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123. A LOWER EOCENE FORAMINIFERAL FAUNULE FROM THE WOODSIDE AREA, SAN MATEO COUNTY, CALIFORNIA

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ABSTRACT—Smaller Foraminifera from numerous samples of Eocene shales ("Chico" of the Santa Cruz Folio of 1909) in the vicinity of Woodside, San Mateo County, California, are recorded and illustrated. No new species are listed although some forms of rare occurrence, poor preservation, or fragmentary condition are unlike any previously described. There are 138 species and varieties in the assemblage, most of which have been previously figured from the Middle Eocene Canoas siltstone member of the Kreyenhagen shale (Laiming's basal A-2 zone) 150 miles to the south in Kings and Fresno counties, California, and from its southern hemisphere correlative, the Agua Fresca shale of Chile. Many of the species have been listed from the type locality of the Lodo formation (Paleocene-Eocene) of California.

Among the Woodside fossils are various pelagic and benthonic species of such limited stratigraphic range or characteristic occurrence elsewhere that a Lower Eocene age should be assigned to the shales containing them. The composition of the faunule indicates that the enclosing sediments were deposited in a neritic to upper bathyal environment with open-sea connections.

ACKNOWLEDGMENTS

The writers wish to express their gratitude to R. M. Touring, Eugene, Oregon, for permission to study some of his assemblages from the Woodside area; to C. C. Church, Tidewater Associated Oil Company, San Francisco, California; to Klaus Küpper, Stanford University; and to H. S. Edgell, Richfield Oil Company, Long Beach, California, for their many helpful suggestions during the course of study. Sincere thanks are given Myra Keen and H. E. Thalmann, Stanford University, for reading portions of the text; and the untiring efforts of Mary Wagner and Carol Mead, Palo Alto, California, in preparation of the camera lucida figures, are also deeply appreciated.

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INTRODUCTION

Recent pipeline excavations near Woodside in southeastern San Mateo County, California, have opened exposures hitherto unavailable for stratigraphic studies. The Eocene rocks in the mapped area (Fig. 1) consist of sandstone and shale exposed in small discontinuous patches along creek banks and road cuts, usually in regions of undulating hills and valleys, which permit of little stratigraphic and structural control.

These sandstones and shales, too disconnected to justify naming as a formation in this report, occur in a N.W.-S.E.-trending synclinal flexure and are underlain by or in fault contact with undifferentiated rocks, apparently of Cretaceous age. They are overlain unconformably by sediments of Miocene age. The thickness of exposed Eocene rocks has been estimated to range from 4,000 to 6,000 feet (Thomas, 1951).

Many of the structural features of the area probably result from its proximity to the San Andreas fault zone, which borders the district on the southwest.

The Foraminifera recorded in the check list and investigated from areas shown on the geologic sketch map occur in light gray to mottled gray-green and reddish-brown shale or claystone, usually associated with sandstone lenses. Localities of only a few of the many samples collected are indicated on the map, but those assemblages selected for detailed examination are believed to be representative of the entire collection. Unfortunately, the assemblages from the eight registered localities cannot be placed in stratigraphic sequence due to structural complications, but their well-preserved foraminifers merit illustration and description.

PREVIOUS WORK

For many years the sandstone and shales in the Woodside area were assigned to the Chico formation (Branner *et al.*, 1909) mainly on the basis of lithologic similarity to that Upper Cretaceous unit. However, about 1935 these "Chico" exposures were reinvestigated upon discovery that they contained microfossils which might aid in establishing their geologic age. In 1936 Martin recorded certain foraminifers from "Chico" beds along San Francisquito Creek (southern portion of our Fig. 1) which showed affinities with those of the Velasco shale of Mexico, the Lizard Springs formation of Trinidad, and the Moreno shale of California. She dated the strata containing these fossils as younger than the Turonian and older than the Danian. However, a few years later in an unpublished report[1] she reassigned the "Chico" assemblage to the Eocene.

Quackenbush[1] discovered in the "Chico" formation along Bear Creek, west of Whiskey Hill Road (western portion of our Fig. 1), microfossil assemblages

1 This report was part of an Eocene project at Stanford University under the direction of H. G. Schenck during the years 1940-1943 on which the following persons, among others, worked: J. Zimmerman, H. Foxhall, R. Carpenter, Lois Martin, and W. Quackenbush.

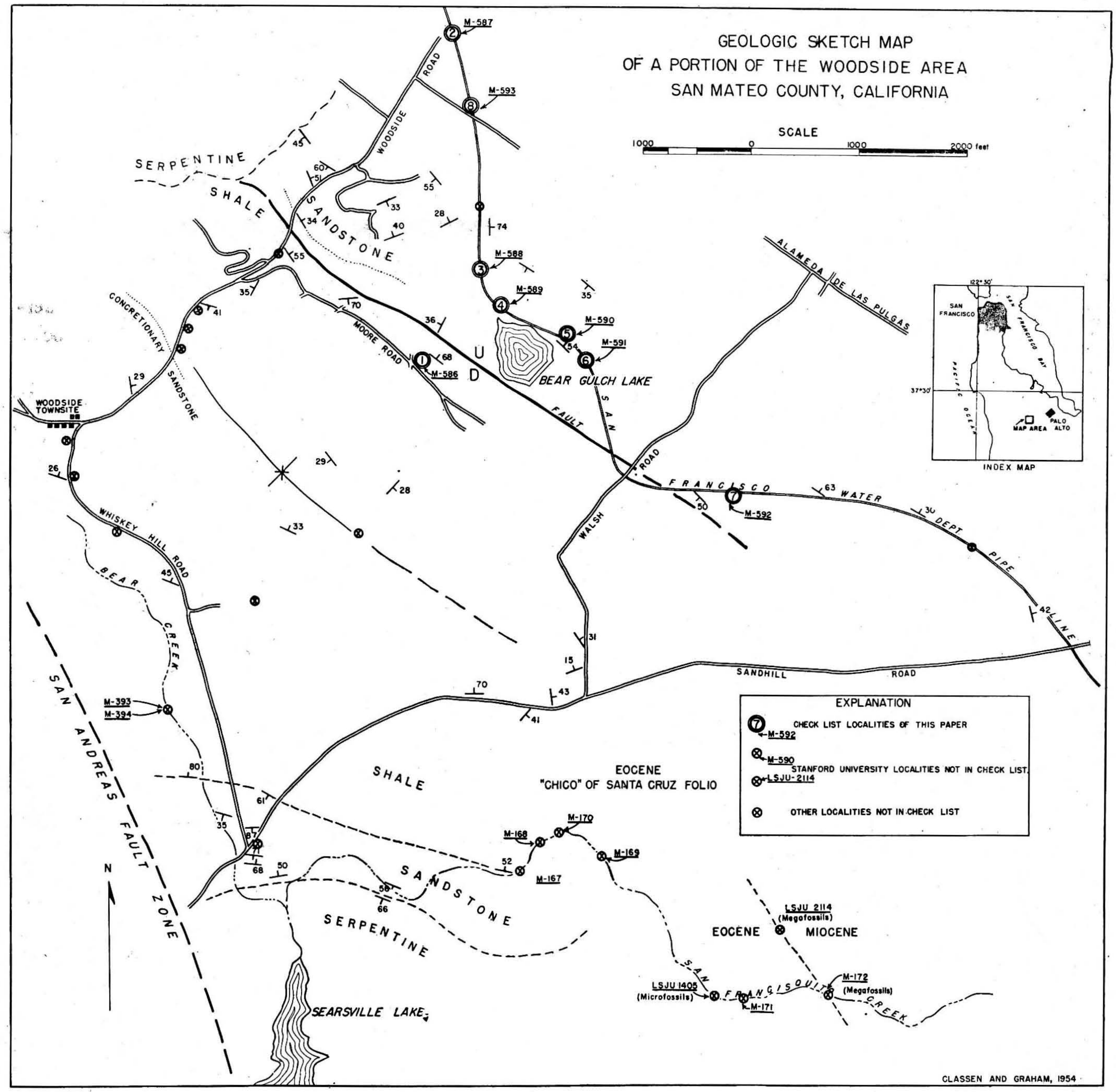


FIGURE 1. Sketch Map of the Woodside area, San Mateo County, California

similar to those from San Francisquito Creek. Following Martin, he assigned these foraminifer-bearing beds to the Eocene.

The latest published information on the geology of the district (Thomas, 1951) deals with an example of re-intrusion of serpentine southwest of Redwood City. In this paper Thomas gives an Eocene or Paleocene age for the so-called "Chico" beds, basing this age assignment on collections of Foraminifera made by Martin (1937) and by himself.

FAUNAL SUMMARY

The present micropaleontological investigations in the Woodside area are based on a study of Foraminifera from eight selected stations and 20 other localities in the region. Included among assemblages from the latter are two from the Bear Creek section (Stanford University localities M-393, M-394) and five from the San Francisquito Creek section (M-167 to M-171 inclusive), and LSJU 1405, previously mentioned. Only those foraminifers from Stations 1-8 are recorded on the accompanying check list; however, those from the remaining localities show a similar aspect.

The faunule consists of representatives of 22 foraminiferal families, 67 genera and 138 species. Several species have but few individuals, and some of these are poorly preserved or are fragmentary. Bionomically, the faunule is mainly of calcareous perforate and arenaceous forms. There is a high percentage of lagenid, buliminid, anomalinid, and ellipsoidinid species among the calcareous fossils, whereas the arenaceous species are few but with numerous specimens in some samples. In many assemblages the pelagic foraminifers are so abundant that they mask the benthonic forms. Radiolaria, fish fragments, ostracodes, and echinoid spines are often present.

Little investigation on the ecology of the Woodside faunule has been attempted. The abundance of arenaceous, planktonic, and lagenid species with a scarcity of miliolids suggests a neritic to upper bathyal habitat with open-sea connections. Similar ecologic conditions have also been construed for the Agua Fresca shale of Chile (Todd and Kniker, 1952, p. 4) the fauna of which has many species in common with the Woodside assemblages.

AGE AND CORRELATION

The Woodside faunule shows marked similarity to the Canoas siltstone faunule of the *"Marginulina" asperuliformis* zone (Middle Eocene) of the lower part of the type Kreyenhagen shale in Kings and Fresno counties, California. This latter faunule, described by Cushman and Siegfus (1942), occurs within the basal portion of Laiming's A-2 zone (or Laiming's A-3 zone according to Beck, 1952) in the California Eocene sequence, which was established on the basis of foraminiferal studies in the San Joaquin Valley (Laiming, 1940a, b; 1943). However, Laiming (1940a, p. 543-545) stated that the lowermost 50-100 feet of the type locality of the Kreyenhagen formation in Reef Ridge may represent an older Eocene horizon, and that in some districts, the basal portion of the A-2 zone, or other horizons as well, within the zone, may contain numerous species with affinities to those of the C zone of the "Lower Eocene." This similarity of assemblages is also thought by Laiming to be due to recurrence through redeposition, and when certain species, such as *Uvigerina churchi* and *U. garzaensis* are absent from the basal A-2 assemblage, he believes that the latter "is indistinguishable from that of zone C."

Since the Woodside and Canoas siltstone faunules contain many species in common, the question arises as to which of the two zones (basal A-2 or C), if either, they indicate. Additional data concerning the differences between the two zones are shown in Goudkoff and Mendoza's chart (1950) which deals with the stratigraphic occurrences in California of Eocene Foraminifera (characteristic and occasional occurrences of various species). As only the foraminifers in the *Vaginulinopsis asperuliformis* (formerly *Marginulina asperuliformis*) zone are concerned in studies of zones A-2 and C, a comparison of the relative abundance of species in these zones is important.

The following species characterize the *Vaginulinopsis asperuliformis* zone according to Cushman and Siegfus (1942, pp. 399-400):

1. *Vaginulinopsis asperuliformis* (Nuttall) [As *Marginulina asperuliformis* (Nuttall)]
2. *Bifarina nuttalli* Cushman and Siegfus
3. *Dentalina hispido-costata* Cushman and Siegfus
4. *Valvulineria advena* Cushman and Siegfus
5. *Globorotalia aragonensis* Nuttall (listed as *Globorotalia* cf. *aragonensis* in Cushman and Siegfus's check list)
6. *Anomalina dorri* Cole var. *aragonensis* Nuttall
7. *Bulimina corrugata* Cushman and Siegfus
8. *Buliminella grata* Parker and Bermudez
9. *Saccorhiza ramosa* (H. B. Brady)
10. *Martinottiella* cf. *M. petrosa* (Cushman and Bermudez)

Two of these, *Saccorhiza ramosa* and *Martinottiella* cf. *M. petrosa,* were not recorded by Laiming (1940a, pp. 544-545) from his basal A-2 zone, and a third, *Bulimina corrugata,* is recorded only from above the basal portion of the zone. In their chart showing the occurrences of nine of the ten above-mentioned species (*Saccorhiza ramosa* is not recorded) Goudkoff and Mendoza (1950) list 7 of the 9 species as having characteristic occurrence only in Zone C, and one species, *Bulimina corrugata,* with characteristic occurrence in Zone A-2. The remaining species, *Martinottiella* cf. *M. petrosa,* occurs only in Zone A-2, where it has occasional representation. Thus, the species characterizing the Canoas siltstone faunule are, in reality, more characteristic of Zone C than of basal A-2.

It is always difficult to assign a zonal age to an isolated assemblage of microfossils from a California Eocene unit, especially if stratigraphic control has not been definitely established or a partial section is involved. Furthermore, if some faunules are repeated at different horizons due to facies variations or to redeposition, it is doubly difficult to determine their geologic age.

And since, as Glaessner (1945, p. 224) shows, a high ratio of identical species does not prove that two assemblages are correlative, when the stratigraphic ranges of species are not well documented the problem becomes even more puzzling.

As it appears difficult to assign the *Vaginulinopsis asperuliformis* zonal elements to either the A-2 or the C zone, and intervening zones are not present for stratigraphic control, other diagnostic elements must be sought. In many foraminiferal assemblages the pelagic (planktonic of some authors) foraminifers have been ignored for some reason, although their importance for correlation has been widely recognized for many years. Concerning the use of benthonic and planktonic smaller Foraminifera for correlation and paleoecologic purposes, Todd (1954) has recently stated:

> "Benthonic (bottom-dwelling) species, so far as is known, are characteristically responsive to variation in the sedimentary environment even between closely juxtaposed depositional sites. At the same time, they may be little affected by age difference, even as great as that between Miocene and Recent epochs.
>
> "Planktonic (floating) species are subject to

wide and geologically rapid dispersal by ocean currents and, thus, should be well suited for use in long-range correlation. The planktonic species, however, are generally limited in their occurrence to open-sea facies and, thus, are available for correlation only between such facies. Planktonic species are commonly good indicators of temperature and may be interpreted to suggest direction of flow of oceanic currents, but they have little bearing on bottom paleoecology except as contributors to the sediment.

"Benthonic species, on the other hand, are commonly provincial and may become good local paleoecologic indicators with further knowledge of their living habits and associations.

"The apparent correlation of seemingly identical but widely separated planktonic assemblages is commonly weakened by (i) rarity or lack of associated fossils that might support or oppose the indicated age, (ii) rarity or lack of intervening occurrences of the same assemblage, and (iii) incomplete knowledge of the lineages of the species involved."

From the foregoing it appears that the occurrence in an assemblage of pelagic species, together with benthonic forms whose stratigraphic value is well established, is of greater value for correlation than assemblages whose pelagic elements are not listed or whose benthonic species are not diagnostic.

Very few pelagic forms have been recorded from the Middle and Upper Eocene of California, but numerous species have been listed from the Lower Eocene and Paleocene of the State. Perhaps this marked difference in the distribution in time of the pelagic forms has been overlooked by micropaleontologists in their efforts toward refinement of Lower Tertiary strata in California. In the basal A-2 zone, the only pelagic species listed are *Globigerina* sp. and *Globorotalia* cf. *G. aragonensis* Nuttall; since this latter foraminifer is more characteristically abundant in the Lower Eocene zones, perhaps more emphasis should be placed on its presence or on that of other pelagic species for correlation purposes.

Besides having many benthonic foraminifers in common with the Canoas siltstone faunule (with which it has been correlated by various micropaleontologists), the Woodside faunule contains pelagic species of such limited stratigraphic range elsewhere that there is ample evidence for an age older than Middle Eocene for it. The following pelagic species (with their Gulf Coast-Caribbean stratigraphic ranges) and benthonic species (with characteristic occurrence in zones older than A-2 in California) in the Woodside faunule form a combination which indicates to the writers that it is at least Lower Eocene (Zone C) in age:

Pelagic Species[2]

Globorotalia membranacea Ehrenberg (U. Midway-L. Wilcox)
Globorotalia crassata (Cushman) (L.?-M.?-U. Eocene)
Globorotalia crassata var. *aequa* Cushman and Renz (Paleocene)
Globorotalia naussi Martin (?Wilcox-?Claiborne)
Globorotalia velascoensis var. *acuta* Toulmin (U. Midway-L. Wilcox)
Globigerina pseudobulloides Plummer (Midway)
Globigerina triloculinoides Plummer (L. Midway-L. Claiborne)
Globigerina nitida Martin (?Wilcox-?Claiborne)
Hastigerinella eocanica Nuttall (U. Wilcox-U. Jackson)

Benthonic Species[3]

Glomospira charoides (Jones and Parker - (D)
Elongate form of *Spiroplectammina* similar to *gryzbowskii, directa,* or *clotho* - (C, D)
Nonion micrus Cole [*Globigerinella* according to some authors], probably listed as *Nonion* cf. *N. wilcoxensis* Cushman and Ponton - (C, D, E)
Osangularia mexicana (Cole), probably listed as *O. cutler* (Parker and Jones) - (C)
Anomalina dorri Cole var. *aragonensis* Nuttall - (C, D, E)
Silicosigmoilina californica Cushman and Church - (C, D, E)
Vaginulinopsis asperuliformis (Nuttall) - (C)
Quadrimorphina advena (Cushman and Siegfus) - (C)
Pullenia eocenica Cushman and Siegfus - (C)
Amphimorphina ignota Cushman and Siegfus - (C)
Nodosaria cf. *N. velascoensis* Cushman - (C, E)
Tritaxilina colei Cushman and Siegfus - (C)
Chilostomelloides cyclostoma (Rzehak) or probably related form - (C, D)
Aragonia capdevilensis (Cushman and Bermudez) - (B-4, C)

The faunule also contains other species known from the Paleocene and Lower Eocene of California (Lodo formation), the Gulf Coast of the United States (Midway and Wilcox formations), certain Lower Tertiary strata in Trinidad and Cuba, and the Lower Eocene of Mexico (Aragon formation), the presence of which further substantiates its Lower Eocene age.

The Woodside assemblages all seem to be of the same geologic age, and the occurrence of one specimen of *Uvigerina garzaensis* Cushman and Siegfus (which is more characteristic of the Kreyenhagen shale above the Canoas siltstone member) and of rare specimens of *Bulimina corrugata* Cushman and Siegfus (the latter is characteristic of Zone A-2 and has not been re-

2 Stratigraphic ranges after Grimsdale (1951), Cushman and Bermudez (1949), and the writers.

3 Characteristic occurrences after Goudkoff and Mendoza (1950).

corded from Zone C), simply indicates a lower stratigraphic range for these foraminifers.

In addition to those previously mentioned, other faunal papers with many species similar to or identical with the Woodside fossils include Martin's on the type Lodo formation (1943) and one by Todd and Kniker (1952) on the Agua Fresca shale of southernmost Chile. This latter paper lists species common or related to the Canoas siltstone faunule with which it is correlated.

It is interesting to note that Israelsky (1943, pp. 1269-1270), in a review of Martin's Lodo work, stated that his B zone assemblage (he divided the Lodo formation into three faunal zones for ease of analysis) and the Canoas siltstone faunule belong in the same stage—probably Zone C of Laiming. He considered also that "most Gulf Coast micropaleontologists would place his Zone B in the Midway-Wilcox (lower Eocene of the U.S.G.S.)" and that he himself would regard "at least for the present, zone B of the Lodo as Wilcox in age." Israelsky's age assignment of the Canoas siltstone faunule contrasts with that of Cushman and Siegfus (1942, pp. 397-398) who stated that "the Canoas siltstone member, which underlies the Markley microfaunal zone, may well correspond to Clark's transition stage," [Middle or Upper Eocene] and that its "foraminiferal fauna, characterized by species found in the Claiborne and older formations, would appear to support this view." However, in their earlier papers on the Kreyenhagen shale, Cushman and Siegfus (1935, 1939) figured many species which are identical with those in the Lower Eocene of Mexico, implying, as Laiming states (1940a, p. 545), "a correlation with the Aragon formation of that region."

If *Vaginulinopsis* (= *Marginulina*) *asperuliformis* (Nuttall), described from the Aragon formation of Mexico, is restricted to the Lower Eocene, it is indeed puzzling why the zone of this name in the lower portion of the type area of the Kreyenhagen shale in California should be considered Middle Eocene in age, a procedure contrary to the principles of geologic correlation. Furthermore, if the basal A-2 fauna is a result of redeposition from Zone C, as Laiming (1940a, p. 544) believed to be likely, or ecologic conditions were such that there was a recurrence of the C fauna in A-2, then it is impossible to differentiate one zone from the other.

The excellent state of preservation of most of the foraminiferal tests in the Woodside faunule, the similar constitution of the matrix and filling of these tests, and the seeming lack of reworked fossils indicate that its faunal composition is apparently normal.

Repository of Types.—Hypotypes and other figured specimens are in the Stanford University Paleontological Type Collection, Catalogue numbers 8114 to 8251 inclusive.

Synonymy.—No attempt is made in recording the Woodside fossils to give a complete synonymy, and in nearly every citation the original reference and one or two others only are listed. In many cases the last-mentioned citation refers to a more complete history of the species or varieties. The synonymy does not include check list references to assemblages of approximately the same age as the Woodside faunule (e. g., Martin's type Lodo list).

Location and description of check list localities.

Station 1 (M-586)[4] — Small gully southwest of water tanks adjoining W. J. Classen property. Greenish to reddish gray claystone, interbedded with thin yellow to buff medium-grained sandstone.

Station 2 (M-587) — San Francisco Water Department pipeline ditch southeast of the Woodside Road, east of the Menlo Country Club. Greenish gray, massive claystone.

Station 3 (M-598) — San Francisco Water Department pipeline ditch where it crosses Stockbridge Ave. into Eleanor Drive in Woodside Heights. Reddish to gray claystone, with large sandstone lenses.

Station 4 (M-589) — San Francisco Water Department pipeline ditch where it crosses northwest property line of the California Water Service Company property. Red and green claystone.

Station 5 (M-590) — San Francisco Water Department pipeline ditch northeast of the southeast end of Bear Gulch Lake. Brownish to gray claystone interbedded with sandstone.

Station 6 (M-591) — San Francisco Water Department pipeline ditch 300 feet east of northeast corner of Bear Gulch Lake dam. Massive reddish claystone.

Station 7 (M-592) — San Francisco Water Department pipeline ditch 1,000 feet east of Walsh Road. Reddish claystone.

Station 8 (M-593) — San Francisco Water Department pipeline ditch 600 feet southeast of the Woodside Road. Gray to greenish massive claystone.

SYSTEMATIC DESCRIPTIONS

Family ASTRORHIZIDAE

Genus **Astrorhiza** Sandahl, 1858

?**Astrorhiza** sp.

Plate 1, figures 2, 4, 5

A few fine-grained smoothly arenaceous fragments of irregular outline may belong to this genus. Except for being distorted they resemble *Astrorhiza* cf. *A. vermiformis* Goës from the Oligocene Cipero marl of Trinidad (Cushman and Stainforth, 1945, p. 13, pl. 1, figs. 1-2). The figured straight forms considered to belong to this foraminifer resemble also *Bathysiphon*

4 M-586 to M-593 refer to Stanford University microfossil localities.

sp. (?) from the Miocene beds of the Los Sauces Creek area, California (Cushman and Laiming, 1931, p. 92, pl. 9, fig. 1) except that they appear to be constricted at various places.

Length .825 mm., width .264 mm. (8114-a)
Length .66 mm., width .231 mm. (8114-b)
Length .495 mm., width .264 mm. (8114-c)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8114 a-c.

Locality.—Station M-586.

Family RHIZAMMINIDAE

Genus **Bathysiphon** M. Sars, 1872

Bathysiphon eocenicus Cushman and G. D. Hanna

Plate 1, figure 1

Bathysiphon eocenica CUSHMAN and G. D. HANNA, Proc. Calif. Acad. Sci., ser. 4, vol. 16, 1927, p. 210, pl. 13, figs. 2, 3.

Bathysiphon eocenicus TODD and KNIKER, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 5, pl. 1, figs. 3, 4.

Fragments of various sized individuals of this species are recorded from numerous localities in the Woodside area. Preservation is usually good although some specimens are slightly distorted or have the interior filled with foreign material.

B. eocenicus, described from Eocene beds near Coalinga, California, has been recorded from numerous Lower Tertiary formations of the world.

Length 1.848 mm., width .561 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8115.

Locality.—Station M-586.

?**Bathysiphon** sp.

Plate 1, figure 3

Small compressed fragments composed of coarse sand grains can only be questionably referred to this genus; they may be related to species of *Rhabdammina* or *Saccorhiza* which have been widely recorded from Lower Tertiary formations of the world.

Israelsky (1951, p. 5, pl. 2, figs. 7-9) records similar appearing forms from the type Lodo formation of California as *Bathysiphon* sp. B.

Length .528 mm., width .231 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8116.

Locality.—Station M-586.

Family AMMODISCIDAE

Genus **Ammodiscus** Reuss, 1861

Ammodiscus glabratus Cushman and Jarvis

Plate 1, figure 6

Ammodiscus glabratus CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 86, pl. 12, fig. 6.—CUSHMAN and RENZ, Cushman Lab. Foram. Res. Spec. Publ. No. 24, 1948, p. 6, pl. 1, fig. 16.

Smooth, highly polished, multi-coiled, concave specimens of rare to fairly common occurrence belong to this species described from the Lizard Springs formation (Upper Cretaceous of some authors, Lower Tertiary of others) of Trinidad.

Some forms are brown or amber-colored; others are grayish-white. Similar color differences of other specimens in our assemblages apparently result from variations in preservation.

Length .726 mm., width .561 mm., thickness .231 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8117.

Locality.—Station M-586.

Genus **Glomospira** Rzehak, 1888

Glomospira charoides (Jones and Parker)

Plate 1, figures 7a, b

Trochammina charoides JONES and PARKER, in Carpenter, Parker and Jones, Intro. Foram., 1862, p. 141, pl. 11, fig. 3.

Glomospira charoides NUTTALL, Journ. Pal., vol. 4, 1930, p. 279, pl. 23, fig. 1.—CUSHMAN and STAINFORTH, Cushman Lab. Foram. Res. Spec. Publ. No. 14, 1945, p. 14, pl. 1, figs. 12, 13.—CUSHMAN and RENZ, Cushman Lab. Foram. Res. Spec. Publ. No. 24, 1948, p. 7, pl. 1, figs. 18, 19.

Very rare specimens, several of which are crushed or poorly preserved, resemble this widely distributed species. Goudkoff and Mendoza (1950, p. 10), in their publication dealing with the distribution of Eocene Foraminifera in California, record this species from Laiming's Zone D only.

The type of the species (*Trochammina squamata* Jones and Parker var. *charoides* Jones and Parker) was not figured by these authors in their 1860 publication (p. 304) on the Recent rhizopod fauna of the Mediterranean region.

Width .313 mm., thickness .231 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8118.

Locality.—Station M-586.

Family LITUOLIDAE

Genus **Ammobaculites** Cushman, 1910

Ammobaculites cubensis Cushman and Bermudez

Plate 1, figure 8

Ammobaculites cubensis CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 13, 1937, pp. 106-107, pl. 16, figs. 4, 16-18.—TODD and KNIKER, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 6, pl. 1, figs. 12-14.

A coarsely arenaceous well-cemented specimen with an indistinctly coiled initial stage and two rectilinear uniserial chambers belongs to this species described from the Eocene of Cuba and recorded from the Eocene of California, the Dominican Republic, Trinidad, and Chile, and the Oligocene of Cuba and the Dominican Republic (see synonymy in Todd and Kniker, 1952, p. 6.). It resembles also *Ammobaculites* cf. *A. foliaceus* (H. B. Brady) from the Eocene of Trinidad (Cushman and Renz, 1948, p. 11, pl. 2, fig. 9).

Length .99 mm., width .66 mm., thickness .429 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8119.

Locality.—Station M-586.

Genus **Cyclammina** H. B. Brady, 1876

Cyclammina simiensis Cushman and McMasters

Plate 1, figures 9a, b

Cyclammina simiensis Cushman and McMasters, Journ. Pal., vol. 10, 1936, p. 509, pl. 74, figs. 3a, b. —Todd and Kniker, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 6, pl. 1, fig. 9.

Fairly abundant at many localities are fine-grained, slightly glossy, lenticular specimens which resemble this Middle Eocene species described from the Llajas formation of California. *Cyclammina simiensis* has also been recorded from the Lower Tertiary Lodo formation of California and the Eocene Chira and Agua Fresca shales of Peru and Chile respectively.

Several fossils are compressed to such degree that they appear to possess a keel, resembling in this respect *Cyclammina samanica* W. Berry from the Kreyenhagen formation of California (Cushman and Siegfus, 1942, p. 401, pl. 15, fig. 5).

Length .66 mm., width .561 mm., thickness .231 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8120.

Locality.—Station M-586.

Genus **Haplophragmoides** Cushman, 1910

Haplophragmoides sp.

Plate 1, figures 10a, b

Rare, medium-grained specimens, nearly all of which are crushed, probably belong to this genus. The figured nautiloid form resembles *Haplophragmoides longifissus* Israelsky from the Lodo formation of California (Israelsky, 1951, p. 12, pl. 2, figs. 34, 35), but well-preserved specimens are needed for specific identification.

Length .561 mm., width .528 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8121.

Locality.—Station M-586.

Genus **Trochamminoides** Cushman, 1910

?**Trochamminoides** sp. A

Plate 1, figure 11

A smoothly arenaceous specimen with its initial stage irregularly coiled and possessing several external constrictions in its later *Ammodiscus*-like development is questionably referred to this genus.

It resembles *Ammodiscus* sp. from the Kreyenhagen shale (Cushman and Siegfus, 1942, p. 401, pl. 15, fig. 4) in its form of coiling and test construction.

Diameter .429 mm., thickness .198 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8123.

Locality.—Station M-586.

