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PLEISTOCENE FORAMINIFERA OF THE GULF COAST

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CONTENTS

I. ABSTRACT

238 species and 21 subspecies of Foraminifera are identified in the Louisiana Pleistocene. Five species and three subspecies are new. Stratigraphic ranges of forms previously thought more restricted are emended. Sedimentary cycles are indicated by foraminiferal frequencies in cores from a well near the edge of the continental shelf. Trans-Atlantic correlation of Gulf Coast sediments is suggested by the discovery in coastal Louisiana wells of Calabrian index fossils.

II. INTRODUCTION

The purpose of this report is to record the species, frequencies, and associations of Foraminifera in samples from the Pleistocene of subsurface Louisiana. One hundred

forty-seven cores from the upper 4300 feet of a well drilled at the mouth of the Mississippi River near the edge of the continental shelf constituted the bulk of the material examined during this investigation (figure 1), but additional cores from other wells were also used as indicated in the notes on species.

A. Geologic Setting

Sedimentary cycles are evidenced in the subsurface marine Pleistocene of the Gulf Coast by the vertical distribution of foraminiferal tests and other constituents of the sediments. These cycles have been correlated with the alluvial terrace formations to the north in Louisiana by dense well control (Akers and Holck, 1957). The lowest cycle and the one which contains the greatest marine transgression, the Williana, is considered to represent Nebraskan and Aftonian time. However, there is disagreement on the subdivisions within the Pleistocene and the ages of the terraces, and Doering (1958) considers both the Williana and the overlying Bentley to be of pre-Nebraskan (Calabrian) age.

The Calabrian of the Italian Mediterranean region was formerly considered Pliocene. It was placed in the Pleistocene with the definition by the 18th International Geological Congress of the Plio-Pleistocene boundary as the "time of the first appearance of 'cold' northern species of marine invertebrates, including *Hyalinea balthica* (Schroeter), in the continuous Plio-Pleistocene sequences of Italy." As now defined, the Pleistocene of Europe contains deposits which antedate the Günz glaciations, and we would expect the thick, subsurface Gulf Coast section to contain beds of equivalent age (pre-Nebraskan Pleistocene or Calabrian). Our present study has disclosed evidence for such deposits with the identification of the "cool water immigrants," *Hyalinea balthica* (Schroeter) and *Globigerina inflata* d'Orbigny, near the mouth of the Mississippi river at depths in excess of 4200 feet. The base of the Pleistocene (base of Calabrian) in the South Pass Block 41 well may be at a depth of approximately 10,000 feet. The base of the Nebraskan is thought to be in the vicinity of 4200 feet. (Akers and Holck, 1957).

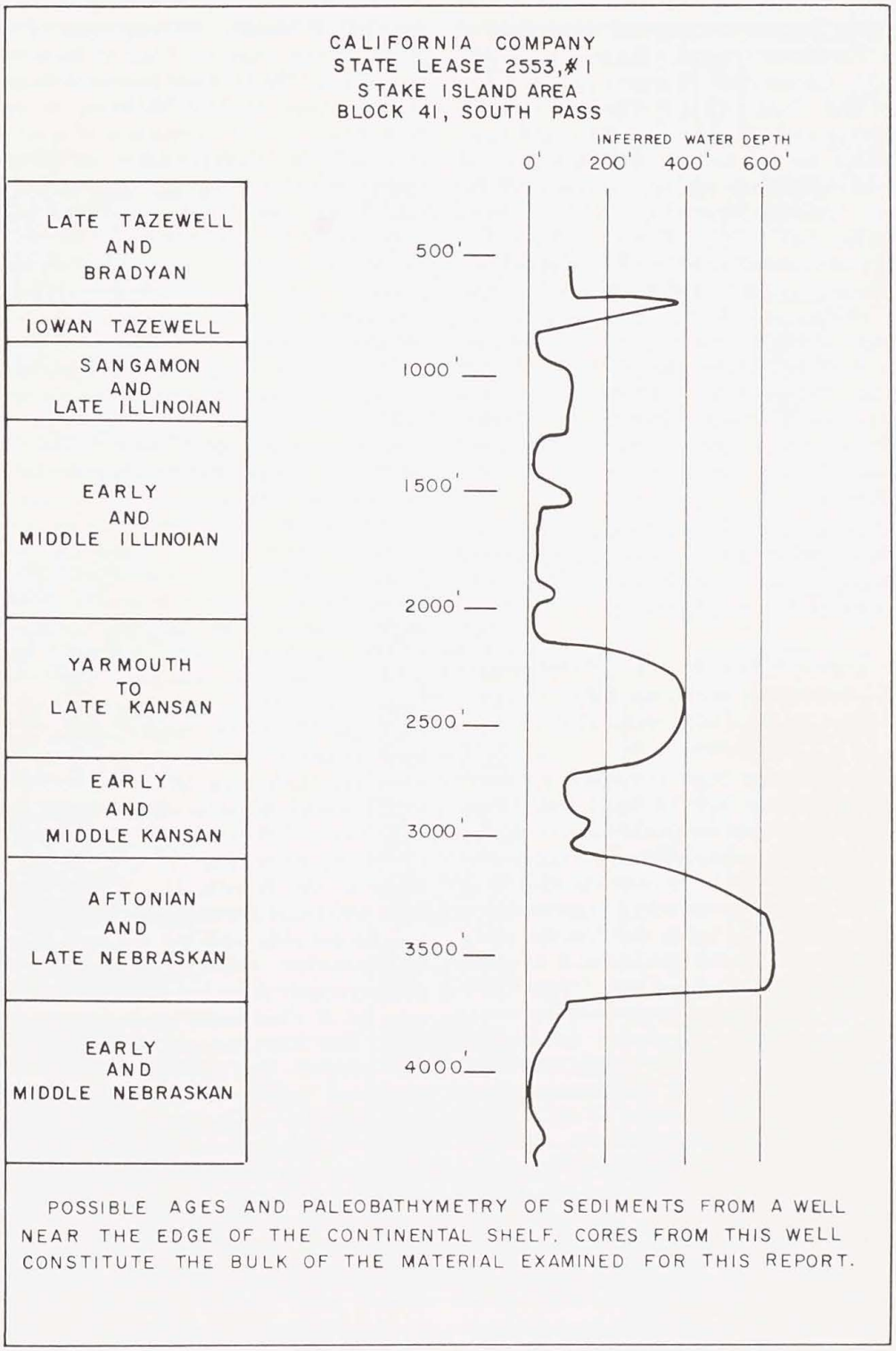
The presence of 10,000 feet of Quaternary sediments at the edge of the continental shelf of Louisiana is not surprising if one recalls that the strand line was farther inland during the long interglacial ages and that not only the present shelf area but some of the inshore areas received sediments and supported a marine environment. As a result of these conditions, "the most nearly complete record of Pleistocene history in this country should be found in the sediments of the Gulf Coastal area and the offshore continental shelf" (Trowbridge, 1954, p. 810).

Ranges of species from the section of possible Calabrian age, (the pre-Nebraskan Pleistocene of Doering, 1958), are not charted in our present study of Pleistocene Foraminifera.

B. Acknowledgments

This project was supported by The California Company. We are grateful to the other members of the Paleontology Staff of The California Company for suggestions and assistance. R. J. Drury and D. K. Cameron were particularly helpful with preparation of material. Alfred R. Loeblich, Jr., and Miss Ruth Todd loaned types from the United States National Museum. Miss Todd also compared types of some of the Recent and Miocene species. Comparisons facilitated by these individuals contributed to the taxonomic study and also to our understanding of foraminiferal ranges. Foraminiferal comparisons and identifications were aided by Recent and Tertiary samples from the Caribbean region, the Mediterranean region, and China. Some of these were made available to the senior writer during the past ten years by H. M. Bolli, Li-Sho Chang, M. B. Cita, B. L. Hill, Jr., H. V. Kaska, A. R. Loeblich, Jr., G. C. Munsey, Jr., C. M. Quigley, Jr., G. Ruggieri, and H. E. Stacy. Mr. E. Robinson of the Geological Survey of Jamaica assisted the senior writer for three days in the field, and it was possible by means of his cooperation to obtain assemblages from the younger Tertiary of Jamaica for comparison with our Pleistocene faunules.

Some phases of the work would have been delayed for years, and other phases could not have been accomplished at all, if previous results of taxonomic, ecologic, and stratigraphic investigations in the Gulf-Caribbean and Mediterranean regions had not been made available. The following significant publications are among these: For the Gulf Coast Foraminifera of Middle Tertiary to



POSSIBLE AGES AND PALEOBATHYMETRY OF SEDIMENTS FROM A WELL NEAR THE EDGE OF THE CONTINENTAL SHELF. CORES FROM THIS WELL CONSTITUTE THE BULK OF THE MATERIAL EXAMINED FOR THIS REPORT.

FIGURE 1

Pleistocene age, Cole (1931), Cushman (1918, 1930), and Cushman and Cahill (1933); for the Tertiary and Pleistocene of the Caribbean region, Bermudez (1949, 1950), Coryell and Rivero (1940), Cushman and Todd (1945), Drooger (1953), Galloway and Heminway (1941), and Renz (1948); for the Tertiary and Pleistocene of the Mediterranean region, Foraminiferi Padani (AGIP Mineraria, 1957), Ascoli (1957), Cita (1957), Colom (1946), Cuvillier and Szakall (1949), Dardenne (1954), d'Orbigny (1846), LeCalvez (1956), and Zei (1956); for Recent Foraminifera, Andersen (1961), Brady (1884), Cushman (1918-1931), d'Orbigny (1839), Parker (1954), Phleger (1955), Phleger and Parker (1951), and Phleger, Parker, and Peirson (1953). Other useful reports are cited within the text and are included in our bibliography.

This paper would not have gone to press without the insistence, encouragement, and editorial guidance of Professor Hubert C. Skinner of Tulane University.

III. Foraminifera as Age Determinants

A. Review of Methods; Problems in Application to Upper Cenozoic Sediments

Paleontologists have attempted to determine the relative ages of fossil assemblages by (1) comparing the percentages of Recent species in the assemblages; (2) comparing the number of species in common with those of other faunas (proportional species correlation); and (3) using the known stratigraphic ranges of the species as a standard. It is a fatuous assumption that Upper Cenozoic beds can be dated exclusively by means of the percentages of species in common with the Recent or by the proportional species correlation method. All three methods may be misleading because of (1) insufficient knowledge of both Recent and fossil faunas; (2) different opinions as to specific identification; and (3) inadequate understanding of the influence of ecologic factors.

All Cenozoic samples in our collection were examined, and a search of the literature was made in order to tabulate other occurrences of the Louisiana Pleistocene Foraminifera (figure 2). Comparisons of our Pleistocene Foraminifera with Tertiary and Recent species were made by means of the literature and by topotype material from Austria, France, Italy, Florida, Jamaica, and the Gulf of Mexico. Primary types of many of the species from the Gulf of Mexico and the Atlantic Ocean were borrowed from the United States National Museum. It should be pointed out that comparison of specimens with only the holotype and a few paratypes may be misleading and can result in synonymy. When possible, adequate topotype material should be examined for an understanding of the ranges of variation shown by any particular form. One of the most important conclusions reached from this study is that far more comprehensive studies of Foraminifera must be made both horizontally and vertically in order to understand the evolution and ecology of these organisms. This idea is in accord with Ager (1956) who holds that "geographical studies on the largest possible scale are essential to the true understanding of any fossil species and are the most likely lines of attack for the accurate unravelling of any fossil lineage." Comprehensive taxonomic studies of worldwide material, like that by Boltovskoy (1958) on *Melonis affine* (Reuss), are essential if we are to develop a more intelligible foraminiferal nomenclature.

Of the 221 forms charted, only 77 have been recorded in the literature on other Pleistocene sediments, 96 from the Pliocene of the world, 82 from the Miocene of the Gulf Coast, 125 from the Miocene of the Caribbean region, and 192 from Recent seas. Many of the Foraminifera herein recorded have previously been reported from Miocene and Recent sediments but not from Pliocene or Pleistocene, although some of the species previously described from deep-sea cores may be of Pleistocene age rather than Recent. This literature gap is largely due to the relative inaccessibility in the Gulf-Caribbean regions of Pliocene and Pleistocene deposits which contain these Foraminifera. Drilling on the continental shelf off Louisiana has disclosed Pleistocene facies favorable for filling the gap in the ranges of some of these Middle Tertiary to Recent species; the ranges of a few species have been extended from the Miocene to the Pleistocene; some species previously unknown, except in Recent sediments, are recorded from the Pleistocene; and a few previously undescribed species appear to be restricted to the Pleistocene.

GULF COAST PLEISTOCENE FORAMINIFERA	TYPE HORIZON AND TYPE LOCALITY	RECENT	OTHER PLEISTOCENE	PLIOCENE	MIOCENE		
					GULF COAST	CARIBBEAN	OTHER
PLANKTONIC							
GLOBIGERINA AEQUILATERALIS H. B. BRADY	RECENT; N. PACIFIC OCEAN	X	X	X	X	X	WORLD-WIDE
GLOBIGERINA ALTISPIRA ALTISPIRA CUSHMAN AND JARVIS	MIOCENE; JAMAICA		?	X	X	X	WORLD-WIDE
GLOBIGERINA BRADYI WIESNER	RECENT; SOUTHERN OCEAN	X			X	X	
GLOBIGERINA BULLOIDES D'ORBIGNY	RECENT; ADRIATIC SEA	X	X	X	X	X	WORLD-WIDE
GLOBIGERINA CONGLOBATA H. B. BRADY	RECENT; ATLANTIC OCEAN	X	X	X	X	X	ITALY
GLOBIGERINA EGGERI RHUMBLER	RECENT; ATLANTIC AND PACIFIC OCEANS	X	X	X			
GLOBIGERINA GLUTINATA EGGER	RECENT; OFF E. COAST OF BRAZIL	X	X	X	X	X	ITALY
GLOBIGERINA INFLATA D'ORBIGNY	RECENT; CANARY ISLANDS	X	X	X			
GLOBIGERINA PARKERAE (LOEBLICH AND TAPPAN)	RECENT; GULF OF MEXICO	X	X	X	X	X	
GLOBIGERINA RUBRA D'ORBIGNY	RECENT; WEST INDIES	X	X	X	X	X	WORLD-WIDE
GLOBIGERINA TRILOBA REUSS	TERTIARY; GERMANY	X	X	X	X	X	WORLD-WIDE
GLOBIGERINA UNIVERSA (D'ORBIGNY)	RECENT; ADRIATIC SEA	X	X	X	X	X	WORLD-WIDE
GLOBOROTALIA HIRSUTA (D'ORBIGNY)	RECENT; CANARY ISLANDS	X	X	X	X	X	ITALY, FIJI
GLOBOROTALIA MENARDII MENARDII (D'ORBIGNY)	RECENT; ADRIATIC SEA	X	X	X	X	X	WORLD-WIDE
GLOBOROTALIA MENARDII MIOCENICA D. K. PALMER	MIOCENE; JAMAICA		?	X	X	X	MOROCCO
GLOBOROTALIA MENARDII MULTICAMERATA CUSHMAN AND JARVIS	MIOCENE; JAMAICA		?	?	X	X	
GLOBOROTALIA MENARDII TUMIDA (H. B. BRADY)	RECENT?; BEACH, NEW GUIANA	X	X	X			TAIWAN
GLOBOROTALIA PUNCTULATA (D'ORBIGNY)	RECENT?; RIMINI, ITALY	X	X	X	X	X	ITALY, TAIWAN
GLOBOROTALIA TRUNCATULINOIDES (D'ORBIGNY)	RECENT; CANARY ISLANDS	X	X	X			
PULLENIATINA OBLIQUILOCULATA (PARKER AND JONES)	RECENT; ATLANTIC AND INDIAN OCEANS	X	X	X	?	X	
SPHAEROIDINELLA DEHISCENS (PARKER AND JONES)	RECENT; ATLANTIC OCEAN	X	X	X	X	X	
BENTHONIC							
AMPHISTEGINA LESSONII D'ORBIGNY	RECENT; L'ILE-DE-FRANCE	X	X	X	X	X	WORLD-WIDE
ARCHAIAS ANGULATUS (FICHTEL AND MOLL)	RECENT; MEDITERRANEAN (?), ARABIAN SEA	X	X	X	X	X	
ARTICULINA AURICULATA (EGGER)	RECENT; INDIAN OCEAN	X					
ARTICULINA MAYORI CUSHMAN	RECENT; DRY TORTUGAS ISLANDS	X			X		
ARTICULINA PAUCICOSTATA CUSHMAN	RECENT; OFF DRY TORTUGAS, FLA.	X					
ASTERIGERINA CARINATA D'ORBIGNY	RECENT; CUBA AND JAMAICA	X	X		X	X	
BIGENERINA IRREGULARIS PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
BIGENERINA TEXTULARIOIDEA (GOËS)	RECENT; PROBABLY CARIBBEAN	X	X	X	X	X	MALLORCA
BILOCULINELLA TODDAE ANDERSON							
BOLIVINA ACEROSA CUSHMAN	MIOCENE; DOMINICAN REPUBLIC		?	X		X	
BOLIVINA ALATA (SEGUENZA)	PLEISTOCENE; ITALY	X	X	X	X	X	ITALY, MALLORCA
BOLIVINA ALBATROSSI CUSHMAN	RECENT; ATLANTIC OCEAN	X				X	
BOLIVINA BARBATA PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
BOLIVINA CATANENSIS SEGUENZA	PLEISTOCENE; SICILY	X	X	X			MALLORCA
BOLIVINA DAGGARIUS PARKER	RECENT; GULF OF MEXICO	X					
BOLIVINA DIFFORMIS (WILLIAMSON)	RECENT; PROBABLY BRITISH ISLES	X	X				
BOLIVINA FRAGILIS PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
BOLIVINA GOESII CUSHMAN	RECENT; ATLANTIC OCEAN	X					
BOLIVINA HASTATA PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
BOLIVINA LOWMANI PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
BOLIVINA MINIMA PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
BOLIVINA ORDINARIA PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
BOLIVINA PACIFICA CUSHMAN AND MC CULLOCH	RECENT; PACIFIC OCEAN	X					
BOLIVINA PLICATELLA CUSHMAN	RECENT; ATLANTIC OCEAN	X	X	X	X	X	
BOLIVINA SPINATA CUSHMAN	RECENT; CARIBBEAN	X					
BOLIVINA SUBAENARIENSIS CUSHMAN	RECENT; ATLANTIC OCEAN	X	?				
BOLIVINA SUBAENARIENSIS LUCIDA AKERS AND DORMAN	PLEISTOCENE; LA. GULF COAST	X	?			?	
BOLIVINA SUBAENARIENSIS MEXICANA CUSHMAN	RECENT; GULF OF MEXICO	X		X		X	
BOLIVINA SUBSPINESCENS CUSHMAN	RECENT; ATLANTIC OCEAN	X					EGYPT
BOLIVINA THALMANNI RENZ	MIOCENE; VENEZUELA				X	X	
BOLIVINA TRANSLUCENS PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
BUCCELLA HANNAI PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
BULIMINA ACULEATA D'ORBIGNY	RECENT; ITALY	X		X		X	ITALY, MOROCCO, MALLORCA
BULIMINA ALAZANENSIS SPATIOSA CUSHMAN AND TODD	MIOCENE; JAMAICA					X	
BULIMINA MARGINATA D'ORBIGNY	RECENT; RIMINI, ITALY	X	X	X	X	X	ITALY
BULIMINA PATAGONICA D'ORBIGNY	RECENT; BAY OF SAN-BLAS, ARGENTINA	X					
BULIMINA SPICATA PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
BULIMINA STRIATA MEXICANA CUSHMAN	RECENT; ATLANTIC OCEAN	X				X	
BULIMINELLA ELEGANTISSIMA D'ORBIGNY	RECENT; W. COAST OF S. AMERICA	X	X	X	X	X	OFF W. COAST OF S. AMERICA
CANCRIS SAGRA (D'ORBIGNY)	RECENT; CUBA AND JAMAICA	X	X	X	X	X	
CASSIDULINA CARINATA SILVESTRI	PLIOCENE; ITALY	X	X	X	X		ITALY
CASSIDULINA CRASSA D'ORBIGNY	RECENT; FALKLAND ISLANDS	X	X	X	X	X	ITALY, AUSTRIA
CASSIDULINA CURVATA PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
CASSIDULINA LAEVIGATA D'ORBIGNY	NOT GIVEN	X	X	X	X	X	CALIFORNIA, ITALY
CASSIDULINA NORCROSSI AUSTRALIS PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
CASSIDULINA SUBGLOBOSA H. B. BRADY	RECENT; NOT GIVEN	X	X	X	X	X	ITALY, MOROCCO
CIBICIDES IO CUSHMAN	RECENT; W. COAST OF PATAGONIA	X		X	X	X	
CIBICIDES NUCLEATUS (SEGUENZA)	MIOCENE; ITALY	X			X	X	ITALY, BALEARIC ISLANDS
CIBICIDES UMBONATUS PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
CLAVULINA MEXICANA CUSHMAN	RECENT; GULF OF MEXICO	X				X	CALIFORNIA, FRANCE
CUNEOLINA ANGUSTA CUSHMAN	MIOCENE; JAMAICA	X				X	
CYCLAMMINA CANCELLATA H. B. BRADY	RECENT; NOT GIVEN	X		X	X	X	WORLD-WIDE
CYCLOGYRA PLANORBIS (SCHULTZE)	RECENT; COAST OF MOZAMBIQUE	X					

FIGURE 2—Geographic and Stratigraphic Occurrence of Louisiana Pleistocene Foraminifera

GULF COAST PLEISTOCENE FORAMINIFERA	TYPE HORIZON AND TYPE LOCALITY	RECENT	OTHER PLEISTOCENE	PLIOCENE	MIOCENE		
					GULF COAST	CARIBBEAN	OTHER
DENTALINA VERTEBRALIS ALBATROSSI (CUSHMAN)	RECENT; GULF OF MEXICO	X				X	MALLORCA
DENTALINA COMMUNIS D'ORBIGNY	RECENT; ADRIATIC SEA	X	X	X	X	X	MALLORCA, MORROCCO
ELPHIDIUM DISCOIDALE (D'ORBIGNY)	RECENT; CUBA AND JAMAICA	X	?	?		X	
ELPHIDIUM FIMBRIATULUM (CUSHMAN)	PLIOCENE; FLORIDA	X	X	X	X	X	
ELPHIDIUM POEYANUM (D'ORBIGNY)	RECENT; CUBA AND JAMAICA	X	X	X	X	X	
ELPHIDIUM SAGRUM (D'ORBIGNY)	RECENT; CUBA	X	X	X	X	X	
EPISTOMINELLA VITREA PARKER	RECENT; GULF OF MEXICO	X		X			
EPONIDELLA GARDENISLANDENSIS AKERS	RECENT; GULF OF MEXICO	X					
FRONDICULARIA SAGITTULA VANDEN BROECK	RECENT; WEST INDIES	X				X	
FURSENKOINA COMPLANATA (EGGER)	RECENT; OFF WESTERN AUSTRAILIA	X	X	X		X	
FURSENKOINA FINISSIMA AKERS AND DORMAN	PLEISTOCENE; LA. GULF COAST						
FURSENKOINA MEXICANA (CUSHMAN)	RECENT; GULF OF MEXICO	X					
FURSENKOINA PONTONI (CUSHMAN)	MIOCENE; FLORIDA	X			X	X	CALIFORNIA
FURSENKOINA SCHREIBERSIANA (CZJZEK)	MIOCENE; VIENNA BASIN	X	X	X	?	?	CALIFORNIA; ITALY
GAUDRYINA ARQUA CUSHMAN	RECENT; ATLANTIC OCEAN	X					
GAUDRYINA (PSEUDOGAUDRYINA) ATLANTICA (BAILEY)	RECENT; ATLANTIC OCEAN	X	?		X	X	
GLOBOBULIMINA AFFINIS (D'ORBIGNY)	RECENT; CUBA	X	X	X		X	ITALY, MALLORCA
GLOBOBULIMINA MISSISSIPPIENSIS PARKER	RECENT; GULF OF MEXICO	X					
GLOBULINA CARIBAEA D'ORBIGNY	RECENT; CUBA	X					
GUTTULINA AUSTRALIS (D'ORBIGNY)	RECENT; BAY OF SAN-BLAS, ARGENTINA	X					MARYLAND, S. CAROLINA
GUTTULINA PULCHELLA D'ORBIGNY	RECENT; CUBA AND MARTINIQUE	X		X			
GYPSINA VESICULARIS (PARKER AND JONES)	PROBABLY RECENT; NOT GIVEN	X			X	X	
GYROIDINA NEOSOLDANII BROTZEN	RECENT; S. PACIFIC, N. PACIFIC	X	X	X			ITALY
GYROIDINA ORBICULARIS D'ORBIGNY	RECENT; ADRIATIC SEA, NEAR RIMINI	X					VIRGINIA
GYROIDINOIDES REGULARIS (PHLEGER AND PARKER)	RECENT; GULF OF MEXICO	X					
GYROIDINOIDES SOLDANII ALTIFORMIS (R. E. AND K. C. STEWART)	PLIOCENE; CALIFORNIA	X		X	X	X	ITALY
HANZAWAIA CONCENTRICA (CUSHMAN)	MIOCENE; FLORIDA	X	X	X	X	X	
HANZAWAIA STRATTONI (APPLIN)	MIOCENE; LOUISIANA	X			X	?	
HAUERINA NACCHARA AKERS AND DORMAN	PLEISTOCENE; LA. GULF COAST						
HÖGLUNDINA ELEGANS (D'ORBIGNY)	NOT GIVEN; PLIOCENE, ITALY?	X	X	X		X	MEDITERRANEAN REGION
HYALINEA BALTHICA (SCHROETER)	RECENT; BALTIC SEA	X	X				
KARRERIELLA BRADYI (CUSHMAN)	RECENT; ATLANTIC OCEAN	X	X	X	X	X	BALEARIC ISLANDS, ITALY
KARRERIELLA CYCLOSTOMATA SINUATA AKERS AND DORMAN	PLEISTOCENE; LA. GULF COAST						
LAGENA GRACILLIMA (SEGUENZA)	MIOCENE; SICILY	X		X			SICILY, ITALY
LAGENA GRACILLIMA MOLLIS CUSHMAN	RECENT; CASCO BAY, MAINE	X					
LAGENA HEXAGONA (WILLIAMSON)	RECENT; ENGLAND	X	X	X	X	X	ITALY
LAGENA STRIATA (D'ORBIGNY)	RECENT; FALKLAND ISLANDS	X	X	X	X	X	MEDITERRANEAN REGION
LAGENA SULCATA SPICATA CUSHMAN AND MC CULLOCH	RECENT; PACIFIC OCEAN	X					
LENTICULINA BOWDENENSIS (CUSHMAN)	MIOCENE; JAMAICA	X				X	
LENTICULINA CALCAR (LINNÉ)	RECENT; ADRIATIC SEA	X	X	X	X	X	WORLD-WIDE
LENTICULINA CULTRATUS(MONTFORT)	PLIOCENE; ITALY	X	X	X	X	X	MEDITERRANEAN REGION
LENTICULINA LUCIDUS (CUSHMAN)	RECENT; ATLANTIC OCEAN	X				X	
LENTICULINA MELVILLI(CUSHMAN AND RENZ)	MIOCENE; VENEZUELA					X	
LENTICULINA OCCIDENTALIS (CUSHMAN)	RECENT; N. ATLANTIC OCEAN	X					
LENTICULINA ORBICULARIS (D'ORBIGNY)	TERTIARY; ITALY	X	X	X	X	X	ITALY, MOROCCO
LENTICULINA PEREGRINA (SCHWAGER)	MIOCENE; KAR NIKOBAR	X		X		X	JAPAN, ITALY
LENTICULINA ROTULATUS (LAMARCK)	TERTIARY; FRANCE	X	X	X	X	X	ITALY; MOROCCO
LENTICULINA SENNI LACRIMATUS AKERS AND DORMAN	PLEISTOCENE; LA. GULF COAST						
LIEBUSELLA SOLDANII (JONES AND PARKER)	MIOCENE; SANTA DOMINGO	X				X	FRANCE
MARGINULINA BASISPINOSA CUSHMAN AND RENZ	MIOCENE; VENEZUELA					X	
MARGINULINA GLABRA D'ORBIGNY	PLIOCENE; SIENNA, ITALY	X	X	X	X	?	ITALY, MOROCCO
MARGINULINA MARGINULINOIDES (GOËS)	RECENT; GULF OF MEXICO	X					
MARGINULINA SUBACULEATA GLABRATA (CUSHMAN)	RECENT; GULF OF MEXICO	X				X	
MARGINULINA SUBLITUUS MULTICAMERATA CUSHMAN AND STAINFORTH	MIOCENE; TRINIDAD					X	
MELONIS AFFINE (REUSS)	OLIGOCENE; GERMANY	X	X	X	X	X	WORLD-WIDE
NEOEPONIDES CORYELLI (PALMER)	MIOCENE; JAMAICA					X	
NEOEPONIDES PARANTILLARUM (GALLOWAY AND HEMINWAY)	MIOCENE; PUERTO RICO		X			X	
NEOEPONIDES TUMIDULUS (H. B. BRADY)	RECENT; S. ATLANTIC OCEAN	X					
NEOEPONIDES TURGIDUS (PHLEGER AND PARKER)	RECENT; GULF OF MEXICO	X					
NODOBACULARIELLA ATLANTICA CUSHMAN AND HANZAWA	RECENT; ATLANTIC OCEAN	X					
NODOBACULARIELLA CASSIS (D'ORBIGNY)	RECENT; SHORE SANDS, CUBA	X		X	X	X	
NODOSARIA COMATULA CUSHMAN	RECENT; GULF OF MEXICO	X			X	X	
NODOSARIA FUSTA CUSHMAN AND TODD	MIOCENE; JAMAICA					X	
NODOSARIA HISPIDA D'ORBIGNY	TERTIARY; AUSTRIA	X	X	X	X	X	MOROCCO, FRANCE
NODOSARIA PYRULA D'ORBIGNY	PLIOCENE; SIENNA, ITALY	X		X		X	CALIFORNIA
NODOSARELLA GRACILLIMA (CUSHMAN AND JARVIS)	MIOCENE; TRINIDAD					X	
NONION GRATELOUPI (D'ORBIGNY)	RECENT; CUBA	X	X	X	X	X	FRANCE
NONIONELLA ATLANTICA CUSHMAN	RECENT; ATLANTIC OCEAN	X	X			X	
NONIONELLA OPIMA CUSHMAN	RECENT; ATLANTIC OCEAN	X					
ORIDORSALIS UMBONATUS ECUADORENSIS (GALLOWAY AND MORREY)	EOCENE?; ECUADOR	X		X	X	X	ITALY
PAVONINA ATLANTICA CUSHMAN	RECENT; ATLANTIC OCEAN	X			X	X	
PENEROPLIS PROTEUS D'ORBIGNY	RECENT; CUBA AND JAMAICA	X	X	X	X	X	
PLANORBULINA MEDITERRANENSIS D'ORBIGNY	RECENT; MEDITERRANEAN COAST	X	X	X	X	X	ITALY, MALLORCA, AUSTRIA
PLANULARIA QUASITRINAE AKERS AND DORMAN	PLEISTOCENE; LA. GULF COAST						
PLANULINA EXORNA PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
PLANULINA FOVEOLATA (H. B. BRADY)	RECENT; BERMUDA	X				X	
PLANULINA WUELLERSTORFI (SCHWAGER)	MIOCENE; KAR NIKOBAR	X	X	X	X	X	KAR NIKOBAR, ITALY, MOROCCO
PLECTOFRONDICULARIA FLORIDANA CUSHMAN	MIOCENE; FLORIDA				X	X	
POROEPONIDES CRIBRORepandus ASANO AND UCHIO	PLIOCENE; JAPAN	X		X	X	X	JAPAN
PULLENIA BULLOIDES (D'ORBIGNY)	MIOCENE; AUSTRIA	X	X	X	X	X	ITALY, AUSTRIA, CALIFORNIA
PULLENIA QUINQUELOBA (REUSS)	OLIGOCENE; GERMANY	X	X	X		X	ITALY, MALLORCA, MOROCCO

FIGURE 2 (continued)

GULF COAST PLEISTOCENE FORAMINIFERA	TYPE HORIZON AND TYPE LOCALITY	RECENT	OTHER PLEISTOCENE	PLIOCENE	MIOCENE		
					GULF COAST	CARIBBEAN	OTHER
PYRGO CARINATA (D'ORBIGNY)	RECENT; CUBA AND SAINT THOMAS	X					
PYRGO COMATA (H. B. BRADY)	RECENT; WEST INDIES	X				X	
PYRGO MURRHINA (SCHWAGER)	MIOCENE; KAR NIKOBAR	X				X	KAR NIKOBAR
PYRGO NASUTUS CUSHMAN	RECENT; WEST INDIES	X					
PYRGO VESPERTILIO (SCHLUMBERGER)	RECENT; BAY OF GASCONY	X					
QUINQUELOCULINA AGGLUTINANS D'ORBIGNY	RECENT; JAMAICA	X	X	X			
QUINQUELOCULINA BICOSTATA D'ORBIGNY	RECENT; CUBA	X			X		
QUINQUELOCULINA HORRIDA CUSHMAN	RECENT; OFF S. CAROLINA	X					
QUINQUELOCULINA LAMARCKIANA D'ORBIGNY	RECENT; CUBA AND JAMAICA	X	X	X	X	X	FRANCE
QUINQUELOCULINA POLYGONA D'ORBIGNY	RECENT; CUBA AND JAMAICA	X				X	
RAMULINA GLOBULIFERA H. B. BRADY	RECENT; N. ATLANTIC AND S. PACIFIC	X	X	X		X	SPAIN, ITALY, MALLORCA
RECTOBOLIVINA ADVENA (CUSHMAN)	RECENT; TORTUGAS	X				X	S. CAROLINA (?)
REUSSELLA MINUTA DROOGER AND KAASSCHIETER	RECENT; CARIBBEAN	X					
REUSSELLA MIOCENICA CUSHMAN	MIOCENE; FLORIDA	X			X	X	
ROSALINA BULBOSA (PARKER)	RECENT; NORTHEASTERN GULF OF MEXICO	X					
ROSALINA CONCINNA (H. B. BRADY)	RECENT; PACIFIC OCEAN	X					
ROSALINA FLORIDANA (CUSHMAN)	RECENT; FLORIDA	X	X	X	X	X	
ROSALINA FLORIDENSIS (CUSHMAN)	RECENT; S. OF CAPE HATTERAS	X	X			X	
"ROTALIA" TRANSLUCENS PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
SAGRINA PULCHELLA D'ORBIGNY	RECENT; CARIBBEAN SEA	X		X	X	X	AUSTRIA
SARACENARIA ITALICA DEFRANCE	FOSSIL; ITALY	X	X	X	X	X	ITALY, FRANCE
SIGMOILINA DISTORTA PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X			?	?	
SIGMOILOPSIS SCHLUMBERGERI (SILVESTRI)	RECENT; FRANCE	X	X	X		X	ITALY
SIGMOILOPSIS SUBPOETANA (CUSHMAN)	RECENT; DRY TORTUGAS ISLANDS	X			X	X	
SIPHOGENERINA RAPHANUS (PARKER AND JONES)	RECENT; NOT DESIGNATED	X		X		X	
SIPHONINA PULCHRA CUSHMAN	MIOCENE; CUBA	X		X		X	
SIPHONODOSARIA ANTILLEA (CUSHMAN)	RECENT; ATLANTIC OCEAN	X				?	
SIPHONODOSARIA VERNEUILI (D'ORBIGNY)	MIOCENE; AUSTRIA					X	AUSTRIA, ITALY, SUMATRA
SIPHOTEXTULARIA AFFINIS (FORNASINI)	PLIOCENE; ITALY	X		X			MALLORCA
SIPHOTEXTULARIA HOLSHAUSENI PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
SORITES MARGINALIS (LAMARCK)	RECENT; EUROPE	X	X	X	?	X	
SPHAEROIDINA BULLOIDES D'ORBIGNY	RECENT AND FOSSIL; NOT GIVEN	X	X	X	X	X	WORLD-WIDE
SPIRILLINA VIVIPARA EHRENBERG	RECENT; GULF OF MEXICO	X			?	X	
SPIROLOCULINA DEPRESSA D'ORBIGNY	PLIOCENE AND RECENT; ITALY	X	X	X	?	?	ITALY
STETSONIA MINUTA PARKER	RECENT; GULF OF MEXICO	X					
TEXTULARIA CANDEIANA D'ORBIGNY	RECENT; CUBA, MARTINIQUE, SAINT THOMAS	X		X	X	X	
TEXTULARIA CONICA D'ORBIGNY	RECENT; CUBA AND JAMAICA	X	X	X	X	?	
TEXTULARIA FOLIACEA OCCIDENTALIS CUSHMAN	RECENT; CUBA	X			X	X	
TEXTULARIA MAYORI CUSHMAN	RECENT; DRY TORTUGAS ISLANDS	X		X	X		
TEXTULARIA MEXICANA CUSHMAN	RECENT; CARIBBEAN SEA	X		X	X	X	CALIFORNIA, FRANCE
TEXTULARIA SICA LALICKER AND BERMUDEZ	RECENT; CUBA	X					
TEXTULARIELLA BARRETTII (JONES AND PARKER)	RECENT; JAMAICA	X		X	X	X	
TRIFARINA BELLA (PHLEGER AND PARKER)	RECENT; GULF OF MEXICO	X					
TRIFARINA EXIMIA (CUSHMAN AND JARVIS)	MIOCENE; JAMAICA					X	
TRIFARINA HOLCKI AKERS AND DORMAN	PLEISTOCENE; LA. GULF COAST						
TRILOCULINA CIRCULARIS BORNEMANN	OLIGOCENE; GERMANY	X	X	X		X	FRANCE
TRILOCULINA INSIGNIS (H. B. BRADY)	RECENT; GÜLERRA ISLAND	X					
TRILOCULINA TRICARINATA D'ORBIGNY	RECENT; RED SEA	X	X	X		X	FRANCE
TRILOCULINA TRIGONULA (LAMARCK)	EOCENE; PARIS BASIN	X	X	X	X	X	
TRIMOSINA DENTICULATA AKERS AND DORMAN	PLEISTOCENE; LA. GULF COAST			X			
TRITAXILINA YASICAENSIS BERMUDEZ	MIOCENE; DOMINICAN REPUBLIC					X	
UVIGERINA BELLULA BANDY	RECENT; GULF OF MEXICO	X					
UVIGERINA FLINTII CUSHMAN	RECENT; FLORIDA STRAIT	X				X	ITALY
UVIGERINA PEREGRINA CUSHMAN	RECENT; ATLANTIC OCEAN	X	X	X	X	X	ITALY
UVIGERINA PEREGRINA BRADYANA CUSHMAN	RECENT; ATLANTIC OCEAN	X		X			CALIFORNIA
UVIGERINA PEREGRINA PARVULA CUSHMAN	RECENT; GULF OF MEXICO	X	X	X		X	
VAGINULINOPSIS PLANATA (PHLEGER AND PARKER)	RECENT; GULF OF MEXICO	X					
VALVULINERIA HERRICKI HADLEY	OLIGOCENE; CUBA					X	
VALVULINERIA LAEVIGATA PHLEGER AND PARKER	RECENT; GULF OF MEXICO	X					
VALVULINERIA MINUTA PARKER	RECENT; GULF OF MEXICO	X					
VALVULINERIA PALMERAE CUSHMAN AND TODD	MIOCENE; JAMAICA	X			X	X	

FIGURE 2 (continued)

Gulf Coast Pleistocene microfaunas show a higher percentage of species in common with microfaunas recorded from the Caribbean Oligo-Miocene than with those recorded from the Miocene of the American Gulf Coast. This could be due partly to a closer similarity of Caribbean Middle Tertiary environmental conditions under which portions of our Pleistocene section were deposited, but it is also due at least in part to a deficiency in the literature on micropaleontology of Gulf Coast subsurface Tertiary deposits. Similarly, the closer statistical relationship with Recent faunas than with other Pleistocene or Pliocene assemblages is a reflection of the more abundant literature on Recent Foraminifera and the relative dearth of information on Upper Tertiary micropaleontology.

