RECENT FORAMINIFERA FROM THE SOUTHERN COAST OF PUERTO RICO

A Thesis

Presented to

the Faculty of the Department of Geology

the University of Houston

In Partial Fulfillment

of the Requirement for the Degree

Master of Science in Geology

---

by

Warren W. Brooks

May, 1971

RECENT FORAMINIFERA FROM THE SOUTHERN COAST OF RUERTO RICO

An Abstract of a Thesis

Presented to

the Faculty of the Department of Geology

the University of Houston

In Partial Fulfillment

of the Requirement for the Degree

Master of Science in Geology

---

by

Warren W. Brooks

May, 1971

RECENT FORAMINIFERA FROM THE SOUTHERN COAST OF PUERTO RICO

ABSTRACT

The narrow continental shelf along the southern coast of Puerto Rico is rich in a wide variety of tropical environments. Foraminiferal assemblages of the area reflect the patterns of species associations, controlled by the ecology and distribution of species in the Caribbean-Antilles province.

The collections of Recent Foraminifera in the study area from 36 sediment samples consist of 144 species belonging to 72 genera, of which 131 species are benthonic and 13 species are planktonic. Amphistegina gibbosa, Archaias angulatus, Quinqueloculina seminulum, and Discorbis rosea comprise over 50 percent of the total foraminiferal population, and 53 species comprise less than one percent. Three species are new: Quinqueloculina macelloconcha, Triloculina pyramidiforma, and Lenticulina kaczkae. A systematic study of all species of Foraminifera is included in this report.

An analysis of cluster patterns was determined based on Jaccard coefficients of association using presence/absence data. Six biotopes and eight biofacies were determined using cluster analysis. The environmental parameters controlling the biotopes are salinity variations and wave agitation in the nearshore area, sediment distribution and wave agitation on the shallow shelf, and cool temperatures and moderately

quiet waters on the outer shelf platform. The biofacies patterns do not correspond to the assemblages that characterize the biotopes.

Comparison of the patterns of distribution of Recent Foraminifera from the study area with Recent distributions in other areas of the Caribbean-Antilles region reflect the basic similarity of the faunal assemblages.

TABLE OF CONTENTS

TEXT-FIGURES

TABLES

PLATES

INTRODUCTION

The taxonomic relationships among the Foraminifera of the Caribbean-Antilles province are not well understood, even though the main elements of the rich and diverse foraminiferal assemblages in this region have been known since the time of d'Orbigny (1839). Many local studies will be necessary for future understanding of foraminiferal biogeography of the Caribbean-Antilles province. The purpose of this study is to document fully the foraminiferal associations of one small locality along the south central coast of Puerto Rico. The complete systematic treatment of 144 species from the study area is a major part of this report.

In addition, the patterns of consistent species associations have been mapped. These patterns have been compared with other regions in order to understand the factors controlling foraminiferal ecology and species distribution in the Caribbean region. The distribution studies were accomplished by the use of cluster analysis with presence/absence data. This method has been applied successfully by Kaesler (1966), Maddocks (1966), Valentine (1966), and others demonstrating its usefulness in paleoecological and biostratigraphical studies.

Previous Investigations

Most species of Foraminifera in the Caribbean-Antilles region have been described and named; however, the systematic work that has been done is in need of revision by modern taxonomic methods. The first systematic study of Recent Foraminifera in the Caribbean was by d'Orbigny (1839) and consists of 117 species collected from Cuba, Jamaica, and islands of the Lesser Antilles. Recent and fossil Foraminifera from Jamaica were reported by Jones and Parker (1863, 1876). Their studies resulted in a species list of eleven fossil and thirty-seven Recent Foraminifera. Brady (1884) described the Foraminifera that were collected during the Challenger Expedition (1873 to 1876). One of the most significant contributions of Brady's work was 184 plates of illustrations. Barker (1960) has reproduced these plates with some revisions concerning classification of some of the species. Flint (1899) also illustrated Recent Foraminifera from the Caribbean. His descriptions and illustrations, which include 80 plates, were of specimens recovered during the cruise of the U.S. Fish Commission Steamer Albatross. From 1918 to 1931, Cushman published a monograph in eight parts covering the Recent Foraminifera of the Atlantic Ocean. These studies provided good descriptions and illustrations of a large group of Foraminifera from the Atlantic Ocean and of the Caribbean-Antilles region. He described many new species and revised several previously named species. While all these studies provided a necessary taxonomic background, much revision by modern taxonomic methods is necessary.

Numerous studies have been provided on specific geographic areas within

the Caribbean-Antilles province. Bermudez (1935) described Recent Foraminifera of the northern coast of Cuba. Bermudez (1949) also described and illustrated Tertiary Foraminifera of the Dominican Republic. Phleger and Parker (1951) discussed the distribution and described and illustrated Recent Foraminifera of the Gulf of Mexico. Todd and Bronnimann (1957) described and illustrated Recent Foraminifera from the Gulf of Paria, Trinidad, that included several new species. Drooger and Kaasschieter (1958) identified and illustrated over 175 species, subspecies, and varieties of Foraminifera of the Orinoco-Trinidad-Paria shelf. They also distinguished several distinct faunal provinces and biotopes, each of which has its characteristic species. Bermudez and Seiglie (1963) described and illustrated 205 species of Recent Foraminifera from the Gulf of Cariaco, Venezuela, of which sixteen species are new.

In addition to these studies, several more specific papers concerning descriptions of one or two species or faunal lists provide pertinent information. Systematic works of Recent Foraminifera are available for the Bahama Islands (Acosta, 1940a),Cuba (Acosta, 1939, 1940b; Bermudez 1934, 1938, 1939; Bermudez and Acosta, 1940; Bermudez and Key, 1952; Cushman and Bermudez, 1945; Lalicker and Bermudez, 1941); Florida (Cushman, 1922b, 1947; Lynts, 1965; Stubbs, 1940); Jamaica (Bermudez, 1937; Cushman, 1921); Trinidad and the Lesser Antilles (Broeck, 1876; Cushman and Bronnimann, 1948; Hofker, 1964; Saunders, 1957, 1959); and Venezuela (Bermudez, 1964; Hedberg, 1934; Seiglie, 1964, 1965, 1966). These studies have added in varying degrees to the knowledge of Caribbean faunal composition.

Systematic studies of Recent Foraminifera of Puerto Rico are sparse. Flint (1902) published a brief faunal list from ten stations on the northern coast of Puerto Rico. Cushman (1926) studied Recent Foraminifera from eight stations in San Juan Harbor and one station in Ponce. He described one new species and listed the remaining Foraminifera from all stations. Cushman (1935) described fourteen new species from the area of stations 23 and 24 of the Challenger Expedition, off the northern coast of Puerto Rico.

The distribution of Recent Foraminifera in the Caribbean-Antilles region has been studied by very few writers, but in all cases only a qualitative or semi-quantitative approach has been undertaken. Stubbs (1940) studied the distribution of Foraminifera from Biscayne Bay in Florida in which he noted the dominance of the Miliolacea. Illings (1950, 1952) discussed the mechanical distribution of sediments and the distribution of certain Foraminifera within the littoral zone of the Bahama Banks sediments. Moore (1957) described the foraminiferal environments of the northern Florida Keys area in terms of the relative abundance and distribution of the families present. Cebulski (1961) studied the living and total foraminiferal populations from the British Honduras shelf. He recognized two distinct faunas, one characteristic of the lagoon and the other of the barrier reef. Lynts (1962, 1966) studied the distribution of Recent Foraminifera and discussed the variations of the foraminiferal standing crop over short lateral distances in Florida Bay. Benda and Puri (1962) defined four benthonic assemblages in the Cape Romano area of Florida which correspond to four vaguely defined environments based on the patterns of distribution of Recent Foraminifera and Ostracoda. Seiglie and Bermudez

(1963) studied the distribution of 205 species of Recent Foraminifera from the Gulf of Cariaco, Venezuela. Wilcoxin (1964) discussed the distribution of Foraminifera of the southern Atlantic coast from North Carolina to Florida. Bandy (1964) studied the foraminiferal biofacies of the Gulf of Batabano, Cuba, and he recognized three separate benthonic foraminiferal biofacies. Lidz and Lidz (1965) found two biofacies, a mixed biofacies of Ammonia beccarii group and an Elphidium-miliolid group, and a fossil foraminiferal biofacies in the reefs off Veracruz, Mexico. Seiglie (1966) studied the distribution of more than 400 species of benthonic Foraminifera and 25 species of planktonic Foraminifera from the sediments of Araya-Los Testigos shelf and upper slope on the northern coast of Venezuela. He recognized twelve faunal assemblages in which he indicated a close relationship between the distribution of the Foraminifera and the distribution of the sediments. Wantland (1969) described the different faunas of the coastal lagoons of British Honduras and related them to the sediments and hydrography.

The distribution of Recent Foraminifera of the southeastern coast of Puerto Rico was studied by Seiglie (1970). He determined four foraminiferal facies from Yabucoa Bay in southeastern Puerto Rico. His glauconitized and goethitized facies is considered to be useful in the comparison of present and fossil environments. Seiglie also has in press a report on the distribution of Foraminifera of Cabo Rojo paltform in southwestern Puerto Rico and their paleoecological significance, and another concerning the distribution of Foraminifera in Mayagues and Anasco Bays, Puerto Rico.

Quantitative techniques of distribution using cluster analysis applied to the study of ecology have increased through the application of the high-speed digital computer. Kaesler (1966) applied this technique in his study of the re-evaluation of biofacies analysis by Walton (1955) and Benson (1959) of Recent Foraminifera and Ostracoda of Todos Santos Bay, Mexico. Maddocks (1966) compared the distribution patterns of living and sub-fossil podocopid ostracodes of Nosy Be, Madagascar. Valentine (1966) applied numerical analysis to the molluscs off the northern Pacific shelf from California to Alaska. Mello and Buzas (1968) applied cluster analysis as a method of determining biofacies in a re-evaluation of a work by Phleger (1956) of the Recent Foraminifera off the central Texas coast. Cairns and Kaesler (1969) applied cluster analysis to living protozoans in the Potomac River.

Regional Setting

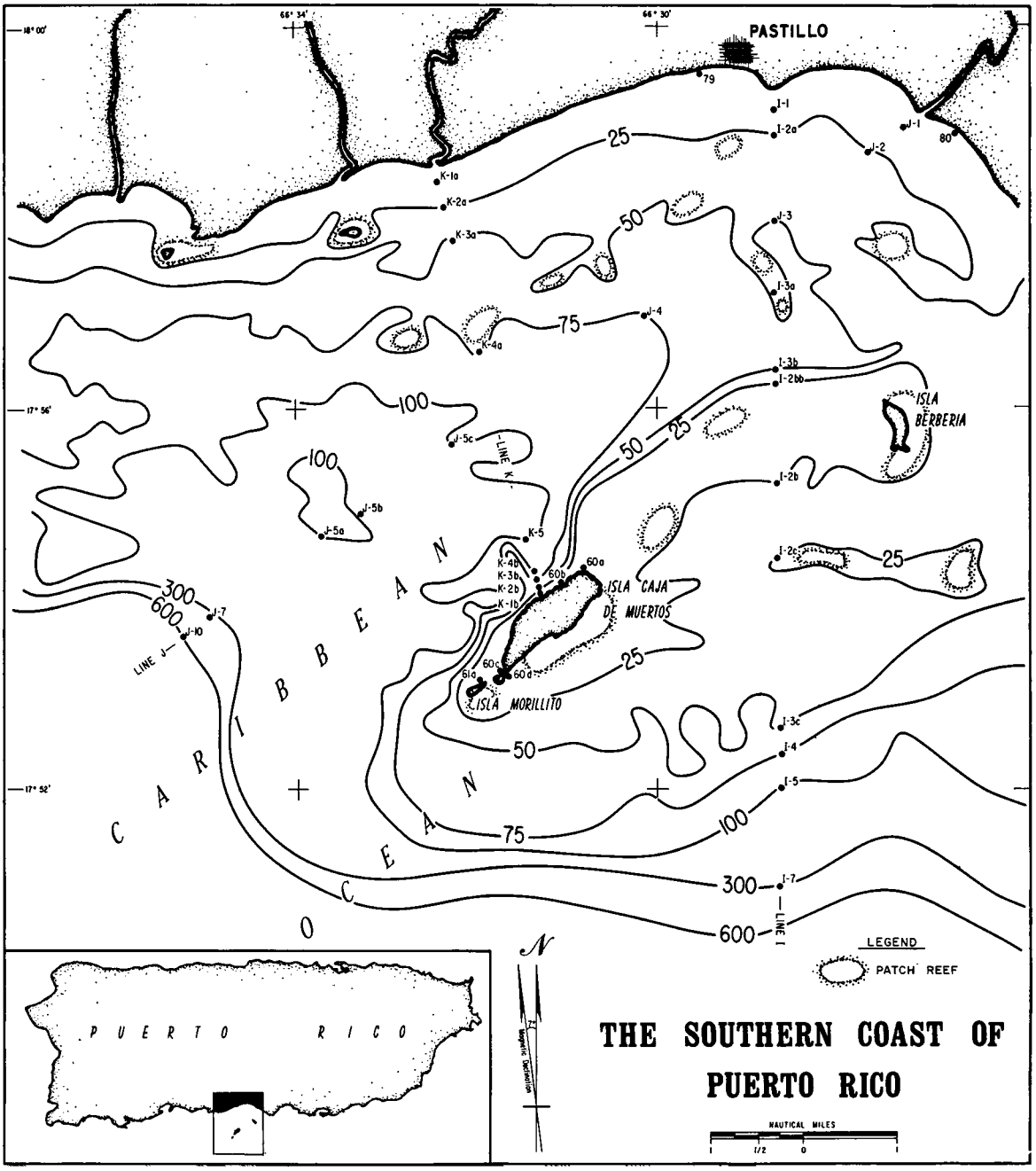
Puerto Rico is an island approximately 100 miles long and 40 miles wide, located in the northeastern portion of the Caribbean Ocean. The area of investigation lies on the south central coast of the island of Puerto Rico near the city of Ponce (Text-figure 1) between 17°50' and 18°00' North Latitude and 66°26' and 66°36' West Longitude. The continental shelf is very narrow along this coast, having a minimum width of four and a maximum width of eight miles. The Isla Caja de Muerto and Isla Morillito lie about five miles offshore. Isla Berberia lies about two miles offshore, to the east of the other two islands.

Currents off the southern coast are dominated by the Antilles Current, which is part of the North Equatorial Current. The warm equatorial currents flow along the southern coast moving from east to west and from south to north. The south coast is affected less directly by the currents and waves because of the abundant patch reefs and shoals that protect it, resulting in an irregular bottom topography (Kaye, 1959.)

The marine sediments in the Ponce area are predominantly carbonate sands and gravels derived from the patch and barrier reefs to the east. However, onshore, the rock fragments that make up the sediments in the nearshore environment are predominantly quartz arenite, litharenite, and arkose which have been deposited at and near the river mouths and extend only a very short distance away from the rivers. These fine terrigeneous sediments grade rapidly into the carbonate sediments composed of bioclastic sand and gravel, calcareous sand, skeletal

TEXT-FIGURE 1

Location of sample stations, patch reefs, and bathymetry (in feet)

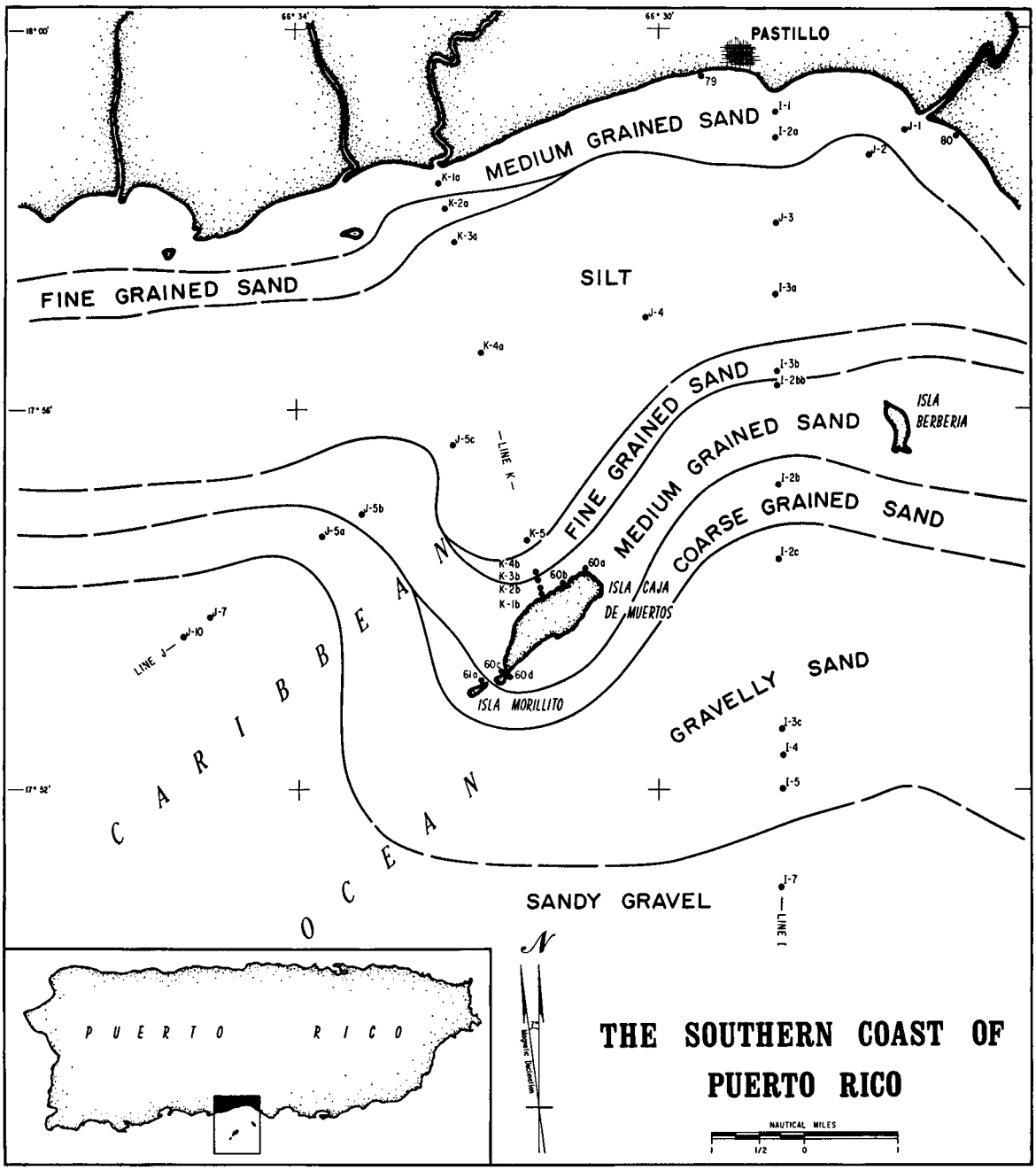

PASTILLO
ISLA BERBERIA
ISLA CAJA DE MUERTOS
ISLA MORILLITO
LINE K
LINE J
LINE I
CARIBBEAN SEA
PUERTO RICO
LEGEND
PATCH REEF
NAUTICAL MILES
THE SOUTHERN COAST OF PUERTO RICO

fragments, and reef material (Text-figure 2). The bottom topography, wave action, and currents apparently exert a strong control on the distribution of the sediment types. Carbonate gravelly sand and sandy gravel are found on the outer shelf and represent an area of non-deposition, which is most likely a relic Pleistocene reef connected with the last low-stand of sea-level.

Available salinity and temperature measurements are sparse but their distribution appears variable. The south coast has slightly lower salinities than other areas of Puerto Rico, and this can be explained by the continental dilution by drainage from the rivers into the calm shoal waters. Temperatures range from an average of 29°C at the surface to 20°C at 200 meters below sea-level (Wüst, 1964.)

TEXT-FIGURE 2

Sediment distribution map



THE SOUTHERN COAST OF PUERTO RICO

Methods of Study

Drs. Dan Feray and Neil Hulings collected the samples during the summer of 1963 under National Science Foundation Grant GP-1183. The purpose of their work was to study the role of tectonics and environmental factors in the origin and distribution of the sediments of Puerto Rico. They collected the samples with a "bucket" dredge constructed from a steel casing ten inches in diameter and 18 inches long. The bucket was pulled along the bottom at each station locality for a variable length of time (Feray, personal communication).

The 36 samples used in this study were collected on the south central coast and consist of three lines of profile (I, J, and K) leading away from the beach; they were collected at depths of 10, 25, 50, 75, 100, 300, and 600 feet. Seven beach samples were also collected from various locations in the area.

The samples were washed on a number 200 U.S. Standard Sieve to eliminate the clay and allowed to dry. Representative cuts of 5 to 10 mg. were taken from each sample, and all of the Foraminifera in the cut were picked and transferred to micropaleontological slides and identified. As the samples were not stained with Rose Bengal at the time of collection, the population is considered a death assemblage.

Total population counts for each sample range from 199 to 1206 specimens. Identifiable fragments of greater than 50 percent of the specimen were

counted as whole specimens. The total foraminiferal population in the sediment samples number over 16,000 specimens, belonging to 72 genera and 144 species. Of these, four species, Amphistegina gibbosa, Archaisas angulatus, Quiqueloculina seminulum, and Discorbis rosea comprise over 50 percent of the total population. Twenty-nine species are represented by single specimens and twenty-four additional species are rare or very rare. These 53 species together comprise less than one percent of the total population. Thirteen planktonic species are restricted to the deep water of 300 to 600 feet, and 131 benthonic species are found throughout the area at all depths and in all biotopes.

ACKNOWLEDGEMENTS

The writer wishes to thank Dr. Rosalie F. Maddocks for her generous help and encouragement during this project. Dr. Dan Feray loaned the sediment samples used during this study and Union Oil Company of California contributed major financial support and materials for the preparation of this paper. Dr. John C. Butler of the Department of Geology and Dr. Edwin H. Bryant of the Department of Biology of the University of Houston offered valuable assistance and constructive advice during the project. Dr. Lukas Hottinger of the Paleontological Institute, Bernoullianum, Basle, Switzerland and Mr. James H. Baker of the University of Houston were very helpful, and many of the ideas put forth were stimulated in discussions with these individuals. Appreciation is also expressed to Mr. Glen Fisher of the University of Houston and Mr. Clarence Zaozirny of Getty Oil Company for their help with the revision of the computer program. The Department of Geology of the University of Houston provided laboratory facilities and computer time. Mrs. Dolly Fulsom typed the numerous drafts of the manuscript and Mr. David Avery offered suggestions in the preparation of the illustrations.

QUANTITATIVE DISTRIBUTION ANALYSIS

The purpose of a distributional study of Recent Foraminifera is the discovery of meaningful patterns of association between species. Analysis of biofacies is the recognition of these patterns of association. If biofacies analysis is to be applicable to interpretation of the past, the biotopes and biofacies should be established from data on distribution of the Foraminifera and then interpreted empirically on the relationships of the distribution to environmental parameters.

Kaesler (1966) pointed out that both biofacies and biotopes can clearly be determined by cluster analysis. He defined biotope as "an area of uniform environmental conditions as evidenced by a particular fauna found in the area and adapted to the environmental conditions of the area." He defined biofacies, in reference to Recent organisms, as a "group of organisms found together and presumably adapted to environmental conditions in their place of occurrence, such groups differing from contemporary assemblages found in different environments." He also stated that a biofacies analysis is "the study of assemblages of organisms, their areal and chronologic distribution, and environmental factors that affect them." These definitions provide a working hypothesis for paleocological and ecological interpretations. The environmental factors that determine the assemblages of organisms can be recognized by determining the assemblages of the organisms throughout the area.

Choice of Coefficients

Numerous coefficients of association have been applied in recent years (Cheetham and Hazel, 1969, p. 1131-1134) to delimit similarity between areas and species. As the samples in this study area were collected with a bucket dredge, and as no attempt was made to use precise quantitative sampling methods, these data are most appropriate for a presence/absence or two-state association coefficient, rather than a more rigorous coefficient.

The Jaccard coefficient (Jaccard, 1908; Sneath, 1957) and Sokal and Michener's coefficient of association (Sokal and Michener, 1958) are two coefficients that are well adapted to an analysis of presence/absence data. The Jaccard coefficient (Sj) compares the frequencies of matches (present at both stations) and mismatches (present at one, absent at another) and ignores negative matches (absent at both stations) as shown in the following equation.

$$Sj = \frac{p}{p + m}$$

where p = frequency of positive matches

m = frequency of mismatches

Sokal and Michener's coefficient of association (Ssm) on the other hand, not only includes positive matches and mismatches, but also includes the frequency of negative matches.

$$Ssm = \frac{p + n}{p + n + m}$$

where p and m as above

n = frequency of negative matches

Kaesler (1966, p. 31) favored the Jaccard coefficient for biofacies analysis because the absence of two species provides no useful information for clustering species into biofacies and, therefore, negative matches should be ignored. He included the negative matches for biotope analysis, as two stations with similar absences indicate a mutual similarity between the two stations.

The Jaccard coefficient is used in this study for biotope and biofacies analysis. Most of the species in this area are rare or very rare, and the use of Sokal and Michener's coefficient, including species jointly absent from an area, results in an unnaturally high level of similarity. This was pointed out by Maddocks (1966) in her study of Nosy Be, which is a very diverse area with most species occurring at only a few of the many stations sampled.

Clustering Methods

The data on which this analysis is based are the distribution of Foraminifera at all stations. The stations are compared on the basis of the joint occurrence of foraminiferal species at each station (Q-mode). The species of Foraminifera are then compared with each other on their joint occurrence throughout the stations (R-mode). The result in either case is a matrix of similarity coefficients, one for each pair-comparison. The resulting matrix of similarity coefficients was subjected to cluster analysis.

The results of clustering are displayed as a dendrogram, which is a two-dimensional hierarchical diagram. The difficulty in using a hierarchical diagram to display levels of similarity is that once two items (stations or species) are paired, they are then pooled for subsequent comparisons with other items. Thus, dendrograms force objects into heirarchical groups, even though these groups may not exist in nature. Previous studies have shown the highest fidelity between dendrogram representations and the original pair-wise similarity matrix, both empirically (Sokal and Rohlf, 1962) and analytically (Farris, 1969) is achieved by use of the Unweighted Pair Group Method. It is the most reliable method for minimizing distortion during clustering.

The clusters visible on the resulting diagram may be interpreted as biotopes (station groups) or biofacies (species groups), but the number of clusters and the level of similarity characterizing the clusters are a matter of individual interpretation. Thus this method provides an

objective and replicable evaluation of similarities without imposing arbitrary interpretations and conclusions.

The clustering method used in this study is an analysis of similarity using Jaccard coefficients of association and the Unweighted Pair Group Method for cluster analysis. Observations of each species are recorded in a two-state form as presence or absence at each station. The computations were carried out using a computer program written by Bonham-Carter (1967) and subsequently modified by the writer for use on a Univac 1108 digital computer. The species counts from which the presence/absence data were taken and a copy of the modified computer program is stored with the Department of Geology at the University of Houston. This information can be obtained on request.

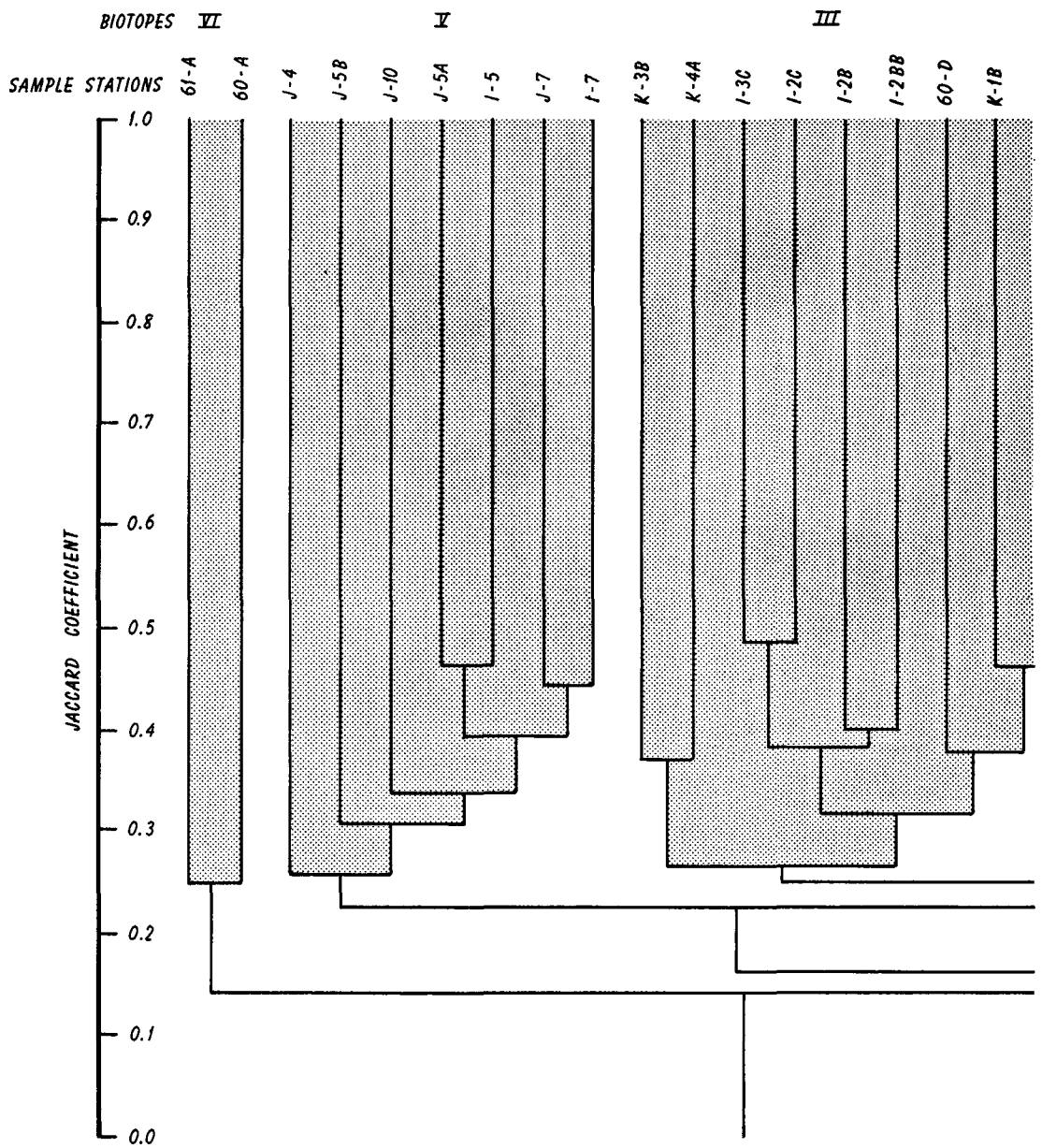
Determination of Biotopes

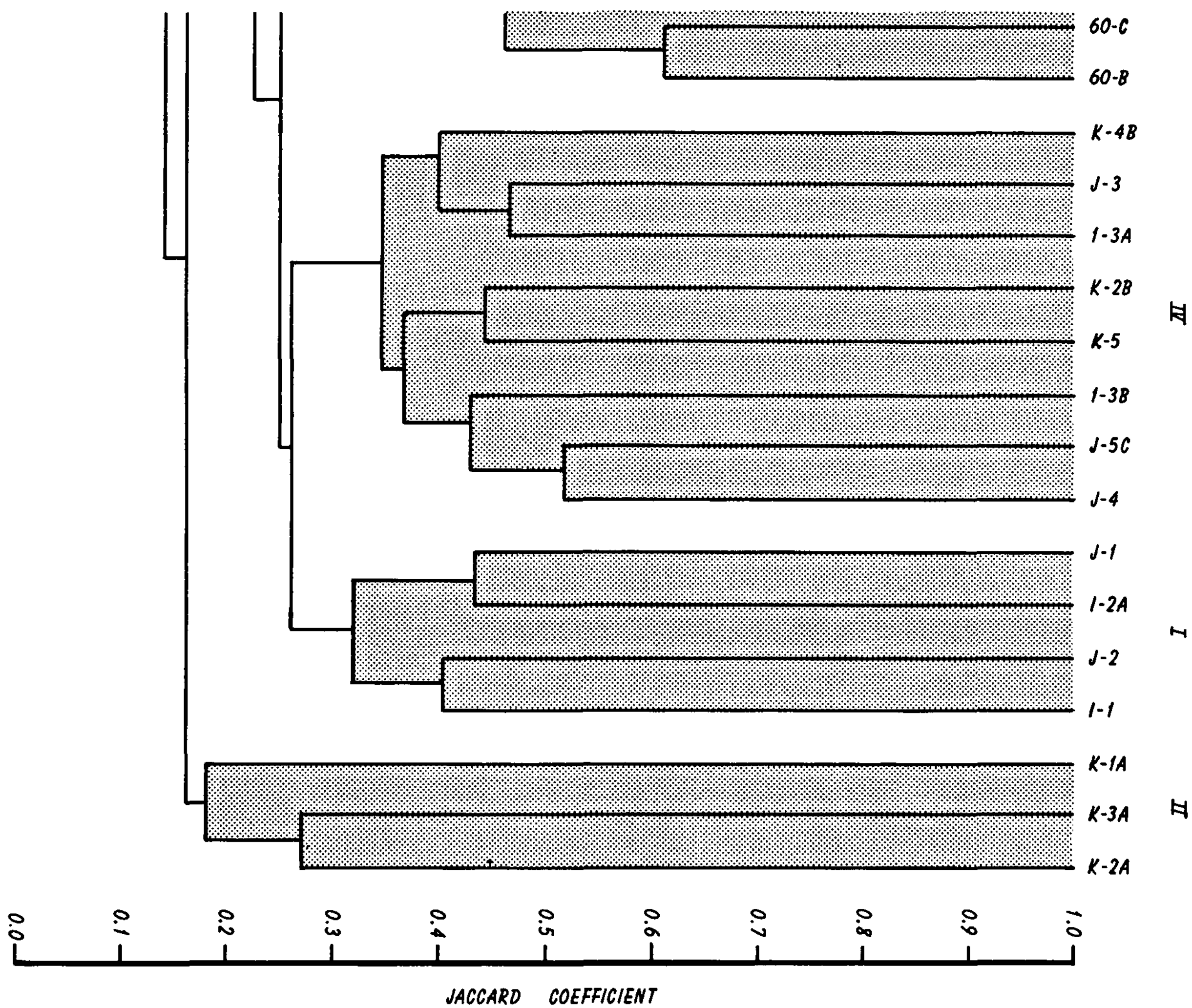
A total of 34 of the 36 sample stations were clustered together on the basis of occurrence or nonoccurrence of 115 foraminiferal species. The two extra stations, 79 and 80 near the village of Pastillo, are barren of Foraminifera and, therefore, are excluded from this study. 115 of the total of 144 species are used. The 29 species omitted from the cluster analysis are those species represented by single specimens. In theory all species should be used, but for practical purposes the species that occur one time only are omitted. The writer feels that the ecological conditions are best reflected by the distribution of the abundant species. The results of this analysis are shown in the dendrogram in Text-figure 3. Six biotope clusters are recognized at the 0.25 level of similarity. This level was chosen on the basis of the natural clusters of the dendrogram and on the writer's opinion that the clusters adequately reflect the biotopes that exist in the area. The shaded portions of the dendrogram represent the writer's interpretation of the biotopes, but it should not be inferred that this is the only interpretation. An attempt to determine the biotopes using Sokal and Michener's coefficient of association and the Unweighted Pair Group Method showed markedly less distinct clusters, and the dendrogram is not reproduced here. Text-figure 4 is a map of the resulting biotopes.

Biotope I is located along the mainland margin and is represented by sample stations I-1, I-2a, J-1, and J-2. These stations are in water depths to 10 to 25 feet, and the sediment is a dark ray, medium-grained quartzose sand that grades seaward into carbonate silt. The Rio

TEXT-FIGURE 3

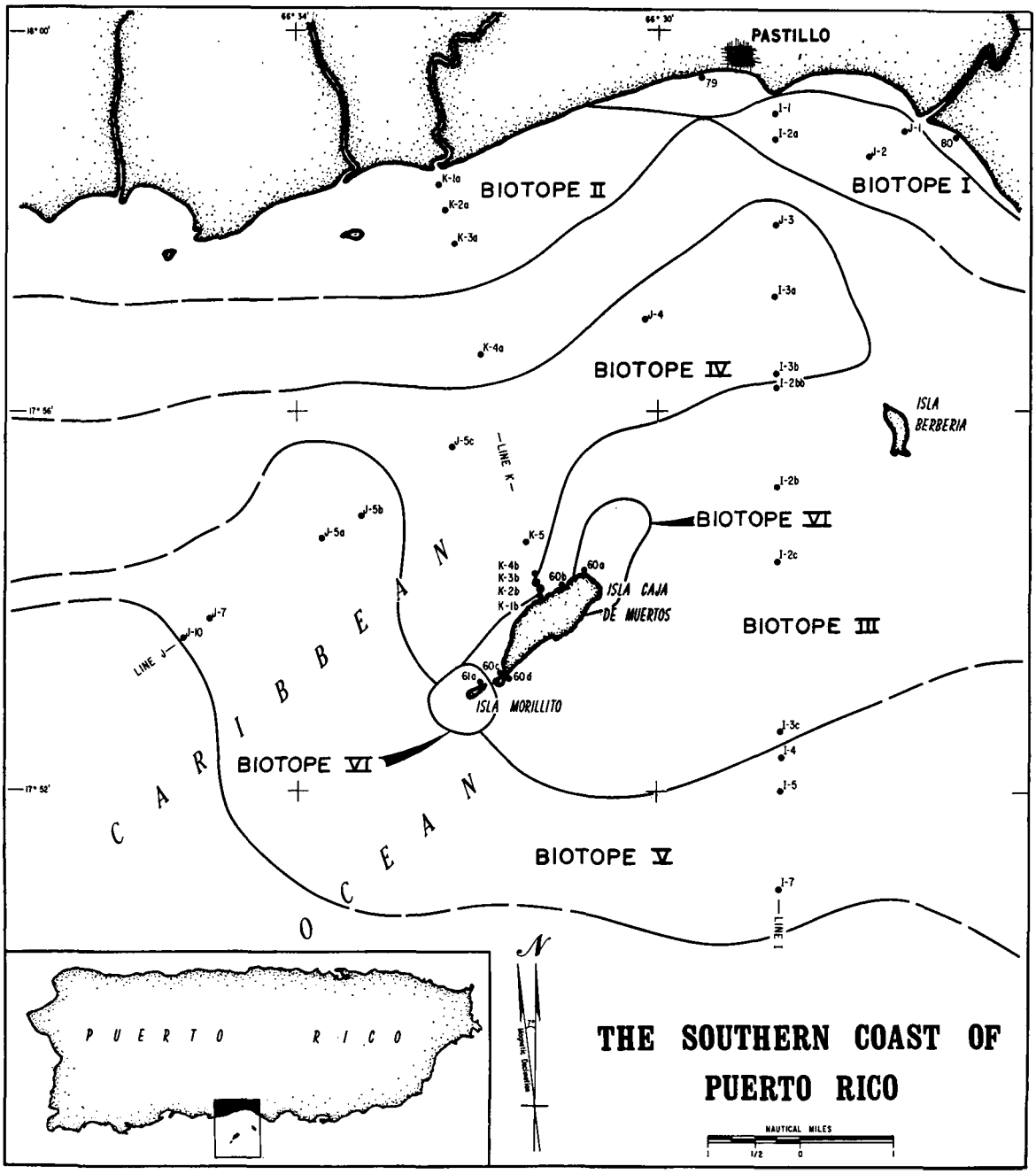
Dendrogram (UPGMA) based on Jaccard coefficients of association computed from occurrence data for species of Foraminifera, Q-mode.


