LIVING AND FOSSIL REEF TYPES OF SOUTH FLORIDA

A Guidebook for Field Trip No. 3, Geological Society of America Convention; November 1964

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Convention; November, 1964; Field Trip No. 3

by

J. Edward Hoffmeister
James I. Jones
John D. Milliman
Donald R. Moore
H. Gray Multer

Additional copies of this guidebook are available from the Miami Geological Society, P.O. Box 344156, Miami, FL 33114.

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INTRODUCTION

Welcome to south Florida! We hope you enjoy your visit and that the trip we have planned for you will be both interesting and rewarding. The following outline of activities will give you an idea of what to anticipate and will introduce you to the various topics to be covered. We hope that the background information provided here will help make the trip more meaningful and enjoyable.

The south Florida area provides a unique opportunity for the geologist to compare and contrast Recent and ancient patterns of carbonate sedimentation and reef development. We will visit a variety of living reefs and Recent sedimentary environments, after which you will be shown their fossil counterparts. We will attempt to demonstrate the environmental and biological relationships of the various features which you will observe as an aid in interpreting similar features when encountered in the geologic record. The following discussion has been largely adapted from field-trip guides by Ginsburg and Milliman.

We wish to thank the American Association of Petroleum Geologists and the Geological Society of America for permission to reproduce the figures and tables used in this guidebook. Photographs are by J. Jones.

Personnel

J. Edward Hoffmeister

James I. Jones

John D. Milliman

Donald R. Moore

H. Gray Multer

Schedule

0800 Leave Deauville Hotel (front entrance) via Grayline Bus
0945 Arrive boat dock, Port Largo
1000 Leave boat dock, via M/V SEAFAN
1200 Lunch aboard SEAFAN
1300 Return dock
1330 Leave Port Largo via bus for outcrop stops in Upper and Middle Keys
2000 Arrive Deauville Hotel

DISCUSSION

Regional Setting

Peninsular Florida is located on the eastern side of a much larger submarine plateau as depicted in Figure 1. This platform, called the Floridian Plateau by Agassiz (1888), is surrounded by deeper water on three sides; on the east and southeast it is separated from the Bahama Banks and from Cuba by the narrow Straits of Florida, the floor of which deepens from about 750 meters below sea-level off Miami to 1500 meters or more between Key West and Havana, Cuba. The Florida Current, which becomes the Gulf Stream off Cape Hatteras, flows northward through this trough.

Our knowledge of the structure and origin of the Floridian Plateau is limited to the relatively few exploratory oil wells drilled on the Florida peninsula and the Florida Keys. From this stratigraphic information, Applin (1951) suggested that the peninsular part of the plateau was an area of non-deposition in post-Silurian Paleozoic time, and that its present structure is due to regional movements in the Mesozoic and Cenozoic.

The southeastern part of the plateau has long been an area of non-clastic deposition which has been subsiding differentially, as shown by the southward thickening of the Mesozoic and Cenozic section from the Ocala Uplift near the central part of the peninsula to near Key West (Figures 2 and 3). Pressler (1947) includes this southern part of the plateau with Cuba and the Bahamas

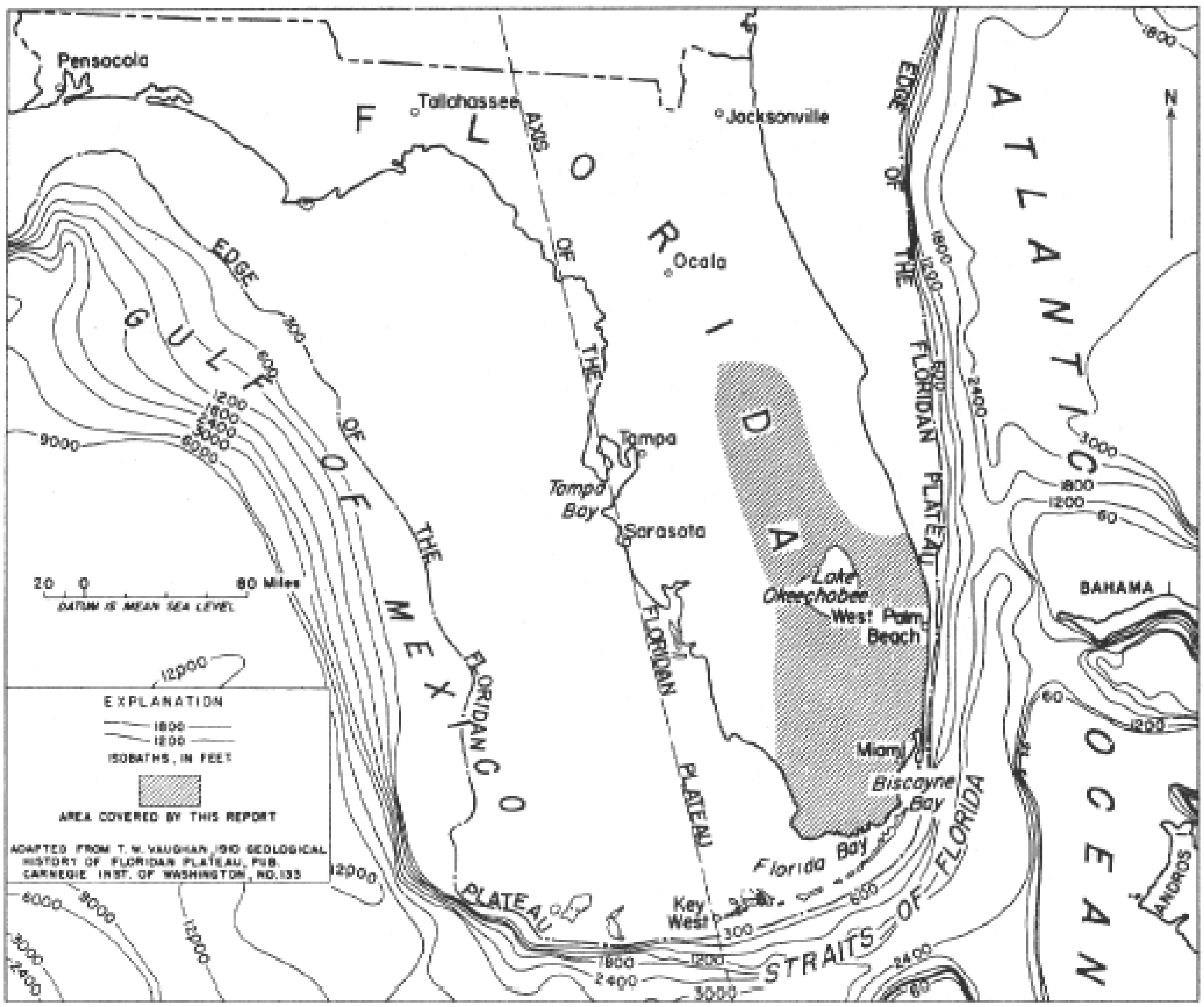


Figure 1. Florida and the Floridan Plateau
(after Parker, et al., 1955)