Use of the proportional species correlation method is difficult because of differences of opinion concerning limits of variability of a species. It was found that a species may be reported from beds of one age, whereas only a variant of this species may be recorded from beds of another age, for example, *Elphidium fimbriatulum* (Cushman) which is identified in Pliocene and

Miocene sediments, and *E.* cf. *E. fimbriatulum* which is reported from the Gulf of Mexico (Phleger and Parker, 1951, p. 10). *E. poeyanum* (d'Orbigny) has been identified from the Recent and from the Miocene of the Caribbean but not from the Miocene of the Gulf Coast, except as *E.* aff. *E. poeyanum* (Applin and Jordan, 1945, p. 129). *E. discoidale* (d'Orbigny) has been identified in Recent seas and from the Miocene of the Dominican Republic but as *E. discoidale multiloculum* Cushman and Ellisor in the Middle Tertiary of the Gulf Coast (Cushman and Ellisor, 1945, p. 561). *Lagena sulcata* (Walker and Jacob) is reported from both the Atlantic and the Pacific and also from the Middle Tertiary of Texas, Florida, and the Dominican Republic. *L. sulcata spicata* Cushman and McCulloch is reported from various Pacific localities and may also occur in Tertiary sediments having been lumped by investigators with *L. sulcata.*

Specialists in taxonomic work have been inclined to underestimate both the ranges in time and the lateral distribution of foraminiferal species. The result is a battery of synonyms which may be long undiscovered because of the difficulty of comparing holotypes. *Pavonina atlantica* Cushman appears in reports on Foraminifera from the Atlantic and the Gulf of Mexico. *Pavonina miocenica* Cushman and Ponton occurs in reports on the Miocene of Florida, Colombia, the Dominican Republic, and Jamaica. Topotypes and primary types of these species show no basis for differentiation. *Plectofrondicularia floridana* Cushman has been recorded from the Miocene of Florida, Bowden, Jamaica, the Dominican Republic, Colombia, Venezuela, Trinidad, and Barbados. *P. diversicostata* (Neugeboren), another Miocene species, is reported from Buff Bay, Jamaica, and the Miocene of Hungary and Egypt. These are probably conspecific. *Gyroidinoides scalata* (Garrett) from the Gulf Coast Middle Tertiary, *G. planulata* (Cushman and Renz) from the Middle Tertiary of Venezuela, Trinidad, Ecuador, Barbados, and the Dominican Republic, and *G. laevis* (Coryell and Rivero) from the Middle Tertiary of Haiti are obviously related. The latter two species possibly should be considered as synonyms or at least as variants of *G. scalata* (Garrett). *G. regularis* (Phleger and Parker) of Gulf Coast Recent and Pleistocene sediments appears to be descended from *G. scalata* and also may be considered as a variant of that species.

Too frequently, published comparisons of faunas have been made only with other local assemblages or by means of illustrations rather than with actual specimens. Generalizations arrived at by such methods are confusing and misleading, especially for those unfamiliar with the pitfalls of identification and inadequacies of the literature. In charting the type localities and Tertiary records of our Pleistocene Foraminifera, those species and subspecies which were identified with question are omitted. It is necessary to keep in mind the possibility of error in age assignment for the Tertiary rocks from which many of the Foraminifera were described or reported. In most cases the age assignments of the original authors were used, but where recent data have indicated a different age, current concepts have been followed with references, or we have used a more inclusive stratigraphic term. "Middle Tertiary", for example, is employed for those rocks for which Upper Oligocene to Middle Miocene ages have been argued. The Tertiary beds of Kar Nicobar, from which Schwager (1866) described new foraminiferal species, is now considered to be of Miocene age rather than Pliocene, according to Dr. Mohsen-ul Haque, Deputy Director, Geological Survey of Pakistan (personal communication, April 12, 1958).

B. Ranges of Planktonic Foraminifera as Age Determinants—Middle Tertiary to Recent

Most specialists on Foraminiferida have ceased within the last 15 years to apply seriously the gross statistical methods enumerated above to fine age determinations or to regional and inter-regional correlation problems. Recent emphasis has been on planktonic Foraminifera. The Caribbean paleontologists and stratigraphers have made notable contributions in determining and publishing the ranges of this group of fossils in Middle Tertiary and older sediments. The ranges of planktonic species seem to exist in the same relationship to each other wherever they are found, whether in Trinidad, Venezuela, Ecuador, the Louisiana Gulf Coast, Saipan, Sumatra, or the Mediterranean region. Thus a *Globorotalia kugleri-Globigerinatella insueta-Globorotalia fohsi fohsi*

sequence in the Cipero of Trinidad is now generally accepted as synchronous with the same sequence in the Middle Tertiary of any other region. There has long been a need for such definitive work on the Upper Tertiary and Quaternary planktonics. We have supposed that the Pleistocene saw the extinction of some of the Tertiary forms and the incipience of many modern species. A dearth of literature on Pleistocene planktonic species and the relative inaccessibility of sediments of this age containing abundant and well developed planktonics jointly explain the scarcity of information in this field. It is believed that this report helps to fill the gap in the recorded ranges of some of the planktonic species and also of many benthonic forms.

A total of 22 species and subspecies of planktonic Foraminifera are identified in the Louisiana Pleistocene. Nineteen of these were described from the Recent and 3 from the Miocene. Three have not been recorded from Recent sediments, but this report extends the published ranges of these 3 from Tertiary to Lower Quaternary. Seventeen of the species and subspecies are recorded from the Miocene of the American Gulf Coast and 17 from the Oligo-Miocene of the Caribbean region. Only 4 of the Pleistocene forms are not reported from either Gulf Coast Miocene or the Caribbean Oligo-Miocene.

Globigerina altispira altispira Cushman and Jarvis, *Globorotalia menardii miocenica* D. K. Palmer, and *G. menardii multicamerata* Cushman and Jarvis were described from the Miocene of Jamaica and have not been recorded as occurring above the Pleistocene. These three foraminifers have not been established previously in sediments younger than Miocene. In coastal and offshore Louisiana, however, *Globorotalia menardii miocenica* is a guide fossil for the Lower Pleistocene. The subsurface interval which contains this useful foraminifer has been identified in wells from the mouth of the Mississippi River to continental shelf areas off eastern Texas. Specimens of *Globigerina eggeri* Rhumbler from modern deep sea samples closely resemble *G. altispira altispira* in having apertural teeth; and occasionally specimens of *Globorotalia menardii menardii* (d'Orbigny) are found in Recent assemblages which are closely related to *G. menardii multicamerata.*

The three planktonic species which have not been recorded from sediments as old as Miocene are *Globigerina eggeri* Rhumbler, *G. inflata* d'Orbigny, and *G. truncatulinoides* (d'Orbigny). We have seen all of these in the Louisiana Pliocene, but not in older beds. *Globorotalia truncatulinoides* and *Globigerina inflata* have been reported from the Italian Pliocene, although Colom (1954, p. 49) has been unable to verify the latter species in pre-Pleistocene sediments of the Mediterranean region.

The general aspect of early Pleistocene planktonic assemblages is closer to that of Recent assemblages than to Miocene. Although most of the planktonic species and subspecies of the Pleistocene have been identified in Miocene rocks as well as from Recent seas, there are numerous other planktonic Foraminifera in the Gulf Coast and Caribbean Middle Tertiary which have not been found in sediments younger than Miocene. One must be careful, therefore, with lack of evidence; absence of one or even several species does not necessarily offer strong evidence of a particular age. Even modern deep-sea sediments are known which contain abundant tests of certain planktonic species to the exclusion of others. As pointed out above, comparison with Pliocene assemblages is difficult because of the paucity of Pliocene pelagic facies which have been studied. All the planktonic species and subspecies of the post-Aftonian sediments (Akers and Holck, 1957) occur in the Gulf of Mexico and the Atlantic Ocean. The slightly different composition of the Aftonian and late Nebraskan planktonic assemblages is not surprising.

Some samples contained abundant tests of Foraminifera recognizable as planktonic but too small to identify to species. Juvenile similarity and morphological intergradation among the Globigerinidae are common in deep-sea samples (Bé, 1959, pp. 83-84, text-figure 1), and it was thought advisable to log these minute forms on our frequency chart (figure 3) as "planktonic indeterminants."

The writers are in agreement with Hofker (1959) on the splitting of planktonic genera and have applied his ideas in the systematic treatment of the globigerinids in this report. In so doing it is believed that a more realistic scheme is followed, which is more in keeping with the zoologist's restrictions on

nomenclature. These restrictions we believe to be not only possible but desirable in view of the fact that most of the Foraminifera treated herein are living today in modern seas. A return of several planktonic species to the original genera of d'Orbigny and Brady is proposed in our systematics, with the contention that splitting of these groups is based on an over-estimation of the significance of test feaures.

IV. Comparison of the Louisiana Pleistocene Assemblages with Other Foraminiferal Faunas of Pleistocene Age

The warm, shallow-water foraminiferal assemblages of Cushman (1918) and Cole (1931) from the Pleistocene and Pliocene of Florida are similar to some of the Pleistocene faunules from wells on the continental shelf off Louisiana, but the high frequency of planktonics and certain benthonics found in some of the intervals in deep continental shelf wells are not present in the Florida samples. Such components are also lacking in foraminiferal suites described from the Atlantic Coastal Plain of the United States (Bagg, 1898; Clark, 1906; Cushman and Cole, 1930). More similar is the suite of species identified by Drooger (1953) from a boring at Oranjestad, Aruba. Most of the species from this section, however, are considered by Drooger to be of Miocene age on the basis of "known stratigraphical ranges of the species," and only a few of the species and the upper part of the section are believed to represent Pleistocene deposition. His own criticism of the methods of age determination, however, leaves us with reservations as to the true age of the sequence on Aruba.

Gulf Coast Pleistocene assemblages are less similar to those of California than to Upper Miocene faunas of the Caribbean region. Cold water elements of the Pleistocene planktonic assemblages are much more in evidence in California than in the Gulf Coast. *Globigerina pachyderma* (Ehrenberg), for example, is abundant, and tests are large, in the Pleistocene of California, whereas specimens in the Louisiana Pleistocene are so small and rare as to be doubtfully identified with this species. *Globigerina bulloides* d'Orbigny is relatively more abundant in the West Coast Pleistocene than in the Gulf Coast; but some of the warm water planktonic species, such as *Globorotalia menardii menardii* and related forms which are frequent in the Gulf Coast-Caribbean region throughout Middle Miocene to Recent sediments, are rare or absent in the California section. Although a few benthonic species are common with the Louisiana and California Pleistocene, such as some of the *Cassidulina* spp. and *Uvigerina* spp., the West Coast Pleistocene has a different aspect in the presence of large forms restricted to the Pacific region.

Pleistocene assemblages from offshore Louisiana wells have few species in common with Pliocene and Pleistocene assemblages examined by van Voorthuysen (1950, 1953) from borings at the Hague and near Oosterhout. These borings did not encounter the numerous planktonic Foraminifera and the deep-water benthonic species characteristic of intervals in the Gulf Coast section believed to represent interglacial stages (Akers and Holck, 1957).

Many of the Louisiana Pleistocene Foraminifera occur in the Pliocene and Pleistocene of Italy. Some of these may be significant environmental and age indicators. *Hyalinea balthica* (Schroeter) has been found in rather high frequency in the Lower Pleistocene sediments of the Louisiana section. Heretofore, this benthonic form has been reported only from the Calabrian (Lower Pleistocene) of Italy and from the deep, cool waters of the eastern North Atlantic Ocean, the Baltic Sea, and the Mediterranean Sea. In Italy, the marine Pleistocene (Calabrian) is recognized and differentiated from marine Pliocene on the lowermost occurrence of this foraminifer and other cool water species (Alliata, 1946, 1947; Coggi and Alliata, 1950; Ilacqua, 1956). This practice is in keeping with the definition of the Plio-Pleistocene boundary at the 18th International Geological Congress of 1948 as the "time of the first appearance of 'cold' northern species of marine invertebrates (including *Hyalinea balthica*) in the continuous Plio-Pleistocene sequences of Italy." *H. balthica* in association with the planktonic *Globigerina inflata* and other Foraminifera suggests that Gulf of Mexico and Mediterranean environments were similar during the early Pleistocene and that, as expected, the Gulf of Mexico was colder than at the present time. Faunal similarity further suggests that these two basins were not isolated

from each other at least during the early Pleistocene.

V. Paleoecologic Considerations

The major ecologic implications of the cores from the South Pass Block 41 well have been discussed elsewhere (Akers and Holck, 1957, pp. 989-990). It was shown that intervals of deep water benthonics with a high planktonic component corresponded with marine transgressive tongues and that regressive wedges contained the benthonic assemblages characteristic of bays, lagoons, or brackish lakes. Inferences as to depositional environment are verified by the wealth of information published during the past ten years on the distribution of Foraminifera in the Gulf of Mexico, and we are tempted to postulate water depths and temperatures for suites of cores from the South Pass Block 41 well on the basis of our information on Recent species. Some of these data are given in our systematic section on forms which seem to be particularly diagnostic for certain environments. It is believed, however, that the relative changes in water depth represented in the previous report by Akers and Holck (1957, pl. 1) for the coastal Pleistocene are conservative deductions and that finer subdivisions might be speculative.

A. Frequency Chart

A frequency chart (figure 3) was constructed for those to whom quantitative data are significant; by means of the data shown thereon the interested investigator may draw his own conclusions regarding depositional environments. The chart also serves to supplement the ranges of Foraminifera previously unknown later than the Tertiary and others not previously identified in sediments older than Recent. Foraminiferal numbers (Schott, 1935) were computed for the core samples as a basis of comparison of populations. The term, foraminiferal number, is defined by Ellison (1951, p. 221) as the number of Foraminifera contained in one gram of dry original sediment or rock. This number is composed of a benthonic component and a planktonic component. The chart shows a total foraminiferal number, a benthonic foraminiferal number, and a planktonic foraminiferal number for each core. Frequency symbols are also shown with these numbers to facilitate recognition of fluctuating abundances on the chart. The same system of graphic representation is employed to depict the frequencies of individuals of the various species in each sample. The number of individuals of each species was computed for a single gram of each sample, but symbols were plotted rather than the actual figures for ease of interpretation.

The basic data used in computing foraminiferal occurrences are also charted for each core sample. For example, the sample at 412 feet weighed 8.29 grams (dry). After washing on a U.S. Standard Sieve, screen series No. 270, the residue weighing 0.02 grams (dry) was quartered by means of a microsplit for counting. The foraminiferal content of a gram of the sample was then computed on the basis of counts of individuals in one quarter of the sample. The degree of splitting was varied because of different characteristics of the samples. It was necessary to split some of the highly fossiliferous cores to 1/256, and even so, as many as 15 hours were sometimes spent by one of the authors in counting and tabulating specimens in the small aliquot. This small aliquot (in which the Foraminifera were actually counted) is shown for each sample in order for other interested investigators to better understand the nature of the data and consequent limitations.

All samples were washed on a No. 270 screen. The openings in this screen measure 0.0021 inches, or 0.053 mm. Thus, on the Wentworth scale, all particles with at least the dimensions of very fine sand and coarser silt were retained. The finer silt and clay size particules were discarded. It can be seen, then, by comparing the column of residue weights with the column of original weights, that the principal constituents of nearly all of the samples were of clay or fine to medium silt size.

The No. 270 screen retains a large percentage of "microforaminifera." Those of Wilson and Hoffmeister (1952) from "deep wells and Recent sediments" had dimensions of 30 to 150 microns. Our Pleistocene Foraminifera within this size category, like those of the above authors, belong mostly to the megalospheric generation of previously described species. Many of those minute tests consisted of only the proloculus or the initial two or three chambers. We do not believe that any species were overlooked because of insufficient magnification or excessive sieve openings, but the foraminiferal

number of a few of the samples would probably have been slightly larger if finer screens could have been used. Any additional tabulations would have been for indeterminant benthonics and planktonics, however, because accurate specific identifications can rarely be made by means of only the first few chambers.

It is interesting that four of the samples may be considered, by the definition of Correns, 1939, p. 375, as *Globigerina* ooze. According to this definition, a typical *Globigerina* ooze contains about 6000 specimens of planktonic Foraminifera (larger than 200 microns in diameter) per gram of sediment. The core at 578 feet contained (as computed) 6,359 planktonic specimens per gram, but 13,564 benthonic specimens per gram were also computed for it. The core at 3300 feet was the most fossiliferous sample obtained from the entire well. It was computed to have a total of 76,722 specimens of Foraminifera per gram, of which 40,812 were planktonic. The core at 3560 feet contained 17,344 specimens per gram, of which 10,726 were planktonic, and at 3574 feet a total of 25,452 specimens were computed to the gram, of which 16,223 were planktonic.

These last three samples are from the interval considered by Akers and Holck (1957, pl. 1) to represent the large scale marine transgression at the end of Nebraskan glaciation. It was also during this time that the cold water immigrant, *Hyalinea balthica*, was approaching its final occurrence in the Gulf of Mexico after appearing here for the first time in sediments of possible Calabrian age (9990 feet in the South Pass Block 41 well).

Other sedimentary cycles can be interpreted from the chart by those with experience in foraminiferal ecology. Generalizations as to post-Calabrian paleo-temperatures can also be made on the basis of foraminiferal associations, but the salient features of this section have already been described in the previous paper by Akers and Holck (1957).

Association in the Louisiana Pleistocene of cold-temperate and subtropical planktonic species may indicate (1) a mixing of tests from alternating seasons, or (2) allochthonous populations from different water masses.

VI. Recent Assemblages at the Well Site of the South Pass Block 41 Well

A Recent assemblage from the exact location of the South Pass Block 41 well (from which our suites of Pleistocene cores were taken) is described here for comparative purposes. The distribution and ecologic aspects of Foraminifera from this part of the Gulf of Mexico have been reported by Akers (1952), Bandy (1954, 1956), Kornfeld (1931), Parker (1954), Phleger (1954, 1955), and Warren (1956). A grab sample of the bottom sediments was taken in six feet of water at the well location for comparison with our Pleistocene assemblages. This sample, which was dark gray in color, was washed on a No. 270 screen, (U.S. Standard Sieve Series) as were the Pleistocene sidewall cores, and split by the same methods applied to the cores. Counts were made of the Recent Foraminifera in an aliquot portion and the foraminiferal number computed for the sample.

The weight of this grab sample (dry) was 15.6 grams. After screening, the weight of the residue was 1.9 grams. This small residue consisted of coarse, quartz silt (m.d., 0.05 mm), plant fibers (some carbonized), small Foraminifera, small, thin shelled pelecypods, ostracodes, diatoms, and mica flakes. The openings in the U.S. Standard Sieve No. 270 are 0.053 mm. Constituents of the original samples with dimensions less than this were not included in the study. Bottom sediments at the well site, as shown by this sample and others not included in our report, are largely of clay and silt size.

The foraminiferal number of the sample is 2085. No planktonic species were noted. The greater part of this number (1100) consists of *Ammonia beccarii* variants; 476 specimens belong to *Elphidium* spp., and 213 to miliolid species. Other species present in lesser frequencies are as follows:

Ammoscalaria pseudospiralis (Williamson)
Bolivina lowmani Phleger and Parker
Buliminella elegantissima (d'Orbigny)
Eponidella gardenislandensis Akers
Guadryina cf. *G. exilis* Cushman and Bronnimann
Guttulina australis d'Orbigny
Nonionella basiloba Cushman and McCulloch

Textularia earlandi Parker
Tiphotrocha comprimata (Cushman and Bronnimann)

Specimens of *Chiloguembelina cubensis* Palmer, undoubtedly reworked, were also found.

The arenaceous species found in this sample, *Ammoscalaria pseudospiralis, Gaudryina* cf. *G. exilis, Tiphotrocha comprimata,* and *Textularia earlandi,* are common in other near-shore localities in the Texas-Louisiana Gulf Coast. These species in association with other arenaceous Foraminifera have been found to be characteristic of sound, estuary, and marsh environments in both the Gulf Coast and the Caribbean region (Cushman and Bronnimann, 1948a; Cushman and Bronnimann, 1948b; Hedberg 1934; Lehmann, 1957; Phleger, 1954; Phleger, 1955; Post, 1951; Warren, 1956). The apparent absence of these arenaceous species from the thick Pleistocene sediments of coastal and offshore Louisiana is noteworthy and suggests that estuary, marsh, and possibly sound environments are not represented in our fossil record of Pleistocene events. It has been suggested, however, that the tests of these Foraminifera may be more susceptible to breakage or disaggregation with burial and compaction than are other fossils and that their absence in Pleistocene beds is due to their destruction. The latter argument is not convincing when confronted with Tertiary assemblages from coastal Louisiana wells with high frequencies of arenaceous species, some of which are identical with those found in modern marsh and estuary facies. The weight of our evidence indicates that the necessary combination of ecologic factors for the existence or accumulation of these arenaceous inshore assemblages did not persist here during the Pleistocene.

VII. Notes on Species and Descriptions of New Taxa

Throughout this report the neutral term, *form,* is used in the biologic connotation. In the sense of Mayr (1942, p. 108), "we often speak of a *form* when we do not know whether the systematic unit in question is, for example, a full species or merely a subspecies of a larger species, or whether it is a subspecies or an individual variant, or whether it is a subspecies or a phenotypical modification. We also use the term (in the plural) when we combine two unequal units; for example, in order to characterize the joint attributes of a species and a subspecies, we say 'these two forms'."

A total of 270 species and subspecies, or forms, were identified in this investigation. Ten of these have not previously been described, and with the exception of *Bolivina subaenariensis lucida,* n. subsp., have not been observed by the writers except in the Pleistocene or Pliocene of Louisiana. *Ammonia beccarii* is not subdivided here, and all specimens are grouped together as variants of that species. Several small miliolids of uncertain specific affinity have been tabulated in the frequency chart with the benthonic indeterminants. *Lenticulina* and the *Uvigerina* spp. probably have not been subdivided as much as some workers would consider feasible. It is not unlikely that more than 300 biologic forms of the Foraminiferida are present in the Gulf Coast Pleistocene and could be differentiated if larger samples comparable in size to those obtainable on outcrops were available. The total would be even higher if we include the section now thought to be Calabrian in age.

Other published occurrences, both stratigraphic and geographic, are given in the following discussion of species. In most instances authority for such occurrences is not cited for ease of reading and conservation of space. Literature consulted for this project is acknowledged in our introduction.

An alphabetical arrangement is followed for the presentation of genera and species rather than a phylogenetic system which is controversial and to many workers speculative. The writers do not mean to imply that evolutionary studies should not be done but only that an alphabetical order is more convenient for those who may wish to apply observations made in this paper to their own research.

All holotypes and paratypes will be deposited in the collection of the U. S. National Museum, Washington, D. C.

A. Planktonic Foraminifera

Globigerina aequilateralis H. B. Brady
Pl. XIII, figs. 1, 2

1879. *Globigerina aequilateralis* H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, p. 71.
1884. *Globigerina aequilateralis* H. B. Brady, Rept. Voy. Challenger, Zool., vol. 9, p. 605, pl. 80, figs. 18-21.

As in Recent sediments of the Gulf of Mexico, most of our specimens are asymmetrical. The form illustrated by Brady, however, is included within the range of variation of Pleistocene and Recent specimens (See Phleger and Parker, 1951, p. 35). The species is recorded from Miocene to Recent in Mediterranean and Caribbean regions. Miocene references may include *Globorotalia obesa* Bolli. Maximum diameter of plesiotype, 0.35 mm.

GLOBIGERINA ALTISPIRA ALTISPIRA
Cushman and Jarvis
Pl. XII, figs. 3-5

1936. *Globigerina altispira* CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 12, p. 5, pl. 1, figs. 13, 14.

Pleistocene specimens are indistinguishable from types from the Miocene of Jamaica. The uppermost zone of the Gulf Coast Pleistocene in which this planktonic foraminifer has been found is the richly fossiliferous transgressive marine clays which have been correlated with the Williana Formation (Akers and Holck, 1957, Plates 1 and 3). The subspecies is also recorded from the Middle Tertiary of Haiti, Cuba, the Dominican Republic, the Balearic Islands, Italy and Louisiana. The senior writer has identified it in the Miocene of Florida and the Pliocene of Louisiana. Diameter of plesiotype, pl. XII, fig. 3, 0.46 mm; pl. XII, figs. 4, 5, 0.36 mm.

Dr. Mohsen-ul Haque, Deputy Director, Geological Survey of Pakistan, has observed *G. altispira altispira* in the Miocene and Pliocene of the Mekran coastal region of Pakistan (personal communication, April 12, 1958). There is a possibility that the Pliocene individuals were reworked, but such a condition has not been conclusively established, according to Dr. Haque. This foraminifer has also been observed in the Miocene of Taiwan, China.

The absence of *G. altispira* s.l. in recorded Pliocene assemblages of the world would suggest to some that the Pleistocene form may be of polyphyletic origin. Until a better understanding of relationships within this group is reached, however, the range probably should be considered as Lower Miocene to Lower Pleistocene. Specimens from Aruba may be of Pleistocene age instead of Miocene, as concluded by Drooger (1953). Our form may be related to Blow's specimens from the Upper Miocene of Venezuela to which he has given the name, *Globoquadrina pozonensis* (Blow, 1959, p. 184). An identical or closely allied form has been observed by the senior writer in the Manchioneal Formation (Pliocene?) of Portland, Jamaica, but it is not nearly so abundant there as is the form in the nearby Buff Bay beds (Upper Miocene?). An occurrence in the lowermost Pliocene of Sicily has been noted (Maria Bianca Cita, personal communication, April 29, 1960; Ruggieri, 1960, p. 11). The species has also been reported from the Lichi Formation (Miocene and Pliocene) of Taiwan (Chang, 1960, Table 1).

The locality at Milepost 71, Portland, Jamaica, which was recorded as the type by Cushman and Jarvis for *G. altispira,* was examined in 1957 by Mr. E. Robinson of the Geological Survey of Jamaica and the senior writer. Rocks here were found to contain abundant orbitoids rather than the expected planktonic assemblage, and due to the greater age and unlikely paleoecology of these sediments, it was concluded that Cushman and Jarvis erred in their locality records for *G. altispira.* Their specimens probably came from the Buff Bay Miocene locality.

GLOBIGERINA BRADYI Wiesner
Pl. XIII, figs. 8, 9

1884. *Globigerina* sp. H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 603, pl. 82, figs. 8, 9.

1901-1903. *Globigerina bradyi* WIESNER, Deutsche Sudpolar - Expedition, vol. 20 (Zool., vol. 12), p. 133 (for figs. see Brady *op. cit.*).

Specimens from the Louisiana Pleistocene rarely attain the high spired stage of typical specimens from Recent seas. Chamber arrangement, size, and apertural characteristics are close, however. This small species is reported from the Middle Tertiary of Trinidad, and it has been found by the senior writer in the Miocene of Louisiana. Diameter of plesiotype, 0.15 mm.

GLOBIGERINA BULLOIDES d'Orbigny
Pl. XIII, figs. 11, 12

1826. *Globigerina bulloides* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 277, no. 1; Modèles, no. 76; and young, no. 17.

Specimens are small, rarely exceeding 0.30 mm in the greatest diameter. Size of aperture and number of chambers in final whorl are somewhat variable. Pleistocene speci-

mens definitely are within range of variation of the species, but care must be taken in differentiating between *G. bulloides* and the pre-orbuline stage of *Orbulina universa.* Diameter of plesiotype, pl. XIII, fig. 11, 0.36 mm. Diameter of plesiotype, pl. XIII, fig. 12, 0.34 mm.

Although this species has been reported widely throughout the stratigraphic column from Lower Cretaceous to Recent, critical study indicates that typical representatives did not appear before Middle or Upper Miocene (Bolli, 1954, p. 1). The species is not included by Bolli (1957) in his thorough report on planktonic Foraminifera of the Oligocene-Miocene Cipero and Lengua formations of Trinidad. The present writers have not authenticated pre-Pliocene occurrences in the Gulf of Mexico-Caribbean region. Rare specimens from the Choctawhatchee stage of Florida may be assignable to *G. bulloides,* but further study is required to settle this issue. It is possible that this cool water form was not typically developed in the Miocene Gulf of Mexico-Caribbean. Specimens from the Tortonian of the Vienna Basin are typical, however, as are specimens from the Helvetian or younger Miocene of the Balearic Islands, and an almost worldwide Pliocene distribution of the species seems to be properly documented.

GLOBIGERINA CONGLOBATA H. B. Brady
Pl. XII, figs. 9, 10

1879. *Globigerina conglobata* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 72.
1884. *Globigerina conglobata* H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 603, pl. 80, figs. 1-5; pl. 82, fig. 5.

Pleistocene specimens are typical of the form now living in the Gulf of Mexico and Atlantic Ocean. This group shows little variation. It is recorded in the Miocene of the Dominican Republic by Bermudez (1949, p. 280), and the senior writer has it from the Miocene of Jamaica and the Upper Miocene of Louisiana. *G. conglobata* is not recorded by Bolli (1957) from the Middle Tertiary Lengua and Cipero of Trinidad. Reports of the species from pre-Upper Miocene sediments may be misidentifications. It is abundant in the Pliocene (?) of Taiwan (Huang, 1960, Table 1). Diameter of plesiotype, 0.55 mm.

GLOBIGERINA EGGERI Rhumbler
Pl. XII, figs. 6-8

1879. *Globigerina dubia* H. B. BRADY (not Egger), Quart. Journ. Micr. Sci., vol. 19, n. ser., p. 71.
1884. *Globigerina dubia* H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 595, pl. 79, figs. 17a-c.
1900. *Globigerina eggeri* RHUMBLER, Nordische Plankton, pt. 14, Foraminiferen, p. 19, text figs. 20a-c.

A highly variable group is referred to this planktonic species. Both low and high turreted forms occur together in the cores. Gradational specimens present difficulty in subdividing the group on the basis of spire height. Asano (1957) was able to differentiate between *G. eggeri* and *G. subcretacea* Lomnicki on this basis in the Japanese seas and by the confinement of *G. eggeri* to the warm Kuroshio waters. Gulf Coast Pleistocene specimens are also variable in size, number of chambers in the final whorl, and in the aperture. In some specimens, the aperture has a peripheral lip. Small apertural teeth are present in some well-preserved specimens, suggesting relationship with *G. altispira.* Small apertural teeth have also been noted in Recent specimens from deep-sea sediments. Very young, tightly coiled specimens may be mistaken for *Globigerina pachyderma.* Low spired forms bear a marked similarity to *Globigerina mayeri* (Cushman and Ellisor). Thus at one extreme, there is resemblance to *Globigerina altispira* Cushman and Jarvis while the other extreme in variation approaches the form of *Globigerina mayeri.* The phylogenetic line is conjectural. Both *Globigerina altispira* and *Globigerina mayeri* occur in the Tertiary of the Gulf Coast and Caribbean regions, and both of these species appear to be related to *Globigerina eggeri.* Small specimens occur in the Louisiana Pliocene, but similar forms of pre-Pliocene age are closer to either *Globigerina mayeri* or *Globigerina altispira.* Diameter of plesiotype, 0.48 mm.

GLOBIGERINA GLUTINATA Egger
Pl. XIII, figs. 3, 4, 10

1893. *Globigerina glutinata* EGGER, K. bayer. Akad. Wiss., math.-physik. Cl., Abh., bd. 18, (1895) abth. 2, p. 371, pl. 13, figs. 19-21.
1909. *Globigerina glutinata* Egger. RHUMBLER, Plankton - Exped. Humboldt-Stift. 3:148, pl. 29, figs. 15, 18-20, 22, pl. 34, fig. 1 (not pl. 29, figs. 14, 16, 17, 21, 23-26, and not pl. 33, fig. 20).

1950. *Globigerinatella* aff. *insueta* Cushman and Stainforth. BRONNIMANN, Contr. Cushman Found. Foram. Res., vol. 1, pts. 3-4, p. 82, pl. 14, fig. 11.
1951. *Globigerinita naparimaensis* BRONNIMANN (part), Contr. Cushman Found. Foram. Res., vol. 2, pt. 1, p. 18, text figs. 3-14 (not text figs. 1-2).
1953. *Globigerinita glutinata* (Egger). PHLEGER, PARKER, and PEIRSON (part), Rept. Swedish Deep-Sea Exped., vol. 7 (1), p. 16, pl. 2, fig. 15 (not figs. 12-14).
1954. *Globigerinita naparimaensis* BRONNIMANN. Conato, Riv. Ital. Paleon. Strat., vol. 60, (1), p. 30, pl. 3, figs. 1-12.
1954. *Globigerinita glutinata* (Egger). PARKER, Harvard, Bull. Mus. Comp. Zool., vol. 111, no. 10, p. 477.
1955. *Globigerinita incrusta* AKERS, Journ. Paleontology, vol. 29, no. 4, p. 655, pl. 65, figs. 2A-2D.
1957. *Tinophodella ambitacrena* LOEBLICH and TAPPAN, Journ. Washington Acad. Sci., vol. 47, no. 4, p. 114, figs. 2a-3c.

Small specimens belonging to this rather variable planktonic species are found in the Gulf Coast in marine sediments from Miocene to Recent. There seem to be no significant differences between the Miocene specimens and those found living in the Gulf of Mexico and other waters. The supplementary chamber or umbilical cover plate is variable in size, number of apertures, and character of perforations. This chamber may be bulbous in some specimens and absent in others. Because of its small size, the species may have been disregarded or overlooked by many Tertiary workers, and it probably is worldwide in distribution. Diameter of plesiotypes, pl. XIII, fig 10, 0.28 mm; figs. 3, 4, 0.20 mm.

GLOBIGERINA INFLATA d'Orbigny
Pl. XIII, figs. 17-19

1839. *Globigerina inflata* D'ORBIGNY, *in* BARKER-WEBB and BERTHELOT, Hist. Nat. Iles Canaries, vol. 2, pt. 2, "Foraminifères," p. 134, pl. 2, figs. 7-9.

Fossil specimens are typical of the species. A few individuals were found at 3560 feet in the South Pass Block 41 well which have a final small chamber similar to that in *Globigerina nipponica* Asano. We have insufficient material to differentiate these two species. Diameter of plesiotype, 0.42 mm.

We have found *G. inflata* in the South Pass Block 41 well as deep as 9440 feet (Calabrian?), but presence of the species in beds older than this has not been substantiated. Colom (1954, p. 49) has been unable to verify its presence in the Mediterranean region before Pleistocene time, although Zei (1955, p. 536) reports it in the Pliocene as well as in the Calabrian of Italy. Chang (1960, Table 1) indicates that the species is found in beds of both Pleistocene and Pliocene age in Taiwan. Occurrence in the Liuchiuhsu mudstone (Pliocene?) of Taiwan is confirmed by Huang (1960, Table 1).

GLOBIGERINA cf. G. PACHYDERMA (Ehrenberg)
Pl. XIII, fig. 6

1861. *Aristerospira pachyderma* EHRENBERG, Monatsbericht k. preuss. Ak. Wiss. Berlin, p. 303.
1872. *Aristerospira pachyderma* EHRENBERG, (1873) Abhandl. d. k. Akad. Wiss. Berlin, p. 386, pl. 1, fig. 4.

Small specimens, less than 0.20 mm in diameter, resemble the cold water *G. pachyderma.* The large size of typical specimens of this species from the North Atlantic is not attained by Gulf Coast specimens, and it is possible that most, if not all, of these small forms are juveniles of other planktonic species, possibly of *Globigerina eggeri* Rhumbler. The specimen figured is the largest found in our material, and the closest to *G. pachyderma.* Maximum diameter of plesiotype, 0.19 mm.

The small size of this globigerinid and its similarities to other larger species suggest that it is a paedomorphic form, even in Recent seas, in which either directly or indirectly as a result of ecologic conditions the early developmental stage of the test has been retained during maturity.

GLOBIGERINA PARKERAE (Loeblich and Tappan)
Pl. XIII, fig. 5

1909. *Globigerina lamellosa* Terquem. RHUMBLER (not Terquem, 1882), Ergeb. Plankton - Exped. Humboldt-Stift 3: pl. 30, figs. 1-6.
1954. *Globigerina* sp. PARKER, Harvard, Bull. Mus. Comp. Zool. 111 (10) : 476.
1957. *Globigerinita parkerae* LOEBLICH and TAPPAN, Journ. Washington Acad. Sci., vol. 47, no. 4, p. 113, figs. 1a-c.

Our small Pleistocene specimens fall within the range of variation of Recent specimens from the Gulf of Mexico. The senior writer collected this species from the Mio-

cene Buff Bay locality in Jamaica, and it has been observed in the Upper and Middle Tertiary of the Gulf Coast. Diameter of plesiotype, 0.21 mm.

GLOBIGERINA RUBRA d'Orbigny
Pl. XII, figs. 11, 12

1839. *Globigerina rubra* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères," p. 82, pl. 4, figs. 12-14.
1880. *Globigerina gomitulus* SEGUENZA, Mem. Acc. Lincei, (3) VI, p. 228, t. XVII, ff. 16, 162.
1927. *Globigerina cyclostoma* GALLOWAY and WISSLER, Journ. Paleontology, vol. 1, no. 1, p. 42, pl. 7, figs. 8, 9.

Specimens belonging to this species can usually be recognized by the height of the final chamber, the position of the aperture, and the character of the wall. Variations are seen, however, in the size and shape of the test, number of chambers in the final whorl, and in the size and shape of the aperture. These variations seem to be shown by the species everywhere that it is recorded. Diameter of plesiotype, pl. XII, fig. 11, 0.44 mm; pl. XII, fig 12, 0.32 mm.

In addition to the typical form, elongate specimens are often found. These appear to belong with *Globigerina elongata* d'Orbigny. We are undecided as to whether this is an individual variation or whether it should be considered of subspecific or even specific rank.

GLOBIGERINA TRILOBA Reuss
Pl. XIII, figs. 15, 16

1850. *Globigerina triloba* REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, p. 374, pl. 47, fig. 11.
1877. *Globigerina sacculifera* H. B. BRADY, Geol. Mag., vol. 4, p. 535.
1879. *Globigerina sacculifera* H. B. BRADY, Quart. Journ Micr. Sci., vol. 19, p. 73.
1884. *Globigerina sacculifera* H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 604, pl. 80, figs. 11-17; pl. 82, fig. 4.

This species is interpreted to include forms with the sac-like final chamber observed in some specimens as well as forms in which this type of chamber is not developed. The group may be recognized by the sphericity of the later chambers (excluding the sac-like chamber), the position of the aperture with respect to earlier chambers, and the character of the wall which is more coarsely punctate than in most other planktonic species. Diameter of plesiotype, 0.53 mm.

