

CONTRIBUTIONS FROM THE CUSHMAN  
LABORATORY FOR FORAMINIFERAL RESEARCH

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78. AN AMERICAN VIRGULINA RELATED TO  
V. PERTUSA REUSS

By JOSEPH A. CUSHMAN

One of the most interesting species of *Virgulina* is *V. pertusa* Reuss. It is usually noted as having been described from the Pliocene, Crag, of Antwerp. In his paper, "Beiträge zur tertiären Foraminiferen—Fauna. 1. Die Foraminiferen des Crag's von Antwerpen. 2. Die Foraminiferen von Dingden in Westphalen" (Sitz. k. Akad. Wiss. Wien, vol. 42, 1860, pp. 355-370, pls. 1, 2), Reuss described two distinct faunas. *Virgulina pertusa* first occurs on p. 362, which is included in the Antwerp part, and again on p. 368 from the Miocene of Dingden. I have material from both localities, and have failed to find it from Antwerp, but it is abundant in the Miocene material from Dingden. This species was included by Reuss in his set of Models as No. 36. Its main characteristic is the peculiar ornamentation above the sutures. At first glance, these remind one of the retral processes of *Elphidium*. A study of these in section and broken specimens seems to show that these processes are simple projections of the base of the chamber across the sutural region, but that there are no supplementary apertures or openings into the chambers.

A series of characteristic specimens from Dingden is figured in Plate 9, figures 1-4. Figure 4 is a young specimen. In the adult, there is a considerable inflation of the later chambers so that the greatest breadth is usually well above the middle. The aperture is large and fairly broad, the inner end often somewhat enlarged. There are the following additional records for

*Virgulina pertusa*: Reuss, Bull. Acad. Roy. Sci. Belg., ser. 2, vol. 15, 1863, p. 153 (Pliocene, Crag of Antwerp, Belgium); Hosius, Ver. Nat. Hist. Ver. Pr. Rheinlande, vol. 50, 1893, p. 119 (Miocene of the Rhineland region); and Chapman, Journ. Linn. Soc. Zool, vol. 30, 1910, p. 403, pl. 54, fig. 2 (Recent, off Funafuti, 2,715 fathoms). This last record is accompanied by a figure of a specimen which does not show the peculiar sutural characters of the typical, and probably is not this species. The record of Reuss is probably a repetition of his earlier record, while that of Hosius is unaccompanied by a figure. The species is then abundant in the Miocene of Dingden, in Westphalia, Germany, and possibly elsewhere in the Miocene of the same general region, and possibly in the Pliocene, Crag, of Antwerp.

With this data in regard to *Virgulina pertusa* Reuss, it is interesting to find a closely allied species from the Miocene of America. This may be described as follows:

VIRGULINA FLORIDANA Cushman, new species  
Plate 9, figures 7-10

Test two or three times as long as broad, early portion tri-serial, later chambers irregularly biserial, sides in the adult nearly parallel, greatest width typically at or below the middle; later chambers not greatly inflated; sutures distinct, marked by a row of depressions between the processes that extend backward from the margins of the later-formed chamber; wall smooth, finely perforate; aperture elongate, narrow, extending from the inner margin of the chamber well toward the apex. Length up to 0.60 mm.; breadth 0.20 mm.; thickness 0.18 mm.

Holotype (Cushman Coll. No. 12043) from the Miocene of the Choctawhatchee marl of Walton County, Florida near Red Bay. The species occurs abundantly at several other localities in the Choctawhatchee marl of Florida.

The species is much smaller and more slender than *Virgulina pertusa* Reuss which is often nearly a millimeter in length, and 0.40 mm. in breadth. Instead of being greatly inflated toward the apertural end, *V. floridana* has the sides nearly parallel, the whole test slender, fusiform, and the aperture is elongate but narrow. The openings above the sutures are much smaller in the Florida species.

The Choctawhatchee marl has other species related to those of the Miocene of Europe.

79. SOME SPECIES OF SIPHOGENERINOIDES FROM  
THE CRETACEOUS OF VENEZUELA

By JOSEPH A. CUSHMAN

A single species of *Siphogenerinoides*, *S. plummeri* (Cushman), has been recorded from the American Cretaceous. In addition, three new species from Venezuela are described here, and another species described and figured by Karsten is noted. These are well characterized species, most of them of considerable size. The genus will be briefly reviewed and the species described.

**Genus SIPHOGENERINOIDES Cushman, 1927**Genoholotype, *Siphogenerina plummeri* CUSHMAN

*Siphogenerinoides* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 3, pt. 3, 1927, p. 63; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 239.

*Siphogenerina* (part) CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, 1926, p. 15.

Test elongate, slightly tapering, the early stages at least in the microspheric form biserial or irregularly triserial, the later stages uniserial; wall calcareous, perforate, usually with longitudinal costae; aperture typically with a neck and phialine lip but usually without siphons between the chambers.

The known species of this genus are from the Upper Cretaceous, and are evidently closely related to *Pseudowigenerina*.

**SIPHOGENERINOIDES PLUMMERI (Cushman)**

*Siphogenerina plummeri* CUSHMAN, Proc. U. S. Nat. Mus., vol. 67, 1926, p. 18; Contr. Cushman Lab. Foram. Res., vol. 2, 1926, p. 15, pl. 1, figs. 7 a-c.

*Siphogenerinoides plummeri* CUSHMAN, l. c., vol. 3, 1927, p. 63, pl. 13, fig. 16; Special Publ. No. 1, Cushman Lab. Foram. Res., 1928, p. 239, pl. 33, fig. 27; pl. 34, fig. 16.

For description and figures of this species see the above references especially the second. The species is known from the Navarro of Texas.