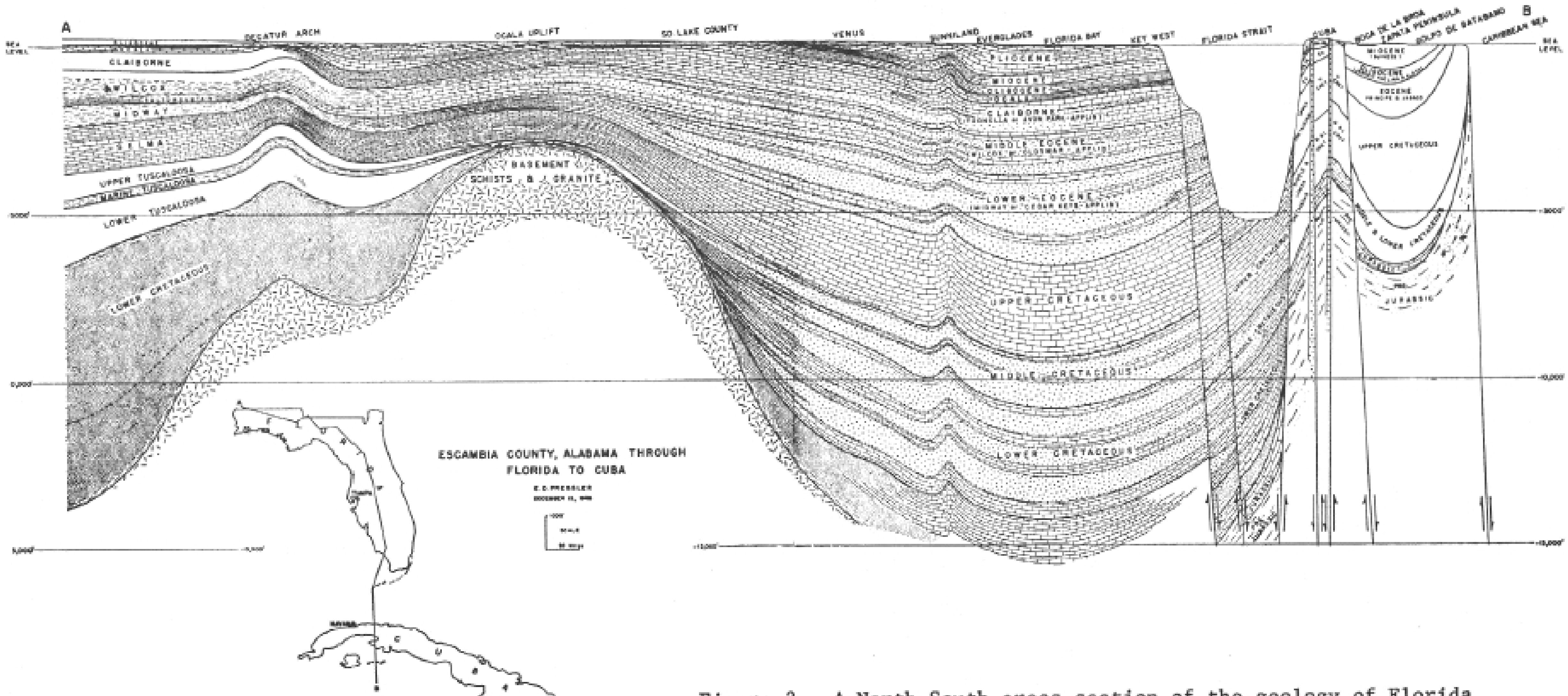


Figure 2. A North-South cross section of the geology of Florida (after Presseler, 1947)

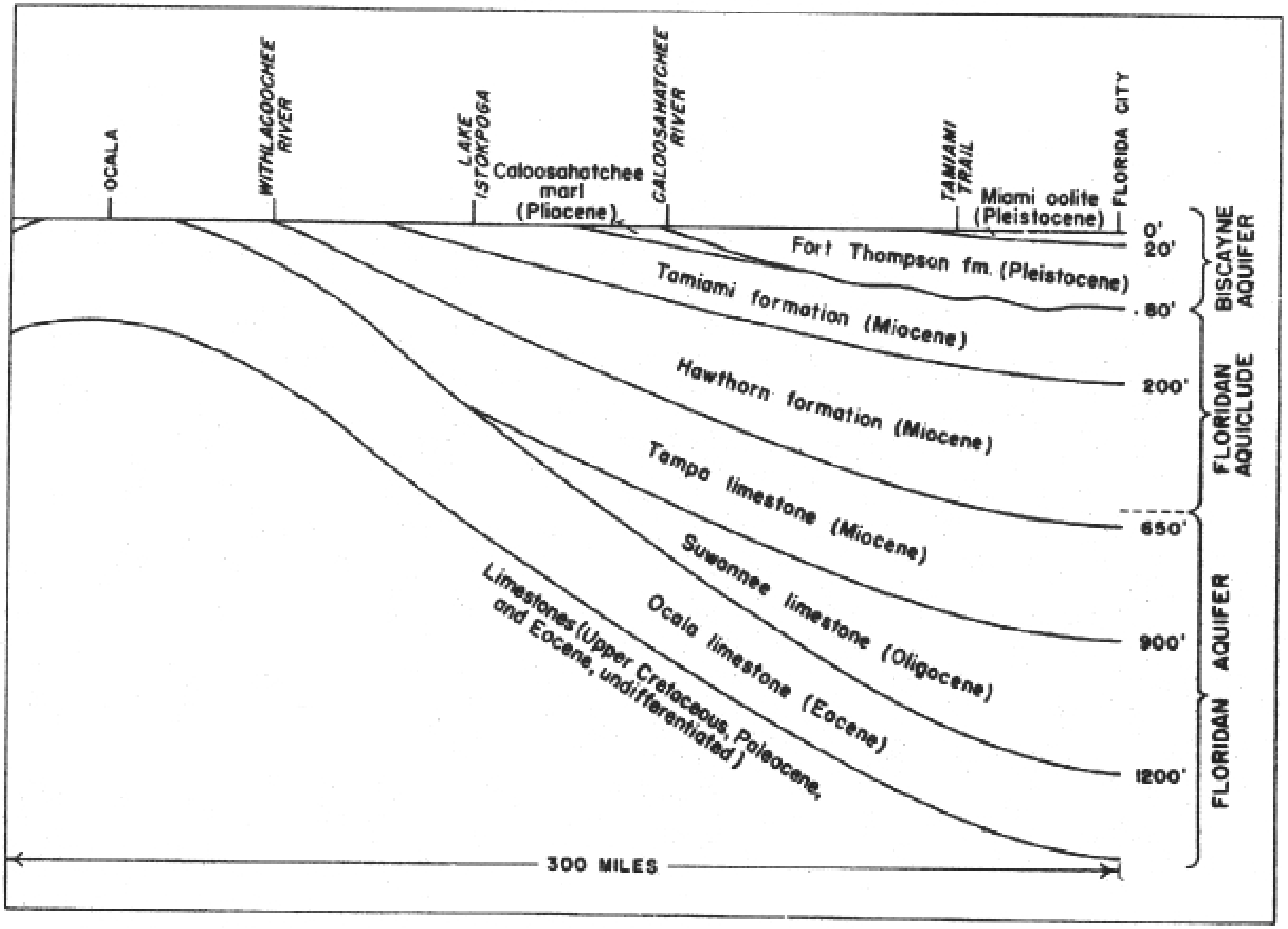


Figure 3. The geology of South Florida (after Parker, et al., 1955)

in what he called the South Florida Embayment. For further discussion of the subsurface stratigraphy see Pressler (1947) and Applin (1951). Table 1 (after Parker, et al, 1955) summarizes the stratigraphy of the region.

Bottom contours (Figure 4) show the existence of a crescent-shaped platform between Miami and Key West. This surface, which slopes gently from a depth of about 180 to 540 meters, is called the Pourtales Plateau. Bathymetric surveys of this area have disclosed the existence of what appear to be ancient sink holes near the outer edge of a terrace-like surface about 250 meters below sea-level off Key West (Jordan, 1954). These holes are one kilometer or more in diameter at the top and 140 to 170 meters deep. If they were formed subaerially, which is probable, the Pourtales Plateau is more likely due to subsidence or downfaulting (Shepard, 1948) than to erosion by the Florida Current.

From the examination of numerous dredgings in the Straits of Florida, Agassiz (1888) recognized three main bottom types in the Straits: (a) coral bottom or coral sand made up of the fragments of invertebrate skeletons, extending from the reefs to depths of about 100 fathoms; (b) the rocky bottom of the Pourtales Plateau at depths of 180 to 540 meters which consists of the debris of coral, mollusks, and echinoderms consolidated by serpulid worm tubes and coralline algae; and (c) the globigerina ooze of the deep trough of the Straits.

The Florida Keys

The Florida Keys are an arcuate chain of small islands which begin in the region of Miami and extend in a south - southwestern direction to Key West, a total distance of about 220 kilometers. Excluding the mangrove areas their average elevation is about 1 meter above sea-level and they reach a maximum height of 5.4 meters.