?**Trochamminoides** sp. B

Plate 1, figures 12a, b

A fine-grained, coiled, arenaceous specimen divided into a series of segments or chambers and slightly distorted is questionably referred to this genus solely on the basis of its resemblance to *Trochamminoides* sp. from the Eocene Hospital Hill formation of Trinidad (Cushman and Renz, 1948, p. 10, pl. 2, fig. 4).

Length .924 mm., width .66 mm., thickness .363 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8122.

Locality.—Station M-586.

Family TEXTULARIIDAE

Genus **Spiroplectammina** Cushman, 1927

Spiroplectammina adamsi Lalicker

Plate 1, figures 13a, b

Spiroplectammina adamsi Lalicker, Contr. Cushman Lab. Foram. Res., vol. 11, 1935, pp. 39-40, pl. 6, figs. 1, 2.—Todd and Kniker, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 6, pl. 1, figs. 18, 19.

Rare specimens of this species described from the Martinez formation of Santa Susana, California, and recorded from the Eocene of Oregon and Chile, occur at several localities. The figured form resembles closely the figure of the paratype.

Length .396 mm., width .396 mm., thickness .231 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8124.

Locality.—Station M-586.

Spiroplectammina sp.

Plate 1, figures 14, 15, 16

Arenaceous specimens smoothly finished with siliceous cement and having characteristics similar to *Bolivinopsis directa* (Cushman and Siegfus) from the type area of the Kreyenhagen shale of California (Cushman and Siegfus, 1939, p. 26, pl. 6, figs. 7-8; 1942, pp. 409-410, pl. 16, figs. 27-28) occur in scattered areas in the Woodside district. Investigation of paratypes of the Kreyenhagen species indicates that their walls are arenaceous, not calcareous as Cushman and Siegfus stated. Todd and Kniker (1952, p. 7) in comparing Kreyenhagen specimens with their *Spiroplectammina brunswickensis* from the Eocene Agua Fresca shale of Chile likewise are of this opinion.

The writers find it difficult to distinguish the variable Woodside specimens (most of which are not figured in this publication) from the figures and descriptions of Todd and Kniker's *S. brunswickensis* and *S. elgansoensis* from the Agua Fresca shale (1952, pp. 6-7, pl. 1, figs. 16, 17) and from *S. grzybowskii* Frizzell from the Upper Cretaceous Mal Paso of Peru (Frizzell, 1943, pp. 339-340, pl. 55, figs. 12, 13). It is interesting also to note that Todd and Kniker are of the opinion that *Bolivinopsis directa* and *Spiroplectammina brunswickensis* "seem to be very closely related and may prove to be indistinguishable."

Inasmuch as the elongate Cretaceous-Eocene spiroplectamminid foraminifers need monographic study to permit specific assignment, no determination of the Woodside specimens is made.

Length .792 mm., width .33 mm., thickness .165 mm. (8125-a)

Length .792 mm., width .231 mm., thickness .132 mm. (8125-b)

Length .759 mm., width .198 mm., thickness .132 mm. (8125-c)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8125 a-c.

Locality.—Station M-586.

Genus **Textularia** Defrance, 1824

Textularia sp.

Plate 1, figures 17a, b, 18

The few specimens of this genus are poorly preserved. Figured forms are thought to belong to a single species.

Length .445 mm., width .297 mm., thickness .132 mm. (8126-a)

Length .462 mm., width .247 mm., thickness .165 mm. (8126-b)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8126a, b.

Locality.—Station M-587.

Genus **Vulvulina** Orbigny, 1826

Vulvulina curta Cushman and Siegfus

Plate 1, figure 19

Vulvulina curta Cushman and Siegfus, Contr. Cushman Lab. Foram. Res., vol. 11, 1935, p. 91, pl. 14, figs. 1, 2.—Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, pp. 401-402, pl. 15, figs. 7-8.

Specimens of this species are rare and show considerable variation in test outline. The type was described from the Kreyenhagen shale of California.

Length .561 mm., width .495 mm., thickness .264 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8127.

Locality.—Station M-586.

Family VERNEULINIDAE

Genus **Clavulinoides** Cushman, 1936

Clavulinoides sp.

Plate 1, figures 20a, b, 21a, b

Rare specimens of small, probably juvenile, forms of this genus are not specifically identified. Most tests are slightly twisted, triangular in outline, smoothly finished, and composed of fine to medium-grained sand grains with varying amounts of cement. They may be related to *Clavulinoides aspera* (Cushman) described from the Upper Cretaceous of Mexico and Texas (Cushman, 1937a, pp. 122-123, pl. 16, figs. 27-31; pl. 17, figs. 1-3).

Cushman and Siegfus (1942, p. 402, pl. 19, figs. 1-3, especially fig. 1) record similar forms from the Canoas siltstone as *Clavulinoides* sp.

Length 1.155 mm., width .627 mm. (8128-a)

Length 1.056 mm., width .528 mm. (8128-b)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8128a, b.

Locality.—Station M-590.

Genus **Gaudryina** Orbigny, 1839

Gaudryina brunswickensis Todd and Kniker

Plate 1, figures 22a, b

Gaudryina brunswickensis Todd and Kniker, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 10, pl. 1, figs. 24-26.

The only previous record of this species is from the Eocene Agua Fresca shale of Chile. Variability in our specimens is indicated by differences in size, degree of coarseness of wall texture, and shape of apertural reentrant. They are of rare occurrence.

Length 1.285 mm., width .429 mm., thickness .379 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8129.

Locality.—Station M-593.

Family MILIOLIDAE

Genus **Quinqueloculina** Orbigny, 1826

Quinqueloculina sp.

Plate 1, figures 23a, b

One specimen only of this genus was observed in our material. It resembles *Quinqueloculina yeguaensis* Weinzerl and Applin from the Eocene of the Marysville Buttes area, California (Israelsky, 1939, p. 572, pl. 2, figs. 2, 3); however, the fossil is too poorly preserved to be assigned to this species with any degree of certainty.

Length .429 mm., width .214 mm., thickness .148 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8130.

Locality.—Station M-593.

Genus **Spiroloculina** Orbigny, 1826

Spiroloculina sp.

Plate 1, figure 24

The few planispirally coiled fragments of this genus are not specifically identified. They resemble *Spiroloculina cretacea* Reuss from the Cretaceous of Texas (Cushman and Todd, 1944, pp. 3-4, pl. 2, figs. 1-4, especially figs. 4a, b), but well-preserved forms are needed for species identification.

Cushman and Siegfus (1942, p. 404, pl. 15, figs. 15-17) found in the type area of the Kreyenhagen formation of California similar forms which they questionably refer to this genus.

Length .396 mm., width .214 mm., thickness .066 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8131.

Locality.—Station M-593.

Family VALVULINIDAE

Genus **Dorothia** Plummer, 1931

Dorothia asiphonia (Andreae)

Plate 1, figure 25

Gaudryina siphonella Reuss var. *asiphonia* Andreae, Abh. Geol. Spec. Karte Elsass-Lothr., Bd. 2, 1884, pp. 108, 139, pl. 7, fig. 7.

Dorothia ? sp. Cushman and Siegfus, Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, p. 402, pl. 19, figs. 4-6.

Dorothia asiphonia Todd and Kniker, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 11, pl. 2, figs. 6, 7.

Numerous specimens, nearly all of which are distorted, appear to belong to this species described from the Oligocene of Alsace.

Dorothia asiphonia has also been recorded from the Eocene and Oligocene of South America, the Oligocene of Mexico and the West Indies, and from the Eocene of Europe.

Length .594 mm., width .231 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8132.

Locality.—Station M-593.

Dorothia principensis Cushman and Bermudez

Plate 1, figures 26a, b

Dorothia principensis Cushman and Bermudez, Contr. Cushman Lab. Foram. Res., vol. 12, 1936, p. 57, pl. 10, figs. 3, 4.—Todd and Kniker, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 12, pl. 2, figs. 8, 9.

Rare specimens of this species described from the Eocene of Cuba and recorded from the Eocene of California, the Gulf Coast of the United States, Haiti, and Chile, occur at a few localities in the Woodside district.

Length .462 mm., width .264 mm., thickness .231 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8133.

Locality.—Station M-586.

Genus **Karreriella** Cushman, 1933

Karreriella chilostoma (Reuss)

Plate 1, figures 27a, b

Textularia chilostoma Reuss, Zeitschr, Deutsch. Geol. Ges., Bd. 4, 1852, p. 18, text figs. a, b.

Karreriella chilostoma Cushman, Cushman Lab. Foram. Res. Spec. Publ. No. 8, 1937, pp. 126-127, pl. 15, figs. 1-8.

Well-preserved specimens from several localities seem to fall within the range variation of this species as interpreted by Cushman (see synonymy). The type is from the Middle Oligocene of Germany.

A few Lower Tertiary occurrences of this species in the Western Hemisphere are: Eocene and Oligocene of Trinidad (Cushman and Renz, 1948, p. 18, pl. 3, figs. 15, 16; and Cushman and Stainforth, 1945, p. 19, pl. 2, figs. 6, 7, respectively) and the Upper Oligocene of the Dominican Republic (Bermudez, 1949, p. 90, pl. 5, figs. 17-20).

Length .627 mm., width .429 mm., thickness .396 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8134.

Locality.—Station M-586.

Genus **Marssonella** Cushman, 1933

Marssonella oxycona (Reuss)

Plate 1, figures 28a, b

Gaudryina oxycona Reuss, Sitz. Akad. Wiss. Wien, Bd. 40, 1860, p. 229, pl. 12, fig. 3.

Marssonella oxycona Cushman, Contr. Cushman Lab. Foram. Res., vol. 9, 1933, p. 36, pl. 4, figs. 13a, b. —Cushman, Cushman Lab. Foram. Res. Spec. Publ. No. 8, 1937, pp. 56-59, pl. 5, figs. 27-29; pl. 6, figs. 1-17.—Toulmin, Journ. Pal., vol. 15, 1941, pp. 573-575, pl. 78, figs. 12, 13.

Very rare specimens appear to fall within the range of variation of this species as interpreted by Cushman (see synonymy, 1937). The type was described from the Upper Cretaceous of Germany.

Toulmin's fossils from the Lower Eocene Salt Mountain limestone of Alabama resemble closely the Woodside foraminifers.

Length .858 mm., width .66 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8135.

Locality.—Station M-586.

Genus **Plectina** Marrson, 1878

Plectina garzaensis Cushman and Siegfus

Plate 1, figures 29a, b

Plectina garzaensis Cushman and Siegfus, Contr.

Cushman Lab. Foram. Res., vol. 11, 1935, p. 92, pl. 14, figs. 3, 4; Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, p. 403, pl. 15, figs. 10, 11.

Specimens of this species described from the Kreyenhagen shale of California show considerable variation in chamber arrangement. Some small individuals resemble *Plectina trinitatensis* Cushman and Renz (1948, p. 15, pl. 3, fig. 12) from the Eocene Navet formation of Trinidad.

Length 1.056 mm., width .544 mm., thickness .528 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8136.

Locality.—Station M-586.

Genus **Tritaxilina** Cushman, 1911

Tritaxilina colei Cushman and Siegfus

Plate 1, figures 30a, b, 31

Tritaxilina colei CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 11, 1935, p. 92, pl. 14, figs. 5, 6.—TODD and KNIKER, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 12, pl. 2, fig. 10.

Specimens of this species described from the Eocene Chapapote formation of Mexico occur at many localities in the shales around Woodside.

In addition to being recorded from many other California Eocene units, *Tritaxilina colei* has also been reported from the Eocene of South America and the West Indies.

Length 1.318 mm., width .627 mm. (8137-a)

Length .825 mm., width .495 mm. (8137-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8137 a, b.

Locality.—Station M-586.

Family SILICINIDAE

Genus **Silicosigmoilina** Cushman and Church, 1929

Silicosigmoilina californica Cushman and Church

Plate 1, figure 32

Silicosigmoilina californica CUSHMAN and CHURCH, Calif. Acad. Sci. Proc., 4th ser., vol. 18, 1929, pp. 502-503, pl. 36, figs. 10-12.—ISRAELSKY, U. S. Geol. Surv. Prof. Paper 240a, 1951, p. 10, pl. 2, figs. 19-21; pl. 10, fig. 20.

Rare to fairly common at most localities are variable forms resembling this species described from Upper Cretaceous beds near Coalinga, California. Israelsky (see synonymy) recorded similar forms from the Lodo formation of California, and Martin (1943, p. 12) has observed the species in the Lodo formation of California. Laiming (1940a, p. 545) in listing the foraminifers characteristic of his A-2 zone reported a small variety of *Silicosigmoilina* cf. *S. californica* from near the base of the zone.

Sigmoilina? sp. from the Kreyenhagen shale (Cushman and Siegfus, 1942, p. 404, pl. 15, fig. 18) is remarkably similar to some of our specimens.

Length .726 mm., width .396 mm., thickness .165 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8138.

Locality.—Station M-586.

Family TROCHAMMINIDAE

Genus **Trochammina** Parker and Jones, 1859

?**Trochammina** sp.

Plate 1, figures 33, 34

Rare specimens in various degrees of distortion are questionably referred to this genus. The chamber arrangement and apertural characteristics of the fine-grained arenaceous forms are indistinct.

Length .66 mm., width .594 mm. (8139-a)

Length .66 mm., width .528 mm. (8139-b)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8139a, b.

Locality.—Station M-590.

Family LAGENIDAE

Genus **Astacolus** Montfort, 1808

Astacolus sp.

Plate 2, figure 1

Specimens referred to this genus are so variable in chamber arrangement that it is difficult to assign them to any described species. There are numerous references in the literature to planispiral forms similar to that figured whose last-formed chamber extends toward or reaches the periphery of the coil—and the wide divergence of opinion as to their generic designation is indicated by assignment to either *Robulus, Lenticulina, Planularia,* or *Astacolus*.

The figured specimen is our best preserved adult form. It resembles *Lenticulina theta* Cole? from the Kreyenhagen shale of California (Cushman and Siegfus, 1942, p. 405, pl. 15, fig. 26).

Length .759 mm., width .495 mm., thickness .198 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8140.

Locality.—Station M-590.

Genus **Chrysalogonium** Schubert, 1907

?**Chrysalogonium granti** (Plummer)

Plate 2, figure 2

Nodosaria granti PLUMMER, Texas Univ. Bull. 2644, 1926, pp. 83-84, pl. 5, figs. 9a-d.

Chrysalogonium granti CUSHMAN, U. S. Geol. Surv. Prof. Paper 232, 1951, pp. 24-25, pl. 13, fig. 11.

An elongate fragment with its apertural end missing is questionably referred to this species described from the Midway of Texas and recorded from numerous other Lower Tertiary localities in the United States and elsewhere.

Length 1.815 mm., width .313 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8141.

Locality.—Station M-590.

Genus **Dentalina** Orbigny, 1826

Dentalina cf. **D. communis** (Orbigny)

Plate 2, figure 3

A few well-preserved slightly arcuate specimens consisting of eight chambers which increase in size as added may be related to this species described from the Adriatic Sea. According to published records, *Dentalina communis* has wide geographic and stratigraphic ranges and is extremely variable in shape. *D. communis* from the Cowlitz River Eocene of Washington (Beck, 1943, pp. 598-599, pl. 105, fig. 22) resembles the Woodside fossils except that it is slightly larger and has an initial spine, and *D.* cf. *communis* from the Eocene Cocoa sand of Alabama (Cushman, 1946a, p. 14, pl. 3, fig. 8) also seems to be close to our figured specimen.

Length .924 mm., width .132 mm., thickness .132 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8142.

Locality.—Station M-586.

Dentalina cf. **D. consobrina** Orbigny

Plate 2, figures 4, 5, 6

Rare fragments usually consisting of two elongate chambers, the initial one (proloculus) slightly bulbous, are compared to this species described from the Miocene of the Vienna Basin (Orbigny, 1846, p. 46, pl. 2, figs. 1-3). Similar specimens are recorded by Cushman (1940a, p. 84, pl. 14, figs. 22-26) from the Upper Cretaceous of Tennessee and Trinidad as *Dentalina* cf. *D. consobrina.* Stainforth (1952, p. 12) places this species in the genus *Siphonodosaria.*

Length 1.155 mm., width .264 mm. (8143-a)

Length 1.584 mm., width .231 mm. (8143-b)

Length 1.287 mm., width .231 mm. (8143-c)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8143a-c.

Locality.—Station M-586.

?**Dentalina globulicauda** Gümbel

Plate 2, figures 7, 8

Dentalina globulicauda GÜMBEL, K. Bayer. Akad. Wiss. Math-Physik. Cl., Abh., Bd. 10 (1870), Abt. 2, 1868, p. 623, pl. 1, fig. 38.

Fragmentary specimens resemble this globular-chambered species described from the Eocene of Europe except that their initial portions are straight, not curved.

Similar fossils from the Kreyenhagen shale of California (Cushman and Siegfus, 1942, p. 406, pl. 16, fig. 5) are recorded as *Dentalina*? sp.

Length .825 mm., width .231 mm. (8144-a)

Length .891 mm., width .165 mm. (8144-b)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8144a, b.

Locality.—Station M-586.

Dentalina havanensis Cushman and Bermudez

Plate 2, figure 11

Dentalina havanensis CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 13, 1937, pp. 11-12, pl. 1, figs. 39, 40.—CUSHMAN and STAINFORTH, Cushman Lab. Foram. Res. Spec. Publ. No. 14, 1945, p. 24, pl. 3, fig. 13.

A few fossils appear to be identical with this Cuban Eocene species which has also been recorded from the Cipero marl of Trinidad.

Length .528 mm., width .132 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8145.

Locality.—Station M-593.

Dentalina mucronata Neugeboren

Plate 2, figures 9, 10

Dentalina mucronata NEUGEBOREN, Denkschr. Akad. Wiss. Wien, Bd. 12, 1856, p. 83, pl. 3, figs. 8-11.

Very rare, elongate, slightly arcuate specimens expanding rapidly from a pointed initial end appear to belong to this species described from the Miocene of Rumania.

Length 1.186 mm., width .20 mm., thickness .198 mm. (8146-a)

Length 1.185 mm., width .198 mm., thickness .247 mm. (8146-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8146a, b.

Locality.—Station M-593.

Dentalina cf. **D. soluta** Reuss

Plate 2, figure 14

A few isolated chambers may be fragments of this species described from the Eocene [= Oligocene] of Germany (Reuss, 1851, p. 60, pl. 3, figs. 4a, b). Similar single-chambered fragments of this species have been recorded from the Lower Tertiary of Amchitka, Aleutian Islands (Todd, 1953, pp. 2-3, pl. 5, figs. 5-8, especially figs. 6 and 8). *Ellipsonodosaria*? sp. A from the Tertiary Tumey formation of California (Cushman and Simonson, 1944, p. 200, pl. 33, figs. 6, 7, especially fig. 7) also resemble Reuss' species.

Length .363 mm., width .214 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8147.

Locality.—Station M-587.

Dentalina cf. **D. wilcoxensis** Cushman

Plate 2, figure 15

A few small specimens are compared to this strongly oblique-sutured species described from the Lower Eocene Bashi formation of Alabama (Cushman, 1944a, pp. 8-9, pl. 1, figs. 5, 6). Our fossils taper toward the initial end in contrast to Cushman's types which have nearly equal width throughout.

Length .495 mm., width .132 mm., thickness .099 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8148.

Locality.—Station M-586.

Dentalina sp. A

Plate 2, figures 12, 13

Very rare fragments showing various degrees of obliquity of the sutures are not specifically identified. They may be related to *Dentalina mucronata* from the Eocene Agua Fresca shale of Chile (Todd and Kniker, 1952, p. 15, pl. 3, fig. 5) or to *D.* cf. *D. mucronata* from Trinidad (Cushman and Renz, 1948, p. 19, pl. 4, fig. 3) either of which appears to be within the range of variation of our foraminifers; however, the types of *D. mucronata* from the Miocene of Rumania (Neugeboren, 1856, p. 83, pl. 3, figs. 8-11) expand more rapidly from a pointed initial end. No fossils with the apertural ends intact were observed.

Length .726 mm., width .198 mm. (8149-a)

Length .66 mm., width .165 mm. (8149-b)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8149a, b.

Locality.—Station M-586.

Dentalina sp. B

Plate 2, figure 16

Very rare, small specimens with slightly inflated chambers separated by oblique sutures are not specifically identified. Similar fossils have been classified by various authors as *Dentalina communis* (Orbigny) or *D. legumen* Reuss (e.g., *D.* cf. *communis* from the type McBean formation (Eocene) of Georgia in Cushman and Herrick, 1945, p. 59, pl. 9, fig. 17; *D. legumen* from the Upper Cretaceous Ripley formation of Tennessee in Cushman, 1940a, p. 77, pl. 13, figs. 7, 8, especially fig. 8).

Length .627 mm., width .132 mm., thickness .132 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8150.

Locality.—Station M-586.

Dentalina sp. C

Plate 2, figure 17

The figured fragment is the only specimen with this type of oblique sutural pattern observed in the Woodside samples. It resembles closely *Dentalina obliquesuturata* Stache from the Lower Eocene Salt Mountain limestone of Alabama (Toulmin, 1941, p. 586, pl. 79, fig. 18); however, neither the Woodside fossil nor the Alabama specimen is arcuate or tapers as rapidly as Stache's type from the Lower Tertiary of New Zealand (Stache, 1865, pl. 22, fig. 36). *D. obliquesuturata* from the Eocene Poway conglomerate of California (Cushman and Dusenbury, 1934, p. 54, pl. 7, figs. 22-25) represents forms totally different from our specimen.

D. crassicauda Seguenza (1880, p. 138, pl. 13, fig. 5) from the Miocene of Italy has a similar chamber arrangement but is not so broad. There are also some forms of *D. wilcoxensis* Cushman (e.g., those from the Eocene Aquia formation of Virginia (Cushman, 1944b, p. 22, pl. 4, fig. 10) and Coal Bluff marl member of the Naheola formation of Alabama (Cushman, 1944c, p. 36, pl. 5, figs. 22-24, especially fig. 24) which resemble the Woodside foraminifer, but the types of this species from the Lower Eocene Bashi formation of Alabama (Cushman, 1944a, pp. 8-9, pl. 1, figs. 5, 6) possess sutures of reverse obliquity.

Length .825 mm., width .198 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8151.

Locality.—Station M-593.

Dentalina sp. D

Plate 2, figure 18

Rare specimens with few chambers and oblique sutures are not specifically identified. They resemble figures of some fossils referred to *Dentalina wilcoxensis* Cushman; however, as stated previously, (page ,) there is considerable difference in the angle of formation of the chambers of these latter foraminifers and the types of *D. wilcoxensis*.

Length .495 mm., width .115 mm., thickness .089 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8152.

Locality.—Station M-593.

Dentalina sp. E

Plate 2, figure 19

A three-chambered fragment is not specifically identified. It is circular to slightly compressed in cross section and has the initial suture only oblique to the periphery.

Dentalina wilcoxensis Cushman from the Lower Eocene Bashi formation of Alabama (Cushman, 1944a, pp. 8-9, pl. 1, figs. 5, 6) has a slight resemblance to the Woodside specimen; however, its sutural pattern is oblique throughout.

Length .825 mm., width .264 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8153.

Locality.—Station M-586.

Dentalina sp. F

Plate 2, figure 20

A solitary specimen with five smooth to slightly rough-textured globular to subglobular chambers and an eccentric tubular-necked aperture is not specifically identified.

It resembles *Vaginulina atlantisae* Cushman from an Eocene core off the eastern coast of North America (Cushman, 1939a, p. 59, pl. 10, figs. 23-26, especially figs. 24-26), but this species has chamber walls with short stout spines. There is also some similarity to *Dentalina lorneiana* Orbigny from the Upper Cretaceous of Tennessee (Cushman, 1940a, pp. 77-78, pl. 13, fig. 14 only) and to *D. catenula* Reuss from the Taylor marl of Texas (Cushman, 1946b, pp. 67-68, pl. 23, figs. 27-32), except that the latter species possesses a spine at the base of the initial chamber.

Length 1.155 mm., width .231 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8154.

Locality.—Station M-586.

Genus **Lagena** Walker and Jacob, 1798

Lagena costata (Williamson)

Plate 2, figure 21

Entosolenia costata WILLIAMSON, Ray Soc., 1858, p. 9, pl. 1, fig. 18.

Lagena costata CUSHMAN, U. S. Geol. Surv. Prof. Paper 181, 1935, p. 23, pl. 9, figs. 7, 8.—CUSHMAN and PONTON, Contr. Cushman Lab. Foram. Res., vol. 8, 1932, pp. 59-60, pl. 7, figs. 21a, b.—CUSHMAN and GARRETT, Contr. Cushman Lab. Foram. Res., 1939, vol. 15, p. 80, pl. 14, fig. 7.

A few specimens with numerous costae are considered to belong to this Recent species described from the Isle of Skye, off the west coast of Scotland. The figured fossil resembles more closely, however, forms referred to the species from the Upper Eocene Cooper marl of South Carolina and Lower Eocene Wilcox beds of Alabama (see synonymy). No specimens with the apertural end intact were observed.

Length .264 mm., width .198 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8155.

Locality.—Station M-591.

Lagena substriata Williamson

Plate 2, figure 22

Lagena substriata WILLIAMSON, Ann. Mag. Nat. Hist., ser. 2, vol. 1, 1848, p. 15, pl. 2, fig. 12.

Tear-shaped, finely costate specimens are thought to belong to this Recent species described from England and recorded from numerous Tertiary localities.

Length .33 mm., width .165 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8156.

Locality.—Station M-593.

Lagena sp.

Plate 2, figure 23

A botuliform specimen with a pronounced radiate aperture does not appear to be like any described species. It differs from *Lagena botula* Matthes (1939, p. 65, pl. 4, fig. 36, Miocene of Germany) and from *L. felsinea* Fornasini (1901, p. 47, fig. 1, Pliocene of Italy) in being stubby and possessing an external radiate aperture instead of an internal tube, and from *Dentalina bierigi* Bermudez (1937, p. 243, pl. 21, fig. 3) from the Upper Eocene Principe formation of Cuba in being more cylindrically inflated and less tapering and in having the radiate aperture set off by a faint constriction. The single chamber of this fossil places it in the genus *Lagena.*

Length .726 mm., width .264 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8157.

Locality.—Station M-586.

Genus **Marginulina** Orbigny, 1826

Marginulina cf. **M. eximia** Neugeboren

Plate 2, figure 24

Very rare, small, and variable, poorly preserved specimens may be related to this species described from the Miocene of Hungary (Neugeboren, 1851, p. 129, pl. 4, fig. 17) and widely recorded from the Paleocene and Eocene of the United States (Cushman, 1951, p. 17) and other countries.

Length .396 mm., width .132 mm., thickness .115 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8158.

Locality.—Station M-586.

Marginulina subbullata Hantken

Plate 2, figure 25

Marginulina subbullata HANTKEN, Magyrkir. földt. int. Evkön, vol. 4, 1876, p. 39, pl. 4, figs. 9, 10; pl. 5, fig. 9.

Rare specimens of this widely distributed species described from the Oligocene of Hungary are within its range of variation.

Length .594 mm., width .363 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8159.

Locality.—Station M-586.

Marginulina tumida Reuss

Plate 2, figure 26

Marginulina tumida REUSS, Deutsch. Geol. Ges., Zeitschr., Berlin, 1851, Bd. 3, p. 64, pl. 3, figs. 14a, b.

A solitary three-chambered specimen with oblique sutures is assigned to this species described from the Eocene [= Oligocene] of Germany.

Length .429 mm., width .165 mm., thickness .165 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8160.

Locality.—Station M-589.

Marginulina sp.

Plate 2, figure 27

The figured fossil may be an immature specimen of this genus.

Length .396 mm., width .148 mm., thickness .132 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8161.

Locality.—Station M-593.

?**Marginulina** sp.

Plate 2, figure 28

A solitary, poorly preserved, cylindrical-shaped specimen consisting of three chambers which increase rapidly in size is questionably referred to this genus. It is similar to *Marginulina laeviuscula* Cushman and Bermudez (1937, p. 10, pl. 1, figs. 33, 34, Eocene of Cuba) whose last-formed chamber constitutes a large portion of the test—a feature characteristic of the Woodside fossil. However, the latter foraminifer does not have the inflated final chamber typical of the Cuban species.

Length .726 mm., width .198 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8162.

Locality.—Station M-586.

Genus **Marginulinopsis** A. Silvestri, 1904

?**Marginulinopsis** sp.

Plate 2, figure 29

There are a few specimens from one locality only that may belong to this genus. They consist of three or four chambers which, except for the initial one, are slightly inflated and circular in outline. The basal portion of the initial chamber of all specimens is compressed in such manner that it gives a "coiled appearance" to the test. The sutures are slightly oblique to transverse, and the radiate aperture is centrally located.

Until additional specimens are available for study it can not be definitely established if the compression of the first-formed chamber is primary or the result of deformation.

Length .825 mm., width .231 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8163.

Locality.—Station M-586.