BIOTOPES VII V III
SAMPLE STATIONS 61-A 60-A J-4 J-5B J-10 J-5A I-5 J-7 I-7 K-3B K-4A I-3C I-2C I-2B I-2BB 60-D K-1B
JACCARD COEFFICIENT
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0


60-C
60-B
K-4B
J-3
1-3A
K-2B
K-5
1-3B
J-5C
J-4
J-1
1-2A
J-2
1-1
K-1A
K-3A
K-2A
III
I
II
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
JACCARD COEFFICIENT

TEXT-FIGURE 4

Quantitative foraminiferal biotopes based on a dendrogram of Jaccard coefficients of association (UPGMA), Q-mode.



THE SOUTHERN COAST OF PUERTO RICO

Descalabrado, a river that flows the year around, empties into Biotope I. The major species that occur in Biotope I, in order of their abundance, are the following:

Ammonia beccarii

Quinqueloculina seminulm

Cribroelphidium poeyanum

Quinqueloculina lamarckina

Quinqueloculina bradyana

Triloculina baldai

The species of Biotope I are euryhaline, robust forms that can withstand changing salinities caused by fresh river water runoff and the effects of waves that break up the tests of the more fragile species. The distribution of these species corresponds to the distribution of the coastal terrigeneous quartzose sands.

Biotope II is represented by stations K-1a, K-2a, and K-3a that are in water depths of 10 to 50 feet. The sediment is also a dark gray, fine to medium-grained quartzose sand that grades seaward into carbonate silt. The Rio Jacaquas is directly opposite these stations and does not flow the year around. The major species that occur in Biotope II, in order of their abundance are the following:

Quinqueloculina seminulm

Cribroelphidium poeyanum

Ammonia beccarii

Triloculina baldai

Quinqueloculina lamarckina

Florilus grateloupi

The assemblages of Biotope I and II are similar, except Florilus grateloupi is present and Quinqueloculina bradyana is absent in Biotope II. The environment of Biotope II is also similar to Biotope I, except the salinity variations are less pronounced as evidenced by the lesser number of A. beccarii, and the effects of the waves are less as evidenced by the presence of F. grateloupi and the absence of Q. bradyana.

Biotope III consists of five stations adjacent to Isla Caja de Muertos in water depths of 5 to 50 feet and five stations in water depths of 25 to 75 feet. This biotope is primarily limited to the eastern portion of the study area, which has patch reefs and characteristic reef sediments and Foraminifera. The Foraminifera are predominantly the Miliolacea, the Discorbacea and Amphistegina gibbosa that are living in the shallow marine areas of calcium carbonate deposition. The assemblage is characterized by:

Archaias angulatus

Amphistegina gibbosa

Discorbis rosea

Discorbis mira

Quinqueloculina seminulum

Quinqueloculina bradyana

Peneroplis pertusus

Peneroplis bradyi

Peneroplis proteus

The major environmental parameters are shallow, clear water, normal marine salinity, warm temperatures, and moderate wave agitation.

Biotope IV is represented by eight stations in water depths of 25 to 100 feet. This biotope occurs in the well sorted carbonate silt, and fine to medium-grained carbonate sand. This area presumably receives maximum current agitation as it is in the channel of Rio Descalabrado. The assemblage found in Biotope IV is associated with the back-reef environments and represents a lag deposit of the reef-associated organisms. The assemblage is similar to that of Biotope III but the number of specimens of each species is not as great. The most abundant species occurring in Biotope IV are:

Quinqueloculina seminulum

Quinqueloculina lamarckina

Asterigerina carinata

Discorbis rosea

Discorbis mira

Discorbis sp. cf. D. australis

Triloculina baldai

Triloculina trigonula

Archaias angulatus

Amphistegina gibbosa

Bigenerina irregularis

Cibicides lobatulus

Cibicides pseudoungarianus

The major environmental parameters are well sorted carbonate sand, normal marine salinity, and moderate to strong currents.

The deeper waters of 75 to 600 feet make up Biotope V. This area is representative of the outer shelf, and the fauna living there are the

deeper, cold-water species, the arenaceous species, and the planktonic species. The carbonate sands and gravels in Biotope V represent an area of non-deposition which is most likely a relic Pleistocene reef. The major species found there are the following:

Amphistegina gibbosa

Cycloribiculina compressa

Archaias angulatus

Eponides antillarum

Eponides repandus

Cibicides pseudoungarianus

Siphonina pulchra

Vertebralina cassis

Articulina pacifica

Arenaceous species

- Ammolagena clavata
- Bigenerina irregularis
- Dorothea bradyana
- Liebusella soldanii
- Reophax bacillaris
- Textularia candeiana
- Textulariella barrettii

Planktonic species

The major environmental parameters are poorly sorted carbonate sediments, moderately quiet water, normal marine salinity, and cold temperatures.

Two sample stations, 60a and 61a, make up Biotope VI. These stations are in 5 feet of water adjacent to Isla Caja de Muertos and Isla

Morillito respectively. An insufficient number of specimens were recovered from stations 60a and 61a to provide adequate information for clustering. If a sufficient number were recovered, Biotope VI should become a part of Biotope III. The most abundant species from VI are:

Discorbis rosea

Archaias angulatus

Amphistegina gibbosa

The biotopes resulting from this cluster analysis appear to be regions of uniform environmental parameters and thus correspond well to the existing conditions of the study area.

Determination of Biofacies

A total of 115 foraminiferal species were clustered together on the basis of their distribution at 34 sample stations. The results of this cluster analysis can be seen in the dendrogram in Text-figure 5. Eight biofacies clusters are recognizable at the 0.15 level of similarity. This level was chosen on the basis of the natural breaks in the dendrogram. Here again, the shaded portions of the dendrogram represent the writer's interpretation of the biofacies. Also, an attempt to determine the biofacies using Sokal and Michener's coefficient of association and the Unweighted Pair Group Method showed less distinct clusters, and the dendrogram is not reproduced here. The assemblages of Foraminifera that make up the biofacies recognized are listed below. The number prefixing a name is its identification in the dendrogram in Text-figure 5.

Biofacies A

This is the outer shelf biofacies. The members of Biofacies A are the planktonic and arenaceous species found at depths of 300 to 600 feet, and their distribution corresponds approximately to the limits of Biotope V. The benthonic species are cold-water forms. The planktonic species are found nowhere else in the study area.

1 Ammolagena clavata (Jones and Parker)

16 Cancris sagra (d'Orbigny)

17 Candeina nitida d'Orbigny

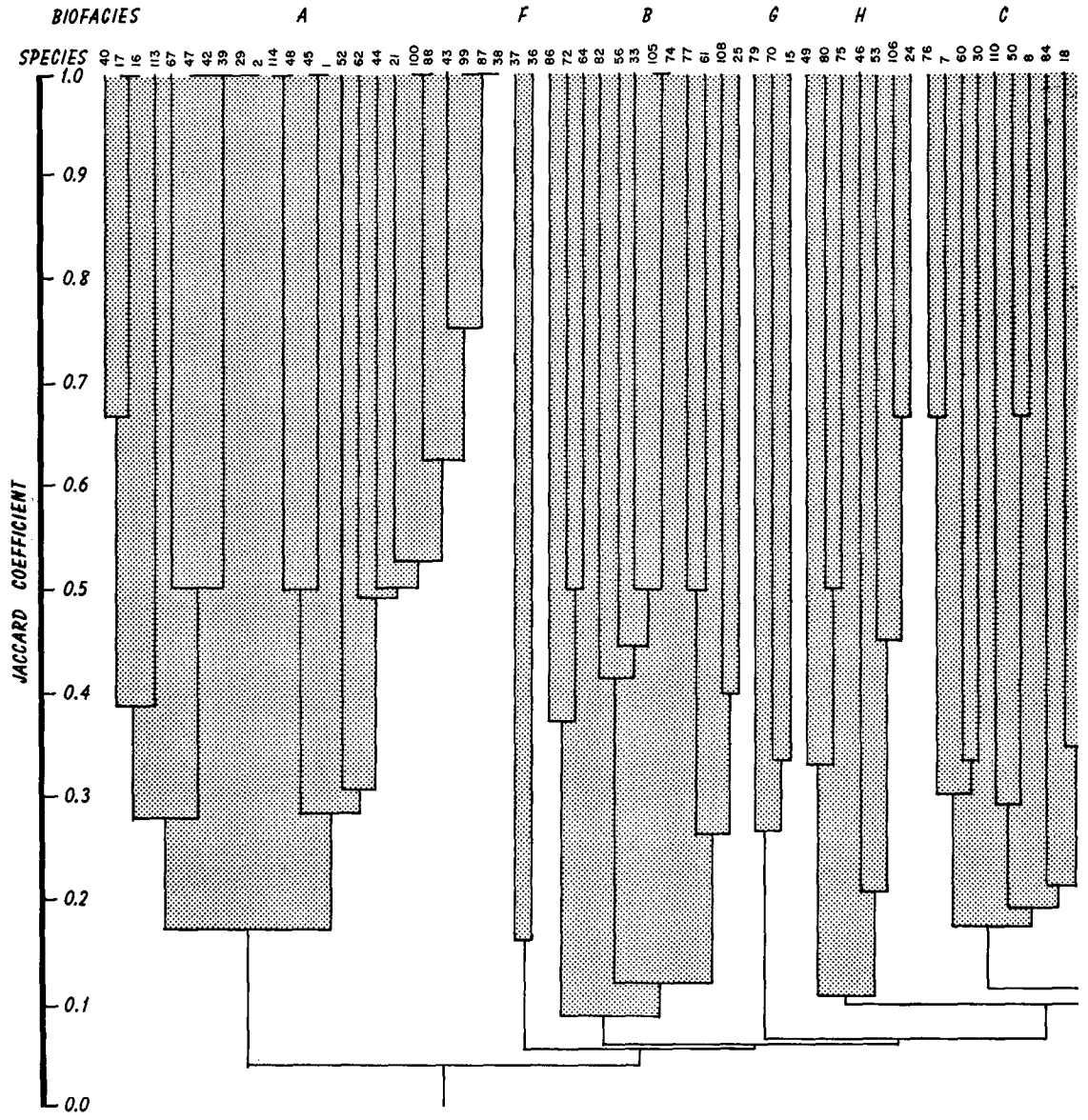
21 Cibicorbis sp. A

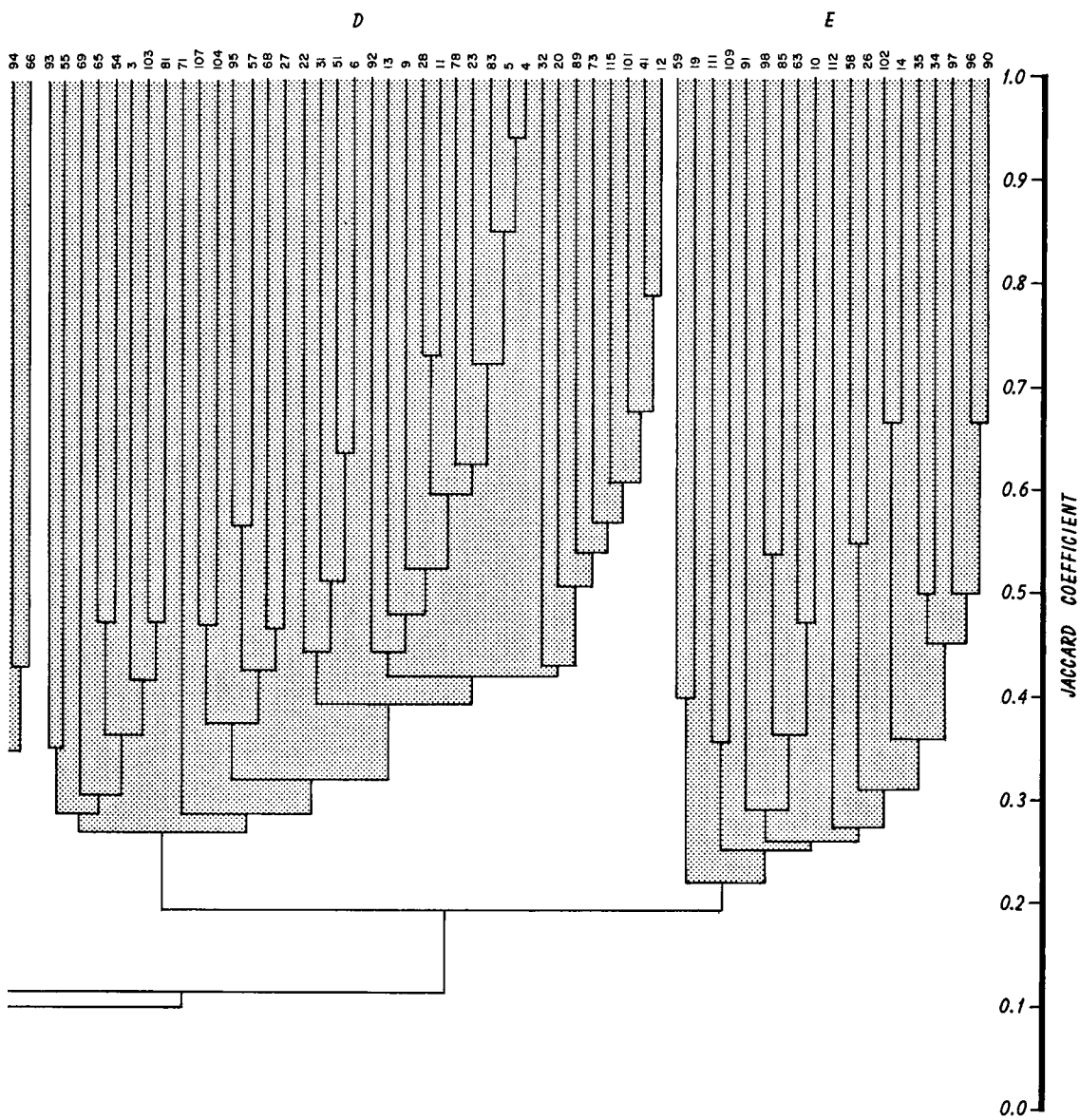
29 Dorothea bradyana Cushman

38 Globigerina eggeri Rhumbler

TEXT-FIGURE 5

Dendrogram (UPGMA) based on Jaccard coefficients of association computed from occurrence data for species of Foraminifera, R-mode.


BIOFACIES
A
F
B
G
H
C
SPECIES
40 17 16 113 67 47 42 39 29 2 114 48 45 1 52 62 44 21 100 88 43 99 87 38
37 36
86 72 64 82 56 33 105 74 77 61 108 25
79 70 15
49 80 75 46 53 106 24
76 7 60 30 110 50 8 84 18
JACCARD COEFFICIENT
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0


D
E
94 66 93 55 69 65 54 3 103 81 71 107 104 95 57 68 27 22 31 51 6 92 13 9 28 11 78 23 83 5 4 32 20 89 73 115 101 41 12
59 19 111 109 91 98 85 63 10 112 58 26 102 14 35 34 97 96 90
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
JACCARD COEFFICIENT

39 Globigerina radians Egger

40 Globigerinoides conglobatus (Brady)

42 Globigerinoides sacculifera (Brady)

43 Globorotalia hirsuta (d'Orbigny)

44 Globorotalia menardii (d'Orbigny)

45 Globorotalia truncatulinoides (d'Orbigny)

47 Hanzawaia concentrica (Cushman)

48 Hastegerina aequilateralis (Brady)

52 Lenticulina kaczkae Brooks, n. sp.

62 Orbulina universa d'Orbigny

67 Placopsilina bradyi Cushman and McCulloch

87 Reophax bacillaris Brady

88 Liebusella soldanii (Jones and Parker)

2 Sigmoilopsis schlumbergeri (Silvestri)

99 Textularia mayori Cushman

100 Textulariella barrettii (Jones and Parker)

113 Triloculina sp. A

114 Uvigerina perigrina Cushman

Biofacies B

This is the back-reef biofacies. The members of Biofacies B are found in water depths of 75 to 300. The distribution of this biofacies corresponds approximately to the limits of Biotope IV, however, Peneroplis carinatus, Reophax arayaensis, and Triloculina planciana are deep-water species found also in Biotope V, and Dentostomina aguaoi, Neopateoris cumanaensis, and Pyrgo jugosus are shallow-water species found also in Biotope III.

25 Dentostomina aguaoi Farfante

56 Miliolinella dilatata (d'Orbigny)

61 Neopateoris cummanaensis Bermudez and Seiglie

64 Peneroplis carinatus d'Orbigny

72 Pyrgo jugosus Cushman

74 Quinqueloculina angulata (Williamson)

77 Quinqueloculina bosciana d'Orbigny

82 Quinqueloculina riveroae Bermudez and Seiglie

86 Reophax arayaensis Bermudez and Seiglie

105 Triloculina brogniartiana d'Orbigny

108 Triloculina planciana d'Orbigny

Biofacies C

This is the shallow-water biofacies. The members of this biofacies are found predominately in the shallow waters of 25 to 100 feet, and their distribution corresponds approximately to the combined limits of Biotopes I, II, and III.

7 Articulina atlantica Cushman

8 Articulina lineata Brady

18 Cellanthus discoidale (d'Orbigny)

30 Elphidium lanieri (d'Orbigny)

50 Hauerina speciosa (Karrer)

60 Neoconorbina terquemi (Rzehak)

66 Peneroplis proteus d'Orbigny

76 Quinqueloculina bicostata d'Orbigny

84 Quinqueloculina tricarinata d'Orbigny

94 Spiroculina anderseni Todd and Bronnimann

110 Triloculina rotunda d'Orbigny

Biofacies D

The members of this biofacies are widespread or even ubiquitous. Many of the species are reef dwellers, but most are found at all depths and in all biotopes. In most cases the members of this biofacies are the most abundant species of each station.

3 Ammonia beccarii (Linné)

4 Amphistegina gibbosa d'Orbigny

5 Archaias angulatus (Fichtell and Moll)

9 Articulina pacifica Cushman

11 Asterigerina carinata d'Orbigny

12 Bigenerina irregularis d'Orbigny

13 Borelis pulchra (d'Orbigny)

20 Cibicides pseudoungarianus (Cushman)

22 Clavulina tricarinata d'Orbigny

23 Cribroelphidium poeyanum (d'Orbigny)

6 Cyclorbiculina compressa (d'Orbigny)

27 Discorbis mira Cushman

28 Discorbis rosea (d'Orbigny)

31 Eponides antillarum (d'Orbigny)

32 Eponides repandus (Fichtell and Moll)

41 Globigerinoides ruber (d'Orbigny)

51 Heterostegina antillarum d'Orbigny

54 Amphisorus hemprichii Ehrenberg

55 Miliolinella californica Rhumbler

57 Miliolinella fichtelliana (d'Orbigny)

65 Peneroplis pertusus (Forskal)

68 Planispirinella exigua (Brady)

69 Planorbulina mediterranensis d'Orbigny

71 Pyrgo denticulata (Brady)

73 Pyrgo subsphaerica (d'Orbigny)

78 Quinqueloculina bradyana Cushman

81 Quinqueloculina lamarckina d'Orbigny

83 Quinqueloculina seminulum (Linné)

89 Reussella atlantica Cushman

92 Siphonina pulchra Cushman

93 Sorites marginalis (Lamerck)

95 Spiroloculina antillarum d'Orbigny

101 Textularia candeiana d'Orbigny

103 Triloculina baldai Bermudez and Seiglie

104 Triloculina bicarinata d'Orbigny

107 Triloculina lineata d'Orbigny

115 Vertebralina cassis d'Orbigny

Biofacies E

The members of Biofacies E are also widespread. The most abundant species of this biofacies are found in water depths of 10 to 100 feet, and the distribution of this biofacies spans Biotopes I, II, III, IV, and V.

10 Articulina sagra d'Orbigny

14 Brizalina lowmani Phleger and Parker

19 Cibicides lobatulus (Walker and Jocob)

26 Discorbis sp. c. D. australis Parr

34 Florilus grateloupi (d'Orbigny)

35 Fursenkoina pontoni (Cushman)

58 Miliolinella oblonga (Montagu)

59 Miliolinella subrotunda (Montagu)

63 Peneroplis bradyi Cushman

85 Quinqueloculina macellonconcha Brooks, n. sp.

90 Rosalina floridana (Cushman)

91 Rosalina subauricana (Cushman)

96 Spiroloculina communis Cushman and Todd

97 Spiroloculina exima Cushman

98 Spiroloculina guppyi Todd and Bronniman

102 Trifarina bella (Phleger and Parker)

109 Triloculina quadrilateralis d'Orbigny

111 Triloculina trigonula Lamarck

112 Triloculina pyramidiforma Brooks, n. sp.

Biofacies F, G, and H

These biofacies are seemingly artifacts of the clustering method and do not correspond to real assemblages in the study area. Small clusters of rare species are a usual result of the method. The members of Biofacies F, G, and H are rare or very rare species found chiefly at stations J-5a, J-5c, and K-5. Consistent occurrence of rare species at the same stations may reflect increasing faunal diversity with depth, proximity to reef front, or to increased size of sample at these stations.

Biofacies F

36 Globigerina bulloides d'Orbigny

37 Globigerina conglomerata Schwager

Biofacies G

15 Brizalina striatula (Cushman)

70 Broeckina orbitolitoides Hofker

79 Quinqueloculina candeiana d'Orbigny

Biofacies H

24 Cymbaloporetta squammosa (d'Orbigny)

46 Gypsina vesicularis (Parker and Jones)

49 Hauerina occidentalis Cushman

53 Loxostomum mayori (Cushman)

75 Quinqueloculina berthelotiana d'Orbigny

80 Quinqueloculina compta Cushman

106 Trilocilina gracilis d'Orbigny

The species distributions in the study area show that Biofacies A is more or less restricted to the deeper water area of the open shelf defined by Biotope V, Biofacies B corresponds approximately to the area defined by Biotope IV, and Biofacies C corresponds approximately to the area defined by Biotopes I, II, and III. Biofacies D and E comprise widespread and ubiquitous species, and Biofacies F, G, and H are clusters of rare species. Thus, the biofacies achieved by this method correspond, at least in part, to the species associations of this region and to the characteristic assemblages of each biotope.

Several possible reasons may explain the failure of this method to define more meaningful species occurrence patterns. First, many species (115) cannot be adequately separated based on a small number of stations (34). Secondly, the use of hierarchical cluster analysis forces each species into one group or another, and no species can belong to more than one biofacies. Thus the biofacies do not necessarily correspond to the assemblages that characterize the biotopes. Strong discontinuities of species associations may not exist in the study area because this is a small area with rather uniform environments. Furthermore, transport

after death would blur the distinctness of the faunal patterns that may have existed in life.

FAUNAL COMPARISONS

Ecological Distributions

The continental shelf of the southern coast of Puerto Rico contains an assemblage of Foraminifera that is basically similar to other regions of the tropical Caribbean-Antilles province. Table 1 is a distribution of all of the Foraminifera in the study area, and their recorded occurrence in other areas throughout the Caribbean region, Atlantic Ocean, European coast, and Indo-Pacific Ocean. Differences between this and other areas of the Caribbean region can be ascribed to recognizable bathymetric and environmental parameters. The Gulf of Batabano, Cuba (Bandy, 1964), Florida Bay (Moore, 1957; Lynts, 1962), British Honduras shelf (Wantland, 1969), Orinoco-Trinidad-Paria shelf (Drooger and Kaasschieter, 1958), and Venezuela shelf (Seiglie, 1966) are five shelf areas in the Caribbean-Antilles province, and it is informative to compare the similarities and differences of this study with those area. Table 2 shows the major distributions of the Foraminifera in all six areas.

The assemblages of all of these regions have distinct indigenous nearshore associated faunas that grade into a widespread cosmopolitan fauna, with an abundance of the Miliolacea on the carbonate shelf. The reef-front platform has an abundance of species of Amphistegina and Archaias. The nearshore waters contain species of Foraminifera that can withstand variable salinities and shallow turbid waters. Ammonia beccarii is common in all shallow-water nearshore areas. Arenaceous species are common in coastal lagoons of British Honduras. These species are adapted

TABLE 1

Distribution of Recent Foraminifera by geographic region

x = present

Species name	Southern coast of Puerto Rico: Biotope	Biofacies	Gulf of Mexico	Caribbean Sea	Antilles Region	Atlantic Ocean	Indo-Pacific	European Coast
Ammolagena clavata	V	A			x	x	x	x
Reophax arayaensis	V	B			x			
Reophax bacillaris	V	A	x			x		x
Placopsilina bradyi	V	A	x			x		x
Textularia candeiana	I,II,III,IV,V	A	x		x		x	
Textularia earlandi	V	D	x	x	x			
Textularia mayori	V		x		x			
Bigenerina irregularis	III,IV	D	x	x	x			
Dorothea bradyana	V	A		x				
Dorothea pseudoturris	V		x			x		
Liebusella soldanii	V	A	x		x	x	x	
Clavulina tricarinata	I,II,III,IV,V	D	x			x		
Textulariella barrettii	V	A	x	x		x		
Planispirinella exigua	I,III,IV,V	B					x	
Spiroloculina anderseni	I,III,IV	D		x	x			
Spiroloculina antillarum	I,III,IV	D	x	x	x	x	x	
Spiroloculina communis	IV	E		x			x	
Spiroloculina exima	IV	E		x			x	
Spiroloculina guppyi	I,II,III,IV	E		x	x			
Vertebralina cassis	III,IV,V	D	x	x	x			
Quinqueloculina angulata	IV	B		x	x		x	
Quinqueloculina berthelotiana	III,V	H		x				

Species name	Southern Coast of Puerto Rico: Biotopes	Biofacies	Gulf of Mexico	Caribbean Sea	Antilles region	Atlantic Ocean	Indo-Pacific	European coast
Quinqueloculina bicostata	III,IV	C		x	x			
Quinqueloculina bosciana	III,IV	B		x	x			
Quinqueloculina bradyana	all	D		x				
Quinqueloculina candeiana	I,IV	G		x				
Quinqueloculina compta	III	H		x	x			
Quinqueloculina funafutiensis	IV			x			x	
Quinqueloculina lamarckina	I,II,III,IV,VI	D	x	x	x			
Quinqueloculina macelloconcha	I,II,III,IV,V	D						
Quinqueloculina polygona	I			x	x			
Quinqueloculina riveroae	IV	B			x			
Quinqueloculina seminulum	all but VI	D	x	x	x	x		x
Quinqueloculina tricarinata	IV,V	C		x	x			
Quinqueloculina sp A	III,V							
Quinqueloculina sp B	III							
Dentostomina aguaoi	I,III	B		x				
Massilina protea	IV		x	x				
Massilina secans	I		x	x	x			x
Neopateoris cumanaensis	III	B			x			
Pyrgo denticulata	III,V	D		x	x		x	
Pyrgo johnsoni	V			x				
Pyrgo jugosus	III,V	B		x				

Species name	Southern Coast of Puerto Rico: Biotope	Biofacies	Gulf of Mexico	Caribbean Sea	Antilles region	Atlantic Ocean	Indo-Pacific	European coast
Pyrgo subsphaerica	III,IV,V	D		x	x			
Sigmoilopsis schlumbergeri	V	A	x	x		x		
Triloculina baldai	I,II,III,IV	D			x			
Triloculina bicarinata	II	D		x	x			
Triloculina brogniartiana	IV	B		x	x	x	x	
Triloculina gracilis	II,IV	H		x	x			
Triloculina linneiana	I,III,IV	D		x				
Triloculina planciana	III,V	B		x				
Triloculina pyramidiforma	II,IV,V	E						
Triloculina quadrilateralis	I,II,III,IV,VI	E		x				
Triloculina rotunda	III	C		x				
Triloculina trigonula	I,II,III,IV	E	x	x	x	x	x	
Triloculina sp A	II	A						
Miliolinella californica	I,II,III,IV	D		x			x	
Miliolinella dilatata	IV	B		x				
Miliolinella fichtelliana	III,IV,V	D		x	x	x		
Miliolinella oblonga	III,IV,V	E		x	x	x	x	x
Miliolinella subrotunda	II,IV,V	E			x	x		x
Ammomassilina alveoliniformis	V			x				
Hauerina occidentalis	III,IV,V	H		x	x			
Hauerina speciosa	IV	C		x		x		

Species name	Southern Coast of Puerto Rico: Biotope	Biofacies	Gulf of Mexico	Caribbean Sea	Antilles region	Atlantic Ocean	Indo-Pacific	European coast
Articulina atlantica	III,IV,V	C		x		x		
Articulina lineata	IV			x		x		
Articulina pacifica	all but VI	D				x	x	x
Articulina sagra	all but VI	E		x	x			
Peneroplis bradyi	all but VI	E		x	x	x		
Peneroplis carinatus	III,V	B		x	x	x		
Peneroplis pertusus	I,III,IV,V	D		x			x	x
Peneroplis proteus	III,IV	C		x		x		
Sorites marginalis	I,III,IV,V	D		x		x	x	
Spirolina acicularis	III			x	x	x		x
Broeckina orbitolitoides	IV	E	x		x	x		
Archaias angulatus	all	D	x	x	x	x	x	x
Cyclorbiculina compressa	all but II	D	x	x	x	x		
Amphisorus hemprichii	I,III,IV	D		x	x	x	x	x
Borelis pulchra	III,IV,V,VI	D		x		x		
Nodosaria catsbyi	III		x	x	x			
Dentalina communis	V		x		x			
Frondicularia sagittula	V		x	x	x	x		
Lagena gracillima	I			x	x	x	x	x
Lagena hispidula	I			x	x	x		
Lagena striata	III				x	x		x
Marginulina planata	V		x		x			

Species name	Southern Coast of Puerto Rico: Biotope	Biofacies	Gulf of Mexico	Caribbean Sea	Antilles region	Atlantic Ocean	Indo-Pacific	European coast
Lenticulina kaczkae	I,III,V	A						
Lenticulina sp A	III							
Pseudonodosaria comatula	III,V		x	x		x		
Pseudonodosaria sp A	III							
Brizalina lowmani	IV	E	x	x	x			
Brizalina pacifica	IV			x			x	
Brizalina striatula	III,IV	G		x	x			
Brizalina variablis	I,II,III,IV		x	x	x			x
Reussella atlantica	all	D	x	x	x	x		
Uvigerina perigrina	V	A	x		x	x		
Sagrina puchella	II			x				
Trifarina bella	IV,V	E	x	x				
Discorbis sp cf D australis	III,IV,V	E					x	
Discorbis mira	III,IV	D		x	x	x		
Discorbis rosea	all	D		x				
Neoconorbina terquemi	I,III,IV	C	x	x	x	x	x	
Rosalina floridana	I,II,IV	E	x	x	x	x		
Rosalina subauricana	I,III,IV	E		x				
Cancris oblongus	V		x			x		x
Cancris sagra	II,III,V	A	x	x	x	x		
Siphonina pulchra	II,VI	D	x	x	x	x		

Species name	Southern Coast of Puerto Rico: Biotope	Biofacies	Gulf of Mexico	Caribbean Sea	Antilles region	Atlantic Ocean	Indo-Pacific	European coast
Asterigerina carinata	all but VI	D	x	x	x			
Spirillina decorata	II		x			x		x
Spirillina limbata	IV			x		x	x	
Ammonia beccarii	I,II,III,IV	D	x	x	x	x	x	x
Elphidium alvarezanum	III				x	x		
Elphidium lanieri	III,V	C		x				
Elphidium lessonii	III					x		
Cellanthus discoidale	III,IV	C	x	x	x			
Cribroelphidium poeyanum	all but VI	D	x	x	x			
Heterostegina antillarum	III,IV,V,VI	D		x	x			
Hastigerina aequilateralis	V	A	x	x	x	x	x	
Globorotalia hirsuta	V	A		x	x	x	x	
Globorotalia menardii	I,IV,V	A	x	x	x	x	x	
Globorotalia truncatulinoides	V	A	x	x	x	x	x	
Globigerina bulloides	I,II,IV,V	F	x	x	x	x	x	x
Globigerina conglomerata	V	F		x	x			
Globigerina eggeri	V	A	x	x	x	x	x	
Globigerina radians	V	A		x	x		x	
Globigerinoides conglobatus	II,V	A	x	x	x	x	x	
Globigerinoides ruber	all but VI	D	x	x	x	x	x	x
Globigerinoides sacculifera	V	A	x	x	x	x	x	x
Orbulina universa	V	A	x	x	x	x	x	x

Species name	Southern Coast of Puerto Rico: Biotope	Biofacies	Gulf of Mexico	Caribbean Sea	Antilles region	Atlantic Ocean	Indo-Pacific	European coast
Candeina nitida	V	A		x	x	x		
Eponides antillarum	all but VI	D	x	x	x			
Eponides repandus	all but VI	D	x	x		x		
Cibicorbis sp A	V	A						
Amphistegina gibbosa	all	D	x	x	x	x		
Cibicides lobatulus	I,IV,V	E	x	x	x		x	
Cibicides pseudoungarianus	all but IV	D	x	x	x	x		
Planorbulina mediterranensis	I,II,IV,V	D		x	x	x	x	x
Gypsina vesicularis	III,IV	H	x		x	x	x	
Cymbaloporetta squammosa	IV,V	H		x			x	x
Fursenkoina pontoni	II,III,IV	E	x	x	x	x		
Loxostomum mayori	IV,V	H	x	x		x	x	
Florilus atlanticus	I		x	x				
Florilus grateloupi	II,IV,V	E	x	x	x	x		
Hanzawaia concentrica	V	A	x	x	x			

to low salinity coastal waters with restricted communication with the nearshore marine environments. The shallow shelf areas have different assemblages that can be ascribed to currents and circulation conditions that mix the fauna in the shallow-water. The shallow shelf of the study area and British Honduras is narrow, current swept, and reef-associated. Neither area has a distinct shallow shelf assemblage separate from a reef-associated assemblage. All of the reef-associated areas contain an abundance of Amphistegina gibbosa and species of the Miliolacea. The reef-associated areas are characterized by shallow-water, warmer temperatures, and semi-restricted circulation. The back-reefs represent lag deposits from reef-associated areas, and these assemblages are moved about by the moderate to high current agitation. Conversely, the back-reef area of the Gulf of Batabano and Florida Bay is a Miliolacean assemblage characterized by a large population and a low energy environment. The outer shelf assemblages are primarily the planktonic species and the deeper cold-water species. In the Gulf of Batabano some of the species found have been removed from the platform to the slope. In Trinidad, a relic Pleistocene assemblage is recognized. There is also a relic Pleistocene reef in the study area characterized by the carbonate sands and gravels in an area of non-deposition, but the foraminiferal assemblage is not of Wisconsin age.

The patterns of foraminiferal assemblages of the six study areas are similar. Each area is bordered on the seaward margin by a planktonic and a cold-water benthonic assemblage. Landward, the assemblage patterns are variably developed depending on the width of the shelf and the interaction of shelf hydrography and bathymetry. In the shallow-water reef-associated areas, a concentric pattern of foraminiferal relationships is

TABLE 2

Comparison of Recent Foraminifera from various regions throughout the Caribbean Ocean

	NEAR SHORE	SHALLOW SHELF	REEF ASSOCIATED	BACK REEF	OUTER SHELF
Study Area, Southern Coast of Puerto Rico (Brooks, 1971)	*Ammonia* *Cribroelphidium* *Quinqueloculina*		*Amphistegina* *Archaias* *Discorbis* *Quinqueloculina* *Peneroplis*	*Asterigerina* *Discorbis* *Quinqueloculina*	*Amphistegina* *Archaias* *Eponides* *Cibicides* *Siphonina* Arenaceous Planktonics
Gulf of Batabano, Cuba (Bandy, 1964)	*Ammonia*	*Elphidium* Miliolids	*Amphistergina* *Asterigerina* *Discorbis*	Miliolids	*Cibicides* *Florilus*
Florida Bay (Moore, 1957; Lynts, 1962)	*Ammonia*	*Elphidium* *Ammonia* *Archaias*	*Amphistegina* *Archaias*	Miliolids	
British Honduras (Wantland, 1969)	*Ammonia* *Elphidium* Arenaceous		*Asterigerina* *Archaias*	*Quinqueloculina* *Triloculina* *Cribroelphidium*	
Orinoco Trinidad Paria Shelf (Drooger and Kaasschieter, 1958)	*Ammonia*	*Florilus* *Uvigerina*	*Amphistegina* *Quinqueloculina* *Cibicides* *Textularia*	*Amphistegina* *Heterostegina* *Peneroplis*	*Uvigerina* *Florilus* *Ammonia*
Venezuela Shelf (Seiglie, 1966)	*Ammonia* *Cribroelphidium*	*Florilus* *Buliminella*	*Amphistegina* *Textularia* *Bigenerina* Miliolids	*Hanzawaia* *Reussella*	*Uvigerina* *Brizalina* *Florilus* Planktonics

developed. These assemblages have an abundance of Miliolacea. The shallow-water areas all have similar faunas. These areas adjacent to a landmass show varying patterns depending on the nature of the nearshore processes involved and the degree of influence of fresh water.

Comparison of Foraminiferal and Ostracodal Biotopes

Baker and Hulings (1966) studied Recent ostracode assemblages of Puerto Rico from 27 of the 36 samples from stations located in this study area collected by Feray and Hulings. Although their study covered the whole of the continental shelf around Puerto Rico, it is informative to compare their assemblage results on the southern coast with the biotopes recognized in this study.

The distribution of ostracodes was based on live counts correlated with the sediment type, organic carbon content, and depth. Ostracode assemblage A includes 18 species of ostracodes occurring in a mixture of sand and mud in 5 to 300 feet of water. In the study area, this assemblages is at one station in 75 feet of water within foraminiferal Biotope IV.

Ostracode assemblage B includes five species occurring in sandy mud in water depths from 5 to 100 feet. In the study area it is in water depths of 25 to 100 feet and coincides with Biotope IV, with one station in Biotope III and one station in Biotope II.

Ostracode assemblage C includes 17 species occurring in muddy sand in water depths from 5 to 300 feet. In the study area this assemblage is in water depths from 10 to 50 feet. It coincides with Biotope III and Biotope I, with two stations in Biotope IV and one station in Biotope II.