Age	Formation	Characteristics	Thickness (feet)
Recent and Pleistocene	Soils	Peat and muck, all Recent in age; laterite.	0-12
	Lake Flirt marl	White to gray calcareous mud rich with shells of *Helisoma* sp., a fresh-water gastropod. In places case-hardened to a dense limestone. Relatively impermeable.	0-6
Pleistocene	Pamlico sand	Quartz sand, white to black or red, depending upon nature of staining materials, very fine to coarse, averaging medium. Mantles large areas underlain by oolite and the Anastasia formation. Occurs in sand dunes and old beach ridges in elevations up to about 60 feet. Yields water to sand-point wells.	0-60
	High terrace deposits (including Penholoway and Talbot formations)	Principally unconsolidated quartz sand with intercalated clay and silt beds in places, especially the Kissimmee River area. Locally consolidated to scabby ferric sandstone. Generally permeable. Yields water to sand-point wells.	0-100
	Miami oolite	Limestone, soft, white to yellowish, containing streaks or thin layers of calcite, massive to cross-bedded and stratified; generally perforated with vertical solution holes. Fair to very high permeability.	0-40
	Anastasia formation	Coquina, sand, calcareous sandstone, sandy limestone, and shell marl. Composed of deposits equivalent in age to the marine members of Fort Thompson formation. Fair to high permeability.	0-100
(Contemporaneous in part)	Key Largo limestone	Coralline reef rock, ranging from hard and dense to soft and cavernous. Probably contemporaneous with the marine members of the Fort Thompson formation. Outcrops along southeastern coastline of Florida from Soldier Key in Biscayne Bay to Bahia Honda. Highly permeable.	0-60
	Fort Thompson formation	Alternating marine, brackish, and fresh-water marls, limestones, and sandstones. Very low permeability in the upper Everglades-Lake Okeechobee area, but it is the major component of the highly permeable Biscayne aquifer (see p. 160) of coastal Dade, Broward, and Palm Beach Counties, which yields copious supplies of ground water.	0-200
Pliocene	Caloosahatchee marl	Sandy marl, clay, silt, sand, and shell beds. Yields some water, in places under low artesian head, but is little used because of low permeability and generally poor quality of water, especially in the Everglades-Lake Okeechobee area. Not nearly so widely spread as was once believed but occurs chiefly as erosion remnants.	0-50
Miocene	Tamiami formation	Creamy-white limestone, and greenish-gray clayey and calcareous marl locally hardened to limestone, silty and shelly sands, and shell marl. Upper part, where permeability is high, is only a few feet thick, and, forms the lower part of Biscayne aquifer. Lower, and major part of the formation, is of low to very low permeability and forms the upper part of the Floridan aquiclude.	0-150
	Hawthorn formation	Sandy, phosphatic marl, interbedded with clay, shell marl, silt, and sand. Greenish colors predominate. Contains beds of flattened, well-worn quartzite and phosphate pebbles up to half an inch in greatest diameter. Water is generally scarce, of poor quality, and in the permeable beds is confined under low pressure head. Comprises the major part of the Floridan aquiclude.	50-500
	Tampa limestone	White to tan, soft to hard, often partially recrystallized limestone. Yields artesian water but not so freely as lower parts of the Floridan aquifer.	150-250
Oligocene	Suwannee limestone	Creamy, soft to hard limestone, similar lithologically to underlying Ocala limestone and often included with it in some earlier reports. With the Ocala, is part of the Floridan aquifer.	0-450
Eocene	Ocala limestone	White to cream, porous and cavernous to dense, in part cherty, in part highly foraminiferal, limestone. An excellent water-bearing formation, although the water is saline in large areas, especially south of Lake Okeechobee and along the Atlantic and Gulf coasts some distance northward. Principal component of the Floridan aquifer.	100-350
	Avon Park limestone	White to cream, foraminiferal limestone, with dark brown to tan crystalline to saccharoidal dolomite. Generally an excellent water-bearing formation and a part of the Floridan aquifer.	150-350
	Lake City limestone	Dark-brown dolomite and chalky limestone. Hydrologic characteristics imperfectly known. Probably a part of the Floridan aquifer.	200-250

Table 1. The geologic formations in South Florida (after Parker, et al., 1955)

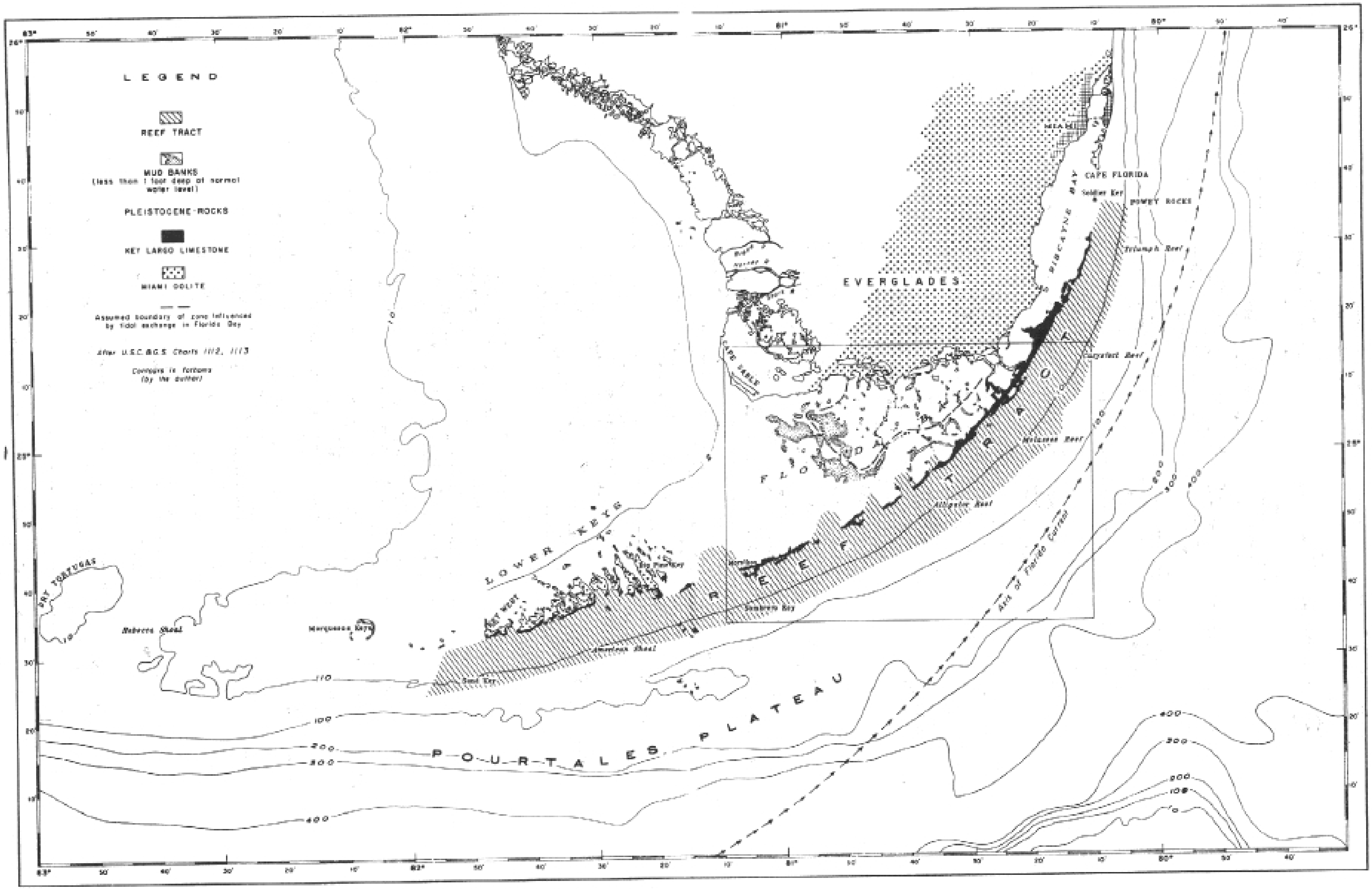


Figure 4. A chart of the Florida Keys (after Ginsburg, 1956)

It has long been known that the Keys are composed of two major lithologic units, the Key Largo Limestone and the Miami Oolite. The former has been traced at the surface from Soldier Key in the north through the Newfound Harbor Keys of the southern extension of Big Pine Key. The latter covers all the lower Keys from Big Pine through Key West.

