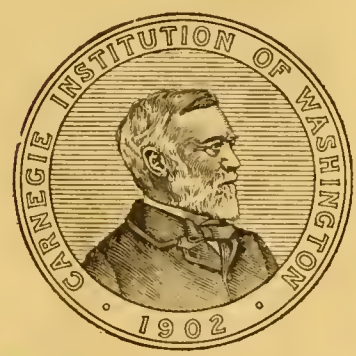
DEPARTMENT OF MARINE BIOLOGY
OF
THE CARNEGIE INSTITUTION OF WASHINGTON
ALFRED G. MAYOR, DIRECTOR

VOLUME XVII

SHALLOW-WATER FORAMINIFERA OF THE TORTUGAS REGION

BY

JOSEPH AUGUSTINE CUSHMAN



WASHINGTON, D. C.
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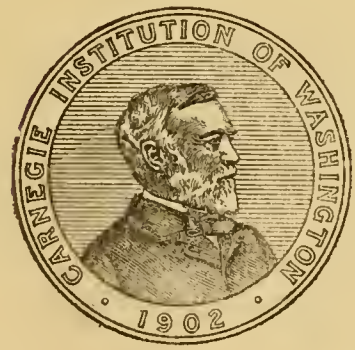

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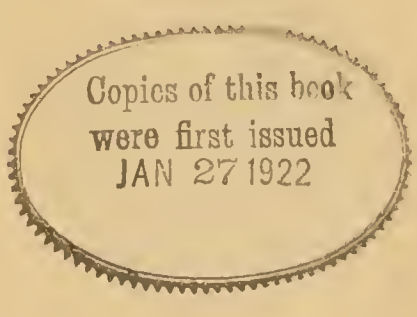

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CONTENTS.

SHALLOW-WATER FORAMINIFERA OF THE TORTUGAS REGION.

By Joseph Augustine Cushman.

INTRODUCTION.

The present paper gives the results of a study of collections made in the waters about the Tortugas Laboratory of the Carnegie Institution of Washington. The Dry Tortugas are a group of small keys well out from the Florida Coast; both in the lagoon which is formed by the group of islands and in the waters outside they afford a range of conditions of much interest. In general, the range of temperature was not great, due to the proximity of the mass of warm Gulf Stream water which sweeps by to the southerly side of the group. Within the limited area, however, varied ecological conditions were found which will be later noted and which seem to have a direct influence on the presence or absence of certain species in those places.

Collecting was done largely from the boats, the most satisfactory method that used with the *Darwin*. This is equipped with glass-bottomed wells, and it was possible in collecting on the reef areas to let the snapper down to within a short distance of the bottom, where in the clear water it could be easily seen at several fathoms; then, on passing over a suitable spot, free from corals, the gear was allowed to run and samples of the bottom were obtained before coral heads again came in the way. Collecting in the moat at Fort Jefferson on Garden Key and in shallow water on Long Key, as well as on the reefs and flats, was done by hand.

An opportunity was afforded of studying living forms. Results of these studies are also given here, some of them being of special interest as throwing light upon disputed problems.

I gratefully acknowledge the many courtesies shown me by Dr. Alfred G. Mayor, Director of the Tortugas Laboratory, in the carrying on of the work while at the Tortugas, and to the Carnegie Institution of Washington for the services of Mr. J. Henry Blake, who has so carefully drawn the figures on the plates in this report. The text-figures I have drawn myself.

The Tortugas region presents an ideal spot for studying the shallow-water tropical Foraminifera of this particular region. It is far removed from influence of shore conditions; the water is at all times warm and pure, so that ecological conditions that are present are constant. The shallow-water Foraminifera of the Gulf of Mexico

and Caribbean are very inadequately known. Except for d'Orbigny's classic work on the Foraminifera of the shore sands of Cuba and other West Indian Islands,[1] published in 1839, little has been published. Flint[2] in 1900 published on a few shallow-water samples from off Porto Rico. I have just published a paper on the Foraminifera obtained in a few samples from the north coast of Jamaica,[3] and a few short lists are given in Publication 213 of the Carnegie Institution of Washington, published in 1918. The present collection, therefore, is useful in giving information for a little-known region and the results have been interesting. Several genera are here recorded for the first time from the Atlantic, and the extension of ranges of others is considerable. A number of undescribed species were also obtained, as well as certain of the species originally described by d'Orbigny from the West Indian region and not since recorded.

An extension of the present work to include the deeper-water Foraminifera which occur in the adjacent region to the southward would undoubtedly prove of interest in the determination of the bathymetric ranges of many of the genera and species of the region. This would be of much use in the interpretation of the faunas of many of our Tertiary deposits of the Gulf Coastal Plain of the United States.

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[1] D'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères."
[2] Flint, Bull. U. S. Fish Commission, 1900.
[3] Proc. U. S. Nat. Mus., vol. 59, 1921.

OBSERVATIONS ON LIVING SPECIMENS.

MOVEMENT.

Specimens belonging to several families were kept under observation at different times. It was found in all cases, where no injury to the animal had taken place, that pseudopodia were thrust out within 5 minutes of the time of contraction. This was true of *Iridia* and *Haliphysema* in the Astrorhizidæ, *Discorbis* in the Rotaliidæ, *Polystomella* in the Nummulitidæ, and *Quinqueloculina*, *Orbiculina*, and *Orbitolites* in the Miliolidæ.

One observation of much significance, in view of the widespread view that individuals of various species or even genera may unite, seems to entirely disprove this theory. In all cases where specimens of the same species even were brought near enough to have their pseudopodia touch there was a repellant rather than an attractive action. The same was true of specimens of different species and those of different genera. While specimens were under observation, they occasionally altered their course abruptly. In such cases it was often found that the pseudopodia of the specimen under observation had come into contact with those of another. In all such cases the first specimen changed its direction, usually rotated the test somewhat, and started off in a new course, often 90° from that in which it was at first traveling.

Portions of the same specimen, however, when separated by cutting, threw out pseudopodia rapidly, and when those of one part touched those of the other they quickly anastomosed and the two masses moved toward one another and coalesced.

The rate of movement of the protoplasm in the pseudopodia was recorded in *Iridia diaphana* and *Orbitolites duplex*. The unit of measurement in all experiments was 10 units of the micrometer scale, which on the slide represented about 0.2 mm. As in the movement of the whole test, there is apparently a rhythmic movement instead of a constant one. In one specimen of *Iridia diaphana* the movement along the more slender pseudopodia was as follows for the return current—the rate in seconds for the 0.2 mm.

8, 8, 8, 9.6, 7.5, 10.2, 8 seconds.

The average of movement in the slender pseudopodia was about 40 seconds per millimeter. In large coalesced pseudopodia it was slower, averaging about 60 seconds per millimeter.

One group of records shows the rhythmic character in 10 successive units of 0.2 mm. each:

10, 8, 7.8, 8.4, 9.2, 10, 9.4, 9, 8.2 seconds.

A series of measurements of the pseudopodia in *Orbitolites duplex* gave the following for 0.2 mm. units:

12.8, 8.8, 9.2, 14, 12, 7.8 seconds.

In *Orbitolites duplex* the pseudopodia were very straight and slender, extending out rapidly to a distance equal to the diameter of the test. They are put out in groups of 3 to 12 from each of the marginal apertures of the test. There is very little coalescing in the pseudopodia of *Orbitolites duplex* in contrast with *Iridia diaphana*, where anastomosing is of usual occurrence. In *Orbitolites*, pseudopodia an inch in length were several times noticed. One specimen of *Orbitolites* was broken in being taken from a leaf of *Posidonia* and the two halves of the test were separated, leaving a clear space entirely across, after which pseudopodia were sent out from the entire periphery. In *Haliphysema advena* the pseudopodia were very slender and showed little tendency to join.

One important observation was that in the case of *Iridia diaphana* taken from *Posidonia* leaves and placed in Petri dishes over night. In the morning some of these were found to have left their test empty and were moving about as naked masses of protoplasm with a free and comparatively rapid movement. That the animal may leave the test and pass some time without one is very significant from the standpoint of the method of growth. Growth of the test in those species which have a single chamber has often been a subject of speculation. If the test can be abandoned at will and another secreted or made by collecting more material in the case of those which have agglutinated tests, this difficulty is solved, and we may also understand how various sedentary species can collect various materials which are not common for their tests. Given free movement and a power of discrimination, which seems to be a characteristic of certain species, it is not difficult to explain how such tests are made of one sort of building-material—spicules, mica flakes, ambulacral plates of brittle-stars, etc. The occurrence of specimens of *Iridia* on *Posidonia* some inches above the bottom, while its test is made of material from the bottom is also explained. The material could easily be carried up to this elevation while ingested in the moving mass of protoplasm, and then sent out to the surface when the animal settled down to build the test.

TABLE 1.

Minutes.	Seconds.	Minutes.	Seconds.	Minutes.	Seconds.	Minutes.	Seconds.
1	17	1	13	.....	54	.....	12
2	20	1	32	.....	50	.....	14
1	11	1	40	.....	40	.....	15
1	5	2	30	.....	26	.....	15
0	54	1	58	.....	24	.....	12
1	8	1	20	.....	19	.....	14

The movement of the whole animal without the test was observed and measured in *Iridia diaphana*, and with the test in *Discorbis*

sp.?, *Orbiculina adunca*, and *Orbitolites duplex*. In all observations a rhythmic movement was noted rather than a steady rate. Table 1 gives the rate for a specimen of *Iridia diaphana* which had left its test. The intervals of time for traveling one-sixth of a millimeter are for a continued movement which covered 4 mm.

Table 2 gives the rate of movement of a specimen of *Discorbis* during a short interval. The distance is again a unit of one-sixth of a millimeter.

TABLE 2.

Minutes.	Seconds.
....	50
1	10
1	30
1	43
2	5
1	32
1	38
1	22
1	2

TABLE 3.

Minutes.	Seconds.
1	50
1	40
2	10
2	..
2	4
1	30

TABLE 4.

Minute.	Seconds.
1	40
..	47
..	25.8
..	40.4
..	46.4

At the end of the period given above, the movement abruptly stopped, and it was found that the pseudopodia had come into contact with those of an *Orbiculina* in the same dish. Those pseudopodia in contact with *Orbiculina* gradually were withdrawn and movement was continued nearly at right angles to the previous direction. The test had been broadside down during the first movement, but with the change in direction the test itself was tilted on edge. Table 3 gives the rate of movement of a specimen of *Orbiculina adunca* during a short interval. The distance is in units of one-sixth of a millimeter.

Table 4 gives a few time-intervals for a short movement of the test in *Orbitolites duplex* for unit distances of one-sixth of a millimeter.

As a rule, it seems that specimens with very slender pseudopodia, such as are developed in *Orbiculina* and *Orbitolites*, have a comparatively slower movement than that in which the pseudopodia are thicker and there is a greater coalescence, as in *Iridia*.

In both *Orbiculina adunca* and *Orbitolites duplex* the pseudopodia are very slender, there is very little anastomosing, and the branching, when it occurs, is at a very acute angle. In *Orbiculina adunca* the pseudopodia are put out only from the apertures of the periphery. They are very numerous, and with the constant streaming motion soon bring in various kinds of foreign matter to the apertural border, covering it for some distance with a ring or band of such material.

In *Orbitolites duplex* a group of 3 to 12 pseudopodia are thrust out from each aperture.

COLOR IN LIVING SPECIMENS.

Most of the Miliolidæ, unless incrusted with colored sand-grains, have little color in dried tests. In the living state, however, there is often much color, due to different causes. In the Quinqueloculine group there is often a beautiful light-pink color in live specimens, due to the color of the protoplasm, as may be seen in that projecting from the aperture. This is often sufficient to color the whole test, especially with transmitted light.

In *Orbitolites duplex* there is usually a salmon-color in living specimens which do not have commensal algæ. The outer one or two annuli usually are filled with nearly colorless protoplasm. Often the general color is due to algæ, as will be noted later.

In the Rotaliidæ there is often a reddish-brown color, in the earlier chambers at least. Instead of being caused by the protoplasm alone, it seems in some species at least (see *Tretomphalus bulloides*, p. 42) to be due to a thin lining of colored material which is distinct from the calcareous wall of the test. In *Truncatulina rosea* there is developed a peculiar rose-red color which persists and colors nearly the whole test. A bright red color is also characteristic of *Homotrema*, which is abundant in the reefs. In the Globigerinidæ, especially in *Globigerina rubra*, there is again a distinctly rose color, especially in the early chambers.

Found with the *Homotrema* is a small crab with reddish spots of the same color as the *Homotrema*, the remainder of the carapace and legs of the color of the dead coral. The resemblance is very striking.

COMMENSAL ALGÆ.

The association of unicellular algæ with certain of the Foraminifera has been known for some time. There is evidently a commensal relation between the two, although the exact interrelations have not been definitely made out. In *Iridia diaphana* there are often great numbers of a small unicellular alga, somewhat fusiform in shape, of a brownish color, and about 0.006 to 0.007 mm. in length. These are usually associated with the pseudopodia in *Iridia*. When the pseudopodia are extended and active, nearly all the algæ are outside the actual test, and when quiescent they are apparently stored in the area at the peripheral portion of the central mass and in the radial canals.

In *Orbitolites duplex* there are bodies in the test, usually in the more central portions. These are brownish and completely pack the chambers, irregularly rounded and about 0.006 mm. in diameter. These are very different from the algæ noted in *Iridia*.

In the Philippine collections, green algæ were noted in great abundance in *Orbitolites* and *Cyclolypeus*, but no green ones were noted at the Tortugas.

DEVELOPMENTAL STAGES.

Too little attention has been paid to the study of the developmental stages in the Foraminifera. It has been denied by many authors that such stages as are seen in the tests of many of the multilocular Foraminifera have any significance. If, however, the developmental stages are studied and compared with what is known of the development of the particular group in the fossil series, a close relation will be found. This comparison is somewhat complicated by the lack of certain stages in the asexual or megalospheric forms. In the microspheric or sexual form, where the stages are most nearly complete, the comparison leads to a very close relationship between the ontogeny and the phylogenetic history of the group. It seems fair to say that if a careful study is made along these lines, a very complete classification can be developed in many of the families which will rest upon better ground than the present classification.

The Tortugas collection shows many interesting problems in developmental stages, but they will be considered in this paper only in an incidental way.

VARIATION.

Much of the so-called variation in the Foraminifera may be divided into groups. The first of these may be the differences due to the different stages in development and which are no more to be classed as variation than the differences in such molluscan shells as *Cypræa*, when the young is a coiled spire and the adult a greatly expanded chamber covering the whole early stages.

The second of these are the differences due to the two distinct forms, asexual and sexual, or megalospheric and microspheric. These differences should be taken into consideration in eliminating so-called variation. Differences due to these causes should strictly no more be classed as variations than the differences in sexual characters among the higher animals. The third group of characters show true variations. That is, actual size in adults, variations in ornamentation in adults (not in comparison of young and adult tests), and other like characters. When such characters alone are taken it will, I am very sure, be found that the actual amount of true variation in this group is relatively small.

An additional cause for much of the so-called variation is probably the failure of many authors to carefully divide species. A study of the Foraminifera from an area such as that of the western Atlantic from Newfoundland to the coast of Brazil shows that many faunas in the region have very definite limits, bathymetrically and geographically. Some species are very restricted in their distribution and others more widespread, exactly as in other groups of the animal

kingdom. A study of intensive collections from a restricted region like the Tortugas shows this, even in its limited area, as will be noted in detail later. When such collections from widely separated localities, as Samoa, the Philippines, New Zealand, and Hawaii, are studied, although of one great geographic fauna, the differences are even more marked. If this is still further extended to a study of Tertiary and Cretaceous, and even older deposits, the differences become greater, just as they do in all other groups of organisms.

DISTRIBUTION OF FORAMINIFERA OF THE TORTUGAS REGION.

The twenty stations from which bottom samples were studied in the preparation of this paper, together with collections from reef flats and from the eel-grass, give a considerable range of conditions. The bottom differs in depth and general character. It will be seen by a glance at the accompanying table of distribution (table 5) that at station 42, which was in 18 fathoms to the west of the Tortugas group, there are a number of species not found elsewhere. These are probably species from the deeper Gulf region to the westward. In shallow water in the reef itself, where the bottom is of coarse material and often disturbed, comparatively few species are found, and most of these with heavy, thick tests. From the "Drewite" bottom, with its quiet conditions, many delicate tests occur, belonging to species not found in such numbers elsewhere in the region. In the moat at Fort Jefferson, where the shallow water often becomes very warm, species are found not common in the deeper, somewhat cooler waters. According to Dr. Mayor, the temperature in the moat on July 23, 1911, rose to 32.8° to 33.3° C. The water in tide pools on the reef was as high as 33° to 38° C. At such temperatures many of the animals are killed.

With this information, it is of interest to note that the only stations at which *Rotalia* was found are two in the moat at Fort Jefferson on Garden Key and the other in a very shallow lagoon a few inches deep at Long Key nearby, where the water was warm to the hand at low tide in June. By most authors these specimens would ordinarily be referred without question to *Rotalia beccarii* (Linnæus). I have noticed, however, differences from northern material, and in all probability the Tortugas specimens belong to different species. The various species of *Rotalia* of this group are, however, in such poor shape that a study of specimens from various regions will give interesting results.

On the banks of dead coral which become exposed at spring tides great masses of attached Foraminifera develop. Of these, the most abundant is *Homotrema*, which makes an appreciable con-

tribution to the mass of material. With it, in crevices of the dead coral, was a new species of *Haliphysema*.

On the eel-grass (*Posidonia*), which forms considerable areas in shallow water inside the reef, there is an association of several species. *Iridia*, *Planorbulina*, *Discorbis*, *Orbitolites*, with a peculiar miliolid which spreads over the surface, form the greater number of these. The mass of these must add appreciably to the amount of carbonate of lime added to the bottom. The forms are rapid in their growth, as the leaves of *Posidonia* are quickly covered in their growth by Foraminifera and other incrusting animals.

RELATION OF THE TORTUGAS FAUNA TO THOSE OF OTHER REGIONS.

While at Key West, opportunity was taken to make two collections of bottom material among the keys. A comparison of these with the bottom samples from the Tortugas shows that some of the species common at Key West are not represented in the Tortugas collection. This shows the change even in this short distance. A comparison with the fauna of the north shore of Jamaica and that from the Bahamas shows differences in all these localities, although conditions of temperature, etc., are not great. It tends to show that the Foraminifera are not universally distributed, but even within a limited area have a definite distribution.

Many of the Tortugas species are closely related to those of the general Indo-Pacific region. Some of the genera in this collection are here recorded for the first time from the Atlantic. These are known from various parts of the Indo-Pacific in warm, shallow waters. Whether their distribution in the West Indian region is wide remains to be shown by further work. It is certain that in general the foraminiferal fauna of the Tortugas and that of the shallow water of the West Indian region also are much more closely related to the Indo-Pacific than to any other part of the Atlantic.

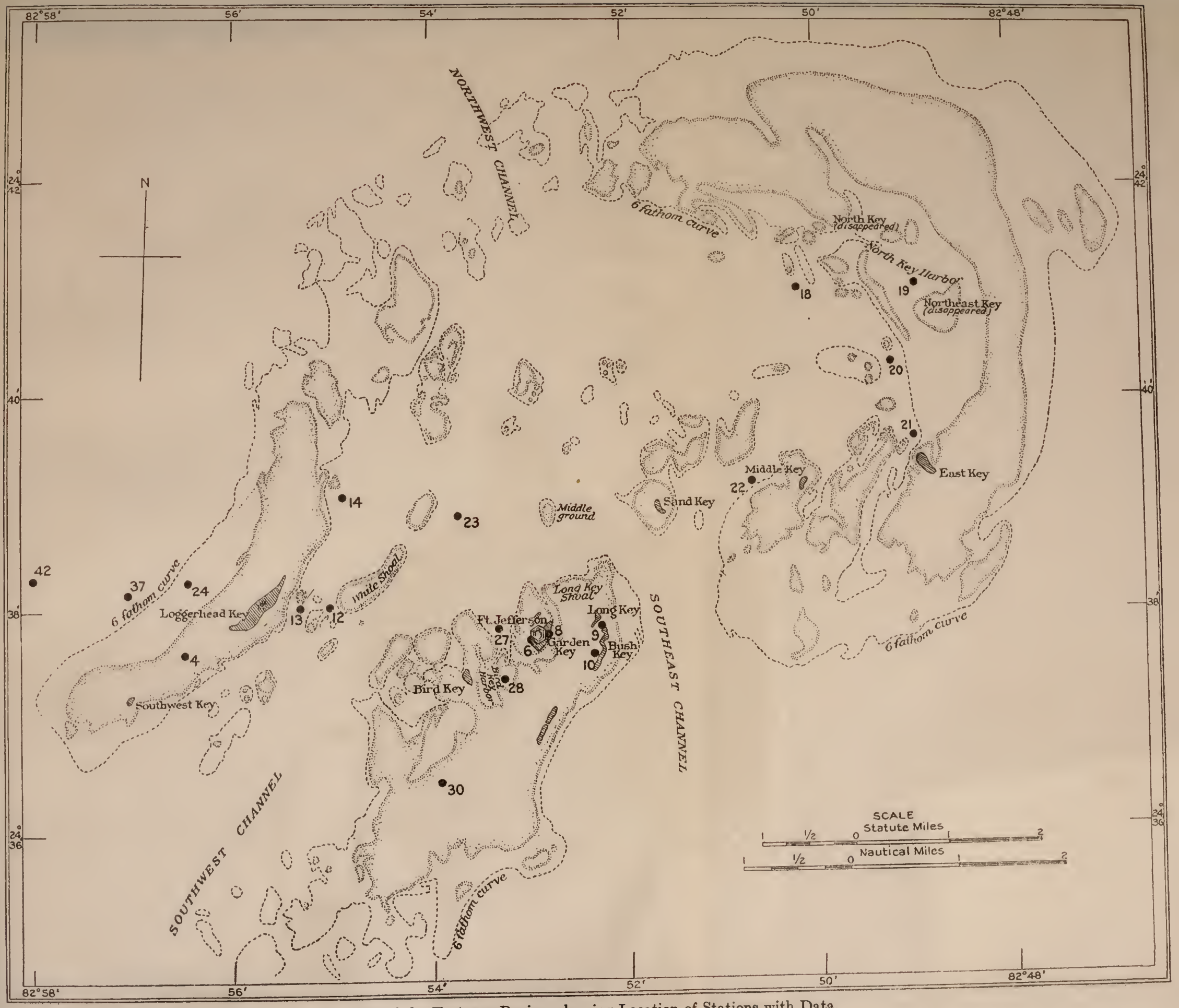
This fauna of the Tortugas is, again, more or less closely related to the fossil faunas of the Tertiary of the Coastal Plain of the United States. Some of the relations, especially with the Lower Oligocene of Mississippi and Alabama, are very interesting and will be made use of when the fauna of the Lower Oligocene is published.

STATIONS AND DATA.

While at the Tortugas, nearly 50 stations were occupied, and in most cases bottom samples were obtained. Of these, 20 were selected for detailed study, giving very well the varied conditions of the region from the warm, almost stagnant water of the moat at Fort Jefferson on Garden Key and the lagoon on Long Key to the quiet waters of greater depth, such as Bird Key harbor, the waters of the channels among the keys, and the open water outside the reefs. An extension into water of 50 or 100 fathoms would greatly increase the number of species, but the present list of species and varieties is very fair for such a limited region in shallow water. This compares with species from the north coast of Jamaica, although the latter represented a very few stations in comparison.

The accompanying map of the region shows the location of the stations given here, and also the data for these stations.


82°58'
24°
42'
40'
42
38'
6
24°
36'
82°58'



Map of the Tortugas Region, showing Location of Stations with Data.

Station No.

4. 1 mile southwest of southern end of Loggerhead Key, old bank of dead coral. May 16, 1919.
6. In the moat at Fort Jefferson, on Garden Key, in 4 to 5 feet of water; higher temperature than outside; muddy bottom. May 17, 1919. (See Tortugas papers for general hot, stagnant conditions.)
8. In the moat at Fort Jefferson, halfway around from the entrance; slightly weedy bottom. May 17, 1919. (Much fine material in washing.)
9. In the lagoon on Long Key, in 6 to 12 inches of water. May 17, 1919. (Water at low tide warm to the hand, stagnant.)
10. Middle of channel, upper end of Southwest Channel, between buoys N4 and C3; 11 fathoms; bottom temperature 23.2° C.; sandy bottom. May 19, 1919.
12. Between White Shoal and Loggerhead Key; 7 fathoms; bottom temperature 23° C.; hard bottom. May 19, 1919.
13. Between White Shoal and Loggerhead Key; 11 fathoms; bottom of fine sand. May 19, 1919.
14. 1 mile northeast of Loggerhead Key; 12 fathoms; bottom of fine sand. May 19, 1919.
18. Middle Key, bearing due south, Texas Rock bearing due west; 7 fathoms; bottom of fine white sand. May 19, 1919. (Many Foraminifera.)
19. Northeast Key Harbor; 5.75 fathoms; bottom of very fine, whitish sand. May 19, 1919. (Numerous Foraminifera, mostly Miliolidæ.)
20. 0.5 mile northwest of East Key; 7 fathoms; bottom of fine white sand. May 19, 1919. (Original sample, 120 c. c., washed through 80-mesh, leaving 10 c. c.)
21. 0.25 mile northwest of East Key; 6 fathoms; bottom of fine white sand. May 19, 1919. (Original sample, 62 c. c., washed through 80-mesh, leaving 48 c. c.)
22. 0.5 mile west of Middle Key; 6 fathoms; bottom of fine, white, soft sand. May 19, 1919. (Original sample 75 c. c., washed through 80-mesh, leaving 30 c. c.)
23. Between Middle Ground buoy and buoy N8 at north end of White Shoal; 10.5 fathoms; bottom of soft, muddy, white sand. May 19, 1919. (Original sample, 80 c. c., washed through 80-mesh, leaving 30 c. c.)
24. 0.5 mile northwest of Loggerhead Key light, inside main reef; 3.5 fathoms; bottom of coarse white sand. May 21, 1919.
27. Between Garden Key and Bird Key; 7 fathoms; bottom of soft white sand and mud (Drewite). May 22, 1919. (Original sample, 300 c. c., washed through 80-mesh, leaving 27 c. c.)
28. Bird Key Harbor; 4.75 fathoms; bottom of fine white sand. May 22, 1919. (Original sample, 150 c. c., washed through 80-mesh, leaving 30 c. c.)
30. 1.5 miles south of Bird Key; 2 fathoms; sand in pocket of reef. May 22, 1919.
37. 1.5 miles due west of Loggerhead Key light; 11 fathoms; bottom of fine sand. May 24, 1919.
42. 2 miles west of Loggerhead Key light; 18 fathoms; bottom of sand. May 25, 1919.

TABLE 5.

Species.	Station.																			
	4	6	8	9	10	12	13	14	18	19	20	21	22	23	24	27	28	30	37	42	M
Iridia diaphana	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	C
Haliphysema advena	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R
Ammobaculites reophaciformis	...	...	...	...	R	...	...	...	R	...	...	...	...	...	...	...	...	...	...	...	...
Trochammina advena	...	...	...	...	...	...	...	...	...	...	R	...	...	R	...	...	R	...	...	...	...
Carterina spiculotesta	...	...	...	...	...	...	...	...	...	...	...	...	R	...	...	...	...	...	...	...	...
Textularia agglutinans	C	C	C	F	C	C	C	C	C	C	C	C	C	C	F	C	C	R	C	C	...
candeiana	...	...	...	...	F	C	C	C	C	...	...	...	...	C	...	...	F	F	F	F	...
rugosa	...	...	R	...	...	...	...	...	...	...	...	...	...	...	R	...	...	R	...	...	...
mayori	...	...	...	...	...	...	...	R	...	...	...	R	...	R	...	...	...	...	R	R	...
floridana	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R	...
conica	...	...	...	...	...	...	...	...	...	...	...	...	...	R	...	...	...	...	...	R	...
Bigenerina nodosaria	...	...	...	...	C	A	A	A	A	A	A	A	A	A	...	A	A	F	C	C	...
Bolivina pulchella	...	...	...	...	...	...	...	...	R	...	...	R	F	...	...	...	F	...	R	R	...
compacta	...	...	...	...	...	...	...	...	...	...	R	...	R	...	...	...	...	...	...	...	...
limbata var. costulata	...	F	...	...	...	R	F	...	...	R	...	R	C	...	...	F	...	...	...	R	...

