROM THE  
EASTERN PACIFIC

By JOSEPH A. CUSHMAN

In studying some of the Recent material from the *Albatross* collections from the eastern Pacific, one station in particular, H 1805, from off the West coast of Mexico, Lat.  $18^{\circ} 33' 30''$  N., Long.  $114^{\circ} 44' W.$ , in 1,732 fms., bottom temperature  $35^{\circ} F.$ , has a very interesting foraminiferal fauna. Among the species occurring at this station are abundant specimens of *Angulogerina*. These are noted below. One at least of these species has already been recorded by Brady from this same general region.

## ANGULOGERINA CARINATA Cushman (Pl. 6, figs. 7, 8)

*Uvigerina angulosa* H. B. BRADY (not WILLIAMSON), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 74, fig. 18.

*Angulogerina carinata* CUSHMAN, Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, No. 10, 1927, p. 159, pl. 4, fig. 3.

Test generally triangular in section, initial end in mégalospheric form bluntly rounded, in the microspheric sharply pointed, triangular in transverse section, the angles sharp with carinae; chambers distinct, only slightly inflated, angular; sutures distinct, depressed; wall smooth, thick, opaque; aperture with a very short neck and distinct lip, terminal. Length up to 1.00 mm.; diameter 0.22-0.27 mm.

Brady recorded this species in the above reference from a *Challenger* station North of Juan Fernandez in comparatively deep water. I described the species in 1927 from *Guide* Station 12, Lat.  $32^{\circ} 28' N.$ , Long.  $118^{\circ} 20' W.$ , in 429 fms., and it also occurred at other stations in the same general region. In the present material taken by the *Albatross* the species is common, and shows some variation in the angularity of the chambers themselves although the peripheral angles are usually continuous, and has a considerable difference in the shape of the mégalospheric and microspheric specimens especially in the early portions as will be seen in the accompanying figures.



## ANGULOGERINA CARINATA Cushman, var. BRADYANA Cushman, n. var.

(Pl. 6, figs. 9, 10)

*Uvigerina angulosa* H. B. BRADY (not WILLIAMSON), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 74, fig. 17.

Variety differing from the typical in the ornamentation of the chambers which consists of numerous, low, longitudinal costae, those of each chamber separate from adjacent ones, the later chambers usually smooth.

Holotype of variety (Cat. No. 22368, U.S.N.M.) from *Albatross* H 1805.

This costate variety occurs with the type form, and was figured by Brady from the same *Challenger* station North of Juan Fernandez. Specimens referred to *Angulogerina carinata* Cushman were found in the same general region in the collections made by Dr. Waldo L. Schmitt from Cumberland Bay, Juan Fernandez. These specimens were also slightly costate.

## ANGULOGERINA ALBATROSSI Cushman, n. sp. (Pl. 6, figs. 11, 12)

Test elongate, irregular, early chambers spirally coiled, later ones becoming somewhat loosely uncoiled, initial end bluntly rounded, early chambers inflated and rounded, later ones becoming angular; sutures distinct, depressed; wall smooth; aperture terminal, with a slight neck and distinct phialine lip. Length up to 1.00 mm.; diameter 0.25-0.35 mm.

Holotype (Cat. No. 22371, U.S.N.M.) from *Albatross* H 1805.

This species is a common one in the collections, and shows a very considerable range of variation in its elongate, uncoiling shape in the adult. Only the last-formed chambers become decidedly angular. It is accompanied by the following variety.

## ANGULOGERINA ALBATROSSI Cushman, var. ORNATA Cushman, n. var.

(Pl. 6, figs. 13, 14)

Variety differing from the typical in the ornamentation of the chambers consisting of numerous longitudinal costae, those of each chamber distinct from adjacent ones, the last chamber often smooth. In this variety the later chambers become much more angular than in the typical form, and there is not the same tendency to have the chambers so loosely spiral.

Holotype of variety (Cat. No. 22373, U.S.N.M.) from *Albatross* H 1805.

This variety may be found to belong to a distinct species, as there are some considerable differences between this and the

typical form, both in the general shape and the tendency for the test to become more compact. The two occur together, however, and seem to be closely related.

ANGULOGERINA OCCIDENTALIS (Cushman) (Pl. 6, figs. 15, 16)

*Uvigerina angulosa* CUSHMAN (not WILLIAMSON), Publ. 311, Carnegie Instit. Washington, 1922, p. 34, pl. 5, figs. 3, 4.

*Uvigerina occidentalis* CUSHMAN, Bull. 104, U. S. Nat. Mus., pt. 4, 1923, p. 169.