Ostracode assemblage D includes three species occurring in sand in water depths of 5 to 50 feet. Assemblage D is in 5 to 10 feet of water in the

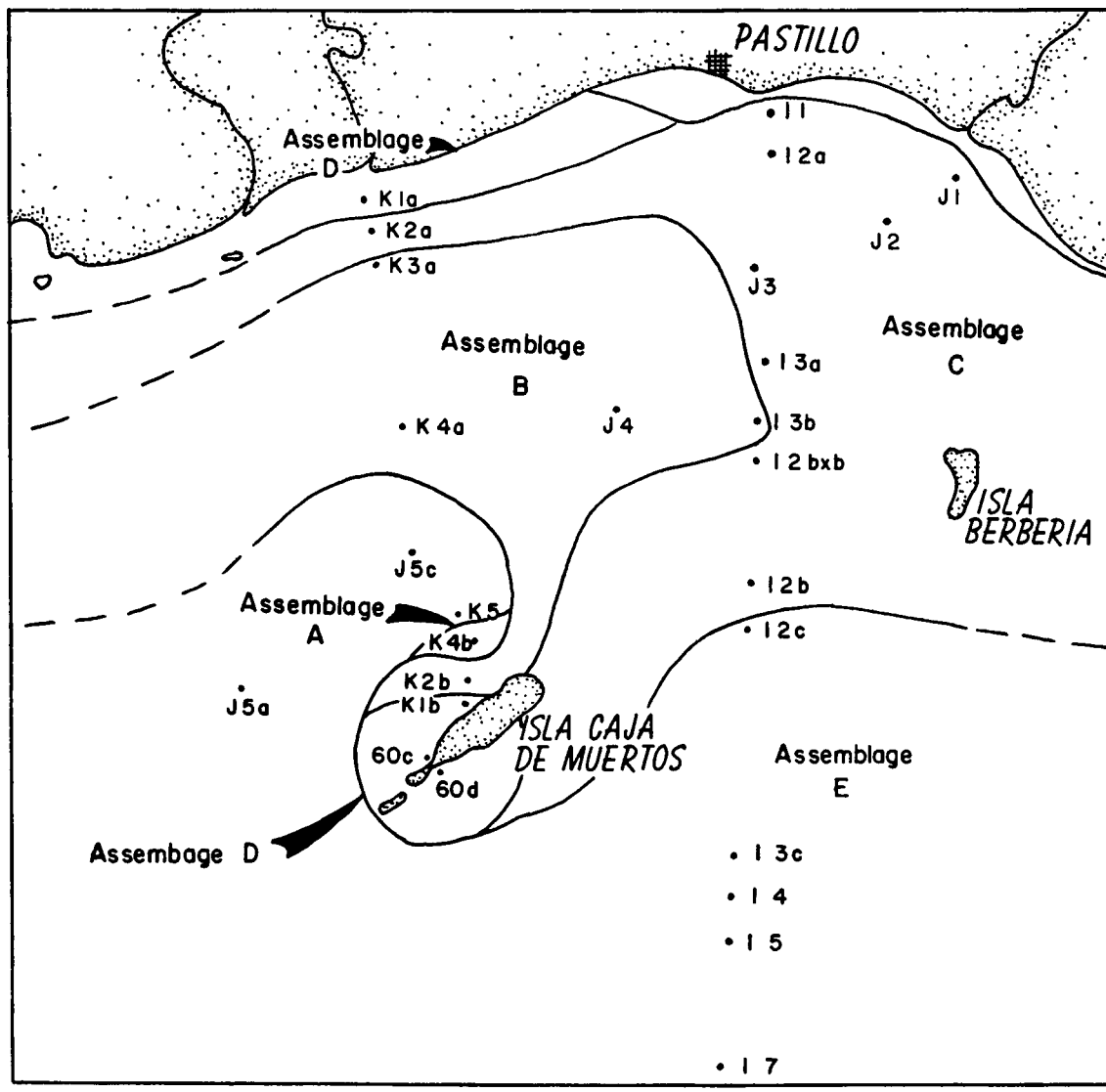
study area and is covered by part of Biotope II and Biotope III.

Ostracode assemblage E includes 8 species found in water depths of 5 to 600 feet in all types of sediments. The limit of this assemblage is essentially what is left after all of the other assemblages have been defined (Baker, personal communication). In the study area this assemblage is in water depths of 25 to 100 feet and coincides with Biotope V, with one station in Biotope IV and two stations in Biotope III.

Baker and Hulings indicated that there is a close relationship between the assemblages of ostracodes and the distribution of the sediment types. Text-figure 6 represents the writer's interpretation of the assemblages determined by Baker and Hulings. The overall distribution patterns of their assemblages and the biotopes of this study fit fairly well. Assemblage A is isolated with respect to this study, and Assemblage D is divided among Biotopes II, III, and VI. However, Assemblage B coincides fairly well with Biotope IV, Assemblage C fits well with Biotopes I and III, and Assemblage E follows the limits of Biotope V. The small discrepancies can be accounted for; their study was based on the distribution of living ostracodes in relation to the substrate, whereas this study was confined to the distribution of dead Foraminifera without regard to the type of sediment.

TEXT-FIGURE 6

Ostracode biotopes determined by Baker and Hulings (the writer's interpretation).


PASTILLO
Assemblage D
K1a
K2a
K3a
I1
I2a
J1
J2
J3
Assemblage B
Assemblage C
I3a
K4a
J4
I3b
I2bxb
ISLA BERBERIA
J5c
Assemblage A
K5
K4b
I2b
I2c
K2b
K1b
J5a
60c
60d
ISLA CAJA DE MUERTOS
Assemblage E
Assembage D
I3c
I4
I5
I7

CONCLUSIONS

1. The foraminiferal population on the south-central coast of Puerto Rico consists of 72 genera and 144 species. Of these, Amphistegina gibbosa, Archaias angulatus, Quinqueloculina seminulum, and Discorbis rosea comprise over 50 percent of the total population. Twenty-nine species are represented by single specimens and twenty-four are rare or very rare. Thirteen planktonic species are restricted to the deep water of 300 to 600 feet, and 131 benthonic species are found throughout the area at all depths.

2. Six biotopes are established at the 0.25 level of similarity using the Jaccard coefficient and the Unweighted Pair Group Method based on presence/absence of 115 foraminiferal species at the 34 stations sampled. The limits of the six biotopes are controlled by environmental parameters, chiefly salinity, turbidity, wave agitation, and temperature. Biotope I and II are controlled by the salinity variations from the river runoff and wave agitiation in the shallow water. Biotope III is reef-associated, and the environmental parameters are shallow clear water and moderate wave agitation. Biotope IV is in an area of maximum current agitation, and Biotope V is controlled by colder temperatures and moderately quiet water. Biotope VI is unreliable because an insufficient number of specimens were recovered. This classification seems to correspond well to the biotopes existing in the study area.

3. Eight biofacies are established at the 0.15 level of similarity using the Jaccard coefficient and the Unweighted Pair Group Method based on presence/absence at 34 stations of the 115 foraminiferal species considered in this analysis. The species clusterd reflect in part the

biofacies that exist in the area, but they do not necessarily correspond to the assemblages that characterize the biotopes. Biofacies A is restricted to the area defined by Biotope V, Biofacies B corresponds fairly well to the characteristic assemblage of Biotope IV, and Biofacies C corresponds to the species inhabiting Biotopes I, II, and III. Biofacies D and E are ubiquitous species and Biofacies F, G, and H are clusters of very rare species.

4. Four explanations for this failure to establish unambiguous biofacies are the small number of stations compared to the number and species, the requirement of the clustering method that the clusters be mutually exclusive, a lack of discontinuities in a small area with rather homogeneous conditions, and transport and mixing of assemblages after death.

5. Comparisons of the distribution of Recent Foraminifera in this area with carbonate shelf environments in other parts of the Caribbean-Antilles region reveals basic similarities in patterns in nearshore, reef-associated, and outer shelf areas. Differences in the shallow shelf and back-reef areas are are attributed to variations of shelf configuration and bathymetry.

SYSTEMATIC PALEONTOLOGY

The classification of the Recent Foraminifera from the southern coast of Puerto Rico is based on the classification set forth by Loeblich and Tappan (1964). Synonymic lists and distributions of the Foraminifera are based on literature on the Gulf of Mexico, Caribbean-Antilles region, and north Atlantic Ocean.

In the following systematic section, each species has been described if an adequate description is not available in the previous literature. The well described species have not been described in this paper. Similarly, each species has been illustrated except for those that are very rare in this study area or that have been well illustrated in the previous literature.

The holotype and representative paratypes of all new species named and described in this paper will be deposited in the U. S. National Museum, Washington, D. C., after publication. All rare species found in the study area, not previously published are left in open nomenclature. Representative paratypes and faunal slides will be deposited with the Department of Geology, University of Houston.

Geographic regions as defined in this paper are as follows:
Gulf of Mexico - Texas, Louisiana, Mississippi, Alabama, and the eastern coast of Mexico.
Caribbean Sea - The southern coast of Florida, Cuba, Haiti, Dominican Republic, Puerto Rico, Jamaica, Bahamas, Yucatan, eastern coast of

Central America, and northern coast of Colombia.

Antilles Region - The islands of the Lesser Antilles, northern coast of Venezuela, and Trinidad.

North Atlantic Ocean - The eastern coast of Brazil, eastern coast of the United States, and Bermuda.

References to frequency of population of Foraminifera in the sediment samples are as follows:

Very abundant - greater than 100 specimens

Abundant - 25 to 99 specimens

Common - 10 to 24 specimens

Several - 5 to 9 specimens

Rare - 3 to 4 specimens

Very rare - 1 to 2 specimens.

Order FORAMINIFERIDA Eichwald, 1830

Suborder TEXTULARIINA Delage and Herouard, 1896

Superfamily AMMODISCACEA Reuss, 1862

Family AMMODISCIDAE Reuss, 1862

Subfamily TOLYPAMMININAE Cushman, 1928

Genus Ammolagena Eimer and Fickert, 1899

Ammolagena clavata (Jones and Parker)

Plate 9, figure 1

Trochammina irregularis (d'Orbigny) var. clavata JONES and PARKER, 1860, p. 304

Weebina clavata (Jones and Parker). - BRADY, 1882, p. 771. - BRADY, 1884, p. 41, figs. 12-16. - GOES, 1894, p. 32, pl. 6, figs. 245,246. Ammolagena clavata (Jones and Parker). - EIMER and FICKERT, 1899, p. 673. - CUSHMAN, 1918, p. 90, pl. 34, figs. 2-5, pl. 35, figs. 1-3. - BARKER, 1960, p. 84, pl. 41, figs. 12-16.

Diagnosis: Test attached, flask-shaped, with elongated tubular neck; wall finely arenaceous; aperture terminal and rounded.

Dimensions: Length, 1.00 to 1.30 mm.; width, 0.55 to 0.70 mm.

Distribution: Eleven specimens of A. clavata were found at one station at a depth of 600 feet in Biotope V. This species is a member of Biofacies A. It has been reported from Recent sediments of the Gulf of Mexico, Caribbean Sea, Atlantic Ocean, eastern coast of South America, North Sea, Mediterranean Sea, South Pacific Ocean, and in the Upper Cretaceous of Trinidad and Central Texas.

Superfamily LITUOLACEA Blainville, 1825

Family HORMOSINIDAE Haeckel, 1894

Subfamily HORMOSININAE Haeckel, 1894

Genus Reophax Montfort, 1808

Reophax arayaensis Bermudez and Seiglie

Plate 1, figure 1-2

Reophax arayaensis BERMUDEZ and SEIGLIE, 1963, p. 146, pl. 7, fig. 1,2, pl. 2, fig. 1

Diagnosis: Test contains large sized sand grains; aperture terminal, has a tendency to become triangular in shape.

Dimensions: Length, 1.00 to 1.50 mm.; width, 0.50 to 0.70 mm.

Remarks: This species was first described from the Gulf of Cariaco off the northern coast of Venezuela in water depths from 18 to 39 meters, and this is the first known occurrence of this species outside of that area.

Distribution: Very rare. Two specimens were found at a depth of 300 feet at one station. This species in a member of Biofacies B.

Reophax bacillaris Brady

Plate 1, figures 25-26

Reophax bacillaris BRADY, 1881, p. 49. - BRADY, 1884, p. 293, pl. 30 figs. 23-24. - CUSHMAN, 1920, p. 19, pl. 5, fig. 6. - BARKER, 1960, p. 62, pl. 30, figs. 23,24.

Diagnosis: Test elongate, with more than 10 to 12 chambers; sutures distinct and sides rounded; wall fine to coarse sand grains; aperture terminal, rounded with a buliminid-like toothplate.

Dimensions: Length, 1.25 to 2.00 mm.; width, 0.30 to 0.50 mm.

Distribution: Common. This species was found in depth of water of 300 to 600 feet in Biotope V. It is the most abundant member of Biofacies A, and has been reported from throughout the Recent sediments of the Caribbean-Antilles region, North Atlantic, northeastern coast of the United States, Leeward Islands, and west coast of Africa.

Family LITUOLIDAE Blainville, 1825

Subfamily PLACOPSILININAE Rhumbler, 1913

Genus Placopsilina d'Orbigny, 1850

Placopsilina bradyi Cushman and McCulloch

Plate 2, figure 23

Lituola cenomana JONES and PARKER, 1860. p. 302.

Placopsilina cenomana (Jones and Parker). - BRADY, (Part, not P. cenomana d'Orbigny), 1884, p. 315, pl. 36, figs. 1-3. - CUSHMAN, 1920, p. 70, pl. 14, fig. 5.

Placopsilina bradyi CUSHMAN and McCULLOCH, 1939, p. 112, pl. 12, figs. 14-15. - BARKER, 1960, p. 74, pl. 36, fig. 1.

Diagnosis: Test attached, distinguished by close coiled early stage of one or more whorls, later uncoiled portion of uniform diameter; chambers elongate; wall coarse sand particles; aperture terminal.

Dimensions: Length, 0.75 to 1.50 mm.

Distribution: Very rare. Five specimens were found at two stations from 100 to 300 feet of water depth. This species occurs in Biotope V and is a member of Biofacies A. This species has been reported from Recent sediments of the Caribbean-Antilles region, Gulf of Mexico, North Atlantic, and North Sea.

Family TEXTULARIIDAE Ehrenberg, 1838

Subfamily TEXTULARIINAE Ehrenberg, 1838

Genus Textularia Defrance, 1824

Textularia candeiana d'Orbigny

Plate 1, figures 12-14

Textularia candeiana D'ORBIGNY, 1839a, p. 143, pl. 1, figs. 25-27. - CUSHMAN, 1922b, p. 8, pl. 1, figs. 1-3. - BERMUDEZ, 1935, p. 8, pl. 2, fig. 4. - BERMUDEZ, 1949, p. 60, pl. 2, figs. 28-20. - DROOGER and KAASSCHIETER, 1958, p. 74, map fig. 33. - BERMUDEZ and SEIGLIE, 1963, p. 170, pl. 3, fig. 1.

Textularia sagittula Defrance, var. candeiana MILLET, 1899, p. 562, pl. 7, fig. 2.

Distribution: This species is a common form occurring throughout the area and all depths. It is associated with no particular biotope and is a member of Biofacies D. It has been reported in abundance from Recent sediments of the Gulf of Mexico, Caribbean-Antilles region, Pacific coasts of California and Mexico, and in the Oligocene of Mexico and Puerto Rico.

Textularia earlandi Parker

Plate 1, figures 7-9

Textularia earlandi PARKER, 1952, p. 458. - BERMUDEZ and SEIGLIE, p. 171, pl. 3, fig. 5.

Remarks: T. earlandi has been reported living on muddy bottoms near mangroves in water depths of 2 to 50 meters from Venezuela. It has also been reported in abundance from water depths of 4 to 32 meters from Trinidad.

Distribution: Very rare. One specimen was found in 300 feet of water. This species has been reported from Recent sediments of the Gulf of Mexico, Trinidad, and Venezuela.

Textularia mayori Cushman

Plate 9, figure 2

Textularia mayori CUSHMAN, 1922b, p. 23, pl. 2, fig. 3. - ANDERSEN, 1961, p. 22, pl. 1, figs. 6-8.

Diagnosis: Test elongate, very compressed, with sharp periphery and spinose chambers, thickest near center and apertural end; sutures indistinct; wall finely arenaceous, smooth; aperture elongate, on the interior margin at the base of the last chamber.

Dimensions: Length, 0.70 to 1.10 mm.; width, 0.30 to 0.40 mm.

Remarks: This species has been reported as Spiroplectammina floridana by numerous writers. The difference is that S. floridana has a distinct and well developed initial coil and T. mayori has no coil at all.

Distribution: This species occurs in water depths of 300 to 600 feet in Biotope V and is a member of Biofacies A. It was originally described from the Florida Keys and has been reported from Recent shallow-water sediments of the Gulf of Mexico, Caribbean-Antilles region, and in waters of 100 to 300 feet depth on the continental platform of Venezuela.

Genus Bigenerina d'Orbigny, 1826

Bigenerina irregularis Phleger and Parker

Plate 9, figure 3

Bigenerina irregularis PHLEGER and PARKER, 1951, p. 4, pl. 1, figs. 16-21. - DROOGER and KAASSCHIETER, 1958, p. 27, map fig. 5. - ANDERSEN, 1961, p. 25, pl. 2, fig. 8.

Diagnosis: Test elongate; chambers biserial, usually at an angle to rest of test, making up one-forth of total test length, later becoming uniserial, with rounded uniform size; sutures distinct, depressed; wall coarsely arenaceous with wide variations both in size and shape of test material, composed of sand grains, calcareous fragments and randomly oriented sponge spicules; aperture terminal, rounded, with little or no neck.

Dimensions: Length, 0.90 to 1.10 mm.; diameter, 0.20 to 0.40 mm.

Distribution: This species is common in the deep waters of 300 to 600 feet in Biotope V, but also occurs in Biotopes III and IV. It is a member of Biofacies D, and it has been reported from Recent sediments in water shallower than 100 meters in the Gulf of Mexico, between 50 and 100 meters on the Orinoco shelf, and in the shallow lagoons of British Honduras.

Family ATAXOPHRAGMIIDAE Schwager, 1877

Subfamily GLOBOTEXTULARIINAE Cushman, 1927

Genus Dorothea Plummer, 1931

Dorothea bradyana Cushman

Plate 1, figures 5-6

Gaudryina subrotundata BRADY (not Schwager), 1884, p. 380, pl. 46, figs. 13a-c.

Dorothea bradyana CUSHMAN, 1936, p. 31, pl. 5, fig. 2. - BARKER, 1960, p. 94, pl. 46, fig. 13.

Distribution: Nine specimens of D. bradyana were found at one station in 600 feet of water in Biotope V. This species is a member of Biofacies A, and it has been reported from Recent sediments of the northern coast of Puerto Rico.

Dorothea pseudoturris (Cushman)

Textularia turris BRADY (not d'Orbigny), 1884, p. 366, pl. 44, figs. 4,5.

Textularia pseudoturris CUSHMAN, 1922a, p. 19, pl. 3, fig. 1.

Dorothea pseudoturris CUSHMAN, 1937, p. 100. - BARKER, 1960, p. 90, pl. 44, figs. 4,5.

Distribution: Very rare. One specimen was found in 300 feet of water. It has been reported from Recent sediments of the Caribbean-Antilles region, coast of Brazil, Bermuda, and southeastern coast of the United States.

Subfamily ATAXOPHRAGMIINAE Schwager, 1877

Genus Liebusella Cushman, 1933

Liebusella soldanii (Jones and Parker)

Plate 1, figures 10-11

Lituola soldanii JONES and PARKER, 1860, p. 307.

Haplostiche soldanii (Jones and Parker). - BRADY, 1884, p. 318, pl. 32, figs. 12-18.

Liebusella soldanii (Jones and Parker). - THALMANN, 1937, p. 340. - DROOGER and KAASSCHIETER, 1958, p. 53. map fig. 20. - BARKER, 1960, p. 66, pl. 32, figs. 12, 14-18.

Diagnosis: Test short with five to six chambers rapidly increasing in size, the early chamber indistinct, later ones more distinct and in a straight line; wall with labrinthic structure, coarse sand grains with numerous short spines which occur randomly throughout test.

Dimensions: Length, 1.00 to 1.50 mm.; width, 0.25 to 0.50 mm.

Distribution: This species is common in water depths of 300 to 600 feet in Biotope V and is an abundant member of Biofacies A. It has been reported in shallow tropical waters of 5 to 50 meters, commonly associated with coral reef faunas. It has been reported from 70 to 275 meters in the Gulf of Mexico and 40 to 70 meters on the Trinidad shelf.

Subfamily VALVULININAE Berthelin, 1880

Genus Clavulina d'Orbigny, 1826

Clavulina tricarinata d'Orbigny

Plate 1, figures 3-4

Clavulina tricarinata D'ORBIGNY, 1839a, p. 111, pl. 2, figs. 16-18. - CUSHMAN, 1922a, p. 29, pl. 3, fig. 3. - CUSHMAN, 1922b, p. 89, pl. 17, figs. 3,4. - BERMUDEZ, 1935, p. 154, pl. 11, figs. 4-6.

Diagnosis: Test elongate, triangular in cross-section, increasing in diameter to apertural end; chambers triserial later becoming uniserial, distinct; suture distinct, slightly depressed; wall arenaceous; aperture terminal, rounded and with a valvular tooth.

Dimensions: Length, 0.75 to 0.90 mm.; diameter, 0.15 to 0.25 mm.

Distribution: Several. C. tricarinata is not common at any particular depth or biotope. It is found in low frequencies in several samples, although it occurs most abundantly in the eastern portion of the area. It is a member of Biofacies D and is very common in Recent sediments in the Caribbean-Antilles region and Bermuda. It has also been reported in the Miocene of Puerto Rico and Florida.

Family PAVONITINIDAE Loeblich and Tappan, 1961

Subfamily PAVONITININAE Loeblich and Tappan, 1961

Genus Textulariella Cushman, 1927

Textulariella barrettii (Jones and Parker)

Plate 1, figures 23-24

Textularia barrettii JONES and PARKER, 1863, p. 80, 105. - JONES and PARKER, 1876, p. 99. - CUSHMAN, 1922a, p. 20, pl. 3, figs. 3-6.

Textularia trochus BRADY, 1884, p. 366, pl. 43, fig. 17, (not 15, 16, 18, 19), pl. 44, figs. 1-3, (not T. trochus d'Orbigny).

Textularia conica GOES (not d'Orbigny), 1896, p. 43.

Textularia goesii CUSHMAN, 1911, p. 15, fig. 24.

Textulariella barretti (Jones and Parker). - CUSHMAN, 1927b, p. 24, pl. 5, fig. 3. - CUSHMAN, 1937, p. 66, pl. 7, figs. 5-8. - BERMUDEZ, 1949, p. 80, pl. 4, figs. 19,20. - DROOGER and KAASSCHIETER, 1958, p. 75, pl. 4, fig. 1. - BARKER, 1960, p. 88, pl. 43, fig. 17, p. 90, pl. 44, figs. 3, 6-8. - BERMUDEZ and SEIGLIE, 1963, p. 170, pl. 3, fig. 2.

Diagnosis: Test conical, compressed; chambers several, with labrinthic structure; sutures distinct; wall finely arenaceous; aperture a narrow slit on the interiomargin of the final chamber.

Dimensions: Length, 0.45 to 0.65 mm.; diameter, 0.40 to 0.50 mm.

Distribution: Twelve specimens were found at two sample stations at depths of 300 to 600 feet in Biotope V. It is a member of Biofacies A and is abundant in Recent sediments of the Caribbean-Antilles region, Gulf of Mexico, Bermuda, coast of Brazil, and in the Miocene of Jamaica and Venezuela.

Suborder MILIOLINA Delage and Herouard, 1896

Superfamily MILIOLACEA Ehrenberg, 1839

Family FISCHERINIDAE Millett, 1898

Subfamily FISCHERININAE Millett, 1899

Genus Planispirinella Weisner, 1931

Planispirinella exigua (Brady)

Plate 1, figures 15-16

Planispirina exigua BRADY, 1884, p. 196, pl. 12, figs. 1-4, text - fig. 5b.

Planispirinella exigua (Brady). - WIESNER, 1931, p. 69. - BARKER, 1960, p. 24, pl. 12, figs. 1-4

Diagnosis: Test planispiral with slightly inflated umbilicus; three chambers in outer whorl; sutures slightly depressed, indistinct; wall smooth; aperture is a slit in last chamber on final whorl.

Dimensions: Length, 0.30 to 0.55 mm.; thickness 0.08 to 0.15 mm.

Distribution: Rare. Twenty-one specimens were found at ten stations at depths of 25 to 100 feet. It is a member of Biofacies D and is found throughout Recent sediments of the Caribbean-Antilles region, Atlantic Ocean, and South Pacific Ocean.

Family NUBECARIIDAE Jones, 1875

Subfamily SPIROLOCULININAE Wiesner, 1920

Genus Spiroloculina d'Orbigny

Spiroloculina anderseni Todd and Bronnimann

Plate 6, figure 6

Spiroloculina anderseni TODD and BRONNIMANN, 1957, p. 28, pl. 4, figs. 10-12.

Diagnosis: Test compressed with flat sides all in a single plane; chambers angular, compressed, and thin; wall with very fine striations; aperture terminal, simple.

Dimensions: Length, 0.70 to 0.90 mm.; width, 0.35 to 0.45 mm.; thickness, 0.10 to 0.15 mm.

Distribution: Nine specimens were found at four stations in water depths of 50 to 100 feet in Biotope IV. This species is a member of Biofacies C, and it has been reported from Recent sediments of Trinidad and British Honduras.

Spiroloculina antillarum d'Orbigny

Plate 6, figure 7

Spiroloculina antillarum D'ORBIGNY, 1839a, p. 166, pl. 9, figs. 3, 4. - CUSHMAN, 1929, p. 43, pl. 9, fig. 3. - CUSHMAN and TODD, 1944, p. 44, pl. 6, figs. 28, 32. - ANDERSEN, 1961, p. 35, pl. 5, fig. 6. - BERMUDEZ and SEIGLIE, 1963, p. 161, pl. 12, fig. 3, pl. 13, fig. 71.

Diagnosis: Test compressed, elongate; chambers rounded, three to four in number; wall with coarse longitudinal costae; aperture with a bifid tooth.

Dimensions: Length, 0.75 to 1.00 mm.; width, 0.40 to 0.50 mm.; thickness, 0.10 to 0.15 mm.

Distribution: Several specimens were found in the shallow water in Biotopes I, III and IV. It is a member of Biofacies D and it has been reported in abundance from shallow water Recent sediments of the

Caribbean-Antilles region, Gulf of Mexico, Atlantic Ocean, and Indo-Pacific region. It has also been reported in the Miocene of Puerto Rico.

Spiroloculina communis Cushmann and Todd

Plate 6, figure 9

Spiroloculina communis CUSHMAN and TODD, 1944, p. 63, pl. 9, figs. 4-8. - BARKER, 1960, p. 18, pl. 9, figs. 5, 6, p. 20, pl. 10, figs. 3,4.

Diagnosis: Test compressed, elongate, small; chambers quadrangular in cross section, three to five in numbers; sutures distinct; wall smooth; aperture terminal, rounded, with a short neck, with a bifid tooth.

Dimensions: Length, 0.40 to 0.60 mm.; width, 0.20 to 0.30 mm.; thickness, 0.10 to 0.15 mm.

Distribution: Eight specimens were found at five stations in water depths of 50 to 100 feet in Biotope IV. It is a member of Biofacies E, and it has been reported from Recent sediments of the Caribbean-Antilles region and South Pacific Ocean.

Spiroloculina exima Cushman

Plate 6, figure 8

Spiroloculina exima CUSHMAN, 1922b, p. 61, pl. 11, fig. 2.

Diagnosis: Test compressed, elongate, small; chambers rounded, four to six in number; sutures distinct, depressed, smooth; aperture terminal, with a bifid tooth.

Dimensions: Length, 0.40 to 0.60 mm.; width, 0.20 to 0.40 mm.; thickness, 0.10 to 0.15 mm.

Distribution: Twelve specimens were found at four stations in water depth of 25 to 100 feet, in Biotope IV. It is a member of Biofacies E, and it has been reported from Recent sediments of the Caribbean-Antilles region and Samoa.

Spiroloculina guppyi Todd and Bronnimann

Plate 2, figures 1-3

Spiroloculina guppyi TODD and BRONNIMANN, 1957, p. 29, pl. 4, figs. 1, 2.

Diagnosis: Test small, elongate, compressed; chambers rounded, three to four in number, with a short neck and lip, with a simple tooth.

Dimensions: Length, 0.50 to 0.60 mm.; width, 0.25 to 0.30 mm.; thickness, 0.05 to 0.10 mm.

Distribution: Several specimens were found in shallow water in Biotopes I, II, III, and IV. It is a member of Biofacies E, and it has been reported from Recent sediments of Trinidad and British Honduras.

Subfamily NODOBACULARIINAE Cushman, 1927

Genus Vertebralina d'Orbigny, 1826

Vertebralina cassis d'Orbigny

Plate 7, figures 5, 10

Vertebralina cassis D'ORBIGNY, 1939a, p. 51, pl. 7, figs. 14-15. - CUSHMAN, 1929a, p. 96, pl. 22, fig. 4. - BERMUDEZ, 1935, p. 174. Nodobacullariella cassis (d'Orbigny). - PHLEGER and PARKER, 1951, p. 8, pl. 4, figs. 12-14. - DROOGER and KAASSCHIETER, 1958, p. 55. - BERMUDEZ, and SEIGLE, 1963, p. 103, pl. 15, fig. 3.

Diagnosis: Test small, compressed; chambers trochospiral, two or three in the last whorl; sutures distinct, raised; periphery with a thin keel; wall porcelaneous with fine longitudinal costae; aperture terminal slit with sharp, flaring, recurved apertural lip.

Dimensions: Length, 0.40 to 0.50 mm.; width, 0.50 to 0.60 mm.; thickness, 0.08 to 0.15 mm.

Remarks: This species has been reported as Nodobacullariella cassis by numerous writers. The generic assignment is based on whether the species is planispirally coiled or trochospirally coiled. The species in this study area are trochospirally coiled, but comparative material from other areas of the Caribbean has not been examined to determine if two species exist in the Caribbean-Antilles region or whether V. cassis has occasionaly been misassigned to the genus Nodobacullariella.

Distribution: Common. Numerous specimens were found in water depths of 25 to 300 feet in Biotopes III, IV, and V. It is a member of Biofacies D and it has been reported in abundance from shallow-water Recent sediments of the Gulf of Mexico, Cuba, Trinidad, the Lesser Antilles, southern Florida and Venezuela.

Family MILIOLIDAE Ehrenberg, 1839

Subfamily QUINQUELOCULININAE Cushman, 1917

Genus Quinqueloculina d'Orbigny, 1826

Quinquelocula angulata (Williamson)

Plate 6, figures 13, 18

Miliolina bicornis (Walker and Jacob) var. angulata WILLIAMSON, 1858 p. 88, pl. 7, fig. 196.

Quinqueloculina bicornis (Walker and Jacob) var. angulata (Williamson). - CUSHMAN, 1929a, p. 33, pl. 6, figs. 3-4.

Quinqueloculina angulata (Williamson). - BERMUDEZ and SEIGLIE, 1963, p. 127, pl. 9, fig. 5.

Distribution: Five specimens were found at one station at 75 feet of water in Biotope IV. It is a member of Biofacies B and it has been reported from Recent sediments of Venezuela, British Honduras, the coast of Great Britain, and the Mediterranean.

Quinqueloculina berthelotiana d'Orbigny

Quinqueloculina berthelotiana D'ORBIGNY, 1839a, p. 142, pl. 3, figs. 25-27.

Diagnosis: Test elongate, small; chambers angular, sinuous; sutures distinct, depressed; periphery with a thin angular keel; wall finely granular, with a small number of longitudinal costae; aperture terminal, on a long neck, with a single tooth.

Dimensions: Length, 0.40 to 0.45 mm.; width, 0.10 to 0.15 mm.

Remarks: This species is similar to Q. riveroae. Both species have sinuous chambers but the chambers of Q. berthelotiana are more sharply angled than Q. riveroae.

Distribution: Very rare. Four specimens were found at four stations. It is a member of Biofacies H, and it has been reported from Recent sediments of Cuba, Jamaica, and British Honduras.

Quinqueloculina bicostata d'Orbigny

Quinqueloculina bicostata D'ORBIGNY, 1839a, p. 195, pl. 12, figs. 8-10. - BERMUDEZ and SEIGLE, 1963, p. 129, pl. 8, fig. 3.
Quinqueloculina lamarckina d'Orbigny var. bicostata D'ORBIGNY.
- DROOGER and KAASSCHIETER, 1958, p. 63, map fig. 25.

Diagnosis: Test inflated, nearly as broad as long; chambers inflated, distinct; two rounded keels on the peripheral margin of each chamber; sutures distinct, depressed; wall with very fine longitudinal striae; aperture terminal, on a stout neck with a thin lip, and a simple tooth extending slightly above the lip.

Dimensions: Length, 0.70 to 0.80 mm.; width, 0.35 to 0.50 mm.; thickness, 0.25 mm.

Remarks: This species resembles Q. lamarckina, except the chambers of Q. lamarckina are sharply angular and the chambers of this species are rounded.

Distribution: Very rare. Five specimens were found from two stations in water depths of 25 to 50 feet. It is a member of Biofacies C, and it has been reported in rare quantities from Recent sediments of Cuba, Jamaica, British Honduras, Trinidad, and Venezuela.

Quinqueloculina bosciana d'Orbigny

Quinqueloculina bosciana D'ORBIGNY, 1839a, p. 191. pl. 11, figs. 22-24. - BERMUDEZ and SEIGLIE, 1963, p. 130. pl. 7, fig. 3.

Diagnosis: Test elongate; chambers very long, inflated; periphery rounded; sutures distinct, slightly depressed; wall flat and polished with uniform white color; aperture very small, circular, with a slight lip, with a simple tooth.

Dimension: Length, 0.25 to 0.35 mm.

Distribution: Very rare. Three specimens were found at two stations in water depths of 25 and 75 feet. It is a member of Biofaices B, and it has been reported from shallow-water sediments of Cuba, British Honduras, and Venezuela.

Quinqueloculina bradyana Cushman

Plate 1, figures 17-19

Miliolina undosa BRADY (not Quinqueloculina undosa Karrer), 1884, p. 176, pl. 6, figs. 6-8.

Quinqueloculina bradyana CUSHMAN, 1917, p. 52, pl. 18, fig. 2. - CUSHMAN, 1929, p. 23, pl. 1, fig. 3. - BERMUDEZ, 1935, p. 155. - BARKER, 1960, p. 12, pl. 6, figs. 6-8.

Diagnosis: Test elongate, stout, large; chambers slightly angular, inflated; sutures distinct, depressed; periphery rounded; wall arenaceous, of fine sand particles; aperture terminal with a small tooth.

Dimensions: Length, 0.70 to 1.00 mm.; width, 0.45 to 0.65 mm.; thickness, 0.20 to 0.30 mm.

Distribution: Abundant. This species was found throughout the study area in all biotopes. It is a member of Biofacies D, and it has been reported from Recent sediments of Jamaica, southern Florida, and British Honduras.

Quinqueloculina candeiana d'Orbigny

Plate 6, figures 14-15

Quinqueloculina candeiana D'ORBIGNY, 1839a, p. 199, pl. 12, figs. 24-26. CUSHMAN, 1929, p. 27. - CUSHMAN, 1931, p. 4, pl. 1, fig. 10.

Diagnosis: Test triangular in cross section; chambers angled, distinct, the periphery sharply keeled, sutures distinct, depressed; wall smooth; aperture terminal, on a short neck, with a small lip and bifid tooth.

Dimensions: Length, 0.45 to 0.60 mm.; width, 0.15 to 0.25 mm.

Remarks: This species is similar to Q. lamarckina except that Q. candeiana is narrower and shorter and has a more elongated neck.

Distribution: Seven specimens were found from three stations in water depths of 25 to 100 feet. It is a member of Biofacies G, and it has been reported from Recent sediments of the Caribbean-Antilles region.

Quinqueloculina compta Cushman

Quinqueloculina compta CUSHMAN, 1947, p. 87, pl. 19, fig. 2. - DROOGER and KAASSCHIETER, 1958,p. 61. - ANDERSEN, 1961, p. 29, pl. 4, figs. 2, 3.

Diagnosis: Test elongate, compressed; chambers rough, slightly inflated; periphery with a thin jagged keel; sutures distinct, depressed; wall rough, slightly agglutinated, thin; aperture terminal, on a short neck, with a thin lip and simple tooth.

Dimensions: Length, 0.35 to 0.65; width, 0.15 to 0.30 mm.

Distribution: Rare. Five specimens were found at one station in five feet of water in Biotope III. It is a member of Biofacies H, and it has been reported from Recent sediments of the Gulf of Mexico, British Honduras, and Trinidad.

Quinqueloculina funafutiensis (Chapman)

Miliolina funafutiensis CHAPMAN, 1900, p. 178, pl. 19, fig. 6.
Quinqueloculina funafutiensis (Chapman). - CUSHMAN, 1922b, p. 67, pl. 13, fig. 3. - CUSHMAN, 1929, p. 30, pl. 4, fig. 4.

Diagnosis: Test elongate, triangular in cross section; chambers angled; periphery angled; sutures distinct, depressed wall with slight longitudinal striae; aperture terminal, rounded, with a simple tooth.

Dimension: Length, 0.30 to 0.40 mm.; width, 0.15 to 0.25 mm.

Distribution: Very rare. One specimen was found in 75 feet of water. It has been reported from Recent sediments of southern Florida, British Honduras, and Samoa.

Quinqueloculina lamarckina d'Orbigny

Quinqueloculina lamarckina D'ORBIGNY, 1939a, p. 189, pl. 11, figs. 14, 15. - CUSHMAN and PARKER, 1929, p. 4, pl. 1, fig. 10 - CUSHMAN and CAHILL, 1933, p. 9, pl. 2, fig. 4. - TODD and BRONNIMANN, 1957, p. 27, pl. 3, fig. 12. - DROOGER and KAASSCHIETER, 1958, p. 62, map fig. 25.

Distribution: Abundant. This species was found in shallow water and occurs in frequencies of over 3 percent. It is a member of Biofacies D, and it has been reported from Recent Sediments of the Gulf of Mexico, Caribbean-Antilles region, and Atlantic Ocean. It has also been reported in the Miocene of the coastal plains of eastern United States.

Quinqueloculina macelloconcha Brooks, n. sp.

Plate 2, figures 17-19

Derivation of name: Latin macellus, thin + Latin concha, shell.

Type specimens: Holotype USNM 000000; paratypes USNM 000000, UH 814.

Type locality: Southern coast of Puerto Rico, sample J-4-75 (dredge sample of carbonate silt in 75 feet of water). Latitude, 17° 57' 00"; Longitude, 68° 30' 00".

Diagnosis: This species is distinguished by the small elliptical test, slightly depressed early chambers, thin, smooth, transparent wall, and large recessed tooth. It is similar to Quinqueloculina sp. B of Wantland (1969), which is probably conspecific with Q. orbignyana Streeter (unpublished), but lacks the long, narrow tooth that extends slightly above the apertural margin and the inflated chambers of these species.

Material: Southern coast of Puerto Rico; 42 specimens.

Description: Test small, elliptical, two to three times longer than wide, elliptical in cross-section; chambers rounded, distinct, early chambers slightly depressed; periphery rounded; sutures distinct, slightly depressed, slightly overlapping previous chamber; wall calcareous, imperforate, very smooth, very thin, transparent; aperture terminal, elliptical, without a neck or lip, with a large recessed tooth.

Dimensions: Length, 0.28 mm.; width, 0.11 mm.; thickness, 0.06 mm.

Distribution: Forty-two specimens were found in water depths of 10 to 600 feet in all biotopes except Biotope VI. It is most commonly found in water depths of 25 to 100 feet in silt and fine-grained sand. It is a member of Biofacies D. This species apparently prefers to live in areas of low energy below wave base in soft silt and mud where the thin test will not be subjected to

destruction.