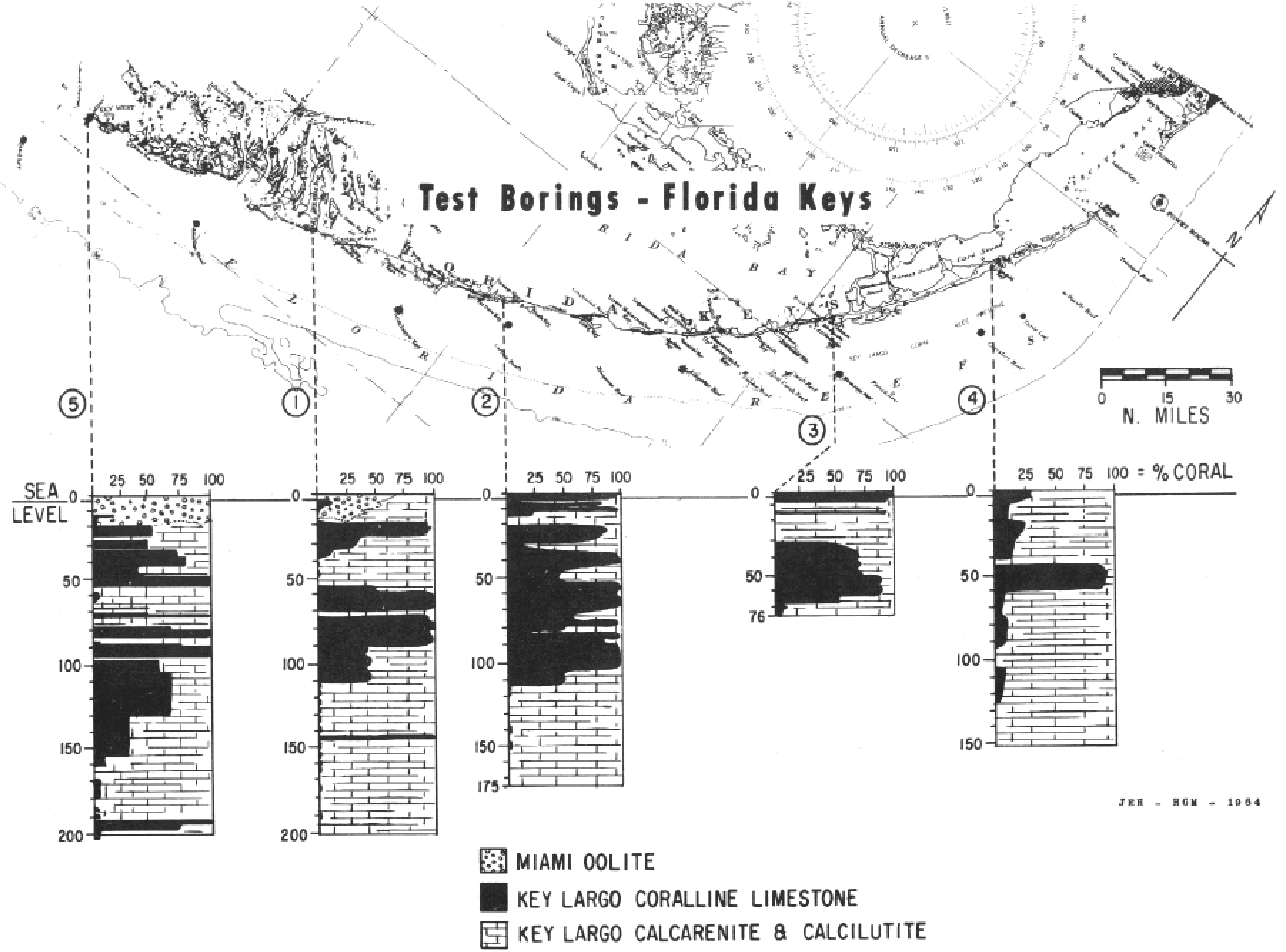
The Key Largo Formation

The Key Largo is an elevated coral reef of Pleistocene age. Its horizontal extent is now fairly well known by aerial examination and core borings (Figure 5). It underlies Miami Beach in the north, comes to the surface at Soldier Key and is again submerged beneath the Miami Oolite from Big Pine through Key West. In addition it has recently been found a few feet beneath sea-level along the eastern shore of the Florida mainland from Miami southward for at least 40 miles.

It varies considerably in thickness. At Key West and Big Pine Key it is at least 54 meters thick, at Grassy Key 51 meters, at middle Key Largo 21 meters and at the northern top of Key Largo 44 meters. Wherever its base has been located it rests on an unconsolidated quartz and calcareous sand.

Its composition is that of a typical coral reef with large, massive coral heads, many in place, surrounded by smaller coral colonies, shells and shell fragments of all sizes of common marine organisms. Reef building corals are found from top to near the bottom of the formation but in general are more prolific in the upper two-thirds than in the lower third. An indurated calcarenite of varied organic components is probably the most important rock by volume.

Probably the dominant coral species of the formation are *Montastrea annularis*, *Diploria clivosa*, *D. strigosa*, *D. labyrinthiformis* and several species of *Porites*. In addition *Acropora cervicornis* is prolific at several



Test Borings - Florida Keys
0 15 30
N. MILES
5
1
2
3
4
25 50 75 100 = % CORAL
SEA LEVEL
0
50
100
150
175
200
76
MIAMI OOLITE
KEY LARGO CORALLINE LIMESTONE
KEY LARGO CALCARENITE & CALCILUTITE
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EXPLANATION OF FIGURE 5.

MIAMI OOLITE

The Miami Oolite overlies and is in part contemporaneous with the Key Largo Limestone. It usually is a poorly cemented rock with variable amounts of mollusk debris. Individual aragonitic ooliths average .5 mm in diameter and are usually incompletely cemented at the points of grain contact by calcite.

KEY LARGO LIMESTONE

Preliminary binocular examination of outcrop samples and cores from the Key Largo Formation indicates three main lithologic types which are, in order of decreasing abundance, CALCARENITE, CORALLINE LIMESTONE, and CALCILUTITE. Variability within these units, sporadic occurrence as illustrated by the distribution of coralline limestone in Figure 5, and poor core recovery limit lateral correlation.

Calcarenite: This rock consists of varying amounts of mollusk debris, *Halimeda*, coralline algae, forams, bryozoans, coral and rock fragments bonded by microcrystalline and sparry calcite. Minor constituents include pellets, echinoid spines, sponge spicules, ooliths and worm tubes.

Coralline limestone: Large masses of coral in growth position or as detached fragments recrystallized to calcite occur as shown in Figure 5. *Montastrea*, *Diploria*, *Porites* and *Acropora* are the common genera. This limestone can be porous or dense with common boring mollusk holes and cavities often lined with drusy calcite or filled with varying amounts of sand-size debris.

Calcilutite: This dense rock made up of well cemented silt-clay size carbonate commonly displays pinpoint to finger-size holes. Limited amounts of skeletal hash are often present.

[1] NOTE: Rock estimates and descriptions made in Figure 5 based on continuous coring from test wells. However, since core recovery was usually less than 50% all information should be regarded as estimates only.

localities. Practically all the coral species found living today on the Florida reef tract can be recognized in the Key Largo. One notable exception is Acropora palmata. This species, commonly known as the Elkhorn coral, is one of the most prolific in the living reefs and as yet has never been located in the Key Largo.

The upper part of the Key Largo can be seen in many cuts, canals and boat slips found throughout the Keys. One of the best exposures is on Key Largo where a canal has been cut entirely thru the Key, from the Atlantic side to the Bay of Florida, exposing a maximum thickness of about 3 meters of the formation. Certainly one of the most striking features here is the presence of several huge colonies of Montastrea annularis which have been bisected exposing the internal structure of the specimens. These are undoubtedly in their original position of growth.

One of the best preserved of the colonies of Montastrea annularis stands 2.1 meters high and has a branch which measures 2.4 meters in length. It is interesting to estimate the time required to grow a specimen of this size. On the basis of a series of growth-rate experiments on Florida corals, Hoffmeister and Multer (1964) estimated that it required 230 years for the specimen to produce a length of 2.4 meters. The time required to produce the thickness of 2.1 meters of coral reef, including the coral, is a period of 250 to 500 years (Ibid.).

A quarry of the coral reef rock on Windley Key offers probably the best opportunity to examine the material at close range. The great bulk of the Key Largo Limestone is greatly altered and recrystallized. Some excellent specimens of well preserved corals can be found here. From these it has been determined, on the basis of the Thorium-Uranium ratio, that the apparent age of the upper part of the Key Largo Formation is about 100,000 years.

One of the most interesting types of lithology of the Key Largo is what has been called for want of a better name "holey limestone". This rock displays an unusual framework structure in which numerous large and irregularly shaped holes, which comprise 40 to 60 percent of the total volume, are present. The rock is found chiefly a few feet below sea-level and is brought to the surface in large quantities by dredges engaged in making cuts for boat slips and canals.

The origin of this rock has posed a difficult problem. Although it is believed to have been formed in more than one way it is now known that the accumulation of tremendous amounts of fragments of a thin branched *Porites* accounts for much of it.

The surface of both the Key Largo Limestone and the Miami Oolite is commonly protected by a laminated crust averaging about 3 centimeters in thickness. In places, however, it may be as much as 12 centimeters thick. It is believed that some of this may have been produced in the intertidal zone although laboratory experiments have demonstrated that similar crusts can form under subaerial conditions.

Both the Key Largo Limestone and the Miami Oolite have been greatly affected by solution. This has resulted in the formation of surface pits varying in size and shape. Many of the pits are occupied by solution breccias consisting of angular, calcareous fragments enclosed in a matrix of various colors. In general the fragments are composed of the material common to the bedrock although it is believed that some may have originated at some distance and were carried by wave action to their present position.

The stratigraphic relation between the Key Largo Limestone and Miami Oolite can be seen at a contact at the southeastern point of Big Pine Key. Here the Miami Oolite gently overlaps the old coral reef in a southern direction. The contact appears to be of a transitional character. No other surface contact has been seen in the lower Keys. However it is known that the oolite cover of these Keys is relatively thin, particularly along their southern borders. For example at Boca Chica and Stock Island it has a thickness of only 1 to 2 meters. The oolite cover appears to thicken gradually to the north; at the center of Key West it has a thickness of 6 meters.

Most writers have considered the Key Largo coral reef as having formed entirely during the Sangamon interglacial period of the Pleistocene. Parker, et al (1955), however, are inclined to the belief that it began its formation during the Aftonian and was added to during Yarmouth and Sangamon times. An unconformity found near sea-level on Key Largo strengthens the possibility of a prolonged history.

Major Environments, Florida Bay and Reef Tract

The discontinuous island barrier formed by the Pleistocene Key Largo reef separates the present band-shaped reef tract from a series of shallow bays and sounds. Table 2 compares the bathymetry, areal geography, and hydrography of these two areas. These differences were sufficiently large for Ginsburg (1956) to separate the area into two major environments, the reef tract and Florida Bay. The changes between the two are extremely rapid, consisting for the most part of narrow transition zones where channels and passages occur between the islands of the Florida Keys. Figure 6 shows the detailed geography of this area.

