II.

FOSSIL FORAMINIFERA FROM THE WEST INDIES.

By Joseph Augustine Cushman.

With fifteen plates and eight text-figures.

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INTRODUCTION.

Very little has been known of the fossil Foraminifera of the West Indies, perhaps except Trinidad and Jamaica, and, although the present paper is based on collections from Cuba, Haiti, and Jamaica of the Greater Antilles, and from Antigua, St. Bartholomew, Anguilla, and St. Martins of the Leeward Islands, the area as a whole has still been scarcely more than touched. As the larger orbitoid genera were heretofore almost unknown from the Lesser Antilles, it is fortunate that the present collections are fairly rich in them, both in species and in individuals, because from a study of these it has been possible to make some general correlations with both continental America and with Europe. The smaller Foraminifera are at present less valuable for correlation purposes on account of the lack of the sharp discrimination of the species representing them in adjacent regions. Some of the Miocene species, however, afford a basis for definitely correlating some West Indian exposures at least with Panama and the Coastal Plain of the United States, collections from both of which I have described in reports recently published. The smaller Foraminifera, because they are very liable to exhibit differences in faunal assemblage, according to different depths and different conditions of temperature, are of value in supplying information on the physical conditions under which sediments containing them were deposited.

A summary statement regarding the collections and the general characters of the foraminiferal faunas from the different islands will be given at once, so that the data may be available for the later discussion.

LEEWARD ISLANDS.

Collections, all made by T. W. Vaughan, in 1914, from four of the Leeward Islands, viz, St. Bartholomew, Antigua, Anguilla, and St. Martin, were submitted to me. Much of the material is more or less indurated rock, and although it is very rich, especially in specimens of large forms, the species present are comparatively few. Because of their being firmly embedded in a matrix, the smaller species may be discovered only by sections, which are necessarily more or less at random. These reveal that smaller Foraminifera are numerous; but as a rule they are very unsatisfactory as they do not allow surface characters, on which specific characters so largely depend, to be studied; and from them it is usually possible to indicate little more than the genus

to which a specimen belongs. A few of the genera are noted here for later comparisons.

In general the Foraminifera show the faunal sequence already published by Vaughan.[1] The presence in St. Bartholomew of two species of *Orthophragmina* and associated *Nummulites* seems undoubtedly to indicate upper Eocene as the age of the St. Bartholomew limestone. The presence in Antigua of abundant specimens of large species of *Lepidocyclina*, as large as or larger than any species hitherto described, and the absence of *Orthophragmina* seem clearly to indicate an Oligocene age; while *Orbitolites* (*Sorites*) *duplex* from Anguilla and St. Martin seems to indicate a still younger horizon.

One of the species of *Orthophragmina* from St. Bartholomew appears to be close to a species already described from Marianna, Florida (*O. mariannensis*), but none similar to the other has yet been found on the continent. Nearly all the larger species are believed to be undescribed and should furnish excellent means of correlation with other West Indian or continental geologic formations.

The following table of species from the four islands contains the station numbers, the full data for which are given in the distribution of each species:

List of species of Foraminifera from the Leeward Islands.

Species.	Station No.	Species.	Station No.
From Saint Bartholomew:		*From Antigua*—continued	
Globigerina	6921	Lepidocyclina undulata, n. sp.	6863
Conulites americana, n. sp.	6902		6858
Carpenteria proteus, n. sp.	6921		6880?
	6924		6881
	6895		6942
Nummulites antillea, n. sp.	6924	Lepidocyclina undosa, n. sp.	6869
	6895	Lepidocyclina favosa, n. sp.	6881
	6897	Lepidocyclina parvula, n. sp.	6862
Nummulites parvula, n. sp.	6903		6854
	6924		
	6921	*From Anguilla:*	
Lepidocyclina antillea, n. sp.	6897	Textularia	6894
	6897*b*	Gypsina globulus (Reuss)	6966
	6902	Nonionina	6894
	6903	Heterosteginoides antillea, n. sp	6894
Orthophragmina antillea, n. sp	6895		6965
			6966
Orthophragmina marginata, n. sp	6924	Quinqueloculina	6966
		Orbitolites duplex Carp	6894?
From Antigua:		Alveolina	6966
Heterostegina antillea, n. sp.	6869		
	6854	*From St. Martin's:*	
Lepidocyclina gigas, n. sp.	6862	Spiroloculina	6949
	6854	Orbitolites duplex Carp	6949
	6857	Alveolina	6949

[1] Vaughan, T. W. Study of the stratigraphic geology and of the fossil corals and associated organisms in several of the smaller West Indian Islands. Carnegie Inst. Wash. Year Book No. 13, pp. 358–360, 1914.

SANTO DOMINGO.

The collection containing fossil Foraminifera from Santo Domingo was placed in my hands for study in connection with the work of Dr. T. W. Vaughan on other groups of the same material. The collection is that of Dr. Carlotta J. Maury of Cornell University, and represents several horizons and different localities. Only those localities at which Foraminifera were found are mentioned here.

Three localities with the following data have furnished the Foraminifera: Zone A, Rio Gurabo; Zone G, Rio Gurabo; Zone H, Rio Cana; Zone I, Rio Cana; Bluff 2, Cercado de Mao; Bluff 3, Cercado de Mao.

In all, these localities have yielded 33 species of Foraminifera. As is usual in such material, a few species dominate while the others are obtained only after long and diligent search of the finer material and are too often represented by single specimens. For this reason the occasional scattered records of one species present in one locality and not in another when the general assemblage in the two is very much alike may mean that there are certain uniques which, if the search could be prolonged indefinitely, would be represented in the similar lot of material from which it now appears to be absent. Such an explanation is probably sufficient for most of the records of this sort in Zones H and I and Bluffs 2 and 3. It explains probably the two species of *Polystomella* which are represented at single localities by single specimens, while the third species is common and represented at all four of the stations. It does not account for the *Orbitolites*, however, which is almost if not quite the most abundant genus in the Bluff 3 material and is lacking in the others. This again may be accounted for in the possible slight difference in ecologic conditions. In the tropics especially, *Orbitolites* is very apt to occur in great numbers under certain conditions. For example, about Montego Bay, Jamaica, *Orbitolites* is met with occasionally or even frequently in dredgings of several fathoms in the sand among the reefs, but about the Bogue Islands to the west of the bay, in a few inches of water, *Orbitolites* becomes very abundant. The short *Posidonia* to which the young of *Orbitolites* attach themselves is here abundant in the comparatively quiet waters and the specimens of *Orbitolites* make up a large part of the deposit about the roots of *Posidonia*. Some such conditions probably explain the very great abundance of *Orbitolites* and of *Asterigerina* and *Amphistegina* in certain of the other localities.

The geological sequence seems to present three phases at least. Zone A is the youngest and is represented by but 2 species in the rather limited material at hand. Both of these species occur living at the present time and the bed containing the fossils can not be of any but late Tertiary age.

Zone G is represented by a single species in considerable numbers unlike anything in the other beds, but generically like those of the lower members. Its age from this seems to be Miocene.

Zones H and I, which may be considered with the material from Bluffs 2 and 3 as one unit as far as the Foraminifera are concerned, seem to be in general early Miocene, possibly upper Oligocene. The

Distribution of fossil Foraminifera, Santo Domingo.

List of species.	Zone A, Rio Gurabo.	Zone G, Rio Gurabo.	Zone H, Rio Cana.	Zone I, Rio Cana.	Bluff 2, Cercado de Mao.	Bluff 3, Cercado de Mao.	Cercado de Mao.
Textulariidæ:							
Bulimina ovata d'Orb					×		
Globigerinidæ:							
Globigerina bulloides d'Orb						×	
inflata d'Orb				×	×	×	
conglobata H. B. Brady						×	
Orbulina universa d'Orb	×				×		
Rotaliidæ:							
Discorbis orbicularis Terq						×	
Truncatulina lobatula Walk. & Jac						×	
haidingerii d'Orb					×		
Gypsina inhærens Schultze			×		×	×	
globulus (Reuss.)					×	×	
Asterigerina carinata, n. sp					×		
angulata, n. sp			×	×	×	×	
rotundata, n. sp		×					
tuberculata, n. sp				×		×	
Nummulitidæ:							
Amphistegina lessonii d'Orb., flat var	×						×
evolute var				×	×	×	
Nonionina grateloupi d'Orb					×	×	
sloani d'Orb					×	×	
Polystomella sagra d'Orb					×		
lanieri d'Orb			×	×	×	×	
striatopunctata F. & M						×	
Miliolidæ:							
Quinqueloculina agglutinans d'Orb			×		×	×	
cf. Q. kerimbatica H. All. & Earl					×	×	
cuvieriana d'Orb				×	×		
auberiana d'Orb			×		×	×	
pulchella d'Orb			×	×	×	×	
gualteriana d'Orb			×	×		?	
Triloculina fichteliana d'Orb						×	
Vertebralina cassis d'Orb			×				
Biloculina sp						×	
Peneroplis pertusus var. discoideus Fl.						×	
var						×	
Orbiculina adunca F. & M			×	×	×	×	
Orbitolites complanata Lam., var						×	

evidence would seem to favor Miocene. Here is an assemblage of 31 species, several of which are represented by abundant specimens. The foraminiferal fauna is typical of shallow-water tropical conditions, while the few specimens of *Orbulina* and *Globigerina* do not occur in sufficient numbers to indicate any considerable depth. Their presence in very small numbers is only confirmatory of the shallow-water conditions which the more abundant species clearly indicate.

It is interesting to note that many of the species fit much more closely the original figures and descriptions given by d'Orbigny in his Cuba paper (d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, "Foraminifères") than they do any other later figures and descriptions, either of these same or other species. In fact, many of the d'Orbignyan species originally described in the above paper have since been changed by subsequent authors, so that the later figures assigned to such species are not at all specifically like the originals. After careful comparison it has seemed best to reestablish several of d'Orbigny's species, such as *Polystomella lanieri* and others, as fitting the present material under consideration much more definitely than do the recent species under which they have been placed as synonyms.

Similarly, in the matter of the genus *Asterigerina* d'Orbigny, it has seemed best to use that name here. While it is true that *Discorbis* has species which have "asterigerine" developments on the ventral side, and while *Amphistegina* also has similar characters, yet here are several species certainly not closely related to *Discorbis* nor yet with the highly developed characters of *Asterigerina*. Under such circumstances, as they fit d'Orbigny's genus *Asterigerina* perfectly, that name is here applied to them.

Only those specimens are figured which are believed to be new. For the others, a reference to figures, either to d'Orbigny or other authors, is given. A few species must be left in a questionable condition, either because they are uniques or are too worn or broken to give full details.

A table is given showing the distribution in the different localities.

JAMAICA.

In his Geology of Jamaica, Hill[1] gives records of Foraminifera, identified by Dr. R. M. Bagg, from a number of localities and horizons. The collections available for the present work are limited to the Bowden marl from Bowden, Jamaica. In 1876 Jones and Parker,[2] gave a list of the species they found in the Bowden marl, and Brady, in the same volume (p. 309), described a new species from the same formation. The list given by Jones and Parker is as follows:

Nodosaria raphanistrum Linné.
Dentalina acicula Lamarck.
Vaginulina striata d'Orbigny.
Frondicularia complanata Defrance.
Cristellaria rotulata Lamarck.
cultrata Montfort.
calcar Linné.
Cristellaria italica Defrance.
Tinoporus vesicularis Parker and Jones.
Bulimina ovata d'Orbigny.
Cuneolina pavonia d'Orbigny.
Vertebralina (Articulina) striata d'Orbigny.
Lituola soldani Parker and Jones.

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[1] Hill, R. T. The geology and physical geography of Jamaica. Study of a type of Antillean development. Based upon surveys made for Alexander Agassiz. Bull. Mus. Comp. Zoöl., vol. 34, pp. 147 *et. seq.*, 1899.

[2] Jones, T. R., and W. K. Parker., Ann. Soc. Mal. Belg., vol. 11, Mem. pp. 91–103, 1876.

Tinoporus pilaris was described by Brady.

As has already been noted in discussing the species from Santo Domingo, occasional specimens of rare species in fossil deposits are apt to be found again only after persistent search, as the chance of finding them in any definite amount of material depends upon their rarity. Therefore it is not surprising to find certain species, such as *Cristellaria italica*, which could hardly be mistaken for anything else, given in Parker and Jones's list from Bowden, but not seen since. A single specimen only was found, according to the original list.