TABLE 5—*Continued.*

Species.	Station																			
	4	6	8	9	10	12	13	14	18	19	20	21	22	23	24	27	28	30	37	42	M
Bolivina mayori	...	...	...	...	...	...	...	R	C	R	R	R	R	R	...	...	...	...	...	...	...
striatula	...	...	R	...	...	...	...	...	R	R	R	...	R	...	...	...	R	...	R	...	...
rhomboidalis	...	...	...	...	...	...	...	...	R	...	...	...	...	...	...	...	R	...	...	...	...
Verneuilina spinulosa	...	...	...	...	...	...	...	...	R	...	...	R	R	R	...	R	...	...	F	R	...
Valvulina oviedoiana	...	R	F	C	...	...	...	...	...	R	...	...	...	...	F	...	...	R	...	...	...
Clavulina tricarinata	...	C	F	...	...	F	...	F	R	R	...	F	...	...	...	F	F	...	F	R	...
sp.?	...	...	...	R	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
nodosaria	...	...	R	...	...	...	...	...	...	...	...	R	...	...	...	...	R	...	...	...	...
Buliminoides williamsoniana	...	...	...	...	...	...	...	...	R	...	...	...	...	...	...	...	...	...	...	...	...
Virgulina punctata	...	...	...	...	R	...	R	R	A	A	A	C	A	F	...	A	A	...	F	C	...
Nodosaria (Glandulina) rotundata	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R	...
sp.?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R	...
Cristellaria sp.?	...	...	...	...	R	...	...	R	...	...	...	...	...	...	...	...	...	...	...	...	...
Polymorphina regina	...	...	...	...	F	...	...	...	...	...	...	...	...	R	...	...	...	...	C	C	...
pulchella	...	...	...	...	R	...	...	...	...	R	...	...	...	R	...	...	...	...	R	R	...
gibba	...	...	...	...	R	...	...	...	R	...	...	...	...	...	...	...	...	...	...	R	...
lactea var.	...	...	...	...	...	...	...	R	...	...	...	...	...	R	...	...	...	...	...	...	...
sp.?	...	...	...	...	R	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
sp.?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R	...
Uvigerina angulosa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R	...
Siphogenerina advena	...	...	...	...	...	...	...	...	F	R	R	R	...	R	...	F	...	...	...	R	...
raphanus	...	...	...	...	...	...	...	R	...	...	...	...	...	...	...	...	R	...	...	...	...
Globigerina bulloides	...	...	...	...	...	...	...	...	...	...	R	...	...	...	...	...	...	...	...	...	...
æquilateralis var.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R	...
dutertrei	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	F	...
rubra	...	...	...	...	R	...	...	...	...	...	F	F	...	F	...	...	...	C	...	F	...
Spirillina vivipara	R	...	R	...	...	...	...	...	...	...	R	R	R	...	...	R	...	...	...	...	...
vivipara var.	...	...	...	...	...	...	...	...	...	...	...	...	R	...	...	...	...	...	...	...	...
Discorbis orbicularis	F	F	F	...	R	F	R	F	R	C	C	C	C	...	...	F	F	...	...	...	...
mira	...	F	C	C	...	...	C	C	R	F	F	C	C	...	...	F	C	...	F	...	...
floridana	R	...	...	...	R	...	...	C	...	...	...	F	C	...	...	...	F	...	C	...	...
advena	R	...	...	...	R	R	...	R	...	R	C	F	C	C	...	R	C	...	F	...	...
auberii	...	...	...	R	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
subaraucana	...	R	R	...	...	C	C	C	C	C	C	C	C	C	...	F	C	...	...	F	...
Cymbaloporα squammosa	...	C	F	C	...	R	F	F	C	C	F	C	C	C	...	F	C	C	...	R	...
Tretomphalus bulloides	...	...	...	...	R	...	R	...	...	...	...	...	...	...	...	...	F	...	...	...	*C
Planorbulina acervalis	R	...	...	...	...	R	C	R	R	F	...	R	C	...	...	R	R	...	...	...	...
mediterranensis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	R	...
Truncatulina rosea	R	A	A	A	...	F	...	...	R	F	R	C	C	F	A	F	F	C	F	...	...
candeiana	C	R	R	...	F	C	F	C	F	C	C	C	A	...	R	F	F	...	C	R	...
antillarum	...	...	...	...	...	...	...	...	...	...	...	...	...	F	...	...	...	...	...	C	...
cora	...	...	...	...	...	...	...	...	...	...	...	R	C	...	...	...	C	...	...	...	...
advena	...	...	...	...	...	R	...	...	R	...	F	F	F	...	R	...	...	...	F	...	...
Siphonina pulchra	...	...	...	R	...	...	R	R	...	R	...	F	F	F	...	R	F	...	F	...	...
Anomalina edwardsiana	...	R	...	...	...	...	F	...	...	...	...	...	R	F	...	...	...	...	...	F	...
ammonoides	...	...	...	R	...	...	...	...	...	...	...	...	...	...	...	...	R	...	...	...	...
Pulvinulina menardii	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	F	...	...
incerata	...	...	...	...	...	...	...	...	...	...	...	...	...	R	...	...	...	...	...	C	...
repanda	...	R	...	...	...	R	C	...	...	...	...	R	R	R	C	...	R	R	R	R	...
semipunctata	...	...	...	...	...	...	...	...	...	...	...	R	R	...	...	...	R	...	...	R	...
Rotalia beccarii	...	C	C	R	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Homotrema rubrum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	C
Asterigerina carinata	C	F	C	C	A	C	A	A	C	C	C	A	A	A	C	R	C	C	C	C	...
Nonionina grateloupi	...	...	...	...	F	C	F	C	C	C	C	C	C	F	...	C	C	...	F	F	...
Polystomella poeyana	...	...	R	...	F	R	F	F	C	C	C	C	C	C	...	C	C	F	C	C	...
discoidalis	...	...	...	R	C	R	F	C	C	...	C	F	C	C	...	...	R	R	C	R	...
macella var.	...	...	R	R	...	F	...	...	...	F	...	F	F	...	...	...	R	...	...	...	...
advena	...	...	...	...	...	...	...	F	F	...	F	F	...	...	...	...	...	...	F	...	...
Amphistegina lessonii	...	C	C	C	R	C	A	F	...	F	F	C	C	A	A	F	F	C	C	C	...
Heterostegina antillarum	...	...	R	R	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cornuspira involvens	...	...	...	...	R	R	...	C	F	F	C	C	F	...	...	C	F	...	...	R	...
Nubecularia antillarum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	C
Nodobacularia tibia	...	...	...	...	...	R	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Fischerina dubia	...	...	...	...	...	...	...	...	...	...	R	R	R	...	...	...	...	...	...	...	...
Spiroloculina grateloupi	...	...	...	...	...	R	...	...	...	R	...	...	...	R	...	F	...	...	...	F	...
plaoulata	...	...	...	...	...	F	...	...	...	R	...	R	R	...	...	...	...	...	...	...	...
ornata	...	R	...	...	R	...	...	...	R	R	...	F	R	...	...	...	R	...	...	...	...
eximia	...	...	R	R	...	...	R	F	...	...	R	...	...	R	...	F	R	...	...	R	...

* From tow net.

TABLE 5—*Concluded.*

Species.	Station.																			
	4	6	8	9	10	12	13	14	18	19	20	21	22	23	24	27	28	30	37	42	M
Spiroloculina caduca								F					C								
antillarum		F	C	F	R		R	C	R	F	C	C	C	R		F	R				
antillarum var. angulata							F	F	F	R	F	C	C				F			F	
arenata	F				R	F	F	C	C	F	F	C	C	R		R	C			R	
Planispirina auriculata								R									R				
Vertebralina cassis					R				C	F	C	F	C		F				F	C	
var. mucronata	C		F	F	C	C	C	C	C	C	C	A			R	R	F	F	C		
Quinqueloculina agglutinans	F	A	A	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
bidentata			F		R	R	R						F	F		F	F				
alveoliniformis											R	R	R		R		R	F		R	
lamarckiana						A	A	A	C	F	C	C	C	A	F	C	C	R	C	A	
lævigata					R		F	C	C	C	C	F	C			C	C		C	C	
candeiana					F		R							F		C				F	
collumnosa												C	C								
poeyana						R		R	R	C	C	C	C			F	F				
subpoeyana		C	R		F	F	F	F	F		C	F	C	C		F	F		C	C	
costata			C							R											
striata						R															
funafutiensis						R			F	R	F										
bradyana		F					C		R		F	F	C								
tricarinata			F			R	F					F			C			F	R		
cf. kerimbatica var. philippinensis					R	R		R													
parkeri var. occidentalis							R						R								
polygona							F	F	C	C	C	C	C	C		F	C		C	F	
dilatata											R									R	
Massilina crenata								R			R								R		
alveoliniformis								R						R					R		
Articulina sagra					R	R			F			R	F								
mexicana															A				R		
lineata								R	R	R	R	R								R	
antillarum									C	F			F			C	F				
mayori													R			R					
Hauerina bradyi			R		R	R	R	R		R		R	R			R	R	R	R	F	
ornatissima	R								R							R	R				
Triloculina trigonula	R				R				C	F		R	R	C		F	F			R	
tricarinata									R										F		
oblonga			F	C	F	R	C	C	C	F	C	C	F			F	C	R	C	F	
circularis		R	R	F	F	F	F	A	A	A	A	A	A	F		C	C	F			
rotunda	C	C	C	R	F	F	R	C	F	F	F	C	C	F	F	F	R	R	F	F	
gracilis					R						R					R	R				
transversestriata								R		R											
planciana	R	F		F		F		C	F	C	F	F	C	R		F	F	F	F		
fichteliana						R		F	F	F	F	R	F						R	R	
carinata	R	C	F		C		F	F		R		C	F	F	C		R	F			
linneiana	F	R	F	F	R	C	F	C				F	F		R	R		C	C	F	
quadrilateralis	F	C	C	R	C	F	F	F	C	C	C	C	C	F		C	C	R	F		
bicarinata					F	F	F		R		R			F	R				R	R	
labiosa					R	F	R	F	F			F	F				F		R		
Biloculina subsphærica	C	F		F	C	F	C	C	C	C	C	C	C	C		C	C	F	C	F	
millettii											R										
denticulata	R	F	R	R		C	F	C			R		F	C		R		F	F	C	
var. striolata								R	R			R			R				R		
Peneroplis pertusus						R						C	C								
carinatus													C	C							
planatus						F		F			C	C	C	C		C	F	F	F	F	
proteus		C	C	F	F	F		C	C	F	F	C	C	C	F	C	C		C	C	
arietinus								R													
cylindraceus												R	R								
discoideus									C										C	F	
Orbiculina compressa					C	C	R	C	C	C	C	A	C	A		C		R	C	R	
adunca	C	A	A	C	C	F	R	C	C	C	F	C	C	C	C	C	C	C	A	C	
Orbitolites duplex		C	R	F	R	R	R	C	F	C	R	A	C			C	C	R			
Alveolina pulchra		R																C			
Monalysidium polita									R			R	R			R	R				

Family ASTRORHIZIDÆ.

Genus IRIDIA Heron-Allen and Earland, 1914.

Iridia diaphana Heron-Allen and Earland.

Iridia diaphana Heron-Allen and Earland, Trans, Zool. Soc. London, vol. 20, 1914, p. 371, pl. 36; 1915, p. 607.—Cushman, Proc. U. S. Nat. Mus., vol. 57, 1920, pp. 153–158, pls. 19 to 21.

Test attached, composed of an upper convex surface of agglutinated sand-grains and a ventral thin, transparent, chitinous layer; periphery of test flattened, containing numerous radial canals from central cavity to exterior. Diameter of the Tortugas specimens up to 5 mm.

Attached to various objects there are specimens which are referred to this species, described by Heron-Allen and Earland from the Kerimba Archipelago, off the eastern coast of Africa. These are most usually found attached to the broad leaves of *Posidonia*, which covers the bottom in shallow water in various places.

Numerous observations on the living animal were recorded from the Tortugas in the paper above referred to (Cushman, 1920). The association of unicellular algæ with this species has been noted in the introduction of this paper.

Genus HALIPHYSEMA Bowerbank, 1862.

Haliphysema advena, new species.

Haliphysema tumanowiczii Moebius (not Bowerbank), Meeresfauna Insel Mauritius, 1880, p. 72, pl. 1; pl. 2, fig. 1.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 611.—Cushman (in part), Bull. 104, U. S. Nat. Mus., pt. 1, 1918, p. 87.

Test attached by a spreading base, main body cylindrical, the distal end capitular, subspherical, with a radiating mass of acerose sponge-spicules from a base of amorphous fine material; wall of cylindrical portion of broken sponge-spicules arranged generally lengthwise of the column, those of the base irregular with numerous sand-grains, tubular body about 10 times as long as diameter, the enlarged distal end about twice the diameter of tubular body. Length of whole test, exclusive of the spicules of the crown, about 6 mm.; diameter of cylindrical body 0.4 mm.

Specimens including the one here figured were found on the underside, or in cavities, of worn coral masses on the banks near Long Key.

This species is interesting in its relations to other already described species of 2 genera. From its enlarged base and expanded top it is evidently a species of *Haliphysema*, differing specifically from either *H. tumanowiczii* Bowerbank or *H. ramulosum* Bowerbank. It is evidently, from a comparison of the figures, close to or identical with the species figured by Moebius from Mauritius. Heron-Allen and Earland, at a nearby locality, the Kerimba Archipelago, off the eastern coast of Africa, record the species, noting the resemblance of their specimens to the figures of Moebius. The specimen I have noted from the Caribbean is probably the same. The specimen here figured from the Tortugas, in shallow water, is very evidently close to the specimens of Moebius. These are different from the typical clavate form of *H. tumanowiczii* Bowerbank from the British

Isles. There are, therefore, one or more tropical species of the form described here in both the Indo-Pacific and the West Indian regions. In general it may be said that the faunas of these two regions are much more nearly allied than are either of them to the fauna of the British Isles.

In the living specimens which I had under observation it was noted that the pseudopodia followed out the spicules of the "capitulum" and then off into the water, while others came out apparently through interstices of the cylindrical part. The pseudopodia were all very fine and clear, with few branches and little anastomosing, as shown by Moebius in his figures. The spicules of the "capitulum" were variously placed, some with the point of the spicules out, others with a rounded end outward. These spicules were usually entire and more or less covered by a film of foreign material, evidently brought in by the contracting of the pseudopodia. In the specimen figured (fig. 1), an appendage of a copepod had been inserted among the spicules and extended out to several times the length of the spicules. Moebius (loc. cit., pl. 1, fig. 4) shows a specimen with a peculiar body standing up above the spicules.

In this connection it seems fitting to call attention to the observations of Heron-Allen and Earland on *Marsipella cylindrica* H. B. Brady (Journ. Roy. Micr. Soc., 1912, p. 388). They show there that a specimen from the Faroë Channel found by Earland had a capitular end very similar to that figured here. It may be questioned whether that specimen is really "the perfect organism" referred to by the authors, or whether it may not have originally had a base and been really a species of *Haliphysema*. In short, is not *Marsipella cylindrica* H. B. Brady really *Haliphysema cylindrica* (H. B. Brady)? Instead of modifying Norman's original description of *Marsipella* to include the capitular head and cylindrical body, it seems very probable that a base will later be found for the *Marsipella cylindrica*. The type species of *Marsipella*, *M. elongata* Norman, is evidently a very different organism from *M. cylindrica*, the fusiform shape of *M. elongata* and the tapering necks at either end from a body composed largely of sand-grains making it seem in its general relations very different from that found by Earland.

FIG. 1.—*Haliphysema advena*, new species. ×25. Showing general outline of specimen, a broad basal portion, slender cylindrical column, and capitular "head." The long, projecting body is an appendage of a copepod which was used among the usual sponge-spicules.

Family LITUOLIDÆ.

Genus AMMOBACULITES Cushman, 1910.

Ammobaculites reophaciformis Cushman.

(Plate 1, Figure 1.)

Haplophragmium agglutinans H. B. Brady (part, not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 32, fig. 22 (not 19 to 21, 23 to 36).

Ammobaculites reophaciformis Cushman, Proc. U. S. Nat. Mus., vol. 38, 1910, p. 440; Bull. 104, U. S. Nat. Mus., pt. 2, 1920, p. 67, pl. 13, fig. 6; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 49.

Test elongate, tapering, early portion consisting of a few chambers planospirally coiled and much compressed, making up but a small portion of the test, later and by far the larger part uncoiled, forming a straight linear series, circular in transverse section, and progressively increasing in size, the last-formed one being the largest; chambers fairly distinct; sutures slightly depressed; wall composed of angular fragments, smoothly finished; aperture circular, terminal, simple, occasionally with a slight neck; color usually white or gray.

Length of the Tortugas specimens hardly more than 1 mm.

This species, which might be expected to be fairly common in this shallow-water coral-reef region, has been found to be surprisingly rare here. Single specimens were obtained at only 2 of the 20 stations. This seems all the more noteworthy, as it occurs at a number of stations in the West Indies, and such conditions as prevail in the Tortugas region would seem to be ideal for its development.

The specimen figured is very typical, showing the early coiled portion and the more or less pyriform chambers of the uncoiled part, gradually increasing in size toward the end. The only figure referred to above from the *Challenger* Report seems to represent this species, which should not be confused with *Ammobaculites agglutinans* (d'Orbigny).

The species is known also from the Hawaiian Islands and westward across the Pacific, at least to the Philippine region.

Genus TROCHAMMINA Parker and Jones, 1860.

Trochammina advena, new species.

(Plate 1, Figures 2 to 4.)

Test small, composed of about 2.5 volutions, unequally biconvex, the dorsal side much more flattened than the ventral, the final whorl composed of 4 chambers, more or less inflated; sutures slightly depressed; wall composed of sand-grains, apparently of quartz, with a considerable amount of light grayish cement; the surface rather smooth, whole test umbilicate below; the aperture at the inner margin of the final chamber short, rounded, with a very slight overhanging lip; color gray.

Diameter up to 0.45 mm.

The three stations from which specimens were obtained are all within the lagoon, and range from 4.75 to 10.5 fathoms. The bottom in all three stations is a fine white sand, mostly of calcareous

origin, and the fact that the wall in this species is composed almost entirely of quartz grains shows the selective power of the organism. A considerable amount of bottom sand must be gone over by the animal before a sufficient amount of quartz grains can be obtained for the making of the test. The specimens are very uniform in size, shape, and general characters, and are to be looked for under shallow-water tropical conditions elsewhere. It differs from the species which I have found in the Gulf of Mexico and in the Caribbean in deeper water.

Genus CARTERINA H. B. Brady, 1884.

Rotalia Carter (in part), Ann. Mag. Nat. Hist., ser. 4, vol. 20, 1877, p. 470.
Carterina H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 345.—Chapman, The Foraminifera, 1902, p. 152.

Test rotaliform, biconvex, of numerous chambers, those of the dorsal side all visible, from the ventral side only those of the last-formed coil; umbilicate; wall composed of numerous oval spicular bodies, elongate, rounded, or pointed at the ends; aperture ventral, opening on the umbilicate area.

This genus is represented by the single species *Carterina spiculotesta* (Carter). This has been placed with the Lituolidæ, although the test is entirely a secreted one and not dependent on the outside bodies for its formation.

Carterina spiculotesta (Carter).

(Plate 1, Figure 5.)

Rotalia spiculotesta Carter, Ann. Mag. Nat. Hist., ser. 4, vol. 20, 1887, p. 470, pl. 16; ser. 5, vol. 3, 1879, p. 144; ser. 5, vol. 5, 1880, p. 452.
Carterina spiculotesta H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 346, pl. 41, figs. 7 to 10.—Millett, Journ. Roy. Micr. Soc., 1899, p. 365.—Chapman, Journ. Linn. Soc., Zool., vol. 28, 1900, p. 184.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., 1905, p. 6, pl. 1, fig. 10.—Heron-Allen and Earland, Trans. Linn. Soc., Zool., vol. 20, 1915, p. 620.

Test normally adherent, rotaliform, biconvex, the dorsal side rounded, ventral side slightly rounded, flattened or concave in the central portion, umbilicate, composed of 3 or 4 volutions, the earlier ones regular, the later ones becoming irregular; chambers distinct; walls thin, translucent, composed largely of fusiform calcareous spicules, with a calcareous cement; aperture small, at the umbilical margin of the ventral side of the last-formed chamber, with a slight lip; color of the central part dark brown, the later-formed portion white.

Diameter of the Tortugas specimen 0.50 mm.

This species, which heretofore has been recorded only from the Indo-Pacific region, has occurred as a single specimen from station 22, in 6 fathoms. The specimen is referred to this species, and is composed almost entirely of the peculiar fusiform spicules so characteristic of this genus. The species seems usually to be attached to *Halimeda*, and it may be much more common in this region than the single specimen indicated, if it had been looked for under such conditions.

There is a tendency to strengthen the very thin test by the building of supporting interior walls. In this specimen there is usually a single long wall across the chamber, with secondary ones at the sides, but on the final chamber there are at least two long walls, besides the supplementary ones. The spicular bodies are rather uniform in size, on the ventral side running more or less parallel to the margin, while on the dorsal side they are more nearly radial. The aperture is small, at the ventral border of the chamber, and has a slight projecting lip above it, of about the width of two of the spicular bodies. Our specimen is very nearly free from any foreign material, the spicules being neatly cemented and forming practically the entire wall of the test.

This is one of the interesting finds of the collection, giving an Atlantic record for this hitherto Pacific species. It is unknown in a fossil condition, and is now known from the Pacific from Funafuti (Chapman), the Malay region (Millett), the South Pacific and the Gulf of Manaar (Carter), the Gulf of Suez (Brady), the Kerimba Archipelago off southeastern Africa (Heron-Allen and Earland), and the Mediterranean (Sidebottom).

Family TEXTULARIIDÆ.

Genus TEXTULARIA Defrance, 1824.

Textularia agglutinans d'Orbigny.

(Plate 1, Figure 6.)

Textularia agglutinans d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 136, pl. 1, figs. 17, 18, 32 to 34.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 49, pl. 11, figs. 1 to 3.

Test elongate, tapering from the subacute base to the broadly rounded aperteral end; chambers numerous, inflated; sutures depressed; in side view chambers wider than high; wall arenaceous, but rather smoothly finished; aperture an elongate, somewhat arched, opening at the inner margin at the base of the last-formed chamber; color white.

Length of the Tortugas specimens up to 1 mm.

Textularia agglutinans has occurred at nearly all the Tortugas stations, usually in considerable numbers. There seem to be two forms of this species—a microspheric form in which the total length is greater and the early development commencing with smaller chambers, so that the initial end is pointed and tapering, and a megalospheric form which is more bluntly pointed at the end, not nearly so tapering, shorter, and of fewer chambers. D'Orbigny's specimens were much like those shown in plate 1, figure 6. He gives 1 mm. as the length of these specimens. They were from Cuba, St. Thomas, Martinique, and Jamaica. I have already recorded the species from shallow water from the north coast of Jamaica, and it is doubtless common in such habitats in the Gulf of Mexico and the Caribbean region.

A glance at the figures in the literature referred to this species will show that the name has been very loosely used, and many of the specimens to which it has been referred are very different from the types.

Textularia candeiana d'Orbigny.

(Plate 2, Figure 2.)

Textularia candeiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 143, pl. 1, figs. 25 to 27.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 12, figs. 14 to 17 (in text); Proc. U. S. Nat. Mus., vol. 59, 1921, p. 50, pl. 11, figs. 7, 8.

Test elongate, tapering rapidly from a very small pointed initial end to the broad, swollen apertural end; chambers numerous, distinct; sutures slightly depressed, oblique; wall arenaceous, early portion especially more or less roughened; aperture an elongate arched slit at the base of the inner margin of the last-formed chamber, with an overhanging lip; color white.

Length of the Tortugas specimens 1 mm., or slightly more.

The Tortugas specimens of this species are much more nearly typical than those which I have figured from off the Hawaiian Islands and more so than any of the other figures referred to this species. The species is common at a number of the stations and is easily distinguished from *T. agglutinans* by the rougher surface, lower chambers, and the rapidly increasing breadth and thickness toward the apertural end. D'Orbigny originally described it from Cuba, Martinique, and St. Thomas, and I have recorded it from Jamaica as well as from the Hawaiian Islands and the East Indian region.

Textularia rugosa Reuss?

(Plate 2, Figure 1.)

There are a very few specimens of a large, stout species, one of which is figured here (plate 2, fig. 1). In this species, especially in the later-formed portion, the basal part of the chambers is excavated, somewhat similar to *Textularia rugosa* Reuss. This species, however, has not been found to be characteristic of the West Indies, as it is of the Philippines and the East Indian region. This material is too scanty to definitely determine what the relationships of this form are. The others do not show the reëntrants as definitely.

Textularia mayori, new species.

(Plate 2, Figure 3.)

Test compressed, increasing rapidly in breadth, initial end rounded, apertural end obliquely truncate; surface fairly smooth; chambers rather indistinct; sutures slightly depressed; periphery of each chamber with an elongate, conical, spinose projection, often broken at the tips, those of the early portion directed backward, the later ones extending straight outward; wall arenaceous, of angular sand-grains with much fine cement; aperture very low, elongate, at the inner border of the last-formed chamber, in a reëntrant of the border, with a thin lip above; color gray.

Length up to 0.80 mm.

This species occurred at 5 stations in the area, usually those of greater depths. I have failed to find it in other material from the West Indies or Caribbean, although it is a striking form and could hardly be overlooked. With its peripheral spines it resembles such species as *T. carinata* d'Orbigny, *T. horrida* Egger, and *T. sagittula* Defrance var. *fistulosa* H. B. Brady, but is different from any of these.

It is named in honor of Dr. Alfred G. Mayor, Director of the Tortugas Laboratory of the Carnegie Institution of Washington.

Textularia floridana, new species.

(Plate 1, Figure 7.)

Textularia transversaria Flint (not H. B. Brady), Rep. U. S. Nat. Mus., 1897 (1899), p. 283, pl. 28, fig. 4.

Test elongate, two to three times as long as wide, much compressed, periphery acute, the ends of the chambers forming tubular projections, but often broken, showing a truncate or concave area which is hollow; the initial end rather sharply pointed, the apertural end broadly rounded; chambers numerous, thickest near the center, increasing somewhat in height toward the apertural end; sutures indistinct, slightly if at all depressed; wall finely arenaceous, smooth; aperture small, rounded, at the base of the inner margin of the last-formed chamber.

Length slightly more than 1 mm.

There is a single specimen of this species from station 42, in 18 fathoms. It is very typical and like those collected from off Florida. From the other records, it is evidently not a species of very shallow water, and this may account for its rarity in the Tortugas collection. There are records for its occurrence as far north as the coast of South Carolina.

Textularia conica d'Orbigny.

(Plate 2, Figure 4.)

Textularia conica d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 143, pl. 1, figs. 19, 20.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 365, pl. 43, figs. 13, 14, pl. 113, fig. 1.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 50, pl. 11, figs. 4 to 6.

Test usually wider than high, triangular in front view, broadly oval in end view, slightly compressed, the apex bluntly pointed; chambers comparatively few, distinct; sutures distinct, slightly depressed; wall arenaceous, smooth, or slightly roughened; aperture a narrow slit at the base of the inner margin of the last-formed chamber, with a slight overhanging lip; color grayish-white.

Length of the Tortugas specimens usually less than 1 mm.

Specimens seem to be very rare in all the Tortugas material examined. The original figure given by d'Orbigny is more or less conventionalized, showing a smooth surface, but otherwise gives the general shape fairly well. He recorded it from Cuba and Jamaica, and I have had material from the latter locality. It occurs elsewhere in the Gulf of Mexico and in the Caribbean. According to the records, it seems to be a species of warm, tropical waters.

Genus BIGENERINA d'Orbigny, 1826.

Bigenerina nodosaria d'Orbigny.

(Plate 2, Figures 5, 6.)

Bigenerina nodosaria d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 261, pl. 11, figs. 9–11; Modèles, 1826, No. 57.

Test composed of two portions, the early textularian biserial portion, much compressed, generally triangular in front view, followed by a uniserial series, the wall arenaceous, usually of calcareous grains, rather neatly cemented; aperture in the early portion like that of *Textularia*, in the uniserial portion becoming central, terminal, generally circular; color grayish-white.

Length of the Tortugas specimens up to 1.5 mm.

There seem to be two distinct forms in this species, developed in the Tortugas collection. The first is like that figured by d'Orbigny and others, in which the early textularian portion is broad, making up in length about one-half of the entire test, followed by 3 or more chambers, circular in cross-section, but whose diameter is considerably less than that of the early portion; the second form (which is common in this collection from the Tortugas) has a biserial portion, very small, and which may be followed by 6 or more chambers in a uniserial arrangement, increasing in size as added and becoming considerably greater in diameter than the early biserial portion. It may be that these represent the first megalospheric and the second microspheric form of a single species, both forms usually occurring together and the specimens being clearly one or the other without intermediate forms. This species is one of the commonest in the collection, and it seems strange that d'Orbigny had nothing in his Cuban monograph which can be definitely referred to this species.

Genus BOLIVINA d'Orbigny, 1839.

Bolivina pulchella (d'Orbigny).

(Plate 1, Figures 8, 9.)

Sagrina pulchella d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 150, pl. 1, figs. 23, 24.

