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RECENT BENTHONIC FORAMINIFERA OF THE
BRITISH HONDURAS SHELF.

Rice University, Ph.D., 1967
Geology

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RECENT BENTHONIC FORAMINIFERA OF
THE BRITISH HONDURAS SHELF

by
Kenneth Franklin Wantland

A THESIS SUBMITTED
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

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INTRODUCTION

Purpose and Scope

Paleoecology has come to encompass a wide array of interdisciplinary studies and to have different meanings in different contexts. But regardless of the particular definition chosen, one of the central themes of paleoecology remains the delineation of factors effecting the distribution of organisms in space and time. This is the prime concern of this study of Recent Foraminifera of the British Honduras shelf.

The specific purposes of this report are: 1) to delineate foraminiferal faunal patterns in an area characterized by a variety of carbonate, mixed carbonate-terrigenous and wholly terrigenous sedimentary regimes; 2) to examine the relationships of the gross environmental parameters with species and assemblages of benthonic Foraminifera; 3) to compare distributional patterns in several carbonate shelf environments to elucidate regional relationships of shelf assemblages; and 4) to emphasize the applicability of this knowledge in approaching paleoecologic problems.

Regional Setting

British Honduras is located on the western edge of the Caribbean Sea on the southeast margin of the Yucatan Peninsula (Fig. 1). The country is bordered on the north
FIGURE 1 - REGIONAL LOCATION MAP
(After E. G. Purdy)
by Mexico and on the west and south by Guatemala. The present study area is the narrow, elongate, submarine shelf that borders the eastern coast of British Honduras. The shelf is approximately 120 miles in length and averages 15 miles in width. The study area lies wholly within the tropical climate belt and extends from latitude $16^\circ 00' \text{ to } 18^\circ 30' \text{ N}$ and from longitude $87^\circ 50' \text{ to } 88^\circ 55' \text{ W}$. The shelf comprises a broad spectrum of marine environments from coral reef to marine lagoon, brackish-water bay, marginal marsh and delta. The edge of the continental shelf is the site of extensive barrier reef development.

Previous Work

A complete accounting of the literature concerning the systematics and ecology of Recent tropical and sub-tropical shelf Foraminifera is beyond the scope of this report. A compilation of dominantly taxonomic studies including most of the older literature on West Indian and Gulf of Mexico Foraminifera is presented in the Selected References.

Four tropical to sub-tropical areas dominated largely by calcium carbonate sedimentary regimes have been the subject of recent, quantitative, distributional studies of benthonic Foraminifera. They are: 1) Bahama Banks (Streeter, 1963); 2) Golfo de Batabano, Cuba (Bandy, 1964a); 3) British Honduras (Cebulski, 1961); 4) southern Florida shelf (Bandy, 1956; Moore, 1957; Bush, 1958; Lynts, 1962; Wright, 1964; Scholz, 1962).
The report by Cebulski (1961) is the only previous work on the Foraminifera of the British Honduras shelf. Cebulski studied living and total populations from an area bounded approximately by the Belize River delta on the north and the town of Placentia on the south (Fig. 2). He collected fifteen samples from the carbonate reef platform and 74 from the southern shelf lagoon. Cebulski recognized two distinct foraminiferal faunas, one characteristic of the "barrier reef" and the other of the "lagoon." A "transitional fauna" between these two was delineated on the basis of scatter diagrams.

In addition to these studies, a number of more specific papers provide pertinent information. Studies by Norton (1930), Illing (1950, 1952), Drooger and Kaasschieter (1958), Boltovskoy (1958a, 1963), Sandberg (1961), Todd and Low (in Cloud, 1962), Ayala-Castanares (1963), Seiglie and Bermudez (1963), Seiglie (1964a,b, 1965a,b), Barnhart (1963), Davis (1964), Rivera (1964), Howard (1965), Hofker (1964), Lidz and Lidz (1966), and Lynts (1966) have added in varying degrees to the knowledge of West Indian-Gulf of Mexico faunal composition and distributions. In addition, some information concerning foraminiferal distributions in this area can be derived from studies devoted to sediment distributions, such as those of Creager (1958), Hoskins (1963), Pusey (1964) and Matthews (1965a, 1966).

Because the British Honduras study area embraces marginal marine features and shallow continental shelf in
FIGURE 2 - FORAMINIFERAL SAMPLE LOCALITIES
addition to the reef and reef-related environments, a large and familiar literature from the Gulf of Mexico is pertinent. Faunal patterns and taxonomic identifications in that area have been established in papers by Kornfeld (1931), Lowman (1949, 1951), Treadwell (1955), Post (1951), Phleger (1951a,b, 1954a,b, 1955, 1956, 1960a,b,c, 1964), Phleger and Lankford (1957), Phleger and Parker (1951), Parker, Phleger, and Peirson (1953), Parker (1954), Bandy (1954, 1956), Lankford (1959, 1966), Rusnak (1960), Shifflett (1961), Waldron (1963), Walton (1955, 1964a,b) and Upshaw, Creath and Brooks (1966). Many additional, localized studies have been conducted (including a number of unpublished theses) that are too numerous to list in detail.

Studies devoted wholly or in part to the faunas of mangrove marshes include: Benda and Puri (1962), Saunders (1957, 1958) and Todd and Bronnimann (1957). Additional pertinent studies of the Foraminifera of a variety of other marsh environments have been published by Phleger and Walton (1950), Phleger (1965), Phleger and Bradshaw (1966), Parker and Atteharn (1959), Andersen (1951, 1953), and Warren (1956, 1957).

Outside the Caribbean area, the Foraminifera of carbonate environments have been described by Houbolt (1957) and Murray (1965, 1966a,b,c) from the Persian Gulf; Jell, Maxwell, and MacKellar (1965) and Collins (1958) from the Great Barrier Reef, Australia; and by Braga (1961) and Heron-Allen and Earland (1914-15) from the east coast of Africa.
Aspects of sedimentation in the British Honduras area have been studied by Krueger (1963), Pusey (1964), Matthews (1965a,b,c, 1966), Purdy (1965), Purdy and Matthews (1965), Ebanks and Tebbutt (1966), Scott (1966), Ebanks (1967), Tebbutt (1967) and High (1967), and some sedimentary analyses were also included in the report by Cebulski (1961).

Method of Study

Field. The samples for this study were collected during five summer field seasons from 1961 through 1965. The basic pattern of sample distribution is shown in Figure 2. The writer spent the summer of 1962 in the field. During that season approximately 200 of the 500 preserved sediment samples were collected and the writer had the opportunity to visit nearly all of the shelf area. Sampling in 1961 and 1962 was devoted largely to broad coverage traversing the shelf. Sampling subsequent to 1962 was primarily detailed collecting in specific study areas.

Two sampling techniques were employed in obtaining equal volume (15 cc) samples of surface sediment in this study. In the shallower areas (less than 20-30' in depth) samples were taken by hand. A short plastic tube 1-5/8" inside diameter was inserted vertically into the sediment and stoppered. At the surface the core was extruded and the top centimeter of sediment was sliced off and preserved in buffered formalin and sea water (see Aves, 1958, and Phleger, 1960c, for discussion of preserving techniques).
In deeper water areas bottom samples were taken by a Peterson grab sampler. The sampler was opened carefully on deck in order to retain an undisturbed sediment surface. The surface was usually characterized by a brown organic scum. Occasionally plants were retained in growth orientations.
The plastic tube was inserted into the sediment surface and the sample was collected and treated as above. Plants and other vertical elements on which Foraminifera attach during life were collected and preserved occasionally. In addition data were collected on temperature and salinity of surface and bottom waters and bulk sediment samples were taken.

The problem of adequate sampling in highly variable environments and other statistical aspects of methodology in Recent foraminiferal-sediment studies have been discussed at length by Wright (1964), and the reader is referred to that paper for a detailed analysis.

Laboratory. The preserved samples were stained with Rose Bengal (Walton, 1952), washed over a 62 micron sieve, dried and stored. All the 500 samples collected were examined for their foraminiferal content. Approximately 120 samples were selected for detailed, quantitative analysis. Except for detailed study areas the distribution of the quantified samples is shown in Figure 2. These samples were rewetted and the stained (herein termed "living") individuals were counted. It should be noted that some workers have experienced difficulty recognizing living Foraminifera by this stain method when dealing with somewhat
opaque, porcellanous tests, particularly larger peneroplids such as *Archaias angulatus* (Fichtell and Moll). When dealing with samples of this type it was generally necessary to work with transmitted light in addition to or instead of reflected light. The external surface of most miliolids and peneroplids takes on a pinkish cast when the sample is stained and some care must be exercised in making live-dead determinations. It was sometimes necessary to break tests open to determine whether or not the chambers contained stained protoplasm. This was not a common necessity, and it is thought that test destruction was not frequent enough to bias the counting of the total populations.

These samples also were dried and split to a fraction containing 300-500 tests. These were counted dry and constitute the total (living plus dead) population. In some cases the Foraminifera were concentrated by carbon tetrachloride flotation. This was not possible in many samples because certain forms (e.g. *Amphistegina gibbosa* (d'Orbigny) do not float.
DESCRIPTION OF THE AREA

Physiography

The British Honduras shelf is divided areally into an inner lagoon and an outer barrier reef-cay complex; the lagoon is divisible into northern and southern segments at the latitude of Belize (Fig. 2). For descriptive purposes these areas have been subdivided into hydrographic provinces by Purdy (personal communication)(Fig. 3). Northern British Honduras is divided into the Northern Shelf Lagoon (which extends parallel to the mainland from the Belize delta to the southern tip of Ambergris Cay), Chetumal Bay (the largely enclosed water body extending north into Mexico) and the Outer Platform (which parallels the mainland along the seaward margin of the shelf). The barrier reef occupies the seaward edge of the Outer Platform. Throughout Northern British Honduras water depths are shallow, generally less than three fathoms (Fig. 4). This geographic terminology differs slightly from that of Pusey (1964, p. 23).

South of the Belize the inner shelf or Southern Shelf Lagoon forms a trough that deepens gradually from the area of the Belize delta (depths of less than ten fathoms) toward the south (depths as great as 35 fathoms). Seaward, an elongate, scarp-bounded platform termed the Barrier Platform (Purdy, personal communication) borders the edge of
FIGURE 3 - HYDROGRAPHIC PROVINCES
(After E. G. Purdy)
FIGURE 4 - BATHYMETRY

(After E. G. Purdy)

(The locations of the profile lines A-A' to J-J' are not pertinent to this report)
the continental shelf. This feature varies in width from one to seven miles. Its upper surface is less than five fathoms below sea level, and it is the site of extensive reef development. The seaward margin of the platform is marked by almost continuous barrier reef growth. The Barrier Platform is broadest from the area off the Belize delta to approximately the latitude of the Sittee River delta. South of this point the platform narrows markedly. Concurrently, the Southern Shelf Lagoon widens and deepens and becomes the site of development of numerous steep-sided carbonate shoals. At the southernmost extent of the shelf in the Gulf of Honduras province no barrier is present at the shelf margin, and deep portions of the shelf lagoon and the open Caribbean Sea are juxtaposed. The eastern edge of the British Honduras shelf is a scarp that drops steeply into depths exceeding 100 fathoms.

High (1967) has studied and described the mainland coast of British Honduras as characterized by narrow beaches, coastal marshes and many inshore lagoons and estuaries. Two river deltas, the abandoned Belize River delta and the Sittee River delta form prominent sedimentary bulges into the shelf lagoon. Carbonate shoals are also encountered along the mainland margin of the Southern Shelf Lagoon, particularly in the Port of Honduras area.

Hydrography

The patterns of surface and bottom water salinity are depicted in Figures 5 and 6, respectively. This
FIGURE 5 - SURFACE WATER SALINITY (°/oo)
(After E. G. Purdy)
FIGURE 6 - BOTTOM WATER SALINITY (°/oo)
(After E. G. Purdy)
represents the patterns of the summer wet season in this area and demonstrates that near-marine salinities persist over most of the floor of the shelf lagoon and platform areas. Dilution of normal marine water by fresh water discharged by streams creates a narrow salinity gradient perpendicular to the mainland coast. This is most pronounced in Southern British Honduras where land relief and annual rainfall are greater, and stream density and runoff are higher than Northern British Honduras. The increased runoff in Southern British Honduras is also evident in a comparison of bottom and surface water salinities. Surface water salinities show a marked decrease eastward and northward from southernmost British Honduras relative to bottom water salinities. Very little contrast is evident in a comparison of surface and bottom salinities of the shallow areas of Northern British Honduras due to thorough mixing of the water by wind action.

Chetumal Bay is an area of restricted circulation. The southern limit of the bay is bounded by a mudshoal complex; Ambergris Cay forms an effective barrier to the east. These features inhibit the circulation of marine waters into the bay. The Rio Hondo and New River discharge fresh water at the head of the bay and produce a salinity gradient approximately along the axis of the bay. The mainland margin of Chetumal Bay is lined with shallow, irregularly-shaped, pond-like lagoons. These enclosed ponds undoubtedly have marked variation in salinity and temperature. They are
shallow enough to be considerably freshened by seasonal rainwater, or, alternatively, to act as hypersaline evaporating pans. Only Northern River Lagoon receives a fairly constant supply of fresh water. Similar shallow lagoons with presumably varying water characteristics exist on the west side of Ambergris Cay.

In the shallow areas of the north current patterns are complex due to the interaction of runoff, prevailing winds, and slight tidal effects (Pusey, 1964, p. 43, 44). In the Southern Shelf Lagoon there is a general southward drift current indicated on nautical charts (Hydrographic Office charts 1496, 1497, 1498). Tidal effects are not marked; the tidal range is 1.5 feet under normal conditions (Hydrographic Office Pub. No. 20). Strong northerly winds and hurricanes may produce short-term tidal effects of a much more extreme character.

Turbidity is variable. Throughout the Barrier and Outer Platform areas underwater visibility is maximum for the study area and has been estimated at 50 feet (Pusey, 1964, p. 44). In the shallow water of the Northern Shelf Lagoon and Chetumal Bay wind-induced currents frequently suspend mud-sized carbonate and underwater visibility may become zero.

Sedimenta

The sediments of the British Honduras shelf are diverse in composition and texture and reflect a wide array
of depositional environments. Figure 7 illustrates the percentage of mud (silt plus clay) comprising the sediment and Figure 8 depicts the abundance of calcium carbonate in the same area.

Pusey (1964) described and delineated the sedimentary facies of Northern British Honduras. The sediments of the shallow Northern Shelf Lagoon and Outer Platform display a west to east gradation from lime mud with some terrigenous material to lime mud characterized by abundant miliolid Foraminifera to a skeletal "Halimeda facies" to a "reef facies." In Chetumal Bay miliolid-rich lime mud dominates. A special facies is developed on the east side of lower Chetumal Bay in a band from the lee side of Ambergris Cay to the north-south trending line of cays in the bay. This is the "peneroplid-sand facies" distinguished by carbonate sands composed almost wholly of tests of Archaia angulata. At the mouth of the Rio Hondo, New and Belize Rivers mud deposits are characterized by the presence of ostracodes with very few associated organisms.

The sediments of the Barrier Platform are pure calcium carbonate, almost wholly skeletal in origin but of contrasting texture. Sediments from agitated areas of the outer barrier margin are rounded, well-sorted carbonate sands. In areas protected from wave and current action, particularly those stabilized by marine grass (Thalassia) meadows, the sediments are poorly-sorted muds containing angular, fragmental skeletal grains. In some areas currents sweep the
FIGURE 7 - WEIGHT PER CENT MUD IN
SEDIMENTS (<1/16 mm)
(After E. G. Purdy)
FIGURE 8 - PER CENT CARBONATE IN SEDIMENTS
(After E. G. Purdy)
coral rock clean of sediment and material accumulates only in localized depressions and other protected areas. The texture and grain size of sediments throughout this area are strongly influenced by \textit{in situ} production of carbonate constituents.

Skeletal carbonate sands accumulate at the base of carbonate shoals in the Southern Shelf Lagoon and grade outward into fine-grained lime muds away from the loci of shoal sediment influx. The lagoonal muds of the southern shelf grade from almost pure lime muds in the deeper areas surrounding the carbonate shoals to dominantly terrigenous muds toward the mainland. The sediments of the elongate inner portion of the Southern Shelf Lagoon are dominantly mixed carbonate-terrigenous sediments. Coarser-grained relatively pure quartz sand deposits in an otherwise fine-grained mixed carbonate-terrigenous mud area are encountered rarely, and these are probably relict sediments. The nearshore deposits bordering the mainland are almost wholly terrigenous in origin.
FORAMINIFERAL ASSEMBLAGES

The basic data used to delineate foraminiferal assemblages in this study are those derived from total foraminiferal population counts. These assemblages are groups of foraminiferal populations that are similar with respect to: taxonomic composition, faunal diversity, faunal dominance and faunal density.

*Taxonomic composition* is a qualitative parameter consisting simply of the list of foraminiferal taxa in each sample.

*Faunal diversity*, as used in this study, refers to the number of species or genera counted in each volumetrically equal sample of sediment. Faunal diversity is a distinctive aspect of population structure even though the factors affecting this parameter are poorly understood and somewhat speculative.

*Faunal dominance* is used in several ways in this report. In the strictest sense it is the number, expressed in per cent, of the most abundant single taxon in a sample; this is *species dominance*. However, *generic dominance* is also used to characterize individual populations by the most common genera (*e.g.* *Heterillina-Triloculina-Miliolinella* association) and to identify assemblages (*e.g.* *Quinqueloculina-Cribroelphidium*-dominant assemblage).
Faunal density refers simply to the number of foraminiferal tests (living or total) counted, or extrapolated from a count of a fraction, in a constant volume of sediment.

Foraminiferal assemblages based on the above criteria are found to be areally extensive, mappable faunal units. In most cases the boundaries separating these assemblages are gradational, but where they correspond to abrupt discontinuities in the physical environment, they are very sharp.

The assemblages are based on total populations rather than living populations for a number of reasons. Total populations are geologically significant because they reflect all biological and sedimentological effects influencing the distribution at the time of burial. Further, total populations represent a degree of homogenization in highly variable environments because living populations are subject to innumerable local and/or short-term, sometimes seasonal, effects. It is evident that living populations provide a wealth of detailed ecologic information concerning the habitats of individual species and communities; but in a complex environmental setting the variation among samples is unmapable and the data too detailed for delineation of gross distributional patterns related to the relatively coarse environmental measurements now available.

The following foraminiferal assemblages are delineated in this report:
Quinqueloculina-Cribroelphidium-dominant
Low diversity Cribroelphidium-dominant
High diversity Cribroelphidium-dominant
Cassidulina-dominant
High diversity Miliolid-dominant
Archaias-Asterigerina-dominant
Cribroelphidium-Quinqueloculina-dominant mixed fauna
Low diversity Miliolid-dominant
Archaias-Miliolid-dominant

The distribution of these assemblages is shown in Figure 9. Figure 10 illustrates the pattern of faunal diversity of the total foraminiferal populations and Figure 11 depicts the same parameter for the living foraminiferal populations.

Quinqueloculina-Cribroelphidium-Dominant Assemblage

Total Populations. A small number of samples contain distinct faunas dominated by certain species of the genera Quinqueloculina and Cribroelphidium, and are composed largely of the following species:

Cribroelphidium poeyanum (d'Orbigny)
Quinqueloculina compta Cushman
Q. bicostata d'Orbigny
Q. lamarckiana d'Orbigny
Q. funafutiensis (Chapman)
Ammonia beccarii (Linne)

Such faunas have relatively high total population diversity (75-115 species per sample), high species dominance
FIGURE 9 - FORAMINIFERAL ASSEMBLAGES
FIGURE 10 - FAUNAL DIVERSITY IN TOTAL FORAMINIFERAL POPULATIONS

(Species/Sample)
FIGURE 11 - FAUNAL DIVERSITY IN LIVING FORAMINIFERAL POPULATIONS
(Species/Sample)
(20-25%); and the dominant species is always *Cribroelphidium poeyanum*. Total population density is approximately 10,000 tests per sample. None of the species is restricted to the area of assemblage occurrence; however, the conspicuous species of *Quinqueloculina* listed above characterize populations only in samples assigned to this assemblage.

**Living Populations.** The associated living populations contain 25 to 65 species per sample and are never dominated by *C. poeyanum*. The taxonomic compositions of the populations vary from sample to sample, but the following taxa are generally the most common:

- *Quinqueloculina* (several species)
- *Discorbis* (several species)
- *Buliminella elegantissima* (d'Orbigny)
- *Sagrina pulchella* d'Orbigny
- *Brizalina striatula* (Cushman)
- *Ammonia beccarii* (Linne)

Living population density is low with generally less than 100 specimens per sample.

**Areal Extent and Ecology.** Populations of this character are distributed along the mainland margin of Southern British Honduras with the exception of the Port of Honduras embayment. They are always in water less than five fathoms deep. Bottom water salinity is less than normal marine; however, these populations are not associated with areas of strong river influence and deltaic sedimentation. The distribution of this assemblage is wholly within and
corresponds to the distribution of coastal, terrigenous, quartzose muddy sands and sandy muds. The mud content of the substrate is always less than 25%. Carbonate content never exceeds 30%. The assemblage is essentially confined to nearshore conditions marked by active erosion and winnowing of sediments. South of Port of Honduras to the mouth of the Tomash River there are no samples to substantiate the presence of this assemblage along the mainland coast; however, it is inferred to be present on the basis of the following environmental conditions:

1. Less than normal marine salinities (less than 26°/oo)
2. Low per cent mud in the sediments (less than 25°/o).
3. Low per cent carbonate in the sediments (less than 30°/o).

This assemblage is associated with a "Continental Shore" mollusk fauna (Robertson, 1963). It grades seaward into the low diversity and high diversity Cribroelphidium-dominant assemblages. Shoreward it is bordered by the inshore lagoon and marginal marsh assemblages of the mainland coast. It is distinct from the mixed Cribroelphidium-Quinqueloculina-dominant faunas of the shoal-influenced lagoon in 1) the relatively high frequencies of Q. computa, Q. bicostata and Q. Lamarckiana; 2) the lack of generic diversity, and 3) the absence of most typical carbonate shoal taxa (e.g. Peneroplis, Hauerina, Articulina,
Cymbaloporretta, etc.); and 4) the absence or very low frequency of occurrence of genera characteristic of the deeper lagoon (e.g., Reussella, Fursenkoina, Nouria, Cassidulina, etc.).

Additional Marginal Marine Assemblages

There are several disjunctly distributed assemblages associated with nearshore, marginal marine conditions. These assemblages have not been adequately sampled in this area; indeed very few quantitative, preserved samples were collected in marginal environments. Examination of bulk sediment collections (courtesy of Messrs. High and Ebanks), however, demonstrates the existence of these marginal faunas and they are noted here for completeness although their areal extent and population structure have not been determined. These populations are not unlike marginal marine faunas that have been described in considerable detail elsewhere. They include:

a) Ammonia-Ammobaculites-dominant faunas characteristic of the effluents of some major rivers (Belize, Sittee, Rio Grande, Tomash).

b) Cribroelphidium-Ammonia-dominant faunas prevalent in the low salinity, mainland lagoons of Southern British Honduras.

c) Palmerinella-dominant faunas near the present mouth of the Belize River.

d) Miliammina-dominant and Arenoparrella-dominant faunas in the Belize River delta marshes and the marshes bordering the Southern Shelf Lagoon.
Low Diversity *Cribroelphidium*-Dominant Assemblage

**Total Populations.** Total foraminiferal populations dominated by the genus *Cribroelphidium* characterize the sediments throughout the Southern British Honduras shelf except on the Barrier Platform and carbonate shoals. The first group of *Cribroelphidium*-dominant total populations is characterized by low taxonomic diversity and a rather uniform population structure. These are almost invariably *Cribroelphidium*-Ammonia-Florilus faunas composed of less than 50 species. The dominant species is always *Cribroelphidium poeyanum* (d'Orbigny) occurring in frequencies of 20-30%. The major portion of the fauna in every case is composed of the following species:

- *Cribroelphidium poeyanum* (d'Orbigny)
- *Cellanthus gunteri* (Cole)
- *Cellanthus discoidale* (d'Orbigny)
- *Ammonia beccarii* (Linne)
- *Florilus atlantica* (Cushman)
- *F. grateloupi* (d'Orbigny)

Commonly associated species occurring in lower frequencies are:

- *Buliminella elegantissima* (d'Orbigny)
- *Sagrina pulchella* d'Orbigny
- *Fursenkoina pontoni* (Cushman)
- *Reussella atlantica* (Cushman)
- *Lagenammina atlantica* (Cushman)
- *Nouria polymorphinoides* Heron-Allen and Earland
- *Eggerella advena* (Cushman)
No species are restricted to the areas of assemblage occurrence. Nearly all species noted in this assemblage occur also in the high diversity Cribroelphidium-dominant assemblage. Those that do not occur in this latter assemblage do range into one or more of the marginal marine assemblages (e.g. Ammonia beccarii). Buliminella, Eggerella and Nouria attain their highest frequencies in the low diversity Cribroelphidium-dominant assemblage and are found rarely elsewhere on the shelf. Total population density is another relatively constant parameter. Nearly all samples in this assemblage contain 7,000 to 10,000 tests. Although population density ranges from 3,000 to 41,000 tests per sample, these extremes are represented by single samples.

Living Populations. The living populations associated with this assemblage are somewhat variable in their taxonomic composition. They are low diversity populations composed of 10 to 20 species, and they are never dominated by Cribroelphidium. The dominant genera in these populations vary from Florilus-Cribroelphidium-Fursenkoina or Florilus-Fursenkoina-Ammonia to Buliminella-Florilus-Cribroelphidium or Fursenkoina-Eggerella-Cribroelphidium. Species dominance ranges from 20 to 45%. Living population density ranges from 20 to 200 individuals with most samples containing an average of 100-150 stained tests.

Areal Extent and Ecology. Samples assigned to the low diversity Cribroelphidium-dominant assemblage occur in two disjunct areas in the Southern Shelf Lagoon. The larger
area extends from the south side of the Belize River delta to approximately the point where the lagoon narrows markedly, near Placentia and into Victoria Channel. The assemblage is replaced seaward by a zone of faunal mixing at the base of the Barrier Platform. Toward the mainland the assemblage grades into a variety of coastal faunas and the Quinqueloculina-Cribroelphidium-dominant assemblage. Southward it grades into the high-diversity Cribroelphidium-dominant assemblage. Water depths in the area of occurrence range from 5-15 fathoms occurring rarely in depths less than five fathoms. Bottom water salinities approximate normal marine conditions—34-36°/oo. Little is known of the water circulation; however, with limited river influence along the mainland coast and the strong physical barrier of the shallow platform between the lagoon and the open ocean, it is probable that a somewhat restricted hydrographic regime is developed in the area. The sediments are largely mixed carbonate-terrigenous muds although relict quartz sands are encountered occasionally. The carbonate content of the lagoon sediments varies from 30-90%. The bottom is relatively level with little topographic variation and it supports virtually no macroscopic flora. The associated mollusk fauna is largely an infaunal mud assemblage (Robertson, 1963).

The second area of occurrence for this assemblage is the Gulf of Honduras in the extreme southwestern portion of the British Honduras shelf. Environmental conditions are similar to those described above differing slightly in that
the carbonate content of the sediments is less than 30%, the greater river influx may produce periods of reduced bottom salinity, and bottom topography is somewhat irregular. Water depth and associated fauna and flora are similar.

In summary, it seems likely that this assemblage is limited ecologically by factors associated with depth, salinity and perhaps circulation. Neither composition nor texture of the substrate seem to be significant factors affecting assemblage distribution. It is not evident what factors associated with depth exclude this assemblage from the shoalest portions of the lagoon. Some of the dominant taxa (Cribroelphidium, Ammonia) are abundant in extremely shallow and brackish waters, but the total assemblage does not persist to the lagoon margin. It is evident that most species of the assemblage are best adapted to conditions associated with deeper water and that these forms are replaced shoreward by forms adapted to nearshore conditions.

It is possible that the two areas of occurrence of this assemblage reflect slightly different factors effecting the faunal diversity. In the Gulf of Honduras the dominant factor limiting diversity may be the somewhat variable bottom water salinity. Throughout much of the Southern Shelf Lagoon area further north (including Victoria Channel) the dominant factor may be restricted circulation.

**High Diversity Cribroelphidium-Dominant Assemblage**

**Total Populations.** A second widespread group of Cribroelphidium-dominant total populations is characterized
by a relatively high faunal diversity and a distinct, though variable, taxonomic composition. Ninety to 110 species are present in individual samples. Species dominance is only 10-15%, but the dominant species of the total populations is still *Cribroelphidium poeyanum*. The fauna is composed of a variety of taxa of which the most abundant and most commonly occurring are:

- *Cribroelphidium poeyanum* (d'Orbigny)
- *Fursenkoina pontoni* (Cushman)
- *Florilus* spp.
- *Sagrina pulchella* d'Orbigny
- *Cassidulina minuta* Cushman
- *Textularia* spp.
- *Reussella atlantica* Cushman
- *Quinqueloculina* spp.
- *Lagenammina atlantica* Cushman
- *Brizalina* spp.

Commonly associated genera present in lower frequencies are:

- *Discorbis*
- *Cibicides*
- *Hanzawaia*
- *Neoconorbina*
- *Triloculina*
- *Miliolinella*

The genus *Ammonia* is virtually absent from this assemblage as are *Buliminella*, *Eggerella* and *Nouria*. 
It is noteworthy that very few species are restricted to this high diversity assemblage. Nearly all species, even rare forms, occur in at least one other assemblage on the British Honduras shelf. Thus it seems that high diversity in this case is not the result of limitation or restriction of a number of certain species to an area by environmental variables but rather the existence of environmental conditions that affect the coexistence and support of a large number of taxa in a relatively small area.