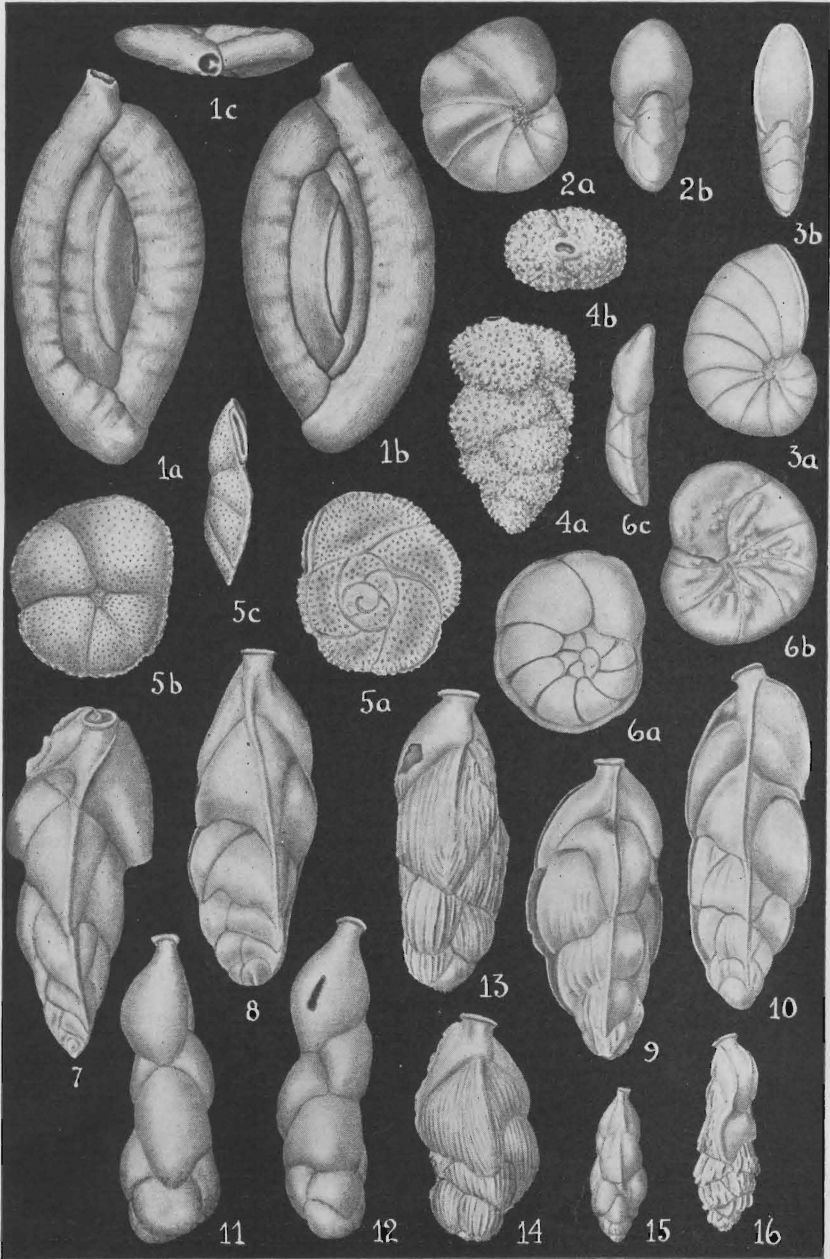
*Angulogerina occidentalis* CUSHMAN, Bull. 4, Fla. State Geol. Survey, 1930, p. 50, pl. 9, figs. 8, 9.—CUSHMAN and PARKER, Proc. U. S. Nat. Mus., vol. 80, Art. 3, 1931, p. 17.—COLE, Bull. 6, Fla. State Geol. Survey, 1931, p. 44, pl. 2, fig. 5.—CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 112, pl. 12, figs. 15, 16.

Test minute, elongate, triangular in transverse section, the periphery somewhat lobulate; chambers distinct, those of the last-formed portion becoming more distinct and remote; sutures distinct and depressed; wall ornamented with longitudinal costae on

EXPLANATION OF PLATE 6

- FIGS. 1 a-c. *Massilina humblei* Cushman and Ellisor, n. sp.  $\times 35$ . a, b, opposite sides; c, apertural view.
- FIGS. 2 a, b. *Nonion scaphum* (Fichtel and Moll), var. *inflatum* Cushman and Ellisor, n. var.  $\times 50$ . a, side view; b, apertural view.
- FIGS. 3 a, b. *Nonion hantkeni* (Cushman and Applin), var. *fayettei* Cushman and Ellisor, n. var.  $\times 50$ . a, side view; b, apertural view.
- FIGS. 4 a, b. *Tubulogerina eocenica* Cushman and Ellisor, n. sp.  $\times 100$ . a, front view; b, apertural view.
- FIGS. 5 a-c. *Siphonina carltoni* Cushman and Ellisor, n. sp.  $\times 45$ . a, dorsal view; b, ventral view; c, peripheral view.
- FIGS. 6 a-c. *Discorbis farishi* Cushman and Ellisor, n. sp.  $\times 65$ . a, dorsal view; b, ventral view; c, peripheral view.
- FIGS. 7, 8. *Angulogerina carinata* Cushman.  $\times 45$ . Fig. 7, Microspheric form. Fig. 8, Megalospheric form.
- FIGS. 9, 10. *Angulogerina carinata* Cushman, var. *bradyana* Cushman, n. var.  $\times 45$ . Fig. 9, Holotype.
- FIGS. 11, 12. *Angulogerina albatrossi* Cushman, n. sp.  $\times 45$ . Fig. 11, Holotype.
- FIGS. 13, 14. *Angulogerina albatrossi* Cushman, var. *ornata* Cushman, n. var.  $\times 45$ . Fig. 13, Holotype.
- FIGS. 15, 16. *Angulogerina occidentalis* (Cushman).  $\times 45$ . Fig. 15, Specimen with reduced costae. Fig. 16, Specimen with very prominent costae.