Bolivina costata Goës (not d'Orbigny), Svensk. Vet. Akad. Handl., vol. 19, no. 4, 1882, p. 71, pl. 4, figs. 129 to 132.

Bolivina caribœa Goës (not d'Orbigny), Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 48.

Test rhomboid in front view, gradually increasing in width from the subacute base, the last-formed two chambers making the maximum width; chambers numerous, distinct; sutures slightly depressed, oblique, the outer angle of each chamber ending in a spinose point; wall ornamented by longitudinal costæ, each ending at the peripheral angle of the chamber in a slight projecting spine; wall thin and translucent; aperture elongate, extending from the base of the inner margin of the chamber to the distal point of the last-formed chamber, usually with a slight elevated lip.

Length up to 0.4 mm.

From a study of the Tortugas specimens it seems probable that they are the same as that described by d'Orbigny as *Sagrina pulchella*. In the front view in the original figures the margin of each

chamber is opposite the peripheral angles, as in our specimens, and the longitudinal costæ are similar, over the projecting point at the basal angle. Our specimens, however, are more compressed than that figured by d'Orbigny in end view and have an entirely different aperture. D'Orbigny shows a small, rounded aperture with a projecting neck at the upper end of the last-formed chamber. In the Tortugas specimens they all have a much elongated aperture, extending from the inner margin to the upper limit of the chamber, and at each point there is a projection of the lip at the outer end of the aperture itself. This might easily be mistaken for the character as figured by d'Orbigny if not carefully examined from the apertural end. D'Orbigny's dimensions, 0.5 mm., are closely approximate to that of these specimens from the Tortugas. His original specimens were from the shore sands of Cuba, St. Thomas, and Jamaica. Goës evidently had this species from the Caribbean, referring it first to *B. costata* and later to *B. caribœa*. It seems to be fairly common in the Tortugas region, as it has occurred at 6 of the stations.

Bolivina compacta (Sidebottom).

(Plate 1, Figure 10.)

Bolivina robusta H. B. Brady var. *compacta* Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 15, pl. 3, fig. 7.
Bolivina compacta Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 36, fig. 58 (in text).

Test elongate, tapering, periphery rounded, initial end bluntly pointed, apertural end obliquely rounded; chambers numerous, somewhat inflated; sutures very slightly depressed, not very distinct; wall ornamented by a series of large coarse punctæ, somewhat irregularly arranged, those of the last-formed chambers finer and more numerous; aperture elongate, extending from the base of the inner margin of the last-formed chamber to the highest point of the chamber; color white.

Length of the Tortugas specimens 0.5 mm.

Specimens of this species are extremely rare, a single typical specimen occurring at station 20 in 7 fathoms and another less typical specimen from station 22 in 6 fathoms. Sidebottom originally described this as a variety of *Bolivina robusta* from the Mediterranean, and I have referred to it specimens from the tropical Pacific.

Bolivina limbata H. B. Brady var. costulata, n. var.

(Plate 3, Figure 8.)

Variety differing from the typical form of the species mainly in the addition of longitudinal costæ, usually few in number, and near the base of the test. The specimens are almost invariably somewhat twisted as in the typical.

Length of largest specimen 0.75 mm.

All of the Tortugas specimens seem to be of this variety. The typical form of the species does not seem to be common in the Atlantic, the only records I have had being from off the coast of South America. This species, however, is fairly common in the Tortugas

region as represented by this variety, and it may be found to be common in the shallower waters of the tropical Atlantic.

Bolivina mayori, new species.

(Plate 3, Figures 5, 6.)

Test elongate, somewhat compressed, of nearly uniform width, except in the extreme young; chambers numerous, distinct; sutures depressed; wall thin, translucent, coarsely punctate, especially in the young; chambers in the later portion extending clear across the test, the last-formed chamber in the adults forming the entire width of the test and usually of a less diameter than the preceding; the wall smooth, except in the early portion, which has a few longitudinal costæ; aperture in the adult terminal, elongate, extending nearly across the peripheral end of the last-formed chamber with a slight projecting lip.

Length up to 0.85 mm.

This species most nearly resembles *B. porrecta* H. B. Brady, but differs in the more attenuate form and the ornamentation of the early portion. The punctations over a large part of the surface are arranged in longitudinal lines. In old-age specimens the diameter of the test is considerably less in the last-formed chamber than at the maximum width of the preceding chambers. The aperture would place this species in the subgenus *Bifarina*. It has occurred at nearly half the stations, but not in any considerable numbers.

These specimens resemble very much Brady's figure in the *Challenger* Report (plate 53, fig. 14), which he refers to *Bolivina nobilis* Hantken. A comparison of these with Hantken's original figures shows that the two are probably different species. Brady's specimens were all from the South Pacific, and our specimens from the Tortugas are probably identical or very closely related to those of the South Pacific.

Bolivina striatula, new species.

(Plate 3, Figure 10.)

Test elongate, gradually tapering from the somewhat rounded initial end to the broad apertural end; chambers numerous, distinct, slightly inflated; sutures very slightly depressed; early portion of the test less compressed than the adult, the peripheral margin rounded in the young, sharply angled in the adult, early portion of the test with numerous longitudinal striations occupying about half the length of the test, following the chambers with a very fine reticulate pattern, the final chambers being smooth, hardly punctate.

Length 0.35 mm.

This species is peculiar in the three different stages of ornamentation and the development of the test. The early portion is more or less rounded, with numerous fine longitudinal costæ, followed by a few more compressed chambers, the surface of which has a very fine reticulate pattern, not seeming to be raised from the surface of the test and yet distinct with a considerable magnification. The last-

formed chambers are still more compressed, with a sharp edge, and are composed of clear, transparent shell material, the wall being not even punctate over a large part of the surface.

Bolivina rhomboidalis (Millett).

Textularia rhomboidalis Millett, Journ. Roy. Micr. Soc., 1899, p. 559, pl. 7, fig. 4.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, 1905, No. 5, p. 8, pl. 2, fig. 2.

Test generally triangular in front view, increasing in breadth from the rather bluntly pointed initial end to the broad apertural end, which is oblique; chambers numerous, distinct, obliquely placed, so that the test in end view, instead of having the sides at right angles to one another, has them more or less oblique, giving a rhomboid shape to the test in end view; wall translucent, coarsely punctate; aperture a low slit at the base of the inner margin of the last-formed chamber within a reëntrant of the margin; color white.

Length of the Tortugas specimens 0.40 mm.

This is from station 28, in Bird Key Harbor, in 4.75 fathoms. This species was described by Millett under the genus *Textularia* from the Malay Archipelago, and he gives also *Challenger* station 185, off Raine Island, and other localities in Torres Strait, and also the Ægean Sea. Sidebottom's specimens were from the Mediterranean. This single Tortugas specimen is very similar to that figured by Millett. It has not previously been recorded from the Atlantic, but should be looked for further in the West Indian region.

Genus VERNEUILINA d'Orbigny, 1840.

Verneuilina spinulosa Reuss.

(Plate 3, Figure 11.)

Verneuilina spinulosa Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 374, pl. 47, fig. 12.—Egger, Neues Jahrb., 1857, p. 292, pl. 9, figs. 17, 18.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 384, pl. 47, figs. 1 to 3.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 219, pl. 42, fig. 15 (not fig. 14).—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 472.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1900 (1902), p. 185.—Millet, Journ. Roy. Micr. Soc., 1900, p. 11.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 49, No. 5, 1905, p. 10, pl. 2, fig. 5.—Rhumbler, Zool. Jahrb., Abth. Syst., vol. 24, 1906, p. 61, pl. 5, fig. 53.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 132.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 55, fig. 88 (in text).—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 631.—Cushman, Carnegie Inst. Wash., Pub. 291, 1919, p. 34; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 51.

Test pyramidal, triangular in transverse section, the sides flat and slightly concave, the initial end sharply pointed, thence gradually tapering to the greatest width, which is somewhat below the apertural end, periphery angled, sometimes spinose, the initial end sometimes with a short apical spine; chambers numerous, distinct; sutures slightly if at all depressed; wall smooth, punctate, the punctations often largest and most numerous near the borders of each chamber; the aperture at the inner margin of the last-formed chamber.

Length of the Tortugas specimens usually not exceeding 0.5 mm.

The species is not common in the region, but has occurred at 7 of the 20 stations. It is a common species in comparatively shallow water in tropical regions.

Genus VALVULINA d'Orbigny, 1826.

Valvulina oviedoiana d'Orbigny.

(Plate 2, Figures 7, 8.)

Valvulina oviedoiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 103, pl. 2, figs. 21, 22.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 51, pl. 11, figs. 11 to 14.

Verneuilina affixa Cushman (in part), Carnegie Inst. Wash., Pub. 213, 1918, p. 271, et seq.

Test pyramidal, triangular in transverse section, initial end pointed, apertural end broadly rounded, triserial; chambers numerous, fairly distinct; sutures slightly depressed; wall rather coarsely arenaceous, somewhat roughened; aperture at the base of the inner margin of the last-formed chamber, small, oval or elliptical, with a projecting lip extending out over it, forming in a reëntrant a considerable channel leading into an umbilical area; color white.

Length of the Tortugas specimens up to 1 mm.

Except for the above reference, this species has been allowed to lapse since its original description. It was found to be fairly common in shallow-water material from the north coast of Jamaica and occurs elsewhere in the West Indian region. In Publication 213 of the Carnegie Institution of Washington I have referred to this as *Verneuilina affixa*, from the Bahamas and from various points off the coast of Florida, mostly in shallow water. It is evidently one of the characteristic species of the West Indian region in shallow water. The type figures of d'Orbigny were somewhat conventionalized and smooth, but otherwise fit this species exceedingly well and there seems to be no doubt that this is the species that d'Orbigny had.

It is very probable that this is the same species as that described by Chapman as *Valvulina davidiana* from the Funafuti Atoll, Ellice Islands. As far as the Tortugas collection shows, it occurs only at the shallowest stations, the deepest record being 5.75 fathoms. The species is heavily walled and can therefore withstand rougher conditions of shallow water than can other more delicate ones, and this may account for its greater abundance in such situations.

Genus CLAVULINA d'Orbigny, 1826.

Clavulina tricarinata d'Orbigny.

(Plate 3, Figure 3.)

Clavulina tricarinata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 11, pl. 2, figs. 16 to 18.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 52, pl. 12, figs. 1, 2.

Test elongate, early portion triserial, later portion, which forms a large part of the test, uniserial, triangular in transverse section; chambers numerous, distinct, the angles of the chambers extending back over the preceding ones, the sides being somewhat concave at the base; sutures depressed, usually distinct, except in the early portion; wall coarsely arenaceous, but smoothly finished, calcareous; aperture circular, terminal, central, often with a distinct, straight, simple tooth; color white.

Length of the Tortugas specimens up to 1.5 mm.

As I have already noted in a previous paper on the Jamaican collection (Proc. U. S. Nat. Mus., vol. 59, 1921, p. 52), d'Orbigny's name of *Clavulina tricarinata* should be used for the West Indian material. A study of the Tortugas collection more strongly confirms this view. Specimens are very constant in their characters and agree very closely with the original figure and description given by d'Orbigny, and undoubtedly the specimens referred from this region by various authors to *Clavulina angularis* d'Orbigny should be really *C. tricarinata* d'Orbigny. It is evidently the same as the species of the tropical Pacific, and probably those of the Mediterranean are *Clavulina angularis* d'Orbigny. It has occurred at numerous stations, but never in great abundance, so far as the collection shows.

Clavulina sp.?

(Plate 3, Figure 4.)

There is a single specimen from station 9 in very shallow water (6 inches to 1 foot) from the lagoon on Long Key, which seems to differ from any of the other specimens of this genus obtained in this area. A reference to the figure (pl. 3, fig. 4) will show that the early portion is triserial and definitely triangular in transverse section, the uniserial portion being circular throughout. It may be an aberrant form of *Clavulina tricarinata* d'Orbigny.

Clavulina nodosaria d'Orbigny.

(Plate 3, Figures 1, 2.)

Clavulina nodosaria d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 110, pl. 2, figs. 19, 20.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 53, pl. 12, fig. 3.

Test small, elongate, tapering, the early portion triserial, later uniserial, the uniserial chambers typically more or less rounded, especially the later ones; chambers distinct, inflated; sutures depressed; wall finely arenaceous, composed of translucent grains, with a small amount of cement, smooth; aperture circular, with a simple tooth, usually projecting above the level of the aperture; color yellowish- or brownish-white.

Length of the Tortugas specimens up to 0.75 mm.

This species seems to be very distinct from *C. tricarinata*, not only in its size, but also in the more rounded chambers, and especially in the characters of the wall, which in *C. tricarinata* are thick and heavy, with much cement and opaque; those of *C. nodosaria* being very thin, with little cement and translucent. D'Orbigny's original specimens were from Cuba and Martinique, and I have already recorded it from the north coast of Jamaica. In the Tortugas collection it has been found at a number of stations in considerable numbers and I have recorded it elsewhere off the coast of Florida. It is a small, delicate species, hardly to be confused with any of the others of the genus.

Genus BULIMINOIDES Cushman, 1911.

Buliminoides williamsoniana (H. B. Brady).

(Plate 3, Figure 7.)

Bulimina williamsoniana H. B. Brady, Quart. Journ. Micr. Soc., vol. 21, 1881, p. 56; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 408, pl. 51, figs. 16, 17.—Millett, Journ. Roy. Micr. Soc., 1900, p. 279, pl. 2, fig. 8.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 136.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 641.

Buliminoides williamsoniana Cushman, Bull. 71, U. S. Nat. Mus., part 2, 1911, p. 90, fig. 144 (in text).

Test elongate, subcylindrical, composed of numerous chambers which are not distinct from the outside, the main ornamentation of the surface consisting of longitudinal costæ, usually somewhat spirally twisted, running from the initial end to the aperture; the aperture itself rounded, in the center of the oblique, apertural face; the costæ of the surface running in to the center, making a radiate pattern about the aperture itself; color white.

Length of the Tortugas specimen 0.4 mm.

This species is one of the "finds" of the Tortugas collection. It has not previously been recorded from the Atlantic. So far as known, its distribution has been from shallow water of the Indo-Pacific region. Brady, in the *Challenger* Report, gave seven localities for this, as follows: "Port Stephens and Port Jackson, New South Wales, 2–10 fathoms; off Levuka, Fiji, 12 fathoms; off the New Hebrides, 125 fathoms; Torres Strait, 155 fathoms; Humboldt Bay, Papua, 37 fathoms; Nares Harbour, Admiralty Islands, 17 fathoms." Millett's specimens came from two stations in the Malay region. Bagg recorded this species from a single *Albatross* station, H4694, in 865 fathoms, off the Hawaiian Islands, and in 1911 I added another station, H2922, in 268 fathoms, off the same Islands. The other record is from the Kerimba Archipelago, off the eastern coast of Africa, where Heron-Allen and Earland recorded it. Its natural habitat is evidently in comparatively shallow water in tropical seas. It is a small species and one that is apt to be overlooked, and it may be fairly common in the Caribbean and the Gulf of Mexico, although it was certainly rare in the Tortugas region.

Genus VIRGULINA d'Orbigny, 1826.

Virgulina punctata d'Orbigny.

(Plate 3, Figure 9.)

Virgulina punctata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 139, pl. 1, figs. 35, 36.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 52, pl. 11, fig. 15.

Virgulina squammosa Cushman, (not d'Orbigny, 1826), Carnegie Inst. Wash. Pub. 213, 1918, p. 284.

Test elongate, fusiform, broadest near the middle, the initial end bluntly pointed, composed of numerous chambers, the earliest few triserial, those of the adult portion irregularly biserial; chambers somewhat inflated; sutures slightly depressed, distinct; wall smooth, punctate, especially in the earlier portion, the later chambers being usually clear, except for punctations near the lower edge; aperture elongate, connecting with the previous aperture by a tubular connection; color white.

Length of the Tortugas specimens rarely exceeding 0.5 mm.

This species, which was originally described by d'Orbigny in his Cuban monograph and recorded by him from Cuba and Jamaica, I found also at Montego Bay, Jamaica.

In the Tortugas collection this is a very abundant species, and fits remarkably well the figure and description given by d'Orbigny. The triserial portion is limited to the very earliest development, and except for the slight irregularity in the arrangement of the chambers, the later portion might easily be taken for a *Bolivina*. It is probably widely distributed in the Gulf of Mexico and the Caribbean regions in similar habitats. In spite of the numerous specimens, it shows remarkably little variation.

Family LAGENIDÆ.

Genus NODOSARIA Lamarck, 1812.

Nodosaria (Glandulina) rotundata (Reuss).

(Plate 4, Figure 1.)

Glandulina rotundata Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 366, pl. 46, fig. 2. *Nodosaria (Glandulina) rotundata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 491, pl. 61, figs. 17 to 19.—Flint, Ann. Rep. U. S. Nat. Mus., 1897 (1899), p. 308, pl. 54, fig. 5.—Millett, Journ. Roy. Micr. Soc., 1902, p. 510.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 47, pl. 28, fig. 6.

Test oval or subovate, broadest in the middle, composed of few chambers, apical end broadly rounded, without spines, apertural end more elongate, aperture with radiate lines about the margin; last-formed chamber occupying one-half or more of the visible test.

Length of the Tortugas specimens 0.8 mm.

The species occurred at but one station and as a single specimen. This is very typical, as shown (plate 4, fig. 1).

Nodosaria sp.?

(Plate 4, Figure 2.)

There is a single two-chambered specimen of a costate species, which is evidently the young, possibly of *Nodosaria vertebralis* (Batsch). A figure of this is given (plate 4, fig. 2). In its general characters it may be compared to the two-chambered specimen figured by d'Orbigny (in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," plate 1, figs. 8 to 10), which he named *Nodosaria catesbyi*. There are no adult specimens, so it is impossible to determine to what species this should belong.

Genus CRISTELLARIA Lamarck, 1812.

Cristellaria sp.?

(Plate 4, Figure 3.)

The specimen figured (pl. 4, fig. 3) is the only one of its genus found in the collection from the Tortugas region. It is few-chambered and small; therefore may be a young, rather than an adult, specimen, and as such I hesitate to place it definitely under any specific name.

Genus POLYMORPHINA d'Orbigny, 1826.

Polymorphina regina H. B. Brady, Parker, and Jones.

(Plate 4, Figures 5, 6.)

Polymorphina regina H. B. Brady, Parker, and Jones, Trans. Linn. Soc. London, vol. 27, 1870, p. 241, pl. 41, figs. 32 *a*, *b*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 571, pl. 73, figs. 11 to 13.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 310, pl. 9, figs. 45, 50, 51.—Millett, Journ. Roy. Micr. Soc., 1903, p. 265.—Chapman, Journ. Quekett Micr. Club, 1907, p. 132, pl. 10, fig. 4.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 139.—Chapman, Proc. Roy. Soc. Victoria, vol. 22, 1910, p. 281.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 91, pl. 41, figs. 6, 7.—Heron-Allen and Earland, Trans. Linn. Soc. Zool., vol. 20, 1915, p. 673.—Cushman, Proc. U. S. Nat. Mus., vol. 56, 1919, p. 619.

Test fusiform; chambers several, inflated, with deep sutures; wall ornamented with elongate, coarse costæ, usually not broken on the individual chambers; aperture radiate, produced.

Length of the Tortugas specimens not exceeding 0.75 mm.

Almost all the records for this species seem to be from the Indo-Pacific region, but there is a considerable development of specimens in the region of the Tortugas which may be referred to this species. It has been recorded in the fossil state from the Miocene and Oligocene in the Coastal Plain of the United States. It is evidently one of those species, related to the present fauna of the Indo-Pacific, which has existed in this region of the Gulf of Mexico since Oligocene time with little change.

Polymorphina pulchella (d'Orbigny).

(Plate 4, Figures 7, 8.)

Guttulina pulchella d'Orbigny, in De la Sagra, Hist Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 129, pl. 2, figs. 4 to 6.

Polymorphina pulchella H. B. Brady, Parker, and Jones, Trans. Linn. Soc. London, vol. 27, 1870, p. 239, pl. 41, figs. 28 *a*, *b*.

Test elongate, fusiform, somewhat compressed, both ends acute; chambers few; sutures distinct, slightly depressed; wall translucent, with numerous longitudinal costæ; aperture slightly extended, radiate.

Length of the Tortugas specimens up to 0.75 mm.

This is one of the species described by d'Orbigny from the shore sands of Cuba and Martinique, and except for the reference given by Brady, Parker, and Jones, who copied d'Orbigny's figure, little has been known about the species. Very excellent specimens, which agree well with d'Orbigny's original figures, as a comparison will show (plate 4, figs. 7 and 8), were found at several of the stations in the Tortugas region. It is a beautiful species with its clear shell wall and very delicate longitudinal costæ, and can hardly be taken for any other when once seen.

Polymorphina gibba d'Orbigny.

(Plate 4, Figure 9.)

"Polymorphina Subcordiformia vel Oviformia" Soldani, Testaceographia, vol. 1, pt. 2, 1791, p. 114, vol. 113, figs. *zz*, *C*, etc.

Polymorphina (*Globulina*) *gibba* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 226, No. 20; Modèles, 1826, No. 63.—Egger, Neues Jahrb. für Min., 1857, p. 288, pl. 13, figs. 1 to 4.

Polymorphina gibba H. B. Brady, Parker, and Jones (part), Trans. Linn. Soc. London, vol. 27, 1870, p. 216, pl. 39, figs. 2 *a* to *d*.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 561, pl. 71, figs. 12 *a*, *b*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 3, 1913, p. 85, pl. 41, fig. 4.

Test rotund, front view nearly circular, end view broadly oval; visible chambers few, broad; sutures slightly excavated; wall smooth; aperture somewhat produced.

Length of the Tortugas specimens not over 0.5 mm.

There are single specimens from two stations which may be referred to this species.

Polymorphina lactea (Walker and Jacob) var.

(Plate 4, Figures 10, 11.)

There are a few specimens of a small rounded form with a slightly roughened surface which I have referred to this species. They are not typical, however, the rough surface seeming to be constant, and one of the specimens which is here figured (plate 4, fig. 10) is attached to a calcareous fragment by slight stolon-like processes.

Polymorphina sp.?

(Plate 4, Figure 4.)

There is a single specimen which is here figured (plate 4, fig. 4), with a smooth surface, generally fusiform shape, and few-chambered, which, in the absence of further material, I have not wished to place under a specific name.

Polymorphina sp.

(Plate 5, Figure 1.)

The specimen figured (plate 5, fig. 1) may possibly be related to the preceding and may be only an irregular specimen. Under these conditions it does not seem warranted that this should be placed under a definite name.

Genus UVIGERINA d'Orbigny, 1826.

Uvigerina angulosa Williamson.

(Plate 5, Figures 3, 4.)

There are a few specimens which can be referred to this species. They are small, and, as shown by the specimen figured (plate 5, fig. 4), there is a tendency in the later development for the chambers to become more remote than in the early development. At the same time, the characteristic ornamentation of longitudinal costæ seems to be lacking in these last-formed chambers. The specimens are all small, not exceeding 0.5 mm. in length.

Genus SIPHOGENERINA Schlumberger, 1883.

Siphogenerina advena, new species.

(Plate 5, Figure 2.)

Test elongate, somewhat compressed, early portion either triserial or biserial; later portion, which makes up the larger portion of the test, uniserial; chambers numerous, distinct, inflated; sutures somewhat depressed, the early portion and a part of the uniserial portion with fine, longitudinal costæ, more or less broken, followed by 2 or 3 chambers slightly spinose, after which the remaining chambers are smooth and very finely punctate; aperture elliptical, each one connecting with the preceding by an internal funnel-shaped tube.

Length up to 0.65 mm.

This is a very small, delicate species, but very characteristic and constant in form and ornamentation. It is unlike any of the described species and is probably characteristic of this general region, as it was found at a considerable number of stations in the area.

Siphogenerina raphanus (Parker and Jones).

(Plate 5, Figure 5.)

Uvigerina (Sagrina) raphanus Parker and Jones, Philos. Trans., vol. 155, 1865, p. 364, pl. 18, figs. 16, 17.

Sagrina raphanus H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 585, pl. 75, figs. 21 to 24.—Millett, Journ. Roy. Micr. Soc., 1903, p. 272.—Chapman, Journ. Linn. Soc. Zoology, vol. 30, 1910, p. 415.

Siphogenerina (Sagrina) raphanus Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 317, pl. 9, fig. 36.

Siphogenerina raphanus Cushman, Bull. 71, U. S. Nat. Mus., part 3, 1913, p. 108, pl. 46, figs. 1 to 5.

Siphogenerina costata Schlumberger, Feuille des Jeunes Naturalistes, ann. 13, 1883, p. 118, fig. 13.

Test elongate, cylindrical, or tapering, chambers of the uniserial portion broader than long; surface marked by several rather widely separated, well-developed costæ, each extending nearly the length of the test and not affected by the sutures; aperture typically with a short tubular neck and well-developed flaring lip.

Length of the longest Tortugas specimens 1 mm.

A single fine, large, typical specimen occurred at station 14 in 12 fathoms, on the outside of the group off Loggerhead Key. There is another small, poorly developed specimen from station 28, in Bird Key Harbor, 4.75 fathoms.

Family GLOBIGERINIDÆ.

Genus GLOBIGERINA d'Orbigny, 1826.

Globigerina bulloides d'Orbigny.

Globigerina bulloides d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 277, No. 1; Modèles, 1826, Nos. 17, 76.

Globigerina siphonifera d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 83, pl. 4, figs. 15 to 18.

This very widely spread species has occurred at only two stations in the bottom material of the Tortugas collection and was obtained very rarely in the surface tows made off Loggerhead Key. It is not nearly so common as the following species.

Globigerina æquilateralis H. B. Brady var.

There is a single broken specimen which suggests the variety *involuta* Cushman, which I have described from the Philippine region. It is, however, too broken to be positively identified.

An interesting thing about the specimen, however, is that while the later chambers are smooth, those of the early coils, which are exposed in the breaking of the specimen, show long spines still attached.

Globigerina dutertrei d'Orbigny.

(Plate 5, Figures 8, 9.)

Globigerina dutertrei d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 84, pl. 4, figs. 19 to 21.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 601, pl. 81, figs. 1 *a* to *c*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 4, 1914, p. 8; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 55, pl. 12, fig. 7.

Test rotaliform, generally rounded, very convex on the ventral side, the last coil usually consisting of 5 chambers; chambers gradually increasing in size, the later ones much inflated; sutures depressed; aperture single, on the inner margin of the last-formed chamber in the umbilicate area; color white.

Length of the Tortugas specimens 0.6 mm.

Specimens occurred only at the deeper-water station off Loggerhead Key Light, in 18 fathoms, and were not noticed in the tow net. D'Orbigny originally described this species from Cuba and recorded it also from Martinique and Guadeloupe. I have recorded it from Montego Bay and Runaway Bay, on the north coast of Jamaica. It seems to be widely distributed in deep water.

Globigerina rubra d'Orbigny.

(Plate 14, Figures 1, 2.)

Globigerina rubra d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 82, pl. 4, figs. 12 to 14.

Test composed of several inflated chambers arranged in an elongate trochoid spire of about 3 volutions, each with 3 chambers; walls reticulate, with spines in pelagic specimens; aperture an arched opening at the umbilical border of the chamber, and in the later chambers this is supplemented by two or more nearly circular openings on the upper border of the chamber near its connection with the preceding chambers; color of the early chambers, sometimes of all the chambers, pink.

Length of the Tortugas specimens about 0.75 mm.; diameter slightly less.

D'Orbigny described this species from shore sands of Cuba, recording it also from Jamaica, Guadeloupe, and Martinique. I recorded the species from shallow water off the north coast of Jamaica (Proc. U. S. Nat. Mus., vol. 59, 1921, p. 55, plate 12, fig. 6). It occurred as few specimens at several stations in the area and was almost always found, although not in any great numbers, in the tow nets. It is abundant in the deeper water of the Caribbean, Gulf of Mexico, and the Atlantic regions.

Family ROTALIIDÆ.

Genus SPIRILLINA Ehrenberg, 1841.

Spirillina vivipara Ehrenberg.

(Plate 5, Figure 7.)

Spirillina vivipara Ehrenberg, Abh. Akad. Wiss. Berlin, 1841, p. 442, plate 3, fig. 41.—Moebius, Beitr. Meeresfauna Insel Mauritius, 1880, p. 88, pl. 8, figs. 1, 2.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 630, pl. 85, figs. 1 to 5.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 326, pl. 71, fig. 4—Millett, Journ. Roy. Micr. Soc., 1903, p. 693.—Rhumbler, Zool. Jahrb., Abth. Syst., vol. 24, 1906, p. 32, pl. 2, fig. 7.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 3, pl. 1, figs. 1, 2; fig. 1 (in text).