In his Geology of Jamaica, Hill gives a list of the Foraminifera identified by R. M. Bagg from Bowden. Except for changes in nomenclature, this list is very similar to that given by Parker and Jones. The list as identified by Bagg follows:

Haplostiche soldanii (Parker and Jones).
Textularia barrettii (Jones and Parker).
trochus d'Orbigny.
Orbiculina adunca (Fichtel and Moll).
compressa d'Orbigny.
Cristellaria cultrata (Montfort).
cassis (Fichtel and Moll).
calcar (Linné).
Gypsina globulus (Reuss).
vesicularis (Parker and Jones).
Cuneolina sp.
pavonia d'Orbigny.
Vaginulina legumen (Linné).
Nummulites ramondi d'Archiac.
Amphistegina lessonii d'Orbigny.

Each of these lists contains the names of 14 species, with probably 7 species in common, or a possible total of 21 species.

In this work I have had, through the kindness of Professor E. W. Berry, of Johns Hopkins University, a considerable quantity of marl from Bowden, and persistent searching has added a number of species not previously recorded, and yet has not revealed certain species listed by earlier workers; 17 of these seem to be additions to the previous lists.

Allowing for possible mistakes in identification or duplication of names, it seems fair to limit the present list to 31 species. A number of these are also found in the Miocene of Santo Domingo, Cuba, Panama, and the Coastal Plain of the United States. A few of the Bowden forms seem on critical examination to be undescribed.

The Bowden marl is characterized by an abundance of large species of *Haplostiche*, *Cuneolina*, *Cristellaria*, etc., which do not occur in the collections from the other Miocene formations, already referred to, and in a way seems to be unique. It is a striking fact that the same species and varieties of *Haplostiche* and *Cuneolina* are found living off the Barbados in 100 fathoms. They may live at lesser depths in the same region, but are not present in very shallow water of the tropics, so far as records are available. *Cuneolina* is also abundant in similar or lesser depths in the colder water off the Atlantic Coast of the eastern United States, although no published records give this. The data above given, therefore, suggest that, if the depth were slight, the water conditions were cooler than at present. The presence of *Orbiculina* and other Miliolidæ in very small quantities and a lack of *Polystomella*

also seem to indicate that the Bowden was deposited at a considerable depth, even if it was less than 100 fathoms.

The revised list of Bowden species follows:

List of species of fossil Foraminifera from Bowden, Jamaica.

Psammosphæra fusca Schultze.
Haplostiche dubia var. dubia v. Brk.
Haddonia minor Chapman.
Texularia barrettii Jones & Parker.
Cuneolina pavonia d'Orb.
Cuneolina pavonia var. angusta, n. var.
Bulimina ovata d'Orb.
Nodosaria vertebralis Batsch.
Frondicularia alata d'Orb.
Cristellaria calcar Linn.
bowdenensis, n. sp.
italica (Defr).
gemmata H. B. Brady.
Globigerina bulloides d'Orb.
rubra d'Orb.
sacculifera, H. B. Brady
Globigerina subcretacea Chapman.
Spæroidina dehiscens var. immatura, n. var.
Discorbis allomorphinoides (Reuss).
Truncatulina præcincta Karrer.
Gypsina vesicularis (Parker & Jones).
globulus var. pilaris (H. B. Brady).
Pulvinulina sagra d'Orb.
Amphistegina lessonii d'Orb.
Quinqueloculina auberiana d'Orb.
parkeri var. bowdenensis, n. var.
Triloculina brongniartiana d'Orb.
tricarinata d'Orb.
Vertebralina striata d'Orb.
Orbiculina compressa d'Orb.

CUBA.

The Cuban collections are mainly from about Guantánamo Bay, Santiago, and Matanzas. Most of the material obtained near Santiago is from the manganese mines, and contains a great number of individuals and several species of *Orthophragmina*, which seems clearly to be of Eocene age. The collections from near Guantánamo are rich in *Lepidocyclina* and evidently represent deposits of Oligocene age. A richly fossiliferous, foraminiferal marl from near Matanzas, of Miocene age, yielded 30 species of smaller Foraminifera, a list of which is given. The table on page 30 shows the distribution at the different stations of the larger and more important species from the eastern end of the island about Santiago and Guantánamo.

Some of the Eocene species seem to be related to those of St. Bartholomew and the exposure near David, Panama.

List of species from U. S. G. S. Sta. 3461, marl gorge of Yumuri River, Matanzas, Cuba.

Textularia cf. T. candeiana d'Orb.
Bolivina limbata H. B. Brady.
punctata d'Orb.
lobata var. cubensis, n. var.
Verneuilina spinulosa Reuss.
Virgulina punctata d'Orb.
Gaudryina triangularis Cushman.
Cassidulina subglobosa H. B. Brady.
Uvigerina cf. U. canariensis.
Globigerina bulloides d'Orb.
subcretacea Chapman.
Orbulina universa d'Orb.
Pullenia obliqueloculata Parker & Jones.
Anomalina.
Truncatulina lobatula Walk. & Jac.
Siphonina reticulata (Czjzek).
pulchra, n. sp.
Pulvinulina.
sagra d'Orb.
Planorbulina retinaculata Parker & Jones.
Discorbis saulcii d'Orb.
Polystomella lanieri d'Orb.
sagra d'Orb.
Nonionina cf. N. asterizans F. & M.
grateloupi d'Orb.
sloanii d'Orb.
Amphistegina lessonii d'Orb.
Quinqueloculina sp.
Biloculina cf. B. bulloides d'Orb.

Distribution of other Cuban Foraminifera according to stations at which found.

	3448	3473	3475	3478	3567	7348	7505	7512	7513	7516	7518	7519	7521	7522	7543	7548	7554	7664	7666	6117	6118	6119	6120	6122	6123	6124	6125
Orthophragmina cubensis[1]	×	..	×	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	×	×	×	×	×	×	×	×	×
subtaramellei[1]	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×?	..	..	..	×	..	×	×	×
sculpturata[1]	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	×	×	..	×	..	..	..
crassa[1]	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	×	×	..	×	×	×	×
pustulata[1]	×	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lepidocyclina crassata[1]	..	..	..	..	..	..	..	×	×	..	..	×	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..
perundosa[1]	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
subraulinii[2]	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	..
morgani[2]	..	..	..	..	..	..	..	..	×	×	..	?	..	?	×	..	×	..	..	..	..	..	..	..	..	..	..
schlumbergeri[3]	..	..	..	..	..	..	..	×	..	..	×	..	..	×	×	..	..	×	..	..	..	..	..	..	..	..	..
marginata[3]	..	..	..	..	..	..	..	×	?	..	×	×	×	?	×	..	..	×	..	..	..	..	..	..	..	..	..
sumatrensis[4]	..	..	..	..	..	..	..	..	×	×	..	×	..	..	×	..	×	×	..	..	..	..	..	..	..	..	..
canellei var. yurnagunensis[1]	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Linderina? sp.?	×	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	..
Carpenteria proteus[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	..
americana[1]	..	..	..	..	..	..	..	..	×	..	×	..	×	×	..	..	..	×	..	..	..	..	..	..	..	..	..
Conulites americana[1]	×	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	×
Textularia cf. T. agglutinata[5]	..	..	..	..	..	..	..	×	×	×	..	..	×	..	×	×	..	..	..	..	..	..	..	..	..	..	..

[1] New species. [2] Lemoine and R. Douvillé. [3] Michellotti. [4] Brady. [5] d'Orbigny.

ASTRORHIZIDÆ.

Psammosphæra fusca F. E. Schulze.

Psammosphæra fusca F. E. Schulze, II Jahr. Comm. wiss. Unt. deutsch. Meer in Kiel, p. 113, plate 2, figs. 8 *a* to *f*, 1875; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 249, plate 18, figs. 1, 5 to 8 (not 2 to 4), 1884.

The following is a description of this species:

Test spherical, composed of a single layer of sand grains held together by a grayish cement, exterior rough, aperture consists only of the interstitial spaces. Diameter up to 2 mm.

Specimens from Bowden seem referable to this species.

LITUOLIDÆ.

Haplostiche dubia (d'Orbigny) var. intermedia (Vanden Broeck).

(Plate 6, Figures 1 to 4.)

Lituola soldanii Jones and Parker var. *intermedia* Vanden Broeck, Ann. Soc. Belg. Micr., vol. 2, p. 74, plate 2, figs. 1, 3, 4, 6, 1876.
Lituola soldanii Jones and Parker, Ann. Soc. Mal. Belg., vol. 11, p. 98, 1876; Hill, Bull. Mus. Comp. Zoöl., vol. 34, p. 147, 1899.

The following is a description of this variety:

Test elongate, subcylindrical, tapering gradually from the broad apertural end to the almost pointed initial end, chambers numerous, 10 to 12, hemispherical, the proximal portion overlapping the preceding chamber, sutures excavated, chambers in a linear series with a straight axis or often curved or sharply bent toward the distal end; wall composed of agglutinated sand grains with occasional tests of other Foraminifera; aperture terminal, central, usually somewhat dendritic; interior of chamber labyrinthic, in transverse section showing the subdivisions arranged in radial manner.

Length up to 6 mm.

This is one of the most conspicuous and commonest of the Foraminifera of the Bowden marl. It was recorded by Jones and Parker as *Lituola soldanii* Parker and Jones, and it is in Hill's list as *Haplostiche soldanii* (Parker and Jones).

The variety differs from the typical form of the species in its much more distinct chambers, more elongate tapering form, and in the curious tendency to a bending of the axis toward the apertural end.

Vanden Broeck described this variety from recent material dredged in 84 fathoms off the Barbados. I have seen some of these specimens and they are apparently identical with those from Bowden.

Haddonia minor Chapman.

Haddonia minor Chapman, Journ. Linn. Soc., Zoology, vol. 28, p. 384, plate 36, figs. 1, 2, 1902.

The following is a description of this species:

Test attached at least by the earlier chambers, afterward growing erect or in a vermiform manner; the earlier chambers often triserial, later ones variable; wall roughened somewhat; aperture horseshoe-shaped.

Length 2 to 4 mm.

Two specimens from the Bowden marl seem very close to this species, described by Chapman from Funafuti Atoll. This is not a surprising distribution, as many things found in the Tertiary of the West Indies are represented by allied forms now living in the Indo-Pacific.

TEXTULARIIDÆ.

Textularia barrettii Jones and Parker.

(Plate 6, Figures 5 to 7.)

Textularia barrettii Jones and Parker, Report Brit. Assoc., Newcastle Meeting, p. 80 and p. 105, 1863; Ann. Soc. Mal. Belg., vol. 11, p. 99, woodcut, 1876; Hill, Bull. Mus. Comp. Zoöl., vol. 34, p. 147, 1899.

The following is a description of this species:

Test broadly conical, circular or somewhat compressed in end view, the compression parallel to the line of union between the series of chambers, exterior smoothly finished, wall of fine arenaceous material with a grayish cement, sutures fairly distinct but not depressed, apertural end with the line between the last-formed chambers depressed, trough-like, nearly straight, the central third slightly excavated at the aperture, which is long and low; interior of the aperture often denticulate, showing slightly at the surface; chambers labyrinthic within, the divisions radially arranged in transverse section.

Length of fossil specimens up to 3 mm.

This species is recorded from Bowden by Jones and Parker and by Hill. It is rather a common and conspicuous species, but as far as I have seen does not reach the dimensions of recent specimens from the same general region.

In Hill's list of species identified by Dr. R. M. Bagg is *Textularia trochus* d'Orbigny. I have failed to find specimens of this species,

although the younger specimens of *T. barrettii* often resemble *T. trochus* in contour, but the surface characters of the two are distinctive, as well as the size, *T. trochus* not usually exceeding a millimeter in length. The later chambers of *T. barrettii* also tend to assume a definitely cylindrical shape which is also distinctive.

Textularia species cf. T. candeiana d'Orbigny.

Textularia candeiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba," Foraminifères," p. 143, plate 1, figs. 25 to 27, 1839; Cushman, Bull. 71, U. S. Nat. Mus., part 2, p. 12, figs. 14 to 17, 1911.

A single specimen from station 3461, marl, gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan, seems to be the young of this species. The material of the test, however, has little agglutinated particles, consisting largely of clear shell material. The species was described by d'Orbigny from sands of Cuba, but it is common in shallow waters in the Indo-Pacific region.

Textularia species.

(Plate 5, Figure 7.)