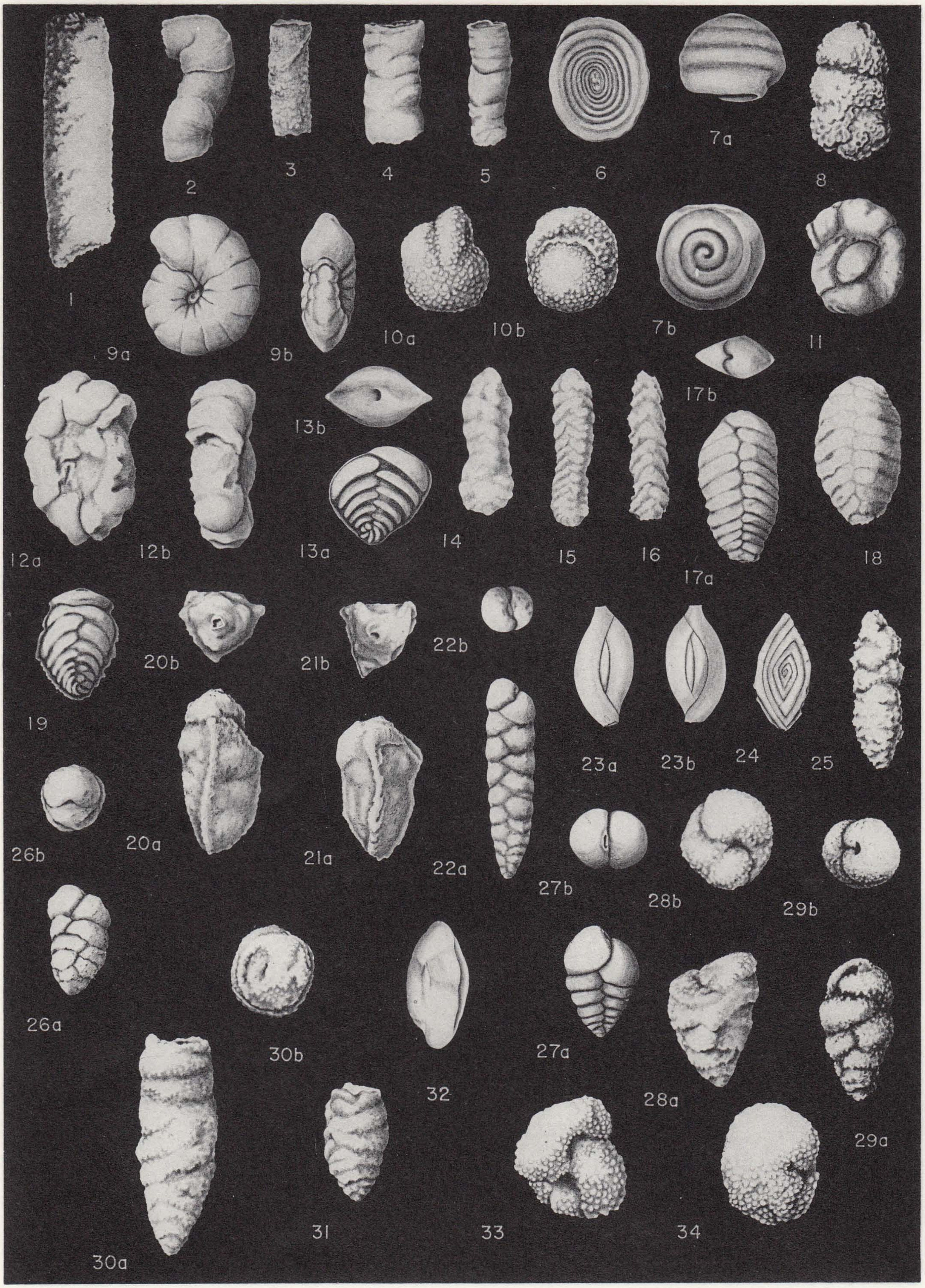
Genus **Nodosaria** Lamarck, 1812

Nodosaria cf. **N. approximata** Reuss

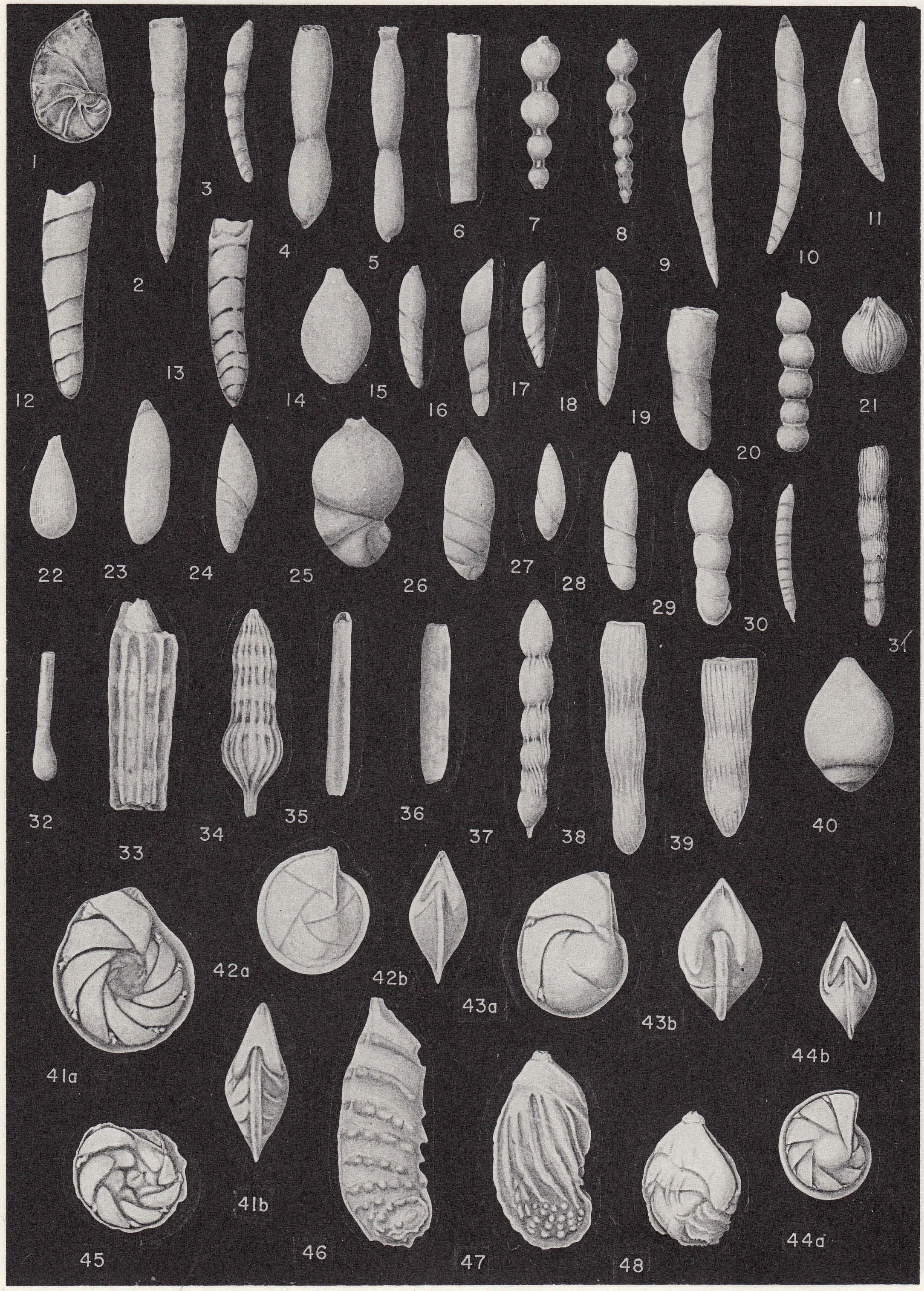
Plate 2, figure 30

A few slender arcuate specimens bearing spines on the proximal and distal ends are compared to this species described from the Oligocene of Germany (Reuss, 1866, p. 134, pl. 2, fig. 22) and recorded from numerous Tertiary localities throughout the world.

EXPLANATION OF PLATE 1



Graham and Classen: Lower Eocene Foraminifera from the Woodside Area, San Mateo County, California



Graham and Classen: Lower Eocene Foraminifera from the Woodside Area, San Mateo County, California

Length 1.038 mm., width .148 mm., thickness .132 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8164.

Locality.—Station M-593.

Nodosaria boffalorae Martinotti

Plate 2, figure 31

Nodosaria boffalorae MARTINOTTI, Atti. Soc. Ital. Sci. Nat., vol. 62, 1924, p. 333, pl. 7, figs. 31-33.—NUTTALL, Journ. Pal., vol. 6, 1932, p. 15, pl. 3, fig. 6.

Nodosaria sp. COLE, Bull. Amer. Pal., vol. 14, 1929, p. 8, pl. 3, fig. 11.

A solitary, finely striated, six-chambered fragment appears to belong to this species described from the Lower Oligocene of Italy.

Nodosaria boffalorae has been recorded from the Lower Oligocene Alazan shale of Mexico and the Tertiary of Trinidad; and it appears to the writers that *Nodosaria* sp. of Cole from the Chapapote formation of Mexico belongs to this species also.

Length .99 mm., width .165 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8165.

Locality.—Station M-588.

Nodosaria clavaeformis Neugeboren

Plate 2, figure 32

Nodosaria clavaeformis NEUGEBOREN, Siebenb. Ver. Naturw. Hermannstadt, Verh. Mitt., Jahrg. 3, no. 4, 1852, p. 53, pl. 1, fig. 38.

Several two-chambered rectilinear calcareous fragments with a bulbous proloculus and a cylindrical second segment appear to belong to this species described from the Tertiary of Rumania.

The Woodside foraminifers are also similar to *Ellipsonodosaria* sp. A of Cushman and Siegfus (1942, p. 417, pl. 17, figs. 15-18, especially fig. 17) from the Kreyenhagen shale of California and to *Nodosaria? longiscata* Orbigny from the Midway of Alabama (Cushman, 1940b, pp. 59-60, pl. 10, fig. 28), except that the latter fossil has one or two additional chambers.

Nodosaria longiscata from the Tertiary of Trinidad (Nuttall, 1928, p. 81, pl. 4, fig. 13), *Nodosaria? longiscata* from the Paleocene of Arkansas (Cushman and

EXPLANATION OF PLATE 2

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11.	*Dentalina havanensis* Cushman and Bermudez. × 45. Loc. M-593.	11
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14.	*Dentalina* cf. *D. soluta* Reuss. × 47. Loc. M-587.	11
15.	*Dentalina* cf. *D. wilcoxensis* Cushman. × 37. Loc. M-586.	11
16.	*Dentalina* sp. B × 37. Loc. M-586.	12
17.	*Dentalina* sp. C × 19. Loc. M-593.	12
18.	*Dentalina* sp. D × 42. Loc. M-593.	12
19.	*Dentalina* sp. E × 26. Loc. M-586.	12
20.	*Dentalina* sp. F × 21. Loc. M-586.	12
21.	*Lagena costata* (Williamson). × 43. Loc. M-591.	13
22.	*Lagena substriata* Williamson. × 46. Loc. M-593.	13
23.	*Lagena* sp. × 30. Loc. M-586.	13
24.	*Marginulina* cf. *M. eximia* Neugeboren. × 49. Loc. M-586.	13
25.	*Marginulina subbullata* Hantken. × 38. Loc. M-586.	13
26.	*Marginulina tumida* Reuss. × 49. Loc. M-589.	13
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30.	*Nodosaria* cf. *N. approximata* Reuss. × 20. Loc. M-593.	14
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32.	*Nodosaria clavaeformis* Neugeboren. × 27. Loc. M-586.	15
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35, 36.	*Nodosaria longiscata* Orbigny. 35, × 39. 36, × 40. Loc. M-591.	16
37, 38, 39.	*Nodosaria* cf. *N. velascoensis* Cushman. 37, × 20. 38, × 39. 39, × 37. Loc. M-586.	16
40.	*Pseudoglandulina* sp. × 33. Loc. M-586.	16
41.	*Robulus arcuato-striatus* (Hantken) var. *carolinianus* Cushman. × 21. a, side view; b, apertural view. Loc. M-586.	16
42, 43.	*Robulus inornatus* (Orbigny). 42, × 23, a, side view; b, apertural view. 43, × 19, a, side view; b, apertural view. Loc. M-593.	17
44.	*Robulus* sp. A × 19. a, side view; b, apertural view. Loc. M-586.	17
45.	*Robulus* sp. B × 34. Side view. Loc. M-586.	17
46, 47, 48.	*Vaginulinopsis asperuliformis* (Nuttall). Side views. 46, × 18. 47, × 26. 48, × 36. Loc. M-586.	17

Todd, 1946, p. 52, pl. 8, fig. 26), *Nodosaria longiscata* from the Agua Salada group (Oligocene-Miocene) of Venezuela (Renz, 1948, p. 146, pl. 5, figs. 1-4, especially fig. 2), *N. ewaldi* Reuss from the Alazan shale (Lower Tertiary) of Mexico (Cushman, 1927, p. 153, pl. 24, figs. 1, 2, especially fig. 2), and *Tubinella jenningsi* Coryell and Embich (1937, p. 293, pl. 41, fig. 14) from the Upper Eocene Tranquilla shale of Panama are a few among many other fossils which appear to be closely related to our specimens.

Length .693 mm., width .132 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8166.

Locality.—Station M-586.

Nodosaria latejugata Gümbel

Plate 2, figures 33, 34

Nodosaria latejugata GÜMBEL, K. Bayer. Akad. Wiss. Math-Physik Cl., Abh., Bd. 10, (1870), Abt. 2, 1868, p. 619, pl. 1, fig. 32.—CUSHMAN and G. D. HANNA, Proc. Calif. Acad. Sci. 4th ser., vol. 16, 1927, pp. 212-213, pl. 13, figs. 15-17.

A few specimens, most of which are fragmentary, belong to this species described from the Eocene of Bavaria. A small form (megalospheric ?) with a bulbous proloculus and a straight-sided specimen (microspheric ?) are figured.

Nodosaria latejugata is widely distributed in the Lower Tertiary of California although there are few references to its occurrence. However, typical forms are recorded from the Eocene near Coalinga (see synonymy).

Length of fragment 1.384 mm., width .495 mm. (8167-a)

Length 1.122 mm., width .363 mm. (8167-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8167a, b.

Locality.—Station M-590.

Nodosaria longiscata Orbigny

Plate 2, figures 35, 36

Nodosaria longiscata ORBIGNY, Foram. Foss. Bass. Tert., Vienne, 1846, p. 32, pl. 1, figs. 10-12.

Rare fragments of this widely recorded species described from the Tertiary of the Vienna Basin occur at scattered localities. They are of various lengths and widths.

Among the specimens recorded by Cushman and Siegfus (1942, pp. 417, 418) from the Kreyenhagen shale as *Ellipsonodosaria* sp. A and *Ellipsonodosaria* sp. B are several (pl. 17, figs. 18, 22) that resemble our figures.

Similar forms have been referred to *Nodosaria arundinea* Schwager or *N. ewaldi* Reuss.

Length .693 mm., width .099 mm. (8168-a)

Length .594 mm., width .132 mm. (8168-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8168a, b.

Locality.—Station M-591.

Nodosaria cf. **N. velascoensis** Cushman

Plate 2, figures 37, 38, 39

Rare specimens with longitudinal costae spirally arranged over most of the test may be within the range of variation of this species as interpreted by Cushman (1946b, pp. 73-74, pl. 26, figs. 27-30). No forms identical with the type figures, however, were observed in the Woodside material. Most fossils are fragmentary or poorly preserved, and few have the initial spine shown in the figure of our long specimen.

Nodosaria velascoensis was described from the Velasco shale of Mexico (Cushman, 1926, p. 504, pl. 18, fig. 12) and has been recorded from various Upper Cretaceous and Lower Tertiary formations.

Length 1.782 mm., width .264 mm. (8169-a)

Length .891 mm., width .204 mm. (8169-b)

Length .726 mm., width .231 mm. (8169-c)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8169a-c.

Locality.—Station M-586.

Genus **Pseudoglandulina** Cushman, 1929

Pseudoglandulina sp.

Plate 2, figure 40

The few amber-colored specimens of this genus are not specifically identified. They resemble *Pseudoglandulina laevigata* (Orbigny) from an Eocene submarine core off the eastern coast of North America (Cushman, 1939a, p. 58, pl. 10, figs. 15, 16); however, the type of this latter species is a *Glandulina,* not a *Pseudoglandulina* inasmuch as it is biserial (Cushman, 1948, p. 216).

Length .627 mm., width .462 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8170.

Locality.—Station M-586.

Genus **Robulus** Montfort, 1808

Robulus arcuato-striatus (Hantken) var. **carolinianus** Cushman

Plate 2, figures 41a, b

Robulus arcuato-striatus (HANTKEN) var. *carolinianus* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 9, 1933, p. 4, pl. 1, figs. 9a, b.—TODD and KNIKER, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 14, pl. 2, fig. 24.

This variety described from the Upper Eocene of Alabama and recorded from various other Gulf Coast localities in the United States, as well as from California and Central and South America, is rare in a few Woodside samples.

Length 1.188 mm., width 1.122 mm., thickness .462 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8171.

Locality.—Station M-586.

Robulus inornatus (Orbigny)

Plate 2, figures 42a, b, 43a, b

Robulina inornata ORBIGNY, Foram. Foss. Bass. Tert., Vienne, 1846, p. 102, pl. 4, figs. 25, 26.

Robulus inornatus TOULMIN, Journ. Pal., vol. 15, 1941, p. 577, pl. 78, fig. 19; Text fig. 2B.

Rare specimens resemble this species described from the Miocene of Austria and recorded from numerous localities throughout the world. Our largest figured form is remarkably similar to Toulmin's fossil from the Lower Eocene Salt Mountain limestone of Alabama (see synonymy).

Length .825 mm., width .66 mm., thickness .478 mm. (8172-a)

Length 1.122 mm., width .99 mm., thickness .561 mm. (8172-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8172a, b.

Locality.—Station M-593.

Robulus sp. A

Plate 2, figures 44a, b

There are a few specimens in nearly every sample that resemble *Robulus inornatus* (Orbigny) from the Tertiary of the Vienna Basin (Orbigny, 1846, p. 102, pl. 4, figs. 25, 26) except that they possess a sharp keel.

Length .825 mm., width .726 mm., thickness .396 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8173.

Locality.—Station M-586.

Robulus sp. B

Plate 2, figure 45

A few specimens with overlapping triangular-shaped chambers are not specifically identified. They may be related to *Robulus alato-limbatus* (Gümbel)? from the Kreyenhagen formation of California (Cushman and Siegfus, 1942, p. 204, pl. 5, figs. 19-21).

The figured specimen has been moistened in order to show the arrangement of earlier formed chambers.

Length of broken specimen .462 mm., width .429 mm., thickness .231 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8174.

Locality.—Station M-586.

Genus **Vaginulinopsis** A. Silvestri, 1904

Vaginulinopsis asperuliformis (Nuttall)

Plate 2, figures 46, 47, 48

Cristellaria asperuliformis NUTTALL, Journ. Pal., vol. 4, 1930, p. 282, pl. 23, figs. 9, 10.

Marginulina asperuliformis CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 24, pl. 6, figs. 1-3.—TODD and KNIKER, Cushman Fnd. Foram. Res., Spec. Publ. No. 1, 1952, p. 15, pl. 2, figs. 32-34.

This distinctively ornamented species described from the Lower Eocene Aragon formation of Mexico has been recorded from numerous localities in California, as well as from Cuba and Chile. There is considerable variation in degree of limbation of the sutures and in size and form of tubercles in the Woodside specimens. It is not a common species in our samples but its presence aids in determining the age of the shales of the district.

The compressed test of this species places it in the genus *Vaginulinopsis* rather than *Marginulina.*

Length 1.98 mm., width .991 mm., thickness .561 mm. (8175-a)

Length 1.122 mm., width .594 mm., thickness .396 mm. (8175-b)

Length .561 mm., width .396 mm., thickness .264 mm. (8175-c)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8175a-c.

Locality.—Station M-586.

Family POLYMORPHINIDAE

Genus **Globulina** Orbigny, 1839

Globulina sp.

Plate 3, figures 1a, b

A fistulose, three-chambered, slightly compressed specimen does not appear to be like any described species. It has the general outline of *Globulina guttula* Reuss from the Eocene of Germany (Reuss, 1851, p. 82, pl. 6, figs. 46a, b); however, the latter species is not fistulose.

Length .693 mm., width .396 mm., thickness .297 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8176.

Locality.—Station M-586.

Genus **Pyrulina** Orbigny, 1839

Pyrulina sp.

Plate 3, figures 2a, b

A solitary slightly crushed specimen is not specifically identified. It is almost identical to *Pyrulina* cf. *P. cylindroides* (Roemer) from an Eocene submarine core off the eastern coast of North America (Cushman, 1939a, p. 61, pl. 10, fig. 37); however, comparison of figures of this latter form with Roemer's type figures from the late Tertiary of Germany (Roemer, 1838, p. 385, pl. 3, figs. 26a, b) shows they are markedly dissimilar.

Length .627 mm., width .363 mm., thickness .264 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8177.

Locality.—Station M-586.

Genus **Ramulina** Rupert Jones, 1875
Ramulina cf. **R. globulifera** H. B. Brady
Plate 3, figure 3

Specimens compared with this Recent species (Brady, 1879, p. 272, pl. 8, figs. 32, 33) are rare and fragmentary. The short, smooth stoloniferous tubes, as well as the subglobular central chamber, may have been hispid originally.

Forms possibly related to the figured foraminifer include *Ramulina* cf. *R. aculeata* (Orbigny) from the Paleocene of the Gulf Coast of the United States (Cushman, 1951, pp. 36-37, pl. 10, figs. 24-26; also see references to other occurrences in this latter publication) and *Ramulina* (?) *sp.* (?) from an Eocene submarine core off the eastern coast of North America (Cushman, 1939a, p. 61, pl. 10, figs. 39-40, especially fig. 40).

Length .297 mm., width .264 mm., thickness .231 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8178.

Locality.—Station M-591.

Family NONIONIDAE
Genus **Nonion** Montfort, 1808
Nonion havanense Cushman and Bermudez
Plate 3, figures 4a, b

Nonion havanense CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 13, 1937, p. 19, pl. 2, figs. 12, 13.—CUSHMAN and RENZ, Cushman Lab. Foram. Res. Spec. Publ. No. 24, 1948, p. 22, pl. 5, fig. 4.

Specimens of this species are very rare and of small size in the Woodside material. The type was described from the Eocene of Cuba and has been recorded from the Eocene and Oligocene of Trinidad.

Length .297 mm., width .231 mm., thickness .132 mm.

Hypotype.—Stanford Univ. Paleo. Type. Coll. No. 8179.

Locality.—Station M-586.

Nonion micrus Cole
Plate 3, figures 5a, b, 6a, b, c, 7, 8

Nonion micrus COLE, Bull. Amer. Pal., vol. 14, 1927, p. 22, pl. 5, fig. 12.

Nonion micrum CUSHMAN and RENZ, Cushman Lab. Foram. Res. Spec. Publ. No. 24, 1948, pp. 22-23, pl. 5, fig. 5.

Nonion micrus BERMUDEZ, Cushman Lab. Foram. Res. Spec. Publ. No. 25, 1949, p. 166, pl. 11, fig. 19.

This small species, described from the Eocene Guayabal formation of Mexico and recorded from numerous localities in the Gulf Coast of the United States, Cuba, and Trinidad, is fairly common at few localities in the Woodside area. There is considerable variation in chamber outline in our specimens, some forms resembling *Nonion wilcoxensis* Cushman and Ponton from the Eocene Agua Fresca shales of Chile (Todd and Kniker, 1952, p. 18, pl. 3, figs. 34a, b) and others *N. danvillensis* Howe and Wallace (in Cushman [as *Nonion danvillense*], 1939b, p. 5, pl. 1, fig. 19) from the Upper Eocene of Louisiana.

Glaessner (1937, p. 30, pl. 1, figs. 4a, b, text-fig. 2) has referred Cole's species to the genus *Globigerinella;* Grimsdale (1951, p. 468) in his discussion of Tertiary pelagic Foraminifera has some doubt as to its generic features by questionably allocating it to *Globigerinella.*

Length .297 mm., width .231 mm., thickness .165 mm. (8180-a)

Length .264 mm., width .198 mm., thickness .099 mm. (8180-b)

Length .297 mm., width .264 mm., thickness .132 mm. (8180-c)

Length .247 mm., width .198 mm., thickness .099 mm. (8180-d)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8180 a-d.

Locality.—Station M-590, (8180a, b); M-593, (8180c, d).

Nonion sp.
Plate 3, figure 9

Very rare, small specimens are too poorly preserved for specific identification. They resemble *Nonion planatum* Cushman and Thomas from the Claiborne of Texas (Cushman, 1939b, pp. 4-5, pl. 1, figs. 15a, b), except that the sutures are not so curved.

Length .33 mm., width .231 mm., thickness .132 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8181.

Locality.—Station M-592.

Family HETEROHELICIDAE
Genus **Amphimorphina** Neugeboren, 1850
Amphimorphina ignota Cushman and Siegfus
Plate 3, figures 10, 11

Amphimorphina ignota CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 27, pl. 6, figs. 10-13; Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, pp. 410-11, pl. 16, figs. 31-35.

Very rare specimens are within the range of variation of this species described from the Kreyenhagen shale and recorded from the type Lodo formation of California.

Length .495 mm., width .165 mm., thickness .165 mm. (8182-a)

Length .99 mm., width .214 mm., thickness .198 mm. (8182-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8182a, b.

Locality.—Station M-586.

Amphimorphina sp.
Plate 3, figure 12

A solitary fragment with longitudinal costae and compressed in its biserial portion does not appear to be a described species. It may be an immature *Amphimorphina ignota* Cushman and Siegfus with a well-developed biserial stage.

Length .478 mm., width .115 mm., thickness .115 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8183.

Locality.—Station M-588.

Genus **Aragonia** Finlay, 1939
Aragonia aragonensis (Nuttall)
Plate 3, figures 13a, b

Textularia aragonensis NUTTALL, Journ. Pal., vol. 4, 1930, p. 280, pl. 23, fig. 6.
Bolivina aragonensis CUSHMAN and SIEGFUS, Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, p. 413, pl. 19, figs. 7, 8.

This species shows considerable variation in test outline in the Woodside material where it is rare at scattered localities. The majority of the tests are longer than wide, whereas others have about equal length and width. Chamber shape is also variable, and the limbate raised sutures have fine projections which extend into overlying chambers and are discernible usually under high magnification only.

This and many related species, such as *Bolivina capdevilensis* Cushman and Bermudez (1937, p. 14, pl. 1, figs. 49, 50) from the Lower Eocene of Cuba, *Bolivinoides trinitatensis* Cushman and Jarvis from the Upper Cretaceous of Trinidad (Cushman and Jarvis, 1928, p. 99, pl. 14, figs. 10a, b), *B. velascoensis* (Cushman) from the Velasco shale of Mexico (Cushman, 1925, p. 18, pl. 3, figs. 1a-c), *Bolivina monilifera* Galloway and Morrey (1931, p. 349, pl. 40, figs. 3a, b) from the late Cretaceous of Mexico, *Bolivina semireticulata* LeRoy from the Lower Tertiary Esna shale of Egypt (LeRoy, 1953, p. 20, pl. 8, fig. 36) and other similar flat-form species should be placed in the genus *Aragonia* Finlay (see Finlay, 1939, pp. 318-319 for description of this genus).

This species was described from the Lower Eocene Aragon formation of Mexico and has been recorded from the Canoas siltstone member of the Kreyenhagen formation.

Length .396 mm., width .363 mm., thickness .165 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8184.

Locality.—Station M-593.

Aragonia capdevilensis (Cushman and Bermudez)
Plate 3, figures 14a, b

Bolivina capdevilensis CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 13, 1937, p. 14, pl. 1, figs. 49, 50.—BERMUDEZ, Cushman Lab. Foram. Res. Spec. Publ. No. 25, 1949, p. 188, pl. 12, figs. 42, 43.

This species was described from the Lower Eocene of Cuba and has been recorded from the Paleocene of that country, the Lower Eocene of Hispaniola, and the Paleocene-Eocene Lodo formation of California. It is fairly common at a few localities and shows considerable variation in test outline.

It differs from *Aragonia aragonensis* (Nuttall) mainly in lacking fine, raised projections in its sutural pattern.

Length .264 mm., width .231 mm., thickness .099 mm.

Hypotype.—Stanford Univ. Type Paleo. Coll. No. 8185.

Locality.—Station M-586.

Genus **Plectofrondicularia** Liebus, 1903
Plectofrondicularia palmerae Cushman and Bermudez
Plate 3, figure 15

Plectofrondicularia palmerae CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 12, 1936, p. 61, pl. 11, figs. 20-24.

Very rare compressed specimens with a short biserial chamber arrangement followed by rapidly expanding uniserial chambers appear to be within the range of variation of this species described from the Eocene Principe formation of Cuba.

Length .775 mm., width .478 mm., thickness .115 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8186.

Locality.—Station M-586.

Family BULIMINIDAE
Genus **Angulogerina** Cushman, 1927
Angulogerina sp.
Plate 3, figure 16

A poorly preserved, stubby, triangular-shaped specimen with rounded angles and an indistinct chamber arrangement is not specifically identified. Its shape is intermediate between *Pseudouvigerina* sp. A and *Pseudouvigerina* sp. B (Laiming, 1943, p. 198, fig. 83, 1a, b; 2a, b) from the Llajas and Lodo formations of California respectively; however, well-preserved specimens are needed for adequate diagnosis and comparison.

Length .33 mm., width .148 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8187.

Locality.—Station M-592.

Genus **Bulimina** Orbigny, 1826
Bulimina corrugata Cushman and Siegfus
Plate 3, figures 17a, b

Bulimina corrugata CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 11, 1935, pp. 92-

93, pl. 14, figs. 7a, b.—TODD and KNIKER, Cushman Fnd. Foram. Res., Spec. Publ. No. 1, 1952, p. 22, pl. 4, fig. 4.

This species, recorded from California, Washington, and Chile, occurs rarely in our samples. The type was described from the Kreyenhagen shale of California.

Length .297 mm., width .165 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8188.

Locality.—Station M-587.

Bulimina cf. **B. guayabalensis** Cole

Plate 3, figures 18, 19a, b

Specimens compared with this species described from the Guayabal (Eocene) formation of Mexico (Cole, 1927, pp. 24-25, pl. 1, figs. 1-2) are common at scattered localities. The Woodside fossils have the same general chamber arrangement as the Mexican species, but differ in that the individual chambers are not so inflated. There are also some tests in our material which taper more rapidly than those figured.

Cushman and Siegfus (1942, p. 413, pl. 16, fig. 39) have referred to this species a form in the Kreyenhagen assemblage that is similar to some of our specimens.

Length 1.023 mm., width .495 mm. (8189-a)

Length .858 mm., width .462 mm. (8189-b)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8189a, b.

Locality.—Station M-586.

Bulimina semicostata Nuttall

Plate 3, figure 20

Bulimina semicostata NUTTALL, Journ. Paleo., vol. 4, 1930, pp. 274, 285, pl. 23, figs. 15, 16.—CUSHMAN and PARKER, U. S. Geol. Surv. Prof. Paper 210-D, 1947, p. 93, pl. 21, figs. 28, 29.

This finely costate species is rare to fairly common in numerous Woodside samples. It was described from the Eocene Aragon formation of Mexico and has been recorded from the Eocene of Cuba and Trinidad. The figured specimen resembles the Cuban forms (see Cushman and Parker in synonymy) more than Nuttall's type.

Length .462 mm., width .264 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8190.

Locality.—Station M-586.

Bulimina serratospina Finlay

Plate 3, figures 21a, b

Bulimina serratospina FINLAY, New Zealand Journ. Sci. Tech., sec. B, vol. 28, 1947, p. 283, pl. 5, figs. 83-86.

There are a few specimens from various localities that resemble this sharply keeled species with serrated chambers described from the Paleocene-Lower Eocene of New Zealand. They appear to be related also to *Bulimina trinitatensis* Cushman and Jarvis from the Lizard Springs formation of Trinidad (Cushman and Renz, 1946, p. 37, pl. 6, figs. 8, 9).