As in Recent and Tertiary sediments, Pleistocene specimens with and without this sac-like chamber (probably a reproductive stage) coexisted.

GLOBIGERINA UNIVERSA (d'Orbigny)
Pl. XIII, fig. 7

1839. *Orbulina universa* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 3, pl. 1, fig. 1.
1846. *Globigerina bilobata* D'ORBIGNY, Foraminifères fossiles du bassin tertiaire de Vienne, p. 164, pl. 9, figs. 11-14.
1941. *Orbulina bilobata* (d'Orbigny). PALMER, Mem. Soc. Cubana Hist. Nat., vol. 15, p. 286, pl. 28, fig. 3.
1951. *Orbulina suturalis* BRONNIMANN, Contr. Cushman Found. Foram. Res., vol. 2, part 4, p. 135, text-fig. 2, figs. 1-2, 5-8, 10; text-fig. 3, figs. 3-8, 11, 13-16, 18, 20-22; text-fig. 4, figs. 2-4, 7-12, 15-16, 19-22.
1956. *Biorbulina bilobata* (d'Orbigny). BLOW, Micropaleontology, vol. 2, no. 1, pp. 69-70, text-fig. 2, no. 16.

The *"Orbulina suturalis"* and *"Biorbulina"* forms of various authors are present in very low frequencies. The typical *G. universa* form is abundant in deep water intervals throughout the Pleistocene. This planktonic species has almost universal distribution in Middle and Upper Tertiary sediments, as well as in Recent seas.

We hold with Hofker (1959, p. 8) that *Orbulina* and *Biorbulina* forms are reproductive stages of other globigerines and have no value as genera. It is not unlikely that all of these forms, to which various specific names have been given by as many authors, represent the variable reproductive stages of a single long-ranging globigerine species. Diameter of plesiotype, 0.46 mm.

GLOBOROTALIA HIRSUTA (d'Orbigny)
Pl. XIV, figs. 6-9

1839. *Rotalina hirsuta* D'ORBIGNY *in* BARKER-WEBB and BERTHELOT, Hist. Nat. Iles Canaries, vol. 2, pt. 2, "Foraminifères", p. 131, pl. 1, figs. 37-39.
1953. *Globorotalia hirsuta* (d'Orbigny). PHLEGER, PARKER and PEIRSON, Repts. Swedish Deep-sea Exped., 1947-1948, vol. VII, Fasc. 1, p. 19, pl. 4, figs. 1-7.

The criteria of Phleger, Parker, and Peirson in the above reference are followed for recognizing this planktonic species. Forms

which are biconvex are referred to *G. hirsuta*. Similar forms which are plano-convex are referred to *G. punctulata* (d'Orbigny). The close relationship between these two species groups as suggested in this reference is supported by our Pleistocene material. In some cases, however, separation is arbitrary. Typical specimens of *G. hirsuta* occur in the "upper marine beds" (Akers and Holck, 1957, pls. 1 and 3). Diameter of plesiotype, pl. XIV, figs. 8, 9, 0.27 mm; pl. XIV, figs. 6, 7, 0.34 mm.

This species occurs in the subsurface Miocene of Louisiana and in the Choctawhatchee stage of the Florida Miocene. It has been identified in the Caribbean Miocene under various other names and is probably the form referred to by Drooger (1953, p. 143) as *Globorotalia canariensis* (d'Orbigny) from the Pleistocene and supposed Miocene of Aruba. The senior writer has also seen the species in the Pliocene of Italy and the Miocene Suva of Fiji.

GLOBOROTALIA MENARDII MENARDII
(d'Orbigny)
Pl. XIV, figs. 10-15; Pl. XII, figs. 13-15

1826. *Rotalia menardii* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 273, no. 26; Modèles no. 10.
1884. *Pulvinulina menardii* (d'Orbigny). H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 690, pl. 103, figs. 1, 2.

This planktonic group has variable characteristics, some of which are size, thickness of the test, thickness of the keel, number of chambers in the final whorl, inflation of the chambers on the umbilical side, lobulation of the periphery, and direction of coiling. The coiling direction is over 90% sinistral throughout the Pleistocene of the Gulf Coast, except for a zone near the base of the "upper marine beds". In this interval, specimens distinct from *G. menardii miocenica* are invariably dextral. Diameter of plesiotype, pl. XII, figs. 13-15, 0.70 mm; pl. XIV, figs. 12, 13, 0.44 mm; pl. XIV, figs. 10, 11, 0.34 mm; pl. XIV, figs. 14, 15, 0.57 mm.

The literature contains numerous "identifications" of this form in beds of pre-Pleistocene age. Both literature and samples have been examined by the senior writer, and in no case has a pre-Pleistocene specimen attained the large size observed in Recent and Pleistocene individuals. Large related *Globorotalia* in South American and Pacific Tertiary sediments invariably differ in the number of chambers or (and) the height of the spire. Among these have been described *G. menardii multicamerata* Cushman and Jarvis, *G. menardii tumida* (H. B. Brady), and *G. menardii fijiensis* Cushman. Small forms from the Upper Miocene of the Gulf Coast, Venezuela, and Trinidad which have been grouped under *G. menardii menardii* seldom exceed half the diameter of large, compressed Recent specimens. Whether these larger, more oblong forms are actually descended from Upper Miocene *Globorotalia*s presently included in the same taxon rather than arising from another group such as *G. menardii tumida*, *G. menardii fijiensis*, or *G. menardii multicamerata* is only speculative. Indeed, variation observable in *G. menardii menardii* in modern seas is not well understood, and it is not improbable that the group is polyphyletic.

GLOBOROTALIA MENARDII MIOCENICA
D. K. Palmer
Pl. XIV, figs. 1-5; 19-21

1945. *Globorotalia menardii* (d'Orbigny) var. *miocenica* D. K. PALMER, Bull. Amer. Paleontology, vol. 29, no. 115, p. 70, pl. 1, fig. 10.

This form is not usually found above the lower part of the "upper marine beds" (Akers and Holck, 1957, pls. 1 and 3) of coastal and offshore Louisiana. The frequency of the subspecies in this part of the Lower Pleistocene is a criterion for recognizing regional stratigraphic position by means of well samples. A few small specimens have been found higher in the Pleistocene section (one at 1270, one at 1436, one at 1454, and one at 1609 feet in the South Pass well).

Approximately 200 topotypes from the Miocene of Jamaica were examined for comparison with Louisiana Pleistocene specimens. About 90 per cent of these Jamaican specimens are flat on the spiral side and have a high umbilical side. The remainder are bi-convex. In our Pleistocene samples, this relationship varies. In some of the assemblages approximately 90 per cent of the specimens are plano-convex. In other samples, the majority of the specimens are biconvex with only occasional plano-convex specimens. As in the Miocene Jamaican assemblages, however, all specimens observed are coiled dextrally. Diameter of plesiotype, pl. XIV, figs. 19-21, 0.48 mm; pl. XIV, figs.

3-5, 0.47 mm; pl. XIV, figs. 1, 2, 0.40 mm.

Specimens approximating the form of *G. menardii miocenica* and also dextrally coiled are found in the Choctawhatchee Stage of the Florida Miocene and in well samples from the Pliocene and Upper Miocene of coastal and offshore Louisiana. This foraminifer is also reported from the Upper Miocene of Morocco and the Dominican Republic, and typical specimens have been examined from cores in 3570 meters of water off the eastern coast of the United States (D. B. Ericson, personal communication). This latter occurrence and the occurrences in Aruba assumed by Drooger (1953) to be Miocene may be of Pleistocene age.

GLOBOROTALIA MENARDII MULTICAMERATA
Cushman and Jarvis
Pl. XIV, figs. 22-25

1930. *Globorotalia menardii* (d'Orbigny) var. *multicamerata* CUSHMAN and JARVIS, Journ. Paleontology, vol. 4, no. 4, p. 367, pl. 34, fig. 8.

Occasional specimens are found with *Globorotalia menardii miocenica* in the "upper marine beds" of the Gulf Coast Pleistocene. In these samples, it is possible that such forms are aberrant individuals of the *Globorotalia menardii miocenica* group. Both forms are always dextrally coiled, and they are similar in convexity. Topotypes of *G. menardii multicamerata* from the lowest zone of the Buff Bay Formation of Jamaica are also invariably dextral, but the keel is variable in thickness. Jamaican specimens may easily be separated into a thick-keeled group and a thin-keeled group. A higher zone in the Buff Bay Formation yields forms collected by the senior writer which are predominantly thin-keeled and sinistrally coiled, the ratio being 12:1 in favor of sinistral coiling. Diameter of plesiotype, pl. XIV, figs. 22, 23, 0.55 mm; pl. XIV, figs. 24, 25, 0.94 mm.

There is similarity between the individuals of this group and *Globorotalia menardii fijiensis* Cushman from the Miocene Suva of the South Pacific Region. The *Globorotalia menardii fijiensis-multicamerata* observed by Stainforth (1948, p. 125) in the Miocene of Ecuador also seems to belong to the same group. The relationship of these *Globorotalias* to *Globorotalia fohsi lobata* Bermudez, another similar Miocene planktonic, is further interesting and poorly understood. The single occurrence reported from Recent sediments north of Cuba (Cushman and Bermudez, 1949, p. 30) is probably of Tertiary or Pleistocene age. Presence of this form in Recent sediments has not been authenticated.

GLOBOROTALIA MENARDII TUMIDA
(H. B. Brady)
Pl. XIV, figs. 26-28

1877. *Pulvinulina menardii* d'Orbigny var. *tumida* H. B. BRADY, Geol. Mag., vol. 4, p. 294.

1884. *Pulvinulina tumida* H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 692, pl. 103, figs. 4-6.

Forms are found in the Pleistocene cores which appear to be intermediate between *Globorotalia menardii menardii* and *Globorotalia menardii tumida* of Recent samples. Some of the thicker specimens may be assigned to *G. menardii tumida.* This variation within the *Globorotalia menardii* group seems to have begun before the Pleistocene. D. B. Ericson (personal communication) identified *G. menardii tumida* in Pleistocene cores from the Atlantic and Caribbean. *Globorotalia menardii tumida* is reported from Saipan in rocks for which a Miocene age has been assumed (Todd, 1957). In Taiwan the range has been reported as Miocene through Pleistocene (Chang, 1960, Table 1). The form is abundant in the Pliocene (?) Liuchiuhsu mudstone of Taiwan (Huang, 1960, Table 1), and the senior writer has it from the Miocene (?) Suva.

GLOBOROTALIA PUNCTULATA (d'Orbigny)
Pl. XIII, figs. 20-22

1826. *Globigerina punctulata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 277, no. 8.

1898. *Globigerina punctulata* d'Orbigny. FORNASINI, Paleont. Ital, vol. 4, p. 210, text. fig. 5.

1953. *Globorotalia punctulata* (d'Orbigny). PHLEGER, PARKER, and PEIRSON, Repts. Swedish Deep-Sea Exped., 1947-1948, vol. VII, Fasc. 1, p. 20, pl. 4, figs. 8-12.

This species was found in marine sediments throughout the Pleistocene. Similarity to *G. hirsuta* is discussed under that species. An excellent synonymy is contained in the reference above by Phleger, Parker, and Peirson. Maximum diameter of plesiotype, 0.60 mm; thickness, 0.34 mm.

G. punctulata has been identified by the senior writer in the *Ecphora* Facies, Choctawhatchee Stage, of the Florida Miocene. It is uncommon in the subsurface Miocene of Louisiana. The species is also reported from the Miocene of Jamaica and Taiwan and the Pliocene and Pleistocene of Italy.

GLOBOROTALIA TRUNCATULINOIDES
(d'Orbigny)
Pl. XIV, figs. 16-18

1839. *Rotalina truncatulinoides* D'ORBIGNY *in* BARKER-WEBB and BERTHELOT, Hist. Nat. Iles Canaries, vol. 2, pt. 2, "Foraminifères", p. 132, pl. 2, figs. 25-27.

As in Recent sediments, the species has variable characteristics. The periphery varies from acute to rounded. The umbilicus may be almost closed or it may be open. The thickness is perhaps the most variable characteristic. The spiral side is always flat, but the umbilical side varies from almost flat to extremely high. Thick specimens are readily recognized as belonging to this group, but low specimens are easily confused with *Globorotalia menardii miocenica, G. hirsuta,* and *G. punctulata.* The species is present in marine zones throughout the Gulf Coast Pleistocene. Maximum diameter of plesiotype, 0.55 mm.

G. truncatulinoides is recorded from the Pleistocene and Upper Pliocene of Italy. We have also seen it in the Louisiana Pliocene, but pre-Pliocene evidence for the species seems to be lacking. It is also listed by Chang in the Pliocene and Pleistocene of Taiwan. It is abundant in the Pliocene (?) Liuchiuhsu Mudstone of Taiwan (Huang, 1960, Table 1).

This species was examined for coiling ratios in cores throughout the Pleistocene of the South Pass Block 41 well. Shifts in coiling dominance in deep-sea cores from the North Atlantic and adjacent seas have been useful for correlation (Ericson, D. B., G. Wollin, and J. Wollin, 1954; Ericson, D. B., 1961, p. 538). We were surprised and disappointed to find that *G. truncatulinoides* is dominantly dextral in every core where it was identified by us. Either this portion of the northern Gulf of Mexico remained a province in which the species was dominantly dextral throughout the Pleistocene, or sinistral preferences existed here but were not observed due to inadequate sampling of the well. It is possible, too, that planktonic-poor intervals, though thoroughly sampled, may be correlative with nearby sediments in which sinistral shifts are present.

PULLENIATINA OBLIQUILOCULATA
(Parker and Jones)
Pl. XII, figs. 1, 2

1865. *Pullenia obliquiloculata* PARKER and JONES, Phil. Trans., vol. 155, p. 368, pl. 19, figs. 4a, b.

This planktonic species is known from Upper Miocene to Recent sediments. It is reported from the Pliocene of Panama, Pliocene and Upper Miocene of the Netherlands East Indies, Pliocene and Pleistocene of Taiwan, and from the Upper Miocene of the Dominican Republic. Diameter of plesiotype, 0.42 mm.

SPHAEROIDINELLA DEHISCENS
(Parker and Jones)
Pl. XIII, figs. 13, 14

1865. *Sphaeroidina dehiscens* PARKER and JONES, Phil. Trans., vol. 155, p. 369, pl. 19, figs. 5a-c.

This Miocene to Recent planktonic species is recorded in the Miocene of Louisiana, Jamaica, Haiti, and the Dominican Republic and from the Pliocene of Italy and Taiwan. Maximum diameter of plesiotype, pl. XIII, fig. 13, 0.50 mm; pl. XIII, fig. 14, 0.63 mm.

B. BENTHONIC FORAMINIFERA

ALVAREZINA BRADYI (Cushman)
Pl. I, fig. 22

1911. *Gaudryina bradyi* CUSHMAN, U. S. Natl. Mus., Bull. 71, pt. 2, p. 67, text figs. 107a-c.

1949. *Karreriella bradyi* (Cushman). BERMUDEZ, Cushman Lab. Foram. Res., Spec. Publ. 25, p. 89-90, pl. 5, figs. 11-16.

This species is not recorded shallower than 155 meters nor deeper than about 800 meters in the Gulf of Mexico according to Phleger (1951, p. 47). Bermudez in the reference above gives a complete synonymy and records the species from "the whole of the Tertiary of the Dominican Republic". This species is recorded from both the Atlantic and the Pacific Oceans as well as from various Caribbean Tertiary localities. It has also been reported from the Miocene of the Balearic Islands, the Alazan beds of Mexico, and from Lower Eocene to Quaternary of Italy. Length of plesiotype, 0.48 mm; breadth, 0.30 mm; thickness, 0.29 mm.

This form is listed in figures 2 and 3 as *Karreriella bradyi* (Cushman).

ALVAREZINA CYCLOSTOMATA SINUATA
Akers and Dorman, n. subsp.
Pl. II, figs. 1, 2

The subspecies differs from the typical only in that the aperture is an elongate, narrow, strongly curved, sometimes sigmoidal slit rather than a circular or elliptical opening. The aperture in our Pleistocene forms has a thin low lip, whereas the apertural lip in *A. cyclostomata* (Galloway and Morrey) is thick, high, and almost a neck.

Holotype and paratype of the subspecies are from a core at 2420 feet in The Texas Co., Delta Duck Club, Unit 2, Well 1-A, Sec. 1, T21S, R19E, Plaquemines Parish, Louisiana. Dimensions of holotype: length, 0.95 mm; breadth, 0.84 mm. Length of paratype, 0.65 mm; breadth, 0.50 mm.

The primary types of *Alvarezina mexicana* (Nuttall) from the Tertiary of Mexico and *A. barbati* (Cushman) from the Tertiary of California were compared. Cushman's holotype and paratype belong to two distinct species, possibly to different genera. His paratype is identical with the holotype of Nuttall.

Hundreds of specimens from the Louisiana Oligocene and Miocene were examined. These are referred by some Gulf Coast paleontologists to *A. mexicana* (Nuttall), but it was found that the aperture in these forms is variable. At one extreme, it is circular, as in *A. cyclostomata;* at the other it is elongate-elliptical, sometimes gently curved. In all cases, the opening has a thickened lip which is never so low or contorted in shape as in the Pleistocene form.

A. mexicana must be considered as a synonym, or at most, as a subspecies of *A. cyclostomata.* Apparent variations in test shape may be produced by compaction of the enclosing clays and shales.

This form is listed as *Karreriella cyclostomata sinuata* in figure 3.

This foraminifer with *Globorotalia menardii miocenica* seems to have become extinct in the Gulf of Mexico during the Aftonian. *A. cyclostomata* disappeared during the Pliocene or upper Miocene.

AMMONIA BECCARII (Linné) variants
Pl. X, figs. 14, 15

1758. *Nautilus beccarii* LINNÉ, Syst. Nat., ed. 10, p. 710.

The example of previous American workers is followed in assigning small specimens to *A. beccarii* (Linné) although these probably constitute a distinct species or several distinct species from the larger specimens in the Tertiary of the Mediterranean region. As in Recent sediments of the Gulf of Mexico, a high frequency of this group indicates deposition in shallow nearshore waters. Diameter of figured specimen, 0.29 mm.

AMPHICORYNA cf. A. INTERCELLULARIS
(H. B. Brady)
Pl. VI, fig. 4

1881. *Nodosaria intercellularis* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, p. 63.
1884. *Nodosaria intercellularis* H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 515, pl. 65, figs. 1-4.

Our Pleistocene specimens usually consist of only two chambers. The type figure of *Nodosaria catesbyi* (shore sands of Cuba) shows 14 costae. That of *Nodosaria spinicosta* (Vienna Basin) shows 18. Our specimens have 20 to 22 longitudinal costae. Our form seems closer to this Recent Atlantic and Caribbean species than to any other species of *Amphicoryna* or *Nodosaria.* Length of figured specimen, 0.40 mm; diameter, 0.19 mm.

This form is listed in figure 3 as *Nodosaria* cf. *N. intercellularis* H. B. Brady.

AMPHISTEGINA LESSONII d'Orbigny
Pl. XI, figs. 32, 33

1826. *Amphistegina lessonii* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 304, no. 3, pl. 17, figs. 1-4, Modèles no. 98.

In Pleistocene beds, this species is restricted to calcareous zones. Phleger and Parker (1951, p. 26) report it as rare in Recent sediments of the Gulf of Mexico, except in calcareous areas. Pleistocene specimens show variations similar to Recent specimens in thickness of test and size of umbo. Our specimens are referred to d'Orbigny's species (Recent of Mauritius) in the absence of a satisfactory means of subdividing the group. Maximum diameter of plesiotype, 0.95 mm.

A. lessonii has been recorded from the Miocene of Florida, Louisiana, South Caro-

lina, North Carolina, Virginia, Venezuela, Haiti, Jamaica, and the Dominican Republic, and from the Upper Oligocene of Cuba. This form probably has world-wide distribution in Middle Tertiary and younger beds. It is reported throughout the Italian post-Paleocene Tertiary and from the Pleistocene of Aruba.

Additional investigation may indicate reference of this form to *A. gibbosa* d'Orbigny (see Barker, 1960, p. 228).

ANOMALINOIDES IO (Cushman)
Pl. XV, figs. 9, 10

1931. *Cibicides pseudoungeriana* (Cushman) var. *io* CUSHMAN (part), U. S. Natl. Mus., Bull. 104, pt. 8, p. 125, pl. 23, fig. 1 (not fig. 2).

Pleistocene specimens are very close to Recent forms from the Gulf of Mexico which have been referred to this species by Parker (1954). Maximum diameter of plesiotype, 0.36 mm; thickness, 0.14 mm.

The species has been reported from the Miocene of coastal Louisiana, Cuba, Haiti, Puerto Rico, and the Dominican Republic and from the Upper Oligocene (?) and Pliocene of Cuba.

This form is listed in figures 2 and 3 as *Cibicides io* Cushman.

ARCHAIAS ANGULATUS (Fichtel and Moll)
Pl. VII, fig. 30

1798. *Nautilus angulatus* FICHTEL and MOLL, Testacea microscopica aliaque, minuta ex generibus Argonauta et Nautilus, Wien, Osterreich, p. 113, pl. 22, figs. a-e.
1839. *Orbiculina compressa* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 66, pl. 8, figs. 4-7.
1930. *Archaias angulatus* (Fichtel and Moll). CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 7, p. 46, pl. 16, figs. 1-3; pl. 17, figs. 3-5.
1956. *Archaias angulatus* (Fichtel and Moll). BANDY, U. S. Geological Survey Professional Paper 274-G, p. 192.

Although *Archaias compressus* (d'Orbigny) and *A. angulatus* (Fichtel and Moll) seem to be distinct in some assemblages, Bandy, in the above reference, has pointed out that growth sequences show *A. angulatus* to be quite variable, depending on size. However, Cushman, in his reference above, believed the two to be separate and recommended a study involving the relationships of microspheric and megalospheric forms by means of sections. Pending such a definitive investigation, *A. angulatus* will be interpreted as including other species and varieties of various authors.

This species occurred most frequently in the interval 592-610 feet in the South Pass Block 41 well. Maximum diameter of plesiotype, 1.43 mm.

A. angulatus has been reported from the Tertiary of Puerto Rico and the Dominican Republic. The range of the species appears to be Middle Oligocene to Recent (Bermudez, 1949, p. 174). In Cuba it occurs throughout the section above Middle Oligocene (Jaruco) according to Bermudez (1950, p. 328).

ARTICULINA AURICULATA (Egger)
Pl. II, fig. 20

1893. *Planispirina auriculata* EGGER, Abhandl. k. bay. Akad. Wiss. München, vol. 18, pt. 2, p. 245, pl. 3, figs. 13-15.
1954. *Wiesnerella auriculata* (Egger), PARKER, Harvard, Bull. Mus. Comp. Zool., vol. 111, no. 10, p. 501, pl. 5, fig. 13.

Our Pleistocene species seems to be the same as that reported by Parker in the above reference from the northeastern Gulf of Mexico. This is very close to Egger's figures of specimens from the Indian Ocean. Coloration in the species is striking and variable. Some specimens are white. Others are white for the most part but with a black rim around the apertural area. In some specimens only the costae are black, and these may be either numerous and closely spaced or few and widely spaced. Still other specimens are entirely black. The writers observed specimens which become rectilinear. Length of plesiotype, 0.44 mm; breadth, 0.27 mm.

ARTICULINA MAYORI Cushman
Pl. III, figs. 8-10

1922. *Articulina mayori* CUSHMAN, Carnegie Inst. Washington, Publ. no. 311, p. 71, pl. 13, fig. 5.

Only two small broken specimens (at 610 feet) were found in the South Pass Block 41 well. These show the faint costae typical of the species. This foraminifer is also recorded from the Miocene Chipola Facies of the Florida panhandle. Length of fragment, pl. III, fig. 8, 0.34 mm. Length of fragment, pl. III, figs. 9, 10, 0.38 mm.

ARTICULINA PAUCICOSTATA Cushman
Pl. III, fig. 11

1944. *Articulina paucicostata* CUSHMAN, Cushman Lab. Foram. Res., Spec. Publ. 10, p. 14, pl. 3, figs. 13, 14.

Only two specimens (at 610 feet) were found in the South Pass Block 41 well. These are different from *A. mayori* in having considerably fewer and better developed costae. Our specimens are assigned to *A. paucicostata* although the costae are somewhat irregularly spaced and the number of costae slightly variable. Length of plesiotype, 0.46 mm.

ASTERIGERINA CARINATA d'Orbigny
Pl. XI, figs. 22, 23

1839. *Asterigerina carinata* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 118, pl. 5, fig. 25; pl. 6, figs. 1, 2.

All specimens of this genus from the Pleistocene of Louisiana seem to belong to a single species. It has been reported from the Miocene of Cuba, Jamaica, and the Dominican Republic and from the Pleistocene of Aruba. Diameter of plesiotype, 0.78 mm.

BIGENERINA IRREGULARIS Phleger and Parker
Pl. I, fig. 15

1951. *Bigenerina irregularis* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 4, pl. 1, figs. 16-21.

Pleistocene specimens show variations in size and mineralogy of grains as do Recent specimens, according to the above reference. It is possible that this group includes several varieties. The specimens from 2418 feet in the South Pass Block 41 well may belong to a different species, but, except for size, they seem to belong here. As in Recent sediments of the Gulf of Mexico, Pleistocene specimens from calcareous zones are composed of shell fragments rather than quartz grains. Length of plesiotype, 0.71 mm.

BIGENERINA TEXTULARIOIDEA (Goës)
Pl. I, figs. 16, 17

1894. *Clavulina textularioidea* GOES, Kongl. Svensk. Vet.-Akad. Handl., vol. 25, no. 9, p. 41, pl. 8, figs. 387-399.

As in *Bigenerina irregularis*, a variety of agglutinated materials is employed in the test. In some large specimens from calcareous zones, this material consists of the entire tests of calcareous Foraminifera. In these cases, the tests usually have a shiny, polished appearance.

An excellent synonymy is given by Bermudez (1949, p. 67). This foraminifer has been reported from the Recent of the Caribbean-Antillean region and the Gulf of Mexico and from the Miocene of Florida, Jamaica, the Dominican Republic, and Mallorca. In Cuba, the range is given as Middle Miocene to Recent. Length of plesiotype, pl. I, fig. 16, 0.97 mm; maximum breadth, 0.42 mm. Length of plesiotype, pl. I, fig. 17, 1.24 mm; maximum breadth, 0.73 mm.

BILOCULINELLA TODDAE Andersen
Pl. III, figs. 25-28

1961. *Biloculinella toddae* ANDERSEN, Louisiana Dept. Conserv., Geol. Bull. 35, pt. II, p. 41, pl. 9, figs. 6a, b.

Test small, biloculine in the adult, both chambers inflated, final chamber in some specimens enclosing all but a small rounded area of the next preceding chamber; apertural extremity of test slightly extended; aperture semi-elliptical in shape completely filled by a broad concave toothplate. Maximum diameter of plesiotype, pl. III, figs. 27, 28, 0.36 mm; pl. III, figs. 25, 26, 0.32 mm.

BOLIVINA ACEROSA Cushman
Pl. VIII, fig. 23

1936. *Bolivina acerosa* CUSHMAN, Cushman Lab. Foram. Res., Spec. Publ. 6, p. 54, pl. 8, fig. 1.

Several hundred specimens were found in a small sidewall core at 2580 feet in the South Pass Block 41 well. Well preserved individuals have clear areas at the upper and inner portion of each chamber. Wall character in this respect is similar to that in *Bolivina pacifica* Cushman, *B. translucens* Phleger and Parker, and *B. daggarius* Parker. Our specimens were compared with the holotype from the Gurabo Formation of the Dominican Republic with which they compare closely in test dimensions, number and arrangement of chambers, and pore arrangement.

The species has not been found in sediments younger than approximately Middle Pleistocene. It is also reported from Middle Tertiary beds of Cuba and Costa Rica. The writers have it from the Miocene Buff Bay locality, Jamaica, and from the Pliocene of Louisiana. This species is reported from beds in Aruba believed to be Miocene in age (Drooger, 1953), but which may be Pleis-

tocene. Length of plesiotype, 0.40 mm; breadth, 0.10 mm; thickness, 0.09 mm.

BOLIVINA ALATA (Seguenza)
Pl. VIII, fig. 24

1862. *Vulvulina alata* SEGUENZA, Atti Accad. Gioenia Sci. Nat., ser. 2, vol. 18, p. 115, pl. 2, figs. 5, 5a.

Pleistocene specimens from Louisiana show considerable variation in breadth, but this range of variation seems to be similar to the range of variation observed in specimens from Italy. Our Pliocene specimens from the vicinity of Cecina, Italy, are identical with some of the Louisiana individuals in all respects.

The holotype of the species is from the Pleistocene of Italy. Specimens are also recorded from the Recent of the Gulf of Mexico and the Miocene of Jamaica, Venezuela, the Dominican Republic, and Mallorca. Bagg (1904, p. 473) recorded this foraminifer from the Calvert Formation (Miocene) of Chesapeake Beach, Maryland. It ranges in Italy from Miocene to Recent. Length of plesiotype, 0.42 mm; breadth, 0.17 mm.

BOLIVINA ALBATROSSI Cushman
Pl. VIII, fig. 7

1922. *Bolivina albatrossi* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 3, p. 31, pl. 6, fig. 4.

Some of the Pleistocene specimens appear to be identical with the holotype from off the Carolina coast (873 meters of water). There is variation in the reticulated nature of the test, however, some specimens being smooth throughout while others show reticulations throughout; others have only the early portion of the test marked by a network of fine reticulations.

According to Phleger and Parker (1951, p. 41), the species is especially characteristic of water deeper than about 200 meters in the Gulf of Mexico. In the South Pass Block 41 well, this species was most abundant within the interval 3104 feet to 3490 feet. *B. albatrossi* is also recorded from the Miocene of Jamaica. Specimens in our collection from Buff Bay are identical with those from Gulf Coast Recent and older sediments. Length of plesiotype, 0.36 mm; breadth, 0.16 mm.

BOLIVINA BARBATA Phleger and Parker
Pl. VIII, fig. 34

1951. *Bolivina barbata* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 13, pl. 6, figs. 12a, b, 13.

Pleistocene specimens are typical of the species. Length of plesiotype, 0.42 mm; breadth, 0.19 mm.

BOLIVINA CATANENSIS Seguenza
Pl. VIII, figs. 3, 21

1862. *Bolivina catanensis* SEGUENZA, Atti Accad. Gioenia Sci. Nat., ser. 2, vol. 18, p. 29, pl. 2, figs. 3, 3a, 3b.

Pleistocene specimens were compared with material from the Pliocene near Cecina, Italy. The Mediterranean forms reach a length of 0.6 mm whereas our specimens seldom exceed 0.3 mm. Recent specimens from the Gulf of Mexico are approximately the same size as the Louisiana Pleistocene forms. They are similar to *Bolivina goësii*, although the shape of the test is markedly different, being wider and more compressed in the latter. The species ranges from Miocene to Recent in the Mediterranean region. Types are from the Pleistocene of Catania, Sicily. Length of plesiotype, pl. VIII, fig. 3, 0.25 mm; breadth, 0.13 mm. Length of plesiotype, pl. VIII, fig. 21, 0.28 mm; breadth, 0.13 mm.

BOLIVINA DAGGARIUS Parker
Pl. VIII, fig. 22

1955. *Bolivina daggarius* PARKER, Contr. Cushman Found. Foram. Research, vol. 6, pt. 1, p. 52, pl. 31, fig. 9.

Only two specimens were found which are referable to this species. Length of plesiotype, 0.26 mm; breadth, 0.06 mm.

BOLIVINA DIFFORMIS (Williamson)
Pl. VIII, fig. 8

1858. *Textularia variabilis* Williamson var. *difformis* WILLIAMSON, Rec. Foram. Gt. Britain, p. 77, pl. 6, figs. 166, 167.
1937. *Bolivina difformis* (Williamson). CUSHMAN, Cushman Lab. Foram. Res., Spec. Publ. 9, pp. 164-165, pl. 15, figs. 13-17.

A single specimen, probably a juvenile, was found at 545 feet in the South Pass Block 41 well. The length of the specimen is only 0.19 mm; breadth, 0.13 mm. Numerous localities are given by Cushman in the above reference. Some of these are from the present waters about the British Isles northward to the coast of Norway, and possibly into the Mediterranean. There are also nu-

merous records for the species in the Pleistocene clays of England and Ireland.

BOLIVINA FRAGILIS Phleger and Parker
Pl. VIII, figs. 14, 26

1951. *Bolivina fragilis* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 13, pl. 6, figs. 14, 23, 24a, b.

This species is rare in the Gulf Coast Pleistocene. It is present in rather high frequencies in only two cores in the South Pass Block 41, well, 1100 feet and 2238 feet. Specimens at 3258 feet are not typical and may belong to another species.

Pleistocene specimens show considerable peripheral variation. Some, like the holotype, have a distinct keel, but others have a subacute periphery. There is also variation in the costae which are distinct in some individuals but faint to absent in others. Only a few of our specimens have a short spine at the initial end. Length of microspheric plesiotype, pl. VIII, fig. 26, 0.59 mm; breadth, 0.19 mm. Length of megalospheric plesiotype, pl. VIII, fig. 14, 0.42 mm; breadth, 0.18 mm.

BOLIVINA GOËSII Cushman
Pl. VIII, fig. 1

1922. *Bolivina goësii* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 3, p. 34, pl. 6, fig. 5.

Pleistocene specimens are identical with Recent forms from the Gulf of Mexico including homeotypes of Phleger and Parker (1951, pl. 6, fig. 13). The species is also reported from the Miocene of the Dominican Republic. Length of plesiotype, 0.42 mm; breadth, 0.25 mm.

BOLIVINA HASTATA Phleger and Parker
Pl. VIII, fig. 12

1951. *Bolivina hastata* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 13, pl. 6, figs. 18a, b, 19.

This species closely resembles in many respects the larger *Bolivina fragilis*, and, like *B. fragilis*, it shows variation in the costae, most of the Pleistocene specimens being smooth. Nearly all specimens have an apical spine. Length of plesiotype, 0.32 mm; breadth, 0.13 mm.

BOLIVINA LOWMANI Phleger and Parker
Pl. VIII, fig. 5

1951. *Bolivina lowmani* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 13, pl. 6, figs. 20a, b, 21.

This species occurs in abundance in 6 feet of water at the present location of the South Pass Block 41 well. The species was also found in this boring at a depth of 4900 feet, near the top of the Pliocene, as well as in marine intervals throughout the Pleistocene. Length of plesiotype, 0.23 mm; breadth, 0.09 mm.

BOLIVINA MINIMA Phleger and Parker
Pl. VIII, fig. 11

1951. *Bolivina minima* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 14, pl. 6, figs. 22a, b, 25; pl. 7, figs. 1, 2.

This distinctive species is rare in the Gulf Coast Pleistocene. Fossil specimens are identical with the holotype and paratypes from the Gulf of Mexico. The species resembles *Bolivina catanensis* Seguenza from which it is easily distinguished by its serrate margin and more slender test. Length of homeotype, 0.29 mm; breadth, 0.14 mm.

BOLIVINA ORDINARIA Phleger and Parker
Pl. VIII, fig. 4

1951. *Bolivina simplex* PHLEGER and PARKER, (not *B. interjuncta* Cushman var. *simplex* Cushman and Renz, 1941), Geol. Soc. America, Mem. 46, pt. 2, p. 14, pl. 7, figs. 4-6.
1952. *Bolivina ordinaria* PHLEGER and PARKER, Contr. Cushman Found. Foram. Res., vol. 3, pt. 1, p. 14.

A few specimens are identical with the holotype and paratypes from the Gulf of Mexico. Length of plesiotype, 0.23 mm; breadth, 0.13 mm.

BOLIVINA PACIFICA Cushman and McCulloch
Pl. VIII, fig. 17

1942. *Bolivina acerosa* Cushman var. *pacifica* CUSHMAN and MCCULLOCH, Allan Hancock Pacific Exped., vol. 6, no. 4, p. 185, pl. 21, figs. 2-3.

Paratypes of *B. acerosa pacifica* borrowed from the U. S. National Museum show similarity to holotype of *B. acerosa* Cushman only in slenderness of test. Cushman's species is less compressed. The two foraminifers do not appear so closely related as indicated by Cushman and McCulloch. Pleistocene specimens of *B. pacifica* show varia-

tions in size and width of test but include the dimensions of primary types in the range of variation. Our specimens have distinct, clear areas at the upper and inner portion of each chamber as do specimens from the Pacific Recent described by the above authors. In this respect, *B. pacifica* resembles *B. translucens* Phleger and Parker and *B. daggarius* Parker. Length of plesiotype, 0.32 mm; breadth, 0.13 mm; thickness, 0.06 mm.

BOLIVINA PLICATELLA Cushman
Pl. VIII, fig. 16

1930. *Bolivina plicatella* CUSHMAN, Florida Geol. Survey, Bull. 4, p. 46, pl. 8, figs. 10a, b.

Small, infrequent specimens occur in the lower part of the Pleistocene section, particularly in the sidewall core at 3258 feet in the South Pass Block 41 well. These compare closely with topotypes from the type locality, cut in road leading to Watson's Landing, Apalachicola River, Liberty County, Florida. This species has also been reported from the Pliocene of N. Carolina, Florida, and Cuba, and from the Miocene of N. Carolina, Maryland, and the Buff Bay Formation in Jamaica. Cushman reported it in the Pleistocene of the Panama Canal zone and as living in the W. Indian region and southward. There is close similarity with *Bolivina pseudoplicata* Heron-Allen and Earland with which there may be an infraspecific relationship. Length of plesiotype, 0.19 mm; breadth, 0.16 mm.

BOLIVINA SPINATA Cushman
Pl. VIII, fig. 10

1936. *Bolivina striatula* Cushman var. *spinata* CUSHMAN, Cushman Lab. Foram. Res., Spec. Publ. 6, p. 59, pl. 8, figs. 9a, b.

Typical specimens were found only in the uppermost beds of the Pleistocene. They were compared with the holotype from north of Puerto Rico. Length of plesiotype, 0.48 mm; breadth, 0.15 mm.

BOLIVINA cf. B. STRIATULA Cushman
Pl. VIII, fig. 9

1922. *Bolivina striatula* CUSHMAN, Carnegie Inst. Washington, Publ. 311, p. 27, pl. 3, fig. 10.

Due to the fragmental condition of the few small forms found, this reference is made with reservations. The two Pleistocene specimens from 578 feet in the South Pass Block 41 well are relatively wider than Recent specimens from the Gulf of Mexico. Length of figured specimen (incomplete test), 0.40 mm; breadth, 0.17 mm.

B. striatula has been reported from the Pleistocene of Florida, and from the Miocene of Jamaica and the Dominican Republic.

BOLIVINA SUBAENARIENSIS Cushman
Pl. VIII, figs. 20, 28

1899. *Bolivina aenariensis* FLINT (part, not Costa), Rept. U. S. Natl. Mus., (1897), pt. 2, p. 292, pl. 37, fig. 6.
1922. *Bolivina subaenariensis* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 3, p. 46, pl. 7, fig. 6.