A single sectioned specimen of *Textularia* was found in a slide from U.S.G.S. No. 6894, southwest side of Crocus Bay, Anguilla. It is elongate, composed of about 25 chambers. It is apparently the microspheric form, as the early chambers are arranged in an irregularly spiral manner. In general its shape suggests *T. agglutinata* or some related species, but determinations based on the section alone are practically valueless. The occurrence of the genus, however, should be noted both for correlation work and in order that the species may be looked for by others working on the material from the same locality at a later time.

A somewhat similar form occurs in the Cuban material from several stations. It is a form which is here figured.

Textularia species cf. T. agglutinata d'Orbigny.

(Figure 1.)

There is a large species of *Textularia* that occurs in the thin sections of material from a number of the Cuban stations. It is made up evidently of rather coarse sand grains, elongate, somewhat decreasing in diameter toward the apertural end. In general characters it is like *T. agglutinata* d'Orbigny.

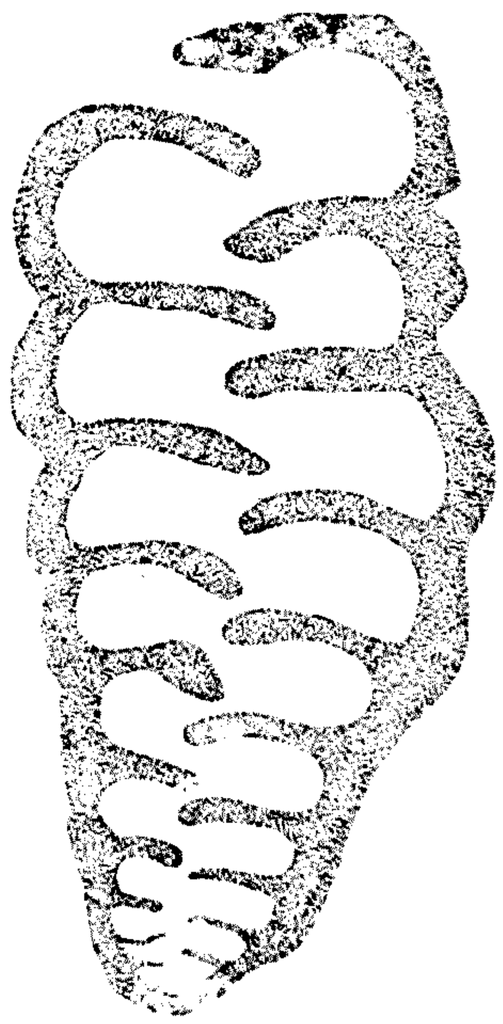

FIG. 1.—*Textularia* cf. *agglutinata* d'Orbigny. Longitudinal section. × 35. Specimen from station 7516, west end of Los Melones Mountain, Cuba.

As it is so large and striking a species, it has been used here to check up certain of the Cuban stations in the table.

The species occurs in material from the following stations in Cuba, collected by O. E. Meinzer: 7512, Ocujal; 7513, orbitoidal limestone, outcrop where Palmer Trail joins Ocujal Trail; 7516, west end, Los Melones Mountain; 7521, limestone, top of Mogote Peak; 7543, limestone outcrop, east side of Yateras; and 7548, flexure, 2 miles south of Yurnaguna.

This is very similar to the specimen figured, plate 5, figure 7, from Anguilla.

Bolivina punctata d'Orbigny.

Bolivina punctata d'Orbigny, Voyage Amér. Mérid., vol. 5, plate 5, "Foraminifères," p. 63, plate 8, figs. 10 to 12, 1839; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 417, plate 52, figs. 18, 19, 1884.

One specimen was found in marl from station 3461, gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan. It is referred to this species, although the name *Bolivina punctata* has had so many different forms of smooth *Bolivina* placed under it that it means little until a close study can be made of some of the various species now passing under that name.

This same species was found in the Miocene Gatun formation of the Panama Canal Zone.

Bolivina lobata H. B. Brady var. cubensis, new variety.

(Plate 14, Figure 1.)

The following is a description of this variety:

Test elongate, biserial, somewhat compressed, chambers of the earlier portion close, those of the later portions more distinct and somewhat separated, sutures deep and distinct, somewhat thickened, apertural end obliquely truncated; chambers with the walls more or less granular, the outer margin extended into elongate processes in most of the chambers, outline lobate; aperture elongate, oval, with a broad lip and a sharply defined border.

Length, 0.50 mm.

Type specimen (U. S. N. M. No. 328176) from station 3461, marl from gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan.

The type form of the species was described by Brady from off New Guinea, and I have seen specimens of it obtained between Midway Island and Guam. The variety above described differs in its much more spinose appearance and its broader aperture with a flaring collar-like lip.

Bolivina limbata H. B. Brady.

Bolivina limbata H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, p. 57, 1881; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 419, plate 52, figs. 26–28, 1884.

This species is represented by a single specimen from station 3461, from marl, gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan. As a recent species it is most abundant in the Indo-Pacific region, although widely distributed elsewhere in smaller numbers.

Cuneolina pavonia d'Orbigny.

(Plate 7, Figure 1.)

Cuneolina pavonia d'Orbigny, Foram. Foss. Vienne, p. 253, plate 21, figs. 50 to 52, 1846; Cours élém. Paléont., etc., vol. 1, p. 203, fig. 30, 1849; vol. 2, plate 2, p. 648, fig. 526, 1852; Carpenter, Parker, and Jones, Introd. Foram., p. 193, plate 12, fig. 17, 1862; Jones and Parker, Ann. Soc. Mal. Belg., vol. 11, p. 98, 1876; Schwager, Boll. R. Com. Geol. Ital., vol. 8, p. 26, plate, fig. 61, 1877; Hill, Bull. Mus. Comp. Zoöl., vol. 34, p. 147, 1899.

The following is a description of this species:

Test strongly compressed in a plane parallel to that of the junction between the chambers, which are biserially arranged, nearly as wide as long, the sutures appearing at the narrow sides of the test, outline from the flattened side triangular, the apertural end broad and slightly convex, initial end pointed, in side view test narrow with nearly parallel sides, chambers slightly inflated, sutures slightly depressed, wall arenaceous with an abundance of cement, smoothly finished exteriorly; aperture extending nearly the entire width of the test, divided into a series of smaller circular or elliptical openings by prolongations of the apertural wall.

Length up to 4 mm. or slightly more; breadth equal to the length.

This is one of the commonest and most striking of the Bowden species. D'Orbigny's figure shows a specimen fully as broad as long and from its early stages being very broad. In the Bowden material there are two forms which, although they vary somewhat, seem nevertheless worthy of distinction.

Cuneolina pavonia d'Orbigny var. angusta, new variety.

(Plate 7, Figure 2.)

The following is a description of this variety:

Test differing from the typical in its much narrower form, the length usually twice the width, slightly thicker than the typical, the chambers occasionally showing a tendency toward an angle in the center.

Length up to 5 mm. or more.

This narrower variety is much more common than the broader typical form. Vanden Broeck did not record it from his material off Barbados, but it occurs in considerable numbers there in 100 fathoms with *Haplostiche dubia* var. *intermedia* Vanden Broeck and other species. It is also met with rather frequently off our eastern coast, although it is practically unrecorded as a recent species.

Verneuilina spinulosa Reuss.

Verneuilina spinulosa Reuss, Denkschr. Akad. Wiss. Wien, vol. 1, p. 374, plate 47, fig. 12, 1850; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 384, plate 47, figs. 1 to 3, 1884.

The species is represented by a single specimen, very typical in all its characters, from station 3461, from marl, gorge of Yumurí River, Matanzas, Cuba, T. W. Vaughan, collector.

Gaudryina triangularis Cushman.

Gaudryina triangularis Cushman, U. S. Nat. Mus. Bull. 71, part 2, p. 65, fig. 104, 1911.

A single specimen from station 3461, marl, from gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan, is very similar to this species described from the Pacific. It was found as a fossil in the lower part of the Culebra formation in the Panama Canal Zone.

Bulimina ovata d'Orbigny.

Bulimina ovata d'Orbigny, Foram. Foss. Bass. Tert. Vienne, p. 185, plate 11, figs. 13, 14, 1846.

A single specimen from Bluff 2, Cercado de Mao, which is rather too elongate for this species, but in the absence of more material it is referred here questionably. Under this name Jones and Parker record a single specimen from the Bowden marl measuring 2 mm. in length. I have not been able to find it in the Bowden material I have examined.

Virgulina punctata d'Orbigny.

Virgulina punctata d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 139, plate 1, figs. 35, 36, 1839.

This species, described by d'Orbigny in the Cuba monograph, has been referred to but once since. Specimens in the material from station 3461, marl from the gorge of the Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan, in their outline and form of the chambers are almost identical with the figure given by d'Orbigny.

Cassidulina subglobosa H. B. Brady.

Cassidulina subglobosa H. B. Brady, Quart. Journ. Micr. Sci., vol. 21, p. 60, 1881; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 430, plate 54, figs. 17 *a* to *c*, 1884; Cushman, U. S. Nat. Mus., Bull. 71, part 2, p. 98, figs. 152 *a* to *c*, 1911.

A specimen that has an aperture like that of this species, but with the whole test somewhat more compressed, was found in the material from station 3461, marl from gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan. This species is practically unknown in the fossil state.

LAGENIDÆ.

Nodosaria vertebralis (Batsch).

(Plate 7, Figures 3 to 5.)

Nautilus (*Orthoceras*) *vertebralis* Batsch, Conch. Seesandes, p. 3, No. 6, plate 2, figs. 6 *a*, *b*, 1791.

Nodosaria vertebralis H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 514, plate 63, fig. 35; plate 64, figs. 11 to 14, 1884; Flint, Rep. U. S. Nat. Mus., p. 312, plate 57, fig. 5, 1897 (1899); Cushman, U. S. Nat. Mus., Bull. 71, part 3, p. 60, plate 32, fig. 1, 1913.

The following is a description of this species:

Test elongate, slender, somewhat tapering to the almost pointed initial end, straight or more often somewhat arcuate, chambers numerous, little inflated, sutures between the chambers of clear shell material appearing darker than the main, more opaque chamber walls; surface with a few longitudinal costæ,

prominent, and little affected by the individual chambers, running uninterruptedly from one end of the test to the other; specimens, when complete, with a short spine at the initial end; aperture radiate, slightly produced.

Length up to 7.5 mm.

This species is a common one in the Carribbean and Gulf of Mexico at the present time and in the Pacific tropical regions as well. Its main characteristics are the clear sutural areas between the chambers and the slightly curved elongate test. Although by no means common, well-developed specimens are found occasionally in the material from Bowden. Jones and Parker record *Nodosaria raphanistrum* Linné from the Bowden marl, and probably this is the same as recorded here as *N. vertebralis*. In Hill's list of species identified by Bagg no *Nodosaria* appears, but *Vaginulina legumen* (Linné). Possibly this may have been a specimen of *N. vertebralis*. Jones and Parker also record single specimens referred to *Dentalina acicula* Lamarck and *Vaginulina striata* d'Orbigny. Both of these and their *N. raphanistrum* are given as 5.25 mm. in length, and it is a question if they are not perhaps all *N. vertebralis*. In all the material I have examined the only Nodosarian specimens I have seen may all be referred to *N. vertebralis*.

Nodosaria species.

(Figure 2, *a* and *b*.)

In the sections 2 specimens of *Nodosaria* occur, one showing 3, the other 4 chambers. They are small, of fairly uniform diameter, and may represent a small, few-chambered species or may be the young of some larger species, although if the latter the adults were not observed.

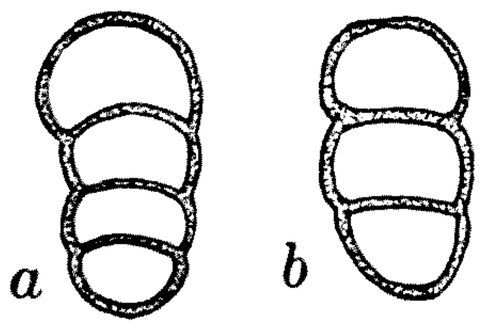

FIG. 2.—Longitudinal sections of either young or few-chambered specimens of *Nodosaria*. Figure *a*, four-chambered specimen from station 7519, drift near top of landslide next north of Los Melones Mountain, Cuba. Fig. *b*, three-chambered specimen from station 7513, limestone outcrop where Palmer Trail joins Ocujal Trail, Cuba.

The stations are 7513, orbitoidal limestone, outcrop where Palmer Trail joins Ocujal Trail and 7519, from drift near top of landslide next north of Los Melones; both collected by O. E. Meinzer.

Frondicularia alata d'Orbigny.

(Plate 8, Figure 1.)