## SIPHOGENERINOIDES BRAMLETTI Cushman, new species

Plate 9, figures 5, 6

Test slender, slightly tapering, about 4 times as long as broad, greatest width at the apertural end; chambers numerous, the later ones distinct, earlier ones usually obscured by the ornamentation; sutures of the uniserial chambers distinct, curved backward along the costae; wall ornamented by a few, usually 8 to 10, distinct, plate-like, longitudinal costae, running uninterruptedly from the initial end to the base of the last-formed chamber which is smooth; aperture rounded without a neck and only a trace of a thickened lip. Maximum length 0.80 mm.; breadth 0.20 mm.

Holotype (Cushman Coll. No. 12045) from the Upper Cretaceous, Colon shale, of Quebrada Honda, Venezuela.

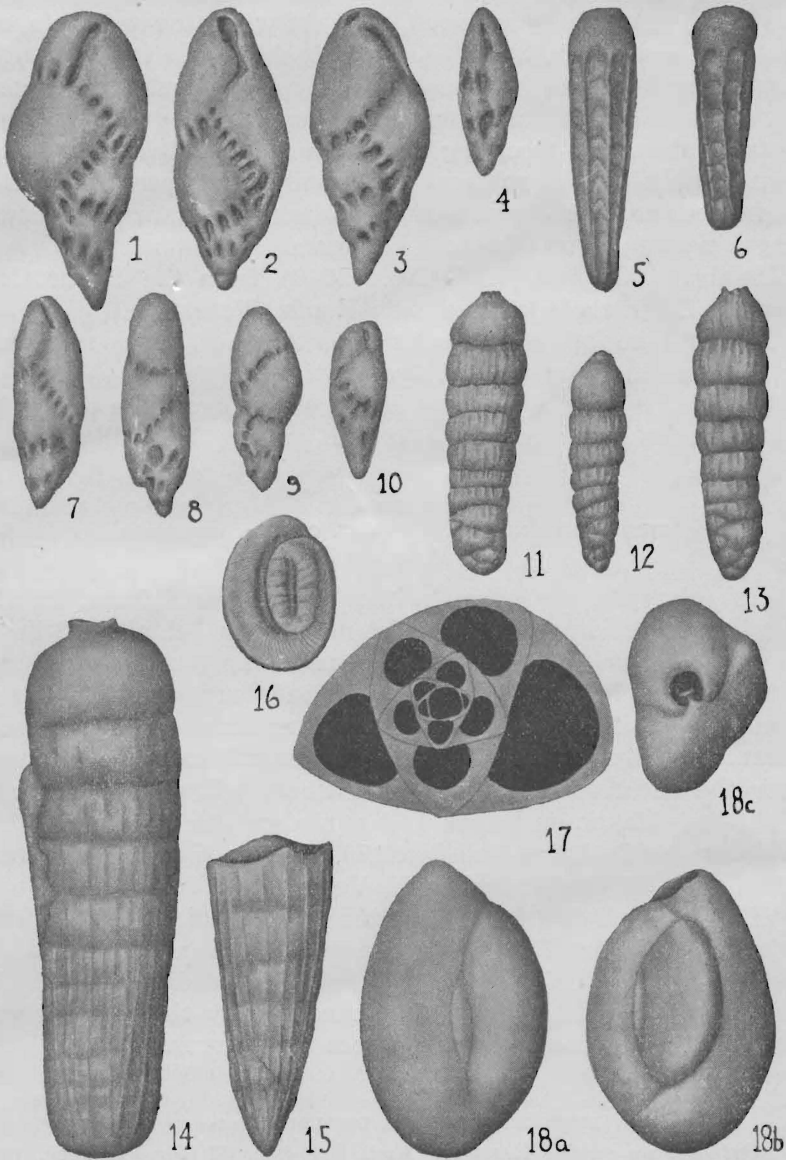
This species is named in honor of Mr. M. N. Bramlette to whom the author is indebted for the material from which this and the following species were taken.

*S. bramletti* is closely related to *S. plummeri* and, like it, is found toward the top of the Cretaceous. It differs from *S. plummeri* in having the costae obsolete on the last-formed chamber, the costae higher, the sutures more curved between the costae, and the lip almost wanting.

## EXPLANATION OF PLATE 9

- FIGS. 1-4. *Virgulina pertusa* Reuss.  $\times 50$ . Specimens from the Miocene of Dingden, Germany.
- FIGS. 5, 6. *Siphogenerinoides bramletti* Cushman, new species.  $\times 50$ . Fig. 5, Holotype.
- FIGS. 7-10. *Virgulina floridana* Cushman, new species.  $\times 50$ . Fig. 7, Holotype.
- FIGS. 11-13. *Siphogenerinoides parva* Cushman, new species.  $\times 50$ . Fig. 11, Holotype.
- FIGS. 14, 15. *Siphogenerinoides cretacea* Cushman, new species.  $\times 50$ . Fig. 14, Holotype, megalospheric. Fig. 15, Microspheric.
- FIGS. 16-18. *Quinqueloculina seminula* (Linné). Fig. 16 (After original figure of Gualtieri). Fig. 17, Section (After Schlumberger). Figs. 18 a-c, Specimen from Rimini, Italy. a, b, opposite sides; c, apertural view.

Figures drawn by Margaret S. Moore



SIPHOGENERINOIDES PARVA Cushman, new species  
Plate 9, figures 11-13

Test elongate, very slightly tapering, the sides nearly parallel, about 4 times as long as broad, greatest width toward the apertural end; chambers numerous, distinct, slightly inflated; sutures distinct and slightly depressed, nearly transverse to the long axis of the test; wall ornamented by numerous, low, longitudinal costae, sometimes becoming obsolete on the last-formed chambers, broken at the sutures, not continuous; aperture with a slight neck and a slight lip, often broken or serrate. Maximum length nearly 1 mm.; breadth 0.25 mm.

Holotype (Cushman Coll. No. 12048) from the Upper Cretaceous, Colon shale, of Quebrada Honda, Venezuela.

This and the following species occur together, but do not occur in the same horizon with *S. bramletti*.

