

CONTRIBUTIONS FROM THE CUSHMAN
LABORATORY FOR FORAMINIFERAL RESEARCH

103. NEW LATE TERTIARY FORAMINIFERA FROM
VITILEVU, FIJI

By JOSEPH A. CUSHMAN

The few species described here are all from the Island of Vitilevu, Fiji, collected by Dr. H. S. Ladd. The material in general represents a *Globigerina*-ooze, and is very rich in foraminifera. Most of these have already been described either by Brady in his work on the "So-called Soapstone of Fiji", or in other papers such as that of Schwager from Kar Nikobar, or described from other sources. Many of the species are also recorded by Karrer from the Late Tertiary of Luzon, Philippines, by Schubert from the Pliocene and Pleistocene of the Bismarck Archipelago, and by Koch from the Late Tertiary of Java and East Borneo. The fauna is a widely distributed one in the Late Tertiary of the Indo-Pacific, and most of the species are still living in the same general area.

In the working up of this paper, it has been of great help to have at hand a portion of the original collection of material from Kar Nikobar studied by Schwager, and from which I have been able to obtain topotype specimens of many of Schwager's species.

It has seemed best to describe these few new forms while awaiting the publication of the complete paper which will appear with the others of the series on this collection from Fiji. My thanks are due to Dr. Herbert K. Gregory of the Bishop Museum, Honolulu, and to Dr. H. S. Ladd for permission to publish these species before the appearance of the final paper. The types of these new forms are to be deposited in the U. S. National Museum.

Family TEXTULARIIDAE

Subfamily 1. Spiroplectammininae

Genus SPIROPLECTAMMINA Cushman, 1927

SPIROPLECTAMMINA PARALLELA Cushman, n. sp.

Plate 4, figures 1 a, b

Test elongate, slender, sides nearly parallel for most of the length, compressed, periphery acute; early portion composed of planispirally coiled chambers, later ones biserial, fairly distinct, not inflated, often 8-10 pairs in the adult; sutures fairly distinct, very slightly depressed, oblique; wall of fine sand grains with much cement; aperture at the base of the inner margin of the chamber, textularian. Length 0.65 mm.; breadth 0.20 mm.; thickness 0.10 mm.

Holotype from 1½ miles south of Suva P. O., less than ¼ mile from coast, 10' above high tide, Fiji. Collected by H. S. Ladd.

This species occurs in the Late Tertiary of the Pacific region and is still living in the Pacific. It has been referred to as "*Spiroplecta annectens*", but is not that species from the Lias. Brady records it fossil from Fiji (Quart. Journ. Geol. Soc., vol. 44, 1888, p. 5).

Family LAGENIDAE

Subfamily 2. Lageninae

Genus LAGENA Walker and Jacob, 1798

LAGENA SCHWAGERIANA Cushman, n. sp.

Plate 4, figure 2

Lagena formosa SCHWAGER (part), *Novara-Exped.*, Geol. Theil, vol. 2, 1866, p. 206, pl. 4, figs. 19 b, c (not a, d).

Test with a central body and a peripheral fringe, the latter marked by numerous fine tubules extending out in a radial manner, the body of the test smooth and without a definitely raised border, apertural end with a definite neck ending in a broad, raised, hood-like structure confluent with the peripheral fringe. Length 0.35-0.75 mm.; breadth 0.25-0.50 mm.

Holotype from the Pliocene of Fiji, collected by Dr. H. S. Ladd.

This species is very different from the typical form of *Lagena formosa* described by Schwager and already noted. The apertural end, the ornamentation and the keel are all very different.

LAGENA SPIRO-STRIOLATA Cushman, n. sp.

Plate 4, figure 3

Lagena lineata SIDEBOTTOM (part) (not WILLIAMSON), Journ. Quekett
Micr. Club, ser. 2, vol. 11, 1912, p. 387, pl. 15, fig. 15.

Test often slightly longer than broad, the apertural end not extended; wall ornamented by numerous fine costae arranged in a spiral manner. Length 0.30 mm.; breadth 0.20 mm.

Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

Our specimen, as will be seen by the figure, agrees very closely with that figured by Sidebottom in the above reference from the Southwest Pacific. It is evidently a species to be looked for in the Late Tertiary and Recent collections from the general Indo-Pacific region.

LAGENA SPINO-ALATA Cushman, n. sp.

Plate 4, figure 4

Test subglobular, slightly broader toward the base, the periphery with a peculiarly shaped keel consisting of four parts, outer ones somewhat hollow, and the two central ones flattened and toothed; wall smooth or punctate. Length 0.25 mm.; breadth with spines 0.30 mm.

Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

This is a very beautifully ornamented little species which might best be referred to *Entosolenia*. Similarly ornamented forms have been referred to *Lagena alveolata* by some authors.

LAGENA BASI-STRIATULA Cushman, n. sp.

Plate 4, figure 5

Test elongate, fusiform, greatest breadth toward the base, 5 or 6 times as long as broad, base ending in a spine, apertural end extended into a tapering, cylindrical neck, surface ornamented by elongate pits arranged more or less in lines, the basal portion with numerous distinct longitudinal costae. Length 0.50 mm.; breadth 0.10 mm.

Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

This is a very distinct, ornamented species which occurs in some numbers in the Fiji collections.

Family NONIONIDAE

Genus NONION Montfort, 1808

NONION GALEATA Cushman, n. sp.

Plate 4, figures 7 a, b

Test close coiled, bilaterally symmetrical, somewhat compressed, the periphery very broadly rounded, sides deeply umbilicate; chambers 10-12 in number, distinct, slightly inflated, the inner end projecting into the central depression; sutures distinct, slightly depressed, very slightly curved; wall smooth, except about the umbilical depression where there are, in the early chambers, roughened areas at the inner part of each chamber; aperture broad and low, extending completely along the base of the final chamber, and with a slight lip, the sides of the chamber extending somewhat outwardly over the umbilical depression. Length 0.65 mm.; breadth 0.35 mm.