Total population density among these samples is extremely variable but high ranging from 10,000 to 160,000 tests per sample. Most samples contain 30,000-40,000 specimens.

**Living Populations.** The living populations in these samples are, again, never dominated by *Cribroelphidium*. The dominant genus is either *Florilus* or *Fursenkoina* and the most common dominant generic associations are *Fursenkoina-Florilus-Cribroelphidium* and *Florilus-Fursenkoina-Hanzawaia*. Similar to the total populations, living populations in this assemblage are more diverse than those of the low diversity *Cribroelphidium*-dominant assemblage. Twenty to 50 living species may be present and uncommonly as many as 80 living species are recorded from a single sample. Species dominance varies from 20 to 30%, and the most commonly dominant living species is *Fursenkoina pontoni*. Living population density is most commonly 300-500 specimens although it ranges from less than 100 to 1,000 tests per sample.
Areal Extent and Ecology. This assemblage occurs over a large area of the southernmost shelf in water depths varying from 5 to 25 fathoms. Bottom water salinities are normal marine (36.0/00) and the sediments are muds or bioclastic muddy sands and sandy muds. Calcium carbonate content of the sediments ranges from 60 to 90%. Again there are few data on water movement, but one can speculate that in this area communication between the lagoon and the open ocean is increased because of the more discontinuous nature of the southern portion of the Barrier Platform. This presumed decrease in restriction together with stability of water characteristics may be factors in the development of a diverse, abundant benthonic foraminiferal fauna.

The distribution of this assemblage is limited by the marginal marine influence toward the mainland, by the distribution of carbonate shoals, by factors associated with depth, and, perhaps, by circulation in the shelf lagoon. This assemblage does not persist in areas of less than normal marine bottom water salinities, and it loses identity in areas of shoal-influenced lagoonal sediments. Among the many shoals separated by relatively deep water in Southern British Honduras the high diversity *Cribroelphidium*-dominant assemblage seems restricted to areas that are not shoal influenced at least in terms of containing no shoal-derived carbonate sands. Toward the mainland this assemblage grades into the low diversity *Cribroelphidium*-dominant assemblage in the Gulf of Honduras and marginal marine assemblages in
other coastal areas. To the north, in the Southern Shelf Lagoon, it grades into the other area of occurrence of low diversity **Cribroelphidium** dominance. Near the shoals it is replaced by the **Cribroelphidium-Quinqueloculina**-dominant mixed fauna assemblage. It should be noted here that within the distribution pattern of this assemblage (Fig. 9) several groups of calcium carbonate shoals are developed (e.g., Snake Cays). These shoals contribute a small amount of sediment to the surrounding bottom, but the area of shoal-influence is so slight that a mixed fauna assemblage could not be shown.

In the deepest part of the shelf (25-35 fm.) a **Cassidulina**-dominant assemblage becomes prevalent.

**Cassidulina**-Dominant Assemblage

**Total Populations.** Two samples on the British Honduras shelf contain a diverse fauna dominated by **Cassidulina** and associated with **Cribroelphidium**, **Fursenkoina**, **Reophax**, **Reussella**, **Brizalina**, **Trifarina**, reef-derived miliolids and the only significant occurrence of planktonic Foraminifera encountered in the study. **Cassidulina minuta** dominates the total populations occurring consistently in frequencies of 12%. Approximately 100 species are present in each sample.

**Living Populations.** Although **Cassidulina** is the most abundant faunal element in the total populations it was rarely found in the living population. The living population
in sample No. 212 is a *Bigenerina-Textularia-Quinqueloculina* fauna; and in No. 213 it is a *Bigenerina-Trifarina-Fursenkoina* fauna. These populations are more typical of the channel or shoal-influenced faunas of the lagoon.

**Areal Extent and Ecology.** This assemblage occurs in the deepest part of the British Honduras shelf (30-35 fathoms) at its southernmost extremity. In this area the barrier reef is absent and the lagoonal waters are open to oceanic influence. There is no effect of river influx and the bottom waters are normal marine in salinity. Sediments are sandy, bioclastic muds. Reef debris is common but not dominant in the sand-size fraction of the sediments. Except for the relatively high abundance of *Cassidulina* and the presence of planktonic forms, this assemblage closely resembles the high diversity *Cribrorhipidium*-dominant assemblage into which it grades shoreward. This assemblage extends seaward to the limit of sampling near the declivity of the continental shelf escarpment. The planktonic species are evidence of oceanic influence. Sample No. 212 contains 12% planktonics in the total population and sample No. 213 contains 3-4%. Planktonic tests are extremely rare in the sediments throughout the remainder of the British Honduras shelf.

**High Diversity Miliolid-Dominant Assemblage**

**Total Populations.** The family Miliolidae strongly dominates the foraminiferal assemblages of the shallow, marine areas of calcium carbonate deposition on the British
Honduras shelf. The total populations grouped in this assemblage are characterized by high faunal diversity and nearly all are dominated by the genera *Quinqueloculina* and *Triloculina* although the populations vary among themselves with respect to taxonomic composition, faunal diversity, faunal dominance and faunal density. The dominant generic associations are *Quinqueloculina-Triloculina-Miliolinella*, *Quinqueloculina-Triloculina-Planorbulina* and *Quinqueloculina-Triloculina-Heterillina*.

Total population diversity for most samples of this assemblage ranges from 100 to 140 species per sample and the average is approximately 120 species. The total population varies widely from 3-5,000 to over 100,000 tests per sample. The greatest total population diversity and density occur in areas of moderate to dense stands of turtle grass (*Thalassia*) growing in poorly sorted, skeletally derived sandy mud. For example, in sample No. 68, 148 species are recorded in a population of over 30,000 tests. *Planorbulina mediterranensis* d'Orbigny is the dominant species in this sample occurring in a frequency of only 5%. The dominant genera of the total population are *Triloculina-Quinqueloculina-Planorbulina*. Similar populations are found in other areas characterized by *Thalassia* growth on the Barrier and Outer Platform and on the carbonate shoals of the Southern Shelf Lagoon.

In contrast, a number of populations dominated by *Quinqueloculina-Triloculina* have lower total population
diversity and smaller size. For example, in sample No. 118, 117 species are identified but only about 3,000 tests are in the measured volume of sediment. This is a *Quinqueloculina-Planorbulina-Dentostomina* fauna from a rocky area near Pelican Cay. Unconsolidated sediments in this locality are sparse and coarse; this sample is characteristic of a number of shallow, current-swept areas in which little sediment accumulates.

Most species encountered in the high diversity Miliolid-dominant assemblage are restricted to the marine carbonate platform environment. Approximately 100 species, more than two-thirds of the species in this assemblage, are not found elsewhere on the British Honduras shelf. Most of the species that are not restricted to this assemblage occur elsewhere in much higher frequencies in both living and total populations indicating that optimum conditions for their development consist of a somewhat different combination of environmental parameters.

**Living Populations.** The living populations found associated with the total populations in the high diversity Miliolid-dominant assemblage are similar to the total populations with respect to taxonomic composition and dominant genera. Most living populations are dominated by *Quinqueloculina* and *Triloculina* and nearly all of the taxa identified in the total populations are found living in the area of assemblage occurrence.
Living population density varies from approximately 100 to 1,000 individuals per sample with most containing 300-500 stained tests.

Areal Extent and Ecology. The high diversity Miliolid-dominant assemblage is characteristic of areas of the British Honduras shelf in which these major environmental parameters are present:

a) shallow, clear water (less than 3-4 fathoms);
b) normal marine salinity;
c) pure calcium carbonate sedimentary regime;
d) moderate to low wave agitation (not highly agitated environments);
e) high diversity of benthic habitats.

Within this assemblage population density and to an extent diversity is affected by the distribution of marine vegetation, current action, and sediment deposition.

Wright (1964) and Murray (1965) among others have pointed out that many if not most of the benthonic Foraminifera inhabiting shallow back-reef environments live attached to plants and other floral and faunal elements above the sediment surface. If this is true, the frequency distribution of living Foraminifera recorded from this study probably does not present an accurate picture of the true living population structure. However, these data demonstrate that most of the taxa are adapted to living in the top centimeter of sediment.
The composition of living populations differs strikingly from that of the total populations in a number of samples. In several (e.g. No. 78, No. 79) Remaneica sp. cf. R. kelletae (Thalman) is a common living form—constituting as much as 6% of the living population. This tiny, attaching foraminiferan is an extremely fragile, agglutinated form which would not likely be preserved in the sediment after death; certainly it is rare in total populations. 

Brizalina torqueta (Cushman and McCulloch) constitutes 6% of the living population in sample No. 82 but represents less than 1% of the total population; in sample No. 98 Bulimina elegantissima (d'Orbigny) represents 12% and Fursenkoina pontoni (Cushman) 7% of the living population; but each of these two species comprises less than 1% of the total population.

It is evident that microenvironmental conditions are extremely complex and variable in the shallow back-reef environment. Local and temporal conditions are reflected in the living populations, the effects of which are diluted by the composition of the total population.

A few species recorded in the total populations were never seen containing stained protoplasm. For example, Amphistegina gibbosa (d'Orbigny) is present in a number of samples and in one sample (No. 134f) accounts for 50% of the total population, but it was not seen alive in the course of this study. Evidently, the habitat of this species was never sampled.
Archaias angulatus is another large foraminiferan that is rarely encountered in living populations in this area. It was found living abundantly in the crown of Penicillus plants collected in sample No. 359 in the Pelican Cay area, and empty tests of this species commonly accumulate in the sediment surrounding the plants. Bandy (1964) found that A. angulatus comprised up to 80% of the total populations over a large, current-swept, carbonate sand area of the shelf of Batabano Bay, Cuba. This population probably represents a lag deposit, and it is unlikely that these organisms lived commonly in the sediment in the area. Intense collection of plants and other attaching sites in the area of high Archaias frequency in the Gulf of Batabano might reveal a diverse living foraminiferal fauna; however, only Archaias accumulates abundantly in the surrounding sediment.

Surprisingly, a number of attaching species were found living in relatively high frequencies in the surface sediments of the Thalassia "meadows." Planorbulina, a large, plano-convex form adapted to attachment on flat surfaces (such as marine grass leaves) was found in consistently higher frequencies in the living population than in the total populations of bottom sediment samples.

The diversity of the living populations attests to the complexity of the microenvironments sampled. Approximately 80-100 living species were identified in most individual samples. When it is considered that this represents the possible existence of 80-100 niches for the Foraminifera
alone in the small volume of substrate collected one begins to realize the degree of complexity of the inter-specific relationships within the benthic community. Some of the factors affecting the diversity of such populations will be considered in a later section.

Areally, this assemblage occurs throughout the Barrier Platform and carbonate shoals of Southern British Honduras and the Outer Shelf Lagoon of Northern British Honduras (Fig. 9). On the Northern Shelf this assemblage grades westward into the low diversity Miliolid-dominant assemblage coincident with the salinity gradient. In Southern British Honduras the boundary between the high diversity Miliolid-dominant assemblage and the Cribroelphidium-dominant and the Cribroelphidium-Quinqueloculina mixed fauna assemblages is a sharp faunal discontinuity coincident with the sharp bathymetric boundary between the steep-sided shoal areas and the lagoon.

**Archaias-Asterigerina-Dominant Assemblage**

**Total Populations.** A small number of samples on the seaward edge of the continental shelf contain unique foraminiferal populations. The total populations are characterized by low diversity, relatively low population density, and high species dominance. The taxonomic composition is markedly different from other populations on the British Honduras shelf. The total populations of these samples are dominated chiefly by a combination of the genera Archaias,
Asterigerina, and rarely Amphiastegina, and to a lesser extent, by Glabratella, Neoconorbina, Trifarina and Discorbis. A few samples included in this assemblage are dominated by Quinqueloculina and Triloculina, but have significant frequencies of the preceding genera plus the distinctive population characteristics stated above. Diversity of the total populations varies from 50-100 species; species dominance is high—generally 25-30%; total populations are generally less than 3,000 tests; the lowest is less than 1,000. It must be noted that the actual figures for the frequency of Archaeas angulatus in this area are subject to some variability. The tests of this form are usually abraded and broken, and considerable subjective interpretation was necessary in counting test fragments and in identifying worn and recrystallized individuals. In this regard considerable operator error may be involved and the figures, therefore, may not be reproducible within large limits.

Living Populations. The living populations generally contain less than 50 species with a range varying between 23 and 87 species per sample. Species dominance is approximately 30%—the frequency of either Glabratella opercularis (Brady), Asterigerina carinata d'Orbigny or Trifarina bella (Phleger and Parker). A. angulatus is extremely rare in living populations. Living population density ranges from less than 100 to 350 individuals per sample.
Areal Extent and Ecology. Populations of this type are found in the well-sorted, often current-rippled carbonate sand areas near the outer shelf edge. These areas presumably receive maximum current agitation and also are virtually devoid of vegetation. This assemblage has little lateral continuity and populations of this type are developed spottily along the seaward reef margin where the unique combination of limiting factors, particularly a mobile substrate and lack of vegetation, inhibits the development of the high diversity Miliolid-dominant assemblage.

None of the species in this assemblage are limited to the samples assigned to this assemblage. All are found in varying but generally low frequencies distributed throughout the extent of the shallow, marine carbonate environment. The maximum frequencies of most species occur in the few samples assigned to the *Archaiaea-Asterigerina*-dominant assemblage.

Adaptive Morphology. The dominant species in this assemblage are obviously adapted to a mobile substrate. Most are small, trochospiral forms that attach ventrally to various grains in the sediment. Individual test development is variable and conforms to the shape of the attachment surface. Examples of this type are Glabratella opercularis, *Neoconorina* spp., ?Remaneica sp. cf. *R. kelletae* and *Discorbis* spp. ?R. sp. cf. *R. kelletae* is an agglutinated form that implants a few calcareous grains in a largely organic test. The flexible nature of the test may prevent breakage. *Asterigerina carinata*, on the other hand, is
larger, thick-shelled and displays minimum phenotypic variability. This more robust form probably lives free in the carbonate sands.

The relatively high living-total ratios in the samples in this assemblage probably reflect removal and destruction of abandoned tests. The abundant small tests of most species in this assemblage presumably are not in hydraulic equilibrium as free grains in the sediment, and when not firmly attached tend to be transported into less agitated areas.

_Cribroelphidium-Quinqueloculina-Dominant
Mixed Fauna Assemblage

Total Populations. A number of total populations are mixtures of Miliolid-dominant and _Cribroelphidium_-dominant faunas. These populations are generally diverse _Quinqueloculina-
_Cribroelphidium_ or _Cribroelphidium-Quinqueloculina_ total populations. These faunas generally contain 100 to 140 species per sample; rarely they contain as few as 50 species. In most of these samples the dominant species is _Cribroelphidium poetanum_ occurring in frequencies of 8-12%. This assemblage differs from the Miliolid-dominant assemblages of the carbonate shoals in the relatively high frequencies of _Cribroelphidium_ and the presence of a number of taxa commonly associated with the _Cribroelphidium_-dominant assemblages but rarely, if ever, in the Miliolid-dominant assemblage. Such taxa include species of _Elphidium, Fursenkoina, Bigenerina, Reophax, Nouria, Hanžawaia, Reussella_, and _Ammonia_. 
It differs from the high diversity Cribroelphidium assemblage in the abundance and diversity of miliolids, peneroplids and other shoal-derived genera (e.g. Planorbulina, Clavulina, Asterigerina, etc.). Total population density ranges from 7,000 to 100,000 tests per sample. Most samples contain large populations of about 30,000 to 40,000 tests.

Living Populations. As in most of the lagoonal assemblages described, the dominant taxa of the total populations rarely dominate the living populations. In the case of faunal displacement and mixing this would be expected. The most abundant genus in most living populations in this assemblage is Fursenkoina. Commonly associated genera are Quinqueloculina, Triloculina, Florilus, Birgerina, Recophax, Cribroelphidium, Elphidium and more rarely Textularia and Sagrina. Living population diversity varies widely with most samples having 30 to 90 species. Species dominance also is variable ranging from 10% to 75%; however, in most samples species dominance is 25-30%. Among the living populations the relationship that high species dominance is associated with lower faunal diversity was observed to be generally true. The density of living populations ranges from 20 to 700 individuals with most samples containing 200 to 300 living specimens.

Areal Extent and Ecology. This assemblage represents a mixture of displaced shoal faunas and endemic deeper lagoon populations. It occurs as a narrow strip along the
western margin of the well-developed Barrier Platform from the Belize delta south to the latitude of South Stann Creek. Throughout this area it grades abruptly shoreward into the low diversity *Cribrorhynchum*-dominant assemblage. Further south it occurs throughout the complex of shoals on the southern British Honduras shelf. It rims the shoals, lines the channels and blankets the enclosed shelf atoll lagoons. In each case it borders a development of the high diversity Miliolid-dominant assemblage and away from the area of shoal influence it grades abruptly into *Cribrorhynchum*-dominant assemblages. The area is generally one of deeper water (10-25 fms.) on the shelf; hydrographic conditions are normal marine. The associated sediments are 60-100% carbonate in composition. The sediments are poorly sorted muddy sands and sandy muds and are almost wholly shoal-derived. It is presumed that most of the area of assemblage occurrence is subjected to relatively rapid sediment accumulation. The zone of shoal influence and faunal mixing is very narrow. Because of sample density the boundary is generalized throughout; however, several detailed traverses provide some indication of absolute distance of off-shoal transport. For example, in the shelf lagoon a sampling traverse was made from the mouth of South Stann Creek to the Barrier Platform (sample Nos. 281-295, Fig. 12). Proceeding from the coast toward the Barrier Platform marked reef influence (influx of miliolids) was not noted until sample No. 295, approximately 3/4 mile west of the edge of the platform. Strong
FIGURE 12 - PER CENT COMPOSITION OF TOTAL FORAMINIFERAL POPULATIONS IN TRAVERSE ACROSS THE SOUTHERN SHELF LAGOON

- Criboelphidium-Cellanthus-Elphidium
- Ammonia
- Florilus
- Fursenkoina
- Arenaceous
- Miliolid
- Reussella
- Discorbis-Rosalina
- Brizalina-Sagrina
- Miscellaneous
reef influence was evident in sample No. 291, 1/4 mile west of the platform. Rare, disc-shaped, juvenile Planorbulina spp. are encountered in mid-lagoon samples several miles shoreward of the carbonate shoals. These are an indication of shoal proximity, but the tests are spottily distributed and uncommon in the sediments. This detailed traverse and others approaching individual atolls (e.g. Laughing Bird shelf atoll) support the observation that most foraminiferal transport off the Barrier Platform and carbonate shoals is shoreward and terminates in a short distance.

The strong anomalous dominance of Fursenkoina pontoni in the living populations in this assemblage may indicate that this species is best adapted to areas of relatively rapid sedimentation. In this particular area its importance is obscured in the total populations by reef debris. In other areas, however, Fursenkoina dominance in an inorganic sedimentary regime might be a clue to relative sedimentary rates. Similarly Bigenerina and Reophax seem to proliferate under conditions that inhibit most other lagoonal species. Dominance of these arenaceous Foraminifera may be an indication of variable conditions within the milieu of marine shelf environment (not to be confused with the strong domination of many brackish-water environments by arenaceous Foraminifera).

Low Diversity Miliolid-Dominant Assemblage

Total Populations. The total populations of a large number of samples are characterized by: 1) low diversity;
2) overwhelming dominance by small miliolids; 3) high total population density; 4) high per cent generic dominance; and 5) considerable intraspecific morphologic variation. The diversity of these populations ranges from 20 to 50 species per sample although these figures are tenuous because intraspecific variation is great, and definition of species becomes more arbitrary than usual. Genus and species dominance may be as high as 55% and is rarely less than 20%. Total population density is always high, but it varies widely ranging from 20,000 to over 100,000 tests per sample. This high density results at least in part from the small size of the tests of most species and the sparsity of non-foraminiferal matrix in the sediment.

The most common species in this assemblage are:

- *Heterillina cribrostoma* (Heron-Allen and Earland)
- *Triloculina bermudezi* Acosta

and to a lesser extent:

- *Quinqueloculina* sp. B.
- *T. fitterei* Acosta vars.
- *T. sp. A.*
- *Massilina protea* Parker
- *Miliolinella californica* Rhumbler
- *Quinqueloculina laevigata* d'Orbigny
- *Q. poeyana* d'Orbigny
- *Archaias angulatus* (Fichtell and Moll).

Most of these taxa are characterized by small, smooth, unornamented tests. Exceptions are the costate species, *Q.*
poeyana and M. protea, costate varieties of T. fitterei and the large, complex peneroplid, A. angulatus.

Calcareous, perforate species occurring in significant frequencies in this assemblage include:

- Discorbis sp. cf. D. australis Parr
- Cribroelphidium poeyanum (d'Orbigny)
- Cellanthurus galvestonense (Kornfeld)
- G. gunteri (Cole)
- Ammonia beccarii (Linne)

The dominant generic associations found in this assemblage are:

- Heterillina-Triloculina-Quinqueloculina
- Heterillina-Triloculina-Miliolinella
- Miliolinella-Triloculina-Elphidium
- Ammonia-Triloculina-Quinqueloculina.

Although most of the common species in this assemblage are found in other areas of the shelf, particularly in the high diversity Miliolid-dominant assemblage, and under different environmental conditions, these taxa achieve their highest percentages in this area of assemblage distribution.

Locally wave and current action on submarine shoals produce small patches of very different faunal character within melieu of small miliolid dominance. Samples dominated by Archaeas angulatus occur spottily on the large mudshoals as winnowed "beach" deposits associated with tiny cays formed by pioneer mangrove communities (e.g. sample No. 256).
These populations belong to the *Archaia angulatus* assemblage. An areally extensive sedimentary body of this type will be discussed subsequently.

It is a subjective observation that intraspecific variability increases in areas of abundant marine grass cover. It is thought that much of the phenotypic variability of test form observed may result from the conformation of the shell to attaching surfaces (dominantly marine grass leaves) during growth. The cell pattern of *Thalassia* leaves is clearly imprinted on the attaching surface of some tests of *Heterillina oribrostoma*, one of the more variable forms. Intraspecific variability of test morphology in two common miliolid species, *Massilina protea* Parker and *Miliolinella dilatata* (d'Orbigny) is illustrated in Figures 13 and 14, respectively.

**Living Populations.** Living populations are characterized by 1) low diversity; 2) variable to low population density; 3) high genus and species dominance; 4) anomalous high frequencies of certain non-miliolid taxa; and 5) overall dominance of small miliolids.

The diversity of living species varies from 7 to 35 per sample and in most samples a high percentage of the taxa occurring in the total populations are found living. Living population density ranges from 150-200 to approximately 1,000 individuals per sample with most samples containing 200-500 stained tests. Species dominance is highly variable ranging from less than 10% to 70%; species
FIGURE 13 - INTRASPECIFIC VARIABILITY IN MASSILINA PROTEA PARKER
INTRASPECIFIC VARIABILITY IN
MASSILINA PROTEA PARKER
FIGURE 14 - INTRASPECIFIC VARIABILITY IN MILIOLINELLA DILATATA (D'ORBIGNY)
INTRASPECIFIC VARIABILITY IN
MILIOLINELLA DILATATA
(D'ORBIGNY)
dominance is inversely related to faunal diversity in most cases.

In more than one-half of the samples *Discorbis* is either the most abundant genus or one of the three or four most common genera. In these particular samples *Discorbis* is represented almost entirely by *D*. sp. cf. *D. australis*. With this major exception, the taxonomic composition of the living populations corresponds rather well with the total populations. *Heterillina, Triloculina, Quinquiloculina,* and *Miliolinella* comprise the bulk of the remainder of the faunas and dominate those samples in which *Discorbis* does not occur in high frequencies. *Elphidium, Cellanthis, Cribroelphidium, Ammonia, Valvulina* and *Archaia* are locally significant.

The distribution of dominant living taxa in this area is vaguely consistent though inexplicable. *Discorbis* sp. cf. *D. australis*-dominant living populations occur in Chetumal Bay from the south tip of Amergris Cay north to a point opposite the northern tip of Ambergris Cay. The common associated fauna consists of *Triloculina bermudezi* and *Heterillina cribrostoma*.

North of the *Discorbis*-dominant area *Heterillina* and other miliolids common in the total populations dominate the living populations. This is also true south of Chetumal Bay in most samples of this assemblage.

**Areal Extent and Ecology.** The distribution of this assemblage embraces a large area of the Northern Shelf Lagoon and most of Chetumal Bay. It extends from the latitude of
the Belize River delta north to the Mexican border (and probably beyond) and from the mainland margin seaward to a line corresponding approximately with north-south linear cay development in the lagoon.

The hydrography of this area is characterized by variable salinity that is generally less than normal marine. Hypersaline conditions may presumably develop in the dry season throughout much of the shallow bay area and most especially in the marginal, semi-restricted lagoons. During the time of sample collection bottom salinities over the area ranged from 18°/oo near the mainland to 34-36°/oo toward the seaward margin of assemblage distribution. The salinity gradient developed along the axis of Chetumal Bay and from the mainland coast seaward corresponds with gradation in faunal composition. In upper Chetumal Bay the low diversity Miliolid-dominant assemblage grades over a wide area west of Rocky Point into an Ammonia-small miliolid marginal marine assemblage containing Protelphidium delicatum (Bermudez) near the effluents of the New River and Rio Hondo. South of Chetumal Bay the low diversity Miliolid-dominant assemblage grades seaward into the high diversity Miliolid-dominant assemblage. This gradation parallels the salinity transition and coincides with the sedimentary transition from the "miliolid mud" facies to the Halimeda sand" facies. The assemblage includes the areal extent of most of the "miliolid mud," "cryptocrystalline grain" and "terrigenous sand" sedimentary facies. To the
south this assemblage is replaced by an *Ammonia-Ammobaculites* marginal marine assemblage at the mouth of the present Belize River.

The unique living *Discorbis-Triloculina-Heterillina* fauna seems to be associated with variable hydrography but does not persist in river influenced areas such as upper Chetumal Bay nor the areas of more open circulation such as the Northern Shelf Lagoon. It is significant that Streeter (1963) found a very similar fauna inhabiting the Inner Bank area of the Bahamas west of Andros Island. He reported a low diversity fauna characterized by *Triloculina eburnea* d'Orbigny, an undescribed species of ?*Triloculinella*, and an undescribed species of *Discorbis*. (These forms are thought to be conspecific with *Triloculina bermudez*, *Heterillina cribrostoma* and *Discorbis* sp. cf. *D. australis* --see taxonomy.) This fauna (Assemblage I of Streeter) is found in calcium carbonate muds associated with restricted circulation, high salinity (460/oo) and high temperature (Streeter, 1963, p. 21-22). These conditions are perhaps encountered at certain times in Chetumal Bay although high temperature and salinity were not prevalent at the time of sample collection. It is suggested that the dominant living factor for this fauna may be the fluctuating nature of the water characteristics rather than the specific extremes encountered.

In brief the area in which this assemblage predominates is characterized by:
1. very shallow (less than five fathoms), often
turbid water,
2. variable salinity and water temperature,
3. soft lime mud to sandy mud deposition,
4. varying degrees of marine grass cover providing
local increase in habitat diversity.

Archaia-Miliolid-Dominant Assemblage

Total Populations. The total populations of a few sam-
ples are dominated by Archaia angulatus associated with small,
smooth miliolids. The diversity is low--less than 30 species.
Specific dominance is high and may exceed 90% of the total
population, although it is more commonly less. The asso-
ciated genera are those common in the low diversity Miliolid-
dominant assemblage. They include Heterillina, Triloculina,
Quinqueloculina and Massilina and more rarely Cellanthus and
Valvulina. The taxonomic composition of these Archaia-
dominant populations is entirely different from that of
the Archaia-Asterigerina-dominant assemblage of the barrier
reef.

Living Populations. Living population density in this
assemblage is exceedingly low; in some samples no living
individuals were seen. Archaia is extremely rare in living
populations. The most common living forms are Heterillina
cribrostoma, Massilina protea, Quinqueloculina spp. and
Discorbis sp. cf. D. australis. Living population diversity
is low--generally less than 20 species.
**Areal Extent and Ecology.** Samples of this assemblage are located in the eastern area of lower Chetumal Bay bordering the western side of Ambergris Cay (Fig. 9). This distribution coincides with the "peneroplid-sand" sedimentary facies of Pusey. The concentration of *Archaias* tests in this area is considered to be more of a sedimentary phenomenon than a biological one. The sands are often current-ripped, and the component tests display a complete spectrum of preservation with all degrees of recrystallization and abrasion evident. Purdy (1965) used material from this area to demonstrate penecontemporaneous recrystallization of surficial Recent sediments. The sands are well-sorted and have only very sparse grass cover.

The *Archaias* sand is evidently a lag deposit. Purdy (personal communication) has observed cut banks and evidence of active erosion along the margin of the cays that parallel Ambergris Cay in Chetumal Bay. The material being eroded is a small miliolid-*Archaias* mud. Purdy thinks it likely that at an earlier time within the Recent interval marginal island conditions similar to that in which *Archaias* is now living abundantly persisted over a much larger area of Chetumal Bay. As sea level rose to its present position, this area was, and is being, eroded and winnowed leaving the *Archaias* facies as a lag deposit. The *Archaias*-Miliolid-dominant assemblage grades rather abruptly in all directions into the low diversity Miliolid-dominant assemblage. As noted previously *Archaias* occurs in variable, though generally low percentages throughout the low diversity
Miliolid-dominant assemblage and locally is concentrated as a winnowed beach sand around small, newly-formed cays on the mudshoals in Chetumal Bay.