The species may at once be distinguished from the others by the weak costae broken at the sutures, and by the small size.

SIPHOGENERINOIDES CRETACEA Cushman, new species  
Plate 9, figures 14, 15

Test elongate, tapering in the microspheric form, in the megalospheric form with the sides nearly parallel, about 3 times as long as broad, greatest width near the apertural end; chambers distinct, but only very slightly inflated; sutures distinct, slightly depressed, transverse to the long axis of the test; wall ornamented by numerous, fine, longitudinal costae continuous over the sutures; aperture with a short cylindrical neck and slight lip. Maximum length 1.60 mm.; breadth 0.45 mm.

Holotype (Cushman Coll. No. 12051) from Upper Cretaceous, Colon shale, of Quebrada Honda, Venezuela.

This is much the largest of the four species. The microspheric form (fig. 15) is very pointed at the initial end, while the megalospheric form (fig. 14) is very broadly rounded. It may be distinguished from the preceding by the much larger size and the costae continuous across the sutures.

SIPHOGENERINOIDES EWALDI (Karsten)

*Orthocerina ewaldi* KARSTEN, Amtlicher Ber. 32 Vers. deutsch. Nat. Aerzte, 1856 (1858), p. 114, pl. 6, figs. 3 a-c; Geol. Ancienne Colombie, Bolivarienne, Venezuela, Nouvelle Grenade et Ecuador, 1886, p. 62, pl. 6, figs. 3 a-c.

The original figures may possibly be casts although they seem to represent a smooth form with projections at the base of the chamber. A section figured by Karsten indicates an internal tubular structure. The types are from the Cretaceous of "Tocayma", Colombia. Karsten's papers should be noted as they were evidently overlooked by Galloway and Morrey, as they are not included in the papers they note as describing South American smaller foraminifera.

It is apparent from these species noted that they are capable of being used as stratigraphic markers, their vertical ranges evidently being strictly limited.

## 80. ON QUINQUELOCULINA SEMINULA (LINNÉ)

By JOSEPH A. CUSHMAN

Several of the oldest species of the foraminifera have already been reviewed in previous numbers of these Contributions. One of the species which is perhaps referred to as often as any is "*Quinqueloculina seminulum* (Linné)". A study of the older literature together with abundant material from the type locality seems to make rather certain to what form this name should be applied. It is one of the first species of foraminifera to be given a binomial name by Linné.

Linné gave the name "*Serpula seminulum*" in his 12th Edition, and in the 13th Edition (Gmelin's) refers to some of the older figures. Those of Plancus, 1739, pl. 2, figs. 1, A, B, C, evidently represent a *Quinqueloculina* with broadly rounded chambers and truncate apertural end, the whole test inflated and not much longer than broad. The specimens are from the shore sand of Rimini. Gualtieri's figure, 1742, pl. X, fig. S, which is reproduced here (Pl. 9, fig. 16) shows a specimen with four chambers visible on the side as in *Quinqueloculina* and the apertural end truncate, but leaves no indication of the end view. Gualtieri's specimens were also probably from Rimini.

Linné's original description of a few words is as follows: "S. [erpula] testa regulari ovali libera glabra." His localities for

Recent material are the Adriatic [probably Rimini based on Plancus, and Gualtieri] and the Red Sea.

Figures 18 *a-c* on Plate 9 show what may be considered a typical *Quinqueloculina seminula* from shore sand of Rimini, Italy, on the Adriatic. In the large collection I made there in 1927, this species proves to be one of the commonest and most conspicuous ones. It was also abundant in collections made shortly after, somewhat farther north at the Lido, Venice. It is evidently a widely distributed and common form. A section after Schlumberger is given (Plate 9, figure 17) showing the shape of the chambers in section and the quinqueloculine arrangement.

There are a great many references to this species which need checking in the light of what may be taken as typical material. The synonyms are probably numerous but hardly as many as indicated by Brady in the *Challenger* Report. Brady's text figures on p. 159 of that Report will show something of the different forms that have been placed under this species.

From the foregoing, it would seem that the name "*Quinqueloculina seminula* (Linné)" should be applied to the smooth quinqueloculine form, with rounded or very slightly angled chambers, with a truncated apertural end, and the aperture with a simple tooth.

The species does not show a great deal of variation at its type locality.

As a check on the smooth forms both fossil and Recent which resemble this species, careful sectioning will prove very useful as many of the smooth Miliolidae when sectioned show very different characters in the early stages.



## 81. FRANKEINA, A NEW GENUS OF ARENACEOUS FORAMINIFERA

By JOSEPH A. CUSHMAN and C. I. ALEXANDER

In the arenaceous group of foraminifera there are some very interesting forms that occur in the Lower Cretaceous, some of which apparently continue into later formations and possibly to the present oceans. One of these forms seems worthy of generic distinction. The development is very interesting when compared with other forms in the arenaceous group as well as certain of the calcareous forms.

Genus **FRANKEINA** Cushman and Alexander, new genus

Genoholotype, *Frankeina goodlandensis* CUSHMAN and ALEXANDER, new species.

Test free, in the early stages planispiral, compressed, later uncoiling and becoming triangular in section; later chambers uniserial, the development such that one of the angles of the test is in the line of the early axis of coiling and the broad face dorsal instead of ventral as in many calcareous forms, chambers simple, not labyrinthic; sutures in the early portion generally radial, in the uniserial portion much angled toward the apertural end in the middle of the flattened faces; wall coarsely arenaceous but firmly cemented; aperture in the early planispiral portion at the base of the chamber in the median line, in the uncoiled portion simple, terminal.

We take pleasure in naming this genus for Dr. A. Franke of Arnstadt, Germany, who has done so much to make clear the Cretaceous faunas of Germany.

