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Ecology and distribution of foraminifers of a traverse in the northwestern Gulf of Mexico

Faiz Nassir Thomas

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ECOLOGY AND DISTRIBUTION OF FORAMINIFERS OF A
TRAVERSE IN THE NORTHWESTERN GULF OF MEXICO

BY
FAIZ NASSIR THOMAS

A
THESIS
submitted to the faculty of the
UNIVERSITY OF MISSOURI AT ROLLA
in partial fulfillment of the requirements for the
Degree of
MASTER OF SCIENCE IN GEOLOGY
Rolla, Missouri
1966

Approved by

A. C. Streng (advisor)
Ray F. Morgan

H. B. Rupert
J. G. Gregory
ABSTRACT

Foraminiferal populations have been analyzed from five bottom samples along a traverse in the northwestern Gulf of Mexico, approximately 27°20' to 27°15' north latitude and 97°20' to 97°05' west longitude. Eighty-eight species and twenty-nine genera, belonging to eighteen families, were recorded. Species were identified and described.

Statistical studies indicate that probably five benthonic foraminiferal depth facies could be recognized in the area at the following approximate depths: 4 fathoms, 4-8 fathoms, 8-12 fathoms, 12-16 fathoms, and 16-20 fathoms. Determination of facies is based largely on the range of species. The frequency distribution of species of foraminifers was plotted against change in depth. The faunal trend could not be correlated with physical conditions other than change in depth; perhaps such a trend will be found to correlate with salinity, light penetration and turbidity condition.

The wet volume percentage of foraminifers in the sediment and species diversity were found to increase away from shore. The percentage of arenaceous
foraminifers also increased offshore. Planktonic foraminifers were lacking in the samples, except for a single specimen of *Globigerinoides ruber* d'Orbigny which was found at a depth of 20 fathoms.
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I. INTRODUCTION

Foraminifers are relatively small, marine protozoans usually having either a calcareous or an arenaceous test. They contain both planktonic and benthonic populations and reflect the environmental conditions in both habitats. Each population must be considered and interpreted separately when considering the ecological implications of a fauna occurring in sediment samples.

Any group of organisms which is abundant, diverse, and widespread both laterally and bathymetrically should provide an excellent tool for studies of paleooceanography. Foraminifers combine all of these attributes, and have the added advantage that they are well known and are being actively studied by hundreds of workers for geologic purposes.

As an approach toward a better understanding of foraminiferal patterns of distribution and ecological implications thereof, a general frequency study was made, based on five bottom samples, along the line of a traverse, across the inner continental shelf, and perpendicular to the shore line, starting with four fathoms near shore and continuing to a depth of 20 fathoms. Eighty-eight species
and 29 genera, belonging to eighteen families, were recorded (Table 1, pp. 13, 14), the relative abundance of species being arranged according to their first occurrence from shore.

The main objectives of this study were to show the distribution pattern of foraminifers in the area which may be useful in interpreting some ancient environment. The secondary objective was an attempt to interpret the ecological conditions controlling the distribution in the area.

A. Location

The area under consideration is a strip across the inner continental shelf, northwestern Gulf of Mexico, from approximately 27°20' to 27°15' north latitude and 97°20' to 97°05' west longitude (Fig. 1), about 29 miles southeast of Corpus Christi, Texas, and about one mile east of Baffin Bay, across the barrier island of the south Texas coast.

B. Method

The field work was carried out during July and August, 1962, by Dr. Miles O. Hayes, of the University of Massachus- setts, as a part of field work for a doctoral dissertation.
Fig. 1 Index Map of Collecting Stations
Short cores of relatively undisturbed sediments were collected from the inner shelf of the northwestern Gulf of Mexico, from depths of 4 to 20 fathoms, along a traverse with an average distance between stations of approximately one and one-half nautical miles. In muddy bottom, samples were taken by a modified Phleger Corer; in sandy bottoms grab samples were taken by means of a modified Petersen Sampler.

The samples were taken along the traverse at 4, 8, 12, 16 and 20 fathom depths. Because of the uneven slope (Fig. 2), the horizontal distance between stations is not uniform.

The coring tube obtains a short, relatively undisturbed core about one and one-half inches in diameter. As the core was taken from the tube, the top centimeter (20-30 ml) of sediment was cut off, placed in a sample jar, and preserved with alcohol for foraminiferal analysis. All the samples thus obtained contained approximately the same volume of sediment.

Laboratory and faunal analysis followed the standardized procedures as described in number of articles (Bandy and Arnal, 1957). Briefly, the procedure in preparation of the sample involved placing the contents of the sample
jar into a 200-mesh Tyler sieve (0.074 mm. opening). The sediment was washed under a gentle stream of water to remove the fine sediments and to concentrate the foraminifera and coarser sediments. Usually little finer sediment was present. The residue on the screen was dried, and the foraminifera were picked, and mounted on distribution slides. Each specimen was then identified and counted for distributional analysis.

C. Faunal analysis

In the frequency count of species of five stations (Table 1), it became apparent that about 10 species made a very high percentage of the fauna. The more abundant and diagnostic forms compared with the change in physical environment show little correlation except with depth and surface salinity (Fig. 3). In such analyses there are many fluctuations and irregularities that are confusing; however, by making a composite picture of the frequency distribution in the absence of complicating factors associated with slope reversals, the frequency distribution smoothed out.

The wet volume percentage of the foraminifera in the sediment increased rapidly from the near shore end of the traverse outward, a condition probably produced by
Fig. 2. INNER NERITIC ZONE BOTTOM PROFILE. Triangles indicate sample stations along traverse. Base data from U.S.C. & G.S. Charts 6396 and 6403.
Fig. 3. SURFACE SALINITY PROFILE ALONG TRAVERSE
(Miles O. Hayes, oral communications)
the dilution of the foraminiferal elements by sediments near shore. The number of species near shore was found to be generally about less than half the number making up the fauna of the stations near the outer end of the traverse.

D. **Climate**

Climate is probably the most underrated single controlling factors of shallow water organisms, especially foraminifers, because climate affects water temperature and salinity which greatly effect the type of organisms and sediments present.

The south Texas climate undergoes a gradual transition in the southwesterly direction along the coast, ranging from humid near the Louisiana border, through moist sub-humid and dry sub-humid, to semi-arid near the Mexican border (Thornthwaite, 1948). Climatic conditions in the Coastal Bend Area are highly variable. Under normal conditions the climate is semi-arid, but as Price (1949) pointed out, the expectancy rate for normal climatic year in this area is less than 50 per cent.

The wind of the south Texas coast is an extremely important geologic agent (Lohse, 1955, p. 99). In short, winds blow mostly out of the southeast, especially in spring and summer, but strong winter winds blow from
the north and northeast.

E. **Acknowledgements**

The writer is greatly indebted to the Government of Iraq for providing financial support which made this project possible.

The writer gratefully acknowledges the guidance of Dr. D. L. Frizzell, who served as thesis advisor.

Appreciation is expressed to Dr. Miles O. Hayes, of the University of Massachusetts, for providing the samples.

Thanks are also due to Dr. A. J. Scott, of the University of Texas, for suggesting the area of study.

Gratitude is extended to the Department of Geological Engineering and Geology, University of Missouri at Rolla, for providing facilities, equipment and laboratory space.

Many thanks are also due to Mr. Ronald Greeley for drafting the figures in the thesis.
II. PREVIOUS WORK

Foraminiferal investigations in the general area under study fall into two categories: descriptive works and ecological studies. The descriptive works were extremely useful to the present author in identification of species of foraminifers.

Several important studies of ecology and patterns of distribution of Recent marine invertebrates, especially the foraminifera, have been published in the last two decades. These are discussed briefly below. The first category includes the well-known works of d'Orbigny (1839), Brady (1884), Cushman (1921, 1922, 1926), and Kornfeld (1931). Although these monographs are mainly of a taxonomic nature, they contain depth data from which some distributional trends and tendencies may be determined. More recent taxonomic papers include those of Acosta (1940) and Phleger and Parker (1951b). Again, although there are depth data to be found in these papers, there is little information about the relative importance of individual occurrences.

Studies emphasizing the pattern of distribution and ecological conditions began when Vaughan (1918)
compared samples from Australia with samples from Florida and the Bahamas, including some from the Florida Keys. *Archaias* was the most abundant form in the Florida Keys, which is part of the reef complex, and is similar to the platform edge (reef complex) facies of the Batabano platform.

Norton (1930) studied the foraminifers from Australia and the Florida-Bahama region; he divided the foraminifers into depth-temperature zones.

Thorp (1939) studied the calcareous marine deposit from Florida and the Bahama region, reporting that occasional specimens of planktonic foraminifers were swept into shallow waters.

Lowman (1949) was the first who attempted a graphic representation of the frequency distribution of foraminifers from shore to deep water. He used categories broader than species and varieties, thus providing an excellent perspective of the general ranges and dependability of the genera and families.