Typical specimens are abundant in a sidewall core at 3490 feet in the South Pass Block 41 well. The type of this species is from 250 fathoms southeast of Nantucket. Cushman records it in the reference above as common from south of Nova Scotia to Cape Hatteras. Our specimens were compared with the paratypes.

It is interesting that the typical form and the two foraminifers considered as subspecies, *Bolivina subaenariensis mexicana* Cushman and *B. subaenariensis lucida*, n. subsp., occur in the same sample (3490 feet). At 3540 feet in the same well, however, *B. subaenariensis* occurs frequently to the exclusion of both subspecies. The actual genetic relationship of these three sympatric forms is unknown. They may belong to distinct biologic species. Gradations cannot be discerned between these groups in our samples. Further data toward determining whether these forms are truly allopatric in modern seas as implied by Cushman in the above reference would be interesting. Length of plesiotypes, 0.53 mm, 0.50 mm; breadth, 0.23 mm, 0.21 mm; thickness, 0.11 mm, 0.09 mm.

BOLIVINA SUBAENARIENSIS LUCIDA
Akers and Dorman, new subspecies
Pl. VIII, figs. 2, 18, 25

1881-1882. *Bolivina aenariensis* H. B. BRADY (not Costa), Proc. Roy. Soc. Edinburgh, p. 711.
1884. *Bolivina aenariensis* H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 423, pl. 53, figs. 10, 11.
1937. *Bolivina subaenariensis* Cushman var. CUSHMAN, Cushman Lab. Foram. Res., Spec. Publ. 9, p. 156.
1953. *Bolivina subaenariensis* Cushman. DROOGER, Contr. Cushman Found. Foram. Res., vol. 4, pt. 4, p. 132, pl. 21, figs. 11-13.

Distinct differences are seen in this form from *Bolivina subaenariensis mexicana* Cushman. Our specimens probably belong to the same group as those mentioned by Cushman in the above reference from the Atlantic coasts of Europe. The subspecies differs from the typical in having higher, less oblique chambers and clear instead of opaque chambers. *B. subaenariensis lucida* differs from *B. subaenariensis mexicana* Cushman in having fewer costae and in that the costae do not extend so close to the apertural end of the test. In these respects our subspecies is closer to the typical than is *B. subaenariensis mexicana*. *B. subaenariensis lucida* differs from both the typical and *B. subaenariensis mexicana* in that the sutures are limbate with considerable increase in limbosity at the median line. Our subspecies has a short spine at the apical end as do the other forms. The test is thin and fragile. Of several hundred specimens examined not one was entire. Length of holotype (pl. VIII, fig. 25), 0.63 mm; width, 0.25 mm. Length of paratypes, 0.55 mm, 0.45 mm; width, 0.21 mm for both specimens.

Holotype and paratypes are from the core at 3300 feet in California Company State Lease 2553, well number 1, South Pass Block 41, Plaquemines Parish, Louisiana. Drooger's specimens from Aruba (see above reference) seem to belong to this group, but their age may be Pleistocene rather than Miocene.

BOLIVINA SUBAENARIENSIS MEXICANA Cushman

Pl. VIII, figs. 13, 19

1922. *Bolivina subaenariensis* Cushman var. *mexicana* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 3, p. 47, pl. 8, fig. 1.

Bolivina subaenariensis mexicana and *B. lowmani* occur most frequently in the Gulf Coast Pleistocene of all representatives of this genus. Length of plesiotype, pl. VIII, fig. 19, 0.50 mm; breadth, 0.21 mm. Length of plesiotype, pl. VIII, fig. 13, 0.42 mm; breadth, 0.23 mm.

The holotype of this foraminifer is from the Gulf of Mexico. Miocene occurrences are reported for Jamaica and the Dominican Republic. The writers have it from the Louisiana subsurface Pliocene.

BOLIVINA SUBSPINESCENS Cushman

Pl. VIII, figs. 6, 15

1922. *Bolivina subspinescens* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 3, p. 48, pl. 7, fig. 5.

Fossil specimens are typical of the species. Most records for this species in the Atlantic and Gulf of Mexico are deeper than 50 meters. It is reported from the Miocene of Egypt. Length of plesiotype (fig. 15), 0.29 mm; breadth, 0.15 mm.

Forms are common in the lower part of the Pleistocene, particularly in the core at 3258 feet in the South Pass Block 41 well, in which the basal portion of the chambers are only slightly granular. Although this results in a somewhat different appearance from the individuals with short spines, these forms are considered here as variants. This is done largely on the basis of variation noted by Cushman in the above reference. Length of figured variant (pl. VIII, fig. 6), 0.23 mm; breadth, 0.11 mm.

BOLIVINA cf. B. SUBTENUIS Cushman

Pl. VIII, fig. 35

1936. *Bolivina subtenuis* CUSHMAN, Cushman Lab. Foram. Res., Spec. Publ. 6, p. 57, pl. 8, fig. 10.

A single, broken specimen may belong to this group. Specimens from the Recent of Samoa are greatly compressed, and this is also a distinctive characteristic of our Pleistocene specimen. Apertural comparisons cannot be made, however, due to the damaged condition of our specimen. Length of figured specimen (incomplete), 0.42 mm; breadth, 0.29 mm; thickness, 0.12 mm.

BOLIVINA THALMANNI Renz

Pl. VIII, fig. 27

1948. *Bolivina thalmanni* RENZ, Geol. Soc. America, Mem. 32, p. 120.

A few specimens are referred to this species although they are not as close to the holotype as are Louisiana Gulf Coast Miocene specimens. Pleistocene individuals, particularly those from the Aftonian beds, approach the dimensions of the holotype from the Pozon Formation in northern Venezuela, but the characteristic ridges are less sharp than those in the Tertiary specimens from the Gulf Coast and Venezuela.

Some of our forms seem to be intermediate between *Bolivina plicatella* Cushman and *Bolivina thalmanni* Renz. *Bolivina plicatella* is smaller, and the longitudinal ridges are

less distinct than in the Pleistocene forms. Possibly these two species belong with *Bolivina pseudo-plicata* Heron-Allen and Earland in a group of *Bolivinas* probably of subgeneric rank in which the test is thick and the wall deeply reticulate. Length of plesiotype, 0.40 mm; breadth, 0.26 mm.

BOLIVINA TRANSLUCENS Phleger and Parker
Pl. VIII, fig. 33

1951. *Bolivina translucens* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 15, pl. 7, figs. 13, 14a, b.

Only a few specimens were found; these seem to be identical with the holotype and paratypes from the Recent sediments of the Gulf of Mexico. Length of plesiotype, 0.21 mm; breadth, 0.08 mm.

BUCCELLA HANNAI (Phleger and Parker)
Pl. X, figs. 3, 4

1951. *Eponides hannai* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 21, pl. 10, figs. 11a, b, 12a, b, 13a, b, 14a, b.

In the South Pass Block 41 well, frequencies are low in beds below the Montgomery Formation. Diameter of plesiotype, 0.27 mm; thickness, 0.17 mm.

BUCCELLA sp.
Pl. X, figs. 29, 30

Two specimens of a small, tightly coiled *Buccella* were found at 2418 feet in the South Pass Block 41 well. The form is distinctive from both *B. hannai* and *B. mansfieldi* in its tight coiling and relatively high spire. Additional specimens are needed for adequate description of the species. Diameter of figured specimen, 0.23 mm; thickness, 0.15 mm.

BULIMINA ACULEATA d'Orbigny
Pl. VII, fig. 33

1826. *Bulimina aculeata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 269, no. 7.

Frequent in the South Pass Block 41 well at two horizons, 3490 and 3574 feet. The species is not common in other zones of the Pleistocene section. Phleger and Parker (1951, p. 44) record it as present in the Gulf of Mexico at depths usually greater than 500 meters. The shallowest record in the Atlantic is at 100 meters. This foraminifer is also recorded from the Miocene of Mallorca, Morocco, Jamaica (Cushman and Todd, 1945, p. 39), and the Dominican Republic (Bermudez, 1949, p. 179) and from the Pliocene and Miocene of Italy. Length of plesiotype, 0.40 mm; breadth, 0.28 mm.

BULIMINA ALAZANENSIS SPATIOSA
Cushman and Todd
Pl. VII, fig. 37

1945. *Bulmina alazanensis* Cushman var. *spatiosa* CUSHMAN and TODD, Cushman Lab. Foram. Res., Spec. Publ. 15, Sharon, Mass., p. 40.

Specimens of Yarmouth age are identical with our topotypes from the Miocene locality 1/2 mile east of Buff Bay, Jamaica. The species is rare in the South Pass Block 41 well, but it is common at 1830 feet in California P.O.D. no. 7, South Pass Block 24 Field. Length of plesiotype, 0.82 mm; breadth, 0.46 mm.

BULIMINA MARGINATA d'Orbigny
Pl. VII, figs. 14, 39

1826. *Bulimina marginata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 269, no. 4, pl. 12, figs. 10-12.

Pleistocene specimens, like Recent forms from the Gulf of Mexico, are variable. Two variants are figured. Length of plesiotype, pl. VII, fig. 14, 0.38 mm; breadth, 0.23 mm. Length of plesiotype, pl. VII, fig. 39, 0.42 mm; breadth, 0.32 mm.

The species has been identified from several Caribbean localities of Miocene age and from the Miocene of Louisiana and Florida. In Italy the range is Upper Miocene to Recent.

BULIMINA PATAGONICA d'Orbigny
Pl. VII, fig. 38

1839. *Bulimina patagonica* D'ORBIGNY, Voy. Amér. Mérid., vol. 5, pt. 5, "Foraminifères", Strasbourg, France, Levrault, p. 50.

Specimens were compared with the holotype of *Bulimina patagonica* d'Orbigny var. *glabra* Cushman and Wickenden from off Chile. Some of our forms are entirely smooth, and they are identical with the variety in size and other aspects, but others have short spines at the bases of the chambers. Our specimens are referred to the species instead of the variety, therefore, on this evidence that the ornamentation is variable. We have also seen this species in Recent samples off the coast of Louisiana. Length of plesiotype, 0.27 mm; breadth, 0.15 mm.

BULIMINA SPICATA Phleger and Parker
Pl. VII, fig. 22

1951. *Bulimina spicata* Phleger and Parker, Geol. Soc. America, Mem. 46, pt. 2, p. 16, pl. 7, figs. 25a-c, 30, 31.

Pleistocene specimens were compared with the holotype and paratype from Recent sediments in the Gulf of Mexico. Phleger and Parker (1951, p. 44) record the species in the Gulf of Mexico at depths greater than about 100 meters. Parker (1954, pp. 510-511) records it deeper than 70 meters in the northeastern Gulf of Mexico. Length of plesiotype, 0.21 mm; breadth, 0.13 mm.

BULIMINA STRIATA MEXICANA Cushman
Pl. VII, fig. 15

1922. *Bulimina striata* d'Orbigny var. *mexicana* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 3, p. 95, pl. 21, fig. 2.

Comparisons were made with the holotype and paratypes from the Atlantic Ocean. The species is common in the Gulf of Mexico, especially below about 200 meters (Phleger and Parker, 1951, p. 44). It also occurs in middle latitudes of the Atlantic from 80 meters to 2430 meters. Our Pleistocene specimens also seem to be identical with individuals from the Miocene locality 1/2 mile east of Buff Bay, Jamaica. Length of plesiotype, 0.38 mm; breadth, 0.32 mm.

BULIMINELLA cf. B. BASSENDORFENSIS Cushman and Parker
Pl. VII, figs. 4-7

1937. *Buliminella bassendorfensis* CUSHMAN and PARKER, Contr. Cushman Lab. Foram. Res., vol. 13, pt. 1, p. 40, pl. 4, figs. 13a, b.

Small specimens are identical with Recent specimens from the Gulf of Mexico which have been referred questionably to this species (Phleger and Parker, 1957, p. 17; Parker, 1954, p. 509). Variants occur at 3520 feet in the South Pass Block 41 well which are approximately twice as large as Recent individuals from the Gulf of Mexico. Most of these tend to be subfusiform, and all specimens at this horizon show a well-developed basal spine. One individual has two small basal spines. Andersen (1961, p. 87) may be correct in referring this form to a new species, *Buliminella morgani* Andersen, although specimens from the Pleistocene and the Gulf of Mexico Recent are similar to the types of *B. bassendorfensis* from the Oregon Oligocene. Length of figured specimen, pl. VII, fig. 7, 0.27 mm; breadth, 0.08 mm. Length of specimen, pl. VII, fig. 4, 0.46 mm; breadth, 0.17 mm. Length of specimen, pl. VII, fig. 5, 0.36 mm; breadth, 0.16 mm. Length of specimen, pl. VII, fig. 6, 0.36 mm; breadth, 0.18 mm.

BULIMINELLA ELEGANTISSIMA (d'Orbigny)
Pl. VII, fig. 36

1839. *Bulimina elegantissima* D'ORBIGNY, Voy. Amér. Mérid., vol. 5, pt. 5, "Foraminifères", p. 51, pl. 7, figs. 13, 14.

B. elegantissima was described from off the west coast of South America. It is found in the Gulf of Mexico from beach sands to 385 meters (Phleger and Parker, 1951, p. 17) and from 15 meters to 90 meters off Maryland (Parker, 1948, p. 222). The senior writer has found it to be most frequent off the coast of Louisiana at depths less than 50 meters. This species has been reported from the Pliocene-Pleistocene and the Miocene of the Dominican Republic. It is also reported from Pliocene to Recent of Cuba and from the Miocene of Florida. Only a few very small specimens were found. Length of plesiotype, 0.15 mm; breadth, 0.07 mm.

CANCRIS SAGRA (d'Orbigny)
Pl. XI, figs. 24, 25

1839. *Rotalina sagra* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 77, pl. 5, figs. 13-15.

A subdivision of Recent and Pleistocene *Cancris* does not seem practical with present data. It seems advisable, therefore, to refer all our specimens to the above species, although some variation may be observed in length of test, curvature of sutures, nature of periphery, and other features. Length of plesiotype, 0.46 mm; breadth, 0.33 mm; thickness, 0.17 mm.

This species group is widely reported from the Recent of the Atlantic, Caribbean, and Gulf of Mexico and from the Miocene of the Caribbean and the Gulf Coast. It is almost worldwide in distribution both in Recent seas and in Tertiary sediments.

CASSIDULINA CURVATA Phleger and Parker
Pl. XI, fig. 5

1951. *Cassidulina curvata* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 26, pl. 14, figs. 5a, b.

Fossil specimens were compared with the holotype from the Gulf of Mexico. Diameter of plesiotype, 0.23 mm.

CASSIDULINA LAEVIGATA d'Orbigny

Pl. XI, fig. 4

1826. *Cassidulina laevigata* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 282, no. 1, pl. 15, figs. 4, 5; Modèles, no. 41.

Our specimens are typical of some of the forms assigned to this species. Diameter of plesiotype, 0.25 mm.

The species is recorded from the Pliocene of North Carolina, the Oligocene of Puerto Rico, and the Miocene of coastal Louisiana, Jamaica, the Dominican Republic, Italy, and Morocco. It is also reported from the Tertiary of Colombia, Venezuela, Barbados, Trinidad, Mexico, and California and from the Plio-Pleistocene of the Netherlands.

CASSIDULINA NEOCARINATA Thalmann

Pl. XI, fig. 1

1896. *Cassidulina laevigata* d'Orbigny var. *carinata* SILVESTRI, Accad. Pont. N. Lincei, Mem. 12, p. 104, pl. 2, fig. 10.

1950. *Cassidulina neocarinata* THALMANN, Contr. Cushman Found. Foram. Res., vol. 1, pts. 3 and 4, p. 44.

The species is reported in Italy from Middle Miocene to Recent. Our Pleistocene specimens were compared with Pliocene specimens from the vicinity of Siena, Italy. This foraminifer is also recorded from the Florida Miocene. Gulf Coast individuals seem to lie within the range of variation of the species. Diameter of plesiotype, 0.27 mm.

This form is listed in figures 2 and 3 as *Cassidulina carinata* Silvestri.

CASSIDULINA NORCROSSI AUSTRALIS
Phleger and Parker

Pl. XI, fig. 6

1951. *Cassidulina norcrossi australis* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 27, pl. 14, figs. 8a, b, 9, 10.

Pleistocene fossil specimens are identical with Recent individuals from the Gulf of Mexico. Diameter of plesiotype, 0.22 mm.

CHRYSALIDINELLA sp.

Pl. IX, fig. 20

A single specimen was found which is not referred to a species. Length of figured specimen, 0.32 mm; breadth, 0.13 mm.

CIBICIDES aff. C. FLORIDANUS (Cushman)

Pl. XV, figs. 26, 27

1918. *Truncatulina floridana* CUSHMAN, U. S. Geol. Surv., Bull. 676, p. 62, pl. 19, fig. 2.

Several variable groups of specimens are referred to this species. It has been noted (Phleger and Parker, 1951, p. 30) that the larger, more limbate Recent forms in the Gulf of Mexico generally occur in the samples from deeper water. This may also have been the case with the Pleistocene forms. The largest of our specimens, which have a diameter of 0.95 mm, occur within the interval 3104 to 3590 feet in the South Pass Block 41 well. Maximum diameter of figured specimen, 0.74 mm; thickness, 0.39 mm.

CIBICIDES NUCLEATUS (Seguenza)

Pl. XV, figs. 21-23

1880. *Truncatulina nucleata* SEGUENZA, Atti R. Accad. Lincei III, vol. 6, p. 64, pl. 7, fig. 8.

1928. *Truncatulina trinitatensis* NUTTALL, Quart. Journ. Geol. Soc. London, vol. 84, p. 97, pl. 7, figs. 3, 5, 6.

1929. *Cibicides nucleata* (Seguenza). GALLOWAY and MORREY, Bull. Amer. Paleontology, vol. 15 (55), p. 31, pl. 4, fig. 9.

1932. *Cibicides trinitatensis* (Nuttall). NUTTALL, Journ. Paleontology, vol. 6, p. 33, pl. 7, fig. 9.

1934. *Cibicides trinitatensis* (Nuttall). HADLEY, Bull. Amer. Paleontology, vol. 20 (70A), p. 29, pl. 4, figs. 10, 11.

1940. *Anomalina nucleata* (Seguenza). CORYELL and RIVERO, Journ. Paleontology, vol. 14, p. 334, pl. 44, figs. 2a-c.

1941. *Anomalina nucleata* (Seguenza). GALLOWAY and HEMINWAY, New York Acad. Sci., Sci. Survey Porto Rico and Virgin Is., vol. 3, pt. 4, p. 388, pl. 22, fig. 2.

1941. *Cibicides nucleatus* (Seguenza). D. K. PALMER, Mem. Soc. Cubana Hist. Nat., vol. 15, p. 296.

1945. *Cibicides nucleatus* (Seguenza). D. K. PALMER, Bull. Amer. Paleontology, vol. 29, no. 115, p. 73.

1948. *Anomalinoides trinitatensis* (Nuttall). RENZ, Geol. Soc. America, Mem. 32, p. 115, pl. X, figs. 11a-c.

1949. *Cibicides nucleatus* (Seguenza). BERMUDEZ, Cushman Lab. Foram. Res., Spec. Pub. 25, 303, pl. 24, figs. 16-18.

1951. *Cibicides robustus* PHLEGER and PARKER, (not Le Calvez, 1949), Geol. Soc. America, Mem. 46, pt. 2, p. 31, pl. 17, figs. 1a, b, 2a, b, 3a, b, 4a, b.

1952. *Cibicides corpulentus* PHLEGER and PARKER, Contr. Cushman Found. Foram. Res., vol. 3, pt. 1, p. 14.
1954. *Cibicides corpulentus* Phleger and Parker. PARKER, Harvard, Bull. Mus. Comp. Zoology, vol. 111, no. 10, p. 541, pl. 12, figs. 4, 8.

Galloway and Heminway point out in the reference above on Puerto Rican Tertiary Foraminifera "considerable variation in sutural limbation and thickness of the umbos in this species (or these species), depending more on the ontogenetic age of the specimens than on the geologic age". Phleger and Parker separate Gulf of Mexico specimens from *C. nucleatus* on the basis of the "much larger plug on dorsal side—and much more limbate sutures".

The writers have compared specimens from the Gulf of Mexico, including holotype and paratypes of *C. corpulentus* Phleger and Parker, with specimens from the Miocene Carapita of Venezuela, the Miocene of Trinidad, the Miocene of Jamaica, the Middle Tertiary of Mexico, the subsurface Miocene of Louisiana, and the Miocene of the Balearic Islands. The range of variation in all of these regions and also in the Gulf Coast Pleistocene is similar. Limbate specimens with large umbos from the Gulf of Mexico, for example, cannot be differentiated from limbate specimens with large umbos from the Carapita of Venezuela.

Other occurrences of this group have been reported from the Middle Tertiary of Ecuador, Cuba, Haiti, Barbados, and Carriacou. *C. nucleatus* was described from the Miocene of Italy. Phleger and Parker found this form limited to water deeper than about 120 meters in the Gulf of Mexico. All of the fossil assemblages containing this species which were examined by the present writers are suggestive of a depositional environment of several hundred meters water depth.

Maximum diameter of plesiotype, 0.74 mm; thickness, 0.38 mm.

CIBICIDES aff. C. PROTUBERANS Parker
Pl. XV, figs. 11, 12

1954. *Cibicides protuberans* PARKER, Harvard, Bull. Mus. Comp. Zoology, vol. 111, no. 10, p. 542, pl. 12, figs. 13, 14, 16.

A few specimens are assigned tentatively to this species although most are smaller than indicated in the above reference for Recent Gulf of Mexico forms. Maximum diameter of figured specimens, 0.34 mm; thickness, 0.13 mm.

The holotype, which was borrowed for purposes of comparison, shows later and wider whorls than do our specimens. Pleistocene individuals appear indistinguishable from the young stages of the Recent specimens, however.

CIBICIDES aff. C. ROBERTSONIANUS
(H. B. Brady)
Pl. XV, figs. 24, 25

1881. *Truncatulina robertsoniana* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, p. 65.
1884. *Truncatulina robertsoniana* H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 664, pl. 95, figs. 4a-c.

A variable group of small specimens is referred tentatively to this species. Maximum diameter of figured specimen, 0.21 mm; thickness, 0.11 mm.

CIBICIDES UMBONATUS Phleger and Parker
Pl. XV, figs. 7, 8

1951. *Cibicides umbonatus* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 31, pl. 17, figs. 7a, b, 8a, b.

Pleistocene specimens were compared with the holotype and paratypes from the Gulf of Mexico, and they seem to be typical in all respects. According to Phleger (1951, p. 45) the species is not recorded in the Gulf of Mexico shallower than 100 meters. Maximum diameter of plesiotype, 0.48 mm; thickness, 0.21 mm.

This species appears to be closely related to *Eponides crebbsi* Hedberg from the Middle Tertiary of Venezuela differing mainly in the character of the sutures on the umbilical side.

CIBICIDES WUELLERSTORFI (Schwager)
Pl. XV, figs. 16, 17

1866. *Anomalina wuellerstorfi* SCHWAGER, Novara-Exped., Geol. Theil., vol. 2, p. 258, pl. 7, figs. 105, 107.

The species ranges in Italy throughout the post-Eocene Cenozoic. There seems to be confusion in the literature between *Planulina ariminensis* d'Orbigny (Recent (?), near Rimini, Italy) and this species. Study of the problem may indicate that *C. wuellerstorfi* is a junior synonym of *P. ariminensis*.

Our specimens are close to those from the Gulf of Mexico which have been referred to *C. wuellerstorfi*. Phleger (1951, p. 48) records it from Gulf of Mexico stations deeper

than 700 meters. In the Atlantic, it is reported from 630 meters to 4450 meters. The species occurs in that part of the Gulf Coast Pleistocene which has been inferred to represent deep water deposition (Akers and Holck, 1957, pl. 1). The species was described from the Miocene of Kar Nikobar. As *"Planulina wuellerstorfi,"* it is also reported from the Middle Tertiary of Trinidad, Colombia, and the Dominican Republic; and it is found in the Louisiana Miocene. Maximum diameter of plesiotype, 0.55 mm; thickness, 0.13 mm.

This form is listed in figures 2 and 3 as *Planulina wuellerstorfi* (Schwager).

CYCLAMMINA CANCELLATA H. B. Brady
Pl. I, fig. 1

1876. *Cyclammina cancellata* H. B. BRADY (MS.) *in* NORMAN, Proc. Roy. Soc., vol. 25, p. 214;
1884. *Cyclammina cancellata* H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 351, pl. 37, figs. 8-16.

A single but typical specimen was found at 1875 feet in the South Pass Block 24 well. The depth range in the Gulf of Mexico recorded for Recent specimens is 366 to 2660 meters. Temperature extremes of 1.9 and 6.72 degrees centigrade have been reported (Akers, 1954, p. 138). The species is widespread in modern seas and Middle Tertiary deposits. Maximum diameter of plesiotype, 2.04 mm; thickness, 0.48 mm.

CYCLOGYRA PLANORBIS (Schultze)
Pl. IV, fig. 5

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

Only a few small specimens were found. As in Recent deposits in the Gulf of Mexico, according to Phleger and Parker (1951, p. 8), the species is characteristic of calcareous sediments. Diameter of plesiotype, 0.19 mm; thickness, 0.06 mm.

DENTALINA COMMUNIS d'Orbigny
Pl. VI, fig. 12

1826. *Nodosaria (Dentalina) communis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 254, no. 25.

A few specimens seem to be referable to this group. Miocene occurrences are reported for Florida, Jamaica, Mallorca, and Morocco. In Cuba, the range is from Upper Eocene to Recent. Length of plesiotype, 0.46 mm; breadth, 0.13 mm.

DENTALINA cf. D. DISPAR Reuss
Pl. V, fig. 32

1851. *Dentalina dispar* REUSS, Zeitschr. deutsch. geol. Ges., vol. 3, p. 61, pl. 3, fig. 7.

A single small specimen is tentatively referred here. The species is reported from the Tertiary of Europe and from Buff Bay, Jamaica. Length of figured specimen, 0.22 mm; breadth, 0.04 mm.

DENTALINA VERTEBRALIS ALBATROSSI (Cushman)
Pl. V, fig. 33

1923. *Nodosaria vertebralis* var. *albatrossi* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 87, pl. 15, fig. 1.

Usually only broken specimens of this large foraminifer are found. Fossil specimens are identical with Recent individuals from the Gulf of Mexico. The subspecies is reported from the Miocene Buff Bay locality of Jamaica and from the Miocene of Mallorca. Length of plesiotype, 4.35 mm; breadth of final chamber, 0.45 mm.

ELPHIDIUM DISCOIDALE (d'Orbigny)
Pl. VII, figs. 16, 17

1839. *Polystomella discoidalis* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 56, pl. 6, figs. 23, 24.

This is probably the most frequently encountered species of the genus in the Gulf Coast Pleistocene. Specimens seem to be largest in calcareous zones. Bermudez (1949, p. 168) records the species from the Tertiary of the Dominican Republic. Forms reported by Drooger (1953) from Aruba may be of Pleistocene or Pliocene age rather than Miocene as he supposed. Maximum diameter of plesiotype, 0.59 mm; thickness, 0.32 mm.

ELPHIDIUM FIMBRIATULUM (Cushman)
Pl. VII, figs. 28, 29

1918. *Polystomella fimbriatulum* CUSHMAN, U. S. Geol. Survey, Bull. 676, p. 20, pl. 8, figs. 5a, b.

Specimens are usually rare and small. They cannot be differentiated from forms which occur in the Miocene Chipola and Hawthorn Facies of the Alum Bluff Stage in Florida. The species is also reported from the Pliocene and Oligocene (?) of Cuba and from the Miocene of Jamaica and the Dominican Republic. It was described from the Pliocene of Florida. A related form with

17 chambers instead of 12 is reported from the Gulf of Mexico (Phleger and Parker, 1951, p. 10). Maximum diameter of plesiotype, 0.50 mm; thickness, 0.23 mm.

ELPHIDIUM POEYANUM (d'Orbigny)
Pl. VII, figs. 31, 32

1839. *Polystomella poeyana* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 55, pl. 6, figs. 25, 26.

Pleistocene specimens are typical of the species which was described from the Recent of the Caribbean. It is also reported from the Pliocene of Cuba and from the Pliocene and Pleistocene of Florida. Miocene occurrences are recorded for Florida, Jamaica, Colombia, Puerto Rico, Cuba, Venezuela, and the Dominican Republic. Maximum diameter of plesiotype, 0.63 mm; thickness, 0.17 mm.

ELPHIDIUM SAGRUM (d'Orbigny)
Pl. VII, figs. 26, 27

1839. *Polystomella sagra* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 55, pl. 6, figs. 19, 20.

This species is most frequently encountered in calcareous zones. It is recorded from both Recent and Tertiary of the Caribbean region and from the Anahuac Formation of Texas and Louisiana. In Cuba it is reported from Upper Oligocene (?) to Recent, and it occurs in the Pliocene and Pleistocene of Florida. Maximum diameter of plesiotype, 0.58 mm; thickness, 0.34 mm.

ELPHIDIUM sp. indeterminate

Specimens with the greatest diameter less than 0.40 mm were not speciated because specific assignment of juveniles is often difficult to determine. Specimens belonging to the genus *Elphidium* may be diagnostic of certain environments, particularly by weight of numbers. For this purpose, forms with a diameter less than 0.40 mm are included in the frequency charts as *Elphidium* sp. indeterminate.

EPISTOMINELLA VITREA Parker
Pl. XI, figs. 7, 8

1953. *Epistominella vitrea* PARKER *in* PARKER, PHLEGER and PEIRSON, Cushman Found. Foram. Res., Spec. Publ. 2, p. 9, pl. 4, figs. 34-36, 40, 41.

Fossil specimens are similar to Recent individuals from the Gulf of Mexico. The same form occurs in the Louisiana Pliocene. Immature individuals resemble *Epistominella exigua* (H. B. Brady). Specimens from 3430 feet in the South Pass Block 41 well may belong to *E. exigua,* but this cannot be established with certainty because of their immaturity. Diameter of plesiotype, 0.19 mm; thickness, 0.08 mm.

EPONIDELLA GARDENISLANDENSIS Akers
Pl. X, figs. 26, 27

1952. *Eponidella gardenislandensis* AKERS, Journ. Paleontology, vol. 26, no. 4, p. 648, figs. 2a, b, c.

Fossil specimens are typical of those found in modern brackish-water bays of South Louisiana. This species is often associated both in Recent and Pleistocene sediments with the reworked tests of *Chiloguembelina.* Diameter of heautotype, 0.15 mm; thickness, 0.06 mm.

FISSURINA sp. "A"
Pl. VII, figs. 19, 20

A single small specimen at 578 feet in the South Pass Block 41 well is not referred to a species because of its small size. Length of figured specimen, 0.15 mm; breadth, 0.11 mm; thickness, 0.08 mm.

FISSURINA sp. "B"
Pl. VII, fig. 10

A single specimen at 3560 feet in the South Pass Block 41 well is distinctive, but additional specimens are not readily available for proper description of the species. Length of figured specimen, 0.27 mm; breadth, 0.19 mm; thickness, 0.13 mm.

FISSURINA sp. "C"
Pl. VII, figs. 8, 9

The illustrated specimen is typical of a species which is rather frequent at 1830 feet in The California Company, P.O.D. #7, South Pass Block 24. Because of confusion in the literature relating to this genus, identification with a described species is deferred. It resembles *Lagena marginata* Walker and Boys as figured by Flint (1899, p. 307, pl. 54, fig. 2) from the Recent of the Caribbean, Gulf of Mexico, and South Atlantic. Length of figured specimen, 0.32 mm; breadth, 0.25 mm; thickness, 0.17 mm.

FISSURINA sp. "D"
Pl. VII, figs. 11, 12

Our specimens seem to belong to the same species as that misidentified by Flint

(1899, p. 307, pl 54, fig. 1) as *Lagena staphyllearia* Schwager from the Caribbean in 896 fathoms. Our species is closer to *Fissurina dominicana* (Bermudez) from the Tertiary of the Dominican Republic. Length of figured specimen, 0.39 mm; breadth, 0.32 mm; thickness, 0.21 mm.

FLORILUS ATLANTICUS (Cushman)
Pl. VI, figs. 26, 27

1947. *Nonionella atlantica* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 23, pt. 4, p. 90, pl. 20, figs. 4, 5.
1954. *Nonionella atlantica* Cushman. PARKER, Harvard, Bull. Mus. Comp. Zool., vol. 111, no. 10, p. 507, pl. 6, figs. 6, 7.

Our specimens are typical of the Atlantic and Gulf of Mexico forms. The species was described from off the Atlantic coast of Florida. Length of plesiotype, 0.48 mm; breadth, 0.34 mm; thickness, 0.23 mm. The species is reported from the Miocene of Colombia and the Calabrian (Lower Pleistocene) of Italy.

This species is listed in figures 2 and 3 as *Nonionella atlantica* Cushman.

FLORILUS GRATELOUPI (d'Orbigny)
Pl. VI, fig. 36

1826. *Nonionina grateloupi* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 294, no. 19.
1839. *Nonionina grateloupi* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 46, pl. 6, figs. 6, 7.

This species, described from the Recent of the West Indies, is present in the Pleistocene in low frequencies. It is reported from the Pleistocene, Pliocene, and Miocene of Florida and from the Tertiary of Cuba, Jamaica, Colombia, the Dominican Republic, and France. Length of plesiotype, 0.59 mm; breadth, 0.38 mm; thickness, 0.21 mm.

This form is listed in figures 2 and 3 as *Nonion grateloupi* (d'Orbigny).

FRONDICULARIA SAGITTULA Vanden Broeck
Pl. VI, figs. 31-33

1876. *Frondicularia alata* d'Orbigny var. *sagittula* VANDEN BROECK, Ann. Soc. Belge Micr., vol. 2, p. 113, pl. 2, figs. 12, 14.

Specimens over 5 mm in length occur in the Upper Pleistocene of the Louisiana Gulf Coast. Although a wide range of variation is shown, they seem to be conspecific with Recent and Miocene specimens from the Caribbean region. Length of plesiotype (incomplete specimen), pl. VI, fig. 31, 2.18 mm; breadth, 1.66 mm. Length of plesiotype (incomplete specimen), pl. VI, fig. 33, 5.46 mm; breadth, 2.98 mm. Length of plesiotype (incomplete specimen), pl. VI, fig. 32, 4.20 mm; breadth, 2.42 mm.

FURSENKOINA cf. F. BRADYI (Cushman)
Pl. VII, fig. 21

1884. *Virgulina subsquammosa* H. B. BRADY (part, not Egger), Rept. Voy. Challenger, Zool., vol. 9, p. 415, pl. 52, figs. 9a-c (7, 8?).
1922. *Virgulina bradyi* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 3, p. 115, pl. 24, fig. 1.

We have only a single specimen which is tentatively referred to *F. bradyi*. Length of figured specimen, 0.44 mm; diameter, 0.17 mm.

FURSENKOINA COMPLANATA (Egger)
Pl. VIII, fig. 31

1893. *Virgulina schreibersiana* Czjzek var. *complanata* EGGER, Abhandl. k. bay. Akad. Wiss. München, vol. 18, pt. 2, p. 292, pl. 8, figs. 91, 92.

This small, slender species is common throughout the marine Pleistocene, and it has been recorded from the Buff Bay Miocene of Jamaica. The species has not been found in our samples from Buff Bay, however. The types are from off Western Australia in 90 to 359 meters. *F. complanata* has been found in the Gulf of Mexico in all depths of water. It is most widespread in depths less than 1000 meters according to Phleger (1951, p. 49). The range in Italy is Tortonian to Quaternary. Length of plesiotype, 0.29 mm; diameter, 0.11 mm.

FURSENKOINA FINISSIMA Akers and Dorman, n. sp.
Pl. VIII, figs. 29, 30

Test very small, elongate, slender, only slightly compressed, translucent; chambers low for the genus; sutures narrow, depressed, oblique, slightly curved; wall smooth, finely perforate; aperture elongate, broad. Length of holotype, 0.25 mm; maximum breadth, 0.05 mm. Holotype from core at 1270 feet in California Company State Lse. 2553, well number 1, South Pass Block 41, Plaquemines Parish, Louisiana.

This species is similar to *F. complanata* Egger, especially in size, but does not develop the abrupt expansion in the later portion of the test commonly seen in that species. The chambers are shorter, and the

aperture is not so broad and conspicuous as in *F. complanata.*

FURSENKOINA MEXICANA (Cushman)
Pl. VII, fig. 35

1922. *Virgulina mexicana* Cushman, U. S. Natl. Mus., Bull. 104, pt. 3, p. 120, pl. 23, fig. 8.

Compressed specimens from the Pleistocene belong to this species group. The types are from the Gulf of Mexico in 347 fathoms. Length of plesiotype, 0.49 mm; breadth, 0.21 mm; thickness, 0.10 mm.

FURSENKOINA FONTONI (Cushman)
Pl. VIII, fig. 32

1932. *Virgulina pontoni* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 8, pt. 1, p. 17, pl. 3, fig. 7.

There is confusion in the literature between this species and *F. schreibersiana* (Czjzek). We have compared *F. pontoni* from the Florida Miocene with *F. schreibersiana* from Miocene beds in the vicinity of Baden, Austria, and also from the Pliocene of Italy. Some of our Pleistocene specimens and specimens from the Florida Miocene are more compressed than the European species. These we believe should be assigned to *F. pontoni,* although in our samples it would not be unreasonable to consider *F. pontoni* as a variant of *F. schreibersiana. F. pontoni* has been recorded from Tertiary beds of Venezuela, Colombia, Trinidad, Jamaica, and California, as well as from the Miocene of Florida and Louisiana. Phleger and Parker (1951, p. 19) have identified the species from the Gulf of Mexico. Length of plesiotype, 0.67 mm; breadth, 0.24 mm; thickness, 0.15 mm.

FURSENKOINA SCHREIBERSIANA (Czjzek)
Pl. VII, fig. 34

1848. *Virgulina schreibersiana* CZJZEK, Haidinger's Nat. Abhandl., vol. 2, p. 11, pl. 13, figs. 18-21.

Some of the Pleistocene specimens are very similar to topotypes in our collection from the vicinity of Baden, Austria. See discussion under *F. pontoni* (Cushman). The species has been identified from the Miocene of California, tentatively (Cushman and Todd, 1945, p. 42) from the Miocene of Jamaica and tentatively from the Middle Tertiary of the Gulf Coast. It has been recorded in Europe from beds of Oligocene to Pliocene age and from stations off the Philippines and southward to Fiji. It is reported from the Weddell Sea by Earland. The range in Italy is Upper Oligocene to Quaternary. Length of plesiotype, 0.82 mm; diameter, 0.20 mm.

GAUDRYINA AEQUA Cushman
Pl. I, fig. 19

1947. *Gaudryina aequa* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 23, pt. 4, p. 87, pl. 18, figs. 18-21.

Fossil specimens seem to belong to the same species as that described by Cushman in the above reference from off the southeastern coast of the U. S. They are identical with specimens from the Gulf of Mexico tentatively referred to this species by Phleger and Parker (1951) and Parker (1954). Length of plesiotype, 0.42 mm; breadth, 0.25 mm.

GAUDRYINA (PSEUDOGAUDRYINA) ATLANTICA (Bailey)
Pl. I, fig. 23

1851. *Textularia atlantica* BAILEY, Smithsonian Contr. Knowl., vol. 2, art. 3, p. 12, pl., figs. 38-43.