This genus is evidently close to *Flabellamina* and to *Ammobaculites*. The most striking thing is the unusual position of the angles of the test. In most uncoiled forms with a triangular section, one of the broad faces comes above the earliest portion of the coil, and may be termed ventral as in *Saracenaria*. In *Frankeina*, however, the broad face is against the later portion of the coiling, and may be termed dorsal while the angle of the test is ventral.

Another species from the Upper Cretaceous of Texas is noted

on the following pages, and it may be suspected that the peculiar species living in the south Pacific named *Verneuilina variabilis* by Brady in the *Challenger* Report belongs here, although further study is necessary to determine this point.

Some of the species from the Upper Cretaceous which have previously been placed under *Haplophragmium* and other genera have been placed under *Ammobaculites* by Dr. Franke who has shown that they have a planispiral early stage. These triangular; uncoiled forms should be carefully studied in section to see if they should not really be placed under *Frankeina*.

A study of the Upper Cretaceous species makes it very suggestive at least that some of the triangular forms now placed under *Clavulina* may have had their origin in such forms as those belonging to *Frankeina*, and the early colling lost by acceleration of development. That some of these uniserial triangular forms have such a source and are not triserial in the young is worthy of consideration. A study of microspheric specimens in section should be undertaken with this possibility in view.

The species from the Goodland may be described as follows:

**FRANKEINA GOODLANDENSIS** Cushman and Alexander, new species  
Plate 10, figures 1, 2

Test elongate, somewhat tapering, early portion planispiral, with a few, 4 or 5, chambers to a coil, later portion uncoiling and triangular in transverse section, the sides concave, angles rounded; sutures distinct, bent upward strongly toward the apertural end in the middle of each flattened or concave face, and backward toward the base at the angles; wall very coarsely arenaceous but the surface fairly smooth and firmly cemented; aperture in the early coiled portion at the base of the apertural face, narrow, in the uncoiled portion terminal, rounded. Length 1 mm.; breadth 0.40 mm.

Holotype (Cushman Coll. No. 12030) from the Upper Cretaceous, Upper Middle Goodland formation at Lake Worth Dam, Fort Worth, Texas.

This species is common at this and other localities in the Upper Cretaceous of the Fort Worth region.

82. SOME ARENACEOUS FORAMINIFERA FROM THE  
TAYLOR MARL OF TEXAS

By JOSEPH A. CUSHMAN and JAMES A. WATERS

There are abundant arenaceous foraminifera in the Cretaceous of Texas and other parts of the Gulf Coastal Plain region of the United States which are worthy of careful study. Some of them are very close to those of Europe, and others identical with European species as are the calcareous forms, but there are some that are new. These are often of large size, and in some cases make excellent horizon markers for stratigraphic work. A few of these belonging to the Lituolidae and occurring in the Taylor Marl are described here.

FRANKEINA TAYLORENSIS Cushman and Waters, new species  
Plate 10, figures 3 a, b

Test large, the very early portion planispirally coiled, later portion uncoiled, uniserial, triangular in section, the sides concave; chambers distinct, slightly inflated; sutures distinct, very slightly depressed, in the middle of the concave faces bent strongly toward the apertural end, at the angles bent downward toward the initial end; wall coarsely arenaceous, somewhat roughly finished, firmly cemented; aperture in the adult terminal, simple. Maximum length 2.25 mm.; breadth 1.25 mm.

Holotype (Cushman Coll. No. 12033) from Upper Cretaceous, Taylor Marl, 360' sample, Sun Oil Co., Martindale D 10, Caldwell Co., Texas.

This is a large striking species with a rather coarse exterior, but the structure well shown. The early planispiral portion is greatly reduced, and appears only at the base of the test. The uncoiled portion while generally triangular is not always symmetrical, the face in the line of the planispiral coiling of the young usually being narrower than the lateral ones.

It would take but a little more acceleration for the coiled stage to be entirely left out and the whole test become uniserial and triangular, in which case it would be difficult to distinguish from *Clavulina* unless the early portion was sectioned. As already noted on a previous page, some of the triserial forms assigned to

*Clavulina* may not have the triserial young and may have been derived directly from *Frankeina*.

**HAPLOPHRAGMIUM TAYLORENSIS** Cushman and Waters, new species  
Plate 10, figures 4, 5

Test large, cylindrical, early portion close coiled and almost completely involute, later and larger portion uncoiled, uniserial, the chambers in a rectilinear series; chambers distinct in the uncoiled portion but somewhat obscured in the early coiled portion; sutures somewhat indistinct, very slightly depressed; wall coarsely arenaceous but with a fairly smooth exterior, very firmly cemented; aperture in the earlier stages simple, in the later chambers becoming multiple. Length of adult 3 mm.; diameter 0.85 mm.

Holotype (Cushman Coll. No. 12036) from Upper Cretaceous, Taylor Marl, Sun Oil Co., Martindale D. 10, Caldwell Co., Texas.

This is a large striking species which may prove to be a good horizon marker in the Taylor. The chambers are simple although the aperture becomes multiple. The early portion is easily broken away so that complete specimens are rare.