"*Nautili candiformes*" Soldani, Testaceographia, vol. 2, p. 13, plate 1, fig. c, 1798.

Frondicularia alata d'Orbigny, Ann. Sci. Nat., vol. 7, p. 256, No. 2, 1826. Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 8, p. 161; plate 10, fig, 66, 1871; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 522, plate 65, figs. 20 to 23; plate 66, figs. 3 to 5, 1884.

Frondicularia alata d'Orbigny var. *lanceolata* Vanden Broeck, Ann. Soc. Belg. Micr., vol. 2, p. 117, plate 2, fig. 13, 1876.

Frondicularia complanata Jones and Parker (not Defrance), Ann. Soc. Mal. Belg., vol. 11, p. 98, 1876.

The following is a description of this species:

Test flattened, in outline triangular, the chambers at the initial end forming nearly a straight base, apertural end bluntly pointed, chambers of nearly

uniform width throughout, initial end usually with several short, blunt, conical spines extending backward, usually best developed at the angles and near the proloculum.

Length up to 7 mm.

Jones and Parker recorded 2 specimens in their early list, "one elliptical, and another oval." In the material I have seen there are several specimens showing considerable variation. The most common form is that figured by Vanden Broeck as var. *lanceolata* and referred to above. In the fossil specimens spinosity of the basal margin is even more marked, in some cases as many as 3 short spines appearing from the proloculum alone and occasionally in pairs one behind the other in front view. These may appear at various parts of the basal margin. Besides this common form there are a few specimens more like Vanden Broeck's var. *sagittula* (*e. c.*, plate 2, figs. 12, 14), and one at least which closely resembles the form described by him as *F. complanata* var. *concinna* (*op. cit.*, plate 3, fig. 2). In general the series is not unlike that of recent material from the Carribbean and Gulf of Mexico.

Cristellaria calcar (Linné) var. aspinosa, new variety.

(Plate 6, Figure 8.)

The following is a description of this variety:

Test small, close-coiled, biconvex, umbonate, smooth, sutures not depressed, peripheral margin acute, with a distinct but very narrow carina with a very slight knob-like spine opposite each chamber.

Diameter about 0.75 mm.

Type specimen from the Miocene Bowden marl, Jamaica (U.S.N.M. No. 328177).

This is very close to the typical form of *C. calcar* as figured (Cushman, Bull. 71, U. S. Nat. Mus., part 3, plate 32, figure 4), but the spines in the Bowden specimens are nearly obsolete. These are not broken spines, but are really shortened and knob-like or almost wanting. It is rare in the Bowden material.

Cristellaria bowdenensis, new species.

(Plate 8, Figure 2.)

The following is a description of this species:

Test comparatively large, much compressed, chambers long and narrow, broadening somewhat toward the periphery, sutures gently curved; peripheral margin with a thin keel of medium width prolonged at irregular intervals into a series of rowel-like spines, short, rounded near the base, and apparently having little relation to the chambers; surface of the chambers smooth, the sutures typically raised, limbate, with a series of tubercles running from the umbilical area to the periphery; aperture somewhat back from the periphery in the last-formed chambers, really terminal in the young, and early chambers peripheral, stellate.

Diameter up to 4 mm.

Type specimen from the Miocene Bowden marl, Jamaica (U.S.N.M. No. 328178).

This is a fairly common species at this locality and is the one from Bowden referred to by various authors as *Cristellaria calcar*. It is not typical *C. calcar* and seems to be distinctive in its size, form, and ornamentation. The nearest approach to it is perhaps the form described from the Carribbean by Goës (Kongl. Svensk. Vet. Akad. Handl., vol. 19, No. 4, p. 49, plate 3, figs. 3, 50, 51, 1888) under the name *Nodosarina crepidula* var. *cassis* (Fichtel and Moll).

Cristellaria gemmata H. B. Brady.

Cristellaria gemmata H. B. Brady, Quart. Journ. Micr. Soc., vol. 21, p. 64, 1881; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 554, plate 71, figs. 6, 7, 1884.

A single very typical specimen of this species was obtained from the Bowden marl, Bowden, Jamaica. Brady's records of its occurrence as a recent species include the Fiji Islands, Torres Strait, and the Philippines.

Cristellaria italica (Defrance).

Saracenaria italica Defrance, Dict. Sci. Nat., vol. 32, p. 177, 1824; vol. 47, p. 344; Atlas Conch., plate 13, fig. 6.

Cristellaria (*Saracenaria*) *italica* d'Orbigny, Ann. Sci. Nat., vol. 7, p. 293, 1826.

Cristellaria italica Parker, Jones, and H. B. Brady, Ann. Mag. Nat. Hist., ser. 3, vol. 16, pp. 21, 31, plate 1, figs. 41, 42, 1865; Jones and Parker, Ann. Soc. Mal. Belg., vol. 11, p. 98, 1876; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 544, plate 68, figs. 17, 18, 20, 23, 1884.

Jones and Parker, in their list of species from the Bowden marl, record a single specimen of this species, measuring about 6 mm. in length. That is about the size of large recent specimens from this same general region. I have not found the species in the material I have examined from the Bowden, but it occurs in material from the Panama Canal Zone.

Polymorphina species.

(Plate 8, Figure 4.)

In the sections from station 7664, north slope La Piedra, northeast of Jamaica, northeast of Guantánamo, collected by N. H. Darton, there are specimens of a large species of *Polymorphina*, with fairly thick walls. One of these is figured in the reference given above.

GLOBIGERINIDÆ.

Globigerina bulloides d'Orbigny.

Globigerina bulloides d'Orbigny, Ann. Sci. Nat., vol. 7, p. 277, No. 1, 1826; in Barker, Webb, and Berthelot, Hist. Nat. Isles Canaries, "Foraminifères," p. 132, plate 2, figs. 1, 3, 28, 1839; Foram. Foss. Bass. Tert. Vienne, p. 163, plate 9, figs. 4, 6, 1846; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 593, plate 77, plate 79, figs. 3 to 7, 1884.

A few specimens of this common species occur in the Bowden, Jamaica, material, accompanied as usual by some specimens which

may be referred to variety *triloba* Reuss. A few specimens were also obtained in material from Bluff 3, Cercado de Mao, Santo Domingo.

This species occurs in the Miocene both of Panama and the Coastal Plain of Florida and Virginia.

Globigerina rubra d'Orbigny.

Globigerina rubra d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, 1839, Foraminifères, p. 94, plate 4, figs. 12 to 14; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 602, plate 79, figs. 11 to 16, 1884.

A single specimen was found which seems referable to this common species so characteristic of the Caribbean region. It is from Jamaica, from the Bowden marl.

Globigerina sacculifera H. B. Brady.

Globigerina helicina Carpenter (not *G. helicina* d'Orbigny), Intr. Foram., plate 12, fig. 11, 1862.
Globigerina sacculifera H. B. Brady, Geol. Mag., Dec. 2, vol. 4, p. 535, 1877; Rep. Voy. *Challenger*, Zoology, vol. 9, p. 604, plate 80, figs. 11 to 17, plate 82, fig. 4, 1884.

One or two specimens are very evidently this common species, so common in Globigerina ooze of recent ocean bottoms, but almost unknown as a fossil species. They occurred in the Bowden marl from Jamaica.

Globigerina subcretacea Chapman.

Globigerina cretacea H. B. Brady (not *G. cretacea* d'Orbigny), Rep. Voy. *Challenger*, Zoology, vol. 9, p. 596, plate 82, fig. 10, 1884.
Globigerina subcretacea Chapman, Journ. Linn. Soc., Zoology, vol. 28, p. 410, plate 36, figs. 16 *a*, *b*, 1902.

A single specimen of this species was obtained in the material from Bowden, Jamaica.

Globigerina inflata d'Orbigny.

Globigerina inflata d'Orbigny, in Barker, Webb, and Berthelot, Hist. Nat. Iles Canaries, "Foraminifères," p. 134, plate 2, figs. 7 to 9, 1839.

A few specimens from Zone I, Rio Cana, and also from both Bluffs 2 and 3, Cercado de Mao, Santo Domingo. It is also known from the Miocene of the Panama Canal Zone.

Globigerina conglobata H. B. Brady.

Globigerina conglobata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 603, plate 80, figs. 1 to 5, 1884.

A single typical specimen from Bluff 3, Cercado de Mao, Santo Domingo. The species also occurs in the Miocene of the Panama Canal Zone.

Globigerina species.

(Plate 5, Figure 13.)

A small species of *Globigerina* in the section illustrated, reminding one of *G. æquilateralis*, occurs at U. S. G. S. No. 6924 from limestone point on northwest side of St. Jean Bay, St. Bartholomew. As the sections do not give the entire form it is impossible to identify it specifically with any certainty.

Globigerina species.

(Plate 8, Figure 3.)

A small species of *Globigerina* is very common in the sections of rock specimens from Cuba. It occurred at station 7513, orbitoidal limestone, outcrop where Palmer Trail joins Ocujal Trail; station 7516, west end, Los Melones; and station 7521, limestone, top of Mogote Peak; all collected by O. E. Meinzer. The figured specimen which seems to be the same is from station 7664, north slope La Piedra, northeast of Jamaica, northeast of Guantánamo, collected by N. H. Darton.

Orbulina universa d'Orbigny.

Orbulina universa d'Orbigny, in Barker, Webb, and Berthelot, Hist. Nat. Iles Canaries "Foraminifères," p. 123, plate 1, fig. 1, 1839.

Single specimens occurred in material from Zone A, Rio Gurabo, and Bluff 2, Cercado de Mao, Santo Domingo. It is known also from the Miocene of the Panama Canal Zone.

Sphæroidina dehiscens Parker and Jones var. immatura, new variety.

(Plate 14, Figure 2.)

The following is a description of this variety:

Test exteriorly composed almost entirely of two visible chambers, with a small portion of a third sometimes slightly showing; chambers spherical, walls coarsely perforate, suture between the chambers very slightly fissure-like on opposite sides, otherwise closed and simply depressed.

Diameter 0.4 to 0.5 mm.

All of the specimens from the Bowden marl seem to belong to this species, but they are very constant in having the characters only slightly developed, the usual separation of the chambers being barely indicated and the division, instead of being a deep-cut fissure, is merely a simple cut in the central part of the sutural region at either side. The specimens also are very small, but are uniform in size and in general characters. A number of specimens were obtained.

Pullenia obliqueloculata Parker and Jones.

Pullenia obliqueloculata Parker and Jones, Philos. Trans., vol. 155, p. 368, plate 19, figs. 4 *a*, *b*, 1865; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 618, plate 84, figs. 16 to 20, 1884; Flint, Rep. U. S. Nat. Mus., 1897, p. 324, plate 70, fig. 6 (1899); Cushman, Bull. 71, U. S. Nat. Mus., part 4, p. 22, plate 10, fig. 3; plate 12, figs. 2, 3, 1914.

This species is very rare in the marl from station 3461, gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan. It is a very rare species in the fossil state.

ROTALIIDÆ.

Discorbis orbicularis (Terquem).

Discorbina orbicularis (Terquem), H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 647, plate 98, figs. 4 to 8, 1884.

A single specimen was found in the material from Bluff 3, Cercado de Mao, Santo Domingo.

Discorbis saulcii (d'Orbigny).

Rosalina saulcii d'Orbigny, Foram. Amér. Mérid., p. 42, plate 2, figs. 9 to 11, 1839.
Discorbina saulcii Parker and Jones, Quart. Journ. Geol. Soc., vol. 28, p. 156, 1872; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 653, plate 91, figs. 6 *a* to *c*, 1884.

Most of the records for this species are from the Pacific. The specimens from station 3461, marl, gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan, are very similar to the published figures.

Discorbis allomorphinoides (Reuss).

Valvulina allomorphinoides Reuss, Sitz. Akad. Wiss. Wien, vol. 40, p. 223, plate 11, fig. 6, 1860.
Discorbina allomorphinoides H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 654, plate 91, figs. 5 and 8, 1884.

Several specimens from the Bowden marl, Bowden, Jamaica, are very close to Brady's figures, especially plate 91, figure 5 in the *Challenger* report, referred to above. Reuss's material was from the Cretaceous of Westphalia, and I am not at all satisfied that Brady was justified in referring the recent specimens from Torres Strait and the Philippines to Reuss's species. It seems more than likely that the Indo-Pacific recent specimens and those from the Miocene of the West Indies may be identical, as there are numerous other instances of West Indian Miocene species persisting in the living fauna of the Indo-Pacific.

