FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

By Joseph A. Cushman,

Of the Boston Society of Natural History.

While in Jamaica in February and March, 1912, with the Carnegie Institution Expedition under Dr. Alfred G. Mayor, I took advantage of spare moments to collect foraminiferal material. There is very little actually known about the shallow-water foraminifera of the West Indies. D'Orbigny's Monograph of the Foraminifera of the Shore Sands of Cuba included other West Indian shore sands as well.[1] Flint recorded a few species from Puerto Rico.[2] Most of the other records are from deeper waters.

In working over this Jamaican material it was evident that the species fitted those described in d'Orbigny's Cuban Monograph much better than any others. This same fact I had also observed in working out the later tertiary material of the West Indies. Therefore, as d'Orbigny had Jamaican specimens in his material, it has seemed desirable to make rather close comparisons of the Jamaican material with the figures and descriptions of the Cuban Monograph. The result has been rather surprising in the accuracy with which most of the material fits these descriptions and figures. Many of d'Orbigny's species have been allowed to lapse and are not referred to in the literature since their original publication in 1839; others have been placed in the synonymy of other species; and still others are in good usage for tropical species. If the synonymy and the original figures and descriptions of many species are carefully studied it will be apparent that d'Orbigny's species in many cases do not deserve the fate of synonyms. Others now in good use, based on Brady's use of them in the *Challenger* Report, are used for entirely different things from those of the originals. I have, therefore, in the present paper tried to reconcile the Jamaican material with d'Orbigny's species and have tried to indicate the results.

In this connection the following quotation from the excellent work of Heron-Allen,[3] in regard to the Cuban Monograph may not be out of place:

> Ramon de la Sagra had intrusted d'Orbigny with the arrangement of the zoological portion of his History of Cuba, and among the material was a small quantity of sand,

[1] D'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères."

[2] Bulletin U. S. Fish Commission, 1900, pp. 415–416.

[3] Alcide d'Orbigny, His Life and His Work, Journal Microscopical Society, 1917, pp. 1–105, pls. 1–13 pp. 44, 45).

the richness of whose foraminiferal fauna struck d'Orbigny at once. He communicated with de Cande, a naval officer stationed in the West Indies, who supplemented de la Sagra's material with sands from Cuba, Haiti, St. Thomas, Jamaica, Martinique, and Guadelupe, and a year's assiduous work on the material proved to d'Orbigny that Cuba provides all the species to be found in any West Indian gatherings, besides many species not found elsewhere in the West Indies. He pronounces the dictum that Cuba can not be compared for Foraminiferal fauna with any place in the world excepting the Adriatic. He found in the Cuban sands 117 species, "one-tenth of the whole of the foraminifera known up to the present day;" and on these results being communicated to de la Sagra they agreed that the work "should serve as a basis for the study of the foraminifera comprehending my general views, my classification, and the succinct characters of all the genera," and he therefore gives an abstract of the general observations which he proposes to publish later in his "ouvrage special." He points out that until that moment nothing at all was known of the Foraminifera of the Antilles except about 20 species that he had noted in the "Tableau Methodique." At the end of his introduction he makes the astonishing statement that so specialized are the Cuban forms that of the whole 117 he had only found 5 in other parts of the world, but this must be read in the light of his views on species from different geographical areas. Very many of his peculiarly Cuban species have been swallowed up in the synonymies of other species of wide tropical distribution. At the same time it may be remarked that he recorded several species in 1826 (from material furnished by de Ferussac) which he did not find again in the 1839 material.

A study of the Jamaican material shows that the species of the Cuban Monograph which are represented fall into three groups: First, those species which are of wide distribution and were found in the West Indies for the first time and are not distinctively tropical or West Indian. Such species are *Globigerina bulloides*, *G. rubra*, *G. dutertrei*, and *Pulvinulina menardii*. Secondly, there are species which are known to have a wide distribution in tropical seas, such species as *Textularia candeiana*, *Cymbalopora poeyi*, *Tretomphalus bulloides*, and *Triloculina linneiana*. The third group contains species so far as known characteristic of the general West Indian regions such as *Truncatulina rosea*, *Polystomella lanieri*, *Asterigerina carinata*, and *Quinqueloculina tricarinata*.

The figures in d'Orbigny's work are occasionally somewhat conventionalized, but as a rule are very faithful in the representation of the species they illustrate, especially when compared, as they should be, with material from the same general region as that from which the originals were obtained.

A comparison of the general characters of the Jamaican collections and of d'Orbigny's species shows that the West Indian region in less than 10 fathoms (18 meters) has a marked scarcity of Astrorhizidae, Lituolidae, and Lagenidae. The great preponderance of the Miliolidae is what would be predicted in a tropical coral reef region. The Textulariidae and Rotaliidae are represented by comparatively few species, not as many as might have been expected.

The region of Montego Bay on the northwest coast of Jamaica is open to the Caribbean, but the area behind the reefs, and especially

the material from among the Bogue Islands, represents the faunal constituents of quiet, protected waters.

All the dredgings are in water of 10 fathoms (18 meters) or less and three of them in 1 fathom (2 meters) or less, so that they correspond well with d'Orbigny's "shore sands."

The material about Montego Bay collected by the writer was from the following stations:

1. In very shallow water, 2 feet deep at mean tide, in the area covered by the short "eel grass," consisting of a sandy mud from a quiet and protected area.
2. In water 1 fathom (2 meters) deep in a protected cove of the Bogue Islands, bottom of fine mud.
3. In 3 fathoms (5 meters) on the inner side of the reefs in the western part of Montego Bay, sandy.
4. In 6 fathoms (11 meters) in a pocket of the reefs surrounded by living coral.
5. In 9 fathoms (16 meters) in muddy sand.
6. In 10 fathoms (18 meters) in "coral sand" of the outer reef.

The material from Runaway Bay was from about the base of calcareous algae collected by Mrs. G. L. Cheney and given me by Mr. Charles W. Johnson, of the Boston Society of Natural History.

Family LITUOLIDAE.

Genus AMMOBACULITES Cushman, 1910.

AMMOBACULITES REOPHACIFORMIS Cushman.

Ammobaculites reophaciformis CUSHMAN, Proc. U. S. Nat. Mus., vol. 38, 1910 p. 440, figs. 12–14.

Specimens are rare at Montego Bay in 6 fathoms (11 meters) and at Runaway Bay. There is nothing corresponding to this species figured in d'Orbigny's work.

It occurs in various parts of the West Indies and on the coast of Florida, and extends westward to the Philippines and other tropical regions of the Indo-Pacific.

Family TEXTULARIIDAE.

Genus TEXTULARIA Defrance, 1824.

TEXTULARIA AGGLUTINANS d'Orbigny.

Plate 11, figs. 1–3.

Textularia agglutinans D'ORBIGNY, Foram. Cuba, 1839, p. 144, pl. 1, figs. 17, 18, 32–34.

Specimens are fairly common in the material occurring both at Montego Bay, stations 2, 4, 5, 6, and at Runaway Bay. It is a

common species in the West Indies noted by d'Orbigny from Cuba, St. Thomas, Martinique, and Jamaica. The figures given by d'Orbigny show a rather smooth species, but the description says "rugose." The Jamaican specimens are, however, smoother than specimens I have seen from other regions.

The figures given by many writers and referred to this species show that the name has been used to cover many forms, many of which do not represent this species as it is figured by d'Orbigny and as it occurs in the West Indies. It is evidently found in shallow tropical waters in many regions, but it is very doubtful if the material from deep, cold water often referred to it is the same at all.

TEXTULARIA CONICA d'Orbigny.

Plate 11, figs. 4–6.

Textularia conica D'ORBIGNY, Foram. Cuba, 1839, p. 143, pl. 1, figs. 19, 20.

D'Orbigny's figure is somewhat conventionalized and smooth, but otherwise illustrates fairly well this common tropical species found in shallow water of the West Indies and other regions. D'Orbigny recorded it from Cuba and Jamaica.

At Montego Bay it occurred at the two deeper stations at 9 and 10 fathoms (16 and 18 meters), but not in the shallower water nor at Runaway Bay.

TEXTULARIA CANDEIANA d'Orbigny.

Plate 11, figs. 7, 8.

Textularia candeiana D'ORBIGNY, Foram. Cuba, 1839, p. 143, pl. 1, figs. 25–27.

D'Orbigny does not mention Jamaica, although he found the species in material from Cuba, Martinique, and St. Thomas. The Jamaican specimens I have are very close to those figured by d'Orbigny except perhaps slightly shorter. The great increase in size toward the apertural end is fully as striking as in the types. There are several specimens from Montego Bay in 10 fathoms (18 meters), but not from the shallower stations.

This is one of the specific names allowed to lapse by subsequent authors. It is not again recognized until Millett, in 1899, referred a Malay form to this name as a variety under *T. sagittula*.[4] This is a short form not unlike this in some ways, and with the material I referred to *T. candeiana* in 1911 from the Hawaiian Islands and Gaspar Straits it would seem that this species has a wide distribution in shallow waters in the tropics.

[4] Cushman, Bull. 71, U. S. Nat. Mus., pt. 2, 1911, p. 12.

Genus BOLIVINA d'Orbigny, 1839.

BOLIVINA PUNCTATA d'Orbigny.

Plate 11, figs. 9, 10.

Bolivina punctata D'ORBIGNY, Voy. Amer. Mérid., vol. 5, pt. 5, "Foraminifères," 1839, p. 63, pl. 5, figs. 10–12.
Textularia caribaea D'ORBIGNY, Foram. Cuba, 1839, p. 145, pl. 1, figs. 28, 29.

A comparison of the two sets of figures given above with the original descriptions leaves very little to choose between the two. The material from Jamaica might represent either and it does not seem possible to distinguish the two, so that the earlier name is here used. As this name has been extensively used while *T. caribaea* has been entirely neglected, the choice of the two is fortunate. D'Orbigny's records for *T. caribaea* are Cuba, Jamaica, and Martinique. A few specimens occurred at station 2, Montego Bay.

Genus BIGENERINA d'Orbigny, 1826.

BIGENERINA NODOSARIA d'Orbigny.

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

It seems strange that this species does not occur in the Cuban Monograph. It is one of the commonest species in shallow water in the West Indies. It occurred at Montego Bay at stations 4, 5, and 6, and at Runaway Bay also.

D'Orbigny's original specimens to this species come from the Adriatic, both his figures and Modèle showing much more regular form of test than is usually found in West Indian and other tropical material that I have seen.

Genus VERNEUILINA d'Orbigny, 1840.

VERNEUILINA SPINULOSA Reuss.

Verneuilina spinulosa REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 374, pl. 47, fig. 12.

Specimens of this shallow water tropical species occur at two stations at Montego Bay, stations 2 and 4. It is not common.

More characteristic species occur along the Florida Keys in comparatively shallow water.

Genus VALVULINA d'Orbigny, 1826.

VALVULINA OVIEDOIANA d'Orbigny.

Plate 11, figs. 11–14.

Valvulina oviedoiana D'ORBIGNY, Foram. Cuba, 1839, p. 103, pl. 2, figs. 21, 22.

This species has been entirely neglected since its first description and was not even used by Brady as a synonym in the *Challenger* Report. The material from Jamaica is fairly common at the three

shallowest stations, Montego Bay, stations 1 and 2, and Runaway Bay.

D'Orbigny's figure is perhaps a little too smooth and even, but it shows the characteristic outline and apertural region of the species. The chambers are angled and well set apart from one another, as is well shown in the type figures.

This seems certainly a species which should be revived at least for the West Indian material, which is like nothing else and was well characterized and figured by d'Orbigny. D'Orbigny's types were from Cuba, and as it is found at both localities in Jamaica it undoubtedly has a wider range in the shallow water of the West Indian region. This species is very close to *V. davidiana* Chapman, from Funafuti Atoll, Ellice Islands.

This is evidently the same as the material I have referred to *Verneuilina affixa* from the coast of Florida.[5] It has a wide range in the West Indian region and in the Gulf of Mexico, and is very constant in its characters.

Either this species is closely allied to *V. davidiana* Chapman, or else both represent a single species of wide tropical distribution.

Genus VIRGULINA d'Orbigny, 1826.

VIRGULINA PUNCTATA d'Orbigny.

Plate 11, fig. 15.

Virgulina punctata D'ORBIGNY, Foram. Cuba, 1839, p. 139, pl. 1, figs. 35, 36.

This species, recorded by d'Orbigny from Cuba and Jamaica, has occurred in the material from Montego Bay at station 5. This is another of d'Orbigny's species allowed to lapse without being used as a synonym. It is very clearly the species found in this material and as such should be used for the recent West Indian form. The figure given by d'Orbigny with the narrow oblique chambers is a very good representation of the Montego Bay specimen.

It is quite likely that the specimens I have referred to *V. squamosa* from Fort Jefferson Channel, Tortugas, Florida,[6] may belong to this species.

Genus CLAVULINA d'Orbigny, 1826.

CLAVULINA TRICARINATA d'Orbigny.

Plate 12, figs. 1, 2.

Clavulina angularis D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 268, pl. 12, fig. 7.
Clavulina tricarinata D'ORBIGNY, Foram. Cuba, 1839, p. 111, pl. 2, figs. 16-18.

The original specimens of d'Orbigny's *Clavulina angularis* were from the Mediterranean, from the shores of the Island of Corsica.

The figure shows an elongate test, the early portion of which is triangular in cross section, the later chambers rounded after the

[5] Papers from the Department of Marine Biology, Carnegie Institution of Washington, vol. 9, 1918 pp 271, etc.
[6] Idem, p. 284.

early portion. D'Orbigny's West Indian *Clavulina tricarinata* shows the test triangular throughout, except perhaps for the last-formed chamber, which is more rounded. His specimens were from Cuba and Jamaica.

Such specimens are very common in the West Indies and on the coast of Florida, not only in shallow water, but at moderate depths. They are very constant in their characters, and it seems quite likely that this may differ from the Mediterranean *Clavulina angularis*. A comparison of the specimens from these two regions should determine this.

It is interesting in this connection to note that Sidebottom in his paper on the foraminifera from the Bay of Palermo [7] figures a specimen which is very much like that given by d'Orbigny in 1826, also from the Mediterranean, but it is very unlike the typical *C. tricarinata* of the West Indies. This seems to throw some evidence on the side of the two being distinct from one another.

The *Challenger* figures (pl. 48, figs. 22–24) are more definitely angular. Although the locality for these is not given, they are probably from the East Indies, where rather typical specimens occur in abundance.