Length .462 mm., width .33 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8191.

Locality.—Station M-586.

Bulimina sp.

Plate 3, figures 22a, b

A poorly preserved, elongate, tapering specimen with its greatest breadth across the last-formed chambers and with longitudinal costae covering all but the final whorl does not appear to be like any described species. It may be related to *Bulimina aguafrescaensis* Todd and Kniker (1952, p. 22, pl. 4, fig. 5) from the Eocene Agua Fresca shale of Chile from which it differs mainly in having a more rapidly tapering test.

Length .363 mm., width .198 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8192.

Locality.—Station M-587.

Genus **Buliminella** Cushman, 1911

Buliminella grata Parker and Bermudez

Plate 3, figures 23a, b

Buliminella grata PARKER and BERMUDEZ, Journ. Pal., vol. 11, 1937, pp. 515-516, pl. 59, figs. 6a-c.—CUSHMAN and RENZ, Cushman Lab. Foram. Res. Spec. Publ. No. 24, 1948, pp. 24-25, pl. 5, fig. 12.

This species is rare in the Woodside material. It was described from the Upper Eocene of Cuba and has been recorded from the Kreyenhagen formation of California and the Eocene of Trinidad.

Length .429 mm., width .33 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8193.

Locality.—Station M-586.

Genus **Fissurina** Reuss, 1850

Fissurina marginata (Walker and Boys)

Plate 3, figure 24

Serpula (Lagena) marginata WALKER and BOYS, Test. Min., 1784, p. 2, pl. 1, fig. 7.

Vermiculum marginatum MONTAGU, Test. Britannica, 1803, p. 524.

Rare specimens of this smooth, keeled, ovate species are recorded from scattered localities. The type is a Recent species from Kent, England.

Length .429 mm., width .33 mm., thickness .198 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8194.

Locality.—Station M-586.

Fissurina cf. **F. orbignyana** Seguenza

Plate 3, figure 25

Very rare specimens with a pronounced median keel and well-developed secondary keels parallel to the median keel are compared with this species described from the Miocene of Italy (Seguenza, 1862, p. 66, pl. 2, figs. 25, 26).

There are numerous records of this species, or closely related forms, in various Lower Tertiary formations of the world. The Woodside fossils resemble closely *Lagena orbignyana* (Seguenza) from the Midway of Mississippi (Kline, 1943, p. 38, pl. 4, figs. 5a, b).

Length .594 mm., width .726 mm., thickness .495 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8195.

Locality.—Station M-593.

Genus **Loxostomum** Ehrenberg, 1854

Loxostomum sp.

Plate 3, figure 26

The figured specimen is the only representative of this genus observed in the Woodside material. It does not appear to resemble any described or recorded form and may be new. Additional fossils are needed, however, for adequate description.

Length .561 mm., width .165 mm., thickness .165 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8196.

Locality.—Station M-591.

Genus **Siphonodosaria** A. Silvestri, 1924

Siphonodosaria cf. **S. cocoaensis** (Cushman)

Plate 3, figure 27

Very rare fragments are compared with this species recorded from an Eocene submarine core off the eastern coast of North America as *Ellipsonodosaria cocoaensis* (Cushman, 1939a, pp. 68-69, pl. 11, figs. 27-33). The Woodside fossils are not as arcuate as Cushman's forms. The writers follow Stainforth (1952, p. 11) in considering this species as belonging to the genus *Siphonodosaria.*

Length .594 mm., width .132 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8197.

Locality.—Station M-586.

Siphonodosaria gracilis (Palmer and Bermudez)

Plate 3, figures 28, 29

Ellipsonodosaria gracilis PALMER and BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 10, 1936, p. 296, pl. 18, figs. 8, 9.

Siphonodosaria gracilis TODD and KNIKER, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 23, pl. 4, fig. 10.

Our specimens show variation in chamber ornamentation in that several possess spines at the base of some chambers, whereas others have smooth to delicately hispid walls. They are of rare occurrence at their recorded localities.

Dentalina? sp. from the Kreyenhagen shale of California (Cushman and Siegfus, 1942, p. 406, pl. 16, fig. 8) may be related to the Woodside fossils.

Length 1.221 mm., width .264 mm. (8198-a)

Length 1.186 mm., width .264 mm. (8198-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8198a, b.

Locality.—Station M-586.

Siphonodosaria cf. **S. pauperata** (Orbigny)

Plate 3, figures 30, 31

Rare, slightly arcuate specimens with chambers longer than wide are compared with this Tertiary species described as *Dentalina pauperata* from the Vienna Basin (Orbigny, 1846, p. 46, pl. 1, figs. 57, 58).

Several similar, but not identical, forms are *Dentalina* cf. *D. pauperata* from the type Naheola formation of Alabama (Cushman and Todd, 1942, pp. 29-30, pl. 5, figs. 17, 18, especially fig. 18), *D. colei* Cushman and Dusenbury from the Salt Mountain Limestone (Eocene) of Alabama (Toulmin, 1941, p. 584, pl. 79, fig. 12), *D.* cf. *D. approximata* Reuss from the Middle Eocene Llajas formation of California (Cushman and McMasters, 1936, p. 512, pl. 75, figs. 7, 8, especially fig. 7), *Nodosaria pauperata* (Orbigny) from the Midway formation of Texas (Plummer, 1926, pp. 79-80, pl. 4, fig. 11), and *Dentalina?* sp. from the Kreyenhagen formation of California (Cushman and Siegfus, 1942, p. 405, pl. 16, figs. 1, 2, especially fig. 1).

Apertural characteristics place this species in the genus *Siphonodosaria* according to Stainforth (1952, p. 13).

Length 1.219 mm., width .297 mm. (8199-a)

Length 1.188 mm., width .231 mm. (8199-b)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8199a, b.

Locality.—Station M-586.

Siphonodosaria sp.

Plate 3, figure 32

A six-chambered fragment with spinose chambers increasing in size and becoming bulbous toward the distal end is referred to this genus because of its cylindrical aperture.

Length .825 mm., width .198 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8200.

Locality.—Station M-592.

?**Siphonodosaria** sp.

Plate 3, figure 33

A few fragmentary specimens consisting of several elongate chambers slightly constricted at the sutural line are questionably referred to this genus solely on the basis of their resemblance to *Ellipsonodosaria* sp. B of Cushman and Siegfus (1942, pp. 417-418, pl. 17, figs. 19-23, especially fig. 23) from the type area of the Kreyenhagen shale of California. Apparently the apertural characteristics of the Kreyenhagen fossils (especially fig. 21) would place them in the genus *Siphonodosaria*. No specimens with the apertural end preserved were observed in the Woodside samples.

Length .891 mm., width .198 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8201.

Locality.—Station M-586.

Genus **Uvigerina** Orbigny, 1826

Uvigerina garzaensis Cushman and Siegfus

Plate 3, figure 34

Uvigerina garzaensis CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, pp. 28-29, pl. 6, figs. 15a, b.

One specimen only of this finely hispid species described from the Kreyenhagen shale and recorded from various localities in California has been observed in the Woodside samples.

Length .528 mm., width .264 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8202.

Locality.—Station M-587.

Uvigerina sp.

Plate 3, figure 35

A solitary, coarsely costate, elongate specimen with the apertural end incomplete is not specifically identified.

Length .528 mm., width .264 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8203.

Locality.—Station M-587.

Genus **Virgulina** Orbigny, 1826

Virgulina cf. **V. danvillensis** Howe and Wallace

Plate 3, figure 36

A solitary specimen is compared with this species described from the Eocene Jacksonian beds of Louisiana, especially with topotype figures as given by Cushman (1937b, p. 9, pl. 1, figs. 29a, b).

Additional fossils are necessary to justify specific assignment since the Woodside fossil is more narrowly elongate than the holotype (Howe and Wallace, 1932, p. 65, pl. 11, figs. 2a, b).

Length .561 mm., width .165 mm., thickness .165 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8204.

Locality.—Station M-593.

Virgulina sp. A

Plate 3, figure 37

The figured specimen with its rapidly expanding biserial chambers following the early twisted portion of the test does not appear to belong to any described species. Inasmuch as variation within species of this genus usually involves considerable test differences, especially in the initial portions of both microspheric and megalospheric forms, it is necessary to have additional specimens for complete diagnosis.

Length .412 mm., width .148 mm., thickness .132 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8205.

Locality.—Station M-593.

Virgulina sp. B

Plate 3, figure 38

A solitary, small, perhaps immature, gently twisted specimen with slightly inflated chambers and an apertural slit which narrows as it approaches the base of the last-formed chamber is not specifically identified. It differs from *Virgulina tegulata* Reuss from the Cretaceous Austin Chalk of Texas (Cushman, 1946b, p. 126, pl. 53, figs. 4a, b) in having chambers which are slightly more inflated.

Length .363 mm., width .165 mm., thickness .132 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8206.

Locality.—Station M-593.

Family ELLIPSOIDINIDAE

Genus **Ellipsoglandulina** A. Silvestri, 1900

Ellipsoglandulina cf. **E. labiata** (Schwager)

Plate 3, figures 40a, b, 41

Numerous specimens with a large last-formed chamber are compared with this species (described as *Glandulina labiata*) from the Pliocene Kar Nicobar beds of India (Schwager, 1866, p. 237, pl. 6, fig. 77).

Several of the fossils resemble *Ellipsoglandulina labiata* from the Lower Oligocene Alazan shale of Mexico (Nuttall, 1932, p. 24, pl. 4, fig. 17), *E. principiensis* Cushman and Bermudez from the Tertiary of the Dominican Republic (Bermudez, 1949, pp. 228-229, pl. 14, figs. 40, 41), and *Ellipsonodosaria* sp. Cushman and Siegfus (1942, p. 418, pl. 17, fig. 29) from the Kreyenhagen formation of California.

The figured forms indicate the range in variation of the initial portion of the test.

Length .363 mm., width .297 mm. (8207-a)

Length .429 mm., width .363 mm. (8207-b)

Depository.—Stanford Univ. Paleo. Type Coll. No. 8207a, b.

Locality.—Station M-586.

Ellipsoglandulina multicostata (Galloway and Morrey)

Plate 3, figures 39a, b

Daucina multicostata GALLOWAY and MORREY, Bull. Amer. Pal., vol. 15, 1929, p. 42, pl. 6, fig. 13.

Ellipsoglandulina multicostata NUTTALL, Journ. Pal., vol. 6, 1932, pp. 24-25, pl. 4, fig. 4.

Very rare costate specimens may be identical to this species described from the Upper Eocene of Mantua, Ecuador, and recorded by Nuttall from the Lower Oligocene Alazan shale of Mexico. *Nodosarella ignota* Cushman and Siegfus (1939, p. 30, pl. 6, fig. 21) from the Kreyenhagen formation of California appears to be similar to Galloway and Morrey's species; however, Cushman and Siegfus state that their species shows "traces of a biserial condition," a chamber arrangement not characteristic of the Mantua, Alazan, and Woodside specimens.

Costae are faintly developed (observable under high magnification only) on the basal half of the final chamber in the Woodside fossils.

Length .561 mm., width .231 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8208.

Locality.—Station M-586.

Ellipsoglandulina sp. A

Plate 3, figures 42a, b

A two-chambered specimen with its final chamber more bulbous than the initial one is not specifically identified.

Length 1.219 mm., width .577 mm., thickness .528 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8209.

Locality.—Station M-590.

Ellipsoglandulina sp. B

Plate 3, figure 43

Very rare ovate specimens are not specifically identified. They resemble *Ellipsoglandulina labiata* (Schwager) as figured and described by Bermudez (1949, p. 228, figs. 42, 43) from the Upper Miocene Mao formation of the Dominican Republic but differ from Schwager's type (1866, p. 237, pl. 6, fig. 77) in having an elongate last-formed chamber.

Length .759 mm., width .429 mm.

Depository.—Stanford Univ. Type Paleo. Coll. No. 8210.

Locality.—Station M-586.

Genus **Ellipsoidella** Heron-Allen and Earland, 1910

Ellipsoidella sp.

Plate 3, figure 44

A solitary specimen with a short biserial chamber arrangement (slightly broken) does not resemble any described species of this genus.

Length .99 mm., width .231 mm., thickness .264 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8211.

Locality.—Station M-593.

Genus **Nodosarella** Rzehak, 1895

Nodosarella advena Cushman and Siegfus

Plate 3, figures 45, 46a, b

Nodosarella advena CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 30, pl. 6, figs. 19, 20; Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, pp. 416-417, pl. 17, figs. 12, 13a, b.

This species, described from the Kreyenhagen shale of California, is rare in the Woodside samples. Cushman and Siegfus state that the earliest portion of *Nodosarella advena* shows "traces of a biserial condition in the obliquity of the sutures"—a feature observed in only one Woodside fossil (fig. 45). If the name *Nodosarella* should be applied to species with uniserial, not biserial, chamber arrangement of the initial portion of the test, as advocated by Stainforth (1952, p. 7), then forms with biseriality would be placed in a different genus, possibly *Ellipsoidella,* as suggested by this same author (ibid).

Length 1.122 mm., width .264 mm. (8212-a)

Length .561 mm., width .198 mm. (8212-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8212a, b.

Locality.—Station M-586.

Nodosarella sp.

Plate 3, figure 47

A solitary specimen with a sharply pointed initial end and with 3 chambers, of which the last-formed is inflated, does not appear to be like any described species. It resembles *Nodosarella constricta* Cushman and Bermudez (1937, p. 18, pl. 2, figs. 4-7, especially fig. 5) from the Eocene of Cuba except that there are fewer chambers in the Woodside fossil.

Length 1.087 mm., width .264 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8213.

Locality.—Station M-586.

Genus **Pleurostomella** Reuss, 1860

Pleurostomella cf. **P. elliptica** Galloway and Heminway

Plate 4, figures 1a, b

Very rare specimens are compared to this species described from the Upper Oligocene and Lower Miocene (Ponce formation) of Porto Rico (Galloway and Heminway, 1941, pp. 438-439, figs. 3a, b). Our fossils differ from type, however, in being a little larger, in having a slightly different chamber arrangement, and in lacking the small teeth on the lower side of the lunate apertural opening. The figured specimen closely resembles *Pleurostomella alternans* Schwager (1866, p. 238, pl. 6, fig. 80 only; Schwager's fig. 79 is designated as the type of *P. alternans* by Galloway and Heminway) from the Pliocene of Kar Nikobar, India and *P. alternans* Schwager from the Eocene of Trinidad (Cushman and Harris, 1927, p. 129, pl. 25, fig. 28). The latter fossil, however, is placed in synonymy with *P. elliptica* by Galloway and Heminway.

Length .957 mm., width .264 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8214.

Locality.—Station M-586.

Pleurostomella nuttalli Cushman and Siegfus

Plate 4, figures 2a, b

Pleurostomella nuttalli CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 29, pl. 6, figs. 17, 18; Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, pp. 415-16, pl. 17, figs. 10, 11.

Specimens of this distinctive species described from the Kreyenhagen shale and recorded from various other Eocene formations in California occur at scattered localities in the Woodside area.

Forms closely related to our specimens and likewise assigned to this species have been recorded from the Oligocene Cipero marl and Ste. Croix formation of Trinidad (Cushman and Stainforth, 1945, p. 51, pl. 8, fig. 9, and Cushman and Renz, 1947, p. 31, respectively) and the Hospital Hill formation of Trinidad (Cushman and Renz, 1948, p. 30, pl. 6, fig. 4).

Length 1.089 mm., width .264 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8215.

Locality.—Station M-586.

Pleurostomella sp.

Plate 4, figures 3a, b

A three-chambered specimen with its two last-formed chambers expanded so that they nearly cover the proloculus and having a "cloak-like" appearance similar to the frontal view of some specimens of *Pleurostomella alternans* Schwager is not specifically identified. It may be an immature stage of *P. alternans, P. brevis* Schwager, *P. gerontica* Galloway and Heminway, *P. cubensis* Cushman and Bermudez or other similar forms. The Woodside fossil differs from *P.* cf. *P. rimosa* Cushman and Bermudez from the Kreyenhagen shale (Cushman and Siegfus, 1942, p. 415, pl. 17, fig. 9) in its "cloak-like" chamber configuration and from *P. acuta* Hantken also from the same formation (pl. 17, fig. 8) in possessing a rounded, not pointed initial chamber.

Length .478 mm., width .396 mm., thickness .363 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8216.

Locality.—Station M-593.

Family ROTALIIDAE

Genus **Cancris** Montfort, 1808

Cancris cf. **C. cocoaensis** Cushman

Plate 4, figures 4a, b

A poorly preserved, small, five chambered specimen with a periphery which is slightly lobulate along the two last-formed chambers may be related to this species described from the Upper Eocene Cocoa sand of Alabama (Cushman, 1946a, p. 35, pl. 7, figs. 5a, b). The aperture is indistinct.

Length .297 mm., width .247 mm., thickness .165 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8217.

Locality.—Station M-587.

Genus **Eponides** Montfort, 1808

Eponides umbonatus (Reuss)

Plate 4, figures 5a, b, 6

Rotalina umbonata REUSS, Deutsch. Geol. Gesell, Zeitschr., Bd. 3, 1851, p. 75, pl. 5, figs. 35a-c.

Eponides umbonata CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 5, 1929, p. 98, pl. 14, figs. 8a-c. —NUTTALL, Journ. Pal., vol. 6, 1932, p. 26, pl. 6, figs. 4, 5.—CUSHMAN and SIEGFUS, Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, pp. 419-420, pl. 17, figs. 35a, b.

This wide-spread species is rare in most Woodside samples. The figured form is similar to the Venezuelan, Mexican, and Californian specimens referred to in the synonymy. The type was described from the Eocene of Germany.

Length .429 mm., width .396 mm., thickness .264 mm. (8218-a)

Length .363 mm., width .33 mm., thickness .198 mm. (8218-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8218a, b.

Locality.—Station M-586.

Genus **Gyroidina** Orbigny, 1826

Gyroidina orbicularis Orbigny

Plate 4, figures 8a, b, c

Gyroidina orbicularis ORBIGNY, Ann. Sci. Nat., Paris, ser. 1, tome 7, 1826, p. 278.—LEROY, Geol. Soc. Amer., Mem. 54, 1953, p. 35, pl. 7, figs. 12-14.

Very rare specimens are remarkably similar to figures of this species described by LeRoy (see synonymy) from the Lower Tertiary Esna shales of Egypt.

The type is a Recent species from the Adriatic Sea (see Ellis and Messina, 1940, for figures).

Length .264 mm., width .214 mm., thickness .148 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8219.

Locality.—Station M-593.

Gyroidina sp.

Plate 4, figures 7a, b

A small, planoconvex, nine-chambered specimen—perhaps an immature form—with an indistinct chamber arrangement in the earlier formed dorsal whorl is not specifically identified. It may be related to *Gyroidina orbicularis* Orbigny var. *obliquata* Cushman and McMasters (1936, p. 514, pl. 76, figs. 4a, b) from the Eocene Llajas formation of California, to *Gyroidina orbicularis* Orbigny from the Lower Tertiary Esna shale of Egypt (LeRoy, 1953, p. 35, pl. 7, figs. 12-14), or may be a juvenile *Gyroidinoides soldanii* (Orbigny).

Length .231 mm., width .198 mm., thickness .132 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8220.

Locality.—Station M-592.

Genus **Gyroidinoides** Brotzen, 1942

Gyroidinoides soldanii (Orbigny)

Plate 4, figures 9a, b, c, 10a, b, c

Gyroidina soldanii ORBIGNY, Ann. Sci. Nat., tome 7, 1826, p. 278; Modèles No. 36, ii livraison.—CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 5, pp. 98-99, pl. 14, figs. 6, 7a-c, especially figs. 7.—CUSHMAN, STEWART and STEWART, State of Oregon, Dept. Geol. and Min. Ind., Bull. No. 36, 1948, p. 79, pl. 10, figs. 6a-c.

Gyroidinoides cf. *soldanii* RENZ, Geol. Soc. Amer., Mem. 32, p. 140, pl. 8, figs. 14a-c.

The authors are referring to this Recent species, described from near Rimini, Italy, specimens which show considerable variation in test character. Dorsally flat to convex forms having 8-10 chambers in the last-formed whorl and with rounded to acute peripheral edges are considered to be variations within the species. Some Woodside fossils are also similar to *Gyroidina soldanii* var. *octocamerata* Cushman and Hanna (1927, p. 223, pl. 14, figs. 16-18) from the Eocene of California, which seems to be indistinguishable from *G. soldanii.* Todd and Kniker (1952, p. 24) in their study of the Agua Fresca fauna from the Eocene of Chile are of the same opinion in regard to forms which resemble Cushman and Hanna's species.

The open umbilicus and apertural lip in some specimens (broken off or faintly preserved in others) place Orbigny's species, and Cushman and Hanna's species as well, in the genus *Gyroidinoides.*

Gyroidinoides soldanii and related forms (e. g., *Gyroidina allani* Finlay (1939, pp. 323-324, pl. 28, figs. 134-136) have been recorded from numerous Tertiary localities of the world. The species occurs in many Woodside localities.

Length .495 mm., width .429 mm., thickness .33 mm. (8221-a)

Length .462 mm., width .396 mm., thickness .313 mm. (8221-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8221a, b.

Locality.—Station M-586.

Genus **Nuttallides** Finlay, 1939

Nuttallides trümpyi (Nuttall)

Plate 4, figures 12a, b, c

Eponides trümpyi NUTTALL, Journ. Pal., vol. 4, 1930, pp. 287-288, pl. 24, figs. 9, 13, 14.—BERMUDEZ, Cushman Lab. Foram. Res., Spec. Publ. No. 25, 1949, p. 249, pl. 17, figs. 16-18.

Nuttallides trümpyi (NUTTALL) FINLAY, Trans. Roy. Soc. New Zealand, vol. 68, 1939, pp. 520, 521.

This species described from the Lower Eocene Aragon formation of Mexico is common at most localities in the Woodside area. It is also abundant in the Lower Eocene and Paleocene of Cuba.

"Asterigerina" crassaformis Cushman and Siegfus (1935, pp. 94-95, pl. 14, figs. 10a-c; 1949, p. 420, pl. 14, figs. 1a-c) from the Kreyenhagen formation of California is placed in this genus by Bermudez (1952, p. 66).

Length .297 mm., width .264 mm., thickness .165 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8223.

Locality.—Station M-586.

Genus **Osangularia** Brotzen, 1940

Osangularia mexicana (Cole)

Plate 4, figures 11a, b

Pulvinulinella culter (PARKER and JONES) var. *mexicana* COLE, Bull. Amer. Pal., vol. 14, 1927, p. 31, pl. 1, figs. 15, 16.

Parrella mexicana CUSHMAN and RENZ, Cushman Lab. Foram. Res. Spec. Publ. No. 24, 1948, p. 35, pl. 7, figs. 9, 10.

Specimens from several localities appear to belong to this species described from the Upper Eocene Guayabal formation of Mexico and widely recorded from the Lower Tertiary of South America, Cuba, Trinidad, Mexico, Jamaica, and from a core off the eastern coast of North America.

The Woodside fossils differ, however, from the type mainly in having fewer chambers (9-10 instead of about 16) and in being smaller; in these respects, they are like the Trinidad and Atlantic core foraminifers. Fairly common at one locality, rare at others.

For reinstatement of the genus *Osangularia* Brotzen, 1940, for *Parrella* Finlay, 1939 (non Ginsburg, 1938), see Thalmann and Graham, 1952, pp. 31, 32.

Length .478 mm., width .462 mm., thickness .247 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8222.

Locality.—Station M-593.

Family CASSIDULINIDAE

Genus **Alabamina** Toulmin, 1941

Alabamina atlantisae (Cushman) var. **dissonata** (Cushman and Renz)

Plate 4, figures 13a, b

Pulvinulinella atlantisae CUSHMAN var. *dissonata* CUSHMAN and RENZ, Cushman Lab. Foram. Res., Spec. Publ. No. 24, 1948, p. 35, pl. 7, figs. 11, 12.

This variety described from the Eocene of Trinidad is typically developed but of rare occurrence at a few localities only.

Length .412 mm., width .346 mm., thickness .214 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8224.

Locality.—Station M-592.

Genus **Cassidulina** Orbigny, 1826

Cassidulina globosa Hantken

Plate 4, figures 14a, b

Cassidulina globosa HANTKEN, Magyr. kir földt. int. Evkön. vol. 4, 1876, p. 64, pl. 16, figs. 2a, b.

A few specimens at scattered localities are similar to this widely distributed species described from the Upper Eocene of Hungary. The figured fossil is not shown, however, in the same positions as Hantken's type. *Cassidulina globosa* has been recorded from numerous Eocene localities in the Pacific Coast states of America.

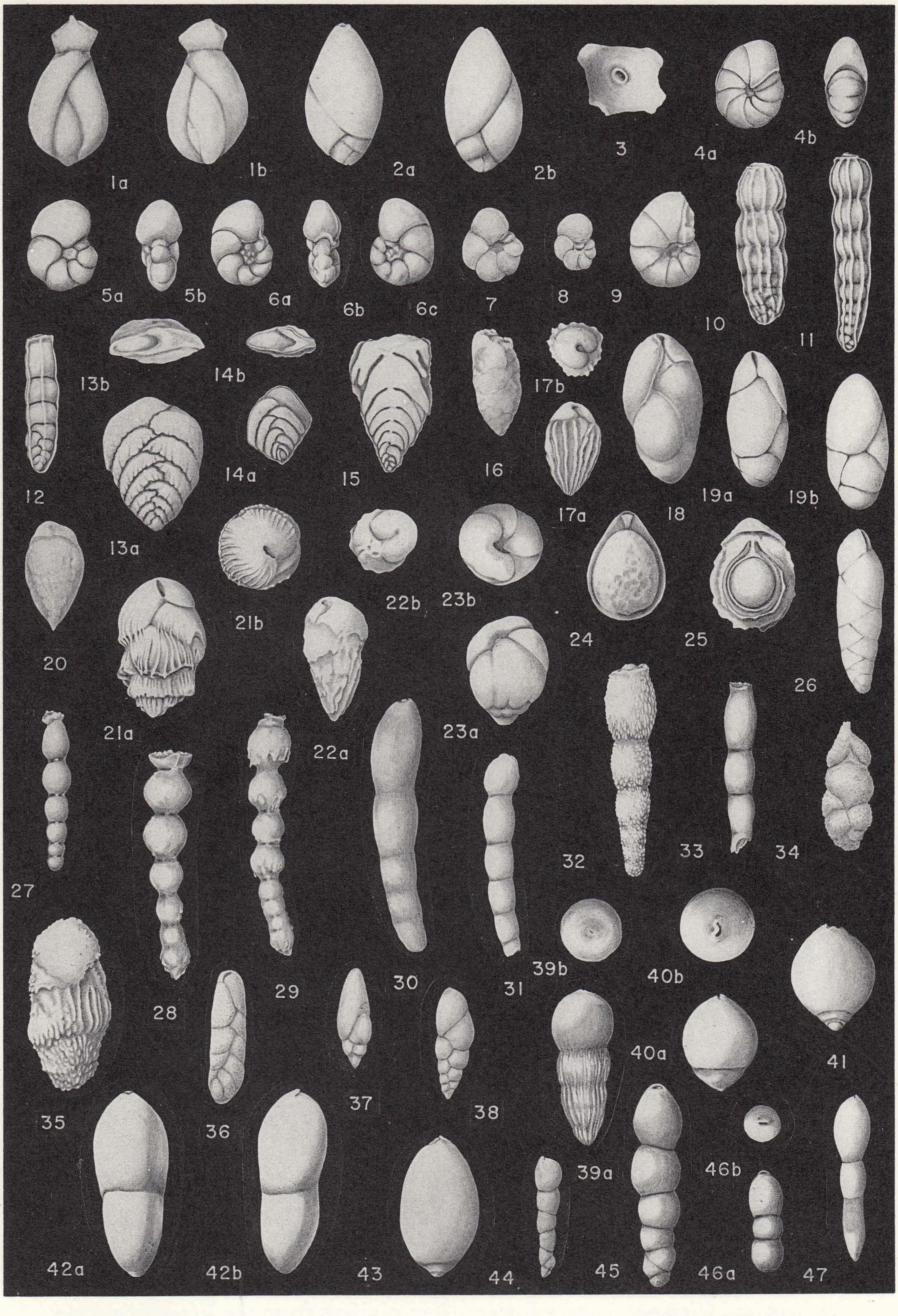
Length .297 mm., width .264 mm., thickness .264 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8225.

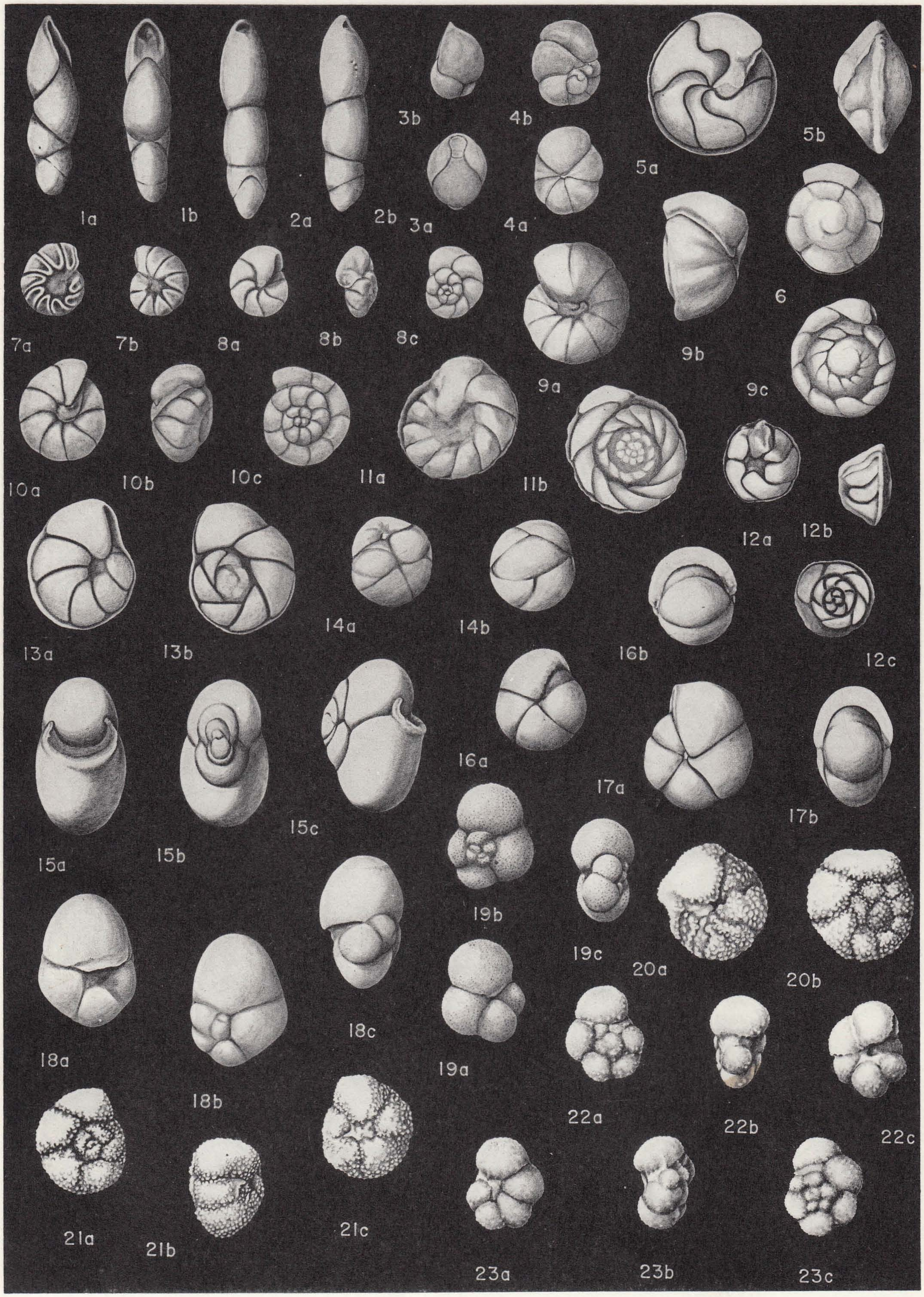
Locality.—Station M-586.