Planorbulina retinaculata Parker and Jones.

Planorbulina retinaculata Parker and Jones, Phil. Trans., vol. 155, p. 380, plate 19, fig. 2, 1865.

A single specimen with irregularly placed chambers, very coarsely perforate, and with the peripheral spinose character of the type figure, was found at station 3461, marl from gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan. The type specimens were from the tropics.

Truncatulina lobatula (Walker and Jacob).

Truncatulina lobatula (Walker and Jacob), H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 660, plate 92, fig. 10; plate 93, figs. 1, 4, 5, 1884.

A single specimen was found in material from Bluff 3, Cercado de Mao, Santo Domingo. The later chambers are somewhat irregular, as is often the case in attached recent specimens. The species also occurs in the Miocene of South Carolina and Virginia.

Truncatulina haidingerii (d'Orbigny).

Rotalina haidingerii d'Orbigny, Foram. Foss. Bass. Tert. Vienne, p. 154, plate 8, figs. 7 to 9, 1846.

A single specimen from Bluff 2, Cercado de Mao, Santo Domingo.

Truncatulina præcincta (Karrer).

Rotalia præcincta Karrer, Sitz. Akad. Wiss. Wien., vol. 58, p. 189, plate 5, fig. 7, 1868; Seguenza, Atti. Accad. Lincei, ser. 3, vol. 6, pp. 56, 64, 1897.
Truncatulina præcincta H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 667, plate 95, figs. 1 to 3, 1884.

The following is a description of this species:

Test free, biconvex, dorsal side slightly, ventral side strongly, peripheral margin bluntly rounded, chambers numerous, sutures on dorsal side oblique,

ventrally slightly curved, line between the whorls clearly marked by a raised rounded ridge of clear shell material, sutures ventrally marked in a similar manner, strongest toward umbilicus, where they often unite in a raised ring; aperture elongate, in the middle of the ventral side next to the previous whorl.

Diameter about 1 mm.

Several specimens of this species were found in the Bowden material from Jamaica. It is a species which as a recent one is practically confined to tropical and subtropical regions. It was described by Karrer from the Miocene of the Banat region of Hungary and has been recorded from the Miocene and Pliocene of Italy by several authors.

Siphonina reticulata (Czjzek).

Rotalina reticulata Czjzek, Haidinger's Nat. Abh., vol. 2, p. 145, plate 13, figs. 7–9, 1848.
Siphonina reticulata Bronn, Lethæa Geognostica, ed. 3, vol. 3, p. 227, plate 35, figs. 23 *a* to *c*, 1853–1856; Cushman, Bull. 71, U. S. Nat. Mus., part 5, p. 43, fig. 48 (in text), plate 16, fig. 4, plate 28, fig. 3, 1915.
Truncatulina reticulata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 669, plate 96, figs. 5 to 8, 1884.

There are a few specimens referable to this species in the marl from station 3461, gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan. It was recorded from the Miocene, Gatun formation, at Monkey Hill, in the Panama Canal Zone.

Various forms or species are present in the Tertiary of America and need careful study and separation rather than the general lumping of all these under the one name of *S. reticulata*, as has been the usual procedure. The following species is very different and distinct.

Siphonina pulchra, new species.

(Plate 14, Figures 7 *a* to *c*.)

The following is a description of this species:

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 subacute 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 about 1 mm.

Type specimen from Cuba, station 3461, in marl from gorge of Yumurí River, near Matanzas.

This is a much larger species than the other of the same genus that occurs with it and here referred to *S. reticulata*. *S. pulchra* has no fimbriated periphery and practically no keel, which with its larger size and peculiar ornamentation will serve to distinguish it.

Conulites americana, new species.

The following is a description of this species:

Test conical, height about two-thirds the width at the base, apex broadly rounded, base slightly convex, peripheral angle subacute, the peripheral region standing out somewhat from the general conical mass of the rest of the test; early chambers spirally arranged, later ones annular, exterior of test in section tubular, central portion made up of irregularly curved chambers, more or less irregularly divided into labyrinthic subdivisions; surface fairly smooth.

Diameter at base slightly less than 2 mm.

Type specimen (U. S. N. M. No. 328179), section from station 6902, southeast section of southwest side of island near Nègre Point, elevation 360 feet, St. Bartholomew, Leeward Islands. Sectioned specimens were also observed in material from the following stations in Cuba: 3448, limestone from hillside south of Panupo manganese mine, La Maya, near Santiago, collected by T. W. Vaughan; 3478, Nuevitas, collected by A. C. Spencer; 7666, from Sierra Guaso, northeast of Guantánamo, collected by N. H. Darton.

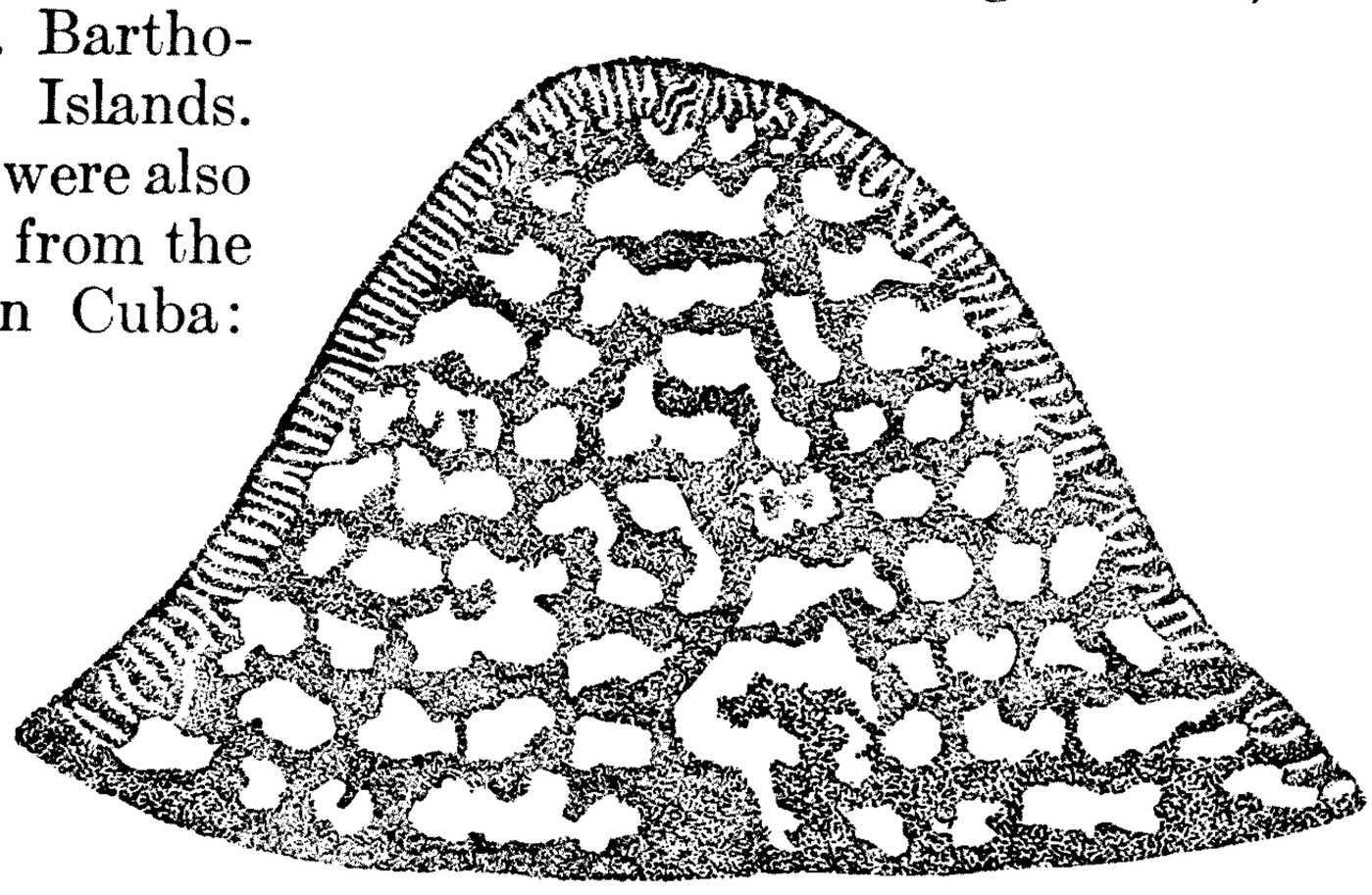

FIG. 3.—*Conulites americana*, new species. Vertical section showing coarser structure and outer layer with fine tubules. × 35. Specimen from station 6902, St. Bartholomew, Leeward Islands.

This is similar to the *C. ægyptiensis* Chapman from the Eocene of Egypt and Italy, but differs in its general proportions and in the flange-like extension of the peripheral border at the base.

Gypsina vesicularis (Parker and Jones).

Orbitolina vesicularis Parker and Jones, Ann. Mag. Nat. Hist., ser. 3, vol. 6, p. 31, No. 5, 1860.
Tinoporus vesicularis Carpenter, Introd. Foram., p. 224, plate 15, figs. 1 to 4, 1862; Parker and Jones, Ann. Soc. Mal. Belg., vol., 11, p. 98, 1876.
Gypsina vesicularis Carter, Ann. Mag. Nat. Hist., ser. 4, vol. 20, p. 173, 1877; H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 718, plate 101, figs. 9 to 12, 1884; Hill, Bull. Mus. Comp. Zoöl., vol. 34, p. 147, 1899.

Parker and Jones and also Hill record this species from the Bowden marl of Jamaica, but I have failed to find it in that I have examined. Parker and Jones mention a single specimen, 4.75 mm. in size.

Gypsina inhærens (Schultze).

Gypsina inhærens (Schultze) H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 718, plate 102, figs. 1 to 6, 1884.

Specimens which are evidently of this species were collected at three stations: several specimens at Bluff 3, Cercado de Mao; rare at Bluff 2, Cercado de Mao; and Zone H, Rio Cana, Santo Domingo.

Gypsina globulus (Reuss).

(Plate 4, Figure 7.)

Ceriopora globulus Reuss, Haidinger's Nat. Abh., vol. 2, 1847, p. 33, plate 5, fig. 7.
Gypsina globulus H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 717, plate 101, fig. 8, 1884.

In the material from U. S. G. S. No. 6966, southwest shore of Crocus Bay, Anguilla, occasional specimens occur which seem to belong to this species. A median section of a small specimen is shown here. There does not seem to be the definite radial arrangement of chambers that is usually the case in the fossil specimens of this species. I have the species in fossil condition from Santo Domingo. Two specimens were found at Bluff 2 and a single one at Bluff 3, Cercado de Mao.

Gypsina globulus (Reuss) var. pilaris (H. B. Brady).

(Plate 9, Figures 1, 2.)

Tinoporus pilaris H. B. Brady, Ann. Soc. Mal. Belg., vol. 11, p. 103, 1876.
Gypsina globulus Hill, Bull. Mus. Comp. Zoöl., vol. 34, p. 147, 1899.

The following is a description of this variety:

Test spherical, comparatively large, exterior appearing smooth, but when magnified showing an areolate surface due to the walls of the chambers; wall calcareous, perforate; chambers in radial columns increasing in diameter from the center to the periphery.

Diameter up to 4 mm. or more.

Brady described this variety as a species of *Tinoporus* from the Miocene of Jamaica. It is probably the most conspicuous species and is very abundant in the Bowden material. The variety differs from typical *G. globulus* mainly in size, the typical having a much smaller test. Plate 9, figure 2, gives a general idea of the internal structure of the test.

There are specimens from station 3446, first deep cutting on railroad east of La Cruz, near Santiago, Cuba, collected by T. W. Vaughan, which in size, shape, and general characters seem very close to this variety. The internal structure, as far as it is preserved, seems also to be identical with the Bowden material. The geologic occurrence of these specimens is in the Miocene La Cruz marl.

Gypsina species.

Sectioned specimens from 3 stations in Cuba showed what seem to be sections of *Gypsina*. They are associated in each case with *Lepidocyclina* and *Carpenteria*. The stations are 7513, outcrops where Palmer Trail joins Ocujal Trail; 7521, limestone in place, top of Mogote Peak; and 7522, also Mogote Peak; collected by O. E. Meinzer.

Pulvinulina sagra (d'Orbigny).

Rotalina sagra d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 77, plate 5, figs. 13 to 15, 1839.