A species evidently like many others occurs in the West Indian region and across the tropical Pacific, and that from the Mediterranean may, like other examples, be separated from it when a study is made of the two.

It occurred at Montego Bay at stations 2, 4, 5, and 6, and at Runaway Bay. It was most common at the stations in deeper water, although in considerable numbers even in the shallow water of Runaway Bay.

CLAVULINA NODOSARIA d'Orbigny.

Plate 12, fig. 3.

Clavulina nodosaria D'ORBIGNY, Foram. Cuba, 1839, p. 110, pl. 2, figs. 19, 20.

This is another species which has remained neglected. In the examination of the Montego Bay material a small slender species was found at two stations, 2 and 6, which is evidently this species. The early chambers are rounded triangular, the uniserial ones subglobose, with constricted sutures and distinctly nodular as in the original figure. While found at these stations with *C. angularis*, it is, nevertheless, very distinct as it is rounded at a very early stage, has nodosarian chambers, and does not attain but a fraction of the size of *C. angularis*. D'Orbigny's specimens were from Cuba and Martinique, which, with the Jamaica record, shows that it is probably widely distributed in the West Indies.

[7] Proc. Mem. Manchester Lit. Philos Soc. .vol. 54, no. 16, 1910, p. 11, pl. 1, fig. 10.

Family LAGENIDAE.

Genus POLYMORPHINA d'Orbigny, 1826.

POLYMORPHINA cf. VITREA (d'Orbigny).

Plate 12, fig. 4.

Guttulina vitrea D'ORBIGNY, Foram. Cuba, 1839, p. 133, pl. 2, figs. 1–3.

A single station from Montego Bay, station 6, is nearer to this than any other of d'Orbigny's species. As there is but the single specimen, it is difficult to say whether it is an adult or an immature specimen. It is the only representative of the family in the Jamaican material which is remarkable. as several of the genera are abundant

FIG. 1.—CLAVULINA NODOSARIA D'ORBIGNY. SPECIMEN FROM 10 FATHOMS, MONTEGO BAY. OUTLINE. × 100.

FIG. 2.—POLYMORPHINA CF. VITREA D'ORBIGNY. SPECIMEN FROM 10 FATHOMS, MONTEGO BAY. × 50.

at moderate depths in the Gulf of Mexico and Caribbean. In d'Orbigny's work, however, the family was represented by but few species, showing that they are not common in the very shallow water

Family GLOBIGERINIDAE.

Genus GLOBIGERINA d'Orbigny, 1826.

GLOBIGERINA BULLOIDES d'Orbigny.

Plate 12, fig. 5.

Globigerina bulloides D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 277, No. 1; Modèles, Nos. 17 and 76.
Globigerina siphonifera D'ORBIGNY, Foram. Cuba, 1839, p. 83, pl. 4, figs. 15–18.

Specimens of this widespread species occurred at four stations, Montego Bay, stations 2, 4, and 6, with few specimens in each; and rare at Runaway Bay. D'Orbigny does not record this species in the Cuban Monograph. However, his *G. siphonifera* is apparently the same species and may account for it, being a specimen with the bases of the spinose projections still attached to the test. Such specimens are not uncommon in well preserved material of *G. bulloides* throughout its range. D'Orbigny recorded *G. siphonifera* from Cuba and Jamaica.

GLOBIGERINA RUBRA d'Orbigny.

Plate 12, fig. 6.

Globigerina rubra D'ORBIGNY, Foram. Cuba, 1839, p. 82, pl. 4, figs. 12–14.

The only specimens of this species are from Montego Bay, stations 4 and 6. Specimens are not at all common in spite of the fact that the species is very common in the general region in deeper water. D'Orbigny describes it from shore sands of Cuba, and also recorded it from Jamaica, Guadeloupe, and Martinique. Specimens both with and without the reddish coloring occur in the material, the form alone being sufficient to determine the species. The West Indian material of this species has a peculiar deep red color; but, although the species is recorded from the Pacific, while it often has a similar form, it almost invariably lacks the color.

GLOBIGERINA DUTERTREI d'Orbigny.

Plate 12, fig. 7.

Globigerina dutertrei D'ORBIGNY, Foram. Cuba, 1839, p. 84, pl. 4, figs. 19–21.

D'Orbigny described this species from Cuba and recorded it also from Martinique and Guadeloupe. It occurred at Montego Bay, at stations 4 and 6, and also at Runaway Bay. It is now known to be widely distributed.

Family ROTALIIDAE.

Genus PLANORBULINA d'Orbigny, 1826.

PLANORBULINA ACERVALIS H. B. Brady.

Plate 12, fig. 8.

Planorbulina acervalis H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 657, pl. 92, fig. 4.

Somewhat of a problem is presented by the Jamaican specimens of *Planorbulina*. All the material—and it is abundant—seems very definitely to be *P. acervalis*. In the Cuban Monograph d'Orbigny describes *P. vulgaris*, which seems from the figures and notes to be identical with *P. mediterranensis* d'Orbigny, described in 1826, Neither species as figured by d'Orbigny seems like actual material I have examined, and one is brought to the conclusion that the regular spiral condition shown is due to the conventionalizing of the drawings. The Cuban specimen is evidently curved and seemingly an attached form. At Montego Bay the most abundant locality for *Planorbulina* was the short eel grass of the protected areas behind the Bogue Islands. There it was in great numbers attached to the eel grass. It was, however, also found at stations 2, 4, 5, 6, and at Runaway Bay.

Typical *P. mediterranensis* is not definitely known from the West Indian region in shallow water. Goës, in 1882, records and figures two forms under the name *Planorbulina farcta* var. *vulgaris*, of which figure 227 seems most like *P. mediterranensis* or *P. vulgaris*. Figure 226, however, is *P. acervalis* H. B. Brady without any doubt. These were both from the Caribbean. In 1896 Goës [8] records *Planorbulina* again from the Caribbean as *P. mediterranensis*, and places his earlier *P. farcta*, var. *vulgaris* as a synonym, but figure 226 as *P. acervalis*, as noted above. Goës gives the following not very clear note (p. 74):

A pygmy form of this species is not seldom met with in the Caribbean Sea in 300 fathoms of water. A variety of higher development that Brady has described under a separate denomination (*P. acervalis*) is also joined with the type, but of more rare occurrence.

As both forms occur together and one is a "pygmy form" it is possible that this is but the young of *P. acervalis*. Flint [9] records both species from the Gulf of Mexico, a single specimen of *P. mediterranensis* from *Albatross* station D2377, and *P. acervalis* from D2399 (number of specimens not given). The diameter of the former is given as 1 mm., that of the latter 1.5–2.5 mm. The specimen given as *P. mediterranensis* is evidently broken, from the evidence of the figure. The accumulative evidence then shows that *P. acervalis* is abundant in the West Indies and *P. mediterranensis* very rare or of doubtful occurrence.

Therefore it might seem from the incomplete evidence that d'Orbigny's *P. vulgaris* might possibly be the same as *P. acervalis* of Brady, and if so, would necessarily be used instead of *acervalis* for this species. The only means of really settling the problem would be the examination of the type specimens of *P. vulgaris* if they are extant, but the problem is here raised for consideration.

Genus TRUNCATULINA D'Orbigny, 1826.

TRUNCATULINA ROSEA (d'Orbigny).

Plate 13, figs. 1–3.

Rosalina rosea D'ORBIGNY, Foram. Cuba, 1839, p. 72, pl. 3, figs. 9–11.

This is typically a West Indian species described by d'Orbigny in the Cuban Monograph and recorded but a few times since. It is recorded from the shores of Cuba, Martinique, Guadeloupe, St. Thomas, Jamaica, and Haiti. Flint records it from Puerto Rico.[10] In the latter case, however, it is noteworthy that Flint records it only from the shallowest station depths 4–7½ fathoms (7–15 meters), and not in any of the others from 14¾–23 fathoms (27–42 meters), indicating

[8] Bull. Mus. Comp. Zoöl., vol. 29, 1896, p. 73.
[9] Ann. Rept. U. S. Nat. Mus., 1897 (1899), p. 328.
[10] Bull. U. S. Fish Commission, 1900, p. 415-416.

that its natural habitat is very shallow water. In the Montego Bay material it is astonishingly abundant, the specimens giving color to the finer material. It occurs at all the stations at Montego Bay, and also from Runaway Bay. It was very abundant in from 1–3 fathoms (2–5 meters), much less so in the 6–10 fathoms (11–18 meters) of the deeper stations. I recorded a single specimen from the dock piles at Woods Hole [11] which was very typical, but there are not any intermediate records. I have recorded this species from Fort Jefferson Channel, Tortugas, Florida,[12] and it occurs at other stations in the Gulf of Mexico, always, so far as I have seen, in shallow water. Egger [13] records *T. rosea* from West Australia in 90–359 fathoms (165–656 meters) depth. Egger's figures, however, do not remotely suggest the real characters of this species, and it is evidently not this species.

Just what the habits of this species are which keep it so closely confined to shallow water in the West Indies, yet allow it to occur there in such numbers, would be interesting to determine. Its color is very attractive, being one of the few foraminifera showing a red color.

TRUNCATULINA CANDEIANA (d'Orbigny).

Plate 13, figs. 4, 5.

Rosalina candeiana D'ORBIGNY, Foram. Cuba, 1839, p. 97, pl. 4, figs. 2–4.

Specimens identical with this species as figured by d'Orbigny were found at Montego Bay stations 4, 5, and 6, and from Runaway Bay. D'Orbigny's specimens were from Cuba.

This name has been entirely neglected since its application. It seems to have been applied to a definite species, the distribution of which outside the West Indian region is at present unknown. Most of the specimens are close to the 0.5 mm. diameter given by d'Orbigny.

TRUNCATULINA ANTILLARUM (d'Orbigny).

Plate 13, figs. 6–8.

Rosalina antillarum D'ORBIGNY, Foram. Cuba, 1839, p. 75, pl. 5, figs. 4–6.

Description.—Test nearly equally convex, punctate, margin carinate, spire conical, slightly convex; chambers seven in the last-formed coil, curved and oblique from above; sutures obliquely curved; below triangular, the sutures straight and radial; aperture elongate, slightly curved as the inner margin of the chamber. Diameter, 0.5–1 mm.

This is another of the species described by d'Orbigny which has been entirely neglected. Material from Montego Bay, stations 5 and 6, is very close to the original figures of d'Orbigny's Monograph. D'Orbigny's specimens were from Cuba and Jamaica.

[11] Proc. Boston Soc. Nat. Hist., vol. 34, No. 2, 1908, p. 30.
[12] Publ. 213 Carnegie Inst., Washington, 1918.
[13] Abh. Kais. Akad. Wiss. München, vol. 18, 1893, p. 397, pl. 16, figs. 4–6.

Genus CYMBALOPORA Hagenow, 1850.

CYMBALOPORA POEYI (d'Orbigny).

Plate 13, figs. 9–12.

Rotalia squammosa D'ORBIGNY (*nomen nudum*), Ann. Sci. Nat., vol. 7, 1826, p. 272, No. 8.

Rosalina poeyi D'ORBIGNY, Foram. Cuba, 1839, p. 92, pl. 3, figs. 18–20.

[?] *Rosalina squammosa* D'ORBIGNY, Foram. Cuba, 1839, p. 91, pl. 3, figs. 12–14.

D'Orbigny described this species from the West Indies, noting that it occurs plentifully adhering to *Fucus* and *Ulva Lactuca*. The form described as *R. squammosa* has a much higher spire, but seems, from the figures at least, to be very close, if not identical with, *C. poeyi*. The low form is the one that is abundant at Jamaica.

Although not observed attached to algae at Montego Bay, the specimens were noted as occurring in much greater abundance in depths of 1 fathom (2 meters) or less, than in 3–10 fathoms (5–18 meters). At the lesser depths it was very abundant. Specimens were collected at stations 1, 2, 4, and 6 at Montego Bay and at Runaway Bay.

This is one of the species which is widely distributed either in its typical form or varieties in the tropical Pacific, as well as the West Indian region.

Genus TRETOMPHALUS Moebius, 1880.

TRETOMPHALUS BULLOIDES (d'Orbigny).

Plate 13, fig. 13.

Rosalina bulloides D'ORBIGNY, Foram. Cuba, 1839, p. 98, pl. 3, figs. 2, 3.

Cymbalopora bulloides CARPENTER, PARKER, and JONES, Introd. Foram., 1862, p. 216.

Tretomphalus bulloides MOEBIUS, Beitr. Meeresfauna Insel Mauritius, 1880, p. 98, pl. 10, figs. 6–9.

This is rare in 6 fathoms (11 meters) at Montego Bay. It is a pelagic species at least in adult condition, and has a wide range in comparatively shallow water in the Pacific and Indian Oceans, as well as south to Australia.

Genus SIPHONINA Reuss, 1849.

SIPHONINA RETICULATA (Czjzek).

Rotalina reticulata CZJZEK, Haidinger's Nat. Abh., vol. 2, 1848, p. 145, pl. 13, figs. 7–9.

Truncatulina reticulata BRONN, Lethaea Geognostica, ed. 3, vol. 3, 1853–1856, p. 227, pl. 35 (?), figs. 23*a–c*.

There seems to be no figure or description in d'Orbigny's Cuban Monograph which at all apply to this species. Specimens were found at Montego Bay at stations 1 and 5, at both of which it was rare.

The numerous forms or species referred to this species are evidently a complex which needs revision. There are numerous species in this general region, both living, and in the Tertiary, a close study of which should give some idea as to the relation of the different forms.

Genus DISCORBIS Lamarck, 1804.

DISCORBIS AUBERII (d'Orbigny).

Plate 14, figs. 1–3.

Rosalina auberii D'ORBIGNY, Foram. Cuba, 1839, p. 94, pl. 4, figs. 508.

Description.—Test trochoid, with a low spire, periphery carinate, acute, ventral side slightly if at all convex, composed of several coils with four chambers in each, sutures distinct, wall of the chambers rather coarsely perforate, aperture at the base of the last-formed chamber, elongate. Diameter, 0.4 mm.

The only specimens were from Runaway Bay.

This species has not been referred to since its first description, but it fits admirably the material above mentioned. D'Orbigny's specimens were from Cuba and Martinique.

DISCORBIS VALVULATA (d'Orbigny).

Plate 14, figs. 4, 5.