Phleger (1951a) has completed a study that contributes much detailed information concerning the ranges of species and varieties of the foraminiferal population offshore. Bandy (1954) presented a study similar in nature to that of Phleger (1951a), but for shallow water foraminifers.
Bandy and Arnal (1957) studied the distribution of Recent foraminifers off the West Coast of Central America. They recognized five faunal zones based on the distribution of empty tests from only 36 samples at depths ranging from one to 1045 fathoms and over a distance of approximately 1200 nautical miles. Their faunal zones follow: inner shelf fauna (0-25 fathoms), outer shelf fauna (25-66 fathoms), upper bathyal fauna (66-333 fathoms), middle bathyal fauna (333-666 fathoms), and lower bathyal fauna (666-1045 fathoms).
Table 1. Check list of species identified. Numbers opposite specific names indicate numbers of individuals.

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III. ECOLOGY

A. Foraminiferal distribution

Depth is one of the obvious variables in the ocean. It has long been known that there is a depth zonation of larger marine benthonic organisms, but useful and reliable data are scant, with some exceptions. Information on depth distribution of benthonic foraminifers appears to be more reliable and abundant than for any other group of organisms. There is, however, a certain amount of apparent confusion about these depth distributions inasmuch as each worker has defined somewhat different depth zones. This may be due to actual environmental differences with depth in different areas or to different interpretations of similar data, or both. In several bathymetric studies of the distribution patterns of the tests of Recent foraminifers, well defined zones have been recognized. In the northwestern Gulf of Mexico, Phleger (1951) reports that the most marked faunal boundary is at a depth of approximately 100 m., and other deeper boundaries are reported at 200 m., 600 m., 1000 m., and 2000 m., water depth. None of these boundaries is sharp but each has a variability in depth of 10 to 20%.
Bandy (1954) has studied several samples from three shore traverses west of the Mississippi Delta in the northern Gulf of Mexico from depths of 27 feet (8 m.) to 130 feet (40 m.). He has recognized faunal depth boundaries at 55 feet (17 m.) and 75 feet (23 m.).

Recently, boundaries between foraminiferal assemblages have been reported for the continental shelf off southwest Texas (Phleger, 1956) at 20 to 30 m., 50 to 70 m., and 100 m.

Bandy (1956) recognized boundaries between different faunas on the continental shelf in the northeastern Gulf of Mexico at 12 m., 32 m., 55 m., 76 m., and 122 m.

A few generalizations may be made from examination of the depth distribution shown in Table 1. It appears that each species has its own characteristic depth distribution which differs from the ranges of most of all other species. The following species are believed to be characteristic of the following depths.

0-4 fathoms depth characteristic species:

1. Elphidium cf. E. advenum (Cushman)

2. E. incertum (Williamson) var. mexicanum Kornfeld
4-8 fathoms characteristic species:
1. *Anomalina* species
2. *Quinqueloculina poeyana* d'Orbigny
3. *Spiroloculina terquemiana* Fornsini
5. *T. fichteliana* d'Orbigny

8-12 fathoms characteristic species:
1. *Ammonia beccarii* (Linnaeus) var. *parkinsoniana* (d'Orbigny)
2. *A. beccarii* (Linnaeus) var. *tepida* (Cushman)
3. *Cibicides cf. C. io* Cushman
4. *Elphidium discoidale* (d'Orbigny)
5. *E. gunteri* Cole

12-16 fathoms characteristic species:
1. *Quinqueloculina laevigata* (d'Orbigny)
2. *Massilina peruviana* (d'Orbigny)
3. *M. aff. M. quadrans* Cushman and Ponton
4. *M. spinata* Cushman and Ponton var. *galberta* Cushman and Ponton
5. *Nonion aff N. depressulum* (Walker and Jacob) var. *matagordanum* Kornfeld
6. **N. aff N. germanicum** (Ehrenberg)
7. **Recurvoides** sp.
8. **Sigmoilina edwardsi** (Schlumberger)
9. **Triloculina** sp.

16-20 fathoms characteristic species:
1. **Ammonia beccarii** (Linnaeus)
2. **Buccella hannai** Phleger and Parker
3. **Cibicides** sp.
4. **Cribroelphidium** cf. **C. koeboeensis** (LeRoy)
5. **Elphidium** aff. **E. culebrense** (Cushman)
6. **E. aff. E. metagordanum** (Kornfeld)
7. **E. aff. E. incertum** (Williamson)
8. **Hanzawaia strattoni** (Applin)
9. **Nonionella** cf. **N. atlantica** (Cushman)
10. **Textularia barrettii** Jones and Jacob.

Each species has a more or less characteristic depth range, but these are rather general gradational boundaries between different assemblages. From the available data it was not possible to establish a well defined and sharp boundary between the various foraminiferal assemblages in the area due to the following reasons:
1. The whole study was based on dead foraminifers. Phleger (1960, p. 277) reported that every distributional study of foraminifers not based on living foraminifers may be misleading because dead foraminifers are possibly displaced down slope due to gravity, wave action, current, etc.

2. The samples on which the study were based are few and not adequate for establishing such depth zonation.

3. Stations were widely spaced within the traverse, making it very difficult in this case to find out the actual range of the species.

Many associations found in the present investigation are similar to those reported from other areas. It is of interest to compare the distribution pattern in the present area with those of known faunas in other parts of the Gulf of Mexico. The general distribution pattern of the foraminifers in the present area is positively correlated with the distribution pattern recognized by Bandy (1954) for the western Mississippi River delta area. Both faunas show general increase in population, species diversity (number of species per sample) offshore (Figs. 4B, C). The percentage of the arenaceous foraminifers are also increased away from shore (Fig. 4A).
Planktonic foraminifers were lacking in all the samples except from one specimen (Globigerinoides ruber d'Orbigny) which was found at 20 fathoms depth.

B. Ecological factors affecting depth distribution of foraminifers

The exact causes of distribution of foraminifers are not clearly understood. The ecological factors which influence the physiological activities and, hence, the distribution of marine organisms, may be one, several, or all of the following: Temperature, salinity, food supply, bottom plants, oxygen, water chemistry, hydrostatic pressure, turbidity, turbulence, substrata, current, biological competition, diseases, etc.

The effects of depth (pressure) and salinity on distribution of foraminifers probably have been overemphasized. This is due in part to abundance of depth and salinity data available and the relative ease of making additional observations.

Some workers have attempted by laboratory experiments to evaluate these various factors. The results of such experiments are useful in indicating the relative importance of the factors existing in nature. But the natural environments are always changing. The dimensions are
extremely large and dynamic equilibria may exist among many factors. A laboratory culture on the other hand is small in scale and static in nature. One should use care in applying results from experiments to natural phenomena.

Environmental limiting factors should be more easily assessed for the offshore area than for the shallow-water area inasmuch as the general ecology is somewhat more uniform and stable in the offshore environment.

A regular progression in conditions occurs offshore with increase of depth and pressure. One of the best demonstrations of the independent effects of temperature and depth (pressure) on the foraminifers is that of Crouch (1952). In his study of the cores of some deep basins off southern California, he found that the fauna and temperature did not change between the sill and the bottom of several deep basins. In contrast, there is a regular succession of faunas on the open sea bottom at equivalent depths in the same general area. In that environment, temperature and not depth (pressure) appears to be the main controlling ecological factor. The general increase in number of species, species diversity, percentage of arenaceous foraminifers (Figs. 4A, B, C)
FIGURE 4. FORAMINIFERAL VARIATION WITH RESPECT TO DEPTH.
and the general foraminiferal trend in the area is positively correlated with the increase of depth (temperature) offshore. Temperature changes are gradational from shallow to deep bottom, and they seem to show a changing pattern that is reflected in the fauna. Natland (1933) noted that where the temperature changes most rapidly, the fauna changes rapidly. This correlation has been noted also by Bandy (1953) in his frequency charts for the offshore area of California. In the check list (Table 1), there is an apparent correlation between depth (temperature) and faunal variation.

Variation in salinity is an important ecologic factor in the more shallow waters, especially along the coast where brackish conditions exist near the debouchments of rivers. Although the salinity variation in the present area is very small (35.44 to 35.80 o/oo, Fig. 3) there is a general correlation between the increase in salinity offshore and the foraminiferal trend. Probably this little variation is an important factor in the distribution of the foraminifers in the area.

Oxygen, nutrients, and bottom plants are closely related factors which vary with increasing depth of
water in large part due to decreasing light intensity. Myers (1943) has contributed much to an understanding of the interrelationships between foraminiferal populations and bottom plants. It should be emphasized that the successive changes occurring in the character of the bottom plants with increasing depth would be expectably reflected in the benthonic populations of foraminifers. Unfortunately, data on oxygen, nutrients, and bottom vegetation are not available.

Turbidity seems to be also of importance as an ecologic factor to some of the species of foraminifers.

With the ecologic data available, mainly depth (temperature) and salinity are the most important factors affecting the distribution of foraminiferal species; however, other factors are or may be significant also.
IV. CONCLUSIONS

The results of this study of distribution of foraminifers in bottom-sediment samples collected in the northwestern part of the Gulf of Mexico suggest several general conclusions:

(1) Within a depth range of about 20 fathoms, it is possible to establish diagnostic foraminiferal assemblages believed to be characteristic of 5 different depths.

(2) The faunal trend could not be correlated with the physical conditions other than change in depth. Perhaps such a trend will be found to correlate with salinity, turbidity conditions, light penetration or characteristics of bottom plants.

(3) The wet volume percentages of foraminifers, number of species and species diversity (number of species per sample) increased away from shore.

(4) The percentage of arenaceous foraminifers generally increased offshore.