Marine Geology of the Reef Tract

For purposes of this discussion, a coral reef is defined as a bioherm in which the most visually obvious component is coral. In terms of biomass and productivity the algae contribute much more material than the entire

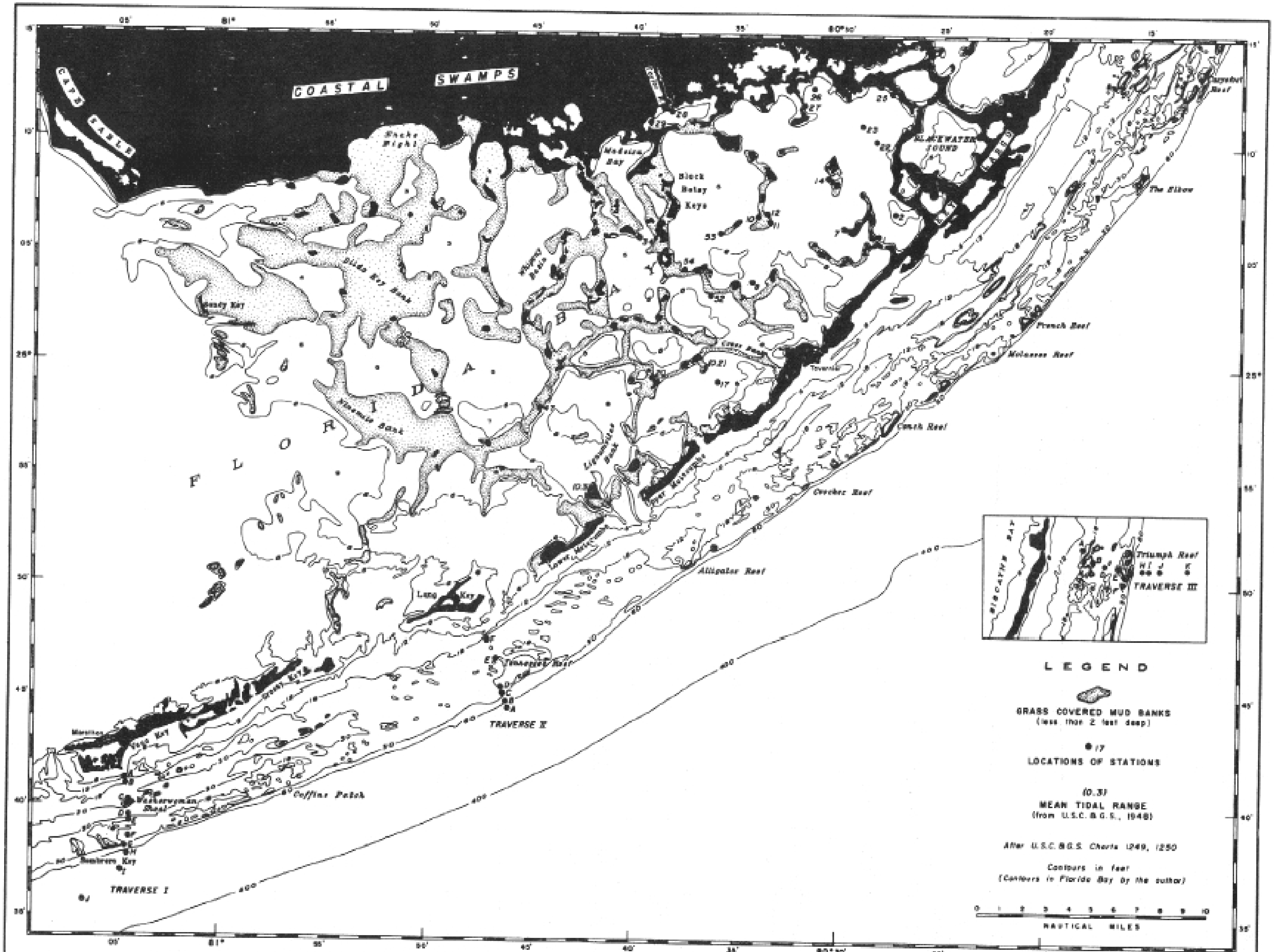

Figure 6. The upper Florida Keys, showing the Reef Tract and Florida Bay (after Ginsburg, 1956)

	Florida Bay	Reef Tract
BATHYMETRY		
Depth range	0-10 feet	0-300 feet
Maximum local relief	6 feet	30 feet
AREAL GEOGRAPHY		
Shape	Solid triangular	Arcuate band
HYDROGRAPHY		
Circulation	Restricted, periodic tides only on margins	Open, semi-diurnal tidal exchange with Florida Current
Variations in temperature and salinity		
Temperature	15°-40°C	15°-33°C
Salinity	10-40 °/₀₀	32-38 °/₀₀
Available plankton and nutrients	Low	Normal for tropical waters
Turbidity	Generally high	Periodically high only in lagoonal part

Table 2. The physical environments of the Reef Tract and Florida Bay (After Ginsburg, 1956)

animal population (Odum and Odum, 1955). From studies of reefs it seems apparent that the primary limiting environmental factors for coral growth are light, temperature, salinity, sediment, and currents. Temperature seems to be the main limiting factor, in that hermatypic corals can tolerate temperatures only above approximately 20°C, and are thus limited to the equatorial areas of the world. In the Atlantic some 26 genera with 35 species exist. Most of the Atlantic coral reefs are of the fringing type.

Two major geologic environments may be recognized in the south Florida area, the reef tract and Florida Bay. The outer reef tract consists of scattered platform reefs, related to the fringing reef type, but not continuous nor adjacent to land. The Key Largo Dry Rocks (Figure 7) are typical of this reef type, consisting of an outer edge rubble zone (fore reef) with generally coarse materials; a zone of Montastrea annularis with sporadic massive coral heads; a Millepora alcicornis zone; an Acropora palmata zone with strongly oriented representatives of this species; a reef-flat, and a back-reef.

The back-reef area may be subdivided into three main sub-environments: an area with a thin covering of ripple-marked sediment over rocks, an area with or without a thick covering of marine grasses or algae consisting of non-ripple-marked sediment (turtle grass, Thalassia testudinum, being the main type of grass), and areas of patch reefs.

Thalassia testudinum acts as a sedimentary baffle (Ginsburg and Lowenstam, 1958) and results in the generally finer nature of the sediments. Halimeda, mollusk shells, and fine carbonates increase in abundance towards the shore. The decrease in grain size landward of the outer reef can also be partially explained by the decrease in the influence of the waves and currents.

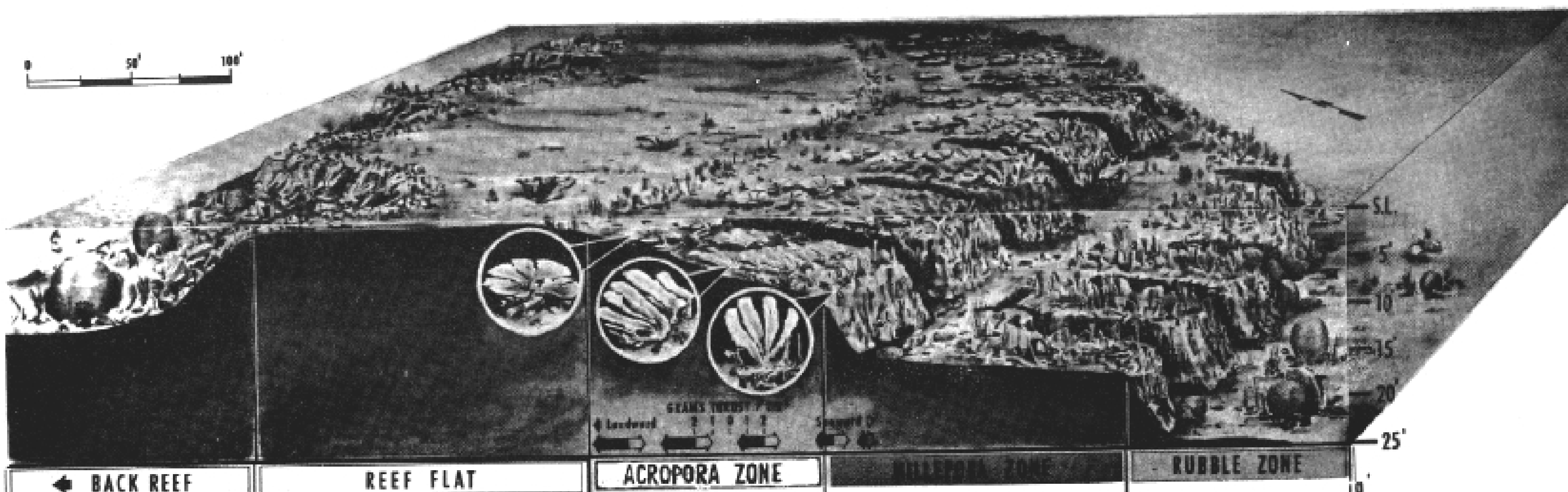

Figure 7. Block diagram of the Key Largo Dry Rocks, showing the ecologic zones and the major types of Acropora palmata growth forms (after Shinn, 1961)

Coral patches, commonly called patch reefs, are not uncommon in the lagoon. These are the principal areas where coral fragments are common in the lagoonal sediment.