Seaward the assemblage is bounded by the little-studied populations of the saline lake and marsh complex of Ambergris Cay. Samples from this area are non-quantitative, but they demonstrate that Archaias is common in both living and total populations in a number of areas bordering the Chetumal Bay side of the large island. These samples are all low diversity small Miliolid-dominant associations, but qualitative observation indicates that the contribution of Archaias to these foraminiferal populations varies widely. In some of these samples Archaias appears to be quite abundant; but it is associated with a mud matrix and abundant small miliolids. In such cases the large Archaias do not dominate populations numerically, but might well be the "dominant" faunal element when viewed from the standpoint of competing for living necessities. Here the great range in test size of the various species must influence interpretation of faunal dominance.

Areas of Archaias dominance are not uncommon on carbonate platforms elsewhere. Streeter (1963) found a disjunct distribution of such populations on the Bahama Banks and concluded that they were polygenetic. Deposits of relatively fresh tests in muds of the Inner Bank were thought by him to represent living populations (Streeter did not have the opportunity to study stained samples) and worn,
abraded populations associated with carbonate sands on the bank margin were thought to be secondarily concentrated. Observations in British Honduras support these hypotheses.

Bandy (1964) reported that a very large portion of the marine carbonate shelf of Batabano Bay, Cuba, was characterized by *Archeias angulatus* assemblages in which that species comprised up to 80% of the foraminiferal populations. These populations were associated with carbonate sands (ovoid grains of Daetwyler and Kidwell, 1959) in a current swept area. Bandy decided that the total populations represented living populations and in considering their distribution concluded that *Archeias angulatus* is a stenomaline species.

The distribution of *Archeias angulatus* in British Honduras and elsewhere (i.e. Bahama Banks) indicates that this species is adapted not only to constant marine conditions, but also to variable, marginal marine conditions not influenced by terrigenous sediment influx.
FACTORS AFFECTING THE DIVERSITY OF MARINE BENTHOMIC POPULATIONS

It is evident that the number of species present is a significant parameter of the foraminiferal populations studied. Together with faunal dominance, the overall taxonomic composition of the populations and population density, faunal diversity serves to identify mappable and environmentally significant assemblages. Assuming that morphologically defined groups approximate true species, it is a simple matter to tabulate the number of distinct morphological entities per sediment sample and to describe the geographic distribution of the diversity data.

It is common knowledge that certain marine environments are inhabited by more or fewer species of animals than others. Tropical faunas are generally more diverse than temperate faunas; reef faunas are more diverse than adjacent lagoonal faunas; marine shelf faunas are more diverse than brackish-water bay faunas.

Such empirical relations among Recent Foraminifera are found to be of considerable help in the interpretation of Tertiary paleobathymetry. Walton (1964a), Gibson (1966a,b) and others have shown that foraminiferal diversity generally increases on the continental shelf of the Gulf of Mexico from the shore to the edge of the shelf-slope break and both Walton and Gibson conclude that the trend in variation of diversity reflects relative environmental
stability (i.e. invariability of environmental parameters such as temperature, salinity, etc.). But the reasons that this is true are not readily apparent. To say that there are fewer species in brackish-water than in marine area because the hydrography is more variable in a bay is, to a certain degree, begging the question. If five or ten species can exist under variable conditions, why not 50 or 100 or as many as exist under normal marine conditions? Granted stenohaline marine forms may not be physiologically adapted to invade brackish environments, but why is there not a proliferation of endemic species in areas of variable hydrography? There are evidently many factors that affect population diversity both through ecologic limitation of species distribution and regulation of species formation.

A number of hypotheses developed by neontologists are pertinent to this discussion. One of the basic ideas as expressed by Connell and Orias (1964) suggests that available solar energy in an environment is channeled by organisms into two fundamental processes: 1) maintenance, and 2) reproduction. "Maintenance" includes all regulatory activities that buffer the organism's system against fluctuation of the environment. "Reproduction" is a collective term for growth, development, and production of offspring. In non-fluctuating ("non-stress" or "stable") environments energy expenditure for "maintenance" is presumably minimal and most available energy is utilized for reproduction. As a result there is an increase in population size, a larger
gene pool, hence potentially greater genetic variability. Further, an increase in population size increases areal extent of the population and exposes it to new environments creating greater potentiality for speciation and increased diversity. In fluctuating ("stress" or "unstable") environments the reverse would be the case. Most energy is allocated for "maintenance" and the above manifestations of "reproduction" are denied, hence low diversity. An example of stable conditions in the present study might be the carbonate shoal environments characterized by stenohaline, stenothermal conditions and inhabited by highly diverse populations, and an example of unstable conditions might be the low diversity populations of Chetumal Bay. Some environments of the Southern Shelf Lagoon in British Honduras, however, are highly stable but support lower diversity faunas than the carbonate shoals. Conversely, unstable and fluctuating marginal marshes are known to contain relatively diverse foraminiferal assemblages. Therefore, environmental stability alone cannot entirely control faunal diversity.

Another subject that has bearing on this discussion is that of community evolution. It is evident that interdependence of species within a community reflects evolution of community structure and diversity is one aspect of community development. Elton (1958) has shown that the invasion of a foreign species into an established, diverse community is extremely difficult while adaptation of a foreign species to unpopulated or low diversity areas is
relatively easier. Further, Hutchinson (1959) indicates that although diversity in a community increases from the time of original invasion, diversification does not proceed indefinitely or at a constant rate. He concludes that there is evidently an optimum community structure (diversity being one aspect) integrated with prevalent environmental conditions which produces optimum community stability. Just as individual species develop homeostatic mechanisms to regulate their systems, faunal communities develop complex interspecies relationships which buffer the community as a whole from environmental contingencies. Thus, there is a tendency for the community to develop a degree of diversity with time and this development may be somewhat independent of the physical variety within the environment. Margaleff (1963) and Shaffer (1965) contend that diversity is directly related to "ecosystem maturity" and environmental stability; fluctuating environments tend to suppress ecosystem development. According to Shaffer (1965, p. 283) coral reefs represent the most mature ecosystems in the modern marine realm.

The role of habitat diversity and the "number of available niches" also requires discussion. Connell and Orlas (1964) argue that one cannot predict the number of niches present in a given area because there are many factors other than observable physical parameters that contribute to the definition of the fundamental niche of an organism (as defined by Hutchinson, 1957, and Slobodkin,
1964, Ch. 3). Many such factors are biologic and depend to an extent on the degree of community development. Therefore, the number of niches can be estimated only in retrospect. This is probably true; however, the diversity of habitats within a marine environment does affect the number of species of certain groups of organisms present. Thorson (1957) noted that latitudinal variation in mollusk diversity is related to the distribution of marine flora. He noted that the infauna does not diversify greatly toward the tropics, but that the epifauna related to the marine flora diversifies markedly. Thus, an increase in the diversity of available habitats can influence the number of species in a marine community. Reef environments probably epitomize high habitat diversity, and this is doubtless reflected in the foraminiferal populations. Conversely, Wieser (1960) has speculated that speciation among deep-sea benthic microfaunas takes place under extremely uniform conditions through fragmentation of breeding populations without extrinsic geographic barriers or marked environmental variety. (An example of this might be the formation of the endemic species Buliminella silvae in the Gulf of Cariaco discussed subsequently.)

In summary, it seems likely that a variety of interacting factors can and do affect the diversity of marine populations and awareness of these factors is a prerequisite for the interpretation of fossil populations.

Thus, relatively low diversity may reflect one or a combination of community-environmental attributes notably:
1) low habitat diversity
2) environmental instability
3) early stage of community development
4) low available energy.

Conversely, relatively high diversity may reflect:
1) high habitat diversity
2) environmental stability
3) advanced stage of community development
4) high available energy.

For example, the high diversity Miliolid-dominant assemblage occurs in an area of high stability (stenohaline, stenothermal) with high habitat diversity, probably high energy (shallow, clear water with abundant green plants). In contrast the high diversity Cribroelphidium-dominant assemblages, containing fewer species, occurs in an area of high environmental stability, but lower habitat diversity and perhaps lower environmental energy due to the greater depth of water light must penetrate. The low diversity Cribroelphidium-dominant assemblage is similar to the preceding except that hydrographic restrictions may inhibit the invasion of many typically lagoonal species. The low diversity Miliolid-dominant assemblage occurs in an area of relatively low habitat diversity and fluctuating hydrography. Marginal marshes also endure highly variable hydrography but are characterized by higher habitat diversity (plants) and probably higher available energy input, and generally contain more diverse foraminiferal faunas than the adjacent bay environment.
PATTERN AND SIGNIFICANCE OF LIVING FORAMINIFERAL POPULATIONS IN THE SOUTHERN SHELF LAGOON

In this study it is a consistent observation that the taxonomic composition and faunal dominance of the living populations in the Southern Shelf Lagoon differ from those of the total populations. Species that dominate living populations are commonly inconspicuous in the total population counts and in very few samples are the living and total populations dominated by the same species or generic associations. Nearly all of the total populations are dominated by *Cribroelphidium* and although this genus is not uncommon in living populations, it is rarely the most abundant taxon.

The composition of the living populations of assemblages in the Southern Shelf Lagoon has been discussed in the foregoing sections. The distribution of these populations is complex; however, a semblance of pattern can be recognized in the shelf lagoon as a whole, and the pattern of generic dominance in the Southern Shelf Lagoon is shown in Figure 15. In general, living species of *Florilus* dominate the populations of the shallower portions of the lagoon (exclusive of most coastal areas) particularly in the vicinity of the Belize delta in the north and the Gulf of Honduras in the south. *Fursenkoina* tends to dominate living populations in the deeper lagoon areas particularly
FIGURE 15 - DOMINANT GENERA IN THE LIVING POPULATIONS OF THE SOUTHERN SHELF LAGOON
DOMINANT GENERA IN THE LIVING POPULATIONS OF THE SOUTHERN SHELF LAGOON
where affected by carbonate shoal sedimentation. Locally *Bulimina* and arenaceous genera, *Eggerella*, *Reophax*, and *Bigenerina* are the most abundant taxa. This pattern is grossly oversimplified, however, and there are numerous exceptions. Moreover, evidence contrary to the living population distribution as outlined in this study is presented in Cebulski's report (1961). He stated that living populations in the portion of the shelf he studied were in accord with total populations and that both were strongly dominated by *Elphidium* (=*Cribroelphidium*, *Cellantheus*, *Elphidium*) with *Nonion* (=*Nonionella*) and *Streblus* (=*Ammonia*) as consistent associated elements. This paradox cannot be reconciled at present. Assuming that the living populations recorded in the present study are representative of the true distribution of the prevalent foraminiferal faunas, it is imperative to discuss the difference between the living and total populations and the ecologic significance of the pattern of living Foraminifera.

Some factors that might result in differences between living and total populations cannot be adequately evaluated at present. For example, differential reproductive rates among foraminiferal species could give rise to higher contribution to total populations than living populations by some species, but very little is known about reproductive rates and life cycles of most Foraminifera. Differences between living and total populations could also result from seasonal changes in reproduction rates. The sampling for
this study was, of necessity, conducted only in the summer season, and it is not known if the population statistics are representative of all seasons. It is thought, however, that these factors cannot account for all differences in taxonomic composition, faunal dominance, faunal diversity, and faunal density between living and total populations observed in this study, and it is suggested that changing environmental conditions concurrent with the development of the British Honduras shelf during the Recent interval is an important factor effecting the composition and structure of both living and total foraminiferal populations.

Walton (1964a) concluded that faunas in which living populations are dominated by species not conspicuous in the total populations result from recent ecological changes. In short, there is a lag effect. Environmental conditions shift, living populations change, and the sediment is contaminated with numerous empty tests of the former dominant species. Such mixed populations would be expected in marginal marine and shallow reef associated environments which are subject to shifting conditions.

Such has probably been the case during the Holocene of the southern British Honduras shelf. Relict and reworked Pleistocene sediments are evident in the lagoon and relict faunas would not be unexpected. Presumably environmental conditions have changed from marginal, probably brackish-water, environments during early Holocene sea level rise to present-day marine shelf environments with varying degrees
of restriction imposed on the lagoonal hydrography as the result of seaward Barrier Platform development. *Cribroelphidium* is common in living populations of brackish-water lagoons on the present southern shelf coast as well as in the marine environment, and the same species were probably abundant during much of the Holocene history in most areas of the shelf lagoon. Thus, these older faunas may contribute to some degree to the composition of total populations in some areas of the Southern Shelf Lagoon.

The dominant living foraminiferal taxa of the shelf lagoon of British Honduras are common elements in shallow shelf environments elsewhere. In the northeastern Gulf of Mexico, *Florilus*- and *Buliminella*-dominant faunas are common in 10 to 30 fathoms of water near the eastern margin of the Mississippi River delta (Walton, 1964). Data in Phleger and Parker (1951) show local areas of arenaceous taxa- and *Buliminella*-dominance in the inner continental shelf of the northwestern Gulf of Mexico. In a study of the Recent Foraminifera of the Gulf of Cariaco, Seiglie and Bermudez (1963) described benthonic faunas dominated by *Buliminella* (*Buliminella silviae* Bermudez and Seiglie, *B. elegantissima*) and *Virgulina pontoni* (*=Fursenkoina pontoni*) among other biofacies. The Gulf of Cariaco is a silled basin almost totally enclosed by land on the north coast of Venezuela. The *Buliminella*-dominant fauna is characterized by very low diversity (approximately four species) and high species dominance. It occurs over most of the central Gulf area associated with grey-green muds in depths from 15-25 meters
to almost 100 meters, the deepest part of the Gulf. Although hydrography is not discussed in detail, one might speculate that restricted circulation is a significant limiting factor in the distribution of this biofacies. In the British Honduras shelf lagoon living Buliminella-dominant faunas are grouped in an area coincident with the area of most continuous Barrier Platform development, and perhaps minimum circulation in the Southern Shelf Lagoon. Although the living Buliminella faunas of British Honduras are not as limited in faunal diversity as those of the Gulf of Cariaco, they may reflect similar though less extreme conditions. The area of Virgulina pontoni (=Fursenkoina pontoni) dominance in the Gulf of Cariaco occurs in a narrow band bordering the mainland coast in water depths of 18 to 41 meters. It is associated with terrigenous sands, silts and clays. The steep topographic gradient and poorly sorted land-derived sediments may be indicative of relatively rapid sedimentation. In the British Honduras shelf area Fursenkoina pontoni consistently dominates living populations in areas presumed to be subject to rapid off-shoal sedimentation, but the high per cent of shoal-derived foraminiferal debris in these areas masks the occurrence of this species in total populations.

In summary, the present distribution of living and total foraminiferal populations in the British Honduras Southern Shelf Lagoon seems to reflect at least in part the historical development of the shelf and the influence of the Barrier Platform, both directly through its sediment
contribution to the adjacent lagoon and indirectly through its effect on lagoonal water circulation.
COMPARISON OF BRITISH HONDURAS FORAMINIFERAL COMMUNITIES
WITH THOSE OF OTHER REEF-BOUNDED CARBONATE AREAS

This study of the British Honduras Foraminifera has attempted to describe major faunal assemblages and to relate them to recognizable environmental parameters. It would be a mistake, however, to dwell at length on the uniqueness of this area and the contained populations and to ignore similar studies. To the contrary a geologically significant point is the fundamental similarity of carbonate shelf assemblages and the fact that differences in faunal patterns among them can be ascribed to recognizable bathymetric and hydrographic parameters. Comparison of three well-studied tropical to sub-tropical areas, the Bahama Banks, the Gulf of Batabano, and the Southern Florida Shelf illustrates this point.

Bahama Banks

The northwestern part of the Great Bahama Bank is a shallow, scarp-bounded platform nowhere deeper than 3-5 fathoms evidencing a crude concentricity of sedimentary facies (Purdy, 1963). Streeter (1963) described five foraminiferal assemblages from this area. They are:

1) An Inner Bank assemblage characterized by low diversity and dominance of small miliolids with distinct species of Discorbis and peneroplids associated with lime mud sediments and restricted hydrography.
2) An assemblage characterized by abundant and diverse *Discorbis* spp. associated with near normal marine conditions and extensive *Thalassia* grass meadows.

3) A disjunctly distributed assemblage characterized by *Archaias* dominance.

4) An assemblage dominated by *Nodobaculariella* that roughly corresponds to portions of the distribution of grapestone sediments.

5) An Outer Bank assemblage dominated by a diverse *Miliolid-Asterigerina* fauna associated with normal marine conditions and coralgel, oolitic and grapestone sediments.

Streeter encountered no *Cribroelphidium*-dominant populations nor any *Ammobaculites, Ammonia* or *Cribroelphidium*-dominant marginal marine assemblages.

Streeter noted that assemblages 1, 2 and 5 replace one another in sequence paralleling the transition from Inner Bank to Outer Bank conditions.

**Gulf of Batabano, Cuba**

The Gulf of Batabano is a shallow carbonate-mantled shelf bordered on the north by Cuba and on the south by a sharp declivity dropping steeply into the Caribbean Sea.

Foraminiferal assemblages on the shelf of the Gulf of Batabano have been described by Bandy (1964). He recognized three major associations:
1) An *Archaia*s-dominant assemblage characterized by minimum diversity, small populations and maximum species dominance associated with the strongest current regime, ovoid grain sediments and normal marine hydrography. This assemblage occurs over a large area of the southeastern shelf.

2) A broad back-reef Miliolid-dominant assemblage characterized by maximum diversity, and large populations associated with weak currents and lime mud matrix. This assemblage occurs over most of the southwestern shelf. It is significant that much of the area of this assemblage occurrence coincides with the highest frequencies of *Discorbis*.

3) A Miliolid-*Elphidium*-dominant fauna characterized by low diversity and variable population size associated with weak currents, hyposaline conditions and lime mud matrix. This assemblage occupies the central northern portions of the shelf and the highest frequencies of *Elphidium* generally correspond to the deeper portions of the shelf.

The Miliolid-*Elphidium* assemblage grades landward into river-influenced *Ammonia* faunas occurring along the mainland margin.

Bandy also noted that the outer reef-fringed rim of the shelf is characterized by a distinct *Amphistegina-Asterigerina-Rotorbinella* fauna.
Florida Reef Tract-Florida Bay

The southern Florida shelf is a shallow carbonate platform adjacent the low lying Florida Peninsula. In this area the Florida Keys form a strong linear hydrographic barrier between the restricted environment of Florida Bay landward of the islands and the normal marine reef tract seaward of the islands.

No single study of the Foraminifera of the Southern Florida Shelf unifies the assemblage distribution. Studies by Moore (1957), Bush (1958), Lynts (1962), Scholz (1963), and Wright (1964), however, demonstrate a pattern similar to that of Batabano Bay and the Bahama Banks.

The outer reef tract is dominated by a peneroplid-Amphistegina fauna. The shallow, normal marine, back-reef area is characterized by a high diversity Miliolid-dominant assemblage. Florida Bay is characterized by a variety of low diversity Miliolid-dominant assemblages associated with Ammonia, Elphidium and Archaias. In this area there is no evident widespread development of a Discorbas-Rosalina-dominant assemblage.

Discussion

It is evident that each area described contains basically similar faunas with some unique characteristics.

Each reef-bounded area is bordered on its seaward margin by a high diversity Miliolid-dominant assemblage and a disjunctly distributed assemblage characterized by
a group of non-miliolid genera including *Asterigerina*, *Archaias*, and *Amphistegina*. Landward or bankward, whichever the case may be, a variety of assemblages is developed depending on the width and submarine topography of the shelf and the interaction of shelf bathymetry and hydrography. On the Bahama Banks the diverse *Discorbis-Rosalina* populations seem to result from the existence of a broad, shallow area characterized by current, turbidity and circulation conditions intermediate between that of the Outer and Inner Bank. An indication of similar development in the Gulf of Batabano is evidenced by the extensive high diversity Miliolid-*Discorbis-Rosalina* faunas in shallow areas removed from the shelf edge but not strongly influenced by terrigenous influx nor marked restriction. Such faunas are not present in British Honduras. In Southern British Honduras the narrowness of the relatively shallow Barrier Platform mitigates against the development of areally extensive environmental attributes intermediate between those of open and markedly restricted circulation. In Northern British Honduras the barrier line of cays, of which Ambergris Cay is the largest, induces a rapid transition from the normal marine waters of the Outer Platform to the hyposaline, restricted circulation of the Northern Shelf Lagoon and Chetumal Bay. The Florida Keys play a similar role, thus explaining the evident absence of *Discorbis-Rosalina* faunas in that area.

The shallow areas of restricted hydrography in all of these areas have similar faunas. The Inner Bank assemblage
of the Bahamas is similar to both that of the shallow Chetumal Bay area west of Amergris Cay and the shallow markedly restricted area of Florida Bay.

In those areas adjacent to a landmass a variety of marginal marine assemblages is developed depending on the nature of the nearshore processes involved and the degree of influence of terrigenous sediment and fresh-water influx. Such assemblages are, of course, absent from the shallow unattached platform of the Bahama Banks, although marsh faunas associated with island development should certainly be in evidence.

The *Nodobaculariella*-dominant assemblage of the Bahama Banks is not encountered in any of the other areas described. It is noteworthy that grapestone sediment with which it is associated in the Bahamian area is found only rarely in the other carbonate shelf areas.

Faunal mixing is not a major factor in back-reef assemblages of any area except Southern British Honduras. Moreover, only in this area are steep-sided carbonate shoals developed in a relatively deep back-reef lagoon. The other areas are largely very shallow shelves and only in the deeper back-reef portions of Batabano Bay are found *Cribroelphidium*-dominant assemblages similar to those of the Southern Shelf Lagoon of British Honduras.

The extensive area of *Archaias* dominance on the shelf of the Gulf of Batabano is unique to that area and evidently reflects a strong, constant current regime as
discussed previously (p. 55, 76-78). Much smaller areas of Archaias dominance are evident in the other shelf areas and are thought to result from either winnowing of sediment or prolıﬁc production of Archaias.

From these comparisons it is possible to develop a diagrammatic scheme of foraminiferal assemblage relationships in a variety of carbonate shelf areas (Fig. 16).

On a shallow bank with no deep back-reef lagoon nor terrigenous influence from an adjacent landmass, a more or less concentric pattern of foraminiferal relationships might be expected to develop (Fig. 16A). These assemblages would be dominated by miliolids and would progress from a high diversity Miliolid-dominant assemblage near the edge of the bank to a low diversity Miliolid-dominant assemblage toward the center of the bank. This change would be coincident with decreasing current velocity and water circulation and increasing salinity from outer to inner bank. Intermediate conditions would produce a miliolid fauna associated with high frequencies of Discorbis and Rosalina. The zone of maximum turbulence at the bank margin would coincide with an Archaias-Asterigerina-Amphistegina-dominant assemblage.

If a line of cays and shoals are developed on a shallow bank or shelf area creating an effective barrier to water circulation, a more abrupt transition in foraminiferal assemblages would develop (Fig. 16B). A high diversity Miliolid-dominant assemblage would still be present at the shelf margin, but the Discorbis-Rosalina fauna might be
FIGURE 16 - DIAGRAMMATIC RELATIONSHIPS OF FORAMINIFERAL ASSEMBLAGES OF REEF-BOUNDED CARBONATE AREAS

FORAMINIFERAL ASSEMBLAGES

LOW DIVERSITY MILIOLID

DISORBIS-ROSALINA-MILIOLID

HIGH DIVERSITY MILIOLID

ARCHAIAST-ASTERGERINA-AMPHISTEGINA

MARGINAL MARINE

CRIBROELPHIDIIUS

CARBONATE SHOAL-DEEP LAGOON MIXED FAUNA
A. SHALLOW CARBONATE BANK WITHOUT ADJACENT MAINLAND

- Maximum turbulence
- Increasing salinity
- Decreasing current velocity
- Minimum circulation
- Normal salinity
- Maximum turbulence

- Maximum faunal diversity
- Decreasing faunal diversity
- Normal salinity
- Sea level

B. SHALLOW CARBONATE SHELF WITH STRONG HYDROGRAPHIC BARRIER AND ADJACENT MAINLAND

- Decreasing current velocity
- Decreasing salinity
- Minimum circulation
- Normal salinity
- Maximum turbulence
- Sea level

- Maximum faunal diversity
- Decreasing faunal diversity

C. CARBONATE SHELF WITH DEEP BACK-REEF LAGOON AND ADJACENT MAINLAND

- Decreasing salinity
- Normal salinity
- Maximum turbulence
- Sea level

- Minimum circulation
- Maximum faunal diversity
- Decreasing faunal diversity

DIAGRAMMATIC FORAMINIFERAL ASSEMBLAGE RELATIONSHIPS
essentially excluded. Instead, an abrupt transition landward or bankward across the hydrographic barrier to a low diversity Miliolid-dominant assemblage would occur. If the area is subjected to terrigenous influence from an adjacent mainland, this latter assemblage would grade landward into marginal marine assemblages.

If instead of a relatively shallow bank or shelf, a deep back-reef lagoon is developed, different shelf assemblages would be present (Fig. 16C). The shallow seaward reef area would still contain a high diversity Miliolid-dominant assemblage. In the back-reef lagoon, however, a narrow zone of mixed shoal-derived and lagoonal faunas would be present at the base of the carbonate shoals and a Cribroelphidium-dominant assemblage would develop in the lagoon. If circulation in the back-reef lagoon is restricted by reef development, this lagoonal Cribroelphidium fauna would be characterized by minimum diversity. At the landward margin of the shelf this assemblage would grade into one or another of the marginal marine assemblages.

Assemblages dominated by larger foraminiferal tests such as Archaeas would develop in most shallow carbonate shelf or bank areas subjected to strong wave and current action and effective winnowing of sediments.
CONCLUSIONS

1. Foraminiferal assemblages based on four population parameters, generic dominance, faunal diversity, taxonomic composition, and population density, are natural, mappable, environmentally significant faunal units.

2. Assemblages are delineated from total populations rather than living populations because the total populations are more geologically significant. Living populations rarely form areally consistent faunal units because they reflect both short-term environmental effects and micro-environmental complexities. Differences between living and total populations probably reflect: 1) changing environmental conditions with residual relict faunas (as in the Southern Shelf Lagoon); 2) inadequate sampling of habitats (as on the Barrier Platform); 3) displaced faunas (as in lagoonal sediments subjected to near-shoal sedimentation; and 4) unknown factors (as in portions of Chetumal Bay). The degree to which differential reproductive rates and seasonal reproduction contribute to differences between living and total populations is not known.

3. The faunal assemblages recognized in the shelf sediments of British Honduras are: 1) a high diversity Miliolid-dominant assemblage associated with stenohaline conditions, shallow, clear water, high habitat diversity and carbonate sediments of varying textures; 2) an *Archeias-Asterigerina*-dominant assemblage associated with maximum
turbulence along the edge of the barrier reef rim; 3) a low diversity Miliolid-dominant assemblage related to shallow, sometimes turbid water, poikilohaline conditions, dominantly lime mud sediments, weak currents and moderate to low habitat diversity; 4) an *Archaia*-Miliolid-dominant assemblage resulting from the winnowing of certain portions of the low diversity Miliolid-dominant areas of occurrence; 5) a low diversity *Cribroelphidium*-dominant assemblage that develops in response to several different sets of environmental conditions in the Southern Shelf Lagoon, including factors associated with variable salinity conditions and those associated with restricted circulation; 6) a high diversity *Cribroelphidium*-dominant assemblage associated with constant normal marine salinity, mixed carbonate-terrigenous sediments of variable texture and low habitat diversity in the Southern Shelf Lagoon; this assemblage is not notably reef influenced; 7) a *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage resulting from influx of shoal-derived debris into adjacent lagoonal areas; living faunas in these sediments are evidently adapted to conditions associated with relatively rapid sedimentation; 8) a *Cassidulina*-dominant assemblage with the only significant incursion of planktonic forms encountered on the shelf and associated with the deepest portion of the Southern Shelf Lagoon and uninhibited circulation of oceanic water; 9) a *Quinqueloculina-Cribroelphidium*-dominant assemblage restricted to the mainland margin of Southern British Honduras characterized by shallow water,
nearshore sedimentary processes, and quartzose sand deposition; 10) a variety of poorly documented marginal marine assemblages including typical delta, marsh, and mainland lagoon faunas; faunas of this type are well-known from numerous studies elsewhere.

4. It is evident that the Barrier Platform development strongly influenced the structure of foraminiferal communities of the Southern Shelf Lagoon, both directly through sediment contribution at the base of the shoals and indirectly through restriction of back-reef water circulation.

5. Faunal diversity is a significant parameter in the study of benthonic foraminiferal populations because it is independent of taxonomic identification and is therefore potentially useful in the environmental interpretation of fossil populations. Variation in faunal diversity has been attributed largely to variations in the hydrographic stability of the environment. It is important to note that this factor alone is sufficient for interpretation and other factors notably habitat diversity, and community succession may be equally important in the determination of faunal diversity.

6. Comparison of the distribution of foraminiferal assemblages in British Honduras with carbonate shelf environments elsewhere illustrates the basic similarity of assemblage relationships. The major factor affecting assemblage distribution is the interaction of shelf bathymetry with marine hydrography. Recognition of these variations
in ancient faunal assemblage patterns can facilitate the reconstruction of carbonate shelf environments in the geologic record.
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SYNOPTIC SYSTEMATICS

Approximately 200 species of benthonic Foraminifera are identified from material collected for this study. Nearly all of these categories represent species described previously; therefore, rigorous description of the forms is not presented. Emphasis in the following species descriptions is on the distribution of individual taxa within the study area. Pertinent notations concerning taxonomy are confined to "Remarks."

Most forms are illustrated in the accompanying plates. The illustrations are camera lucida pencil drawings done by the writer. The illustrated specimens will be deposited in the foraminiferal collection of the U. S. National Museum. Additional collections of British Honduras Foraminifera will be deposited in the Department of Geology, Rice University, and the Instituto de Geologia, Universidad Nacional Autonoma de Mexico.
**Glomospira gordialis** (Jones and Parker)

Pl. 1, Fig. 1

**Trochammina squamata** Jones and Parker var. **gordialis**

Jones and Parker, 1860, Butschli in Bronn, Klassen and C. Thier-reichs, 196, v. 22.