(5) Planktonic foraminifers were absent from all depths except for one single species *Globigerinoides ruber* d'Orbigny found at depth of 20 fathoms.

(6) The close agreement of the foraminiferal facies with the geographic and oceanographic features of the
area indicate possible successful use of fossil foraminiferal facies analysis in the correlation of shore and near shore paleogeography and paleooceanography of areas of marine sedimentation during the geologic past, particularly the Tertiary. Phleger (1954, pp. 610-611) has reached a similar conclusion based on his studies of foraminiferal distributions in the vicinity of the Mississippi River delta.
V. SYSTEMATICS

The arrangement followed is that of A. R. Loeblich, Jr., and H. Tappan. Genera and species are listed in alphabetical order within subfamilies and families. This is not meant to express an opinion or preference as to a system of classification, but rather to conform to an order of arrangement currently in wide use. Illustrations of species are not given, but all are adequately illustrated in recent and readily available papers. Within the synonymic entries, references to illustrations identical to the species studied are indicated by capitalization of the author's name.

Family LITUOLIDAE de Blainville, 1825

Subfamily HAPLOPHRAGMIDINAE Maync, 1952

Genus RECURVOIDES Earland, 1934

RECURVOIDES species

Description. - Test small, free, planispiral, chamber very distinctly subglobular, seven chambers in last coil; sutures distinct, depressed; umbilical regions depressed, surrounded by subglobular chambers; wall agglutinated, thin, very light gray; aperture small, with small bordering lip.
Family TEXTULARIIDAE Ehrenberg, 1838
Subfamily TEXTULARIINAE Ehrenberg, 1838
Genus BIGENERINA d'Orbigny, 1826
BIGENERINA IRREGULARIS Phleger and Parker

Bigenerina irregularis PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 4, Pl. 1, Figs. 16-21.

Description. - Test elongate, initial biserial portion compressed and usually set at angle to rest of test which is rounded and more or less uniform in size throughout; biserial portion 1/3 to 1/5 of total length; chambers distinct, approximately 4 pairs in biserial portion, up to 6 pairs in uniserial portion; suture distinct, depressed; wall coarsely arenaceous with considerable variations in size of sand grains or calcareous fragments; aperture terminal, rounded, at end of short neck.

Genus TEXTULARIA Defrance, 1824
TEXTULARIA BARRETTII Jones and Parker

Textularia barrettii Jones and Parker. Cushman, 1922,
U. S Nat. Mus. Bull. 104, Pt. 3, p. 20, Pl. 3,
Fig. 3 (not 4, 5, 6).

Description. - Test medium size, tapering, about twice
as long as broad, very slightly compressed, broadest near
apertural end, apical end bluntly pointed, later portion
of test often with nearly straight sides; chambers dis-
tinct, numerous; sutures distinct, not depressed; wall
finely arenaceous with abundant cement, very smoothly fin-
ished; aperture a narrow slit at base of inner margin of
last chamber, sides of the chamber slightly projecting
beyond it on each side.

TEXTULARIA MAYORI Cushman

Textularia mayori Cushman, 1922, Carnegie Inst. Washing-
ton, Vol. 17, p. 23, Pl. 2, Fig. 3. - PHLEGER and
PARKER, 1951, Geol. Soc America, Mem. 46, Pt. II,
p. 5, Pl. 2, Fig. 5 (not 1-4).

Description. - Test medium elongate, club-shaped,
initial biserial portion compressed, narrow, edges almost
carinate, slightly tapering to round-pointed apex, later
chambers enlarging rapidly, much inflated; chambers
distinct, numerous (about 5 pairs); sutures distinct, depressed; wall coarsely arenaceous with considerable variation in size of sand grains; aperture in broad but shallow sinus at base of inner margin of chamber.

Subfamily PSEUDOBOLIVINAE Wiesner, 1931
Genus PLANCTOSTOMA Loeblich and Tappan, 1955
PLANCTOSTOMA ROLSHAUSENI (Phleger and Parker)
Siphotextularia rolshauseni PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. 2, p. 4, Pl. 1, Fig. 23 (not 24a,b).


Description. - Test small, slightly compressed, 1-1/2 to 2 times as long as broad, periphery rounded, lobulate; chambers distinct, inflated, about 5 pairs in biserial portion, with younger chambers larger than older and more or less rounded; sutures distinct, depressed, almost at right angle to central axis; wall finely arenaceous, smooth except for occasional projecting grains; aperture almost rounded with slightly raised lip.
Family NUBECULARIIDAE Jones, 1875
Subfamily SPIROLOCULINAE Wiesner, 1920
Genus SPIROLOCULINA d'Orbigny, 1826
SPIROLOCULINA TERQUEMIANA Fornasini

Spiroloculina terquemiana Fornasini, 1900, Mem. Accad. Sci., Inst. Bologna, Ser. 5, Vol. 8, p. 360, Fig. 3. — CUSHMAN, 1944, Cushman Lab. Foram. Research, Spec. Publ. No. 11, p. 43, Pl. 1, Fig. 19, Pl. 6, Figs. 25, 26.

Description. — Test large, longer than wide, thin, flat, periphery rounded, chambers distinct, almost a half coil in length, last two chambers rounded in cross-section, making outline of the test; sutures distinct, very slightly depressed; wall calcareous imperforate, smooth; aperture terminal, at end of distinct neck, with lip single simple tooth on inner margin.

Family MILIOLIDAE Ehrenberg, 1839
Subfamily QUINQUELOCULINAE Cushman, 1917
Genus MASSILINA Schlumberger, 1893
MASSILINA PERUVIANA (d'Orbigny)

Quinqueloculina peruviana (d'Orbigny), 1839, Voy. Amer. Merid., Vol. 5, Pt. 5, p. 73, Pl. 4, Figs. 1-3. 
Massilina peruviana (d'Orbigny), LEHMANN, 1957, Micropaleont., Vol. 3, No. 4, p. 346, Pl. 1, Fig. 13 (not figs. 12, 18).
Description. - Test large, planispiral; chambers few, early chambers close coiled, later with tip of apertural end standing away from previous chamber; sutures distinct; wall smooth, white, dull; apertural end of chamber produced to form elongate neck, which has a well-developed phialine lip and single simple tooth on inner margin of aperture which is flattened on inner side.

MASSILINA SP. aff. M. QUADRANS Cushman and Ponton


Description. - Test much compressed, only slightly longer than broad, periphery truncate in side view; chambers distinct, numerous, quadrate in transverse section, sides nearly parallel, periphery almost squarely truncate but with distinct keel; sutures very distinct, slightly depressed; wall smooth, shiny; aperture elongate oval with elongated tooth.

MASSILINA SPINATA Cushman and Ponton var. GLABRATA

Cushman and Ponton

Massilina spinata Cushman and Ponton var. glabrata.

CUSHMAN and PONTON, 1932, Fla. Geol. Survey, Bull No. 9, p. 49, Pl. 5, Figs. 7a,b.

Description. - Test large, elongate, slightly longer than wide, periphery rounded, sides convex; chambers
distinct, almost rounded in cross-section, greatest width near middle; sutures distinct, slightly depressed; wall smooth, white, dull; aperture semicircular, terminal, with simple tooth at tip, in front view projecting above border of aperture.

Remarks. - Variety differing from the typical in smooth surface.

Genus QUINQUELOCULINA d'Orbigny, 1826

QUINQUELOCULINA COMPTA Cushman

Quinqueloculina compta CUSHMAN, 1947, Cushman Lab. Foram. Res., Contr., Vol. 23, Pt. 4, p. 87, Pl. 19, Fig. 2.

Description. - Test small, elliptical or oval in end view, base broadly rounded, apertural end truncate; chambers fairly distinct, inflated, increasing rather rapidly in length and diameter as added; sutures distinct, very slightly depressed; wall calcareous imperforate, smooth; aperture rounded, terminal, with distinct lip.

QUINQUELOCULINA SP. aff. Q. FUNAFUTIENSIS (Chapman)

Quingueloculina funafutiensis (Chapman). Cushman, 1929, U. S. Nat. Mus., Bull. 104, Pt. 6, p. 30, Pl. 4, Figs. 4a,b.

Description. - Test large, free, about as long as wide, widest dimension at upper third of test, peripheral angles with a few oblique costae not highly developed; chambers distinct, curved, depressed, sides convex; sutures thin, distinct, slightly depressed; wall generally smooth, shiny; aperture large, rounded, not projecting above outline of test, with simple tooth.

Quingueloculina laevigata d'Orbigny

Quingueloculina laevigata d'Orbigny, Cushman, 1922, Carnegie Instit. Washington, Pub. 311, p. 65, Pl. 13, Fig. 2; 1929, U. S. Nat. Mus., Bull. 104, Pt. 6, p. 30, Pl. 4, Figs. 3a,c.

Description. - Test small, elongate, about twice as long as wide, periphery rounded, sides straight, chambers distinct, almost rounded in cross-section; sutures distinct, slightly depressed; wall not entirely smooth but shows slight traces of longitudinal costae; aperture small, rounded (no tooth in this specimen).
QUINQUELOCULINA sp. aff. Q. LAMARCKIANA d'Orbigny


?Quinqueloculina lamarckiana (d'Orbigny). LEHMANN, 1957, Micropaleont., Vol. 3, No. 4, p. 347, Pl. 1, Fig. 30 (not 28, 29).