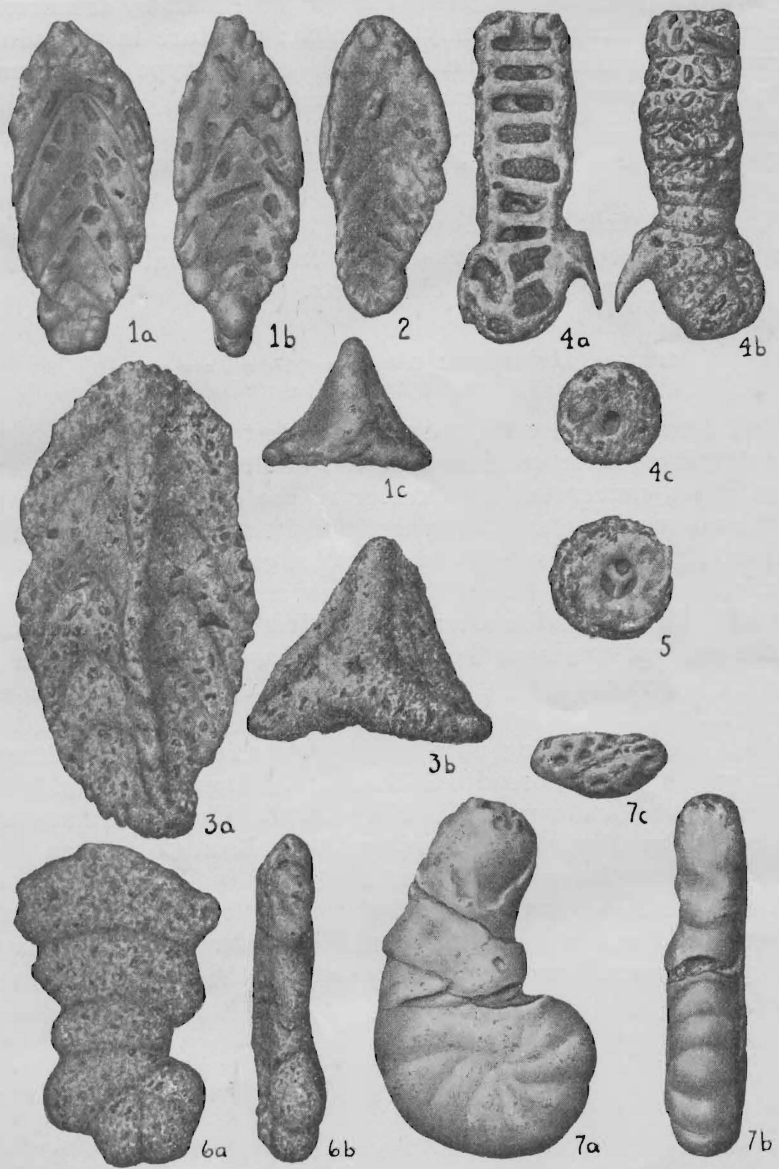
**AMMOBACULITES TAYLORENSIS** Cushman and Waters, new species  
Plate 10, figures 6 a, b

Test large, compressed, early portion close coiled, completely involute, planispiral, composed of 4 or 5 chambers to each coil,

EXPLANATION OF PLATE 10

- FIGS. 1, 2. *Frankeina goodlandensis* Cushman and Alexander, new species.  $\times 50$ . a, side view; b, front view; c, apertural view. Fig. 1, Holotype.
- FIGS. 3 a, b. *Frankeina taylorensis* Cushman and Waters, new species.  $\times 28$ . a, side view; b, apertural view.
- FIGS. 4, 5. *Haplophragmium taylorensis* Cushman and Waters, new species.  $\times 28$ . a, section; b, side view; c, apertural view. Fig. 4, Holotype. Fig. 5, Apertural view of paratype showing multiple aperture.
- FIGS. 6 a, b. *Ammobaculites taylorensis* Cushman and Waters, new species.  $\times 35$ . a, side view; b, peripheral view.
- FIGS. 7 a-c. *Lituola taylorensis* Cushman and Waters, new species.  $\times 10$ . a, side view; b, peripheral view; c, apertural view.

Figures drawn by Margaret S. Moore



later portion uncoiled, uniserial, rapidly spreading; chambers distinct, the later ones rapidly broadening as added; sutures distinct, slightly depressed, gently curved; wall coarsely arenaceous but smoothly finished, firmly cemented; aperture in the adult, terminal, elliptical, simple. Length of holotype 1.25 mm.; breadth 0.80 mm.; thickness 0.25 mm.

Holotype (Cushman Coll. No. 12038) from Upper Cretaceous, Taylor Marl, Sun Oil Co., Martindale D. 10, Caldwell Co., Texas at 760'.

This is a striking species related to some of the European Upper Cretaceous forms but distinct in its general form, shape of chambers and apertural characters.

**LITUOLA TAYLORENSIS** Cushman and Waters, new species  
Plate 10, figures 7 a-c

Test large, compressed, most of the test planispirally coiled and involute; later chambers in the adult uncoiled, chambers labyrinthic, numerous, the number in the coil varying greatly in the microspheric and megalospheric forms, and in the young and adult stages; sutures distinct, slightly depressed; wall coarsely arenaceous but with a large amount of cement and smoothly finished on the exterior, very firmly cemented; aperture in the earliest stages at the base of the apertural face, quickly passing to the central portion of the apertural face and becoming multiple, in the uncoiled adult becoming terminal and the various openings taking up a large portion of the face. Maximum length 5 mm.; breadth 3.75 mm.; thickness 1.25 mm.

Holotype (Cushman Coll. No. 12039) Upper Cretaceous, Upper Taylor Marl, from Marquez Dome, Leon Co., Texas.

This is a fine large species, and one which is likely to prove of value as a marker for this part of the Taylor Marl. The wall is very solid and not easily broken, the labyrinthic walls have the openings small, and the main cavity of the chambers nearly filled.

## 83. PLIOCENE LAGENAS FROM CALIFORNIA

By JOSEPH A. CUSHMAN

The Pliocene Lagenas of southern California are very close to and in most species identical with those now living off the same coast. The species noted and figured in this paper are all from one sample of Lower Pliocene from a small gulch 5-10 yards N. of D. M. S. & B. Lime Pit, Palos Verdes Hills, Los Angeles County, California, kindly sent me by Mr. R. E. Stewart. Its position in the section may be indicated by the great numbers of *Plectofrondicularia californica* Cushman and Stewart that are present in the sample. As the Lagenas were not figured in my paper on "Recent Foraminifera from off the West Coast of America" (Bull. Scripps Instit. Oceanography, Tech. Ser., vol. 1, No. 10, 1927), it seems that the actual figures of these species with their identifications will be useful, especially to those who are working constantly with this Pliocene fauna. Specimens with an asterisk are also recorded from off the coast, and for these species the references will be found in the above work.