Quinqueloculina polygona d'Orbigny

Plate 6, figures 19-20

Quinqueloculina polygona D'ORBIGNY, 1839a, p. 198, pl. 12, figs. 21-23. - CUSHMAN, 1929, p. 28, pl. 3, fig. 5. - BERMUDEZ, 1935, p. 159. - BERMUDEZ and SEIGLIE, 1963, p. 138, pl. 9, fig. 5.

Distribution: Very rare. One specimen was found in 25 feet of water. It has been reported from Recent sediments of Jamaica, Cuba, southern Florida, Venezuela, and the Atlantic Ocean.

Quinqueloculina riveroae Bermudez and Seiglie

Plate 6, figures 16-17

Quinqueloculina riveroae BERMUDEZ and SEIGLIE, 1963, p. 139, pl. 9, fig. 1.

Distribution: Very rare. Two specimens were found at two stations in 50 and 75 feet of water in Biotope IV. It is a member of Biofacies B, and it was first described from Recent sediments of the Gulf of Cariaco, Venezuela.

Quinqueloculina seminulum (Linné)

Serpula seminulum LINNÉ, 1758, p. 786.

Miliolina seminulum (Linné). - WILLIAMSON, 1858, p. 85, pl. 7, figs. 183-185.

Quinqueloculina seminulum (Linné). - CUSHMAN, 1929, p. 24, pl. 2, figs. 1-2. - TODD and BRONNIMAN, 1957, p. 27, pl. 3, figs. 9-10. - BERMUDEZ and SEIGLIE, 1963, p. 140.

Distribution: Nine specimens were found in water depths from 50 to 100 feet at five stations in Biotopes IV and V. It is a member of Biofacies C and has been reported in rare quantities from the Recent sediments of the Caribbean-Antilles region.

Quinqueloculina sp. A

Plate 7, figures 1-2

Diagnosis: Test large, angular; chambers distinct, with sharp acute angles; sutures distinct, slightly depressed; wall imperforate, porcelaneous, smooth, milky white color; aperture terminal, on a long angular neck, with a simple tooth.

Dimensions: Length, 0.81 mm.; width, 0.43 mm.

Remarks: This species is similar to Q. collumnosa but the chambers of this species are undulated, the neck is not as long or cylindrical, the angles of the chambers and of the neck are very acute, and the aperture is without a lip.

Distribution: Four specimens were found at three stations in water depths of 10, 25, and 600 feet.

Quinqueloculina sp. B

Plate 7, figures 8-9

Diagnosis: Test large, angular; chambers inflated, contorted; sutures distinct, very depressed; wall calcareous, slightly perforate; aperture terminal, rounded, on a short neck, with a small lip and simple tooth.

Dimension: Length, 0.81 mm.; width, 0.52 mm.

Remarks: This species resembles Q. angulata and Q. tricarinata but the chambers of this species are much more inflated and contorted.

Distribution: Very rare. Three specimens were found at three stations in 50 feet of water.

Genus Dentostomina Carmen, 1933

Dentostomina aguaoi Farfante

Plate 1, figures 20-22

Dentostomina aguaoi FARFANTE, 1938, p. 318, pl. 45, figs. 4-6

Remarks: The specimens of this species were in poor condition and a positive identification is difficult, so they may be true Quinqueloculinas. For a discussion of Dentostomina see Loeblich and Tappan (1964, p. 458), Carman (1933, p. 31) and Farfante (1938, p. 318).

Distribution: Thirteen specimens were found from four stations in water depths of 10 to 25 feet in Biotopes I and III. It is a member of Biofacies B, and it has been reported from Recent sediments of the southern coast of Cuba.

Genus Massilina Schlumberger, 1893

Massilina protea Parker, Phleger, and Pierson

Massilina protea PARKER, PHLEGER, and PIERSON, 1953, p. 10, pl. 2, figs. 1-4

Diagnosis: Test ellipsoidal, small; chambers inflated rounded; sutures depressed, distinct; wall irregular, with longitudinal costae; aperture terminal on a short neck with a lip and bifid tooth.

Dimensions: Length, 0.30 to 0.40 mm.; width, 0.25 to 0.35 mm.; thickness, 0.07 to 0.10 mm.

Distribution: Very rare. One specimen was found at one station in 100 feet of water. It has been reported from Recent sediments of the Texas Gulf Coast and British Honduras.

Massilina secans (d'Orbigny)

Quinqueloculina secans D'ORBIGNY, 1826, p. 303.
Miliolina secans (d'Orbigny). - BRADY, 1884, p. 167, pl. 6, figs. 1, 2.
Massilina secans (d'Orbigny). - SCHLUMBERGER, 1893, p. 218, pl. 4, figs. 82, 83. - CUSHMAN, 1929, p. 37, pl. 7, figs. 3, 4.

Diagnosis: Test quinqueloculine in early states, later chambers added into one plane; chambers four or five on each side, distinct; sutures distinct, depressed; periphery, rounded or acute, sometimes keeled; wall smooth; aperture terminal, elongate, with a simple tooth.

Dimensions: Length, 0.60 to 0.70 mm.; width, 0.50 to 0.60 mm.; thickness, 0.15 to 0.20 mm.

Distribution: Very rare. One specimen found at one station in 25 feet of water. It has been reported from Recent sediments of the Caribbean-Antilles region, coast of western Europe, and Mediterranean.

Genus Neopateoris Bermudez and Seiglie, 1963

Neopateoris cumanaensis Bermudez and Seiglie

Plate 8, figures 2-3

Neopateoris cumanaensis BERMUDEZ and SEIGLIE, 1963, p. 102, pl. 14, figs. 2-5.

Diagnosis: Test planispiral, compressed; periphery rounded; chambers inflated, rounded all in one plane, three chambers in the last whorl; wall smooth, polished, translucent to opaque; aperture an opening on the last chamber, with a simple tooth.

Dimensions: Width, 0.35 to 0.50 mm.; height, 0.25 to 0.40 mm.

Distribution: Very rare. Two specimens were found at one station in 25 feet of water in Biotope III. It is a member of Biofacies B, and it has been reported from Recent sediments of the Gulf of Cariaco, Venezuela.

Genus Pyrgo Defrance, 1824

Pyrgo denticulata (Brady)

Plate 3, figures 16-17

Biloculina ringens (Lamarck) var. denticulata BRADY, 1884, p. 143, pl. 3, figs. 4, 5. - HERON-ALLEN and EARLAND, 1915, p. 551, pl. 40, figs. 11-13. Biloculina denticulata (Brady). - CUSHMAN, 1917, p. 80, pl. 33, fig. 1. Pyrgo denticulata (Brady). - CUSHMAN, 1929, p. 69, pl. 18, figs. 3, 4. - BARKER, 1960, p. 6, pl. 3, figs. 7-8.

Distribution: Several specimens were found in water depths of 25 to 300 feet in Biotopes III and V in the area around Isla Caja de Muertos. It is a member of Biofacies D and has been reported from Recent sediments of the Caribbean-Antilles region, Atlantic Ocean, and South Pacific Ocean.

Pyrgo johnsoni Cushman

Pyrgo johnsoni CUSHMAN, 1935, p. 6, pl. 2, figs. 6-8. - BERMUDEZ, 1935, p. 173, pl. 13, figs. 1-3.

Diagnosis: Test oblate, short; chambers very inflated; periphery broadly rounded; sutures distinct, depressed; wall, smooth; aperture terminal, on a short neck, with a lip and simple tooth.

Dimensions: Length, 1.00 to 1.25 mm.; width, 0.70 to 0.90 mm.

Distribution: Very rare. One specimen was found at one station in 300 feet of water. It has been reported from Recent sands of the northern coast of Cuba and the northern coast of Puerto Rico.

Pyrgo jugosus Cushman
Plate 3, figures 7-9

Pyrgo jugosus CUSHMAN, 1935, p. 6, pl. 2, figs. 9-11.

Diagnosis: Test ellipsoidal; chambers slightly inflated, the dorsal chamber having a distinct ridge, with two supplementary ridges on each side; periphery keeled, jagged; sutures distinct, depressed; wall smooth except for the keel; aperture terminal, with a broad tooth, somewhat expanded.

Dimensions: Length, 0.90 to 1.10 mm.; width, 0.60 to 0.75 mm.; thickness, 0.60 to 0.70 mm.

Distribution: Rare. Eight specimens were found at two stations in 25 and 300 feet of water. It is a member of Biofacies B and it has been reported from Recent sediments of the northern coast of Puerto Rico.

Pyrgo subsphaerica (d'Orbigny)

Plate 3, figures 18-20

Biloculina subsphaerica D'ORBIGNY, 1939a, p. 162, pl. 8, figs. 25-27

Pyrgo subsphaerica (d'Orbigny). - CUSHMAN, 1929, p. 68, pl. 18, figs. 1-2. - BERMUDEZ and SEIGLIE, 1963, p. 125, pl. 13, fig. 8

Diagnosis: Test small, globular; chambers inflated, rounded; sutures distinct, slightly depressed; wall smooth, unornamented; aperture terminal, oval, with a small tooth.

Dimensions: Length, 0.50 to 0.65 mm.; width, 0.35 to 0.50 mm.

Distribution: Several specimens were found in water depths of 50 to 300 feet in Biotopes III, IV, and V. It is a member of Biofacies D, and it has been reported from Recent sediments of southern Florida, Jamaica, Cuba, Puerto Rico, the Bahamas, and from the Oligocene of Puerto Rico.

Genus Sigmoilopsis Finlay, 1947

Sigmoilopsis schlumbergeri (Silvestri)

Plate 2, figures 20-22

Sigmoilina schlumbergeri SILVESTRI, 1904, p. 267, 269.

Sigmoilopsis schlumbergeri (Silvestri). - FINLAY, 1947, p. 270.

Diagnosis: Test ellipsoidal; chambers of one half coil in length, coiling begins quinqueloculine, then changes with increased angle between planes of coiling; sutures slightly depressed, indistinct; wall arenaceous; aperture terminal, rounded, with a short neck and recurved lip.

Dimensions: Length, 1.00 to 1.25 mm.; width, 0.45 to 0.60 mm.; thickness, 0.20 mm.

Distribution: Very rare. Three specimens were found at one station in 300 feet of water in Biotope V. It is a member of Biofacies A and has been reported from Recent sediments of the Gulf of Mexico, Caribbean Sea, and North and South Atlantic Ocean.

Genus Triloculina d'Orbigny, 1826

Triloculina baldai Bermudez and Seiglie

Plate 6, figures 5, 10

Triloculina baldai BERMUDEZ and SEIGLIE, 1963, p. 177, pl. 10, fig. 2.

Diagnosis: Test stout, robust; chambers inflated, with slight traces of longitudinal costae; sutures very distinct, depressed; wall very smooth; aperture terminal with a lip and large tooth.

Dimensions: Length, 0.80 to 0.90 mm.; width, 0.75 to 0.80 mm.

Distribution: Abundant. Numerous specimens were found in the near-shore waters of 10 to 75 feet deep in Biotopes I, II, III, and IV. It is a member of Biofacies D, and it has been reported from Recent sediment of the Gulf of Cariaco, Venezuela.

Triloculina bicarinata d'Orbigny

Plate 6, figures 11-12

Triloculina bicarinata D'ORBIGNY, 1839a, p. 158, pl. 10, figs. 18-20. - CUSHMAN, 1929, p. 66, pl. 17, fig. 5. - BERMUDEZ, 1935, p. 169. - BERMUDEZ and SEIGLIE, 1963, p. 178, pl. 10, figs. 4-5.

Distribution: Several. This species was found throughout the study area in all biotopes but Biotope II. It is a member of Biofacies D, and it has been reported from Recent sediments of the Caribbean-Antilles region.

Triloculina brogniartiana d'Orbigny

Plate 6, figures 3-4

Triloculina brogniartiana D'ORBIGNY, 1839a, p. 176, pl. 10, figs. 6, 8. - CUSHMAN, 1929, p. 63, pl. 16, fig. 4. - BERMUDEZ and SEIGLIE, 1963, p. 179, pl. 11, fig. 7.

Miliolina brogniartii HOWCHIN, 1889, p. 2.

Distribution: Rare. Seven specimens were found at one station in 75 feet of water. It is a member of Biofacies B, and it has been reported from Recent sediments of Cuba, British Honduras, eastern Atlantic Ocean, and the northern coast of Australia. It has also been reported in the Oligocene of Puerto Rico.

Triloculina gracilis d'Orbigny

Plate 2, figures 7-9

Triloculina gracilis D'ORBIGNY, 1839a, p. 181, pl. 11, figs. 10-12. - CUSHMAN, 1929, p. 59, pl. 14, fig. 4. - BERMUDEZ and SEIGLIE, 1963, pl. 11, fig. 3.

Diagnosis: Test elongate, slender; chambers rounded; sutures distinct, slightly depressed; wall smooth or very finely striate; aperture terminal, on a long cylindrical neck, with a phialine lip and a small bifid tooth.

Dimensions: Length, 0.50 to 0.70 mm.; width, 0.30 to 0.40 mm.; thickness, 0.10 mm.

Distribution: Very rare. Four specimens were found at three stations in Biofacies II and IV. It is a member of Biofacies H and has been reported from Recent sediments of the Caribbean Sea.

Triloculina linneiana d'Orbigny

Plate 7, figures 3-4

Triloculina linneiana D'ORBIGNY, 1839a, p. 172, pl. 9, figs. 11-13. - CUSHMAN, 1929, p. 61, pl. 16, figs. 1-2.

Diagnosis: Test large, elongate; chambers large, inflated; sutures indistinct; wall ornamented with several sharp longitudinal ridges and deep concave troughs; aperture terminal, elliptical, with a bifid tooth.

Dimension: Length, 1.10 to 1.40 mm.; width, 0.80 to 1.00 mm.; thickness, 0.40 to 0.60 mm.

Distribution: Several specimens were found in water depths of 10 to 50 feet in Biotopes I, III, and IV. It is a member of Biofacies D, and it has been reported from Recent sediments of Cuba, Jamaica, and British Honduras.

Triloculina planciana d'Orbigny

Plate 2, figures 4-6

Triloculina planciana D'ORBIGNY, 1839a, p. 173, pl. 9, figs. 17-19. - CUSHMAN, 1929, p. 62, pl. 15, figs. 5-6.

Diagnosis: Test elongate; chambers inflated, distinct; sutures distinct, slightly depressed; periphery broadly rounded wall with numerous fine longitudinal striations; aperture terminal, elliptical, with simple tooth.

Dimensions: Length, 0.55 to 0.65 mm.; width, 0.30 to 0.40 mm.; thickness, 0.15 to 0.20 mm.

Distributions: Very rare. Four specimens were found at three stations in 25, 100 and 300 feet of water in Biotopes III and V. It is a member of Biofacies B, and it has been reported from Recent sediments of Cuba, Jamaica, British Honduras, and southern Florida.

Triloculina pyramidiforma Brooks, n. sp.

Plate 7, figures 6-7

Derivation of name: Latin pyramis, - idis + Latin forma, shape.

Type specimen: Holotype USNM 000000; paratypes USNM 000000, UH 815.

Type locality: Southern coast of Puerto Rico, sample I-5-100 (dredge sample of carbonate gravelly sand in 100 feet of water), Latitude, 17° 52' 00"; Longitude, 66° 28' 00".

Diagnosis: This species is distinguished by the small, pyramidal test, smooth wall, milky white color, and black markings at the ends of each chamber. It is similar to Triloculina terquemiana and Triloculina trihedra but differs in being smaller in size, having more rounded angles in the chambers and having a single short tooth rather than a bifid tooth.

Material: Southern coast of Puerto Rico; 83 specimens.

Description: Test pyramidal, small, as wide as it is long; chambers angular, triangular in cross-section, distinct; periphery smooth, slightly rounded but still showing the angularity of the chambers; sutures distinct, very slightly depressed; wall porcelaneous, imperforate, thick, smooth, milky white color with black markings at the ends of each chamber at the suture lines; aperture terminal, rounded, without a neck, with a simple tooth.

Dimensions: Length, 0.36 mm.; width, 0.32 mm.; thickness, 0.21 mm.

Remarks: The mineralogic content of the black markings at the apeces of the chamber is not known.

Distribution: Eighty-three specimens were found at six stations in water depths of 25 to 100 feet in Biotopes II, IV, and V. It is a member of Biofacies E. This species is found in silt, fine-grained sand and in gravelly sand. The test wall is thick and apparently it can stand all levels of wave energy.

Triloculina quadrilateralis d'Orbigny

Plate 2, figures 10-12

Triloculina quadrilateralis D'ORBIGNY, 1839a, p. 173, pl. 9, figs. 14-16 CUSHMAN, 1922b, p. 76. - CUSHMAN, 1929, p. 64. - BERMUDEZ, 1935, p. 171.

Diagnosis: Test quadrangular with two thin peripheral margins on each chamber; chambers inflated; wall smooth; aperture elliptical with a single elongated tooth which projects slightly above outline of the aperture.

Dimensions: Length, 0.50 to 0.65 mm.; width, 0.30 to 0.40 mm.; thickness, 0.20 to 0.30 mm.

Distribution: Several specimens were found in water depth of 10 to 100 feet in all biotopes except Biotope V. It is a member of Biofacies E, and has been reported from Recent sediments of Cuba, Jamaica, southern Florida, and British Honduras. It has also been reported in the Miocene of Puerto Rico and Florida.

Triloculina rotunda d'Orbigny

Plate 3, figures 1-3

Triloculina rotunda D'ORBIGNY, 1826, p. 299. - CUSHMAN, 1929, p. 59, pl. 14, fig. 3.

Miliolina rotunda MILLETT, 1898, p. 267, pl. 5, figs. 15-16.

Diagnosis: Test compressed; chambers rotund, the test made largely of the two last-formed chambers; sutures distinct, slightly depressed; wall smooth; aperture rounded, with a bifid tooth.

Dimensions: Length, 0.55 to 0.65; width, 0.40 to 0.45 mm.; thickness 0.25 to 0.30 mm.

Distribution: Rare. Six specimens were found at two stations in 25 feet of water in Biotope III. It is a member of Biofacies C, and it has been reported from Recent sediments of southern Florida and British Honduras.

Triloculina trigonula Lamarck

Plate 2, figures 13-16

Miliolites trigonula LAMARCK, 1804, p. 351.

Triloculina trigonula (Lamarck). - CUSHMAN, 1929, p. 56, pl. 12, figs. 10-11, pl. 13, figs. 1-2. - BERMUDEZ, 1935, p. 167. - TODD and BRONNIMANN, 1957 , p. 27, pl. 3, figs. 18-19. - DROOGER and KAASSCHIETER, 1858, p. 76. - BERMUDEZ and SEIGLIE, 1963, p. 182, pl. 11, fig. 5.

Diagnosis: Test triangular in cross section; chambers inflated; periphery broadly convex, end view showing triangular shape, depressed; sutures distinct; wall smooth; aperture terminal with a broad bifid tooth.

Dimensions: Length, 0.70 to 0.90 mm.; width, 0.40 to 0.55 mm.; thickness, 0.40 to 0.55 mm.

Distribution: Several specimens were found in water depths of 10 to 100 feet in Biotopes I, II, III, and IV. It is a member of Biofacies E, and it has been reported from Recent sediments of Cuba, Jamaica, Puerto Rico, Trinidad, Venezuela, British Honduras, the Gulf of Mexico and the Atlantic Ocean. It has also been reported from the Eocene of Louisiana, Mississippi, and the Paris Basin.

Triloculina sp. A

Plate 3, figures 4-6

Diagnosis: Test small, elliptical; chambers rounded, slightly inflated; sutures distinct, slightly depressed; wall smooth; aperture terminal, rounded with a small bifid tooth.

Dimensions: Length, 0.84 mm.; width, 0.52 mm.; thickness, 0.22 mm.

Distribution: Four specimens were found at one station in water depth of 25 feet near Isla Caja de Muertos. It is a member of Biofacies A.

Subfamily MILIOLINELLINAE Vella, 1957

Genus Miliolinella Wiesner, 1931

Miliolinella californica Rhumbler

Plate 3, figures 10-12

Miliolinella californica RHUMBLER, 1936, p. 215, pl. 4, fig. 4

Remarks: M. californica and M. oblonga are very similar in size and shape, but M. californica has an open crescentic aperture, and M. oblonga has a tightly closed crescentic aperture.

Distribution: Rare. Twenty specimens were found at nine stations in shallow water in Biotopes I, III, IV, andV. It is a member of Biofacies D and it has been reported from Recent sediments of southern Germany, British Honduras, and the coast of southern California.

Miliolinella dilatata (d'Orbigny)

Plate 3, figures 21-23

Quinqueloculina dilatata D'ORBIGNY, 1839a, p. 192, pl. 11, figs. 28-30. - CUSHMAN, 1929, p. 26, pl. 2, fig. 5.

Diagnosis: Test broad, compressed; chambers slightly inflated, rounded; sutures distinct, depressed; wall smooth; aperture elongate, crescentic.

Dimensions: Length, 0.55 to 0.60 mm.; width, 0.65 to 0.75 mm.; thickness, 0.30 to 0.40 mm.

Remarks: Miliolinella dilatata encompasses a broad range of variability. It is very similar to forms identified as Q. dilatata but also appears similar to forms identified as M. labiosa (Hofker, 1964; Andersen, 1961; Barker, 1960). It may also be conspecific with Pseudomassilina dilatata (Bandy, 1964).

Distribution: Very rare. Two specimens were found at two stations in 75 feet of water in Biotope IV. It is a member of Biofacies B, and it has been reported from Recent sediments of the Gulf of Mexico, Cuba,

and British Honduras.

Miliolinella fichtelliana (d'Orbigny)

Plate 8, figures 17-18

Triloculina fichtelliana D'ORBIGNY, 1839a, p. 171. pl. 9, figs. 8-10. - CUSHMAN, 1929, p. 63, pl. 17, fig. 1.
Miliolinella fichtelliana (d'Orbigny). - DROOGER and KAASSCHIETER, 1958, p. 54, pl. 3, fig. 6. - BERMUDEZ and SEIGLIE, 1963, p. 99, pl. 12, fig. 8.

Remarks: This species is distinguished from other species of Miliolinella by the numerous longitudinal costae.

Distribution: Several specimens were found in all water depths in Biotopes III, IV, and V. It is a member of Biofacies D, and it has been reported from Recent sediments of Cuba, Jamaica, Trinidad, British Honduras, Venezuela, and the Atlantic Ocean.

Miliolinella oblonga (Montagu)

Plate 3, figures 13-15

Vermiculum oblongum MONTAGU, 1803, p. 522, pl. 14, fig. 9
Triloculina oblonga (Montagu). - D'ORBIGNY, 1826, p. 300. - CUSHMAN, 1929, p. 57, pl. 6, figs. 4-5.

Miliolinella oblonga(Montagu). - BERMUDEZ and SEIGLIE, 1963, p. 101.

Diagnosis: Test elliptical; sutures distinct, slightly depressed; wall smooth; aperture semi-circular, at open end of chambers, with a distinct lip.

Dimensions: Length, 0.70 to 0.85 mm.; width, 0.50 to 0.60 mm.; thickness, 0.35 mm.

Distribution: Several specimens were found at seven stations in water depth from 25 to 600 feet in Biotopes III, IV, and V. It is a member of Biofacies E, and it has been reported from the shallow water Recent sediments of Cuba, Venezuela and British Honduras. It is also abundant in the Atlantic Ocean, Pacific Ocean, and the European coast.

Miliolinella subrotunda (Montagu)

Plate 8, figures 6, 9

Vermiculum subrotundum MONTAGU, 1803, p. 521.

Quinqueloculina subrotunda (Montagu). - D'ORBIGNY, 1826, p. 302.

Triloculina subrotunda (Montagu). - MARKS, 1951, p. 40.

Miliolinella subrotunda (Montagu). - DROOGER and KAASSCHIETER, 1958, p. 54, map fig. 21. - BERMUDEZ and SEIGLIE, 1963, p. 101, pl. 11, fig. 4.

Diagnosis: Test spherical; chambers triloculine in cross section, inflated; sutures distinct, depressed; wall, smooth with slight transverse bands; aperture semicircular at open end of chambers, with distinct lip.

Dimensions: Length, 0.60 to 0.65 mm.; width, 0.45 to 0.55 mm.; thickness, 0.35 to 0.40 mm.

Distribution: Rare. Twelve specimens were found at six stations in 50, 75, 300 and 600 feet of water in Biotopes II, IV, and V. It is a member of Biofacies E, and it has been reported from Recent sediments of Trinidad, Venezuela, the eastern coast of North America, Atlantic Ocean, coast of Europe, and South Pacific Ocean. It has also been reported from the Miocene of Australia.

Subfamily MILIOLINAE Ehrenberg, 1839

Genus Ammomassilina Cushman, 1933

Ammomassilina alveoliniformis (Millett)

Massilina alveoliniformis MILLETT, 1898, p. 609.

Ammomassilina alveoliniformis (Millett). - CUSHMAN, 1933, p. 32.

Diagnosis: Test compressed, nearly circular; chambers quinqueloculine in early stages, later in a single plane; periphery rounded; sutures distinct, depressed; wall arenaceous, with medium-sized sand particles; aperture obscured.

Dimensions: Length, 0.80 to 1.00 mm.; width, 0.70 to 0.80 mm.; thickness, 0.25 mm.

Distribution: Very rare. One specimen was found at one station in 100 feet of water. It has been reported from Recent sediments of the Malay Archipelago, southern Florida, and British Honduras.

Genus Hauerina d'Orbigny, 1839

Hauerina occidentalis Cushman

Plate 8, figures 4-5

Hauerina occidentalis CUSHMAN, 1946, p. 9, pl. 1, figs. 22-24. - BERMUDEZ and SEIGLIE, 1963, p. 90, pl. 12, fig. 1.

Diagnosis: Test discoidal, compressed; chambers, quinqueloculine in early development, three in the outer whorl; wall with coarse radiate costae and crenulations perpendicular to the costae; aperture terminal, cribrate.

Dimensions: Diameter, 0.65 to 0.75 mm.; thickness, 0.25 to 0.30 mm.

Distribution: Six specimens were found at four stations in 5, 25, and 100 feet of water in Biotopes III, IV, and V. It is a member of biofacies H, and it has been reported from Recent sediments of British Honduras, southern Florida, Puerto Rico, and Venezuela.

Hauerina speciosa (Karrer)

Plate 9, figures 11-12

Spiroloculina speciosa KARRER, 1868, p. 135, pl. 1, fig. 8.
Hauerina speciosa (Karrer). - CUSHMAN, 1946, p. 5.

Diagnosis: Test flat, planispiral; two to three chambers in a whorl; quinqueloculine in early stage, periphery rounded; sutures distinct, depressed; wall with radiate costae and crenulations perpendicular to the costae; aperture terminal, cribrate.

Dimensions: Length, 0.65 to 0.70 mm.; width, 0.55 to 0.60 mm.; thickness, 0.12 to 0.15 mm.

Distribution: Three specimens were found at three stations in 50 and 100 feet of water in Biotope IV. It is a member of Biofacies C, and it has been reported from Recent sediments of southern Florida and British Honduras.

Subfamily TUBINELLINAE Rhumbler, 1906

Genus Articulina d'Orbigny, 1826

Articulina atlantica Cushman

Plate 7, figures 14, 19

Articulina atlantica CUSHMAN, 1947, p. 89, pl. 19, fig. 6.

Diagnosis: Test compressed, elliptical in cross-section; chambers fairly distinct, inflated, two to three visible in adult, increasing in bredth and diameter as added; sutures slightly depressed; wall with coarse longitudinal costae; aperture terminal, elliptical, with an erect lip.

Dimensions: Length, 0.80 to 0.90 mm.; width, 0.30 to 0.40 mm.; thickness, 0.15 to 0.20 mm.

Remarks: In the original description, Cushman pointed out that several of the specimens were without a rectilinear stage and were considered to be juvenile. The illustrations on plate 7 of this report are juveniles.

Distribution: Seventeen specimens were found at three stations in water depths from 5 to 50 feet in Biotopes III, IV, and VI. It is a member of Biofacies C, and it has been reported from Recent sediments of the Atlantic Ocean.

Articulina lineata Brady

Plate 7, figures 17-18

Articulina lineata BRADY, 1884, p. 183, pl. 12, figs. 19-21. - CUSHMAN, 1929, p. 52, pl. 11, figs. 8-10, pl. 12, fig. 1. - BARKER, 1960, p. 24, pl. 12, figs. 19-21.

Diagnosis: Test linear, compressed; two to three chambers in linear arrangement; sutures distinct, depressed; wall with coarse longitudinal costae; aperture a terminal slit with a thin lip.

Dimensions: Length, 0.90 to 1.10 mm.; width, 0.25 to 0.35 mm.; thickness, 0.15 to 0.25 mm.

Remarks: This species is very similar to A. sagra in size, shape, and arrangement of chambers. However, the aperture of A. lineata is narrow and thin and A. sagra has a recurved lip.

Distribution: Very rare. Three specimens were found at two stations in water depths of 50 to 75 feet in Biotope IV. It is a member of Biofacies C, and it has been reported from Recent sediments of Jamaica, southern Florida, Bermuda, and British Honduras.

Articulina pacifica Cushman

Plate 7, figures 11, 16

Articulina sulcata BRADY (not Reuss), 1884, p. 183, pl. 12, figs. 12-13.
Articulina conico-articulata CUSHMAN (not Batsch), 1917, p. 58, pl. 22, fig. 6.
Articulina pacifica CUSHMAN, 1944, p. 17, pl. 3, fig. 7. - NARCHI, 1956, p. 167, pl. 1, fig. 8.

Diagnosis: Test short, compressed, early portion triloculine, usually with a single uniserial chamber; chambers distinct, two in triloculine portion with the apertural lip projecting from the second chamber, three with the triloculine portion and a uniserial chamber connected to the second chamber; sutures distinct, raised; wall with coarse longitudinal costae, slightly anastomosing; aperture terminal with a slight lip.

Dimensions: Length, 0.50 to 0.60 mm.; width, 0.45 to 0.55 mm.; thickness, 0.15 to 0.25 mm.

Remarks: The occurrence of this species in the study area is the first known occurrence in the Caribbean-Antilles region.

Distribution: This species is abundant at all depths and in all biotopes except Biotope VI. It is a member of Biofacies D, and it has been reported from Recent sediments of Fiji, Hawaii, Kerimba Archipelago, and the coast of Brazil.

Articulina sagra d'Orbigny

Plate 7, figures 12-13

Articulina sagra D'ORBIGNY, 1839a, p. 183, pl. 9, figs. 23-26. - CUSHMAN, 1929, p. 51, pl. 11, fig. 7. - DROOGER and KAASSCHIETER, 1960, p. 26.

Diagnosis: Test elongate; chambers triloculine in early stage, later uniserial, sutures distinct, depressed; wall with coarse longitudinal costae; aperture a terminal slit, with a flaring recurved lip.

Dimensions: Length, 0.80 to 0.90 mm.; width, 0.30 to 0.40 mm.; thickness 0.15 to 0.25 mm.

Distribution: Several specimens were found in the shallow waters of 25 to 100 feet in all biotopes except Biotope VI. It is a member of Biofacies E, and it has been reported from Recent sediments of Cuba, Jamaica, Martinique, Puerto Rico, and southern Florida.

Family SORITIDAE Ehrenberg, 1839

Subfamily PENEROPLINAE Schultze, 1854

Genus Peneroplis Montfort, 1808

Peneroplis bradyi Cushman

Peneroplis bradyi CUSHMAN, 1930, p. 40, pl. 14, figs. 8-10

Diagnosis: Test small, compressed, planispirally coiled in early stage, later flaring and partially evolute; chambers distinct, lacking chamberlets; sutures distinct, depressed; wall smooth; aperture in a central line of the apertural face.

Dimensions: Diameter, 0.55 to 0.65 mm.; thickness, 0.10 to 0.20 mm.

Remarks: This species is generally associated with the current-swept, mud-free sediments. It is similar to P. proteus except it is not as large and the last chambers are not circular.

Distribution: Common. This species was found in water depths of 25 to 100 feet in all biotopes except Biotope VI. It is a member of Biofacies E, and it has been reported from Recent sediments of southern Florida, Jamaica, British Honduras, and Bermuda.

Peneroplis carinatus d'Orbigny

Plate 5, figures 1-2

Peneroplis carinatus D'ORBIGNY, 1839b, p. 33, pl. 3, figs. 7, 8. - CUSHMAN, 1930, p. 36, pl. 12, figs. 7-10, pl. 14, fig. 1. - BERMUDEZ and SEIGLIE, 1963, p. 115, pl. 15, fig. 6.

Distribution: Very rare. Six specimens were found at four stations in water depths of 25, 75, 100, and 300 feet in Biotopes III and V. It is a member of Biofacies B, and it has been reported from Recent sediments of southern Florida, Bermuda, the coast of Argentina, and Venezuela. It has also been reported in the Miocene of Puerto Rico.

Peneroplis pertusus (Forskal)

Plate 7, figure 15

Nautilus pertusus FORSKAL, 1775, p. 125.

Peneroplis pertusus (Forskal). - JONES, PARKER, and BRADY, 1865, p. 19. - CUSHMAN, 1930, p. 35, pl. 12, figs. 3-6. - BERMUDEZ and SEIGLIE, 1963, p. 116, pl. 16, figs. 1, 2.

Distribution: Several specimens were found in water depths from 10 to 100 feet in Biotopes I, III, IV, and V. This species becomes very abundant adjacent to Isla Caja de Muertos. It is a member of Biofacies D, and it has been reported from Recent sediments of Puerto Rico, Cuba, Jamaica, southern Florida, the Mediterranean, and the Indo-Pacific region.

Peneroplis proteus d'Orbigny

Plate 7, figure 20

Peneroplis protea D'ORBIGNY, 1839a, p. 60, pl. 7, figs. 7-11.

Peneroplis dubius D'ORBIGNY, 1839a, p. 62, pl. 6, figs. 21, 22.

Orbiculina adunca BRADY, 1884, pl. 14, figs. 3, 4.

Peneroplis proteus CUSHMAN, 1921, p. 75, pl. 18, figs. 13-19. - CUSHMAN, 1930, p. 37, pl. 13, figs. 1-17. - HOFKER, 1952, p. 450, 455. - BERMUDEZ and SEIGLIE, 1963, p. 116.

Diagnosis: Test close coiled, tightly enrolled, completely involute; the last two to three chambers increase in a divergent manner but does not become completely circular; chambers numerous, not more than 10 to

12 in early portion; sutures distinct, depressed; wall porcelaneous, smooth; aperture a series of pores on the medial line of the apertural face.

Dimensions: Diameter 0.60 to 0.70 mm.; thickness, 0.20 to 0.25 mm.

Distribution: Several specimens were found in water depths of 10 to 50 feet in Biotopes III and IV. This species increases in abundance adjacent to Isla Caja de Muertos. It is a member of Biofacies C, and it has been reported from Recent sediments of Cuba, Jamaica, the Bahamas, Puerto Rico, Bermuda, coast of Brazil, and western Atlantic Ocean. It has also been reported in the Miocene of Florida and Puerto Rico.

Subfamily SORITINAE Ehrenberg, 1839

Genus Sorites Ehrenberg, 1839

Sorites marginalis (Lamarck)
Plate 8, figures 13, 16

Orbulites marginalis LAMARCK, 1816, p. 196.
Orbitolites marginalis (Lamarck). - CARPENTER, 1883, p. 560, fig. 1.
Sorites marginalis (Lamarck). - CUSHMAN, 1930, p. 49, pl. 18, figs. 1-4. - BERMUDEZ and SEIGLIE, 1963, p. 157.

Remarks: This species is especially adapted to attaching itself to the blades of the flat Thallasia testudinum sea grass which flourishes in areas of carbonate mud and silt.

Distribution: Several specimens were found in water depths from 10 to 100 feet in Biotope I, III, IV, and V. It is a member of Biofacies D, and it has been reported from Recent sediments of the Bahamas, Jamaica, British Honduras, Venezuela, Atlantic Ocean and the Indo-Pacific region.

Genus Spirolina Lamarck, 1804

Spirolina acicularis (Batsch)

Nautilus (Lituus) acicularis BATSCH, 1791, p. 4, pl. 6, fig. 16.
Spirolina acicularis (Batsch). - CUSHMAN, 1930, p. 42, pl. 15, figs. 1-3. - BERMUDEZ and SEIGLIE, 1963, p. 160, pl. 15, figs. 7, 8.

Distribution: Very rare. One specimen was found in 5 feet of water. It has been reported from Recent sediments of Venezuela in 3 to 4 meters of water, British Honduras on the carbonate platform, western Atlantic, Mediterranean, and the Red Sea.

Subfamily MEANDROPSININAE Henson, 1948

Genus Broeckina Munier-Chalmas, 1882

Broeckina orbitolitoides (Hofker)
Plate 8, figures 14-15

Praesorites orbitolitoides HOFKER, 1930, p. 149, pl. 55, figs. 8, 10-11, pl. 57, figs. 4,6. - ANDERSEN, p. 86, pl. 19, fig. 1.
Archaias compressus (d'Orbigny). - CUSHMAN, 1930, p. 48, pl. 17, figs. 1, 2.

Distribution: Very rare. Four specimens were found at one station in 50 feet of water in Biotope IV. It is a member of Biofacies E, and it has been reported from Recent sediments of the Gulf of Mexico, Trinidad, and Bermuda.

Subfamily ARCHAIASINAE Cushman, 1927

Genus Archaias Montfort, 1808

Archaias angulatus (Fichtell and Moll)

Plate 9, figures 16-20

Nautilus angulatus FICHTELL and MOLL, 1798, p. 112, pl. 21.
Archaias angulatus (Fichtell and Moll). - CUSHMAN, 1928, p. 218, pl. 31, fig. 9. - CUSHMAN, 1930, p. 46, pl. 16, figs. 1-3, pl. 17, figs. 3-5. - BERMUDEZ and SEIGLIE, 1963, p. 12, pl. 15, fig. 4.

Diagnosis: Test compressed, close coiled; chambers numerous, divided into series of chamberlets, at right angles to the periphery; sutures distinct, slightly depressed; wall smooth; aperture a series of pores, one to each chamberlet, in a median line on the peripheral face.

Dimensions: Diameter, 0.50 to 1.50 mm.; thickness, 0.20 to 0.40 mm.

Distribution: Very abundant. This species was found at all but two stations and therefore spans all water depths and all biotopes. This species composes over 13 percent of the total population. It is a member of Biofacies D, and it has been reported from Recent sediments from throughout the world. It has also been reported in the Miocene in Puerto Rico and Dominican Republic.

Genus Cyclorbiculina Silvestri, 1937

Cyclorbiculina compressa (d'Orbigny)

Plate 8, figure 11

Orbiculina compressa D'ORBIGNY, 1839a, p. 66, pl. 8, fig. 4-7.
Archaias compressus (d'Orbigny). - CUSHMAN, 1919, p. 70, pl. 7, fig. 1. - CUSHMAN, 1930, p. 48, pl. 17, figs. 1, 2.
Cyclorbiculina compressa (d'Orbigny). - SILVESTRI, 1937, p. 88. - LOEBLICH and TAPPAN, 1964, p. 495, fig. 383.

Remarks: The systematic position of this species and A. angulatus is discussed in detail by Loeblich and Tappan (1964, p. 495) and Barker (1960, p. 28). The distinction between A. angulatus and C. compressa is made on the basis of the semiepidermal partitions found only in C. compressa. This species is often found attached to the blades of Thallasia testudinum, a common seagrass in the Caribbean-Antilles region.