Description. - Test large, nearly as broad as long, basal end broader than the apertural end; chambers distinct; generally triangular in transverse section, periphery sub-acute not carinate; sutures slightly depressed; wall smooth, shiny; apertural end of chamber slightly extended, forming elliptical neck with elongate tooth.

QUINQUELOCULINA sp. aff. Q. LATA Terquem


?Quinqueloculina lata Terquem. CUSHMAN, 1944, Cushman Lab. Foram. Research, Spec. Publ. No. 12, p. 14, Pl. 2, Fig. 16.
Description. - Test medium size, about twice as long as broad, slightly compressed, periphery subacute; apertural end not extending beyond main body of rest; chambers distinct, flattened, with some depressions on outer surface of last 2 chambers; sutures depressed; wall calcareous imperforate, smooth; aperture rounded, with lip and simple tooth in inner margin.

QUINQUELOCULINA POEYANA d'Orbigny

Quinqueloculina poeyana d'Orbigny, 1839, in De La Sagra, Hist. Phys. Pol. Nat. Cuba, Foram., p. 191, Pl. 11, Figs. 25-27. - Cushman, 1918, U. S. Geol. Survey, Bull. 676, p. 24, Pl. 6, Fig. 2; 1930, U. S. Nat. Mus., Pt. 7, Pl. 5, Fig. 2a-c. - LEHMANN, 1957, Micropaleont., Vol. 3, No. 4, p. 347, Pl. 1, Fig. 32 (not 31, 33).

Description. - Test medium size, slightly longer than wide, greatest width near middle; chambers distinct, of nearly uniform diameter, periphery rounded; sutures distinct, very slightly depressed; wall smooth, polished, shiny; aperture large, rounded, with simple tooth.
QUINQUELOCULINA sp. cf. Q. SEMINULUM (Linnaeus)


Description. - Test medium size, free, longer than wide, greatest width near middle; chambers distinct, of nearly uniform diameter, periphery rounded; sutures distinct; wall smooth, calcareous imperforate, polished; aperture rounded, large, with simple tooth.

QUINQUELOCULINA sp. aff. Q. VULGARIS d'Orbigny


Description. - Test large, stout, about as long as wide, slightly depressed, peripheral margin in last formed chambers broadly rounded; chambers distinct, overlapping, sides convex; sutures narrow, distinct, slightly depressed; wall thick, smooth, shiny; aperture terminal, circular, with small simple tooth.

QUINQUELOCULINA species

A number of eroded specimens have been encountered that are not specifically identifiable.

Genus SIGMOILINA Schlumberger, 1887

SIGMOILINA EDWARDSI (Schlumberger)


Description. - Test small, slightly longer than broad, somewhat sigmoidal in end view, periphery rounded to sub-acute; chambers fairly distinct; sutures flush, indistinct;
wall smooth, highly polished, aperture rounded, with very short simple tooth.

Genus TRILOCULINA d'Orbigny, 1826

TRILOCULINA sp. aff. T. ANCONENSIS Schultze


Description. - Test small, elongate, about two and one-half times as long as wide, periphery broadly rounded; chambers distinct, generally rounded in outline; sutures distinct, depressed; wall smooth, translucent, thin; aperture rounded, with flattened lip and simple tooth.

TRILOCULINA BREVIDENTATA Cushman

Triloculina brevidentata CUSHMAN, 1944, Cushman Lab. Foram. Research, Spec. Publ. No. 12, p. 16, Pl. 2, Fig. 25.

Description. - Test medium size, about twice as long as broad, periphery rounded, basal end broadly rounded, slightly larger than the apertural end, apertural end with short neck; chambers distinct, inflattened; sutures
distinct, very slightly depressed; wall smooth, polished; aperture large, semicircular, with short neck and short simple tooth.

TRILOCULINA FICHELIANA d'Orbigny


Description. - Test subcircular in front view, somewhat compressed, periphery rounded; chambers distinct; sutures slightly depressed; wall ornamented by numerous longitudinal costae; aperture semicircular, with bifid tooth in inner margin which in side view projects beyond outline of aperture.

TRILOCULINA TRICARINATA d'Orbigny


Triloculina tricarinata (d'Orbigny). CUSHMAN, 1929, U. S. Nat. Mus., Bull., Vol. 104, Pt. 6, p. 56, Pl. 13, Fig. 3c (not 3a, 3b).
Description. - Test large, somewhat longer than wide, in end view triangular, sides almost straight, angles of chambers sharp and almost carinate; sutures distinct, slightly depressed; wall smooth, polished, with vitreous luster; aperture large, rounded with narrow bifid tooth, variously angled in some specimens.

TRILOCULINA sp. aff. T. TRIGONULA (Lamarck)

?Miliola trigonula Lamarck, 1804, Ann. Mus., Vol. 5, No. 3, p. 351, Pl. 17, Fig. 4.


?Triloculina trigonula (Lamarck). CUSHMAN, 1929, U. S. Nat. Mus., Vol. 104, Pt. 6, p. 56, Pl. 13, Figs. 1a-c (not Pl. 12, Figs. 10, 11; Pl. 13, Fig. 2).

Description. - Test medium size, longer than wide, angles rounded, periphery broadly convex, in end view rounded triangular; sutures distinct, slightly depressed; wall smooth, polished; aperture rounded, with simple tooth in inner margin.

Remarks. - This specimen resembles Cushman's illustration, except that the Gulf specimen is much more compressed and slightly longer.
TRILOCULINA species

Description. - Test medium size, about as long as broad, periphery subactue, greatest width near middle, biconvex in side view; sutures distinct, slightly depressed; wall smooth, white, dull; aperture large, rounded, terminal, with simple tooth.

Family NODOSARIIDAE Ehrenberg, 1838
Subfamily NODOSARIINAE Ehrenberg, 1838
Genus LAGENA Walker and Jacob, 1798

LAGENA species

Description. - Test small, elongate, with long entosolenian neck, upper portion of test smooth, lower portion ornamented with very numerous closely-set longitudinal sulci; wall calcareous perforate, semitransparent, neck marked with longitudinal lines which extend a little way down test.

Family BOLIVINITIDAE Cushman, 1927
Genus BOLIVINA d'Orbigny, 1839

BOLIVINA species

Description. - Test medium size, elongate, about 3 times as long as broad, periphery subacute to rounded, early stage rapidly increasing in width as chambers added, after which sides become nearly parallel; chambers distinct, not strongly inflated, increasing very slightly in size as added,
about 9 chambers making up last half of test; sutures somewhat distinct, very slightly depressed; wall finely perforate, surface of early portion ornamented with very fine numerous longitudinal costae, later portion smooth; aperture slit-like.

**BOLIVINA SUBSPINESCENS** Cushman


*Bolivina subspinescens* (Cushman). PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 15, Pl. 7, Fig. 12 (not 11).

**Description.** - Test medium size, 2-1/2 to 3 times as long as broad, tapering, greatest breadth formed by last pair of chambers, periphery strongly lobate, broadly rounded; chambers distinct, much inflated, about as high as broad, of rather uniform shape throughout, increasing rather uniformly in size as added; sutures distinct, depressed, oblique, forming angle of less than 45° with horizontal; wall of upper portion of each chamber smooth, basal portion roughened, with short spine; aperture broadly oval.

**BOLIVINA TRANSLUCENS** Phleger and Parker

*Bolivina translucens* PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 15, Pl. 7, Figs. 13, 14a,b.
Description. - Test small, very slightly tapering, periphery rounded, slightly lobate; chambers numerous, increasing gradually in size as added, about 10 pairs in adult form, slightly inflated; sutures straight, narrow, very slightly oblique, slightly depressed; wall thin, translucent, lower half of chambers with conspicuous, rather fine perforations, upper portion with very fine perforations; aperture narrow.

Family BULIMINIDAE Jones, 1875
Subfamily BULIMININAE Jones, 1875
Genus BULIMINA d'Orbigny 1826
BULIMINA MARGINATA d'Orbigny

Bulimina marginata d'Orbigny, 1826, Ann. Sci., Nat., Vol. 7, p. 269, No. 4, Pl. 12, Figs. 10-12. - PHLEGER, 1960, Ecology and distribution of Recent foraminifera, p. 71, Pl. 2, Fig. 5.

Description. - Test small, 2-1/2 to 3 times as long as broad, initial end sometimes with small spine, consisting of 3 or 4 whorls, last whorl forming about 2/5 of test; chambers fairly distinct, those of each whorl slightly overhanging previous ones, chambers of last whorl somewhat inflated; sutures of last formed chambers distinct, depressed, earlier sutures indistinct; wall generally smooth, with short spines below margin of chambers pointing downward; aperture broken, apparently elongate, extending over apex of test.
Remarks. - This specimen is smaller than the typical, with more sharply undercut chambers.

Subfamily PAVONININAE Eimer and Fickert, 1899
Genus REUSSELLA Galloway, 1933
REUSSELLA ATLANTICA Cushman

Reussella spinulosa (Reuss) var. atlantica Cushman

Reussella atlantica Cushman. PHLEGER and PARKER, 1951,
Geol. Soc. America, Mem. 46, Pt. 2, p. 18, Pl. 8, Fig. 8.