## Genus LAGENA Walker and Jacob, 1798

## \*LAGENA ELONGATA (Ehrenberg)

Plate 11, figure 1

Test elongate, slender, the central portion subcylindrical, the ends rather tapering, apertural end with a slightly thickened lip, opposite end closed; wall translucent, smooth.

The ends of this and the following species are very easily broken, and specimens are rare with the complete characters unless they are handled very carefully in the preparation of the material for study.

## \*LAGENA GRACILIS Williamson

Plate 11, figure 2

Test elongate, fusiform, broadest in the middle, apertural end tapering into a long, cylindrical neck with a slightly expanded lip, opposite end pointed, closed; surface ornamented by a few, distinct, longitudinal costae.

## LAGENA CLAVATA (d'Orbigny)

Plate 11, figure 3

Test elongate, clavate or fusiform, with a long neck at the apertural end and an elongation of the test somewhat variable in length at the base; surface smooth; wall thin, transparent or translucent; aperture circular at the end of the elongate slender neck, with a phialine lip.

For reference to this species, see Cushman, Bull. 104, U. S. Nat. Mus., pt. 4, 1923, p. 10.

The shape of the body of the test is somewhat variable.

## \*LAGENA SUBSTRIATA Williamson

Plate 11, figure 4

Test elongate, body of the test longer than broad, basal end rounded, apertural end tapering into an elongate neck; wall ornamented with numerous, fine, longitudinal costae, continuous from the base of the chamber to the neck, sometimes a few on the neck itself.

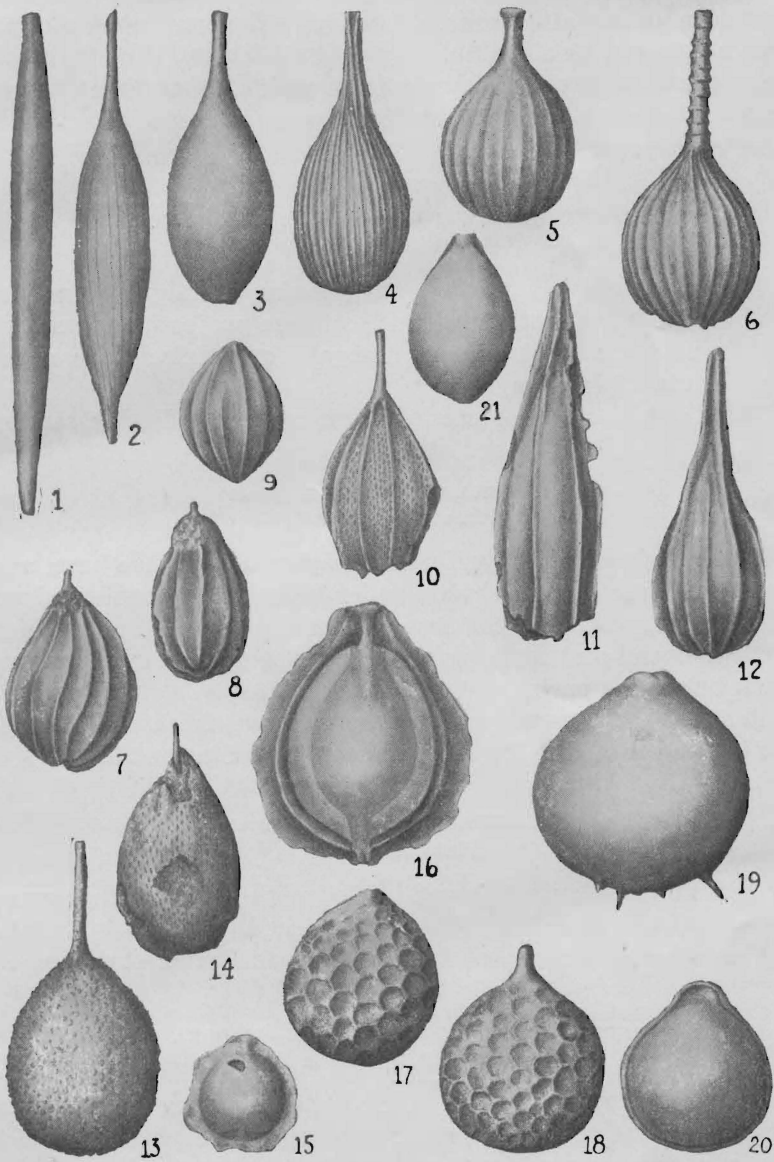
This is a very finely costate species, the costae often very numerous.

## EXPLANATION OF PLATE 11

- FIG. 1. *Lagena elongata* (Ehrenberg). × 135.  
 FIG. 2. *Lagena gracilis* Williamson. × 100.  
 FIG. 3. *Lagena clavata* (d'Orbigny). × 100.  
 FIG. 4. *Lagena substriata* Williamson. × 100.  
 FIG. 5. *Lagena sulcata* (Walker and Jacob). × 80.  
 FIG. 6. *Lagena striata* (d'Orbigny), var. *strumosa* Reuss. × 100.  
 FIGS. 7, 8. *Lagena williamsoni* (Alcock). × 100.  
 FIG. 9. *Lagena costata* (Williamson). × 100.  
 FIG. 10. *Lagena angelina* Cushman, new species. × 100.  
 FIGS. 11, 12. *Lagena costata* (Williamson), var. *amphora* Reuss. × 80.  
 FIG. 13. *Lagena hispida* Reuss. × 100.  
 FIG. 14. *Lagena lamellata* Sidebottom. × 100.  
 FIG. 15. *Lagena marginata* (Walker and Jacob). × 80.  
 FIG. 16. *Lagena orbignyana* (Seguenza), var. *elliptica* Cushman. × 80.  
 FIG. 17. *Lagena hexagona* (Williamson), var. *scalariformis* (Williamson). × 125.  
 FIG. 18. *Lagena hexagona* (Williamson). × 100.  
 FIG. 19. *Lagena clypeata* Sidebottom (?). × 100.  
 FIG. 20. *Ellipsolagena* (?) sp (?). × 100.  
 FIG. 21. *Lagena sacculus* Fornasini (?). × 100.