**Distribution:** Rare. This species is distributed randomly in a few samples scattered throughout most of the southern shelf area including the carbonate platform, nearshore, and Southern Shelf Lagoon. It occurs living in samples from depths of less than 10 feet to depths of 200 feet. It comprises less than 3% of the living and less than 1% of the total population in the samples in which it occurs.

**Ammodiscus gullmarensis** Hoglund

Pl. 1, Figs. 2a,b,c


**Distribution:** Rare. Species found in very few samples scattered throughout the Southern British Honduras shelf. It comprises generally less than 1% of both living and total foraminiferal populations.
?Ammodiscus sp.

Remarks: This form is planar with very irregular coiling of the elongate chamber. It is very low in outline, one side flattened and the other slightly convex. It is doubtless adapted to an encrusting habitat. The form is encountered very rarely in shallow marine Thalassia-covered areas. It was never seen living and was always less than 1% of the total population. This species is very similar in appearance to Glomospira adhearens Parr.

_Lagenammina atlantica_ (Cushman)

Pl. 1, Fig. 3


_Lagenammina atlantica_ (Cushman); Lankford, 1959, Amer. Assoc. pet. Geol. Bull., p. 2098, pl. 1, fig. 1.

Distribution: This is a common form throughout the deeper portions of much of the narrow Southern Shelf Lagoon. It is not found on the Barrier Platform, the Northern British Honduras shelf, nor in nearshore areas. It is generally confined to portions of the lagoon deeper than five fathoms. It is most commonly a constituent of the _Reophax, Eggerella, Fursenkoia_ or _Buliminella_-dominant living populations in the lagoonal _Cribrorotalia-elpheidium_-dominant total population assemblages.
Reophax sp. cf. R. arayensis Bermudez and Seiglie

Pl. 1, Fig. 5


Distribution: This species is common in the Southern Shelf Lagoon in depths greater than 5 fathoms. In some lagoonal areas influenced by shoal debris influx this species may represent up to 18% of the living population though it is more commonly less than 5%. It is only rarely present in frequencies greater than 1% in total populations.

Remarks: This form is characterized by large size and coarse grained texture. Commonly a transparent grain is fitted like a "window" in test wall.

Reophax nana Rhumbler

Pl. 2, Fig. 4

Reophax nana Rhumbler, 1911, Foram. Plankton-Exped., pt. 1, pl. 8, figs. 6-12.

Distribution: Rare. This species is encountered in a few samples scattered over most of the Southern British Honduras shelf and at the effluent of the Belize River delta. It is most common in nearshore, river-influenced areas though it is an extremely rare constituent of lagoonal and some carbonate shoal samples. It is always less than 2% of the living and less than 1% of the total populations.
Reophax spiculifer Brady

Reophax spiculifer Brady, 1884, Rpt. Foram. dredged H.M.S. "Challenger", pl. XXXI, fig. 16, 17.

Remarks: The species is unique in that the test wall is composed wholly of sponge spicules oriented parallel to the long axis of test development. This species is extremely rare occurring only in the deepest portion of the Southern Shelf Lagoon. It was not found in living populations.

Nouria polymorphinoides Heron-Allen and Earland

Pl. 1, Figs. 6a,b


Distribution: This species is common in deeper portions of the Southern Shelf Lagoon. Living population frequencies are generally less than 5% except locally in near-shoal areas where abnormally high percentages may occur. The species usually comprises less than 1% of the total population. It is generally associated with Reophax, Eggerella, Fursenkoina and Buliminella-dominant living populations in the Cribroelphidium-dominant total population assemblages.

Milliammina fusca (H. B. Brady)

Pl. 1, Figs. 7a,b,a

Millemmina fusca (H. B. Brady), Hada, 1936, Zool. Mag.,
v. 48, p. 852, t.f.5.

Distribution: This species was counted in very few quantified samples all located at or very near the effluents of rivers along the Southern British Honduras mainland margin. Living populations occur in frequencies up to 8%; total populations are less than 1%. This species is associated with Ammonia-Ammobaculites or Cribroelphidium-dominance in the samples encountered. This species was observed living abundantly in non-quantitative samples from marshes in the Belize River delta area and the inshore margin of the Southern Shelf Lagoon.

Haplophragmoides spp.

Remarks: Extremely rare forms generally characterized by small test size and coarsely arenaceous wall. Several species occur in very low frequencies in both living and total populations in a few samples on the Southern British Honduras shelf. Species are most common in nearshore areas but are scattered also in deeper portions of the lagoon and on the carbonate platform.

Ammoastuta inepta (Cushman and McCulloch)
Pl. 1, Figs. 8a,b

Ammobaculites ineptus Cushman and McCulloch, 1939, South. Calif. Univ. Publ., Allan Hancock Pacific Exped., v. 6, no. 1, p. 89, pl. 7, fig. 6.
Ammoastuta inepta (Cushman and McCulloch), Saunders, 1958,
Micropaleontology, v. 4, p. 83, pl. 1, figs. 4-7.

Distribution: Very rare. Species encountered in only three
quantified samples from nearshore, river-influenced
areas. Both living and total frequencies are less than
1% of the respective population counts.

Ammobaculites dilatatus Cushman and Bronnimann

Ammobaculites dilatatus Cushman and Bronnimann, 1948, Contr.
Cushman Lab. Foram. Res., v. 24, pt. 2, p. 39, pl. 7,
figs. 10-11.

Distribution: Rare. This species is found in a few samples
in low frequencies largely confined to areas of river
influence in Southern British Honduras. It is, however,
the only living arenaceous form encountered in samples
near the effluent of the Rio Hondo in Northern British
Honduras.

Remarks: This species is distinguished by the highly com-
pressed form and large diameter of the initial coil.

Ammobaculites directus Cushman and Bronnimann

Pl. 1, Fig. 12

Ammobaculites directus Cushman and Bronnimann, 1948, Cush.
figs. 3, 4.

Remarks: This species is very distinct being characterized
by small size, finely arenaceous test, very flattened
shape and chevron or inverted "v"-shaped sutures. This
species was not encountered in quantified samples. Qualitatively, this form was observed in a few samples confined to marginal brackish-water environments of Southern British Honduras associated with **Ammobaculites**-dominant faunas.

**Ammobaculites exiguis** Cushman and Bronnimann

Pl. 1, Fig. 9


**Distribution:** Rare. This species is found in very low frequencies in most samples assigned to the low diversity *Cribroelphidium*-dominant assemblage. Living population frequencies are always less than 4% and most are less than 1%. Total population frequencies are less than 1%. This species occurs in extremely low frequencies in a few samples in nearshore and shoal-influenced sediments.

**Ammobaculites exilis** Cushman and Bronnimann

Pl. 1, Fig. 10


**Distribution:** This form is locally common and characteristic of the effluents of major rivers in Southern British Honduras (Belize, Sittee). It was found in
total populations in nearly all samples assigned to the *Quinqueloculina-Cribroelphidium*-dominant marginal marine assemblage. It occurs abundantly in living and total populations of deltaic samples (e.g. 57, 161). It is not found in Northern British Honduras even at the mouth of the Rio Hondo. It is possible that a relatively high sedimentary rate and/or a notable influx of organic debris is necessary for an abundance of this species. This is consistent with its distribution elsewhere.

**Remarks:** This species is characterized by straight, nearly cylindrical to slightly compressed uniserial portion, nearly straight sutures, and moderate test size. *Ammotium salsum* (Cushman and Bronnimann) a compressed form with oblique sutures was counted separately then combined with this category for convenience.

*Ammobaculites* sp.

Pl. 1, Fig. 11

**Description:** Test moderate in size, slightly compressed; initial coil broadly rounded; chambers slightly inflated; sutures distinct; uniserial portion of test sub-rounded in cross-section only one or two uniserial chambers present; aperture terminal, rounded; wall composed of relatively coarse-grained carbonate debris, rare quartz grains and considerable cement.

**Distribution:** Rare. This species occurs in relatively few samples scattered throughout the Southern Shelf Lagoon. Living specimens were observed only in shoal-influenced lagoonal sediments; dead tests were encountered in samples from the carbonate platform, as well as the shelf lagoon.
Remarks: This form is the only species of *Ammobaculites* that was observed to utilize carbonate debris commonly in test construction. In form it is much like *A. exilis* though larger.

Several other calcareous, agglutinated species of *Ammobaculites* have been recorded. (*e.g.* *A. agglutinans* (d'Orbigny) and *A. calcareus* (Brady), but the British Honduras species resembles none of these forms.

*Ammoscalararia pseudospiralis* (Williamson)  
Pl. 1, Fig. 13


Remarks: This species is very rare in the study area and is limited to the Southern Shelf Lagoon. It has a highly compressed coarsely arenaceous test except for the elongate neck which is characteristically very fine-grained and white.

*Textularia agglutinans* d'Orbigny  
Pl. 1, Figs. 15a,b


Distribution: *T. agglutinans* is a common form in the high diversity Miliolid-dominant and *Cribroelphidium*-
Quinqueloculina-dominant mixed fauna assemblages. It occurs in most carbonate shoal and shoal-influenced samples including rare occurrences on the poorly developed nearshore carbonate shoals in the Port of Honduras area. Both living and total population frequencies range as high as 11% but are more commonly less than 5% of the respective faunal counts.

Remarks: This biserial, agglutinated form is distinguished by relatively large size and by the gradual increase in chamber size in the course of test development.

Textularia candeiana Cushman
Pl. 1, Figs. 16a,b


Distribution: The distribution of this species is largely concurrent with that of T. agglutinans though T. candeiana occurs in fewer samples and in generally lower frequencies. Living forms constitute less than 3% of the population in which they occur and total counts are less than 1% of the total population in most samples. The species is generally confined to carbonate shoal and shoal-influenced environments although rare, dead tests are found in scattered shelf lagoons and even nearshore samples.
Remarks: This species is characterized by flaring appearance resulting from rapid increase in size and inflation of chambers during test growth.

Textularia conica d'Orbigny

Pl. 1, Figs. 14a,b


Distribution: This species is very rare in the study area. It occurs in only three samples in the high diversity Miliolid-dominant assemblage on the carbonate platform and in scattered lagoonal samples in areas of shoal-sediment influence. Living population frequencies are less than 3% with most being less than 1%. Total population frequencies are all less than 1%.

Remarks: The forms encountered in this study are typically developed with rapid increase in chamber size and markedly flattened apertural face.

Textularia mayori Cushman

Pl. 2, Figs. 1a,b

Textularia mayori Cushman, 1922, Carnegie Inst. Washington, Publ. No. 311, p. 23, pl. 2, fig. 3.

Distribution: The distribution of this species is limited to six samples in shoal-influenced deeper water lagoon areas assigned to the Cribroelphidium-Quinqueloculina-dominant mixed fauna assemblage and the Cassidulina-
dominant assemblage. Frequencies of occurrence vary widely with living individuals comprising up to 7% of the counted populations and total counts comprising up to 11% of the total populations.

Remarks: This form is probably the same as *Spiroplectammina floridana* (Cushman) of numerous writers. Loeblich and Tappan (1964, p. C251) state, "*Spiroplectammina* differs from *Textularia* in having a distinct and well developed initial coil." Illustrations of the type species (Loeblich and Tappan, 1964, fig. 163,1) indicate that the initial coil comprises a considerable portion of the test. This is not the case in *Textularia mayori*. The initial coil in this species, when observable, comprises only the first few, small chambers. Moreover, Cushman (1948, p. 115) noted that the initial chambers of microspheric forms of *Textularia* commonly are planispirally coiled.

*Bigenerina irregularis* Phleger and Parker

Pl. 2, Fig. 2


Distribution: This species occurs living and dead in varying frequencies confined largely to shoal-influenced deeper water lagoonal areas. It is a constituent of the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage and the *Cassidulina*-dominant assemblage.
Cebulski (1961, p. 45, 51,) reported a *B. irregularis*-dominant living population in Eastern Channel, a shoal-sediment influenced deep water cut through the Barrier Platform. It appears that the highest percentage occurrences of this species both living (up to 23%) and total (up to 7%) are associated with lagoonal areas characterized by influx of shoal sediment. The species occurs in low frequencies in a few samples distributed elsewhere in the Southern Shelf Lagoon and a few extremely rare occurrences on the carbonate platform.

**Remarks:** This form demonstrates wide variability of size, shape and test material; however, no consistently differing features were evident to justify subdivision of the *Bigenerina* specimens.

**Haeuslerella hoeglundi** (Uchio)

Pl. 2, Fig. 3

**Textularia bigenerinoides** Hoglund (not Lacroix) 1947, Zool. Bidrag. fran Uppsala, v. 26, p. 181, pl. 13, fig. 6, text. fig. 159.


**Haeuslerella hoeglundi** (Uchio), Lankford, 1962, Unpubl. Ph.D. dissertation, Univ. of Calif., San Diego, p. 208, pl. 3, fig. 5.

**Distribution:** Rare. This species is found in living and total frequencies of less than 1% in samples scattered throughout the marine areas of the Southern British
Honduras Shelf Lagoon. It is extremely rare on the carbonate platform and is absent from the nearshore, marginal marine, and shallow lagoon environments.

**Remarks:** The test of this species is small and fragile and can easily be destroyed during sample preparation.

**Siphotextularia sp.**

Pl. 2, Figs. 4a,b

**Distribution:** This form was found in only one sample (№. 212)

It comprised 7% of the living population and less than 1% of the total population.

**Remarks:** This species is characterized by the obliquely angled, lipped, areal aperture, the size and shape of the test and the smoothly finished texture of the test wall.

**Trochammina advena** Cushman

Pl. 2, Figs. 5a,b,c


**Distribution:** This is the only widely distributed species of *Trochammina* encountered in the study. It is found in varying frequencies living and dead throughout the Southern British Honduras shelf. It is most common in living populations (up to 10% though generally much less) in the deeper lagoonal areas removed from shoal-sediment influence. Living forms were also observed throughout the Southern Shelf Lagoon, in nearshore
areas, and, very rarely, on the carbonate platform. It never comprised more than 1% of the total population in any sample.

*Trochammina inflata* (Montagu)

*Nautilus inflata* Montagu, 1808, Test. Brit., p. 81, pl. 18, fig. 3.

*Trochammina inflata* (Montagu), Carpenter, Parker and Jones, 1862, p. 141, pl. 11, fig. 5.

**Remarks:** This species was not encountered living in this study and was counted only as a 0.5% constituent of the total population of sample No. 103. It was also observed in non-quantitative samples from the saline mangrove marsh on the lee side of Ambergris Cay (No. 274) associated with *Tricholymulus aquavoi* and miliolids including *Pyrgo eburnea*.

*Arenoparrella mexicana* (Kornfeld) emend. Anderson

Pl. 2, Figs. 6a,b

*Trochammina inflata* (Montagu) var. *mexicana* Kornfeld, 1931, Cont. Dept. Geol. Stanford Univ., v. 1, p. 86, pl. 13, fig. 5a-c.

*Arenoparrella mexicana* (Kornfeld) emend. Andersen, Saunders, 1957, Smithsonian Inst., Misc. Coll., v. 134, no. 5, p. 12, pl. 4, fig. 5a-c.

**Distribution:** This species occurs in the total populations only of three quantified samples. These samples are associated with areas of deltaic sedimentation along
the mainland margin of Southern British Honduras. This species is abundant in several non-quantitative samples from low salinity marshes on the Belize River delta.

?Remaneica sp. cf. R. kelletae (Thalmann)

*Trochammina peruviana* Cushman and Kellett (not W. Berry, 1928) 1929, Proc. U. S. Nat. Mus., v. 75, art. 25, p. 4, pl. 1, fig. 8.


**Distribution:** This species displays a unique distribution.

It is most common in the *Archaias-Asterigerina* assemblage in samples scattered along the seaward edge of the sampling pattern on the barrier reef and in additional samples on the carbonate platform and shoals. It achieves living frequencies of up to 8% in those areas. Total population frequencies are only rarely greater than 1%. It is virtually absent from samples in the Southern Shelf Lagoon, but is found in a number of samples from nearshore areas of the Southern British Honduras mainland. It appears that this species is well adapted to wave and current agitated environments wherever such conditions occur (pp. 58-59). It is doubtful if many specimens of this species survive destruction after death due to the nature of test construction. It is rare in total populations and would be extremely rare in the geological record.
Remarks: The small, flattened test, relatively small proportion of agglutinated material compared to amount of organic cement, and the unique "zig-zag" trace of the ventral sutures distinguish this species. The test of this species is extremely fragile when dry. Further, the tests are distorted with drying; therefore none were illustrated in this study.

**Gaudryina compressa** Cushman

Pl. 2, Figs. 7a,b

*Gaudryina compressa* Cushman, 1935, Smithsonian Inst. Misc. Coll., v. 91, no. 21, p. 3, pl. 1, fig. 9.

Distribution: Rare. This species is encountered in only five samples on the Southern British Honduras shelf from carbonate shoal, deep, shoal-influenced lagoon, and near-shore areas. It was observed living only in sample No. 340 from Pelican Cay shoal in frequency of 0.3%. It comprised less than 1% of the total population in each of the five samples.

Remarks: This species of *Gaudryina* is characterized by the quadrate cross section of the later, biserial portion of the test and the large, projecting pairs of supplementary apertures on each chamber.

**Gaudryina exilis** Cushman and Bronnimann

Pl. 2, Fig. 8


Distribution: This species is widely distributed in low frequencies over the Southern British Honduras shelf. It occurs in a few samples on the carbonate platform and
shoals though very rarely living. It is found throughout the Southern Shelf Lagoon. It is most common in nearshore, river-influenced environments (e.g. sample Nos. 57, 201, 217) where living frequencies are locally as high as 11% and total frequencies as high as 16%. Throughout most of the area of occurrence, frequencies in both living and total populations do not exceed 1%.

**Remarks:** This species is characterized by the small, delicate test. The initial, triserial stage is extremely small and is commonly broken off.

_Eggerella advena_ (Cushman) emend. Loeblich and Tappan

Pl. 2, Figs. 9a,b,10a,b

Verneuilina advena Cushman, 1922, Contr. Canadian Biol.,
(1921), no. 9, p. 141.


**Distribution:** This is a common form in much of the Southern Shelf Lagoon, and is a characteristic faunal element in the low diversity _Cribroelphidium_-dominant assemblage. _E. advena_ is the dominant living species in one sample of the central, narrow portion of the Southern Shelf Lagoon (sample No. 288), frequency 18.5%) and contributes significantly to most Buliminella, Reophax and Fursenkoina-dominant living populations in this area in frequencies between 1% and 10%. It comprises up
to 3% of the total populations in these samples. It occurs in living and total frequencies of generally less than 1% in some nearshore samples and a few samples in the deeper portions of the southernmost portions of the shelf. This species is evidently one of a suite of Foraminifera that can adapt to lagoonal conditions that exclude most marine shelf forms.

Remarks: This form is characterized by its extremely small size, and the triserial chamber arrangement of all but the earliest portion of the test. It was originally counted as two separate categories, an obese form with highly inflated chambers (Pl. 2, Fig. 10a,b) and a thin, elongate form (Pl. 2, Fig. 9a,b). It was concluded that the two forms are probably distinct generations of the same species in that they occur in a relatively constant ratio and never occur separately.

Valvulina oviedoiana d'Orbigny

Pl. 2, Figs. 11a,b,12a,b


Distribution: This species is common in most shallow water carbonate shelf areas of British Honduras occurring in 31 samples. It was found living in the lower portions of Chetumal Bay, the more marine portions of the Northern Shelf Lagoon and throughout the normal marine
carbonate platform and shoal sediments of Southern British Honduras. It comprises up to 3% of the living population in lower Chetumal Bay (e.g. sample Nos. 12, 15, 38, 41). The highest living population frequency is 7% in sample No. 391 located in a Thalassia meadow in the narrow Outer Shelf Lagoon of Northern British Honduras. Throughout the rest of its area of occurrence it comprises less than 1% of the living population although it is commonly represented only in total populations. The species rarely comprises more than 1% of the total population and a maximum of 4% is encountered in sample No. 391.

Remarks: This form is characterized in general by the large size, the triserial chamber arrangement, and large tooth that almost completely fills the aperture. This species occurs in two distinct forms. As in the case of Eggerella advena, one is characterized by a broad test with inflated chambers that increase rapidly in size (Pl. 2, Figs. 11a,b); the other form has an extremely thin, "stem-like" early portion and only the final whorl of chambers is inflated (Pl. 2, Figs. 12a,b). These distinct forms have been considered to be distinct generations (Cushman, 1931; Lynts, 1965). Streeter (1963, p. 85) noted that forms found in the Outer Platform of the Bahama Banks "...tend to have more sharply angled chambers..." "while those of the inner part of the bank are more rounded." Such
is also the case in the British Honduras area. Chambers of specimens from lower Chetumal Bay tend to be rounded while those of the carbonate platform have a more angled or "fluted" appearance.

**Clavulina tricarinata** d'Orbigny

Pl. 2, Figs. 14a,b


**Distribution:** The distribution of this species is largely limited to the normal marine, shallow carbonate shelf areas of British Honduras. It is found in low frequencies in nearly all samples assigned to the high diversity Miliolid-dominant assemblage and in a few nearshoal lagoonal samples assigned to the *Cribroelphidium-Quinqueloculina* mixed fauna assemblage. Living population frequencies are rarely greater than 1% with a maximum of 4%. Total population frequencies are less than 1% in all samples.

**Clavulina nodosaria** d'Orbigny

Pl. 2, Figs. 13a,b


**Distribution:** This species exhibits a distribution pattern similar to *C. tricarinata* although *C. nodosaria* occurs in slightly fewer samples and in slightly lower
frequencies in both living and total populations. It is essentially confined to the area of occurrence of the high diversity Miliolid-dominant assemblage with rare specimens being found in the lagoonal sediments adjacent the carbonate shoals.

**Liebusella soldanii** (Jones and Parker)

Pl. 2, Figs. 15a,b


**Distribution:** Very rare. This species was encountered in only two samples (Nos. 148f, 213) in the deepest shelf areas. Living specimens occurred only in No. 148f comprising 0.6% of the living population. Total population frequencies are less than 1%.

**Cyclogyra planorbis** (Schultze)

Pl. 3, Figs. 1a,b

**Cornuspira planorbis** Schultze, 1854, Organismus Polythal., p. 40, pl. 2, fig. 21.

**Cyclogyra planorbis** (Schultz), Streeter, 1963, PhD dissertation, Columbia University, p. 87, pl. 1, fig. 15.

**Distribution:** This species is a widely distributed form occurring in all areas of the British Honduras shelf except Chetumal Bay and highly variable marginal marine environments. It is most common in the shallow
water marine carbonate shelf areas associated with the high diversity Miliolid-dominant assemblage. In this area it comprises up to 3% of the living and 1% of the total population. It occurs commonly in populations throughout the Southern Shelf Lagoon, including some nearshore areas, in all depths, in all sediment types and in all foraminiferal assemblages. In the Southern Shelf Lagoon it is commonly not found living or rarely in frequencies greater than 1% of the living population. The small, light discoidal test is undoubtedly transported with relative ease by current action.

Fischerina helix Heron-Allen and Earland
Pl. 3, Figs. 2a,b


Distribution: Rare. Species occurs in eight samples on the carbonate platform associated with the high diversity Miliolid-dominant assemblage. It was found living only in sample No. 317 with frequency of 0.5%. Total population frequencies are all less than 1%.

Remarks: This species is distinguished by its translucent test, trochoïd coiling and few number of chambers.

Wiesnerella auriculata (Egger)
Pl. 3, Fig. 3

Planispirina auriculata Egger, 1893, abh, Kon, bay, Akad.

Distribution: This species occurs in a few samples on the shallow-water marine carbonate platform. It is found living in 11 of 16 samples in which it occurs in this area associated with the high diversity Miliolid-dominant assemblage and Archaias-Asterigerina assemblage. Living frequencies vary from less than 1% to 4%; total frequencies vary up to 3%. Rare, dead tests of this species were found in two samples from shoal-sediment influenced lagoonal areas.

Spiroloculina andersoni Todd and Bronnimann
Pl. 3, Figs. 4a,b


Distribution: Species distributed in low frequencies in living and total populations of the carbonate platform and shoals and deeper, shoal-influenced portions of the Southern Shelf Lagoon. Frequencies of occurrence are less than 1% in all samples in both living and total populations. It is found only in the total populations in a few samples of nearshoal sediments from the narrow, restricted portion of the Southern Shelf Lagoon.

Remarks: The test of this species is somewhat irregular and compressed with sharply truncated chambers. This species and Spiroloculina guppy Todd and Bronnimann
are characterized by thin, translucent chamber walls; all other species of Spiroloculina have opaque tests. *S. anderseni* previously has been reported only from the Gulf of Paria. Specimens from British Honduras are identical to type material at the U. S. National Museum.

*Spiroloculina antillarum* d'Orbigny

Pl. 3, Figs. 5a,b


**Distribution:** This form is not common. Its distribution is largely limited to twelve samples scattered over the shallow carbonate platform as a constituent of the high diversity Miliolid-dominant assemblage. It was encountered living in only three of these samples in frequencies less than 1%. Total population frequencies range up to 1%. The species was also counted in total populations of a few nearshoal lagoonal samples.

*Spiroloculina attenuata* Cushman

Pl. 3, Figs. 6a,b

*Massilina inaequalis* Cushman, 1921, U. S. Nat. Mus. Proc., v. 59, no. 2360, p. 72, pl. 17, figs. 12,13.


**Distribution:** Rare. Species occurs in five samples on the Barrier Platform, one nearshoal lagoonal sample and
one mainland margin sample No. 199 associated with near-shore patch reef development. Living and total frequencies were always less than 1% of the respective populations.

Remarks: The specimens from British Honduras are identical to the type Massilina inaequalis specimens in the U. S. National Museum collection.

Spiroloculina caduca Cushman

Pl. 3, Figs. 7a,b

Spiroloculina caduca Cushman, 1922, Carnegie Inst. Washington, Publ. 311, p. 61, pl. 11, figs. 3,4.

Distribution: Rare. This species occurs in only three samples on the carbonate platform in extremely low frequencies of living and total populations. It occurs in 10 samples distributed throughout the deeper portion of the Southern Shelf Lagoon associated with the Cribroelphidium-Quinqueloculina-dominant mixed fauna and the high diversity Cribroelphidium-dominant assemblages. Living frequencies range up to 1%; total frequencies are less than 1%.

Spiroloculina communis Cushman and Todd

Pl. 3, Figs. 8a,b

Distribution: Very rare. This is the least common species of Spiroloculina identified in the study area. It was found living in only two of the nine samples in which it occurs. The occurrences were largely limited to nearshoal Southern British Honduras lagoonal sediments although it was found in two samples on the carbonate platform. Frequencies of both living and total counts were very low—all less than 1%.

Spiroloculina eximia Cushman
Pl. 3, Figs. 9a,b

Spiroloculina eximia Cushman, 1922, Carnegie Inst. Washington, Publ. 311, p. 61, pl. 11, fig. 2.

Distribution: Rare. Species occurs in low frequencies in six samples from the carbonate platform and nine lagoonal, nearshore samples. Living forms comprise less than 1% of the population in only two platform and one lagoonal sample. Total population frequencies were extremely low—all less than 1%.

Spiroloculina guppyi Todd and Bronnimann
Pl. 3, Figs. 10a,b


Distribution: Rare. Distribution very similar to that of S. anderseni. Occurrences are largely confined to samples scattered on the carbonate platform and shoals and in
the deeper portions of the Southern Shelf Lagoon. Frequencies of living and total populations range up to 1% of the respective populations.

Remarks: This species is distinguished by translucent shell wall, rounded chambers, and irregular ornamentation. Specimens identical to type material at the U. S. National Museum.

**Quinqueloculina angulata** (Williamson)

Pl. 3, Figs. 1la,b,c

**Miliolina bicorns** (Walker and Jacob), var. **angulata**


**Quinqueloculina bicorns** (Walker and Jacob), var. **angulata**

(Williamson), Cushman, 1929, U. S. Nat. Mus. Bull. 104, pl. 6, figs. 3, 4.

**Quinqueloculina angulata** (Williamson); Bermudez, 1963, Bol. Inst. Oceanog. Univ. Oriente, Cumana, p. 127, pl. 9, fig. 5.

Distribution: This is a common species occurring in most samples on the carbonate platform and shoals associated with the high diversity Miliolid-dominant assemblage. The frequency of occurrence of living individuals in this area is commonly less than 1% with a maximum of 4.8%. Total population frequency for this species is generally less than 3%. This species occurs in lower frequencies in both living and total sediments throughout the deeper portions of the Southern Shelf Lagoon.
It is not present in nearshore or marginal marine areas of Southern British Honduras nor in the Northern Shelf Lagoon and Chetumal Bay areas of Northern British Honduras.

Remarks: This species is distinguished by the angular, truncated chambers, relatively small size, and absence or small number of longitudinal costae. It tends to grade morphologically into a more densely costate form with rounded chambers herein assigned to Q. bicorns (Walker and Jacob). The end members are certainly distinct; it was thought that the discontinuity between the forms was constant and justified their separation. In other similar cases (e.g. Massilina protea Parker, Triloculina fitterei Acosta) a more complete gradation from smooth to costate tests was evident and the distinction of multiple varieties or species was abandoned.

**Quinqueloculina berthelotiana** d'Orbigny

Pl. 3, Figs. 12a,b,c


Distribution: This species was encountered in all samples assigned to the high diversity Miliolid-dominant assemblage. It occurred in living populations in frequencies up to 6% but generally less than 3%; in total populations it occurred in frequencies generally less
than 3%; in total populations it occurred in frequencies generally less than 2%. *Q. berthelotiana* was found in only ten nearshore lagoon samples and was counted in the living population only in sample No. 212.