Rosalina valvulata D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 271, No. 4; in Barker, Webb, and Berthelot, Hist. Nat. Îles Canaries, 1839, vol. 2, pt. 2, "Foraminifères," p. 136, pl. 2, figs. 19–21; Foram. Cuba, 1839, p. 96, pl. 3, figs. 21–23.

Description.—Test much compressed, translucent, very thin-walled, dorsally with a very low slightly convex spire, ventrally slightly concave; chambers with the periphery rounded and slightly thickened, sutures distinct but only very slightly depressed, on the ventral side with slight alar projections toward the umbilicus; wall thin except at the chamber margins; punctations very fine; aperture at the inner margin of the ventral side of the chamber; color slightly yellowish. Length, about 0.5 mm.

The only material which belongs to this species is from 6 fathoms (11 meters) at Montego Bay. It is, however, very typical and shows that the figures of d'Orbigny were very accurate for this species. It is evident also that the figures of the Canaries Monograph are much poorer copies of the same figures as in other cases. The original specimens mentioned by d'Orbigny in 1826 were from the coast of Martinique in the West Indies. It is also clear that Brady referred to this species material which is very different and does not belong here. The figures of the *Challenger* Report (pl. 87, figs. 5–7) show a much thicker, heavier test, with coarse punctations, entirely different shape, fewer chambers, and in short the two have nothing in common except the limbate sutures, which in the Cuba specimen are more a difference in texture of the wall than truly limbate in character.

Brady's species, therefore, is an entirely different one from the West Indian one described by d'Orbigny.

DISCORBIS ORBICULARIS (Terquem).

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.

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

This is another of the species of the West Indies which d'Orbigny does not seem to have had in his material. Brady gives it as plentiful amongst the West Indies. Very typical material was obtained at Montego Bay, in 6 fathoms (11 meters).

Genus PULVINULINA Parker and Jones, 1862.

PULVINULINA MENARDII (d'Orbigny).

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

Pulvinulina menardii OWEN, Journ. Linn. Soc. London (Zool.), vol. 9, 1867, p. 148, pl. 5, fig. 6.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 690, pl. 103, figs. 1, 2.

This species, a pelagic one of open oceans, was not recorded by d'Orbigny in his Cuban Monograph. It did not occur in the shallow water material at Montego Bay or Runaway Bay, but rare specimens were found at the deeper stations at Montego Bay in 9 and 10 fathoms, (16 and 18 meters) evidently coming in from open water.

PULVINULINA OBLONGA (Williamson).

Nautilus auricula, var., FICHTEL and MOLL, Test. Micr., 1803, p. 108, pl. 20, figs. *d-f*.

Rotalina oblonga WILLIAMSON, Rec. Foram. Great Britain, 1859, p. 51, pl. 4, figs. 98-100.

Pulvinulina oblonga, H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 688, pl. 106, figs. 4*a–c*.

A single specimen of this species was found in the dredging from 10 fathoms (18 meters), Montego Bay. Specimens of this general form are common in the tropics, both in the West Indian region and in the tropical Pacific, but need close study to determine whether or not they all belong to one species.

Genus ASTERIGERINA d'Orbigny, 1839.

ASTERIGERINA CARINATA d'Orbigny.

Plate 14, figs. 6–8.

Asterigerina carinata D'ORBIGNY, Foram. Cuba, 1839, p. 118, pl. 5, fig. 25; pl 6, figs. 1–2.

D'Orbigny described this species from shore sands of Cuba and Jamaica. In the material both from Runaway Bay and Montego Bay this is one of the most common of the species found. It is very definite in its characters, and shows that *Asterigerina*, at least as far

as this species and *A. lobata* are concerned, is very close to *Amphistegina* rather than to *Discorbis*, as it is placed by Brady. The characters are very constant, and there is evidently in this region a remarkable development of foraminifera of this genus, both in recent sands and in late tertiary deposits. The figures given by d'Orbigny of this species are excellent. Specimens exceed somewhat the diameter given by d'Orbigny of one-half mm., but do not attain a size of more than 0.75–0.80 mm. in this material. An examination of the West Indian and Florida material shows that this species is very abundant in comparatively shallow water throughout a large part of the region, extending north as far as Cape Hatteras on the Atlantic coast.

Genus NONIONINA d'Orbigny, 1826.

NONIONINA GRATELOUPI d'Orbigny.

Plate 14, figs. 9–11.

Nonionina grateloupi d'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 294, No. 19; Foram. Cuba, 1839, p. 46, pl. 6, figs. 6–7.—CUSHMAN, Publ. 291, Carnegie Inst. Washington, 1919, p. 48.

Specimens identical with this species as figured by d'Orbigny were dredged at Montego Bay in 1, 6, and 10 fathoms (2, 11, and 18 meters). D'Orbigny's specimens were from Cuba, Jamaica, and Martinique. D'Orbigny's figure of the side view, with the peculiar angle made by the last few chambers and the swollen median portion in front view, are characteristic.

N. sloanii, which was not found in the Jamaican material, is, however, found in the later Tertiary of the West Indies, occurring both in Cuba and Santo Domingo. It seems to be a valid species, and with its greater compression in front view can be distinguished from forms usually assigned to *N. boucana*.

Genus POLYSTOMELLA Lamarck, 1822.

POLYSTOMELLA LANIERI d'Orbigny.

Plate 14, figs. 12, 13.

Polystomella lanieri d'ORBIGNY, Foram. Cuba, 1839, p. 54, pl. 7, figs. 12-13.—CUSHMAN, Publ. 291, Carnegie Inst. Washington, 1919, p. 49.

Brady, in the *Challenger* Report (p. 736), places this species as a synonym of *P. crispa* Linnaeus. While this may be a reasonable disposition of the species, the Jamaican specimens are very close to d'Orbigny's figures of *P. lanieri*. They occurred at stations 1 and 2 at Montego Bay and at Runaway Bay.

No specimens were found of *P. sagra* d'Orbigny, but the species is found in the West Indies as a late Tertiary fossil, both in Santo Domingo and Cuba, and probably is a valid recent species. D'Orbigny noted it as rare in the shore sands of Cuba.

POLYSTOMELLA cf. STRIATO-PUNCTATA (Fichtel and Moll).

This is a much overworked species, which undoubtedly includes several distinct species or varieties.

The Jamaican specimens apparently represent two distinct forms, of which one is close to *P. poeyana* d'Orbigny of the Cuban Monograph. Until a revision of the genus can be attempted with abundant specimens the material had best be referred here. Specimens were from Montego Bay, stations 1, 4, and 6.

Genus AMPHISTEGINA d'Orbigny, 1826.

AMPHISTEGINA GIBBOSA d'Orbigny.

Amphistegina gibbosa D'ORBIGNY, Foram. Cuba, 1839, p. 120, pl. 8, figs. 1–3.

The Jamaican specimens, which are very numerous at nearly all the stations, but especially so from 6–10 fathoms (11–18 meters), are all of the form described by d'Orbigny in the Cuban Monograph. Whether this is really different from *A. lessonii* d'Orbigny may be questioned, but can be better answered after a study of the Recent and Tertiary material, where many forms of the genus occur.

Genus HETEROSTEGINA d'Orbigny, 1826.

HETEROSTEGINA ANTILLARUM d'Orbigny.

Heterostegina antillarum D'ORBIGNY, Foram. Cuba, 1839, p. 122, pl. 7, figs. 24–25.

Specimens were occasionally found in the Montego Bay material which in side view seemed very much like this species in all its characters, but in front view were seen to be the young of *Orbiculina adunca*, where the translucent character of the walls allowed the chamberlets to be seen apparently as markings on the outer wall. No true *Heterostegina* was found.

Family MILIOLIDAE.

Genus CORNUSPIRA Schultze, 1854.

CORNUSPIRA INVOLVENS (Reuss).

Operculina involvens REUSS, Denkschr. Akad. Wiss. Wien, vol. 1, 1849, p. 370, pl. 45, fig. 20.

Cornupsira 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. 1–3.

No specimens are recorded from Cuba by d'Orbigny which could possibly be this species. It is rare, being found at but two of the Jamaica stations at Montego Bay, 1 and 4.

Genus SPIROLOCULINA d'Orbigny, 1826.

SPIROLOCULINA ANTILLARUM d'Orbigny.

Plate 14, figs. 14, 15.

Spiroloculina antillarum D'ORBIGNY, Foram. Cuba, 1839, 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*.

An examination of the Jamaican material and a comparison of the material with the figures given by d'Orbigny seem to show that *S. antillarum* should be the name used for our recent species so common among coral reefs in shallow water. In that case it would take precedence over *S. grata* Terquem, which Brady took for the name for our recent species. A comparison of Terquem's and d'Orbigny's figures would seem to show that the Cuban species certainly as fully represents our recent species as does that from the Pliocene of the Isle of Rhodes. D'Orbigny's name was published nearly 40 years earlier. Brady's figure, which he refers to *Spiroloculina antillarum*, is not typical of this species, as it occurs in the West Indies.

Specimens were found in dredgings from Montego Bay, stations 1, 2, and 4, and from Runaway Bay.

SPIROLOCULINA ANTILLARUM d'Orbigny, var. ANGULATA Cushman.

Plate 14, fig. 16.

Spiroloculina grata H. B. BRADY (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.

This variety occurs with typical *S. antillarum*. It was noted at Montego Bay at stations 1, 2, 3, and 10.

SPIROLOCULINA ARENATA, new species.

Plate 14, fig. 17.

Description.—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, 0.6–0.9 mm.

Type specimen (U.S.N.M. No. 15989) from station 2, Montego Bay, Jamaica. Specimens were also obtained from stations 1, 4, and 6 at Montego Bay.

This has a different form from *S. asperula* Karrer. Occasionally the chambers leave openings in the test where the newly-formed

chamber is added without completely filling in the space between it and the previously formed coil.

SPIROLOCULINA cf. ORNATA d'Orbigny.

Spiroloculina ornata D'ORBIGNY, Foram. Cuba, 1839, p. 167, pl. 12, figs. 7, 7[1].

A single specimen from station 2 at Montego Bay is very much like the figure given by d'Orbigny under this name. The originals are from sands of Cuba; rare.

Genus VERTEBRALINA d'Orbigny, 1826.

VERTEBRALINA CASSIS d'Orbigny.

Plate 15, figs. 1–8.

Vertebralina cassis D'ORBIGNY, Foram. Cuba, 1839, p. 51, pl. 7, figs. 14–15.
Vertebralina mucronata D'ORBIGNY, Foram. Cuba, 1839, p. 52, pl. 7, figs. 16–19.

Brady placed this species as a synonym of *Articulina sagra* d'Orbigny. However, by the law of priority, the name *cassis* should take precedence, even though the two were considered the same. The development of the two genera has already been studied, and *Vertebralina* seems related to *Spiroloculina* as a derivative, while *Articulina* seems to have been derived from the Milioline series, either *Quinqueloculina* or *Triloculina*. As different genera the two need not be confused and in fact it does not seem that the two should ever have been placed together.

Vertebralina cassis is common in the Jamaican material at Montego Bay at stations 2, 4, and 6, and at Runaway Bay. The material is very typical at all the stations.

It seems evident that *V. mucronata* is a synonym of *V. cassis* as indicated by Brady.

D'Orbigny had material from several West Indian islands, and I have found it in the Gulf of Mexico and on the coast of Florida.

VERTEBRALINA, species?

In the Montego Bay material, from stations 4, 5, and 6, there are rare specimens, evidently young, of a smooth species of this genus, but not in sufficient quantity to warrant description.

Genus QUINQUELOCULINA d'Orbigny, 1826.

QUINQUELOCULINA ALVEOLINIFORMIS (H. B. Brady).

Miliolina alveoliniformis H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 181, pl. 8, figs. 15–20.
Quinqueloculina alveoliniformis CUSHMAN, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 43.

This is a large species peculiar to tropical regions in fairly shallow water. Specimens occurred in the Runaway Bay material and in the dredgings from 9 fathoms (16 meters) in Montego Bay. It is singular that this species is not recorded in some form in the Cuban Monograph.

QUINQUELOCULINA AGGLUTINANS d'Orbigny.

Plate 15, figs. 9, 10.

Quinqueloculina agglutinans D'ORBIGNY, Foram. Cuba, 1839, p. 195, pl. 12, figs. 11–13.

This has become a convenient name to use for almost any arenaceous quinqueloculine species. The Jamaican material is of the form described and figured by d'Orbigny. It was common in the Montego Bay material and found at stations 1, 2, 4, and 5.

D'Orbigny's records are from Jamaica and rare in Cuba. I have had material from numerous stations in the shallow water of the Gulf

FIG. 3.—QUINQUELOCULINA AGGLUTINANS D'ORBIGNY. APERTURAL VIEW OF SPECIMEN FROM 1 FATHOM, BOGUE ISLANDS, MONTEGO BAY. × 40.

FIG. 4.—QUINQUELOCULINA BIDENTATA D'ORBIGNY. APERTURAL VIEW OF SPECIMEN FROM RUNAWAY BAY. × 40.

of Mexico and along the Florida Keys, as well as in the Bahamas. All have the typical form as shown in d'Orbigny's figure.

QUINQUELOCULINA BIDENTATA d'Orbigny.

Plate 15, figs. 11, 12.

Quinqueloculina bidentata D'ORBIGNY, Foram. Cuba, 1839, p. 197, pl. 12, figs. 18–20.

This species differs from *Q. agglutinans* in the shape of the chambers especially and the more elongate form. It was found frequently at Runaway Bay, but not at Montego Bay where *Q. agglutinans* is common.

D'Orbigny's specimens were from Cuba.

QUINQUELOCULINA LAMARCKIANA d'Orbigny.

Plate 15, figs. 13, 14.

Quinqueloculina lamarckiana D'ORBIGNY, Foram. Cuba, 1839, p. 189, pl. 11, figs. 14, 15.

Quinqueloculina auberiana D'ORBIGNY, Foram. Cuba, 1839, p. 193, pl. 12, figs. 1–3.

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

In the Cuban Monograph *Q. lamarckiana* is given from Cuba and Jamaica, and *Q. auberiana* from Cuba and Martinique. The descriptions of the two are almost identical, and it seems that they should be

considered as one species. In that case the name *Q. lamarckiana* must take precedence. Brady placed *Q. lamarckiana* as a synonym of *Q. cuvieriana*, but that species has the secondary costae marking the test and is distinct; also Brady's figures of *cuvieriana* do not represent that species as described and figured by d'Orbigny, but rather belong to *Q. lamarckiana*. It is a species widely distributed in the tropical Pacific as well as in the West Indies.