EXPLANATION OF PLATE 3

FIGS.		PAGE
1.	*Globulina* sp. × 33. a, b, opposite sides. Loc. M-586.	17
2.	*Pyrulina* sp. × 34. a, b, opposite sides. Loc. M-586.	17
3.	*Ramulina* cf. *R. globulifera* H. B. Brady. × 33. Loc. M-591.	18
4.	*Nonion havanense* Cushman and Bermudez. × 45. a, side view; b, apertural view. Loc. M-586.	18
5, 6, 7, 8.	*Nonion micrus* Cole. 5, × 50, a, side view; b, apertural view; 6, × 50, a, c, opposite sides; b, apertural view; 7, × 45, side view; 8, × 37, side view. Loc. M-590; 593.	18
9.	*Nonion* sp. × 40. Side view. Loc. M-592.	18
10, 11.	*Amphimorphina ignota* Cushman and Siegfus. 10, × 50; 11, × 30. Loc. M-586.	18
12.	*Amphimorphina* sp. × 44. Loc. M-588.	19
13.	*Aragonia aragonensis* (Nuttall). × 51. a, side view; b, apertural view. Loc. M-593.	19
14.	*Aragonia capdevilensis* (Cushman and Bermudez). × 44. a, side view; b, apertural view. Loc. M-586.	19
15.	*Plectofrondicularia palmerae* Cushman and Bermudez. × 26. Loc. M-586.	19
16.	*Angulogerina* sp. × 45. Loc. M-592.	19
17.	*Bulimina corrugata* Cushman and Siegfus. × 47. a, side view; b, apertural view. Loc. M-587.	19
18, 19.	*Bulimina* cf. *B. guayabalensis* Cole. 18, × 22, side view; 19, × 23, a, b, opposite sides. Loc. M-586.	20
20.	*Bulimina semicostata* Nuttall. × 36. Loc. M-586.	20
21.	*Bulimina serratospina* Finlay. × 46. a, side view; b, apertural view. Loc. M-586.	20
22.	*Bulimina* sp. × 50. a, side view; b, apertural view. Loc. M-587.	20
23.	*Buliminella grata* Parker and Bermudez. × 35. a, side view; b, apertural view. Loc. M-586.	20
24.	*Fissurina marginata* (Walker and Boys). × 35. Loc. M-586.	20
25.	*Fissurina* cf. *F. orbignyana* Seguenza. × 28. Loc. M-593.	21
26.	*Loxostomum* sp. × 42. Loc. M-591.	21
27.	*Siphonodosaria* cf. *S. cocoaensis* (Cushman). × 30. Loc. M-586.	21
28, 29.	*Siphonodosaria gracilis* (Palmer and Bermudez). 28, × 29; 29, × 31. Loc. M-586.	21
30, 31.	*Siphonodosaria* cf. *S. pauperata* (Orbigny). 30, × 31; 31, × 26. Loc. M-586.	21
32.	*Siphonodosaria* sp. × 38. Loc. M-592.	21
33.	?*Siphonodosaria* sp. × 29. Loc. M-586.	21
34.	*Uvigerina garzaensis* Cushman and Siegfus. × 37. Loc. M-587.	22
35.	*Uvigerina* sp. × 48. Loc. M-587.	22
36.	*Virgulina* cf. *V. danvillensis* Howe and Wallace. × 36. Loc. M-593.	22
37.	*Virgulina* sp. A × 36. Loc. M-593.	22
38.	*Virgulina* sp. B × 46. Loc. M-593.	22
39.	*Ellipsoglandulina multicostata* (Galloway and Morrey). × 40. a, side view; b, apertural view. Loc. M-586.	23
40, 41.	*Ellipsoglandulina* cf. *E. labiata* (Schwager). 40, × 40, a, side view; b, apertural view. 41, × 37. Loc. M-586.	22
42.	*Ellipsoglandulina* sp. A × 23. a, b, opposite sides. Loc. M-590.	23
43.	*Ellipsoglandulina* sp. B × 27. Loc. M-586.	23
44.	*Ellipsoidella* sp. × 18. Loc. M-593.	23
45, 46.	*Nodosarella advena* Cushman and Siegfus. 45, × 27; 46, × 27, a, side view; b, apertural view. Loc. M-586.	23
47.	*Nodosarella* sp. × 23. Loc. M-586.	23



Graham and Classen: Lower Eocene Foraminifera from the Woodside Area, San Mateo County, California



Graham and Classen: Lower Eocene Foraminifera from the Woodside Area, San Mateo County, California

Family CHILOSTOMELLIDAE

Genus **Chilostomelloides** Cushman, 1926

Chilostomelloides cyclostoma (Rzehak)

Plate 4, figures 15a, b, c

Chilostomella cyclostoma RZEHAK, Natur. Hofmus., Ann. Wien. Bd. 3, 1888, p. 258, figs. 1a-c.

Very rare, well-preserved specimens with a prominent semi-circular aperture appear to be closely related to this species described from the Eocene or Oligocene of Austria.

Chilostomella czizeki Reuss from the Tertiary of Porto Rico (Galloway and Heminway, 1941, p. 409, pl. 28, figs. 3a-c) and *Chilostomelloides ovicula* Nuttall from the Eocene and Oligocene of Trinidad (Cushman and Renz, 1948, p. 38, pl. 7, figs. 13, 14; also see their synonymy) resemble the Woodside foraminifers in general appearance.

Length 1.089 mm., width .693 mm., thickness .792 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8226.

Locality.—Station M-593.

Genus **Pullenia** Parker and Jones, 1862

Pullenia eocenica Cushman and Siegfus

Plate 4, figures 16a, b

Pullenia eocenica CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 31, pl. 7, fig. 1.—TODD and KNIKER, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 26, pl. 4, fig. 29.

Typical specimens of this Kreyenhagen shale species occur at several localities. There are, however, a few specimens smaller than the figured form.

In addition to being recorded from numerous Eocene formations in California, *Pullenia eocenica* has also been observed in the Eocene of Maryland.

Length .495 mm., width .462 mm., thickness .495 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8227.

Locality.—Station M-586.

Pullenia quinqueloba (Reuss) var. **angusta** Cushman and Todd

Plate 4, figures 17a, b

Pullenia quinqueloba (REUSS) var. *angusta* CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 19, 1943, p. 10, pl. 2, figs. 3, 4.—CUSHMAN, Cushman Lab. Foram. Res. Spec. Publ. No. 16, p. 37, pl. 7, fig. 11.

There are a few specimens of this variety described from the Midway of Texas and recorded from various Eocene localities of the Gulf Coast and Mexico. They differ from *Pullenia alazensis* Cushman (1927, p. 168, pl. 26, figs. 14, 15), a closely allied form from the Alazan clays (Oligocene) of Mexico (p. 13), in being

EXPLANATION OF PLATE 4

FIGS.		PAGE
1.	*Pleurostomella* cf. *P. elliptica* Galloway and Heminway. × 28. a, side view; b, apertural view. Loc. M-586.	23
2.	*Pleurostomella nuttalli* Cushman and Siegfus. × 27. a, apertural view; b, side view. Loc. M-586.	24
3.	*Pleurostomella* sp. × 24. a, apertural view; b, side view. Loc. M-593.	24
4.	*Cancris* cf. *C. cocoaensis* Cushman. × 43. a, ventral view; b, dorsal view. Loc. M-587.	24
5, 6.	*Eponides umbonatus* (Reuss). 5, × 50, a, ventral view; b, apertural view. 6, × 46, dorsal view. Loc. M-586.	24
7.	*Gyroidina* sp. × 46. a, dorsal view; b, ventral view. Loc. M-592.	25
8.	*Gyroidina orbicularis* Orbigny. × 39. a, ventral view; b, apertural view; c, dorsal view. Loc. M-593.	.24
9, 10.	*Gyroidinoides soldanii* (Orbigny). 9, × 36, a, ventral view; b, apertural view; c, dorsal view. 10, × 33, a, ventral view; b, apertural view; c, dorsal view. Loc. M-586.	25
11.	*Osangularia mexicana* (Cole). × 39. a, ventral view; b, dorsal view. Loc. M-593.	25
12.	*Nuttallides trümpyi* (Nuttall). × 40. a, ventral view; b, apertural view; c, dorsal view. Loc. M-586.	25
13.	*Alabamina atlantisae* (Cushman) var. *dissonata* (Cushman and Renz). × 46. a, ventral view; b, dorsal view. Loc. M-592.	26
14.	*Cassidulina globosa* Hantken. × 45. a, apertural view; b, opposite side. Loc. M-586.	26
15.	*Chilostomelloides cyclostoma* (Rzehak). × 21. a, apertural view; b, opposite side; c, side view. Loc. M-593.	27
16.	*Pullenia eocenica* Cushman and Siegfus. × 30. a, side view; b, apertural view. Loc. M-586.	27
17.	*Pullenia quinqueloba* (Reuss) var. *angusta* Cushman and Todd. × 41. a, side view; b, apertural view. Loc. M-592.	27
18.	*Quadrimorphina advena* (Cushman and Siegfus). × 36. a, ventral view; b, dorsal view; c, apertural view. Loc. M-587.	28
19.	*Globigerina bulloides* Orbigny. × 47. a, ventral view; b, dorsal view; c, apertural view. Loc. M-593.	28
20, 21.	*Globigerina nitida* Martin. 20, × 48, a, ventral view; b, dorsal view. 21, × 47, a, dorsal view; b, apertural view; c, ventral view. Loc. M-590.	28
22, 23.	*Globigerina pseudo-bulloides* Plummer. 22, × 47, a, dorsal view; b, apertural view; c, ventral view. 23, × 45, a, ventral view; b, apertural view; c, dorsal view. Loc. M-590.	28

less compressed only. The figures of this latter species, as given by Todd and Kniker (1952, p. 26, pl. 4, figs. 30a, b) in their publication dealing with the Agua Fresca shale fauna of Chile, show a marked similarity to the illustrated Woodside foraminifer.

Length .462 mm., width .429 mm., thickness .33 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8228.

Locality.—Station M-592.

Genus Quadrimorphina Finlay, 1939

Quadrimorphina advena (Cushman and Siegfus)

Plate 4, figures 18a, b, c

Valvulineria advena CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 31, pl. 6, figs. 22a-c.

Quadrimorphina advena CUSHMAN and TODD, Contr. Cushman Lab. Foram. Res., vol. 25, 1949, p. 71, pl. 12, figs. 13a-c.—TODD and KNIKER, Cushman Fnd. Foram. Res., Spec. Publ. No. 1, 1952, p. 25, pl. 4, figs. 19a-c.

Rare specimens of this species described from the Kreyenhagen formation and recorded from the Eocene Agua Fresca shale of Chile occur at few localities in the Woodside area.

Length .544 mm., width .379 mm., thickness .099 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8229.

Locality.—Station M-587.

Family GLOBIGERINIDAE

Genus **Globigerina** Orbigny, 1826

Globigerina bulloides Orbigny

Plate 4, figures 19a, b, c

Globigerina bulloides ORBIGNY, Ann. Sci. Nat., tome 7, 1826, p. 277, Modèles, Nos. 17, 76.—NUTTALL, Journ. Pal., vol. 6, 1932, p. 29, pl. 6, figs. 13-15.

This species, described from the Adriatic Sea and recorded from numerous areas throughout the world, is rare in our samples. The figured specimen is within the wide range of variation assigned to Orbigny's species by various authors and is almost identical with Nuttall's fossil from the Lower Eocene Alazan shale of Mexico.

Length .33 mm., width .264 mm., thickness .198 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8230.

Locality.—Station M-593.

Globigerina nitida Martin

Plate 4, figures 20a, b, 21a, b, c

Globigerina nitida MARTIN, Stanford Univ. Publ. Univ. Ser., Geol. Sci., vol. 3, no. 3, 1943, p. 25, pl. 7, figs. 1a-c.

This granulated species is fairly common at one locality only (M-590) and rare at others in the Woodside area. The type is from the Paleocene-Eocene Lodo formation of California.

Length .363 mm., width .33 mm., thickness .28 mm. (8231-a)

Length .33 mm., width .297 mm., thickness .231 mm. (8231-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8231a, b.

Locality.—Station M-590.

Globigerina pseudo-bulloides Plummer

Plate 4, figures 22a, b, c, 23a, b, c

Globigerina pseudo-bulloides PLUMMER, Univ. Texas Bull. No. 2644, 1926, pp. 133-134, pl. 8, figs. 9a-c.

Specimens of this widely recorded species are rare in the Woodside material. The type was described from the Paleocene (Midway) of Texas.

Length .297 mm., width .247 mm., thickness .181 mm. (8232-a)

Length .313 mm., width .297 mm., thickness .231 mm. (8232-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8232a, b.

Locality.—Station M-590.

Globigerina triloculinoides Plummer

Plate 5, figures 1a, b

Globigerina triloculinoides PLUMMER, Univ. Texas Bull. No. 2644, 1926, pp. 134-135, pl. 8, figs. 10a-c.

This species is common in most samples. In addition to occurring at numerous localities in the Gulf and Pacific Coast regions of the United States it is widely recorded from Lower Tertiary sediments of other continents. The type was described from the Midway of Texas.

Length .528 mm., width .396 mm., thickness .363 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8233.

Locality.—Station M-586.

Genus **Hastigerinella** Cushman, 1927

Hastigerinella eocanica Nuttall

Plate 5, figure 2

Hastigerinella eocanica NUTTALL, Journ. Pal. vol. 2, 1928, p. 376, pl. 50, figs. 9-11.—CHURCH, Rept. State Min. Calif., 1931, p. 206, pl. B, fig. 8.—CUSHMAN and STONE, Cushman Lab. Foram. Res. Spec. Publ. No. 20, 1947, pp. 24-25, pl. 3, fig. 18. —CUSHMAN and RENZ, Cushman Lab. Foram. Res. Spec. Publ. No. 24, 1948, p. 38, pl. 7, fig. 17.

Very rare, fragmentary, specimens are thought to belong to this species. The chambers of the Woodside and Markley (Kreyenhagen of Church—see synonymy) specimens are, however, slightly more inflated than those of the type from the Eocene of Mexico.

Hastigerinella eocanica has also been reported from the Eocene of Trinidad, Peru, Italy, and the Oligocene of Cuba and Italy.

Length .66 mm., width .33 mm., thickness .33 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8234.

Locality.—Station M-586.

Family GLOBOROTALIIDAE
Genus **Globorotalia** Cushman, 1927
Globorotalia crassata (Cushman)

Plate 5, figures 3a, b, 4a, b, c

Pulvinulina crassata CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 9, 1925, p. 300, pl. 7, fig. 4.

Globorotalia crassata COLE, Bull. Amer. Pal., vol. 14, 1927, p. 34, pl. 1, figs. 7, 8.—CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 25, 1949, p. 37, pl. 7, figs. 4-6.

This species occurs at several localities in the Woodside area but usually is of rare occurrence. It was described from the Eocene of Mexico and has been recorded from numerous Eocene localities of the Gulf and Pacific coasts of the United States, Cuba and Trinidad, and from an Eocene core off the eastern coast of North America (see last citation in above synonymy).

Length .495 mm., width .396 mm., thickness .313 mm. (8235-a)

Length .396 mm., width .379 mm., thickness .28 mm. (8235-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8235a, b.

Locality.—Station M-586.

Globorotalia crassata (Cushman) var. **aequa** Cushman and Renz

Plate 5, figures 5a, b, c

Globorotalia crassata (CUSHMAN) var. *aequa* CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 18, 1942, p. 12, pl. 3, fig. 3.—CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 25, 1949, p. 37, pl. 1, figs. 7-9.

Very rare specimens of this variety have been observed at one locality only in the Woodside area.

The variety was described from the Paleocene Soldado formation of Trinidad and has been recorded from the Paleocene of Alabama (Naheola formation), Cuba (Madruga formation), and Maryland (Hammond well sample).

Length .412 mm., width .313 mm., thickness .231 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8236.

Locality.—Station M-588.

Globorotalia membranacea (Ehrenberg)

Plate 5, figures 6a, b, c

Planulina membranacea EHRENBERG, Microgeol., 1854, p. 23, pl. 25, (1A), fig. 41; pl. 26, fig. 43.

Globorotalia membranacea WHITE, Journ. Pal., vol. 2, 1928, pp. 280-281, pl. 38, figs. 1a-c.—GLAESSNER, Publ. Pal. Lab. Moscow Univ., Prob. Paleo., vols. 2-3, 1937, pp. 385-386, pl. 4, figs. 38a-c.—LEROY, Geol. Soc. Amer., Mem. 54, 1953, p. 32, pl. 3, figs. 13, 14.

Well-preserved but variable specimens of this species described from the Cretaceous of Europe and recorded from numerous Cretaceous, Paleocene, and Eocene formations in the United States and elsewhere occur at scattered localities.

Length .297 mm., width .247 mm., thickness .132 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8237.

Locality.—Station M-586.

Globorotalia cf. **G. naussi** Martin

Plate 5, figures 7a, b, c

Very rare, small, specimens may be related to this species described from the type locality of the Paleocene-Eocene Lodo formation of California (Martin, 1943, p. 26, pl. 8, figs. 3a-c).

Length .248 mm., width .198 mm., thickness .165 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8238.

Locality.—Station M-586.

Globorotalia velascoensis (Cushman) var. **acuta** Toulmin

Plate 5, figures 8a, b, c, 9a, b, c

Globorotalia wilcoxensis CUSHMAN and PONTON var. *acuta* TOULMIN, Journ. Pal., vol. 15, 1941, p. 608, pl. 82, figs. 6-8.—CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 25, 1949, pp. 39-40, pl. 7, figs. 19-21.

Globorotalia velascoensis (CUSHMAN) var. *acuta* GRIMSDALE, Third World Petr. Cong., The Hague, Proc., 1951, p. 471.

This variety is fairly common at many localities in the Woodside area. The type was described from the Lower Eocene Salt Mountain limestone of Alabama and has been recorded from the Paleocene Soldado formation of Trinidad, the Paleocene Naheola and Lower Eocene Bashi formations respectively of Alabama, and the Paleocene Madruga formation of Cuba.

Length .495 mm., width .429 mm., thickness .297 mm. (8239-a)

Length .396 mm., width .297 mm., thickness .264 mm. (8239-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8239a, b.

Locality.—Station M-586.

Family ANOMALINIDAE

Genus **Anomalina** Orbigny, 1826

Anomalina crassisepta Cushman and Siegfus

Plate 5, figures 11a, b, c

Anomalina crassisepta CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 11, 1935, p. 95, pl. 14, figs. 12a-c; Trans. San Diego Soc. Nat. Hist., vol. 9, 1942, pp. 422-423, pl. 18, figs. 11a-c.

This species is of rare occurrence at a few localities in the Woodside area. Variation in test features is indicated by the degree of limbation of the dorsal sutures and by the rounded to subacute outline of the peripheral angle. The type was described from the Kreyenhagen shale of California.

Length .528 mm., width .429 mm., thickness .33 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8240.

Locality.—Station M-586.

Anomalina dorri Cole var. **aragonensis** Nuttall

Plate 5, figures 10a, b, c

Anomalina dorri COLE var. *aragonensis* NUTTALL, Journ. Pal., vol. 4, 1930, p. 291, pl. 24, fig. 18; pl. 25, fig. 1.—CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 32, pl. 7, fig. 5.—CUSHMAN and RENZ, Cushman Lab. Foram. Res. Spec. Publ. No. 24, 1948, p. 41, pl. 8, figs. 13, 14.

This variety occurs rarely at scattered localities in the Woodside district. It was described from the Lower Eocene Aragon formation of Mexico and has been recorded from the Eocene of California, Cuba, Trinidad, and other areas.

Length .627 mm., width .495 mm., thickness .396 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8241.

Locality.—Station M-593.

Anomalina garzaensis Cushman and Siegfus

Plate 5, figures 12a, b, c

Anomalina garzaensis CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, p. 32, pl. 7, figs. 3a-c.—TODD and KNIKER, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 26, pl. 4, figs. 35a-c.

Well-preserved specimens of this species described from the Kreyenhagen shale of California and recorded from the Agua Fresca shale of Chile occur at various localities in the Woodside area.

Length .33 mm., width .297 mm., thickness .132 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8242.

Locality.—Station M-593.

Anomalina grosserugosa (Gümbel)

Plate 5, figures 13a, b, c

Truncatulina grosserugosa GÜMBEL, K. Bayer Akad. Wiss., Math.-Physik. Cl., Abh. Bd. 10 (1870) Abt. 2, 1868, p. 660, pl. 2, figs. 104a, b.

Anomalina grosserugosa COLE, Bull. Amer. Pal., vol. 14, 1928, pp. 18-19, pl. 1, figs. 16, 17.

This species is very rare at the only locality where it was observed; however, most specimens are nearly identical with Cole's fossil from the Chapapote formation of Mexico.

The type was described from the Eocene of Europe.

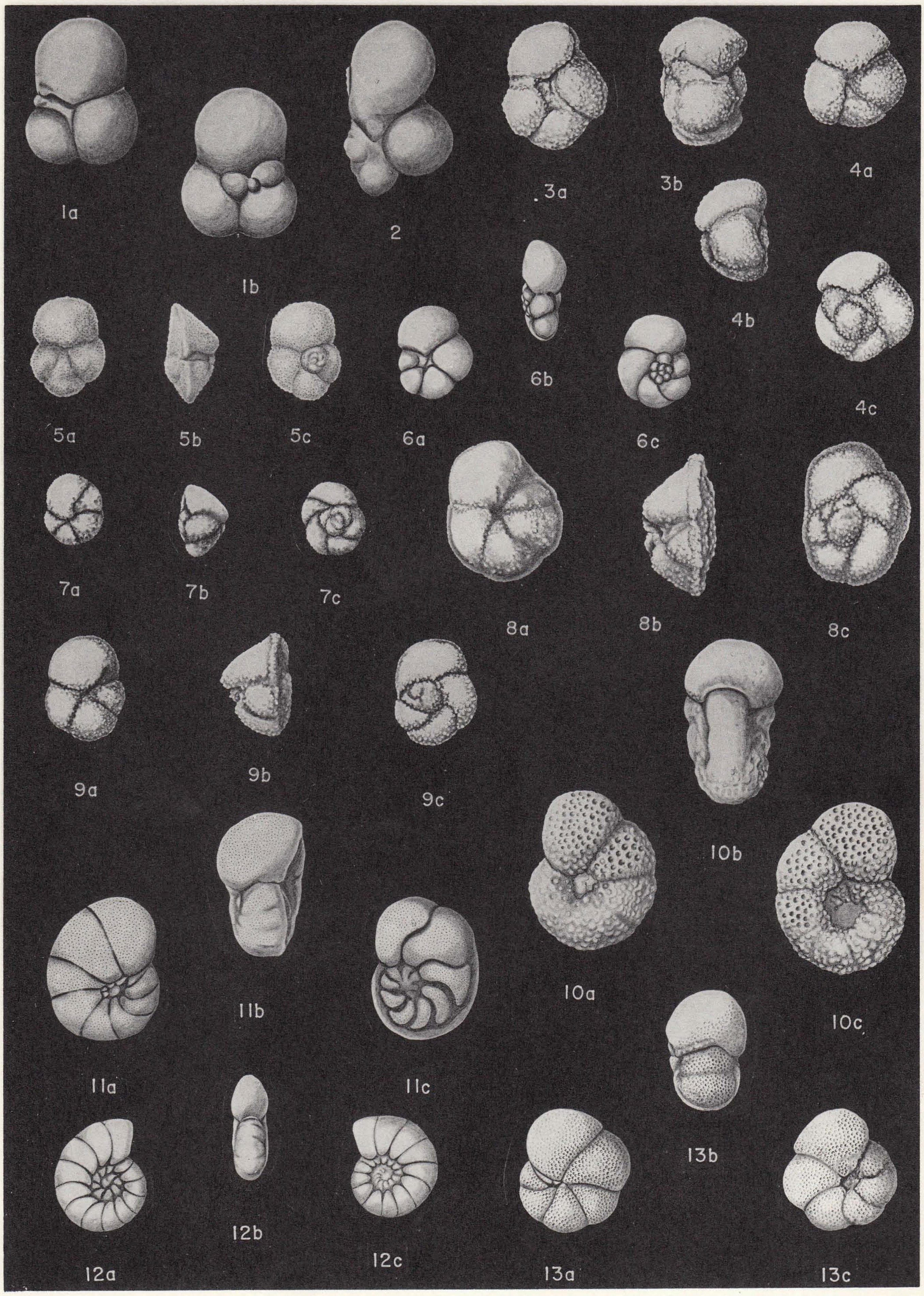
Length .462 mm., width .429 mm., thickness .297 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8243.

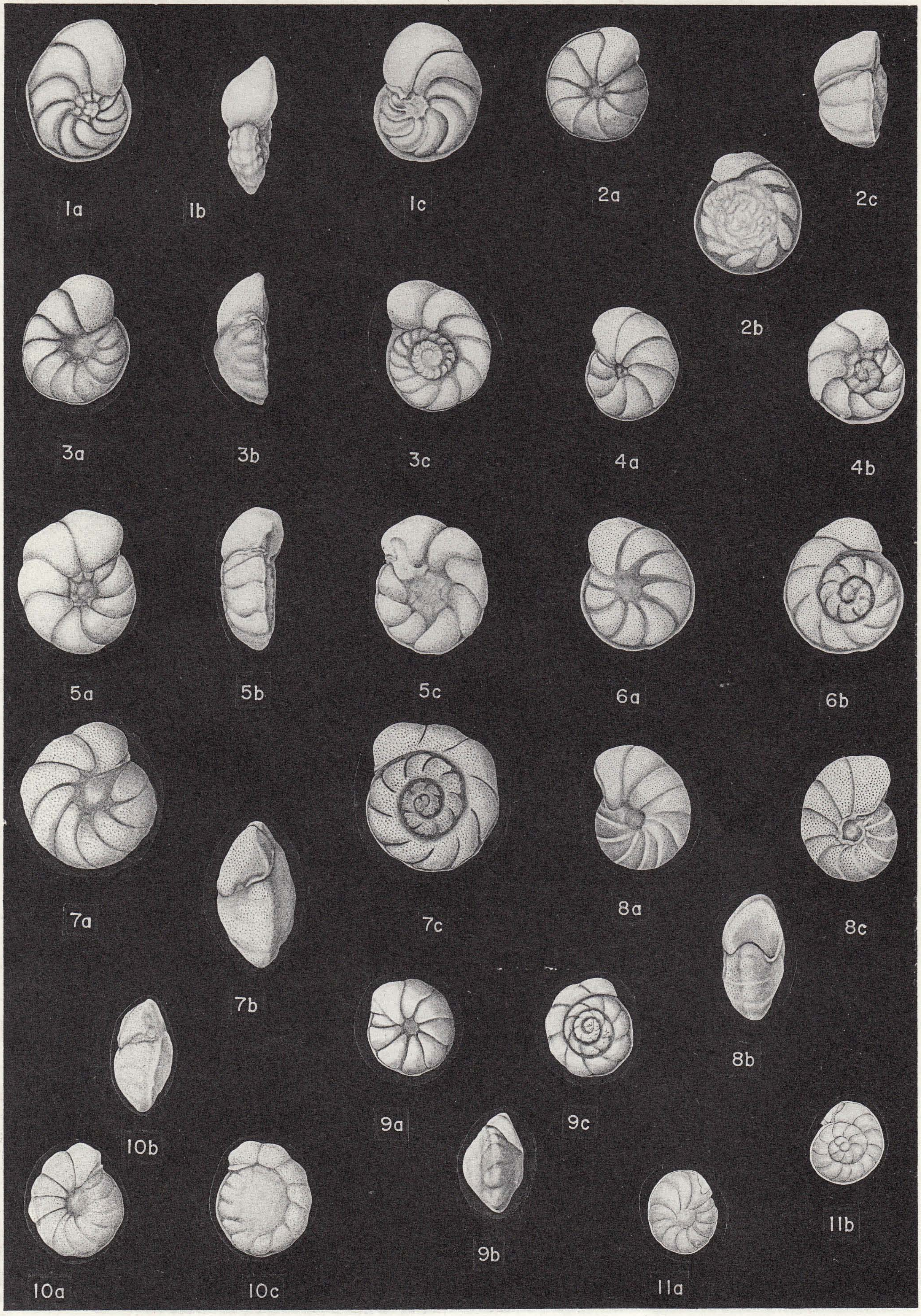
Locality.—Station M-586.