Figures drawn by Margaret S. Moore





\*LAGENA SULCATA (Walker and Jacob)  
Plate 11, figure 5

Test typically subglobose, slightly longer than broad; wall with numerous, rather coarse, longitudinal costae, neck elongate with a definite, phialine lip.

This is close to the following form which has a more elongate, ornamented neck and the basal end with the costae often ending in spinose projections.

LAGENA STRIATA (d'Orbigny), var. STRUMOSA Reuss  
Plate 11, figure 6

Test clavate, body portion subglobular or slightly fusiform, the base with the costae ending in spinose projections; wall with numerous coarse costae; neck elongate, cylindrical with numerous, annular thickenings.

This form has been recorded from numerous Pacific stations.

\*LAGENA WILLIAMSONI (Alcock)  
Plate 11, figures 7, 8

Test subglobular to pyriform, broadest toward the base, apertural end tapering to a short slender neck; wall ornamented with a few high, plate-like costae, occasionally twisted, coalescing at the upper end and forming a collar made up of a reticulate network below the neck.

Most of the records for this species are from the Atlantic, but I found it off the Pacific coast at *Guide Station 21*.

LAGENA COSTATA (Williamson)  
Plate 11, figure 9

Test subglobular, wall ornamented with a few, rather remote costae, apertural end not greatly produced.

This species is recorded from numerous Pacific stations.

LAGENA COSTATA (Williamson), var. AMPHORA Reuss  
Plate 11, figures 11, 12

Test elongate, pyriform, with a long, tapering neck; surface with comparatively few, prominent costae, running up onto the elongate, tapering neck; aperture small, without a lip.

This variety is variable as shown in the two figures. It is very common in the material.

*LAGENA ANGELINA* Cushman, new species  
Plate 11, figure 10

Test small, clavate, basal end broadly rounded, apertural end tapering into a slender cylindrical neck; wall ornamented by a few, thin, high, plate-like costae coalescing at the base of the neck, the area between the costae with longitudinal rows of fine slightly elliptical pits; aperture small, with a slight lip. Length 0.30 mm.; diameter 0.15 mm.

Holotype (Cushman Coll. No. 11971) from Lower Pliocene, from small gulch 5-10 yards N. of D. M. S. & B. Lime Pit, Palos Verdes Hills, Los Angeles County, California.

This rather beautifully ornamented species is common in the material from this locality.

\**LAGENA HISPIDA* Reuss  
Plate 11, figure 13

Test subglobular, the base broadly rounded, apertural end slightly tapering to the very slender, cylindrical neck; wall entirely covered with short spinose projections.

This is another of the common species in the material.

\**LAGENA LAMELLATA* Sidebottom  
Plate 11, figure 14

Test somewhat pyriform with a very slender neck, base broadly rounded; wall compound, surface of thin polygonal flakes supported by a spinose structure beneath, and separating it from the main wall of the test.

This species is known from numerous stations in the Pacific. The surface is delicate and easily broken.

*LAGENA MARGINATA* (Walker and Jacob)  
Plate 11, figure 15

Test somewhat compressed, surrounded by a thin, plate-like extension or keel, apertural end with a short neck.

This species is not as common as most of the others in the material, and most of the specimens are of small size.

\**LAGENA ORBIGNYANA* (Seguenza), var. *ELLIPTICA* Cushman  
Plate 11, figure 16

Test elongate pyriform, central body portion of the test elliptical; peripheral and lateral keels sharp, thin, translucent,

body of the test transparent, thin, made slightly granular by the punctae, the area between the keels and bordering the inner margin on the secondary keel usually opaque; neck short, somewhat expanded at the aperture.

LAGENA HEXAGONA (Williamson)  
Plate 11, figure 18

Test globular or pyriform, basal end broadly rounded, apertural end slightly tapering to the base of the short, slender neck; surface covered with a hexagonal ornamentation, not regularly placed; aperture small, without a lip.

In this species the hexagonal areas are variously placed, and are not necessarily in definite lines.

\*LAGENA HEXAGONA (Williamson), var. SCALARIFORMIS (Williamson)  
Plate 11, figure 17

Test subglobular, surface ornamentation of a generally reticulate pattern, the sides of the reticulations often thickened, forming costae, the top and bottom borders usually less conspicuous; aperture without a neck or lip, slightly protruding.

The figured specimen is not as typical as some of the specimens found after the plate had been prepared and which are much more typical.

LAGENA CLYPEATA Sidebottom (?)  
Plate 11, figure 19

*Lagena auriculata* H. B. BRADY, var. *clypeata* SIDEBOTTOM, Journ. Quekett Micr. Club, ser. 2, vol. 12, 1913, p. 199, pl. 18, fig. 5.

The specimen figured may belong to this form described and figured by Sidebottom from the Southwest Pacific. The spines at the base are variable in number.

\*LAGENA SACCULUS Fornasini (?)  
Plate 11, figure 21

The figured specimen may belong to this species. They are fairly numerous and rather constant in shape. The species has already been recorded living off the coast.

The specimen figured (Pl. 11, fig. 20) needs more material to place it definitely. It is apparently an *Ellipsolagena*, but it is rare, and with the limited material it seems best to note it without further identification.

## RECENT LITERATURE ON THE FORAMINIFERA

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

Silvestri, A.

Osservazioni su fossili Nummulitici.

(Riv. Ital. Pal., Anno 35, 1929, pp. 1-21, pls. I-III.) *Pavia*.

Some excellent figures of sections are given and a bibliography of related papers.

Martinotti, Anna.