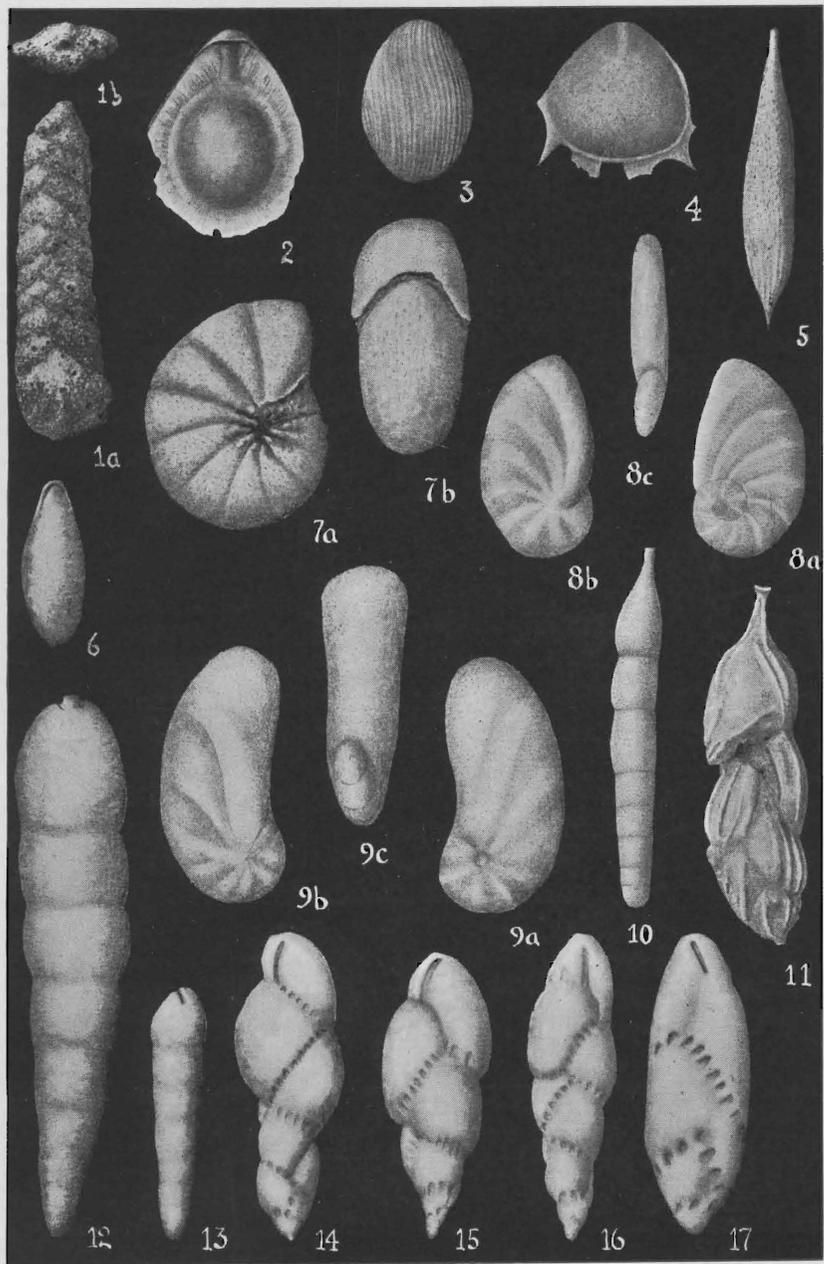
Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

The form of the chambers in this species is peculiar, and reminds one strongly of the German war helmet. The umbilical region is also distinctive.

EXPLANATION OF PLATE 4

- FIGS. 1 a, b. *Spiroplectammina parallela* Cushman, n. sp. $\times 50$. a, side view; b, apertural view.
- FIG. 2. *Lagena schwageriana* Cushman, n. sp. $\times 60$.
- FIG. 3. *Lagena spiro-striolata* Cushman, n. sp. $\times 60$.
- FIG. 4. *Lagena spino-alata* Cushman, n. sp. $\times 60$.
- FIG. 5. *Lagena basi-striatula* Cushman, n. sp. $\times 60$.
- FIG. 6. *Ellipsolagena fijiensis* Cushman, n. sp. $\times 60$.
- FIGS. 7 a, b. *Nonion galeata* Cushman, n. sp. $\times 50$. a, side view; b, peripheral view.
- FIGS. 8 a-c. *Nonionella limbato-striata* Cushman, n. sp. $\times 50$. a, b, opposite sides; c, peripheral view.
- FIGS. 9 a-c. *Nonionella clavata* Cushman, n. sp. $\times 50$. a, b, opposite sides; c, peripheral view.
- FIG. 10. *Siphonodosaria fijiensis* Cushman, n. sp. $\times 65$.
- FIG. 11. *Angulogerina fijiensis* Cushman, n. sp. $\times 90$.
- FIGS. 12, 13. *Nodosarella pacifica* Cushman, n. sp. $\times 18$. Fig 12, microspheric form. Fig. 13, megalospheric form. Fig. 12. Holotype.
- FIGS. 14-16. *Virgulina miocenica* Cushman and Ponton, n. sp. $\times 50$. Fig. 16, Holotype.
- FIG. 17. *Virgulina gunteri* Cushman. $\times 50$.

Figures drawn by Margaret S. Moore.



Genus *NONIONELLA* Cushman, 1926*NONIONELLA LIMBATO-STRIATA* Cushman, n. sp.

Plate 4, figures 8 a-c

Test much longer than broad, trochoid, completely involute on the ventral side, whole test compressed, very narrow in peripheral view, the periphery rounded; chambers distinct, 8-10 in number in the last-formed coil, gradually increasing in length, especially in the last few chambers, not inflated; sutures distinct, curved, limbate, very broad on the ventral side; wall smooth, finely perforate; aperture, a narrow slit at the base of the apertural face. Length 0.30 mm.; breadth 0.15 mm.; thickness 0.06 mm.

Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

This is a small but very distinct species, and the broad sutures being of peculiar type will at once distinguish it from other species of the genus.

NONIONELLA CLAVATA Cushman, n. sp.

Plate 4, figures 9 a-c

Test elongate, broadest near the outer end, making the shape in peripheral view clavate, periphery very broadly rounded; chambers 8-10 in the last-formed coil, distinct, the later ones very much elongated; sutures distinct, limbate, slightly curved; wall smooth, finely perforate; aperture, a very narrow slit at the base of the apertural face. Length 0.55 mm.; breadth 0.30 mm.; thickness 0.18 mm.

Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

This is a very peculiarly shaped species, the last chambers being very greatly extended and swollen at the outer end. The test is not entirely bilaterally symmetrical but nearly so.

Family BULIMINIDAE

Subfamily Uvigerininae

Genus *SIPHONODOSARIA* A. Silvestri, 1924*SIPHONODOSARIA FIJIENSIS* Cushman, n. sp.

Plate 4, figure 10

Test elongate, slender, very slightly tapering, base broadly rounded; chambers 6-10 in number, very slightly inflated especially toward the apertural end, partially involute, the later ones increasing somewhat in length; sutures distinct, very slightly

depressed; wall smooth, except for rather prominent perforations or depressions of the surface giving a peculiar, pearly appearance to the test; apertural end extended into a slightly tapering, elongate, tubular neck with a slight lip. Length 0.75 mm; breadth 0.10 mm.

This is a rather handsome small species with its pearly lustre, few chambers, uniform diameter and definite tubular neck.