Distribution: Very abundant. This species was found at all water depth and in all biotopes except Biotope II. It is a member of Biofacies D, and it has been reported from Recent sediments of the Gulf of Mexico, Caribbean-Antilles region, eastern coast of South America, Bermuda, eastern coast of the United States, and the Atlantic Ocean. It has also been reported in the Miocene of Puerto Rico, Jamaica, Florida, and Panama.

Genus Amphisorus Ehrenberg, 1840

Amphisorus hemprichii Ehrenberg

Plate 8, figure 12

Amphisorus hemprichii EHRENBERG, 1838, p. 134, pl. 3, fig. 3. - CUSHMAN, 1930, p. 51, pl. 18, figs. 5-7. - BERMUDEZ and SEIGLIE, 1963, pl. 15, fig. 2.

Distribution: Several specimens were found in water depths of 10 to 100 feet in Biotopes I, III, and IV. It is a member of Biofacies D, and it has been reported from Recent sediments of Jamaica, British Honduras, Venezuela, Atlantic Ocean, Indo-Pacific Ocean, and Mediterranean.

Family ALVEOLINIDAE Ehrenberg, 1839

Genus Borelis Montfort, 1808

Borelis pulchra (d'Orbigny)

Plate 8, figure 1

Alveolina pulchra D'ORBIGNY, 1839a, p. 70, pl. 8, figs. 19, 20.
Borelis pulchra (d'Orbigny). - CUSHMAN, 1930, p. 55, pl. 15, figs. 9, 10.

Remarks: This species is impossible to identify without the aid of thin sections, but L. Hottinger (personal communication) has tentatively identified this species as B. pulchra. B. pulchra is fusiform to spheroidal, with the septula in a continuous line; the chamberlets are

of equal size without post-septal passage. The aperture is a single row of rounded holes on the apertural face.

Distribution: Several specimens were found in water depth of 5 to 300 feet in Biotopes III, IV, V, and VI. This species becomes more abundant in the shallow water around Isla Caja de Muertos and Isla Morillito. It is a member of Biofacies D, and it has been reported from Recent sediments of Cuba, Bermuda, British Honduras, Jamaica, and southern Florida.

Suborder ROTALIINA Delage and Herouard, 1896

Superfamily NODOSARIACEA Ehrenberg, 1838

Family NODOSARIIDAE Ehrenberg, 1838

Subfamily NODOSARIINAE Ehrenberg, 1838

Genus Nodosaria Lamarck, 1812

Nodosaria catsbyi d'Orbigny

Nodosaria catsbyi D'ORBIGNY, 1839a, p. 16, pl. 1, figs. 8-10. - TODD and BRONNIMANN, 1957, p. 31, pl. 5, fig. 4. - BERMUDEZ and SEIGLIE, 1963, p. 104, pl. 17, fig. 4.

Distribution: Very rare. One specimen was found at one station in 50 feet of water. It has been reported from Recent sediments of Cuba, Jamaica, Trinidad, Venezuela, and in the Oligocene of Texas and Louisiana.

Genus Dentalina Risso

Dentalina communis (d'Orbigny)

Plate 9, figure 9

Nodosaria (Dentalina) communis D'ORBIGNY, 1826, p. 254.
Nodosaria communis d'Orbigny. - REUSS, 1845, p. 28, pl. 12, fig. 21.
Dentalina communis d'Orbigny. - VAN ANDEL and POSTMA, 1954, p. 210, pl. 1, fig. 13. - DROOGER and KAASSCHIETER, 1958, p. 41. - BERMUDEZ and SEIGLIE, 1963, p. 49, pl. 17, fig. 5.

Distribution: Very rare. One specimen was found at one station in 300 feet of water. It has been reported from Recent sediments of Trinidad, Venezuela, and the Gulf of Mexico.

Genus Frondicularia Defrance, 1826

Frondicularia sagittula Broeck

Plate 4, figures 28-29

Frondicularia alata d'Orbigny var. sagittula BROECK, p. 113, pl. 2, figs. 12, 14. - CUSHMAN, 1923, p. 143, pl. 21, fig. 2. - ANDERSEN, 1961 p. 73, pl. 16, figs. 18-21.

Distribution: Very rare. One specimen was found at one station in 600 feet of water. It has been reported from the Recent sediments of Trinidad, Barbados, Gulf of Mexico, and Bermuda. It has also been reported in the Miocene of Jamaica.

Genus Lagena Walker and Jacob, 1798

Lagena gracillima (Seguenza)

Plate 4, figures 7-8

Amphoria gracilima SEGUENZA, 1862, p. 51, pl. 1, fig. 37.
Lagena gracillima (Seguenza). - JONES, PARKER, and BRADY, 1866, p. 45, pl. 1, figs. 36, 37. - CUSHMAN, 1923, p. 23, pl. 4, fig. 5. - DROOGER and KAASSCHIETER, 1958, p. 51.

Distribution: Very rare. One specimen was found at one station in 10 feet of water. It has been reported from Recent sediments of the Caribbean-Antilles region, the eastern coast of the United States, Atlantic Ocean, western coast of South America, coast of New Zealand, Antarctic, Mediterranean, and the British Isles.

Lagena hispidula Reuss

Plate 4, figures 9-10

Lagena hispidula REUSS, 1858, p. 43. - CUSHMAN, 1923, p. 26, pl. 4, figs. 7,8. - ANDERSEN, 1961, p. 74, pl. 16, fig. 9.

Distribution: Very rare. One specimen was found at one station in 10 feet of water. It has been reported from Recent sediments of the Caribbean-Antilles region, Gulf of Mexico, coast of Brazil, and Bermuda.

Lagena striata (d'Orbigny)

Oolina striata D'ORBIGNY, 1839b, p. 21, pl. 5, fig. 12.
Lagena striata (d'Orbigny). - REUSS, 1862, p. 327, pl. 3, figs. 44,45. - BRADY, 1884, p. 460, pl. 57, figs. 22-24. - CUSHMAN, 1923, p. 54, pl. 10, fig. 9. - TODD and BRONNIMANN, 1957, p. 31, pl. 5, figs. 12-15. - BERMUDEZ and SEIGLIE, 1963, p. 94, pl. 17, fig. 9.

Distribution: Very rare. One specimen was found at one station in 50 feet of water. It has been reported from Recent sediments of Trinidad, Venezuela, southern coast of South America, Atlantic Ocean and British Isles.

Genus Marginulina d'Orbigny, 1826

Marginulina planata Phleger and Parker
Plate 4, figures 19-21

Marginulina planata PHLEGER and PARKER, 1951, p. 9, pl. 4, figs. 21, 22, pl. 5, figs. 1-3. - BERMUDEZ and SEIGLIE, 1963, p. 97, pl. 16, fig. 4.

Distribution: Very rare. One specimen was found at one station in 600 feet in water. It has been reported from Recent sediments of the Gulf of Mexico and north coast of Venezuela.

Genus Lenticulina Lamarck, 1804

Lenticulina kaczkae Brooks, n. sp.
Plate 9, figure 5

Derivation of Name: For Mary Kaczka Brooks.

Type specimens: Holotype USNM 000000; paratypes USNM 000000; UH 816.

Type locality: Southern coast of Puerto Rico, sample J-10-600 (dredge sample of carbonate sandy gravel in 600 feet of water); Latitude 17° 53' 30", Longitude 66° 35' 30".

Diagnosis: This species is distinguished by the lenticular, close coiled shape, bladed peripheral keel, slightly arched sutures, and transparent, lens-like umbilicus. It is similar to Lenticulina sp. A (page 114, pl. 9, fig. 4) of this report but L. sp. A has four to five chambers in the last whorl and has a spine on the periphery of each chamber. It is also very similar to Lenticulina (Robulus) australis Loeblich but that species has a bluntly rounded peripheral edge with a thick keel and eight or nine chambers in the last-formed whorl.

Material: Southern coast of Puerto Rico; 39 specimens.

Description: Test lenticular, close-coiled; five to six chambers in the last whorl; periphery with a thin rounded keel; sutures distinct, slightly arched, flush with the chambers; wall hyaline, smooth with a transparent lens-like umbilicus, showing interior chambers; aperture radiate.

Dimensions: Diameter, 0.61 mm.; thickness, 0.18 mm.

Distribution: Thirty-nine specimens were found in water depths of 5, 10, 25, 75, 100, 300, and 600 feet in Biotopes I, III, and V. It is a member of Biofacies A.

Lenticulina sp. A

Plate 9, figure 4

Diagnosis: Test lenticular, close-coiled; four to five chambers in the last whorl; periphery thin, keeled, with one spine on each chamber; sutures distinct, slightly raised, arched; wall hyaline, smooth, with a transparent, lens-like umbilicus, showing interior chambers; aperture radiate.

Dimensions: Diameter, 0.61 mm.; thickness, 0.18 mm.

Distribution: Rare. Six specimens were found at three stations in 50 feet of water in Biotope III.

Genus Pseudonodosaria Boomgaart, 1949

Pseudonodosaria comatula (Cushman)

Nodasaria comata BRADY, 1884, p. 509, pl. 64, figs. 1-5.
Nodasaria comatula CUSHMAN, 1923, p. 83, pl. 14, fig. 5.
Pseudoglandulina comatula (Cushman). - PHLEGER and PARKER, 1951, p. 10, pl. 5, fig. 7-9.
Rectoglandulina comatula (Cushman). - LOEBLICH and TAPPAN, 1955, p. 2-4. - BARKER, 1960, p. 134, pl. 64, figs. 1-5.
Pseudonodosaria comatula (Cushman). - LOEBLICH and TAPPAN, 1964, p. 522.

Diagnosis: Test short, broadly rounded, two to three chambers; sutures distinct, slightly depressed; wall with longitudinal costae; aperture terminal, central, radiate.

Dimensions: Length, 0.85 to 0.90 mm.; diameter, 0.35 mm.

Distribution: Very rare. Four specimens were found at two stations in 50 and 600 feet of water. It has been reported from Recent sediments of the Gulf of Mexico, eastern coast of the United States, Bermuda, and southern coast of South America.

Pseudonodosaria sp. A

Plate 8, figure 20

Diagnosis: Test short, broadly rounded; one to two chambers, rounded, pointed on the end; sutures indistinct; wall thin, transparent, smooth; aperture terminal, central, radiate.

Dimensions: Length, 0.34 mm.; diameter, 0.17 mm.

Distribution: Very rare. One specimen was found at one station in 50 feet of water.

Superfamily BULIMINACEA Jones, 1875

Family BOLIVINITIDAE Cushman, 1927

Genus Brizalina Costa, 1856

Brizalina lowmani (Phleger and Parker)

Plate 4, figures 1-3.

Bolivina lowmani PHLEGER and PARKER, 1951, p. 13, pl. 6, figs. 20, 21. - TODD and BRONNIMANN, 1957, p. 33, pl. 8, fig. 18. - BERMUDEZ and SEIGLIE, 1963, p. 23, pl. 19, fig. 6.

Diagnosis: Test small, biserial; chambers numerous, eight to ten pairs; sutures distinct, slightly depressed; wall finely perforate, smooth; aperture an elongate, narrow slit.

Dimensions: Length, 0.14 to 0.20 mm.; width, 0.07 to 0.12 mm.; thickness, 0.03 to 0.05 mm.

Remarks: The species of Brizalina found in this study have retral processes or backward projecting chamber overlaps.

Distribution: Very rare. Two specimens were found at two stations in 75 and 100 feet of water in Biotope IV. It is a member of Biofacies E, and it has been reported from Recent sediments of the Gulf of Mexico, British Honduras, Trinidad, and Venezuela.

Brizalina pacifica (Cushman and McCulloch)

Plate 4, figures 13-15

Bolivina acerosa Cushman var. pacifica CUSHMAN and McCULLOCH, 1942, p. 185.

Bolivina pacifica (Cushman and McCulloch). - UCHIO, 1960, pl. 7, fig. 2.

Distribution: Very rare. One specimen was found at one station in 50 feet of water in Biotope IV. It has been reported from Recent sediments of British Honduras and the western coast of the United States.

Brizalina straitula (Cushman)

Plate 4, figures 4-6

Bolivina straitula CUSHMAN, 1922, p. 27, pl. 3, fig. 10. - TODD and BRONNIMANN, 1957, p. 34, pl. 8, figs. 12-16. - BERMUDEZ and SEIGLIE, 1963, p. 27, pl. 19, fig. 2.

Remarks: This species closely resembles B. lowmani and the two could be ecotypic variants.

Distribution: Very rare. Three specimens were found at three stations in water depths of 25 to 50 feet in Biotopes III and IV. It is a member of Biofacies G, and it has been reported from Recent sediments of southern Florida, British Honduras, Trinidad, Venezuela, and in the Miocene of Jamaica.

Brizalina variablis (Williamson)

Plate 4, figures 16-18

Textularia variablis WILLIAMSON, 1858, p. 76, pl. 6, figs. 162, 183. Bolivina variablis (Williamson). - CHASTER, 1890-91, p. 59, 69. - CUSHMAN, 1922, p. 49, pl. 4, fig. 3. - PARKER, 1952, p. 445, pl. 4, fig. 12. - TODD and BRONNIMANN, 1957, p. 35, pl. 8, fig. 31. - BERMUDEZ and SEIGLIE, 1963, p. 28, pl. 19, fig. 5.

Remarks: B. variablis is similar to Loxostomum mayori but does not have the longitudinal striations or the depressed sutures of L. mayori.

Distribution: Very rare. Seven specimens were found at five stations in water depths of 25 to 100 feet in Biotopes I, II, III, and IV. It has been reported from Recent sediments of British Honduras, Trinidad, Venezuela, Gulf of Mexico, and the British Isles.

Family BULIMINIDAE Jones, 1875

Subfamily PAVONININAE Eimer and Fickert, 1899

Genus Reussella Galloway, 1933

Reussella atlantica Cushman

Plate 8, figure 19

Reussella spinulosa (Reuss) var. atlantica CUSHMAN, 1947, p. 91, pl. 20, figs. 6, 7.

Reussella atlantica Cushman. - PHLEGER and PARKER, 1951, p. 18, pl. 8, figs. 8, 9. - DROOGER and KAASSCHIETER, 1958, p. 63, map fig. 26.

Diagnosis: Test pyramidal, triserial; chambers inflated: sutures distinct, depressed; wall perforate, finely striate; periphery sharply angled; aperture basal in final chamber with internal tooth plate.

Dimensions: Length, 0.25 to 0.30 mm.

Distribution: Several specimens were found throughout the area at all water depths. It is a member of Biofacies D, and it has been reported from Recent sediments of the Gulf of Mexico, British Honduras, Trinidad, Bermuda, and the Atlantic Ocean.

Family UVIGERINIDAE Haeckel, 1894

Genus Uvigerina d'Orbigny, 1839a

Univerina perigrina Cushman

Plate 4, figures 11-12

Univerina perigrina CUSHMAN, 1923, p. 166, pl. 42, figs. 7-10. - PHLEGER and PARKER, 1951, p. 18, figs. 22, 24-26. - DROOGER and KAASSCHIETER, 1958, p. 77, map fig. 34. - BERMUDEZ and SEIGLIE, p. 189, pl. 18, fig. 5.

Distribution: Rare. Eight specimens were found at one station in 600 feet of water in Biotope V. It is a member of Biofacies A, and it has been reported from Recent sediments of the Gulf of Mexico, Trinidad, Venezuela, and the northeastern coast of the United States. It has also been reported in the Oligocene of Puerto Rico.

Genus Sagrina d'Orbigny , 1839a

Sagrina puchella d'Orbigny

Sagrina puchella D'ORBIGNY, 1839a, p. 150, pl. 1, figs. 23, 24. Bolivina puchella (d'Orbigny). - CUSHMAN, 1922b, p. 25, pl. 1, figs. 8, 9.

Diagnosis: Test triserial in early stages, later becoming biserial; chambers elliptical, slightly inflated; sutures distinct, slightly depressed; wall with fine longitudinal costae; aperture terminal, elliptical.

Dimensions: Length, 0.30 to 0.40 mm.

Remarks: Although this species is very rare in this study area, it has been reported abundant in the shallow lagoons and mangrove swamps of other areas.

Distribution: Very rare. One specimen was found at one station in 50 feet of water. It has been reported from Recent sediments of Cuba, Jamaica, Virgin Islands, southern Florida, and British Honduras.

Genus Trifarina Cushman, 1923

Trifarina bella (Phleger and Parker)

Angulogerina bella PHLEGER and PARKER, 1951, p. 12, pl. 6, figs. 7,8.
- ANDERSEN, 1961, p. 91, pl. 20, fig. 13.

Remarks: T. bella is similar to T. bradyi but the chambers of T. bradyi are not angular.

Distribution: Very rare. Four specimens were found at three stations at 75, 100, and 600 feet in Biotopes IV and V. It is a member of Biofacies E, and it has been reported from Recent sediments of the Gulf of Mexico and British Honduras.

Superfamily DISCORBACEA Ehrenberg, 1838

Family DISCORBIDAE Ehrenberg, 1838

Subfamily DISCORBINAE, Ehrenberg, 1838

Genus Discorbis Lamarck, 1804

Discorbis sp. cf. D. australis Parr

Plate 5, figures 6-8

Rosalina valvulata D'ORBIGNY, 1826, p. 271.

Discorbina valvulata (d'Orbigny). - JONES and PARKER, 1872, p. 114.

Discorbis valvulata (d'Orbigny). - CUSHMAN, 1926, p. 78.

Discorbis australis PARR, 1932, p. 227, pl. 22, fig. 31.

Diagnosis: Test trochospiral, biconvex slightly recurved on ventral side; chambers dorsally evolute, ventrally involute; sutures distinct, slightly depressed; wall coarsely perforate, smooth; aperture a slit on the interior margin at the last chamber, with a slight lip, extending to but not into the dorsal side.

Dimensions: Diameter, 0.25 to 0.35 mm; thickness, 0.06 mm.

Distribution: Several specimens were found in water depths from 25 to 600 feet in Biotopes III, IV, and V. It is a member of Biofacies E. Discorbis australis has been reported from Recent sediments of southern Australia.

Discorbis mira Cushman

Plate 10, figures 1-2

Discorbina turbo BRADY, 1884, p. 642, pl. 87, fig. 8.

Discorbis mira CUSHMAN, 1922b, p. 39, pl. 7, figs. 10, 11. - CUSHMAN, 1931, p. 25, pl. 5, figs. 5, 6. - BERMUDEZ, 1935, p. 205, pl. 15, figs. 1-5. - BERMUDEZ, 1949, p. 239, pl. 15, figs. 28-30.

Discorbina mira (Cushman). - BERMUDEZ and SEIGLIE, 1963, p. 51, pl. 22, fig. 4

Diagnosis: Test trochospiral, plano-convex dorsally evolute, forming a cone, ventrally involute, the last-formed whorl consists of five to

six chambers, umbilicus slightly raised; sutures slightly curved, depressed; periphery slightly lobate; wall coarsely punctate, smooth; aperture an elongate slit on the interior margin of the last chamber.

Dimension: Diameter, 0.55 to 0.60 mm.

Distribution: Abundant. This species was found in abundance in water depths of 25 to 100 feet in Biotopes III and IV. It is a member of Biofacies D, and it has been reported from shallow-water Recent sediments of southern Florida, Venezuela, British Honduras, Bermuda, Cuba, and the coast of Brazil. It has also been reported from the Miocene of Florida and Dominican Republic.

Discorbis rosea (d'Orbigny)

Plate 10, figures 3-4

Rotalia rosea D'ORBIGNY, 1826, p. 272.

Truncatulina rosea (d'Orbigny). - BRADY, 1884, p. 667, pl. 3, figs. 9-11.

Rotorbinella rosea (d'Orbigny). - BANDY, 1944, p. 372.

Discorbina rosea (d'Orbigny). - BARKER, 1960, p. 198, pl. 96, fig. 1.

Remarks: This species is distinguished by its pink pigmentation and by the ornament of short spines on the dorsal side. It has been reported in association with coarse sediments accumulating in current-swept areas.

Distribution: Very abundant. This species was found at all depths in the area and in all biotopes. It comprises over 10 percent of the total population, and it is a member of Biofaces D. It is a conspicuous element in the pink sandy beaches and reefs from Recent sediments of Cuba, British Honduras, and Puerto Rico.

Genus Neoconorbina Hofker, 1951

Neoconorbina terquemi (Rzehak)

Plate 9, figures 7-8

Rosalina orbicularis TERQUEM, 1876, p. 166, pl. 9, fig. 4.

Discorbina orbicularis (Terquem). - BRADY, 1884, p. 182, pl. 88, figs. 4-8.

Discorbina terquemi RZEHAK, 1888, p. 228.

Neoconorbina terquemi (Rzehak). - HOFKER, 1951, p. 435. - BARKER, 1960, p. 182, pl. 88, figs. 4-8. - ANDERSEN, 1961, p. 102, pl. 21, fig. 5.

Rosalina terquemi (Rzehak). - BERMUDEZ and SEIGLIE, 1963, p. 150, pl. 22, fig. 1.

Remarks: This species has been reported attached to algae and sea grasses in the lagoons and throughout carbonate platform and shoal areas.

Distribution: Several specimens were found at six stations in water depths from 25 to 100 feet in Biotopes I, II, and IV. It is a member of Biofacies C and it has been reported from Recent sediments of the Gulf of Mexico, British Honduras, Venezuela, Bermuda, Atlantic Ocean, South Pacific Ocean, and the north coast of Australia.

Genus Rosalina d'Orbigny, 1826

Rosalina floridana (Cushman)

Plate 5, figures 12-14

Discorbis globularis HERON-ALLEN and EARLAND (not d'Orbigny), 1915, p. 694, pl. 51, figs. 36-39.

Discorbis floridana CUSHMAN, 1922b, p. 39, pl. 5, figs. 11, 12. - PHLEGER and PARKER, 1951, p. 20, pl. 10, figs. 5-7. - DROOGER and KAASCHIETER, 1958, p. 42, pl. 2, fig. 6. - BERMUDEZ and SEIGLIE, 1963 p. 53, pl. 22, fig. 2.

Rosalina floridana (Cushman). - PARKER, 1954, p. 524, pl. 8, figs. 19, 20.

Distribution: Rare. Twelve specimens were found at five stations in water depths from 10 to 100 feet in Biotopes I, II, and IV. It is a member of Biofacies E, and it has been reported from Recent sediments of the Gulf of Mexico, British Honduras, Trinidad, Venezuela, Bermuda, and the coast of Brazil. It has also been reported from the Miocene of Dominican Republic.

Rosalina subauracana (Cushman)

Plate 5, figures 9-11

Discorbis subauracana CUSHMAN., 1922b, p. 41, pl. 7, figs. 1, 2. - CUSHMAN. 1931, pl 32, pl. 7, fig. 2.

Diagnosis: Test biconvex, ventral side slightly convex, dorsal side arched; chambers rounded, six to seven chambers in the last whorl; sutures distinct, curved, slightly depressed; wall finely perforate, smooth; aperture at the base of the last chamber on the ventral side.

Dimensions: Diameter, 0.30 to 0.40 mm.

Distribution: Twenty-five specimens were found at eight stations in

water depths from 10 to 100 feet in Biotopes I, III, and IV. It is a member of Biofacies E, and it has been reported from Recent sediments of southern Florida, Cuba, British Honduras, and the eastern coast of the United States. It has also been reported from the Eocene of the southeastern United States and the Miocene of Florida.

Subfamily BAGGININAE Cushman, 1927

Genus Cancris Montfort, 1808

Cancris oblongus (d'Orbigny)

Plate 9, figures 13-14

Nautilus auricula FICHTELL and MOLL, 1803, p. 108, pl. 20, figs. a-c

Valvulina oblinga D'ORBIGNY, 1839c, p. 136, pl. 1, figs. 40-42

Pulvinulina oblonga (d'Orbigny). - WILLIAMSON, 1858, p. 51, pl. 4, figs. 98-100.

Cancris auricula (Fichtell and Moll). - CUSHMAN, 1931, p. 72, pl. 15, fig. 1.

Cancris oblongus (d'Orbigny) . - PHLEGER and PARKER, 1951, p. 20, pl. 9, figs. 17-19.

Diagnosis: Test trochospiral, elongate, with chambers rapidly enlarging, dorsal side evolute, ventral side slightly open; periphery keeled; chambers rounded, the last chamber triangular in cross-section; sutures distinct; wall finely perforate, smooth; aperture a slit on the last chamber on the ventral side projecting into the umbilicus.

Dimensions: Length, 0.80 to 0.95 mm; width, 0.40 to 0.45 mm.

Remarks: This species is similar to C. sagra, and many writers have included the two together. C. oblongus is separated in this study on the basis of the enlarged final chamber.

Distribution: Very rare. One specimen was found at one station in 600 feet of water. It has been reported from Recent sediments of the Gulf of Mexico, coast of western Europe, and the coast of South Africa.

Cancris sagra (d'Orbigny)

Plate 10, figures 11, 16

Rosalina sagra D'ORBIGNY, 1839a, p. 77, pl. 5, figs. 13-15.

Pulvinulina sagra (d'Orbigny). - CUSHMAN, 1918, p. 70, pl. 24, fig. 6.

Cancris sagra (d'Orbigny). - CUSHMAN, 1931, p. 74, pl. 15, fig. 2. - DROOGER and KAASSCHIETER, 1958, p. 34, map fig. 9.

Cancris sagrai (d'Orbigny). - BERMUDEZ and SEIGLIE, 1963, p. 39, pl. 25, fig. 1.

Distribution: Rare. Seven specimens were found at three stations in water depths of 25, 75, and 300 feet in Biotopes II, III, and V. It is a member of Biofacies A, and it has been reported from Recent sediments of the Gulf of Mexico, British Honduras, southern Florida, Trinidad, Venezuela, and the eastern coast of South America. It has also been reported in the Eocene of Louisiana, the Oligocene of Mexico, Cuba, and Puerto Rico, and the Miocene of Florida and Haiti.

Family SIPHONINIDAE Cushman, 1927

Genus Siphonina Reuss, 1850

Siphonina pulchra Cushman

Plate 8, figures 7-8

Siphonina pulchra CUSHMAN, 1919, p. 42, pl. 14, fig. 7. - CUSHMAN, 1931, p. 69, pl. 14, figs. 2,3. - BERMUDEZ, 1949, p. 243, pl. 16, figs. 34, 36. - BERMUDEZ and SEIGLIE, 1963, p. 155, pl. 24, fig. 4.
Siphonina reticulata CUSHMAN (not Czjzek), 1919, p. 42.

Remarks: This species is similar to S. reticulata, and many writers include them as one species. Other writers have separated them into two species on the basis of the thicker wall, more evenly scattered large pores, and more rounded periphery of S. pulchra.

Distribution: Common. This species was found at all depths and in all biotopes except Biotope II and VI. It is a member of Biofacies D, and it has been reported from Recent sediments of the Gulf of Mexico, and the coast of Brazil. It has also been reported from the Miocene and Pliocene of Cuba.

Family ASTERIGERINIDAE d'Orbigny. 1839a

Genus Asterigerina d'Orbigny, 1839a

Asterigerina carinata d'Orbigny

Plate 10, figures 6-7

Asterigerina carinata D'ORBIGNY, 1839a, p. 118, pl. 5, fig. 23, pl. 6, figs. 1, 2. - CUSHMAN, 1931, p. 77, pl. 15, figs. 4, 5. - BERMUDEZ, 1949, p. 265, pl. 19, figs. 31-33. - BERMUDEZ and SEIGLIE, 1963, p. 17.

Distribution: Abundant. This species was found at all depths and in all biotopes excpet Biotope VI. It is a member of Biofacies D, and it has been reported from Recent sediments of the Gulf of Mexico, Cuba, British Honduras, Venezuela, and the coast of southeastern United States. It has also been reported in the Miocene of Dominican Republic.

Superfamily SPIRILLINACEA Reuss, 1862

Family SPIRILLINIDAE Reuss, 1862

Subfamily SPIRILLININAE Reuss, 1962

Genus Spirillina Ehrenberg, 1843

Spirillina decorata Brady

Spirillina decorata BRADY, 1884, p. 633, pl. 85, figs. 22, 25. - CUSHMAN, 1931, p. 9, pl. 2, fig. 3. - PHLEGER and PARKER, 1951, p. 24, pl. 13, fig. 1. - BARKER, 1960, p. 176, pl. 85, figs. 22-25.

Diagnosis: Test discoidal, bilaterally symmetrical, a tube of five to seven convolutions; periphery a thin rounded keel; wall pitted and furrowed; aperture triangular.

Dimensions: Diameter, 0.80 to 0.85 mm.

Distribution: Very rare. Four specimens were found at two stations in water depths of 25 to 50 feet in Biotope II. It has been reported from Recent sediments of the Gulf of Mexico, Azores, southern coast of South

America, western coast of Africa, and the Canary Islands.

Spirillina limbata Brady

Spirillina limbata BRADY, 1879, p. 278, pl. 8, fig. 26. - CUSHMAN, 1931, p. 7, pl. 2, fig. 2. - BARKER, 1960, p. 176, pl. 85, figs. 18-21.

Diagnosis: Test planispiral, thin, discoidal, a tube of fourteen to eighteen convolutions, slightly concave; periphery flat; wall smooth; aperture rounded.

Dimensions: Diameter, 0.65 to 0.70 mm.

Distribution: Very rare. One specimen was found at one station in 100 feet of water. It has been reported from Recent sediments of British Honduras, Atlantic Ocean, coast of Brazill, and the Indo-Pacific region.

Superfamily ROTALIACEA Ehrenberg, 1839

Family ROTALIADEA Ehrenberg, 1839

Subfamily ROTALINAE Ehrenberg, 1839

Genus Ammonia Brunnich, 1772

Ammonia beccarii (Linné)

Plate 10, figures 5, 10

Nautilus beccarii LINNÉ, 1758, p. 710.

Ammonia beccarii (Linné). - BRUNNICH, 1772, p. 246.

Streblus beccarii (Linné). - FISCHER, 1819, p. 75. - BARKER, 1960, p. 220, pl. 107, fig. 2. - BERMUDEZ and SEIGLIE, 1963.

Rotalia beccarii (Linné). - WILLIAMSON, 1858, p. 48, pl. 4, figs. 90-92. - CUSHMAN, p. 58, pl. 12, figs. 1-7, pl. 13, figs. 1, 2. - PHLEGER and PARKER, 1951, p. 23, pl. 12, fig. 7.

Distribution: Abundant. This species was found in the shallow water depths of 5 to 50 feet in the nearshore area and around Isla Caja de Muertos in Biotopes I, II, III, and IV. It is a member of Biofacies D, and it has been reported from Recent sediments throughout the world. It has also been reported in the Miocene, Pliocene and Pleistocene of the southeastern United States.in nearshore lagoon and mangrove deltaic areas

Family ELPHIDIIDAE Galloway, 1933

Subfamily ELPHIDIINAE Galloway, 1933

Genus Elphidium Montfort, 1808

Elphidium alvarezianum (d'Orbigny)

Polystomella alvareziana D'ORBIGNY, 1839b, p. 31, pl. 3, figs. 11, 12.
Elphidium alvarezianum (d'Orbigny). - CUSHMAN, 1930, p. 18, pl. 7, figs. 1-3.

Diagnosis: Test planispiral, compressed; chambers not inflated, eight to ten in the final whorl; periphery rounded; sutures slightly depressed, retral processes short and broad; wall perforate, smooth; aperture several pores at base of apertural face.

Dimensions: Diameter, 0.50 to 0.60 mm.; thickness, 0.15 to 0.20 mm.

Distribution: Very rare. Two specimens were found at one station in 50 feet of water. It has been reported from Recent sediments from the coast of South America as far south as Argentina and as far north

as the eastern coast of Venezuela.

Elphidium lanieri (d'Orbigny)

Plate 10, figure 8

Polystomella lanieri D'ORBIGNY, 1839a, p. 54, pl. 7, figs. 12, 13.
Elphidium lanieri (d'Orbigny). - CUSHMAN, 1930, p. 23, pl. 9, fig. 7.
- HOFKER, 1964, p. 113, fig. 271.

Remarks: It has been reported that this species is adapted to areas of wave and current activity.

Distribution: Rare. Six specimens were found at two stations in water depths of 25 and 100 feet in Biotopes III and V. It is a member of Biofacies C, and it has been reported from Recent sediments of Cuba, Puerto Rico, and British Honduras. It has also been reported in the Oligocene of Puerto Rico and the Miocene of Florida and Cuba.

Elphidium lessonii (d'Orbigny)

Plate 10, figure 12

Polystomella lessonii D'ORBIGNY, 1826, p. 284. - D'ORBIGNY 1839b, p. 29, pl. 3, figs. 1, 2.
Polystomella macella BRADY (not Fichtell and Moll), 1884, pl. 110, fig. 9 (not 8, 10, 11).
Elphidium lessonii (d'Orbigny). - CUSHMAN, 1930, p. 22, pl. 9, figs. 1-4. - BARKER, 1960, p. 228, pl. 110, fig. 9.

Diagnosis: Test planispiral, large, compressed; periphery rounded,

slightly lobate; sixteen to eighteen chambers in last whorl, slightly inflated, umbilicus not umbonate; sutures sigmoid, marked with retral processes, depressed; wall smooth; aperture, a series of rounded pores on the base of the apertural face.

Dimensions: Diameter, 0.72 to 0.80 mm.; thickness, 0.25 mm.

Remarks: This species is distinguished from E. lanieri by the less prominent retral processes and the sigmoid character of the sutures.

Distribution: Very rare. One specimen was found at one station in 50 feet of water. It has been reported from Recent sediments of the South Atlantic Ocean along the coast of South America.

Genus Cellanthus Montfort, 1808

Cellanthus discoidale (d'Orbigny)

Plate 10, figure 9

Polystomella discoidale D'ORBIGNY, 1839a, p. 56, pl. 6, figs. 23, 24. Elphidium discoidale (d'Orbigny). - CUSHMAN, 1930, p. 22, pl. 8, figs. 8, 9. - TODD and BRONNIMANN, 1957, p. 39, pl. 6, figs. 8, 9. - BERMUDEZ and SEIGLIE, 1963, p. 57, pl. 28, fig. 5.

Remarks: This species resembles E. lanieri and is distinguished from it by the less prominent retral processes, more distinct umbilicus, and more depressed sutures.

Distribution: Rare. Nine specimens were found at three stations in water depths from 25 to 75 feet in Biotopes III and IV. It is a member

of Biofacies C, and it has been reported from Recent sediments of the Gulf of Mexico, Cuba, Jamaica, British Honduras, Trinidad, and Venezuela.

Genus Cribroelphidium Cushman and Bronnimann, 1948

Cribroelphidium poeyanum (d'Orbigny)

Plate 10, figure 13

Polystomella poeyanum D'ORBIGNY, 1839a, p. 55, pl. 6, figs. 25, 26. Elphidium poeyanum (d'Orbigny). - CUSHMAN, 1930, p. 25, pl. 10, figs. 4, 5. - CUSHMAN, 1937, p. 54, 55, pl. 14, figs. 25, 26. - TODD and BRONNIMANN, 1957, p. 39, pl. 7, figs. 2-4. - DROOGER and KAASSCHIETER, 1958, p. 43, map fig. 14. - BERMUDEZ and SEIGLIE, 1963, p. 59, pl. 28, figs. 1-3.

Distribution: Abundant. This species was found at all depths and at all biotopes except Biotope VI. It is a member of Biofacies D, and it has been reported from Recent sediments of the Gulf of Mexico, Cuba, Jamaica, British Honduras, Trinidad, and Venezuela. It has also been reported in the Miocene of Puerto Rico and the eastern coast of the United States.

Family NUMMULITIDAE Blainville, 1825

Subfamily CYCLOCLYPEINAE Butschli, 1880

Genus Heterostegina d'Orbigny

Plate 5, figures 15-16.

Heterostegina antillarum D'ORBIGNY, 1839a, p. 121, pl. 7, figs. 24, 25. - CUSHMAN, 1930, p. 33, pl. 12, figs. 1, 2. - DROOGER and KAASSCHIETER, 1958, p. 50, map fig. 18.

Distribution: Several specimens were found in water depths from 25 to 300 feet in Biotopes III, IV, V, and VI. It is a member of Biofacies D, and it has been reported from Recent sediments of Cuba, Brazil, Puerto Rico, and Trinidad.

Superfamily GLOBIGERINACEA Carpenter, Parker, and Jones, 1862

Family HANTKENINIDAE Cushman, 1927

Subfamily HASTIGERININAE Bolli, Loeblich and Tappan, 1957

Genus Hastigerina Thomson, 1876

Hastigerina aequilateralis (Brady)

Globigerina aequilateralis BRADY, 1879, p. 71. - CUSHMAN, 1924, p. 25, pl. 4, figs. 7, 8.

Globigerinella aequilateralis (Brady). - CUSHMAN, 1927, p. 87, pl. 19, fig. 7. - BRADSHAW, 1959, p. 38, pl. 7, figs. 1-2. - BÉ and HAMLIN, 1967, p. 101, fig. 18.

Hastigerina aequilateralis (Brady). - BOLLI, LOEBLICH, and TAPPAN, 1957, p. 29, pl. 22, figs. 1-2. - BARKER, 1960, p. 166, pl. 80, figs. 18-21.

Distribution: Very rare. Three specimens were found at one station in 600 feet of water. It is a member of Biofacies A, and it has been reported from Recent sediments of the Gulf of Mexico, the Caribbean-Antilles region, Atlantic Ocean, and the Pacific Ocean. It has also been reported in the Miocene of Trinidad and Venezuela.

Family GLOBOROTALIIDAE Cushman, 1927

Subfamily GLOBOROTALIINAE Cushman, 1927

Genus Globorotalia Cushman, 1927

Globorotalia hirsuta (d'Orbigny)

Rotalina hirsuta D'ORBIGNY, 1839a, p. 131, pl. 1, figs. 37-39.
Globorotalia hirsuta (d'Orbigny). - CUSHMAN, 1931, p. 99, pl. 17, fig. 6. - BRADSHAW, 1959, p. 44, pl. 8, figs. 1-2. - BÉ and HAMLIN, 1967, p. 103, fig. 38.

Distribution: Several specimens were found in water depths of 300 to 600 feet in Biotope V. It is a member of Biofacies A, and it has been reported from Recent sediments of the Caribbean-Antilles region, Atlantic Ocean, Pacific Ocean, and the Southern Ocean. It has also been reported in the Pliocene of Cuba.

Globorotalia menardii (d'Orbigny)

Rotalia menardii D'ORBIGNY, 1826, p. 273. - BANNER and BLOW, 1960, p. 31, pl. 6, fig. 2.
Rotalina cultrata BAILEY, 1851, p. 11, pl. 4, figs. 14-16.
Pulvinulina repanda var. menardii PARKER and JONES, 1865, p. 394, pl. 16, figs. 35-37.
Pulvinulina menardii var. cultrata BROECK, 1876, p. 141, pl. 3, figs. 13, 15.
Globorotalia menardii (d'Orbigny) - CUSHMAN, 1927, p. 175. - BRADSHAW, 1959, p. 44, pl. 8, figs. 3-4. - BÉ and HAMLIN, 1967, p. 103, fig. 34.
Globorotalia cultrata (d'Orbigny). - PARKER, 1962, p. 235, pl. 5, figs. 3-5.