This species is present in several zones of the Gulf Coast Pleistocene. Recent specimens have been reported in the Gulf of Mexico with a depth range of 90 meters to 300 meters. Fossil specimens are reported from the Miocene of Cuba, Jamaica, the Dominican Republic, and Aruba (possibly Pleistocene). Length of plesiotype, 2.00 mm; breadth, 1.11 m.

GLOBOBULIMINA AFFINIS (d'Orbigny)
Pl. VII, fig. 13

1839. *Bulimina affinis* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 105, pl. 2, figs. 25, 26.
1945. *Bulimina (Desinobulimina) illingi* CUSHMAN and STAINFORTH, Cushman Lab. Foram. Res., Spec. Publ. 14, p. 41, pl. 6, fig. 7.
1954. *Globobulimina affinis* (d'Orbigny). PARKER, Harvard, Bull. Mus. Comp. Zoology, vol. 111, no. 10, pl. 6, fig. 25; pl. 7, figs. 1, 2.

Pleistocene specimens compare closely with Parker's hypotypes from the Gulf of Mexico. The species is also recorded from the Middle Tertiary of Mallorca, Haiti, Cuba, and the Dominican Republic and from Middle Miocene to Recent in Italy. Length of plesiotype, 0.40 mm; breadth, 0.27 mm.

GLOBOBULIMINA MISSISSIPPIENSIS Parker
Pl. VII, fig. 3

1954. *Globobulimina mississippiensis* PARKER, Harvard, Bull. Mus. Comp. Zoology, vol. 111, no. 10, pl. 7, figs. 3, 4, 10.

Identification of our fossil specimens was verified by comparison with the holotype and paratypes from the Gulf of Mexico. Length of plesiotype, 0.44 mm; breadth, 0.29 mm.

GLOBULINA CARIBAEA d'Orbigny
Pl. VI, fig. 30

1839. *Globulina caribaea* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 135, pl. 2, figs. 7, 8.

1954. *Globulina caribaea* d'Orbigny. PARKER, Harvard, Bull. Mus. Comp. Zoology, vol. 111, no. 10, p. 506, pl. 5, fig. 23.

A few Pleistocene specimens were found which are typical of forms from the Gulf of Mexico assigned to this species by Parker in the above reference. Length of plesiotype, 0.42 mm; diameter, 0.36 mm.

GLOBULINA sp.
Pl. VI, fig. 23

Slightly elongate specimens were found which are not assigned to a species. These are rare, and they may have variable characteristics. Length of figured specimen, 0.40 mm; diameter, 0.25 mm.

GUTTULINA AUSTRALIS (d'Orbigny)
Pl. VI, fig. 28

1839. *Globulina australis* D'ORBIGNY, Voy. Amer. Mérid., vol. 5, pt. 5, "Foraminifères", p. 60, pl. 1, figs. 1-4.

1870. *Polymorphina regina* BRADY, PARKER and JONES, Linnaean Soc. London Trans., vol. 27, p. 241, pl. 41, figs. 32a, b.

Pleistocene specimens are typical of Recent forms from the Gulf of Mexico which have been referred to this species. This species group has variable characteristics among which are thickness of the test, length, and height of costae. Length of plesiotype, 0.57 mm; breadth, 0.27 mm.

This foraminifer is recorded from the Miocene of Maryland and South Carolina (Cushman, 1918, p. 54).

GUTTULINA PULCHELLA d'Orbigny
Pl. VI, fig. 29

1839. *Guttulina pulchella* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", A. Bertrand, Paris, France, p. 134.

Specimens are rare. The figured specimen is typical of the species. Length of plesiotype, 0.65 mm; breadth, 0.21 mm.

This species has been reported from the Pliocene of Florida (Cole, 1931, p. 29), but there do not seem to be any records for it in the Miocene.

GUTTULINA sp.
Pl. VI, fig. 13

A few small specimens are not referred to a species. Length of figured specimen, 0.36 mm; breadth, 0.23 mm.

GYPSINA VESICULARIS (Parker and Jones)
Pl. XV, fig. 18

1860. *Orbitolina vesicularis* PARKER and JONES, Ann. Mag. Nat. Hist., ser. 3, vol. 6, p. 31, no. 5.

Specimens typical of Recent forms from the Gulf of Mexico were found to be frequent in the calcareous zone, 578 to 610 feet, in the South Pass Block 41 well. Diameter of plesiotype, 0.69 mm; thickness, 0.47 mm.

The species has been reported from the Middle Tertiary of Venezuela and Trinidad and from the Miocene of Louisiana.

GYROIDINOIDES NEOSOLDANII (Brotzen)
Pl. X, figs. 20, 21

1884. *Rotalia soldanii* H. B. BRADY, (not *Gyroidina soldanii* d'Orbigny, 1826), Rept. Voy. Challenger, Zool., vol. 9, p. 706, pl. 107, figs. 6, 7.

1936. *Gyroidina neosoldanii* BROTZEN, Sver. Geol. Unders., ser. C, no. 396, p. 158.

This species is reported from the South Pacific and North Pacific Oceans and from the Gulf of Mexico. Our small Pleistocene specimens are similar to Recent specimens from the Gulf of Mexico. The species has also been recorded in Italy from Middle Miocene to Recent.

This form is listed in figures 2 and 3 as *Gyroidina neosoldanii* Brotzen.

GYROIDINOIDES ORBICULARIS (d'Orbigny)
Pl. X, figs. 31, 32

1826. *Gyroidina orbicularis* D'ORBIGNY, Ann. Sci. Nat., ser. 1, vol. 7, p. 278; Modèles, no. 13.

Pleistocene specimens are typical of Recent forms from the Gulf of Mexico which

Parker (1954, p. 528) has assigned to *Gyroidina orbicularis* d'Orbigny. Phleger (1951, p. 47) reports this species as most prevalent in the Gulf of Mexico between 500 and 1000 meters but extending from 135 to 1600 meters. Bagg (1898, p. 38) records this foraminifer from the Miocene of Virginia. Diameter of plesiotype, 0.46 mm; height, 0.29 mm.

This form is listed in figures 2 and 3 as *Gyroidina orbicularis* d'Orbigny.

GYROIDINOIDES REGULARIS (Phleger and Parker)
Pl. X, figs. 7, 8

1951. *Eponides regularis* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 21, pl. 11, figs. 3a, b, 4a-c.
1953. *Gyroidina venezuelana* (Renz) var. *arubana* DROOGER, Contr. Cushman Found. Foram. Research, vol. 4, pt. 4, p. 138, pl. 22, figs. 5, 6.

Fossil specimens are typical of Recent specimens assigned to *Eponides regularis* Phleger and Parker. Phleger (1951, p. 46) records the species in the Gulf of Mexico between 150 meters and about 1000 meters. This foraminifer is closely related to *Gyroidinoides scalata* (Garrett) from the Oligocene and Miocene of Louisiana. The Quaternary form has 8 to 9 chambers in the final whorl. The Tertiary form, *G. scalata,* has 12 to 13 chambers in the final whorl. Size, shape of test, and umbilicus are similar in the two species. Both are related to *Gyroidinoides planulata* (Cushman and Renz) from the Middle Tertiary of Venezuela, Trinidad, Ecuador, Barbados, and the Dominican Republic. *G. planulata* and *Gyroidina laevis* Coryell and Rivero from the Tertiary of Haiti probably should be considered synonyms of *Gyroidinoides scalata. G. regularis* is distinctive, however, in having fewer chambers. Diameter of plesiotype, 0.19 mm; height, 0.08 mm.

GYROIDINOIDES SOLDANII ALTIFORMIS (R. E. and K. C. Stewart)
Pl. X, figs. 33-35

1930. *Gyroidina soldanii* d'Orbigny var. *altiformis* R. E. and K. C. STEWART, Journ. Paleontology, vol. 4, no. 3, p. 67, pl. 9, fig. 2.

Specimens are most frequent in the lower part of the marine Pleistocene. These are typical of Recent specimens from the Gulf of Mexico. Phleger (1951, p. 47) reports this form as common down to 1850 meters and not recorded shallower than 200 meters. Natland (1933) records the species from the San Pedro Channel of Southern California between 274 and 2542 meters at temperatures of 3° to 8.5°C. Originally described from the Lower Pliocene of California, the form has been reported from the Middle Tertiary of Venezuela, Trinidad, Jamaica, the Dominican Republic, Cuba, and Mexico. It also occurs in the Miocene of Louisiana. Diameter of plesiotype, 0.61 mm; height, 0.53 mm.

HANZAWAIA CONCENTRICA (Cushman)
Pl. XV, figs. 3, 4

1918. *Truncatulina concentrica* CUSHMAN, U. S. Geol. Surv., Bull. 676, p. 64, pl. 21, fig. 3.

See discussion under *H. strattoni* for differentiation between these two species. Figs. 3, 4, pl. XV, illustrate a specimen arbitrarily assigned to *H. concentrica* but closely related to *H. strattoni.* Diameter of plesiotype, 0.65 mm; thickness, 0.24 mm.

Specimens referred to this species have been reported from the Pleistocene and Pliocene of Cuba and from the Middle Tertiary of Florida, Louisiana, Cuba, Jamaica, Barbados, Haiti, Venezuela, and the Dominican Republic. In the Gulf of Mexico, *H. concentrica* is a shallow water species. According to Phleger (1951, p. 45), the greatest abundance is in depths less than 100 meters.

HANZAWAIA cf. H. CONCENTRICA (Cushman)
Pl. XV, figs. 1, 2

A few specimens were found at 2418 feet in the South Pass Block 41 well which probably constitute a distinct species. These are referred tentatively to *H. concentrica* in the absence of sufficient material for the recognition of persistent features. A well-developed and somewhat unique keel is characteristic of this form. Punctae are rather coarse. Diameter of figured specimen, 0.42 mm; thickness, 0.16 mm.

HANZAWAIA STRATTONI (Applin)
Pl. XV, figs. 13, 14

1925. *Truncatulina americana* Cushman var. *strattoni* APPLIN *in* APPLIN, ELLISOR and KNIKER, Bull. Amer. Petr. Geol., vol. 9, no. 1, p. 99, pl. 3, fig. 3.

Representatives of this species group are variable in limbation of sutures, number of chambers in the final whorl, and height of

chambers. A gradation seems to exist between this species and *Hanzawaia concentrica* (Cushman). We have referred all specimens which are biconvex to *H. strattoni*. Specimens with one side slightly to definitely flattened and with a keel or even the suggestion of a keel are referred to *H. concentrica*. In some cases separation is arbitrary. Comparison of assemblages would be necessary to determine whether some of the specimens from the Middle Tertiary of the Caribbean-West Indian region identified as *H. concentrica* would be referable to *H. strattoni* using the above criteria. The holotype is from the subsurface Miocene of Louisiana. Diameter of plesiotype, 0.53 mm; thickness, 0.21 mm.

HAUERINA NACCHARA Akers and Dorman, n. sp.
Pl. III, figs. 1-6

Test strongly compressed except for early quinqueloculine portion; later portion planispiral with two chambers to the coil; peripheral margin subacute, slightly crenulate in adult forms; wall of adult forms bearing oblique, raised, rounded ridges and depressions; usually white in color with nacreous luster; aperture cribrate.

Diameter of holotype (pl. III, figs. 1-3), 0.44 mm by 0.36 mm. Diameter of paratype (pl. III, figs. 4-6), 0.42 mm by 0.32 mm. Thickness of both specimens, 0.09 mm. Holotype and paratype from core at 610 feet in the California Company, State Lease 2553, well number 1, South Pass Block 41 field.

This form seems to be distinct from previously described species. It resembles *Hauerina speciosa* (Karrer) but is less compressed than figured specimens of that species. Our species does not have the transverse striations on the radial ridges so prominent in *H. ornatissima* (Karrer), and the keel is more rounded than in that species.

HOEGLUNDINA ELEGANS (d'Orbigny)
Pl. XI, figs. 30, 31

1826. *Rotalia (Turbulina) elegans* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 276, no. 54.

Pleistocene specimens are typical of the species. Recent specimens are recorded in the Gulf of Mexico by Parker (1954, p. 531) deeper than 65 meters. Phleger (1951, p. 47) records it between 90 meters and 3550 meters in the Gulf of Mexico. Miocene specimens have been reported from both the Caribbean and the Mediterranean regions. Diameter of plesiotype, 0.55 mm; thickness, 0.30 mm. In Cuba the range has been recorded as Upper Eocene to Recent and in Italy, Upper Oligocene to Recent.

HYALINEA BALTHICA (Schroeter)
Pl. X, figs. 18, 19

1783. *Nautilus balthicus* SCHROETER, Einleitung, vol. 1, p. 20, pl. 1, fig. 2.
1884. *Operculina ammonoides* Parker and Jones (not Gronovius). H. B. BRADY, Rept. Voy. Challenger, Zoology, vol. 9, p. 745, pl. 92, figs. 1, 2.
1931. *Anomalina balthica* (Schroeter). CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 8, pp. 108-109, pl. 19, figs. 3a-c.
1951. *Hyalinea balthica* (Schroeter). HOFKER, Foraminifera of the Siboga Exped., pt. 3, pp. 508-513, figs. 345-348.
1952. *Hofkerinella balthica* (Schroeter). BERMUDEZ, Boletin de Geologia, vol. 2, no. 4, pp. 74-75.
1953. *Anomalina balthica* (Schroeter). PHLEGER, PARKER, and PEIRSON, Repts. Swed. Deep-sea Exped., 1947-1948, vol. 7, fasc. 1, p. 48, pl. 10, figs. 24, 25.

In the South Pass Block 41 well, megalospheric and microspheric specimens occur in abundance between 3258 and 3912 feet. Two megalospheric specimens were found in the core at 9440 feet in association with *Globigerina inflata* and *G. bulloides*. Five specimens, all megalospheric, were identified as part of a sparse fauna in the core at 9990 feet. Previous usage is followed in this assignment although it should be pointed out that the specific identification might be questioned owing to the great discrepancy in the number of chambers in the last formed whorl of the form figured by Schroeter from the Baltic Sea. His figure shows 24 chambers in the final whorl, while specimens from various North Atlantic localities, fossil and Recent individuals from the Mediterranean region, and our Pleistocene specimens do not have more than 11 or 12. The figures by Brady, Cushman, and Phleger, Parker, and Peirson appear identical and are clearly representative of specimens from the Louisiana Pleistocene. Immersion of our specimens in glycerin clearly revealed the simple umbilical canal system described by Hofker in the above reference.

This is one of the few reported occurrences from the western side of the Atlantic. Cushman (1931, p. 109) states that the species is very abundant in the cold waters of the North Atlantic, especially on the eastern side. Colom (1950) records it as frequent to abundant in his deepest facies, 300-878 meters off the west coast of Africa. Hofker's specimens are from the vicinity of Sumatra in 340 and 377 fathoms. *Hyalinea balthica* has been found in the deep, cool waters of the Mediterranean, and in Italy the marine Pleistocene (Calabrian) is recognized and differentiated from marine Pliocene on the lowermost occurrence of this foraminifer and other cool water species (Alliata, 1946, 1947; Coggi and Alliata, 1950; Ilacqua, 1956). Thus the known stratigraphic range of the species in the Mediterranean region and also the Atlantic is Lower Pleistocene (Calabrian) to Recent. To date, sampling in the Gulf of Mexico has failed to disclose *H. balthica* in Recent sediments. It has been found at eighteen stations in the eastern Mediterranean from 106 to 799 meters (Parker, 1958, p. 275).

None of the Gulf Coast Pleistocene specimens exceeds 0.40 mm in diameter. Maximum diameter of microspheric plesiotype, (pl. X, fig. 18), 0.40 mm; thickness, 0.08 mm. Maximum diameter of megalospheric plesiotype (pl. X, fig. 19), 0.29 mm; thickness, 0.08 mm.

ISLANDIELLA CRASSA (d'Orbigny)
Pl. XI, figs. 16-18

1839. *Cassidulina crassa* D'ORBIGNY, Voy. Amér. Mérid., vol. 5, pt. 5, "Foraminifères", p. 56, pl. 7, figs. 18-20.

We are following current interpretations of d'Orbigny's species in this assignment. Forms assigned to this species both in Recent sediments and in Pleistocene beds show variation. There may be several subspecies or even several species grouped here. *I. crassa* has been reported from the Miocene of Florida and the Cojimar (Oligocene?) Formation of Cuba. The reported range in Italy is Upper Miocene to Recent. Maximum diameter of plesiotype, 0.34 mm; thickness, 0.21 mm.

This species is listed as *Cassidulina crassa* d'Orbigny in figures 2 and 3.

ISLANDIELLA SUBGLOBOSA (H. B. Brady)
Pl. XI, fig. 19

1881. *Cassidulina subglobosa* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 21, p. 30 (60);
1884. *Cassidulina subglobosa* H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 430, pl. 54, figs. 17a-c.

Several variants are assigned to this species. Pleistocene variation is similar to that described by Parker (1954, p. 536) for Recent specimens in the northeastern Gulf of Mexico. As in Recent assemblages, the variants appear to merge into one another, and it is not practical to differentiate them. The largest and apparently typical form occurs in relatively high frequency at 3560 feet in the South Pass Block 41 well. This is the form which Parker found limited to deep water in the Gulf of Mexico. Maximum diameter of plesiotype, 0.40 mm.

The species group has been reported from the Tertiary of Cuba, Venezuela, Jamaica, Trinidad, the Dominican Republic, and Morocco. It has been identified throughout the post-Paleocene Cenozoic of Italy.

This species is listed as *Cassidulina subglobosa* H. B. Brady in figures 2 and 3.

LAGENA GRACILLIMA (Seguenza)
Pl. VI, fig. 17

1862. *Amphorina gracillima* Seguenza, Dei terreni Terziarii del distretto di Messina; Parte II—Descrizione dei foraminiferi monotalamici delle marne mioceniche del distrettodi Messina. Messina, Italia, T. Capra, p. 51, pl. 1, fig. 37.

Fragile, broken specimens are recognizable as lying within the range of variation of this species. According to Cushman, however, concerning numerous records in Recent waters, "there seems to be a question as to whether this is really a very widely distributed species or whether, being of a smooth type with very few distinguishing characters, there may be several forms included under this name" (1923, p. 24). The form has been recorded from the Pliocene and Miocene of Italy. Length of plesiotype, 0.32 mm; breadth, 0.11 mm.

LAGENA GRACILLIMA MOLLIS Cushman
Pl. VI, fig. 10

1944. *Lagena gracillima* (Seguenza) var. *mollis* CUSHMAN, Contr. Cushman Lab. Foram. Res., Spec. Publ. 12, p. 21, pl. 3, fig. 3.

Although they are usually fragmental, it is possible to refer a few specimens to this

subspecies. The type is from the Recent of Casco Bay, Maine. Length of plesiotype (broken), 0.29 mm; breadth, 0.08 mm.

LAGENA cf. L. HISPIDA Reuss
Pl. VI, fig. 9

1863. *Lagena hispida* REUSS, K. Akad. Wiss. Wien, Math.-Naturw. Cl., Sitzber., Wien, Osterreich, Bd. 46, Abth. 1, p. 335, pl. 6, figs. 77-79.

A few specimens were found which may belong here. Length of figured specimen, 0.21 mm.

LAGENA STRIATA (d'Orbigny)
Pl. VI, fig. 11

1839. *Oolina striata* D'ORBIGNY, Voy. Amér. Mérid., vol. 5, pt. 5, "Foraminifères", p. 21, pl. 5, fig. 12.

Pleistocene specimens are typical of this species. Miocene specimens are reported from Mallorca, Morocco, Jamaica and the Dominican Republic. The species is also reported from the *Heterostegina* Zone of the Gulf Coast Middle Tertiary (Applin, Kniker, and Ellisor, 1925). In Italy, the form is recorded throughout the post-Eocene Cenozoic. Length of plesiotype, 0.29 mm.

LAGENA SULCATA SPICATA Cushman and McCulloch
Pl. VI, fig. 24

1950. *Lagena sulcata* (Walker and Jacob) var. *spicata* CUSHMAN and MCCULLOCH, Southern California, Univ., Publ., Allan Hancock Pacific Exped., vol. 6, no. 6, p. 360, pl. 48, figs. 3-7.

Pleistocene specimens lie within the range of variation of this widely distributed Pacific species. *Lagena sulcata* (Walker and Jacob) was described from off the coast of England and has been reported from the Middle Tertiary of Texas, Florida, and the Dominican Republic. *L. sulcata spicata* was described from the Pacific Ocean. It is not known whether this form also occurs in Tertiary sediments. Length of plesiotype, 0.21 mm.

LAGENA sp. A

A single smooth form was found, and speciation is deferred pending additional specimens necessary for determination of specific characteristics.

LAGENA sp. B

A single specimen having short spines arranged in longitudinal rows was found. The form is spicate, but our specimen is preserved with only a trace of this feature.

LENTICULINA cf. L. ARCUATO-STRIATA (Hantken)
Pl. IV, figs. 9, 10

1868. *Cristellaria (Robulina) arcuato-striata* HANTKEN, Magyar. Földt. Társ., Munk., Pest. Magyarország, vol. 4, p. 93, pl. 2, fig. 30.

Our Pleistocene specimens may be related to this Oligocene species from Hungary. Comparison should be made with the holotype or topotypes, however, before a definite identification is accepted. The species is also reported from the Middle Tertiary of Cuba and the Dominican Republic. Diameter of figured specimen, 0.69 mm; thickness, 0.41 mm.

LENTICULINA ATLANTICA (Barker)
Pl. IV, figs. 13, 14

1923. *Cristellaria lucida* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 111, pl. 30, fig. 2.

1960. *Robulus atlanticus* BARKER, S.E.P.M. Spec. Publ. no. 9, p. 144, pl. 69, figs. 10-12.

The species was described from the Recent of the Atlantic Ocean. Occurrences are recorded from the Miocene of Jamaica and the Dominican Republic. Maximum diameter of plesiotype, 0.84 mm; thickness, 0.38 mm.

This form is listed in figures 2 and 3 as *Lenticulina lucida* (Cushman).

LENTICULINA BOWDENENSIS (Cushman)
Pl. IV, figs. 22-26

1919. *Cristellaria bowdenensis* CUSHMAN, Carnegie Inst. Wash., no. 291, p. 37, pl. 8, fig. 2.

1923. *Cristellaria antillea* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 116, pl. 31, fig. 1; pl. 32, fig. 1; pl. 33, fig. 1; pl. 34, fig. 1.

Large, compressed specimens are abundant in the upper portion of the Gulf Coast Pleistocene. The species is highly variable in the development of the keel and peripheral spines, thickness of the test, development of beads on the sutures, and beading of the test wall between sutures. The species is recorded from the Miocene of Jamaica and the Dominican Republic as well as from Recent stations listed in the reference above.

Dimensions of plesiotypes are as follows: pl. IV, fig, 24, maximum diameter (including spines), 2.65 mm, thickness, 0.80 mm; pl. IV, fig. 25, 2.21 mm, 0.61 mm; pl. IV, fig. 26, 1.70 mm, 0.44 mm; pl. IV, figs. 22 and 23, 1.64 mm; 0.50 mm.

LENTICULINA CALCAR (Linné)
Pl. IV, fig. 8

1758. *Nautilus calcar* LINNÉ, Syst. Nat., ed. 10, p. 709.
1923. *Cristellaria calcar* (Linné). CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 115, pl. 30, fig. 7; pl. 31, figs. 4, 5.

Pleistocene specimens are identical with Recent specimens from the Gulf of Mexico. This widely reported Recent species is also recorded from numerous Middle Tertiary areas including localities in Ecuador, Colombia, Venezuela, Trinidad, Jamaica, Barbados, Cuba, Haiti, Mexico, Louisiana, California, the Dominican Republic, Mallorca, and Italy. In Italy it ranges from Middle Miocene to Quaternary. Diameter of plesiotype (including spines), 0.47 mm; thickness, 0.24 mm.

LENTICULINA CULTRATA (Montfort)
Pl. IV, fig. 21

1808. *Robulus cultratus* MONTFORT, Conchyliologie systematique et classification methodique des coquilles, Paris, France, F. Schoell, tome 1, p. 215.
1923. *Cristellaria iota* CUSHMAN, U. S. Natl. Mus., Bull. 104, part 4, p. 111, pl. 29, fig. 2; pl. 30, fig. 1.

Our specimens were compared with the holotype of Cushman from the Gulf of Mexico. These are identical, but both probably should be referred to Montfort's species from the Pliocene of Coroncina, Italy. Specimens in our collection from the Pliocene of Piacenza belong to this species group. The species is reported to range throughout the Italian Tertiary (Foraminiferi Padani, AGIP Mineraria, 1957). As *Robulus iotus,* this form is also recorded from the Middle Tertiary of Florida, Texas, Puerto Rico, Jamaica, Venezuela, the Dominican Republic, and Mallorca. As *R. cultratus,* it is reported from the Miocene and Oligocene of Cuba (Bermudez, 1950, p. 358). Maximum diameter of plesiotype (including keel), 2.08 mm; thickness, 0.82 mm.

LENTICULINA MELVILLI (Cushman and Renz)
Pl. IV, figs. 15, 16

1941. *Robulus melvilli* CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 17, p. 12, pl. 2, fig. 12.

Specimens from the lower portion of the Pleistocene seem to be very close to this Miocene species from Venezuela. Middle Tertiary occurrences are also reported in the Dominican Republic and Jamaica. Maximum diameter of plesiotype, 0.66 mm; thickness, 0.38 mm.

LENTICULINA OCCIDENTALIS (Cushman)
Pl. IV, figs. 17, 18

1923. *Cristellaria occidentalis* CUSHMAN, U. S. Natl. Mus., Bull. 104, part 4, p. 102, pl. 25, fig. 2; pl. 26, figs. 1, 2.

Our specimens are similar to the holotype of Cushman from 1658 fathoms off the Northeastern Coast of the U. S. A variety, *Robulus occidentalis* var. *torridus* (Cushman), is recorded from several Caribbean Miocene and Oligocene localities. Maximum diameter of plesiotype, 0.71 mm; thickness, 0.40 mm.

LENTICULINA ORBICULARIS (d'Orbigny)
Pl. IV, figs. 19, 20

1826. *Robulina orbicularis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 288, pl. 15, figs. 8, 9.
1884. *Cristellaria orbicularis* (d'Orbigny). H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 549, pl. 69, fig. 17.
1899. *Cristellaria orbicularis* (d'Orbigny). FLINT, Rept. U. S. Natl. Museum, (1897), pt. 2, p. 317, pl. 64, fig. 3.
1923. *Cristellaria orbicularis* (d'Orbigny). CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 101, pl. 21, fig. 7.

Our specimens are referred to this group as were others from the Atlantic Ocean and the Gulf of Mexico by previous authors, although it is likely that all of these are different from d'Orbigny's species from the Tertiary of Italy. The species has been reported from the Middle Tertiary of the Gulf Coast (Applin, 1926), the Dominican Republic, Morocco, and from the post-Paleocene Cenozoic of Italy. Diameter of plesiotype, 0.69 mm; thickness, 0.42 mm.

LENTICULINA PEREGRINA (Schwager)
Pl. V, figs. 8, 9

1866. *Cristellaria peregrina* SCHWAGER, Novara Exped., Geol. Theil., vol. 2, p. 245, pl. 7, fig. 89.

Typical specimens occur in the Gulf Coast Pleistocene. The illustrated specimen, how-

ever, is thicker than the typical. The species has wide distribution down to 1000 meters in the Gulf of Mexico but is not found shallower than about 45 meters (Phleger, 1951, p. 47). The known depth range in the North Atlantic is from 90 to 3350 meters. This species has also been recorded in Recent material from the Mediterranean, West Indies, and Pacific. The holotype is from the Middle Tertiary of Kar Nikobar. Middle Tertiary occurrences are reported from Japan, Haiti, and Jamaica. It is recorded from the Middle and Upper Miocene and Lower Pliocene of Italy. Length of plesiotype, 0.28 mm; breadth, 0.21 mm; thickness, 0.15 mm.

LENTICULINA ROTULATA (Lamarck)
Pl. V, figs. 24, 25

1806. *Lenticulites rotulata* LAMARCK, Ann. Mus., vol. 8, p. 188, pl. 62, fig. 11.
1923. *Cristellaria rotulata* (Lamarck) ? CUSHMAN, U. S. Natl. Mus., Bull. 104, part 4, p. 108, pl. 22, fig. 2; pl. 28, figs. 1, 2.

Our specimens fit the description by Cushman in the above reference for Recent specimens from the Gulf of Mexico, Caribbean Sea, and Atlantic Ocean. The large umbo is distinctive in this species group. The species was described from probable Tertiary of France. Tertiary occurrences are also on record from Morocco, Panama, Jamaica, and the Dominican Republic. It is recorded throughout the post-Oligocene Cenozoic of Italy and from the *Marginulina* Zone of the Gulf Coast (Applin, Kniker, and Ellisor, 1925, p. 105). Maximum diameter of plesiotype, 0.86 mm; thickness, 0.53 mm.

LENTICULINA sp. "A"
Pl. V, figs. 3, 4

A few specimens of a "beaded" *Lenticulina* from low in the Pleistocene are similar to *Lenticulina senni* but lack the tendency to uncoil so pronounced in that species. Length of figured specimen, 0.97 mm; thickness, 0.55 mm.

LENTICULINA sp. "B"
Pl. V, figs. 1, 2

Insufficient specimens were found for an understanding of the range of variation of this form. Maximum diameter of figured specimen, 0.71 mm; thickness, 0.44 mm.

LENTICULINA sp. "C"
Pl. V. fig. 26

A few, large, compressed specimens were found in the uppermost Pleistocene beds which may be variants of *Lenticulina bowdenensis*. The periphery is distinctive in its marked lobulation. Length of figured specimen (broken), 3.34 mm; thickness, 0.63 mm.

LIEBUSELLA SOLDANII (Jones and Parker)
Pl. II, figs. 5, 6

1860. *Lituola soldanii* JONES and PARKER, Quart. Journ. Geol. Soc., vol. 16, p. 307, no. 184.

This species is widespread in the Middle Tertiary of the Caribbean region. It is also reported in Recent sediments of that region but seems to have been unreported in the Gulf Coast until now. Length of plesiotype, pl. II, fig. 5, 2.81 mm; breadth, 1.05 mm. Length of plesiotype, pl. II, fig. 6, 1.83 mm; breadth, 0.99 mm.

LINGULINA sp.
Pl. VI, figs. 5, 6

A single immature specimen showing similarity to *L. costata* d'Orbigny var. *seminuda* Hantken and *L. tricrenata* Coryell and Rivero was found in the highly fossiliferous core at 3300′ in the South Pass Block 41 well. Length of figured specimen, 0.50 mm; breadth, 0.49 mm; thickness, 0.38 mm.

MARGINULINA BASISPINOSA Cushman and Renz
Pl. V, figs. 11, 12

1941. *Marginulina basispinosa* CUSHMAN and RENZ, Contr. Cushman Lab. Foram. Res., vol. 17, p. 13, pl. 2, figs. 16-18.

Most of our specimens do not have peripheral spines or the costae typical of some of the specimens referred to this species in the above reference. The Pleistocene specimens, however, fall within the range of variation described for this species. A few specimens show short spines. Most are smooth and have limbate sutures. The species is recorded from the Tertiary of Venezuela, Colombia, and Trinidad. Length of plesiotype, pl. V, fig. 11, 1.37 mm; breadth, 0.46 mm; thickness, 0.42 mm. Length of plesiotype, pl. V, fig. 12, 1.07 mm; breadth, 0.48 mm; thickness, 0.40 mm.

MARGINULINA cf. M. COSTATA COARCTATA Silvestri
Pl. V, figs. 14, 15

A single but well-preserved specimen from a core at 1885 feet in The California Company State Lease 1923, well no. 1, Dixon Bay Field, is tentatively assigned to this species from the Pliocene of Italy. The sutures are less distinct, and the test is considerably less compressed than in *M. planata.* Several specimens were found in Helvetian (of Colom, 1958) sediments from the Balearic Islands which seem to be identical with our Pleistocene form. Length of figured specimen, 1.68 mm; breadth, 0.48 mm; thickness, 0.44 mm.

MARGINULINA GLABRA d'Orbigny
Pl. V, fig. 10

1826. *Marginulina glabra* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 259, no. 6.
1923. *Marginulina glabra* d'Orbigny. CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 127, pl. 36, figs. 5, 6.

Two specimens were found at 545 feet in the South Pass Block 41 well. These are 0.36 mm in length as compared with d'Orbigny's measurements, "up to 2.0 mm in length." In other aspects, our specimens are typical of the species, which was described from Tertiary beds near Sienna, Italy. Occurrences in the Florida Miocene and a possible occurrence in the Miocene of Jamaica are reported. A variety, *M. glabra obesa,* is recorded from the Middle Tertiary of Venezuela. In Italy the range of the species is Middle Miocene to Quaternary. Le Calvez (1956, p. 591) records it from the Pliocene of Corsica.

MARGINULINA SUBACULEATA GLABRATA (Cushman)
Pl. V, figs. 16-23

1923. *Cristellaria subaculeata* Cushman var. *glabrata* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 124, pl. 32, fig. 4; pl. 33, fig. 3; pl. 34, figs. 2, 3.
1951. *Marginulina subaculeata* (Cushman) var. *glabrata* (Cushman). PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 9, pl. 5, fig. 4.

Pleistocene specimens are similar to Recent forms from the Gulf of Mexico including homeotypes of Phleger and Parker in above references. Peripheral spines are weakly developed in our specimens. Insufficient data are available for our proper evaluation of the infraspecific position that has been assigned in the above references to this highly variable form.

The following dimensions are recorded for plesiotypes: pl. V, figs. 19 and 20, length 1.43 mm, maximum breadth of *uncoiled portion* 0.74 mm, thickness 0.59 mm; pl. V, figs. 16 and 17, 1.13 mm, 0.53 mm, 0.44 mm; pl. V, figs. 22 and 23, 1.55 mm, 0.58 mm, 0.46 mm; pl. V, figs. 18 and 21, 1.60 mm, 0.55 mm, 0.42 mm.

Cushman (1923, p. 124) records the species from 309 to 384 meters in the Gulf of Mexico. It is reported from the Miocene of Colombia by Redmond (1953, p. 714), the Miocene of Jamaica by Cushman and Todd (1945, p. 18), and the Upper Oligocene (?) of Cuba by Bermudez, 1950, p. 348).

MARGINULINA SUBLITUUS MULTICAMERATA Cushman and Stainforth
Pl. V, fig. 13

1945. *Marginulina sublituus* (Nuttall) var. *multicamerata* CUSHMAN and STAINFORTH, Cushman Lab. Foram. Res., Spec. Publ. 14, p. 23, pl. 3, figs. 6, 7.

Our figured specimen was compared with specimens from the Miocene Buff Bay locality of Jamaica. We have insufficient data to evaluate the infraspecific position of this form. It is possible that both Pleistocene specimens and specimens from the Cipero of Trinidad should be referred to the species of Nuttall from Mexico, although the type figure for this species illustrates a more compressed form. Length of plesiotype (fragmental), 0.48 mm; breadth, 0.19 mm; thickness, 0.15 mm.

MARGINULINOPSIS MARGINULINOIDES (Goës)
Pl. V, fig. 27

1896. *Cristellaria aculeata* d'Orbigny var. *marginulinoides* GOES, Harvard, Bull. Mus. Comp. Zool., vol. 29, p. 56, pl. 5, figs. 15-16.

Our specimens are referred here, although not all have the peripheral spines described for the species. This seems to be a highly variable feature in this genus along with the width of the test and surface ornamentation. Phleger and Parker (1951, p. 9) record the species from the Gulf of Mexico and off Georgia from 125 meters to 180 meters. Length of plesiotype, 0.97 mm; maximum breadth of uniserial portion, 0.41 mm; thickness, 0.37 mm.

This form is listed in figures 2 and 3 as *Marginulina marginulinoides* (Goës).

MARGINULINOPSIS SENNI LACRIMATA
Akers and Dorman, n. subsp.
Pl. IV, figs. 6, 7

Presence in the Gulf Coast Lower Pleistocene of a foraminifer similar to the Miocene guide fossil of Venezuela, *Robulus senni* Cushman and Renz, is here noted. Our Quaternary form is thicker than the types of *Lenticulina senni*, and beads on the uncoiled portion of the test are elongated, tear shaped, in contrast with the beads shown by the species of Cushman and Renz which tend to become noticeably elongated only on the final chamber. Chambers are wider in the Venezuelan form, resulting in a test of greater proportional diameter than that shown by *M. senni lacrimata.* Length of holotype of the subspecies, 1.07 mm; thickness, 0.46 mm.

This form is listed in figure 3 as *Lenticulina senni lacrimata.*

MASSILINA sp.
Pl. II, figs. 14, 15

Only a few specimens of this distinctive form have been found. It is large, compressed, and has a capillate surface. Length of figured specimen, 1.32 mm; breadth, 1.10 mm.

MELONIS POMPILIOIDES (Fichtel and Moll)
Pl. VI, fig. 16

1798. *Nautilus pompilioides* FICHTEL and MOLL, Testacea microscopica, p. 31.
1851. *Nonionina affinis* REUSS, Deutsch. Geol. Ges., Zeitschr., vol. 3, p. 72, pl. 5, fig. 32.
1958. *Nonion affine* (Reuss). BOLTOVSKOY, Micropaleontology, vol. 4, no. 2, pp. 193-200.

This species was described from the Oligocene of Germany. Boltovskoy gives an excellent synonymy in the reference above and calls attention to the nomenclatorial confusion attendant upon this foraminifer.

The species has been reported under various synonyms from Eocene to Recent. It is recorded from Europe, North America, South America, the Caribbean region, and Fiji. It has been found in Recent samples from the North Atlantic, North Pacific, Red Sea, and the Gulf of Mexico and ranges throughout the post-Middle Oligocene Cenozoic of Italy. Parker (1954, p. 506) reports the species in the Gulf of Mexico from 60 meters to 1750 meters. Maximum diameter of plesiotype, 0.21 mm; thickness, 0.08 mm.

This form is listed in figures 2 and 3 as *Melonis affine.*

NEOCUNEOLINA ANGUSTA (Cushman)
Pl. I, figs. 24, 25

1919. *Cuneolina pavonia* d'Orbigny var. *angusta* CUSHMAN, Carnegie Instit. Washington, Publ. 291, p. 34, pl. 7, fig. 2.
1963. *Neocuneolina angusta* (Cushman). BERMUDEZ and RIVERO, Estudio sistematico de los Foraminiferos Quitinosos, Microgranulares y Arenaceos: Univ. Central Venezuela, Ed. Biblioteca, Caracas, p. 270, fig. 25.

Large specimens are present in the Pleistocene section. Some of these exceed 4 mm in length. The species is abundant in the Recent moderately deep seas of the Caribbean-Antillean region, and specimens are also found in Middle Tertiary beds of that region. An excellent synonymy and reference list are given by Bermudez (1949, p. 80). Length of plesiotype, 1.53 mm; maximum breadth, 1.32 mm; thickness, 0.97 mm.

NEOEPONIDES CORYELLI (Palmer)
Pl. X, figs. 11, 12

1945. *Eponides coryelli* PALMER, Bull. Amer. Paleontology, vol. 29, no. 115, p. 58, pl. 2, figs. 3, 4.