Genus *ANGULOGERINA* Cushman, 1927

ANGULOGERINA FIJIENSIS Cushman, n. sp.
Plate 4, figure 11

Test elongate, tapering rapidly at the ends; chambers triserial, generally triangular in section, the later ones somewhat separated from adjacent ones, the lower side excavated; sutures distinct, depressed; wall ornamented by longitudinal costae, several grouped at the angles of the chambers; apertural end produced into a slightly tapering, tubular neck with longitudinal costae, the outer end with a definite lip. Length 0.60 mm.; breadth 0.15 mm.

This is a distinctive species with its somewhat separated chambers and peculiar ornamentation. Brady records *Uvigerina porrecta* from Fiji, but ours is very different from that species.

Family ELLIPSOIDINIDAE

Genus *NODOSARELLA* Rzehak, 1895

NODOSARELLA PACIFICA Cushman, n. sp.
Plate 4, figures 12, 13

Test elongate, slightly tapering, the last-formed chamber having the greatest diameter, rounded in transverse section; early chambers, at least in the microspheric form, showing traces of the biserial character but later ones all uniserial, slightly involute, later chambers somewhat inflated; sutures but little depressed; wall smooth; aperture, a narrow opening with a slightly hooded upper edge or even double in the large specimens. Length of microspheric form 4.00 mm.; breadth 0.95 mm.

The megalospheric form is much smaller and has fewer chambers, usually showing little trace of the biserial arrangement in the young. The microspheric form grows to large size.

Genus ELLIPSOLAGENA A. Silvestri, 1923

ELLIPSOLAGENA FIJENSIS Cushman, n. sp.

Plate 4, figure 6

Test small, compressed, obovate, greatest width toward the base; single chambered; wall smooth; aperture elongate, with one side forming a distinct hood. Length 0.25 mm.; breadth 0.10 mm.

This is a very small, somewhat elongate, compressed species. It is to be looked for elsewhere in the Late Tertiary of the Indo-Pacific.

104. A NEW VIRGULINA FROM THE MIOCENE OF FLORIDA

By JOSEPH A. CUSHMAN and GERALD M. PONTON

In the Choctawhatchee marl of Florida there occurs a species of *Virgulina* which has recently been described as *V. gunteri* Cushman. Notes in regard to this species are given on Page 44 of Bulletin 4, Florida Geological Survey, 1930. The close relation of this species to *V. pertusa* Reuss from the Miocene and Pliocene of western Europe is noted. *V. gunteri* is a much smaller and more slender species, having a definite fusiform shape.

During further work on the other portions of the Miocene of Florida the junior author has found abundant material of another species of *Virgulina* related to *V. pertusa* Reuss and *V. gunteri* Cushman. This species is abundant in the Shoal River and rare in the Oak Grove marls. It is very different in shape from *V. gunteri* (Pl. 4, fig. 17), having its greatest width toward the apertural end, but being much more slender and tapering as well as smaller than *V. pertusa* Reuss of Europe. This new species also occurs further to the north in the Miocene of Chesapeake Beach, Maryland, and probably elsewhere. A description of it follows:

VIRGULINA MIOCENICA Cushman and Ponton, n. sp.

Plate 4, figures 14-16

Test elongate, slender, somewhat compressed, gradually tapering from the subacute initial end to the greatest breadth formed by the last two chambers, somewhat twisted; chambers numerous, distinct, inflated; sutures distinct, depressed, marked by numer-

ous depressions, the sides of which extend backward to the preceding chamber in short distinct processes; wall except for the markings of the sutures smooth, very finely perforate; aperture very elongate, narrow, slightly curved, running from nearly the apex of the last-formed chamber to the inner margin. Length 0.75-0.90 mm.; breadth 0.25-0.30 mm.; thickness 0.20-0.25 mm.

Holotype (Cushman Coll. No. 15481) from the Miocene, Shoal River formation, Shell Bluff, Walton County, Florida.

The species, *Virgulina miocenica* (Pl. 4, figs. 14-16), has occurred at the following localities:

Shell Bluff on Shoal River about 5 miles north of Mossy Head, Walton County, Florida. Type locality of the Shoal River formation.

Whites Creek about 8 miles south of Argyle, Walton County, Florida. Shoal River formation.

Small branch flowing into Alaqua Creek, about $\frac{1}{4}$ mile west of Alaqua (formerly called Pleasant Ridge) about $4\frac{1}{2}$ miles southwest of De Funiak Springs, Walton County, Florida. Cardium Bed, Shoal River formation.

Vaughans Creek, about $\frac{1}{4}$ mile below head, 7 miles south of De Funiak Springs, Walton County, Florida. Choctawhatchee (?) formation.

Yellow River at Old Mill, about 100 yards below highway bridge on Laurel Hill-Oak Grove road, about $\frac{1}{4}$ mile south of Oak Grove. Type locality of Oak Grove formation.

Tanners Mill (Old Senterfeit Mill), $4\frac{1}{2}$ miles southwest of Laurel Hill, Walton County, Florida. Oak Grove formation.

Miocene, Choptank formation, Chesapeake Beach, Maryland.

105. CRETACEOUS FORAMINIFERA FROM ANTIGUA, B. W. I.

By JOSEPH A. CUSHMAN

Some little time ago Dr. T. Wayland Vaughan of the Scripps Institution of Oceanography sent me a small sample of friable White Chalk from the Island of Antigua. An examination of this showed some very interesting relationships. The number of species, while not large, is sufficient to show its very close affinity

with the Craie Blanche of the Paris Basin. Most of these species are also to be found in the Taylor marl of Texas.