Specimens from the Bowden marl, Bowden, Jamaica, and from station 3461, marl from the gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan, seem to be identical with the species

described by d'Orbigny from Cuba in 1839. The exact proportions and relations of the chambers that are shown in d'Orbigny's figures are found in the fossil specimens. The species is known from the Miocene of Florida and Virginia, and probably occurs in Panama as well. It is a common species in the Indo-Pacific.

Rotalia species.

(Plate 8, Figure 6.)

A small, close-coiled, rotaliform species with numerous chambers in each volution occurs at a number of the Cuban stations, as follows: 7512, Ocujal; 7513, orbitoidal limestone, outcrop where Palmer Trail joins Ocujal Trail; 7516, west end, Los Melones Mountain; 7519, from drift near top of landslide next north of Los Melones; and 7543, limestone outcrop, east side of Yateras; all collected by O. E. Meinzer.

Asterigerina carinata d'Orbigny.

Asterigerina carinata d'Orbigny, in De la Sagra, Hist, Fis. Pol. Nat. Cuba, 1839, "Foraminifères," p. 118, plate 5, fig. 25, plate 6, figs. 1, 2.

A very typical specimen came from Bluff 2, Cercado de Mao, Santo Domingo.

Asterigerina angulata, new species.

(Plate 13, Figure 1.)

The following is a description of this species:

Test free, rotaliform, dorsal side very slightly convex, ventral side high, acutely angled at the peripheral edge but not carinate; last-formed whorl with typically about 15 chambers; sutures on the dorsal side obliquely recurved, of clearer material than the chamber walls, occasionally with a slight bead-like enlargement on the inner border, earlier whorls slightly exposed and the umbonate region with a transparent clear area; ventral side with the sutures ending in an angle about midway between the center and the periphery, from which a secondary chamber is developed to the umbilical region, alternating with the main chambers; umbilical region solid, of clearer shell material; aperture rather long and narrow at the inner margin of the ventral face; surface granular or slightly papillate, especially about the aperture.

Average diameter 1.5 to 2 mm.

Specimens of *Asterigerina angulata* are frequent or abundant at the four stations—Zones H and I, Rio Cana, and Bluffs 2 and 3, Cercado de Mao, Santo Domingo.

It is thicker species than *A. carinata* d'Orbigny; and it has an acute but not carinate angle and nearly double the number of chambers.

Asterigerina rotundata, new species.

(Plate 13, Figure 2.)

The following is a description of this species:

Test free, rotaliform, biconvex, dorsal side less convex than the ventral, peripheral angle broadly rounded; last-formed coil with 15 to 18 chambers; sutures on the dorsal side gently recurved, slightly limbate, earlier whorls exposed and forming nearly half the width of the dorsal side of the test

ventral side with the sutures very similar to those of *A. angulata*; the umbilicate region solid, with clearer shell material; surface of test granular throughout, opaque, causing the sutures on both sides to be indistinct; aperture ventral, elongate.

Diameter, 1 to 1.25 mm.

This species was found in considerable numbers at Zone G, Rio Gurabo, Santo Domingo. It differs from *A. angulata* in its rounded periphery, granular, opaque surface, broadly rounded ventral side, and inconspicuous sutures.

Asterigerina tuberculata, new species.

(Plate 13, Figures 3, 4.)

The following is a description of this species:

Test free, rotaliform, biconvex, becoming truncate and short cylindical, peripheral angle in young subangular, becoming rounded in the adult, outline regular in the early stages, in the adult becoming lobed, especially in the last few chambers; dorsal surface rather flat, slightly convex, conspicuously pitted or scrobiculate, last-formed coil narrow, making only the extreme peripheral portion in the adult on the dorsal side; ventral side with large tubercles or knobs developed near the peripheral border, remainder of surface with coarse granulations; in some specimens the height of the test equals its diameter and the ventral and dorsal sides are nearly parallel; the periphery high and flattened to make a short cylindical test; sutures as typical in the genus; aperture ventral, narrow.

Diameter up to 2 mm.

Specimens were obtained from Zone I, Rio Cana, and a single one from Zone 3, Cercado de Mao, Santo Domingo.

This is a peculiarly ornamented and shaped species, the change in outline during development being very marked, as is the very strongly tuberculate ornamentation.

Carpenteria americana, new species.

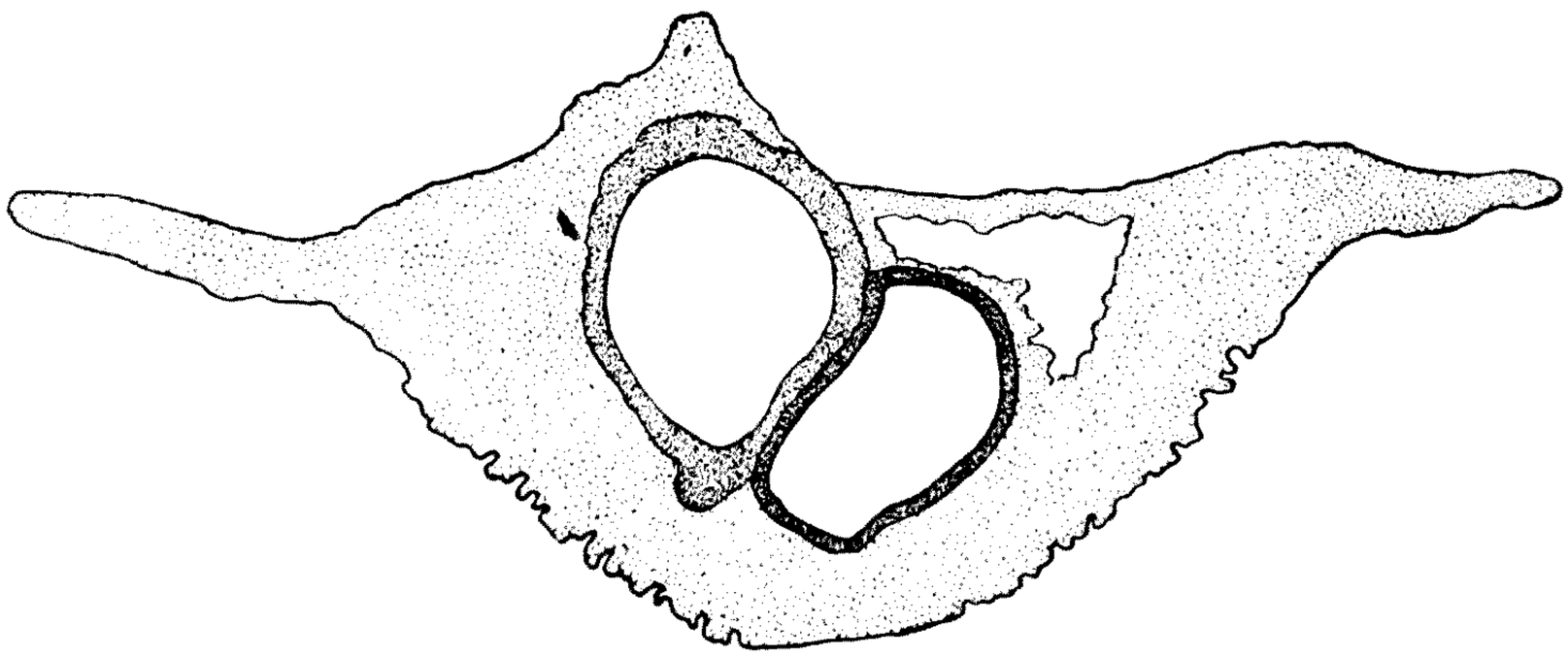

FIG. 4.—*Carpenteria americana* new species. Transverse section of a specimen showing deeply-pitted surface of shell tissue surrounding chambers. × 35. From station 7518, south side, near west end, Los Melones Mountain, Cuba.

The following is a description of this species:

Test attached, composed of several subglobular chambers forming an rregular *Globigerina*-like mass, the base conforming to the object to which

it is attached, the rest of the test in an irregular rounded mass; chambers rounded, thick-walled, with numerous coarse, tubular perforations.

Diameter 2 to 3 mm.

Distribution.—Specimens referable to this species occurred in the sectioned material from the following stations in Cuba: 7513, outcrops where Palmer Trail joins Ocujal Trail; 7518, south side near west end, Los Melones Mountain; 7521, limestone in place, Mogote Peak; 7522, also Mogote Peak, collected by O. E. Meinzer; and at 7664, north slope La Piedra, northeast of Jamaica, northeast of Guantánamo, collected by N. H. Darton.

Carpenteria proteus, new species.

(Plate 5, Figure 3.)

The following is a description of this species:

Test composed of a few subglobular chambers, the smaller end attached, the later chambers larger and extending upward, forming a roughly club-shaped column, walls thick but rather finely perforate, the exterior comparatively smooth.

Length 2 to 3 mm.

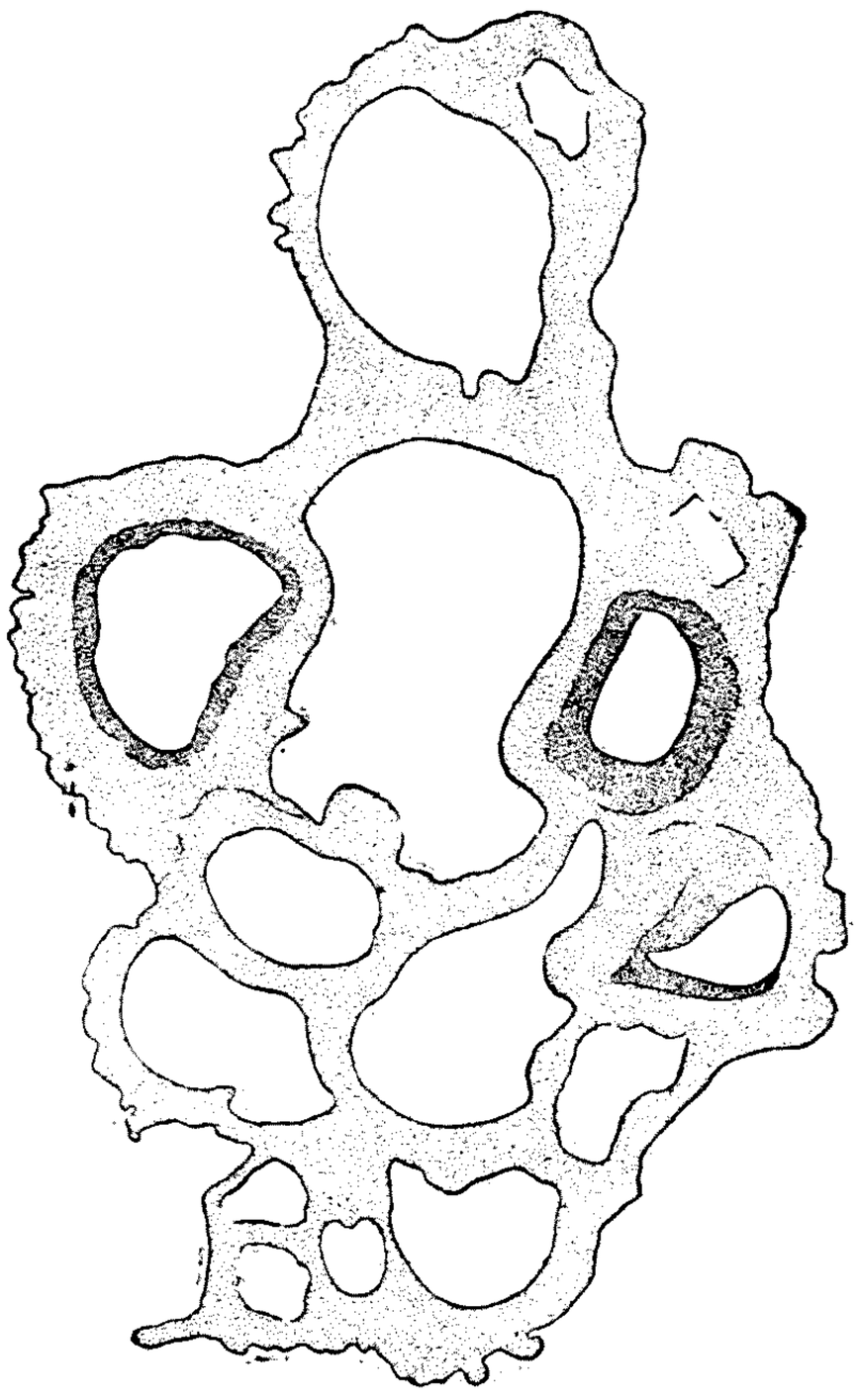

FIG. 5.—*Carpenteria americana*, new sp. A longitudinal section through a well-developed specimen, longest part of figure representing basal portion of specimen. × 50. From station 7513, limestone outcrop where Palmer Trail joins Ocujal Trail. Cuba.