Distribution: Common. This species was found at five stations in water depths of 25, 100, 300, and 600 in Biotopes I, IV, and V. It is a member of Biofacies A, and it has been reported from Recent sediments of the Gulf of Mexico, Caribbean-Antilles region, Atlantic Ocean, and Pacific Ocean. It has also been reported in the Oligocene of Mexico and Cuba, the Miocene of Trinidad, Florida, Haiti, Puerto Rico, and Venezuela.

Globorotalia truncatulinoides (d'Orbigny)

Rotalina truncatulinoides D'ORBIGNY, 1839a, p. 132, pl. 2, figs. 25-27.
Pulvinulina truncatulinoides (d'Orbigny). - PARKER and JONES, 1865, p. 398, pl. 16, figs. 41-43.
Pulvinulina repanda, var. menardii subvar. micheliniana PARKER and JONES, 1865, p. 396, pl. 14, fig. 16, pl. 16, figs. 41-43, (not Rotalina micheliniana d'Orbigny).
Globorotalia truncatulinoides (d'Orbigny). - CUSHMAN, 1927, p. 176. - CUSHMAN, 1931, p. 97, pl. 17, fig. 4a-c. -BRADSHAW, 1959, p. 44, pl. 8, fig. 7-8. -BÉ and HAMLIN, 1967, p. 103, fig. 30.

Distribution: Two specimens were found at one station at 600 feet in depth. This species is the least abundant of the planktonic Foraminifera in this area. However, at a sample station in the Atlantic Ocean off Bermuda at a depth of 3800 meters, the writer (Morse and Brooks, 1971, in press) has observed that G. truncatulinoides makes up over 53 percent of the total planktonic foraminiferal population. It is not inferred that depth is the contributing factor to the abundance of G. truncatulinoides or any of the other planktonic Foraminifera. Seasonal migration by prevailing oceanic currents (Bé, 1960) appears to be a more

likely answer to the abundance frequencies of planktonic populations. G. truncatulinoides has been reported from the Gulf of Mexico, Caribbean-Antilles region, Atlantic Ocean, and Pacific Ocean. It has also been reported in the Miocene of the southeastern United States.

Family GLOBIGERINIDAE Carpenter, Parker, and Jones, 1862

Subfamily GLOBIGERININAE Carpenter, Parker, and Jones, 1862

Genus Globigerina d'Orbigny

Globigerina bulloides d'Orbigny

Globigerina bulloides D'ORBIGNY, 1826, p. 277. - DROOGER and KAASSCHIETER, 1958, p. 84, pl. 4, fig. 16, pl. 5, fig. 3. - BÉ and HAMLIN, 1967, p. 98, fig. 8.

Distribution: Rare. Nine specimens were found at six stations in water depths of 10 to 300 feet in Biotopes I, II, IV, and V. It is a member of Biofacies F. It has been reported from Cretaceous to Recent sediments throughout the world.

Globigerina conglomerata Schwager

Globigerina conglomerata SCHWAGER, 1866, p. 255, pl. 7, fig. 113. - CUSHMAN, 1927, p. 172.

Globigerina detertrei D'ORBIGNY, 1839a, p. 95, pl. 4, figs. 19-21. - CUSHMAN, 1924, p. 11.

Distribution: Very rare. Three specimens were found at one station in 600 feet of water in Biotope V. It is a member of Biofacies F, and it has been reported from Recent sediments of the Caribbean-Antilles region.

Globigerina eggeri Rhumbler

Globigerina dubia EGGER, 1857, p. 281, pl. 9, figs. 7-9. - BRADY, 1884, p. 595, pl. 79, fig. 17.

Globigerina conglomerata SCHWAGER, 1866, p. 255, pl. 7, fig. 133.

Globigerina eggeri RHUMBLER, 1900, p. 19. - BERMUDEZ and SEIGLIE, 1963, p. 67.

Distribution: Common. This species was found at three stations in water depths of 300 to 600 feet in Biotope V. It is a member of Biofacies A, and it has been reported from Recent sediments of the Gulf of Mexico, Caribbean-Antilles region, Atlantic Ocean, and Pacific Ocean.

Globigerina radians Egger

Globigerina radians EGGER, 1895, p. 362. - DROOGER and KAASSCHIETER, 1958, p. 84, pl. 4, fig. 24, pl. 5, fig. 6. - BERMUDEZ and SEIGLIE, 1963, p. 69.

Distribution: Rare. Three specimens were found at one station in 600 feet of water. It is a member of Biofacies A, and it has been reported from Recent sediments of the Caribbean-Antilles region, Atlantic Ocean, and Pacific Ocean.

Globigerinoides ruber (d'Orbigny)

Globigerina rubra D'ORBIGNY, 1839a, p. 82, pl. 4, figs. 12-14. - CUSHMAN, 1924, p. 15, pl. 3, figs. 4-7.

Globigerinoides rubra (d'Orbigny). - BRADSHAW, 1959, p. 42, pl. 7, figs. 12-13.

Globigerinoides ruber (d'Orbigny). - BÉ, 1959, pl. 2, figs. 16-17. - BÉ and HAMLIN, 1967, p. 100, fig. 10.

Distribution: This abundant species is found at all water depths and in all biotopes except Biotope VI. It is a member of Biofacies A, and it has been reported from Recent sediments from throughout the world. It has also been reported in the Miocene in the southeastern United States and Trinidad.

Globigerinoides sacculifera (Brady)

Globigerina sacculifera BRADY, 1877, p. 535. - CUSHMAN, 1924, p. 21, pl. 4, figs. 1-6. - BANNER and BLOW, 1960, p. 21, pl. 4, figs. 1 (lectotype), 2.

Globigerinoides sacculifera (Brady). - CUSHMAN and JARVIS, 1930, p. 366, pl. 34, fig. 4. - PARKER, PHLEGER, and PIERSON, 1953, p. 16, pl. 2, figs. 5-6. - TODD, 1964, p. 1083, pl. 290, figs. 7-8. - BERMUDEZ and SEIGLIE, 1963, p. 79.

Globigerinoides quadrilobatus sacculifer (Brady). - PARKER, 1962, p. 299, pl. 3, figs. 6-10.

Globigerinoides trilobus (Reuss), forma typica BOLTOVSKOY, 1964, p. 13, pl. 2, figs. 6-9.

Globigerinoides trilobus (Reuss), forma sacculifera (Brady). - BOLTOVSKOY, 1964, p. 15, pl. 3, fig. 2.

Globigerinoides tribobus trilobus (Reuss). - CIFELLI, 1965, p. 36, pl. 9, figs. 1-3.

Distribution: Four specimens were found at one station in 300 feet of water. It is a member of Biofacies A, and it has been reported from Recent sediments from throughout the world. It has also been reported in the Miocene of Jamaica.

Subfamily ORBULININAE Schultze, 1854

Genus Orbulina d'Orbigny, 1839

Orbulina universa d'Orbigny

Orbulina universa D'ORBIGNY, 1839a, p. 3, pl. 1, fig. 1. - CUSHMAN, 1924, p. 29, pl. 5, figs. 2-9. - DROOGER and KAASSCHIETER, 1958, p. 86. - BÉ and HAMLIN, 1967, p. 102, fig. 26.

Distribution: Several specimens were found in water depths from 100 to 600 feet in Biotope V. It is a member of Biofacies A, and it has been reported from Miocene through Recent sediments from throughout the world.

Genus Candeina d'Orbigny 1839

Candeina nitida d'Orbigny

Candeina nitida D'ORBIGNY, 1839a, p. 107, pl. 2, figs. 27-28. - CUSHMAN, 1924, p. 35, pl. 5, fig. 1. - DROOGER and KAASSCHIETER, 1958, p. 86. - BÉ and HAMLIN, 1967, p. 102, fig. 28.

Distribution: Three specimens were found at one station in 600 feet of water in Biotope V. It is a member of Biofacies A, and it has been reported from Recent sediments of the Caribbean-Antilles region and Atlantic Ocean.

Superfamily ORBITOIDACEA Schwager, 1876

Family EPONIDIDAE Hofker, 1951

Genus Eponides Montfort, 1808

Eponides antillarum (d'Orbigny)

Plate 5, figures 3-5

Rosalina antillarum D'ORBIGNY, 1839a, p. 75, pl. 5, figs. 4-6. Eponides antillarum (d'Orbigny). - CUSHMAN, 1931, p. 42, pl. 9, fig. 2. - PHLEGER and PARKER, 1951, p. 20, pl. 10, figs. 9, 10. - DROOGER and KAASSCHIETER, 1958, p. 45, map fig. 15. - BERMUDEZ and SEIGLIE, 1963, p. 61, pl. 24, fig. 1.

Distribution: Common. This species was found in all water depths and in all biotopes except Biotope VI. It is a member of Biofacies D, and it has been reported from Recent sediments of the Gulf of Mexico, Cuba, southern Florida, British Honduras, Trinidad, and Venezuela. It has also been reported in the Miocene of Jamaica and Puerto Rico.

Eponides repandus (Fichtell and Moll)

Plate 10, figures 14-15

Nautilus repandus FICHTELL and MOLL, 1798, p. 35, pl. 3, figs. a-d. Eponides repandus (Fichtell and Moll). - MONTFORT, 1808, p. 127. - CUSHMAN, 1931, p. 49, pl. 10, fig. 7. - PHLEGER and PARKER, 1951, pl 21, pl. 11, figs. 5, 6. - DROOGER and KAASSCHIETER, 1958, p. 46, pl. 2, figs. 8, 9.

Diagnosis: Test biconvex, slightly lobate; chambers six to eight in

last whorl; sutures distinct dorsally, slightly raised; periphery keeled; wall coarsely perforate, smooth; aperture an interiomarginal arch on the last formed chamber.

Dimensions: Diameter, 0.60 to 1.50 mm.

Distribution: Common. This species was found in all water depths and in all biotopes except Biotope VI. It is a member of Biofacies D, and it has been reported from Recent sediments of the Gulf of Mexico, British Honduras, Trinidad, and Atlantic Ocean. It has also been reported from the Miocene of Florida and Puerto Rico.

Genus Cibicorbis Hadley, 1934

Cibicorbis sp. A

Diagnosis: Test trochoid, plano-convex, dorsal side evolute, ventral side involute; terminal chamber greatly inflated and triangular in form; sutures distinct, flush; wall finely perforate, smooth; aperture an interiomarginal slit on the ventral side, extending to the periphery.

Dimensions: Diameter, 0.52 mm.

Distribution: Very rare. Two specimens were found at two stations in 600 feet of water in Biotope V. It is a member of Biofacies A.

Family AMPHISTEGINIDAE Cushman, 1927

Genus Amphistegina d'Orbigny, 1826

Amphistegina gibbosa d'Orbigny

Amphistegina gibbosa D'ORBIGNY, 1839a, p. 120, pl. 8, figs. 1-3. - BERMUDEZ and SEIGLIE, 1963, p. 8, pl. 27, fig. 5.

Distribution: This species is the most abundant species in the study area. It was observed at all stations, and the population frequency is commonly over 50 percent at each station. It is a member of Biofacies D, and it has been reported from Recent sediments throughout the Caribbean-Antilles region and the Atlantic Ocean. It has also been reported from the Miocene of Jamaica.

Family CIBICIDIDAE Cushman, 1927

Subfamily CIBICIDINAE Cushman, 1927

Genus Cibicides Montfort, 1808

Cibicides lobatulus (Walker and Jacob)

Plate 10, figures 17-18

Nautilis lobatulus WALKER and JACOB, 1798, p. 642, pl. 14, fig. 36.
Serpula lobatulus (Walker and Jacob). - MONTAGU, 1803, p. 515, p. 160.
Truncatulina lobatula (Walker and Jacob). - D'ORBIGNY, 1839a, p. 134, pl. 2, figs. 22-24.
Cibicides lobatulus (Walker and Jacob). - CUSHMAN, 1931, p. 118, pl. 21, fig. 3. - DROOGER and KAASSCHIETER, 1958, p. 39.

Diagnosis: Test attached, plano-convex, and trochospiral, evolute on dorsal side, involute on ventral side, dorsal side flattened; seven to eight chambers in last whorl, last chamber greatly inflated; sutures distinct, depressed; wall coarsely perforate, smooth; aperture a low interiomarginal narrow slit extending from dorsal side along terminal suture to ventral side.

Dimensions: Diameter, 0.65 to 1.10 mm.; thickness, 0.35 to 0.50 mm.

Remarks: This species is reported to be commonly attached to hydroid stems, algae and sea grasses. There is also considerable variation in this species.

Distribution: Several specimens were found at all water depths in Biotopes I, IV, and V. It is a member of Biofacies E, and it has been reported from Recent sediments of the Gulf of Mexico, Cuba, southern Florida, British Honduras, Trinidad, and the Indo-Pacific region. It has also been reported in the Eocene of Mississippi, the Oligocene of Mississippi, Mexico, and Puerto Rico, and the Pliocene of North Carolina.

Cibicides pseudoungarianus (Cushman)

Plate 10, figures 19-20

Rotalina ungariana D'ORBIGNY, 1846, p. 157, pl. 8, figs. 16-18.

Planorbulina ungariana (d'Orbigny). - BRADY, 1864, p. 469, pl. 48, fig. 12.

Truncatulina ungariana (d'Orbigny). - BRADY, 1884, p. 664, pl. 94, fig. 9.

Truncatulina pseudoungariana CUSHMAN, 1922, p. 97, pl. 20, fig. 9.

Cibicides pseudoungarianus (Cushman). - CUSHMAN, 1931, p. 123, pl. 22, figs. 3-7. - DROOGER and KAASSCHIETER, 1958, p. 39, pl. 2, fig. 1, map fig. 13.

Remarks: This species was found in two sizes, one size of about 0.40 to 0.60 mm. in diameter and the other about 1.00 to 1.50 mm. in diameter. All of the characters were the same. One may be microspheric and the other megalospheric.

Distribution: Abundant. This species was found at all depths of water and in all biotopes except Biotope IV. It is a member of Biofacies D, and it has been reported from Recent sediments of the Gulf of Mexico, British Honduras, eastern coast of the United States, Trinidad, and the Atlantic Ocean. It also has been reported in the Eocene of Mississippi, the Oligocene of Mississippi, and the Miocene of Puerto Rico.

Family PLANORBULINIDAE Schwager, 1877

Genus Planorbulina d'Orbigny, 1826

Planorbulina mediterranensis d'Orbigny

Plate 9, figures 10, 15

Planorbulina mediterranensis D'ORBIGNY, 1826, p. 28, pl. 14, figs. 4-6. - CUSHMAN, 1931, p. 129, pl. 24, figs. 5-8. - DROOGER and KAASSCHIETER, 1958, p. 59. - BERMUDEZ and SEIGLIE, 1963, p. 117.

Diagnosis: Test attached, trochoid, flattened; chambers coiled annular, increasing in size, periphery irregular, angular; sutures distinct, depressed on dorsal side; wall coarsely perforate; aperture, one on each chamber on the periphery.

Dimensions: Diameter up to 1.20 mm.

Distribution: Several specimens were found in water depths from 10 to 300 feet in Biotopes I, II, IV, and V. It is a member of Biofacies D, and it has been reported from Recent sediments of the western Atlantic Ocean, eastern Atlantic Ocean, Caribbean-Antilles region, Mediterranean, western coast of Africa, and the Indo-Pacific region.

Family ACERVULINIDAE Schultze, 1854

Genus Gypsina Carter, 1877

Gypsina vesicularis (Parker and Jones)

Plate 8, figure 10

Orbitolina vesicularis PARKER and JONES, 1960, p. 31.

Gypsina vesicularis (Parker and Jones). - BRADY, 1884, p. 718, pl. 101, figs. 9-12. - BERMUDEZ and SEIGLIE, 1963, p. 86.

Diagnosis: Test very large, flattened, frequently attached; chambers ploygonal, arranged flat; sutures distinct, elevated in central region; periphery rounded; wall calcareous, perforate, smooth; no aperture

Dimensions: Diameter up to 2.00 mm.

Distribution: Very rare. Six specimens were found at three stations in water depths from 50 to 100 feet in Biotopes III and IV. It is a member of Biofacies H and it has been reported from Recent sediments of the Gulf of Mexico, Trinidad, Venezuela, Atlantic Ocean, and the South Pacific Ocean. It has also been reported in the Miocene of Puerto Rico and Jamaica.

Family CYMBALOPORIDAE Cushman, 1927

Genus Cymbaloporetta Cushman, 1928

Cymbaloporetta squammosa (d'Orbigny)

Rotalia squammosa D'ORBIGNY, 1826, p. 272.

Rosalina squammosa (d'Orbigny). - D'ORBIGNY, 1839a, p. 91, pl. 3, figs. 12-14.

Cymbalopora squammosa (d'Orbigny). - CUSHMAN, 1922b, p. 41, pl.6, figs. 4-6.

Cymbaloporetta squammosa (d'Orbigny). - CUSHMAN, 1931, p. 83, pl. 16, fig. 4.

Diagnosis: Test subconical, trochospiral, dorsal side a cone, ventral side flat; six to seven undulating, pie-shaped chambers visible on ventral side, chambers separated by a central depressed area; sutures distinct on ventral side, depressed; wall coarsely perforate on ventral side, finely perforate or absent on dorsal side; aperture a slit at the margin of the last formed chamber.

Dimensions: Diameter, 0.55 to 0.65 mm.

Remarks: This species has been reported as being well adapted to moderate wave and current agitation.

Distribution: Very rare. Three specimens were found at two stations in 100 feet of water in Biotopes IV and V. It is a member of Biofacies H, and it has been reported from Recent sediments of the south Pacific Ocean and the Mediterranean.

Superfamily CASSIDULINACEA d'Orbigny, 1839a

Family CAUCASINIDAE Bykova, 1959

Subfamily FURSENKOININAE Loeblich and Tappan, 1961

Genus Fursenkoina Loeblich and Tappan, 1961

Fursenkoina pontoni (Cushman)

Plate 4, figures 22-24

Virgulina pontoni CUSHMAN, 1932, p. 17, pl. 3, fig. 7. - PARKER, 1954, p. 513, pl. 7, fig. 9. - DROOGER and KAASSCHIETER, 1958, p. 81, map. fig. 37. - BERMUDEZ and SEIGLIE, 1963, p. 192, pl. 19, fig. 14.
Fursenkoina pontoni (Cushman). - LYNTS, 1962, p. 144.

Distribution: Rare. Sixteen specimens were found at five stations at water depths from 25 to 100 feet in Biotopes II, III, and IV. It is a member of Biofacies E, and it has been reported from Recent sediments of the Gulf of Mexico, British Honduras, Trinidad, Venezuela, and the Atlantic Ocean. It has also been reported in the Miocene of Florida, Panama, Cuba, Dominican Republic, and Venezuela.

Family LOXOSTOMIDAE Loeblich and Tappan, 1962

Genus Loxostomum Ehrenberg, 1854

Loxostomum mayori (Cushman)

Plate 4, figures 25-27

Bolivina mayori CUSHMAN, 1922b , p. 27, pl. 3, figs. 5,6
Loxostomum mayori (Cushman). - PHLEGER and PARKER, 1951, p. 17, pl. 8, fig. 5. - BANDY, 1956, p. 195, pl. 31, fig. 11.

Diagnosis: Test elongate, biserial; chambers arching, overlapping, tends to become uniserial; sutures distinct, depressed; wall coarsely perforate, striated; aperture terminal, simple.

Dimensions: Length, 0.60 to 0.70 mm.; width, 0.15 to 0.20 mm.

Distribution: Very rare. Seven specimens were found at four stations in water depths from 50 to 100 feet in Biotopes IV and V. It is a member of Biofacies H, and it has been reported from Recent sediments of the Gulf of Mexico, southern Florida, British Honduras, Atlantic Ocean, and the South Pacific Ocean.

Family NONIONIDAE Schultze, 1854

Subfamily NONIONINAE Schultze, 1854

Genus Florilus Montfort, 1808

Florilus atlanticus (Cushman)

Nonionella atlantica CUSHMAN, 1947, p. 90, figs. 4,5. - DROOGER and KAASSCHIETER, 1958, p. 56, map fig. 22.

Pseudononion atlanticus (Cushman). - ANDERSEN, 1961, p. 84, pl. 18, figs. 1, 2.

Distribution: Very rare. One specimen was found at one station in 10 feet of water. It has been reported from Recent sediments of the Gulf of Mexico, British Honduras, and the eastern coast of the United States.

Florilus grateloupi (d'Orbigny)

Plate 9, figure 6

Nonioniana grateloupi D'ORBIGNY, 1826, p. 294.

Nonion grateloupi (d'Orbigny). - CUSHMAN, 1930, p. 10, pl. 3, figs. 9-11, pl. 4, figs. 1-4. - TODD and BRONNIMANN, 1957, p. 32. pl. 5, figs. 27, 28. - BERMUDEZ and SEIGLIE, 1963, p. 106, pl. 20, fig. 3.

Pseudononion grateloupi (d'Orbigny). - ANDERSEN, 1961, p. 84, pl. 18, fig. 3.

Remarks: There are only small differences between F. atlanticus and F. grateloupi. F. grateloupi is a larger and narrower form with a more peaked final chamber development. The adult forms are distinct but the small juveniles tend to intergrade, and it is possible that these two species should be considered as one variable taxon.

Distribution: Several specimens were found in seven stations in water depths from 50 to 100 feet in Biotopes IV and V. It is a member of Biofacies E, and it has been reported from Recent sediments of the Gulf of Mexico, southern Florida, British Honduras, Trinidad, Venezuela, and the Atlantic Ocean. It has also been reported in the Miocene of France, Cuba and Dominican Republic.

Family ANOMALINIDAE Cushman, 1927

Subfamily ANOMALININAE Cushman, 1927

Genus Hanzawaia Asano, 1944

Hanzawaia concentrica (Cushman)

Truncatulina concentrica CUSHMAN, 1918, p. 64, pl. 21, fig. 3

Cibicides concentricus (Cushman). - RENZ, 1948, p. 127, pl. 10, fig. 8.

Hanzawaia concentrica (Cushman). - DROOGER and KAASSCHIETER, 1958, p. 49, map fig. 17. - ANDERSEN, 1961, p. 124, pl. 28, fig 5. - BERMUDEZ and SEIGLIE, 1963, p. 87, pl. 25, fig. 2.

Distribution: Very rare. Two specimens were found at one station in 300 feet of water in Biotope V. It is a member of Biofacies A, and it has been

reported from Recent sediments of the Gulf of Mexico, Trinidad, British Honduras, and Venezuela. It has also been reported in the Miocene of Florida, Dominican Republic, and Venezuela.

PLATES 1 - 10

PLATE 1

Lituolacea, Miliolacea

1-2 Reophax arayaensis Bermudez and Seiglie

1, side view; 2, apertural view; X 30

3-4 Clavulina tricarinata d'Orbigny

3, side view; 4, apertural view; X 30

5-6 Dorothea bradyana Cushman

5, front view; 6, apertural view; X 30

7-9 Textularia earlandi Parker

7, front view; 8, apertural view; 9 side view; X 60

10-11 Liebusella soldanii (Jones and Parker)

10, side view; 11, apertural view; X 30

12-14 Textularia candeiana d'Orbigny

12, apertural view; 13, side view; 14, front view; X 60

15-16 Planispirinella exigua (Brady)

15, side view; 16, front view; X 60

17-19 Quinqueloculina bradyana Cushman

17, dorsal view; 18, apertural view; 19, ventral view; X 40

20-22 Dentostomina aguaoi Farfante

20, dorsal view; 21, apertural view; 22, ventral view; X 60

23-24 Textulariella barrettii (Jones and Parker)

23, apertural view; 24, side view; X 30

25-26 Reophax bacillaris Brady

25, apertural view; 26, side view; X 30

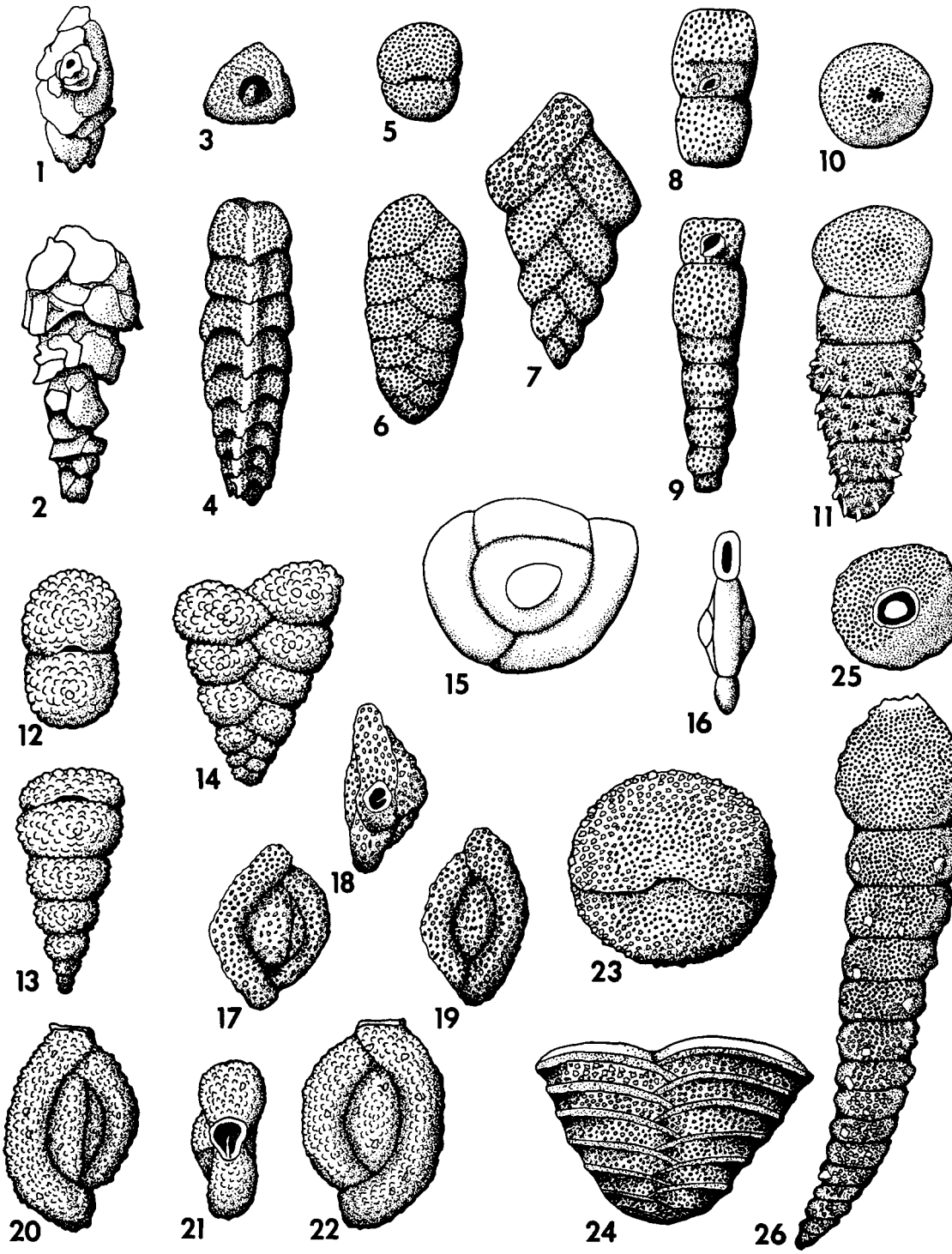

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

PLATE 2

Lituolacea, Miliolacea

1-3 Spiroloculina guppyi Todd and Bronniman

1, 3, side view; 2, apertural view; X 60

4-6 Triloculina planciana d'Orbigny

4, dorsal view; 5, apertural view; 6, ventral view; X 60

7-9 Triloculina gracilis d'Orbigny

7, ventral view; 8, apertural view; 9, dorsal view; X 80

10-12 Triloculina quadrilateralis d'Orbigny

10, ventral view; 11, apertural view; 12, dorsal view; X 60

13-16 Triloculina trigonula Lamarck

13, dorsal view; 14, apertural view; 15, ventral view; 16, front view; X 60

17-19 Quinqueloculina macelloconcha Brooks, n. sp.

17, ventral view; 18, apertural view; 19, dorsal view; X 100

Holotype, USNM 000000.

20-22 Sigmoilopsis schlumbergeri (Silvestri)

20, ventral view; 21, apertural view; 22, dorsal view; X 60

23 Placopsilina bradyi Cushman and McCulloch

23, side view; X 30

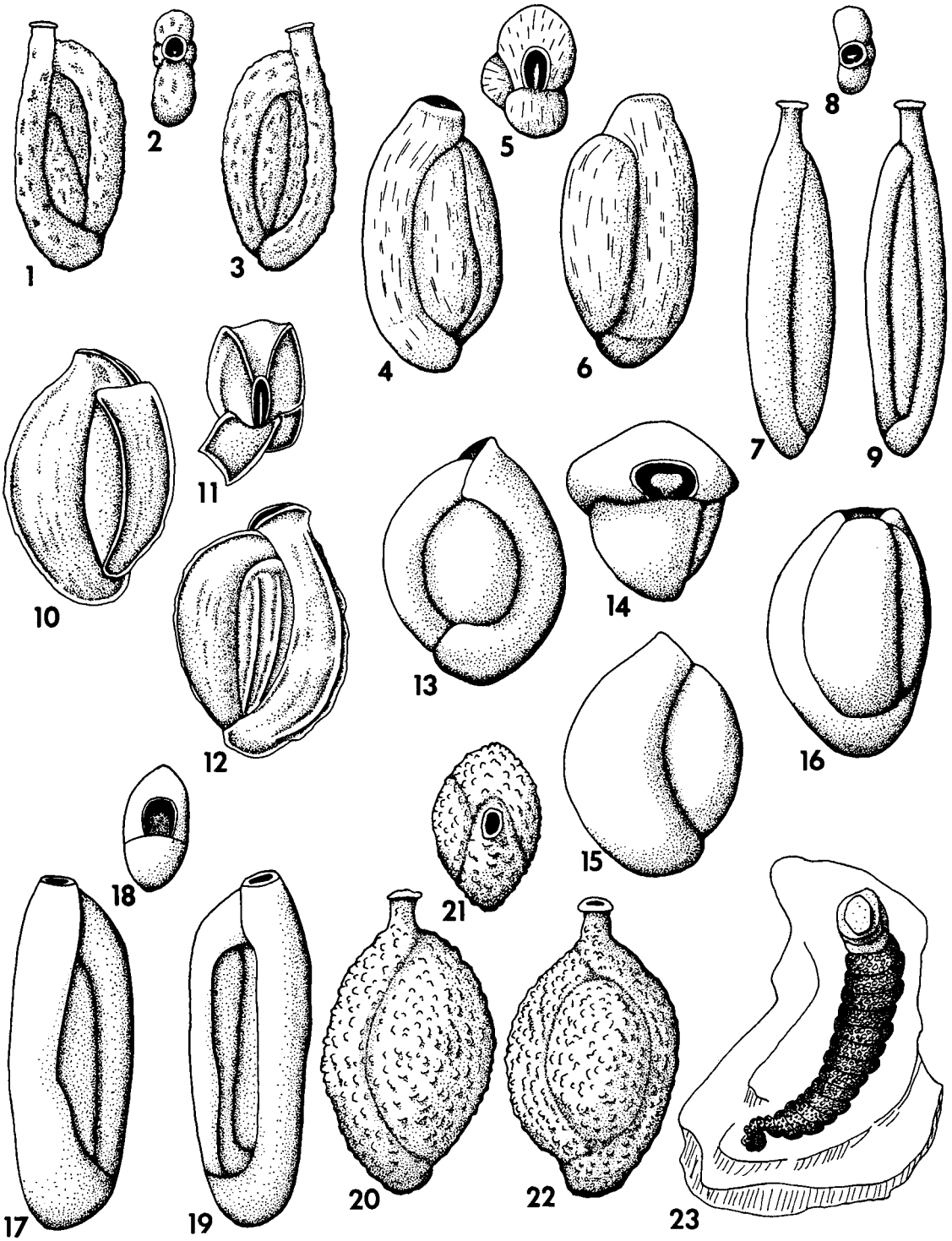

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

PLATE 3

Miliolacea

1-3 Triloculina rotunda d'Orbigny

1, dorsal view; 2, apertural view; 3, ventral view; X 60

4-6 Triloculina sp. A

4, dorsal view; 5, apertural view; 6, ventral view; X 60

7-9 Pyrgo jugosus Cushman

7, front view; 8, apertural view; 9, side view; X 60

10-12 Miliolinella californica Wiesner

10, dorsal view; 11, apertural view; 12, ventral view; X 60

13-15 Miliolinella oblonga (Montagu)

13, ventral view; 14, apertural view; 15, dorsal view; X 60

16-17 Pyrgo denticulata (Brady)

16, apertural view; 17, front view; X 60

18-20 Pyrgo subsphaerica d'Orbigny

18, apertural view; 19, front view; 20, side view; X 60

21-23 Miliolinella dilatata (d'Orbigny)

21, dorsal view; 22, apertural view; 23, ventral view; X 60

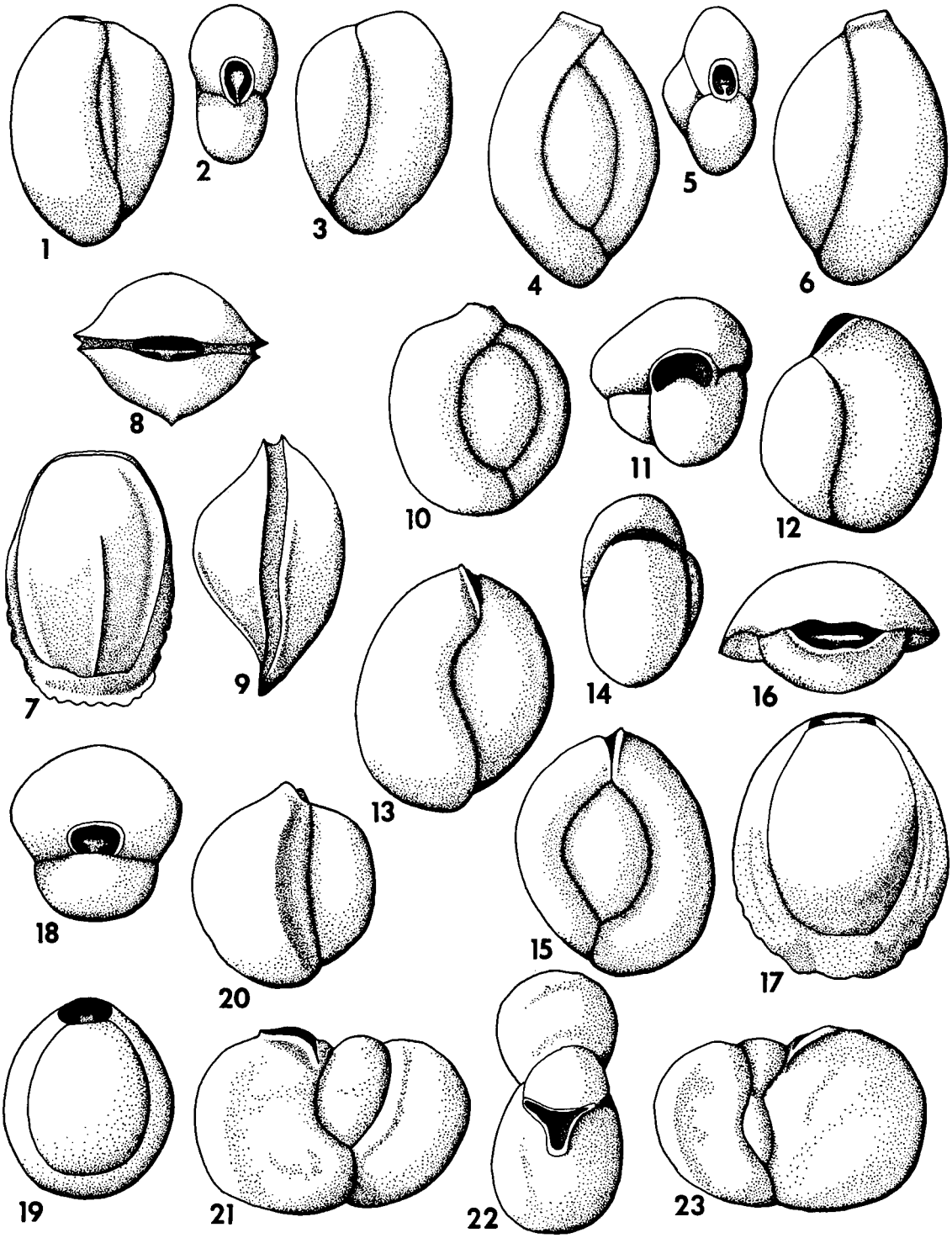

1
2
3
4
5
6
8
10
11
12
7
9
14
16
13
18
20
15
17
19
21
22
23

PLATE 4

Nodosariacea, Buliminacea, Cassidulinacea

1-3 Brizalina lowmani (Phleger and Parker)

1, side view; 2, apertural view; side view; X 100

4-6 Brizalina striatula (Cushman)

4, side view; 5, apertural view; 6, side view; X 100

7-8 Lagena gracillima (Seguenza)

7, side view; 8, apertural view; X 60

9-10 Lagena hispidula Reuss

9, side view; 10, apertural view; X 60

11-12 Urigerina perigrina Cushman

11, side view; 12, apertural view; X 60

13-15 Brizalina pacifica (Cushman and McCulloch)

13, side view; 14, apertural view; 15, side view; X 100

16-18 Brizalina variablis (Williamson)

16, side view; 17, apertural view; 18, side view; X 100

19-21 Marginulina planata Phleger and Parker

19, side view; 20, apertural view; 21, front view; X 60

22-24 Fursenkoina pontoni (Cushman)

22, front view; 23, apertural view; 24, side view; X 100

25-27 Loxostomum mayori (Cushman)