Jamaican material was obtained at Montego Bay at stations 1, 2, 4, 5, and 6, and also from Runaway Bay.

QUINQUELOCULINA CUVIERIANA d'Orbigny.

Plate 16, figs. 1, 2.

Quinqueloculina cuvieriana d'Orbigny, Foram. Cuba, 1839, p. 190, pl. 11, figs. 19–21.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 47, pl. 12, fig. 2.

This is not a common species, a few specimens being found at stations 1 and 5 at Montego Bay, and also at Runaway Bay.

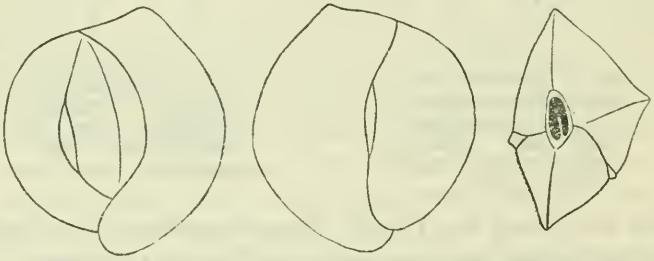


Fig. 5.—Quinqueloculina lamarckiana d'Orbigny. *a*, side view of specimen; *b*, opposite side; *c*, apertural view of specimen from 9 fathoms, Montego Bay. × 50.

D'Orbigny's specimens were from Cuba. I found similar specimens in material from Hongkong in shallow water.

QUINQUELOCULINA BRADYANA Cushman.

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

Quinqueloculina bradyana Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 52, pl. 18, fig. 2.

Most of the records for this species are from the Indo-Pacific, but it has been found in the Jamaican material at Runaway Bay, and at stations 1, 2, 4, 5, and 6 at Montego Bay.

QUINQUELOCULINA POLYGONA d'Orbigny.

Plate 16, figs. 3, 4.

Quinqueloculina polygona d'Orbigny, Foram. Cuba, 1839, p. 198, pl. 12, figs. 21–23.

Brady gives this as a synonym of *Q. ferussacii* d'Orbigny, but the two do not seem to hold much in common. Apparently the species

of Jamaica and Cuba described by d'Orbigny as *Q. polygona* is a very definite species, as shown by the Montego Bay material. These are very different from the slender elongate species usually assigned to *Q. ferussacii*. The chambers are clear cut and squarish, as shown in the type figure.

It occurs at stations 3–6 at Montego Bay and is a much smaller species than *Q. ferussacii*.

QUINQUELOCULINA DILATATA d'Orbigny.

Plate 16, figs. 5, 6.

Quinqueloculina dilatata D'ORBIGNY, Foram. Cuba, 1839, p. 192, pl. 11, figs. 28–30.—SCHLUMBERGER, Mem. Soc. Zool. France, vol. 6, 1893, p. 217, figs. 29, 30; pl. 3, figs. 70–74; pl. 4, figs. 87–90.

This species, described from Cuba and St. Thomas by d'Orbigny as rare, has been recorded by Schlumberger from the region of Marseilles and by Wiesner from the Adriatic.

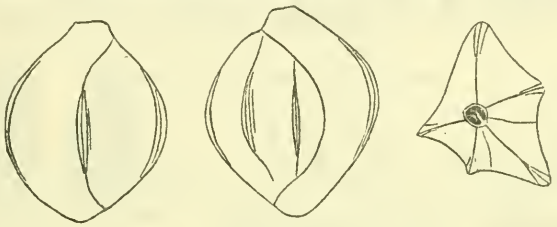


FIG. 6.—QUINQUELOCULINA CUVIERIANA D'ORBIGNY. *a*, SIDE VIEW; *b*, OPPOSITE SIDE; *c*, APERTURAL VIEW. APERTURAL VIEW OF SPECIMEN FROM RUNAWAY BAY. × 50.

It is not common in the Jamaican material, the only station being in 1 fathom (2 meters) at Montego Bay.

QUINQUELOCULINA POEYANA d'Orbigny.

Plate 16, figs. 7, 8.

Quinqueloculina poeyana D'ORBIGNY, Foram. Cuba, 1839, p. 191, pl. 11, figs 25–27.

In the Jamaican material this species stands out very distinctly, of the form and characters shown in d'Orbigny's figure, which is excellent. The species has been allowed to lapse since its description, even Brady, strangely enough, not including it as a synonym under any of the species of the *Challenger* Report.

Specimens were obtained at Montego Bay from stations 1, 4, 5, and 6.

QUINQUELOCULINA ANTILLARUM d'Orbigny.

Plate 16, figs. 9, 10.

Quinqueloculina antillarum D'ORBIGNY, Foram. Cuba, 1839, p. 194, pl. 12, figs. 4–6.

The reticulate ornamentation of the triloculine and quinqueloculine series seems to be largely confined to tropical species. From material

I have been able to examine from widely separated areas in the tropics there seem to be definitely characterized species, which seem to have definite geographical ranges. The *Q. antillarum* of d'Orbigny has very fine reticulations, with numerous transverse wrinkles and a broad truncate peripheral margin. Such specimens were found at Montego Bay in 9 fathoms (16 meters). D'Orbigny's material was from Cuba and Jamaica.

QUINQUELOCULINA TRICARINATA d'Orbigny.

Plate 16, figs. 11, 12.

Quinqueloculina tricarinata D'ORBIGNY, Foram. Cuba, 1839, p. 187, pl. 11, figs. 7–9, 11.

This is another of the d'Orbignyan species that has been ignored since its description. The figure gives the impression of an abnormal specimen, but the study of the Jamaican material shows that it is an accurate figure of this peculiar species, and gives one decided

FIG. 7.—QUINQUELOCULINA DILATATA D'ORBIGNY SPECIMEN FROM 1 FATHOM, BOGUE ISLANDS, MONTEGO BAY. SIDE VIEW. × 50.

FIG. 8.—QUINQUELOCULINA DILATATA D'ORBIGNY. SIDE VIEW OF ANOTHER SPECIMEN FROM THE SAME LOCALITY. × 50.

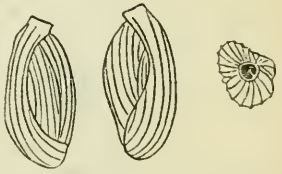


FIG. 9.—QUINQUELOCULINA POEYANA D'ORBIGNY. *a*, SIDE VIEW; *b*, OPPOSITE SIDE; *c*, APERTURAL VIEW. SPECIMEN FROM 10 FATHOMS, MONTEGO BAY.

confidence in d'Orbigny's figures as true representations of the material he had. There is some little variation in the material, but it keeps close to the form described by d'Orbigny.

Quinqueloculina tricarinata was found at all but one of the Jamaican stations, at Montego Bay at stations 1, 2, 4, 5, and 6, and also at Runaway Bay.

It is in certain characters close to *Q. kerimbatica* Heron-Allen and Earland, which was described from the Kerimba Archipelago and which is common in the Philippine region and probably elsewhere in the Indo-Pacific.

D'Orbigny's specimens were from Cuba and Jamaica.

The specimens which I have referred to as *Quinqueloculina*, species cf. *Q. kerimbatica* (Heron-Allen and Earland)[14] may belong to this species. They were from the Tertiary of Santo Domingo.

[14] Publ. 291, Carnegie Institution of Washington, 1919, p. 67, pl. 14, fig. 5.

QUINQUELOCULINA PARKERI (H. B. Brady). var. OCCIDENTALIS, new variety.

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

Type specimen (U.S.N.M. No. 15990) with others from station 5 in 9 fathoms (16 meters), Montego Bay, Jamaica.

The typical form is characteristic of coral reef areas of the Indo-Pacific area.

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. 5–9; Modèles, No. 93.

Specimens occurred at stations 2, 4, and 6 at Montego Bay, but only as single specimens from each station.

TRILOCULINA OBLONGA (Montagu).

Plate 17, figs. 5, 6.

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, No. 95; Foram. Cuba, 1839, p. 175, pl. 10, figs. 3–5.

This species is found in the material from all but one of the Jamaican stations. From Runaway Bay a few specimens only were found, but are more numerous at Montego Bay at stations 1, 2, 4, 5, and 6.

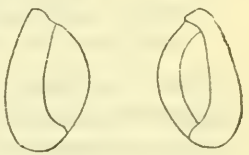


FIG. 10.—TRILOCULINA OBLONGA (MONTAGU). *a*, SIDE VIEW; *b*, OPPOSITE SIDE. SPECIMEN FROM MONTEGO BAY. × 50.

TRILOCULINA SUBORBICULARIS d'Orbigny.

Triloculina suborbicularis D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 300, No. 12: Foram. Cuba, 1839, p. 177, pl. 10, figs. 9–11.
Quinqueloculina suborbicularis D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 302, No. 29.

The only material of this species was found in the dredging from 6 fathoms (11 meters) in Montego Bay.

TRILOCULINA CIRCULARIS Bornemann.

Triloculina circularis BORNEMANN, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 349, pl. 19, fig. 4.

This widely distributed species is in the material from nearly all the Jamaican stations, from Runaway Bay and from stations 1, 2, 4, and 6 from Montego Bay.

TRILOCULINA LABIOSA d'Orbigny.

Plate 16, figs. 13, 14.

Triloculina labiosa D'ORBIGNY, Foram. Cuba, 1839, p. 157, pl. 10, figs. 12–14.

D'Orbigny described this species from Cuba. Specimens were rare in the Cuban material from stations 2, 4, and 6 at Montego Bay.

TRILOCULINA FICHTELIANA d'Orbigny.

Plate 17, figs. 1, 2.

Triloculina fichteliana D'ORBIGNY, Foram. Cuba, 1839, p. 171, pl. 9, figs. 8–10.

The only material of this species is from shallow water at Runaway Bay and in 1 fathom (2 meters) at Montego Bay. D'Orbigny's material was from Cuba and Jamaica, and he later recorded it from the Canaries.

TRILOCULINA LINNEIANA d'Orbigny.

Plate 17, figs. 3, 4.

Triloculina linneiana D'ORBIGNY, Foram. Cuba, 1839, p. 172, pl. 9, figs. 11–13.

D'Orbigny gives this species as common in Cuba and Jamaica, and it certainly is one of the common shallow water species of the West Indian region, as well as elsewhere in the tropics.

Specimens occurred in the material from Runaway Bay and from stations 1, 2, 4, 5, and 6 at Montego Bay.

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*–*c*.

This is evidently a very rare species, or else, as suggested by Brady, overlooked on account of its small size. A single very typical specimen was found at station 4 in Montego Bay.

Brady's specimens were from Torres Strait and Mauritius.

A further study of the West Indian material has shown that this distribution is not unusual for a considerable number of species.

TRILOCULINA PLANCIANA d'Orbigny.

Plate 17, figs. 7, 8.

Triloculina planciana D'ORBIGNY, Foram. Cuba, 1839, p. 173, pl. 9, figs. 17–19.

This is given by Brady as a synonym of *T. oblonga*, stating "the only difference being in its slightly rugose surface." The surface is made up of slightly interrupted costae and the chambers are more nearly rounded in section than oblong and are more definitely set apart. In the Jamaican material the two would hardly be thought of as at all related when seen side by side in the same dredging.

D'Orbigny's material was from Cuba and Jamaica. It has occurred only at the very shallow stations, 1 and 2 at Montego Bay and also at Runaway Bay.

TRILOCULINA QUADRILATERALIS d'Orbigny.

Triloculina quadrilateralis D'ORBIGNY, Foram. Cuba, 1839, p. 173, pl. 9, figs. 14–16.

Specimens of this species were found in the dredgings from Montego Bay from stations 4 and 5. D'Orbigny's specimens were from Cuba. It is somewhat variable, as he says, and the chambers are not all quadrilateral, especially the younger ones.

TRILOCULINA CARINATA d'Orbigny.

Plate 17, figs. 9, 10.

Triloculina carinata D'ORBIGNY, Foram. Cuba, 1839, p. 179, pl. 10, figs. 15–17.

This is the most common reticulate species of the Jamaican material. It is very common at stations 1, 2, 4, and 6, at Montego Bay. The form is constant and the reticulations rather fine and regular as shown

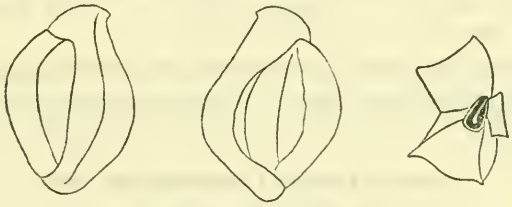


FIG. 11.—TRILOCULINA QUADRILATERALIS D'ORBIGNY. *a*, SIDE VIEW; *b*, OPPOSITE SIDE; *c*, APERTURAL VIEW. SPECIMEN FROM 6 FATHOMS, MONTEGO BAY. × 50.

by d'Orbigny. The basal portion of the last chamber sometimes becomes bifurcate. The species reminds one strongly of var. *reticulata* Heron-Allen and Earland, of *Massilina secans* d'Orbigny.

TRILOCULINA CARINATA d'Orbigny, var. OBSCURA, new variety.

Plate 17, fig. 11.

Description.—Test in the early stages as in the typical, but later adding a covering of closely cemented sand grains which may become thick and entirely hide the reticulations.

Type specimen (U.S.N.M. No. 15991), from station 6 in Montego Bay, Jamaica, in 10 fathoms (18 meters). At this station it was abundant and also found at stations 2, 4, and 5.

It was only when the under surface occasionally showed through in places that the true relation of this abundant variety was seen. In some specimens the coating is of very fine sand grains covering but not entirely obscuring the reticulations, but in others it may show only in small portions, or be entirely covered and the reticulations wholly obscured.

Genus HAUERINA d'Orbigny, 1846.

HAUERINA BRADYI Cushman.

Hauerina compressa H. B. Brady (not *H. compressa* d'Orbigny), Rep. Voy. *Challenger*, Zoology, 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.

This species, known from the tropical Indian and Pacific Oceans, is now found in the West Indian region. It was rather rare, being found in few numbers at only one station, 10 fathoms (18 meters), in Montego Bay.

This species was found in shallow water material from the Tortugas region and from the Gulf of Mexico, and is probably widely distributed in similar locations in the West Indies.

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. 15–22.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 6, 1917, p. 63, pl. 23, figs. 1, 5.