Type specimen (U. S. N. M. No. 328180), section from station 6921, Governor's Bay, point between the bay and Grand or Nègre Point, St. Bartholomew, collected by T. W. Vaughan. It was also collected at 6924, from bed of limestone on point on northwest side of St. Jean Bay, St. Bartholomew, and 6895, spur on southeast side of cay northwest of St. Jean Bay, 170 feet above sea-level, both collected by T. W. Vaughan. In the last two stations it occurs in association with *Orthophragmina*. A similar form occurs in Cuba, station 7666, from Sierra Guaso, northeast of Guantánamo, collected by N. H. Darton, again in association with *Orthophragmina*. It is also very similar to a specimen obtained at station 6512, Panama, limestone in river-bed at David, which specimen is also associated with *Orthophragmina*.

Linderina species.

(Plate 8, Figures 7 and 8.)

A few sectioned specimens which seem to represent Foraminifera belonging to this genus occur in association with *Conulites americana*

at the three stations in Cuba, as follows: Station 3448, limestone from hillside south of Panupo manganese mine, La Maya, near Santiago, collected by T. W. Vaughan; 3478, Nuevitas, collected by A. C. Spencer; and 7666, Sierra Guaso, northeast of Guantánamo, collected by N. H. Darton. It was also obtained at station 6125, railroad cut near San Nicolas manganese mine, west of San Luis, by C. W. Hayes. The two figured specimens give only a somewhat general idea of the sections.

At each of the three stations there is an association of *Linderina?*, *Conulites*, and *Orthophragmina*, three genera usually associated with the Eocene. *Linderina* is, so far as known, an Eocene genus, recorded from England and Belgium, from Celebes, Borneo, and the Loo Choo Islands.

A somewhat similar form occurs at station 6512, Panama, river-bed at David.

NUMMULITIDÆ.

Nonionina grateloupi d'Orbigny.

Nonionina grateloupi d'Orbigny, Ann. Sci. Nat., vol. 7, p. 294, 1826; in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 46, plate 6, figs. 6, 7, 1839.

Specimens identical with d'Orbigny's figures were found in the Cuban material, station 3461, marl, gorge of Yumurí River, Matanzas, collected by T. W. Vaughan, and a single specimen in Doctor Maury's material from Santo Domingo, Bluff 3, Cercado de Mao.

Nonionina sloani d'Orbigny.

Nonionina sloani d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 46, plate 6, fig. 18, 1839.

This species was found in the Cuban material, station 3461, marl, gorge of Yumurí River, Matanzas, collected by T. W. Vaughan, and a single specimen in Doctor Maury's material from Bluff 2, Cercado de Mao, Santo Domingo.

Nonionina species cf. N. asterizans (Fichtel and Moll).

Nautilus asterizans Fichtel and Moll, Test. Micr., p. 37, plate 3, figs. *e* to *h*, 1803.
Pulvinulus asterizans Lamarck, Tab. Encycl. et Méthod., plate 23, plate 466, figs. 10 *a* to *d*, 1816.
Nonionina asterizans Parker and Jones, Ann. Mag. Nat. Hist., ser. 2, vol. 19, p. 287, plate 11, figs. 20, 21, 1857.

A specimen from station 3461, marl from gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan, has many of the characters of this species, but differs in the smaller amount of the umbilical projections and rounder outline from the published figures. It is referred here provisionally.

Nonionina species.

(Plate 5, Figure 11; Plate 8, Figure 5.)

Occasional specimens occur in the sections as shown in the figure, apparently sections of a small species of *Nonionina*. The specimen illustrated by plate 5, fig. 11, is from Anguilla, U.S.G.S. No. 6894,

southwest side of Crocus Bay. Sections, plate 8, fig. 5, which also seem to be *Nonionina* occur in the material from station 6117 from the band of limestone, hill east of railroad and south of Cristo, near Santiago, C. W. Hayes, collector.

Polystomella sagra (d'Orbigny).

Rotalina sagra d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 77, plate 5, figs. 13 to 15, 1839.

A single specimen very exactly fitting the figure given by d'Orbigny was obtained in material from Bluff 2, Cercado de Mao, Santo Domingo. It was also found in the marl from station 3461, gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan. It was also found in the Miocene material from Panama Canal Zone.

Polystomella lanieri d'Orbigny.

Polystomella lanieri d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 54, plate 7, figs. 12, 13, 1839.

Specimens showing very little variation and almost precisely like the figure given by d'Orbigny occur in both Zones H and I, Rio Cana, and Bluffs 2 and 3, Cercado de Mao, Santo Domingo. Brady, in the *Challenger* Report, places this species as a synonym of *Polystomella crispa* Linné, but these fossil specimens are very different from the typical *P. crispa* and are exactly like the figure of *P. lanieri* given by d'Orbigny. In fact, most of our specimens might have been taken for the illustration, so close are the essential details. It certainly seems that this is a valid species and one common in the Tertiary and perhaps the recent seas of the West Indies.

Very typical material was also obtained at station 3461, marl from gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan.

Polystomella striatopunctata (Fichtel and Moll).

Polystomella striatopunctata (Fichtel and Moll), H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 733, plate 109, figs. 22, 23, 1884.

Two specimens, rather more compressed and rounded in side view than usual, are here assigned to this rather overworked species. It has become the habit to place under this species almost any *Polystomella* which has short and simple depressions close to the suture. The specimens are from Bluff 3, Cercado de Mao, Santo Domingo.

Heterostegina antillea, new species.

(Plate 2, Figure 1, *b*; Plate 5, Figures 1, 2.)

The following is a description of this species:

Test compressed, unequally lenticular, umbo excentric, somewhat thicker than the remainder of the test, surface over the septal lines slightly raised in a series of somewhat papillate ribs, area between granular; chambers regularly curved, divided into numerous chamberlets.

Diameter up to 6 mm. or more.

Type specimens from U. S. G. S. No. 6869, Long Island, Antigua. The vertical sections, plate 5, figure 1, which are probably the same

species are from U. S. G. S. No. 6854, Rifle Butts, Antigua, and the horizontal section, plate 5, figure 2, from the same station. At this latter station the specimens are very numerous, making up a large proportion of the rock.

It may be noted here that the material under No. 6854 is of two kinds, as some of the hand specimens are made up almost entirely of *Heterostegina* and are of a slightly pinkish tinge, while others are white and are made up almost entirely of *Lepidocyclina*.

Heterosteginoides antillea, new species.

(Plate 5, Figures 5, 6.)

The following is a description of this species:

Test small, irregularly lenticular, surface somewhat papillate, in vertical section the central line of chambers slightly irregular, the lateral chambers piled in vertical rows in some specimens, in others variously placed.

Diameter 2 to 3 mm. or more.

Type specimens (U. S. N. M. No. 328181) from U. S. G. S. No. 6965, lowest 10 to 15 feet of fossiliferous marls, southwest shore of Crocus Bay, Anguilla. At this station the species is very abundant, making up a large part of the rock. Specimens also are numerous at 6966, same locality, 30 to 50 feet above sea-level, and at 6894, Anguilla.

This is more regular than its relative, *H. panamensis* Cushman, from the Canal Zone, although the figured specimen, plate 5, figure 6, is more than usually regular.

Amphistegina lessonii d'Orbigny.

(Plate 7, Figure 7.)

In the Bowden marl there are two distinct forms, possibly species, of *Amphistegina*. One of these is large, about 3 mm. in diameter, thick, the lower side very granular, the sutures very obscure. The other is about half the diameter, flatter, both sides fairly smooth, a few granules about the aperture, the sutures very distinct. Both these forms are abundant in the Bowden marl of Jamaica.

Amphistegina lessonii d'Orbigny, variety.

Specimens of a very thin, biconvex form of this species, with the last-formed whorl making the entire surface of the test, that is completely involute, occur abundantly at Zone A, Rio Gurabo, Santo Domingo.

Amphistegina lessonii d'Orbigny, evolute variety.

A large evolute variety of *Amphistegina* is common at Zone I, Rio Cana, and both Bluffs 2 and 3, Cercado de Mao, Santo Domingo.

The status of the various species or varieties of *Amphistegina* is very unsatisfactory. They form a very common constituent of our Tertiary deposits and are often very decided and constant in their characters, especially in fossil material.

Nummulities antillea, new species.

(Plate 4, Figures 1, 2.)

The following is a description of this species:

Test large, much compressed, only partially involute, the last coil broad and thin, surface with the suture lines raised, evenly curved, with a trace of papillate ornamentation along the ribs, peripheral margin somewhat thickened and rounded.

Diameter 15 to 18 mm. or more.

Type specimens (U. S. N. M. No. 328182) from U. S. G. S. station 6924, from bed of limestone at top of described section, point on northwest side of St. Jean Bay, St. Bartholomew, collected by T. W. Vaughan. At this station specimens are abundant. The sectioned specimen, plate 4, figure 2, which seems to represent a young or the central portion of this species, is from U. S. G. S. No. 6895, spur on southwest side of cay northwest of St. Jean Bay, St. Bartholomew, 170 feet above sea-level. It may be noted that *Orthophragmina* occurs at both of these stations, although not the same species. A few of the equatorial chambers of *Orthophragmina*, probably *O. antillea*, may be noted in the upper right-hand corner of figure 2.

This seems to be one of the larger of our American species of *Nummulites*.

Nummulites parvula, new species.

(Plate 4, Figures 3 to 6.)

The following is a description of this species:

Test small, closely involute, increase in breadth of test slight with each coil, sutures simple, slightly curved, test rather evenly lenticular, biconvex, chambers thick-walled, usually consisting of 4 or 5 coils.

Diameter up to 4 mm.

Type specimen (U. S. N. M. No. 328183) from U. S. G. S. station 6903, 220 feet above sea-level, N. 67° E. from summit of Négre Point, across low saddleback of point, St. Bartholomew. The vertical sections may not represent this species, although they are very similar, but somewhat smaller. They are all from St. Bartholomew; plate 4, figures 4, 5, from U. S. G. S. No. 6924, from bed of limestone top of section, point on northwest side of St. Jean Bay; figure 6 from 6921, point between Governor's Bay and Nigre Point.

Nummulites species.

In the Cuban material species of *Nummulites* occasionally occur, but are abundant at only one station. From station 3567, lowermost 100 feet of Tertiary running in above serpentine, northwest of Recreo, Matanzas Province, Cuba, collected by A. C. Spencer, *Nummulites* is very common, but the species have not been identified. This abundance with accompanying species of *Orthophragmina* and absence of *Lepidocyclina* would seem strongly to indicate the Eocene age of this particular material.

Orthophragmina cubensis, new species.

(Plate 9, Figure 3; Plate 10, Figures 2 to 4.)

The following is a description of this species:

Test small, lenticular, circular, comparatively thick, thickness in the center greatest, about three-fifths the diameter, circular, gradually thinning toward the periphery, but without a definite border, periphery rounded; surface with numerous rather large papillæ in the center, gradually growing smaller toward the periphery.

Vertical sections showing the general shape of the test, which, due to the straightness of the slope from center to periphery, makes almost a diamond-shaped vertical section; pillars of the center very heavy, thick, increasing rapidly in diameter toward the surface, the peripheral ends projecting above the adjacent lateral chambers; equatorial chambers of the same height, the band hardly increasing in diameter from center to periphery, very small; lateral chambers in vertical columns, up to 20 or more in a column in the thickest central portion, the individual chambers at least 4 or 5 times as wide as high in section.

Horizontal sections show the rectangular chambers of the equatorial region several times as long as wide, the lateral chambers forming an irregular network about the sections of the pillars, often several columns of vertical chambers between the pillars.

Diameter 1.5 to 3.5 mm.

Type specimens (U.S.N.M. No. 328184) from station 3475, Boston mine, near Santiago, Cuba, collected by A. C. Spencer.