25, side view; 26, apertural view; 27, front view; X 60

28-29 Frondicularia sagittula Broeck

28, side view; 29, front view; X 20

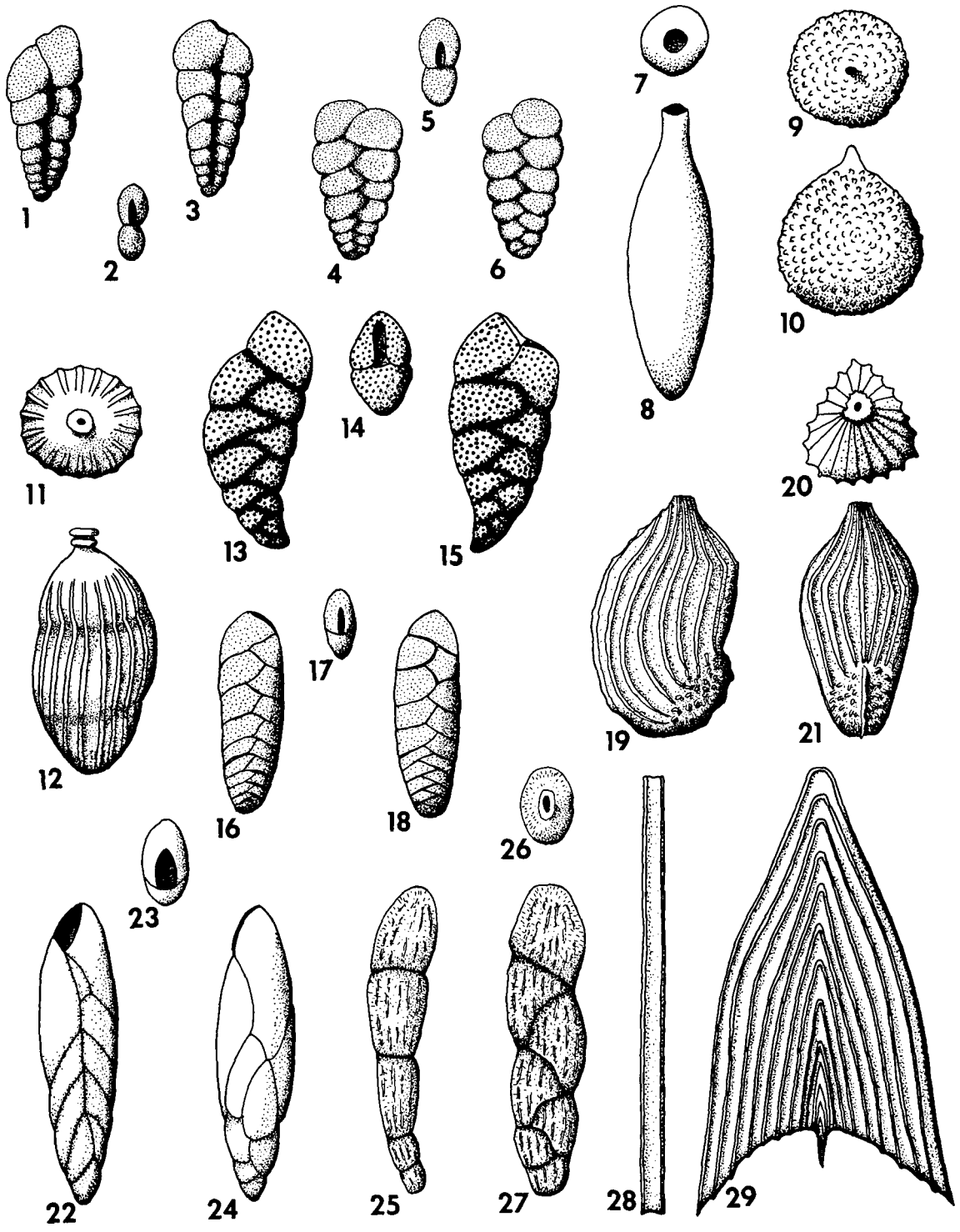

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29

PLATE 5

Miliolacea, Discorbacea, Rotaliacea, Orbitoidacea

1-2 Peneroplis carinatus d'Orbigny

1, side view; 2, front view; X 60

3-5 Eponides antillarum (d'Orbigny)

3, ventral view; 4, apertural view; 5, dorsal view; X 60

6-8 Discorbis sp. cf. D. australis Parr

6, ventral view; 7, apertural view; 8, dorsal view; X 80

9-11 Rosalina subauricana (Cushman)

9, dorsal view; 10, apertural view; 11, ventral view; X 60

12-14 Rosalina floridana (Cushman)

12, ventral view; 13, dorsal view; 14, apertural view; X 60

15-16 Heterostegina antillarum d'Orbigny

15, side view; 16, front view; X 30

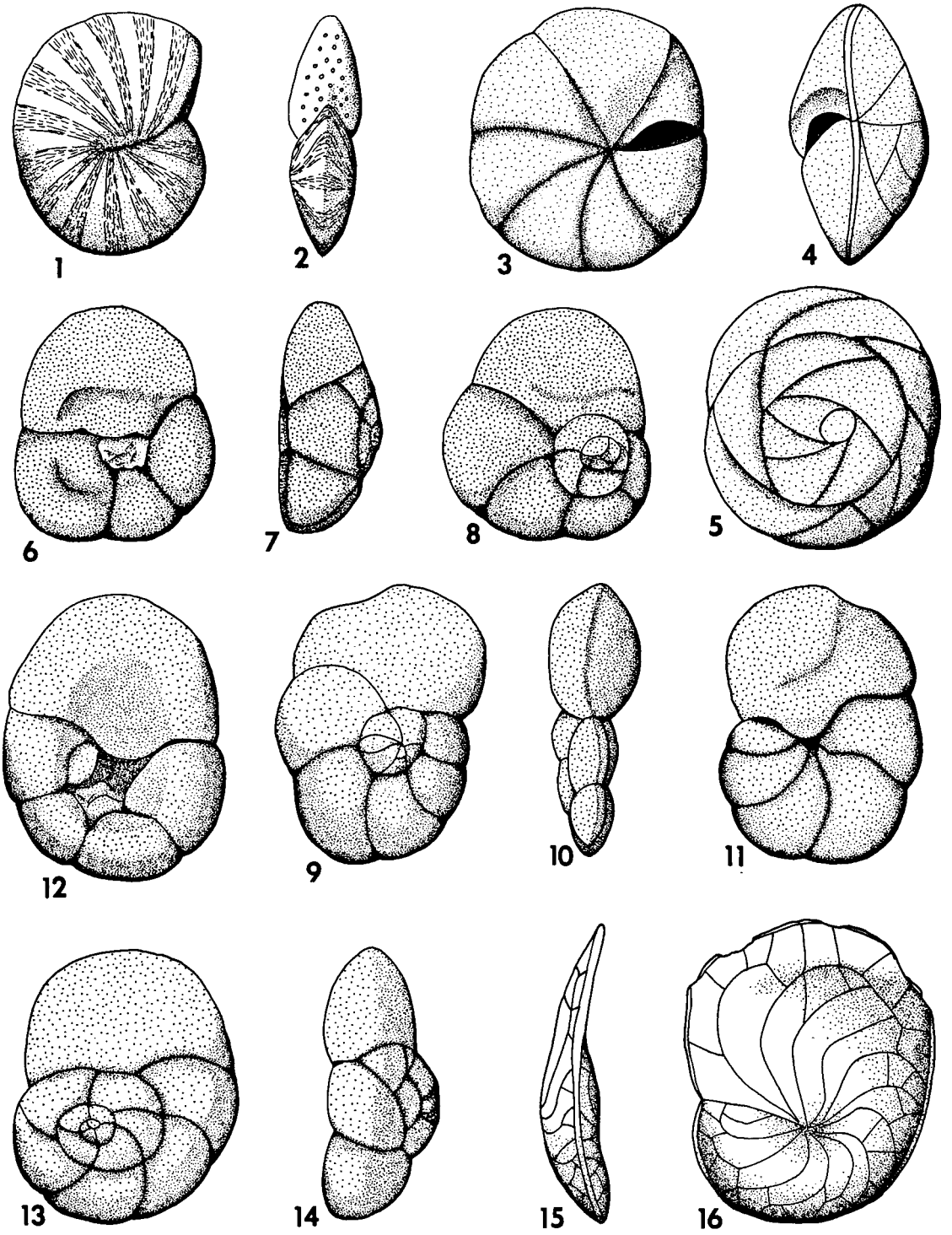

1
2
3
4
6
7
8
5
12
9
10
11
13
14
15
16

PLATE 6

Miliolacea

1-2 Quinqueloculina tricarinata d'Orbigny

1, ventral view; 2, dorsal view; X 60

3-4 Trioculina brogniartiana d'Orbigny

3, dorsal view; 4, ventral view; X 60

5, 10 Triloculina baldai Bermudez and Seiglie

5, dorsal view; 10, ventral view; X 40

6 Spiroloculina anderseni Todd and Bronnimann

6, side view; X 60

7 Spiroloculina antillarum d'Orbigny

7, side view; X 60

8 Spiroloculina exima Cushman

8, side view; X 60

9 Spiroloculina communis Cushman and Todd

9, side view; X 60

11-12 Triloculina bicarinata d'Orbigny

11, dorsal view; 12, ventral view; X 40

13, 18 Quinqueloculina angulata (Williamson)

13, ventral view; 18, dorsal view; X 60

14-15 Quinqueloculina candeiana d'Orbigny

14, dorsal view; 15, ventral view; X 60

16-17 Quinqueloculina riveroae Bermudez and Seiglie

16, ventral view; 17, dorsal view; X 60

19-20 Quinqueloculina polygona d'Orbigny

19, ventral view; 20, dorsal view; X 60

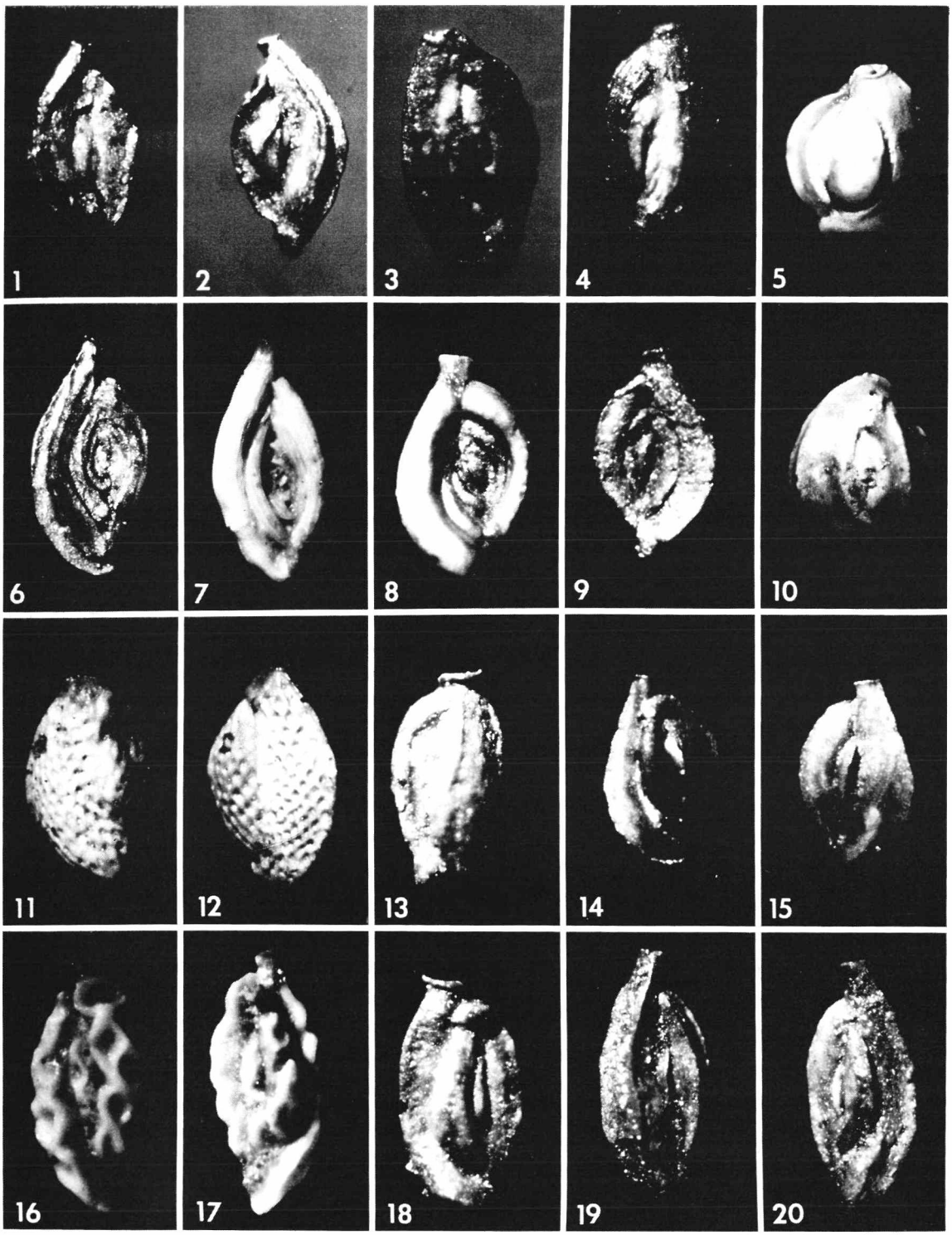

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

PLATE 7

Miliolacea

1-2 Quinqueloculina sp. A

3-4 Triloculina linneiana d'Orbigny

3, dorsal view; 4, ventral view; X 40

5, 10 Vertebralina cassis d'Orbigny

5, ventral view; 10, dorsal view; X 60

6-7 Triloculina pyramidiforma Brooks, n. sp.

6, dorsal view; 7, ventral view; X 60

Holotype, USNM 000000.

8-9 Quinqueloculina sp. B

8, dorsal view; 9, ventral view; X 60

11, 16 Articulina pacifica Cushman

11, ventral view; 16, dorsal view; X 60

Morphologic variant

12-13 Articulina sagra d'Orbigny

12, dorsal view; 13, ventral view; X 60

14, 19 Articulina atlantica Cushman

14, ventral view; 19, dorsal view; X 60

Juvenile

15 Peneroplis pertusus (Forskal)

15, side view; X 60

17-18 Articulina lineata Brady

17, dorsal view; 18, ventral view; X 60

20 Peneroplis proteus d'Orbigny

20, side view; X 40

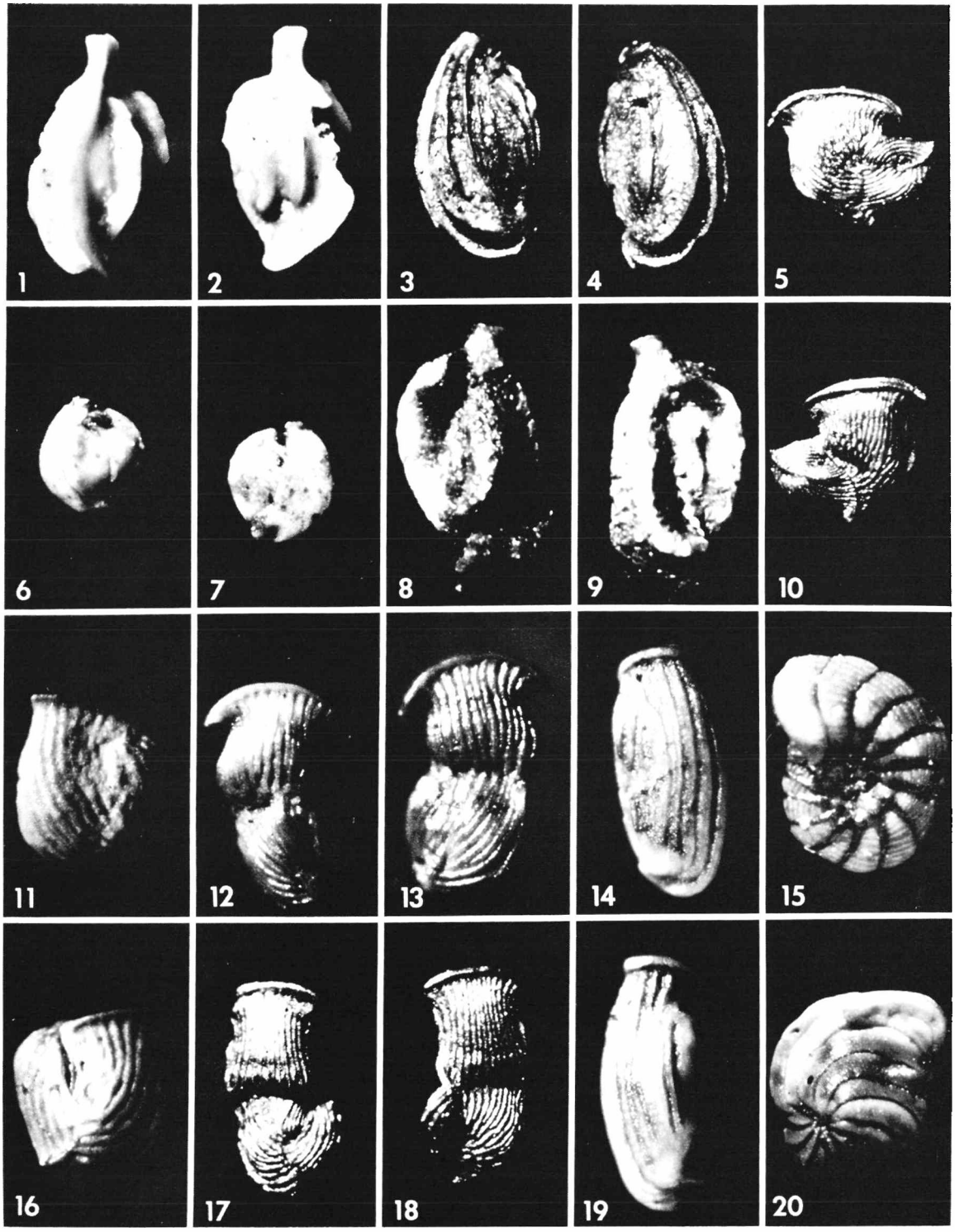

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

PLATE 8

Miliolacea, Nodosariacea, Buliminacea, Discorbacea, Orbitoidacea

1 Borelis pulchra (d'Orbigny)

1, side view; X 60

2-3 Neopateoris cumanaensis Bermudez and Seiglie

2, dorsal view; 3, ventral view; X 60

4-5 Hauerina occidentalis Cushman

4, ventral view; 5, dorsal view; X 60

6, 9 Miliolinella subrotunda (Montagu)

6, ventral view; 9, dorsal view; X 60

7-8 Siphonina pulchra Cushman

7, dorsal view; 8, ventral view; X 60

10 Gypsina vesicularis (Parker and Jones)

10, side view; X 20

11 Cyclorbiculina compressa (d'Orbigny)

11, side view; X 20

12 Amphisorus hemprichii Ehrenberg

12, side view; X 60

13, 16 Sorites marginalis (Lamarck)

13, 16, side view; X 60

14-15 Broeckina orbitolitoides Hofker

14, 15, side view; X 60

17-18 Milioinella fichtelliana (d'Orbigny)

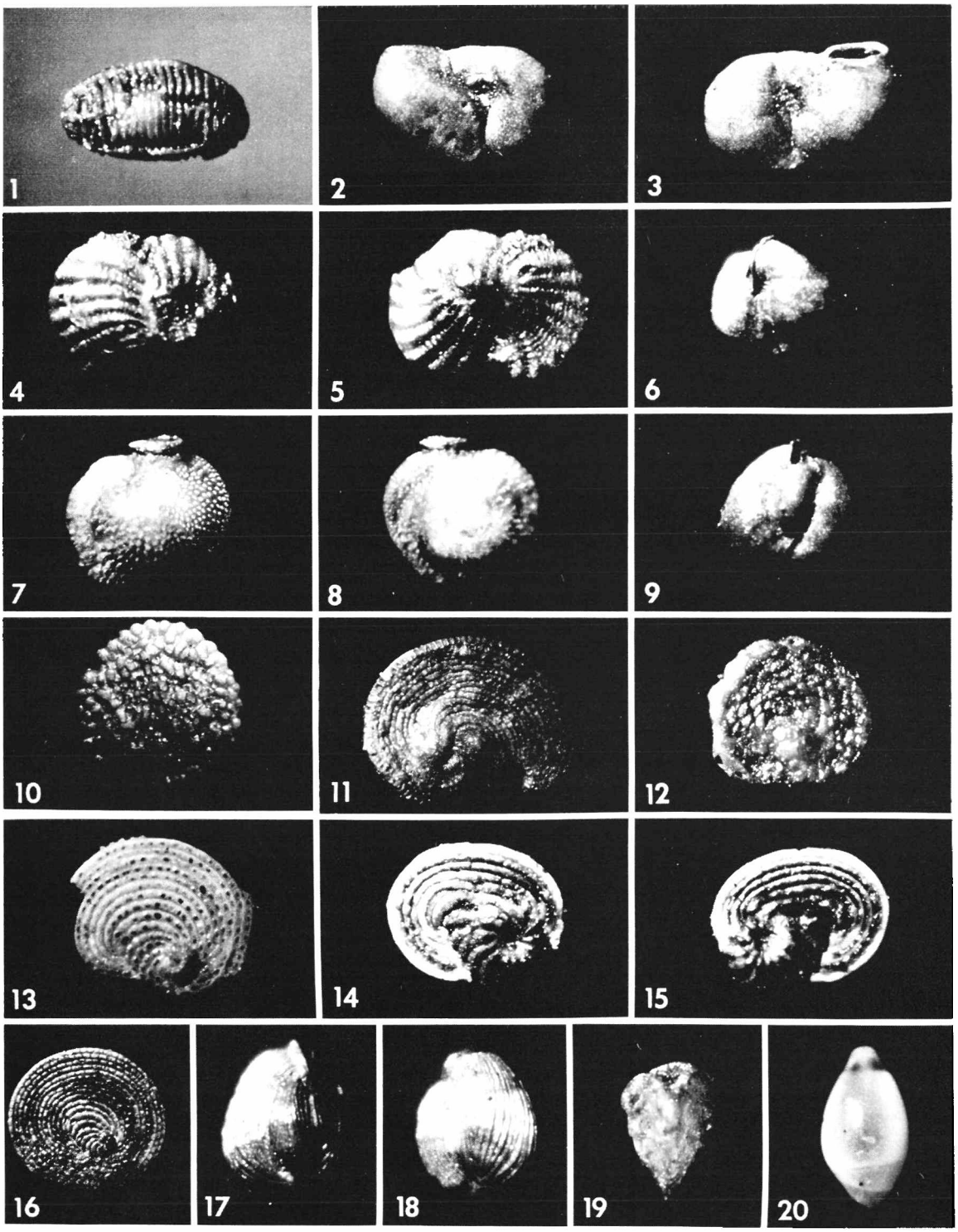
17, dorsal view; 18, ventral view; X 60

19 Reussella atlantica Cushman

19, side view; X 90

20 Pseudonodosaria sp. A

20, side view; X 90


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

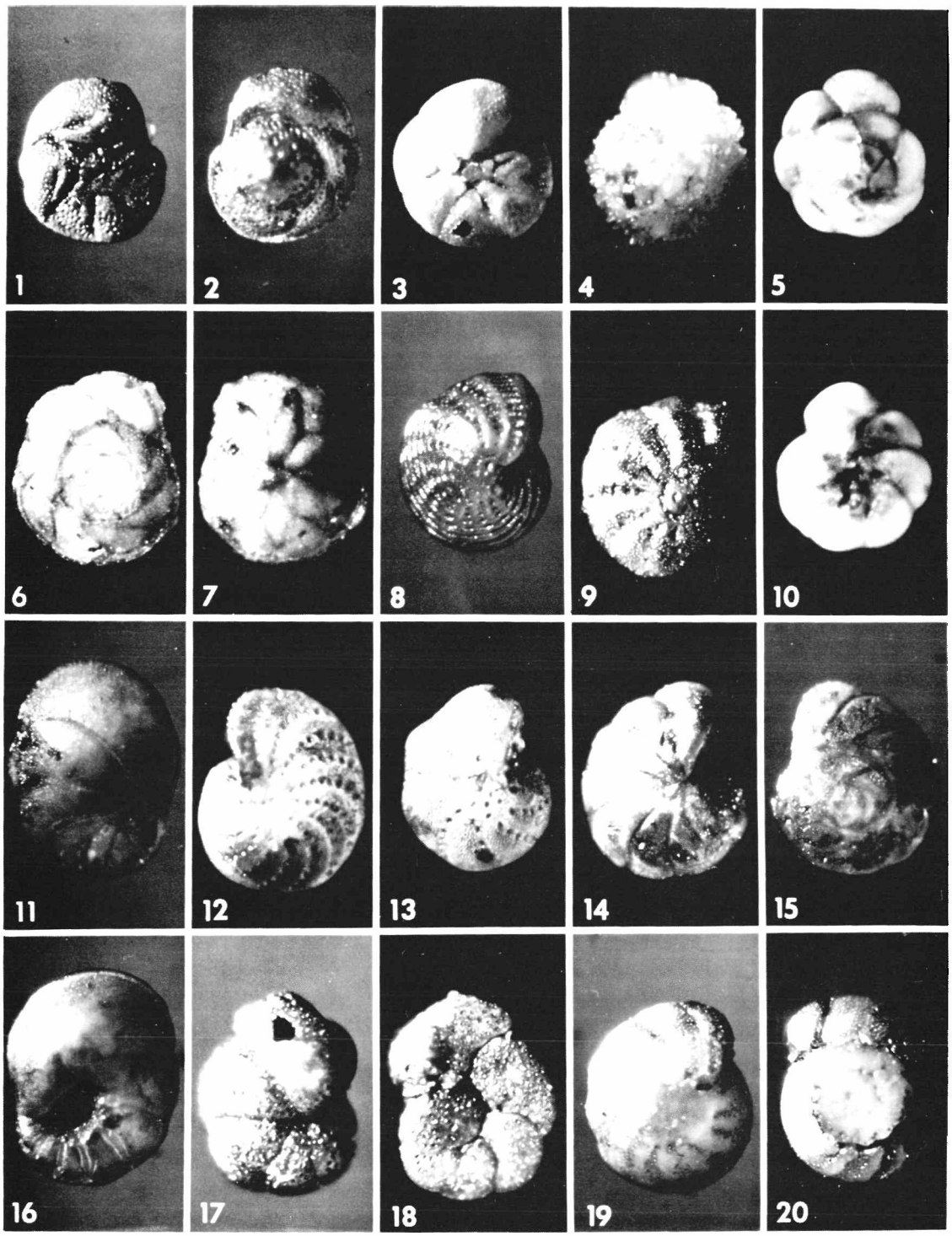

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

PLATE 9

Ammodiscacea, Lituolacea, Miliolacea, Nodosaracea, Discorbacea

Orbitoidacea, Cassidulinacea

1 Ammolagena clavata (Jones and Parker)

1, side view attached to calcareous fragment; X 60

2 Textularia mayori Cushman

2, side view; X 60

3 Bigenerina irregularis Phleger and Parker

3, side view; X 40

4 Lenticulina sp. A

4, side view; X 60

5 Lenticulina kaczkae Brooks, n. sp.

5, side view; X 60

Holotype, USNM 000000.

6 Florilus grateloupi (d'Orbigny)

6, side view; X 80

7-8 Neoconorbina terquemi (Rzehak)

7, dorsal view; 8, ventral view; X 60

9 Dentalina communis (d'Orbigny)

9, side view; X 30

10, 15 Planorbulina mediterranensis d'Orbigny

10, dorsal view; 15, ventral view; X 30

11-12 Hauerina speciosa (Karrer)

11, dorsal view; 12, ventral view; X 60

13-14 Cancris oblongus (d'Orbigny)

13, ventral view; 14, dorsal view; X 60

16-20 Archaias angulatus (Fichtell and Moll)

16, 18-20, side view; 17, apertural view; X 30

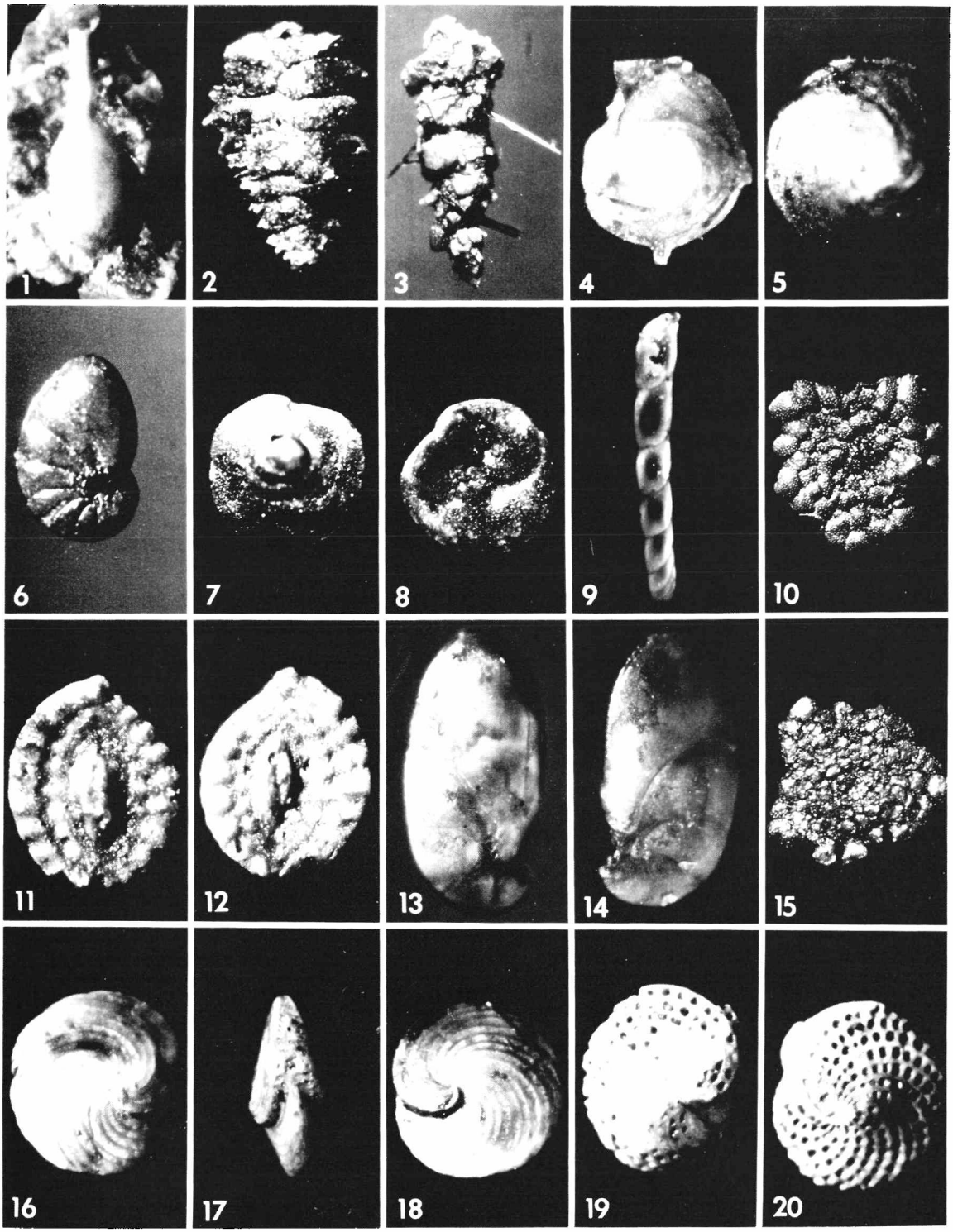

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

PLATE 10

Discorbacea, Rotaliacea, Orbitoidacea

1-2 Discorbis mira Cushman

1, ventral view; 2, dorsal view; X 60

3-4 Discorbis rosea (d'Orbigny)

3, ventral view; 4, dorsal view; X 100

5, 10 Ammonia beccarii (Linne)

5, dorsal view; 10, ventral view: X 100

6-7 Asterigerina carinata d'Orbigny

6, dorsal view; 7, ventral view; X 60

8 Elphidium lanieri (d'Orbigny)

8, side view; X 60

9 Cellanthus discoidale (d'Orbigny)

9, side view; X 60

11, 16 Cancris sagra (d'Orbigny)

11, dorsal view; 16, ventral view; X 60

12 Elphidium lessonii (d'Orbigny)

12, side view: X 60

13 Cribroelphidium poeyanum (d'Orbigny)

13, side view; X 60

14-15 Eponides repandus (Fichtell and Moll)

14, ventral view; 15, dorsal view; X 60

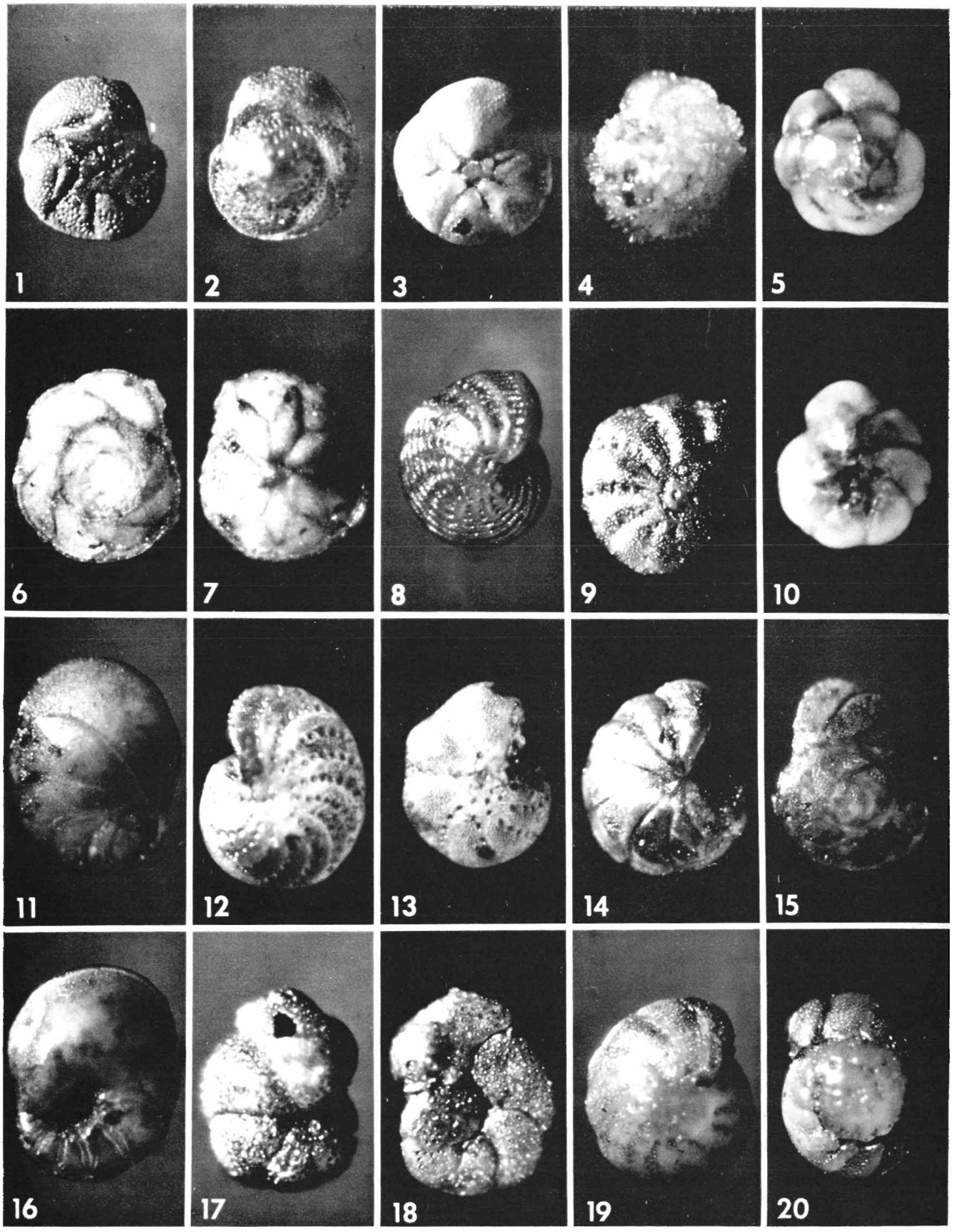
17-18 Cibicides lobatulus (Walker and Jacob)

17, ventral view; 18, dorsal view; X 60

19-20 Cibicides pseudoungarianus (Cushman)

19, ventral view; 20, dorsal view; X 60

Megalospheric form


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

REFERENCES

ACOSTA, J. T.

1939 Quinqueloculina torrei, un nuevo Foraminifero de la costa de Cuba. Torreia, vol. 1, pp. 1-4.

1940a Nuevos Foraminiferos de la costa sur de Cuba. Soc. Cubana Hist. Nat., Mem., vol. 14, pp. 269-276.

1940b Triloculina bermudezi, un nuevo Foraminifero de las islas Bahamas. Soc. Cubana Hist. Nat., Mem., vol. 14, pp. 37-38.

ANDEL, T. J. VAN, and POSTMA, H.

1954 Recent sediments of the Gulf of Paria. Amsterdam: North-Holland Publ. Co., vol. 1, pp. 1-245, pls. 1-6.

ANDERSEN, H. V.

1961 Genesis and paleontology of the Mississippi River mudlumps, Pt. II, Foraminifera of the mudlumps, lower Mississippi River delta. Louisiana Dept. Conserv., Geol. Bull. 35, pp. 1-208, pls. 1-29.

ASANO, K.

1944 Hanzawaia, a new genus of Foraminifera from the Pliocene of Japan. Geol. Soc. Japan, Jour., vol. 51, no. 606, pp. 97-98, pl. 4.

BAILEY, J. W.

1851 Microscopical examination of soundings made by the U. S. Coast Survey off the Atlantic coast of the U. S. Smithsonian Contr. Know., vol. 2, art. 3, pp. 1-15, pl. 1.

BANDY, O. L.

1944 Eocene Foraminifera from Cape Blanco, Oregon. Jour. Paleontology, vol. 18, pp. 366-377, pls. 60-62.

1964 Foraminiferal biofacies in sediments of the Gulf of Batabano, Cuba and their geological significance. Bull., Am. Assoc. Petr. Geol., vol. 48, no. 10, pp. 1666-1679.

BANNER, F. T., and BLOW, W. H.

1960 Some primary types of species belonging to the superfamily Globigerinacea. Cushman Found. Foram. Research, Contrib., vol. 11, pt. 1, pp. 1-41, pls. 1-8.

BARKER, R. W.

1960 Taxonomic notes on the species figured by H. B. Brady in his report on the Foraminifera dredged by H. M. S. Challenger during the years 1873-1876. Soc. Econ. Pal. and Min. Spec. Publ. no. 9, pp. 1-238, pls. 1-115.

BATSCH, A. I. G. C.

1791 Sech kupfertafeln mit conchylien des Seesandes, gezeichnet und gestochen von A. I. G. K. Jena: Batsch, pp. 1-60, pls. 1-6.

BE, A. W. H.

1959 Ecology of Recent planktonic foraminifera. Part 1. Areal distribution in the western North Atlantic. Micropaleontology, vol. 5, no. 1, pp. 77-100, pls. 1-2.

1960 Ecology of Recent planktonic foraminifera. Part 2. Bathymetry and seasonal distributions in the Sargasso Sea off Bermuda. Micropaleontology, vol. 6, no. 4, pp. 373-392.

BE, A. W. H., and HAMLIN, W. H.

1967 Ecology of Recent planktonic foraminifera. Part 3. Distribution in the North Atlantic during the summer of 1962. Micropaleontology, vol. 13, no. 1, pp. 87-106.

BENDA, W., and PURI, H. S.

1962 Distribution of Foraminifera and ostracodes off the Gulf Coast of Cape Romano area, Florida. Gulf Coast Assoc. Geol. Soc., Trans., vol. 12, pp. 303-341.

BENSON, R. H.

1959 Ecology of Recent ostracodes of the Todos Santos Bay region, Baja California, Mexico. Univ. Kansas Paleont. Contrib., Arthropoda, art. 2, pp. 1-52.

BERMUDEZ, P. J.

1934 Un género y especie nueva de Foraminíferos vivientes de Cuba. Soc. Cubana Hist. Nat., Mem., vol. 8, pp. 83-86.

1935 Foraminíferos de la Costa Norte de Cuba. Soc. Cubana Hist. Nat., Mem., vol 9, no. 3, pp. 129-224, pls. 10-17, text-figs. 1-3.

1937 Foraminíferos recientes colectados por el Dr. Luis Howell Rivero en Jamaica. Soc. Cubana Hist. Nat., Mem., vol. 11, pp. 249-252.

1938 Aguayoina asterostomata, un Foraminífero nuevo del Mar Caribe. Soc. Cubana Hist. Nat., Mem., vol 12, pp. 385-388.

1939 Resultados de la primera expedición en las Antillas del ketch Atlantis bajo los auspicios de las Universidades de Harvard y Habana. Soc. Cubana Hist. Nat., Mem., vol. 13, pp. 9-12, 57-62, 247-251.