EXPLANATION OF PLATE 5

FIGS.		PAGE
1.	*Globigerina triloculinoides* Plummer. × 41. a, ventral view; b, dorsal view. Loc. M-586.	28
2.	*Hastigerinella eocenica* Nuttall. × 37. Loc. M-586.	28
3, 4.	*Globorotalia crassata* (Cushman). 3, × 38, a, ventral view; b, apertural view. 4, × 41, a, ventral view; b, apertural view; c, dorsal view. Loc. M-586.	29
5.	*Globorotalia crassata* (Cushman) var. *aequa* Cushman and Renz. × 36. a, ventral view; b, apertural view; c, dorsal view. Loc. M-588.	29
6.	*Globorotalia membranacea* (Ehrenberg). × 46. a, ventral view; b, apertural view; c, dorsal view. Loc. M-586.	29
7.	*Globorotalia* cf. *G. naussi* Martin. × 42. a, ventral view; b, apertural view; c, dorsal view. Loc. M-586.	29
8, 9.	*Globorotalia velascoensis* (Cushman) var. *acuta* Toulmin. 8, × 42, a, ventral view; b, apertural view; c, dorsal view. 9, × 39, a, ventral view; b, apertural view; c, dorsal view. Loc. M-586.	29
10.	*Anomalina dorri* Cole var. *aragonensis* Nuttall. × 37. a, c, opposite sides; b, apertural view. Loc. M-593.	30
11.	*Anomalina crassisepta* Cushman and Siegfus. × 39. a, c, opposite sides; b, apertural view. Loc. M-586.	30
12.	*Anomalina garzaensis* Cushman and Siegfus. × 46. a, c, opposite sides; b, apertural view. Loc. M-593.	30
13.	*Anomalina grosserugosa* (Gümbel). × 38. a, c, opposite sides; b, apertural view. Loc. M-586.	30



Graham and Classen: Lower Eocene Foraminifera from the Woodside Area, San Mateo County, California



Graham and Classen: Lower Eocene Foraminifera from the Woodside Area, San Mateo County, California

Genus **Cibicides** Montfort, 1808

Cibicides americanus (Cushman)

Plate 6, figures 1a, b, c

Truncatulina americana CUSHMAN, U. S. Nat. Mus., Bull. 103, 1918, p. 68, pl. 23, figs. 2a-c.

Cibicides americanus CUSHMAN and LAIMING, Journ. Pal., vol. 5, 1931, p. 119, pl. 14, figs. 6a-c.

This species, described from the Oligocene Culebra formation of Panama and recorded from numerous Tertiary localities in America, is rare in our samples. The forms from the Miocene Duplin marl of South Carolina (Cushman, 1918, p. 63, pl. 20, figs. 2a-c; pl. 21, figs. 1a-c) described also as *Truncatulina americanus* Cushman appear to be a different species, although some authors (see Todd and Kniker, 1952, p. 27) place them in synonymy with Cushman's earlier (by one week) described species.

Length .478 mm., width .363 mm., thickness .198 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8244.

Locality.—Station M-588.

Cibicides grimsdalei Nuttall

Plate 6, figures 2a, b, c

Cibicides grimsdalei NUTTALL, Journ. Pal., vol. 4, 1930, pp. 290-291, pl. 25, figs. 7, 8, 11.—CUSHMAN and RENZ, Cushman Lab. Foram. Res. Spec. Publ. No. 24, 1948, p. 41, pl. 8, figs. 17-19.

This plano-convex, finely perforate species with limbate ventral sutures occurs rarely at scattered localities in the Woodside area. The species was described from the Lower Eocene Aragon formation of Mexico and has been recorded from the Eocene of Trinidad and Italy.

Our specimens resemble more closely the figures of Cushman and Renz's Trinidad fossil than those of the type.

Length .429 mm., width .396 mm., thickness .264 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8245.

Locality.—Station M-586.

Cibicides mauricensis Howe and Roberts

Plate 6, figures 3a, b, c, 4a, b, 5a, b, c

Cibicides mauricensis HOWE and ROBERTS, La. Dept. Conserv. Geol. Surv., Geol. Bull. 14, 1939, p. 87, pl. 13, figs. 4, 5.

There is considerable variation among the specimens assigned to this species described from the Eocene (Claiborne) Cook Mountain formation of Louisiana. Most forms are planoconvex, have flat dorsal and convex ventral sides, and usually consist of about 3 whorls on the dorsal side. The ventral side may have a small boss of clear shell material in the umbilical region although there are several specimens in which chambers of an earlier whorl are visible in this portion of the test.

Some specimens appear to be almost indistinguishable from *Cibicides lobatulus* (Walker and Jacob) from the Alazan clays of Mexico (Cushman, 1927, p. 170, pl. 27, figs. 12, 13).

C. mauricensis is rare to fairly common at various localities.

Length .495 mm., width .396 mm., thickness .189 mm. (8246-a)

Length .528 mm., width .429 mm., thickness .231 mm. (8246-b)

Length .429 mm., width .363 mm., thickness .214 mm. (8246-c)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8246a-c.

Locality.—Station M-586.

Cibicides perlucidus Nuttall

Plate 6, figures 6a, b, 7a, b, c

Cibicides perlucida NUTTALL, Journ. Pal., vol. 6, 1932, p. 33, pl. 8, figs. 10-12.

Cibicides perlucidus TODD and KNIKER, Cushman Fnd. Foram. Res. Spec. Publ. No. 1, 1952, p. 27, pl. 4, figs. 40a-c.

Specimens of this species are usually well preserved but vary in size, and most are smaller than the fig-

EXPLANATION OF PLATE 6

FIGS.		PAGE
1.	*Cibicides americanus* (Cushman). × 42. a, ventral view; b, apertural view; c, dorsal view. Loc. M-588.	31
2.	*Cibicides grimsdalei* Nuttall. × 38. a, ventral view; b, dorsal view; c, apertural view. Loc. M-586.	31
3, 4, 5.	*Cibicides mauricensis* Howe and Roberts. 3, × 38, a, ventral view; b, apertural view; c, dorsal view. 4, × 35, a ventral view; b, dorsal view. 5, × 40, a, ventral view; b, apertural view; c, dorsal view. Loc. M-586.	31
6, 7.	*Cibicides perlucidus* Nuttall. 6, × 38, a ventral view; b, dorsal view. 7, × 25, a ventral view; b, apertural view; c, dorsal view. Loc. M-586.	31
8.	*Cibicides venezuelanus* Nuttall. × 45. a, ventral view; b, apertural view; c, dorsal view. Loc. M-593.	32
9.	*Cibicides* sp. A × 33. a, ventral view; b, apertural view; c, dorsal view. Loc. M-586.	32
10.	*Cibicides* sp. B × 26. a, ventral view; b, apertural view; c, dorsal view. Loc. M-586.	32
11.	*Cibicides* sp. C × 55. a, ventral view; b, dorsal view. Loc. M-592.	32

ured form. They occur in many Woodside assemblages.

Cibicides perlucidus has been recorded from numerous localities in Cuba, Mexico, West Indies, South America, and the United States. Most occurrences are, however, in strata of Oligocene or Miocene age.

The type was described from the Lower Oligocene Alazan shale of Mexico.

Length .495 mm., width .462 mm., thickness .264 mm. (8247-a)

Length .825 mm., width .759 mm., thickness .429 mm. (8247-b)

Hypotypes.—Stanford Univ. Paleo. Type Coll. No. 8247a, b.

Locality.—Station M-586.

Cibicides venezuelanus Nuttall

Plate 6, figures 8a, b, c

Cibicides venezuelana NUTTALL, Journ. Pal., vol. 9, 1935, p. 131, pl. 15, figs. 25-27.

Cibicides venezuelanus CUSHMAN and SIEGFUS, Contr. Cushman Lab. Foram. Res., vol. 15, 1939, pp. 32-33, pl. 7, figs. 4a-c.—BERMUDEZ, Cushman Lab. Foram. Res., Spec. Publ. No. 25, 1949, p. 308, pl. 26, figs. 19-21.

This coarsely perforate species, described from the Upper Eocene Pauji shale of Venezuela and recorded from the Kreyenhagen shale of California, the Eocene of Cuba, and the Middle Oligocene of the Dominican Republic, is of very rare occurrence.

Length .396 mm., width .33 mm., thickness .198 mm.

Hypotype.—Stanford Univ. Paleo. Type Coll. No. 8248.

Locality.—Station M-593.

Cibicides sp. A

Plate 6, figures 9a, b, c

There are a few specimens at numerous localities which, except for apertural differences, appear to resemble *Eponides* cf. *E. patelliformis* Stadnichenko from the Kreyenhagen shale of California (Cushman and Siegfus, 1942, p. 419, pl. 17, figs. 33a, b). The Woodside fossils possess a short apertural slit which crosses the peripheral edge at about equal distances on both the ventral and dorsal sides, whereas the aperture of the Kreyenhagen form is unobservable (or at least not indicated in its figure) due to a broken last-formed chamber.

Stadnichenko's species, described from the Yegua formation of Texas (Stadnichenko, 1927, p. 232, pl. 38, figs. 6-8), has an elongate aperture between the periphery and the open umbilical area, thus differing in these characteristics from our specimens and possibly from the Kreyenhagen form as well.

Length .33 mm., width .363 mm., thickness .231 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8249.

Locality.—Station M-586.

Cibicides sp. B

Plate 6, figures 10a, b, c

Rare specimens at several localities appear to be related to forms compared to *Cibicides pseudoungerianus* (Cushman) by Todd and Kniker (1952, p. 28, pl. 4, figs. 36a-c) from the Eocene Agua Fresca shale of Chile.

The Woodside fossils are biconvex, consist of 9-11 chambers in the last-formed whorl, have a slight lobulate periphery in the final half of the test, and possess on the dorsal side a thin layer of clear shell material which covers earlier-formed whorls. Comparison with the type figure of Cushman's species (*Truncatulina pseudoungeriana*) from the Oligocene Byram marl of Mississippi (Cooke and Cushman, 1922, p. 97, pl. 20, fig. 9) show they are dissimilar.

Length .61 mm., width .544 mm., thickness .297 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8250.

Locality.—Station M-586.

Cibicides sp. C

Plate 6, figures 11a, b

Small, convex, poorly preserved specimens with 10-12 chambers in the last-formed whorl are not specifically identified. They are rare and nearly all specimens have the final chamber broken.

Cibicides sp. *C.* resembles the figures of *Cibicides martinezensis* Cushman and Barksdale (1930, p. 68, pl. 12, figs. 9a-c) from Eocene beds at Martinez, California; however, comparison with the type of this latter species indicates they are dissimilar.

Length of broken specimen .217 mm., width .264 mm., thickness .132 mm.

Depository.—Stanford Univ. Paleo. Type Coll. No. 8251.

Locality.—Station M-592.

CHECK LIST OF EOCENE FORAMINIFERA WOODSIDE AREA, SAN MATEO CO., CALIFORNIA

Families and Species	Stations*							
	1	2	3	4	5	6	7	8
	M-586	M-587	M-588	M-589	M-590	M-591	M-592	M-593
ASTRORHIZIDAE								
1. ?*Astrorhiza* sp.	x			x				
RHIZAMMINIDAE								
2. *Bathysiphon eocenicus* Cushman and G. D. Hanna	x	x	x		x	x	x	
3. ?*Bathysiphon* sp.	x					x	x	
AMMODISCIDAE								
4. *Ammodiscus glabratus* Cushman and Jarvis	x		x		x			x
5. *Glomospira charoides* (Jones and Parker)	x		x					x
LITUOLIDAE								
6. *Ammobaculites cubensis* Cushman and Bermudez	x							
7. *Cyclammina simiensis* Cushman and McMasters	x	x	x		x		x	x
8. *Haplophragmoides* sp.	x	x						
9. ?*Trochamminoides* sp. A	x							
10. ?*Trochamminoides* sp. B	x							
TEXTULARIIDAE								
11. *Spiroplectammina adamsi* Lalicker	x			x				
12. *Spiroplectammina* sp.	x	x					x	
13. *Textularia* sp.		x						
14. *Vulvulina curta* Cushman and Siegfus	x				x	x		
VERNEULINIDAE								
15. *Clavulinoides* sp.					x		x	
16. *Gaudryina brunswickensis* Todd and Kniker					x	x		x
MILIOLIDAE								
17. *Quinqueloculina* sp.								x
18. *Spiroloculina* sp.								x
VALVULINIDAE								
19. *Dorothia asiphonia* (Andreae)	x	x	x				x	x
20. *Dorothia principensis* Cushman and Bermudez	x				x			
21. *Karreriella chilostoma* (Reuss)	x	x			x	x		x
22. *Marssonella oxycona* (Reuss)	x	x						
23. *Plectina garzaensis* Cushman and Siegfus	x		x	x				
24. *Tritaxilina colei* Cushman and Siegfus	x	x		x	x	x		
SILICINIDAE								
25. *Silicosigmoilina californica* Cushman and Church	x	x	x		x	x		x
TROCHAMMINIDAE								
26. ?*Trochammina* sp.	x		x	x	x		x	
LAGENIDAE								
27. *Astacolus* sp.	x				x	x		
28. ?*Chrysalogonium granti* (Plummer)					x			
29. *Dentalina* cf. *D. communis* (Orbigny)	x				x	x		
30. *Dentalina* cf. *D. consobrina* Orbigny	x							
31. ?*Dentalina globulicauda* Gümbel	x	x	x		x	x	x	x
32. *Dentalina havanensis* Cushman and Bermudez								x
33. *Dentalina mucronata* Neugeboren					x			x
34. *Dentalina* cf. *D. soluta* Reuss		x						
35. *Dentalina* cf. *D. wilcoxensis* Cushman	x							
36. *Dentalina* sp. A	x		x					

37. *Dentalina* sp. B	x							
38. *Dentalina* sp. C								x
39. *Dentalina* sp. D								x
40. *Dentalina* sp. E	x							
41. *Dentalina* sp. F	x							
42. *Lagena costata* (Williamson)						x	x	
43. *Lagena substriata* Williamson								x
44. *Lagena* sp.	x							
45. *Marginulina* cf. *M. eximia* Neugeboren	x			x				
46. *Marginulina subbullata* Hantken	x	x	x		x			
47. *Marginulina tumida* Reuss				x				
48. *Marginulina* sp.								x
49. ?*Marginulina* sp.	x							
50. ?*Marginulinopsis* sp.	x							
51. *Nodosaria* cf. *N. approximata* Reuss								x
52. *Nodosaria boffalorae* Martinotti			x					
53. *Nodosaria clavaeformis* Neugeboren	x							
54. *Nodosaria latejugata* Gümbel					x			
55. *Nodosaria longiscata* Orbigny		x				x	x	
56. *Nodosaria* cf. *N. velascoensis* Cushman	x				x			x
57. *Pseudoglandulina* sp.	x							
58. *Robulus arcuato-striatus* (Hantken) var. *carolinianus* Cushman	x							x
59. *Robulus inornatus* (Orbigny)								x
61. *Robulus* sp. B	x	x	x					
62. *Vaginulinopsis asperuliformis* (Nuttall)	x	x						x
POLYMORPHINIDAE								
60. *Robulus* sp. A	x	x	x	x	x	x	x	x
63. *Globulina* sp.	x							
64. *Pyrulina* sp.	x							
65. *Ramulina* cf. *R. globulifera* H. B. Brady						x		
NONIONIDAE								
66. *Nonion havanense* Cushman and Bermudez	x					x		
67. *Nonion micrus* Cole				x	x			
68. *Nonion* sp.		x					x	
HETEROHELICIDAE								
69. *Amphimorphina ignota* Cushman and Siegfus	x	x	x				x	x
70. *Amphimorphina* sp.			x					
71. *Aragonia aragonensis* (Nuttall)	x		x				x	x
72. *Aragonia capdevilensis* (Cushman and Bermudez)	x						x	x
73. *Plectofrondicularia palmerae* Cushman and Bermudez	x		x					
BULIMINIDAE								
74. *Angulogerina* sp.							x	
75. *Bulimina corrugata* Cushman and Siegfus		x		x				
76. *Bulimina* cf. *B. guayabalensis* Cole	x				x	x		
77. *Bulimina semicostata* Nuttall	x		x		x	x		x
78. *Bulimina serratospina* Finlay	x	x			x		x	
79. *Bulimina* sp.		x						
80. *Buliminella grata* Parker and Bermudez	x							
81. *Fissurina marginata* (Walker and Boys)	x				x	x		x
82. *Fissurina* cf. *F. orbignyana* Seguenza					x	x		x
83. *Loxostomum* sp.						x		
84. *Siphonodosaria* cf. *S. cocoaensis* (Cushman)	x		x					
85. *Siphonodosaria gracilis* (Palmer and Bermudez)	x				x	x	x	x
86. *Siphonodosaria* cf. *S. pauperata* (Orbigny)	x							
87. *Siphonodosaria* sp.							x	
88. ?*Silphonodosaria* sp.	x					x		
89. *Uvigerina garzaensis* Cushman and Siegfus		x						

90. *Uvigerina* sp.		x						
91. *Virgulina* cf. *V. danvillensis* Howe and Wallace								x
92. *Virgulina* sp. A								x
93. *Virgulina* sp. B								x
ELLIPSOIDINIDAE								
94. *Ellipsoglandulina* cf. *E. labiata* (Schwager)	x	x	x		x	x		x
95. *Ellipsoglandulina multicostata* (Galloway and Morrey)	x							
96. *Ellipsoglandulina* sp. A					x			
97. *Ellipsoglandulina* sp. B	x							
98. *Ellipsoidella* sp.								x
99. *Nodosarella advena* Cushman and Siegfus	x		x		x	x		
100. *Nodosarella* sp.	x							
101. *Pleurostomella* cf. *P. elliptica* Galloway and Heminway	x		x					
102. *Pleurostomella nuttalli* Cushman and Siegfus	x	x			x	x		x
103. *Pleurostomella* sp.								x
ROTALIIDAE								
104. *Cancris* cf. *C. cocoaensis* Cushman		x						
105. *Eponides umbonatus* (Reuss)	x		x		x	x	x	x
106. *Gyroidina orbicularis* Orbigny								x
107. *Gyroidina* sp.							x	
108. *Gyroidinoides soldanii* (Orbigny)	x	x			x	x	x	x
109. *Nuttallides trümpyi* (Nuttall)	x	x			x	x	x	
110. *Osangularia mexicana* (Cole)		x	x		x			x
CASSIDULINIDAE								
111. *Alabamina atlantisae* (Cushman) var. *dissonata* (Cushman and Renz)		x					x	
112. *Cassidulina globosa* Hantken	x	x			x			
CHILOSTOMELLIDAE								
113. *Chilostomelloides cyclostoma* (Rzehak)								x
114. *Pullenia eocenica* Cushman and Siegfus	x	x			x	x		
115. *Pullenia quinqueloba* (Reuss) var. *angusta* Cushman and Todd		x	x				x	
116. *Quadrimorphina advena* (Cushman and Siegfus)		x			x			
GLOBIGERINIDAE								
117. *Globigerina bulloides* Orbigny				x				x
118. *Globigerina nitida* Martin				x	x			
119. *Globigerina pseudo-bulloides* Plummer					x	x		
120. *Globigerina triloculinoides* Plummer	x	x	x		x		x	x
121. *Hastigerinella eocanica* Nuttall	x							
GLOBOROTALIIDAE								
122. *Globorotalia crassata* (Cushman)	x		x	x				
123. *Globorotalia crassata* (Cushman) var. *aequa* Cushman and Renz			x					
124. *Globorotalia membranacea* (Ehrenberg)	x			x	x		x	
125. *Globorotalia* cf. *G. naussi* Martin	x		x				x	
126. *Globorotalia velascoensis* (Cushman) var. *acuta* Toulmin	x		x	x			x	x
ANOMALINIDAE								
127. *Anomalina crassisepta* Cushman and Siegfus	x	x	x					x
128. *Anomalina dorri* Cole var. *aragonensis* Nuttall			x		x	x		x
129. *Anomalina garzaensis* Cushman and Siegfus			x	x	x	x	x	x
130. *Anomalina grosserugosa* (Gümbel)	x							
131. *Cibicides americanus* (Cushman)			x					
132. *Cibicides grimsdalei* Nuttall	x	x			x		x	
133. *Cibicides mauricensis* Howe and Roberts	x	x	x		x			
134. *Cibicides perlucidus* Nuttall	x	x			x	x		x
135. *Cibicides venezuelanus* Nuttall		x						
136. *Cibicides* sp. A	x	x			x	x	x	x
137. *Cibicides* sp. B	x				x	x		
138. *Cibicides* sp. C		x					x	

* Stratigraphic sequence of stations not known due to structural complications

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124. RECENT FORAMINIFERA FROM SHORE SANDS AT QUEQUÉN, PROVINCE OF BUENOS AIRES, AND CHANGES IN THE FORAMINIFERAL FAUNA TO THE NORTH AND SOUTH

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This paper is the result of an investigation of twenty-five samples of beach sands taken along 30 Km. of the coast between Punta Negra and Punta Carballida, in the vicinity of Quequén harbor. Samples were floated with carbon tetrachloride, but, due to thick walls, some forms were too heavy to float, and it was necessary to examine the original samples under the microscope. Nineteen of the samples were barren or had rare foraminiferal tests. The other six samples were relatively rich in foraminifera, containing 38 species, the relative abundance of which was readily seen in the samples themslves. Although the study is limited to a few samples from a small area, it is felt that its results will be of some interest since this section of the coast has not been previously studied as to its foraminiferal fauna. Sven Ekman in "Zoogeography of the Sea," 1953, states that "the region between Patagonia and Rio de Janeiro is one of the world's least known regions as far as the coastal fauna is concerned."

Cordial thanks are due M. Teruggi and J. Remire for the samples which they placed at my disposal.

The most common forms of this fauna are: *Quinqueloculina seminulum* (Linné), *Rotalia beccarii beccarii* (Linné), *Buccella depressa* Andersen,* *Textularia gramen* Orbigny, *Quinqueloculina intricata* Terquem, and *Elphidium discoidale* Orbigny. While there is nothing noteworthy about the first three, the last three show some interesting features.

Textularia gramen is the most abundant species; among many typical specimens are others varying considerably in form. Some are very short with the last chambers far broader than is normal for the species, while others are oblong with nearly parallel peripheral margins, but these variants are normal otherwise and there is no doubt about their belonging to a single species.

More important morphologic changes are shown by *Quinqueloculina intricata.* Terquem (1873, p. 73) noted and figured its great variability. Our specimens show considerable variations in the shape of their chambers. Along with typical individuals like those of the first illustration of Terquem (1878, pl. 13, fig. 16) of a normal specimen, there are many individuals with chambers far more convex, larger and truncate. This last characteristic is often combined with a reduction or even a complete lack of ornamentation. Many specimens look like *Q. italica,* described by Terquem in the same work. Neck and tooth are found in all individuals but these vary. Retarded specimens with only two chambers, representing the juvenile stage, often attain the size of the normal adult. There is intergradation between all variants.

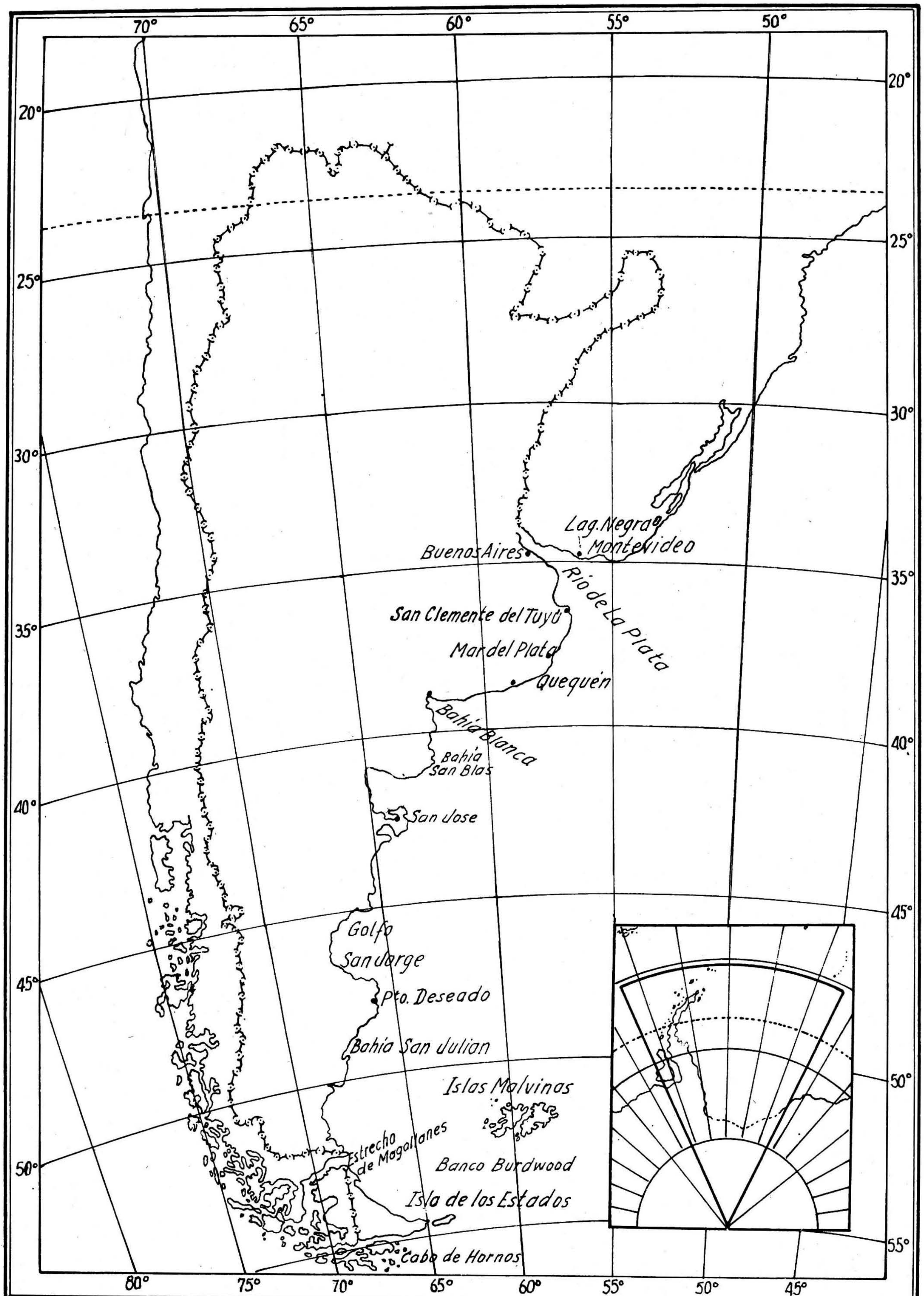
Elphidium discoidale specimens are not wholly typical. In many, the umbilical area is not convex, but flat and occasionally even slightly depressed, while the periphery is too rounded. Sutures too are sometimes depressed, an atypical feature, thus approaching *E. poeyanum.* With topotypes of these two forms from Cuba and abundant material from several places on the continental shelf, it was possible to make comparisons and determine that this is a somewhat aberrant *E. discoidale.* There are still greater variations in this species south of Quequén harbor. Its southern limit of occurrence seems to be about the southern part of the Gulf of San Jorge.

Slightly less common are *Quinqueloculina lamarckiana* Orbigny, *Q. angulata* (Williamson), *Triloculina subrotunda* (Montagu), *T. gibba* Orbigny, *Pyrgo patagonica* Orbigny, *P. nasuta* Cushman, and *Spiroloculina planulata* (Lamarck). Of these, *Quinqueloculina lamarckiana* is somewhat atypical, its peripheral margin not being as sharp as the type, and *Pyrgo nasuta* varies from the type in the absence of a well developed neck and in the rounded outline of the test.

In still fewer numbers are *Massilina secans* Orbigny, *Quinqueloculina patagonica* Orbigny, *Miliammina agglutinata* (Cushman), *M.* sp. cf. *M. frigida* (Parker), *M. horrida* (Cushman ?), and *Cibicides* sp. cf. *C. mckannai* (Galloway and Wissler).

Lack of material for comparison and the poor state of preservation of the specimen makes the determination of *M. horrida* doubtful. *M.* sp. cf. *M. frigida* dif-

* In the manuscript submitted by the author "**Eponides frigidus** (Cushman)" was used for one of the species mentioned. To conform to recent usage, this was changed to "**Buccella depressa** Andersen" (Jour. Wash. Acad. Sci., Vol. 42, No. 5, 1952). After the manuscript had been sent to the printer a letter was received from the author requesting that the specific name "**frigida**" be restored in his paper since "**depressa**" fell well within the limits of the variable species "**frigida**" found on the Argentine continental shelf, and was therefore a synonym of the latter. Ed.



TEXT FIGURE 1. ARGENTINA: LOCALITY MAP

fers from typical *M. frigida* in having less distinctly salient chambers and a slightly different cement. It should be noted that the cement of *M. agglutinata* was gray, not yellowish. There seems to be a general lack of iron-containing cement in the whole region, as all specimens of *Ammodiscus incertus* found near Montevideo were gray instead of yellowish. Heron-Allen and Earland (1932, p. 342) also found gray *A. incertus* on the shelf, although the typical color of this species is yellowish.

Cibicides sp. cf. *C. mckannai* differs from *C. mckannai* in a lack of convexity, in a smaller number of chambers, and in having slightly different sutures. This species is widespread in San Blás Bay. Lacking comparative material, it is not possible to state whether or not it is a new species.

Rare or single specimens were found of *Pyrgo oeensis* (Martinotti), *Triloculina cultrata* (Brady), *Trochammina* sp. indet., *Lagena aspera* (Reuss), *Oolina caudigera* (Wiesner), *Fissurina lucida* (Williamson), *Guttulina problema* Orbigny, *Globulina australis* Orbigny, *Elphidium excavatum* (Terquem), *E. advenum depressulum* Cushman, *E.* sp. "A," *Notorotalia clathrata* (Brady), *Bulimina marginata* Orbigny, *B. elongata* Orbigny, *B. patagonica* Orbigny, *Buliminella elegantissima* (Orbigny), *Discorbis nitidus* (Williamson), *Discorbis floridanus* Cushman, *Cibicides refulgens* Montfort.

Of this last group, *Pyrgo oeensis* has not been reported previously from the Atlantic so far as is known. *Globulina australis* had been found by the writer previously in material from San Blás Bay, d'Orbigny's type locality. The considerable number of specimens available permitted definite identification of this species. The work of Cushman and Ozawa (1930) unfortunately has left an erroneous impression in the literature concerning this species. As stated by d'Orbigny, it has but three chambers at most as shown in his illustration. An unimportant difference is that d'Orbigny's illustration shows the costae a little too clearly. There is a remarkably high percentage of undeveloped (retarded) specimens as in the case of *Quinqueloculina intricata* mentioned above.

Elphidium sp. *"A"* seems to be new but the few specimens found are insufficient to be sure of this. Finding *Notorotalia clathrata* in Quequén Bay is interesting since it throws some doubt on the assertion of Heron-Allen and Earland (1932) that this species travelled from the Pacific to the Atlantic via Cape Horn instead of through the Strait of Magellan, as they had not found it north of the Strait.