Marine Geology of Florida Bay

Florida Bay consists of two major biotopes, the marginal area connecting the reef area with the Bay, and the Bay itself. The marginal area is very limited, occurring only in the cuts and passes through the Florida Keys. In these areas the coral genera _Porites_ and _Siderastrea_ occur in patches with many sponges and abundant algal forms. The carbonate banks in the Bay are covered mainly with mangroves, and mark a transition environment between marine and terrestrial conditions. These islands act as sediment traps, and once formed are self-perpetuating, gradually increasing in size and coalescing with other nearby islands. These keys and shoals have finer sediment than the bottom of the Bay, due to their more sheltered conditions. The mud flats consist primarily of algal laminated sediments. The binding cohesiveness of the algae add to the compaction and lamination of the muds. A similar method of origin has been postulated for the fossil features known as stromatolites and cryptozoan structures (Ginsburg, 1960).

The Field Trip

En route to the boat dock in the Upper Florida Keys the bus will traverse a portion of the Overseas Highway, which connects Key West with the Florida mainland. South of the city of Miami we will pass through an agricultural area where tomatoes, potatoes and beans are grown. Farther south we will cross a portion of the Florida Everglades before entering the Florida Keys at Key Largo. This journey affords an opportunity to observe the gradual change from a terrestrial to marine environment in this sub-tropical region, as well as the important effect the mangrove community exerts on sediment deposition in this area.

We will board the M/V SEAFAN at Port Largo, near the southern end of the island of Key Largo. The boat trip will take approximately three hours and will visit areas representative of the major biotopes characteristic of the Florida Keys. Following is a brief summary of the characteristic environmental and sedimentary situations, concluded by a list of the more common organisms found in each of the habitats.

The near-shore area is dominated by marine algae, predominantly sea grasses and calcareous types. Although the genus Halimeda is not the most abundant plant in the area, it is one of the primary sediment-producing plants and its plates form a large portion of the reef-tract sediment. Corals are not abundant in this zone, although some representatives of the genus Porites may be observed in association with the algae. Mollusks, echinoderms, sponges and a variety of worms also inhabit this environmental zone. In crossing from shore to the outer reef the grassy areas will appear green with areas of white coral sand between the grass patches.

The patch reefs will have a more brownish appearance, particularly in the shallows, than the grassy areas. The outer reef tract will also have this brownish color, characteristic of living coral. If a sea is running it will be marked by a breaker zone over the outer edge and reef flat.

A number of patch reefs will be crossed in the Mosquito Bank area, with ample opportunity to observe the variety of alcyonarian coral types which dominate this zone and also the massive corals which will become the primary fossil should these patches be preserved in the geologic record. At this and the other major zones sediment samples will be collected to illustrate the relationship existing between biotope and lithotope in this dominantly calcium carbonate depositional area. In examining the sediment samples and comparing them with the depositional environment the control of sediment type by the extant organisms will be obvious.

Several crossings of the outer reef tract will be made in the vicinity of Molasses Reef to provide maximum opportunity to observe the coral zonation patterns which occur in these reefs. Briefly, the following zones may be recognized: the back-reef, consisting of grass and sand patches, isolated colonies of massive corals near the reef flat, and a zone of *Acropora cervicornis* adjacent to the reef flat; the reef flat, consisting primarily of dead colonies of *Acropora palmata* with algal and other debris filling the interstices (we may not directly observe this zone due to the moderately deep draft of our vessel); the fore-reef, composed of a zone of living *Acropora palmata*, becoming strongly oriented in growth form off-shore from the reef flat and producing the spur and groove structures typical of many reef areas; a zone of *Millepora*, encrusting upon dead colonies (spurs) of *Acropora palmata*; a rubble zone, characterized by coarse coral sand and larger coral fragments; and a zone of ripple-marked coral sand with occasional massive coral heads, primarily species of the genus *Montastrea*. In particular the spur and groove structures, which have been shown by Shinn (1963) to be related to the growth orientation pattern of *Acropora palmata*, will be studied, as well as the rapid lateral and vertical environmental changes which are characteristic of reef areas.

The faunal diversity of the reef biota and associated sub-environments will be emphasized. Later in the day you will be given the opportunity to compare the living reef with its fossil counterpart on Key Largo, and to note the comparative simplicity of the preserved fauna in contrast to the biologic complexity of the living community.

Faunal Assemblage

The following lists of the dominant organisms found in each of the habitats observed are not meant to be complete. They do, however, contain most of the organisms which are commonly associated with each biotope.

Outer Reef Assemblage

Agaricia agaricites Acropora palmata Acropora cervicornis Montastrea annularis Montastrea cavernosa Siderastrea siderea Porites asteroides Diploria strigosa Diploria labyrinthiformis Millepora alcicornis (Hydrocoral)	Corals
Thais deltoidea Astrea caelata Conus regius Mitra nodulosa Vasum muricatum Corallophilla abbreviata	Mollusks
Diadema antillarum Eucidaris tribuloides	Sea Urchins
Sphyraena barracuda (fish)	
Panulirus argus	Spiny Lobster

Patch Reef Assemblage

Montastrea annularis Montastrea cavernosa Siderastrea siderea Diploria labyrinthiformis Palythoa mammilatus (encrusting soft coral) Antillogorgia acerosa (sea whip) Antillogorgia americana (sea whip) Pterogrogia anceps (sea whip) Plexaurella dichotoma (sea whip Gorgonia flabellum (sea fan)	Corals
Pecten sentus Calliostoma jujubinum Astrea tecta	Mollusks

Near-Shore Shallow Banks Assemblage

Porites furcata _Siderastrea radians_ _Manicina areolata_ _Favia fragum_ _Solenastrea hyades_	Corals
Thalassia testudinum _Syringodium filiforme_	Sea Grasses
Goniolithon strictum _Halimeda sp._	Calcareous Algae
Conus jaspidea _Cerithium floridana_ _Lima scabra_	Mollusks
Ircinia campana	Vase Sponge

Florida Bay Assemblage

Thalassia testudinum _Syringodium filiforme_	Sea Grasses
Caulerpa sp. _Gracilaria sp._ _Acetabularia crenulata_ _Digenia simplex_	Algae
Spheciospongia vesparia	Loggerhead Sponge
Pinctada radiata _Astraea tecta_ _Cerithium muscarum_ _Bittium varium_ _Conus spurius_	Mollusks

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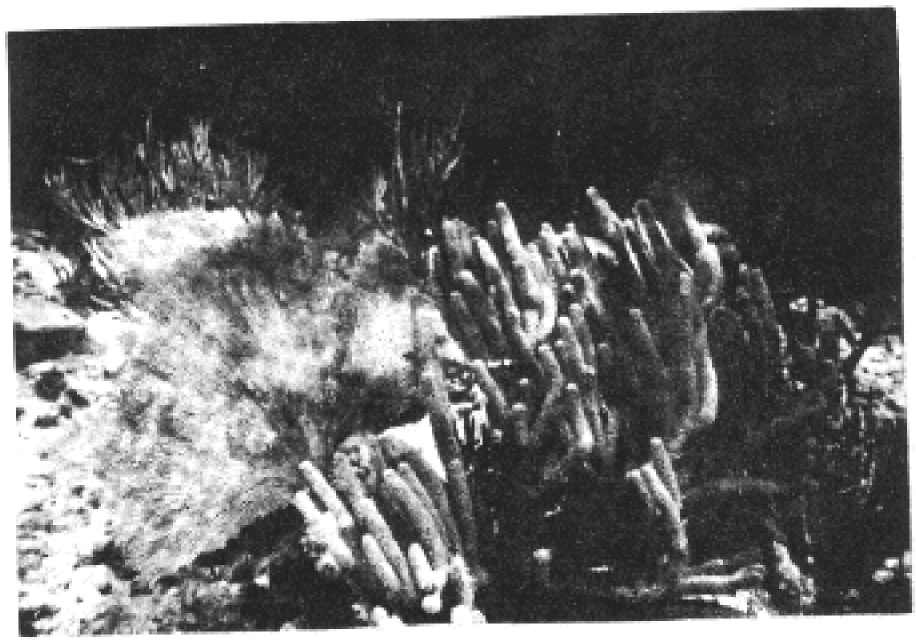