Test typically free, rarely adherent, planospiral, coils of early portion in microspheric specimens at least narrow, those of later coils much wider and of nearly uniform width, faces somewhat flattened, but more often concave on both sides; sutures usually distinct and often considerably depressed; peripheral border rounded; wall marked by conspicuous perforations, irregularly scattered and most prominent on the last-formed volutions; aperture somewhat crescentic.

Diameter of the Tortugas specimens 0.50 to 0.60 mm.

Ehrenberg originally described this species from off the coast of Mexico, therefore in this same faunal region. His figure shows a specimen with a single series of pores near the outer edge of the coil. Our specimens have the pores smaller and irregularly scattered, as shown (plate 5, fig. 7). In comparing d'Orbigny's figures in the Cuban monograph, the reason for taking his *Operculina incerta* as the type of *Ammodiscus incertus* seems very questionable, the only thing in his description which would tend to seem like *Ammodiscus* being the single word "flavescente." Except for this, it would seem that d'Orbigny might have had a *Spirillina* of the form here figured (plate 5, fig. 7). The measurements given by him, 0.60 mm. (not 0.10 mm., as given by Brady), fits very closely this series of Tortugas specimens. *Ammodiscus* was not found at any of the Tortugas stations nor in the collection from the north coast of Jamaica, and I have not found it in shallow water from the coast of Florida or the Bahamas. A study of d'Orbigny's type, if it is extant, should show whether or not his *Operculina incerta* really was *Ammodiscus* or whether it was a *Spirillina*. Until such examination can be made it can not be definitely decided what should be the disposition of this d'Orbignyan species. The material from the West Indian and Floridian collections seems to be in favor of its being *Spirillina*. If this is true, the present species will have to be known as *Spirillina incerta* (d'Orbigny), and *Ammodiscus* will take its name probably from Williamson and be known as *Ammodiscus arenacea* (Williamson).

Spirillina vivipara Ehrenberg var.

(Plate 5, Figure 6.)

There is a form of this species which, instead of the coarse, irregularly scattered punctations, has them very numerous and arranged

more or less regularly in oblique lines, giving a very different appearance to the surface of the test than the typical form of the species.

Genus DISCORBIS Lamarck, 1804.

The genus *Discorbis* Lamarck, which has been more often used under the name *Discorbina* of Parker and Jones, has evidently a large number of species with probably well-defined faunal limitations. A study of shallow-water material from almost any region shows a considerable number of such species, and the Tortugas region is no exception. There are here developed several species which are very distinct from one another and in which the amount of variation is not great. A comparison of these with certain of the original figures given by Brady, based presumably on the specimens from the Indo-Pacific, shows very close relations. However, a comparison of Brady's figures with those of the original author's in most cases shows a very decided discrepancy. The *Challenger* figures are excellent and in using them for comparison it is possible to refer some of the Tortugas species to the groups represented by the *Challenger* figures. If, however, an attempt is made to trace back the names assigned by Brady to these figures difficulties are at once encountered. It is evident that in the Gulf of Mexico and in the Caribbean certain species are developed which are close to if not identical with the species from the warmer parts of the Pacific. Most later authors have followed the disposition of these species given in the *Challenger* report and in certain cases there seem to be no specific names available for the particular species found in this collection; as such, new names necessarily had to be applied. Heron-Allen and Earland, in their Clare Island Survey paper, have dealt with many of the species which can be referred to this genus and have given a number of excellent figures of the specimens from that region. Comparison of their figures with specimens from the Tortugas region shows very little in common between the two groups, as might be expected from the varying conditions and different faunal relations of these widely separated localities. Little is to be gained by using a very few names to cover widely divergent forms, and a considerable increase in names used by Heron-Allen and Earland is really a step toward precise work, rather than towards complexity.

Discorbis orbicularis (Terquem)?

(Plate 5, Figure 10.)

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

Discorbis orbicularis Berthelin, Foram. de Borgneuf et Pornichet, 1878, p. 39, No. 63.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 16, pl. 11, fig. 1; fig. 18 (in text); Proc. U. S. Nat. Mus., vol. 59, 1921, p. 60.

Discorbina orbicularis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 647, pl. 88, figs. 4 to 8.

Numerous specimens are here referred to Terquem's species, although they probably belong to perhaps more than one species, and it is doubtful if any of them are identical with that of Terquem. They are probably more nearly related to such forms as occur in the shallow Indo-Pacific region than to that of the European coast.

Discorbis mira, new species.

(Plate 6, Figures 10, 11.)

Discorbina turbo H. B. Brady (and subsequent authors; not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 642, pl. 87, figs. 8 *a* to *c*.

Test planoconvex, dorsal side forming a low cone, ventral side flattened and very slightly convex, trochoid, the last-formed chamber consisting of about 6 chambers; sutures oblique, curved very slightly, if at all, depressed on the dorsal side, on the ventral side depressed, the area thus formed often filled by alar prolongations from the center; periphery slightly lobulate, on the dorsal side the sutures often slightly limbate; the walls coarsely punctate, on the dorsal side irregularly so, the punctæ near the outer margin of the chamber, less frequent elsewhere; aperture an elongate, slightly arched slit at the inferior margin of the chamber; color white.

Diameter up to 0.65 mm.

Specimens of this species have been fairly common in the region, occurring at most of the stations, often in considerable numbers, the specimens agreeing very closely with the figures given by Brady in the *Challenger* report. A comparison of these figures, however, with the Modèle of d'Orbigny and the subsequent figure given by Fornasini, will show that the *Rotalia* (*Trochulina*) *turbo* of d'Orbigny is a very different species from that figured by Brady and which I have figured here. D'Orbigny's specimens were found fossil in the Paris Basin. From the abundance of this species in the Tortugas region it is probable that it is widely distributed, both here and in the tropical Pacific.

In spite of the considerable number of specimens, the characteristics of the species are very closely held and very little variation is shown.

Discorbis floridana, new species.

(Plate 5, Figures 11, 12.)

Test rotaliform, periphery slightly, if at all, lobulated, dorsal side rounded, much convex, ventral side concave, somewhat umbilicate; chambers comparatively few, 5 or 6 in the last-formed coil, on the dorsal side coarsely punctate, on the ventral side punctate near the periphery, but on the inner concave portion smooth, with very fine punctæ, if any; sutures in the younger portion slightly limbate, those of the later portion not limbate, rather indistinct, very slightly depressed; aperture an elongate, arched opening at the base of the last-formed chamber, opening on the umbilicate area, often with a slight, thin lip; color of the early whorls brown, of the last whorl white.

Diameter not exceeding 0.4 mm.

These specimens, which occurred in considerable numbers at several stations, do not seem to fit any of the described species.

They have a beautiful brown color, the wall translucent, and on the ventral side especially have a peculiar appearance, due to the lack of the punctæ in the umbilical area. There is some slight variation, as shown in the figures (plate 5, figs. 11, 12), but all have the characteristic color and general appearance from both the dorsal and ventral sides.

Discorbis advena, new species.

Discorbina rosacea H. B. Brady (in part) (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 644, pl. 87, fig. 1.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 327, pl. 72, fig. 3 ?.

Test rotaliform, dorsally convex, ventrally concave, composed of numerous chambers, usually 6 in the last-formed coil, distinct, the periphery rounded in the final chambers, earlier development with a rather acute edge; sutures distinct, very slightly depressed, oblique; wall fine, translucent, very finely punctate; on the ventral side the test is umbilicate, the chambers ending in a peculiar inflated point; aperture a very narrow, slightly curved opening at the base of the inner margin of the last-formed chamber.

Diameter up to 0.5 mm.

This is one of the most common species of this genus in the collection, occurring at more than half the stations. It is very close to the figure given by Brady, referred to *Discorbina rosacea* d'Orbigny. A comparison of this with d'Orbigny's original Modèle, however, shows little in common between the two. The figures given by Flint may possibly be this species also. This is very different from the figures given by Brady as *Discorbina rosacea* (plate 87, fig. 4). The species does not seem to have been definitely described and figured, and I have here given it a new name in order that it may be distinguished, if, as is probable, this distribution may be fairly wide in the warm waters of this general region in the Atlantic. Specimens in the Tortugas collection showed very little variation, and the species has been a very clear-cut one at all the stations where it occurred.

Discorbis auberii (d'Orbigny).

Rosalina auberii d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 94, pl. 4, figs. 5 to 8.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 59, pl. 14, figs. 1 to 3.

Test rotaliform, with a low spire; periphery carinate, acute, the ventral side slightly, if at all, convex; composed of several coils with 4 chambers in each; sutures distinct, somewhat depressed, oblique on the dorsal side, nearly radiate on the ventral; wall rather coarsely perforate; aperture at the base of the last-formed chamber, a curved, narrow slit.

Diameter of the Tortugas specimens 0.40 mm.

D'Orbigny described this species from Cuba and Martinique, and I have recorded it from the north coast of Jamaica. The only station in the Tortugas collection at which it has occurred is station 10, where it is rare.

Discorbis subaraucana, new species.

(Plate 7, Figures 1, 2.)

Test unequally biconvex, dorsal side somewhat arched, the ventral side very slightly convex, flattened, or even somewhat concave; periphery not lobulated, composed of about 2.5 coils, 6 to 8 chambers in the last-formed one; sutures oblique, curved, limbate on the dorsal side, except in the last 2 or 3 chambers in the adult, ventrally also somewhat limbate, especially in the early stages; wall with numerous punctæ; aperture at the base of the ventral side of the last-formed chamber, narrow; color of the earlier chambers reddish-brown, those of the last-formed ones usually white.

Diameter up to 0.40 mm.

The Tortugas material shows a species which is common and which is more like the figures referred by Brady to *Discorbis araucana* than it is to the originals of d'Orbigny. The figures here given (plate 7, figs. 1 and 2) show the general characters of these specimens. It is the most common in the area and is probably widely distributed in the Pacific and Indian Oceans.

Genus CYMBALOPORA Hagenow, 1850.

Cymbalopora squammosa (d'Orbigny).

(Plate 6, Figures 4 to 6.)

Rotalia squammosa d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 272, No. 8.

Rosalina squammosa d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 91, pl. 3, figs. 12 to 14.

Rosalina poeyi d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 62, pl. 3, figs. 18 to 20.

Cymbalopora poeyi Carpenter, Parker, and Jones, Introd. Foram., 1862, p. 215, pl. 13, figs. 10 to 12.—Moebius, Beitr. Meeresfauna Insel Mauritius, 1880, p. 97, pl. 10, figs. 1 to 5.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 636, pl. 102, figs. 13 *a* to *c*.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 226, pl. 46, fig. 12.—Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, 1906, p. 71, pl. 5, fig. 59.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 24, pl. 10, fig. 1; pl. 14, fig. 5; fig. 28 (in text).—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 687.

Discorbina poeyi Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 19, 1882, No. 4, p. 107, pl. 8, figs. 264, 265.

Test subconical, trochoid, dorsal side forming a cone, bluntly pointed, of variable height, ventral side flattened or very slightly concave, consisting usually of 6 or 7 chambers, of peculiar shape, widest at the outer border, thence contracted, widening again, and finally contracted again, tapering toward the center, where all are united; chambers separated by a definite depressed area; aperture at the margin of the base of the last-formed chamber; color of the earlier portion reddish-brown, the latter part white.

Diameter of the Tortugas specimens up to 0.75 mm.

This is one of the common species in the region, occurring at nearly all the stations. It was originally given a name by d'Orbigny in 1826, his specimens coming from Martinique. In 1839 he described the species under the genus *Rosalina*, and with it *Rosalina poeyi*. These have been considered the same species by most authors, but the name *poeyi* was taken by Carpenter in 1862 and has since been followed. However, according to the rules of priority, the name *squammosa* used in 1826 by d'Orbigny is not a nomen

nudum, as the species was described and figured by d'Orbigny in 1839, and also appears earlier, both on the plate and in the text, than does *poeyi*. Therefore there is no alternative, if the two are considered the same species, but to use the name *squammosa* for this species.

There is some variation in the height of the test, but not enough to warrant separation into two varieties. The West Indian species differs in some ways from those of the Pacific, but it may be a question whether or not they both belong to a single species. This is related to *Tretomphalus bulloides* d'Orbigny, but, as will be noted under that species, the two are distinct, as *C. squammosa* does not form a "float-chamber."

Genus TRETOMPHALUS Moebius, 1880.

Tretomphalus bulloides (d'Orbigny).

Rosalina bulloides d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 104, pl. 3, figs. 2 to 5.

Cymbalopora bulloides Carpenter, Parker, and Jones, Introd. Foram., 1862, p. 216.—H. B. Brady, Quart. Journ. Micr. Soc., vol. 19, 1879, p. 80; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 638, pl. 102, figs. 7 to 12; text-figures, 20 *a* to *c*.—Egger, Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 381, pl. 18, fig. 53.—Murray, Nat. Sci., vol. 11, 1897, p. 20, fig. 3.—Chapman, Journ. Linn. Soc. London, Zoology, vol. 28, 1902, p. 189; Earland, Journ. Quekett Micr. Club, ser. 2, vol. 8, 1902, p. 309, pl. 16, figs. 6 to 9.—Millett, Journ. Roy. Micr. Soc., 1904, p. 697, pl. 7, fig. 4.—Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, 1906, p. 72.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 688.—Heron-Allen, Phil. Trans., ser. B, vol. 206, 1915, p. 252, et seq., pls. 16, 17 (in part).

Tretomphalus bulloides Moebius, Beitr. Meeresfauna Insel Mauritius, 1880, p. 98, pl. 10, figs. 6 to 9.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 26, pl. 14, figs. 3, 4; fig. 29 (in text); Proc. U. S. Nat. Mus., vol. 59, 1921, p. 58, pl. 13, fig. 13.

Discorbina bulloides Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 19, 1882, p. 106, pl. 8, figs. 262, 263.

Test free, subglobular; early chambers rotaliform, numerous, rather coarsely perforate, forming a cap to which is attached a large final "balloon-chamber," subspherical, with coarse perforations on the ventral side, and within a "float-chamber" with a single opening at the base, from which a tubular neck projects inward; color of the early chambers dark brown, the large chamber colorless.

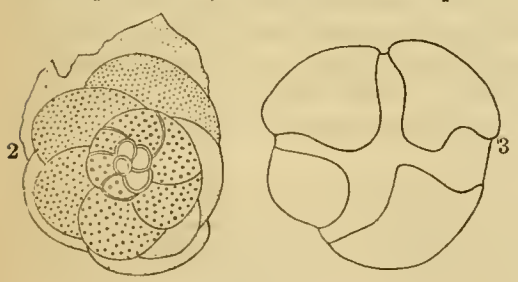
Diameter of the Tortugas specimens up to 0.40 mm.

D'Orbigny originally described this species as *Rosalina bulloides* in the Cuban monograph, his specimens being from Cuba and Haiti. By most authors it has been assigned to *Cymbalopora*, but Moebius in 1880 erected the genus *Tretomphalus* for this species, and in view of the structures revealed by later studies it seems best to use this name. The *Cymbalopora millettii* of Heron-Allen and Earland should also be known as *Tretomphalus millettii*. These two species have had considerable attention from various authors, especially Moebius, Murray, Brady, Earland, and Heron-Allen.

Tretomphalus bulloides occurs both as a pelagic species and as a bottom form. This fact has led to various theories concerning its life history. From what is known of the pelagic form it undoubtedly becomes empty and sinks to the bottom. Whether all

the bottom specimens may thus be accounted for can not be stated with any degree of certainty. It seems possible that the enlarged "balloon-chamber" is developed from a bottom-living form, as many species adapted to a pelagic life develop a more or less inflated final chamber with large pores. These evidently allow free passage of the protoplasm, which, being extended and containing gases, floats the test without difficulty. Sir John Murray, while on the *Challenger*, observed living specimens of *Tretomphalus bulloides*, filled with "flagelli spores(?)" which were then noted and have since been referred to by various authors. These had small bodies at one side which took stain more freely than the general mass.

In the tow-nets in the work at the Tortugas I frequently took *Tretomphalus bulloides* at the surface, especially in the open waters off Loggerhead Key. Some of these had the "float-chamber" containing a large air (?) bubble about half the diameter of the test. Murray also noted this in his fresh material. In these pelagic specimens there were often swarms of what were apparently zoospores, capable of rapid movement, but showing no flagellæ or cilia, so far as could be observed. It was suggested by Earland that these might be discharged and on rupture of the "balloon-chamber" the upper rotaliform portion might settle down to the bottom again and live on as *Discorbis* or as *Cymbalopora poeyi*. My own observations would tend to disprove this, for in all the specimens observed no protoplasmic mass was left in the rotaliform portion, this also being filled with zoospores, as was shown by crushing this part when none were observed in the "float-chamber." On crushing such specimens, numbers of zoospores came from the smaller cham-



FIGS. 2, 3.—*Tretomphalus bulloides* (d'Orbigny).

2. Dorsal side, showing change in size of pores in progressive chambers.
3. Outline of ventral side after removal of final chamber.

bers of the rotaliform portion, but no undifferentiated protoplasm. Murray has already noted that none of his pelagic specimens contained the ordinary form of protoplasm seen in the other Foraminifera. These zoospores are so minute (0.001 to 0.0015 mm.) that they could easily pass through the pores of the spherical "balloon-chamber" and to it from any part of the rotaliform portion through the apertures of the early chambers.

In connection with this, another very interesting fact was noted in regard to the coloration of the initial portion of the test. It

has been assumed by most writers that the color of the test in certain of the Rotaliidæ, for example in *Discorbis*, was due to the contained protoplasm. I had supposed that the specimens with deep color were specimens in the living condition when taken. Heron-Allen makes a similar note (loc. cit., footnote, page 257) in speaking of *Tretomphalus bulloides* as follows:

"The color varies from pure white to a deep brown, owing to the contained protoplasm, which is frequently as dark as in *Discorbina mediterranensis* (d'Orbigny) and therefore of that group."

In crushing specimens which had a series of dark-brown chambers in the rotaliform portion, I found a thin, nearly transparent brown lining that could be separated from the interior of these chambers, after which they were white. This lining seemed structureless, suggesting a chitinous character, and appeared to be the source of the color in the chambers. The specimens had not been dried and the lining was of uniform character and thickness, and could scarcely have been dried protoplasm. It may be suggested that a similar condition should be looked for in other colored Rotaliidæ, especially where the early chambers only are colored.

When the "float-chamber" was removed the under side of the rotaliform portion had the appearance shown in figure 3, very different from even the small specimens of *Cymbalopora poeyi*. The suggestion that *Tretomphalus bulloides* is a stage of *Cymbalopora*, or of *Planorbulina*, or of *Discorbis* does not seem to hold in the Tortugas region. All the pelagic specimens of *Tretomphalus bulloides* were much smaller than those of *Cymbalopora poeyi* and had a different shape and general character. The ventral side does resemble that of *Cymbalopora poeyi*, but only in a general way. It may be that these small forms are all megalospheric and are thus producing the sexual zoospores for the formation of the microspheric generation, but no specimens referable to the latter were found in the tow-nets during my stay at the Tortugas.

A peculiar character of the pores of the test was noted, as shown. The early chambers have comparatively large pores, which increase in numbers but decrease in size in the succeeding chambers until in the "balloon-chamber" they are very fine, except for the large pores at the base.

A preliminary study of abundant material of *Tretomphalus bulloides* from Samoa, collected by Dr. Alfred G. Mayor, seems to show that a very different species of the genus is developed there and that instead of *Tretomphalus* and its enlarged "balloon-chamber" being a stage in several genera, as suggested by Heron-Allen, it seems really to be a genus with several distinct species with definite distributions. This is further indicated by the second species, *Tretomphalus millettii* (Heron-Allen, and Earland), which is known from the Indo-Pacific.

Genus PLANORBULINA d'Orbigny, 1826.

Planorbulina acervalis H. B. Brady.

(Plate 6, Figure 3.)

Planorbulina acervalis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 657, pl. 92, fig. 4.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 227, pl. 46, fig. 11.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 328, pl. 72, fig. 7.—Millett, Journ. Roy. Micr. Soc., 1904, p. 490.—Rhumbler, Zool. Jahrb., Abteil Syst., vol. 24, 1906, p. 67.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 53, 1909, p. 2, pl. 1, fig. 4; vol. 54, No. 16, 1910, p. 27.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 705.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 29, pl. 14, fig. 1; fig. 32 (in text); Proc. U. S. Nat. Mus., vol. 59, 1921, p. 55, pl. 12, fig. 8.

Test typically adherent, composed of numerous chambers, early ones spiral, later ones irregularly annular, those of the periphery lobulated, the newly added chambers extending outward a considerable distance beyond the preceding ones; ventral surface often covered by a mass of small acervuline chambers; wall conspicuously porous; apertures lipped.

Diameter of the Tortugas specimens up to 3 mm.

A discussion of this species as it occurs in the West Indies has already been given in the Jamaica paper. *Planorbulina acervalis* seems to be common in the Gulf of Mexico and in the Caribbean. Whether or not this is really identical with *P. vulgaris* d'Orbigny is a question which must be left to an examination of the type. There is nothing in the Tortugas collection, any more than in that from Jamaica, which would seem to belong to *vulgaris*, unless it is material referred to *P. acervalis* H. B. Brady. There are a few very large specimens which have the chambers added on both sides, indicating that probably these specimens have become freed from their attachment and then added chambers on the whole of the exterior of the test. Such specimens remind one of *Gypsina*, but are evidently related to *P. acervalis*. As in Jamaica, *P. acervalis* is found commonly attached to the short eel-grass (*Posidonia*), which grows in quantity in shallow water in protected places.

Planorbulina mediterranensis d'Orbigny.

(Plate 6, Figures 1, 2.)

Planorbulina mediterranensis d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 280, pl. 14, figs. 4 to 6; Modèles, 1826, No. 79; Foram. Foss. Bass. Tert. Vienne, 1846, p. 166, pl. 9, figs. 15 to 17.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 656, pl. 92, figs. 1 to 3.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 227, pl. 45, fig. 18.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 53, 1909, p. 1, pl. 1, figs. 1–3; vol. 54, No. 16, 1910, p. 26.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 28, pl. 12, fig. 1; fig. 31 (in text).

Test adherent, flattened; early chambers distinctly spiral, later ones less so, often irregularly annular in their arrangement, more or less lobulated on the ventral face; periphery irregular, often angular; wall very conspicuously perforated; early chambers usually with a brownish color, later chambers grayish white; sutures depressed, often clearly marked on the dorsal face by a distinct band of shell material; aperture at either side of the chamber in the adult, simple, each with a raised lip.

Diameter of the Tortugas specimens up to 1 mm.

The original figures of this species given by d'Orbigny show an irregularly spiral test not unlike that figured in the Cuban monograph as *P. vulgaris*. The specimens, however, are not so regular as that figured by d'Orbigny. However, the specimens here figured show a distinct spiral tendency that is evidently not the same as the one referred here to *P. acervalis*. Such specimens are similar to the figure given by Goës (Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, 1882, plate 97, fig. 227), which he referred in 1896 to *P. mediterranensis* instead of *P. farcta* var. *vulgaris*, the name used in 1882. This species is far less common than *P. acervalis* in the region, occurring at but one station, and then rarely.

Genus TRUNCATULINA d'Orbigny, 1826.

Truncatulina rosea d'Orbigny.

(Plate 14, Figures 3 to 5.)

Rotalia rosea d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 272, No. 7; Modèles, 1826, No. 35.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 24, pl. 3, figs. 7 to 9.

Rotalina rosea d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 72, pl. 3, figs. 9 to 11.

Truncatulina rosea H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 667, pl. 96. fig. 1.—Flint, Bull. U. S. Fish Commission No. 484, 1900, p. 416.—Cushman, Proc. Boston Soc. Nat. Hist., vol. 34, No. 2, 1908, p. 30; Carnegie Inst. Wash, Pub. 213, 1918, p. 284; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 56, pl. 13, figs. 1 to 3.

Test biconvex, trochoid, dorsal side much convex, ventral side less so; chambers numerous, about 9 or 10 in the last-formed whorl, coarsely punctate; sutures somewhat limbate, oblique on the dorsal side, radiate on the ventral side, forming a central boss following the umbilicus; sutures not depressed, except on the ventral side, the spire of the dorsal side often ornamented with rows of beads projecting above the general surface, in some specimens rising considerably above the surface of the test; the aperture an elongate slit at the inner margin of the ventral side of the last-formed chamber, with a considerable lip developed above it; color a beautiful rose-red, especially in the earlier portion, but usually in live specimens present throughout the test.

Diameter of the Tortugas specimens up to 0.55 mm.

This species seems to be peculiar to the West Indian region, except for a record I have given for it from Woods Hole.

Egger, in 1893 (Abh. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, p. 397, pl. 16, figs. 4 to 6), recorded *T. rosea* from off West Australia, but, except for the reddish color, little in his description suggests this species, and his figures show something entirely different from this definite West Indian species.

Heron-Allen and Earland (Trans. Zool. Soc. London, vol. 20, 1915, p. 708) record this species also, in the following words:

"A few typical specimens of this species, one of the few Foraminifera characterized by pink coloration, and hitherto, with the exception of a *Gazelle* record from West Australia, known exclusively from the West Indian seas. The Kerimba specimens resemble Egger's figure more closely than d'Orbigny's Modèle, having a somewhat more depressed shell."

This statement is somewhat contradictory, for if the specimens were typical they should hardly resemble Egger's rather than d'Orbigny's forms, and it is to be suspected that another reddish species may be developed in the Indian Ocean. Possibly Heron-Allen and Earland's material may be this species, as some of the West Indian forms range as far west as that. Egger's material, however, does not seem to be this. I have already recorded it from off the Tortugas in 1918 and from the north coast of Jamaica. In Publication 213, Carnegie Institution of Washington (1919), I did not record this species in the material from the Bahamas or the eastern coast of Florida. It seems to be most common in very shallow water, where it often occurs in great numbers. Specimens were found at almost all of the Tortugas stations.

Truncatulina candeiana (d'Orbigny).

(Plate 6, Figures 7 to 9.)

Rosalina candeiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 97, pl. 4, figs. 2 to 4.
Truncatulina candeiana Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 57, pl. 13, figs. 4, 5.

Test trochoid, composed of about 2.5 coils, the last-formed coil composed of about 6 chambers, rapidly increasing in size, inflated; periphery rounded, lobulated; sutures depressed, except in the early part of the test, ventrally somewhat umbilicate, concave; wall coarsely perforate, the opening of each perforation small and surrounded by a ring of whitish thickened shell material, the remainder of the wall translucent; aperture a narrow, arched slit at the base of the last-formed chamber with a slight lip; color of the early portion dark reddish-brown, becoming lighter, and the last few chambers white.

Diameter of the Tortugas specimens usually not exceeding 0.4 mm.

This is one of the species described by d'Orbigny from Cuba. It has been neglected since that time except the reference I have made to it when recording it from the north coast of Jamaica. It has proved to be one of the most common species in the Tortugas collection, occurring at 17 of the 20 stations. It is very definite in its characters and shows very little variation. The peculiar coarse ornamentation of the wall is very characteristic and constant, and with the shape and size it should make this easily distinguished from other species. D'Orbigny's figures of this are very good, the ventral side only not being entirely typical, as a comparison of our figures will show. The chambers of the earlier coils are very indistinct, but the later ones stand out very strongly one from another. The color in living specimens is a dark brown, except the last few chambers, but in empty tests this becomes much less noticeable.

The records from Cuba, Jamaica, and the Tortugas show that *T. candeiana* is perhaps widely distributed in shallow water in the West Indian region, and possibly elsewhere.

Truncatulina antillarum (d'Orbigny).

Rosalina antillarum d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 75, pl. 5, figs. 4 to 6.
Truncatulina antillarum Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 57, pl. 13, figs. 6 to 8.

Test biconvex, trochoid, consisting of 4 coils; chambers numerous, rather indistinct on the dorsal side, 7 or 8 in the last-formed coil; sutures on the dorsal side very oblique, somewhat limbate, not depressed, if anything slightly raised, on the ventral side radiate, from a slight umbilical depression; wall thick, finely punctate, carinate; aperture an elongate, somewhat curved opening extending from the umbilicus about two-thirds of the way to the periphery on the ventral side of the last-formed chamber, with a slight, thin, overhanging lip, the chamber continuing beyond on the periphery, forming an angle in which the outer end of the aperture terminates; color white.

Diameter of the Tortugas specimens up to 1 mm.

T. antillarum was found at but two of the stations in the Tortugas collection, most abundant at station 42, in 18 fathoms, outside of the lagoon. The surface has a peculiar, waxen luster. Although the specimens show the sutures of the test much less clearly than do d'Orbigny's figures, the general characters are the same. I have already recorded this from Montego Bay. D'Orbigny's specimens were from Cuba and Jamaica, and the species is probably widely distributed in this general region. The species evidently related to this, occurred fossil in the Coastal Plain of the United States as far back as the Oligocene.

Truncatulina cora (d'Orbigny).

(Plate 7, Figures 3 to 5.)