Figures drawn by Margaret S. Moore.



all but the last-formed chambers in the adult; apertural end drawn out into a short tubular neck and slight phialine lip. Length 0.45-0.60 mm.; diameter 0.15-0.20 mm.

This species is much less common than the others at this *Albatross* station. It is, however, widely distributed both in the West Indian region and in the Late Tertiary of both Florida and California. There is considerable variation in the amount of ornamentation, two extremes being shown in our figures.

### RECENT LITERATURE ON THE FORAMINIFERA

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

Parr, Walter J.

Victorian and South Australian Shallow-Water Foraminifera—Part I.

(Proc. Roy. Soc. Victoria, vol. XLIV, pt. 1, [New Series], Feb. 29, 1932, pp. 1-14, pl. 1, figs. A-E [in text].) *Melbourne.*

Describes and figures 20 forms, of which 5 are new.

Parr, Walter J.

A New Species of the Foraminifera. *Cassidulinoides chapmani.*

(Victorian Naturalist, vol. XLVIII, 1931, figs. a-c [in text].)

*Melbourne.*

This species is from the Miocene of Victoria.

Thomas, H. Dighton.

Origin of Spheres in the Georgetown Limestone.

(Journ. Pal., vol. 6, No. 1, March, 1932, pp. 100-101.)

*Menesha.*

Shows that these so-called Orbulinas are of inorganic origin.

Vaughan, Thomas Wayland.

American Species of the Genus *Dictyoconus.*

(Journ. Pal., vol. 6, No. 1, March, 1932, pp. 94-99, pl. 14.)

*Menesha.*

An account of 5 forms with figures.

Nuttall, W. L. F.

Lower Oligocene Foraminifera from Mexico.

(Journ. Pal., vol. 6, No. 1, March, 1932, pp. 3-35, pls. 1-9.)

*Menesha.*

A large fauna is described and illustrated with 23 new species and 5 new varieties.

Nuttall, W. L. F.

The Stratigraphy of the Upper Ranikot Series (Lower Eocene) of Sind, India.

(Rec. Geol. Surv. India, vol. LXV, pt. 2, 1931, pp. 306-313.)

Records a few foraminiferal species.

Lacroix, E.

Textularidae du plateau continental mediterraneen entre Saint-

Raphael et Monaco.

(Bull. Instit. Oceanographique, No. 591, Feb. 15, 1932, pp.

1-28, figs. 1-33 [in text].)

*Monaco.*

Fifteen species are described and figured, 5 new.

Reichel, M.

Sur la structure des Alveolines.

(Eclogae geologicae Helvetiae, vol. 24, No. 2, 1931, pp. 289-303, pls. XIII-XVIII.)

*Basel.*

A detailed discussion with many illustrations.

Zuffardi-Comerci, Rosina.

Necrologia di Anna Martinotti.

(Boll. Soc. Geol. Ital., vol. 50, fasc. 2, 1931, pp. cxxviii-cxxx.)

A tribute to Dr. Martinotti's patient and detailed work on the foraminifera of Italy.

Cushman, Joseph A. and P. W. Jarvis.

Upper Cretaceous Foraminifera from Trinidad.

(Proc. U. S. Nat. Mus., vol. 80, Art. 14, 1932, pp. 1-60, pls. 1-16.)

*Washington.*

One hundred twenty-nine species and varieties are noted and figured, 10 new.

Berry, Willard.

The larger Foraminifera of the Talara shale of north western Peru.

(Journ. Washington Acad. Sci., vol. 22, No. 1, Jan. 4, 1932,  
pp. 1-9, figs. 1-11 [in text].) *Baltimore.*

Ten species are described, all as new.

Jedlitschka, Heinr.

Neue Beobachtungen über Dentalina Verneuilli (d'Orb.) und  
Nodosaria abyssorum (Brady).

(Firgenwald, Anstalt Sudetendeutsch Heimat., 4 Jahrg.,  
Heft 3, 1931, pp. 121-127, figs. 1-25 [in text].) *Reichenberg.*

Describes a new genus, *Sagrinnodosaria*.

Croneis, Carey, Paul H. Dunn and David Hunter.

Pre-Carboniferous Foraminifera.

(Science, vol. 75, No. 1935, Jan. 29, 1932, pp. 138, 139 [sep-  
arate, 1-4].) *Tarrytown.*

Notes occurrence of arenaceous foraminifera in several  
early formations.

J. A. C.