Discorbis nitidus also is not represented by typical specimens, as some, not all, have a more or less well developed boss on the ventral side, with transition forms to *D. praegeri* of Heron-Allen and Earland, which these authors probably erroneously separated from *D. nitidus* in 1913 on account of this boss.

A comparison of this foraminiferal fauna with that of the area to the south (Gulf of San Jorge, San Blás Bay, etc.) indicates that:

a) In spite of the fact that some new species appear at Quequén (*Textularia gramen, Massilina secans, Triloculina gibba, Spiroloculina planulata, Miliammina agglutinata, M.* sp. cf. *M. frigida, Fissurina lucida, Elphidium* sp. "A") and a few others (as *Quinqueloculina intricata*) are present in greater number, the general faunal pictures are similar and are fairly typical of the foraminiferal fauna of the whole northern part of the Patagonian shelf.

b) Many species, as *Elphidium discoidale, Quinqueloculina intricata, Q. angulata, Triloculina subrotunda, Buccella depressa, Rotalia beccarii beccarii,* etc., increase considerably in size to the north. This is remarkable since some data indicate that the size of foraminiferal tests generally diminishes from south to north. Up to the present, however, the minimum size has been found between Bahia Blanca and San Blás, where specimens of nearly all species are exceptionally small. It is believed that this is due to poor food conditions. In a paper now in press, the writer discusses more fully the importance of food for the development of tests of foraminifera. It is not clear just why food conditions should be better in the Quequén area than farther south; it may be due to the mixing of waters from the meeting of north and south currents.

Comparing the Quequén fauna with that of the mouth of the Rio de La Plata between San Clemente del Tuyu and the shelf between Montevideo and Laguna Negra, the latter does not differ materially from that already described. In both faunas *Buccella depressa* and *Elphidium discoidale* predominate. Many species are common to both such as *Textularia gramen, Quinqueloculina lamarckiana, Miliammina agglutinata M.* sp. cf. *M. frigida, Massilina secans, Spiroloculina planulata, Triloculina subrotunda, Pyrgo patagonica, Globulina australis, Elphidium advenum depressulum, Buliminella elegantissima* and others.

Some new forms, however, not met with farther south, appear in the La Plata mouth area: *Elphidium sagrai* (Orbigny) (very small and atypical specimens), *Rotalia beccarii parkinsoniana* and others, the latter subspecies replacing *Rotalia beccarii beccarii* found at Quequén.

There is little data on the foraminiferal fauna north of the mouth of the Rio de La Plata; even this scanty information suggests that the coastal foraminifera change slowly and gradually to the north. In 1931, Cushman and Parker published a list of foraminifera for Rio de Janeiro Bay and, in 1952, Carvalho and Chermont listed 27 species for the coast of the State of Sao Paulo. Such typical Patagonian forms as *Buccella depressa* are no longer found, but many species are common to the Brazilian coast south of Rio de Janeiro and to the La Plata mouth, Quequén, San

Blás Bay, Gulf of San Jorge and even as far south as San Julian.

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EXPLANATION OF PLATE 7

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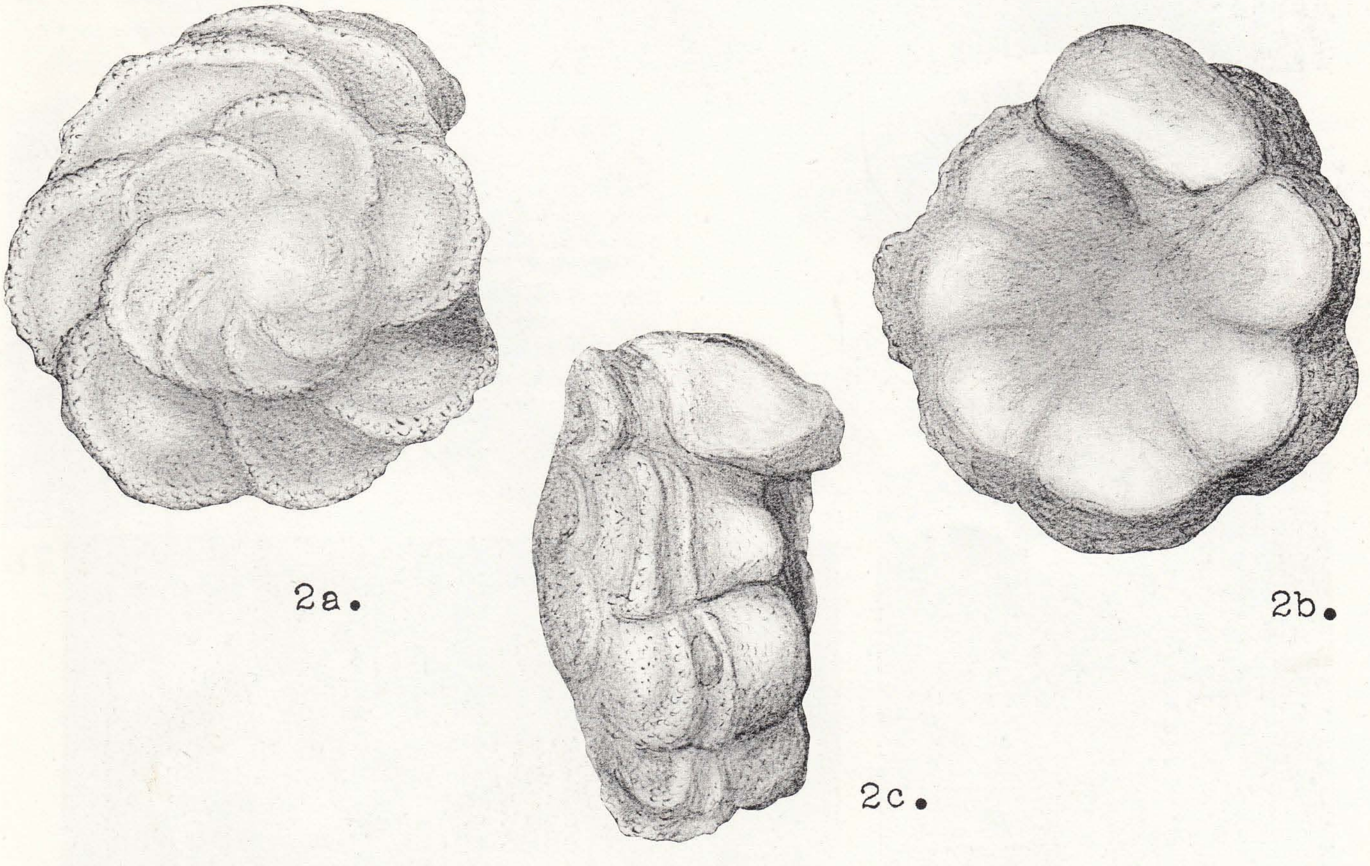
1.	Boltovskoy: Foraminiferal Assemblage, Beach near Port of Quequén, Argentina.	39
2.	*Globotruncana lobata* Klasz, n. sp. × 75. a, dorsal view; b, ventral view; c, edge view.	43

(Camera lucida drawings by Helen Tappan Loeblich.)

1.



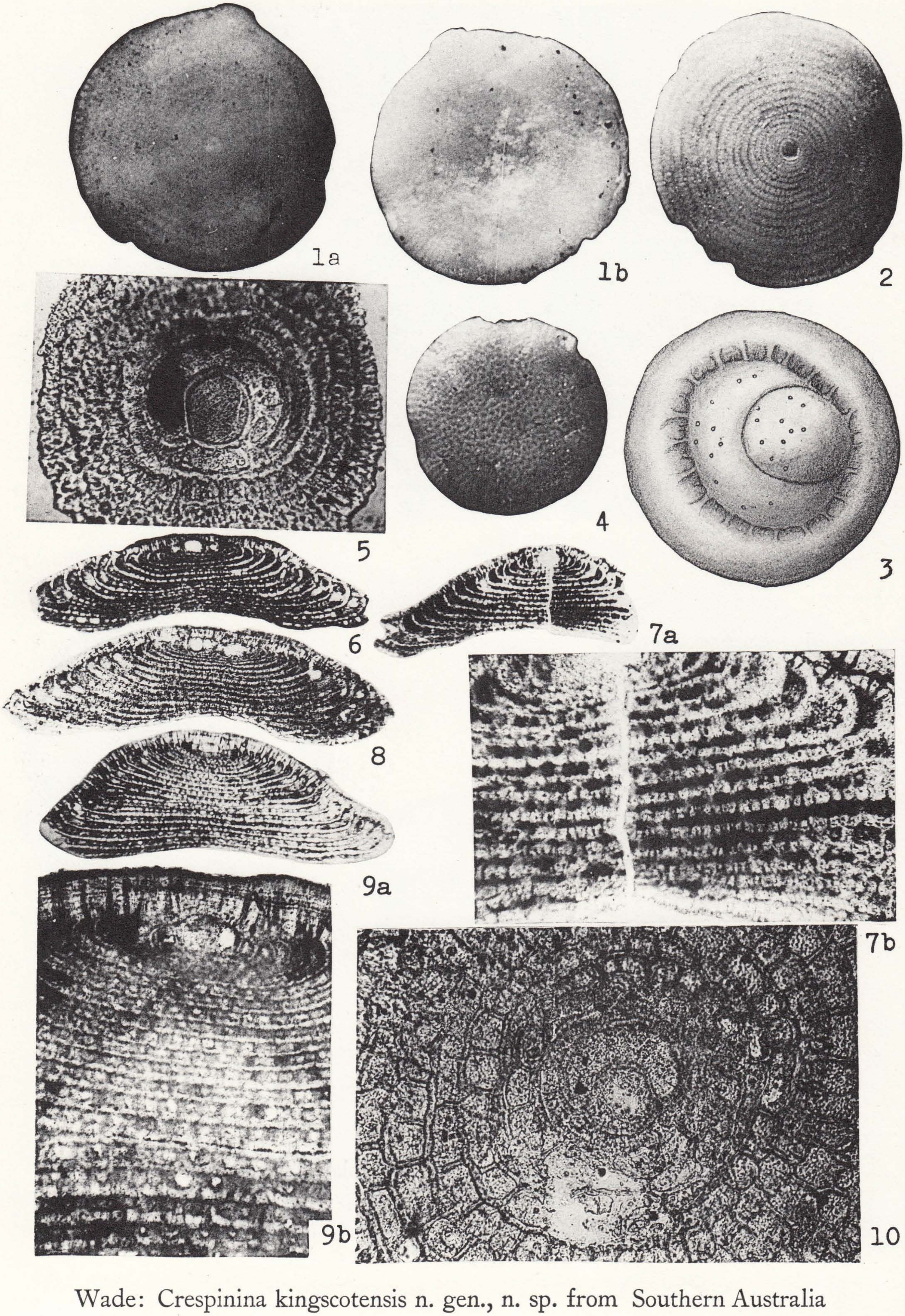
2a.

2b.

2c.

Fig. 1: Boltovskoy: Foraminiferal Assemblage, Beach near Port of Quequén, Argentina

Fig. 2: De Klasz: Globotruncana lobata n. sp., Upper Cretaceous, Bavarian Alps



Wade: Crespinina kingscotensis n. gen., n. sp. from Southern Australia

CONTRIBUTIONS FROM THE CUSHMAN FOUNDATION
FOR FORAMINIFERAL RESEARCH
VOLUME VI, PART 1, JANUARY, 1955

125. A NEW *GLOBOTRUNCANA* FROM THE BAVARIAN ALPS AND NORTH AFRICA

I. DE KLASZ

The species of *Globotruncana* which is described below, was found for the first time in the Upper Cretaceous of the Bavarian Alps near Eisenärzt in the South of Traunstein, Upper Bavaria. It occurs in the Upper Campanian portion of a shale-complex, for which in a former publication (de Klasz, 1953, p. 224) the name "Buchecker Layers" was proposed. The portion of these layers, in which the new species of *Globotruncana* occurs, is composed of rather hard, greenish- or bluish-grey, mostly fissile shales, containing a rich microfauna of pelagic character.

Family GLOBOROTALIDAE
Genus **Globotruncana** Cushman
Globotruncana lobata Klasz, n. sp.
Plate 7, figures 2a-c

Derivation.—From *lobatus* (lat.) = lobate.

Diagnosis and Description.—A double-keeled *Globotruncana* with the following peculiarities: Dorsal side almost completely flattened, with only a slight central elevation, umbilical side strongly convex. The periphery of the test is lobate. On the dorsal side there are in general three whorls visible, the chambers of the innermost whorl appearing indistinct. The sutures of the dorsal side are strongly curved opposite to the direction of coiling. The number of the chambers in the last formed whorl is 7 to 9; on the umbilical side they are very slightly overlapping, their sutures slightly curved. The sutures of the central whorls of the dorsal side and on some specimens those of the first 3 or 4 chambers of the last formed whorl on the umbilical side are beaded. These last mentioned 3 or 4 chambers on most specimens show small, irregular rugosities; on some specimens the 3 or 4 last formed chambers of the test tend to drop below the normal plane of the dorsal side, in such a manner, that their upper side is lower than that of the other chambers. Because of the high number of chambers and the relatively high test the species appears robust.

Greatest diameter of the holotype, 0.76 mm.; least diameter, 0.67 mm.; greatest thickness 0.40 mm.

Type Locality.—Small creek 5 meters SE of the bridge, 175 meters SSE of Schöneck, NE Eisenärzt, Upper Bavaria.

Type Stratum.—Higher Buchecker layers (upper part of the Upper Campanian).

Geologic Range.—Upper Campanian to ? Lowermost Maestrichtian.

Depository of Types.—Holotype and paratypes in the U. S. National Museum, Washington, D. C.

Relationships.—Presumably *Globotruncana lobata*

EXPLANATION OF PLATE 8

FIGS.		PAGE
1.	*Crespinina kingscotensis* sp. nov., holotype, F15056. (a) dorsal view showing the proto- and deuteroconch (whitish) through the thickening of the test wall, and the sutures of the last few chambers. (b) ventral view showing central depression and some of the marginal partitions. × 30.	46
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3.	Paratype, F15062, ventral view of a nepionic specimen showing the perforations in the ventral side of the proto- and deuteroconch, and the large pores in the base of the third chamber. Some of the divisions between the smaller dorsal pores show through the ventral pores. × 300.	46
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evolved from *G. lapparenti* Brotzen var. *tricarinata* (Quereau).

Remarks.—In the Buchecker Layers near Eisenärzt this very characteristic species is associated with *Pseudoclavulina eggeri* Cushman, *Rzehakina epigona* (Rzehak), *Quinqueloculina antiqua* Franke var. *angusta* Franke, *Bolivinoides decorata decorata* (Jones), *B. decorata* (Jones), var. *delicatula* Cushman, *B. draco* (Marsson) subsp. *miliaris* Hiltermann and Koch, *Bolivinitella eleyi* Cushman, *Pseudotextularia elegans* Rzehak, *Ventilabrella sp.*, *Reussella szajnochae* Grzybowski, *Bolivina incrassata* Reuss, *Globotruncana stuarti* Lapparent, *G. tricarinata* (Quereau), *G.* sp. aff. *G. fornicata* Plummer, *Dictyomitra* sp. cf. *D. multicostata* Zittel (Radiolaria) and others. This new species was found also in a sample from the Upper Cretaceous of Tunisia, in the region of El Alia, near Bizerte (probably late Campanian).

Acknowledgments.—I am grateful to R. Dehm, Munich, for the material from the Cretaceous of Tunisia, and H. Bolli, Pointe-à-Pierre, Trinidad, for advice and information concerning the genus *Globotruncana.*

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126. A NEW GENUS OF THE CHAPMANININAE FROM SOUTHERN AUSTRALIA

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ABSTRACT—The new genus and species, described below, has a wide geographical distribution in southern Australia, with a restricted stratigraphical range in the early Tertiary. Its morphology is described in detail, and its taxonomic position shown to be among the Chapmanininae.

INTRODUCTION

During examination of Tertiary sediments from Kingscote, Kangaroo Island, South Australia, comparatively large foraminiferal tests with complex structures were found to occur commonly in a very richly bryozoal limestone. They had not been previously described. Comparison with samples from other areas showed that the new form described below occurs in smaller numbers at several localities of Eocene age in South Australia. A search was made of the faunal slides of the Parr Collection (National Museum of Victoria). It was found that the new genus also occurs frequently in the Castle Cove limestone west of Cape Otway, and rarely elsewhere, in beds immediately overlying known Eocene strata with *Hantkenina.*

In view of the wide geographical and restricted stratigraphical distribution of this easily recognised form, it was considered desirable to describe it, and to investigate its taxonomic position. A thorough investigation of its internal structures was made by means of about thirty-five thin sections in horizontal and vertical planes, and examination of broken and juvenile specimens. A study of the available literature showed it to be most closely related to the Chapmanininae which were so clearly described by Frizzell (1949). All the specimens obtained (about 200) belong to one species, but the differences between it and the other members of the Chapmanininae are sufficient to establish its generic distinction.

DEPOSITORY OF TYPES

All numbered specimens are deposited in the Palaeontological Collection of the University of Adelaide, South Australia.

ACKNOWLEDGMENTS

This work was made possible by a grant from the General Research Funds of the University of Adelaide. Samples from borings at Moorlands and Willunga we:e provided by the South Australian Mines Department. Thanks are due to M. F. Glaessner for advice and constructive criticism at all stages of the work, to W. R. Riedel for drawing a nepionic specimen, to Miss M. Boyce for help with the diagrams, and to A. N. Carter for the loan of specimens.

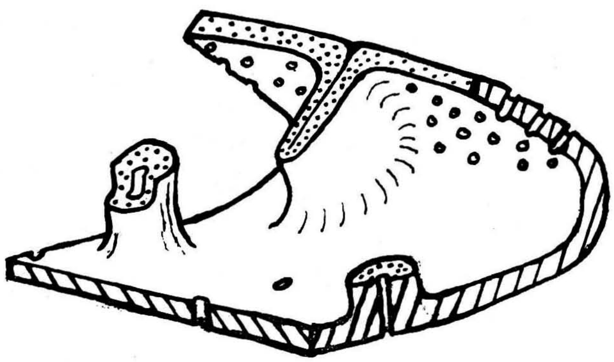
DESCRIPTION OF NEW GENUS AND SPECIES

Crespinina gen. nov.

Genotype: *Crespinina kingscotensis* n. sp.

Test calcareous, perforate, translucent. Its shape is a low cone varying in height, with a flat, convexo-concave, or concave base. In the megalospheric generation the spherical protoconch is followed by a U-shaped deuteroconch, and one or more annular chambers each extending further beneath the ventral sides of the proto- and deuteroconch, until saucer-shaped adult chambers are formed. The last chambers may again be annular. The microspheric generation has a planispiral juvenile stage, during which the neanic chambers increase rapidly in length and embrace the nepionic chambers. All chambers are visible from the dorsal side which is perforate, while the ventral side is partly imperforate. The adult chambers are subdivided marginally by imperforate radial partitions and centrally contain perforate pillars, neither of which are continuous from chamber to chamber, but end against the ventral wall of the preceding chamber. Connection between the chambers is by means of fine pores through the central part of the otherwise imperforate ventral wall; some of these pores open directly into the chamber, others penetrate the length of the pillars before they open into the chamber immediately below the ventral wall of the preceding chamber. As each new chamber is added, a thin, translucent layer of calcareous material, continuous with the dorsal wall of the new chamber, is deposited over the dorsal side of the test.

This genus shows marked structural affinities to the genera of the subfamily Chapmanininae erected by Frizzell (1949) who gives the following diagnosis: "Test calcareous-perforate, small, free, conical, with flat or convex base. Simple forms with test composed of a coarsely perforate wall and an imperforate septum; advanced forms with septum replacing perforate wall, septum sometimes double and with intraseptal spaces. Plan of growth a trochoid spiral, followed by a uniserial series of low chambers extending in the direction of the axis of the trochoid coils; septa of the uniserial chambers invaginating into tubes *(Ferayina),* tubes and annular chamberlets *(Chapmanina)*, or annular and central chamberlets with vestigial tubes *(Preverina)*. Apertures provided by openings of tubes." Although *Crespinina* has a planispiral juvenile stage, it shows the same conical arrangement of low, wide chambers; perforate dorsal walls, and partly imperforate ventral walls equivalent to Frizzell's "septa"; imperforate marginal partitions formed mainly from the ventral walls and perforate pillars formed from the ventral walls (text figure 1). Neither the partitions



TEXT FIGURE 1

Structural diagram of *Crespinina* showing perforated pillars and pores in the otherw se imperforate ventral wall, the perforate dorsal wall, and an imperforate partition apparently formed by an infolding of ventral and dorsal walls.

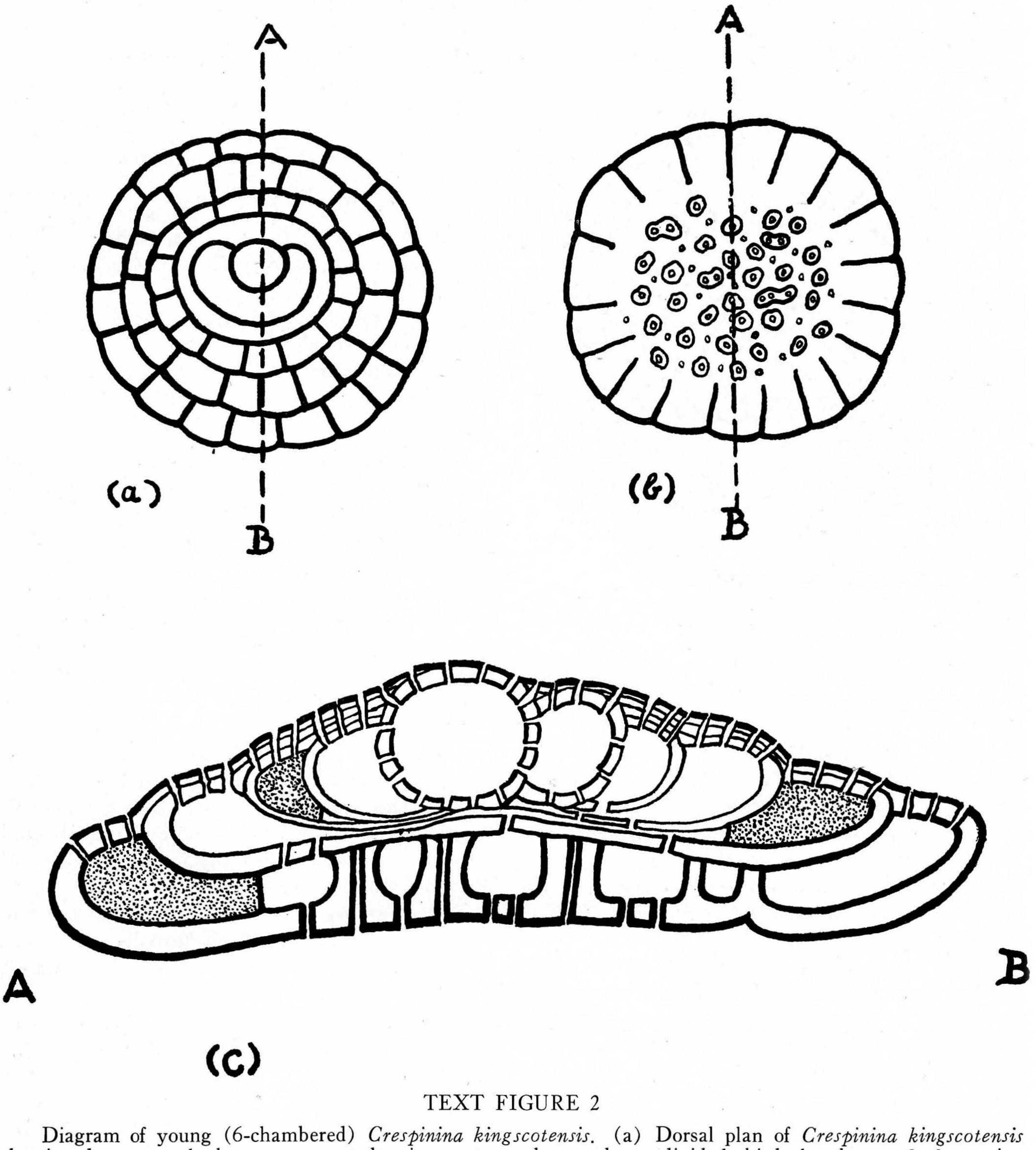
nor the pillars are continuous from chamber to chamber. Later dorsal walls are extended over the earlier part of the dorsal side of the test, and the original perforations are continued through the new material. *Crespinina* differs from all three genera discussed by Frizzell in its greater apical angle. In particular it differs from *Ferayina* in the possession of marginal partitions, and more numerous more finely perforate pillars; and from *Chapmanina* in its single ventral wall, lack of closed marginal chamberlets, possession of marginal partitions, and more numerous finely perforate pillars. Silvestri's figure and description do not allow a conclusive opinion of the internal structures of *"Chapmanina" galea* Silvestri 1929, chosen as type species of *Preverina* by Frizzell, and its supposed "annular and central chamberlets" may prove to be pillars, in which case its relationship to *Ferayina* would be very close; its initial trochospiral part, lack of marginal partitions, relatively few uniserial chambers, and much smaller apical angle are sufficient to differentiate *Preverina* from *Crespinina*. *Crespinina* has a superficial likeness to *Dictyoconoides*, and in the absence of specimens of *Dictyoconoides* was compared with the figures and descriptions given by Davies (1932), Gill (1949) and others. The rotaline early stage, multiple spiral whorls, solid, continuous pillars, and outer layer of chambers which exist in *Dictyoconoides* preclude a close relationship between it and *Crespinina*.

The genus is named in honour of Miss I. Crespin, whose work on Australian foraminifera is well known.

Crespinina kingscotensis sp. nov.
Plate 8, figures 1-10

Test conical, the flatter specimens may be wavy. In specimens of 1 mm. or more in diameter, the apical angle varies from 100° to just over 180° (in one extreme case). The apical angle is measured as the angle at the apex of a cone having the diameter and height of the test. All the numerous chambers are visible from the dorsal side, they are very low and upturned at the outer edge (saucer-shaped); the ventral side of the last chamber forms the base of the test except in the last stages of growth, when the chambers gradually recede from the centre leaving a large, shallow depression. (The upturned margin of each chamber is considered as part of the ventral side since it is continuous with it in structure, as is seen in vertical sections, and imperforate, while the dorsal side—the area enclosed between two sutures—is distinctly perforate). As each chamber is added a continuous layer of translucent calcareous material is deposited over the dorsal side of the test, but the perforations are continued through it and are not obscured. The marginal part of each chamber is subdivided by radial partitions which connect the ventral and dorsal wall and terminate against the ventral wall of the preceding chamber, while the remaining part of the chamber is traversed by pillars which similarly terminate against the ventral wall of the preceding chamber. The central part of the ventral wall is penetrated by pores which may open directly into the chamber, or traverse the length of the pillars and open into the chamber immediately below the ventral wall of the previous chamber. These pores are the only connection between the chambers. The partitions, which are much thinner than the pillars, are imperforate. There is no obvious correlation between the position of partitions and pillars in the same chamber, but usually they alternate with spaces in the chambers above and below (text figure 2). In specimens with long partitions their inner ends are wavy. In cross-section, at magnifications of 100× or more, the partitions can be seen to consist of two layers separated by a dark line which is continuous with the outer surface of the test.

The megalospheric generation is by far the most common. The earliest known stage varies in diameter from about .14 to .24 mm. It consists of a protoconch half to three-quarters embraced by a U-shaped deuteroconch, both entirely perforate, and an annular third chamber which, like all succeeding chambers, is perforate on the dorsal side but not on the ventral side. On the ventral side near its junction with the proto- and deuteroconch, the third chamber has a row of large pores with the wall peaked up between them (pl. 8, fig. 3.); the dorsal side has a similar row of smaller pores, almost twice as numerous. Successive chambers overlap the nepionic chambers more and more on the ventral side, vertical sections show that

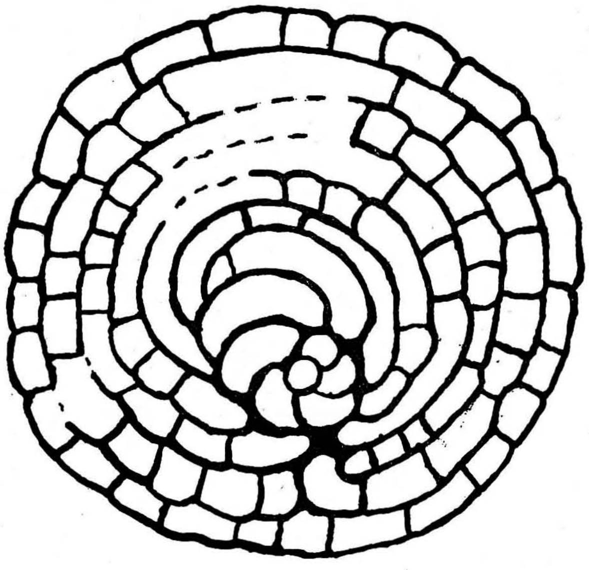


TEXT FIGURE 2

Diagram of young (6-chambered) *Crespinina kingscotensis.* (a) Dorsal plan of *Crespinina kingscotensis* showing deuteroconch three-quarters embracing protoconch, annular undivided third chamber, and alternating partitions in later chambers. (b) Ventral plan showing marginal partitions, perforate pillars, and pores. (c) Vertical section through nepionic chambers showing entirely perforate protoconch and deuteroconch, large pore in base of third chamber, gradual overlap of chambers on the ventral side of the proto- and deuteroconch, and introduction of imperforate marginal partitions, central perforate pillars, pores in the centre of the ventral side, the perforate dorsal side and extensions of the dorsal chamber walls over the dorsal side of the test. AB line of section, (a) and (b) approx. × 120, (c) approx. × 350.

the fourth chamber usually is the first to completely cover them ventrally; the chambers have no tendency to overlap previous chambers on the dorsal side.

Only two microspheric specimens have been obtained. They are very depressed cones, the larger is saddle-shaped, the smaller flat. The dorsal sides are heavily masked by shelly material, which was partly ground away from the smaller specimen to see the early whorls which are planispiral. Eight chambers increasing rapidly in length, of which six make the first whorl, comprise the earliest portion of the test, the next five embrace the early portion more and more, the fourteenth chamber completely enclosing the earlier ones. Marginal partitions begin to appear in the eighth chamber and soon become regular (text figure 3). Grinding the edge of the test to give a vertical section showed the adult stage to be similar in structure to the megalospheric.