Description. - Test medium size, free, pyramidal, three-sided, sides flat or slightly concave; chambers distinct, numerous, closely appressed, with flattened walls; sutures distinct, flush, slightly curved; diameter increasing toward apertural end, tapering toward initial end; wall thin, coarsely perforate; aperture at inner border of last formed chamber.

Family DISCORBIDAE Ehrenberg, 1838
Subfamily DISCORBINAE Ehrenberg, 1838
Genus BUCCELLA Anderson, 1952
BUCCELLA HANNAI (Phleger and Parker)

Epinoides hannai PHLEGER and PARKER 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 21, Pl. 10, Figs. 13a, b (not 11a,b).

**Description.** - Test medium size, about 3-1/2 whorls; periphery rounded; chambers distinct, 6-7 in last whorl, slightly inflated on ventral side; sutures distinct, narrow, sharply curved on dorsal side, straight on ventral side, depressed, filled with opaque amorphous material radiating from center; wall smooth, finely perforate except on radiating area on ventral side; aperture rounded, on ventral side.

**BUCCELLA sp. aff. B. HANNAI** (Phleger and Parker)

?Eponides hannai PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 21, Pl. 10, Figs. 14a,b (not 11a,b; 12a,b; 13a,b).


**Description.** - Test medium size, about 3-1/2 whorls, periphery acute, lobulate, not keeled; chambers distinct, 7 or 8 in last whorl, inflated on ventral side; sutures distinct, narrow, sharply curved on dorsal side, straight on ventral side, depressed, filled with opaque amorphous material radiating from center; wall smooth, finely perforate except in radiating area on ventral side; aperture narrow.
Remarks. - The species resembles *Eponides hannii* Phleger and Parker, the differences being the absence of the keel and the wider aperture.

Genus *DISCORBIS* Lamarck, 1804

*DISCORBIS* sp. aff. *D. COCOAENSIS* Cushman and Garrett

?*Discorbis subaraucana* (Cushman and Garrett.) CUSHMAN, 1935 (not 1922), U. S. Geol. Survey, Prof. Paper 181, p. 43, Pl. 18, Figs. 1a-c.


Description. - Test medium size, unequally biconvex, dorsal side more convex than ventral, ventral side slightly convex toward periphery, with central part flattened or even slightly concave, umbilicate, periphery rounded; chambers distinct, 7-8 chambers in last whorl, rapidly increasing in size as added, later chambers slightly inflated; sutures curved, earlier sutures strongly limbate, later sutures slightly depressed; wall distinctly perforate; aperture not definite, apparently elongate and slit-like.

*DISCORBIS FLORIDENSIS* Cushman

*Discorbis bertheloti* (d'Orbigny) var. *floridensis*

Cushman, 1931, U. S. Nat. Mus., Bull. 104, Pt. 8, p. 17, Pl. 3, Figs. 3-5.
Discorbis floridensis CUSHMAN (in part), 1951, Geol. Soc. Amer., Mem. 46, Pt. II, p. 20, Pl. 10, Figs. 7a,b (not 6a and b).

Description. - Test medium size, planoconvex, oval, much compressed, peripheral margin acute, dorsal surface nearly flat, ventral side somewhat convex; chambers about five to seven in final whorl, somewhat carinate at border; sutures slightly depressed, distinct; wall smooth, finely perforate; aperture a narrow slit at inner margin of chamber on ventral side.

Subfamily BAGGININAE Cushman, 1927

Genus CANCRIS DeMONTFORT, 1808
CANCRIS OBLONGA (Williamson)

Rotalia oblonga Williamson, 1858, Recent British foram., p. 51, Pl. 4, Figs. 98-100.

Cancris auricula Fichtel and Moll). Cushman, 1931, U. S. Nat. Mus. Bull. 104, Pt. 8, p. 72, Pl. 15, Fig. 1.

Cancris oblonga (Williamson). PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 20, Pl. 9, Figs. 17a,b (not 18, 19).

Description. - Test medium size, about 1-1/2 times as long as broad, about equally biconvex, periphery subacute with very slight keel of clear shell material; chambers uniform in shape, increasing rapidly in size as added, 7-8
in last whorl, acute on dorsal side with greatest height near distal end and tapering toward proximal end, slightly inflated on ventral side, earlier chambers showing small bosses at inner ends, overlapping so that last chamber comprises about half ventral surface of test; suture on dorsal side limbate and strongly curved, depressed and nearly radial on ventral side; wall smooth, finely perforate except for small oval clear area on ventral side at base of last chamber; aperture a low elongate opening on ventral side under lobe of last chamber.

Family ROTALIIDAE Ehrenberg, 1839
Subfamily ROTALIINAE Ehrenberg, 1839
Genus AMMONIA Brunich, 1772
AMMONIA BECCARII (Linnaeus)


*Discorbula ariminesis* Lamarck, 1816, Tabl. Encycl et. Meth, Pl. 466, Figs. 6a,b.


12, Figs. 1-7.

**Description.** - Test medium size, trochoid, 2-1/2 to 3 whorls; almost equally biconvex; chambers distinct, gradually increase in size as added, 7-9 chambers in last whorl; periphery broadly rounded; suture distinct on both sides, wide, slightly curved on dorsal side, straight, depressed, narrow on ventral side, especially around umbilicus, which ends in curved angular points in umbilical region; wall coarsely perforate, smooth; aperture small, rounded, half-way between umbilicus and periphery.

**AMMONIA BECCARI (Linnaeus) var. TEPIDA (Cushman)**


**Description.** - Test small, almost equally biconvex, dorsal side slightly more than ventral; chambers distinct, 6 chambers in last whorl; peripheral margin rounded; sutures slightly limbate above, ventrally much depressed toward umbilicus; chamber separated, forming angular, open space, end of chambers extended to a point; wall smooth, finely punctate; aperture narrow slit beneath inner angle of last chamber.
**AMMONIA BECCARII** (Linnaeus) var. **PARKINSONIANA** (d'Orbigny)

*Rosalina parkinsoniana* d'Orbigny, 1839, *in* De La Sagra.

*Rotalia beccarii* (Linnaeus) var. *parkinsoniana* (d'Orbigny). PHLEGER and PARKER 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 23, Pl. 12, Figs. 6a,b.

**Description.** - Test small, 3 whorls, biconvex; periphery slightly rounded; chambers distinct, 8 in last whorl, narrow, inflated on ventral side; sutures distinct, narrow, slightly curved on dorsal side, straight and depressed on ventral side; wall smooth, finely perforate, shiny on dorsal side, umbilicus with fairly large distinct boss; aperture small, slit like.

**AMMONIA ECUADORANA** (Cushman and Stevenson)

*Rotalia ecuadorana* CUSHMAN and STEVENSON, 1948, Cushman Lab. Foram. Research, Vol. 24, Pt. III, p. 65, Pl. 10, Fig. 17.

**Description.** - Test small, biconvex, dorsal side less strongly so, periphery slightly rounded to subacute, ventral side with central boss; chambers fairly distinct, 8 to 10 in last whorl, increasing very gradually in size as added; sutures distinct, somewhat depressed and nearly radial on the ventral side, dorsally nearly radial, not depressed; wall smooth; aperture on ventral border of last chamber.
AMMONIA PAUCILOCULATA (Phleger and Parker)

**Rotalia pauciloculata** Phleger and Parker, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 23, Pl. 12, Figs. 8a,b, 9a,b.

**Streblus pauciloculata** (Phleger and Parker). LEHMANN, 1957, Micropaleont., Vol. 3, No. 4, p. 349, Pl. 3, Fig. 32.

**Description.** - Test small, 2-1/2 to 3 whorls, biconvex, periphery subacute or very slightly rounded; chambers distinct, about 5 in last whorl, narrow, inflated on ventral side; sutures distinct, narrow slightly curved, depressed on ventral side, somewhat limbate on dorsal side, flush with surface; wall of dorsal side smooth, finely perforate, on ventral side roughened around open umbilicus, with small, irregular raised processes, roughness increased by irregular, rounded lip projecting into umbilicus from chambers outer part of ventral side smooth, with somewhat larger perforation than on dorsal side; aperture small.

AMMONIA ROLSHAUSENI (Cushman and Bermudez)

Description. - Test small, trochoide, biconvex, dorsal side slightly convex, ventral side more strongly so, periphery bluntly angular; chambers distinct, about 6 in last whorl, slightly inflated, increasing gradually and rather uniformly in size as added; sutures distinct, somewhat depressed, slightly curved, somewhat limbate; wall very finely perforate, thin, smooth; aperture a low opening on ventral border of last formed chamber.

Family ELPHIDIIDAE Galloway, 1933
Subfamily ELPHIDIINAE Galloway, 1933
Genus CRIBROELPHIDIDUM Cushman and Bronnimann 1948
CRIBROELPHIDIDUM sp. cf. C. KOEBOEENSIS (Le Roy)
?Cribroelphidium cf. koebeneensis (LeRoy). LEHMANN, 1957, Micropaleont., Vol. 3, No. 4, p. 348, Pt. 2, Fig. 23 (not 21, 22, 24).