1949 Tertiary smaller Foraminifera of the Dominican Republic. Cushman Lab. Foram. Research Spec. Publ. 25, pp. 1-322, pls. 1-26.

1964 Estudio microfaunal de muestras de la Laguna de Unare, Estado Anzoategui. Rev. Lagena, Univ. Oriente. vol. 1, pp. 7-13.

BERMUDEZ, P. J., and ACOSTA, J. T.

1940 Resultados de la primera expedicion en las Antillas del ketch Atlantis bajo los auspicios de las Universidades de Harvard y Habana. Soc. Cubana Hist. Nat., Mem., vol. 14, pp. 55-58.

BERMUDEZ, P. J., and KEY, C. E.

1952 Tres generos nuevos de Foraminiferos de las familias Reophacidae y Valvulindae. Soc. Cien. Nat. La Salle, Mem., vol. 12, pp. 71-76.

BERMUDEZ, P. J., and SEIGLIE, G.

1963 Estudio sistemático de los Foraminiferos del Golfo de Cariaco. Bol. Inst. Oceanogr. Univ. Oriente, Cumana, vol. 2, no. 2, pp. 1-253, pls. 1-29.

BERTHELIN, G.

1880 Mémoire sur les Foraminiféres fossiles de l'Etage Albien de Moncley. Soc. géol. France, Mém., ser. 3, vol. 1, no. 5, pp. 1-84, pls. 24-27.

BLAINVILLE, H. M. D. DE

1825 Manual de Malacologie et de conchyliologie. Paris: F. G. Levrault, pp. 1-664, pls. 1-87.

1826 Dictionnaire des Sciences Naturelles. Paris: F. G. Levrault, vol. 41, pp. 1-558.

1830 Dictionnaire des Sciences Naturelles. Paris: F. G. Levrault, vol. 60, pp. 1-631.

BOLLI, H. M., LOEBLICH, A. R., JR., and TAPPAN, HELEN

1957 Planktonic Foraminifera families Hantkeninidae, Orbulinidae, Globorotaliidae, and Globotruncanidae, in Loeblich, A. R., Jr., Studies in Foraminifera. U. S. Nat. Mus. Bull. 215, pp. 3-50.

BOLTOVSKOY, E.

1964 Distribucion de los foraminiferos planctonicos vivos en el Atlantico Ecuatorial, parte oeste (Expedicion "Equalant"). Argentina, Serv. Hidrogr. Naval, Publ., no. H 639, pp. 1-54, pls. 1-4.

BONHAM-CARTER, G. F.

1967 Fortran IV program for Q-Mode cluster analysis of nonquantitative data using IBM 7090/7094 computers. Computer Contrib. 17, State Geol. Surv., Univ. Kansas, pp. 1-28.

BOOMGAART, L.

M.S. Smaller foraminifera from Bodjonegoro (Java). Univ. Utrecht: Dissertation, pp. 1-175, pls. 1-14, chart, 1949.

BRADSHAW, J. S.

1959 Ecology of living planktonic foraminifera in the north and equatorial Pacific Ocean. Cushman Found. Foram. Research, Contrib., vol. 10, pt. 2, pp. 25-64, pls. 6-8.

BRADY, H. B.

1864 Contributions to the knowledge of the Foraminifera—on the rhizopodal fauna of the Shetlands. Trans. Linn. Soc., vol. 24, pp. 463, 476, pls. 1-48.

1877 Supplementary note on the foraminifera of the Chalk (?) of the New Britain Group. Geol. Mag., n. ser., vol. 4, no. 12, pp. 534-536.

1879 Notes on some of the reticularian Rhizopoda of the "Challenger" Expedition. Quart. Jour. Micr. Sci., n. ser., vol. 19, pp. 261-299, pl. 8.

1881 Notes on some of the reticularian Rhizopoda of the Challenger Expedition. Note on Biloculina mud. Quart. Jour. Micro. Sci., vol. 21, pp. 31-71.

1882 in Tizard and Murry, Report on the Foraminifera. Exploration of the Faroe Channel, during the summer of 1880 in H. M.'s hired ship "Knight Errant", with subsidiary reports. Roy. Soc. Edinburgh, Proc., vol. 11, (1880-1882), no. 111, pp. 708-717.

1884 Report on the Foraminifera dredged by H. M. S. Challenger, during the years 1873-1876. Rept. Voy. Challenger, Zool., vol. 9, pt. 36, pp. 1-8.4, pl. 1-115.

BROECK, E. VANDEN

1876 Etude sur les foraminiferes de la Barbade recueillis par L. Agassiz, precede de quelques considerations sur la classification et la nomenclature des foraminiferes. Ann. Soc. Belg. Micr., vol. 2, pp. 55-152.

BRUNNICH, M. T.

1772 M. T. Brunnish Zoologiae fundamenta. Hafniae ed Lipsiae: Grunde i Dyreloeren, pp. 1-253.

BUTSCHLI, O.

1880 in Bronn, Klassen und Ordnungen des Thier-Reichs. Leipzig and Heidelberg: C. F. Winter, vol. 1 Protozoa, pt. 1 Sarkodina und Sporozoa, pp. 1-1097, pls. 1-55.

BYKOVA, N. K.

1959 in Rauser-Chevnousova, D. M. and Fursenko, A. V., Osnovy Paleontologii. Obshchaya Chast Prosteishie. Akad. Nauk. S. S. S. R., pp. 1-368.

CAIRNS, J., JR., and KAESLER, R. L.

1969 Cluster analysis of Potomac River survey stations based on protozoan presence-absence data. Hydrobiologia, vol. 34, pp. 414-432.

CARMAN, KATHARINE W.

1933 Dentostomina, a new genus of the Miliolidae. Cushman Lab. Foram. Research, Contrib., vol. 9, pt. 2, pp. 31-32, pl. 3.

CARPENTER, W. B., PARKER, W. K., and JONES, T. R.

1862 Introduction of the study of Foraminifera. Ray Soc. Publs., pp. 1-319.

CARTER, H. J.

1877 On a Melobesian form of Foraminifera (Gypsina melobesioides, mini); and further observations on Carpenteria monticularis. Ann. and Mag. Nat. Hist., ser. 4, vol. 20, pp. 172-176.

CEBULSKI, D. E.

1961 Distribution of Foraminifera in the Barrier Reef and Lagoon of British Honduras. Texas A and M Dept. Oceanogr. and Meterol., Proj. NR083-036 Tech. Rept., Ref. 61-13T, vol. 24, pp. 1-98.

CHAPMAN, F.

1900 On some new and interesting Foraminifera from the Funafuti Atoll, Ellice Islands. Jour. Linn. Soc., zool., vol. 28, pp. 1-27, pl. 1-4.

CHEETHAM, A. H., and HAZEL, J. E.

1969 Binary (presence-absence) similarity coefficients. Jour. Paleontology, vol 43, no. 5, pp. 1130-1136.

CIFELLI, R.

1965 Planktonic foraminifera from the western North Atlantic. Smithsonian Inst., Misc. Coll., vol. 148, no. 4, publ. 4599, pp. 1-35, pls. 1-9.

COLE, W. S.

1965 Structure and classification of some Recent and fossil Peneroplids. Bull. Am. Paleont., vol. 49, no. 219, pp. 1-37.

COSTA, O. G.

1856 Paleontologia del regno di Napoli, Parte II. Accad. Pont. Napoli, Atti, vol. 7, pt. 2, pp. 113-278, pls. 9-27.

CUSHMAN, J. A.

1911 A monograph of the Foraminifera of the North Pacific Ocean. Pt. 2. Textulariidae. U. S. Nat. Mus., Bull. 71, pp. 1-108, text-figs. 1-156.

1917 A monograph of the Foraminifera of the North Pacific Ocean. Pt. 6. Miliolidae. U. S. Nat. Mus., Bull 71, pp. 1-108, pl. 1-39, text-figs. 1-52.

1918a The Foraminifera of the Atlantic Ocean. Pt. 1. Astrorhizidae. U. S. Nat. Mus., Bull. 104, pp. 1-111, pls. 1-39.

1918b Some Pliocene and Miocene Foraminifera of the coastal plain of the United States. U. S. Geol. Survey Bull. 676, pp. 5-99, pls. 1-8.

1919 in Vaughan, T. W., Fossil Foraminifera from the West Indies, Contributions to the geology and paleontology of the West Indies. Carnegie Inst. Washington, publ. 291, pp. 23-71.

1920 The Foraminifera of the Atlantic Ocean. Pt. 2. Lituolidae. U. S. Nat. Mus., Bull. 104, pp. 1-111, pls. 1-39.

1921 Foraminifera from the north coast of Jamaica. U. S. Nat. Mus., Proc., vol. 59, pp. 47-82.

1922a The Foraminifera of the Atlantic Ocean. Pt. 3. Textulariidae. U. S. Nat. Mus., Bull. 104, pp. 1-143, pls. 1-26.

1922b Shallow-water Foraminifera of the Tortugas region. Carnegie Inst. Washington, Publ. 311, pp. 1-85, pls. 1-14.

1922c The Foraminifera of the Byram calcareous marl at Byram, Mississippi. U. S. Geol. Survey, Prof. Paper 129-E, pp. 87-105, pls. 14-28.

1923 The Foraminifera of the Atlantic Ocean. Pt. 4. Lagenidae. U. S. Nat. Mus., Bull. 104, pp. 1-228, pls. 1-42.

1924 The Foraminifera at the Atlantic Ocean. Pt. 5. Chilostomellidae and Globigerinidae. U. S. Nat. Mus., Bull. 104, pp. 1-55, pls. 1-8.

1926 Recent Foraminifera of Porto Rico. Carnegie Inst. Washington, Publ. 344, pp. 73-84, pl. 1.

1927a An outline of a re-classification of the Foraminifera. Cushman Lab. Foram. Research, contrib., vol. 3, pt. 1, pp. 1-105, pls. 1-24.

1927b Recent Foraminifera from off the West Coast of America. Bull. Scripps Inst. Oceanogr. Tech. Ser., vol. 1, no. 10, pp. 119-188, pls. 1-6.

1928 Foraminifera their classification and economic use. Cushman Lab. Foram. Research Spec. Publ. 1, pp. 1-401, pls. 1-59.

1929 The Foraminifera of the Atlantic Ocean. Pt. 6. Miliolidae, Ophthalmidiidae and Fischerinidae. U. S. Nat. Mus., Bull. 104, pp. 1-129, pls. 1-22.

1930 The Foraminifera of the Atlantic Ocean. Pt. 7. Nonionidae, Camerinidae, Peneroplidae and Alveolinillidae. U. S. Nat. Mus., Bull. 104, 1-79, pls. 1-18.

1931 The Foraminifera of the Atlantic Ocean. Pt. 8. Rotaliidae, Amphistteginidae, Calcarinidae, Cymbaloporettidae, Rupertiidae and Homotremidae. U. S. Nat. Mus., Bull. 104, pp. 1-179, pls. 1-26.

1932 Notes on the genus Virgulina. Cushman Lab. Foram. Research, Contrib., vol. 8, pt. 1, pp. 7-23, pls. 2-3.

1933 Some new foraminiferal genera. Cushman Lab. Foram. Research, Contrib., vol. 9, pt. 2, pp. 32-38, pls. 3, 4.

1935 Fourteen new species of Foraminifera. Smithsonian Misc. Coll., vol. 91, no. 21, pp. 1-9, pls. 1-3.

1936 New genera and species of the families Verneuilinidae and Valvulinidae and of the subfamily Virgulininae. Cushman Lab. Foram. Research, Spec. Publ. 6, pp. 1-71, pls. 1-8.

1937 A monograph of the foraminiferal family Valvulinidae. Cushman Lab. Foram. Research, Spec. Publ. 8, pp. 1-210, pls. 1-24.

1944 The genus Articulina and its species. Cushman Lab. Foram. Research, Spec. Publ. 10, pp. 1-21, pls. 1-4.

1946 The genus Hauerina and its species. Cushman Found. Foram. Research, Contrib., vol. 22, pp. 2-15, pls. 1-2.

1947 New species and varieties of Foraminifera from off the northeastern coast of the United States. Cushman Lab. Foram. Research, Contrib., vol. 23, pt. 4, pp. 86-92, pls. 1-2.

CUSHMAN, J. A., and BERMUDEZ, P. J.

1945 A new species of Globobulimina from the western Atlantic. Cushman Lab. Foram. Research, Contrib., vol. 24, no. 1, pp. 15-21.

CUSHMAN, J.A., and BRONNIMANN, P.

1948 Some new genera and species of Foraminifera from brackish water of Trinidad. Cushman Lab. Foram. Research, contrib., vol. 24, pt. 1, pp. 15-21, pls. 3, 4.

CUSHMAN, J.A., and CAHILL, E.D.

1933 Miocene Foraminifera of the coastal plains of the eastern United States. U.S. Geol. Surv. Prof. Paper 175A, pp. 1-50, pls. 1-13.

CUSHMAN, J.A., and JARVIS, P.W.

1930 Miocene Foraminifera from Buff Bay, Jamaica. Jour. Paleontology, vol. 4, no. 4, pp. 353-368.

CUSHMAN, J.A., and MC CULLOCH, IRENE

1939 A report on some arenaceous Foraminifera. Allan Hancock Pacific Exped., vol. 6, no. 1, pp. 1-113, pl. 17.

CUSHMAN, J.A., and PARKER, FRANCES L.

1929 Recent Foraminifera from the Atlantic coast of South America. U.S. Nat. Mus., vol. 80, art. 3, pp. 1-24, pl. 1.

CUSHMAN, J.A., and TODD, RUTH

1944 The genus Spiroloculina and its species. Cushman Lab. Foram. Research Spec. Publ. 11, pp. 1-81, pls. 1-9.

DEFRANCE, M.J.L.

1824 Dictionnaire des Sciences Naturelles. Paris: F.G. Levrault, vol. 32, pp. 1-567.

1826 Dictionnaire des Sciences naturelles. Paris: F. G. Levrault, vol. 53, pp. 1-508.

DELAGE, Y., and HÉROUARD, E.

1896 Traité de zoologie concrète. Tome T. La Cellule et les Protozoaires. Paris: p. 1-584.

DROOGER, C. W., and KAASSCHIETER, J. P. H.

1958 Foraminifera of the Orinoco-Trinidad-Paria Shelf. Report of the Orinoco Shelf Expedition. Nederland: Verh. Konink., vol. 4, Akad. Wetens., atd. Natuur. 1 Reeks. Deel 22, pp. 1-97, pls. 1-54.

EGGER, J. G.

1857 Die Foraminiferen der Miocan-Schichten bei Ortenburg in Nieder-Bayern. Neues Jahrb. Mineral. Geogn. Geol. Petref., pp. 266-311, pls. 5-15.

1895 Foraminiferen aus Meersgrundproben, gelothet von 1874 bis 1876 von S. M. Sch. Gazelle. K. bayer. Akad. Wiss. Math-physik. Cl., Abh., Munchen, Deutschland, 1895, bd. abth. 2, p. 363.

EHRENBERG, C. G.

1838 Über dem blossen Auge unsichtbare kalkthierchen und kieseltheirchen als Hauptbestandtheile der kreidegebirge. Berlin: K. Preuss. Akad. Wiss, vol. 3, p. 192-200.

1839 Die Infusionthierchen als volkommene Organismen. Leipzig: L. Voss, pp. 1-547, atlas pls. 1-64.

1840 Das grossere Infusorienwerke. K. Preuss Akad. Wiss. Berlin, Ber. (1840), pp. 198-219.

1843 Verbreitung und Einfluss des Mikroskopischen Lebens in Sud- und Nord-Amerika. Berlin: K. Preuss. Akad. Wiss.

1854 Mikrogeologie. Leipzig: L. Voss, pp. 1-374, pls. 1-40.

EIMER, G. H. T., and FICKERT, C.

1899 Die Artbildungund Verwandtschaft oei den Foraminiferen, Entwurf einer naturlichen Eintheilung derselben. Zeitschr. Wiss. Zool., vol. 65, no. 4, pp. 527-636, text-figs. 1-45.

FARRIS, J. S.

1969 On the cophenetic correlation coefficient. Syst. zool., vol. 18, pp. 279-285.

FICHTELL, L. VON, and MOLL, J. P. C. VON

1798 Testacea microscopica aliaque minuta ex generibus Argonauta et Nautilus ad naturam picta et descripta. Wien: Camesina pp. 1-123, pls. 1-24.

FINLAY, H. J.

1947 New Zealand Foraminifera, key species in stratigraphy. New Zealand Jour. Sci. Tech., vol. 28, no. 5, sec. B, pp. 259-292, pls. 1-9.

FISCHER DE WALDHEIM, G.

1819 Adversaria zoologica. Soc. Imper. Nat. Moscow, Mem., fasc. 2, pp. 1-201.

FLINT, J. M.

1899 Recent Foraminifera, a descriptive catalogue of specimens dredged by the U. S. Fish Commission Streamer Albatross. U. S. Mat. Mus., Rept. pp. 249-349, pls. 1-80.

1902 The Foraminifera of Porto Rico. U. S. Fish Com., Bull. vol. 20, pp. 415-416.

GALLOWAY, J. J.

1933 A manuel of Foraminifera. Indiana: Principia Press, James Furman Kemp Memorial Ser., publ. 1, pp. XII-483, pls. 1-42.

GOES, A.

1894 A synopsis of the Arctic and Scandinavian Recent marine Foraminifera hitherto discovered. Kong. Svenska Vetenskaps. Handl., Bandet 25, no. 9, pp. 1-127, pls. 1-25.

1896 The Foraminifera. Harvard Univ., Mus. comp. zool., Bull., vol. 29, no. 1, pp. 1-103, pls. 1-10.

HADLEY, W. H., JR.

1934 Some Tertiary Foraminifera from the north coast of Cuba. Bull. Am. Paleontology, vol. 20, no. 70A, pp. 1-40, pls. 1-5.

HAECKEL, E.

1894 Systematische Phylogenie, Entwurf eines naturlichen systems der organism auf grund ihrer stammesgeschichte, Theil 1, systematische phylogenie der protistem und pflanzen. Berlin: Georg Reimer, pp. 1-400.

HEDBERG, H. D.

1934 Some recent and fossil brackish to freshwater Foraminifera. Jour. Paleontology, vol. 8, no. 4, pp. 469-476.

HENSON, F. R. S.

1948 Larger imperforate Foraminifer of southwestern Asia, Families Lituolidae, Orbitolinidae and Meandropsinidae. British Museum (Nat. Hist.), Mon. pp. 1-127, pls. 1-16, figs. 1-16.

HERRON-ALLEN, E., and EARLAND, A.

1915 The Foraminifera of the Kerimba Archipelago. Zool. Soc. London, Trans., vol. 20, pt. 17, pp. 543-793, pls. 40-53.

HOFKER, J.

1930 The Foraminifera of the Siboga-Expedition. Part II. Siboga Expiditie, Uitkomsten op zoologisch, botanisch, oceanographisch en geologisch. Neder. Oost-Indie 1899-1900. H. M. Siboga. Leiden, Nederl: E. J. Brill, 1930, pp. 1-149.

1951a The Foraminifera of the Siboga Expedition. Siboga Expanditie, Mon. IV, pt. 3, pp. 1-513.

1951b The toothplate—Foraminifera. Arch. Neerlandaisies zool., vol. 8, pt. 4, pp. 353-372, figs. 1-30.

1952 Recent Peneroplidae. Royal Micro. Soc. London, Jour., ser. 3, vol. 71, pp. 450-463, text-figs. 36-51.

1964 Foraminifera from the tidal zone in the Netherlands Antilles and other West Netherlands Antilles and other West Indian Islands. Stud. Fauna Curacao and other Carib. Islands, vol. 21, pp. 1-119.

HOWCHIN, W.

1889 The Foraminifera of the Older Tertiary of Australia. (No. 1, Muddy Creek, Victoria). Roy. Soc. S. Australia, Trans. and Proc., vol. 12 (1888-1889), pp. 1-20, pl. 1.

ILLINGS, MARJORIE A.

1950 The mechanical distribution of Recent Foraminifera in Bahama Banks sediments. Ann. and Mag. Nat. Hist., ser. 12, vol. 3, no. 33, pp. 757-761.

1952 Distribution of certain Foraminifera within the littoral zone of the Bahama Banks. Ann. and Mag. Nat. Hist., ser. 12, vol. 5, no. 51, pp. 275-285.

JACCARD, P.

1908 Nouvelles recherches sur la distribution florale. Bull. Soc. Vaud. Sci. Nat., vol. 44, pp. 223-270.

JONES, T. R.

1875 in Griffith and Henfrey, the micrographic dictionary. ed. 3, vol. 1, pp. 316-320.

JONES, T. R., and PARKER, W. K.

1860 On the rhizopodal fauna of the Mediterranean. Geol. Soc. London, Quat. Jour., vol. 16, pp. 292-307.

1863 Notes on some fossils and Recent Foraminifera collected in Jamaica. Rept. Brit. Assoc. Newcastle-on-Tyne meeting, pp. 80.

1876 Notice sur les Foraminiferes vivants et fossiles de Jamaique. Soc. Malacol. Belg., Ann., vol. 11, Mem., pp. 91-103.

JONES, T. R., PARKER, W. K., and BRADY, H. B.

1866 A monograph of the Foraminifera of the Crag.. Pt. 1. Paleont. Soc. London, vol. 19, pp. 1-72, pls. 1-4.

KAESLER, R. L.

1966 Quantitative re-evaluation of ecology and distribution of Recent Foraminifera and Ostracoda of Todos Santos Bay, Baja California, Mexico. Univ. Kansas Paleont. Contrib., Ecology, Paper 10, pp. 1-50.

1969 in Merriam ed., Aspects of quantitative distributional paleoecology. New York and London: Plenum Press, Computer applications in earth sciences, pp. 99-120.

KARRER, F.

1868 Die miocene Foraminiferen fauna von kostej im Banat. K. Akad. Wiss. Wien. Math-Naturwiss. Cl., Sitzungber., vol. 58, pt. 1, pp. 121-193, pls. 1-5.

KAYE, C. A.

1959 Shoreline features and Quaternary shoreline changes, Puerto Rico. U. S. Geol. Survey Pros. Paper, 317-B, pp. 49-140.

LALICKER, C. G., and BERMUDEZ, P. J.

1941 Some Foraminifera of the family Textulariidae collected by the first "Atlantis" expedition. Torreia, vol. 8, pp. 1-19.

LAMARCK, J. B.

1804 Suite des mémoires sur les fossiles des environs de Paris. Mus. Natl. Hist. Nat. Paris, Ann., vol. 5, pp. 349-357, pl. 17.

1812 Extrait du cours de zoologie du Museum d'Histoire naturelle sur les animaux invertèbres. Paris: pp. 1-127.

1816 Histoire naturelle des animaux sans vertèbres. Paris: Verdière, vol. 2, pp. 1-568.

LIDZ, L., and LIDZ, BARBARA

1965 Foraminiferal biofacies of Veracruz reefs. Inst. Marine Sci., Univ. Miami, Contr. 695, pp. 1514-1517.

LINNÉ, C.

1758 Systema naturae. Lipsiae: G. Engelman, ed. 10, vol. 1, pp. 1-824.

LOEBLICH, A. R., JR., and TAPPAN, HELEN

1955 A revision of some glanduline nodosariidae. Smithsonian Misc. Coll., vol. 126, no. 3, pp. 1-9.

1961 Supragenic classification of the Rhizopodea. Jour. Paleontology, vol. 35, pp. 245-330.

1962 Six new generic names in the Mycetozoida (Trichiidae) and Foraminiferida (Fischerinidae, Buliminidae, Caucasinidae and Pleurostomellidae) and a redescription of Loxostomum. Biol. Soc. Washington, Proc., vol. 75, pp. 107-113.

1964 Treatise on Invertebrate Paleontology. R. C. Moore, ed., Pt. C, Protista, Sarcodina Chiefly "Thecamoebians" and Foraminiferida. pp. 1-900

LYNTS, G. W.

1962 Distribution of Recent Foraminifera in upper Florida Bay and associated sounds. Cushman Found. Foram. Research, Contrib. vol. 8, pp. 127-144.

1966 Variation of foraminiferal standing crop over short lateral distances in Buttonwood Sound, Florida Bay. Limn. and Oceanogr., vol. 11, no. 4, pp. 562-566.

MADDOCKS, ROSALIE F.

1966 Distribution patterns of living and subfossil podocopid ostracodes in the Nosy Bé area, northern Madagascar. Univ. Kansas Paleont. Contrib., Ecology, Paper 12, pp. 1-72.

MARKS, P., JR.

1951 A revision of the smaller Foraminifera from the Miocene of the Vienna Basin. Cushman Found. Foram. Research, Contrib. vol. 2, pp. 33-73, pls. 5-8.

MELLO, J. F., and BUZAS, M. A.

1968 An application of cluster analysis as a method of determining biofacies. Jour. Paleontology, vol. 42, no. 3, pp. 747-758.

MICHENER, C. D., and SOKAL, R. R.

1957 A quantitative approach to a problem in classification. Evolution, vol. 11, pp. 130-162.

MILLETT, F. W.

1898 Report on the Recent Foraminifera on the Malay Archipelago. Roy. Micro. Soc., Jour., pt. 3, pp. 607-614, pl. 1-16.

1899 Report on the Recent Foraminifera on the Malay Archipelago. Roy. Micro. Soc., Jour., pt. 4, pp. 249-255, pl. 1-4.

MONTAGU, G.

1803 Testacea Britannica. England: J. S. Hollis, pp. 1-606, pls. 1-16.

MONTFORT, D. DE

1808 Conchyliologie systématique. vol. 1, pp. 1-409.

MOORE, W. E.

1957 Ecology of Recent Foraminifera in northern Florida Keys. Bull., Am. Assoc. Petr. Geol., vol. 41, pp. 727-741.

MORSE, J. W., and BROOKS, W. W.

MS The relationships of carbonate kinetics, planktonic Foraminifera, and deep sea sedimentation. Bermuda Biol. Sta. for Research Spec. Publ., 1970, in press.

MUNIER-CHALMAS, E.

1882 La Connaissance de phases successives par lesquelles passent les Foraminiferes. Soc. geol. France, Bull., ser. 3, vol. 10 (1881-82), pt. 6, pp. 424-425.

MURRAY, J.

1876 Preliminary reports to Professor Wyville Thompson, F. R. S., director of the civilian scientific staff, on work done on board the "Challenger". Roy. Soc. London, Proc., vol. 24, pp. 471-544, pls. 20-24.

ORBIGNY, A. D.

1826 Tableau methodique de la classe de Cephalopodes. Paris: Crochard, Ann. Sci. Nat. Paris, ser. 1, vol. 7, pp. 245-314, pls. 10-17.

1839a in Ramon de la Sagra, Histoire physique politique et naturelle de l'île de Cuba. Foraminiferes. Paris: Arthus Bertrand pp. XIVIII-224, pls. 1-12.

1839b Voyage dans l'Amerique Meridionale-Foraminiferes. Strasbourg: V. Levrault, vol. 5, pt. 5, pp. 1-86, pls. 1-9.

1839c in Barker, Webb and Berthelot, Histoire naturelle de l'îles Canaries. Paris: Bethune, vol. 2, pt. 2, zool., pp. 119-146, pls. 1-3.

1840 Memoire sur les Foraminiferes de la craie blanche du bassin de Paris. Soc. geol. France, Mem., vol. 4, pt. 1, pp. 1-51, pls. 1-4.

1846 Foraminiferes fossiles du Bassin Tertiare de Vienne. Paris: Gide et Compe, pp. 1-312, pls. 1-21.

1850 Prodrôme de paleontologie stratigraphique universelle des animaux mollusques et rayonnes. Paris: V. Masson, fide Ellis and Messina, Bibliog., pp. 181.

PALMER, DOROTHY K.

1945 Notes on the Foraminifera from Bowden, Jamaica. Bull. Am. Paleontology, vol. 29, pp. 5-78.

PARKER, FRANCES L.

1952 Foraminiferal distribution in the Long Island Sound-Buzzards Bay Area. Mus. Comp. Zool. Harvard, Bull. vol. 106, no. 10, pp. 427-473, pls. 1-7.

1954 Distribution of the Foraminifera in the northeastern Gulf of Mexico. Mus. Comp. Zool. Harvard, Bull., vol. 111, no. 10, pp. 453-588, pls. 1-13.

1962 Planktonic foraminiferal species in Pacific sediments. Micropaleontology, vol. 8, no. 2, pp. 219-254, pls. 1-10.

PARKER, FRANCES L., PHLEGER, F. B., and PEIRSON, JEAN F.

1953 Ecology of foraminifera from San Antonio Bay and envions, Southwest Texas. Cushman Found. Foram. Research Spec. Publ. 2, pp. 1-75, pls. 1-4.

PARKER, W. K., and JONES, T. R.

1860 On the nomenclature of the Foraminifera. Ann. and Mag. Nat. Hist., pt. 4, ser. 3, vol. 6, pp. 29-40.

1865 On some foraminifera from the North Atlantic and Arctic Oceans, including Davis Straits and Baffin's Bay. Roy. Soc. London, Philos. Trans., vol. 155, pp. 325-441, pls. 12-19.

PARR, W.J.

1932 Victorian and South Australian shallow-water Foraminifera. Royal Soc. Victoria, Proc., new ser., vol. 44, pt. 1, pp. 1-14, pl. 1.

PHLEGER, F.B.

1956 Significance of living foraminiferal populations along the central Texas coast. Cushman Found. Foram. Research Contrib., vol. 7, pp. 106-151.

PHLEGER, F.B., and PARKER, FRANCES L.

1951 Ecology of Foraminifera, northwest Gulf of Mexico. Geol. Soc. America, Mem 46, pp. 1-64, pls. 1-20.

PLUMMER, HELEN J.

1931 Some Cretaceous Foraminifera in Texas. Univ. Texas Bull. 3101, pp. 109-203, pls. 8-15.

RENZ, H.H.

1948 Stratigraphy and fauna of the Aqua Salada group, State of Falcon, Venezuela. Geol. Soc. America, Mem. 32, pp. 1-219, pls. 1-12.

REUSS, A.E.

1845 Die Versteinerungen der bohmischen kreideformation. Stuttgart: pt. 1, pp. 1-148, pls. 14-51.

1850 Neues Foraminiferen aus den Schichten des Osterreichischen Tertiarbeckens. K. Akad. Wiss. Wien, Math-Naturwiss. Cl., Denkschr., vol. 1, pp. 365-390, pls. 46-51.

1858 Ein Beitrag zur genaueren kenntniss der Kreidegebilde Mecklenburgs. Deutsch. geol. Gesell., Zeitschr., vol. 10, pp. 1-56.

1862 Entwurf einer systematischen Zusammen tellung der Foraminiferen. K. Akad. Wiss. Wien, Math.-Naturw. Cl., Sitzungsber, vol. 44, pt. 1, p. 325-396.

RHUMBLER, L.

1906 Foraminiferen von Laysan und den Chatham-Inseln. Zool. Jahresber., vol. 24, no. 1, pp. 21-80, pls. 2-5.

1913 Die Foraminiferen (Thalamophoren) der Plankton-Expedition. Ergebnisse der Plankton-Exped. der Humboldt-Stifung. Pt. 2, Systematik. Arrhabdammidia, Arammodisclidia, und Arnodosammidia. vol. 3, Lief. c., pp. 332-476, figs. 1-65.

1936 Foraminiferen der Kieler Bucht, gesammelt durch A. Remane, Teil II. Kieler Meeresforschungen, Bd. 1, Heft. 1, pp. 179-242, text-figs. 127-246.

RISSO, A.

1826 Histoire naturelle des principales productions de l'Europe méridionale et particulièrement de celles des environs de Nice et des Alps maritimes. Paris and Strassburg: F. G. Levrault, vol. 4, pp. 1-439.

RZEHAK, A.

1888 Die Foraminiferen der Nummulitenschichten des Waschberges und Michelsberges bei Stockerau in Nieder-Oestereich. K. K. Geol. Reichsanst., Verhandl., vol. 1888, pp. 226-229.

SAUNDERS, J. B.

1957 Trochamminidae and certain Lituolidae from the recent brackish-water sediments of Trinidad. Smithsonian Inst., Misc. Coll., vol. 134, no. 5, pp. 1-16.

1959 Recent Foraminifera of mangrove swamps and river estuaries and their fossil counterparts in Trinidad. Micropaleontology, vol. 4, no. 1, pp. 72-92.

SCHLUMBERGER, C.

1893 Monographie des Miliolidées du golfe de Marseille. Soc. Zool. France, Mem., vol. 6, pp. 57-80, pls. 1-4, text-figs. 1-37.

SCHULTZE, M. S.

1854 Ueber den organismus der polythalamien (Foraminiferen), Nebst Bemerkungen uber die Rhizopoden im Allgemeinen. Leipzig: Wilhelm Engelmann, pp. 1-68.

SCHWAGER, C.

1866 Fossile Foraminiferen von Kar-Nicobar. Novara-Exped., Geol. Theil., vol. 2, pp. 187-268, pls. 4-7.

1876 Saggio di una classificazione die Foraminiferi avuto riguardo alle loro famiglie naturalii. R. Comitato Geol. Italia, Bull., vol. 7, no. 11-12, p. 275-485.

1877 Quadro del proposto sistema del classificazione dei foraminiferi con guscio. R. Comitato Geol. Italia, Bull., vol. 8, no. 1-2, pp. 18-27.

SEGUENZA, G.

1862 Die terreni terziarii del distretto di Messina, Parte II. Descrizione dei foraminiferi monotalamici delle marne mioceniche del distretto di Messina. Messina: T. Capra, pp. 1-84, pls. 1-2.

SEIGLIE, G. A.

1964 Algunos Foraminiferos arenaceous recientes de Venezuela. Inst. Oceanogr. Univ. Oriente, Bol. 3, no. 1, 2, pp. 5-14.

1965 Un género nuevo y dos especies nuevas de Los Testigos, Venezuela. Inst. Oceanogr. Univ. Oriente, Bol. 4, no. 1, pp. 51-59.

1966a Estudio sistemático de los Foraminiferos de la plataforma continental de Araya a Los Testigos. Suborden Textulariina. Inst. Oceanogr. Univ. Oriente, Lagena no. 8, pp. 13-37.

1966b Estudio sistemática de los Foraminiferos de la plataforma continental de Araya a Los Testigos. Suborden Miliolina. Inst. Oceanogr. Univ. Oriente, Lagena no. 9, pp. 3-32.

1966c Distribution of Foraminifera in the sedimente of Araya-Los Testigos shelf and upper slope. Carib. Jour. Sci., vol. 6, no. 1-4, pp. 92-117.

1970 The distribution of the foraminifers in the Yabucoa Bay, southeastern Puerto Rico and its paleoecological significance. Revista Espanola Micropal., vol. 2, no. 2, pp. 183-208, pls. 1-2.

SEIGLIE, G. A., and BERMUDEZ, P. J.

1963 Distribution de los Foraminiferos del Golfo de Cariaco. Inst. Univ. Oriente, Bol. 2, no. 1, pp. 5-87.

SILVESTRI, A.

1904 Ricerche strutturali su alcune forme dei Trubi di Bonfornello. Accad. Pont. Nuovi Lincei, Mem., vol. 22, pp. 235-276.

1937 Foraminiferi dell'Oligocene e del Miocene della Somalia. Paleont. Italica, vol. 32, suppl. 2, pp. 45-264, pls. 4-22.

SNEATH, P. H. A.

1957 Some thoughts on bacterial classification. J. Gen. Microbiol., vol. 17, pp. 201-226.

SOKAL, R. R., and MICHENER, C. D.

1958 A statistical method for evaluating systematic relationships. Univ. Kansas Sci. Bull., vol. 38, pp. 1409-1438.

SOKAL, R. R., and ROHLF, F. J.

1962 The comparison of dendrograms by objective methods. Taxon., vol. 11, pp. 33-40.

STUBBS, S.

1940 Studies of Foraminifera of the southern Atlantic coast of the United States. Cushman. Found. Foram. Research, Contrib., vol. 15, no. 1, pp. 1-24.

TERQUEM, O.

1876 Essai dur le classement des animaux qui vivent sur la plage et dans les environs de Dunkerque. Soc. Dunquerquoise Hem. vol. 20, pt. 2, pp. 55-100, pls. 7-12.

THALMANN, H. E.

1933 Nachtrag zum Nomenclator zu Brady's Tafelfand der Foraminiferen der Challenger Expedition. Ecol. geol Helvet. Band XXVI, no. 2, pp. 251-255.

THOMSON, W.

1876 in Murray, Preliminary reports to Professor Wyville Thomson, F. R. S., director of the civilian scientific staff on work done on board the "Challenger". Roy. Soc. London, Proc., vol. 24, pp. 534, pls. 22-23.

TODD, RUTH

1964 Planktonic foraminifera from deep-sea cores off Eniwetok Atoll. U. S. Geol. Survey, Prof. Paper, no. 260-CC, pp. 1067-1100.

TODD, RUTH, and BRONNIMANN, P.

1957 Recent Foraminifera and Thecamoebina from the eastern Gulf of Paria. Cushman Found. Foram. Research, Spec. Publ. 3, pp. 1-43, pls. 1-12.

UCHIO, T.

1960 Ecology of living benthonic Foraminifera from the San Diego, California, area. Cushman Found. Foram. Research, Spec. Publ. 5, pp. 1-72, pls. 1-10.

VALENTINE, J. W.

1966 Numerical analysis of marine molluscan ranges on the extratropical northeastern Pacific shelf. Limnol. Oceanogr., vol. 11, pp. 198-211.

VELLA, P.

1857 Studies in New Zealand Foraminifera. New Zealand Geol. Survey, Paleont. Bull. 28, pp. 1-64, pls. 1-9.

WALKER, G., and JACOB, B.

1798 in Kanmacher, 1798, Adams Essays on the microscope; the second edition with considerable additions and improvements. London: Dillion and Keating, pp. 1-712.

WALTON, W. R.

1955 Ecology of living benthonic Foraminifera, Todos Santos Bay, Baja California. Jour. Paleontology, vol. 29, pp. 952-1018.

WANTLAND, K. F.

1969 Foraminiferal assemblages of the coastal lagoons of British Honduras. Lagunas Costeras, un Simposio. Mem. Simp. Intern. Lagunas Costeras. UNAM-UNESCO, Nov. 28-30, 1967. Mexico P. F. pp. 621-644.

WEISNER, H.

1920 Zur Sywtematik der Miliolideen. Zool Anzeiger, vol. 51, pp. 13-20.

1923 Die Milioden der ostlichen Adria. Prag-Bubenc: Wiesner, pp. 1-113, pls. 1-20.

1931 Die Foraminiferen der deutschen Südpolar Exped. 1901-03. Deutsche Sudpolar Exped. 1901-03, vol. 20, zool., vol. 12, pp. 53-165, pls. 1-24.

WILCOXON, J. A.

1964 Distribution of Foraminifera of the southern Atlantic coast. Cushman Found. Foram. Research, Contrib., vol. 15, no. 1, pp. 1-24.

WILLIAMSON, W. C.

1858 On the Recent Foraminifera of Great Britain. Ray Soc. Publs., pp. XX + 107, pls. 1-7.

WÜST, G.

1964 Stratification and circulation in the Antillean-Caribbean basins. New York: Columbia Univ. Press, pp. 1-201.