Rosalina cora d'Orbigny, Voy. Amér. Mérid., vol. 5, pt. 5, 1839, "Foraminifères," p. 45, pl. 6, figs. 19 to 21.

Test plano-convex, dorsal side slightly convex, ventral side flattened; composed of numerous chambers, usually about 6 in the last-formed whorl; sutures on the dorsal side nearly radiate near the center, thence curving backward, on the ventral side generally radiate, but with peculiar sinuous curves; wall coarsely punctate; aperture a narrow slit on the ventral side of the last-formed chamber, extending from the periphery of the preceding coil to the umbilicus; color of the early chambers a very dark brown, gradually becoming lighter, until the last two or three are white.

Diameter of the Tortugas specimens up to 0.50 mm.

This is a species described by d'Orbigny from the coast of Peru, which seems to have had little attention paid to it since. The specimen figured by d'Orbigny is evidently somewhat abnormal, although such specimens occur, as will be seen by a reference to plate 7, figure 5. The most striking features are the very flat lower side and the peculiar sinuous curves on the sutures of the ventral side. The ventral side of the test, although each chamber is flattened, is not a single plane, each chamber level being raised slightly above the preceding. The species has not been common in the area. It seems to be related to *T. candeiana* d'Orbigny, the

dorsal side of the two being very similar, but the ventral side very different, that of *T. candeiana* being distinctly convex, while that of *T. cora* is very flat.

Truncatulina advena (d'Orbigny).

(Plate 7, Figures 6 to 9.)

Truncatulina advena d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 97, pl. 6, figs. 3 to 5.

Test plano-convex, dorsal side flattened, ventral side rounded; periphery lobulated; last-formed coil composed of about 8 chambers; sutures of the dorsal side much curved, those of the ventral side nearly radial, gently curved, depressed much more on the ventral than on the dorsal side; wall coarsely punctate; aperture close to the periphery at the inner edge of the last-formed chamber, short and somewhat arched; color very slightly brown in the inner whorls, otherwise white.

Diameter of the Tortugas specimens not exceeding 0.50 mm.

This species, described by d'Orbigny from the shore sands of Cuba and Jamaica, has occurred at several stations in the Tortugas collection. It is somewhat closely related to *Truncatulina lobatula* (Walker and Jacob), but differs in several points from that species as developed in temperate climates. The sutures in *T. lobatula* are typically limbate and the periphery carinate, but in this tropical *T. advena* such characters do not occur. From the flattened dorsal surface it would seem that the species is probably an attached one.

Genus SIPHONINA Reuss, 1849.

Siphonina pulchra Cushman.

(Plate 7, Figures 11, 12.)

Siphonina pulchra Cushman, Carnegie Inst. Wash., Pub. 291, 1919, p. 42, pl. 14, figs. 7*a* to *c*.
Siphonina reticulata Cushman (not Czjzek), Carnegie Inst. Wash., Pub. 291, 1919, p. 42.

Test in front view nearly circular, rotaliform; composed of numerous chambers in several whorls, in end view much compressed, widest in the central region, thence gradually tapering to the sub-acute periphery, chambers usually about 5 to each whorl, indistinct, except the last-formed chamber, which is somewhat more clearly defined by the slightly depressed suture, those of the other chambers being even with the surface and very indistinct; aperture exsert, with a short neck extending out from the periphery, passing into a broadly flaring lip with a distinct, extended border, aperture itself narrowly elliptical, several times as long as wide; wall of test of a darker gray with markings of a lighter color, those of the center rounded, those toward the periphery more linear.

Diameter of the Tortugas specimens up to 0.65 mm.

Numerous specimens of *S. pulchra* are in this collection from the Tortugas, but usually few from any one station. They are evidently the same as the species I have described from the marl of the gorge of the Yumuri River, Matanzas, Cuba. I also recorded from this same marl *Siphonina reticulata*, but a reexamination of these specimens and a comparison with the Tortugas ones seems to show that the young of *Siphonina pulchra* is somewhat fimbriate on the border, and the ornamentation of the test is much more coarse than in the

adult. This is lost as the test becomes larger and in the adult there is practically no coil. Both young and adult specimens are shown (plate 7, figs. 11 and 12).

Genus ANOMALINA d'Orbigny, 1826.

Anomalina edwardsiana (d'Orbigny).

(Plate 8, Figures 1, 2.)

Rosalina edwardsiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 106, pl. 6, figs. 8 to 10.

Test biconvex, unequally so, the dorsal side flatter than the ventral; periphery very slightly lobulated; the chambers visible on both sides to the center; chambers numerous, 8 or 9 in the last-formed coil, distinct, those of the ventral side with the sutures more limbate and very slightly depressed, those of the ventral side not limbate, but more depressed, wall coarsely punctate; aperture an elongate, curved slit on the ventral side of the last-formed chamber, with a slight, overhanging thin lip; color white.

Diameter of the Tortugas specimens up to 0.50 mm.

D'Orbigny described this species from Cuba and Jamaica. It has occurred at several stations in the Tortugas collection, although usually in very few numbers. In some of its characters it suggests *T. wuellerstorfi* Schwager.

Anomalina ammonoides (Reuss)?

(Plate 7, Figure 10.)

There are single specimens from two stations which seem to be at least related to this species. The figure of one of these is given. The chambers are fewer in number and the coils less than the typical form assigned to this species.

Genus PULVINULINA Parker and Jones, 1862.

Pulvinulina menardii (d'Orbigny).

(Plate 8, Figure 3, 4.)

Rotalia menardii d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 273, No. 26; Modèles, 1826, No. 10.

Pulvinulina menardii Owen, Journ. Linn. Soc. London (Zoology), vol. 9, 1867, p. 148, pl. 5, fig. 6.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 19, pt. 4, 1882, p. 112, pl. 8, figs. 289 to 295.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 690, pl. 103, figs. 1, 2.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 228, pl. 46, fig. 3.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 329, pl. 73, fig. 3.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 54, pl. 22, fig. 2.

Rotalina cultrata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 90, pl. 5, figs. 7 to 9.

Test plano-convex, compressed, dorsal side slightly convex, ventral side flat or somewhat concave, umbilicate, peripheral margin thin, slightly lobulated, carinate; chambers usually 6 in the last-formed coil; sutures somewhat depressed, especially below, on the dorsal side limbate and curved, ventrally simply depressed, straight, in a radial position; wall usually smooth and punctate, but sometimes slightly granular; aperture a rather well-developed opening at the umbilical end of the chamber, with a projecting valvular lip.

Diameter of the Tortugas specimens not exceeding 0.75 mm.

This is a rare species in the collection. It is perhaps closer to the figure given by d'Orbigny in the Cuban monograph as *Rotalina cultrata* than the broader form of the species so abundant in globigerina-ooze.

Pulvinulina incerata, new species.

(Plate 9, Figures 1 to 3.)

Test unequally biconvex, dorsal side somewhat more convex than the ventral, periphery subacute; chambers numerous, 7 or 8 in the last-formed coil; sutures oblique, rather indistinct and very slightly, if at all, depressed on the dorsal side, nearly radiate and somewhat depressed on the ventral side; wall fairly thick, finely punctate, otherwise smooth, ventrally somewhat umbilicate, the apertural face of the last-formed chamber obliquely angled; aperture elongate, at the base of the last-formed chamber; color white.

Diameter up to 1 mm.

At the single deep-water station outside the reef this species was fairly common, but elsewhere only a few specimens occur. It is rather closely related to certain of the species found fossil in the Tertiary of the Coastal Plain region.

Pulvinulina repanda (Fichtel and Moll).

(Plate 8, Figures 10 to 12.)

Nautilus repandus Fichtel and Moll, Test. Micr., 1798, p. 35, pl. 3, figs. *a* to *d*.
Rotalia repanda Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 175, No. 25.
Pulvinulina repanda Parker and Jones, in Carpenter, Parker, and Jones, Introd. Foram., 1862, p. 311.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 19, pt. 4, 1882, p. 110, pl. 8, figs. 276 to 282.—H. B. Brady. Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 684, pl. 104, figs. 18 *a* to *c*.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 95, pl. 16, fig. 801.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 328, pl. 72, fig. 8.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 50, pl. 24, fig. 3.

Test almost equally biconvex; peripheral margin acute, slightly lobulated, carinate; chambers 7 or 8 in the last-formed whorl; sutures somewhat curved above, nearly radial below, limbate on both surfaces, on the ventral side running into one another and merging at the umbilical area; wall smooth, finely punctate; aperture a slightly arched opening halfway between the umbilicus and the peripheral margin.

Diameter of the Tortugas specimens up to 1.25 mm.

This is a species which seems to be most at home in warm, shallow waters, such as are found in the Tortugas. Therefore it is not surprising to find that this is the most common species of the genus in the collection. Specimens were large and well developed, and in the last-formed chamber in the larger specimens there is a tendency somewhat to flatten out and to develop large apertures on the ventral face. The wall is thick and heavy and the sutures limbate.

Pulvinulina semipunctata, new species.

(Plate 8, Figures 5, 6.)

Pulvinulina oblonga H. B. Brady, Parker, and Jones, Trans. Zool. Soc. London, vol. 12, 1888, p. 229, pl. 46, figs. 5 *a* to *c*.

Test unequally biconvex, dorsal side more flattened than the ventral; chambers comparatively few, 7 to 10, rapidly increasing in size in the last-

formed coil, the last-formed chamber on the ventral side making up nearly half the area of the test; periphery sharply carinate; sutures depressed slightly, distinct, curved; wall very finely punctate, except the inner part of ventral side, which is of clear shell material without punctæ, wall very thin, translucent, or even transparent where no punctæ exist; aperture a small opening at the ventral side of the last-formed chamber, narrow, slightly curved.

Diameter up to 0.50 mm.

This species has occurred at four of the stations only, and then rarely. It is very similar to the figure given by Brady, Parker, and Jones in the above reference. Their specimens were found in two of the shallower soundings from the Abrohlos Bank, off Brazil. Somewhat similar forms were found in the tropical Pacific, in the Philippines, and elsewhere. They are very distinct from *Pulvinulina oblonga* Williamson, especially in the ventral side. The dorsal side is very similar to d'Orbigny's figure of *Rotalina sagra* (in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," plate 5, fig. 13), but the ventral side is very different. The wall is finely and evenly punctate, except a considerable area near the ventral angle, where it is transparent and clear. It is very few-chambered, agreeing in that respect both with d'Orbigny's specimen and that already noted off Brazil.

The species is probably widely spread in shallow water in the West Indian region and perhaps in the Indo-Pacific as well. The specimen which I have recorded from Jamaica as *Pulvinulina oblonga* is probably this same species.

Genus ROTALIA Lamarck, 1804.

Rotalia beccarii (Linnæus).

(Plate 8, Figures 7 to 9.)

"Cornu Hammonis" Plancus, Conch. Min., 1739, p. 8, pl. 1, figs. 1 A to C.

"Ammonia unita" Gaultieri, Index Test., 1742, pl. 19, figs. H, I.

Nautilus beccarii Linnæus, Syst. Nat., ed. 12, 1767, p. 1162; ed. 13 (Gmelin's), 1788, p. 3370, No. 4.

Rotalia (*Turbinulina*) *beccarii* d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 275, No. 40; Modèles, 1826, No. 74.—Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 30, pl. 3, fig. 83.

Rotalia beccarii Parker and Jones, Philos. Trans., vol. 155, 1865, p. 388, pl. 16, figs. 29, 30.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 704, pl. 107, figs. 2, 3.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 99, pl. 16, fig. 811.—Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 331, pl. 75, fig. 2.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 67, pl. 30, fig. 3.

Test almost equally biconvex, the dorsal side slightly more than the ventral; chambers numerous, 7 or 8 in the last-formed whorl; peripheral margin rounded; sutures limbate above, ventrally much depressed; toward the umbilicus the chambers separated, forming angular open spaces, the ends of the chambers extended to a point; wall smooth, finely punctate; aperture a narrow slit beneath the inner angle of the last-formed chamber, supplemented in most specimens by a nearly circular, small opening near the base of the ventral face of the last-formed chamber.

Diameter of the Tortugas specimens not over 0.35 mm.

While this has been referred to *Rotalia beccarii* (Linnæus), it may be questioned whether or not our minute tropical species, which is

usually without ornamentation, is the same as that found in the more temperate regions. D'Orbigny does not figure this form in his Cuban monograph. It was not widely distributed in the Tortugas region, being found at but three stations, two of them in the moat at Fort Jefferson, in warm, shallow, stagnant water. The other station was on Long Key, under similar conditions. It seems strange that this species, which is so abundant under these conditions, should not occur at any of the stations in deeper water. This would tend to show that this form is perhaps distinct from the ordinary *R. beccarii*.

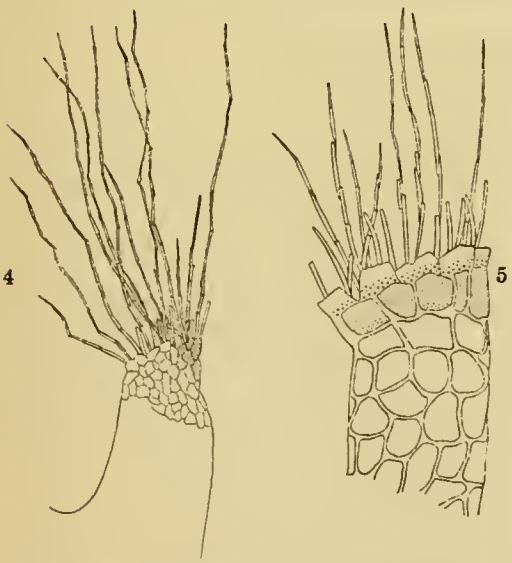
Genus HOMOTREMA Hickson, 1911.

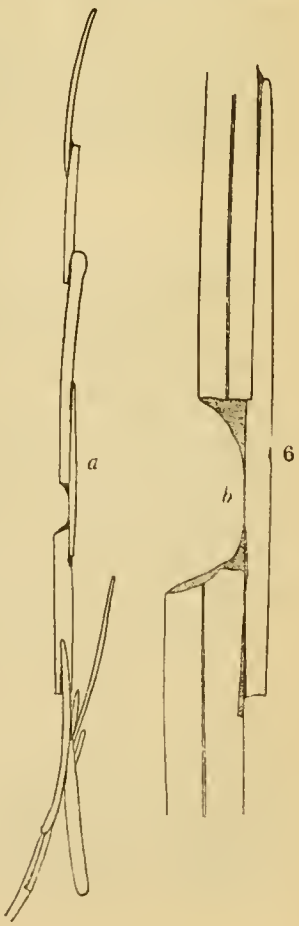
Homotrema rubrum (Lamarck).

(Plate 14, Figures 6 to 8.)

Millepora rubra Lamarck, Hist. Nat. Anim. sans Vert., vol. 2, 1816, p. 202.
Polytrema rubra Dujardin, Hist. Nat. Zooph., 1841, p. 259.—Carpenter, Parker, and Jones, Introd. Foram., 1862, p. 235, pl. 13, figs. 18 to 20.
Homotrema rubrum Hickson, Trans. Linn. Soc. London, Zoology, ser. 2, vol. 14, 1911, pp. 445, 454, pl. 30, fig. 2, pl. 31, fig. 9; pl. 32, figs. 19, 22, 28.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 729.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 364.

At one of the extreme low tides, when the old, dead reefs near Long Key were exposed, it was found that the under sides of most of





FIGS. 4 to 6.—*Homotrema rubrum* (Lamarck).

4. A raised portion, showing the plates and the long, projecting lines of spicules.
5. A more enlarged view of a younger portion, showing the relation of the plates.
6. A portion of one of the lines of spicules with the cementing substance in black.
6a. A portion of the same, enlarged, showing the areas of cement in stipple.

the coral blocks and dead shells were thickly spotted with the tests belonging to this species. In the most perfectly formed of these specimens the test is made up of a circular mass about 8 mm. in diameter, slightly raised above the surface, and with numerous apertures, one central and the others arranged in a ring above this, near the periphery. The details of the surface are very similar to those figured by Hickson. Where these specimens are protected from wear, being in cavities, the apertures are even more elongate, and living specimens have a crown of spicules about each of these, as shown (plate 14, fig. 8). The plates near the edge are more coarsely perforated than those of the main body of the test. The spicular crowns are made up of entire or broken sponge-spicules, pieced together in a peculiar manner. Some of these are shown (text-figs. 4, 5). One of these in more detail is given (text-fig. 6) and a portion of this is enlarged to show the method of cementing. These have a transparent cementing material which seems to be more or less elastic. It is difficult to determine the precise character of the material; strong acids apparently had no effect in dissolving it. With these are certain pinkish forms, apparently distinct from the deep red of the *Homotrema*, and which are very rare, compared with the deep-red form. These need careful study and comparison with similar forms from other parts of the West Indies.

Genus ASTERIGERINA d'Orbigny, 1839.

Asterigerina carinata d'Orbigny.

(Plate 9, Figures 4 to 6.)

Asterigerina carinata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 118, pl. 5, fig. 25; pl. 6, figs. 1, 2.—Cushman, Carnegie Inst. Wash., Pub. 291, 1919, p. 45; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 60, pl. 14, figs. 6 to 8.

Test unequally biconvex, coiled, the dorsal side very slightly convex, the ventral side strongly so, almost conical; chambers numerous, about 3 coils, 6 or 7 forming the last-formed coil; sutures oblique, very slightly limbate, produced to form a slight translucent keel; sutures curved and oblique on the dorsal side, on the ventral side the supplementary chambers extending nearly to the periphery, forming rhomboid areas; sutures distinct, very slightly depressed; wall smooth, finely punctate and usually glistening, often somewhat roughened by lines of small granules near the aperture, which is an elongate, narrow slit, extending from the umbilical region about halfway to the periphery, and usually with a slight, thin lip.

Diameter of the Tortugas specimens not usually exceeding 0.6 mm.

This is described by d'Orbigny from the shore sands of Cuba and Jamaica and I have recorded it from Jamaica and from the Miocene of Santo Domingo, from Bluff 2, Cercado de Mao, and it extends as far north as Cape Hatteras and probably is widely distributed in the West Indian region. Brady did not place the species of *Asterigerina* as synonyms in the *Challenger* report, but mentions them as "probably related to *Amphistegina*." They do have somewhat the

characters of that genus in the supplementary chambers on the ventral side and a peculiar roughened character near the aperture. The supplementary chambers, however, seem to be definite and a part of the test itself, in which they seem to be very different from the development seen on the ventral side of *Discorbis* and other genera with which they have been compared.

The genus *Asterigerina* goes back in the Coastal Plain region at least to the lower Oligocene.

A. carinata is one of the few species that occurred at all the stations here recorded.

Family NUMMULITIDÆ.

Genus NONIONINA d'Orbigny, 1826.

Nonionina grateloupi d'Orbigny.

(Plate 9, Figures 7, 8.)

Nonionina grateloupi d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 294, No. 19; in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 46, pl. 6, figs. 6, 7.—Cushman, Carnegie Inst. Wash., Pub. 291, 1919, p. 48; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 61, pl. 14, figs. 9 to 11.

Test coiled, plano-spiral, the sides equally biconvex, in front view the sides of the chamber almost parallel throughout their length; periphery broadly rounded; chambers numerous, 10 to 12 usually in the last-formed coil in adult specimens, chambers increasing in length rapidly in the last-formed portion, distinct; sutures slightly depressed; wall smooth, finely punctate; aperture small, at the base of the last-formed chamber; color white.

Length of the Tortugas specimens up to 0.60 mm.

N. grateloupi was originally described by d'Orbigny from Cuba, Jamaica, and Martinique. I have recorded it from the marl, gorge of Yumuri River, Matanzas, Cuba, and from Santo Domingo, Bluff 3, Cercado de Mao; I have also recorded it from stations in Montego Bay, on the north coast of Jamaica. All the Nonioninas in the Tortugas collection can be referred to this one species. There is some variation in the form of the test and in the side view, according to whether it has begun to pile up chambers in a straight line in the adult or whether it is still adding to its length. A series of figures showing this development are here given. The most constant character distinguishing this species is the front view, which shows the rounded periphery and the sides of the test nearly parallel. It is common at most of the stations from which the material was obtained.

Genus POLYSTOMELLA Lamarck, 1822.

Polystomella poeyana d'Orbigny.

(Plate 9, Figures 9, 10.)

Polystomella poeyana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 55, pl. 6, figs. 25, 26.

Test equally biconvex, composed of numerous chambers, 8 to 12 in the last-formed coil, each inflated; the periphery somewhat lobulate, especially in the last-formed portion, periphery in apertural view broadly rounded,

retral processes small and numerous in the depressed sutural lines; umbilical region depressed, but without any secondary development of shell material; wall thin, translucent, finely punctate; aperture a row of small pores at the base of the apertural face of the chamber.

Diameter usually not exceeding 0.60 mm. in the Tortugas specimens.

D'Orbigny described this species from the shore sands of Cuba and Jamaica. Some of the specimens which I have recorded from the north coast of Jamaica (Proc. U. S. Nat. Mus., vol. 59, 1921, p. 62) as *Polystomella* cf. *P. striato-punctata* are undoubtedly *P. poeyana*. This differs from the ordinary *P. striato-punctata* of higher latitudes.

Polystomella discoidalis d'Orbigny.

(Plate 10, Figures 3, 4.)

Polystomella discoidalis d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 76, pl. 6, figs. 23, 24.

Test equally biconvex; periphery subacute; umbilical region with a fairly large boss of clear shell material projecting beyond the general contour of the test; chambers numerous, 10 to 14 in the last-formed coil; the periphery slightly lobulated in the last-formed portion; sutures little, if at all, depressed, retral processes short and numerous; wall translucent, with very numerous, closely set punctæ, the central boss clear, with a very few large punctæ; aperture consisting of a row of very small circular openings at the base of the apertural face.

Diameter of the Tortugas specimens up to 1 mm.

P. discoidalis was described by d'Orbigny from shore sands of Cuba and Jamaica, where it was common. Next to *P. poeyana*, it is the most common species of the genus in the Tortugas region.

This seems related to the much more highly developed *P. craticulata* (Fichtel and Moll), which is especially characteristic of the East Indian region.

Polystomella macella (Fichtel and Moll) var.

(Plate 10, Figures 1, 2.)

I have referred to this species numerous specimens from the Tortugas region which have the subacute periphery and the retral processes longer than the intermediate portion of the chamber, but the entire test is less developed than in most specimens referred by authors to this species. This may be a varietal form of *P. macella*, or it may be a new species in this region. Similar specimens are found in the warmer waters off New Zealand and elsewhere.

The specimens which I have referred to *P. crispa* from the Miocene of the Coastal Plain (Bull. 676, U. S. Geol. Survey, 1918, pl. 27, figs. 5 *a*, *b*) are probably the same as these recent ones from the Tortugas.

Polystomella advena, new species.

(Plate 9, Figures 11, 12.)

Polystomella subnodosa H. B. Brady (not Münster), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 734, pl. 110, figs. 1 *a*, *b*.—Chapman, Journ. Linn. Soc. London, Zoology, vol. 28, 1902, p. 203.—Millett, Journ. Roy. Micr. Soc., 1904, p. 604.—Bagg, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 165.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 733.

Test equally biconvex; periphery acute, with a narrow carina, somewhat lobulate; umbilical region depressed, with a small central boss of clear shell material, not extending out to the general contour of the test; retral processes about one-fourth the width of the chamber, in depressed channels above the sutures, the intermediate portions being raised, inflated, gradually increasing in width toward the periphery; wall smooth, translucent, with very minute punctæ; aperture a series of small rounded pores at the base of the apertural face of the chamber.

Diameter up to 0.50 mm.

P. advena, while not as common in this region as the two preceding species, has nevertheless been found at several stations. That it is not the same as Münster's *Robulina subnodosa* will be seen by a comparison of our species with the figures of the type of Münster. While his figures are very small, the general contour of the test in apertural view shows the great difference between these two species. Münster's figure shows a test rhomboid in apertural view, with the greatest width at the umbilical region, while in our species the umbilical region is depressed. The specimens in the Tortugas region are very constant in their characters. The specimens referred to *Polystomella subnodosa* from the general Indo-Pacific region are probably either *P. advena* or a closely allied species.

Genus AMPHISTEGINA d'Orbigny, 1826.

Amphistegina lessonii d'Orbigny.

Specimens of *Amphistegina* are abundant at many of the stations in the Tortugas collection. D'Orbigny referred the West Indian *Amphistegina* to his species *Amphistegina gibbosa*. Many of the specimens from this region are thicker than is typical of those of some parts of the East Indies. A careful study of abundant material from the two general regions may show that there are distinctions which are constant in their character. The West Indian specimens are all comparatively small, none exceeding 2 mm. in diameter.

Genus HETEROSTEGINA d'Orbigny, 1826.

Heterostegina antillarum d'Orbigny.

(Plate 10, Figure 5.)

Heterostegina antillarum d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 121, pl. 7, figs. 24, 25.

There are single specimens from two stations which are *Heterostegina* and may be referred to d'Orbigny's species, although they are not so fully developed as shown in his type figure. *Heterostegina* in the present oceans is limited to warm, shallow waters, such as are characteristic of coral reefs. The development in the tropical Atlantic is very small compared to that of the Indo-Pacific, although in the Eocene of the West Indian region there is a fine development of the genus.

It is worthy of note here that these two specimens were from the two stations where the temperature is abnormally high for the region.

Family MILIOLIDÆ.

Genus CORNUSPIRA Schultze, 1854.

Cornuspira involvens (Reuss).

Operculina involvens Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 370, pl. 45, fig. 20
Cornuspira involvens Reuss, Sitz. Akad. Wiss. Wien, vol. 48, 1863 (1864), p. 39, pl. 1, fig. 2.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 200, pl. 11, figs. 1 to 3.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 216, pl. 40, figs. 1 to 3.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 25, pl. 1, fig. 2; pl. 2, fig. 2; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 62.

Although *C. involvens* occurs at numerous stations, all the specimens are of small size and there is nothing at all to compare with the species as it is developed in the warm coral-reef region of the Indo-Pacific. Both microspheric and megalospheric specimens occur, the former with three to four coils, the latter usually with not more than two.

Genus NUBECULARIA Defrance, 1825.

Nubecularia antillarum, new species.

Test attached, early portion consisting of a proloculum and one or two chambers, forming a single coil, the main portion of the test consisting of an irregular branching tube, slightly convex, with an irregular periphery, spreading over the surface of the test to which it is attached; aperture at ends of the branches.

N. antillarum was first noted attached to *Posidonia* from Montego Bay, Jamaica, in 1912. In the Tortugas region it was found to be

FIGS. 7, 8.—*Nubecularia antillarum*, new species.

7. Outline of a medium-sized specimen from above, showing the miliolid young and the later branching of the chambers.
8. Ventral view of a young specimen, showing the relation of the early chambers and the beginning of the branching.

very abundant under similar conditions. It is perhaps most like *Nubecularia tubulosa* Heron-Allen and Earland (Trans. Zool. Soc. London, vol. 20, 1915, p. 548, pl. 40, figs. 1 to 5), but it differs, especially in the early development, their specimens showing a spiral young, while in our specimens there is usually nothing more than a

proloculum and second Cornuspira-like chamber which is found throughout the early stages of the Miliolidæ, from which the irregular tubes are developed. These tubes are broad and flattened, and may reach to a considerable extent, at least several millimeters. Specimens were found in all stages of development, especially on the newer portion of the leaves of *Posidonia*. It is usually one of the first organisms to be attached to the leaf, and its growth must be rapid.

Genus NODOBACULARIA Rhumbler, 1895.

Nodobacularia tibia (Jones and Parker).

(Plate 11, Figure 1.)

Nubecularia tibia Jones and Parker, Quart. Journ. Geol. Soc., vol. 16, 1860, p. 455, pl. 20, figs. 48 to 51.—H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 52, pl. 8, figs. 1, 2; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 135, pl. 1, figs. 1 to 4.
Nodobacularia tibia Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 39, pl. 8, figs. 1, 2.

The only specimen of *N. tibia* is a fragmentary one, showing the last two chambers with the aperture. The chambers, however, seem to be typical and show the occurrence of the species in this region.

Genus FISCHERINA Terquem, 1878.

Fischerina dubia (d'Orbigny).

(Plate 10, Figures 6, 7.)

Rotalina dubia d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 91, pl. 2, figs. 29, 30; pl. 3, fig. 1.

Test composed of a few coils, the early portion undivided, the last-formed coil divided into 4 or 5 chambers, all visible from the dorsal side, from the ventral only those of the last-formed coil visible, as the chambers extend into the middle at the umbilical region; ventral side somewhat concave, dorsal side convex; sutures distinct; wall thin and translucent; aperture at the end of the last-formed chamber, usually circular.

Diameter of the Tortugas specimens up to 0.30 mm.