Foraminiferi pliocenici di Castrocaro (Forli).

(Atti Soc. Ital. Sci. Nat., vol. 68, 1929, pp. 112-115.) *Milano*.

A list of species is given with note of relative abundance from the Pliocene of this locality in Italy.

Vaughan, Thomas Wayland.

Results of Recent Investigations of American Tertiary Larger Foraminifera.

(Proc. Third Pan-Pacific Science Congress, Tokyo, 1926 (1929), pp. 1850-1957.) *Tokyo*.

Includes a discussion of several genera and a list of papers published since 1923.

Berry, Willard.

Shorter Contributions to the Paleontology of the Eocene of Northwestern Peru: I, Solitary Corals. II, Brachiopods. III, Foraminifer *Gypsina*.

(Journ. Washington Acad. Sci., vol. 19, No. 12, June 19, 1929, pp. 235-240, text figs.) *Baltimore*.

A new species of *Gypsina*, *G. peruviana*, is described and figured from the Tertiary of Peru.

Cushman, Joseph A., and Betty Kellett.

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.) *Washington*.

Collections from the coasts of Chile, Peru and Ecuador are described with 5 new species

Vaughan, Thomas Wayland.

*Actinosiphon semmesi*, a New Genus and Species of Orbitoidal Foraminifera, and *Pseudorbitoides trechmanni* H. Douvillé.

(Journ. Pal., vol. 3, June, 1929, pp. 163-169, pl. 21.) *Austin*.

The new genus and species are from the Lower Eocene of Mexico.

Vaughan, Thomas Wayland.

Species of *Orbitocyclina*, a Genus of American Orbitoid Foraminifera from the Upper Cretaceous of Mexico and Louisiana.

(Journ. Pal., vol. 3, June, 1929, pp. 170-175, pl. 22.) *Austin*.

A new species, *O. nortoni*, is described from the Cretaceous of Louisiana, and another species, *O. minima* (H. Douvillé), from Mexico is figured and described in detail.

Cushman, Joseph A., and Norman L. Thomas.

Abundant Foraminifera of the East Texas Greensand.

(Journ. Pal., vol. 3, June, 1929, pp. 176-184, pls. 23, 24.)

*Austin*.

Several of the common species are described from the Eocene with a new species and a new variety.

Heron-Allen, E., and Arthur Earland.

Some New Foraminifera from the South Atlantic. I.

(Journ. Roy. Micr. Soc., vol. 49, 1929, pp. 102-108, pls. 1-3.)

*London*.

A new species of *Sorosphaera* and a new genus, *Schizamina*, with two new species are described. These are interesting branching arenaceous forms.

Cushman, Joseph A.

The Foraminifera of the Atlantic Ocean. Pt. 6.—Miliolidae, Ophthalmitidae and Fischerinidae.

(Bull. 104, U. S. Nat. Mus., pt. 6, 1929, pp. i-viii, 1-129, pls. 1-22.)

*Washington*.

An introduction places the species and genera of the earlier portions in the new classification. The main body of the paper is devoted to the description, and figures of the Atlantic species of the three families.

Casasnovas, G. Colom.

Las Calizas con "Embriones de Lagena" del Cretacico inferior de Mallorca.

(Bol. Real Soc. Española Hist. Nat., vol. 28, 1928, pp. 393-404, pls. 10, 11, 1 text fig.) *Madrid.*

Discusses the occurrence of these peculiar forms in Cretaceous rocks.

Casasnovas, G. Colom.

Nota sobre el hallazgo de los "embriones de Lagenas" de J. DE LAPPARENT en los sedimentos actuales del Mediterráneo, y enumeración de los foraminiferos de varias muestras de fondos.

(Notas y Resúmenes, Instit. Español de Oceanografía, ser. II, No. 29, Dec. 15, 1928, pp. 1-10, pls. I, II, text fig.) *Madrid.*

Lists numerous species of foraminifera from the Mediterranean.

White, Maynard P.

Some Index Foraminifera of the Tampico Embayment Area of Mexico.

(Journ. Pal., vol. 2, 1928, pp. 177-215, pls. 27-29; pp. 280-317, pls. 38-42; vol. 3, 1929, pp. 30-58, pls. 4, 5.) *Bridgewater.*

The Cretaceous foraminifera of the Mendez and Velasco formations are principally described with many new species named.

Morrison, T. E.

First Authentic Cretaceous Formation Found on Gulf Coast Salt Domes of Texas.

(Bull. Amer. Assoc. Petr. Geol., vol. 13, No. 8, Aug., 1929, pp. 1065-1069.) *Tulsa.*

Lists numerous Cretaceous species from a core of Liberty Salt Dome.

Zavoico, Basil B.

"Petroleum in Persia" by C. P. Nicolesco. Review.

(Bull. Amer. Assoc. Petr. Geol., vol. 13, No. 4, April, 1929, pp. 396-399.) *Tulsa.*

Notes in tabular form foraminifera and other fossils from the Cretaceous and Tertiary.

Sheppard, George.

Age of the Guayaquil Limestone.

(Bull. Amer. Assoc. Petr. Geol., vol. 13, No. 4, April, 1929,  
pp. 383, 384.) *Tulsa.*

Notes occurrence of *Discocyclina* in Eocene of Ecuador.

Umbgrove, J. H. F.

Tertiary Sea-connections between Europe and the Indo-Pacific  
Area.

(Fourth Pacific Science Congress, Batavia-Bandoeng  
(Java), May—June, 1929, pp. 1-14.) *Bandoeng.*

Much of the correlation is based upon foraminifera.

Moore, Raymond C.

Environment of Pennsylvanian Life in North America.

(Bull. Amer. Assoc. Petr. Geol., vol. 13, No. 5, May, 1929,  
pp. 459-487, 3 text figs.) *Tulsa.*

Notes are given on the foraminifera, pp. 467, 468.

J. A. C.