**Remarks:** As noted by Streeter (1963) and others this is a highly variable form. As defined in this study the species probably includes *Q. granulocostata* Gemaraad as illustrated in Barker, 1960, pl. 6, figs. 15-20. Some specimens develop a finely granular texture and are differentiated from *Quinqueloculina bradyana* Cushman by the more slender test and generally more translucent shell wall.

*Quinqueloculina bicornis* (Walker and Jacob)

Pl. 4, Figs. 9a,b,c,10a,b,c


*Quinqueloculina bicornis* (Walker and Jacob), Cushman, 1929, U. S. Nat. Mus. Bull. 104, pt. 6, p. 32, pl. 5, figs. 5-7, pl. 6, figs. 1-2.

**Distribution:** This form is common throughout the carbonate platform and shoal areas of the British Honduras. In these areas it commonly comprises up to 3% of living populations and 5% of the total populations counted. It is present in the total populations of most nearshore sediment samples of the Southern Shelf Lagoon in frequencies less than 1% but is extremely rare in
corresponding living populations. It is encountered only rarely in samples scattered over the remainder of the study area.

Remarks: This species is variable but no consistent subdivisions of it were thought possible. It differs from *Q. poeyana* in its smaller size and shorter, broader form.

*Quinqueloculina bicostata* d'Orbigny

Pl. 3, Figs. 13a,b,c


Distribution: This species is distributed widely over the carbonate platform and the Southern Shelf Lagoon including nearshore areas of Southern British Honduras. The highest frequencies of both living and total *Q. bicostata* occur in the nearshore environments and the species is a diagnostic, if not dominant, constituent of the *Quinqueloculina-Cribroelphidium* mainland margin assemblage. In this area it comprises up to 6% of the living and up to 5% of the total populations. On the carbonate platform living forms of this species are rare comprising less than 1% of the populations, and it is extremely rare in total populations. *Q. bicostata* occurs in approximately 20 samples of lagoonal shoal-influenced sediments but was never encountered in living populations in that environment.
Quinqueloculina bidentata d'Orbigny

Pl. 4, Figs. la,b,c


Distribution: This species occurs in total populations of nearly all samples assigned to the high diversity Miliolid dominant assemblage. It is essentially restricted to normal marine shallow water areas on the carbonate platform and shoals. Frequencies of occurrence are low; the species is commonly absent from living populations or represents less than 1% of the living population and rarely occurs in frequencies greater than 1% of total populations. It occurs occasionally in nearshoal lagoon sediments.

Remarks: Agglutinated miliolid characterized by large size in adult, sharply truncated chambers in adult and large lipped aperture with single bifid tooth.

Juvenile forms of the large agglutinated Quinqueloculina species do not commonly have the distinctive specific characters of the adults. As a result specific assignment of juveniles is extremely difficult.
Quinqueloculina bosciana d'Orbigny

Pl. 4, Figs. 2a,b,c


Distribution: Common. This species is distributed throughout the British Honduras Shelf area. It occurs in total populations in nearly all samples from the carbonate platform and shoals, most samples from the Northern and Southern Shelf lagoons, including nearshore environments, and in a few samples from Chetumal Bay. The frequency of Q. bosciana in total population ranges up to 3% with most samples containing less than 1%. The highest frequencies are associated with the high diversity Miliolid-dominant and Cribroelphidium-Quinqueloculina-dominant mixed fauna assemblages and the lowest are in the low diversity Miliolid-dominant assemblage.

Living specimens were encountered commonly in frequencies up to 3% on the carbonate platform and shoals. Extremely rare living individuals were encountered in lagoonal sediments adjacent the shoals and no living Q. bosciana were encountered in the remainder of the Southern Shelf Lagoon, nearshore areas or Chetumal Bay.

Remarks: This species of Quinqueloculina is smooth, elongate and compressed. It is characterized by a flared, apertural lip.
Quinqueloculina bradyana Cushman
Pl. 4, Figs. 3a,b,c

Miliolina undosa Brady (not Quinqueloculina undosa Karrer),
Quinqueloculina bradyana Cushman, 1917, U. S. Nat. Mus.
Bull. 71, pt. 6, p. 52, pl. 18, fig. 2.
Dentostomina bradyana (Cushman), Streeter, 1963, Unpub.
Ph. D. dissertation, p. 90, pl. 1, fig. 20.
Distribution: The distribution of Q. bradyana is very similar
to that of Q. bidentata though the former occurs in
slightly fewer samples. Q. bradyana is essentially
restricted to the high diversity Miliolid-dominant
assemblage occurring in both living and total popula-
tions in frequencies less than 1% of the respective pop-
ulations. Agglutinated miliolid is distinguished from
other species of Dentostomina by the smaller size, fine-
grained wall texture and sinuous, truncated chamber
development.

Quinqueloculina candieana d'Orbigny
Pl. 4, Figs. 4a,b,c,5a,b,c
Quinqueloculina candieana d'Orbigny, 1839, in De la Sagra,
Distribution: Common. This species is distributed widely
over the normal marine portion of the British Honduras
shelf. It is not found in Chetumal Bay. On the car-
bonate platform it is commonly found living in the
poorly sorted sediments and areas of marine grass cover
and is a persistent faunal element in the high diver-
sity Miliolid-dominant assemblage. It is also a common
constituent of nearshoal lagoonal sediment populations
and is present in low frequencies throughout most of the Southern Shelf Lagoon. It is rarely found in living or total populations in agitated environments. The highest frequencies in living populations are associated with the *Cribroelphidium-Quinqueloculina* mixed fauna assemblage with a maximum of 6%. In most samples frequencies of living *Q. candieana* are less than 1%. Similarly most total population frequencies are under 1% although they range as high as 3%. The species was encountered in total population counts of some nearshore lagoon samples but was never observed to live in marginal marine conditions.

*Quinqueloculina columnosa* Cushman

Pl. 4, Figs. 6a,b,c


*Quinqueloculina columnosa* Cushman, 1922, Carnegie Inst. Washington, Publ. 311, p. 65, pl. 10, fig. 10.

**Distribution**: Rare. Species distribution is limited to seven carbonate platform and shoal samples and one nearshoal lagoonal sample; it is essentially restricted to the high diversity *Miliolid*-dominant assemblage. Living specimens were encountered in only three shallow platform samples in frequencies less than 0.3%. Total population frequencies range up to 0.7%.
Remarks: This species is distinguished by the compressed test with irregularly shaped, sinuous, keeled chambers and narrow, elongate, cylindrical neck. Larger specimens of this species tend to develop a granular wall texture.

**Quinqueloculina compta** Cushman

Pl. 4, Figs. 7a,b,c,8a,b,c

*Quinqueloculina compta* Cushman, 1947, Cushman Lab. Foram. Res., v. 23, pt. 4, p. 87, pl. 19, fig. 2.

**Distribution:** *Q. compta* is widely distributed over most of the British Honduras shelf with the exception of the Chetumal Bay area. It occurs in most samples assigned to the high diversity Miliolid-dominant assemblage on the carbonate platform in living and total frequencies of less than 1% of the respective populations; it is generally excluded from high wave and current action reef environments. The species is a common constituent of total populations in most lagoonal samples in frequencies less than 1% but is extremely rare in the living populations. The highest frequencies of both living and total population occurrence of *Q. compta* are in a few samples in the terrigenous sediments marginal to mainland Southern British Honduras. For example, the frequency of living populations in sample Nos. 87, 167, and 214 is 8.3%, 10.2% and 5.9%, respectively. Total population frequencies are less with a maximum of 7.9% in sample No. 87. The species is a diagnostic faunal
element in the *Quinqueloculina-Cribroelphidium* nearshore assemblage.

**Remarks:** This species exhibits varying degrees of size and of wall texture. Characteristically, the inner portions of the chamber walls are translucent, while more distal portions are thickened and commonly agglutinated. A smaller, more slender form with relatively thin chamber walls was encountered throughout the carbonate platform and most of the shelf lagoon. A larger, more robust, more coarsely granular form was typical of the shallow, nearshore occurrence of the species in the *Quinqueloculina-Cribroelphidium* assemblage. These forms perhaps represent ecotypic variants of *Q. compta*.

*Quinqueloculina exsulcpta* Heron-Allen and Earland

Pl. 5, Figs. 1a,b,c


**Distribution:** Rare. This species occurs in very low frequencies in both living and total populations of a few samples from the carbonate platform and near shoal lagoonal sediments. In no case did frequencies exceed 1% of the counted population.

**Remarks:** This species is characterized by its small size, smooth wall and crescent-shaped transverse cross-section of individual chambers. It was originally described by Heron-Allen and Earland from reef material from the
Kerimba Archipelago and to the writer's knowledge it has not previously been recorded in West Indian foraminiferal faunas.

**Quinqueloculina funafutiensis** (Chapman)

*Pl. 5, Figs. 2a,b,c*


**Quinqueloculina funafutiensis** (Chapman), Cushman, 1922,

*Carnegie Inst. Washington, Publ. 311, p. 67, pl. 13,*

**fig. 3.**

**Distribution:** Rare. **Q. funafutiensis** occurs in very few samples scattered over the Southern British Honduras shelf. It occurs in living and total populations in the carbonate platform area in frequencies less than 1%, only in total populations in very low frequencies in the Southern Shelf Lagoon, and in a few nearshore samples associated with the **Quinqueloculina-Cribroelphidium** assemblage. In one such sample (No. 144f) **Q. funafutiensis** comprises 13% of the living population.

**Remarks:** This species is similar to **Q. lamarckiana** d'Orbigny and is commonly associated with it. **Q. lamarckiana** is not costate.

**Quinqueloculina laevigata** d'Orbigny

*Pl. 5, Figs. 3a,b,c*


p. 301, no. 6.
Distribution: *Q. laevigata* is one of the most common and most widespread forms in the sediments of the British Honduras area; it is present in all except 24 of the quantified samples. It is most common in samples of the high diversity Miliolid-dominant assemblage and a few nearshore samples of the *Quinqueloculina-Cribroelphidium* assemblage. It is least common in the low diversity *Cribroelphidium*-dominant assemblage in the central portion of the Southern Shelf Lagoon being present in less than half of those samples. It is a persistent element throughout most of the shelf lagoon of Northern British Honduras and Chetumal Bay.

The species evidently has few environmental limitations though it seems to thrive best in shallow, somewhat turbulent environments in a variety of hydrographic and sedimentary regimes and is generally excluded only from the more restricted areas of the Southern Shelf Lagoon. The species commonly attains living population frequencies of 3-5% with a maximum of 10% in the carbonate platform area of British Honduras; total population frequencies are generally 2-3%. Lower frequencies are the rule throughout most of the remainder of the distribution area of *Q. laevigata*. The lowest frequencies---less than 1% of the total population and no living representatives---occur in the Southern Shelf Lagoon associated with the low diversity *Cribroelphidium*-dominant assemblage.
Q. lamarckiana d'Orbigny

Pl. 5, Figs. 4a,b,c


**Distribution:** This species is widely distributed over all the study area with the exception of Chetumal Bay. It is a common form throughout the carbonate platform and shoal areas with living and total population frequencies up to 3%. Frequencies in the nearshoal lagoon sediments are variable in both living and total populations. It occurs in very low frequencies of total populations elsewhere in Southern Shelf Lagoon sediments and is only rarely encountered living. Frequencies are variable in living and total populations of the nearshore sediments of Southern British Honduras with a maximum living frequency of 7% in sample No.167. This species is one of the few *Quinqueloculina* species that occurs in and is characteristic of samples of the *Quinqueloculina-Cribroelphidium* dominant assemblage of the nearshore area.

*Quinqueloculina poeyana* d'Orbigny

Pl. 5, Figs. 5a,b,c


**Distribution:** This species is a characteristic element of the high diversity Miliolid-dominant assemblage and is
found only occasionally in samples outside the area of occurrence of the assemblage. Within the distribution of that assemblage *Q. poeyana* prefers areas stabilized by marine grass to areas characterized by effective wave and current agitation and little sediment accumulation. Frequencies average 2-3% in living populations and 1% in total populations throughout most of its distribution. It is extremely rare in the Southern Shelf Lagoon. *Q. poeyana* occurs in a number of samples in low frequencies in lower Chetumal Bay.

**Quinqueloculina polygonal** d'Orbigny

Pl. 5, Figs. 6a,b,c


**Distribution:** This species is essentially limited to the carbonate platform and shoal areas associated with the high diversity Miliolid-dominant assemblage. It occurs in low frequencies in living and total populations rarely accounting for more than 1% of either population count. It is virtually absent from all other areas including near shoal lagoon sediments.

**Remarks:** This species differs from *Q. berthelotiana* in the more regular form of the chambers, more opaque test wall and more diminutive carinae.
_Quinqueloculina sabulosa_ Cushman

Pl. 5, Figs. 7a,b,c


**Distribution:** This species is very common throughout the carbonate platform and shoals comprising 1-3% of the living populations and less than 1% of the total populations in the high diversity Miliolid-dominant assemblage. It is present in the total populations of most nearshoal lagoonal samples, a few lagoonal samples removed from shoal influence and some nearshore Southern British Honduras samples, but it is rarely seen living in these areas. It is not present in Chetumal Bay.

**Remarks:** This species is characterized by the relatively coarse texture of agglutinated particles coating the outside of the test. It is distinguished from juveniles of other agglutinated _Quinqueloculina_ species by the narrow, spindle-shaped test.

_Quinqueloculina seminulum_ (Linne)

Pl. 5, Figs. 8a,b,c,9,10

_Serpula seminulum_ Linne, 1753, Syst. Nat. 10th Ed., p. 786.


**Distribution:** Rare. _Q. seminulum_ was not encountered in living populations in this study. It occurred in low frequencies (less than 1%) in the total populations of nearshore Southern British Honduras and Southern Shelf Lagoon samples.
Remarks: Abnormal specimens of *Q. seminulum* which added vermicular chambers at the aperture of otherwise normal tests were noted in sample No. 296 very close to the effluent of the Sithee River. The occurrence and causes of such forms have been discussed by Arnal (1955).

**Quinqueloculina tricarinata** d'Orbigny

Pl. 5, Figs. 11a,b,c


Distribution: This species is confined to the carbonate platform and shoal areas in which it occurs in only fifteen samples. It rarely comprises more than 1% of the living or total populations. The species occurs in a wide variety of carbonate sediment types including both coarse sands and fine skeletal muds.

Remarks: Juvenile forms of this large-sized species were never positively identified. It is possible that such forms were assigned to either *Q. berthelotiana* or *Q. bradyana* or perhaps even *Q. columnosa*.

Hofker (1964) assigns this species to the genus *Miliola*. For detailed discussion of the taxonomic problems involved the reader is referred to that paper.

**Quinqueloculina wiesneri** Parr

Pl. 6, Figs. 1a,b,c


Distribution: This species is widespread though generally in low frequencies. It occurs most commonly in living and total populations of the high diversity Meliolid-dominant assemblage comprising 1-2% of the living and 1% of the total populations. It is generally excluded from the Southern Shelf Lagoon except in areas of shoal influence. It also occurs in total population of samples scattered along the margin of Southern British Honduras mainland and in upper Chetumal Bay, near the effluent of the Rio Hondo.

Remarks: This species is distinguished by the relatively small size, and finely granular texture of calcareous grains coating the chamber walls. Parker, Phleger and Peirson (1953) found this to be most abundant in marsh and beach samples of the San Antonio Bay area and only rarely from the open gulf. This species is not common in level bottom communities; but it can tolerate a variety of hydrographic regimes.

Quinqueloculina sp. A
Pl. 6, Figs. 2a,b,c

Remarks: This species is one of several small, smooth milio- lids in the study area that have not been identified through available collections and literature. It is possible that these have not been described before, particularly those from restricted environments. For the purpose of this report these forms are given letter designations; they include Q. sp. A, Q. sp. B, Triloculina sp. A and T. sp. B.
Q. sp. A is very rare but it is distinctive and requires mention. It is much like *Triloculina gracilis* in form. It is elongate, narrow, rounded and smooth with an elongate neck, flaring lip and round aperture. But it is several times larger than *T. gracilis* and it is quinqueloculine. No large populations were encountered so the variability is unknown. Also it is very rare and thus ecologically insignificant; therefore, it is not described as new nor treated in detail.

**Quinqueloculina** sp. B

*Pl. 6, Figs. 3a,b,c*

**Distribution:** Very common. This species is widespread, occurring throughout the study area and often in relatively high frequencies of both living and total populations. This species is most common in the carbonate platform and shoal areas associated with the high diversity Miliolid-dominant assemblage. It occurs in a wide variety of platform environments in variable frequencies, ranging from zero or less than 1% to 21% of the living population and from less than 1% to 31% of the total population. The maxima encountered in this area are only rarely approached throughout the remainder of the study area. The species is common in lower Chetumal Bay, and most of the Southern Shelf Lagoon except the area of the low diversity *Cribroroelphidium*-dominant assemblage, in which it occurs only rarely even in total populations.
Remarks: This quinqueloculine species is characterized by the very slender, elongate, rounded test, smooth chamber wall and absence of neck.

Streeter, 1963, described a species from the Bahama Banks which is probably conspecific with Q. sp. B of this study. He named it Q. orbignyana Streeter, but it is as yet unpublished. Miss Ruth Todd (personal communication) noted a marked similarity of Q. sp. B to Triloculina oblonga (Montagu); however, Q. sp. B is quinqueloculine.

*Dentostomina bermudezi* Perez Farfante

Pl. 6, Figs. 4a,b,5a,b


Distribution: Rare. This species was counted in living populations in only two samples from the carbonate platform and shoal area. The species is present in low frequencies of total populations (less than 1%) in eighteen samples scattered over the study area mostly from the platform and shoals and the shoal-influenced lagoonal sediments. It is not present in Chetumal Bay. It is present in total populations of small nearshore carbonate shoals in Gulf of Honduras.

Remarks: None of the agglutinated, quinqueloculine forms studied for this report possess the denticular structures characteristic of *Dentostomina* as described by Carman (1933, p. 31) or Loeblich and Tappan (1964,
p. 0458). As a result all except ?D. bermudezi are referred to *Quinqueloculina*. Perez Farfante's illustrations of *D. bermudezi* show a slightly crenulate aperture. Equally important they show a *Massilina*-like chamber arrangement. The British Honduras forms show little tendency to develop a crenulate aperture but in wall texture and chamber arrangement they are identical to the illustrations of *D. bermudezi*. The writer did not have the opportunity to compare the British Honduras specimens with type material.

**Massilina protea** Parker
Pl. 6, Figs. 6a,b,c


**Distribution:** This species is a characteristic element of the low diversity Miliolid-dominant assemblage and is common throughout Chetumal Bay and the Northern Shelf Lagoon. It is present in low frequencies in some samples of the high diversity Miliolid-dominant assemblage scattered throughout the shallow, normal marine environments of the carbonate platform and shoals. *M. protea* is essentially absent from the Southern Shelf Lagoon and the nearshore environments of Southern British Honduras. In Northern British Honduras this species comprises up to 16% of the living population with most counts approximately 5%; the species comprises
approximately 2% of the total populations. In the carbonate platform area living specimens are absent from most samples and the species never comprises more than 1% of either living or total populations.

Remarks: This small miliolid distinguished by irregular chamber arrangement, longitudinal, irregular costae and lipped aperture is highly variable in chamber arrangement, form and ornamentation. Figure 13 illustrates the range of variation included in the writer's concept of *M. protea*.

*Pyrgo comata* (Brady)

Pl. 6, Figs. 7a,b


*Pyrgo comata* (Brady); Cushman, U. S. Nat. Mus. Bull. 104, pt. 6, p. 73, pl. 19, fig. 8.

Distribution: Very rare. This species was not seen in any living population counts. It occurred in frequencies less than 1% of the total population in three Southern Shelf Lagoon samples.

*Pyrgo denticulata* (Brady)

Pl. 6, Figs. 8a,b

Pyrgo denticulata (Brady); Cushman, 1929, U. S. Nat. Mus. Bull. 104, pt. 6, p. 69, pl. 18, figs. 3, 4.

**Distribution:** Rare. The distribution of *Pyrgo denticulata* is much like that of other species of *Pyrgo* in this study. It occurs in total populations in three samples on the carbonate platform. Living specimens occur in very low frequencies in samples from the deeper portion of the Southern Shelf Lagoon.

?Pyrgo eburnea (d'Orbigny)

Pl. 6, Figs. 9a,b,c


Biloculina eburnea (d'Orbigny); Low in Cloud, 1962, U. S. Geol. Surv. Prof. Paper 350, p. 34, 35, Table 12.

**Distribution:** This species was counted in only one sample (44) in upper Chetumal Bay. However, it is also present in unquantified mangrove marsh samples from the lee side of Ambergris Cay.

**Remarks:** This species is distinctive and is characterized by relatively large size, biloculine chamber arrangement and large elongate tooth that fills the aperture.

Specimens identical to those seen in British Honduras have been seen in samples collected by J. P. Hobson and R. T. Terriere from the mangrove marsh on the West side of Andros Island, Bahama Banks. Similarly British Honduras material is identical to
specimens identified as *Biloculina eburnea* by Doris Low (personal communication) in her study of Bahamian material. Streeter, 1963, did not describe forms of this type from the Bahama Banks. He identified small forms, herein considered to be *Triloculina bermudezi* Acosta, as *Triloculina eburnea* d'Orbigny. None of his material was seen in the course of this study nor is type material available.

The generic assignment is open to question. Biloculine genera are generally distinguished on the basis of tooth structure (flap = *Biloculinella*, simple bifid = *Pyrgo*) after Loeblich and Tappan, 1964. *Biloculina* is a junior synonym of *Pyrgo*. On this basis no genus adequately accommodates the species in question. This form is variable, particularly among larger specimens. Especially large forms develop folds and angularity of the chamber walls.

*Pyrgo nasutus* Cushman

Pl. 7, Figs. 1a,b


**Distribution:** Rare. *P. nasutus* was counted in only six samples in the study area. All of these are in the deeper, southern portions of the Southern Shelf Lagoon. Living specimens were encountered in only three samples (Nos. 157, 148f, 171a). The species occurs in frequencies
less than 1% of living and total populations in which it is found.

Pyrgo sp. cf. P. subsphaerica (d'Orbigny)
Pl. 7, Figs. 2a,b,c


Pyrgo subsphaerica (d'Orbigny); Cushman, 1929, U. S. Nat. Mus. Bull. 104, pt. 6, p. 68, pl. 18, figs. 1, 2.

Distribution: Rare. This species occurs in total populations (less than 1%) in seven stations on the carbonate platform, but was not seen living in that area. Living forms were encountered only in the southern portion of Southern Shelf Lagoon in the deepest portions of the shelf in frequencies less than 1%.

Remarks: This species resembles P. subsphaerica in size and lack of ornamentation, but the chambers of the former are more highly inflated. Too few specimens were observed to establish positive identification.

Pyrgo triloculina Wiesner
Pl. 7, Figs. 3a,b,c

Biloculina elongata d'Orbigny var triloculina Wiesner, 1923, Die miliolideon der ostlichen Adria, p. 87, pl. 17, fig. 249.
Distribution: Rare. This species occurs in low frequencies in only six samples in the Southern Shelf Lagoon including two samples in the shallow nearshore zone of terrigenous sediments. Living specimens were counted only in sample No. 145f.

Remarks: Although only a small number of individuals of this species were counted, it is evident that the forms present represent a unique, distinct entity and is therefore given species status.

*Triloculina bermudezi* Acosta

Pl. 7, Figs. 4a,b,c


Distribution: Very common. This species is distributed throughout the study area in varying frequencies. It is most abundant in Chetumal Bay and the Northern Shelf Lagoon and is characteristic of the low diversity Miliolid-dominant assemblage. In this assemblage *T. bermudezi* commonly comprises over 5% of the living populations with a maximum of 32%. Frequencies of total populations are commonly over 10% with a maximum of 38%.

*T. bermudezi* is present in most samples of the carbonate platform and shoal area. It commonly comprises 4% or more of the total population with a maximum of 8%. It is commonly absent from living populations and only rarely comprises more than 1% of the living
populations. This species is present in low frequencies in samples distributed throughout the Southern Shelf Lagoon.

**Remarks:** This triloculine species is distinguished by small, smooth rounded test and compressed, elongate aperture with slightly flared rim, and large tooth. It is variable in length-width ratio and development of neck and apertural lip.

Although comparative material was not studied, it seems likely that *T. bermudezi* as defined in this study is probably conspecific with *T. eburnea* as used by Streeter, 1963 and perhaps *Triloculina oblongoides* Hofker, 1964.

**Triloculina bicarinata** d'Orbigny

Pl. 7, Figs. 5a,b,c


**Distribution:** This species is largely confined to the carbonate platform and shoal area associated with the high diversity miliolid-dominant assemblage. The species was rarely seen living; it never occurred in frequencies greater than 1% of living population nor greater than 3% of the total populations.
**Triloculina fitterei** Acosta

Pl. 7, Figs. 6a,b,c,7,8,9

*Triloculina fitterei* Acosta, 1940, Torreia, Havana, Cuba, no. 3, p. 25, pl. 4, figs. 6-8.

**Distribution:** This species is distributed throughout the study area. It is common in all well documented foraminiferal assemblages except the low diversity *Cribroelphidium*-dominant assemblage in which it occurs in only two samples. *T. fitterei* is slightly more common in Chetumal Bay and the Northern Shelf Lagoon associated with the low diversity Miliolid-dominant assemblage than elsewhere. In this area *T. fitterei* occurs in frequencies of less than 1% of the living and approximately 1% of the total population. Elsewhere in the study area it occurs commonly but in very low frequencies--always less than 1% of both living and total populations.

**Remarks:** *T. fitterei* as defined in this study includes a plexus of forms including those that might be identified as *T. fitterei* var. *meningozi* Acosta. The species varies in length-width ratio and in number, coarseness, and regularity of costae. Rare forms that are very similar to *Triloculina littoralis* Collins from Great Barrier Reef material (1958, p. 369, pl. 3, fig. 12a-c) were also included in this category.
**Triloculina gracilis** d'Orbigny
Pl. 7, Figs. 10a,b,c


**Distribution:** Rare. This species occurs in only six samples in the study area from the carbonate platform and shoals and nearshore lagoonal sediments in Southern British Honduras. Living specimens were counted only in sample No. 124f. Living and total population frequencies are all less than 1%.

**Triloculina linneiana** d'Orbigny
Pl. 8, Figs. 1a,b,c


**Distribution:** This species is essentially restricted to the carbonate platform and shoal areas associated with the high diversity Miliolid-dominant assemblage. It occurs in most samples assigned to this assemblage; frequencies in living populations are less than 1% and in total populations are less than 2%. This species is counted in total populations of a few lagoonal stations in shoal-influenced sediments.
Triloculina planciana d'Orbigny
Pl. 8, Figs. 2a,b,c


Distribution: This species is widely distributed throughout areas of shallow water carbonate sediment deposition. It is counted in some samples from lower Chetumal Bay in the low diversity Miliolid-dominant assemblage and in most samples of the high diversity Miliolid-dominant assemblage. It is more commonly associated with carbonate mud sediments than with mud-free carbonate sands on the carbonate platform and shoals. T. planciana only occasionally comprises more than 1% of either living or total foraminiferal populations. It is counted in total populations of a few nearshoal sediment samples.

Remarks: This species is characterized by the numerous short, fine longitudinal striations on the chamber walls.

Triloculina quadrilateralis d'Orbigny
Pl. 8, Figs. 3a,b,c


Distribution: Common. This species is effectively restricted to the shallow water, normal marine carbonate platform
and shoal areas, occurring in nearly all samples assigned to the high diversity Miliolid-dominant assemblage. Frequencies of occurrence are variable. *T. quadrilateralis* occasionally comprises up to 6% of the living populations; most samples contain less than 2%. Total population frequencies range up to 8% with most samples containing less than 3%. Rare dead specimens were counted in nearshoal lagoon sediments and two nearshore lagoon samples.

**Triloculina rotunda** d'Orbigny

Pl. 8, Figs. 4a,b,c


**Distribution:** *T. rotunda* is found in relatively few samples largely confined to the more protected portions of the carbonate platform. It is generally associated with carbonate mud sediments. It occurs in low frequencies always less than 1% of both living and total populations. It was counted in living populations in a few samples of the nearshoal lagoon sediments in the *Oribroelphidium-Quinqueloculina* mixed fauna assemblage.

**Triloculina tortuosa** Cushman

Pl. 8, Figs. 5a,b,c


Distribution: Rare. This species was not counted in living populations in this study. It occurred in frequencies less than 1% in 12 samples scattered over the carbonate platform and adjacent lagoonal areas.

Remarks: This agglutinated miliolid is characterized by small size and indistinct chamber arrangement.

Triloculina transversestriata (Brady)
Pl. 8, Figs. 6a,b,c

Miliolina transversestriata Brady, 1881, Jour. Micr. Sci., v. 21, p. 45.

Triloculina transversestriata (Brady); Cushman, U. S. Nat. Mus. Bull. 104, pt. 6, p. 62, pl. 16, fig. 3.

Distribution: Rare. This species occurs in low frequencies in only ten samples, eight of which are in the high diversity Miliolid-dominant assemblage. It is found in both living and total populations in frequencies less than 1%.

Triloculina tricarinata d'Orbigny


Distribution: Rare. This species occurs in low frequencies of total populations of six samples, five of which occur in the Cribroelphidium-Quinqueloculina mixed fauna assemblage in shoal-influenced lagoonal sediments. Living specimens occurred in only one of these samples.
Triloculina trigonula (Lamarck)
Pl. 8, Figs. 7a,b,c
Miliolites trigonula Lamarck, Ann. Mus., v. 5, p. 351, no. 3.
Triloculina trigonula (Lamarck); Cushman, U. S. Nat. Mus.
Bull. 104, pt. 6, p. 56, pl. 12, figs. 10, 11, pl. 13,
figs. 1,2.
Distribution: T. trigonula occurs in 35 samples distributed
over the carbonate platform and shoal area and the near-
shoal lagoon. Living specimens were counted only in
samples assigned to the high diversity Miliolid-dominant
assemblage. Frequency of occurrence throughout the area
of distribution never exceed 1% of either the living or
total populations.