Recent specimens of *Fischerina* seem to be limited mainly to the Indo-Pacific. A comparison of d'Orbigny's figures in the Cuban monograph will show that his *Rotalina dubia* really belongs to *Fischerina* and, allowing for reasonable differences in the figures, our specimens from the Tortugas are undoubtedly the same as those d'Orbigny had from the shore sands of Cuba and Jamaica. D'Orbigny's specimens evidently did not show the aperture, as his figure does not show this feature and his description refers to it with a question mark. From the ventral side *Fischerina dubia* is nearest to *F. helix* Heron-Allen and Earland, which they described from the Kerimba Archipelago. It is not common at the Tortugas.

Genus SPIROLOCULINA d'Orbigny, 1826.

Spiroloculina grateloupi d'Orbigny.

Spiroloculina grateloupi d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 298.—Terquem, Mém. Soc. Géol. France, ser. 3, vol. 1, 1878, p. 52, pl. 5, figs. 5, 6.—Wiesner, Arch. Prot., vol. 25, 1912, p. 208.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 31, pl. 4, figs. 4, 5; Proc. U. S. Nat. Mus., vol. 56, 1919, p. 634; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 396, pl. 78, figs. 4 *a*, *b*; pl. 100, fig. 3; figs. 17, 18 (in text).
Spiroloculina excarata H. B. Brady (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 151, pl. 9, figs. 5, 6.

Test elongate, broadest in the center, tapering toward either end; chambers rapidly thickening as added, in end view the periphery much the broadest portion of the test, central portion deeply excavated; periphery of the chambers in end view much convex, especially in the central portion, the edges broadly rounded; chambers evenly curved, the final chamber somewhat projecting, both at the base and at the apertural ends, the latter having a decided neck with a phialine lip, the aperture itself rounded and with either a single tooth with a bifid end, the two projections forming a concave extremity, or in some cases a pair of such bifid teeth opposite one another; surface of the test dull, somewhat roughened.

Length of the Tortugas specimens not exceeding 1 mm.

This species is not nearly so well developed in the West Indian region as it is in the East Indies. Specimens are smaller and not nearly so deeply excavated. It has occurred at a few stations, but not in any great numbers.

Spiroloculina planulata (Lamarck).

Miliolites planulata Lamarck, Ann. Mus., vol. 5, 1805, p. 352, No. 4.

Spiroloculina planulata Macdonald, Ann. Mag. Nat. Hist., ser. 2, vol. 20, 1857, p. 153, pl. 6, fig. 28.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 148, pl. 9, figs. 11 *a*, *b*.—H. B. Brady, Parker, and Jones, Trans. Zool. Soc., vol. 12, 1888, p. 214, pl. 40, figs. 14, 15.

Test irregularly elliptical; periphery concave, especially in the last-formed chambers, initial end of the chamber projecting considerably beyond the aperture of the previous-formed one, the apertural end very slightly, if at all, projecting, side view concave; sutures distinct; surface matt; aperture with a slight lip and an elongate tooth, slightly bifid at the tip.

Length of the Tortugas specimens not exceeding 1 mm.

The Tortugas specimens are very similar to that figured by Brady, Parker, and Jones in the above reference (plate 40, fig. 15). *S. planulata* is not as common in the Tortugas region as some of the other species, occurring at but 4 stations, and in few numbers.

Spiroloculina ornata d'Orbigny.

(Plate 10, Figure 9.)

Spiroloculina ornata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 150, pl. 12, figs. 7, 7 *a*.

Test elongate, compressed, concave in side view, the apertural end projecting to a considerable distance beyond the rest of the test; the last-formed chamber, and sometimes the one before, ornamented with a secondary costa, running from near the apertural end backward near the inner angle of the chamber; aperture quadrangular, with a single narrow tooth; surface smooth, shining.

Length of the Tortugas specimens up to 1 mm.

D'Orbigny described *S. ornata* from shore sands of Cuba, but the name has been allowed to lapse since. I found a single specimen in the material from the north coast of Jamaica which seemed close to this species, and specimens even more like d'Orbigny's figure and description have occurred from several of the Tortugas stations, not, however, in any numbers at any one station.

Spiroloculina eximia, new species.

(Plate 11, Figure 2.)

Test elongate, elliptical, periphery convex, the opposite faces concave, ends of the chamber projecting; sutures fairly distinct, the outer angle of each chamber projecting above the inner portion of the adjacent next-formed chamber; wall with a granular, dull surface; apertural end with a projecting cylindrical neck, circular, with a single, very thin, slightly bifid tooth.

Length in most specimens not exceeding 0.50 mm.

S. eximia may be distinguished from all the other species in the Tortugas region by its peculiar surface, which is coarsely granular and dull. It somewhat resembles the form I have described as *S. grateloupi* var. *incisa*, but differs from that in the smaller size and the peculiar character of the surface.

Spiroloculina caduca, new species.

(Plate 11, Figures 3, 4.)

Test broadly elliptical, much compressed, the apertural end extended; chambers of the adult with a sharp translucent keel, usually somewhat lobulated; sutures slightly depressed, surface of the chambers with irregular raised costæ, more or less oblique in position; aperture at the end of the cylindrical neck, rounded, with a simple tooth; surface smooth, shining, but the wall very thin and brittle.

Length up to 0.80 mm.

This species, although it occurred at but two stations, is rather constant in its general characters. It has an extremely brittle test, and the peripheral keel is very thin.

Spiroloculina antillarum d'Orbigny.

Spiroloculina antillarum d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 166, pl. 9, figs. 3, 4—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 155, pl. 10, figs. 21 *a*, *b*.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 407, pl. 81, figs. 4 *a*, *b*; pl. 83, fig. 4?

Test elongate, elliptical; chambers nearly circular in cross-section; surface ornamented by numerous longitudinal costæ, often slightly oblique, both ends of the chamber projecting and the intermediate portions thus left either filled by a plate of clear material or occasionally open; apertural end projecting and forming a cylindrical neck with a slight lip and a single tooth, sometimes bifid at the tip.

Length of the Tortugas specimens up to nearly 1 mm.

S. antillarum, which was described by d'Orbigny from shore sands of Cuba, has proved to be common in this general region and is probably widespread in the Indo-Pacific. As I have noted previously, it has probably been recorded by many authors under the name *Spiroloculina grata* Terquem, which Brady took as the name for our recent species, and which has since been followed by many authors. It is a species characteristic of warm, shallow water, especially associated with coral-reef conditions.

Spiroloculina antillarum d'Orbigny var. angulata Cushman.

Spiroloculina grata H. B. Brady (in part), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884 pl. 10, figs. 22, 23.
Spiroloculina grata Terquem var. *angulata* Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 36, pl. 7, fig. 5.
Spiroloculina antillarum d'Orbigny var. *angulata* Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 408, pl. 81, figs. 5*a*, *b*.

This variety differs from the typical in the angular form of the chamber instead of the more or less cylindrical form characteristic of the typical. It is usually associated with the typical where found.

Spiroloculina arenata Cushman.

Spiroloculina arenata Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 63, pl. 14, fig. 17.

Test compressed; chambers in a single plane, each much greater in diameter at the initial end, gradually narrowing to the aperture, both ends projecting beyond the ends of the preceding chamber; apertural end produced into a rounded neck, periphery broadly rounded; sutures deep and distinct; wall of sand-grains rather coarse for the size of the test; aperture rounded.

Length of the Tortugas specimens 0.50 to 0.75 mm.

This species, which I described from collections from the north coast of Jamaica, at Montego Bay, in shallow water, is very common in the Tortugas region, occurring at nearly all the stations, often in considerable numbers. It is rather constant in its characters, both at the Tortugas and in Jamaica, and probably is widely distributed in the West Indian region in shallow water.

Genus PLANISPIRINA Seguenza, 1880.

Planispirina auriculata Egger.

(Plate 10, Figure 8.)

Planispirina auriculata Egger, Abh. Kön. Bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 245, pl. 3, figs. 13 to 15.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 590, pl. 46, figs. 3 to 7.

Test minute, generally oval in outline, biconvex, consisting of a few milioline chambers, the apertural end somewhat extended, turned so that the aperture is entirely at one side of the test; aperture elliptical or rounded, with a broad, flaring lip; sutures fairly distinct, not depressed, wall translucent; color bluish-white.

Length of the Tortugas specimens up to 0.20 mm.

Single specimens of this species occur at two stations in the region, and it must have a fairly wide range, as I have had specimens from Dr. C. H. Edmondson from as far north as the Beaufort region of North Carolina. Egger's specimens were from off Mauritius and western Australia, those of Heron-Allen and Earland from the Kerimba Archipelago, off the eastern coast of Africa.

Genus VERTEBRALINA d'Orbigny, 1826.

Vertebralina cassis d'Orbigny.

Vertebralina cassis d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 51, pl. 7, figs. 14, 15.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 64, pl. 15, figs. 1, 4 (not 2, 3, 5 to 8).

Test compressed, for the most part plano-spiral; periphery of each chamber with a broad, thin keel, 2 to 3 chambers in the last-formed coil, the main

body of each chamber with numerous, somewhat oblique costæ, the last-formed chamber often projecting beyond the periphery of the preceding coil, but carinate, like the earlier ones; aperture elongate, with a distinct, everted lip; early chambers, where visible, spiroloculine.

Diameter of the Tortugas specimens up to or slightly exceeding 1 mm.

D'Orbigny described this species from the shore sands of Cuba. Brady placed it as a synonym of *Articulina sagra* d'Orbigny. A study of these carinate specimens, however, shows that they are really *Vertebralina* and not *Articulina*. In the Tortugas region this species is very distinct from the following and may be specifically or even generically different. *Vertebralina cassis* does not tend to form a linear series of chambers, usually a single one in the adult being all that follows the close-coiled development, and this does not usually have the decided backward extension of the lip as in the following variety. While not as common as the following, this species has occurred at several stations in the area.

Vertebralina cassis d'Orbigny var. mucronata d'Orbigny.

Vertebralina mucronata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 72, pl. 7, figs. 16 to 19; Foram. Foss. Vienne, 1846, p. 120, pl. 21, figs. 18, 19.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 64, pl. 15, figs. 2, 3, 5 to 8 (not 1, 4).

Test of the early portion close-coiled, usually without a carina, the uncoiled portion consisting in the adult usually of 2 chambers, compressed, the last one much broader than the preceding, the apertural end with an everted lip extending back on both sides to a recurved projection; surface ornamented with numerous raised costæ, somewhat shiny; color white.

Length of the Tortugas specimens usually not exceeding 1 mm.

This is one of the common species of the region and fits very closely d'Orbigny's original figure of the adult (plate 7, fig. 16). Although I have placed this as a variety of *Vertebralina cassis*, it may be that this should be placed under *Articulina* as a distinct species. While the later chambers are compressed, the earlier ones, as a rule, are triloculine, which would seem to prove that this is really an *Articulina*. The mass of the test is made up of uniserial chambers, whereas in *V. cassis* there is a single chamber which is merely an addition to the much larger coiled part.

I have recorded both of these from the north coast of Jamaica under the name *Vertebralina cassis*. Brady placed both of these under *Articulina sagra* d'Orbigny, which seems, from a study of the Tortugas material, to be distinct from either of them.

Genus QUINQUELOCULINA d'Orbigny, 1826.

Quinqueloculina agglutinans d'Orbigny.

Quinqueloculina agglutinans d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 195, pl. 12, figs. 11 to 13.

Test longer than broad; wall, at least on the exterior, composed of agglutinated sand-grains, forming a roughened surface; the periphery of the chambers broadly rounded; sutures fairly distinct; aperture slightly extended into a subcylindrical neck which, in well-preserved specimens, has 2 teeth extend-

ing in toward the center from opposite sides, each thickened toward the end, lip slightly everted, thin.

Length of largest Tortugas specimens 1.25 mm.

Q. agglutinans is very common in the region and is very similar to the specimens figured by d'Orbigny. His specimens were from Jamaica and Cuba, and I have found it to be common in the general West Indian region. Many different forms have been referred to this species by authors since d'Orbigny's time, but in the West Indies at least there is a well-defined species which should bear this name. Specimens occurred at every one of the 20 stations in the Tortugas region.

Quinqueloculina bidentata d'Orbigny.

Quinqueloculina bidentata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 197, pl. 12, ; figs. 18 to 20.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 65, pl. 15, figs. 11, 12.

Test somewhat longer than broad; chambers distinct; periphery squarely truncate; wall composed of rather coarse sand-grains; apertural end projecting, with a slightly thickened lip; aperture with a thin tooth with a broad, bifid tip.

Length of largest Tortugas specimens 1.5 mm.

This species originally described by d'Orbigny from Cuba, was found to be frequent at Runaway Bay, on the north coast of Jamaica, and has occurred at several stations in the Tortugas, although it is not nearly so common as *Quinqueloculina agglutinans.*

Quinqueloculina alveoliniformis (H. B. Brady).

Miliolina alveoliniformis H. B. Brady, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 268; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 181, pl. 8, figs. 15 to 20.

Quinqueloculina alveoliniformis Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 43; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 443; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 64.

This is a species of coral-reef areas, in warm, tropical waters. The specimens from the West Indies are thicker and not so elongate nor so large as is characteristic of similar conditions in the East Indies and in the Philippines. It may be that this is a distinct variety in the West Indian region. Although found at several stations, it is never common, so far as the Tortugas collection shows.

Quinqueloculina lamarckiana d'Orbigny.

Quinqueloculina lamarckiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 189, pl. 11, figs. 14, 15.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 65, pl. 15, figs. 13, 14.

Quinqueloculina auberiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 193, pl. 12, figs. 1 to 3.

Quinqueloculina cuvieriana H. B. Brady (not d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 162, pl. 5, figs. 12 *a* to *c*.

Test nearly as broad as long; chambers distinct; sutures slightly depressed; chambers generally triangular in transverse section, the angles subacute but not carinate; wall smooth and shiny; apertural end of the chamber slightly extended, forming an elliptical neck without a definite lip, but with a narrow elongate tooth.

Length of the Tortugas specimens up to 1 mm.

D'Orbigny's *Q. lamarckiana* can hardly be distinguished from *Q. auberiana*, although the latter name has been more commonly used. In the Tortugas material this species is often abundant, and consists of two forms. In one of these the angle of the test is acute, the surface smooth and very shiny. In the other the angle is blunt or even slightly truncate, and the surface dull. It may be that these represent two distinct species in the region. Brady evidently confused this with *Q. cuvieriana*, which has supplementary carinæ near the peripheral angle of the test. This species, as figured in the *Challenger* Report, lacks these. D'Orbigny described *Q. lamarckiana* from Cuba and Jamaica, and his records for *Q. auberiana* are from Cuba and Martinique. I have had the species from the north coast of Jamaica, and it is apparently widespread in the West Indian region, and perhaps in the Indo-Pacific.

Quinqueloculina lævigata d'Orbigny.

(Plate 13, Figure 2.)

Quinqueloculina lævigata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 301, No. 6; in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, 1839, vol. 2, pt. 2, "Foraminifères," p. 143, pl. 3, figs. 31 to 33.

At a number of stations there are elongate, smooth specimens with a shining surface which may be referred to *Q. lævigata* d'Orbigny. They are as a rule larger than *Triloculina oblonga* (Montagu), which they somewhat resemble, but the chambers are more uniform in their width and the specimens are *Quinqueloculina*.

Quinqueloculina candeiana d'Orbigny.

(Plate 13, Figure 1.)

Quinqueloculina candeiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 170, pl. 12, figs. 24 to 26.

Test nearly twice as long as broad; chambers distinct from one another; sutures sharply marked; chambers triangular in transverse section, the periphery sharply keeled; wall smooth, shiny; aperture comparatively small, with a simple tooth, extending somewhat above the outline of the aperture.

Average length of the Tortugas specimens 0.60 mm.

These specimens seem to be identical with that described by d'Orbigny in the Cuban monograph. The angled periphery of the chambers stands out sharply and, with its outline, distinguishes it from any other species in the region.

Quinqueloculina columnosa, new species.

(Plate 10, Figure 10.)

Miliolina cuvieriana Heron-Allen and Earland (not d'Orbigny), Trans. Zool. Soc. London, vol. 20, 1915, p. 571, pl. 4, figs. 33 to 36.

Test slightly longer than broad; chambers somewhat indistinctly marked from one another, the periphery angled and projecting, the last-formed chamber extending out beyond the outline of the test at both ends; chambers somewhat undulate; wall smooth, dull; apertural end much contracted, ex-

tended to form a narrow, cylindrical neck with a small, rounded aperture; lip indistinct.

Length of largest specimens up to 1 mm.

This is very close, if not identical, with the specimens figured by Heron-Allen and Earland from the Kerimba Archipelago and referred by them to d'Orbigny's *cuvieriana*. The specimens have a peculiar outline, very contracted apertural end, and an undulate, projecting, somewhat angled aperture.

Quinqueloculina poeyana d'Orbigny.

Quinqueloculina poeyana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 191, pl. 11, figs. 25 to 27.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 67, pl. 16, figs. 7, 8.

Test two to three times as long as broad; chambers distinct; sutures slightly depressed; periphery rounded; surface ornamented by numerous longitudinal costæ, running from the base of the chamber to the apertural lip; apertural end slightly extended, very slightly, if at all, constricted, lip slight; aperture circular, with a single narrow tooth, somewhat slightly bifid at the tip.

Length of the Tortugas specimens 0.60 mm.

This is one of the Cuban species which Brady did not place as a synonym in the *Challenger* Report. Both in the collections from the north coast of Jamaica and in that from the Tortugas region it is fairly common, and is very constant in its characters, agreeing well with the figures of d'Orbigny, except for the size of the aperture, which is not nearly so small in our specimens as figured by d'Orbigny.

Quinqueloculina subpoeyana, new species.

Test elongate, about 2.5 times as long as wide; chambers distinct; the apertural end projecting a considerable distance beyond the outline of the test; the peripheral border rounded; surface ornamented by numerous longitudinal costæ which, instead of being uniform, are usually irregularly toothed throughout, giving a peculiar roughened appearance to the test; costæ continued to the aperture, which is very slightly contracted, with a very thin lip, with a single tooth; surface dull.

Length up to 0.60 mm.

Q. subpoeyana may be distinguished from *Q. poeyana* by its more open form, much more extended apertural end, and especially by the character of the surface, the uneven-toothed costæ giving it a very unique appearance. This character is constant in the many specimens examined. It is one of the characteristic species of the collection, occurring at most of the stations.

Quinqueloculina costata d'Orbigny.

(Plate 11, Figure 5.)

Quinqueloculina costata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 301, No. 3.—Terquem, Mém. Soc. Géol. France, ser. 3, vol. 1, 1878, p. 63, pl. 6 (11), figs. 3 *a* to 5 *c*.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 49, pl. 15, fig. 1.

Miliolina costata Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 579, pl. 44, figs. 9 to 12.

A few specimens may be referred to this species. It is also known from the Mediterranean (d'Orbigny), from the Kerimba

Archipelago, the Friendly Islands (Heron-Allen and Earland), and from off Hawaii (Cushman). It is distinct from *Q. poeyana*, as a comparison of the figures will show.

Quinqueloculina striata d'Orbigny.

Quinqueloculina striata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 301, No. 4.—Terquem, Mém. Soc. Géol. France, ser. 3, vol. 2, Mem. 3, 1882, p. 184, pl. 20 (28), figs. 10 to 12.

Miliolina striata Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 579, pl. 44, figs. 13 to 17.

There are numerous specimens of *Q. striata* from station 23, on the outer side of Loggerhead Key, inside the main reef, which resemble specimens figured by Heron-Allen and Earland from the Kerimba Archipelago. They have not occurred at the other stations, so far as I have seen.

Quinqueloculina funafutiensis (Chapman).

(Plate I3, Figure 3.)

Miliolina funafutiensis Chapman, Journ. Linn. Soc. London, Zoology, vol. 28, 1902, p. 178, pl. 19, fig. 6; Proc. Zool. Soc. London, vol. 1, 1902, p. 231.—Heron-Allen and Earland (?), Trans. Zool. Soc. London, vol. 20, 1915, p. 566, pl. 42, figs. 21, 22.

There are a few specimens very close to the original figure of this species given by Chapman. They are triangular in transverse section and have a surface ornamentation similar to his type specimen. The figure given by Heron-Allen and Earland, as they note, is not typical. Chapman's types were from the lagoon at Funafuti, and he also recorded it from the Cocos Keeling Atoll. Heron-Allen and Earland record typical specimens from Apia Harbor, Samoa, 7 fathoms.

Quinqueloculina bradyana Cushman.

Miliolina undosa H. B. Brady (not *Quinqueloculina undosa* Karrer), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 176, pl. 6, figs. 6 to 8.

Quinqueloculina bradyana Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 52, pl. 18, fig. 2; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 66.

Test stout, usually but slightly longer than broad; chambers angular, more or less plicated laterally, the outer peripheral angle usually sinuous, the early ones very prominently so; apertural end rarely extended to any considerable length; aperture usually narrow, with a simple tooth.

Length of the Tortugas specimens up to 0.75 mm.

Characteristic specimens have occurred at a few stations. They are similar to the ones I have had from the north coast of Jamaica, and seem similar to those from Hawaii and elsewhere.

Quinqueloculina tricarinata d'Orbigny.

Quinqueloculina tricarinata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 187, pl. 11, figs. 7 to 9, 11.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 68, pl. 16, figs. 11, 12.

Test elongate, the last-formed chamber extending out beyond the rest of the test at either end; in young specimens the chambers have three distinct carinæ, but in the adult specimens there is a more or less irregular condition, due to obliquely transverse costæ dividing up that part of the test into irregular areas; apertural end extending out into a narrow, cylindrical neck, usually with a slight lip and a single tooth, which may become bifid at the end.

Length of the largest Tortugas specimens slightly more than 1 mm.

As I have already noted in a previous paper, *Q. tricarinata* seems related to *Q. kerimbatica* (Heron-Allen and Earland), which they described from the east coast of Africa. D'Orbigny's specimens were from Cuba and Jamaica, and I found specimens which could be referred to this species in the collection from the north coast of Jamaica. Specimens apparently either identical or closely allied to this occur in the Tertiary of Santo Domingo.

Quinqueloculina cf. Q. kerimbatica Heron-Allen and Earland var. philippinensis Cushman.

From 3 stations there are a few specimens which in their general character of ornamentation resemble a variety I have described from the Philippines (Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 438, plate 89, figs. 2, 3). They have a reticulate periphery on each chamber, but the sides are smooth and unornamented.

Quinqueloculina parkeri (H. B. Brady) var. occidentalis Cushman.

(Plate 12, Figure 2.)

Quinqueloculina parkeri (H. B. Brady) var. *occidentalis* Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 69.

Test differing from the typical in the great number of fine, transverse or slightly oblique ridges or crenulations, and the tendency for the chambers to become squarely truncate or even tricarinate.

Length of the Tortugas specimens up to 0.60 mm.

This variety, which I described from the north coast of Jamaica, occurs also in the Tortugas collections, but is rare. It does not reach so large a size as the typical form, and the ornamentation differs also.

Quinqueloculina polygona d'Orbigny.

Quinqueloculina polygona d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 198, pl. 12, figs. 21 to 23.

Test somewhat longer than broad; chambers distinct; sutures slightly depressed; each chamber polygonal in cross-section, the periphery usually concave, with a projecting carina at either angle; apertural end extending into a short, cylindrical neck, aperture circular with an everted lip, and a single bifid tooth; surface usually dull.

Length of the largest Tortugas specimens 0.75 mm.

This species was originally described by d'Orbigny in Jamaica and Cuba, and both in the material I have had from the north coast of Jamaica and this lot of bottom samples from the Tortugas it is common and in the same form as that described and figured by d'Orbigny. It is evidently a species of wide distribution in the West Indian region. Brady places *Q. polygona* as a synonym of *Q. ferussacii* d'Orbigny, but if the original figures of these two species as given by d'Orbigny are compared they seem to have little in common, and it seems as though *Q. polygona* was a well-characterized species in this region.

Quinqueloculina dilatata d'Orbigny.

(Plate 12, Figure 2.)

Quinqueloculina dilatata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 192, pl. 11, figs. 28 to 30.—Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 217, figs. 29, 30 (in text); pl. 3, figs. 70 to 74; pl. 4, figs. 87 to 90.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 67, pl. 16, fig. 5.

Test in front view broader than long; chambers compressed; periphery rounded; sutures distinct, depressed; chambers with rounded periphery, in the adult the last-formed chambers failing to make a complete coil; surface smooth; aperture elongate, oval, with a tooth some distance back from the aperture itself.

Length of the Tortugas specimens 0.45 mm.

The only specimens which can be referred to this species are from station 20, where it is rare. These specimens, however, are typical in their general shape and agree well with d'Orbigny's type figures. His specimens were from Cuba and St. Thomas. It has also been recorded from the Mediterranean by Schlumberger and Wiesner. I found the species in material from the north coast of Jamaica, but there again it was not common.

Genus MASSILINA Schlumberger, 1893.

Massilina crenata (Karrer).

(Plate 11, Figure 6.)

Spiroloculina crenata Karrer, Sitz. Akad. Wiss. Wien, vol. 57, 1868, p. 135, pl. 1, fig. 9.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 156, pl. 10, figs. 24 to 26.
Massilina crenata Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 57, pl. 20, fig. 2; Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 445.

Test in its early development quinqueloculine, adult chambers in a single plane, in front view subelliptical, nearly as broad as long, compressed; chambers long and narrow, margin crenulate, due to the regular contractions or plications of the chamber in the adult; aperture rounded.

Most of the recent records for this species are from the Indo-Pacific. It is interesting, therefore, to find specimens at three of the stations in the Tortugas collection. One of these is a very thin, flattened species with a translucent test, which may be different from the typical form, but it is represented by the single specimen only.

Massilina alveoliniformis Millett.

Massilina alveoliniformis Millett, Journ. Roy. Micr. Soc., 1898, p. 609, pl. 13, figs. 5 to 7.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 584, pl. 45, fig. 15.

From three stations there are single specimens which are evidently this species, originally described by Millett from the Malay Archipelago. Heron-Allen and Earland record it also from the Kerimba Archipelago, off the east coast of Africa. The largest of our specimens, representing an adult test, is very close indeed to the original figure given by Millett. This is, then, another species which definitely connects the West Indian region with that of the East Indies and the Indian Ocean. As suggested by Heron-Allen and

Earland, this may be the same as the species which d'Orbigny named *Q. variabilis*, but as that species was undescribed and not figured until Fornasini's publication in 1905, Millett's name must be kept and d'Orbigny's allowed to lapse.

Genus ARTICULINA d'Orbigny, 1826.

Articulina sagra d'Orbigny.

Articulina sagra d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 160, pl. 9, figs. 23 to 26.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 73, pl. 18, figs. 2 to 5.

Test elongate, composed of two portions, the earlier triloculine, the later uniserial, the triloculine portion generally elliptical, with a rounded periphery and longitudinal costæ, the uniserial portion consisting of from 1 to 3 chambers, each broader than the preceding, transverse section circular or broadly elliptical; the aperture the broadest portion of the test, with an everted lip; the wall of the chamber longitudinally costate.

The longest of the Tortugas specimens measures 1 mm.

D'Orbigny's type figures show specimens very similar to those figured here, and this is undoubtedly the same as the form that he had. It is not common in the Tortugas region. D'Orbigny's specimens were from Cuba, Jamaica, and Martinique.

Articulina mexicana, new species.

(Plate 11, Figures 7, 8.)

Vertebralina sp. Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 64.

Test somewhat compressed, generally rounded, the last-formed coil composed of 2 to 3 chambers; sutures somewhat indistinct, the single, uniserial chamber in the adult somewhat more compressed toward the apertural end, which has a somewhat everted lip, but extending only slightly beyond the general outline of the chamber; surface smooth, shining.

Length of the largest specimens slightly exceeding 1 mm. in the Tortugas collection.

This species is very abundant at one station and rare at one other, both stations on the outer or open-ocean side of Loggerhead Key. They are similar to specimens which I had from the north coast of Jamaica. The test is a thick one, smooth and shining. Specimens with the uniserial chamber are rare.

Articulina lineata H. B. Brady.

(Plate 12, Figure 4.)

Articulina lineata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 183, pl. 12, figs. 19 to 21.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 73, pl. 18, fig. 6.

Test much compressed, even in the early portion, which is triloculine, the later portion consisting of 1 or 2 much compressed chambers in linear arrangement; the aperture with a lip much thickened at the edge, but not everted and not extending out beyond the periphery of chamber; chambers distinct, with numerous fine longitudinal costæ; wall translucent, of a bluish-white color.

Length of the Tortugas specimens up to 1 mm.

A. lineata was described by Brady from the Fijis, and was also recorded off Bermuda by him. I had specimens from two stations

off the north coast of Jamaica, and it has occurred at several stations in the Tortugas, but is rare at all of them. It may be distinguished from *A. sagra* by its much greater compression and the great difference in shape, especially in the uniserial portion, due to the fact that the lip is not everted, and therefore the start of each chamber is not greater than that of the preceding to any amount.

Articulina antillarum, new species.

(Plate 12, Figure 5.)