Specimens are very rare, having been found at stations 4, Montego Bay, and also at Runaway Bay. It has previously been known from the Indo-Pacific.

Genus MASSILINA Schlumberger, 1893.

MASSILINA ASPERULA (Karrer).

Spiroloculina asperula Karrer, Sitz. Akad. Wiss. Wien, vol. 57, 1868, p. 136, pl. 1, fig. 10.—H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 152, pl. 8, figs. 13, 14.

This is a rare species, the few records in recent seas being from the Philippines and South Seas. Specimens were found at Jamaica from station 6. Both the large and small specimens were found as recorded by Brady, and indicating both megalospheric and microspheric specimens.

MASSILINA INAEQUALIS, new species.

Plate 17, figs. 12, 13.

Description.—Test much elongate, in the adult, spiroloculine, from one side very much excavate, the other nearly plane, early chambers quinqueloculine, later ones spiroloculine, chambers very elongate, irregularly quadrate in transverse section, the peripheral side broader than the inner one, one of the other sides angled, the other straight; surface polished, shiny, but with numerous fine, linear depressions breaking the eveness of the surface; aperture rounded, apertural end of the test somewhat projecting; color glistening white. Length up to 1.5 mm.

Type specimen (U.S.N.M. No. 15992) from station 6, Montego Bay, Jamaica, in 10 fathoms (18 meters). Specimens were also obtained at stations 4 and 5.

Genus ARTICULINA d'Orbigny, 1826.

ARTICULINA CONICO-ARTICULATA (Batsch).

Plate 18, fig. 1.

Nautilus (Orthoceras) conico-articulatus BATSCH, Conch. des Seesandes, 1791, p. 3, pl. 3, fig. 11.

Vertebralina conico-articulina PARKER, JONES, and H. B. BRADY, Ann. Mag. Nat. Hist., ser. 3, vol. 16, 1865, p. 22, pl. 1, fig. 2.

Articulina conico-articulata H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 185, pl. 12, figs. 17, 18; pl. 13, figs. 1, 2.

This is one of the common tropical species not recorded by d'Orbigny in the Cuban Monograph. It may not be common in the West Indies. A single typical specimen was found in material from station 6 at Montego Bay.

ARTICULINA SAGRA d'Orbigny.

Plate 18, figs. 2–5.

Articulina sagra D'ORBIGNY, Foram. Cuba, 1839, p. 183, pl. 9, figs. 23–26.

Typical specimens were dredged at Montego Bay in 9 and 10 fathoms (16 and 18 meters), but they are rare. D'Orbigny records it from Cuba, Jamaica, and Martinique.

ARTICULINA LINEATA H. B. Brady.

Plate 18, fig. 6.

Articulina lineata H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 183, pl. 12, figs. 19–21.

Brady described this species from the Fiji Islands, Torres Strait, and off the Bermudas, depths ranging from 155–435 fathoms (283–796 meters), and it has since been recorded in other tropical parts of the world.

Specimens were found in the material from stations 4 and 6 in Montego Bay.

Genus BILOCULINA d'Orbigny, 1826.

BILOCULINA SUBSPHAERICA d'Orbigny.

Biloculina subsphaerica D'ORBIGNY, Foram. Cuba, 1839, p. 162, pl. 8, figs. 25–27.

Specimens agreeing with this small species are common at Runaway Bay and at stations 4, 5, and 6 at Montego Bay. They are all very small, but have the characters described by d'Orbigny in shape of aperture, bifid tooth, and the slight curve of the chamber in side view.

D'Orbigny's specimens were from Cuba and Jamaica.

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.

This is a common species of the Indo-Pacific in shallow water. It occurred at Runaway Bay and at stations 4, 5, and 6 at Montego Bay. Specimens occur at other localities in the West Indian and Florida region.

BILOCULINA ELONGATA d'Orbigny.

Biloculina elongata d'Orbigny, Ann. Sci. Nat., vol. 7, 1826, p. 298, No. 4.
Biloculina oblonga d'Orbigny, Foram. Cuba, 1839, p. 163, pl. 8, figs. 21–23.

This is the least common of the Jamaican species of *Biloculina*. It is represented by single specimens from Runaway Bay and at station 4 in Montego Bay.

As near as can be determined d'Orbigny's *Biloculina oblonga* of the Cuban Monograph is also this species. It is recorded by d'Orbigny from Cuba and Jamaica.

Genus PENEROPLIS Montfort, 1808.

This genus has usually been treated as containing a single variable species. Basing on the *Challenger* report most writers have followed Brady's example. In their paper on the Foraminifera of the Kerimba Archipelago Heron-Allen and Earland have examined into the early descriptions and figures of *Peneroplis* and after an exhaustive treatment have made five species. Such a treatment seems admirable, and all workers on the group will be duly grateful for such a helpful labor. Anyone who has worked over tropical material containing specimens of this genus has probably realized that there are numerous groups which, although variable, are nevertheless variable only within certain limits, and the groups do not merge with one another.

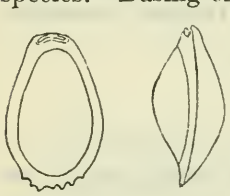


Fig. 12.—Biloculina denticulata (H. B. Brady). *a*, front view; *b*, side view. Specimen from 6 fathoms, Montego Bay. × 50.

The treatment of the Jamaican material follows that of Heron-Allen and Earland with the exception of the addition of two others based upon the West Indian material. D'Orbigny described and figured *Peneroplis proteus* from Cuba and Jamaica, and it has been found to be the most common species in this material. The form described by Flint in 1899 as var. *discoideus* is here placed as a valid species after finding it abundant and constant in both recent and fossil material of the West Indies, showing that its characters must have been fixed for a considerable length of time. For the data arriving at the division into species the reader is referred to the original work of Heron-Allen and Earland.

PENEROPLIS PERTUSUS (Forskål).

Plate 18, figs. 7, 8.

Nautilus pertusus FORSKÅL, Descr. Anim., 1775, p. 125, No. 65.
Peneroplis pertusus JONES, PARKER, and H. B. BRADY, Foram. Crag., 1865, p. 19.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 204, pl. 13, figs. 16, 17.
Peneroplis elegans D'ORBIGNY, Foram. Cuba, 1839, p. 61, pl. 7, figs. 1, 2.

This is not a common species in the Jamaican material, occurring as few or rare specimens at Runaway Bay and at stations 1, 3, 5, and 6 at Montego Bay. D'Orbigny's *P. elegans* is clearly this species and was obtained both in Cuba and Jamaica.

PENEROPLIS PLANATUS (Fichtel and Moll).

Plate 18, fig. 9.

Peneroplis planatus D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 285, No. 1: Modèles, No. 16.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 204, pl. 13, fig. 15.

A few specimens at Montego Bay from stations 4 and 6.

PENEROPLIS ARIETINUS (Batsch).

Plate 18, fig. 10.

Peneroplis arietinus PARKER, JONES, and H. B. 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.

The only specimens are from station 4 at Montego Bay.

PENEROPLIS CYLINDRACEUS (Lamarck).

Plate 18, fig. 11.

Peneroplis cylindraceus H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 205, pl. 13, figs. 20, 21.

A single specimen was obtained in the dredging from station 4, Montego Bay.

PENEROPLIS CARINATUS d'Orbigny.

Plate 18, fig. 12.

Peneroplis carinatus D'ORBIGNY, Foram. Amér. Mérid., 1839, p. 33, pl. 3, figs. 7, 8.—H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 205, pl. 13, fig. 14.

The only specimens are from station 1 in Montego Bay.

PENEROPLIS PROTEUS d'Orbigny.

Plate 18, figs. 13–19.

Peneroplis protea D'ORBIGNY, Foram. Cuba, 1839, p. 60, pl. 7, figs. 7–11.
Peneroplis dubius D'ORBIGNY, Foram. Cuba, 1839, p. 62, pl. 6, figs. 21, 22.

This is by far the most abundant species of *Peneroplis* in the dredgings, and it shows the variable form described and figured by

d'Orbigny. If the very young are compared with the figure of *P. dubius* it will be seen that they are very like that figure, and when a comparison of the magnification of the figures of the two species is made it will be seen that this is probably a correct solution. *Proteus* is a well-chosen specific name, for some specimens were seen where a nearly complete specimen was growing directly from another, and various outgrowths are common.

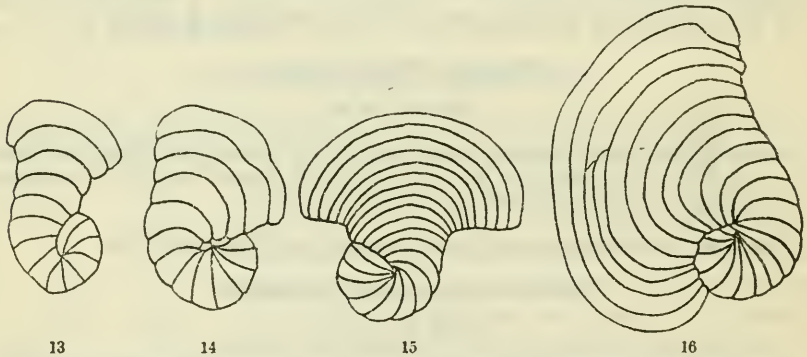
Specimens were common in Montego Bay at stations 3, 4, 5, and 6. D'Orbigny's specimens were from Cuba and Jamaica.

PENEROPLIS DISCOIDEUS Flint.

Plate 18, fig. 20; plate 19, figs. 1–3.

Peneroplis pertusus (Forskål), var. *discoideus* Flint, Ann. Rep. U. S. Nat. Mut., 1897 (1899), p. 304, pl. 49, figs. 1, 2.—Cushman, Publ. 291, Carnegie Inst. Washington, 1919, p. 69.

Specimens of this species were obtained at Montego Bay at station 4. It is found also as a fossil species in the West Indies in the Miocene of



Figs. 13-16.—Peneroplis proteus d'Orbigny. Specimens from 6 fathoms, Montego Bay, showing different forms of this species. × 50.

Santo Domingo, and deserves to rank with the other species of the genus.

Genus ORBICULINA Lamarck, 1816.

ORBICULINA COMPRESSA d'Orbigny.

Plate 19, figs. 4–6.

Orbiculina compressa d'Orbigny, Foram. Cuba, 1839, p. 66, pl. 8, figs. 4–7.—Cushman, Publ. 291, Carnegie Inst. Washington, 1919, p. 70, pl. 7, fig. 6.

There seems to have been a misunderstanding of this species, for it is very distinct from *O. adunca*. Brady remarks about this species, which he places as a synonym of *O. adunca*, as follows:

He [d'Orbigny] stops short, however, at the spiral varieties, and fails to perceive how slight is the modification involved in the addition of a few annular chambers to the already nearly discoidal shell, and distinguishes the circular or nearly circular specimens by a separate name, *Orbiculina compressa*.

There is a difference even in the early stages of the development of these two species, as I have shown.[15]

In this connection also it is interesting to note that d'Orbigny records it as rare in Cuba, more common in Guadeloupe and St. Thomas, but abundant in Jamaica. It may be that it is not widely distributed. However, it is certainly abundant at the deeper station at Montego Bay, occurring at stations 5 and 6 and also at Runaway Bay.

Fossil specimens occur in the Bowden Marl of Jamaica.

ORBICULINA ADUNCA (Fichtel and Moll).

Nautilus aduncus FICHTEL and MOLL, Test. Micr., 1803, p. 115, pl. 23.

Orbiculina adunca LAMARCK, Tabl. Encyl. et Meth., 1816, p. 468, figs. 2*a–c.*—D'ORBIGNY, Foram. Cuba, 1839, p. 64, pl. 8, figs. 8–16.

This is probably the most abundant of the larger foraminifera of the West Indies, making up a large proportion of the dredgings in some places. It is most common at the deepest station, No. 10, but occurs in numbers at stations 2 and 5, and also at Runaway Bay.

Genus ORBITOLITES Lamarck, 1801.

ORBITOLITES DUPLEX Carpenter.

Orbulites macropora (?) LAMARCK, Hist. Nat. Anim. sans Vert., vol. 2, 1816, p. 197, No. 5 (according to 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. 8–14; pl. 4, figs. 6–10; pl. 5, figs. 1–10.

This is the only species which is found in the material from Jamaica, and although both *O. marginalis* and *O. complanata* are recorded in the *Challenger* Report from the West Indian region in deeper water, I have found in the collections that I have seen that *O. duplex* is the common species. It grows attached to the short eel grass in great abundance with *Planorbulina*, and the young stages are easily seen in this way. Specimens were found with megalospheric young in the outer chambers of the parent test.

Specimens occurred at Runaway Bay and at stations 2, 4, and 5 at Montego Bay.

Genus ALVEOLINA d'Orbigny, 1826.

ALVEOLINA PULCHRA d'Orbigny.

Plate 19, figs. 7–9.

Alveolina pulchra D'ORBIGNY, Foram. Cuba, 1839, p. 70, pl. 8, figs. 19, 20.

I am not sure that this species is the same as *A. melo* as Brady places it, and as material for comparison is scarce, I place it under d'Orbigny's name. It occurred at Runaway Bay and at stations 2 and 4 at Montego Bay. D'Orbigny's material was from Cuba.

[15] Bull. 71, U. S. Nat. Mus., pt. 6, 1917, pp. 89–91.

EXPLANATION OF PLATES.

PLATE 11.

FIG. 1. *Textularia agglutinans* d'Orbigny. *a*, front view; *b*, apertural view. (After d'Orbigny, pl. 1, figs. 17 and 18.)

2. *Textularia agglutinans* d'Orbigny. *a*, front view; *b*, side view; *c*, apertural view. (After d'Orbigny, pl. 1, figs. 32–34.)
3. *Textularia agglutinans* d'Orbigny. Photograph of an irregular specimen from Runaway Bay, Jamaica. × 30.
4. *Textularia conica* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 1, figs. 19 and 20.)
5. *Textularia conica* d'Orbigny. Photograph of side view of specimen from Montego Bay, Jamaica. × 30.
6. *Textularia conica* d'Orbigny. Photograph of dorsal view of specimen from same locality. × 30.
7. *Textularia candeiana* d'Orbigny. *a*, front view; *b*, side view; *c*, apertural view. (After d'Orbigny, pl. 1, figs. 25–27.)
8. *Textularia candeiana* d'Orbigny. Photograph of front view of specimen from 10 fathoms (18 meters), Montego Bay. × 30.
9. *Bolivina punctata* d'Orbigny. *a*, front view; *b*, apertural view. (*Textularia caribaea* d'Orbigny; after d'Orbigny, pl. 1, figs. 28 and 29.)
10. *Bolivina punctata* d'Orbigny. Photograph of specimen from shallow water, Bogue Islands, Montego Bay, Jamaica. × 30.
11. *Valvulina oviedoiana* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 2, figs. 21–22.)
12. *Valvulina oviedoiana* d'Orbigny. Photograph of dorsal view of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. × 30.
13. *Valvulina oviedoiana* d'Orbigny. Photograph of front view. × 30.
14. *Valvulina oviedoiana* d'Orbigny. Photograph of apertural view. × 30.
15. *Virgulina punctata* d'Orbigny. *a*, front view; *b*, apertural view. (After d'Orbigny, pl. 1, figs. 35 and 36.)