Triloculina sp. A
Pl. 8, Figs. 8a,b,c
Distribution: This species is distributed widely in the
study area; however, it is most common in Chetumal Bay
and the Northern Shelf Lagoon and is a characteristic
species of the low diversity Miliolid-dominant assem-
blage. It occurs in most samples assigned to this
assemblage; living forms are never common, comprising
up to 1% of the population. Frequencies in the total
populations are as high as 9%, but generally do not
exceed 2%. The species is present in low frequencies
in living and total populations in a few carbonate
platform samples. It is also present in many lagoonal
samples, but only in total populations. The tests of this small form are evidently subject to rather extensive post-mortem transport.

**Remarks:** This triloculine species is distinguished from other forms by the small size, elongate test, smooth chamber walls and characteristic angled truncation of the aperture giving the aperture a "hooded" appearance. The rounded aperture contains a single simple tooth.

*Triloculina* sp. B

Pl. 8, Figs. 9a,b,c

**Distribution:** The distribution of this species is similar to that of *T.* sp. A though *T.* sp. B is less common. It is a persistent element in the low diversity Miliolid-dominant assemblage and is present in many samples of the high diversity Miliolid-dominant assemblage. It occurs in low frequencies in near shoal lagoon sediments and in a few nearshore lagoon samples. In the low diversity Miliolid-dominant assemblage total population frequencies never exceed 1%. Throughout the rest of its distribution in the study area *T.* sp. B does not exceed 1% of either living or total populations.

**Remarks:** This triloculine species is small, smooth, and elongate; chambers are rounded. The species is characterized by the narrow elongate aperture that is nearly filled by a large tooth that is raised considerably above the apertural rim.
This species does not resemble any miliolid examined by the writer. It resembles drawings of *T. elongata* d'Orbigny, 1826, figured by Fornasini (1905) R. Acad. Sci. Est. Vologna, Mem. Sci. Nat., ser. 6, pl. 61, pl. 1, fig. 11 and *T. patagonica* (Wiesner). It differs from *T. bermudezi* in the more elongate, cylindrical form of *T. sp. B*.

*Miliolinella californica* Rhumbler

Pl. 9, Figs. 1a,b,c

*Triloculina circularis* Bornemann; Cushman and Valentine, 1930, Contr. Dept. Geol. Stanford Univ., v. 1, p. 15, pl. 4, fig. 4a-c.

*Miliolinella californica* Rhumbler, 1936, Kiel Meeresf., Kiel, Deutschland, Bd. 1, Heft 1, p. 215.

**Distribution:** Very common. This species is distributed throughout the study area with the exception of samples assigned to the low diversity *Cribroelphidium*-dominant assemblage. The highest frequencies of this species in both living and total populations occur in the low diversity Miliolid-dominant assemblage in which *M. californica* comprises up to 10% of the living and 8% of the total populations. This species occurs in low frequencies (less than 1%) in living and total populations in nearly all samples of the high diversity Miliolid-dominant assemblage. Rare living specimens are encountered in a few nearshore Southern British Honduras lagoon samples and most nearshoal lagoon.
samples. In lagoonal areas not markedly influenced
by shoal debris influx this species is absent or pre-
sent only in total populations.

**Miliolinella dilatata** (d'Orbigny)

Pl. 9, Figs. 2a,b,c

**Quinqueloculina dilatata** d'Orbigny, 1839, *in* De la Sagra,
v. 8, p. 11, figs. 28-30.

**Distribution:** Common. This species is present in most
assemblages but is most common in and characteristic of
the high diversity Miliolid-dominant assemblage. In
this assemblage it generally comprises 2% or less of
the total population and less than 1% of the living
populations. It is a commonly occurring form in lower
frequencies in the adjacent *Cribroelphidium-
Quinqueloculina*-dominant mixed fauna assemblage. It
occurs in low frequencies in a few samples in the low
diversity Miliolid-dominant and high diversity
*Cribroelphidium*-dominant assemblages and is absent
from the low diversity *Cribroelphidium*-dominant
assemblage.

**Remarks:** As defined in this study *M. dilata* encompasses a
rather broad spectrum of variability. Some of this
variability is illustrated in text Figure 14.

Specimens in the U. S. National Museum collections
identified as *Quinqueloculina dilatata* are identical to
some of the forms included in this species; however, it
probably also includes many forms identified in the literature as *M. labiosa* (d'Orbigny) (e.g. Hofker, 1964; Anderson, 1961; Barker, 1960). It is probably also conspecific with *Pseudomassilina dilatata* (d'Orbigny) of Bandy, 1964.

**Miliolinella fichtelliana** (d'Orbigny)

Pl. 9, Figs. 3a, b, c


*Miliolinella fichtelliana* (d'Orbigny); Drooger and Kaaschleiter, 1958, Rept. Orinoco Shelf Exped., v. 4, p. 54, pl. 3, fig. 6.

**Distribution:** *M. fichtelliana* is essentially restricted to the carbonate shoal and platform areas and the near-shoal lagoonal areas influenced by shoal derived sediments. It occurs in nearly all samples of the high diversity Miliolid-dominant assemblage in very low frequencies. It is rarely counted in living populations and never comprises more than 1% of total populations.

**Miliolinella oblonga** (Montagu)

Pl. 9, Figs. 4a, b, c


**Distribution:** Very common. This species is widespread in the study area and is essentially excluded only from the low diversity *Cribroelphidium*-dominant assemblage. Its distribution closely parallels that of *M. californica*. The highest frequencies in living and total populations occur in the low diversity Miliolid-dominant assemblage in which the species comprises up to 14% of the living and 10% of the total populations. However, frequencies in this assemblage are highly variable. The species occurs in most samples of the high diversity Miliolid-dominant assemblage in consistently low frequencies rarely exceeding 1% of the living or 2% of the total populations. Throughout the Southern Shelf Lagoon this species occurs in very low frequencies and is rarely found living.

*Ammomassilina alveoliniformis* (Millett)

Pl. 9, Figs. 5a,b


**Distribution:** Very rare. This species occurs in only one quantified sample (No. 82). Living and dead forms are present in very low frequencies.
Hauerina bradyi Cushman
Pl. 9, Figs. 6a,b

Hauerina compressa d'Orbigny, Brady, 1884, Rept. Voy.
"Challenger", Zool., v. 9, p. 190, pl. 11, figs. 12,13.


Distribution: H. bradyi is a common constituent of the high diversity Miliolid-dominant assemblage. In this assemblage it occurs in frequencies of less than 1% of both living and total populations of most samples. It is only rarely found, however, in mud-free samples of current-swept areas of the carbonate platform.

H. bradyi also occurs in low frequencies in total populations in nearshoal lagoonal sediments.

Remarks: This species is distinguished by the highly compressed, unornamented test.

Hauerina occidentalis Cushman
Pl. 9, Figs. 7a,b


Distribution: The distribution of this species is similar to that of H. bradyi except that H. occidentalis occurs in fewer samples and in even lower frequencies. Living specimens were counted in only four samples of the high diversity Miliolid-dominant assemblage.
Remarks: This species of Hauerina is distinguished by quinqueloculine early development, compressed, planispiral later chambers, strong transverse crenulations and superimposed, regular longitudinal costae.

Hauerina speciosa (Karrer)
Pl. 9, Fig. 8a,b


Distribution: Very rare. This species was counted in total populations in seven samples in this study. No living specimens were seen. The samples are confined to the carbonate platform and nearshoal lagoonal areas. Frequencies of occurrence were less than 0.5% of the total populations.

Remarks: This species of Hauerina is identified by the relatively small size, strongly compressed planispiral test, thin translucent shell and transverse crenulations of the chamber walls.

Heterillina cribrostoma Heron-Allen and Earland
Pl. 9, Figs. 9a,b,10a,b,c

**Distribution:** Very common. This is one of the most abundant and commonly occurring species in the study area. It is most abundant in and characteristic of the low diversity Miliolid-dominant assemblage. Throughout the Northern Shelf Lagoon and Chetumal Bay it occurs in variable but often very high frequencies of both living and total populations. The range of living population frequencies is 0 to 66% and it is greater than 10% in over half the samples. Total population frequencies range from less than 1% to greater than 70%. Samples in upper Chetumal Bay commonly contain over 30% *H. cribrostoma* while most of the rest contain at least 10%.

This species occurs in low frequencies (generally less than 2%) in total populations of nearly all samples of the high diversity Miliolid-dominant assemblage; associated living forms are rare.

*H. cribrostoma* is uncommon even in total populations throughout the remainder of the study area.

**Remarks:** This species is characterized by irregular chamber arrangement, small size, smooth polished test wall and low, arched, cribrate aperture. As defined in this study it is highly variable in form. It varies from compressed attaching forms with one side strongly flattened to nearly spherical forms characterized by rounded chambers. Rarely the cell pattern of *Thalassia* leaves is visibly impressed on the flattened surface of compressed forms—evidence of an attaching habitat.
All gradations between flattened and rounded forms are present including many forms with faceted chambers.

O. L. Bandy kindly examined a suite of these forms and he decided that the flattened forms were a species of *Hauerina* while the more rounded forms were *Heterillina cribrostoma* (Heron-Allen and Earland). It is thought that the variability observed is phenotypic and that perhaps the shape of the test is related to the site upon which young settle and develop. Therefore, all variants are considered to be *H. cribrostoma*.

This species is probably conspecific with the form described by Streeter, 1963, as *?Triloculinella bahamensis* from the Bahama Banks. The ecology of the forms in British Honduras and the Bahama Banks is very similar. Areas of maximum occurrence are characterized by restricted hydrography, fine-grained lime mud deposition and extremely shallow water.

B. W. Logan (personal communication) found a form he referred to *Triloculina cribrostoma* to be abundant in an extensive hypersaline area of Shark Bay, Australia. He noted that it is variable in form and has a cribrate aperture. In that area the species was part of a low diversity fauna containing peneroplids.

*Triloculina funalis* (Brady)

Pl. 9, Fig. 11

*Articulina funalis* Brady, 1884, Rept. Voy. "Challenger", Zool., v. 9, p. 185, pl. 13, figs. 6-11.
Tubinella funalis (Brady), Cushman, 1929, U. S. Nat. Mus.
Bull. 104, pt. 6, p. 54, pl. 12, fig. 8.

Distribution: Rare. This species occurs in total populations of seven samples from the carbonate platform and nearshoal lagoon. Only one sample contained living specimens. Frequencies of both living and total populations are less than 1%.

Articulina cassis (d'Orbigny)
Pl. 9, Figs. 12a,b

Vertebralisina cassis d'Orbigny, 1839, in De la Sagra, Hist.


Distribution: This species is largely restricted to the high diversity Miliolid-dominant assemblage. In the area of occurrence of this assemblage A. cassis occurs in living population frequencies of less than 1% and total population frequencies of less than 2%. It is found living in eight of the 16 samples in which it occurs in this assemblage.

It is very rare in nearshoal lagoon sediments.

Remarks: This species of Articulina is distinguished by broad, compressed test, regular, coarse longitudinal costae and flaring recurved apertural lip much wider than the chamber of which it is a part.
Articulina lineata Brady

Pl. 10, Figs. 1a,b


Distribution: This species is largely restricted to the high diversity Miliolid-dominant assemblage. It occurs in most samples of this assemblage comprising less than 2% of the total populations. Living specimens, always in frequencies of less than 1% of the population, occur in less than 25% of the samples in which this species is found.

A. lineata is a rare form in lagoonal sediments adjacent the carbonate platform and shoals.

Remarks: This species is characterized by compressed test with chambers of uniserial portion enlarging at slow rate, longitudinal costae and thin jagged keel of clear shell material.

Articulina mayori Cushman

Pl. 10, Figs. 2,3

Articulina mayori Cushman, 1922, Carneigie Inst. Washington Publ. 311, p. 71, pl. 13, fig. 5.

Distribution: Rare. This species occurs in only nine samples. One sample is on the carbonate platform but most are in the Southern Shelf Lagoon associated with the high diversity Cribroelphidium-dominant assemblage. All occurrences of living forms are in the latter
association. Population frequencies of both living and total are less than 1%.

Remarks: This species is characterized by slender, smooth tubular uniserial portion of test and lipped aperture. Two distinct forms of this species are evident based on early chamber development. One has a large proloculus and tubular second chamber, the other a quinqueloculine early stage. They were not distinguished in the counting.

Articulina sagra d'Orbigny

Pl. 10, Figs. 4,5


Distribution: This is the most commonly occurring species of Articulina in the study area. It is present throughout the carbonate platform and shoal areas and is common in most nearshoal lagoon sediment samples and some samples in the Southern Shelf Lagoon removed from shoal sediment influx. It is most abundant in the high diversity Miliolid-dominant assemblage in which it comprises up to 2% of the total and 1% of the living populations.

Remarks: As in A. mayorii two distinct forms are present based on early test development. This species is distinguished from A. mayorii by presence of relatively coarse longitudinal costae.
Peneroplis bradyi Cushman
Pl. 10, Figs. 6a,b


Distribution: This species is essentially restricted to the high diversity Miliolid-dominant assemblage; however, it is not found in the current-swept, mud-free sediment areas of the carbonate shoals and platform. It occurs in low frequencies, generally less than 1% of the total population and less than 2% of the living populations. It also occurs in low frequencies in total populations of shoal-influenced lagoonal sediments.

Remarks: This species of Peneroplis is distinguished from others by relatively small size, compressed test, thin test walls, general lack of internal divisions of chambers and presence of very fine pits on the external surface. For exhaustive treatment of the taxonomy of peneroplids in general the reader is referred to: Cole, 1965; and Hofker, 1950-53, 1964.

Peneroplis pertusus (Forskal)
Pl. 10, Figs. 7a,b

Nautilus pertusus Forskal, 1775, Descr. Anim., p. 125, no. 65.
Peneroplis pertusus (Forskal); Cushman, 1930, U. S. Nat. Mus. Bull. 104, pt. 7, p. 35, pl. 12, figs. 3-6.
Distribution: This species is found throughout the area of occurrence of the high diversity Miolid-dominant assemblage. It occurs in frequencies of less than 1% of both living and total populations of nearly all samples assigned to that assemblage. It is also present in very low total population frequencies in samples of the nearshore lagoon.

Remarks: As used in this study this species of *Peneroplis* is distinguished by involute, coiled test and external ornamentation in the form of costae developed parallel to the test perimeter.

*Peneroplis proteus* d'Orbigny

Pl. 10, Figs. 8a,b


Distribution: The distribution of *P. proteus* is very similar to that of *P. pertusus*. It is most common in the high diversity Miolid-dominant assemblage occurring in most samples of that assemblage in frequencies up to 2% of both total and living populations. In the *Cribroelphidium-Quinqueloculina* mixed fauna assemblage it comprises less than 1% of the total populations and is extremely rare in living populations.
Remarks: The taxonomy of this species has been the subject of considerable discussion. As used herein this species is characterized by relatively large size, variability of test form, absence of external ornamentation, and lack of chamber subdivisions at least in the early stages.

*Monalysidium politum* Chapman

Pl. 10, Fig. 9


*Peneroplis* (*Monalysidium polita*) Chapman, 1900, Jour. Linn. Soc. London, Zool., v. 28, p. 4, pl. 1, fig. 5.


Distribution: This species occurs in low frequencies in 20 samples of which most are part of the high diversity Miliolid-dominant assemblage. Frequencies in both living and total populations are less than 1%; living forms actually occur in a small fraction of the samples. Rare specimens of *M. politum* are encountered in lagoonal sediments adjacent carbonate shoals.

*Spirolina acicularis* (Batsch)

Pl. 10, Fig. 10

*Nautilus* (*Lituus*) *acicularis* Batsch, 1791, Conch. Seesandes, p. 4, pl. 6, figs. 16a,b.

**Distribution:** Rare. This species is found in only 14 samples from stations on the carbonate platform and shoals and in nearshoal lagoon sediments. Living forms were counted in only four populations all in the high diversity Miliolid-dominant assemblage. Frequencies of occurrence are always less than 1% of both living and total populations.

**Spiroloina arietinus** (Batsch)

*Nautilus* (Lituus) *arietinus* Batsch (pars), 1791, Conch.

Seesandes, p. 4, pl. 6, fig. 15c.

**Spiroloina arietinus** (Batsch); Cushman, 1930, U. S. Nat. Mus. Bull. 104, pt. 7, p. 43, pl. 15, figs. 4,5.

**Distribution:** Rare. This species occurs in 11 samples. It is most commonly associated with the high diversity Miliolid-dominant assemblage although rare dead specimens are encountered in the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage. Frequencies of occurrence in both living and total populations are always less than 1%.

**Remarks:** This peneroplid species develops an uncoiled uniserial stage. It differs from *Spiroloina acicularis* in the much larger size of the initial coil and shorter uniserial stage.
**Archaias angulatus** (Fichtell and Moll)

Pl. 10, Figs. 11a,b,12a,b


**Archaias angulatus** (Fichtell and Moll); Cushman, 1930, *U. S. Nat. Mus. Bull. 104*, p. 46, pl. 16, figs. 1-3, pl. 17, figs. 3-5.


**Distribution:** Most aspects of the distribution of this species have been discussed previously. This species occurs in extreme abundance as a lag deposit in areas of wave and current action. It is the dominant species in total populations of most samples on the seaward edge of the barrier platform (*Archaias-Asterigerina*-dominant assemblage) and in the shallow current swept areas of Chetumal Bay (*Archaias-Miliolid*-dominant assemblage). It is the dominant species in some of the organic muds of Ambergris Cay as a result of primary production.

In the high diversity Miliolid-dominant assemblage *A. angulatus* is common, occurring in most samples. However, frequencies are low particularly in living populations. In the low diversity Miliolid-dominant living
population frequencies are also low. The total population frequencies, however, are variable. Local
increase in frequencies in total populations is doubtless the result of local, perhaps short-term, winnowing of the carbonate muds in the shallow area of Chetumal Bay. Beaches surrounding newly formed mangrove cays in this area are composed largely of
Archaias tests.

**Remarks:** In the British Honduras material *A. angulatus* is distinguished by the variability of external form, lack of obvious external ornamentation and presence of chambers separated into numerous chamberlets.

The taxonomy of this species has been treated at length by Cole, 1965, Hofker, 1950-53, 1964, Henson, 1950, and Smout and Eames, 1958. The classification used herein generally follows that of Cole, 1965, modified where necessary because of the dependence on external characters for population study in this report.

As defined in this study *A. archaias* includes the form *Cyclorbiculina compressa* (d'Orbigny) as described by Smout and Eames, 1958, and Loeblich and Tappan, 1964. This form was very rare in the collections from British Honduras. It is of interest that it was found living abundantly in the branching crown of a *Penicilus* plant and a single living specimen was imbedded in the stalk of the same plant (sample No. 359).
**Marginopora vertebralis** Quoy and Gaimard

Pl. 10, Figs. 13a,b


*Marginopora vertebralis* Quoy and Gaimard; Cole, U. S. Geol. Survey, Prof. Paper 260-C, p. 383, 583, pl. 210, figs. 10-13, pl. 211, figs. 3-29.

**Distribution:** This species is a common constituent of the high diversity Miliolid-dominant assemblage. It occurs in most samples of this assemblage in both living and total populations. Frequencies are low; the species comprises less than 1% of the living and less than 3% of the total population except for one station at which it accounts for 5% of the total population. The species is present in low frequencies of the total populations in nearshoal lagoonal sediments, and in a few samples from shoals and marine grass meadows near the mainland shore in Southern British Honduras.

**Remarks:** As in the taxonomy of most peneroplids in this study, the writer has followed the detailed analysis by Cole, 1965, and assigned this species to *Marginopora vertebralis*. This species is variable in shape and is well adapted to an attached habitat. The writer has observed that specimens of this species are somewhat flexible when wet, making it suitable for life on a marine grass blade waving in shallow water.
Sorites marginalis (Lamarck)
Pl. 10, Figs. 14a,b


Distribution: Rare. This species was found in very few samples. It was not present in the sediments of the carbonate platform and shoals but was found in low frequencies in the Cribroelphidium-Quinqueloculina-dominant mixed fauna assemblage. Both living and total population frequencies of this species are less than 1%.

Borelis pulchra (d'Orbigny)
Pl. 10, Fig. 15


Borelis pulchra (d'Orbigny); Cushman, 1930, U. S. Nat. Mus. Bull. 104, pt. 7, p. 55, pl. 15, figs. 9, 10.

Distribution: Very rare. This species is counted in only seven samples all in the high diversity Miliolid-dominant assemblage. Living specimens were observed at three stations. Frequencies of occurrences are always less than 1% of living and total populations.
**Buliminella elegantissima** (d'Orbigny)

Pl. 10, Fig. 16

*Buliminella elegantissima* (d'Orbigny); Phleger, 1951, Geol. Soc. Amer. Mem. 46, pt. 1, p. 7, pl. 8, figs. 3, 4.

**Distribution:** This species is common throughout much of the study area. It is most common in the northern portion of the low diversity *Cribroelphidium*-dominant assemblage. In this assemblage it occurs in frequencies of up to 6% of the total population although in most samples it comprises less than 2%. In the living populations, however, frequencies over 10% occurred in almost half the samples with a maximum of 45%, and in several samples *B. elegantissima* was the dominant living species.

This species occurs commonly in low frequencies in lower Chetumal Bay, throughout the carbonate platform and shoals, and the nearshoal lagoon areas. It occurs in high frequencies in several living populations of the *Quinqueloculina-Cribroelphidium*-dominant nearshore assemblage.

The significance of the living *B. elegantissima* distribution of the Southern Shelf Lagoon and its distribution in other shelf areas have been discussed previously.
**Buliminella milleti** Cushman

Pl. 10, Fig. 17


**Distribution**: The distribution of this species is limited to the carbonate platform and shoals and the adjacent lagoonal sediments. This species is most commonly a constituent of the high diversity Miliolid-dominant assemblage occurring in low frequencies—generally less than 1% of both living and total populations. Frequencies in the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage are lower in the total populations and living specimens are rare.

**Remarks**: This is distinguished from *B. elegantissima* by the tapered form and inflated chambers of *B. milleti* as opposed to the cylindrical shape of *B. elegantissima*.

**Sagrina pulchella** d'Orbigny

Pl. 11, Figs. 1a,b


**Distribution**: This species is widely distributed in the study area. It is most common in portions of the Southern Shelf Lagoon and least common in Chetumal Bay and the Northern Shelf Lagoon. In the northern area of
the low diversity *Cribroelphidium*-dominant assemblage this species comprises up to 9% of the total population with most samples containing about 6% *S. pulchella*. Frequencies in the living population in this area are variable ranging from 0 to 20%.

*S. pulchella* is common throughout the barrier platform and carbonate shoals in living population frequencies less than 1% and total population frequencies less than 3%. Frequencies are slightly higher in the lagoonal sediments associated with the near shoal mixed fauna assemblage and the high diversity *Cribroelphidium*-dominant assemblage. Low frequencies are encountered in the Gulf of Honduras area and the species is absent from Chetumal Bay and the Northern Shelf Lagoon.

**Remarks:** This species is identified by the small triserial early portion, biserial, compressed later portion, and coarse longitudinal costae. It varies markedly in size, but no distributional or ecologic significance can be attached to this variation from this study.

The generic assignment of this species follows the resurrection of *Sagrina* from synonomy by Loeblich and Tappan, 1964, for species with early triserial and later biserial stages of chamber development.

*Brizalina lowmani* (Phleger and Parker)

Pl. 11, Fig. 2

**Distribution**: *B. lowmani* is distributed throughout the Southern Shelf Lagoon, Barrier Platform and carbonate shoals. Highest frequencies of living *B. lowmani* occur in some populations of the *Quinqueloculina-Cribroelphidium* nearshore assemblage and most samples in the high diversity Miliolid-dominant assemblage. In these assemblages living population frequencies range up to 3%. Corresponding total population frequencies are less than 1%. Throughout the remainder of the Southern Shelf Lagoon the species occurs commonly in total populations in frequencies less than 1% but is rarely seen living.

**Remarks**: The generic assignment of this and other species follows the splitting of "*Bolivina*" by Loeblich and Tappan, 1964. Species formerly assigned to *Bolivina* that do not have retral processes or backward projecting chamber overlaps are herein assigned to *Brizalina*. This includes all of the "*Bolivina*" species noted in this study.

**Brizalina pacifica** (Cushman and McCulloch)

*Pl. 11, Fig. 3*

*Bolivina acerosa* Cushman var. *pacifica* Cushman and McCulloch, 1942, South. Calif. Publ., Allan Hancock Pacif. Exped., v. 6, no. 4, p. 185.

*Bolivina pacifica* Cushman and McCulloch; Uchio, Cushman

*Found. Spec. Publ. No. 5, pl. 7, fig. 2.*

**Distribution**: This species is present in a variety of foraminiferal assemblages. It occurs in low frequencies
in total populations throughout the Southern Shelf Lagoon and the Barrier Platform and carbonate shoals. It is not present in Chetumal Bay, Northern Shelf Lagoon or marginal marine areas. Living specimens are encountered in several samples of the high diversity Miliolid-dominant assemblage in frequencies up to 6% and rarely in the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage and the high diversity *Cribroelphidium*-dominant assemblage.

**Remarks:** Species of *Brizalina* identified by slender, compressed test with clear, imperforate area at inner, upper portion of each chamber.

*Brizalina paula* (Cushman and Cahill)

Pl. 11, Fig. 4

*Bolivina paula* Cushman and Cahill, 1932, in Cushman and Ponton, 1932, *Florida Geol. Surv. Bull.* No. 9, p. 84, pl. 12, fig. 6.

**Distribution:** This species occurs in relatively few samples. It is most common in the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage. It comprises as much as 6% of the living populations in these assemblages but rarely accounts for more than 1% of the total population.

*B. paula* is present in low frequencies of both living and total populations of a few samples of the high diversity Miliolid-dominant assemblage.
Remarks: This species is characterized by smooth compressed test, ovate outline and strongly recurved sutures.

Brizalina spinescens (Cushman)
Pl. 11, Fig. 5


Distribution: Rare. This species occurs in low frequencies in only eight samples. The samples are scattered throughout the Southern Shelf Lagoon and the Barrier Platform. This species was not seen in Chetumal Bay or the Northern Shelf Lagoon.

Remarks: This species of Brizalina is identified by the long, tapered, compressed test, slightly inflated chambers, and clear, imperforate areas on the inner, upper portion of each chamber.

Brizalina striatula (Cushman)
Pl. 11, Figs. 6,7

Bolivina striatula Cushman, 1922, Carnegie Inst. Publ. 311, p. 27, pl. 3, fig. 10.

Distribution: The distribution of this species is similar to that of B. lowmani except that B. striatula is more abundant. Highest frequencies of living B. striatula occur in portions of the nearshore Quinqueloculina-Cribroelphidium-dominant assemblage and throughout the high diversity Miliolid-dominant assemblage.
Frequencies in the latter occurrence are generally less than 3% with a maximum of 10%. In the former area living population frequencies average 6%. Total population frequencies rarely exceed 2% in either assemblage. Throughout the remainder of the Southern Shelf Lagoon this species occurs commonly in total populations (frequencies less than 1%) and rarely in living populations (frequencies less than 2%).

**Remarks:** This species of *Brizalina* characterized by tapered, compressed test and longitudinal costae in early stages exhibits considerable variability of test size.

*Brizalina torqueata* (Cushman and McCulloch)

Pl. 11, Fig. 8


**Distribution:** Similar to previous *Brizalina* species, *B. torqueata* occurs most commonly in the shallow water areas of the carbonate platform and portions of the Southern British Honduras mainland margin. It is less common elsewhere in the Southern Shelf Lagoon and absent from Chetumal Bay and the Northern Shelf Lagoon. In the high diversity Miliolid-dominant assemblage *B. torqueata* commonly comprises up to 2% of both the living and total populations. Similar frequencies are encountered in samples of the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage. Lower
frequencies persist in total populations throughout most of the Southern Shelf Lagoon and living specimens are rare.

Remarks: This species is distinguished by strongly tapered test, compressed, rhomboid cross-section and irregular, bead-like external ornamentation.

*Brizalina variablis* (Williamson)

Pl. 11, Fig. 9

*Tenuaria variablis* Williamson, 1858, Ray Society, London, p. 76, pl. 6, figs. 162, 183.


**Distribution:** This species is one of the less common *Brizalina* species. It is found in low frequencies in both living and total populations in a few samples from the Barrier Platform and the Southern Shelf Lagoon. It is a constituent of the low diversity *Cribroelphidium*-dominant assemblage, the high diversity *Miliolid*-dominant assemblage and the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage. Living population frequencies commonly attain 3%, but total population frequencies rarely exceed 1%.

Remarks: This species of *Brizalina* is differentiated from others by the compressed test, straight sutures, lack of external ornamentation and presence of coarse perforations in test wall.
**Bolivinita rhomboidalis** (Millett)

Pl. 11, Figs. 10a,b

**Textularia rhomboidalis** Millett, 1899, p. 559, pl. 7, fig. 4.


**Distribution:** This species is essentially confined to the carbonate platform and shoals associated with the high diversity Miliolid-dominant assemblage. It comprises up to 3% of the living and 2% of the total populations in the samples in which it occurs. It also occurs in total populations of some nearshoal lagoon sediment samples.