Test elongate, early portion in the microspheric form milioline, in the megalospheric form *Cornuspira*-like, the remainder and larger portion of the test made up of a linear series of elongate chambers gradually increasing in size toward the apertural end; chambers truncate at the distal end, then somewhat fusiform, and the apertural end fitted with a broadly flaring lip; aperture circular, without a lip; surface of the chambers with several rounded, longitudinal costæ.

Length up to 2 mm.

Specimens of *A. antillarum* were found at a few stations, usually not in any considerable numbers. They resemble somewhat specimens referred to *Articulina conico-articulata* by Millett (Journ. Roy. Micr. Soc., 1898, plate 12, figs. 9, 10), but have a very different shape and appearance. They are very close to some of the specimens referred to this species by Heron-Allen and Earland from the Kerimba Archipelago (Trans. Zool. Soc. London, vol. 20, 1915, plate 45, figs. 29, 31). Our specimens, however, have a much longer test, and their general appearance is somewhat different. There seems to be a difference in the form and shape of the chambers in the two forms, the megalospheric being less fusiform than in the microspheric.

Articulina mayori, new species.

(Plate 13, Figure 5.)

Test elongate, slender, early portion milioline, later chambers elongate, fusiform; surface faintly striate; apertural end contracted, with a distinct, everted lip; aperture circular.

Length 1 mm. or slightly more.

This is a very slender, delicate species, easily broken, and found, probably for this reason, in the material from but two stations. It is very different from the preceding in all its characters, reminding one somewhat of the specimens referred by Brady in the *Challenger* report to *Articulina conico-articulata* (plate 13, fig. 1). No specimens with coiled young were found in this species.

Genus HAUERINA d'Orbigny, 1846.

Hauerina bradyi Cushman.

Hauerina compressa H. B. Brady (not *H. compressa* d'Orbigny), Rep. Voy. *Challenger*, vol. 9, 1884, p. 190, pl. 11, figs. 12, 13.

Hauerina bradyi Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 62, pl. 23, fig. 2; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 72.

Test much compressed, the very earliest ones milioline, later ones becoming spiroloculine, and finally, in the last-formed coil, more than 2 chambers appear, usually 3 making up a complete coil; wall very finely striate-reticulate; periphery rounded or subcarinate; aperture a sieve-plate the entire height of the chamber, curved, with numerous pores.

Diameter of the Tortugas specimens not exceeding 0.60 mm.

This species has occurred at a number of stations, but usually as very few specimens. These are smaller and more delicate than those usually found in the Indo-Pacific, but have the same general characters. I have previously recorded it from the north coast of Jamaica, from the Tortugas, and elsewhere in the Gulf of Mexico.

Hauerina ornatissima (Karrer).

Quinqueloculina ornatissima Karrer, Sitz. Akad. Wiss. Wien, vol. 58, 1868, p. 151, pl. 3, fig. 2.
Hauerina ornatissima H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 192, pl. 7, figs. 15 to 22.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 63, pl. 23, figs. 1, 5; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 72.

This species occurs as single specimens at a few stations. The specimens are characteristic and similar to those which I found in the collection from the north coast of Jamaica. Most of the other records for it are from the Indo-Pacific, and it is one of the striking species which connects that area with the West Indian region.

Genus TRILOCULINA d'Orbigny, 1826.

Triloculina trigonula (Lamarck).

Miliolites trigonula Lamarck, Ann. du Mus., vol. 5, 1804, p. 351, No. 3.
Triloculina trigonula d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 299, No. 1, pl. 16, figs. 5 to 9; Modèles, 1826, No. 93.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 65, pl. 25, fig. 3; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 69.
Miliolina trigonula Williamson, Rec. Foram. Great Britain, 1858, p. 83, pl. 7, figs. 180 to 182.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 164, pl. 3, figs. 14 to 16.

The Tortugas specimens referred to this species are somewhat longer than broad, have the outer angle of the chamber convex, and the sides broadly rounded, the tooth projecting above the aperture somewhat, and the surface very smooth and polished, with a brilliant luster.

The largest specimens measure nearly 1 mm.

Such specimens are found at a number of stations, but not usually in great numbers. I have already recorded this species from the north coast of Jamaica, in shallow water, but there again only as single specimens from the three stations at which it occurred.

Triloculina tricarinata d'Orbigny.

Triloculina tricarinata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 299, No. 7; Modèles, 1826, No. 94.—H. B. Brady, Trans. Linn. Soc. London, vol. 24, 1864, p. 446, pl. 48, fig. 3.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 66, pl. 25, figs. 1, 2; fig. 32 (in text).
Miliolina tricarinata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 165, pl. 3, figs. 17 *a*, *b*.

There are a very few specimens which can be referred to *T. tricarinata*, and these are not of the typical form which is found in deeper water. They are more like some of the varieties which I have noted from shallower water in the Philippines.

Triloculina oblonga (Montagu).

Vermiculum oblongum Montagu, Test Brit., 1803, p. 522, pl. 14, fig. 9.
Triloculina oblonga d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 300, No. 16; Modèles, 1826, No. 95; in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 175, pl. 10, figs. 3 to 5.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 69, pl. 17, figs. 5, 6.

Specimens which may be referred to this species are common at most of the stations in the collection, the most common form being similar to that figured by d'Orbigny in the Cuban monograph. I had specimens also from the north coast of Jamaica, and it seems to be common generally in the West Indian region, and also widely distributed elsewhere.

Triloculina circularis Bornemann.

Triloculina circularis Bornemann, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 349, pl. 19, fig. 4.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 67, pl. 25, fig. 4; pl. 26, fig. 1; figs. 33, 34 (in text); Proc. U. S. Nat. Mus., vol. 59, 1921, p. 69.
Miliolina circularis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 169, pl. 4, figs. 3 *a* to *c*; pl. 5, figs. 13, 14?

Triloculina circularis is one of the most common species of the genus in the collection. It is a species which is characteristic of just such conditions as obtained in the Tortugas region, and is widely distributed in shallow, tropical waters. It is rather surprising that d'Orbigny did not describe it in his Cuban monograph, as it is widely distributed in the West Indian region. The developmental stages are interesting, but may always be distinguished by the large, flattened, semicircular tooth, which is usually placed somewhat out of the aperture itself.

Triloculina rotunda d'Orbigny.

Triloculina rotunda d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 299, No. 4.—Schlumberger, Mém. Soc. Zool. France, vol. 6, 1893, p. 206, pl. 1, figs. 48 to 50.
Miliolina rotunda Millett, Journ. Roy. Micr. Soc., 1898, p. 267, pl. 5, figs. 15, 16.—Sidebottom, Manchester Lit. Philos. Soc., vol. 48, No. 5, 1904, p. 8.

Test somewhat longer than wide; chambers rotund; periphery broadly rounded; surface of the test made up largely or entirely of the two last-formed chambers; sutures very slightly depressed; apertural end somewhat contracted, with a slightly thickened lip; aperture rounded, with a single bifid tooth, projecting somewhat above the outline of the aperture; surface of the test smooth and shining, often with transverse wrinkles.

Length of the Tortugas specimens up to 0.80 mm.

D'Orbigny originally had *T. rotunda* from the Adriatic Sea, and Schlumberger also records it from the Mediterranean, in the Gulf of Marseilles. Sidebottom's record is from the coast of the island of Delos. Millett records and figures it from the Malay Archipelago. Specimens similar to those figured by Millett have occurred at all of the Tortugas stations, often in considerable numbers. Millett notes that the largest specimens which he had were biloculine, and from a study of the Tortugas collection it would seem as though the species might even be better referred to *Biloculina* than to *Triloculina*. The adults are usually biloculine, but smaller specimens still in the triloculine stage are not uncommon.

Triloculina gracilis d'Orbigny.

Triloculina gracilis d'Orbginy, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 159, pl. 11, figs. 10 to 12.

Test elongate, slender, triloculine; chambers rounded; sutures very slightly depressed; apertural end extended into a cylindrical neck, the outer end of which is enlarged and has a phialine lip; surface smooth or very finely striate; aperture circular, with a slight tooth.

Length of the Tortugas specimens up to 0.50 mm.

D'Orbigny described this species as rare, from shore sands of Cuba and Jamaica. I did not find it in the material that I examined from Montego Bay, Jamaica, but it has occurred at 4 stations in the Tortugas region. It is a very slender, delicate species, most easily characterized by the peculiar aperture. D'Orbigny's figures of *T. gracilis* are fairly accurate, but they show more of a surface ornamentation than appears in our specimens.

Triloculina transversestriata (H. B. Brady).

Miliolina transversestriata H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, 1881, p. 45; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 177, pl. 4, figs. 6 *a* to *c*.—Millett, Journ. Roy. Micr. Soc., 1898, p. 268, pl. 6, fig. 5.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 566, pl. 42, figs. 17 to 20.

Triloculina transversestriata Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 70.

Test elongate, 2 to 3 times as long as broad; periphery subacute; surface ornamented by numerous obliquely transverse costæ; apertural end slightly extended; aperture rounded, with a simple tooth.

Length of the Tortugas specimens up to 0.70 mm.

This is one of the species which connects this region with the Indo-Pacific. Brady's original specimens were from Torres Strait and Mauritius. Millett records it from the Malay Archipelago, and Heron-Allen and Earland from the Kerimba Archipelago, off the east coast of Africa, as well as from the Great Barrier Reef of Australia. They also record specimens from Havana, Cuba, and I have had a single specimen from Montego Bay, north coast of Jamaica. In the Tortugas collection this species is represented by single specimens from two stations, but they are typical.

Triloculina planciana d'Orbigny.

Triloculina planciana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 173, pl. 9, figs. 17 to 19.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 70, pl. 17, figs. 7, 8.

Test elongate; chambers distinct; sutures slightly, if at all, depressed; periphery broadly rounded; wall ornamented by numerous short, incised lines; aperture rounded, with a bifid tooth, projecting slightly above the apertural opening; surface shiny.

Length of the Tortugas specimens up to 0.65 mm.

D'Orbigny described this species from Cuba and Jamaica, and I found specimens in the collection from the north coast of Jamaica, at Montego Bay, and also at Runaway Bay. It has occurred at three-fourths of the stations in the Tortugas region. The peculiar

surface markings in *T. planciana* seem to be a constant character and, together with the broadly rounded form of the chambers, make it distinct from any other species of the region.

Triloculina fichteliana d'Orbigny.

Triloculina fichteliana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 171, pl. 9, figs. 8 to 10.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 71; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 70, pl. 17, figs. 1, 2.

Test subcircular in front view, somewhat compressed; periphery rounded; chambers distinct; sutures slightly depressed; wall ornamented by numerous longitudinal costæ; aperture semicircular, with a slight tooth.

Diameter of the Tortugas specimens up to 0.60 mm.

This species, which was described by d'Orbigny from Cuba and Jamaica, is apparently widely distributed in the West Indian region. I have had specimens from shallow water off the north coast of Jamaica, and it has occurred at several stations in the Tortugas collection, but not in any considerable numbers. Our specimens are much more like the type as figured by d'Orbigny than the specimens figured by later authors, in the *Challenger* report and elsewhere.

Triloculina carinata d'Orbigny.

(Plate 12, Figure 6.)

Triloculina carinata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 179, pl. 10, figs. 15 to 17.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 71, pl. 17, figs. 9, 10.

Test longer than broad; surface in the adult made up of three chambers, typically with the periphery carinate, with the surface ornamented with small rounded pits in regular series, covering the entire surface, except about the aperture; sutures distinct, somewhat depressed; aperture elongate, narrow, with a distinct, slightly everted lip, tooth very long and narrow, projecting somewhat above the apertural opening.

Length of the Tortugas specimens up to 1.50 mm.

D'Orbigny described this species from Cuba as rare. I had specimens from the north coast of Jamaica, where it is very common. It has been found at numerous stations in the Tortugas region and seems generally to be well distributed in the West Indies. While the typical form has carinate margins, it is not unusual to find in adults that the chambers become rounded. The reticulations are very regular in their position and size.

Triloculina linneiana d'Orbigny.

Triloculina linneiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 172, pl. 9, figs. 11 to 13.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 72, pl. 27, fig. 4; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 70, pl. 17, figs. 3, 4.

Miliolina linneiana H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 174, pl. 6, figs. 15 to 20.

Test typically with 3 visible chambers in the adult, elongate, tapering toward either end, somewhat depressed; surface ornamented by a few very prominent, raised ridges, with deep, concave depressions between; periphery rounded or slightly elliptical, with a single or bifid tooth.

Length of the Tortugas specimens up to 1.5 mm.

This species, originally described by d'Orbigny as common in shallow water off Cuba and Jamaica, is widely distributed in the West Indian region and occurs in considerable numbers in the Tortugas collection. It seems to be widely distributed across the Indo-Pacific, reaching its best development in waters less than 30 fathoms in warm seas. . There is a certain amount of variation in the number and prominence of the costæ, but in general its characters are very constant.

Triloculina quadrilateralis d'Orbigny.

Triloculina quadrilateralis d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 173, pl. 9, figs. 14 to 16.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 71, fig. 11 (in text).

Test somewhat longer than broad, in the adult the exterior composed of 3 chambers, generally quadrangular in outline, the periphery slightly convex, but the angles acute and projecting, sides concave; wall with numerous fine, incised short lines; aperture oblong, with a single elongate tooth, projecting slightly above the outline of the aperture.

Length of the Tortugas specimens up to 0.65 mm.

D'Orbigny described this species from Cuba, and I found specimens from the north coast of Jamaica which were evidently the same species. It has been found at most of the stations in the Tortugas region, and therefore is probably widely distributed in the general West Indian region in comparatively shallow water. The quadrilateral condition is only developed in the adult, the younger chambers often being simply carinate or sharply angled. In the adult specimens the aperture may become much more elongate than is shown in d'Orbigny's figure and the lip extends out somewhat beyond the periphery of the test.

Triloculina bicarinata d'Orbigny.

(Plate 12, Figure 7.)

Triloculina bicarinata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 158, pl. 10, figs. 18 to 20.

Test longer than broad, triloculine, typically with the chambers with a truncate periphery, the angles somewhat extended; chambers distinct; sutures somewhat depressed; surface ornamented by reticulations both on the sides and on the outer angles; aperture elongate, with a definite thin lip, slightly everted, tooth elongate, narrow, extending above the outline of the aperture.

Length of the Tortugas specimens up to 1.4 mm.

This species, which d'Orbigny described from Cuba, may be distinguished from the preceding, not only by the shape of the test, but also by the difference in reticulations. In *T. bicarinata* the reticulations are as shown by d'Orbigny, more or less rectangular, and much coarser than in *T. carinata*. In that species the reticulations are much smaller and are either rounded or elliptical and much more regularly placed.

Triloculina labiosa d'Orbigny.

(Plate 12, Figure 1.)

Triloculina labiosa d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 157, pl. 10, figs. 12 to 14.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 70; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 70, pl. 16, figs. 13, 14.
Miliolina labiosa H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 170, pl. 6, figs. 3 to 5.

Test much broader than long; surface largely composed of the two last-formed chambers; chambers often somewhat irregular; periphery rounded; surface smooth, but dull; aperture crescentiform, with a somewhat triangular tooth, placed somewhat back from the aperture.

Diameter of the Tortugas specimens up to 0.60 mm.

Specimens agree very closely with d'Orbigny's figure, occurring at several stations, but not in any considerable numbers. D'Orbigny's specimens were from Cuba; I have recorded the species also from several stations from the north coast of Jamaica, and it seems to be widely distributed in warm, shallow waters in the Indo-Pacific. It is very questionable as to whether the specimens recorded by Brady from a great depth in the Pacific really are identical with this species.

Genus BILOCULINA d'Orbigny, 1826.

Biloculina subsphærica d'Orbigny.

Biloculina subsphærica d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 162, pl. 8, figs. 25 to 27.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 73.

The most common *Biloculina* in the Tortugas collection is this small one described by d'Orbigny from Cuba and Jamaica. They agree very well with d'Orbigny's original figure and description, and also with specimens that I have had from the north coast of Jamaica.

It is evidently common in the shallow water in the West Indian region. The specimens are all small, the largest measuring but slightly more than 0.5 mm.

Biloculina millettii Cushman?

Miliolina durrandii Millett (in part), Journ. Roy. Micr. Soc., 1898, p. 268, pl. 6, figs. 8 to 10 (not fig. 7).
Biloculina millettii Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 81, pl. 34, figs. 4, 5.

Test in front view broadly elliptical, in end view, compressed; chambers biconvex; the periphery with a definitely developed carina; wall smooth, except for occasional transverse ribs usually indistinct; aperture slightly produced, broadly elliptical, with a slightly thickened border joining the carina at its outer edge; the aperture with a small bifid tooth.

Length of the Tortugas specimen 0.70 mm.

There is a single specimen in the collection which has the compressed form and the thin peripheral carina and large aperture which characterizes this species. The specimen is, however, somewhat irregular, and, being the only one found, it should await further material before positive identification is made.

Biloculina denticulata H. B. Brady.

Biloculina ringens (Lamarck) var. *denticulata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 143, pl. 3, figs. 4, 5.
Biloculina denticulata Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 180, pl. 33, fig. 1; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 74.

Although not occurring in any such numbers as the preceding species, *Biloculina denticulata* has occurred at most of the stations from which material was studied. It is smaller and does not reach the fine development common in shallow water of the East Indies and Philippine regions. The largest Tortugas specimens are about 0.80 mm. The denticulate border at the base is not always present, but the general shape and character of the specimens, even without this, prove their identity.

Biloculina denticulata H. B. Brady var. striolata H. B. Brady.

Biloculina ringens (Lamarck) var. *striolata* H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 143, pl. 3, figs. 7, 8.—Millett, Journ. Roy. Micr. Soc., p. 1898, 262, pl. 5, fig. 8.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 80, pl. 33, figs. 2, 3.

There are a few specimens of this striate variety which differ from the usual form in having the markings over the entire test rather than the basal portion only. In addition, there are a few specimens referred here which may not be this variety. They have a much more rounded form at the base rather than the compressed plate-like form so common in the typical.

Genus PENEROPLIS Montfort, 1808.

The treatment of the Tortugas material of this genus follows that which I have already used in a paper on the Foraminifera of the north coast of Jamaica (Proc. U. S. Nat. Mus., vol. 59, 1921). This in turn largely followed the treatment of the species given by Heron-Allen and Earland in their paper on the Foraminifera of the Kerimba Archipelago (Trans. Zool. Soc. London, vol. 20, 1915).

These various species seem distinct in the Tortugas collection.

Peneroplis pertusus (Forskål).

Nautilus pertusus Forskål, Descr. Anim., 1775, p. 125, No. 65.
Peneroplis pertusus Jones, Parker, and Brady, Foram. Crag., 1865, p. 19.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 204, pl. 13, figs. 16, 17.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 75, pl. 18, figs. 7, 8.
Peneroplis elegans d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 61, pl. 7, figs. 1, 2.

This is one of the least common of the species found in this collection. It was not common in the Jamaican material either, and is evidently not as common in the West Indian region as in some parts of the Indo-Pacific. The species described by d'Orbigny as *P. elegans* seems undoubtedly to be this species. D'Orbigny had this from both Cuba and Jamaica.

Peneroplis carinatus d'Orbigny.

Peneroplis carinatus d'Orbigny, Voy. Amér. Mérid., vol. 5, pt. 5, 1839, "Foraminifères," p. 33, pl. 3, figs. 7, 8.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 205, pl. 13, fig. 14.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 75, pl. 18, fig. 12.

At two stations in the area there were abundant specimens which can be referred to *P. carinatus* d'Orbigny, but it does not seem to occur elsewhere. It was very rare in the Jamaican collection.

Peneroplis planatus (Fichtel and Moll).

Peneroplis planatus d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 285, No. 1; Modèles, 1826, No. 16.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 204, pl. 13, fig. 15.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 75, pl. 18, fig. 9.

Next to *P. proteus* this is the most common species of the genus in the collection. There are two forms, one in which the test is very thin and translucent, with the surface ornamented by numerous fine, longitudinal costæ, the other with a thicker test, the surface smooth.

Peneroplis proteus d'Orbigny.

Peneroplis protea d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 60, pl. 7, figs. 7 to 11.
Peneroplis dubius d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 62, pl. 6, figs. 21, 22.
Peneroplis proteus Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 75, pl. 18, figs. 13 to 19.

Peneroplis proteus is by far the most common species of the genus in the region, occurring at nearly all of the stations, and often in very considerable numbers. The figures I have given, the specimens from Jamaica, with those given by d'Orbigny, show the range of form in this West Indian species. The surface is smooth and glossy, sutures distinct, and its general characters, in spite of the variability of outline, are very distinctive. *P. dubius* d'Orbigny is undoubtedly the young of this species. I found it common on the north coast of Jamaica and it seems to be widely distributed in the general West Indian region and perhaps elsewhere. D'Orbigny's specimens were from Cuba and Jamaica. The figures given by Brady (Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, plate 14, figs. 3, 4) are probably this species.

Peneroplis arietinus (Batsch).

Peneroplis arietinus Parker, Jones, and Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 26, pl. 1, fig. 18.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 204, pl. 13, figs. 18, 19, 22.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 75, pl. 18, fig. 10.

There is only one specimen in the entire collection which can be referred to this species. This, however, is of the typical form. It was also rare at Montego Bay, Jamaica.

Peneroplis cylindraceus (Lamarck).

Peneroplis cylindraceus H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 205, pl. 13, figs. 20, 21.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 75, pl. 18, fig. 11.

Single specimens occurred at but two stations. These were in very fine sand and in comparatively quiet water. As this is a very delicate species, it may be that its occurrence is much more frequent than these records would indicate. In the Jamaican material a single specimen only was obtained.

Peneroplis discoideus Flint.

Peneroplis pertusus (Forskål) var. *discoideus* Flint, Rep. U. S. Nat. Mus., 1897 (1899), p. 304, pl. 49, figs. 1, 2.—Cushman, Carnegie Inst. Wash., Pub. 291, 1919, p. 69.
Peneroplis discoideus Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 76, pl. 18, fig. 20; pl. 19, figs. 1 to 3.

Very fine specimens of this species, which the late Dr. Flint described from Key West Harbor, occurred in the Tortugas region. It is widely distributed in the West Indies and is apparently found as far back in the fossil series as the Miocene.

Subgenus MONALYSIDIUM Chapman, 1899.

Chapman places in this subgenus specimens evidently allied to *Peneroplis*, but the surface ornamentation, consisting of rows of minute tubercles, the early chambers spiral, the later development linear. Such specimens have occurred in the Tortugas collection as single specimens, only at a few stations. They are so delicately brittle that it seems probable that they were broken before they were studied. Heron-Allen and Earland question whether or not such forms as are figured here have any spiral early portion. Specimens which they had from the Kerimba Archipelago, east coast of Africa, apparently have an aperture at either end of the straight test. In the specimens figured by Brady (*Challenger* report, plate 13, figs. 24, 25) the chambers are separated by a collar-like portion and one end only shows traces of the aperture. Our specimens from the Tortugas are very similar to those figured by Brady, except in the form of the chambers themselves. These usually are broader at the basal end than at the apertural end. In all our specimens one end has a distinct aperture with a definite, projecting lip, the other end in no case shows such a condition. From the shape of the chambers alone it would usually seem possible to orient the specimens.

Monalysidium polita Chapman?

(Plate 13, Figure 4.)

Peneroplis lituus H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 205, pl. 13, figs. 24, 25 (?).
Peneroplis (*Monalysidium*) *polita* Chapman, Journ. Linn. Soc. London, Zoology, vol. 28, 1902, p. 4, pl. 1, fig. 5 (?).
Monalysidium polita Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 603, text-fig. 43 G.

Chapman's specimens from Funafuti, which are the types of this species, do not closely resemble those found in the Tortugas collection, nor are they so close to those figured by Brady in the reference above as are our specimens. Until the completed test is found the specimens may be provisionally referred to Chapman's species. It would be interesting to know where Brady's specimens were from. Little is known of the genus in the Atlantic, the other records being all from the Indo-Pacific.

Genus ORBICULINA Lamarck, 1816.

Orbiculina compressa d'Orbigny.

Orbiculina compressa d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 66, pl. 8, figs. 4 to 7.—Cushman, Carnegie Inst. Wash., Pub. 291, 1919, p. 70, pl. 7, fig. 6; Proc. U. S. Nat. Mus., vol. 59, 1921, p. 76, pl. 19, figs. 4 to 6.

O. compressa, described by d'Orbigny, which makes the complete circle of the test in its later chambers, is very common in the Tortugas collection, perhaps more so than the following species. It is widely distributed, at least in the West Indian region, d'Orbigny recording it as rare in Cuba, more common in Guadeloupe and St. Thomas, and abundant in Jamaica. I found it abundant off the north coast of Jamaica, and fossil specimens occur in the Bowden Marl on the south side of the same island. I have already shown the differences in the early development of this and the following species (Bull. 71, U. S. Nat. Mus., part 6, 1917, pp. 89–91).

Orbiculina adunca (Fichtel and Moll).

Nautilus aduncus Fichtel and Moll, Test. Micr., 1798, p. 115, pl. 23, figs. *a* to *c*.
Orbiculina adunca Lamarck, Tabl. Ency. et Meth., 1816, p. 468, figs. 2 *a* to *c*.—D'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 64, pl. 8, figs. 8 to 16.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 77.

Specimens are all of large size and abundant at most of the stations. *Orbiculina* seems to reach a much greater development in the West Indian region than in any other part of the world, it being the characteristic large foraminifer at shallow and moderate depths, replacing in the West Indies the large *Orbitolites*, *Heterostegina*, and *Operculina* of the East Indies. However, in the Eocene of the West Indian region these genera, now so characteristic of the East Indian region, were abundant and large, *Orbiculina* being a later development.

Genus ORBITOLITES Lamarck, 1801.

Orbitolites duplex Carpenter.

"*Orbitolites* (duplex type)," Carpenter, Philos. Trans., 1856, p. 120, pl. 5, fig. 10; pl. 9, fig. 10.
Orbitolites duplex Carpenter, Rep. *Challenger*, "Orbitolites," 1883, p. 25, pl. 3, figs. 8 to 14; pl. 4, figs. 6 to 10; pl. 5, figs. 1 to 10.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 77.

On the short eel-grass (*Posidonia*) this species is fairly abundant. It also occurs in the bottom samples from most of the stations.

I have recorded it from the north coast of Jamaica, and it seems to be much more abundant in the West Indian region than either *O. marginalis* or *O. complanata.* In this connection it is of interest to note that Millett, in his paper on the Foraminifera of the Malay Archipelago, notes both *O. marginalis* and *O. complanata* as common, but entirely leaves out *O. duplex.* All three were found, however, in the Philippine collections which I have studied.

Genus ALVEOLINA d'Orbigny, 1826.

Alveolina pulchra d'Orbigny.

Alveolina pulchra d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 70, pl. 8, figs. 19, 20.—Cushman, Proc. U. S. Nat. Mus., vol. 59, 1921, p. 77, pl. 19, figs. 7 to 9.

Specimens of this small *Alveolina* were found at a few stations. It may be that it is the same as *A. melo* (Fichtel and Moll), but specimens do not seem to be entirely identical with those from other regions. I have recorded it from the north coast of Jamaica; d'Orbigny's type material was from Cuba.

DESCRIPTIONS OF PLATES.

Plate 1.

Fig. 1. *Ammobaculites reophaciformis* Cushman. Front view. ×50.
2–4. *Trochammina advena*, new species. Fig. 2, dorsal view; fig. 3, peripheral view; fig. 4, ventral view. ×50.
5. *Carterina spiculotesta* (Carter). *a*, ventral view ×75; *b*, portion of surface enlarged, showing arrangement of the spicular bodies. ×400.
6. *Textularia agglutinans* d'Orbigny. Front view. ×50.
7. *Textularia floridana* Cushman. Front view. ×65.
8, 9. *Bolivina pulchella* (d'Orbigny). Front views of two specimens, showing characteristic ornamentation and elongate aperture. ×75.
10. *Bolivina compacta* Sidebottom. Front view, showing peculiar ornamentation of the surface. ×75.

Plate 2.

Fig. 1. *Textularia rugosa* Reuss? Front view, showing traces of reëntrants. ×60.
2. *Textularia candeiana* d'Orbigny. Front view, showing characteristic enlarged later chambers. ×60.
3. *Textularia mayori*, new species. Front view. ×60.
4. *Textularia conica* d'Orbigny. Front view. ×60.
5, 6. *Bigenerina nodosaria* d'Orbigny. Fig. 5, front view of microspheric specimen, showing small textularian early development, the larger portion of the test uniserial; fig. 6, megalospheric specimen in which the test is largely composed of textularian chambers, the uniserial adult portion much smaller in size. ×50.
7, 8. *Valvulina oviedoiana* d'Orbigny. Fig. 7, front view; fig. 8, apertural view. ×50.

Plate 3.