Identification of this species in the Louisiana Pleistocene was confirmed by comparison with topotypes from the Bowden Formation of Jamaica. The species is also present in the Miocene of Haiti and the Dominican Republic. Bermudez (1949, p. 245) gives a detailed synonymy. Maximum diameter of plesiotype, 0.84 mm; thickness, 0.61 mm.

NEOEPONIDES PARANTILLARUM (Galloway and Heminway)
Pl. X, figs. 38, 39

1941. *Eponides parantillarum* GALLOWAY and HEMINWAY, New York Acad. Sci., Sci. Surv., Porto Rico and Virgin Is., vol. 3, pt. 4, p. 374, pl. 18, fig. 1.

Representatives of this species are abundant in several zones of the Pleistocene. Variation is noted in size and in the convexity of the spiral side. Maximum diameter of plesiotype, pl. X, figs. 38, 39, 0.57 mm; thickness, 0.36 mm.

The species has been identified in the Miocene of Puerto Rico, Jamaica, Venezuela, Trinidad, and the Dominican Republic and in the Pleistocene and Miocene (?) of Aruba.

NEOEPONIDES TUMIDULUS (H. B. Brady)
Pl. X, figs. 9, 10

1884. *Truncatulina tumidula* H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 666, pl. 95, figs. 8a-d.
1954. *Eponides tumidulus* (H. B. Brady). PARKER, Harvard, Bull. Mus. Comp. Zool., vol. 111, no. 10, p. 529, pl. 9, figs. 19, 24.

Small specimens occur in marine beds throughout the Pleistocene. These are typical of Recent specimens from the Gulf of Mexico which Parker figures in the above reference. According to Phleger and Parker (1951, p. 21), the species occurs in the northwest Gulf of Mexico at depths of 1000 meters or more. The types are from 2740 fathoms, southwest of the Canaries. Diameter of plesiotype, 0.17 mm; height, 0.13 mm.

NEOEPONIDES TURGIDUS (Phleger and Parker)
Pl. X, figs. 5, 6

1951. *Eponides turgidus* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 22, pl. 11, figs. 9a, b.

Identification of Pleistocene specimens is confirmed by comparison with holotype from the Gulf of Mexico. This species may belong to *Gyroidina* as stated in the above reference. Diameter of plesiotype, 0.13 mm; thickness, 0.06 mm.

NODOBACULARIELLA ATLANTICA Cushman and Hanzawa
Pl. IV, fig. 3

1937. *Nodobaculariella atlantica* CUSHMAN and HANZAWA, Contr. Cushman Lab. Foram. Res., vol. 13, p. 42, pl. 5, figs. 7, 8.

Although we are not clear as to the position of this species with respect to *N. cassis*, specimens are recognized in the Gulf Coast Pleistocene which seem to be close to the types of Cushman and Hanzawa from the eastern coast of the United States. Specimens from the Gulf of Mexico referred by Flint (1897, p. 302, pl. 47, fig. 4) to *Vertebralina insignis* H. B. Brady also belong here. Maximum diameter of plesiotype, 0.84 mm.

NODOBACULARIELLA CASSIS (d'Orbigny)
Pl. IV, fig. 4

1839. *Vertebralina cassis* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 51, pl. 7, figs. 14, 15.

Forms in which the early stages are indistinct are included in this species group. Costae may be fine to coarse, or they may be absent. The test is thicker than that of *N. atlantica* Cushman and Hanzawa. Cushman and Todd (1944, p. 68) observe a more strongly developed keel in *N. cassis* and a tendency in the adult for the final chamber to become rectilinear, but these features are shown by both species in our material.

D'Orbigny's types are from the shore sands of Cuba, and most of our specimens are referred to his species as herein interpreted rather than to *N. atlantica*. *N. cassis* is also reported from the Miocene of the Dominican Republic and from the Miocene and Pliocene of Florida. Maximum diameter of plesiotype, 0.76 mm.

NODOSARIA FUSTA Cushman and Todd
Pl. V, fig. 30

1945. *Nodosaria fusta* CUSHMAN and TODD, Cushman Lab. Foram. Res., Spec. Publ. 15, p. 28, pl. 4, figs. 20-22.

Pleistocene specimens were compared with topotypes from the Miocene of Buff Bay, Jamaica. Length of plesiotype (incomplete specimen), 1.91 mm; diameter, 0.38 mm.

NODOSARIA GRACILLIMA (Cushman and Jarvis)
Pl. IX, fig. 11

1934. *Ellipsonodosaria nuttalli* Cushman and Jarvis var. *gracillima* CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 10, pt. 3, no. 148, p. 72, pl. 10, figs. 7a, b.

Two specimens are referred to this species. One found at 3258 feet in the South Pass Block 41 well is slightly less than half as large as the holotype from the Miocene Cipero Formation of Trinidad, B.W.I. Specimens from the Miocene Buff Bay Formation of Jamaica are also approximately twice as large as our specimens, however the forms from the Pleistocene of Louisiana seem to be identical in other aspects with this Caribbean species. The individual found at 3490 feet differs from the type in having three spines on the initial end, two of which are weakly developed. Length of plesiotype, 0.42 mm; breadth, 0.11 mm.

This form is listed in figures 2 and 3 as *Nodosarella gracillima* (Cushman and Jarvis).

NODOSARIA HISPIDA d'Orbigny
Pl. V, fig. 31

1846. *Nodosaria hispida* D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, p. 35, pl. 1, figs. 24, 25.

The species was described from the Tertiary of Austria. It is recorded from the Middle Tertiary of Cuba and the Dominican Republic and from numerous Recent stations. Typical specimens have been found in the Gulf of Mexico (Flint, 1899, p. 311; Parker, 1954, p. 505). According to Parker in the latter reference, they occur deeper than 145 meters. The species has been observed by the writers in Miocene shales from wells off the coast of Louisiana. It is also known from the Miocene and Pliocene of the Mediterranean region and from the Calabrian of Italy. Length of plesiotype, 0.61 mm; diameter, 0.21 mm.

NODOSARIA PYRULA d'Orbigny
Pl. VI, fig. 19

1826. *Nodosaria pyrula* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 253, no. 13.
1951. *Nodosaria pyrula* d'Orbigny. PHLEGER and PARKER, Geol. Soc. America, Mem. 46, part 2, p. 10, pl. 5, fig. 5.

Although our specimens from the Upper Pleistocene are broken, they show characteristics identical with those of Recent specimens from the Gulf of Mexico. The species has also been identified from the Recent of the Atlantic and from the Ki and Philippine Islands. The holotype is from the Upper Tertiary of Italy. Other Tertiary localities have been reported in Cuba, Trinidad, Jamaica, and the Dominican Republic. Length of figured fragment, 0.80 mm; maximum diameter, 0.15 mm.

NONIONELLA BASILOBA Cushman and McCulloch
Pl. VI, figs. 14, 15

1940. *Nonionella basiloba* CUSHMAN and MCCULLOCH, Allan Hancock Pacific Exped., vol. 6, no. 3, p. 162, pl. 18, figs. 3a-c.
1947. *Nonionella opima* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 23, pt. 4, p. 90, pl. 20, figs. 1-3.
1954. *Nonionella opima* Cushman. PARKER, Harvard, Bull. Mus. Comp. Zool., vol. 111, no. 10, p. 507, pl. 6, figs. 10, 11, 12.
1961. *Nonionella basiloba* Cushman and McCulloch. ANDERSEN, Louisiana Dept. Cons., Geol. Bull. 35, pt. II, p. 85, pl. 18, figs. 5a-c.

This species was described from off the coast of California. Pleistocene specimens are typical of Recent specimens from the Atlantic and the Gulf of Mexico. Length of plesiotype, 0.23 mm; breadth, 0.17 mm; thickness, 0.13 mm.

This form is listed in figures 2 and 3 as *Nonionella opima* Cushman.

NONIONELLA sp.
Pl. VI, fig. 18

A few specimens occur in the Lower Pleistocene beds which, because of their scarcity, are not referred to a species. Length of figured specimen, 0.27 mm; breadth, 0.17 mm; thickness, 0.13 mm.

OOLINA HEXAGONA (Williamson)
Pl. VI, fig. 8

1848. *Entosolenia squammosa* Montagu var. *hexagona* WILLIAMSON, Ann. Mag. Nat. Hist., ser. 2, vol. 1, p. 20, pl. 2, fig. 23.

Several variants are assigned to this species. In the typical form, the hexagons are rather small and numerous. In another form, the hexagons are approximately twice as large and are less regular in shape than in the typical. Other features appear to be the same, and, because of the scarcity of specimens, it is not known whether this variation in the wall has significance. Length of plesiotype, 0.21 mm.

The species is reported from the Miocene of Florida, Jamaica, and the Dominican Republic. It has been identified in the Pliocene of Cuba and the Pleistocene of Florida. In Italy this form is recorded in the Upper Eocene, Upper Miocene, throughout the Pliocene, and in the Quaternary.

This species is listed in figures 2 and 3 as *Lagena hexagona* (Williamson).

ORIDORSALIS UMBONATUS ECUADORENSIS (Galloway and Morrey)
Pl. X, figs. 36, 37

1929. *Rotalia ecuadorensis* GALLOWAY and MORREY, Bull. Amer. Paleontology, vol. 15, no. 55, p. 26, pl. 3, figs. 13a-c.
1937. *Eponides umbonatus* (Reuss) var. *ecuadorensis* (Galloway and Morrey). HEDBERG, Jour. Paleontology, vol. 11, no. 8, p. 679, pl. 91, fig. 22.
1961. *Oridorsalis westi* Andersen, Louisiana Dept. Cons., Geol. Surv. Bull. 35, pp. 107-109, pl. 22, figs. 3a-c.

Hedberg points out in the reference above that material from the type locality of *Rotalina umbonata* Reuss at Hermsdorf, Germany, contains both specimens with nearly straight sutures and those with the characteristic curvature at their inner ends. We follow his conception of this form as an infraspecific group. This form or the typical is reported from the Gulf of Mexico at depths greater than 65 meters and from numerous Tertiary localities in the Mediterranean and Gulf of Mexico-Caribbean region. Maximum diameter of plesiotype, 0.38 mm; thickness, 0.20 mm.

PAVONINA ATLANTICA Cushman
Pl. IX, fig. 30)

1922. *Pavonina atlantica* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 3, p. 51, pl. 19, fig. 1.
1932. *Pavonina miocenica* CUSHMAN and PONTON, Florida Geol. Survey, Bull. 9, p. 73, pl. 12, fig. 19.
1951. *Pavonina atlantica* Cushman. PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 17, pl. 8, figs. 6, 7.

Our specimens were not compared with the type from off Sand Key, Florida, in 92 fathoms. The Pleistocene form, however, is identical with specimens from the Gulf of Mexico which are referred to this species by Phleger and Parker. Miss Ruth Todd compared the types of *P. atlantica* and *P. miocenica* (Miocene of Florida), and she has concluded that they are identical, no characters being evident by which the two can be specifically separated (personal communication). The range of *P. atlantica,* therefore, is here considered as Miocene to Recent. Additional Miocene occurrences are in Colombia, the Dominican Republic, and Jamaica. Length of plesiotype (broken specimen), 0.53 mm; breadth, 0.46 mm; thickness, 0.13 mm.

PENEROPLIS PROTEUS d'Orbigny
Pl. VII, figs. 1, 2

1839. *Peneroplis protea* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, Foraminifères, p. 60, pl. 7, figs. 7-11.

This species, described from Recent sediments of the Caribbean, is characteristic of Pleistocene carbonate zones. The range of the species is probably Miocene to Recent. It is recorded from the Miocene of the Dominican Republic and from the Miocene and Pliocene of Puerto Rico and the Gulf Coast. In Cuba it ranges throughout the post-Oligocene Cenozoic. Maximum diameter of plesiotype, pl. VII, fig. 2, 0.34 mm. Maximum diameter of plesiotype, pl. VII, fig. 1, 0.70 mm.

PLANORBULINA MEDITERRANENSIS d'Orbigny
Pl. XV, fig. 15

1826. *Planorbulina mediterranensis* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 280, no. 2, pl. 14, figs. 4-6 bis.; Modèles, no. 79.

According to Phleger (1951, p. 47), this species ranges from 20 to 200 meters in the Gulf of Mexico. Maximum diameter of plesiotype, 0.57 mm. The species is widely reported both from Recent and Tertiary sediments. In Italy the range is reported as Middle Miocene to Quaternary.

PLANULARIA QUASITRINAE Akers and Dorman, n. sp.
Pl. V, figs. 5-7

Test almost twice as long as broad, very compressed, thin, sides almost parallel, early portion slightly inflated, coiled, later portion uncoiled; chambers numerous, about 20 in adult specimens, increasing gradually in length as added; peripheral margin with a rounded keel; sutures limbate; wall smooth.

Holotype and paratype from sidewall core at 2916 feet in California Company State Lease 1923, well No. 1, Dixon Bay Field, Plaquemines Parish, Louisiana. Dimensions of holotype (pl. V, figs. 5, 6): length, 1.26 mm; width, 0.69 mm; thickness, 0.21 mm. Length of paratype (fig. 7), 0.90 mm; width, 0.53 mm; thickness, 0.17 mm.

This species is similar to *P. trinae* Bermudez from the Tertiary of the Dominican Republic. *P. quasitrinae* is not so broad as *P. trinae,* and the keel is neither so wide nor sharp as in that species. Our holotype clearly shows 21 chambers; about ten may be observed in adult specimens of *P. trinae. P. quasitrinae* has been identified only in marine beds of Aftonian age.

PLANULINA EXORNA Phleger and Parker
Pl. XV, figs. 5, 6

1951. *Planulina exorna* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 32, pl. 18, figs. 5a, b, 6a, b, 7a, b, 8a, b.

This is the most frequent species of *Planulina* in our Pleistocene material. The species was described from the Gulf of Mexico where it is abundant in water shallower than

100 meters (Phleger, 1951, p. 48). Our specimens show variation in thickness and size of perforations. Maximum diameter of plesiotype, 0.36 mm; thickness, 0.10 mm.

PLANULINA FOVEOLATA (H. B. Brady)
Pl. XV, figs. 19, 20

1884. *Anomalina foveolata* H. B. BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 674, pl. 94, fig. 1.

This species, which was described from Recent sediments in the vicinity of Bermuda, occurs in marine zones throughout the Pleistocene. Phleger (1951, p. 48) reports it in the Gulf of Mexico deeper than 85 meters. The species is also reported from the Miocene of Haiti, the Dominican Republic, Cuba, and Jamaica. Maximum diameter of plesiotype, 0.59 mm; thickness, 0.24 mm.

PLECTOFRONDICULARIA FLORIDANA
Cushman
Pl. VII, figs. 23, 24

1930. *Plectofrondicularia floridana* CUSHMAN, Florida Geol. Survey, Bull. 4, p. 41, pl. 8, fig. 1.

Specimens from the lowest marine zone of the Gulf Coast Pleistocene belong with this Miocene species from Walton County, Florida. The species is also recorded from the Tertiary of Bowden, Jamaica, the Dominican Republic, Colombia, Venezuela, Trinidad, and Barbados. *P. diversicostata* (Neugeboren), which has been identified in the Miocene of Hungary, Egypt, and Buff Bay, Jamaica, is similar to *P. floridana.* According to Cushman and Todd (1945, p. 38), *P. diversicostata* "resembles *P. floridana,* but is much slenderer, has larger and more numerous costae, and the test does not broaden as in that species." Length of plesiotype (broken specimen), 0.57 mm; maximum breadth, 0.21 mm.

POLYMORPHINA sp.

Rare specimens were found which are similar to *Pseudopolymorphina rutila* (Cushman) from the Byram Marl of Mississippi. Pleistocene specimens are more compressed than the Oligocene form, and they are too rare in our samples for the determination of specific characteristics.

POROEPONIDES CRIBROREPANDUS Asano and Uchio
Pl. XI, figs. 26, 27

1951. *Poroeponides cribrorepandus* ASANO and UCHIO *in* STACH, Illustrated Catalogue of Japanese Tertiary smaller Foraminifera, pt. 14, Rotaliidae p. 18, tfs. 134, 135.

The type figures for *Nautilus repandus* Fichtel and Moll are not clearly representative of our species, although many authors have identified Recent and Tertiary specimens with this species of Fichtel and Moll. Cushman (1931, p. 48) suggested that *Eponides* (?) *lateralis* (Terquem) might be a variety of the species of Fichtel and Moll. This possible relationship should be investigated.

Specimens here referred to *Poroeponides cribrorepandus* are found commonly in calcareous sediments in the Gulf of Mexico region. This relationship was observed in Recent sediments by Phleger and Parker (1951, p. 21). Our Pleistocene specimens show considerable variation in height, umbilical region, size, and limbate character of sutures. Pores on the apertural face are not always well developed even in large adult specimens. Asano and Uchio described this species from the Pliocene of Japan. It is also present in the Miocene of Japan, according to these authors. Maximum diameter of plesiotype, 0.71 mm.

PSEUDONODOSARIA COMATULA (Cushman)
Pl. V, figs. 28, 29

1923. *Nodosaria comatula* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 83, pl. 14, fig. 5.

Our specimens were compared with topotypes from 210 fathoms in the Gulf of Mexico which were supplied by Dr. A. R. Loeblich, Jr. This species has been reported from the Middle Tertiary of Trinidad, Mexico, Cuba, Venezuela, Jamaica, the Dominican Republic, and subsurface Louisiana. It is also reported from the Upper Eocene of Cuba (Bermudez, 1950, p. 354). Length of plesiotype (pl. V, fig. 28), 0.44 mm; diameter, 0.36 mm; length of plesiotype (pl. V, fig. 29), 0.78 mm; diameter, 0.38 mm.

This form is listed in figures 2 and 3 as *Nodosaria comatula* Cushman.

PULLENIA BULLOIDES (d'Orbigny)
Pl. XI, figs. 11, 12

1826. *Nonionina bulloides* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 293.
1846. *Nonionina bulloides* D'ORBIGNY, Foram. Bass. Tert. Vienne, p. 107, pl. 5, figs. 9, 10.

Figures of the type from the Tertiary of Austria are also representative of our Pleistocene specimens. The species has been found from 65 meters to 1000 meters in the Gulf of Mexico, and it occurs in the Tertiary of California, Jamaica, Trinidad, Ecuador, Venezuela, Puerto Rico, the Dominican Republic, and Mexico. It is recorded throughout the post-Paleocene Cenozoic of Italy. Diameter of plesiotype, 0.29 mm; thickness, 0.25 mm.

PULLENIA QUINQUELOBA (Reuss)
Pl. XI, figs. 3, 15

1851. *Nonionina quinqueloba* REUSS, Zeitschr. deutsch. Geol. Ges., vol. 3, p. 71, pl. 5, fig. 31.

The type of this species is from the Tertiary of Hermsdorf, Germany. The name has been applied to groups from Recent sediments as well as from worldwide Tertiary localities. The species is recorded throughout the post-Paleocene Cenozoic of Italy. Our specimens are typical of those from the Gulf of Mexico to which the name has been applied. The species ranges from 50 meters to 2800 meters in the Gulf of Mexico (Phleger, 1951, p. 48). Diameter of plesiotype, 0.25 mm; thickness, 0.19 mm.

PULLENIA sp.
Pl. XI, fig. 2

Numerous specimens have been found in marine zones of the Pleistocene, but these have not been sufficiently frequent in any single sample to justify a description of the species. Diameter of figured specimen, 0.24 mm; thickness, 0.11 mm.

PYRGO CARINATA (d'Orbigny)
Pl. IV, figs. 11 ,12

1839. *Biloculina carinata* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 164, vol. 8, pl. 8, fig. 24; pl. 9, figs. 1, 2.

Specimens are probably conspecific with Recent forms from Cuba and Saint Thomas. This conclusion is reached on the basis of the figures by d'Orbigny. Length of plesiotype, 0.56 mm; breadth, 0.36 mm; thickness, 0.21 mm.

PYRGO COMATA (H. B. Brady)
Pl. IV, figs. 1, 2

1881. *Biloculina comata* BRADY, Quart. Journ. Micr. Sci., vol. 21, p. 45.
1884. *Biloculina comata* BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 144, pl. 3, fig. 9.

The species is recorded mostly from deep waters in the Atlantic and Caribbean. It has also been reported from the Middle Tertiary of the Dominican Republic. Length of plesiotype, 1.49 mm; breadth, 1.26 mm; thickness, 1.22 mm.

PYRGO MURRHINA (Schwager)
Pl. III, figs. 14, 15

1866. *Biloculina murrhina* SCHWAGER, Novara Exped. Geol. Theil., vol. 2, p. 203, pl. 4, figs. 15a-c.

In the north Atlantic, records for this species are deeper than 200 meters. It is not found shoaler than 45 meters in the Gulf of Mexico (Phleger, 1951, p. 48). Holotype is from the Miocene of Kar Nikobar. The species is reported from the Miocene of Haiti, Jamaica, and Trinidad. Length of plesiotype, 0.39 mm; breadth, 0.36 mm.

PYRGO NASUTUS Cushman
Pl. III, fig. 22

1935. *Pyrgo nasutus* CUSHMAN, Smithsonian Misc. Colln., vol. 91, no. 21, p. 7, pl. 3, figs. 1-4.

Pleistocene specimens are identical with Cushman's specimens from the area to the north of Puerto Rico. The distinctive bend of the test at the base of the aperture is present in our specimens as in the forms from the Recent of the Caribbean. Length of plesiotype, 0.23 mm; breadth, 0.13 mm.

PYRGO VESPERTILIO (Schlumberger)
Pl. III, figs. 29-32

1884. *Biloculina ringens* H. B. BRADY (not Lamarck), Rept. Voy. Challenger, Zool., vol. 9, p. 142, pl. 2, fig. 8.
1891. *Biloculina vespertilio* SCHLUMBERGER, Mem. Soc. Zool. France, vol. 4, p. 174, pl. 10, figs. 74-76, text figs. 20-22.
1917. *Biloculina vespertilio* Schlumberger. CUSHMAN, U. S. Natl. Mus., Bull. 71, pt. 6, p. 77, pl. 30, fig. 1; figs. 37-39 (in text).
1921. *Biloculina vespertilio* Schlumberger. CUSHMAN, U. S. Natl. Mus., Bull. 100, vol. 4, p. 472, pl. 95, figs. 5a, b.

This is a large robust form which has been reported mostly from fairly deep water in the Pacific. There seem to be no differences between our specimens and those figured by

Cushman in the above references. Length of plesiotype, pl. III, figs. 29, 30, 0.56 mm; breadth, 0.50 mm. Length of plesiotype, figs. 31, 32, 0.72 mm; breadth, 0.63 mm.

PYRGO sp. "A"
Pl. III, figs. 23, 24

Several rare specimens, similar to *P. nasutus,* are not speciated. Length of figured specimen, 0.61 mm; breadth, 0.53 mm; thickness, 0.42 mm.

PYRGO sp. "B"
Pl. III, figs. 33-35

A rare form in our material resembles *Pyrgo comata* but is probably distinct in having fewer costae and an elongation of the test at the aboral end. Length of figured specimen, 0.69 mm; breadth, 0.65 mm.

QUADRIMORPHINA VILARDEBOANA GLABRA (Cushman)
Pl. XI, figs. 28, 29

1927. *Valvulineria vilardeboana* (d'Orbigny) var. *glabra* CUSHMAN, Bull. California Univ., Scripps Inst. Oceanogr., Tech. Ser., vol. 1, p. 161, pl. 4, figs. 5, 6.
1951. *Valvulineria laevigata* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 25, pl. 13, figs. 11a, b, 12a, b.

Specimens are rare in Pleistocene samples. The thin, lobe-like umbilical plate is often broken in fossil specimens. This form is reported deeper than 120 meters in the Gulf of Mexico and from 300 meters to 680 meters on the Atlantic continental slope (Parker, 1948, p. 225). Maximum diameter of plesiotype, 0.23 mm; thickness, 0.14 mm.

This form is listed in figures 2 and 3 as *Valvulineria laevigata* Phleger and Parker.

QUINQUELOCULINA AGGLUTINANS d'Orbigny
Pl. II, figs. 24-26

1839. *Quinqueloculina agglutinans* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 195, pl. 12, figs. 11-13.

Our large agglutinated specimens seem to be identical with the type of d'Orbigny from Jamaica. Length of plesiotype, 1.41 mm; breadth, 0.99 mm. The species is also reported from the Pliocene of Florida (Cole, 1931, p. 19) and from the Lower Pliocene to the Quaternary of Italy.

QUINQUELOCULINA BICOSTATA d'Orbigny
Pl. II, figs. 27-29

1839. *Quinqueloculina bicostata* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 195, pl. 12, figs. 8-10.
1954. *Quinqueloculina bicostata* d'Orbigny. PARKER, Harvard, Bull. Mus. Comp. Zool., vol. 111, no. 10, p. 496, pl. 4, figs. 1, 2.

Pleistocene specimens like Recent specimens identified by Parker from the Gulf of Mexico are larger than those described by d'Orbigny from Cuba. Our specimens commonly attain a length of 1.3 mm. Length of plesiotype, 1.28 mm; breadth, 0.92 mm. The species is also reported from the Tertiary of Texas.

QUINQUELOCULINA HORRIDA Cushman
Pl. II, fig. 19

1947. *Quinqueloculina horrida* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 23, pt. 4, p. 88, pl. 19, fig. 1.

Length of plesiotype, 0.27 mm; breadth, 0.20 mm. The types are from off the coast of Charleston, South Carolina, in 120 meters of water.

QUINQUELOCULINA LAMARCKIANA d'Orbigny
Pl. II, figs. 11-13

1839. *Quinqueloculina lamarckiana* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 189, pl. 11, figs. 14, 15.

This widely distributed Recent species is one of the most frequently seen throughout the Louisiana Pleistocene. It is recorded from the Middle Tertiary of the Louisiana Gulf Coast, Florida, Jamaica, Trinidad, Colombia, the Dominican Republic, and France and from the Pliocene and Pleistocene of Florida. It is known in the Calabrian of Italy. Length of plesiotype, 0.74 mm; breadth, 0.63 mm.

QUINQUELOCULINA POLYGONA d'Orbigny
Pl. II, figs. 21-23

1839. *Quinqueloculina polygona* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 198, pl. 12, figs. 21-23.

Pleistocene specimens are typical of the widely distributed Recent species of the West Indian Region. The species is also reported from the Middle Tertiary of Colombia, Jamaica, the Dominican Republic, and

France. Length of plesiotype, 0.60 mm; breadth, 0.29 mm.

RAMULINA GLOBULIFERA H. B. Brady
Pl. VI, fig. 25

1879. *Ramulina globulifera* H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, p. 58, pl. 8, figs. 32, 33.

The species has been recorded from both Atlantic and Pacific Oceans and from the Miocene of Mallorca, Spain, Jamaica, and the Dominican Republic; also Pliocene to Recent of Cuba; and Miocene and Pliocene of Italy. Length of plesiotype, 0.36 mm.

RECTOBOLIVINA ADVENA (Cushman)
Pl. IX, fig. 22

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

Pleistocene specimens were compared with the holotype, and they appear to be identical in every respect except size. The holotype is almost twice as long. Miocene occurrences are recorded for Jamaica and the Dominican Republic. A questionable specimen is reported from the Miocene Duplin Marl of South Carolina (Cushman and Cahill, 1933, p. 28). Length of homeotype, 0.39 mm; maximum breadth, 0.15 mm; thickness, 0.08 mm.

REUSSELLA MINUTA Drooger and Kaasschieter
Pl. IX, fig. 33

1958. *Reussella minuta* DROOGER and KAASSCHIETER, Reports of the Orinoco Shelf Expedition, vol. IV, p. 64, pl. 3, fig. 10.

This small foraminifer, described from the Orinoco-Trinidad-Paria shelf, has not been identified in the Recent of the Gulf of Mexico region. Disappearance or diminution in frequency of the species from the Gulf Coast region suggests that the environment here has changed since Pleistocene times. The species is reported as rare at several stations scattered between 35 and 200 meters on the Orinoco-Trinidad-Paria shelf, but we cannot be sure that these specimens, too, are not of Pleistocene age (Drooger and Kaasschieter, 1958, p. 93). Dimensions of plesiotype: length, 0.40 mm; diameter, 0.21 mm. Our figured specimen is much larger than those usually seen, the average length being in the vicinity of 0.20 mm. The maximum observed length reported by Drooger and Kaasschieter was 0.30 mm.

REUSSELLA MIOCENICA Cushman
Pl. IX, figs. 27, 28, 35

1945. *Reussella miocenica* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 21, part 2, p. 36, pl. 6, figs. 19, 20.
1945. *Reussella aculeata* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 21, part 2, p. 41, pl. 7, figs. 10, 11.
1947. *Reussella spinulosa* (Reuss) var. *atlantica* CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 23, pt. 4, p. 91, pl. 20, figs. 6, 7.
1951. *Reussella atlantica* Cushman. PHLEGER and PARKER (part), Geol. Soc. America, part 2, Mem. 46, p. 18, pl. 8, figs. 8, 9.

This species is rare in our Pleistocene samples. The species was described from the Miocene of Florida; it is also recorded from the Miocene of Colombia and Jamaica. Length of plesiotype (pl. IX, fig. 27), 0.49 mm; maximum breadth, 0.32 mm. Length of plesiotype (pl. IX, fig. 28), 0.36 mm; breadth, 0.29 mm. Length of plesiotype (pl. IX, fig. 35), 0.46 mm; breadth, 0.29 mm.

ROSALINA BULBOSA (Parker)
Pl. IX, figs. 14, 15

1954. *"Discorbis" bulbosa* PARKER, Harvard, Bull. Mus. Comp. Zool., vol. 111, no. 10, p. 523, pl. 8, figs. 10, 11, 12.

Numerous small specimens were found in the upper part of the cored section of the South Pass Block 41 well. Diameter of both plesiotypes, 0.21 mm; thickness, 0.15 mm.

ROSALINA CONCINNA (H. B. Brady)
Pl. IX, figs. 12, 13

1884. *Discorbina concinna* H. B. BRADY, Rept. Voy. Challenger, Zool. vol. 9, p. 646, pl. 90, figs. 7, 8.

A single but typical specimen was found at 592 feet in the South Pass Block 41 well. Maximum diameter of plesiotype, 0.27 mm.

ROSALINA FLORIDANA (Cushman)
Pl. IX, figs. 6, 7

1922. *Discorbis floridanus* CUSHMAN, Carnegie Inst. Washington, Publ. no. 311, p. 39, pl. 5, figs. 11, 12.

Only a few typical specimens were identified. The species is recorded from the Recent of the Antillean region, Florida, the north coast of Cuba, Rio de Janeiro Harbor, the Gulf of Mexico, and the Gulf of Paria. It is reported from the Pliocene and Pleistocene of Florida. Middle Tertiary occurrences are reported in Florida, Jamaica, Colombia, and the Dominican Republic. Maximum diameter of plesiotype, 0.29 mm.

ROSALINA FLORIDENSIS (Cushman)
Pl. IX, figs. 36, 37

1930. *Discorbis bertheloti* (d'Orbigny) var. *floridensis* CUSHMAN *in* CUSHMAN and JARVIS, Journ. Paleontology, vol. 4, no. 4, p. 364, pl. 33, figs. 13a-c.

Specimens are rare but typical of Recent specimens from south of Cape Hatteras. Miocene occurrences are reported for Colombia, Cuba, Jamaica, and the Dominican Republic. The species is reported from the Pleistocene of Aruba. Maximum diameter of plesiotype, 0.67 mm.

ROSALINA cf. R. NITIDA (Williamson)
Pl. IX, figs. 23, 24

1858. *Rotalina nitida* WILLIAMSON, Rec. Foram. Great Britain, p. 54, pl. 4, figs. 106-108.

A few Pleistocene specimens are referred tentatively to this species. Type specimens are not available for comparison, but our forms show a resemblance to the figures of Williamson. Maximum diameter of figured specimen, 0.34 mm.

ROSALINA cf. R. SUEZENSIS (Said)
Pl. X, figs. 24, 25

1949. *Discorbis suezensis* SAID, Cushman Lab. Foram. Res., Spec. Publ. 26, p. 36, pl. 3, fig. 34.

Our specimens are assigned questionably to this species; they are close to forms from the northern Red Sea and the Gulf of Mexico. Maximum diameter of plesiotype, 0.29 mm.

"ROTALIA" TRANSLUCENS Phleger and Parker
Pl. X, figs. 22, 23

1951. *"Rotalia" translucens* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 24, pl. 12, figs. 11a, b, 12a, b.

This common benthonic species from the Gulf of Mexico is also frequent in our fossiliferous Pleistocene cores. Maximum diameter of plesiotype, 0.27 mm.

SAGRINA PULCHELLA d'Orbigny
Pl. IX, figs. 8-10

1839. *Sagrina pulchella* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 150, pl. 1, figs. 23, 24.

1930. *Bolivina pulchella* (d'Orbigny) var. *primitiva* CUSHMAN, Florida Geol. Surv., Bull. 4, p. 47, pl. 8, figs. 12a, b.

1937. *Bolivina pulchella* (d'Orbigny). CUSHMAN, Cushman Lab. Foram. Res., Spec. Publ. 9, p. 151, pl. 15, figs. 9-11.

The type locality of this species was not designated. Recent localities given by d'Orbigny in the above reference are Cuba, St. Thomas, and Jamaica. Our Pleistocene specimens are identical with those from nearshore waters of the Gulf of Mexico. The holotype is not available for comparison, but it is our understanding (personal communication, A. R. Loeblich, Jr., 1958) that the holotype is identical with Recent specimens from the Gulf of Mexico-Caribbean and with specimens from the Miocene of Florida identified as *Bolivina pulchella primitiva* Cushman. As *Bolivina pulchella* (d'Orbigny), the form has been recorded from the Miocene of Jamaica and the Dominican Republic. It is also recorded from the Pliocene of Cuba and Florida. Length of plesiotype (pl. IX, fig. 8), 0.25 mm; breadth, 0.20 mm. Length of plesiotype (pl. IX, figs. 9, 10), 0.19 mm; breadth, 0.07 mm.

SARACENARIA ITALICA Defrance
Pl. VI, figs. 20-22

1824. *Saracenaria italica* DEFRANCE, Dict. Sci. Nat., vol. 32, p. 177.

The range of variation of this widely reported species is not understood. Its reported stratigraphic range is Lower Oligocene to Recent. Middle Tertiary occurrences are recorded from Florida, Louisiana, Italy, Cuba, Jamaica, and the Dominican Republic. The range in Italy is Helvetian to Quaternary. Specimens from the Louisiana Pleistocene are large and typical of the forms usually referred to the species. Length of plesiotype, 1.58 mm.

SARACENARIA sp. "A"
Pl. VI, figs. 2, 3

A specific determination is not made for the rare specimens of this group. Length of figured specimen, 0.42 mm.

SARACENARIA sp. "B"
Pl. VI, fig. 1

Rare specimens of this group are distinctive, but a specific determination is not made due to infrequent occurrence. Length of figured specimen, 0.68 mm.

SARACENARIA sp. "C"
Pl. VI, fig. 7

This form may be the same as that referred by Cushman to *Cristellaria schloenbachi.* Specimens are rare. Length of figured specimen, 0.27 mm.

SIGMOILINA DISTORTA Phleger and Parker
Pl. II, figs. 9 ,10

1951. *Sigmoilina distorta* PHLEGER and PARKER, Geol. Soc. Amer., Mem. 46, pt. 2, p. 8, pl. 4, figs. 3-5.

The Pleistocene form is closer to this species than to the larger, more compressed *S. tenuis* (Czjzek). *S. distorta* may be present in the Miocene of various localities in the Gulf Coast and West Indies but reported as *Sigmoilina tenuis* (Czjzek). Length of plesiotype, 0.34 mm; breadth, 0.17 mm.

SIGMOILOPSIS SCHLUMBERGERI
(A. Silvestri)
Pl. II, figs. 16-18

1904. *Sigmoilina schlumbergeri* A. SILVESTRI, Mem. Pont. Accad. Nuovi Lincei, vol. 22, p. 267.

The reported range of this species is Middle Tertiary to Recent. Middle Tertiary occurrences are reported for Haiti, the Dominican Republic, Cuba, Jamaica, and Trinidad. Length of plesiotype, 1.09 mm; breadth, 0.78 mm.

SIGMOILOPSIS SUBPOEYANA (Cushman)
Pl. II, fig. 7

1922. *Quinqueloculina subpoeyana* CUSHMAN, Carnegie Inst. Washington, Publ. 311, p. 66; U. S. Natl. Mus., Bull. 104, pt. 6, p. 31, pl. 5, fig. 3.
1956. *Sigmoilina subpoeyana* (Cushman). BANDY, U. S. Geol. Survey, Prof. Paper 274-G, p. 197, pl. 29, fig. 1.

Bandy in the above reference is followed in assigning specimens to this species rather than to *Spiroloculina antillarum* d'Orbigny. *S. subpoeyana* is recorded from the Miocene of Florida and northern Colombia. Length of plesiotype, 0.46 mm; breadth, 0.23 mm.

SIPHOGENERINA RAPHANUS (Parker and Jones)
Pl. IX, fig. 25

1865. *Uvigerina (Sagrina) raphanus* PARKER and JONES, Phil. Trans., p. 364, pl. 18, figs. 16, 17.
1913. *Siphogenerina raphanus* (Parker and Jones). CUSHMAN, U. S. Natl. Mus., Bull. 71, part 3, p. 108, pl. 46, figs. 1-5.
1923. *Siphogenerina raphanus* (Parker and Jones). CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 174, pl. 42, fig. 14.
1935. *Siphogenerina raphanus* (Parker and Jones). BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 9, p. 199.
1945. *Siphogenerina* cf. *S. raphanus* (Parker and Jones). D. K. PALMER, Bull. Amer. Paleontology, vol. 29, no. 115, p. 52.
1949. *Siphogenerina raphanus* (Parker and Jones). BERMUDEZ, Cushman Lab. Foram. Res., Spec. Publ. 25, p. 222, pl. 14, fig. 18.

Comparison with material at the U. S. National Museum shows that our specimens are typical of this slender, widely distributed form. In the Gulf Coast Pleistocene, occurrences are in the lower marine shales. The species has been reported from Recent sediments of the Pacific and Atlantic Oceans and from the north coast of Cuba. It has also been reported from the Miocene of Jamaica and the Dominican Republic and from the Pliocene of Cuba. Length of plesiotype (broken specimen), 0.69 mm; diameter, 0.27 mm.

SIPHONINA PULCHRA Cushman
Pl. XI, figs. 13, 14

1919. *Siphonina pulchra* CUSHMAN, Carnegie Inst. Washington, Publ. 291, p. 42, pl. 14, fig. 7.

This is a common species in the Gulf of Mexico. Middle Tertiary occurrences are reported from Cuba, Haiti, Jamaica, Trinidad, Colombia, and the Dominican Republic. Cole (1931, p. 51) reports the species from the Pliocene of Florida. Maximum diameter of plesiotype, 0.46 mm; thickness, 0.22 mm.

SIPHONODOSARIA ANTILLEA (Cushman)
Pl. IX, fig. 34

1923. *Nodosaria antillea* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 91, pl. 14, fig. 9.

In the Gulf Coast Pleistocene, this species has not been found higher than the lowermost marine beds. The type specimen is from 307 meters off the eastern coast of the United States. The species is also recorded from off Brazil in 1234 meters and from possible Miocene in a well in Aruba (Drooger, 1953, p. 137). Length of plesiotype, 0.76 mm. Diameter of largest chamber, 0.19 mm.