**Rectobolivina advena** (Cushman)

Pl. 11, Fig. 11

**Siphogenerina advena** Cushman, 1922, Carnegie Inst. Washington, Publ. 311, p. 35, pl. 5, fig. 2.

**Bifarina decorata** Phleger and Parker, 1951, Geol. Soc. Amer., Mem. 46, pt. 2, p. 12, pl. 6, figs. 9a, b.


**Distribution:** This species is essentially restricted to the Southern Shelf Lagoon. It occurs in nearly all samples of the low diversity *Cribroelphidium*-dominant assemblage and many samples of the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage. In
these assemblages it occurs in living populations of about one-third of the samples. It comprises less than 1% of the living populations and 2% of the total populations in these occurrences.

*R. advena* also occurs in the total populations of a few samples scattered over the carbonate platform and the remainder of the Southern Shelf Lagoon.

**Rectobilivina raphanus** (Parker and Jones)

Pl. 11, Fig. 12

_Uvigerina (Sagrina) raphanus_ Parker and Jones, 1865, Philos. Trans., v. 155, p. 364, pl. 18, figs. 16, 17.

_Siphogenerina raphanus_ (Parker and Jones); Cushman, 1923,


**Distribution**: This species was not common in this study area. It was found in variable frequencies in living and total populations in a variety of nearshore areas including carbonate shoals in Port of Honduras and the delta of the Sittee River. *R. raphanus* was also found in very low frequencies in a few samples on the carbonate platform and in the adjacent nearshoal lagoonal sediments.

**Remarks**: The generic assignment of this species follows the discussion by Loeblieh and Tappan (1964, p. 0570-0571).
Bulimina marginata d'Orbigny

Pl. 11, Fig. 13


Distribution: This species is sparsely distributed over much of the study area associated with a variety of foraminiferal assemblages. It always occurs in low frequencies. It comprises up to 1% of both the living and total populations in many samples of the high diversity Miliolid-dominant assemblage and the northern portion of the low diversity Criboelphidium-dominant assemblage. Throughout the remainder of the Southern Shelf Lagoon it occurs in a few samples with living specimens occurring only rarely.

Bulimina tenuis Phleger and Parker

Pl. 11, Fig. 14


Distribution: Rare. This species occurs in only 11 samples in the study area all in the Southern Shelf Lagoon. Living specimens are rare occurring in only four samples associated with the high diversity Criboelphidium-dominant assemblage. Frequencies of both living and total populations do not exceed 1%.

Pavonina atlantica Cushman

Pl. 11, Fig. 15

Distribution: Very rare. This species occurs in only five samples. Two occurrences and the only living specimens are in the high diversity Miliolid-dominant assemblage. The remainder are in the deeper portions of the Southern Shelf Lagoon. Frequencies are extremely low.

**Chrysalidinella dimorpha** (Brady)

Pl. 11, Fig. 16


Distribution: Very rare. This species occurs in very low frequencies in only five samples from nearshore sediments, Southern Shelf Lagoon, and the Barrier Platform. No living forms were observed.

Remarks: On cursory examination this species resembles *Reussella* in being triangular in cross-section, but *C. dimorpha* exhibits a uniserial later stage of chamber development, and the aperture is cribrate.

**Reussella atlantica** Cushman

Pl. 11, Fig. 17


*Reussella atlantica* Cushman; Phleger and Parker, 1951, Geol. Soc. Amer., Mem. 46, p. 18, pl. 8, figs. 8, 9.
Distribution: This species is extremely widespread throughout the Southern Shelf Lagoon. It is rare on the Barrier Platform, and it is absent from the Northern Shelf Lagoon and Chetumal Bay. This species occurs in living and total populations of most samples of the low diversity *Cribroelphidium*-dominant assemblage with the exception of those occurring in water less than five fathoms deep, the high diversity *Cribroelphidium*-dominant, the *Cassidulina*-dominant, and the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage. The highest living population frequencies, greater than 10%, occur in the low diversity *Cribroelphidium*-dominant assemblage. High total population frequencies are also common in this assemblage, but the maximum for the species (11%) occurs in the high diversity *Cribroelphidium*-dominant assemblage.

*Hopkinsina pacifica* Cushman

Pl. 11, Fig. 18

*Hopkinsina pacifica* Cushman, 1933, *Contr. Cushman Lab. Foram. Res.*, v. 9, pt. 4, p. 86, pl. 8, fig. 16.

Distribution: Rare. *H. pacifica* occurs in only 11 samples in low frequencies. All samples are from the Southern Shelf Lagoon. Living specimens occur in only six samples. Frequencies of both living and total populations are less than 1%.

*Trifarina bella* (Phleger and Parker)

Pl. 11, Figs. 19, 20

*Angulogerina bella* Phleger and Parker, 1951, *Geol. Soc. Amer.*, Mem. 46, pt. 2, p. 12, pl. 6, figs. 7, 8.
Distribution: This species is common throughout most of the Southern Shelf Lagoon and the Barrier Platform. It is most common in the high diversity Cribroelphidium-dominant and the Cassidulina-dominant assemblages in the deeper portions of the lagoon and throughout the high diversity Miliolid-dominant assemblage on the Barrier Platform and carbonate shoals. Also, it is one of the most common living species in the Archaias-Asterigerina-dominant assemblage along the margin of the barrier reef. This species commonly attains living population frequencies up to 10% in the high diversity Miliolid-dominant assemblage with total population frequencies rarely exceeding 3%. In the shelf lagoon living population frequencies range up to 7% in the deepest portions of the shelf with frequencies of less than 1% more common throughout most of the lagoon.

Remarks: As defined in this study, this species varies in size and angularity of chambers. In general, smaller, more angular forms (Pl. 11, Fig. 19) are present in the Southern Shelf Lagoon while larger, more rounded forms (Pl. 11, Fig. 20) are present on the Barrier Platform.

**Discorbis sp. cf. D. australis** Parr
Pl. 11, Figs. 21a,b,c

**Discorbis valvulata** Brady (non Rosalina valvulata d'Orbigny), 1884, Rept. Voy., "Challenger", Zool., v. 9, p. 644, pl. 37, figs. 5-7.

**Distribution:** This species exhibits a unique distribution in the living populations. Very high frequencies of this species occur in living populations of lower Chetumal Bay. This species clearly dominates these populations with frequencies between 40 and 75%. Corresponding total populations are relatively low, ranging up to 10% in the counted samples. It occurs in lower frequencies in living and total populations throughout the area of occurrence of the low diversity Miliolid-dominant assemblage.

Also, this species is distributed sparsely over the Barrier Platform and adjacent lagoonal areas of Southern British Honduras in very low frequencies.

**Remarks:** This species of Discorbis is distinguished by small, biconvex test, coarsely perforate, peaked dorsal side, dark brown color, white ventral portion of ultimate chamber and apertural slit extending into ventral face of chamber. The reference of this species to **D. australis** was suggested by O. L. Bandy (personal communication). It is probably conspecific with a very similar form described from the Inner Bank area of the Bahama Banks by Streeter, 1963, as **Discorbis bahamensis** sp. nov. although comparative material has not been examined.
**Discorbis mira** Cushman

Pl. 11, Figs. 22a,b,c

**Discorbis mira** Cushman, 1922, Carnegie Inst. Washington, Publ. 311, v. 17, p. 39, pl. 6, figs. 10,11.

**Distribution:** This species is widely distributed in the high diversity Miliolid-dominant assemblage. Living population frequencies range up to 4%; total population frequencies are generally less than 2%, although occasional samples contain up to 6% *D. mira*.

Living population frequencies of this species range up to 3% in the *Quinqueloculina-Cribroelphidium*-dominant nearshore assemblage.

*D. mira* also occurs commonly in low frequencies of total populations throughout most of the Southern Shelf Lagoon although it is essentially excluded from the low diversity *Cribroelphidium*-dominant assemblage.

**Discorbis reniformis** (Heron-Allen and Earland)

Pl. 12, Figs. 2a,b


**Distribution:** This species was noted in nine samples in the high diversity Miliolid-dominant assemblage. It was observed in living populations of seven of these samples. Frequencies do not exceed 1% of either living or total populations.
Remarks: This species is distinguished by vague sutures, thick test wall and rounded, almost globular test form. *D. reniformis* was originally described from the Kerimba Archeipelago (East Africa). A single specimen reported by Streeter, 1963, is the only recorded West Indian occurrence prior to this study.

**Discorbis rosea** (d'Orbigny)

Pl. 12, Figs. 1a,b,c


*Rotorbina rosea* (d'Orbigny); Bandy, 1944, *Jour. Paleo.*, v. 18, p. 372.

**Distribution:** This species occurs in only eight samples in the high diversity Miliolid-dominant and *Arohaia-Asterigerina*-dominant assemblages. It is invariably associated with coarse sediment accumulating in agitated, current-swept areas. Living populations occur in four samples in frequencies up to 3%. Total population frequencies do not exceed 1%.

Remarks: This species is a conspicuous element in reef sands in many Caribbean areas. It is characterized by thick test wall ornamented by short, stout protuberances and by pinkish pigmentation of the test wall. Bandy, 1964, reported that this species (*Rotorbina rosea*) was characteristic of the outer edge of the barrier reef of the Gulf of Batabano associated with *Amphistegina* and *Asterigerina*. In
British Honduras this species demonstrates a similar
distribution but is not a common faunal element and
never approaches being the dominant species.

**Rosalina bulbosa** (Parker)

Pl. 13, Figs. 3a,b,c

Bull., v. 111, no. 10, p. 523.

**Distribution:** This species is found in the total populations
of most samples in the Southern Shelf Lagoon. It is
excluded from assemblages on the Barrier Platform, car-
bonate shoals, and all of Northern British Honduras.
It is found living, however, in only seven of the 41
samples in which it occurs. It is uncommon in samples
from depths of less than five fathoms.

**Remarks:** This is a small species with greatly inflated
chambers and an open umbilicus. It is identical to
the illustrations in Parker (1954).

The generic assignment of the **Rosalina** species
in this report is in accord with the revision of
**Discorbis** by Loeblich and Tappan (1964).

**Rosalina candeiana** d'Orbigny

Pl. 12, Figs. 4a,b,c,5a,b,c

**Rosalina candeiana** d'Orbigny, 1839, in De la Sagra, Hist.
Phys. Pol. Nat. Cuba, "Foraminiferes", p. 47, pl. 4,
figs. 2-4.

**Discorbis candeiana** (d'Orbigny); Cushman, 1931, U.S. Nat.
Distribution: This species is present in nearly all samples of the high diversity Miliolid-dominant assemblage. Living populations in most samples are less than 2% with a few samples containing up to 6% living *D. candeiana*. Total population frequencies of this species range up to 3% with most samples containing less than 2%. This species is also present in low frequencies in the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage. Living forms in this assemblage are very rare.

Remarks: The relatively low frequencies of this species which is one of the more widespread *Rosalina* species in the study area is in sharp contrast to the high percentages of *Rosalina-Discorbis* encountered by Streeter, 1963, in certain areas of the Bahama Banks and the areas of high *Rosalina-Discorbis* content described by Bandy, 1964, in the Gulf of Batabano, Cuba.

This species is identified by the coarsely perforate test, lobulate periphery and overall variability of form. This variability is particularly expressed in degree of ventral flattening and test height. It appears to be well adapted to an attaching habitat.

*Rosalina floridana* (Cushman)
Pl. 12, Figs. 6a,b,c


**Distribution:** This species is largely restricted to the high diversity Miliolid-dominant assemblage. It occurs in almost every sample in this assemblage. Frequencies of occurrence are low. Living population frequencies rarely exceed 1% although living forms are present at nearly every station. Total population frequencies range up to 1% in this assemblage.

The species occurs in low frequencies in the near-shoal lagoon sediments, but living species are very rare.

The highest frequency of this species in living populations (6%) occurs in sample No. 131 in the Quinqueloculina-Cribroelphidium-dominant nearshore assemblage. However, this species is not common throughout this assemblage.

**Remarks:** This species is characterized by the nearly circular outline and the imperforate ventral surface.

Rosalina subauracana (Cushman)

Pl. 12, Figs. 7a,b,c


**Distribution:** This is one of the commonest Rosalina species. It is present in living and total populations of most samples of the high diversity Miliolid-dominant assemblages. It comprises up to 3% of the living and less
than 1% of the total populations in this assemblage. 
*R. subauracana* is a significant element in living 
populations of the *Quinqueloculina-Cribroelphidium*
dominant nearshore assemblage and the high diversity 
*Cribroelphidium*-dominant assemblage. The highest liv-
ing population frequency (8%) occurs in the latter 
assemblage.

Rare living forms occur in a few nearshoal lagoon 
samples in the *Cribroelphidium-Quinqueloculina* mixed 
fauna assemblage. Dead individuals are more common 
than living in this assemblage.

**Remarks:** This species is characterized by compressed test, 
angled, keeled periphery, limbate sutures dorsally and 
clear, imperforate area ventrally near the umbilicus.

*Rosalina* sp.  
Pl. 12, Figs. 8a,b,c

**Discorbis floridana** Cushman; Drooger and Kaasschieter, 1958, 
Natuurk, Reeks 1, Deel 22, p. 42, pl. 2, fig. 6. 

**Distribution:** This species, similar to other *Rosalina* species 
in this study, is widely distributed only in the high 
diversity Miliolid-dominant assemblage. It occurs in 
most samples of this assemblage in living and total 
populations in frequencies usually less than 1% of the 
respective populations. A few total population fre-
quencies range as high as 4%.
Living specimens of this species occur commonly in samples along the mainland margin of Southern British Honduras and in one sample from Chetumal Bay.

Dead representatives of \textit{R.} sp. occur in low frequencies in sediments of the Southern Shelf Lagoon.

\textbf{Remarks}: This species is characterized by finely perforate test, both dorsally and ventrally, and by rounded, slightly inflated chambers.

\textit{Rosalina} sp. demonstrates variability in test form, degree of chamber inflation and degree of ventral flattening. This species is commonly associated with marine vegetation and appears to be suited to an attaching habitat.

This species is identical to illustrations of \textit{D. floridana} Cushman in Drooger and Kaasschieter. \textit{Rosalina} sp. is distinct; however, being perforate on the ventral surface. Streeter (1963) noted a similar species in sediments of the Bahama Banks which he referred to \textit{D. floridana} Drooger and Kaasschieter (not Cushman).

\textit{Bronnimania palmerae} (Bermudez)


Distribution: Very rare. This species occurs in only three samples in the high diversity Miliolid-dominant assemblage. No living specimens were seen. Total population frequencies are always less than 1%.

_Buccella frigida_ (Cushman)

Pl. 12, Figs. 10a,b,c

_Pulvinulina frigida_ Cushman, 1922, Contr. Canadian Biology (1921), no. 4, p. 12 (144).


Distribution: This species is distributed throughout the Southern Shelf Lagoon in low frequencies. It is present in nearly all samples of the low diversity and high diversity _Cribroelphidium_-dominant assemblages except where the former occurs in water less than approximately five fathoms deep. It occurs in about half of the samples of the _Cribroelphidium-Quinqueloculina_-dominant mixed fauna assemblage. Frequencies of occurrence throughout the study area are low. Total population frequencies rarely exceed 1%. Only a small percentage of the samples contain living individuals. Frequencies in living populations range up to 2%, but most are much lower.

_B. frigida_ also occurs in low frequencies in four samples of the high diversity Miliolid-dominant assemblage.
Remarks: The large majority of the forms found in British Honduras sediments closely resemble the illustrations in Andersen (1952); however, a few very rare, slightly different forms of *Buccella* were included in this category. Several closely related species may have been included in the counting of this species.

**Neoconorbina terquemi** (Rzehak)

Pl. 13, Figs. 1a,b,c,2a,b,c

**Rosalina orbicularis** Terquem, 1876, Anim. sur la Plage de Dunkerque, p. 75, pl. 9, fig. 4.

**Discorbina terquemi** Rzehak, 1888, Verb. Geol. Reichanst., Wien, p. 228, (nam. subst.).

**Neoconorbina terquemi** (Rzehak); Hofker, 1951, Siboga Exped., Foraminifera, pt. III, p. 435.

Distribution: This species is one of the most common living forms in the high diversity Miliolid-dominant and *Arca*-*Asterigerina*-dominant assemblages throughout the carbonate platform and shoals area. Living population frequencies exceed 6% in about one third of the samples in which it occurs in these assemblages. Total population frequencies are less than 3% in nearly every sample.

This species occurs at a few shallow water near-shore lagoon stations in low living and total population frequencies, and at a number of stations scattered throughout the Southern Shelf Lagoon.
Remarks: This species is rather variable. The form generally illustrated in most publications is a relatively large, low-spired convexo-concave form with a sharply angled periphery. This form grades imperceptively, however, into generally smaller, higher spired forms with a more rounded periphery. The forms common in the nearshore, deltaic areas (e.g. station No. 281) are small, very low forms which are similar to Rosalina concinna (Brady). Streeter, 1963, p. 171, considers the possibility that this is a variety of N. terquemi.

Neoconorbina parkerae (Natland)

Pl. 13, Figs. 3a,b,c

Discorbis parkeri Natland, 1950, Geol. Soc. Amer., Mem. 43, pt. 4, p. 27, pl. 6, fig. 11.


Distribution: This species occurs in low frequencies in 26 samples. It is most commonly found in the high diversity Miliolid-dominant and Archaias-Asterigerina-dominant assemblages associated with mud-free carbonate sands on the Barrier Platform. It is always present in low frequencies. Neither living nor total frequencies exceed 1% of the respective populations. Dead individuals are found in nearshoal lagoonal sediments; rare living and dead tests occur in a few nearshore lagoon samples.
Remarks: This species does not show the variability evident in *N. terquemi*. *N. parkerae* is consistently small, compressed and vitreous with a keeled periphery.

*Cancri sagra* (d'Orbigny)

Pl. 13, Figs. 4a,b,c


*Cancri sagra* (d'Orbigny); Cushman, 1931, U. S. Nat. Mus. Bull. 104, pt. 8, p. 74, pl. 15, fig. 2.

**Distribution:** This species is present in 22 samples. Living specimens are absent in most samples. Living population frequencies greater than 1% occur only in the *Cassidulina*-dominant and high diversity *Cribroelphidium*-dominant assemblages in the deeper portion of the Southern Shelf Lagoon. Dead individuals occur in low frequencies sporadically elsewhere in the lagoon. Three samples of the high diversity Miliolid-dominant assemblage contain *Cancri sagra* with living individuals comprising 0.2% of one of these samples.

*Glabratella opercularis*? (Brady)

Pl. 13, Figs. 5a,b,c

*Discorbina opercularis* Brady (not d'Orbigny), 1884, Rept. Voy. "Challenger", pl. 89, fig. 8, 9.

Distribution: Living specimens of this species are very common in the Archaias-Asterigerina-dominant assemblage on the Barrier Platform. It is the dominant living species in most samples of this assemblage comprising up to 30% of the living population. Total population frequencies are extremely variable ranging from less than 1% to 30%. This species is widespread in both living and total populations in lower frequencies throughout the high diversity Miliolid-dominant assemblage.

G. opercularis? is extremely rare throughout the remainder of the study area except in one sample in the Quinqueloculina-Cribroelphidium-dominant nearshore assemblage (No.103) in which it comprises 34% of the living and 30% of the total population.

Remarks: This small species is characterized by a very low, flattened trochoid test, numerous chambers, strongly curved dorsal sutures and ventral sutures obscured by radial bead-like ornamentation.

This species is apparently well adapted to an attaching habitat. This probably accounts for the marked disparity between living and total populations in wave and current agitated environments.

The generic name of this species has been discussed by Barker, 1960. The assignment in this report results from the revision of Glabratella and related genera by Loeblich and Tappan, 1964. The species
assignment is open to some question as the individuals do not agree in all details with the figures in Brady.

**Siphonina pulchra** Cushman

Pl. 13, Figs. 6a,b,c


**Distribution**: This species occurs in 27 samples, 13 of which are assigned to the high diversity Miliolid-dominant assemblage. The remainder are in a variety of assemblages in the Southern Shelf Lagoon.

Living individuals occur in only four samples, all in frequencies less than 1% of the living population. One such occurrence is on the Barrier Platform, the remainder in the Southern Shelf Lagoon. Total population frequencies are all less than 1%.

**Remarks**: This species cannot be distinguished from *S. bradyana* Cushman on the basis of published illustrations, an observation made by Drooger and Kaasschieter, 1958, and Streeter, 1963.

**Asterigerina carinata** d'Orbigny

Pl. 13, Figs. 7a,b,c


**Distribution**: This is one species that characterizes the *Archaia-Asterigerina*-dominant assemblage. It dominates
some living populations, occurring in frequencies up to 30%. It is also common in the high diversity Miliolid-dominant assemblage.

Living population frequencies in the latter assemblage are variable ranging from 0% to 15%. Total population frequencies range from less than 1% to 10%.

This species is extremely rare in other areas of British Honduras even in lagoonal sediments adjacent carbonate shoals. Evidently this species is not subject to significant current transport.

*Palmerinella palmerae* Bermudez

*Pl. 13, Figs. 8a,b,9*


**Distribution:** This species occurs in only one sample in the quantified series of samples. This species, however, is very common in several unquantified samples from the mouth of the Belize River and in Northern River Lagoon. These samples were not stained or counted. This species evidently thrives in marginal marine areas of reduced salinity influenced by land-derived sedimentation.

*Ammonia beccarii* (Linne)

*Pl. 1j, Figs. 10a,b,c,11a,b,12a,b,c*

*Nautilus beccarii* Linne, 1758, Systemae Naturae, 10th ed., p. 710.

*Ammonia beccarii* (Linne); Brunnich, 1772, Zoologiae Fundamenta, p. 246.
**Distribution:** This species is distributed widely throughout the area in varying quantities. It is most abundant in a few samples near the effluents of major rivers and in inshore lagoons where it is the dominant species in both living and total populations. It is virtually absent from the Outer Platform, Barrier Platform, and carbonate shoals and from the deepest portions of the Southern Shelf Lagoon. Where it is dominant *A. beccarii* may account for over 50% of both living and total populations (e.g. sample Nos. 2, 219).

This species is present in nearly every sample of the low diversity *Cribrorotalia*-dominant assemblage occurring in living population frequencies varying from 1% to 15% and total population frequencies ranging from 1% to 23%. This species is also common in low frequencies throughout the low diversity *Miliolid*-dominant assemblage. Frequencies of occurrence vary in this assemblage also; however, both living and total population frequencies tend to decrease markedly in areas progressively more removed from the influence of river influx.

**Remarks:** All of the varieties of this species of previous workers have been aggregated in the final analysis of this data. Several forms were considered as distinct species in the early stages of the counting but were included together because of difficulty in recognizing consistent morphological entities and the lack of
major distributional distinction among the observable groups.

The problem of the taxonomy of this species has been considered by numerous authors (e.g. Parker, Phleger and Pierson, 1953; Todd and Bronnimann, 1957; Cifelli, 1962) and Hofker, 1964 has recently revised the group in some detail.

**Elphidium advenum** (Cushman)

*Polystomella advena* Cushman, 1922, Carnegie Inst. Washington, v. 17, p. 56, pl. 9, figs. 11, 12.


**Distribution**: Rare. This species occurs in only 14 samples and occurs in living populations in only two. All but one sample in which *E. advena* occurs are from the Southern Shelf Lagoon, but there is no consistent association with any particular foraminiferal assemblage. It occurs in frequencies less than 1% in both living and total populations.

**Remarks**: In this report species with sharply angled peripheries, numerous chambers and without large umbilical bosses are designated *Elphidium* de Montfort *stensu stricto*; species with large umbilical bosses and prominent retral processes are assigned to *Cellanthes* de Montfort; and species with relatively short, subdued retral processes are assigned to *Cribroelphidium* Cushman and Bronnimann.
Elphidium lanieri (d'Orbigny)
Pl. 14, Figs. 2a,b


Elphidium lanieri (d'Orbigny); Hofker, 1964, Natuur.

Distribution: This species is distributed sparsely over portions of this study area always occurring in low frequencies. It is most common living in the high diversity Millocid-dominant assemblage associated with carbonate sands and in the Quinqueloculina-Cribroelphidium-dominant nearshore assemblage. This species seems to be adapted to areas of wave and current activity despite minor hydrographic and sedimentary variations. This species is a rare constituent of total populations of only a few samples in the Southern Shelf Lagoon. Neither living nor total population frequencies exceed 1%.

Cellanthus discoidale (d'Orbigny)
Pl. 14, Figs. 6a,b

Polystomella discoidale d'Orbigny, 1839, in De la Sagra, "Foraminiferes", p. 56, pl. 6, figs. 23, 24.

Elphidium discoidale (d'Orbigny); Cushman, 1930, U. S. Nat. Mus. Bull. 104, pt. 7, p. 22, pl. 8, figs. 8, 9.
**Distribution:** This species is distributed widely throughout the Southern Shelf Lagoon and Barrier Platform. It is a persistent constituent in total populations in most samples of all of the *Cribroelphidium*-dominant and *Cribroelphidium-Quinqueloculina*-dominant assemblages. Total population frequencies are generally less than 1% although frequencies of 7-9% are not infrequent in the low diversity *Cribroelphidium*-dominant assemblage. Living forms are extremely rare in the Southern Shelf Lagoon.

The highest living population frequencies and the most widespread occurrence of living specimens of *C. discoidale* are found in the high diversity Miliolid-dominant assemblage.

Living population frequencies up to 2% are encountered in few stations in the *Quinqueloculina-Cribroelphidium*-dominant nearshore assemblage.

**Remarks:** This species is distinct and easily identifiable in the large, adult form. Juveniles, however, in which the angular periphery and large umbilical boss are not evident are difficult to separate from *Cribroelphidium poeyanum* (d'Orbigny) and even *Cellanthis gunteri* (Cole). Samples in which the adult end members are distinct also contain numerous smaller forms for which specific assignment is difficult.

Bandy, 1964, noted the coexistence of *Elphidium discoidale* and *Elphidium poeyanum* in almost equal
numbers in the deeper back-reef areas of the Gulf of Batabano. Streeter (1963, p. 137) noted that the two species appear to grade into one another in samples from the Bahama Banks. This is thought to be true also in the Southern Shelf Lagoon of British Honduras; however, most of the smaller "Elphidium" tests were assigned to C. poeyanum.

The generic assignment of this common and well-known species is in accord with the revision of the genus Elphidium by Loeblich and Tappan.

**Cellanthus galvestonense** (Kornfeld)
Pl. 14, Figs. 7a,b

*Elphidium gunteri* Cole var. *galvestonensis* Kornfeld (part), 1931, Contr. Dept. Geol. Stanford Univ., v. 1, no. 3, p. 87, pl. 15, figs. 1a,b.


**Distribution**: This species is largely restricted to the low diversity Miliolid-dominant assemblage; it occurs in almost every sample from the Northern Shelf Lagoon and Chetumal Bay. Frequencies are low. Total population frequencies range up to 4%, but most are less than 1%; living population frequencies rarely exceed 1% with a maximum of 5%. However, in sample No. 2 near the mouth of the Rio Hondo, this species comprises 28% of the living population.
Low living and total population frequencies of this species occur in the low diversity Cribroelphidium-dominant assemblage just south of the Belize River delta where the Cribroelphidium-dominant and Millolid-dominant assemblages are juxtaposed.

Remarks: This species is distinguished from G. gunteri in always possessing a single large umbilical boss surrounded by a depressed channel.

*Cellanthus gunteri* (Cole)

Pl. 14, Figs. 8a,b

*Elphidium gunteri* Cole, 1931, Florida State Geol. Surv. Bull. 6, p. 34, pl. 4, figs. 9, 10.

*Elphidium gunteri* Cole var. *galvestonense* Kornfeld (part), 1931, Contr. Dept. Geol. Stanford Univ., v. 1, no. 3, p. 87, pl. 15, figs. 2a,b,3a,b.

Distribution: *G. gunteri* is a common species distributed throughout the study area with the exception of the Barrier Platform, Outer Platform and carbonate shoals. It is a common faunal element throughout the Southern Shelf Lagoon, Northern Shelf Lagoon, Chetumal Bay and portions of the coastal mainland. It is most common in the low diversity Cribroelphidium-dominant assemblage and in Ammonia- and Ammobaculites-dominant deltaic and inshore lagoon assemblages. Frequencies of living and total populations are highly variable. Living frequencies commonly exceed 10% of the living
population with a maximum of 26%; total frequencies commonly exceed 5% with a maximum of 13%.

Throughout the remainder of the Southern Shelf Lagoon *C. gunteri* occurs in most samples but in lower frequencies.

In Northern British Honduras this species is more common nearer the river effluents and less significant toward the areas of normal marine salinities.

Remarks: This species is characterized by large, thick-walled, coarsely perforate test, rounded periphery prominent retoral processes, and umbilicus filled by numerous calcareous bosses. It tends to be variable in shape. Throughout most of its distribution in the Southern Shelf Lagoon it tends to be biconvex, and compressed with a rounded periphery. In some samples from Chetumal Bay this species assumes a broader, more rounded form. Gradation between the two forms is complete.

*Cribroelphidium koebeense* (LeRoy)

Pl. 14, Figs. 3a,b

**Elphidium koebeense** LeRoy, 1939, Natuurk Tijdschr. Nederl.-Indie, dl. 99, afl. 6, p. 240, pl. 9, figs. 6, 7.


Distribution: This species occurs in 33 samples spread over much of the study area. The highest living population
frequencies (4%, 10%) occur in two samples of the Quinqueloculina-Cribroelphidium-dominant assemblage along the coast of Southern British Honduras. Throughout most of its distribution this species rarely exceeds 1% of either the living or total population. The species does not occur in the Northern Shelf Lagoon nor in Chetumal Bay. In the Southern Shelf Lagoon it occurs in very low frequencies in total populations only in the low diversity Cribroelphidium-dominant assemblage.

This species occurs most consistently in living and total population in the high diversity Miliolid-dominant assemblage being present in 14 samples. It is also present in samples of the adjacent nearshoal lagoon.