PLATE 12.

FIG. 1. *Clavulina tricarinata* d'Orbigny. *a*, front view; *b*, side view; *c*, apertural view. (After d'Orbigny, pl. 2, figs. 16–18.)

2. *Clavulina tricarinata* d'Orbigny. Photograph of specimen from 9 fathoms (16 meters), Montego Bay, Jamaica. × 30.
3. *Clavulina nodosaria* d'Orbigny. *a*, front view; *b*, apertural view. (After d'Orbigny, pl. 2, figs. 19 and 20.)
4. *Polymorphina* cf. *vitrea* (d'Orbigny). *a*, front view; *b*, side view; *c*, apertural view. (*Guttulina vitrea* d'Orbigny: after d'Orbigny, pl. 2, figs. 1–3.)
5. *Globigerina bulloides* d'Orbigny. *a*, dorsal view; *b*, ventral view; *c*, side view. (*Globigerina siphonifera* d'Orbigny: after d'Orbigny, pl. 4, figs. 15–17.)
6. *Globigerina rubra* d'Orbigny. *a*, dorsal view; *b*, ventral view; *c*, side view. (After d'Orbigny, pl. 4, figs. 12–14.)
7. *Globigerina dutertrei* d'Orbigny. *a*, dorsal view; *b*, ventral view; *c*, side view. (After d'Orbigny, pl. 4, figs. 19–21.)
8. *Planorbulina acervalis* H. B. Brady. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay, Jamaica. × 30.

PLATE 13.

FIG. 1. *Truncatulina rosea* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina rosea* d'Orbigny: after d'Orbigny, pl. 3, figs. 9–11.)

2. *Truncatulina rosea* (d'Orbigny). Photograph of dorsal view of specimen from 3 fathoms (5 meters), Montego Bay, Jamaica. × 30.

3. *Truncatulina rosea* (d'Orbigny). Photograph of ventral view. × 30.

4. *Truncatulina candeiana* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina candeiana* d'Orbigny: after d'Orbigny, pl. 4, figs. 2–4.)

5. *Truncatulina candeiana* (d'Orbigny). Runaway Bay, Jamaica. × 30.

6. *Truncatulina antillarum* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina antillarum* d'Orbigny: after d'Orbigny, pl. 5, figs. 4–6.)

7. *Truncatulina antillarum* (d'Orbigny). Photograph of dorsal view of specimen from 9 fathoms (16 meters), Montego Bay, Jamaica. × 30.

8. *Truncatulina antillarum* (d'Orbigny). Photograph of ventral view. × 30.

9. *Cymbalopora poeyi* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina poeyi* d'Orbigny: after d'Orbigny, pl. 3, figs. 18–20.)

10. *Cymbalopora poeyi* (d'Orbigny). *a*, dorsal view; b, ventral view; *c*, side view. (*Rosalina squammosa* d'Orbigny: after d'Orbigny, pl. 3, figs. 12–14.)

11. *Cymbalopora poeyi* (d'Orbigny). Photograph of dorsal view of specimen from Montego Bay, Jamaica. ×30.

12. *Cymbalopora poeyi* (d'Orbigny). Photograph of ventral view. ×30.

13. *Tretomphalus bulloides* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina bulloides* d'Orbigny: after d'Orbigny, pl. 3, figs. 2 and 3.)

PLATE 14.

FIG. 1. *Discorbis auberii* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina auberii* d'Orbigny: after d'Orbigny, pl. 4, figs. 5–8.)

2. *Discorbis auberii* (d'Orbigny). Photograph of dorsal view of specimen from Montego Bay, Jamaica. ×30.

3. *Discorbis auberii* (d'Orbigny). Photograph of ventral view. ×30.

4. *Discorbis valvulata* (d'Orbigny). *a*, dorsal view; *b*, ventral view; *c*, side view. (*Rosalina valvulata* d'Orbigny: after d'Orbigny, pl. 3, figs. 21–23.)

5. *Discorbis valvulata* (d'Orbigny). Photograph of specimen from Montego Bay, Jamaica. ×30.

6. *Asterigerina carinata* d'Orbigny. *a*, dorsal view; *b*, ventral view; *c*, side view. (After d'Orbigny, pl. 5, fig. 25; pl. 6, figs. 1 and 2.)

7. *Asterigerina carinata* d'Orbigny. Dorsal view of specimen from Montego Bay, Jamaica. ×30.

8. *Asterigerina carinata* d'Orbigny. Ventral view of specimen from Montego Bay, Jamaica. ×30.

9. *Nonionina grateloupi* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 6, figs. 6 and 7.)

10. *Nonionina grateloupi* d'Orbigny. Montego Bay, Jamaica. ×30.

11. *Nonionina grateloupi* d'Orbigny. Montego Bay, Jamaica. ×30.

12. *Polystomella lanieri* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 7, figs. 12 and 13.)

13. *Polystomella lanieri* d'Orbigny. Photograph of specimen from 2 feet, Bogue Islands, Montego Bay, Jamaica. ×30.

FIG. 14. *Spiroloculina antillarum* d'Orbigny. *a*, front view; *b*, apertural view. (After d'Orbigny, pl. 9, figs. 3 and 4.)

15. *Spiroloculina antillarum* d'Orbigny. Runaway Bay, Jamaica. ×30.

16. *Spiroloculina antillarum* d'Orbigny, var. *angulata* Cushman. Photograph of specimen from 2 feet, Bogue Islands, Montego Bay. ×30.

17. *Spiroloculina arenata* Cushman. Photograph of specimen from 1 fathom (2 meters), Montego Bay, Jamaica. ×30.

PLATE 15.

FIG. 1. *Vertebralina cassis* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 7, figs. 14 and 15.)

2. *Vertebralina cassis* d'Orbigny. Specimen with uncoiled chambers. *a*, side view; *b*, apertural view. (*Vertebralina mucronata* d'Orbigny: after d'Orbigny, pl. 7, figs. 16 and 17.)

3. *Vertebralina cassis* d'Orbigny. Specimen with coiled chambers only. *a*, side view; *b*, apertural view. (*Vertebralina mucronata* d'Orbigny: after d'Orbigny, pl. 7, figs. 18 and 19.)

4. *Vertebralina cassis* d'Orbigny. Photograph of coiled specimen from 10 fathoms (18 meters), Montego Bay. ×30.

5. *Vertebralina cassis* d'Orbigny. Photograph of uncoiled specimen from same locality. ×30.

6–8. *Vertebralina cassis* d'Orbigny. Montego Bay. ×30.

9. *Quinqueloculina agglutinans* d'Orbigny. *a*, side view; *b*, opposite side; c, apertural view. (After d'Orbigny, pl. 12, figs. 11 and 13.)

10. *Quinqueloculina agglutinans* d'Orbigny. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. ×30.

11. *Quinqueloculina bidentata* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 12, figs. 18–20.)

12. *Quinqueloculina bidentata* d'Orbigny. Runaway Bay. ×30.

13. *Quinqueloculina lamarckiana* d'Orbigny. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 11, figs. 14 and 15.)

14. *Quinqueloculina lamarckiana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (*Quinqueloculina auberiana* d'Orbigny: after d'Orbigny, pl. 12, figs. 1–3.)

PLATE 16.

FIG. 1. *Quinqueloculina cuvieriana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 11, figs. 19–21.)

2. *Quinqueloculina cuvieriana* d'Orbigny. Photograph of specimen from 9 fathoms (16 meters), Montego Bay, Jamaica. ×30.

3. *Quinqueloculina polygona* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 12, figs. 21–23.)

4. *Quinqueloculina polygona* d'Orbigny. Photograph of specimen from 10 fathoms (18 meters), Montego Bay. ×30.

5. *Quinqueloculina dilatata* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 11, figs. 28–30.)

6. *Quinqueloculina dilatata* d'Orbigny. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. ×30.

7. *Quinqueloculina poeyana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 11, figs. 25–27.)

8. *Quinqueloculina poeyana* d'Orbigny. Photograph of specimen from 10 fathoms (18 meters), Montego Bay. ×30.

9. *Quinqueloculina antillarum* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 12, figs. 4–6.)

FIG. 10. *Quinqueloculina antillarum* d'Orbigny. Photograph of specimen from 9 fathoms (16 meters), Montego Bay. ×30.

11. *Quinqueloculina tricarinata* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 11, figs. 7–9.)

12. *Quinqueloculina tricarinata* d'Orbigny. Photograph of specimen from Montego Bay. ×30.

13. *Triloculina labiosa* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 10, figs. 12–14.)

14. *Triloculina labiosa* d'Orbigny. Photograph of specimen from 6 fathoms (11 meters), Montego Bay, Jamaica. ×30.

PLATE 17.

FIG. 1. *Triloculina fichteliana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 9, figs. 8–10.)

2. *Triloculina fichteliana* d'Orbigny. Photograph of specimen from Runaway Bay, Jamaica. ×30.

3. *Triloculina linneiana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 9, figs. 11–13.)

4. *Triloculina linneiana* d'Orbigny. Photograph of specimen from 9 fathoms (16 meters), Montego Bay. ×30.

5. *Triloculina oblonga* Montagu. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 10, figs. 3–5.)

6. *Triloculina oblonga* Montagu. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. ×30.

7. *Triloculina planciana* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 9, figs. 17–19.)

8. *Triloculina planciana* d'Orbigny. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. ×30.

9. *Triloculina carinata* d'Orbigny. *a*, side view; *b*, opposite side; *c*, apertural view. (After d'Orbigny, pl. 10, figs. 15–17.)

10. *Triloculina carinata* d'Orbigny. Photograph of specimen from 1 fathom (2 meters), Bogue Islands, Montego Bay. ×30.

11. *Triloculina carinata* d'Orbigny, var. *obscura* Cushman. Photograph of specimen from Montego Bay, Jamaica. ×30.

12. *Massilina inaequalis* Cushman. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

13. *Massilina inaequalis* Cushman. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

PLATE 18.

FIG. 1. *Articulina conico-articulata* (Batsch). Photograph of specimen from 10 fathoms (18 meters), Montego Bay. ×30.

2. *Articulina sagra* d'Orbigny. Specimen with a single linear chamber. *a*, side view; *b*, opposite side. (After d'Orbigny, pl. 9, figs. 23 and 24.)

3. *Articulina sagra* d'Orbigny. Specimen with two linear chambers. *a*, side view; *b*, apertural view. (After d'Orbigny, pl. 9, figs. 25 and 26.)

4. *Articulina sagra* d'Orbigny. Photograph of specimen from 9 fathoms, (16 meters), Montego Bay. ×30.

5. *Articulina sagra* d'Orbigny. Photograph of specimen from 10 fathoms (18 meters), Montego Bay. ×30.

6. *Articulina lineata* Brady. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

7. *Peneroplis pertusus* (Forskål). *a*, side view; *b*, apertural view. (*Peneroplis elegans* d'Orbigny: after d'Orbigny, pl. 7, figs. 1 and 2.)

FIG. 8. *Peneroplis pertusus* (Forskål). Photograph of specimen from 9 fathoms (16 meters), Montego Bay. ×30.

9. *Peneroplis planatus* (Fichtel and Moll). Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

10. *Peneroplis arietinus* (Batsch). Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

11. *Peneroplis cylindraceus* (Lamarck). Photograph of specimen from 6 fathoms (11 meters), Montego Bay. ×30.

12. *Peneroplis carinatus* d'Orbigny. Photograph of specimen from 2 feet, Bogue Islands, Montego Bay. ×30.

13. *Peneroplis proteus* d'Orbigny. *a*, side view; *b*, apertural view. (*Peneroplis protea* d'Orbigny: after d'Orbigny, pl. 7, figs. 7 and 8.)

14. *Peneroplis proteus* d'Orbigny. Specimen with slender form. (*Peneroplis protea* d'Orbigny: after d'Orbigny, pl. 7, fig. 9.)

15. *Peneroplis proteus* d'Orbigny. Specimen with more flaring form. (*Peneroplis protea* d'Orbigny: after d'Orbigny, pl. 7, fig. 10.)

16. *Peneroplis proteus* d'Orbigny. Close-coiled form. (*Peneroplis protea* d'Orbigny: after d'Orbigny, pl. 7, fig. 11.)

17. *Peneroplis proteus* d'Orbigny. *a*, side view; *b*, apertural view. (*Peneroplis dubius* d'Orbigny: after d'Orbigny, pl. 6, figs. 21 and 22.)

18. *Peneroplis proteus* d'Orbigny. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. × 30.

19. *Peneroplis proteus* d'Orbigny. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. × 30.

20. *Peneroplis discoideus* Flint. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. × 30.

PLATE 19.

FIG. 1. *Peneroplis discoideus* Flint. Photograph of specimen from 6 fathoms (11 meters), Montego Bay. × 30.

2. *Peneroplis discoideus* Flint. Photograph of specimen from 10 fathoms (18 meters), Montego Bay. × 30.

3. *Peneroplis discoideus* Flint. *a*, flat view; *b*, edge view. (*Orbiculina compressa* d'Orbigny (part): after d'Orbigny, pl. 8, figs. 5 and 6.)

4. *Orbiculina compressa* d'Orbigny. Adult full-grown specimen. (After d'Orbigny, pl. 8, fig. 4.)