Description. - Test small, free, planispiral, completely involute, umbilical region raised; chambers distinct, 11-12 chambers in last whorl; periphery rounded, smooth, sutures distinct, slightly curved, crossed by minute irregularly spaced holes; wall smooth, finely perforate; aperture consists of several scattered rounded holes.
Genus ELPHIDIUM DeMontfort, 1808

ELPHIDIUM sp. cf. E. ADVENUM (Cushman)


?Elphidium advenum (Cushman), LEHMANN, 1957, Micropaleont., Vol. 3, No. 4, p. 348, Pl. 2, Fig. 30.

Description. - Test small, involute, depressed, slightly elongate, umbilical region depressed, with boss, periphery rounded, slightly lobulate; chambers distinct, increased gradually in size as added, 10-11 chambers in last whorl; sutures depressed, becoming wider toward umbilical region, with very short retral processes; wall smooth, very finely perforate; aperture composed of several small rounded pores at base of septal face.

ELPHIDIUM ALVAREZIANUM (d'Orbigny)

Polystomella alvareziana d'Orbigny, 1839, Voy. Amer. Merid., Vol. 5, Pt. 5, p. 31, Pl. 3, Figs. 11-12.

Elphidium alvarezianum (d'Orbigny). CUSHMAN, 1929, U. S. Nat. Mus., Bull., Vol. 104, Pt. 7, p. 18, Pl. 7, Fig. 2 (not 1 or 3).

Description. - Test small, much compressed, periphery subacute, margin entire, even, sides nearly parallel in peripheral view, umbilical regions not umbonate; chambers not inflated, 10-11 in last whorl; sutures slightly
depressed, wide, marked by retral processes which are short and broad and about 7-8 in number; aperture composed of several rounded openings at base of septal face.

**ELPHIDIUM ARTICULATUM** (d'Orbigny)


**Description.** - Test small, free, involute, periphery rounded, margin slightly lobulate, sides nearly parallel in peripheral view, umbilical regions raised; chambers distinct, about 10 in last whorl, slightly inflated; sutures distinct, slightly depressed, marked by retral processes; aperture consists of several pores.

**Remarks.** - This species resembles d'Orbigny's species, except that the umbilical region is raised with a single boss.

**ELPHIDIUM sp. aff. E. BARTLETTI** Cushman


**Description.** - Test medium size, compressed, involute, free, periphery rounded, margin lobulate, umbilical regions depressed; chambers distinct, inflated, especially in latter
half of last whorl, 10-11 in number; sutures distinct, slightly depressed, occasionally with a slightly beaded appearance in early portion, retral processes numerous and very short, often hardly visible; wall smooth, very finely perforate; aperture composed of several small rounded pores along base of septal face.

**ELPHIDIUM** sp. aff. *E. CULEBRENSE* Cushman

*Elphidium culebrense* Cushman, 1936, Cushman Lab. Foram. Research, Contr., Vol. 12, Pt. 4, p. 80, Pl. 14, Fig. 4.

**Description.** - Test small, slightly elongate, elliptical in peripheral view, periphery rounded, umbilical region umbonate; chambers fairly distinct, not inflated, slightly curved, 12-13 chambers in last whorl; sutures distinct, slightly depressed; retral processes very short, not raised; wall smooth; aperture consists of several rounded openings at base of septal face.

**ELPHIDIUM DISCOIDALE** (d'Orbigny)


Description. - Test medium size, periphery subacute, sides convex in peripheral view, umbilical regions with large rounded boss, in peripheral view protruding strongly beyond outline of test; chambers distinct, averaging about 10 in last whorl; suture broadening toward inner end, marked also by short retral processes; wall smooth; aperture composed of several small rounded openings at base of septal face.

Remarks. - This species resembles Phleger and Parker's illustration, except that the umbilical region has a larger rounded boss, the sutures are more depressed, and the later chambers are more inflated.

ELPHIDIUM sp. aff. E. DISCOIDALE d'Orbigny


Description. - Test small, lenticular, involute, biconvex, periphery broadly rounded; chambers distinct, 8-9 in last whorl; chambers almost lacking inflation; umbilical region raised, umbonate filled with clear shell material; sutures distinct, very slightly depressed, curved, thin, with retral processes; wall smooth, almost transparent, distinctly
perforate; aperture composed of several small rounded pores at base of septal face.

ELPHIDIUM EXCAVATUM (Terquem)

Polystomella excavata Terquem, 1875, Essai class. Anim. Dunkerque, p. 25, Pl. 2, Figs. 2a-f.

Polystomella umbilicatula (not Walker and Jacob), Williamson. 1858, Rec. Foram. Gt. Britain, p. 42, Pl. 3, Fig. 81.

Elphidium excavatum (Terquem). CUSHMAN 1929, U S. Nat. Mus., Bull. 104, Pt. 7, p. 21, Pl. 8, Fig. 4 (not 1, 2, 3, 5, 6, 7).

Description. - Test small, compressed, periphery rounded, margin slightly lobulate, umbilical region slightly elevated, without boss; chambers few, 8-9 making last whorl, slightly inflated; sutures distinct, straight, very slightly depressed, marked by short retral processes with wide openings, 8-10 in number, wall smooth; aperture consists of row of openings at base of septal face.

ELPHIDIUM sp. cf. E. FIMBRIATULUM (Cushman)

?Polystomella fimbriatula Cushman, 1918, U. S. Geol. Surv., Bull. 676, p. 20, Pl. 8, Figs. 5a,b.

?Elphidium fimbriatum (Cushman). LEHMANN, 1957, Micropaleont., Vol. 3, No. 4, p. 348, Pl. 2, Fig. 36.
Description. - Test medium size, highly involute, slightly compressed, periphery subacute, margin entire, with narrow keel, greatest thickness in peripheral view at umbilical region, which is not inflated, about 15 chambers in last whorl; sutures distinct, limbate, raised, retral processes elongate, rod-like, occupying almost entire height of chamber; aperture a series of rounded openings at base of septal face.

**ELPHIDIUM GUNTERI** Cole

_Elphidium gunteri_ COLE, 1931, Fla. Geol. Survey, Bull. No. 6, p. 34, Pl. 4, Figs. 9, 10.

Description. - Test medium size, margin entire, broadly rounded, sides slightly convex in peripheral view, umbilical region with a group of irregular, slightly raised areas of clear shell material; chambers distinct, not inflated, about 14 in last coil; sutures not depressed, marked by slightly raised rectangular retral processes, which at base of chambers tend to fuse; wall smooth, shiny, distinctly and rather coarsely perforate; aperture composed of several rounded openings at base of septal face.

**ELPHIDIUM GUNTERI** Cole var. **GALVESTONENSE** Kornfeld

_Elphidium gunteri_ Cole var. _galvestonense_ Kornfeld, 1931, Stanford Univ., Geol. Dept., Contr. Vol. 1, No. 3, p. 87, Pl. 15, Figs. 1-3. - PHLEGER and

**Description.** - Test medium size, involute, depressed, periphery subacute, margin lobulate especially in latter part of last whorl, umbilical region raised; chambers distinct, increasing gradually in size as added, 10 in last whorl; sutures depressed, curved, with very short retral processes; wall smooth, translucent, finely perforate; aperture composed of several rounded pores at base of septal face.

**ELPHIDIUM GEORGIANUM** Cushman

*Elphidium georgianum* CUSHMAN, 1935, Cushman Lab. Foram. Research, Contr., Vol. 11, Pt. 4, p. 79, Pl. 12, Figs. 5a, b.

**Description.** - Test small, close coiled throughout, completely involute, umbonate, periphery subacute; chambers fairly distinct, about 12 in last whorl; sutures distinct, covered particularly toward periphery with about 10 retral processes; wall fairly thick, distinctly perforate; aperture consisting of a series of small at base of apertural face.

**ELPHIDIUM INCERTUM** (Williamson)

**Polystomella striata-punctata var. incerta** Williamson.


Description. - Test small, elongate, slightly compressed, periphery broadly rounded, margin of last two or three chambers lobulate, umbilical region slightly depressed; chambers few, usually less than 10 in last whorl; sutures distinct, mainly marked by openings which are in a single row, retral processes few and very short; inner margin of sutures slit-like; wall smooth, slightly thick; aperture consists of rounded pores at base of septal face.

**ELPHIDIUM** sp. aff. E. INCERTUM (Williamson)

?**Polystomella umbilicatula** var. incerta Williamson,


Remarks. - This species is quite like Elphidium incertum (Williamson), except that the umbilical region is slightly elevated with a single boss and the chambers are more inflated.

ELPHIDIUM INCERTUM (Williamson) var. MEXICANUM Kornfeld


Description. - Test small, involute, biconvex, periphery broadly rounded; chambers distinct, 9-10 in last whorl; sutures distinct, very slightly depressed, wide, straight, crossed by short retral processes; umbilical region raised, with a single boss; aperture consists of several small pores at base of apertural face.

Remarks. - This species resembles Williamson's, except that the sutures are more straight, and it has about 10 chambers instead of 12.
ELPHIDIUM LANIERI (d'Orbigny)


Elphidium lanieri (d'Orbigny). Cushman, 1929, U. S. Nat. Mus., Bull. 104, Pt. 7, p. 23, Pl. 9, Fig. 7a, b.

Description. - Test small, involute, periphery sub-acute, margin entire, not lobulate, sides convex in peripheral view giving a rhomboid outline to test, umbilical region with large rounded boss, in peripheral view forming greatest width of test but continuous with sides; chambers not inflated, distinct, 16-18 in last whorl; sutures not depressed, marked by 8-10 short retral processes; wall smooth, distinctly perforate, not transparent; aperture composed of several small pores at base of septal face.