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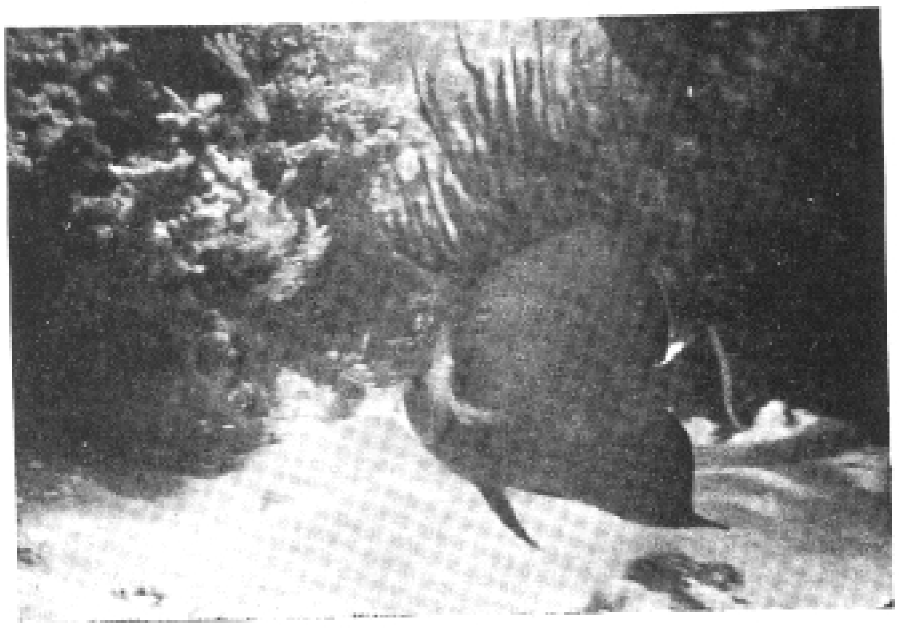

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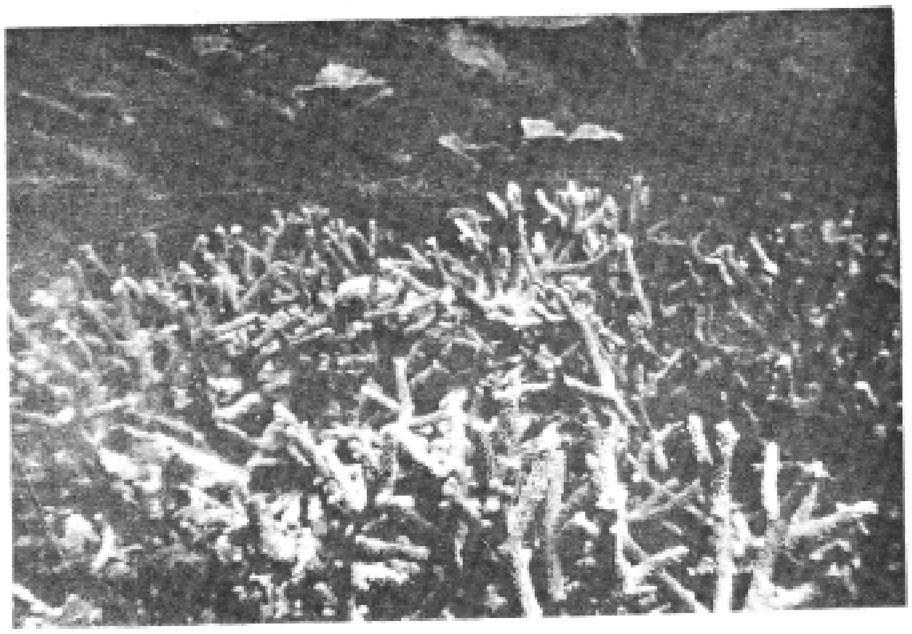

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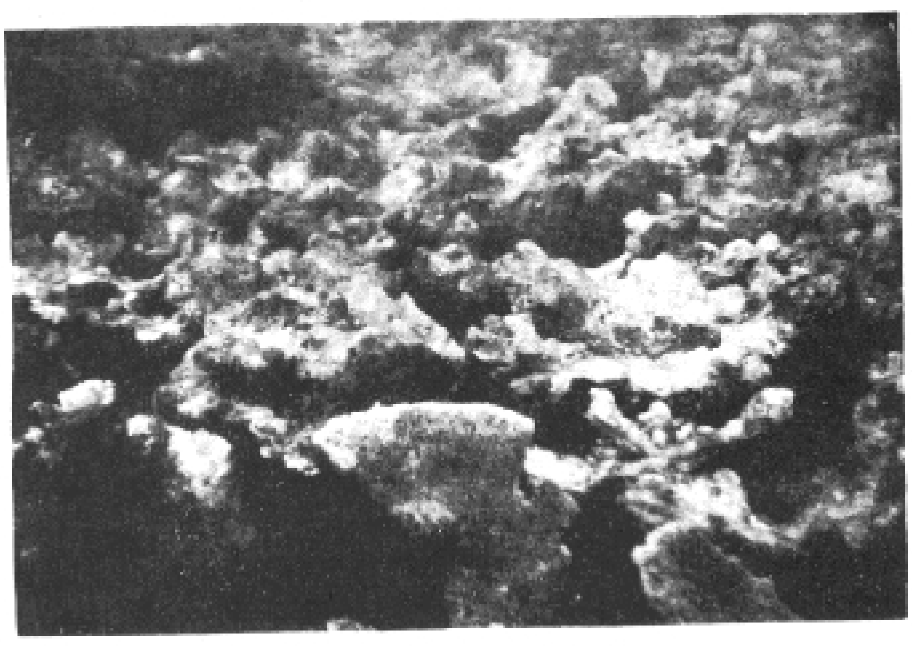

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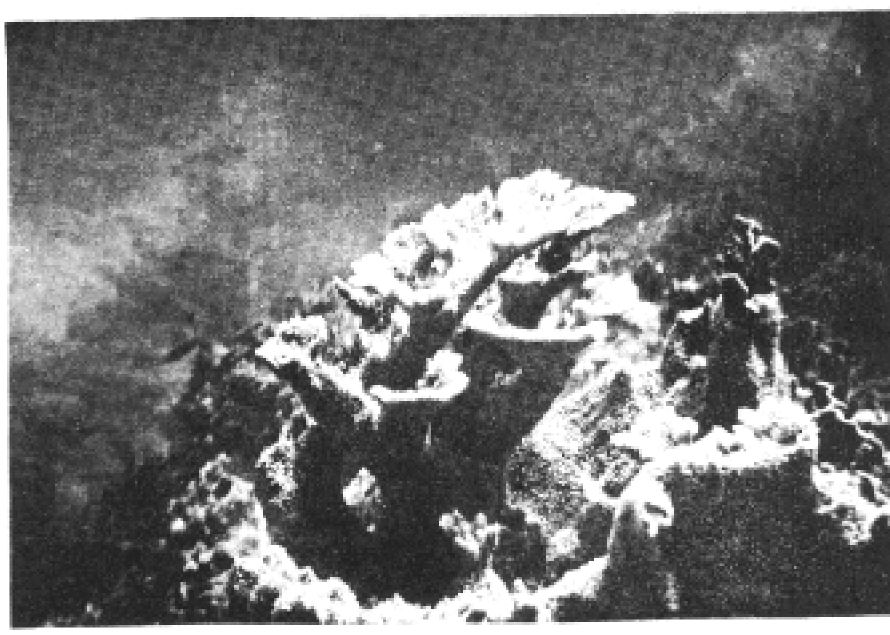

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PLATE 1

EXPLANATION OF PLATE I

Figure 1. Grass flats, Biscayne Bay; *Thalassia* - *Halimeda* community, Cowfish (*Lactophyrys tricornis*) in foreground; depth 2'.

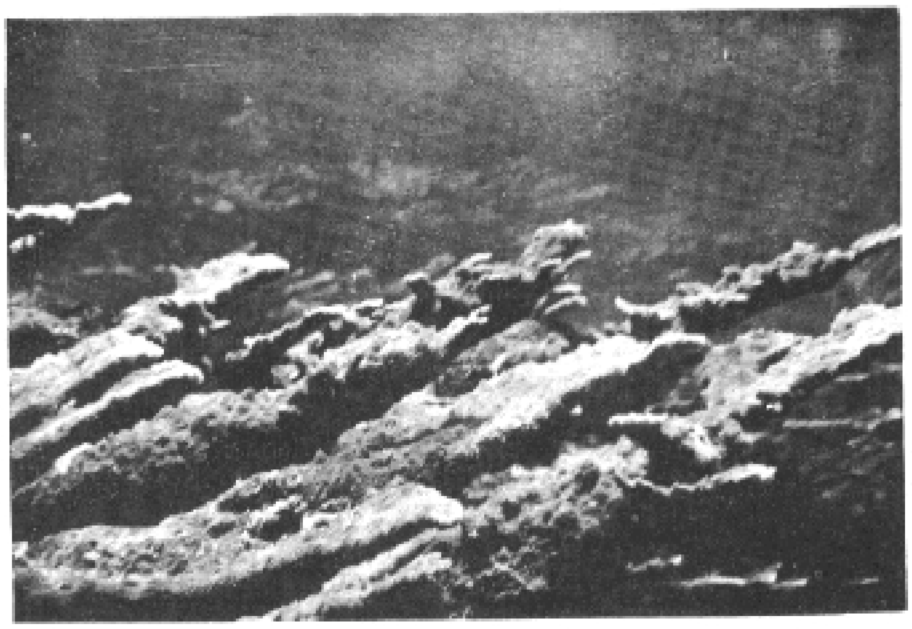
Figure 2. Patch reef community, Mosquito Bank area; *Eunicea sp.*, *Gorgonia flabellum*; depth 5'.