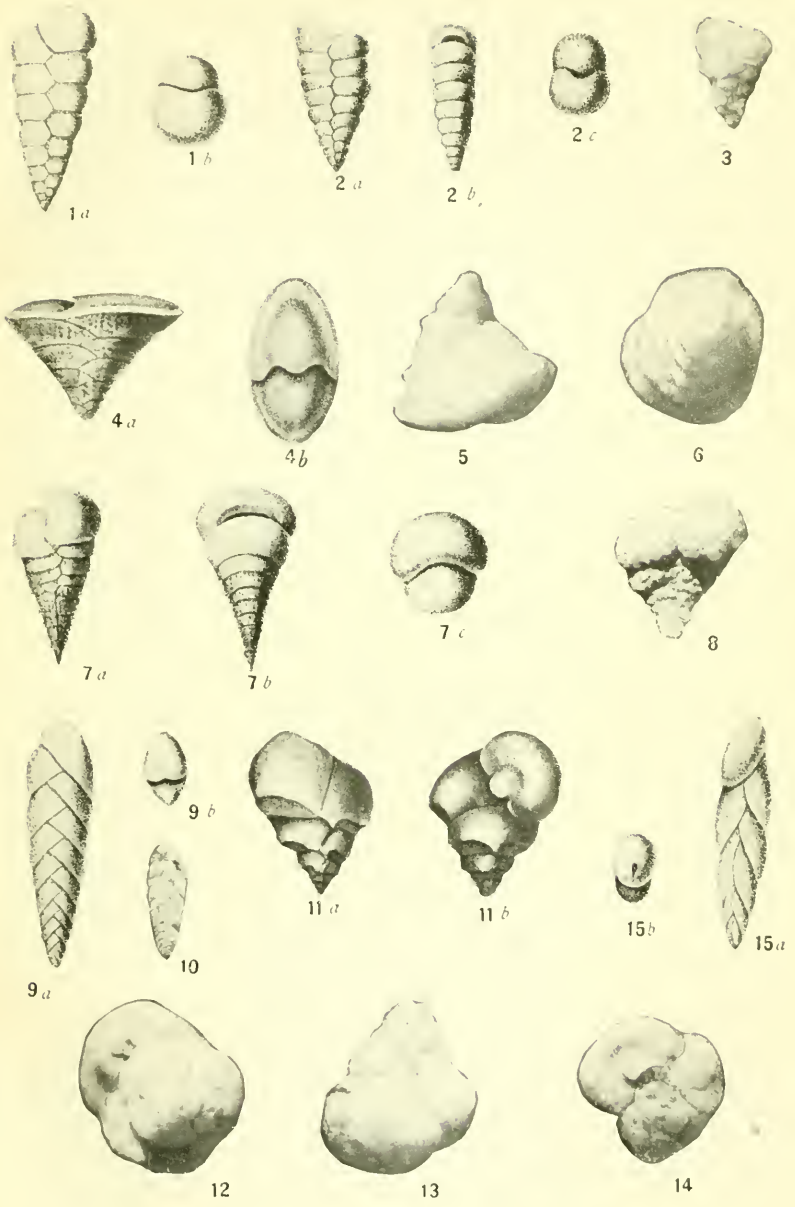
5. *Orbiculina compressa* d'Orbigny. Young specimen. (After d'Orbigny, pl. 8, fig. 7.)

6. *Orbiculina compressa* d'Orbigny. Photograph of specimen from 10 fathoms (18 meters), Montego Bay. × 30.

7. *Alveolina pulchra* d'Orbigny. *a*, end view; *b*, apertural view. (After d'Orbigny, pl. 8, figs. 19 and 20.)

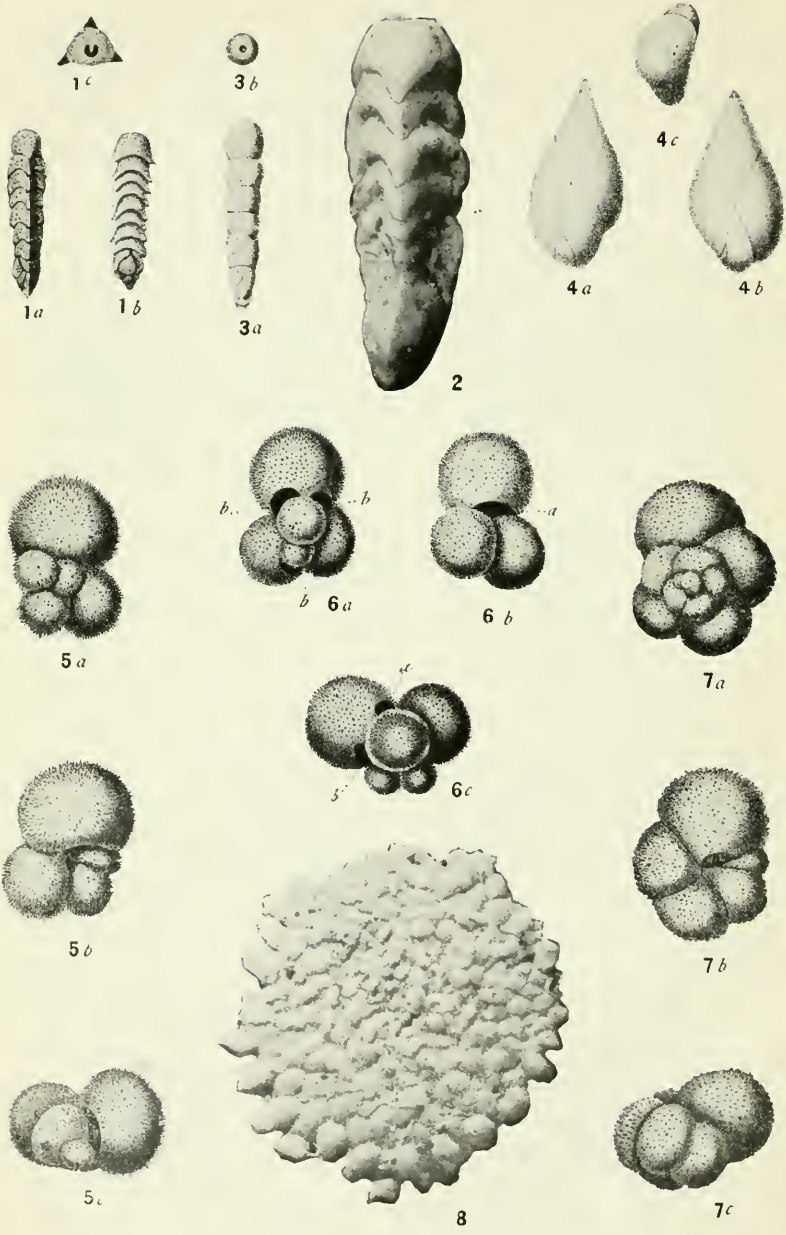
8. *Alveolina pulchra* d'Orbigny. Photograph of specimen from Runaway Bay, Jamaica. × 30.

9. *Alveolina pulchra* d'Orbigny. Photograph of specimen from Runaway Bay, Jamaica. × 30.



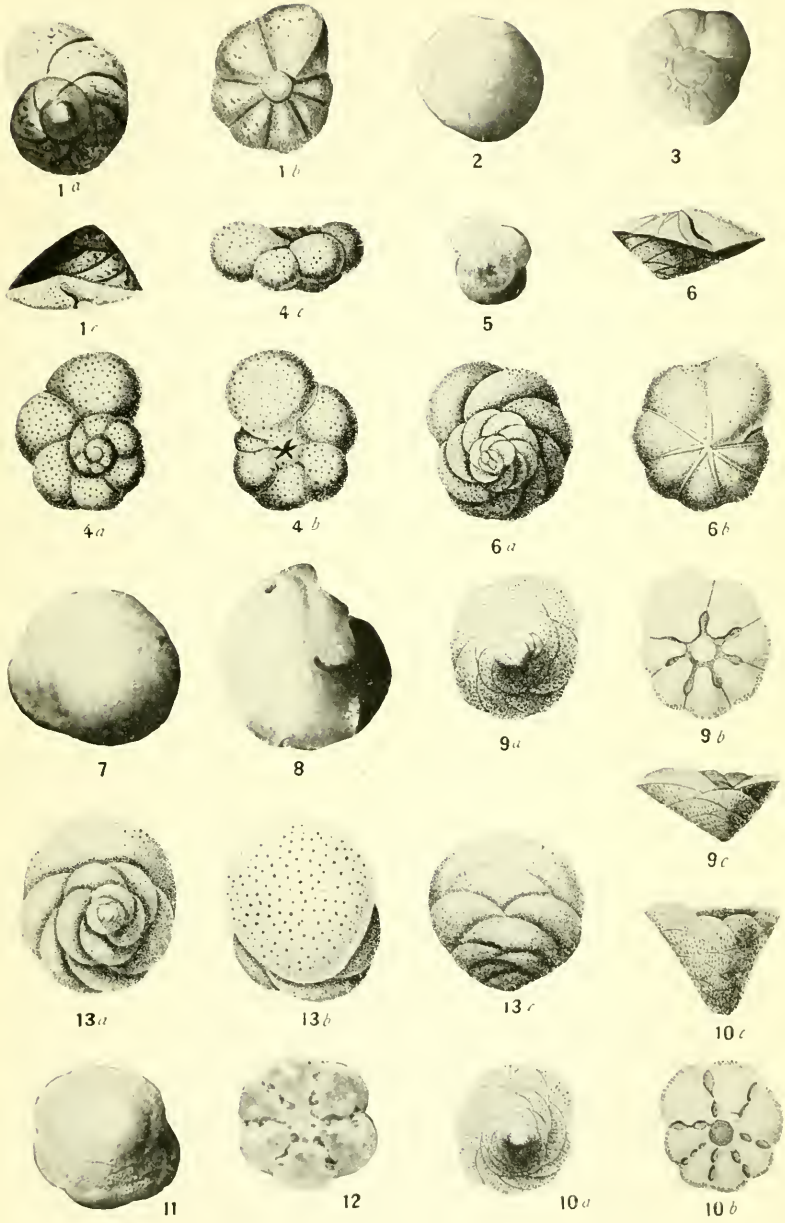
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 78.



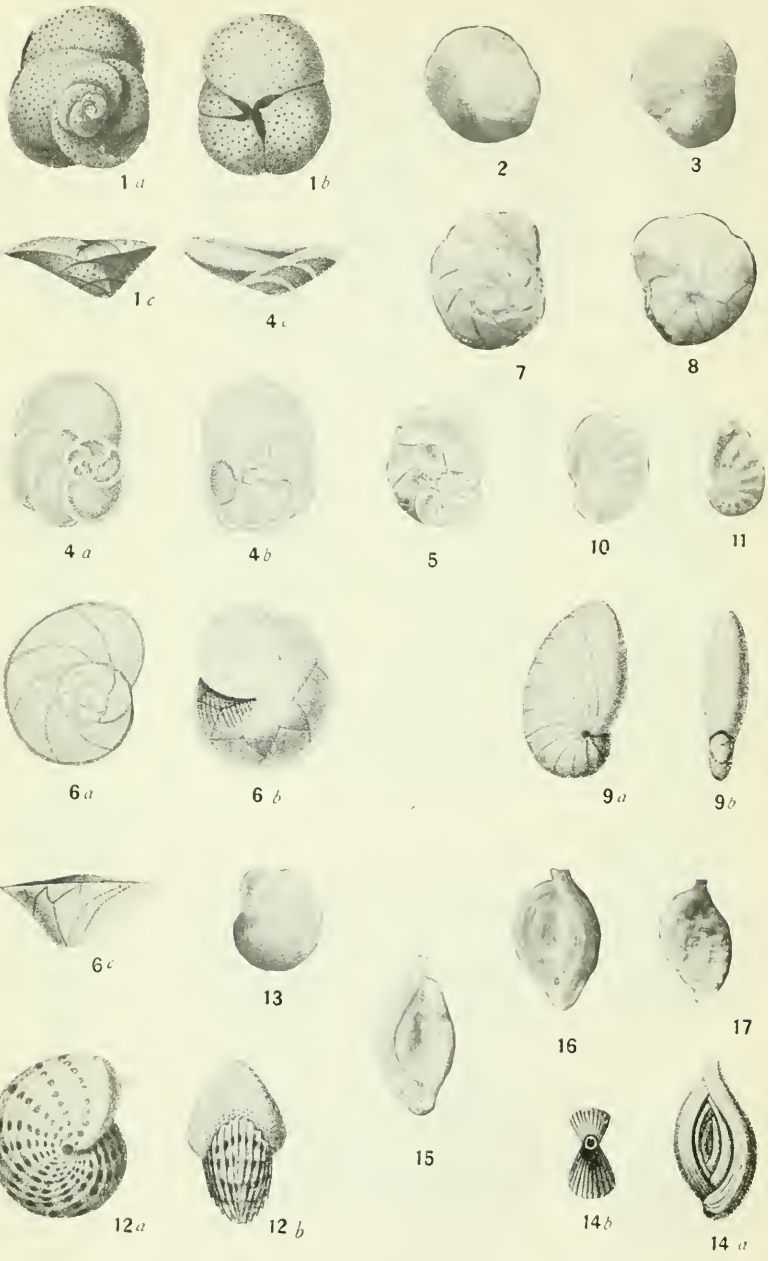
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 78.