*Cribroelphidium poeyanum* (d'Orbigny)

Pl. 14, Figs. 4a, b


**Distribution:** This is the dominant species in the total populations of most samples throughout the Southern Shelf Lagoon and is probably the most abundant non-miliolid taxon in the study area. It comprises 20% or more of the total populations in most samples of
the Southern Shelf Lagoon and rarely occurs in frequencies less than 10%. Only rarely is it the dominant species in living populations of these samples. Frequencies in living populations are much more variable than in total populations ranging from 0 to 36%. High living population frequencies (greater than 10%) are most common in the low diversity *Cribroelphidium*-dominant assemblage.

In Northern British Honduras this species occurs in almost every sample of the low diversity Miliolid-dominant assemblage in total population frequencies up to 11% and living population frequencies generally less than 5%.

*C. poeyanum* is present in low frequencies in most samples of the high diversity Miliolid-dominant assemblage. Total population frequencies rarely exceed 1%. Living forms occur in relatively few samples in frequencies up to 3%.

**Remarks:** This species is somewhat variable in size and shape, and it tends to intergrade at least in young specimens with several other species (see *Cellanthus discoidale*).

*Cribroelphidium translucens* (Natland)

Pl. 14, Figs. 5a,b

**Distribution:** This species occurs throughout much of the Southern British Honduras shelf. It is a common constituent of the high diversity Miolid-dominant assemblage occurring in nearly all samples. Total population frequencies range up to 1%; most living population frequencies are less than 2% in this assemblage. In the Southern Shelf Lagoon it occurs consistently in both living and total populations of the *Cribrorhaphidium-Quinqueloculina* mixed fauna assemblage and erratically in other lagoonal assemblages. It is extremely rare in the assemblages of Northern British Honduras.

**Remarks:** The distinguishing characters of this species are not always obvious in small individuals, and they are difficult to distinguish from small specimens of *C. poeyanum*. Larger forms exhibit an umbilicus covered by clear shell material, a feature lacking in *C. poeyanum*. Rare forms of *C. translucens* tend to develop incipient backward directed spines along the sutures at the periphery of the test.

**Cribrorhaphidium** spp.

**Remarks:** A number of small indeterminate *Cribrorhaphidium* tests are common in many samples, particularly in the Southern Shelf Lagoon. Many of these specimens are thought to be juveniles of more common species but this indeterminate group probably also contains small forms belonging to species not described elsewhere in this report. This category probably contains individuals
belonging to *Cribroelphidium matagordanum* (Kornfeld) and varieties of *Cribroelphidium incertum* (Williamson). This group rarely accounts for more than 1% of the living population, but it commonly comprises up to 5% of the total populations.

**Protelphidium delicatulum** (Bermudez)

Pl. 14, Figs. 1a,b


**Distribution:** Rare. The distribution of this species is restricted to very few samples most of which are located in upper Chetumal Bay associated with the low diversity Miliolid-dominant assemblage and at the effluent of the Rio Hondo and New Rivers associated with Ammonia-dominant faunas. It also occurs in unquantified samples from Northern River Lagoon in Ammonia-dominant associations.

**Remarks:** This species is characterized by slightly evolute test, rounded periphery, nearly parallel sides, umbilicus filled with a complex of small calcareous bosses, lack of retral processes or septal bridges, and radial wall structure. It has been noted to be characteristic of "Interdistributary bay" faunas near the Mississippi Delta (Lankford, 1959) when in abundance and has been found associated with deltaic deposition in several Texas bays (Parker, Phleger and Pierson, 1953, Wantland,
1964). It is very similar to *Protelphidium anglicum*
Murray from the Plymouth area, England.

**Eponides antillarum** (d' Orbigny)

*Pl. 14, Figs. 9a,b,c*


**Eponides antillarum** (d' Orbigny); Cushman, 1931, U. S. Nat. Mus. Bull. 104, pt. 8, p. 42, pl. 9, fig. 2.

**Distribution:** Rare. This species occurs in the total populations (less than 1%) of six samples of the high diversity *Milolid*-dominant assemblage. Living forms occur in two of the seven samples in which it is found in the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblage. Isolated occurrences in both living and total populations are encountered in three other samples from the Southern Shelf Lagoon.

**Eponides repandus** (Fichtell and Moll)

*Pl. 14, Figs. 10a,b,c*

**Nautilus repandus** Fichtell and Moll, 1803, *Test. Micro.,* p. 35, pl. 3, figs. a-d.

**Eponides repandus** (Fichtell and Moll); Phleger and Parker, 1951, *Geol. Soc. Mmer., mem. 46, pt. 2, p. 21, pl. 11, figs. 5, 6.*

**Distribution:** Rare. This species occurs in twelve samples. Most are from the Southern Shelf Lagoon though two are
from the Barrier Platform. Living forms are found in three samples associated with the Cribroelphidium-Quinqueloculina-dominant mixed fauna assemblage and the high diversity Cribroelphidium-dominant assemblage. Total and living population frequencies are less than 1%.

Remarks: This species of Eponides is recognized by large, thick-walled biconvex test, thickened sutures and keel, and flattened apertural face penetrated by a few areal pores. The problem of naming this and related forms is discussed by Barker, 1960, p. 214.

Amphistegina gibbosa d'Orbigny

Pl. 14, Figs. 1la,b,c


Distribution: This species is limited in its distribution to the Barrier Platform, carbonate shoals and adjacent lagoonal sediments. Living individuals are extremely rare occurring in only three of 13 samples in which the species occurs in the high diversity Miliolid-dominant assemblage. Total population frequencies in this species are highly erratic ranging from less than 1% to 50%. The heavy nature of the shell may lend itself to accumulation as a lag deposit which might account for some anomalous frequencies.
In nearshoal lagoonal sediments this species accounts for less than 1% of total populations only in relatively few samples.

**Planulina exorna** Phleger and Parker

Pl. 15, Figs. 1a,b,c

**Planulina exorna** Phleger and Parker, 1951, Geol. Soc. Amer. Mem. 46, pt. 2, p. 32, pl. 18, figs. 5-8.

**Distribution:** Rare. This species occurs in eight samples. In five samples it occurs in low frequencies associated with the high diversity Miliolid-dominant assemblage. The other occurrences are associated with the *Cassidulina*-dominant and high diversity *Cribroelphidium*-dominant assemblages. No living specimens were seen.

**Remarks:** This species appears to be identical to the illustrations in Phleger and Parker, 1951. It is characterized by truncated periphery in early stage, sub-angular, lobulate periphery in later stage, and bead-like ornamentation of early portion of test.

**Cibicides lobatus** (Walker and Jacob)

Pl. 15, Figs. 2a,b,c,3a,b,c

**Nautilus lobatus** Walker and Jacob, 1798, Adams Essays, Kanmacher's ed., p. 642, pl. 14, fig. 36.

**Cibicides lobatus** (Walker and Jacob); Cushman, 1931, U. S. Nat. Mus. Bull. 104, pt. 8, p. 118, pl. 21, fig. 3.

**Distribution:** This species is most common in the high diversity Miliolid-dominant assemblage occurring in nearly
all samples of that assemblage in low frequencies. Total population frequencies range up to 3% although most samples contain less than 1% *C. lobatus*. Living specimens occur in approximately one-half of the samples in frequencies generally less than 3% although anomalously higher frequencies are recorded. Frequencies of *C. lobatus* in both living and total populations tend to increase from the leeward toward the windward side of the Barrier Platform.

In nearshore lagoon sediments this species occurs in low frequencies of total populations.

*Cibicides mayorii* (Cushman)

Pl. 15, Figs. 4a,b,c


**Distribution:** Very rare. This species occurs in only 11 samples, nine on the Barrier Platform, two in the Southern Shelf Lagoon. Living specimens occurred in only two samples; frequencies of both living and total populations are less than 1%.

*Cibicides pseudoungerianus* (Cushman)

Pl. 15, Figs. 5a,b,c


Cibicides pseudoungeriana (Cushman); Cushman, 1931, U. S. Nat. Mus. Bull. 104, pt. 8, p. 123, pl. 22, figs. 3-7. **Distribution:** This species is present in most samples of the high diversity Miliolid-dominant assemblage in low frequencies of both living and total populations. Living population frequencies range up to 3%; total population frequencies rarely exceed 1%.

This species also occurs in the total populations of most samples of the Cribroelphidium-Quinqueloculina-dominant mixed fauna assemblage.

The highest living population frequencies of this species, however, occur in the high diversity Cribroelphidium-dominant assemblage. In one sample (No. 156) C. pseudoungerianus comprises 19% of the living but only 2% of the total population.

**Remarks:** The variability of this species and the resultant taxonomic problems are discussed at length by Drooger and Kaasschieter, 1958, p. 39.

**Planorbulina mediterranensis** d'Orbigny
Pl. 15, Figs. 6a,b,c

Planorbulina mediterranensis d'Orbigny, 1826, Ann. Sci. Nat., v. 7, p. 280, no. 2, pl. 14, figs. 4-6, Mod. no. 79. **Distribution:** This species is widely distributed over the Barrier Platform, Outer Platform, and Southern Shelf Lagoon. It is present in every sample of the high diversity Miliolid-dominant assemblage in both living and total populations. Living populations range up
to 3% with rare anomalously high frequencies. Total population frequencies range up to 9% with most samples containing less than 3%.

This species is a common constituent of total populations in the nearshoal lagoon and more erratically throughout all of the Southern Shelf Lagoon.

Remarks: This species is characterized by large, flat, coarsely perforate, plano-convex test, and multiple apertures. This form is well-adapted to an attaching habitat; however, living forms were commonly found in surface sediments as well as being observed on the leaves of *Thalassia*.

Through error a few specimens probably belonging to the species *Acervalis inhaerens* Schultze, a related form without apertures, were counted in this group. In addition no distinction was made between *P. mediterranensis* and *P. acervalis* Cushman.

A large number of juvenile specimens were assigned to *Planorbulina* juvenile and counted separately because it was not possible to distinguish between juveniles of *Planorbulina* and *Cibicides*. These forms comprised significant percentages of some high diversity Miliolid-dominant living populations. Some small juvenile forms were evidently transported some distance into the Southern Shelf Lagoon and were recorded several miles from the landward edge of the Barrier Platform.
Cymbaloporella bradyi Cushman
Pl. 15, Figs. 7a,b,c

Cymbalopora poeyi (d'Orbigny) var. bradyi Cushman, 1915, U. S. Nat. Mus. Bull. 71, pt. 5, p. 25, pl. 10, fig. 2, pl. 14, fig. 2.

Cymbaloporella bradyi (Cushman); Todd and Bronnimann, 1957, Cushman Found. Foram. Res. Spec. Publ. No. 3, p. 37, pl. 11, fig. 9.

Distribution: This species is most common in the high diversity Miliolid-dominant assemblage occurring in nearly all samples of that assemblage with living population frequencies up to 7% though usually much less and total population frequencies less than 3%.

This specie is also distributed erratically in samples throughout the Southern Shelf Lagoon; living specimens in this area are extremely rare.

Remarks: Extremely rare specimens (none living) of a "Tretomphalus-stage" of this species with a large final inflated chamber were encountered.

Cymbaloporella squamosa (d'Orbigny)
Pl. 15, Figs. 8a,b,c


Cymbaloporella squammosa (d'Orbigny); Cushman, 1931, U. S. Nat. Mus. Bull. 104, pt. 8, p. 83, pl. 16, fig. 4.

Distribution: This species demonstrates a limited distribution occurring only in a few samples of the high
diversity Millolid-dominant and Archaeas-Asterigerina-dominant assemblages. This species is apparently best adapted to areas subjected to moderate wave and current agitation. Total population frequencies rarely exceed 1%; living specimens occur in very few samples in frequencies less than 1%.

**Homotroma rubrum** (Lamarck)


**Remarks:** This species does not occur in the quantified samples of this study. Fragments of this large, red, sessile form are present in bulk sediment samples from many areas of carbonate sand accumulation on the Barrier Platform, Outer Platform and carbonate shoals, and the species was observed attached to the undersides of numerous coral heads in the study area. The distribution and ecologic significance of this form in reef environments is documented in papers by Emiliani (1951) and Zans (1958).

**Fursenkoina complanata** (Egger)

Pl. 15, Fig. 9

Virgulina complanata Egger; Phleger and Parker, 1951, Geol. Soc. Amer., Mem. 46, pt. 2, p. 19, pl. 9, figs. 1-3.


Distribution: Rare. This species occurs in only 20 samples from the Southern Shelf Lagoon scattered throughout areas deeper than five fathoms. Living specimens occur in only two samples. Frequencies in both living and total populations never exceed 1%.

Fursenkoina pontoni (Cushman)
Pl. 15, Figs. 10,11


Distribution: This species is one of the most abundant and significant living forms in the Southern Shelf Lagoon. It is the dominant living species in a number of samples including most of those from areas of marked influx of reef debris into the lagoon. In many Cribroelphidium-Quinqueloculina-dominant mixed fauna samples, F. pontoni comprises over 40% of the living population with a maximum of 77%. Corresponding total population frequencies rarely exceed 10% and are commonly less than 5%.

This species is distributed throughout the Southern Shelf Lagoon in addition to these striking nearshoal
occurrences. It occurs in most samples of the low and high diversity *Cribroelphidium*-dominant assemblages in variable frequencies. It is least common in lagoon samples from depths of less than five fathoms.

*F. pontoni* is essentially absent from the Northern Shelf Lagoon, Chetumal Bay and marginal marine areas. It does occur, however, on the Barrier Platform in variable frequencies. Total population frequencies never exceed 1% in this area, but rare living occurrences range up to 7% of the living populations.

The significance of the living populations of this species in the Southern Shelf Lagoon has been discussed previously.

**Remarks:** In this study all specimens of *Fursenkoina* characterized by a slightly tapered, smooth-sided test, fine perforations, and bluntly rounded initial end are assigned to *F. pontoni*.

Cebulski (1961) evidently assigned these forms to *Virgulina punctata* d'Orbigny. Study of illustrations of *F. pontoni* and *F. punctata* in Andersen, 1961, reveals slight differences in size, perforations and degree of peripheral lobation. In this study these differences were not consistently distinct and the writer could not subdivide the forms into specific groups. Identified material of *F. punctata* has not been examined for comparison. The vast majority of the specimens counted are extremely close to *F. pontoni*. 
Fursenkoina spinicostata (Phleger and Parker)

Pl. 16, Fig. 1

Virgulina spinicostata Phleger and Parker, 1951, Geol. Soc. Amer., Mem. 46, p. 19, pl. 9, figs. 11-14.

Distribution: This species is distributed sparsely over much of the Southern British Honduras Shelf. It is found in total populations throughout the Southern Shelf Lagoon as well as on the Barrier Platform and carbonate shoals.

It occurs in low frequencies in nearly all samples of the low diversity and high diversity Cribroelphidium assemblies though living specimens are extremely rare. It is distributed erratically in variable frequencies in living and total populations of the Cribroelphidium-Quinqueloculina-dominant mixed fauna assemblage; it is rarely encountered in marginal marine or nearshore assemblages.

It occurs in approximately one-third of the high diversity Miliolid-dominant assemblage samples. Living forms occur in more than one-half of these samples. Frequencies of occurrence in both living and total populations rarely exceed 1% in any sample in which F. spinicostata occurs in the study area.

Remarks: The British Honduras specimens are identical to the illustrations of Phleger and Parker (1951).
**Sig mavirigulina tortuosa** (Brady)

Pl. 16, Figs. 2a, b

*Bolivina tortuosa* Brady, 1884, Rept. Voy., "Challenger,"
Zool., v. 9, pl. 52, figs. 31, 32.

**Sig mavirigulina tortuosa** (Brady); Barker, 1960, Soc. Econ. Pal.
and Min. Spec. Publ. N. 9, p. 108, pl. 52, figs. 31, 32.

**Distribution:** Rare. This species occurs in 30 samples in
very low frequencies. It is present in total popula-
tions of 19 samples of the high diversity Miliolid-
dominant assemblage and is found living in 12 of these
samples. Frequencies of occurrence are always less than
1%. The remaining occurrences are scattered throughout
the Southern Shelf Lagoon with most living specimens
being associated with the high diversity *Cribroelphidium-
dominant assemblage.

**Loxostomum limbatum** (Brady)

Pl. 16, Fig. 3

Zool., v. 9, p. 414, pl. 52, fig. 26-28.

**Loxostomum limbatum** (Brady); Cushman, 1937, Cushman Lab.

**Distribution:** Very rare. This species occurs in only seven
samples with living specimens found in only three. All
occurrences are in deeper portions of the Southern
Shelf Lagoon; frequencies of occurrence are always less
than 1% of both living and total populations.
**Loxostomum mayorii** (Cushman)

Pl. 16, Fig. 4

**Bolivina mayorii** Cushman, 1922, Carnegie Inst. Washington, Publ. 311, v. 17, p. 27, pl. 3, figs. 5, 6.

**Loxostomum mayorii** (Cushman); Bandy, 1956, U. S. Geol. Surv. Prof. Paper, 274-G, p. 195, pl. 31, fig. 11.

**Distribution:** This species occurs in 34 samples distributed on the Barrier Platform, carbonate shoals and throughout the Southern Shelf Lagoon. The species occurs consistently in the *Cribroelphidium-Quinqueloculina* mixed fauna assemblage in both living and total populations. Frequencies never exceed 1% of the respective populations. The species occurs in nine samples of the high diversity Miliolid-dominant assemblage though living forms are rare.

Additional occurrences are scattered in other assemblages of the Southern Shelf Lagoon. This species does not occur in the Northern Shelf Lagoon or Chetumal Bay.

**Cassidulina minuta** Cushman

Pl. 16, Figs. 5a,b,c

**Cassidulina minuta** Cushman, 1933, Contr. Cushman Lab. For. Res., v. 9, pt. 4, p. 92, pl. 10, fig. 3.

**Distribution:** This species is distributed throughout the Southern Shelf Lagoon in low frequencies and is the dominant species in the total populations of a few samples in the deepest part of the lagoon.
It is present in the total populations of nearly every sample from the low diversity Cribrorotalis-dominant assemblage in frequencies less than 1%. Living forms are extremely rare. In the Cribrorotalis-Quinqueloculina-dominant mixed fauna assemblage it occurs in total populations of most samples but in higher frequencies—up to 6%. Living forms occur rarely.

The highest total population frequencies occur in the Cassidulina-dominant assemblage and in two samples of the high diversity Cribrorotalis-dominant assemblage. Total population frequencies exceed 10% in these samples. Living forms are rare with a maximum frequency of 3% in sample No. 213.

*C. minuta* is also present in 14 samples from the high diversity Miliolid-dominant assemblage on the Barrier Platform and carbonate shoals. Living forms are present in one-half of these samples; frequencies do not exceed 1%.

**Melonis barleeanus** (Williamson)

Pl. 16, Figs. 8a,b

Nonionina barleeanus Williamson, 1858, "Recent Foraminifera of Great Britain", p. 32, pl. 3, figs. 63, 69.

"Nonion" barleeanus (Williamson); Andersen, 1961, Louisiana Geol. Surv. Bull. No. 35, pt. II, p. 82, pl. 18, figs. 6a,b.

**Distribution:** Rare. This species occurs in low frequencies in 19 samples. Living specimens occur in only four
samples from the Southern Shelf Lagoon associated with the *Cassidulina*-dominant, high diversity *Cribrorhaphidium*-dominant and *Cribrorhaphidium-Quinqueloculina*-dominant mixed fauna assemblages. Eight samples containing dead *M. barleanus* are from the high diversity Miliolid-dominant assemblage. Frequencies do not exceed 1% of the respective living and total populations.

**Nonion** sp.

Pl. 16, Figs. 6a,b

**Distribution:** This species occurs in low frequencies (less than 1%) throughout much of the Southern Shelf Lagoon. Living specimens, however, are extremely rare. It occurs in nearly all samples of the low diversity *Cribrorhaphidium*-dominant assemblage, approximately one-half of the *Cribrorhaphidium-Quinqueloculina*-dominant mixed fauna assemblage samples, and erratically in a few samples of the high diversity Miliolid-dominant assemblage and the high diversity *Cribrorhaphidium*-dominant assemblage. *N.* sp. is absent from Northern British Honduras and marginal marine assemblages.

**Remarks:** The generic assignment of this species follows the revision of the genus *Nonion* by Loeblich and Tappan (1964).

This species is characterized by a small, planispiral involute, hyaline test, granular wall microstructure and very finely perforate chamber walls. It is similar to illustrations of *Nonion* sp. recorded by
Lankford, 1959, in the vicinity of the Mississippi River Delta.

**Bisaccium imbricatum** Andersen

**Bisaccium imbricatum** Andersen, 1951, Jour. Paleo., v. 25, no. 1, p. 32, t.f. 2.

**Distribution:** Rare. This species occurs in only three samples in total population frequencies less than 1%; living forms are rare. This species is restricted to marginal marine, low salinity deltaic environments. Along the British Honduras coast this species occurs in samples from the effluents of the Sittee River, Rio Hondo, and in Northern River Lagoon.

**Remarks:** This form is identical to the illustration in Andersen (1951).

**Florilus astricta** (McCulloch)

Pl. 16, Figs. 7a,b,c

**Nonionella japonica** (Asano) var. **mexicana** Cushman and McCulloch, 1940, South. Calif. Univ. Publ. Allan Hancock Pacif. Exped., v. 6, no. 3, p. 160, pl. 17, fig. 10.


**Distribution:** Rare. This species is found in 13 samples distributed sporadically in the Southern Shelf Lagoon and 12 samples on the Barrier Platform and carbonate shoals. Living forms are extremely rare in the Southern
Shelf Lagoon, but living specimens occur in 11 of the 12 samples in which it occurs in the high diversity Miliolid-dominant assemblage.

Frequencies are low rarely exceeding 1% of either total or living populations.

Remarks: The generic assignment follows the revision of Nonionella in Loeblich and Tappan (1964).

**Florilus atlanticus** (Cushman)

Pl. 16, Figs. 9a,b,c

**Nonionella atlantica** Cushman, 1947, Contr. Cushman Lab.

Foram. Res., v. 23, p. 90, figs. 4, 5.

**Pseudononion atlanticus** (Cushman); Andersen, 1961, Louisiana Geol. Surv. Bull. No. 35, pt. II, p. 34, pl. 18, figs. 1a,b,2a-c.

Distribution: **F. atlanticus** is one of the most common and significant species in the sediments of the Southern Shelf Lagoon. It is the dominant species in the living populations of many samples and is an important constituent in the total populations of most samples. The species occurs in nearly all samples of the low diversity Cribroelphidium-dominant assemblage. The highest living population frequencies of **F. atlanticus** occur in this assemblage with frequencies greater than 25% in a number of samples and a maximum of 70% in sample No. 63. These samples with high living population frequencies are generally found in shallow lagoon areas in normal marine water less than five fathoms deep.
Thus, these high living population frequencies are confined to the northernmost and southernmost portions of the areas characterized by low diversity *Cribroelphidium*-dominant faunas. This species is not common, however, in extremely shallow marginal marine or nearshore areas subject to salinity variation.

Throughout the remainder of the low diversity *Cribroelphidium*-dominant assemblage, the *Cribroelphidium*-Quinqueloculina-dominant mixed fauna assemblage, and the high diversity *Cribroelphidium*-dominant assemblage, living population frequencies are variable with most samples containing less than 10%. *F. atlanticus* total population frequencies throughout the Southern Shelf Lagoon are generally less than 6%.

*F. atlanticus* is also present in living and total populations of most samples of the high diversity Miliolid-dominant assemblage in low frequencies--less than 1%.

This species is essentially absent from Northern British Honduras.

**Remarks:** Although large forms of *F. atlanticus* and *F. grateloupii* are distinct and counted separately in the present study, small forms intergrade. It is possible that these two species should be considered one variable taxon. From an ecologic standpoint separation of the species is not important in that they occur consistently together. They are not ecotypic variants,
at least with respect to their geographic distribution at the scale at which they are considered here.

Cebulski, 1961, did not list *F. atlanticus* among the Foraminifera of British Honduras in his study. He assigned all forms to *Nonion grateloupia* (d'Orbigny) and did not list *F. atlanticus* in his synonymy of that species.

*Florilus grateloupia* (d'Orbigny)

Pl. 16, Figs. 10a,b,c


*Nonion grateloupia* (d'Orbigny); Cushman, 1939, U. S. Geol. Surv. Prof. Paper 191, p. 21, pl. 6, figs. 1-7.

**Distribution:** The distribution of this species is similar to that of *E. atlanticus* but *F. grateloupia* occurs in much lower frequencies and in fewer samples. It is distributed throughout the Southern Shelf Lagoon occurring in most samples. Total population frequencies usually do not exceed 1% and living population frequencies though variable generally are less than 3%. This species is also present in living and total populations of the high diversity Miliolid-dominant assemblage. Living frequencies range up to 7% though are usually much less, and total frequencies are less than 1%.

**Remarks:** The fully developed specimens of this species differ from *F. atlanticus* in the slightly smaller size and the straight, more peaked final chamber development. There
is an indication of intergradation, but it is not fully documented in the specimens in this study.

**Florilus** sp.

Pl. 16, Figs. 11a,b,c

**Distribution:** This species is distributed commonly throughout the Southern Shelf Lagoon, and sparsely over the Barrier Platform and carbonate shoals. It occurs in most samples of the low and high diversity *Cribroelphidium*-dominant and the *Cribroelphidium-Quinqueloculina*-dominant mixed fauna assemblages. Frequencies of both living and total populations are rarely greater than 1% and living forms occur in relatively few samples.

It occurs in low frequencies in only nine samples in the high diversity *Miliolid*-dominant assemblage.

This species is extremely rare in marginal marine and nearshore assemblages and is essentially absent from Northern British Honduras.

**Remarks:** This species is characterized by small size, slightly inflated, gradually enlarging chambers, and assymetrical coiling. It is very similar to *Nonion* sp. in every respect except test symmetry. Intergradation may well exist through even this fundamental morphologic feature, but too few specimens are available to document this possibility.
Trichohyalus aguayoi (Bermudez)

Pl. 16, Figs. 12a,b,c


Nat., v. 9, p. 204, pl. 15, Figs. 10-14.


Trichohyalus aguayoi (Bermudez); Bermudez, 1963, Bol. del Inst. Ocean. Univ. Oriente, Cumana, p. 176, pl. 26, fig. 4.

Distribution: Very rare. This species was counted in only one sample from the Quinqueloculina-Cribroelphidium-dominant assemblage along the coast of Southern British Honduras. It was observed also in non-quantitative samples from the mangrove marshes on the lee side of Ambergris Cay associated with ?Pyrgo eburnea, Massilina protea, Trochammina inflata and abundant small miliolids.

Remarks: This species was the subject of an enlightening series of experiments on test variability reported by Arnold (1954, C.F.F.R., v. 5, p. 4-13). This range of variation was not observable in the small populations in this study.

Hanzawaia concentrica (Cushman)

Pl. 16, Figs. 13a,b,c

Truncatulina concentrica Cushman, 1918, U. S. Geol. Surv.

Bull. 676, p. 64, pl. 21, fig. 3.

Cibicides concentrica (Cushman); Renz, 1948, Geol Soc. Amer., Mem. 32, p. 127, pl. 10, fig. 8.
Hanzawaia concentrica (Cushman); Drooger and Kaasschieter, 1958, Rept. Orinoco Shelf Exped., v. 4, p. 49, fig. in map 17.

**Distribution:** This species is distributed widely over the Southern Shelf Lagoon, Barrier Platform and carbonate shoals. The highest frequencies of occurrence of this species are found in the high diversity *Cribrorhaphidium*-dominant assemblage. In a few samples in this assemblage living frequencies may exceed 10% of the living populations. Total population frequencies are less than 3%. This species is found in most samples of the low diversity *Cribrorhaphidium*-dominant assemblage in total population frequencies less than 1%; living forms are extremely rare.

Frequencies in the *Cribrorhaphidium-Quinqueloculina*-dominant mixed fauna assemblage are variable. Living forms occur in most samples of this assemblage.

*H. concentrica* occurs sparsely in the high diversity Miliolid-dominant assemblage in very low frequencies.

This species is not found in marginal marine or nearshore assemblages nor in Northern British Honduras.

?Conorboidea advena (Cushman)

Pl. 16, Figs. 14a,b,c


**Distribution:** This species occurs in low frequencies in 13 samples. Most samples in which this species is found are from the deeper portions of the Southern Shelf Lagoon associated with the high diversity *Cribroelphidium*-dominant assemblage. It occurs in three samples from the Barrier Platform. Both living and total population frequencies are less than 1%.

**Remarks:** This species closely resembles the illustrations in Barker (1960). Loeblich and Tappan (1964, p. 0769) state that this genus is characterized by aragonitic chamber walls. The mineralogy of the British Honduras form is not now known.

**Cushmanella brownii** (d'Orbigny)

Pl. 16, Figs. 15a, b


**Cushmanella brownii** (d'Orbigny); Hofker, 1956, Skriffer, Univ. Zool. Mus. Copenhagen Publ. 15, p. 144, pl. 22, figs. 1-3, pl. 23, figs. 1-5, 21.

**Distribution:** Very rare. This species occurs in only six samples. Three occurrences including the only observed living specimens are in the high diversity Miliolid-dominant assemblage. The others are in nearshoal
lagoonal sediments. Frequencies are very low, never exceeding 1% of either living or total populations.
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APPENDIX

The following charts present the percentage composition of the living and total foraminiferal populations derived from count data. In addition figures for faunal density are listed. Samples are listed in numerical order and refer to sample localities (Fig. 2). Juvenile and indeterminate individuals are combined as either Miliolid or Non-Miliolid Juvenile and Indeterminate. All planktonic species are combined in one category.

"X" in the total population charts indicates that the species is present in the sample but did not occur in the fraction of the sample that was counted.
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|----------------|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
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| FAUNAL DENSITY |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

**Distribution Frequency of Total Populations**

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**Distribution Frequency of Living Populations** (1 of 4)