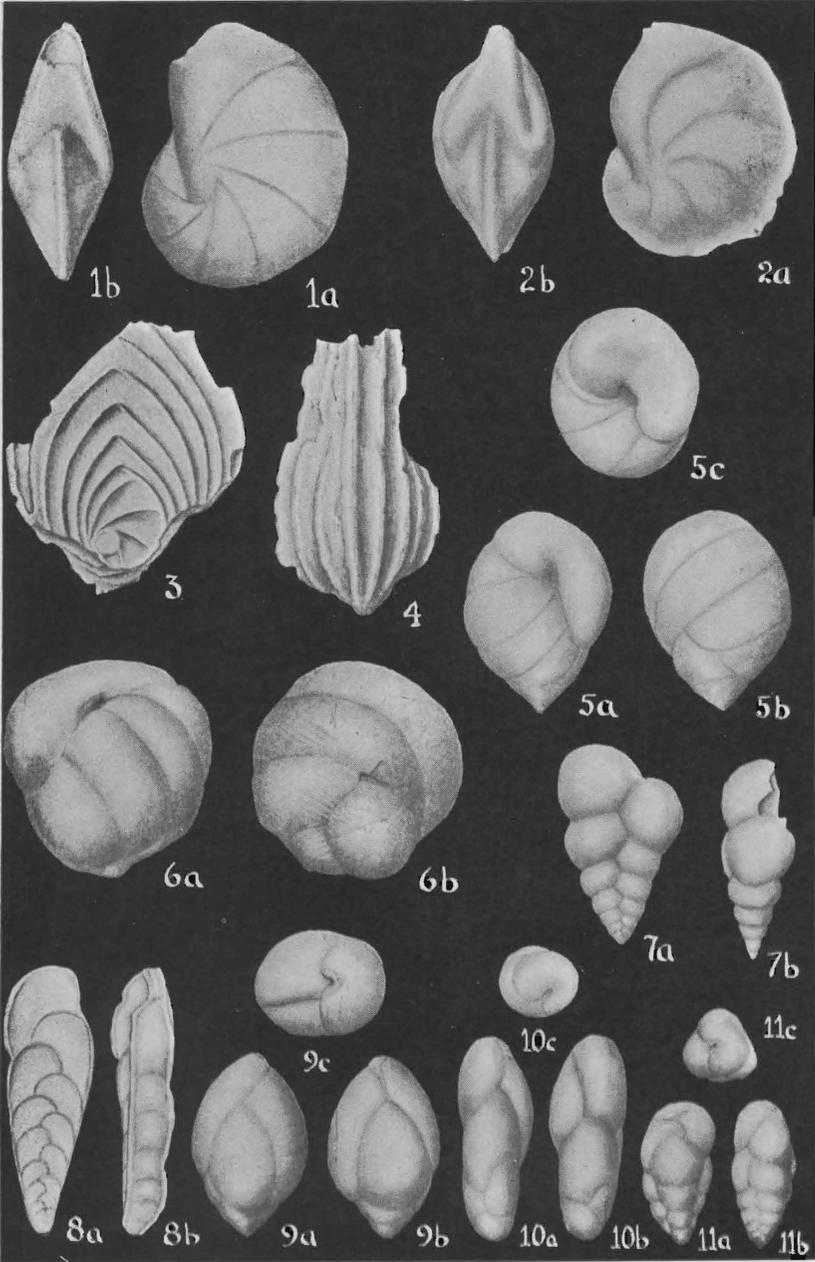
At the suggestion of Dr. Vaughan the geologist of Antigua, Mr. W. R. Forrest, collected more of the material from this locality and sent it directly to me. The material came from a dug well about 40 feet below the surface, and is a very white, fine grained chalk. The preparation of this larger amount of material gave additional species all of which confirmed the earlier ideas of its age and position in the Cretaceous section.

The occurrence of this chalk in Antigua is interesting as it is somewhat lower in the section apparently than the recently discovered Cretaceous of Trinidad, the latter being for the most part closely related to and probably the equivalent of the Velasco shale of Mexico which again is closely related to the Navarro formation of Texas. The White Chalk of Antigua is evidently considerably lower in the Cretaceous section, and represents as previously said the Craie Blanche of the Paris Basin, and is also the equivalent of portions of the Taylor marl and its equivalent in the Gulf Coastal Plain of the United States. Nearly all the species noted here have been described either by d'Orbigny from the White Chalk of the Paris Basin or by others from similar formations of central

EXPLANATION OF PLATE 5

- FIGS. 1 *a, b*. *Lenticulina rotulata* Lamarck. $\times 40$. *a*, side view; *b*, peripheral view.
- FIGS. 2 *a, b*. *Robulus williamsoni* (Reuss). $\times 40$. *a*, side view; *b*, peripheral view.
- FIG. 3. *Flabellina rugosa* d'Orbigny. $\times 50$.
- FIG. 4. *Nodosaria affinis* Reuss. $\times 40$.
- FIGS. 5 *a-c*. *Arenobulimina obliqua* (d'Orbigny). $\times 50$. *a, b*, opposite sides; *c*, apertural view.
- FIGS. 6 *a, b*. *Atazophragmium variabile* (d'Orbigny). $\times 40$. *a, b*, opposite sides.
- FIGS. 7 *a, b*. *Guembelina globulosa* (Ehrenberg). $\times 75$. *a*, front view; *b*, side view.
- FIGS. 8 *a, b*. *Bolivinita eleyi* Cushman. $\times 125$. *a*, front view; *b*, side view.
- FIGS. 9 *a-c*. *Bulimina brevis* d'Orbigny. $\times 75$. *a, b*, opposite sides; *c*, apertural view.
- FIGS. 10 *a-c*. *Bulimina imbricata* Reuss. $\times 125$. *a, b*, opposite sides; *c*, apertural view.
- FIGS. 11 *a-c*. *Bulimina puschi* Reuss. $\times 75$. *a, b*, opposite sides; *c*, apertural view.

Figures drawn by Margaret S. Moore.



Europe. A study of this material confirms the very evident fact that our American Upper Cretaceous is for the most part identical with that of Europe, and most of the species are common to the two regions. Owing to the friable nature of the chalk many of the specimens are more or less broken, but most of them give sufficient details for their specific identification. It seems well to put these species from Antigua on record so that they may be available for those working on the distribution of Cretaceous foraminifera.

My thanks are due to Dr. T. Wayland Vaughan and to Mr. W. R. Forrest for permission to publish the species given below.

Family VALVULINIDAE

Genus ARENOBULIMINA Cushman, 1927

ARENOBULIMINA OBLIQUA (d'Orbigny)

Plate 5, figures 5 *a-c*

Bulimina obliqua D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 40, pl. 4, figs. 7, 8.

This is apparently the same species as that described by d'Orbigny from the White Chalk of the Paris Basin. It is a true *Arenobulimina*, although the material of the test is very finely arenaceous and smoothly finished. There are numerous chambers in the last-formed coil, usually five or more. The aperture is at the base of a definitely depressed area near the center of the test in end view.

The distribution of this species in the general Coastal Plain region of the United States has not yet been thoroughly worked out, but it probably will show a definite connection between the chalk of the Paris Basin, Antigua, and the Coastal Plain region.

Genus ATAXOPHRAGMIUM Reuss, 1861

ATAXOPHRAGMIUM VARIABLE (d'Orbigny)

Plate 5, figures 6 *a, b*

Bulimina variabilis D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 40, pl. 4, figs. 9-12.

This species was originally described by d'Orbigny from the White Chalk of the Paris Basin, and its specific name indicates the variable character of the species. I have much material from the chinks of the Paris Basin and elsewhere in Europe which shows that the species varies widely in shape especially in the micro-

spheric and megalospheric forms. The wall is distinctly arenaceous, and very often has a series of narrow parallel depressions similar to those shown in Figure 6 *b*. Similar surface markings occur in a number of species of the chalks especially from those of the Island of Rügen. The chambers increase rapidly in size as they are added, the whole test being somewhat compressed, and the apertural face flattened with the aperture comparatively large and somewhat quadrate. This species is also found in the chalk facies of the general Taylor section of the Gulf Coastal Plain of Texas and elsewhere. This Antigua record, therefore, helps to fill in the gap between these two widely separated areas.