SIPHONODOSARIA VERNEUILI (d'Orbigny)
Pl. IX, fig. 39

1846. *Dentalina verneuili* D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, p. 48, pl. 2, figs. 7, 8.
1928. *Nodosaria verneuili* (d'Orbigny). NUTTALL, Quart. Journ. Geol. Soc., vol. 84, p. 81, pl. 4, figs. 14, 15.

1929. *Ellipsonodosaria verneuili* (d'Orbigny). CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 5, p. 96, pl. 14, figs. 1-3.
1941. *Nodosarella verneuili* (d'Orbigny). GALLOWAY and HEMINWAY, New York Acad. Sci., Sci. Survey Porto Rico and Virgin Is., vol. 3, pt. 4, p. 440, pl. 35, fig. 10.
1948. *Ellipsonodosaria verneuili* (d'Orbigny). RENZ, Geol. Soc. Amer., Mem. 32, p. 131, pl. 8, figs. 3-5.

There are no significant differences between our Pleistocene specimens and forms in our collection from Italy and Baden, Austria. The species was described from the Miocene of the Vienna basin. It has been reported from the Eocene and Oligocene (?) of Cuba and Venezuela and from Eocene to Miocene in Italy. It is recorded from the Middle Tertiary of Puerto Rico, Trinidad, Ecuador, the Dominican Republic, Jamaica, and Sumatra. Length of fragment, 0.78 mm; diameter, 0.19 mm .

SIPHOTEXTULARIA AFFINIS (Fornasini)
Pl. I, fig. 13

1883. *Sagraina affinis* FORNASINI, Boll. Soc. Geol. Ital., vol. 2, p. 14, pl. 2, figs. 10a-c.

This species is recorded from the Gulf of Mexico and from off the northeast coast of the United States from 90 meters to 300 meters. The type is from the Pliocene of Italy. It is reported from the Miocene of Mallorca by Colom (1946, p. 119). Length of plesiotype, 0.32 mm; breadth, 0.25 mm; thickness, 0.18 mm.

SIPHOTEXTULARIA ROLSHAUSENI Phleger and Parker
Pl. I, fig. 14

1951. *Siphotextularia rolshauseni* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, part 2, p. 4, pl. 1, figs. 23, 24a, b.

Length of plesiotype, 0.25 mm; breadth, 0.17 mm; thickness, 0.11 mm.

SORITES MARGINALIS (Lamarck)
Pl. VII, fig. 18

1816. *Orbulites marginalis* LAMARCK, Syst. Anim. sans Vert., vol. 2, p. 196, no. 1.

This species, described from the Recent of the European region, occurs in abundance in the uppermost beds of the Gulf Coast Pleistocene. These specimens are typical of those from the Gulf of Mexico-Caribbean waters. The species is reported from Upper Oligocene to Upper Miocene in the Dominican Republic. Specimens from the Miocene of Florida and Louisiana referred to in the literature as *Sorites* sp. may belong to this species. The range in Cuba is Miocene to Recent. It also occurs in the Pliocene of Florida. Maximum diameter of plesiotype, 1.12 mm.

SPHAEROIDINA BULLOIDES d'Orbigny
Pl. XI, figs. 9, 10

1826. *Sphaeroidina bulloides* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 267, Modèles, no. 65.

This species is recorded from the Middle Tertiary of California, Louisiana, Cuba, Jamaica, and the Dominican Republic, as well as from modern seas. It is reported from Lower Oligocene to Quaternary in Italy. Maximum diameter of plesiotype, 0.36 mm.

SPIRILLINA VIVIPARA Ehrenberg
Pl. IX, fig. 21

1843. *Spirillina vivipara* EHRENBERG, (1841), Abhandl. k. Akad. Wiss. Berlin, Theil. 1, pp. 323, 422, pl. 3, sec. 7, fig. 41.

Our Pleistocene specimens are small, rare, and usually broken. They are close in appearance to specimens from the Gulf of Mexico. The species is reported from the Miocene of Cuba, the Upper Eocene and Lower Oligocene of Puerto Rico, and questionably from the Anahuac Formation of the Gulf Coast. Diameter of plesiotype, 0.17 mm.

SPIROLOCULINA DEPRESSA d'Orbigny
Pl. II, fig. 8

1826. *Spiroloculina depressa* D'ORBIGNY, Ann. Sci. Nat., ser. 1, tome 7, p. 298; Modèles, no. 92.
1956. *Spiroloculina depressa* d'Orbigny. BANDY, U. S. Geol. Survey, Prof. Paper 274-G, p. 197, pl. 29, fig. 2.

The species has been reported from various European Pliocene and Miocene localities as well as from modern seas (Cushman and Todd, 1944, p. 28). A similar, perhaps conspecific form, *S. alveata* Cushman and Todd, is recorded from the Miocene of Florida and Jamaica. *S. depressa* has been identified in the Pliocene and Pleistocene of Italy. Length of plesiotype, 0.34 mm; breadth, 0.25 mm; thickness, 0.07 mm.

STETSONIA MINUTA Parker
Pl. XI, figs. 20, 21

1954. *Stetsonia minuta* PARKER, Harvard, Bull. Mus. Comp. Zool., vol. 111, no. 10, p. 534, pl. 10, figs. 27, 28, 29.

Specimens are small and rare as in Recent sediments of the Gulf of Mexico. These qualities may have precluded the observation of this species in Tertiary or other Recent samples. Diameter of plesiotype, 0.11 mm; thickness, 0.06 mm.

TEXTULARIA CANDEIANA d'Orbigny
Pl. I, figs. 4, 5

1839. *Textularia candeiana* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 143, pl. 1, figs. 25-27.

The recorded range of this species is Oligocene to Recent. Middle Tertiary occurrences are reported for Florida, Puerto Rico, Jamaica, and the Dominican Republic. It is reported from the Pliocene of Cuba. Length of plesiotype, 0.53 mm; breadth, 0.46 mm; thickness, 0.31 mm.

TEXTULARIA CONICA d'Orbigny
Pl. I, figs. 2, 3

1839. *Textularia conica* D'ORBIGNY *in* DE LA SAGRA, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 143, pl. 1, figs. 19, 20.

T. conica is recorded from the Middle Tertiary of Florida, the *Heterostegina* Limestone of Texas and Louisiana, and from the Pleistocene of Italy and Aruba, as well as from Recent sediments of the Caribbean. It is also reported from the Pliocene of Cuba and from possible Miocene of Aruba. Length of plesiotype, 0.53 mm; breadth, 0.63 mm; thickness, 0.53 mm.

TEXTULARIA FOLIACEA OCCIDENTALIS Cushman
Pl. I, figs. 10, 11

1922. *Textularia foliacea* Heron-Allen and Earland var. *occidentalis* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 3, p. 16, pl. 2, fig. 13.

This foraminifer occurs in several carbonate zones of the Pleistocene. It is easily confused with *T. sica* Lalicker and Bermudez but is not so compressed as that species. The types are from off the coast of Cuba in 45 fathoms. Miocene occurrences are reported from Florida and Jamaica. Length of plesiotype, 0.69 mm; breadth, 0.42 mm; thickness, 0.27 mm.

TEXTULARIA MAYORI Cushman
Pl. I, fig. 12

1922. *Textularia mayori* CUSHMAN, Carnegie Inst. Wash., vol. 17, p. 23, pl. 2, fig. 3.

The species is recorded from the Miocene and Pliocene of Florida. Length of plesiotype, 1.13 mm; breadth, 0.92 mm; thickness, 0.57 mm.

TEXTULARIA MEXICANA Cushman
Pl. I, fig. 6

1896. *Textularia rugosa* Reuss, var., GOES, Harvard, Bull. Mus. Comp. Zool., vol. 29, p. 43, pl. 5, figs. 4, 5.
1899. *Textularia carinata* FLINT (not d'Orbigny), Rept. U. S. Natl. Mus., (1897), pt. 2, p. 284, pl. 29, fig. 1.
1922. *Textularia mexicana* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 3, p. 17, pl. 2, fig. 9.
1941. *Textularia mexicana* LALICKER and BERMUDEZ, Torreia, Habana, no. 8, p. 15, pl. 4, fig. 3.
1945. *Textularia mexicana* CUSHMAN and TODD, Cushman Lab. Foram. Res., Spec. Publ. 15, p. 1, pl. 1, fig. 1.
1940. *Textularia warrenites* CORYELL and RIVERO, Journ. Paleontology, vol. 14, p. 325, pl. 41, fig. 4.

Our specimens are typical of those from the Recent of the Gulf of Mexico and the Caribbean Sea. The species is also reported from the Miocene of California, France, and the Caribbean region, and we have seen typical specimens in the subsurface Louisiana Pliocene and Miocene. Length of plesiotype, 0.86 mm; breadth, 0.64 mm; thickness at median line, 0.42 mm.

TEXTULARIA SICA Lalicker and Bermudez
Pl. I, figs. 8, 9

1941. *Textularia sica* LALICKER and BERMUDEZ, Torreia, no. 8, p. 16, pl. 4, figs. 5, 6.

This compressed *Textularia* is a distinctive species in the upper portion of the marine Pleistocene. The types are from off the North coast of Cuba in 230 fathoms. Length of plesiotype, 0.67 mm; breadth, 0.42 mm; thickness, 0.17 mm.

TEXTULARIA cf. T. YAGUATENSIS Bermudez
Pl. I, fig. 7

1949. *Textularia yaguatensis* BERMUDEZ, Cushman Lab. Foram. Res., Spec. Publ. 25, p. 64, pl. 2, figs. 63-65.

The species to which our Lower Pleistocene specimens are questionably referred was described from the Middle Tertiary of the Dominican Republic. Length of figured

specimen, 0.42 mm; breadth, 0.39 mm; thickness, 0.17 mm.

TEXTULARIELLA BARRETTII (Jones and Parker)
Pl. I, figs. 26, 27

1863. *Textularia barrettii* JONES and PARKER, Rept. British Association Newcastle Meeting, pp. 80-105.

Very large specimens are characteristic of the upper marine zones of the Louisiana Pleistocene. The species was described from the Recent of Jamaica. The recorded range is Upper Oligocene to Recent. Middle Tertiary specimens have been reported from Cuba, Jamaica, Venezuela, and the Dominican Republic. The species is also present in the Miocene of Louisiana and the Pliocene of Cuba. Length of plesiotype, 1.26 mm; diameter, 1.32 mm. Specimens twice the size of our plesiotype are common in the upper zones of the Pleistocene of the lower Mississippi River delta.

TRIFARINA BELLA (Phleger and Parker)
Pl. IX, fig. 32

1951. *Angulogerina bella* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, pt. 2, p. 12, pl. 6, figs. 7, 8.

This species is usually present in marine zones throughout the Pleistocene. Specimens are always small as are Recent members of the species in the Gulf of Mexico. Sharply undercut chambers with pointed projections are typical in our specimens, but low costae are sometimes present so that specimens resemble *A. jamaicensis* Cushman and Todd in this single respect. Length of plesiotype, 0.40 mm.

TRIFARINA EXIMIA (Cushman and Jarvis)
Pl. IX, fig. 19

1936. *Angulogerina eximia* CUSHMAN and JARVIS, Contr. Cushman Lab. Foram. Res., vol. 12, p. 3, pl. 1, figs. 11, 12.

Miocene specimens from the type locality near Buff Bay, Jamaica, reach a length of half again that of our Pleistocene specimens. The Jamaican specimens are also generally more robust, but considerable variation exists in this respect, and our specimens fall within the range of this variation. Pleistocene specimens possibly constitute a subspecies, as perhaps may also the Tertiary Haitian specimens reported by Coryell and Rivero (1940, p. 342) as suggested by Bermudez (1949, p. 214). This foraminifer is also recorded from the Miocene of Cuba. It is rare here except in the core at 2418 feet, California Company State Lease 2553 no. 1. Length of plesiotype, 0.38 mm; breadth, 0.19 mm.

TRIFARINA HOLCKI Akers and Dorman, n. sp.
Pl. IX, figs. 16-18

Test small, stout, fusiform, subtriangular in transverse section, angles so poorly developed in some specimens as to suggest *Uvigerina,* microspheric individuals slightly more than half as broad as long, megalospheric individuals twice as long as broad, maximum width midway of the test; chambers inflated, with slightly depressed sutures; surface bearing numerous, very fine, sometimes indistinct costae, which continue to the base of the neck; aperture terminal with a short neck bearing a slight but definite lip; dimensions of holotype, pl. IX, fig. 17: length including neck, 0.40 mm; breadth, 0.22 mm. Length of paratype, pl. IX, fig. 16, 0.42 mm; breadth, 0.29 mm. Length of paratype, pl. IX, fig. 18, 0.36 mm; breadth, 0.21 mm.

Holotype and paratypes are from the core at 3560 feet in California Company State Lease 2553, well number 1, South Pass Block 41, Plaquemines Parish, Louisiana. This species is restricted in the Louisiana Pleistocene to a zone of only a few hundred feet in thickness (Aftonian, Akers and Holck, 1957), but laterally it has been found in wells in the lower Mississippi delta and in wells off the entire length of the Louisiana coast. It is named in recognition of the work of A. J. J. Holck on the Louisiana Pleistocene.

The species is similar to the larger *Trifarina multistriata* (Bermudez) from the Tertiary of the Dominican Republic. It is less angulate, and the chambers are more bulbous than in *T. multistriata.*

TRILOCULINA CIRCULARIS Bornemann
Pl. III, figs. 12, 13

1855. *Triloculina circularis* BORNEMANN, Zeitschr. deutsch. geol. Ges., vol. 7, p. 349.
1917. *Triloculina circularis* Bornemann. CUSHMAN, U. S. Natl. Mus., Bull. 71, pt. 6, p. 67, pl. 25, fig. 4; pl. 26, fig. 1.

Our specimens are close to the Caribbean form. The species has been reported from the Pliocene and Pleistocene of Florida and from the Miocene of Puerto Rico and

France. It has also been identified in the Calabrian of Italy. Length of plesiotype, 0.29 mm; breadth, 0.27 mm; thickness, 0.22 mm.

TRILOCULINA INSIGNIS (H. B. Brady)
Pl. III, figs. 16-18

1881. *Miliolina insignis* BRADY, Quart. Journ. Micr. Sci., London, n. s., vol. 21, p. 45.
1884. *Miliolina insignis* BRADY, Rept. Voy. Challenger, Zool., vol. 9, p. 165, pl. 4, figs. 8, 10.

Our specimens, except for variation in the apertural tooth, seem to be identical with Brady's types from Recent sediments off Culebra Island in 390 fathoms. Length of plesiotype, 0.99 mm; breadth, 0.84 mm; thickness, 0.98 mm.

TRILOCULINA TRICARINATA d'Orbigny
Pl. III, fig. 21

1826. *Triloculina tricarinata* D'ORBIGNY, Ann. Sci. Nat., tome 7, p. 299, Modèles no. 94.

Pleistocene specimens are typical of the widely distributed group which has been referred to this species. D'Orbigny's type is from the Red Sea. The species is recorded from the Middle Tertiary of Venezuela, Trinidad, Puerto Rico, Jamaica, and France and from the Pliocene of Florida. It is also reported from the Pliocene and Pleistocene of Italy. Length of plesiotype, 0.86 mm; diameter, 0.59 mm.

TRILOCULINA TRIGONULA (Lamarck)
Pl. III, figs. 19, 20

1804. *Miliolites trigonula* LAMARCK, Ann. du Mus., vol. 5, p. 351, no. 3.
1826. *Triloculina trigonula* D'ORBIGNY, Ann. Sci. Nat., vol. 7, p. 299, no. 1, pl. 16, figs. 5-9; Modèles, no. 93.

Our specimens are typical of those from the Recent of the Atlantic Ocean and the Gulf of Mexico which have been referred to this species. The holotype is from the Eocene of the Paris Basin, however, and it is doubtful if the species is adequately understood. *T. trigonula* has been reported from the Middle Tertiary of Trinidad; from the Miocene and Pliocene of Florida; and from the Pliocene and Pleistocene of Italy. Length of plesiotype, 0.67 mm; breadth, 0.57 mm; thickness, 0.63 mm.

TRIMOSINA DENTICULATA Akers and Dorman, n. sp.
Pl. IX, figs. 2-5

Test small, elongate to tapering ovate, broadest between the middle and the apertural end, triserial, angular; sutures distinct; final three chambers inflated and abruptly enlarged, each chamber bearing a downward pointing spine at the marginal angle and several shorter protuberances on the remainder of the wall, initial chamber with an acicular spine; aperture a wide loop-like opening with a thin lip and a narrow plate-like tooth.

Holotype and paratype from California Company State Lease 2553, well no. 1, South Pass Block 41 Field, sidewall core at 3460 feet. Length of holotype (pl. IX, figs. 2, 4), 0.32 mm; diameter, 0.21 mm. Paratype (pl. IX, fig. 5), 0.25 mm in length. Paratype (pl. IX, fig. 3), 0.32 mm in length.

Specimens are particularly frequent in the deep water deposits of Aftonian age. The species seems to have become extinct before the end of the last glacial stage. We have not seen it in Gulf Coast Miocene or Caribbean Tertiary, but it also occurs in the Louisiana Pliocene.

TRITAXIA MEXICANA (Cushman)
Pl. I, figs. 20, 21

1922. *Clavulina humilis* H. B. Brady var. *mexicana* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 3, p. 83, pl. 16, figs. 1-3.

Individuals are variable in size as may be seen by figures 20 and 21, pl. I. The species has been reported from the Gulf of Mexico between 30 meters and 675 meters. In the West Indian region occurrences have been reported from 124 meters to 2431 meters. Tertiary occurrences are reported from California, Cuba, Jamaica, Aruba, and the Dominican Republic. Length of plesiotype, pl. I, fig. 20, 1.20 mm; maximum breadth, 0.48 mm. Length of plesiotype, pl. I, fig. 21, 0.71 mm; maximum breadth, 0.25 mm.

This form is listed in figures 2 and 3 as *Clavulina mexicana* Cushman.

TRITAXILINA YASICAENSIS Bermudez
Pl. II, figs. 3, 4

1949. *Tritaxilina yasicaensis* BERMUDEZ, Cushman Lab. Foram. Res., Spec. Publ. 25, p. 96, pl. 5, figs. 55, 56.

Rare specimens are referred to this species described by Bermudez from the Middle

Tertiary of the Dominican Republic. Length of plesiotype, 0.84 mm; diameter, 0.49 mm.

TUBINELLA cf. T. FUNALIS (H. B.. Brady)
Pl. III, fig. 7

1884. *Articulina funalis* H. B. BRADY, Rept. Voy. Challenger, Zool., pt. 22, vol. 9, p. 185, pl. 13, figs. 6-11.

This species was described from Recent sediments in the vicinity of Prince Edward Island, Indian Ocean. Our specimens are somewhat smaller than the holotype. Length of figured specimen (broken), 0.59 mm.

TURRILINA sp.
Pl. VII, fig. 25

A single, small specimen is assigned to this genus. Length of figured specimen, 0.17 mm; diameter, 0.07 mm.

UVIGERINA BELLULA Bandy
Pl. IX, fig. 1

1956. *Uvigerina bellula* BANDY, U. S. Geol. Surv., Prof. Paper 274-G, p. 199, pl. 31, fig. 13.

This small *Uvigerina* occurs throughout the marine Pleistocene section. The species has been reported from the Gulf of Mexico, the Caribbean, and the Pacific Ocean as *U. auberiana* d'Orbigny var. *laevis* Goës. Length of plesiotype, 0.30 mm; breadth, 0.13 mm.

UVIGERINA FLINTII Cushman
Pl. IX, fig. 29

1923. *Uvigerina flintii* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 165, pl. 42, fig. 13.

Tertiary specimens are reported from Italy, the Georges Bank Canyons, and the Dominican Republic. Length of homeotype, 0.59 mm; breadth, 0.34 mm. Our specimens were compared with the holotype and paratypes from the Recent of the Antillean-Caribbean region. Specimens from the Tertiary Buff Bay of Jamaica referred to *U. laviculata* Coryell and Rivero differ only in being more finely costate.

UVIGERINA PEREGRINA Cushman
Pl. IX, fig. 26

1923. *Uvigerina peregrina* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 166, pl. 42, figs. 7-10.
1940. *Uvigerina peregrina* CORYELL and RIVERO (not Cushman), Journ. Paleontology, vol. 14, p. 343, pl. 44, fig. 19.
1940. *Uvigerina pigmaea* CORYELL and RIVERO (not d'Orbigny), Journ. Paleontology, vol. 14, p. 343, pl. 44, fig. 20.
1941. *Uvigerina peregrina* Coryell and Rivero. CUSHMAN and TODD (part), Contr. Cushman Lab. Foram. Res., vol. 17, p. 51, pl. 14, figs. 14, 15 (not figs. 16, 17).
1941. *Uvigerina gardnerae* GALLOWAY and HEMINWAY (not Cushman), New York Acad. Sci., Sci. Surv., Porto Rico and Virgin Is., vol. 3, pt. 4, p. 429, pl. 33, fig. 13.
1942. *Uvigerina gallowayi* CORYELL and MOSSMAN (not Cushman), Journ. Paleontology, vol. 16, p. 244, pl. 36, fig. 50.
1945. *Uvigerina hispido-costata* CUSHMAN and TODD, Cushman Lab. Foram. Res., Spec. Publ. 15, p. 51, pl. 7, figs. 27, 31.

This assignment is made for a variable group of specimens. The term morphotype in the sense of Sylvester-Bradley (1958, p. 217) probably should be used here instead of species in the biologic sense. Even specimens of this group from the Gulf of Mexico show variation in development of costae and spines, and it is difficult to determine specific or infraspecific groups. There may be several species in the above synonymy, but all possess similarities of test form which distinguish the group from other *Uvigerinas*. Specimens of this general group are recorded from Middle Tertiary sediments of the Gulf Coast and the Caribbean region. In Italy the range is Tortonian to Quaternary. Length of plesiotype, 0.44 mm; diameter, 0.25 mm.

UVIGERINA PEREGRINA BRADYANA Cushman
Pl. IX, fig. 38

1923. *Uvigerina peregrina* Cushman var. *bradyana* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 168, pl. 42, fig. 12.

This variant is recorded from the Tertiary of California and from the Pliocene of Florida. It was described from the Atlantic Ocean. Length of plesiotype, 0.27 mm; diameter, 0.13 mm.

UVIGERINA PEREGRINA PARVULA Cushman
Pl. IX, fig. 31

1923. *Uvigerina peregrina* Cushman var. *parvula* CUSHMAN, U. S. Natl. Mus., Bull. 104, pt. 4, p. 168, pl. 42, fig. 11.

Several variants may be recognized in this group on the basis of the costae which are more numerous and finer in some specimens than in others as observed by Parker (1954, p. 521) in material from the northeastern Gulf of Mexico. This foraminifer has been

reported from the Miocene of Jamaica and from the Pliocene and Pleistocene of California. Length of plesiotype, 0.53 mm; diameter, 0.21 mm.

VAGINULINOPSIS PLANATA (Phleger and Parker)
Pl. VI, figs. 34, 35

1951. *Marginulina planata* PHLEGER and PARKER, Geol. Soc. America, Mem. 46, part 2, p. 9, pl. 4, figs. 21, 22; pl. 5, figs. 1-3.

Large compressed specimens from the upper part of the Pleistocene are typical of Recent specimens from the Gulf of Mexico. Length of plesiotype, 3.02 mm; maximum breadth, 0.90 mm; thickness, 0.50 mm.

VALVULINERIA HERRICKI (Hadley)
Pl. X, figs. 16, 17

1934. *Cibicorbis herricki* HADLEY, Bull. Amer. Paleontology, vol. 20, no. 70A, p. 26, pl. 5, figs. 1-3.

1949. *Cibicorbis herricki* Hadley. BERMUDEZ, Cushman Lab. Foram. Res., Spec. Publ. 25, p. 259-260, pl. 18, figs. 31-33.

Our forms seem to belong to the same species as that reported from various Caribbean Tertiary localities. Bermudez gives a complete synonymy for this species in the above reference. The species was described from the Upper Oligocene (?) of Cuba, and since then has been reported from the Middle Tertiary of Jamaica, Haiti, Venezuela, and the Dominican Republic. Length of plesiotype, 0.48 mm; breadth, 0.36 mm; thickness, 0.22 mm. Specimens of almost twice these dimensions are found in the lower marine beds of the Louisiana Pleistocene.

VALVULINERIA MINUTA Parker
Pl. X, figs. 1, 2

1954. *Valvulineria minuta* PARKER, Harvard, Bull. Mus. Comp. Zool., vol. 111, no. 10, p. 527, pl. 9, figs. 4, 5, 6.

Our identification is verified by comparison with holotype and paratypes from the northeastern Gulf of Mexico. According to the above reference distribution in Recent sediments is at depths greater than 75 meters. Length of plesiotype, 0.18 mm; breadth, 0.14 mm.

VALVULINERIA PALMERAE Cushman and Todd
Pl. X, figs. 13, 28

1945. *Valvulineria palmerae* CUSHMAN and TODD, Cushman Lab. Foram. Res., Spec. Publ. 15, p. 56, pl. 8, fig. 18.

1951. *Valvulineria cf. araucana* (d'Orbigny). PHLEGER and PARKER, (not *Rosalina araucana* d'Orbigny, 1839), Geol. Soc. America, Mem. 46, pt. 2, p. 25, pl. 13, figs. 7a, b, 8a, b.

1954. *Valvulineria mexicana* PARKER, Harvard, Bull. Mus. Comp. Zool., vol. 111, no. 10, p. 526, pl. 9, figs. 1, 2, 3.

Identification is verified by comparison with topotypes from the Miocene Buff Bay Formation of Jamaica. Specimens from the Gulf of Mexico referred to *V. mexicana* Parker are within the range of variation of *V. palmerae*. The species has also been identified in the Upper Miocene (*Buccella mansfieldi* Zone) of offshore Louisiana. *V. palmerae* is very similar to *V. bradyana* (Fornasini) from the Pliocene of Italy but is smaller and has short umbilical processes which *V. bradyana* seems to lack. Distribution in Recent sediments is deeper than 75 meters. Length of plesiotype, 0.25 mm; breadth, 0.19 mm; thickness, 0.15 mm.

VULVULINA cf. V. DOMINICANA Bermudez
Pl. I, fig. 18

1949. *Vulvulina dominicana* BERMUDEZ, Cushman Lab. Foram. Res., Spec. Publ. 25, p. 55, pl. 1, figs. 54-57.

Our specimens are close to this Caribbean Miocene species. There is also a similarity to *V. dermouti* Boomgaart from the Miocene and Pliocene of Java. The Pleistocene specimens, however, are smaller than the holotypes of both of these species. To our knowledge this foraminifer has not been reported from the Gulf of Mexico. Length of figured specimen, 0.71 mm; breadth, 0.46 mm; thickness, 0.29 mm.

VIII. ILLUSTRATIONS

A. PHOTOGRAPHY

In this paper, the authors have followed the photographic techniques described by G. Fournier (1956) as closely as possible and, except for several drawings as noted in the explanation of plates, all illustrations are unretouched photographs.

The microscope used for photography was a Leitz monocular petrographic equipped with three periplanatic oculars 8X, 10X, and

12X, and four achromatic objectives, 3.2X, 10X, 25X, and 45X.

Pinhole diaphragms were constructed using the techniques described by Fournier (1950) of sizes 50 microns, 100 microns, 250 microns, 650 microns and 1000 microns. These diaphragms were fitted over the microscope objectives.

The lamps were Bausch and Lomb "Nicholas" illuminators equipped with blue filters. Most specimens required two or three such illuminators but smaller specimens necessitated a bank of four for adequate lighting.

The bellows assembly was a Kodak Precision Enlarger "A" equipped with a shutter inserted between the ocular and the film holder. A black felt tube connected the shutter to the bellows and the microscope.

The film holder permitted use of 2¼ x 3½ inch cut film. Kodak Panatomic "X" film was selected for this project.

Focusing was done on a ground glass cover placed at the top of the enlarger, and critical focusing was observed with a magnifying glass placed directly on the ground glass.

Specimens were mounted on a clean, clear glass slide by using a transparent, non-drying, gelatine-like glue called "Stay-Flat". This is a trade name for the substance which is primarily used in photographic work to hold large film sheets against the camera back.

A minute drop of "Stay-Flat" was put on the slide and allowed to dry for 10-15 minutes. The specimen was then placed on this material with a fine camel-hair brush and moved into the required position.

This technique allows the photographer to place a specimen in any desired position with ease. Specimens are easily removed with a brush.

Using this technique and equipment, and with an established routine, it was possible to produce an average of 8-10 negatives per hour.

Contact prints were made commercially, then cut out and mounted.

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PLATE DESCRIPTIONS

All figures are unretouched photographs unless otherwise noted. USNM numbers are from Foraminifera Catalog No. 130. For brevity, wells are designated as follows:

Well A California Company State Lease 2553 no. 1, South Pass Block 41, Offshore Plaquemines Parish, Louisiana

Well B California Company State Lease 1923 no. 1, Bay-T23S-R31E, Dixon Bay Field, Plaquemines Parish, Louisiana

Well C California Company P. O. D. no. 7, South Pass Block 24, Offshore Plaquemines Parish, Louisiana

Well D California Company State Lease 1278 no. 1-A, Main Pass Block 69 Field, Plaquemines Parish, Louisiana

Well E California Company U. S. A. no. 1, Burrwood Area, Block 83, Plaquemines Parish, Louisiana

Well F Phillips no. 1 State Bayou LeBoon, Sec. 48-T20S-R29E, Plaquemines Parish, Louisiana

Well G Humble Ellender no. 1, Sec. 23-T19S-R19E, Lirette Field, Terrebonne Parish, Louisiana

Well H Texas Co. Delta Duck Club, Unit 2, Well no. 1-A, Sec. 1-T21S-R19E, Plaquemines Parish, Louisiana

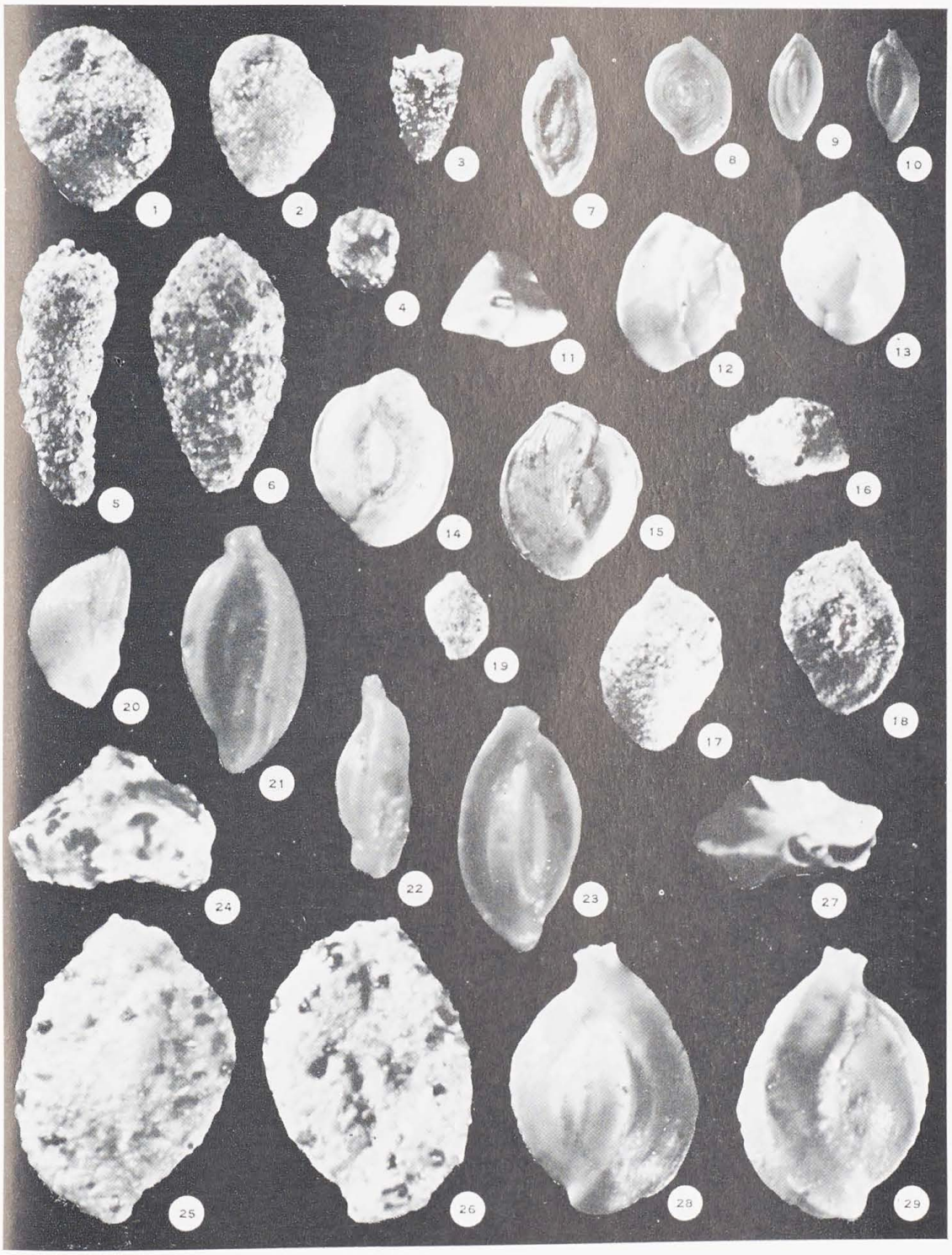
Well I Phillips no. 1 State Bastian Bay, Plaquemines Parish, Louisiana

Well J California Company State Lease 932, Well no. P-1, Block 26, Bay Marchand Field

Plate I

PLATE I

PLATE II



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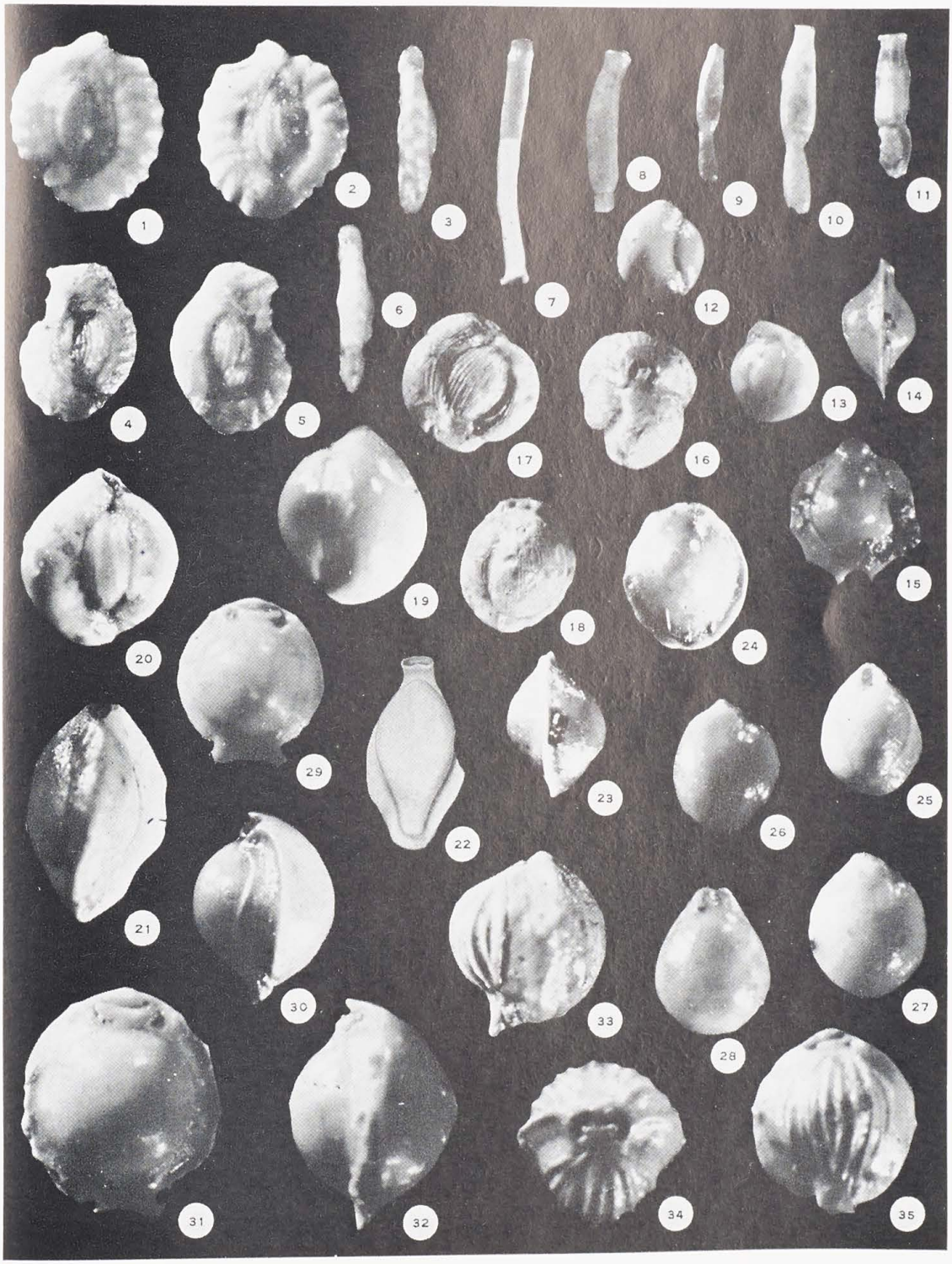
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PLATE III