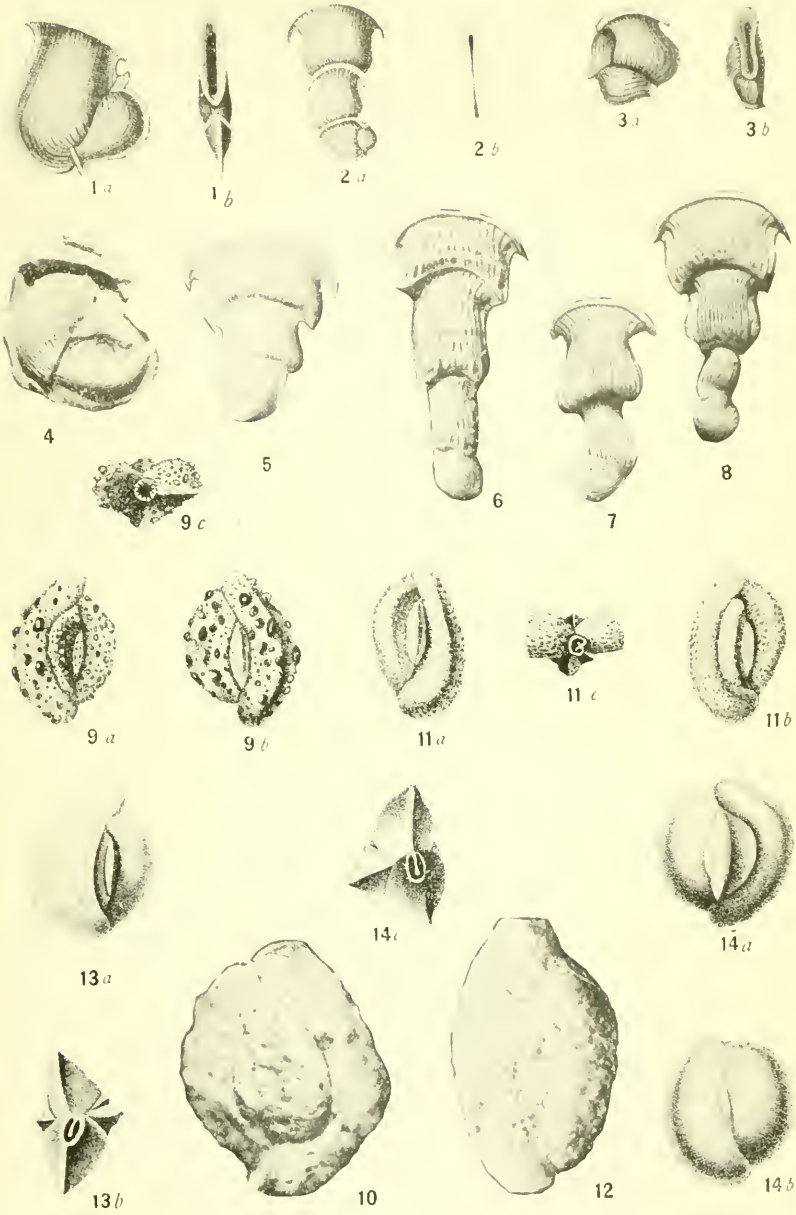
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 79.



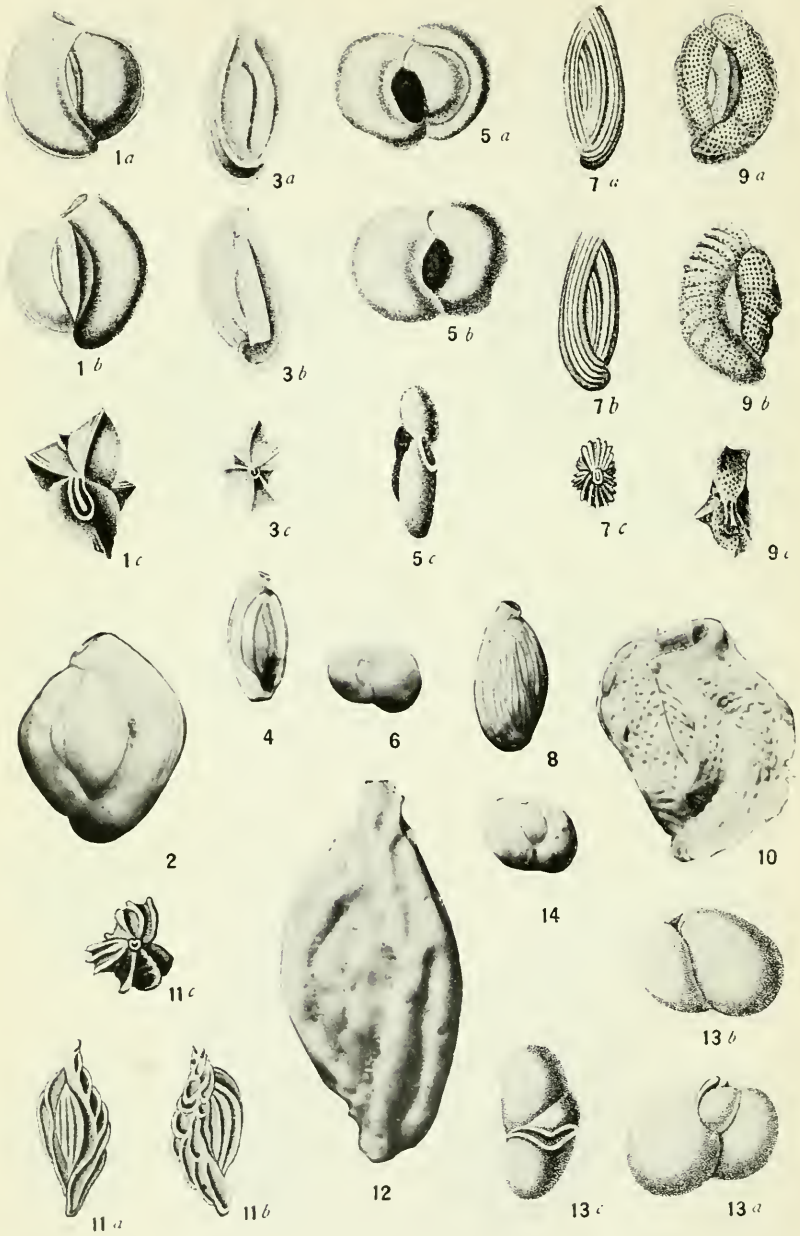
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGES 79 AND 80.



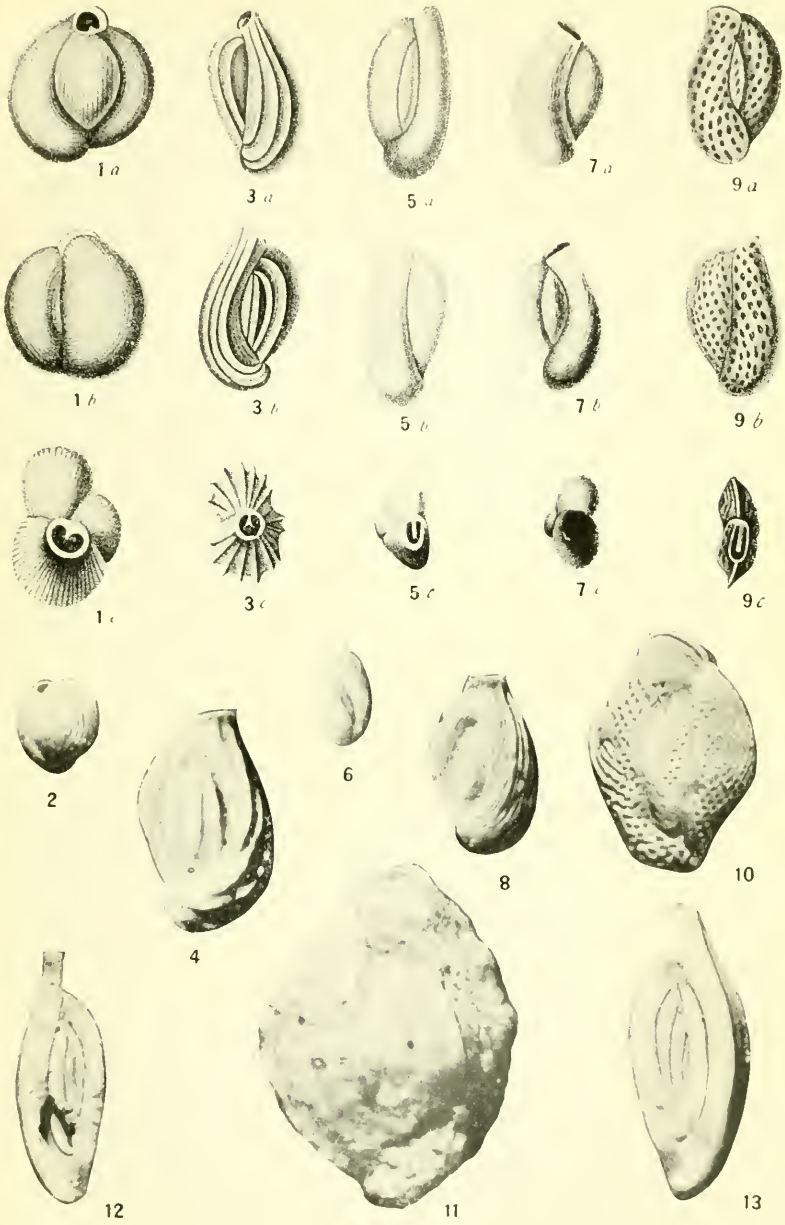
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 80.



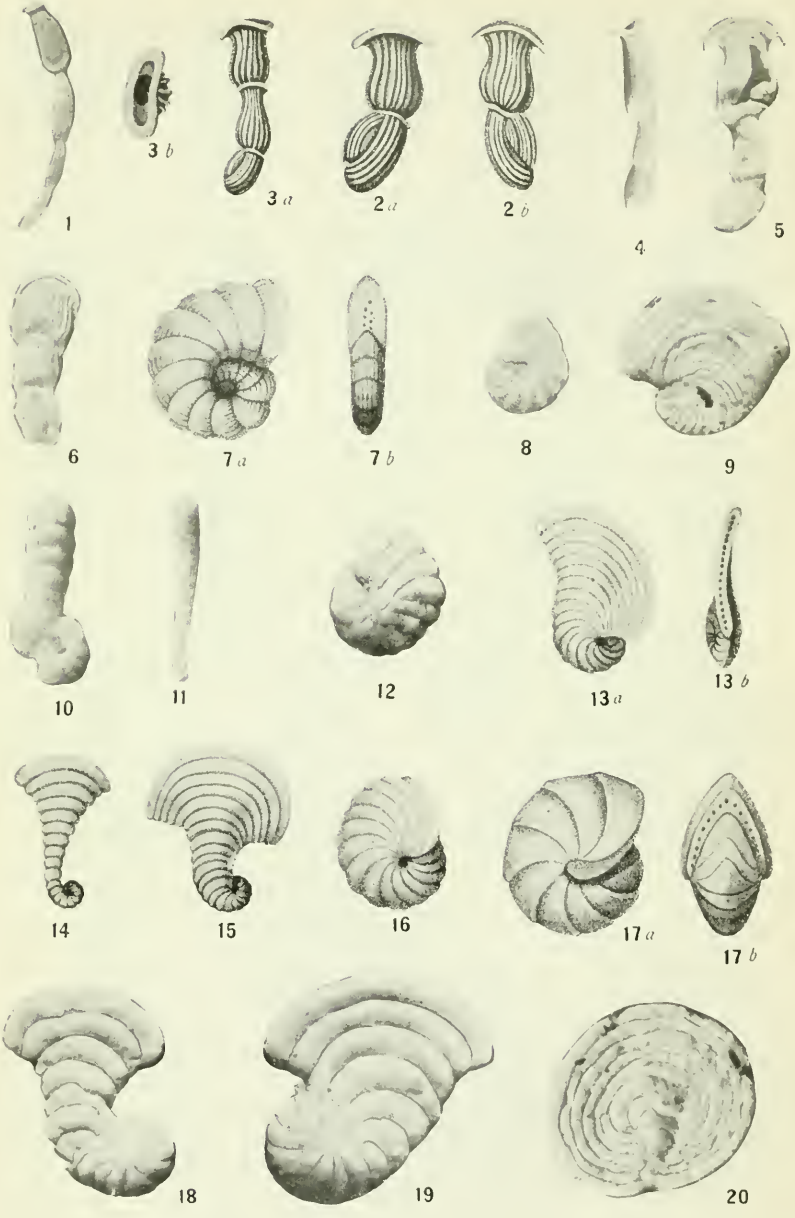
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGES 80 AND 81.



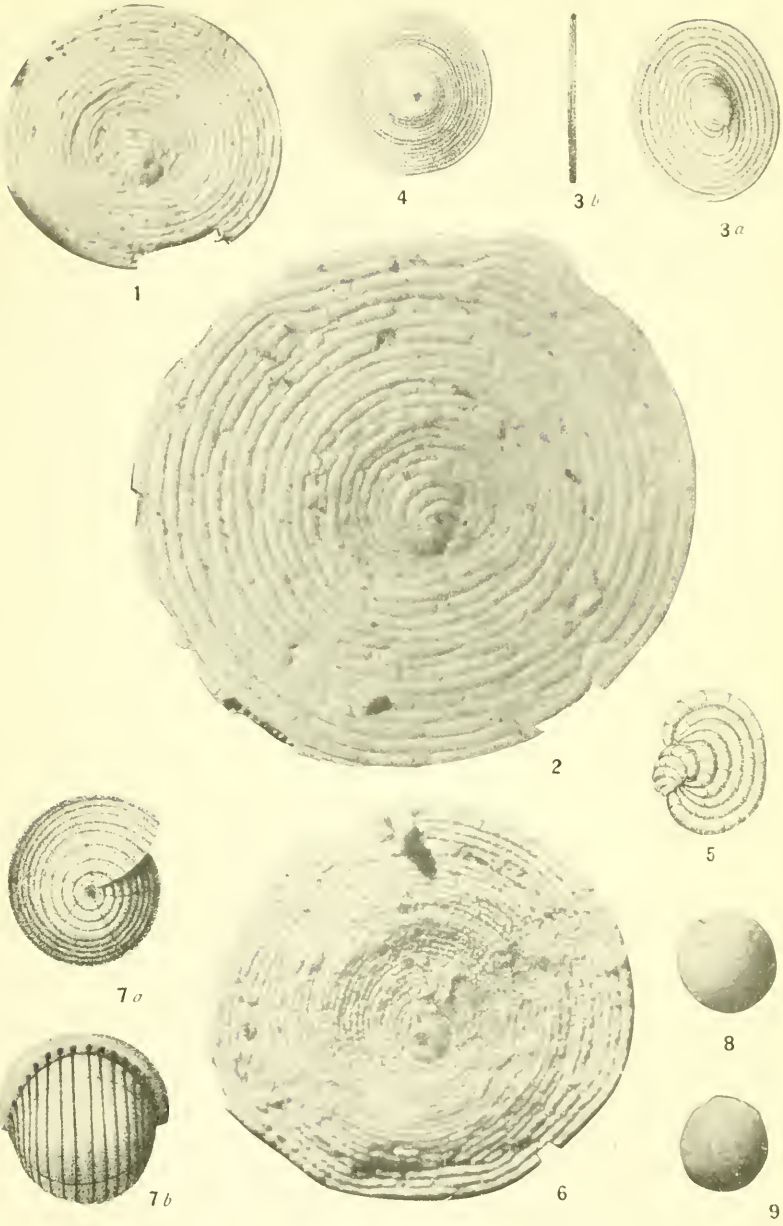
FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 81.



FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGES 81 AND 82.



FORAMINIFERA FROM THE NORTH COAST OF JAMAICA.

FOR DESCRIPTION OF PLATE SEE PAGE 82.