ELPHIDIUM sp. aff. E. MATAGORDANUM (Kornfeld)

?Nonion depressula (Walker and Jacob) var. matagordana
Kornfeld, 1931, Stanford Univ., Dept. Geol., Contr., Vol. 1, No. 3, p. 87, Pl. 13, Fig. 2a-b.

Description. - Test small, compressed, involute, periphery subacute; chambers distinct, 8-9 in last whorl, increasing gradually in size as added; sutures distinct, slightly curved, narrow, flared toward umbilical region, crossed by very small pores; wall smooth, transparent; aperture composed of several small pores at base of septal face.

ELPHIDIUM POEYANUM (d'Orbigny)

Polystomella poeyana d'Orbigny, 1839, in De La Sagra, Hist. Phis. Pol. Nat. Cuba, Foram., p. 55, Pl. 6, Figs. 25, 26. - Cushman, 1922, Carnegie, Instit. Washington, Publ. 311, p. 55, Pl. 9, Fig. 9, 10.

Elphidium poeyanum (d'Orbigny). PHLEGER, 1960, in Shepard, Phleger and Van Andel, Rec. Sed., NW Gulf of Mexico, p. 298, Pl. 3, Fig. 17.

Description. - Test small, compressed, involute, slightly elongate, periphery broadly rounded, sides nearly parallel in peripheral view, umbilical region slightly depressed; chambers distinct, about 10-11 in last whorl, but variable, very slightly inflated; sutures slightly depressed, marked by very short broad retral processes; wall thin, translucent, smooth, finely perforate; aperture composed of several small rounded pores at base of septal face.
ELPHIDIUM TRANSLUCENS Natland


Description. - Test medium size, slightly compressed, periphery rounded, umbilical regions raised, proloculum visible through small central umbo of clear shell material; chambers distinct, 12-13 in last whorl; sutures curved, very slightly depressed, narrow, with very small retral processes; wall smooth, vitreous, finely perforate; aperture composed of several small rounded pores at base of septal face.

ELPHIDIUM species

Description. - Test small, lenticular, involute, bi-convex, periphery rounded; chambers distinct, 8-9 chambers in last whorl, chambers in general lacking inflation; umbilical region raised; sutures distinct, thin, curved, not depressed, crossed by 6-7 small rounded pores separated by irregular space; wall smooth, very finely perforate; aperture consists of small rounded pores at base of septal face.
Family HETEROHELICIDAE Cushman, 1927
Subfamily HETEROHELICINAE Cushman, 1927
Genus BIFARINA Parker and Jones, 1872
BIFARINA DECORATA Phleger and Parker

Bifarina decorata Phleger and Parker, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 12, Pl. 6, Fig. 10 (not 9a, b).

Description. - Test medium size, elongate, about 3 times as long as broad, 3 or 4 pairs of chambers in biserial portion, 5-6 chambers in uniserial part; chambers somewhat inflated; sutures indistinct in biserial portion, distinct, depressed, curved in uniserial portion; wall coarsely perforate, smooth in last formed chamber, throughout rest of test ornamented with very short, blunt spines or raised processes; aperture elliptical, with lip.

Family GLOBIGERINIDAE Carpenter, Parker and Jones, 1862
Subfamily GLOBIGERININAE Carpenter, Parker and Jones, 1862
Genus GLOBIGERINOIDES Cushman, 1927

Globigerinoides ruber (d'Orbigny), Cushman, 1927,

Description. - Test small, free, depressed trochoid, final chamber nearly spherical; initial coil indistinct, typically with 3 chambers in last whorl, final chambers rounded, oval with numerous coarse perforations; depressions from remnant spine sockets distinct, large in comparison to test; sutures narrow, depressed, distinct on final chambers; aperture large, simple, highly arched, at inner margin of chamber, with thin, smooth lip surrounding opening.

Family EPONIDIDAE Hofker, 1951
Genus EPONIDES DeMontfort, 1808
EPONIDES REGULARIS Phleger and Parker

Eponides regularis PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 21, Pl. 11, Figs. 4a,b (not 3a,b).

Description. - Test small, biconvex, dorsal side more convex than ventral, periphery subacute, umbilical region raised and with boss; chambers distinct, increasing gradually in size as added, 8 or 9 in last whorl, inflated especially on dorsal side; sutures almost straight on both ventral and dorsal side, very slightly depressed; wall
smooth, finely perforate, aperture a low arched opening on ventral side.

**EPONIDES sp. aff. E. REGULARIS** Phleger and Parker

*?Eponides regularis* PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 21, Pl. 11, Figs. 4a,b (not 3a,b).

**Description.** - Test medium size, sutures of the ventral side are slightly curved, not very well distinct, depressed near the umbilicus; umbilicus with single boss; aperture rounded at the end, the last chamber half-way between the umbilicus and periphery.

**EPONIDES species**

**Description.** - Test free, biconvex, ventral side more convex than dorsal side, periphery subacute; chambers distinct, about 7-8 in last whorl; suture thin, distinct, straight on both ventral and dorsal side, ventral sutures meet at base of a long umbilical plug; walls finely perforate, smooth; aperture an arched opening on ventral side.

Family CIBICIDIDAE Cushman, 1927

Subfamily CIBICIDINAE Cushman, 1927

Genus CIBICIDES DeMontfort, 1808

**CIBICIDES CONCENTRICUS** (Cushman)

*Truncatulina concentrica* Cushman, 1918, U. S. Geol. Survey, Bull. 676, p. 64, Pl. 21, Fig. 3; 1930,
Cibicides concentrica (Cushman). Cushman, 1931, U. S. Nat. Mus., Bull. 104, Pt. 8, p. 120, Pl. 22, Figs. 1, 2 (not 4a-c).

Cibicides concentricus (Cushman). PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 29, Pl. 15, Figs. 4la,b; 15a,b.

Description. - Test small, nearly planoconvex, dorsal side nearly flat, ventral side convex; periphery subcarinate to rounded; chambers distinct, 7-9 chambers in the last whorl, inner end on dorsal side with definite band about middle, more or less separated by a series of depressions; sutures deep on ventral side, limbate and flush on dorsal side; wall smooth, finely perforate; aperture dorsal, slit-like.

CIBICIDES sp. cf. C. CONCENTRICUS Cushman

?Truncatulina concentrica Cushman, 1918, U. S. Geol. Survey, Bull. 676, p. 64, Pl. 21, Fig. 3; 1930, Fla. Geol. Survey, Bull. 4, Pl. 12, Figs. 4a-c.

?Cibicides concentrica (Cushman). Cushman, 1931, U. S. Nat. Mus., Bull. 104, Pt. 8, p. 120, Pl. 22, Figs. 1, 2 (not 4a-c).

?Cibicides concentricus (Cushman). PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 29, Pl. 15, Figs. 4la,b; 15a,b.
Description. - Test medium size, planoconvex, ventral side convex, dorsal side nearly flat, periphery nearly rounded; chambers distinct, 7-8 in last whorl, inner end on dorsal side with a definite band about middle, almost separated by a series of depressions; sutures distinct, depressed on ventral side, limbate on dorsal side; wall smooth, finely perforate, not transparent; aperture small, arc-shaped.

Remarks. - The species differs from C. concentricus in its larger size, and the last chamber is distinctive.

CIBICIDES DEPRIMUS Phleger and Parker

Cibicides pseudounigeriana (Cushman), var. 10 (part), Cushman, 1931, U. S. Nat. Mus., Bull. 104, Pt. 8, p. 125, Pl. 23, Fig. 2 (not Fig. 1).

Cibicides deprimus PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 29, Pl. 15, Figs. 16a,b (not 17a,b).

Description. - Test medium size, irregularly planoconvex, periphery rounded; chambers distinct, 9-10 in last whorls, raised above umbilical area on involute side, overlapping edge of previous whorl on evolute side, giving depressed effect to central part of test; sutures thickly limbate and raised in early part of test, depressed on later portion; wall smooth, coarsely perforate; aperture small.
CIBICIDES sp. cf. C. 10 Cushman

?Cibicides pseudounqeriana (Cushman) var. io Cushman, 1931, U. S. Nat. Mus., Bull., Pt. 8, p. 125, Pl. 23, Fig. 1 (not Fig. 2).

?Cibicides io Cushman. PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 30, Pl. 16, Figs. 6a,b (not 5a,b).

Description. - Test partially involute, much compressed, plano-convex or moderately biconvex, dorsal side somewhat convex, ventral side flat or slightly convex, periphery rounded to subacute, not keeled; all chambers visible on dorsal side, earlier chambers quite indistinct, only those of last whorl visible ventrally; chambers elongate, increasing gradually in size as added; suture broadly curved, depressed limbate dorsally, less so ventrally; wall smooth, finely perforate; aperture a crescent-shaped slit extending slightly on both sides of test.