TEXT FIGURE 3
Early whorls of *Crespinina kingscotensis* (microspheric form). Diameter of figured part .1 mm.

Type Locality.—Low coastal cliffs at Brownlow Beach, Kingscote, Kangaroo Island, South Australia. Eocene.

Other Occurrences.—1. Willunga, South Australia, South Australian Mines Department bore WB-1, at a depth of 605′-610′ where the next lower sample, 610-′ 618′, contains *Hantkenina alabamensis* Cushman var. *compressa* Parr and in the corresponding basal member of the Blanche Point marls at Blanche Point and Christie's Beach, on the coast of St. Vincent's Gulf, south of Adelaide, Eocene. 2. At Hart's Mine and one mile north of Hart's Mine, Hundred of Muloowurtie, Yorke Peninsula, Eocene. 3. Moorlands, South Australian Mines Department bore KK52 at a depth of 84′-87′, Eocene. This is probably the foraminifer listed by Crespin (1953) as "new genus *aff. Dictyoconoides.*" 4. Castle Cove (slide 14963), and 5. Between the mouths of Johanna River and Brown's Creek (slide 14950); both Victorian occurrences (4 and 5) are in the Castle Cove limestone, it also occurs rarely in the underlying Brown's Creek clays. The specimens were identified in the W. J. Parr Collection (National Museum of Victoria), to which the slide numbers refer. Two further specimens were obtained from clays 40 ft. above the top of the Castle Cove limestone at Castle Cove. Mr. A. N. Carter, who forwarded the specimens, does not consider that this stratigraphic difference is significant. The age of the Victorian occurrences at which the new species is associated with a large number of other Foraminifera is at present under examination. It is believed to be Upper Eocene to Lower Oligocene.

Dimensions.—(in millimeters)

NO.	REMARKS	LOCALITY	DIA.	HGT.
Holotype F15056	sub-conical	Kingscote	1.36	.44
Paratype F15057	small, rather flat	Kingscote	1.08	.33
Paratype F15058	largest, rather flat	Moorlands	2.24	.48
Paratype F15059	conical	Kingscote	1.34	.50
Paratype F15060	microspheric, small, flat	Moorlands	.84	.24
Paratype F15061	microspheric, large, flattened, wavy	Kingscote	1.60	.34
Paratype F15062	juvenile	1 mile N. of Hart's Mine	.15	.07

Some two hundred specimens from various localities were available for study. In those from the four localities where it occurs commonly (Kingscote, Moorlands, Castle Cove, and between the mouths of the Johanna River and Brown's Creek) diameter and height were measured.

The Kingscote and Moorlands samples are of similar mean diameters (1.48 and 1.34 mm. respectively) and the means of the ratio of diameter to height are also similar (3.39 and 3.45), however the Castle Cove and Johanna River-Brown's Creek samples have much smaller mean diameters (.83 and .92 mm.) and the mean of the ratio of diameter to height is less (2.87 for both). This bears out the impression given by the appearance of the samples, that the Victorian specimens are more conical than the South Australian. Although insufficient material is as yet available to prove or disprove it, it seems possible that genotypic variation occurs between South Australia and Victoria. Some of the Victorian specimens are more coarsely perforated than any of the South Australian individuals (though this is emphasized by the preservation), and they often have longer and more wavy marginal partitions than the South Australian specimens, in addition to a smaller apical angle (which ranges down to 87° in a specimen .68 mm. in diameter). Three explanations of the apparent variation are possible: (1) *Mechanical separation,* which may have acted on individuals with a changing growth-rate. However a complete range of growth stages is neither available at one locality nor compositely. The thick cover of shelly material on the dorsal surface of large individuals masks the basic shape of the test, but vertical sections of Kingscote and Moorlands specimens show that most had a greater apical angle than most Victorian individuals at comparable sizes. (2) *Geographical variation,* as a distance of 320 miles separates the closest Victorian and South Australian occurrences. (3) *Stratigraphic position,* as the Victorian specimens may be a little younger than the South Australian. The exact age determination will depend on the results of faunal work now in progress in Victoria and South Australia. Although it may later become possible to differentiate the Victorian specimens as a subspecies, the degree of overlap in their measurable characteristics indicates that they all can be contained in one species.

All individuals from the Willunga bore (six), Blanche Point (one), Christie's Beach (three) and Yorke Peninsula (five) are very young. Ecological conditions in the arm of the sea which extended into the Adelaide Basin at that time may have prevented their development, or mechanical separation may have been active; from the size of other Foraminifera in the deposit, the degree of mechanical separation necessary to remove all but the youngest growth stages does not seem likely. Mechanical separation or perhaps the destruction of young specimens has taken place at Kingscote and Moorlands, leaving only large specimens.

In Victoria the species is associated with littoral deposits rich in planktonic Foraminifera; at Moorlands the deposit is littoral (McGarry, 1953); at Kingscote it is a shallow water deposit, almost without terrigeneous material, a mass of triturated bryozoa forming the limestone. Within the Adelaide Basin proper the juvenile specimens are associated with more finely terrigeneous deposits.

One vertical section of a megalospheric specimen from Kingscote shows twinned nepionic chambers. The fused individuals formed a normal-sized adult, which also shows regeneration (pl. 8, fig. 8).

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127. ON THE VALUE OF ARAGONITE TESTS IN THE CLASSIFICATION OF THE ROTALIIDEA

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ABSTRACT—Aragonite tests seem to be distinctive of the Families Ceratobuliminidae and Robertinidae.

In a recent note, Bandy (1954) reported that among a large number of foraminiferal species examined by means of cobalt nitrate (Meigen's test), only members of the following genera proved to have aragonite tests: *Höglundina (Epistomina), Ceratobulimina, Lamarckina, Pseudobulimina, Colomia,* and *Bigenerina.* One of

TABLE 1
Complete list of species with aragonite tests, as determined by this study.

Species	Stage or Formation and Locality	Age
Family CERATOBULIMINIDAE		
Lamarckina naheolensis Cushman and Todd	Wills Pt. form. Mexia, Texas	Paleocene
L. wilcoxensis Cushman	Wilcox form. RR cut, 1 mile N of Ozark, Alabama	L. Eocene
L. ventricosa (Brady)	Bermudez Station 2963. Atlantic Ocean	Recent
Ceratobulimina (Ceratolamarckina) tuberculata Brotzen	Rugaard, Denmark	Paleocene
C. (Ceratolamarckina) jutlandica Troelsen	Rugaard, Denmark	Paleocene
C. (Ceratolamarckina) perplexa (Plummer)	Wills Pt. form. Mexia, Texas	Paleocene
C. (Ceratobulimina) contraria (Reuss)	Faarup, Denmark	M. Oligocene
C. (Ceratobulimina) crepidula (Finlay)	Goodwood form. New Zealand	L. Miocene
C. (Ceratocancris) clifdenensis Finlay	Loc. 5132, Band 5 (N. Z. Geol. Survey). Clifden, New Zealand	L. Miocene
Cerobertina bartrumi Finlay	Waitematan form., Hutchinsonian stage. Pakaurangi Pt., New Zealand	L. Miocene
C. mahoenuica Finlay	No. F 5730 (N. Z. Geol. Survey). Pakaurangi Pt., New Zealand	L. Miocene
Epistomina caracolla (Roemer)	Speeton clay w. *Belemn. jaculus.* Speeton, England	L. Cretaceous
E. spinulifera (Reuss)	Gault clay. Folkestone, England	L. Cretaceous
E. carpenteri (Reuss)	Gault clay. Folkestone, England	L. Cretaceous
E. chapmani ten Dam	Gault clay. Folkestone, England	L. Cretaceous
E. scalaris Franke	Rugaard, Denmark	Paleocene
E. scalaris Franke	Wills Pt. form. Mexia, Texas	Paleocene
Epistominoides wilcoxensis (Cushman and Ponton)	Wills Pt. form. Mexia, Texas	Paleocene
Family ROBERTINIDAE		
Robertina wilcoxensis Cushman and Ponton	Rugaard, Denmark	Paleocene
R. arctica Orbigny	near Iceland	Recent
Robertinoides declivis (Reuss)	Faarup, Denmark	M. Oligocene
R. sp.	Bermudez Station 2969. Atlantic Ocean	Recent
Geminospira simaensis Makiyama and Nakagawa	Takamatsu, Atsume Penin., Japan	Pleistocene
G. convoluta (Williamson)	Salhus, near Bergen, Norway	Recent
Alliatina excentrica (Napoli)[1]	Astian stage. Castell'Arquato, Piacenza, Italy	U. Pliocene
A. primitiva (Cushman and McCulloch)[2]	James Bay, James Island, Galapagos Islands	Recent
A. translucens (Cushman)[3]	Mokaujar Anchorage, Fiji	Recent
Cushmanella browni (Orbigny)	Cuba	Recent

1 Now known to be ancestral to **Cushmanella** (cfr. Troelsen, 1954, pp. 464-465).
2 = **Cushmanella primitiva** Cushman and McCulloch. 3 = **Nonionella translucens** Cushman.

Bandy's conclusions was that "there is no very close relationship between the genera represented by the aragonite species in this study." Although the present writer is ready to admit that *Colomia* and *Bigenerina* are far removed from the other genera mentioned, it is his (and some other workers') opinion that the three first-mentioned genera are closely related, all three belonging to the Family Ceratobuliminidae (cfr. Troelsen, 1954), while *Pseudobulimina* should be referred to the Family Robertinidae (as Hofker, 1951, defines it).

In order to determine whether the presence of aragonite in the test may be supposed to be of family significance among the Rotaliidea, 10 samples, besides many individual species, ranging in age from the Early Cretaceous to Recent and coming from different parts of the world, were subjected to Meigen's test. The species listed in Table 1, all of which belong to the Families Ceratobuliminidae and Robertinidae, proved to have aragonite tests. Among the numerous species that gave a negative reaction for aragonite, those listed in Table 2 are of special interest because the genera to which they belong have been referred to the Ceratobuliminidae by several authors (Glaessner, 1937; Brotzen, 1942; Sigal, 1952; a.o.), while the present writer previously has attempted to show that they are unrelated to that family (Troelsen, 1954).

It is believed that bias has been avoided by Bandy's and the present writer's examination of a large number of bulk samples. It is, further, emphasized that the grouping of the species and genera listed in Table 1 into the Families Ceratobuliminidae and Robertinidae has been done on independent evidence (Hofker, 1951; Troelsen, 1954). Although Meigen's reaction may not be as sensitive as some other tests, it is, therefore, the present writer's opinion that a good case has been made for considering the presence of aragonite in the tests a distinctive feature of the Families Ceratobuliminidae and Robertinidae.

The writer is indebted to the following individuals for generous gifts of samples or specimens for the present investigation: Mrs. Betty K. Nadeau, Miss Ruth Todd, O. L. Bandy, P. J. Bermudez, N. de B. Hornibrook, T. Makiyama, E. di Napoli Alliata, and G. Troedsson. Special thanks are due to Miss Ruth Todd for valuable suggestions and discussions.

TABLE 2
Selection of species with calcite tests.

Species	Stage or Formation and Locality	Age
Alabamina wilcoxensis Toulmin	Wilcox form. RR cut, 1 mile N of Ozark, Alabama	L. Eocene
Osangularia lens Brotzen	U. Maestrichtian, Kjølby Gaard marl. Kjølby Gaard, Tisted county, Denmark	U. Cretaceous
Pulsiphonina wilcoxensis (Cushman)	Wilcox form. RR cut, 1 mile N of Ozark, Alabama	L. Eocene
Eponidella palmerae Bermudez	Bermudez Sample No. H-6827. N of El Limón, Barahona Province, Dominican Republic	U. Miocene
Asterigerina planorbis Orbigny	Astian stage. Castell'Arquato, Piacenza, Italy	U. Pliocene
Asterigerinata mamilla (Williamson)	Kristineberg, Sweden	Recent

REFERENCES

Bandy, O. L., 1954, Aragonite tests among the foraminifera.—Journal of Sedimentary Petrology, vol. 24, no. 1, pp. 60-61.

Brotzen, F., 1942, Die Foraminiferengattung *Gavelinella* nov. gen. und die Systematik der Rotaliiformes.—Sveriges geol. Undersökning, ser. C., no. 451.

Glaessner, M. F., 1937, On a new family of Foraminifera.—Studies in Micropaleontology (Publ. Labor. Paleont. Univ. Moscow), vol. 1, fasc. 3.

Hofker, J., 1951, The Foraminifera of the Siboga Expedition, pt. III.—Siboga Expeditie, Mon. IV a, Leiden.

Sigal, Jacques, 1952, Foraminifères.—In Jean Piveteau, Traité de Paléontologie, vol. 1 (Paris).

Troelsen, J. C., 1954, Studies on Ceratobuliminidae (Foraminifera).—Meddelelser fra Dansk geologisk Forening, vol. 12, pp. 448-478.

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128. *BOLIVINA DAGGARIUS*, NOM. NOV.

FRANCES L. PARKER
Scripps Institution of Oceanography

The writer was recently informed by Dr. Hans E. Thalmann that *Bolivina lanceolata* F. L. Parker 1954 (Bull. Mus. Comp. Zool., vol. 111, no. 10, p. 514, pl. 7, figs. 17-20), described from the northeastern Gulf of Mexico, is preoccupied by *B. lanceolata* di Napoli Alliata 1952 (Riv. Italiana Pal. e Strat., vol. 58, p. 98, pl. 5, fig. 10), described from the Calabrian of northern Italy. The new name *B. daggarius* is proposed for the Gulf of Mexico form.

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129. NEW NAMES FOR FORAMINIFERAL HOMONYMS II.

HANS E. THALMANN
Stanford University

The following new names are herewith proposed with the authorization by T. Barnard (letter dated London, February 23rd, 1954):

Ammobaculites godmani Barnard, nom. nov.

For: *Ammobaculites minuta* Barnard, 1953, Geologists's Assoc., London, Proc., vol. 64, p. 185, Fig. A, Nr. 3 Upper Oxfordian, England (non *Ammobaculites minuta* Waters, 1927, Journ. Paleont., vol. I, p. 133, pl. 22, fig. 3. Lower Pennsylvanian, Oklahoma, U.S.A.).

Dorothia pupa (Reuss, 1860) var. **britannica** Barnard and Banner, 1953, nom. nov.

For: *Dorothia pupa* (Reuss, 1860) var. *tenuis* Barnard and Banner, 1953, Geol. Soc. London, Quart. Journ., vol. 109, p. 192, pl. 8, fig. 5; text fig. 4-H. Upper Cretaceous, England (non *Dorothia tenuis* Bermudez, 1949, Cushman Lab. Foram. Research, Spec. Publ. Nr. 25, p. 86, pl. 4, figs. 39, 40. Lower Eocene, Haiti).

In the description should be added that the most diagnostic character of this new variety is an "initial whorl consisting of four chambers" (information received from Banner by Barnard).

Attention is drawn to the genus "*Pseudotextulariella* Barnard, 1952" in Barnard and Banner, 1953, Geol. Soc. London, Quart. Journ., vol. 109, p. 198, with *Textulariella cretosa* Cushman, 1932, Cushman Lab. Foram. Res., Contr., vol. 8, p. 97, pl. 11, figs. 17-19, as genotype. The manuscript by Barnard and Banner was sent in during 1952 but was not published until December 1953. Furthermore, the two words "gen. nov." were omitted from the final print. According to Art. 25 of the International Rules of Zoological Nomenclature, Barnard's genus *Pseudotextulariella* has to be accepted as legitimate, as follows:

Pseudotextulariella Barnard, 1953, n. gen.

in Barnard and Banner, 1953, Geol. Soc. London, Quart. Journ., vol. CIX, pt. 2, p. 198. Genotype: *Textulariella cretosa* Cushman, 1932. New genus of the family Valvulinidae. Upper Cretaceous.

Attention is also drawn to the existence of a generic homonym by Krasheninnikov, in a paper (not available to the writer) published in Russian on the morphology and systematics of the Nonionidae in Bjull. Moskovsk. obshch. ispijjatel. Prirody, otdel geol. (1953), No. 3, pp. 88-89, where the new genus *Carpenterella* is proposed, a name already preoccupied by Collenette, 1933, Entom. mon. Mag., vol. 69, p. 258 in Lepidoptera. The writer would welcome any information regarding this paper, especially what regards the genotype for Krasheninnikov's *Carpenterella* and another new genus, *Canalifera,* and the reasons for splitting up the family Nonionidae Reuss into Nonionidae s. str., Elphidiidae new fam., and Canaliferidae new fam.

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RECENT LITERATURE ON THE FORAMINIFERA

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

ALLIATA, ENRICO DI NAPOLI. Microfaune della parte superiore della serie oligocenica del Monte San Vito e del Rio Mazzapiedi-Castellania (Tortona-Alessandria).—Riv. Ital. Pal. Stratig., Mem. VI, 1953, pp. 25-98, pls. 1-4, tables 1, 2.—A deep-water fauna showing affinities with Trinidad; 102 species and varieties, 2 new.

ARNOLD, ZACH M. Culture methods in the study of living Foraminifera.—Journ. Pal., vol. 28, No. 4, July 1954, pp. 404-416.

AVNIMELECH, M. Studies on the Neogene of Israel. I, A new Pliocene outcrop in the central coastal plain of Israel.—Bull. Research Council of Israel, vol. II, No. 4, March 1953 (Sept. 1953), pp. 422-424.—Lists of Foraminifera.

AVNIMELECH, M., and REISS, Z. On the Upper Cretaceous and Tertiary stratigraphy of a boring near Beth-Govrin (Israel).—Bull. Research Council Israel, vol. III, No. 3, Dec. 1953 (Febr. 1954), pp. 171-176, text fig. 1, stratigraphic section.—Age determined by the foraminiferal faunas: Upper Eocene to Campanian.

BARTENSTEIN, HELMUT. Revision von Berthelin's Mémoire 1880 über die Alb-Foraminiferen von Montcley.—Senck. leth., Band 35, Nr. 1/2, Aug. 2, 1954, pp. 37-50, pl. 1.—Notes and, in many instances, new determinations of the 98 species in the Berthelin Memoire. One new name.

Derzeitiger Stand der mikropaläontologischen Arbeitstechnik in Deutschland.—Paläont. Zeitschr., Band 28, Nr. 3/4, August 1954, pp. 208-212, pls. 18, 19.

BARTENSTEIN, H., and HEINEMANN, W. Brackwasser-Foraminiferen im oberen Aquitan des Mittelrhein-Gebietes.—Senck. leth., Band 35, Nr. 1/2, Aug. 2, 1954, pp. 23-35, 3 text figs.—A new **Bolivina.**

BOLTOVSKOY, ESTEBAN. Beobachtungen über den Einfluss der Ernährung auf die Foraminiferenschalen.—Paläont. Zeitschr., vol. 28, No. 3/4, August 1954, pp. 204-207.—Deficient nutrition may result in paucity of species and individuals, emaciated and weakly sculptured tests, and tendency toward assymetry.

BOWEN, R. N. C. Foraminifera from the London clay.—Proc. Geol. Assoc., vol. 65, pt. 2, June 25, 1954, pp. 125-174, text figs. A-D, distribution chart.—One hundred thirty-seven species and varieties, 9 species and 1 variety new, indicating warm, marine conditions, fluctuating from shallow to deep. Distribution of species indicates that they are confined to facies, in general, and are not useful as horizon markers.

CHAUDHURI, ABANINATH, and BISWAS, BUDDHADEB. Recent perforate Foraminifera from Juhu Beach, Bombay.—The Micropaleontologist, vol. 8, No. 4, Oct. 1954, pp. 30-32.

DROOGER, C. W. Two species of **Miogypsina** from southern Peru.—Bol. Soc. Geol. Peru, T. XXVI, 1953, pp. 9-15, text figs. 1-3.—**M. gunteri** and **M. ecuadorensis** indicate middle to late Oligocene age.

FEYLING-HANSSEN, ROLF W. The stratigraphic position of the quick clay at Bekkelaget, Oslo.—Norsk geol. tidsskrift, 33, h. 3-4, 1953, pp. 185-196, pl. 1, text figs. 1-3, tables.—Foraminifera indicate Post-Glacial and Late-Glacial ages for the quick clay and underlying deposit respectively. Eleven species illustrated; one new and one new name.

Elphidium clavatum Cushman from the Late-Glacial of Romerike, Norway.—Norsk geol. tidsskrift, 33, h. 3-4, 1953, p. 228-229, text fig. 1.—The fauna consists exclusively of **E. clavatum.**

HAGN, HERBERT. Geologisch-paläontologische Untersuchungen im Helvetikum und Flysch des Gebietes von Neubeuern am Inn (Oberbayern).—Geol. Bavarica, No. 22, 1954, pp. 1-136, text figs. 1-26, geol. map and sections.—Foraminifera observed in thin sections.

HAGN, HERBERT, and ZEIL, WERNER. Globotruncanen aus dem Ober-Cenoman und Unter-Turon der Bayerischen Alpen.—Eclogae Geol. Helvetiae, vol. 47, No. 1, August 1954, pp. 1-60, pls. 1-7, text figs. 1-3, table 1.—Twenty-seven species and subspecies, 2 new, most of them planktonic forms, are described and illustrated as free specimens and in thin section.

Der Geröllbestand der jungkattischen Konglomerate im Staffelsee bei Murnau (Oberbayern) und seine Bedeutung für die Paläogeographie der subalpinen Molasse.—Geol. Jb., Band 69, Oct. 1954, pp. 537-598, pls. 40-44, text fig. 1 (map).—Larger Foraminifera in thin sections.

HIGUCHI, YU. Fossil Foraminifera from the Miyata formation, Miura Peninsula, Kanagawa Prefecture.—Jour. Geol. Soc. Japan, vol. 60, No. 703, 1954, pp. 138-144, pl. 3, map, section, tables.—Determination of paleo-environment as indicated by the Foraminifera. Distribution and abundance shown for 156 species; 28 species illustrated.

KANMERA, KAMETOSHI. Fusulinids from the Upper Permian Kuma Formation, Southern Kyushu, Japan—with special reference to the Fusulinid zone in the Upper Permian of Japan.—Mem. Fac. Sci., Kyushu Univ., ser. D, Geol., vol. 4, No. 1, June 30, 1954, pp. 1-38, pls. 1-6, text figs. 1, 2 (sections, map).—Fourteen species and subspecies, 6 new, 5 indeterminate.

KATTO, JIRO, NAKAMURA, JUN, and TAKAYANAGI, YOKICHI. Stratigraphical and Paleontological Studies of the Tonohama Group, Kochi Prefecture, Japan.—Research Reports Kochi Univ., vol. 2, No. 32, Dec. 1953, pp. 1-15, pls. 1, 2 (maps, graphs), tables 1-3, text figs. 1, 2.—Distribution and abundance are shown for over 300 species of smaller Foraminifera.

KICINSKI, FELIKS M. Contributo alla stratigrafia nel territorio di Orte (Lazio-Umbria).—Italy Consiglio Naz. Ricerche, Contrib. Sci. Geol., vol. II, Ann. 22, 1952, pp. 24-42, pls. 1-3.—Strata dated as Calabrian. A foram fauna of 34 species, 2 new, is recorded and illustrated.

LOEBLICH, ALFRED R., JR. and TAPPAN, HELEN. Emendation of the foraminiferal genera **Ammodiscus** Reuss, 1862, and **Involutina** Terquem, 1862.—Journ. Washington Acad. Sci., vol. 44, No. 10, Oct. 1954, pp. 306-310, text figs. 1, 2.—**Ammodiscus** a junior synonym of **Spirillina,** and **Involutina** to include forms previously placed in **Ammodiscus.**

The type species of **Bulbophragmium** Maync, 1952.—The

Micropaleontologist, vol. 8, No. 4, Oct. 1954, pp. 32, 33.

PAPP, A., and KÜPPER, K. Die Foraminiferenfauna von Guttaring und Klein St. Paul (Kärnten). III, Foraminiferen aus dem Campan von Silberegg.—Osterreich. Akad. Wissenschaften, Sitz., Abt. I, Band 162, heft 5, 1953, pp. 345-357, pls. 1-3.—Five larger Foraminifera, including one new species of **Pseudorbitoides.**

PARKER, FRANCES L. Distribution of the Foraminifera in the northeastern Gulf of Mexico.—Bull. Mus. Comp. Zool., vol. 111, No. 10, August 1954, pp. 453-588, pls. 1-13, text figs. 1-9, tables 1-30.—A quantitative study of living and dead benthonic and planktonic specimens based on about 200 samples from eleven traverses. Six facies and two subfacies were recognized between 12 and 1000 meters. Lateral changes in faunas appear to be related to nearness to Mississippi River and to the West Indies and to be affected by an environment of non-deposition. Ratio of living to dead specimens may be a function of sedimentation rate. The planktonic population, as compared to that of the Caribbean and Atlantic, throws light on the currents flowing into the Gulf. Generalized distribution by depth is shown graphically for nearly 200 species or groups of species or genera. There are 205 benthonic species included in a systematic section and most of them are illustrated. Ten species and one genus are new. **Stetsonia** (genotype **S. minuta,** n. sp.) in the Cassidulinidae.

PHLEGER, FRED B. Foraminifera and deep-sea research.—Deep-Sea Research, vol. 2, No. 1, Oct. 1954, pp. 1-23, text figs. 1-13 (maps), pl. 1, table 1.—A summary and evaluation of present knowledge and discussion of current problems.

POKORNY, VLADIMIR. Zaklady Zoologicke Mikropaleontologie, Praha, 1954, 651 pp., 756 text figs.—Czechoslovakian textbook includes Foraminifera, pp. 54-287.

PURI, HARBANS S. Contribution to the study of the Miocene of the Florida Panhandle.—Florida Geol. Survey, Geol. Bull. No. 36, 1953, 345 pp.; Part I, Stratigraphy (pp. 11-67, text figs. 1-7, tables 1-3), Part II, Foraminifera (pp. 69-213, pls. 1-30, tables 1-11), Part III, Ostracoda (pp. 215-345, pls. 1-17, text figs. 1-14, tables 1-12).—A new interpretation of the formations and zones as stages and facies, with some different correlations between updip and downdip and toward the west. The Cushman illustrations are re-used with a few changes in nomenclature. **Procerolagena** n. gen. (genotype **Lagena gracilis** Williamson).

SKINNER, JOHN W., and WILDE, GARNER L. The fusulinid subfamily Boultoniinae.—Journ. Pal., vol. 28, No. 4, July 1954, pp. 434-444, pls. 42-45.—A new subfamily to include a group of 7 Permian genera, one new: **Paraboultonia** (genotype **P. splendens** n. sp.). Three species, 2 new, are described.

Fusulinid wall structure.—Journ. Pal., vol. 28, No. 4, July 1954, pp. 445-451, pls. 46-52.

STAINFORTH, R. M. The basis of Paleogene correlation of Middle America.—Bol. Soc. Geol. Peru, T. XXVI, 1953, pp. 247-261, text figs. 1-3.—Contains charts showing various stratigraphic levels as indicated by certain larger and smaller Foraminifera and mollusks.

STAINFORTH, R. M., and RÜEGG, W. Mid-Oligocene transgression in southern Peru.—Bull. Amer. Assoc. Petr. Geol., vol. 37, No. 3, March 1953, pp. 568, 569. —Age based on two species of **Miogypsina.**

TAKAYANAGI, YOKICHI. Foraminifera from the Kushiro Formation, Hokkaido.—Jour. Geol. Soc. Japan, vol. 59, No. 691, 1953, pp. 139-148, pl. 3, text figs. 1, 2, table 1. (In Japanese with English abstract).—Distribution and abundance of 51 species, none new, from this lower Pleistocene formation, with ecologic interpretation. Twenty-three species illustrated.

Distribution of the Recent Foraminifera from the adjacent seas of Japan (I).—Records of Oceanographic Works in Japan, vol. 1, No. 2, n. ser., Dec. 1953, pp. 78-85, tables, map.—Includes oceanographic data and a distribution table of about 130 species, none new, from 11 stations between 13 and 64 meters.

TODD, RUTH, CLOUD, P. E. JR., LOW, DORIS, and SCHMIDT, R. G. Probable occurrence of Oligocene on Saipan.—Amer. Journ. Sci., vol. 252, Nov. 1954, pp. 673-682, pl. 1, text figs. 1, 2 (range chart, map). Includes appendix describing two new species by PAUL BRONNIMANN and by RUTH TODD.—Age based on planktonic species in common with Caribbean region.

TOOMEY, DONALD F. A bibliography of the family Fusulinidae.—Journ. Pal., vol. 28, No. 4, July 1954, pp. 465-484.

TORIYAMA, RYUZO. Geology of Akiyoshi. Part I. Study of the Akiyoshi Limestone Group.—Mem. Fac. Sci., Kyushu Univ., ser. D, Geol., vol. 4, No. 1, June 30, 1954, pp. 39-97, text figs. 1-28 (sections), geol. map and sections.—Six fusulinid zones and 10 subzones.

VALENSI, LIONEL. Microfossiles des Silex du Jurassique Moyen; Remarques Pétrographiques.—Mem. Soc. Géol. France, n. sér., vol. 32, fasc. 4, Mem. No. 68, 1953, pp. 1-100, pls. 1-16, text figs. 1-7, tables 1-5. (Foraminifères, pp. 66-68, pl. 11).—A few genera are illustrated from the flints.

VAN VOORTHUYSEN, J. H. Pliocene and lower Pleistocene in a boring near Oosterhout. Foraminifera.—Meded. Geol. Stichting, n. ser., No. 7, 1953, pp. 38-40, pls. 1, 2, text figs. 1, 3-6, table 3, diagrams.—Foram composition is shown graphically. Twenty-three species are illustrated, one new.

La limite plio-pléistocène dans le bassin de la mer du Nord.—Bull. Soc. Belge Géol., vol. 62, fasc. 2, 3, ann. 1953 (1954), pp. 138-143, text fig. 1 (sections).

WILSON, EUGENE J. Foraminifera from the Gaviota formation east of Gaviota Creek, California.—Univ. Calif. Publ. in Geol. Sci., vol. 30, No. 2, 1954, pp. 103-170, pls. 12-18, text figs. 1-3 (maps, section), tables 1-3.—There are 62 species and varieties (one new species) recorded from this Oligocene formation. Notes on correlation and ecology are included.

ZEIL, WERNER. Geologie der Alpenrandzone bei Murnau in Oberbayern.—Geol. Bavarica, No. 20, 1954, pp. 1-85, pls. 1-9, text figs. 1-5, maps, sections.—A few Foraminifera.

RUTH TODD