Family LAGENIDAE

Genus LENTICULINA Lamarck, 1804

LENTICULINA ROTULATA Lamarck

Plate 5, figures 1 *a*, *b*

Lenticulina rotulata LAMARCK, Ann. Mus., vol. 5, 1804, p. 188; vol. 8, 1806, pl. 62, fig. 11.

The specimen, while it is incomplete at the apertural end, is nevertheless very close indeed to this species the types of which the author examined in the collections of DeFrance at Caen. There are about eight chambers in the last-formed coil, nearly completely involute, and of uniform shape gradually increasing in size as added; the umbonal region distinctly raised. The periphery is subacute, and the sutures distinct but not depressed. The aperture in the complete forms is radiate at the peripheral angle, and has no supplementary slit in the apertural face. This species is widely recorded in many formations, but it seems to be in its typical form restricted to the Upper Cretaceous of various parts of the world. It has already been recorded from the Cretaceous of California (Cushman and Church, Proc. Cal. Acad. Sci., ser. 4, vol. 18, 1929, p. 503, pl. 37, figs. 1, 2).

Genus ROBULUS Montfort, 1808

ROBULUS WILLIAMSONI (Reuss)

Plate 5, figures 2 *a*, *b*

Cristellaria williamsoni REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 6, 1861 (1862), p. 327, pl. 6, figs. 4 *a*, *b*.—EGGER, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 120, pl. 11, figs. 7, 8.

Lenticulina williamsoni CUSHMAN and CHURCH, Proc. Cal. Acad. Sci., ser. 4, vol. 18, 1929, p. 503, pl. 36, figs. 13, 14.

This is a widely distributed species in the Upper Cretaceous, being already recorded from the Cretaceous of Europe and from the Upper Cretaceous near Coalinga, California. It also occurs in the Upper Cretaceous of Trinidad, being one of the few species that is common at these two regions.

The species has a distinct keel, comparatively few chambers, depressed and slightly curved sutures, and a smooth surface. The apertural face is distinctly concave and has raised edges, and the aperture is a supplementary slit at the upper end of the apertural face.

Genus *FLABELLINA* d'Orbigny, 1839

FLABELLINA RUGOSA d'Orbigny

Plate 5, figure 3

Flabellina rugosa D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 23, pl. 2, figs. 4, 5, 7.

The figured specimen is a broken one such as is usually common wherever the species is found, the later chambers being somewhat thin and delicate. The early portion of the test is coiled, and the later chambers become distinctly frondicularian. The sutures are raised into thin, plate-like projections considerably above the general surface of the test, those of the later portion being much less prominent, and in old age specimens frequently wanting. This is the form described by d'Orbigny from the Paris Basin chalk, and which I have already recorded from the Taylor marl of Texas (Contr. Cushman Lab. Foram. Res., vol. 6, 1930, p. 32, pl. 4, fig. 15). In the American Upper Cretaceous this species is particularly characteristic of the chalk facies.

Genus *NODOSARIA* Lamarck, 1816

NODOSARIA AFFINIS Reuss

Plate 5, figure 4

Nodosaria affinis REUSS, Verstein. Böhm. Kreide, 1845-46, pt. 1, p. 26, pl. 13, fig. 16; in GEINITZ, Paleontographica, vol. 20, pt. 2, 1874, p. 83, pl. 20, fig. 12.—FRANKE, Abhandl. Geol. Pal. Institut. Univ. Greifswald, vol. 6, 1925, p. 37, pl. 3, fig. 25.—BERRY and KELLEY, Proc. U. S. Nat. Mus., vol. 76, Art. 19, 1929, p. 6, pl. 1, fig. 8.

Nodosaria proxima BERRY and KELLEY (not SILVESTRI), Proc. U. S. Nat. Mus., vol. 76, Art. 19, 1929, p. 7, pl. 1, fig. 13.

The figured specimen shows only a fragment of the species, but has the proloculum complete and the second chamber nearly so.

Enough of the surface ornamentation is shown so that the species may be placed without question. This is one of the most common species in the Upper Cretaceous of the Gulf Coastal Plain of the United States and in Europe. There is a great amount of variation in the relative size and number of chambers, but the ornamentation remains fairly constant.

Family HETEROHELICIDAE

Genus *GUEMBELINA* Egger, 1899

GUEMBELINA GLOBULOSA (Ehrenberg)
Plate 5, figures 7 *a, b*

Textularia globulosa EHRENBERG, Abhandl. preuss. Akad. Wiss. Berlin, 1838, p. 135, pl. 4, fig. B.

This is one of the most widely distributed species occurring commonly in most parts of the world where Cretaceous deposits occur, especially those of the chalky type. It is a smooth form in which the chambers are rapidly but uniformly increasing in size as added.

Genus *BOLIVINITA* Cushman, 1927

BOLIVINITA ELEYI Cushman
Plate 5, figures 8 *a, b*

Textularia obsoleta ELEY (not REUSS), Geol. in the Garden, 1859, p. 202, pl. 8, fig. 11C; (?) p. 195, pl. 2, fig. 11.—WRIGHT, Irish Nat., 1902, p. 179, List.—(?) CHAPMAN, Bull. Geol. Surv., W. Australia, No. 72, 1917, p. 16, pl. 12, fig. 116.

Bolivinita eleyi CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, 1927, p. 91, pl. 12, figs. 11 *a, b*.

Test somewhat rhomboid, 2 or 3 times as long as broad, greatest width formed by the last two chambers, the periphery flattened as are the other two broader faces, angles very slightly keeled; sutures somewhat indistinct, limbate; surface finely perforate.

Although not recorded by d'Orbigny from the Cretaceous chalk of the Paris Basin, nevertheless this species occurs there in many of our samples from that region as well as from the chalks of England and Ireland. It has been recorded from the Upper Cretaceous of Arkansas, and is often very common in the Upper Cretaceous of Texas in the Taylor marl, especially the chalky facies.

Genus PSEUDOUVIGERINA Cushman, 1927

PSEUDOUVIGERINA sp(?)
Plate 6, figures 1 a-c

This rather peculiarly marked species has occurred as a single specimen in the Antigua material. It is not sufficiently well preserved as to details so that it may be given a specific name, but is recorded here simply to call attention to this form.