CIBICIDES species

Description. - Test small, plano-convex, periphery subacute to rounded, umbilical side convex, involute, dorsal side almost flat, evolute, umbilical region depressed; chambers not distinct, 8-10 in last whorl; sutures flush, depressed in later part of last whorl; wall smooth, very finely perforate, not transparent, aperture slit-like, in lower part of septal face.
Family CAUCASINIDAE N. K. ByKova, 1959
Subfamily FURSENKOININAE Loeblich and Tappan, 1961
Genus FURSENKOINA Loeblich and Tappan, 1961
FURSENKOINA PAUCILOCULATA (H. B. Brady)


Description. - Test small, elongate, about 2-1/2 times as long as broad, not compressed, early spirally twisted chambers irregular, elongate, with 2-3 biserial chambers, somewhat inflated; sutures distinct, slightly depressed, strongly oblique; wall smooth, finely perforate, aperture narrowly elliptical, with opening somewhat narrowed at base of chamber.

FURSENKOINA PONTONI (Cushman)

Virgulina squamosa d'Orbigny. Cushman, 1819, U. S. Nat. Mus., Bull. 103, p. 58, Pl. 21, Fig. 6.

Virgulina floridana (Cushman and Laiming) 1931, Jour. Pal., Vol. 5, p. 109, Pl. 12, Figs. 3a,b (not V. floridana Cushman, 1920).
Virgulina pontoni (Cushman) PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 19, Pl. 9, Figs. 10a,b.


Description. - Test medium size, elongate, about 3-1/2 times as long as broad, tapering, greatest breadth toward apertural end, somewhat compressed; chambers fairly numerous, elongate, slightly inflated; sutures distinct, depressed; wall smooth, finely perforate, aperture comparatively large and broad.

Fursenkoina spinicostata (Phleger and Parker)

Virgulina spinicostata PHLEGER and PARKER, Geol. Soc. America, Mem. 46, Pt. II, p. 19, Pl. 9, Figs. 11a,b.

Fursenkoina spinicostata (Phleger and Parker).


Description. - Test small, gradually tapering, broadest part near apertural end, triserial portion forms about 1/4 of length, usually with about 2 pairs of biserial chambers, periphery rounded, lobulate; chambers distinct, inflated; sutures narrow, depressed; wall of early chambers and lower part of last formed chambers ornamented by narrow low costae, remainder of wall finely perforate, thin; aperture broad, extending to base of chamber.
Family NONIONIDAE Schultze, 1854
Subfamily NONIONINAE Schultze, 1854
Genus NONION DeMotfort, 1808

NONION DEPRESSULUM (Walker and Jacob)

Nautilus depressulus Walker and Jacob, 1798, in Adam's Essays, Kannmacher's ed. p. 641, Pl. 14, Fig. 33.


Nonion depressulum (Walker and Jacob). Cushman, 1930, U. S. Nat. Mus., Bull., Vol. 104, Pt. 7, p. 3, Pl. 1, Fig. 5 (not 4, 6).

Description. - Test small, planispiral, completely involute, bilaterally symmetrical, periphery rounded, umbilical regions slightly excavated with single boss; chambers distinct, 9-10 in last whorl; sutures very slightly depressed, flush, generally limbate, fusing along umbilicus; wall smooth, finely perforate; aperture slit-like, at base of apertural face.

NONION DEPRESSULUM (Walker and Jacob) var. METAGORDANUM (Kornfeld)

Nonion depressula (Walker and Jacob) var. metagordanum
Kornfeld 1931, Stanford Univ., Geol. Dept., Contr., Vol. 1, No. 3, p. 83, Pl. 13, Figs. 2a,b. -
PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, p. 11, Pl. 5, Fig. 17.
Description. - Test small, biconvex, bilaterally symmetrical, involute except umbilicus deeply excavated, periphery very broadly rounded; chambers distinct, 8-9 in last whorl, inflated; sutures curved, flush, generally limbate, fusing along umbilicus to form a slight thickening but not raised above surface; wall smooth, finely perforate; aperture slit-like, between base of septal face and previous whorl.

Remarks. - This form is rare in the sample. The specimen compares closely with Kornfeld's figures, except that the chambers in the Gulf of Mexico specimen are slightly thinner.

NONION aff. GERMANICUM (Ehrenberg)


Description. - Test small, completely involute, planispiral, periphery rounded; chambers distinct, about 8-9 in last whorl, almost uniform in size and shape; sutures slightly depressed, limbate, thickened toward umbilical
region: wall smooth, distinctly but finely perforate, aperture a narrow slit at base of septal face.

**NONION GRATELOUPI (d'Orbigny)**


*Nonion grateloupi* (d'Orbigny). CUSHMAN, 1930, U. S. Nat. Mus., Bull., Vol. 104, Pt. 7, p. 10, Pl. 4, Fig. 2 (not 1, 3, 4).

**Description.** - Test medium size, planispiral, involute, in peripheral view sides nearly parallel, periphery rounded; chambers numerous, usually 10 to 11 in last whorl, increasing rapidly in length, especially in last few chambers; suture distinct, slightly depressed; wall smooth, finely perforate; aperture small, narrow at end of last chamber.

**Genus NONIONELLA** Cushman, 1926

**NONIONELLA ATLANTICA** Cushman

*Nonionella atlantica* Cushman, 1947, Cushman Lab. Foram. Res., Contr., Vol. 23, p. 90, Pt. 4, Pl. 20, Figs. 4, 5. - PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, Pt. II, p. 11, Pl. 5, Figs. 21a,b; 22a,b; 23a,b.
Description. - Test compressed, asymmetrical, periphery rounded, dorsal side showing earlier coils which are covered on ventral side; chambers numerous, about 11 in last whorl, slightly inflated, increasing gradually in size as added; sutures distinct, slightly depressed, very slightly curved, wall smooth except lobe on ventral side, somewhat papillate; aperture extending from periphery along ventral margin of last chamber.

NONIONELLA sp. cf. N. ATLANTICA (Cushman)


Remarks. - This species resembles Nonionella atlantica, except that it is slightly shorter and less compressed.

NONIONELLA sp. cf. N. OPIMA Cushman


Description. - Test medium size, asymmetrical, periphery broadly rounded; chambers distinct, increasing very rapidly in size as added, last chamber on ventral side forming more than half surface of test; sutures distinct, not depressed,
only slightly curved; wall smooth; aperture extending from periphery onto ventral side below overhanging extension of last chamber.

NONIONELLA species

Description. - Test longer than broad, compressed, slightly umbilicate; periphery rounded, chambers distinct, numerous, about 9 in last whorl, increasing somewhat in length as added, but changing very little in height, last chamber extending downward and filling umbilical region on dorsal side; sutures distinct, slightly curved, those of early portion limbate and slightly raised, later ones becoming flush and limbate character disappearing; wall smooth, very finely perforate; aperture a narrow slit at base of last chamber.

Family ALABAMINIDAE Hofker, 1951
Genus GYROIDINA d'Orbigny, 1826

GYROIDINA species

Description. - Test trochoid, plano-convex, dorsal side flattened, ventral side strongly convex, with deep umbilicus, periphery very slightly rounded; chambers numerous, distinct, 9-10 in last whorl; sutures distinct, limbate, on ventral side somewhat depressed around umbilicus and much less so near periphery, dorsal sutures, slightly oblique; wall smooth, thick, finely perforate; aperture an elongate slit at inner margin of ventral side.
Family ANOMALINIDAE Cushman, 1927
Subfamily ANOMALININAE Cushman, 1927
Genus ANOMALINA D'Orbigny, 1826

ANOMALINA species

Description. - Test small, nautiloid, nearly bilaterally symmetrical, almost equally biconcave but slightly more concave ventrally, subcircular in side view, periphery rounded, lobulate; chambers distinct, numerous, making up almost two whorls, inflated, enlarging gradually in size as added; sutures narrow, on both sides of test; wall thick, calcareous, strongly perforate; umbilicus broad; aperture a narrow curved slit at base of last chamber.

Genus HANZAWAIA Asano, 1944

HANZAWAI NITIDULA (Bandy)

Cibicidina basiloba (Cushman) var. nitidula Bandy, 1953, Jour. Paleo., Vol. 27, No. 2, p. 178, Pl. 22, Fig. 3.


Description. - Test planoconvex, involute, dorsal side flattened, ventral side moderately convex, periphery smooth in early part, slightly lobulate in later part of test; not keeled; chambers about 8 in last whorl, increasing rapidly in size as added; dorsal sutures arcuate, radial, limbate, flush, ventral sutures curved, limbate and raised
slightly in the early part, flush or slightly depressed in later portion of test; aperture a low arched opening.

**HANZAWAIA STRATTONI (Applin)**

*Truncatulina concentrica* Applin. Cushman, 1918, U. S. Geol. Survey, Bull. 676, p. 64, Pl. 21, Fig. 3.

*Truncatulina americana* Cushman var. *strattoni* (Applin), 1925 in Applin, Ellisor, and Kniker, Amer. Assoc. Petr. Geol., Bull., Vol. 9, No. 1, p. 99, Pl. 3, Fig. 3.

*Hanzawaia strattoni* (Applin). LEHMANN, 1957, Micropaleont., Vol. 3, No. 4, p. 349, Pl. 3, Fig. 41 (not 42, 43).

**Description.** - Test small, nearly plano-convex, dorsal side nearly flat, ventral side convex, periphery subacute, umbilical region with scattered small bosses; chambers distinct, 7-9 in last whorl, increasing very slightly in size as added; sutures distinct, deep on ventral side, slightly limbate and flush on dorsal side; wall smooth, finely perforate.
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VITA

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