Figs. 1, 2. *Clavulina nodosaria* d'Orbigny. Front view. ×60.
3. *Clavulina tricarinata* d'Orbigny. Front view. ×50.
4. *Clavulina* sp.? Front view. ×50.
5, 6. *Bolivina mayori*, new species. Front views. Fig. 5 showing adult specimen with a senescent stage in which the last chamber extends across the te and the entire size of the chambers reduced. ×75.
7. *Buliminoides williamsoniana* (H. B. Brady). Front view. ×75.
8. *Bolivina limbata* H. B. Brady var. *costulata*, new variety. Front view. ×75.
9. *Virgulina punctata* d'Orbigny. Front view. ×75.
10. *Bolivina striatula*, new species. Front view. ×75.
11. *Verneuilina spinulosa* Reuss. Front view. ×75.

Plate 4.

Fig. 1. *Nodosaria* (*Glandulina*) *rotundata* (Reuss). Front view. ×75.
2. *Nodosaria* sp.? juv. Front view. ×75.
3. *Cristellaria* sp.? juv. Front view. ×75.
4. *Polymorphina* sp.? Front view. ×75.
5, 6. *Polymorphina regina* (H. B. Brady, Parker, and Jones). Fig. 5, adult specimen showing smooth later chambers; fig. 6, front view. ×75.
7, 8. *Polymorphina pulchella* (d'Orbigny). Front views. ×75.
9. *Polymorphina gibba* d'Orbigny. Front view. ×75.
10, 11. *Polymorphina lactea* (Walker and Jacob), var. Fig. 10, attached specimen showing peculiar stolon-like processes; fig. 11, free specimen. ×75.

PLATE 5.

FIG. 1. *Polymorphina* sp.? Front view. ×75.
2. *Siphogenerina advena*, new species. Front view. ×75.
3, 4. *Uvigerina angulosa* Williamson. Fig. 3, front view of normal specimen; fig. 4, front view of specimen, showing senescence. ×75.
5. *Siphogenerina raphanus* (Parker and Jones). Front view. ×60.
6. *Spirillina vivipara* Ehrenberg var. Dorsal view. ×150.
7. *Spirillina vivipara* Ehrenberg. Dorsal view. ×150.
8, 9. *Globigerina dutertrei* d'Orbigny. Fig. 8, front view; fig. 9 showing part of ventral surface. ×75.
10. *Discorbis orbicularis* Terquem? Dorsal view. ×100.
11, 12. *Discorbis floridana*, new species. Fig. 11, dorsal view; fig. 12, ventral view. ×100.

PLATE 6.

FIGS. 1, 2. *Planorbulina mediterranensis* d'Orbigny? Fig. 1, dorsal view of young specimen; fig. 2, of adult specimen. ×50.
3. *Planorbulina acervalis* H. B. Brady. Dorsal view. ×50.
4–6. *Cymbalopora squammosa* (d'Orbigny). Fig. 4, dorsal view; fig. 5, ventral view; fig. 6, side view. ×100.
7–9. *Truncatulina candeiana* d'Orbigny. Fig. 7, dorsal view; fig. 8, ventral view; fig. 9, side view. ×100.
10, 11. *Discorbis mira*, new species. Fig. 10, dorsal view; fig. 11, ventral view. ×100.

PLATE 7.

FIGS. 1, 2. *Discorbis subaraucana*, new species. Fig. 1, dorsal view; fig. 2, ventral view. ×100.
3–5. *Truncatulina cora* d'Orbigny. Fig. 3, dorsal view; fig. 4, ventral view; fig. 5, peripheral view. ×100.
6–9. *Truncatulina advena* d'Orbigny. Figs. 6 and 7, dorsal view; fig. 8, ventral view; fig. 9, peripheral view. ×100.
10. *Anomalina ammonoides* Reuss. (?) Side view. ×100.
11, 12. *Siphonina pulchra* Cushman. Fig. 11, side view of young specimen; fig. 12, side view of adult specimen. ×100.

PLATE 8.

FIGS. 1, 2. *Anomalina edwardsiana* (d'Orbigny). Fig. 1, dorsal view; fig. 2, ventral view. ×100.
3, 4. *Pulvinulina menardii* (d'Orbigny). Fig. 3, dorsal view; fig. 4, ventral view. ×100.
5, 6. *Pulvinulina semipunctata*, new species. Fig. 5, dorsal view; fig. 6, ventral view. ×100.
7–9. *Rotalia beccarii* (Linnæus). Fig. 7, dorsal view; fig. 8, ventral view; fig. 9, side view. ×100.
10–12. *Pulvinulina repanda* (Fichtel and Moll). Fig. 10, dorsal view; fig. 11, ventral view; fig. 12, side view. ×50.

PLATE 9.

FIGS. 1–3. *Pulvinulina incerata*, new species. Fig. 1, dorsal view; fig. 2, ventral view; fig. 3, side view. ×50.
4–6. *Asterigerina carinata* d'Orbigny. Fig. 4, dorsal view; fig. 5, ventral view; fig. 6, side view. ×75.
7, 8. *Nonionina grateloupi* d'Orbigny. Fig. 7, front view; fig. 8, apertural view. ×100.
9, 10. *Polystomella poeyana* d'Orbigny. Fig. 9, front view; fig. 10, apertural view. ×100.
11, 12. *Polystomella advena*, new species. Fig. 11, front view; fig. 12, apertural view. ×100.

PLATE 10.

FIGS. 1, 2. *Polystomella macella* (Fichtel and Moll) var. Fig. 1, side view; fig. 2, apertural view. ×100.
3, 4. *Polystomella discoidalis* d'Orbigny. Fig. 3, side view; fig. 4, apertural view. ×35.
5. *Heterostegina antillarum* d'Orbigny. Side view. ×30.
6, 7. *Fischerina dubia* (d'Orbigny). Fig. 6, dorsal view; fig. 7, ventral view. ×120.
8. *Planispirina auriculata* Egger. Side view. ×120.
9. *Spiroloculina ornata* d'Orbigny. Front view. ×50.
10. *Quinqueloculina collumnosa*, new species. Side view. ×50.

PLATE 11.

FIG. 1. *Nodobacularia tibia* (Jones and Parker). Front view of broken specimen showing final chambers. ×100.
2. *Spiroloculina eximia*, new species. Front view. ×120.
3, 4. *Spiroloculina caduca*, new species. Front views. ×50.
5. *Quinqueloculina costata* d'Orbigny. Front view. ×120.
6. *Massilina crenata* (Karrer). Front view of specimen which is coiled slightly out of the single plane. ×100.
7, 8. *Articulina mexicana*, new species. Front views. Fig. 8 shows a somewhat senescent condition. ×50.

PLATE 12.

FIG. 1. *Triloculina labiosa* d'Orbigny. Front view. ×60.
2. *Quinqueloculina dilatata* d'Orbigny. Front view. ×60.
3. *Quinqueloculina parkeri* H. B. Brady var. *occidentalis*, new variety. Front view. ×100.
4. *Articulina lineata* H. B. Brady. Front view. ×50.
5. *Articulina antillarum*, new species. Front view. ×50.
6. *Triloculina carinata* d'Orbigny. Front view. ×30.
7. *Triloculina bicarinata* d'Orbigny. Front view. ×30.

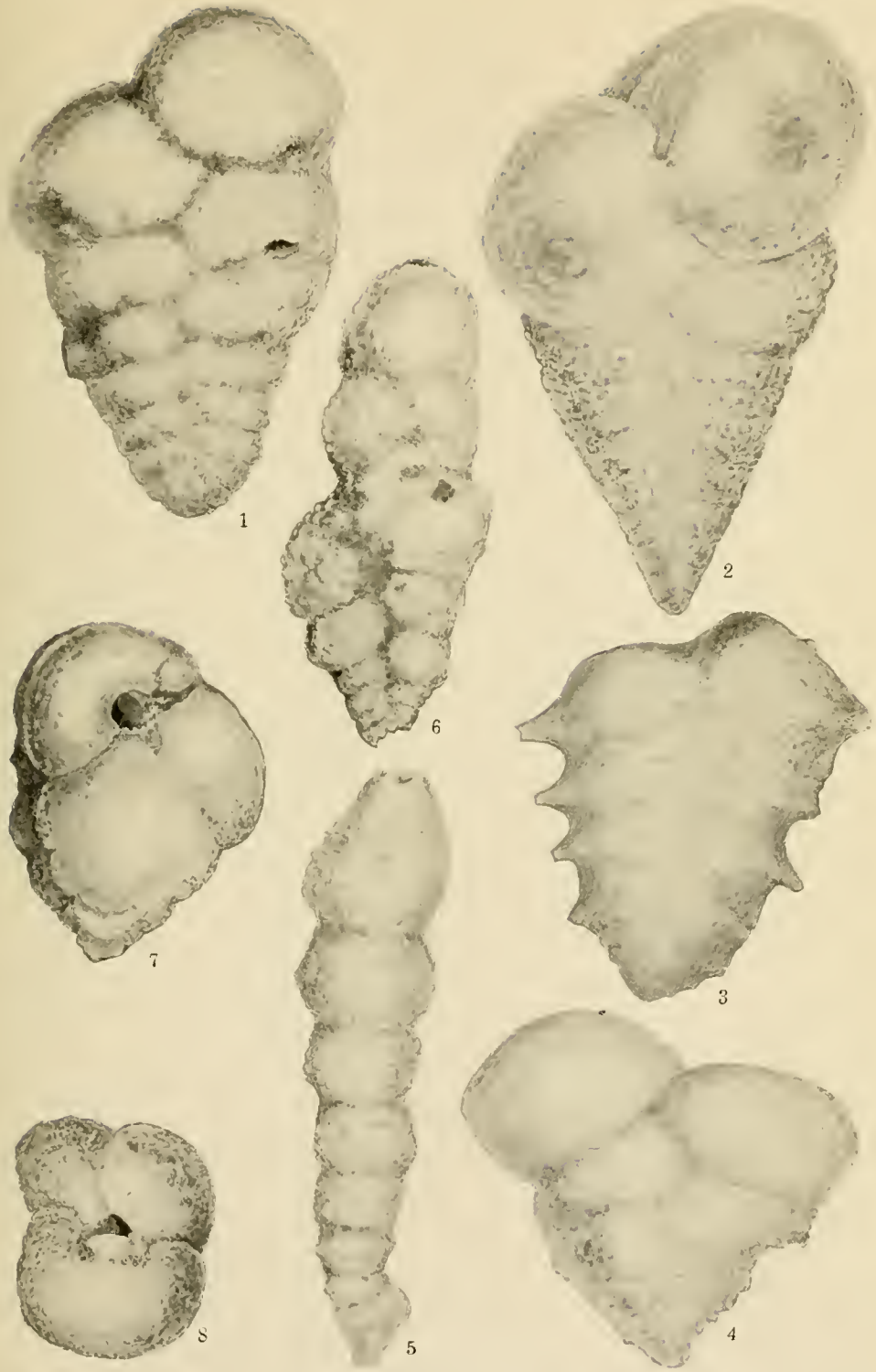
PLATE 13.

FIG. 1. *Quinqueloculina candeiana* d'Orbigny. Front view. ×50.
2. *Quinqueloculina lævigata* d'Orbigny. Front view. ×50.
3. *Quinqueloculina funafutiensis* Chapman. Front view. ×100.
4. *Monalysidium polita* Chapman? Front view. ×100.
5. *Articulina mayori*, new species. Front view. ×100.

PLATE 14.

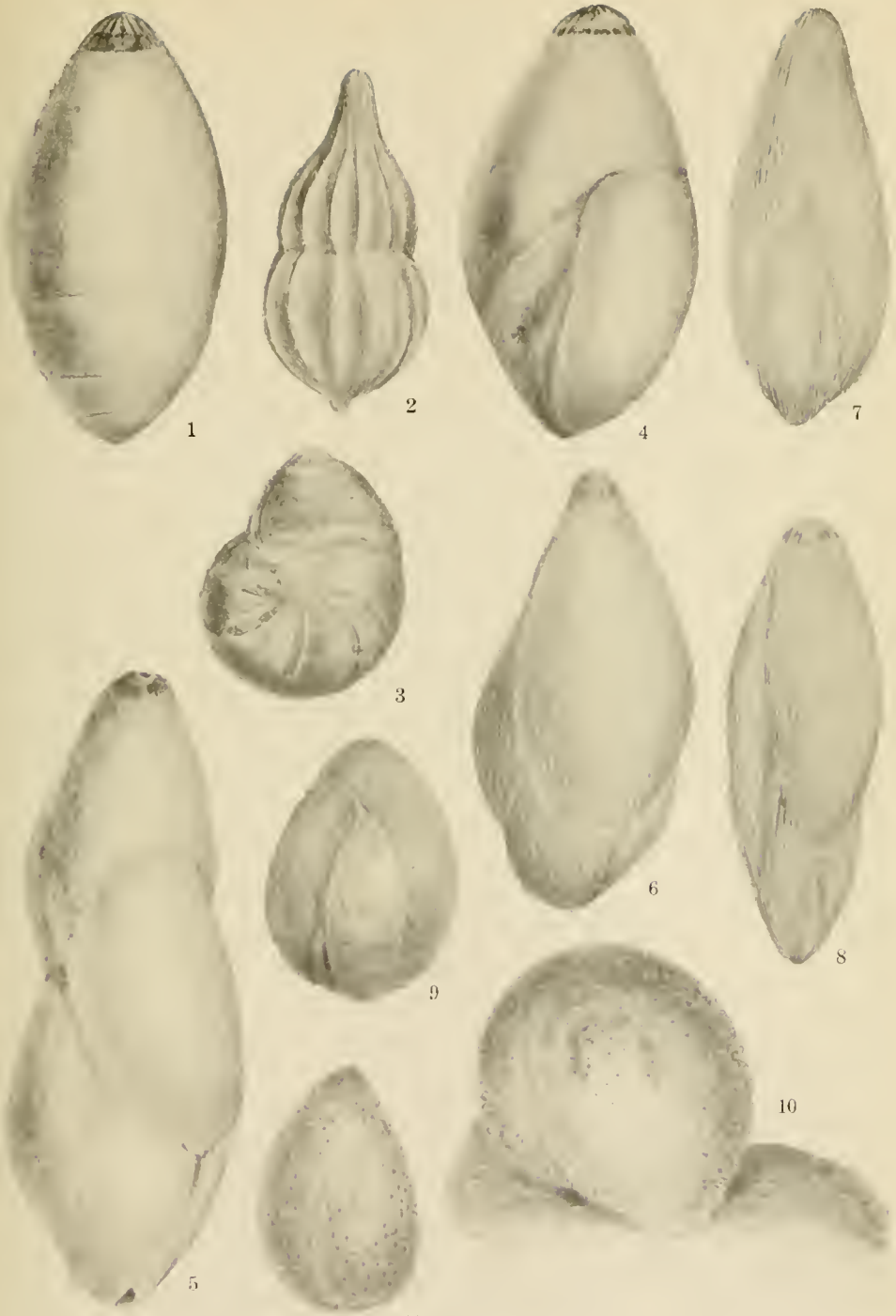
FIG. 1. *Globigerina rubra* d'Orbigny. Front view, showing an adult specimen in which the color is largely confined to the early chambers. ×50.
2. *Globigerina rubra* d'Orbigny. Young specimen. ×50.
3–5. *Truncatulina rosea* d'Orbigny. Fig. 3, ventral view; fig. 4, dorsal view; fig. 5, peripheral view. ×50.
6–8. *Homotrema rubrum* (Lamarck). Fig. 6, fragment of dead coral with several specimens, natural size; fig. 7, specimen viewed from above, ×20, showing structure of the interior as well as of the surface; dead, slightly worn specimen; fig. 8, profile view of live specimen, showing the surface, tubular projections, and numerous sponge spicules projecting from the apertures. ×25.

Figures 1 to 10.



Figures 1 to 8.

Figures 1 to 11.



Figures 1 to 11.

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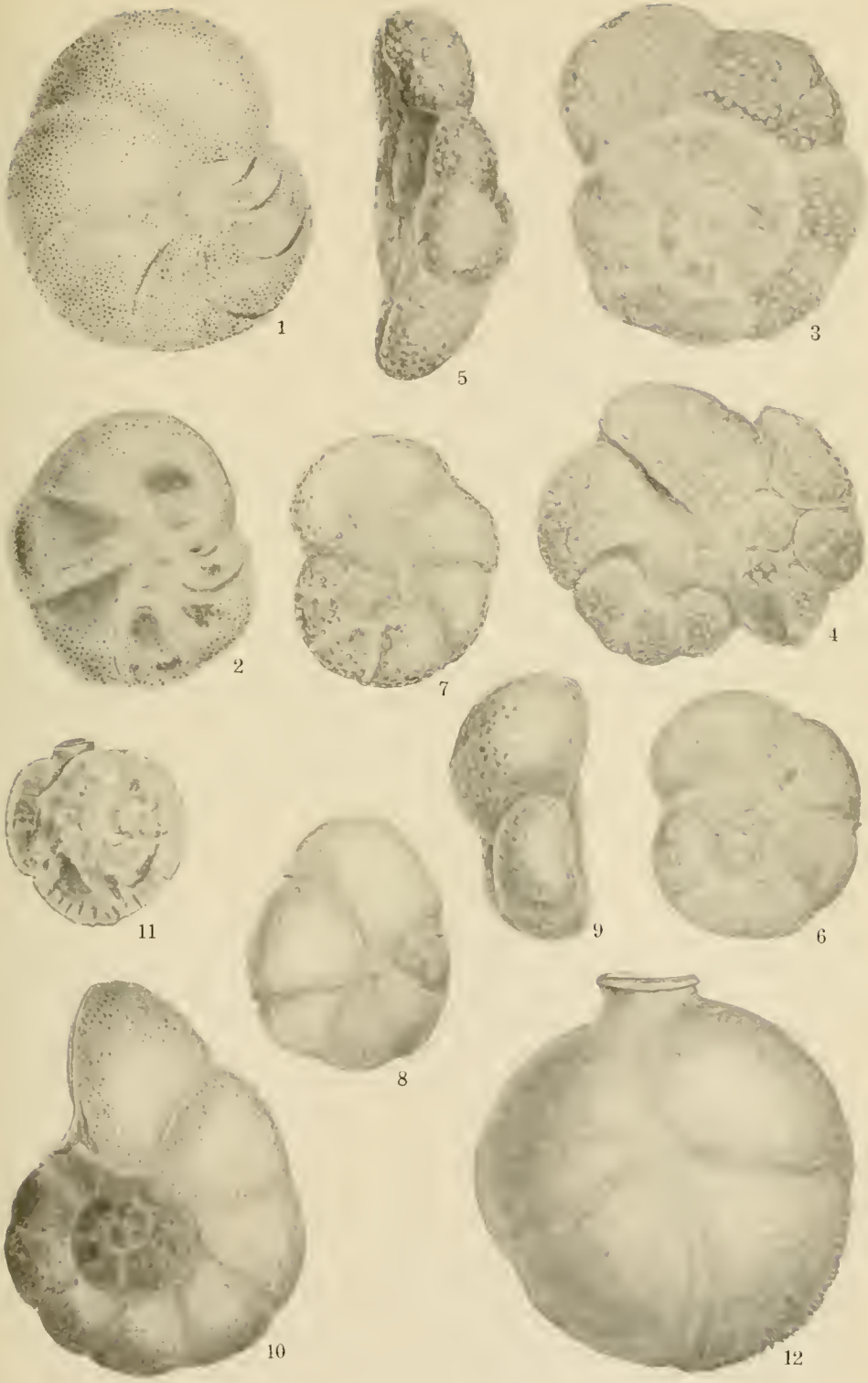

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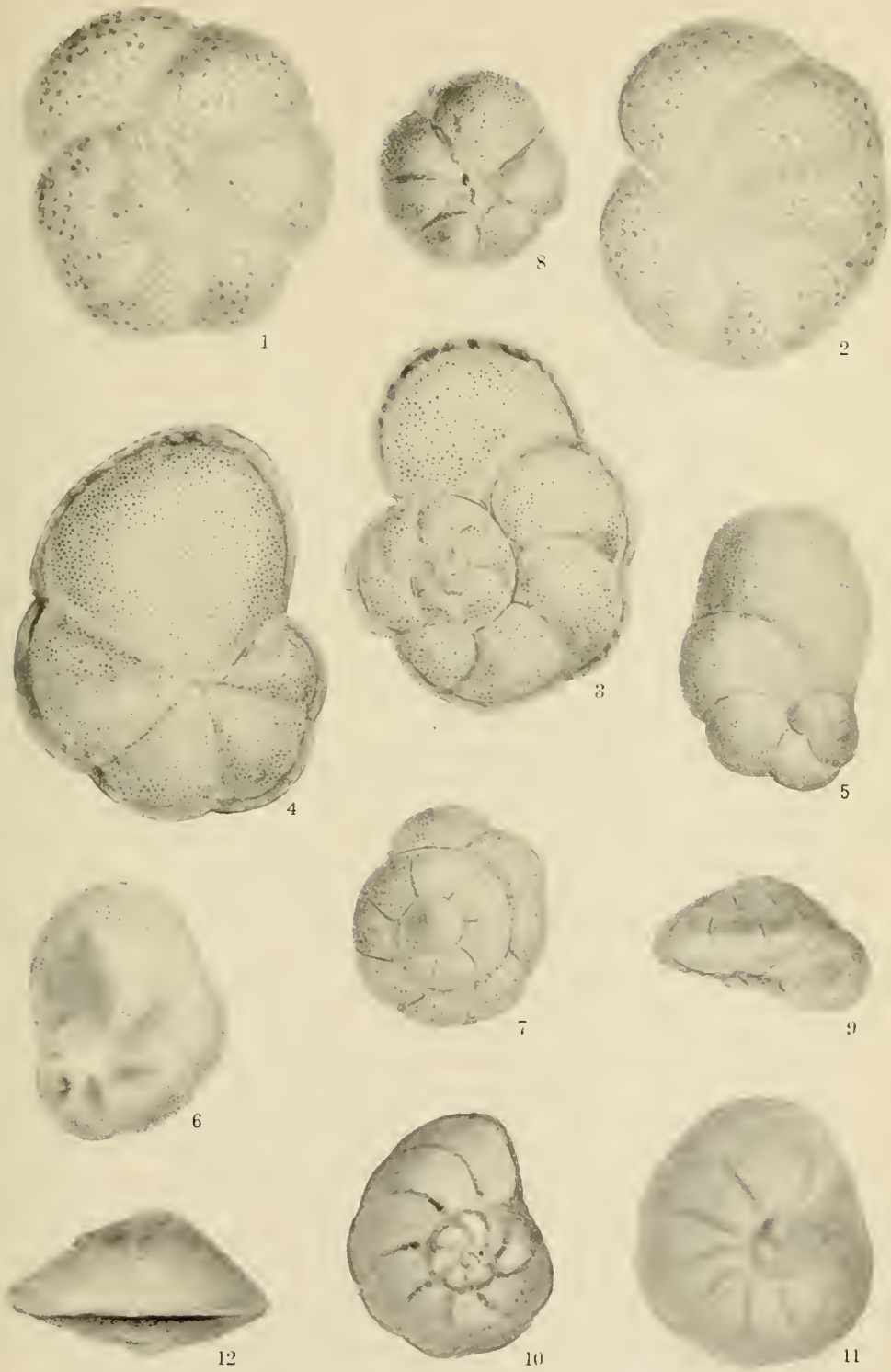

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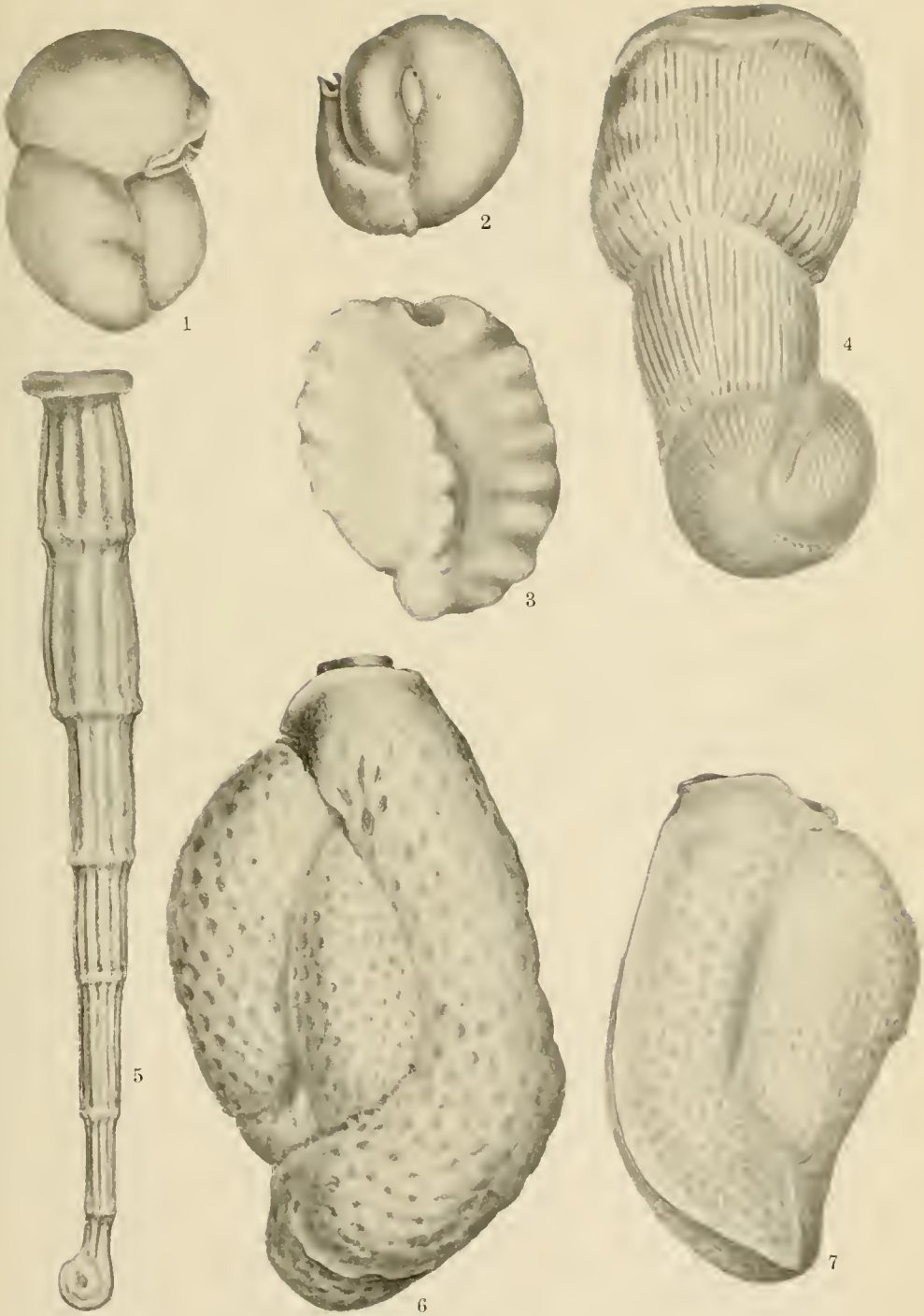

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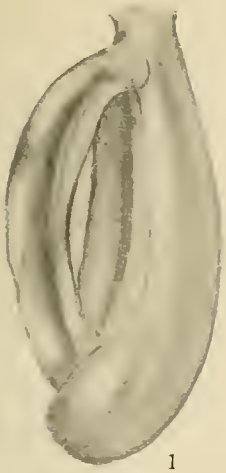

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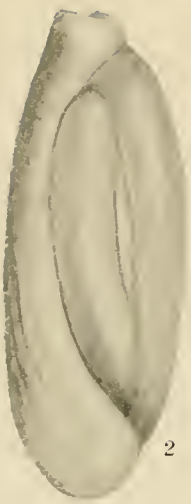

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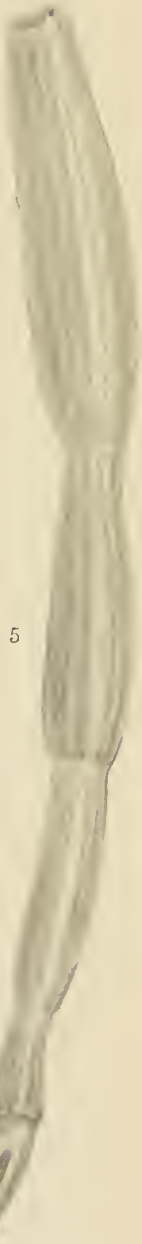

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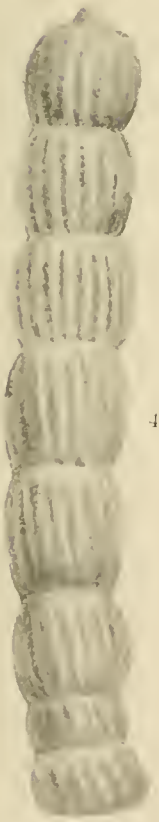

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Figures 1 to 5.

Figures 1 to 8.