Family BULIMINIDAE

Genus BULIMINA d'Orbigny, 1826

BULIMINA BREVIS d'Orbigny
Plate 5, figures 9 a-c

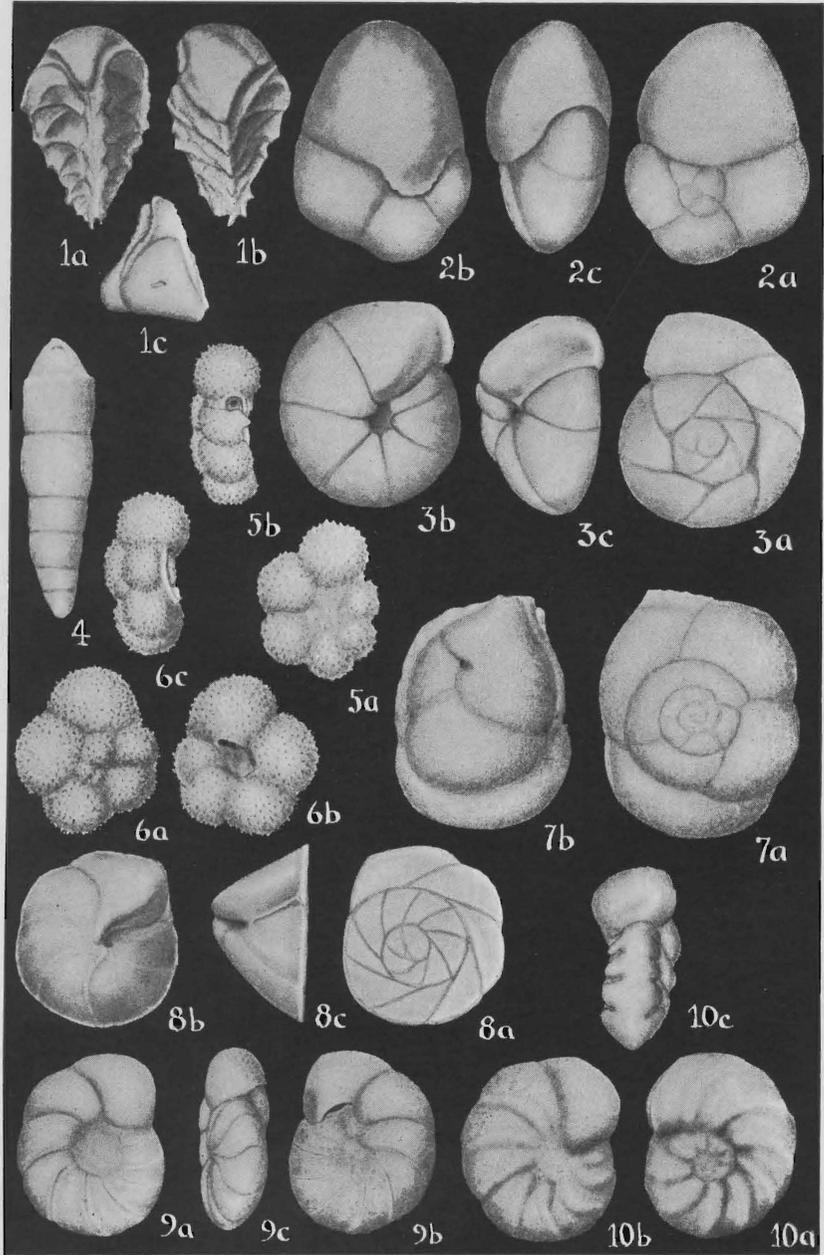
Bulimina brevis D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 270, No. 13;
Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 41, pl. 4, figs. 13, 14.

d'Orbigny's figures of this species in the 1840 report are much shorter and the base more rounded than in the usual form. However, a study of our Cretaceous material from this same area seems to show that the microspheric form at least is similar to that figured here. It is a common species in the chalks of Europe and

EXPLANATION OF PLATE 6

- FIGS. 1 a-c. *Pseudouvierina* sp(?). × 75. a, b, opposite sides; c, apertural view.
 FIGS. 2 a-c. *Valvulineria allomorphinoides* (Reuss). × 75. a, dorsal view; b, ventral view; c, peripheral view.
 FIGS. 3 a-c. *Gyroidina umbilicata* (d'Orbigny). × 75. a, dorsal view; b, ventral view; c, peripheral view.
 FIG. 4. *Nodosarella* sp(?). × 75.
 FIGS. 5 a, b. *Globigerinella aspera* (Ehrenberg). × 75. a, side view; b, peripheral view.
 FIGS. 6 a-c. *Globigerina cretacea* d'Orbigny. × 75. a, dorsal view; b, ventral view; c, peripheral view.
 FIGS. 7 a, b. *Globigerina elevata* d'Orbigny. × 45. a, dorsal view; b, peripheral view.
 FIGS. 8 a-c. *Globorotalia micheliniana* (d'Orbigny). × 75. a, dorsal view; b, ventral view; c, peripheral view.
 FIGS. 9 a-c. *Anomalina lorneiana* (d'Orbigny). × 45. a, dorsal view; b, ventral view; c, peripheral view.
 FIGS. 10 a-c. *Anomalina clementiana* (d'Orbigny). × 45. a, dorsal view; b, ventral view; c, peripheral view.

Figures drawn by Margaret S. Moore.



also in America. It may be noted here that it is very close to the forms described later by Reuss as *Bulimina ovula*. Our material, however, seems to show that these two forms are closely connected and probably identical, in which case they should be given d'Orbigny's earlier name.

BULIMINA IMBRICATA Reuss
Plate 5, figures 10 *a-c*

Bulimina imbricata REUSS, Haidinger's Nat. Abhandl., vol. 4, pt. 1, 1851, p. 38, pl. 3, fig. 7.

In 1851 Reuss described this species from the Upper Cretaceous of Lemberg. His specimen is a much more regular one than ours, but this has been placed at least provisionally under his species which seems, so far as material available shows, to be the same variable species. The later chambers are elongate, and earlier ones much shorter.

BULIMINA PUSCHI Reuss
Plate 5, figures 11 *a-c*

Bulimina puschi REUSS, Haidinger's Nat. Abhandl., vol. 4, pt. 1, 1851, p. 21, pl. 3, fig. 6.—EGGER, Ber. Nat. Ver. Passau, 1907, p. 23, pl. 3, fig. 3.—FRANKE, Abhandl. Preuss. Geol. Landes, vol. 111, 1928, p. 159, pl. 14, fig. 18.

This is a small species, elongate and tapering, with the greatest breadth toward the apertural end. The chambers are numerous, short and subglobular, but in end view the test shows a slight tendency to become triangular. The sutures are distinct and depressed, the wall smooth, and the aperture fairly large. Reuss's species was described from the Upper Cretaceous of Europe, and it also occurs in the Upper Cretaceous of the Gulf Coastal Plain of the United States.