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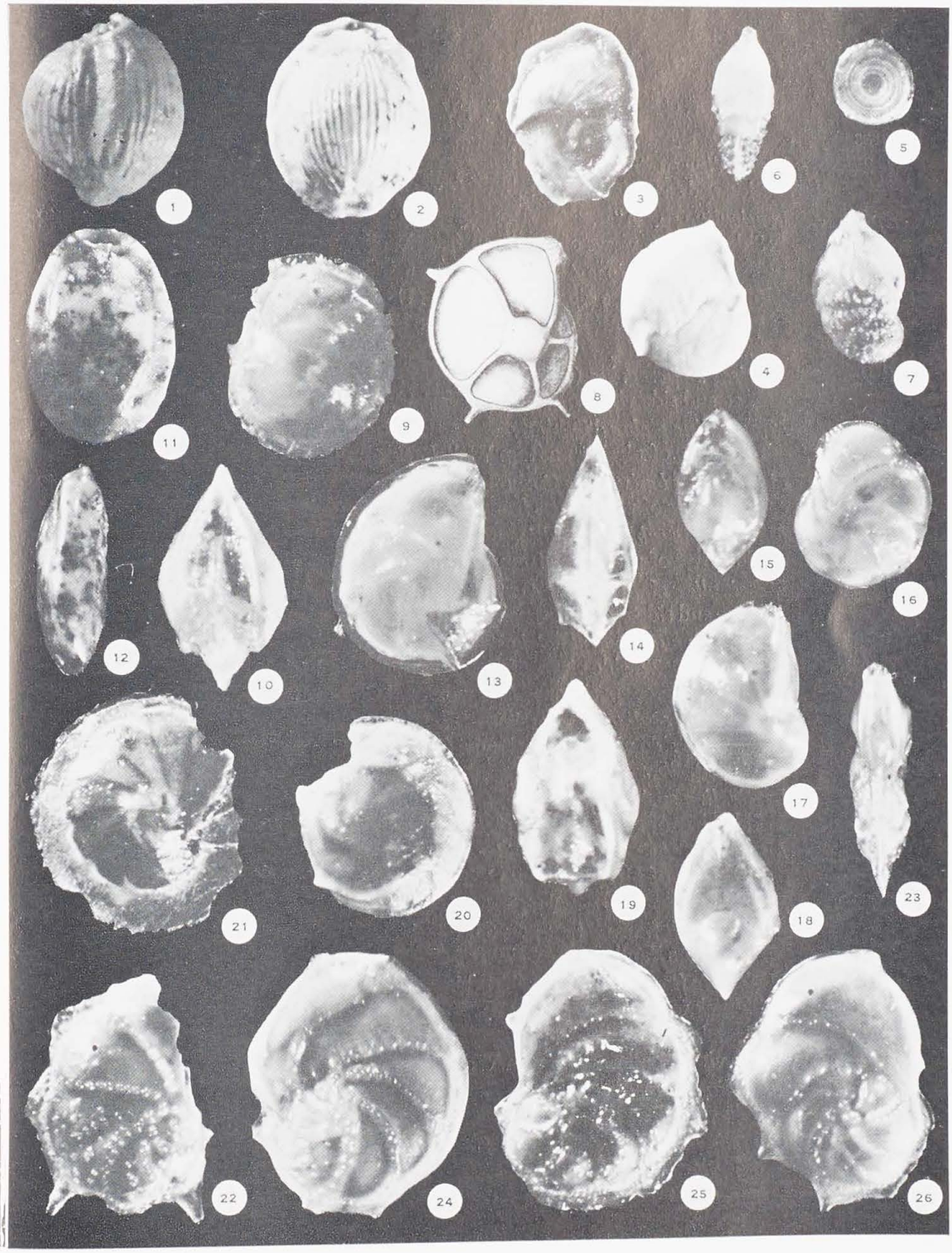

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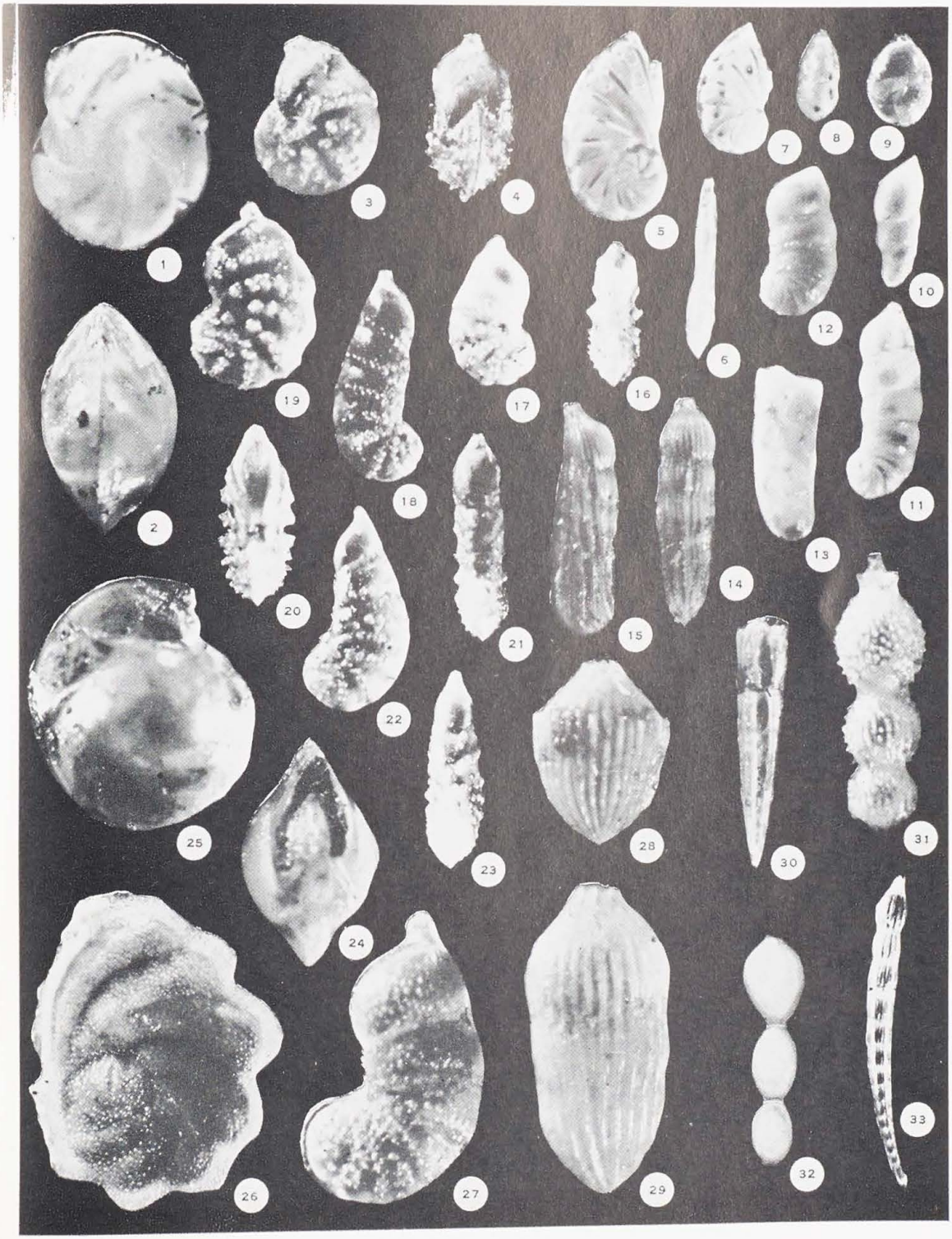
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PLATE V

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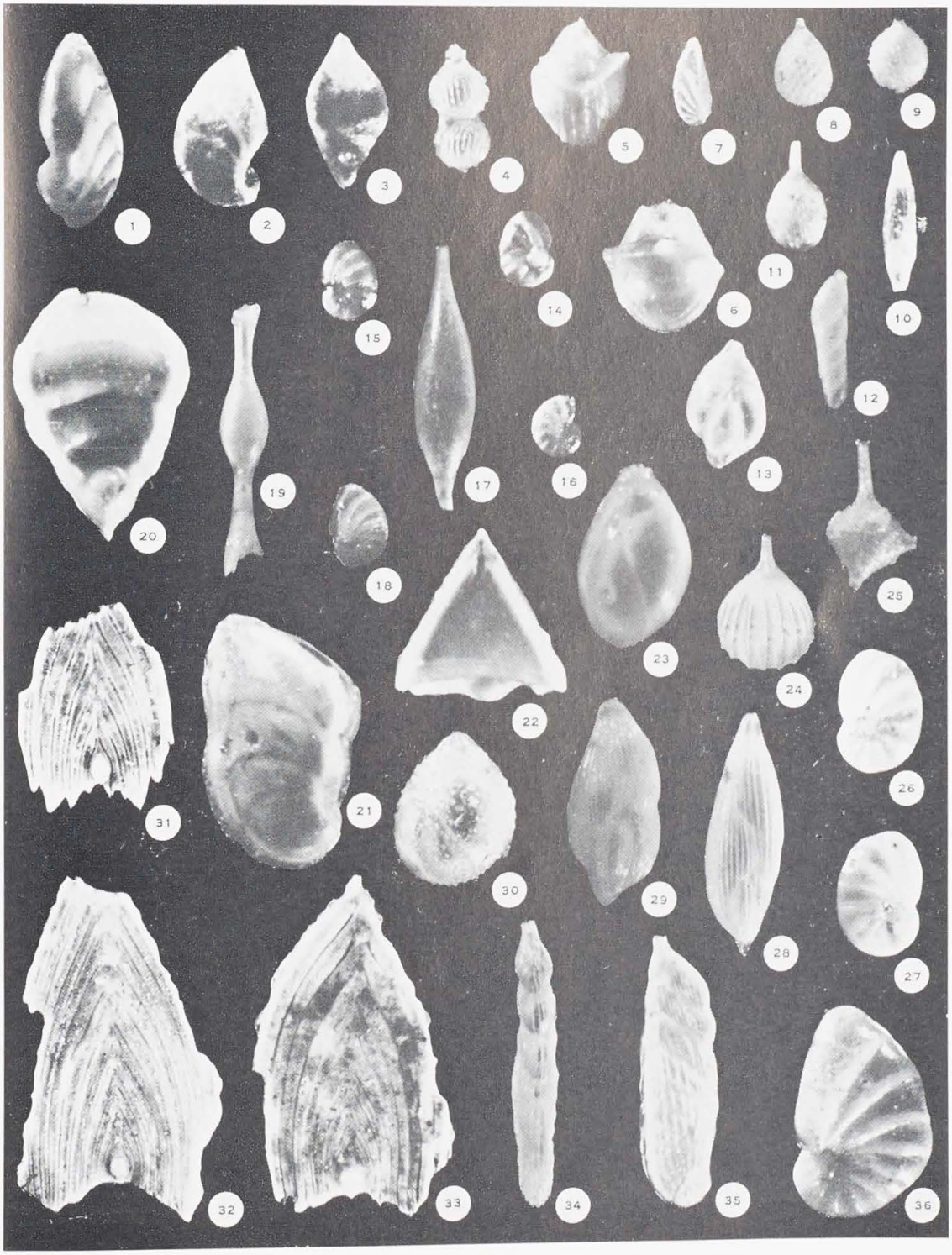
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PLATE VI

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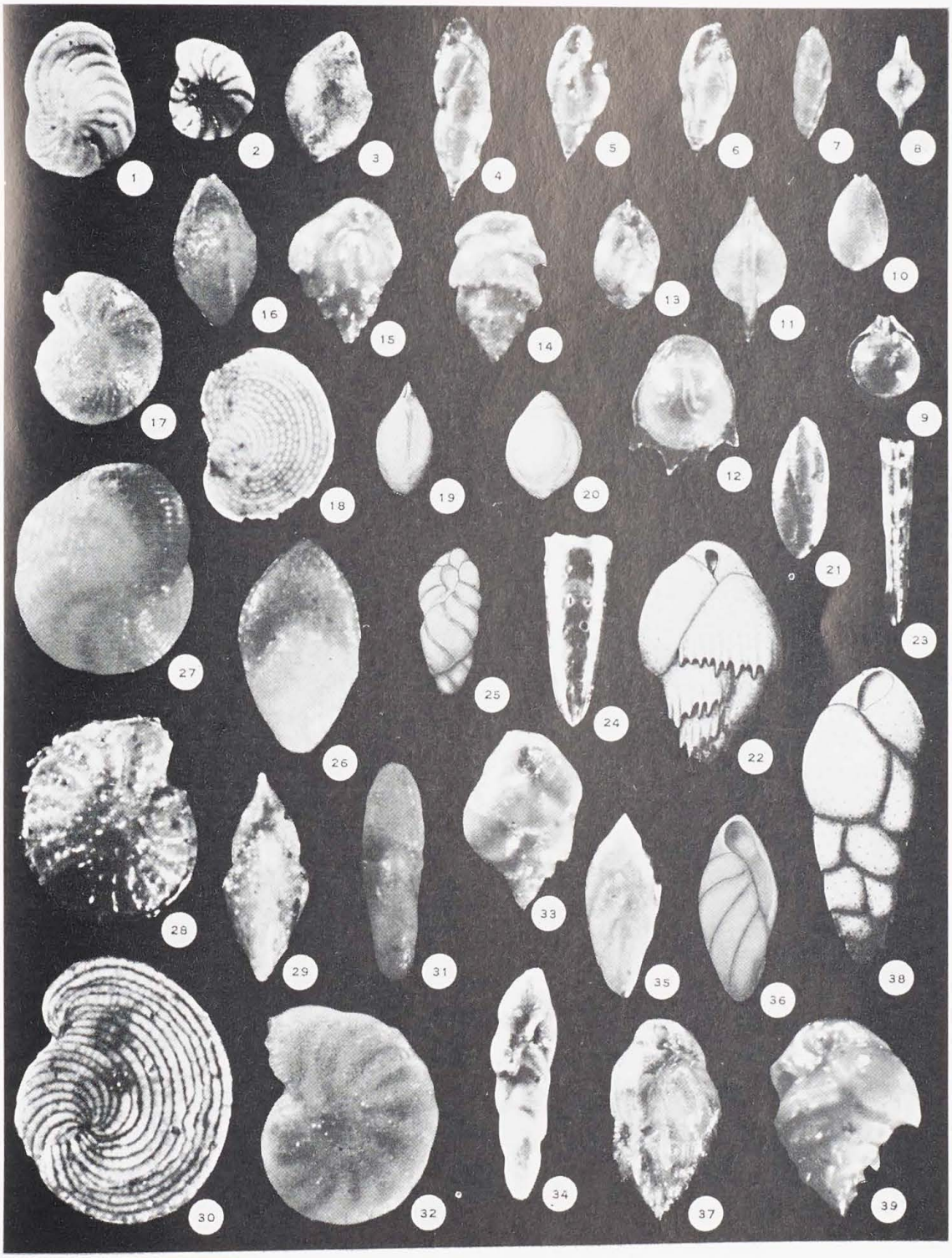
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PLATE VII

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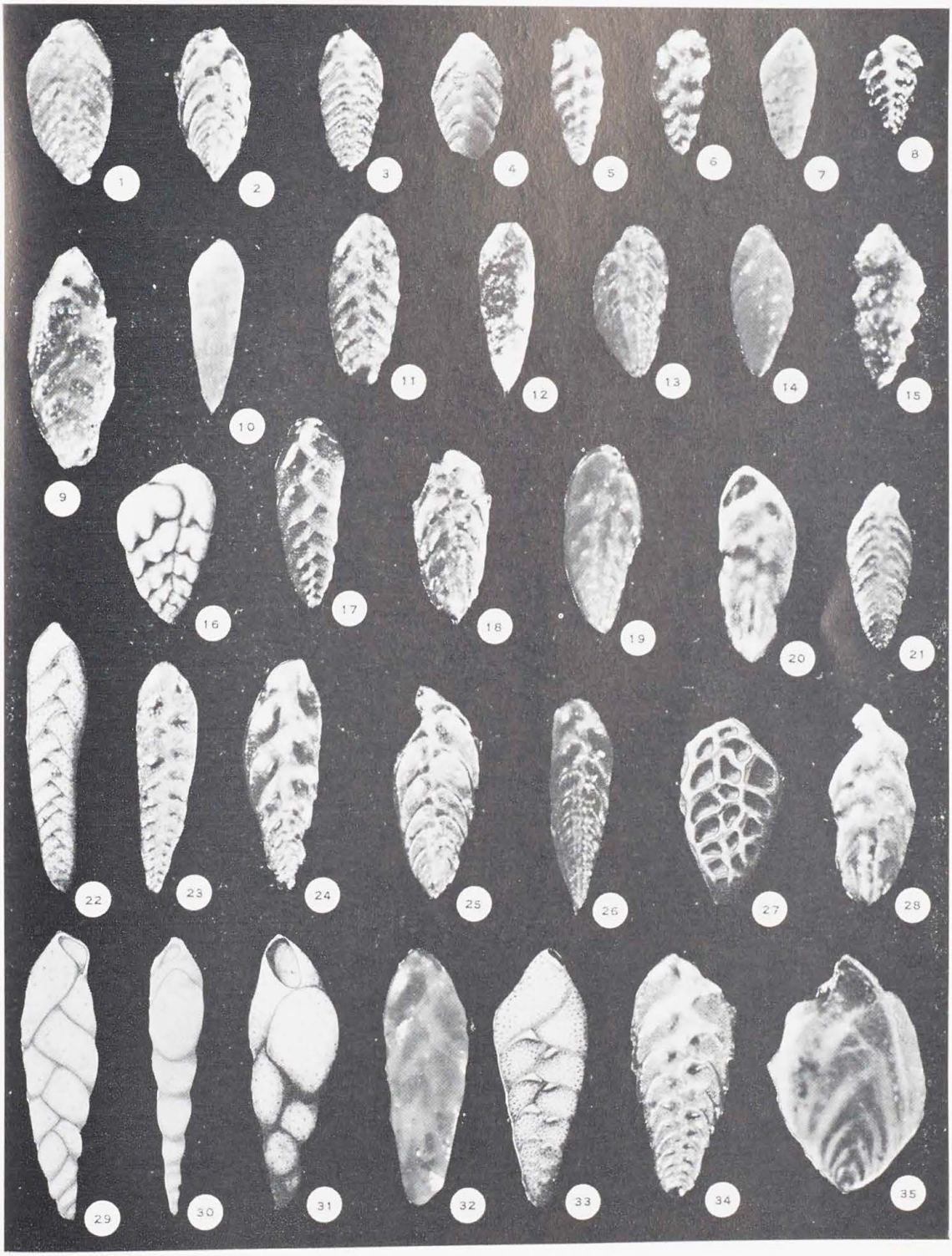
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PLATE VIII

Plate IX


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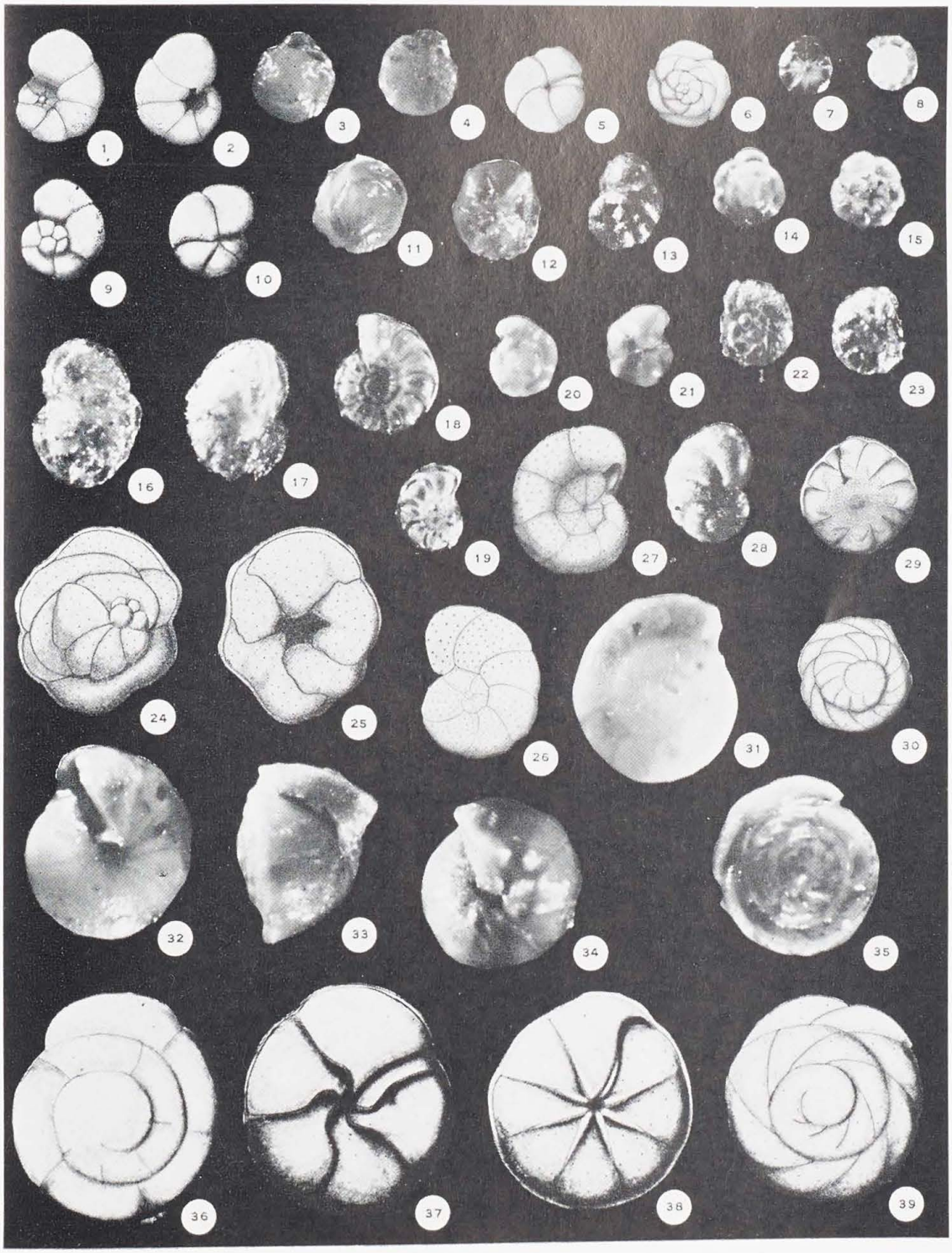
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PLATE X

PLATE XI

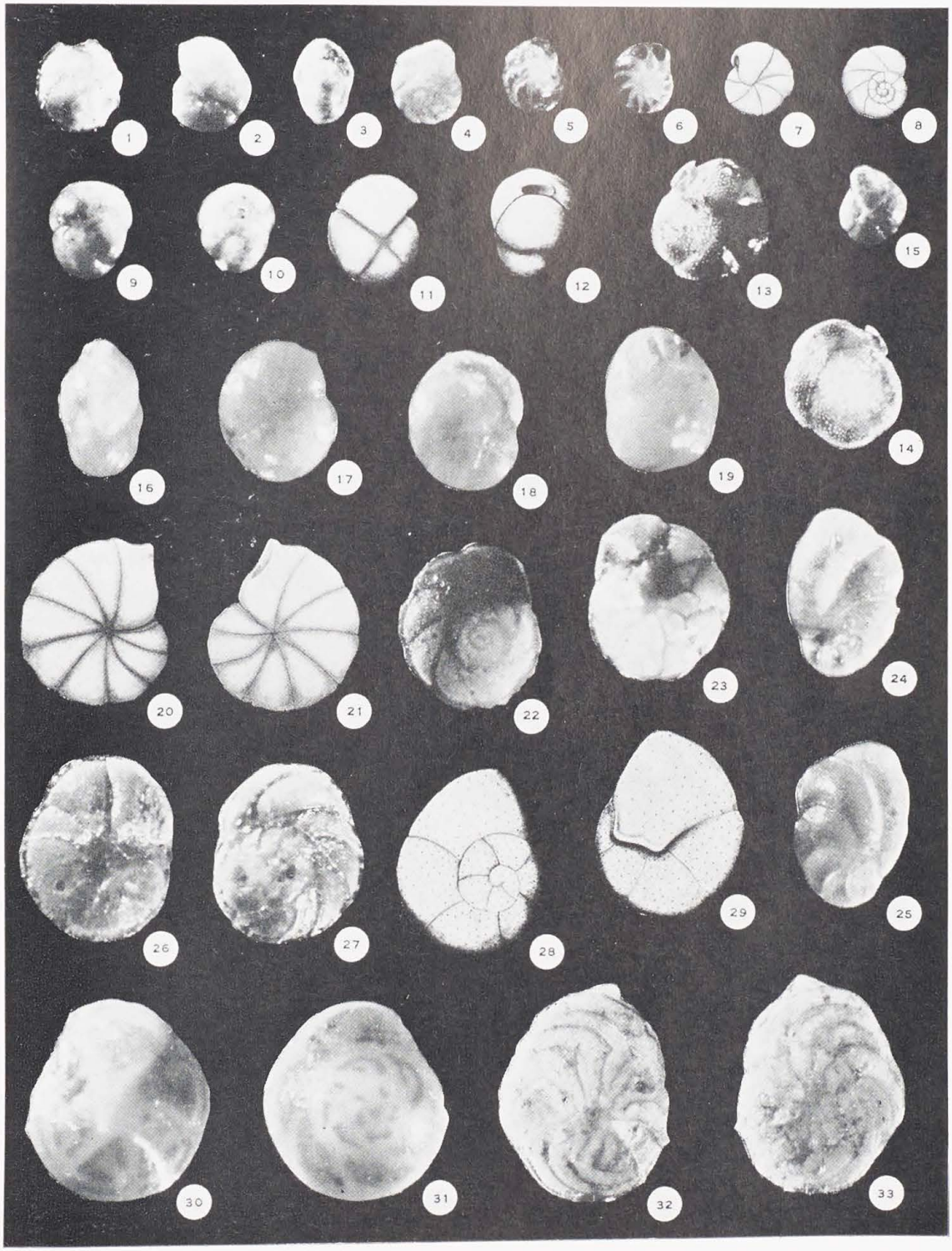
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PLATE XI

PLATE XII

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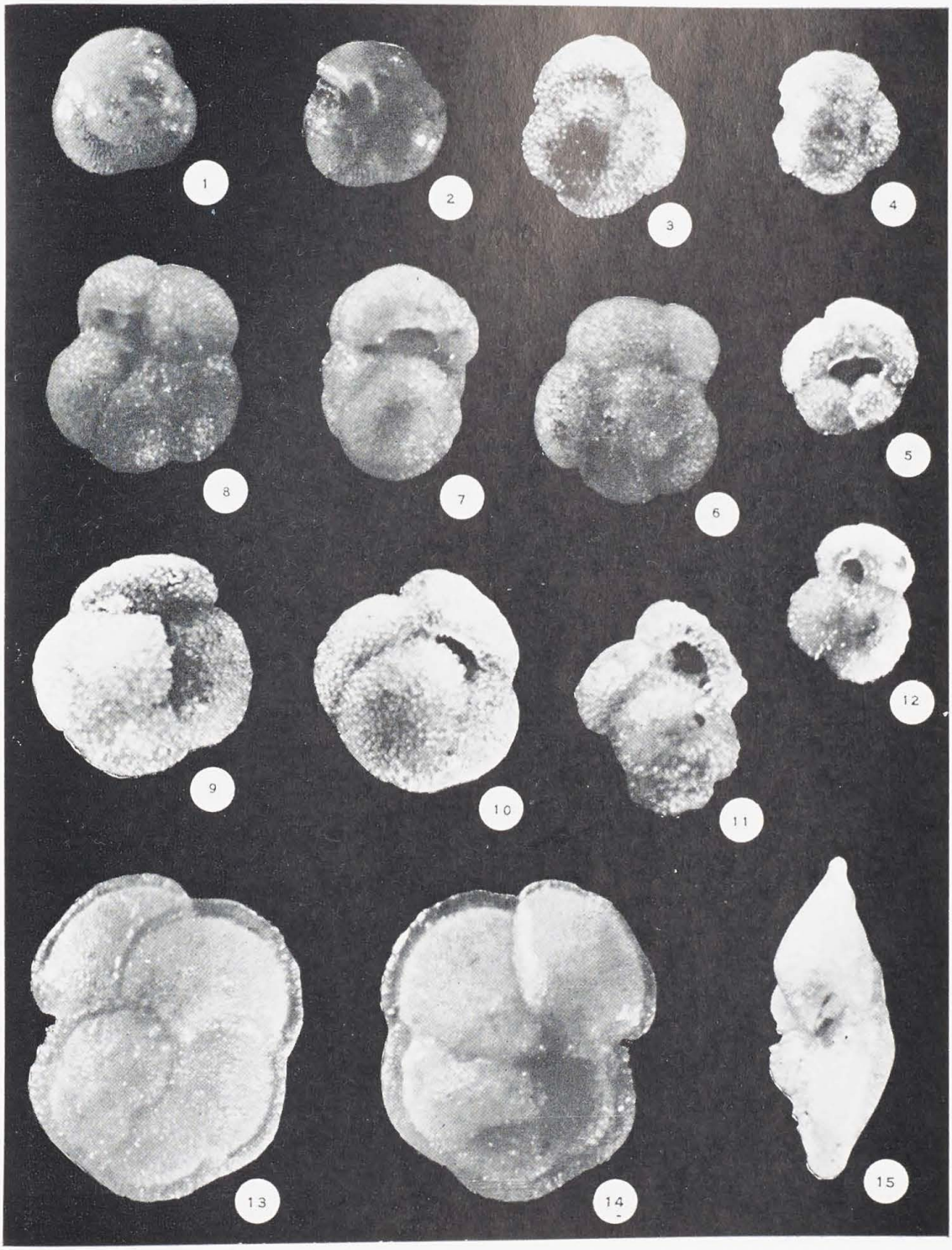

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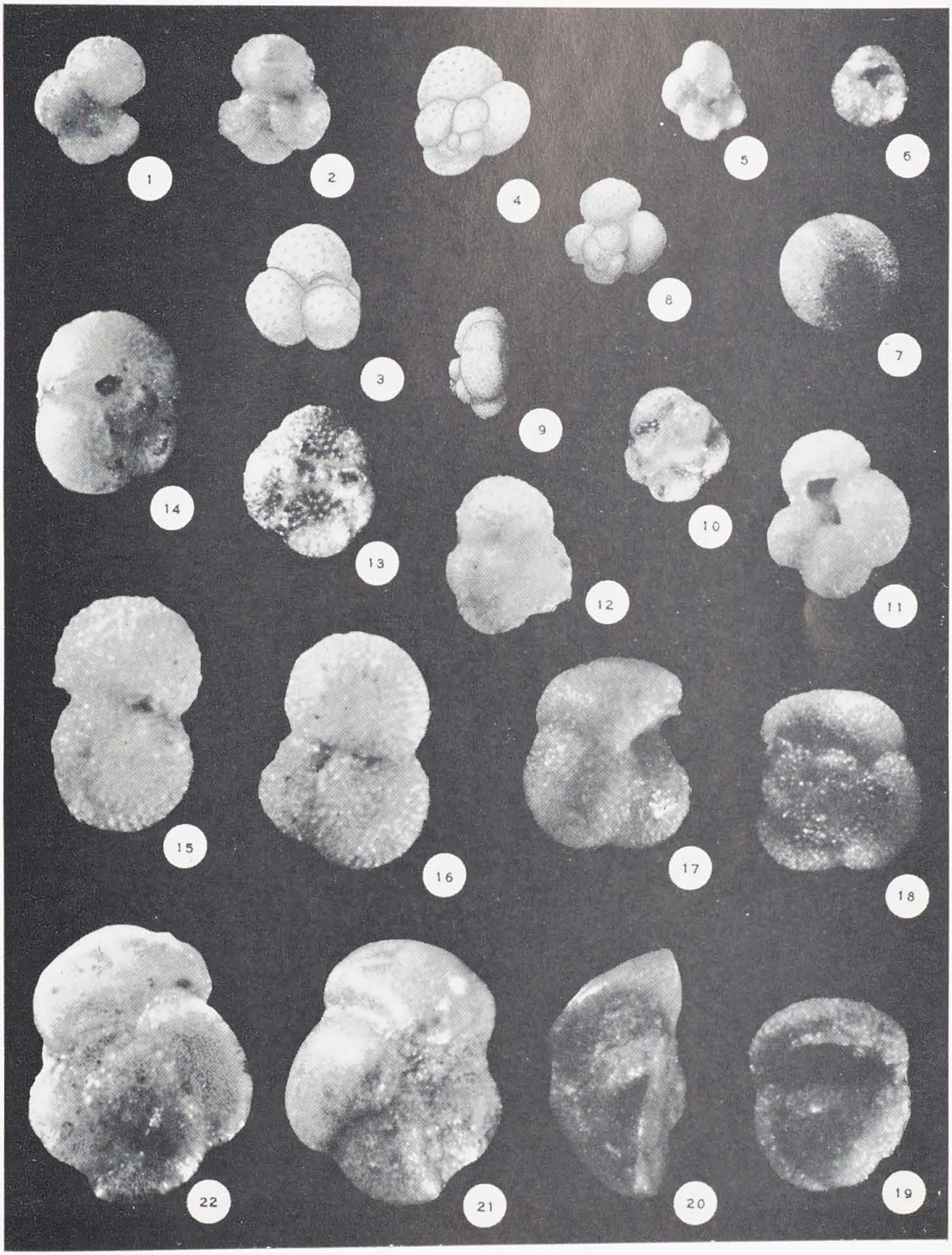

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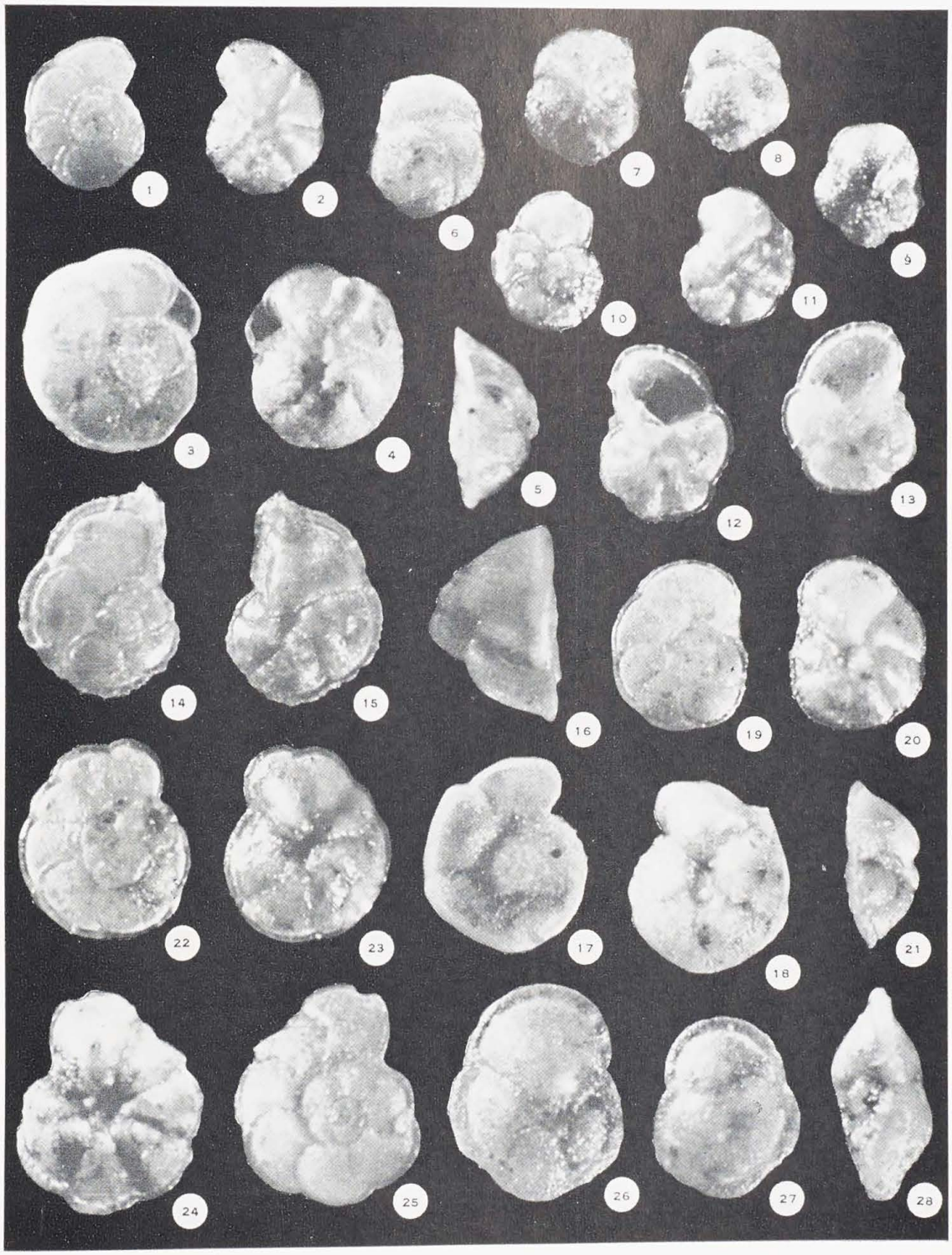

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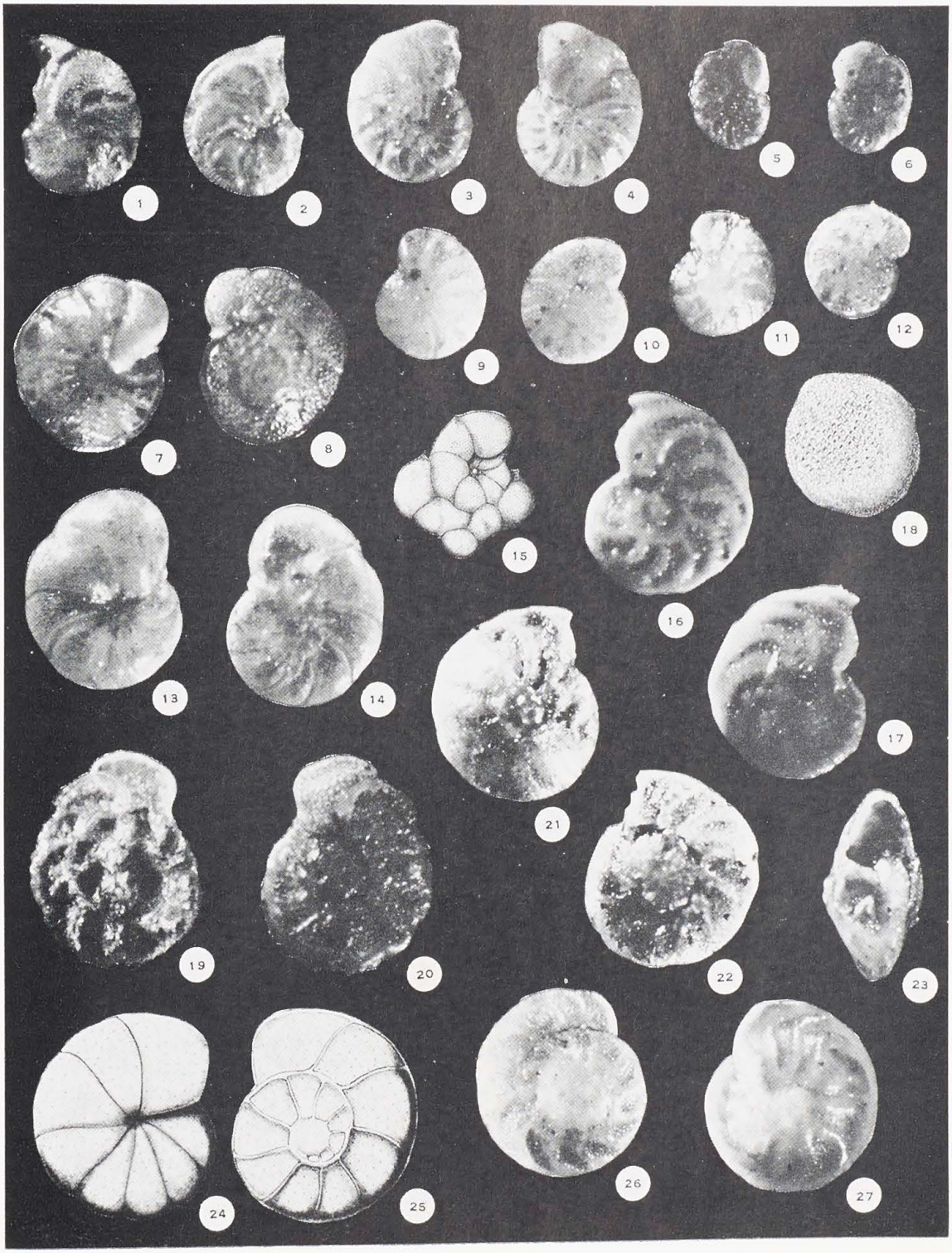

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