Figure 3. Ripple-marked coral sand bordering patch reef, Mosquito Bank area; Black Angelfish (*Pomacanthus arcuatus*) in foreground; depth 7'.

Figure 4. *Acropora cervicornis* zone, Carysfort Reef; depth 8'.

Figure 5. Reef flat, Key Largo Dry Rocks; *Acropora palmata* (mostly dead); depth 2'.

Figure 6. *Acropora palmata*, fore-reef area of Key Largo Dry Rocks; depth 6'.



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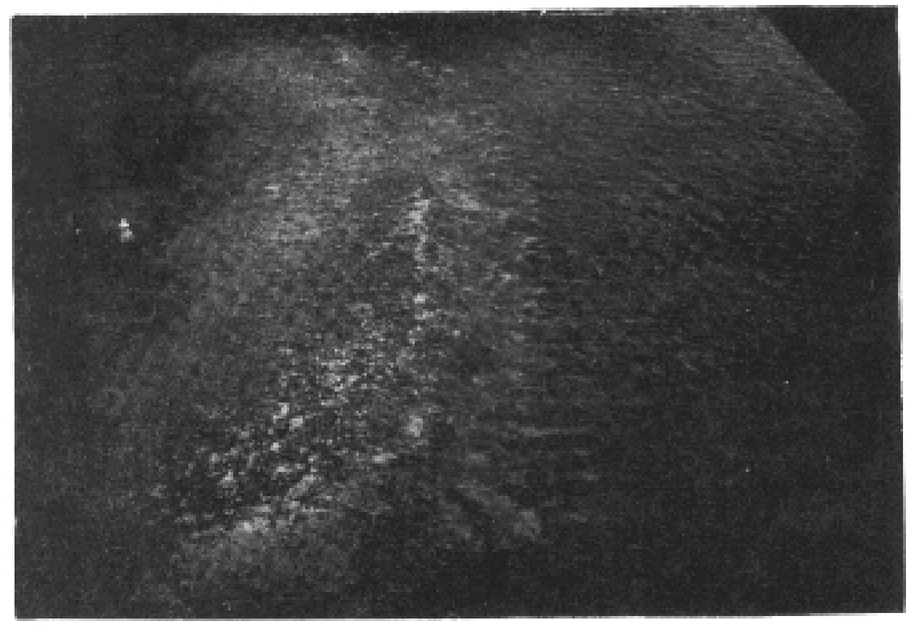

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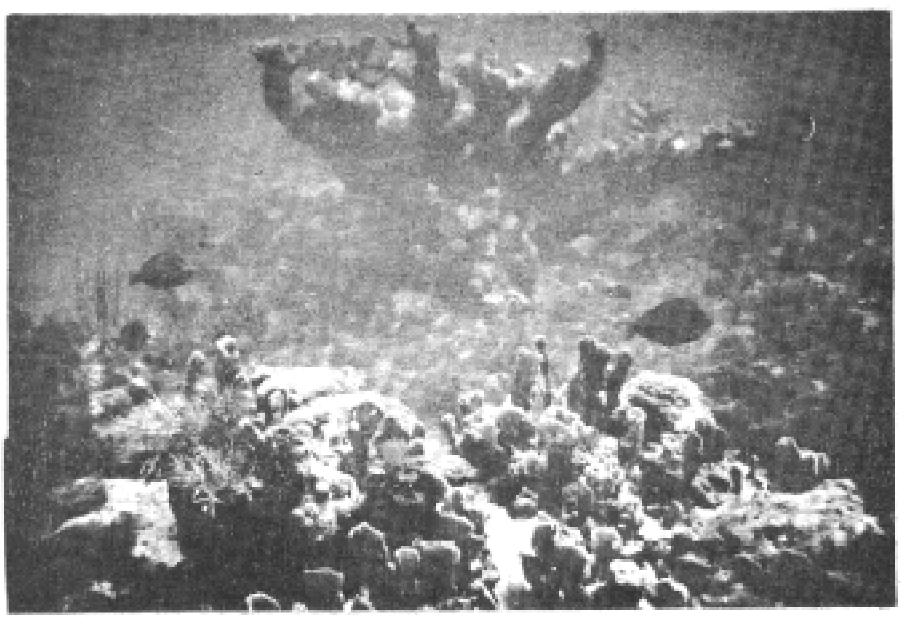

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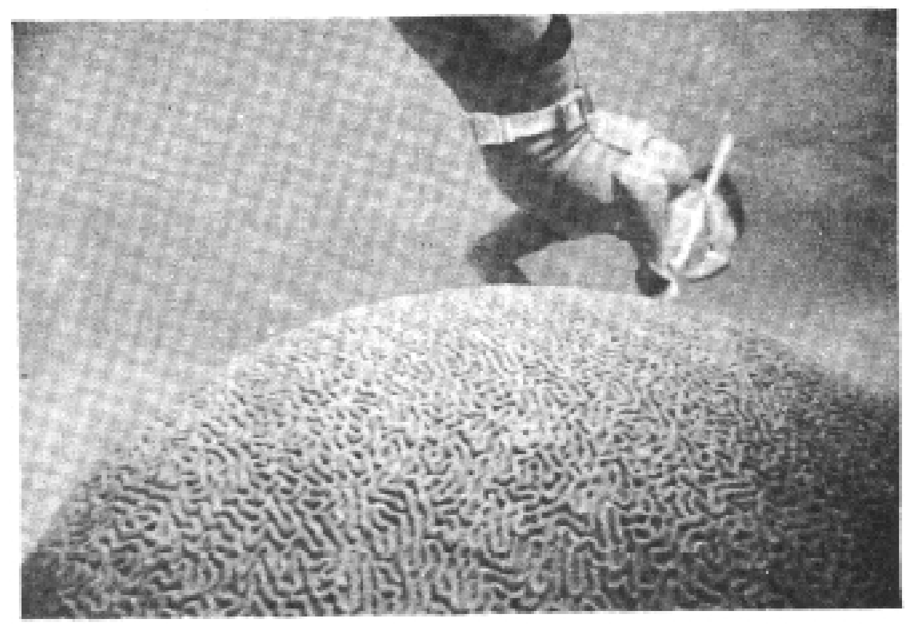

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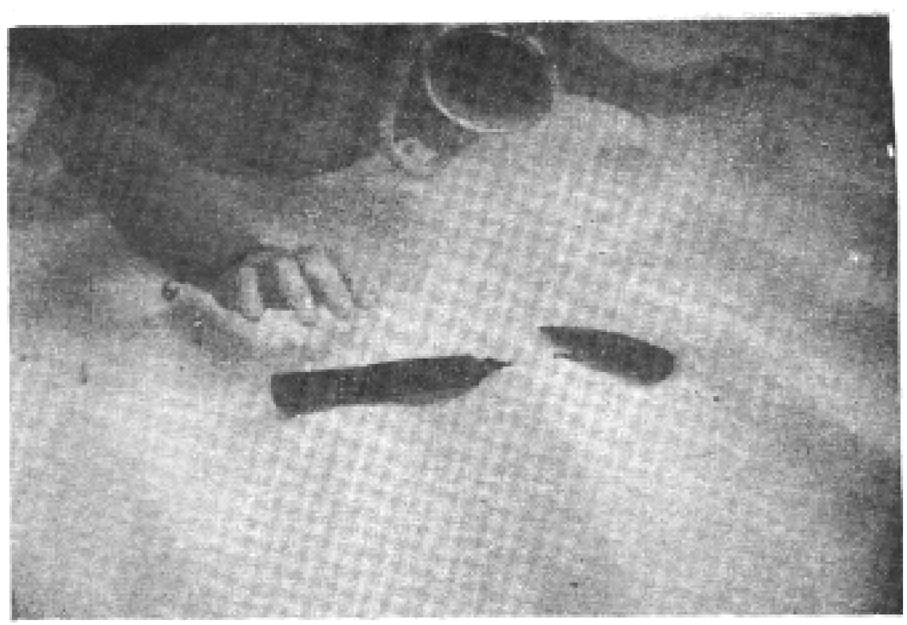

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PLATE 2

EXPLANATION OF PLATE II

Figure 1. Strongly oriented *Acropora palmata*, Molasses Reef; depth 12'.

Figure 2. Aerial view of Molasses Reef showing well developed spur and groove structures, fore-reef, reef flat and back-reef areas; from approximately 1500' altitude.

Figure 3. *Millepora* zone (foreground) with *Acropora palmata* zone in background, Key Largo Dry Rocks; depth 12'.

Figure 4. Massive colony of *Diploria labyrinthiformis* at outer edge of *Millepora* zone, Molasses Reef; depth 15'.

Figure 5. Rubble zone, Molasses Reef; depth 27'.

Figure 6. Ripple-marked sand, fore-reef area, Molasses Reef; depth 32'.

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