Family ELLIPSOIDINIDAE

Genus NODOSARELLA Rzehak, 1895

NODOSARELLA sp(?)
Plate 6, figure 4

There is a single complete specimen uniserial in its development, and with the aperture typical of this group. It is somewhat similar to the species that occur elsewhere in the Cretaceous, but without more complete specimens it is difficult to give any specific name.

Family ROTALIIDAE

Genus VALVULINERIA Cushman, 1926

VALVULINERIA ALLOMORPHINOIDES (Reuss)

Plate 6, figures 2 a-c

Valvulina allomorphinoides REUSS, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 223, pl. 11, figs. 6 a-c.

Discorbina allomorphinoides FRANKE, Abhandl. Geol. Pal. Institut. Univ. Greifswald, vol. 6, 1925, p. 91, pl. 8, figs. 11 a, b; Abhandl. Preuss. Geol. Landes, vol. 111, 1928, p. 189, pl. 18, figs. 7 a, b.

Discorbis allomorphinoides CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 606, pl. 20, figs. 18, 19; pl. 21, fig. 5.

This species is widely distributed in the Upper Cretaceous of Europe and America, and occurs in typical form in this White Chalk of Antigua. The test is biconvex, slightly longer than broad, oval, with a rounded periphery. The chambers are usually very distinct with the earlier whorls visible on the dorsal side, ventrally involute, and usually 4 or 5 chambers in the last-formed whorl. The sutures are distinct, very slightly curved on the dorsal side and slightly depressed, on the ventral side nearly radial. The wall is smooth, and the aperture a narrow slit below an overhanging, flat, plate-like lip.

Genus GYROIDINA d'Orbigny, 1826

GYROIDINA UMBILICATA (d'Orbigny)

Plate 6, figures 3 a-c

Rotalina umbilicata D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 32, pl. 3, figs. 4-6.

This species was originally described by d'Orbigny from the White Chalk of the Paris Basin, and seems to belong to *Gyroidina*, although it is a variable form, and some of the specimens seem to tend toward *Valvulineria*. It is identical with the Paris Basin chalk specimens which so far as I have seen never have quite the rounded form indicated in d'Orbigny's original figures. There are usually about six chambers in the last-formed whorl of the test. The ventral side is decidedly umbilicate, and the chambers themselves inflated.

Family GLOBIGERINIDAE

Genus GLOBIGERINA d'Orbigny, 1826

GLOBIGERINA CRETACEA d'Orbigny

Plate 6, figures 6 a-c

Globigerina cretacea D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 34, pl. 3, figs. 12-14.

The published records for this species cover most formations from Cretaceous to Recent, and from many regions. It was originally described by d'Orbigny from the Paris Basin chalks, and in that and the equivalent formations of Europe, America, and elsewhere it occurs in enormous numbers, and seems to have a very definite form. The type figured has five chambers in the last-formed whorl; the spire is low, and the surface finely ornamented, with the ventral side showing a deep umbilicus. Frequently in well preserved material there is a thin, plate-like structure very largely covering the umbilical region, but this is very fragile and usually not present, although the edges of it may be seen in many specimens.

GLOBIGERINA ELEVATA d'Orbigny

Plate 6, figures 7 a, b

Globigerina elevata D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 34, pl. 3, fig. 15, 16.

d'Orbigny's figures in the Cretaceous Monograph show a peculiar large, high spired form with rather smooth surface. I have had similar specimens from the chalk of the Paris Basin and from other localities in Europe. It has not been recorded in America from the Cretaceous, but from the specimen figured here it should be looked for, as our specimens are in many ways similar to those of d'Orbigny.

Genus GLOBIGERINELLA Cushman, 1927

GLOBIGERINELLA ASPERA (Ehrenberg)

Plate 6, figures 5 a, b

Phanerostomum asperum EHRENBERG, Mikrogeologie, 1854, pl. 30, figs. 26 a, b; pl. 32, pt. 2, fig. 42.

Globigerina aspera EGGER, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, pt. 1, 1899, p. 170, pl. 21, figs. 18-20; Ber. nat. Ver. Passau, 1907, p. 49, pl. 7, fig. 27.—FRANKE, Abhandl. Preuss. Geol. Landes., vol. 111, 1928, p. 192, pl. 18, figs. 10 a-c.

Globigerinella aspera CARMAN, Journ. Pal., vol. 3, 1929, p. 315, pl. 34, fig. 6.

This nearly bilaterally symmetrical species is very common and widely distributed in the Upper Cretaceous of America. There are usually 6 or 7 chambers in the adult, and the surface is very distinctly spinose and roughened, especially in the early chambers, the later ones being often much less spinose as the spines are progressively reduced in size as the chambers are added.

Family GLOBOROTALIIDAE

Genus GLOBOROTALIA Cushman, 1927

GLOBOROTALIA MICHELINIANA (d'Orbigny)

Plate 6, figures 8 *a-c*

Rotalina micheliniana D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 31, pl. 3, figs. 1-3.

This species is a very definite one in the Upper Cretaceous chalks, occurring very widely distributed in different parts of the world. The name was used by Brady for Recent material which should be referred to *Globorotalia truncatulinoides* of d'Orbigny. The Cretaceous form has a very sharp keel and a very high spire, the dorsal side usually flattened or very slightly convex, chambers numerous, in 2 or 3 whorls with usually about seven chambers in the last-formed whorl. The ventral side of the test is very deeply umbilicate, and the surface is usually smooth throughout.

Family ANOMALINIDAE

Genus ANOMALINA d'Orbigny, 1826

ANOMALINA LORNEIANA (d'Orbigny)

Plate 6, figures 9 *a-c*

Rosalina lorneiana D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 36, pl. 3, figs. 20-22.

The type form figured by d'Orbigny from the Paris Basin has the later chambers much inflated, and the sutures very oblique on the dorsal side. There are specimens in our collection from Antigua, one of which is figured here, which show as do the series of French specimens, a decided linking of this species with the following. In the original figures the two look very different, but there are numerous gradations which seem to show that the one may possibly be a variety of the other.

ANOMALINA CLEMENTIANA (d'Orbigny)
Plate 6, figures 10 a-c

Rosalina clementiana D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 37, pl. 3, figs. 23-25.

Anomalina clementiana FRANKE, Abhandl. Geol. Pal. Instit. Univ. Greifswald, vol. 6, 1925, p. 85, pl. 7, figs. 12 a-c; Abhandl. Preuss. Geol. Landes., vol. 111, 1928, p. 179, pl. 16, figs 9 a-c.

Anomalina tennesseensis W. BERRY, in BERRY and KELLEY, Proc. U. S. Nat. Mus., vol. 76, Art. 19, 1929, p. 13, pl. 2, figs. 13-15.

This, as has already been noted under the preceding species, is a very variable form. Similar forms occur in the Upper Cretaceous of Tennessee and elsewhere in our Gulf Coastal Plain Cretaceous. There are 7 to 9 chambers in the last-formed whorl, the periphery rounded. On the ventral side, according to d'Orbigny's figure and from our specimens, the inner end of the chamber itself is often raised into a rounded elevation which extends toward the periphery in a slight curve entirely disappearing before it reaches the periphery itself. It shows very much variation, and d'Orbigny's figure seems to be an extreme one as I have never seen even in typical French chalk such a highly ornamented form.

106. ADDITIONAL LOCALITIES OF THE "CHALLENGER"
FORAMINIFERA

By W. L. F. NUTTALL

In 1927 the writer published a paper entitled "Localities whence the Foraminifera figured in the Report of H. M. S. Challenger by Brady were derived".* Recently Dr. W. A. Macfadyen, while working in the Zoological Museum at Cambridge, England, came across some additional slides, which had become separated in a different cabinet from the Brady Collection. The localities of these, which were noted by him and checked by the writer, are given below and fill omissions in the paper referred to. The plates and figures are those of the Monograph.

PLATE IV

Fig. 10 a. *Miliolina insignis* H. B. Brady, Chal. Stn. 162, Bass Strait.

* Ann. Mag. Nat. Hist. (London), ser. 9, vol. XIX, 1927, p. 209-241.

PLATE VI

- Fig. 14. *Miliolina pulchella* (d'Orbigny); Porcupine, No. AA, Loch Scavaig, Skye.
Fig. 18. *Miliolina linneana* (d'Orbigny), Chal. Stn. 187 A, off Booby Island.

PLATE X

- Fig. 14. *Spiroloculina acutimargo* H. B. Brady, Chal. Stn. 174 A, off Kandavu, Fiji.
Fig. 15. *Idem*, Chal. Stn. 185, off Raine Is., Torres Straits.

PLATE XL

- Fig. 18. *Trochammmina ringens* H. B. Brady, fig. 18 *a*, Chal. Stn. 98, off west coast of Africa; fig. 18 *b*, Stn. 70, N. Atlantic.

PLATE XLI

- Fig. 6. *Trochammmina nitida* H. B. Brady, Chal. Stn. 145, Prince Edward Island.

PLATE LXXXV

- Figs. 22, 24, 25. *Spirillina decorata* H. B. Brady, Chal. Stn. 120, off Pernambuco.

PLATE LXXXVIII

- Fig. 2. *Discorbina vilardeboana* (d'Orbigny), Chal. Stn. 233 B, Inland Sea, Japan.
Fig. 3. *Discorbina patelliformis* H. B. Brady, Stn. 219 A, Admiralty Islands.

PLATE XCVII

- Figs. 4, 6. *Anomalina polymorpha* Costa, Chal. Stn. 164 A, off Sydney, N. S. W.

PLATE CIII

- Fig. 7. *Pulvinulina patagonica* (d'Orbigny), Chal. Stn. 302, off west coast of Patagonia (not Stn. 246, N. Pacific).

PLATE CV

- Fig. 9. *Pulvinulina karsteni* Reuss, N. Polar Exped., 1875-6, Cape Frazer, Lat. 79° 45' N.

RECENT LITERATURE ON THE FORAMINIFERA

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

Vaughan, T. Wayland.

A Note on *Lepidocyclina hilli* Cushman.

(Journ. Pal., vol. 5, No. 1, Mar., 1931, pp. 41-42.) *Tulsa.*

Notes are given on the internal structure of the type.

Thomas, A. O.

Late Devonian Foraminifera from Iowa.

(Journ. Pal., vol. 5, No. 1, Mar., 1931, pp. 40-41, pl. 7.) *Tulsa.*

A new species of *Endothyra* is described and figured.

Skinner, John W.

New Permo-Pennsylvanian Fusulinidae from Northern Oklahoma.

(Journ. Pal., vol. 5, No. 1, Mar., 1931, pp. 16-22, pls. 3-4.)

Tulsa.

Five new species are described and figured.

Nuttall, W. L. F., and A. G. Brighton.

Larger Foraminifera from the Tertiary of Somaliland.

(Geol. Mag., vol. 68, No. 800, Feb., 1931, pp. 49-65, pls. I-IV, figs. 1-3 [in text].) *London.*

Species are described and figured from the Oligocene and Upper and Middle Eocene, with three new species.

Krijnen, W. F.

Het genus *Spiroclypeus* in het Indo-Pacifische gebied (With Summary in English).

(Verhandl. Geol.-Mijn. Gen. Nederland en Kolonien. Geol. Ser., vol. 9, 1931, pp. 77-112, pls. 1-3.) *Gravenhage.*

Figures and describes the Indo-Pacific species of the genus.

Berry, Willard.

Sectioning Orbitoid Foraminifera.

(Science, vol. 73, No. 1894, Apr. 17, 1931, pp. 426-427, 4 text figs.) *Lancaster.*

A simple method of sectioning is given.

Heron-Allen, Edward.

The Further and Final Researches of Joseph Jackson Lister Upon the Reproductive Processes of *Polystomella crispa* (Linné). (An Unpublished Paper Completed and Edited from His Note-Books.)

(Smithsonian Misc. Coll., vol. 82, No. 9 [Publ. 3067], Nov. 26, 1930, pp. 1-11, pls. 1-7.) *Washington.*

Notes on the stages in the development of megalospheric young with an excellent series of photomicrographs.

Plummer, Helen Jeanne.

Gaudryinella, A New Foraminiferal Genus.

(The American Midland Naturalist, vol. 12, No. 9, May, 1931, pp. 341, 342, figs. *a*, *b* [in text].) *Notre Dame.*

Describes the above genus, derived from *Gaudryina* by the addition of a uniserial stage. Lower Cretaceous.

Chapman, F., and W. J. Parr.

Notes on New and Aberrant Types of Foraminifera.

(Proc. Roy. Soc. Victoria, vol. XLIII, pt. II, Feb. 27, 1931, pp. 236-238, pl. IX [in part].) *Melbourne.*

Two new genera, *Heronallenia* and *Hofkerina*, are described and figured.

Chapman, F., and W. J. Parr.

On an Anomalous Specimen of *Homotrema rubrum* (Lamarck).

(l. c., 1931, pp. 238-240, pl. IX [in part].) *Melbourne.*

Chapman, Frederick.

A Report on Samples Obtained by Boring into Michaelmas Reef, about 22 Miles N. E. of Cairns, Queensland.

(Reports of Great Barrier Reef Committee, vol. III, 1931, pp. 32-42, pls. IX, X.)

Lists numerous foraminifera.

J. A. C.