This seems to be a common Cuban species, occurring in material from several stations, as follows: 6117, boulder from the band of limestone, hill east of railroad and south of Cristo, near Santiago, Cuba, collected by C. W. Hayes, April 1901; 6118, limestone near railroad on trail to mines south of Cristo, collected by C. W. Hayes; 6119, Isabella and Boston manganese mine near Santiago, Cuba, collected by C. W. Hayes; 6120, loose material, Santiago Province, Cuba, exact locality unknown; 6122, greensand limestone, Boston manganese mine, 3 miles east of Cristo, Santiago Province, Cuba, collected by A. C. Spencer; 6123, resting on ore-bed 4 to 6 feet thick, Ponupo manganese mine, Santiago Province, Cuba, collected by A. C. Spencer; 6124, foraminiferal limestone, Ponupo manganese mine, Ponupo, Santiago Province, Cuba, collected by R. T. Hill; 6125, railroad cut near San Nicolas manganese mine, west of San Luis, Santiago Province, Cuba, collected by C. W. Hayes; 3448, limestone from hillside south of Ponupo manganese mine, La Maya, near Santiago, Cuba, collected by T. W. Vaughan; 7666, from Sierra Guaso, northeast of Guantánamo, Cuba, collected by N. H. Darton, 1916.

The embryonic chambers of this species, so far as seen, are unequal in size and comparable to those seen in the subgenus *Nephrolepidina* of *Lepidocyclina*, the larger one kidney-shaped and partially embracing the smaller.

In its general characters this species suggests *O. douvillei* Schlumberger, but differs in several essential details.

Orthophragmina crassa, new species.

(Plate 9, Figures 4 and 5; Plate 10, Figures 2 and 4.)

The following is a description of this species:

Test circular, lenticular, very thick in comparison to the diameter, central portion broadly convex, thence straight or even slightly concave to the rather acute periphery; surface fairly smooth, with a few raised ends of pillars making the surface slightly papillate.

Vertical section shows the general shape, in some specimens at least two-thirds as thick as the diameter, central portion broadly rounded, with numerous large pillars, increasing in diameter toward the surface, lateral chambers very numerous, about three times as wide as high, usually at least 2 columns between each two adjacent pillars even in the center; over 30 chambers in the center in some of the columns are indicated; equatorial chambers increasing very slowly in height toward the periphery, but more rapidly than in most species, so that the equatorial band at the periphery may be double the width near the center; embryonic chamber comparatively large, elongate in this section.

Horizontal section shows the usual elongate, rectangular equatorial chambers; the pillars subpolygonal, largest in the center, thence smaller toward the periphery, intermediate lateral chambers irregularly polygonal.

Diameter 3.5 to 5.5 mm.

Type specimen (U.S.N.M. No. 328185) from station 6122, greensand limestone, Boston manganese mine, Santiago Province, Cuba, collected by A. C. Spencer. The species also appears to be present at the following stations: 6123, Ponupo manganese mine, resting on ore-bed 4 to 6 feet thick, Santiago Province, Cuba, collected by A. C. Spencer; 6124, foraminiferal limestone, Ponupo manganese mine, collected by R. T. Hill; 6125, railroad cut near San Nicolas manganese mine, west of San Luis, Cuba, collected by C. W. Hayes; 6118, fossil limestone near railroad, on trail to mines south of Cristo, and 6119, Isabella and Boston manganese mine, Cuba, collected by C. W. Hayes; 3475, Boston mine, near Santiago, Cuba, collected by A. C. Spencer; and apparently from 6117, bowlder from the band of limestone, hill east of railroad and south of Cristo, near Santiago, Cuba, collected by C. W. Hayes.

Orthophragmina subtaramellei, new species.

(Plate 10, Figure 2; Plate 15, Figures 1 to 3.)

The following is a description of this species:

Test stellate, usually with 5 arms, occasionally 6, arms well distinguished from the central body and extending outward freely; thickest in the central region, thence gradually sloping to the angles between the arms, and gradually merging into the median axis of the arms; the arms themselves thickest in the middle, thence sloping to the sides, which are thin and angled, ends of the arms round-pointed; surface with numerous granulations, more pronounced in the central portion.

Vertical sections show the general shape, the equatorial band of chambers increasing slightly if at all from the center to the periphery, pillars well developed, especially in the central region, but not numerous, usually several columns of lateral chambers between them.

Diameter 1.5 to 2 mm.

Type specimen (U. S. N. M. No. 328186) from Boston manganese mine, Santiago Province, Cuba. Besides the type station, according to the sections obtained, the species evidently also occurs at the following stations: 6119, Isabella and Boston manganese mine, Santiago Province, Cuba, collected by C. W. Hayes; 6123, Ponupo manganese mine, Santiago Province, Cuba, resting or ore-bed 4 to 6 feet thick, collected by A. C. Spencer; 6124, foraminiferal limestone, Ponupo manganese mine, collected by T. R. Hill; 6125, railroad cut near San Nicolas manganese mine, west of San Luis, Cuba, collected by C. W. Hayes; 3475, Boston mine, near Santiago, Cuba, collected by A. C. Spencer; 7666, from Sierra Guaso, northeast of Guantánamo, Cuba, collected by N. H. Darton.

This species is very close to *O. taramellei* Munier-Chalmas, but is decidedly smaller, all the species seen from Cuba being less than 2 mm. in diameter between the tips of the arms.

The specimens from station 6120 are weathered out and are numerous, greenish in color.

O. taramellei was described from Villa Lady Bruce (Biarritz); Monte Spilecco (Vicentin); Schönegg, near Kressenburg.

Orthophragmina sculpturata, new species.

. (Plate 9, Figures 8, 9.)

The following is a description of this species:

Test circular, somewhat sellæform, often very slightly so; central portion considerably thickened and occupying one-third to one-fourth the diameter of the test; peripheral portion much flattened and comparatively thin; exterior of central thickened portion, when well preserved, beautifully sculptured, with comparatively few raised papillæ, between which the surface is depressed and reticulated as in *O. marthæ* Schlumberger; peripheral thin portion of the test usually smooth when the surface is well preserved.

Vertical sections show thickening up to 1.5 mm. in the central portion, while the periphery is often but 0.25 mm. in thickness. Equatorial chambers small, increasing hardly at all in diameter from the center to the periphery, central embryonic chambers not well shown in the sections, but at least 6 to 8 times the diameter of adjacent equatorial chambers. Peripheral portion without pillars, central portion with very strong pillars, thick, with a diameter one-third to one-half their length and increasing very slightly in diameter toward the surface; lateral chambers in columns between the pillars very thin compared to their breadth. Central portion of the outline decidedly undulate from the projecting ends of the pillars.

Horizontal sections show very numerous equatorial chambers, elongate, several times as long as broad; lateral chambers in section appearing as polygonal lighter spaces surrounding in a single row the solid, opaque, circular, elliptical, or irregularly polygonal pillar sections, toward the periphery, where the pillars are wanting, forming an irregular network somewhat similar to the arrangement in *O. dispansa* Sowerby (Bull. Soc. Geol. France, ser. 4, vol. 3, plate 12, fig. 51).

Diameter 5 to 7 mm.

Type specimen (U. S. N. M. No. 328187) from Nuevitas, Cuba, collected by A. C. Spencer.

This species in general appearance resembles *O. marthæ* Schlumberger, especially in its characteristic surface ornamentation, but the vertical section seems to be very different from that figured by Schlumberger.

Orthophragmina pustulata, new species.

(Plate 9, Figures 6, 7; Plate 10, Figure 1.)

The following is a description of this species:

Test circular, lenticular, thickest in the middle, thence gradually thinning toward the periphery, which is without a carina or thinner portion, thickness about one-fifth the diameter; surface finely pustulose, papillæ larger and more numerous near the central region, thence gradually decreasing in size and number toward the periphery.

Vertical section shows the general form, equatorial band very thin, increasing hardly at all toward the periphery, pillars numerous, somewhat thickened toward the surface.

Horizontal section shows equatorial chambers elongate, rectangular, length about three times the breadth, annuli irregular in width, pillars irregularly rounded, remote, largest in center, decreasing gradually in size toward the periphery, intermediate space filled with the irregularly polygonal lateral chambers.

Diameter 3.5 to 5 mm.

Type specimen (U. S. N. M. No. 328188), section from station 3567, lowermost 100 feet of Tertiary running in above serpentine, northwest of Recreo, Matanzas Province, Cuba, collected by A. C. Spencer. Specimens, also apparently of this species, were obtained at station 3448, limestone from hillside south of Ponupo manganese mine, La Maya, near Santiago, Cuba, collected by T. W. Vaughan.

This is a larger, flatter species than *O. cubensis* and is easily distinguished in the sections.

Orthophragmina antillea, new species.

(Plate 1, Figure 1; Plate 2, Figures 2 and 3; Plate 4, Figures 2 and 4.)

The following is a description of this species:

Test flattened, octagonal, surface with 8 raised ribs radiating from the central, somewhat raised umbo to the periphery, triangular areas between thin and flattened; umbonal area raised and rounded, with definite pillars appearing as differences in coloration in the type, radial ribs with numerous raised areas and pillars scattered along their whole length; diameter about 12 mm.

Vertical sections show the greater diameter of the equatorial chambers at irregular intervals and the irregular, almost serrate character of the dorsal and ventral surfaces due to the fine projections of the surface, especially along the ribs.

Horizontal sections through the equatorial chambers were obtained only in small fragmentary bits, but enough to show the typical rectangular chambers of the genus.

Type specimen (U. S. N. M. No. 328189) from St. Bartholomew, Leeward Islands, U. S. G. S. No. 6895, spur on southeast side of cay northwest of St. Jean Bay, 170 feet above sea-level; T. W. Vaughan collector.

Specimens are very numerous in this material; but a single specimen was obtained showing the surface conditions with the radiating ribs.

Although it is specifically different, this species is closely related to *Orthophragmina mariannensis* Cushman, from Marianna, Florida.

There appear to be from 5 to 8 layers of superimposed chambers at each side of the horizontal zone of chambers as shown in the sections. A few of the smallest specimens show the proloculum, but it is not well developed or not sufficiently well preserved to make out its characters clearly. The sections given on plate 2, figures 2 and 3, show the general characters of the vertical section.

Occasional oblique sections show the rectangular equatorial chambers characteristic of *Orthophragmina*.

This is the specimen mentioned by Vaughan as "*Orbitoides* sp., large, stellate form" (Vaughan, T. Wayland, Carnegie Inst. Wash. Year Book No. 13, p. 359, 1914).

Orthophragmina marginata, new species.

(Plate 1, Figure 2; Plate 2, Figure 4.)

The following is a description of this species:

Test lenticular, circular, central portion strongly raised and umbonate, regularly curved down to the broad peripheral flange, which is again thickened near the peripheral margin; surface comparatively smooth, very slightly granular, but not at all papillate.

In vertical section the central portion is seen to be strongly biconvex, but not much wider than either part of the surrounding margin-like thinner portion, again thickening toward the extreme peripheral margin, which is rounded.

Equatorial chambers small, in the center very narrow but increasing slightly but gradually toward the periphery, where they are not more than 0.1 mm. in height. The chambers are convex on the peripheral side, almost semicircular in some specimens. Lateral chambers very small and often difficult to distinguish, even with an enlargement of 20 diameters (plate 2, fig. 4). In the central portion there are many layers of these lateral chambers, often 30 to 40 layers on either side of the equatorial band. This number decreases as the convexity becomes less, and over the flattened margin there are but 6 to 8 layers of lateral chambers. At the border this number is somewhat increased, but falls off again at the extreme outer margin. There are traces of pillars in the central umbonate region, but they are not prominent.

Diameter of the type specimen 12 to 14 mm.

Type specimen (U. S. N. M. No. 328190) from St. Bartholomew, Leeward Islands; U. S. G. S. No. 6924, from a bed of limestone on point on the northwest side of St. Jean Bay; T. Wayland Vaughan collector.

Lepidocyclina canellei Lemoine and Douvillé var. yurnagunensis, new variety.

(Plate 12, Figures 7, 8.)

The following is a description of this variety:

Test differing from the typical form of the species mainly in the form of the lateral chambers, which are somewhat broader, and with the upper wall decidedly arched; embryonic chambers either two, subequal or very unequal, or several, the equatorial chambers hexagonal or obscurely diamond-shaped.

Type material from U. S. G. S. station 7348, from flexure 2 miles south of Yurnaguna, Cuba, collected by O. E. Meinzer.

At this station the material is largely composed of this species, as the section (plate 12, fig. 8) shows. None of these sections happens to be exactly vertical. The variety shows the embryonic characters of all three of Douvillé's subgenera: equal chambers, as in the type from Panama (*Isolepidina*); unequal, one small, the other partially encircling and kidney-shaped (*Nephrolepidina*); and with two irregular large embryonic chambers and two or more small ones (*Pliolepidina*). The latter condition is shown in plate 12, figure 7.

In gross appearance, color, and general characters this material very strikingly resembles that from Bohio, Panama, the type locality for *L. canellei*.

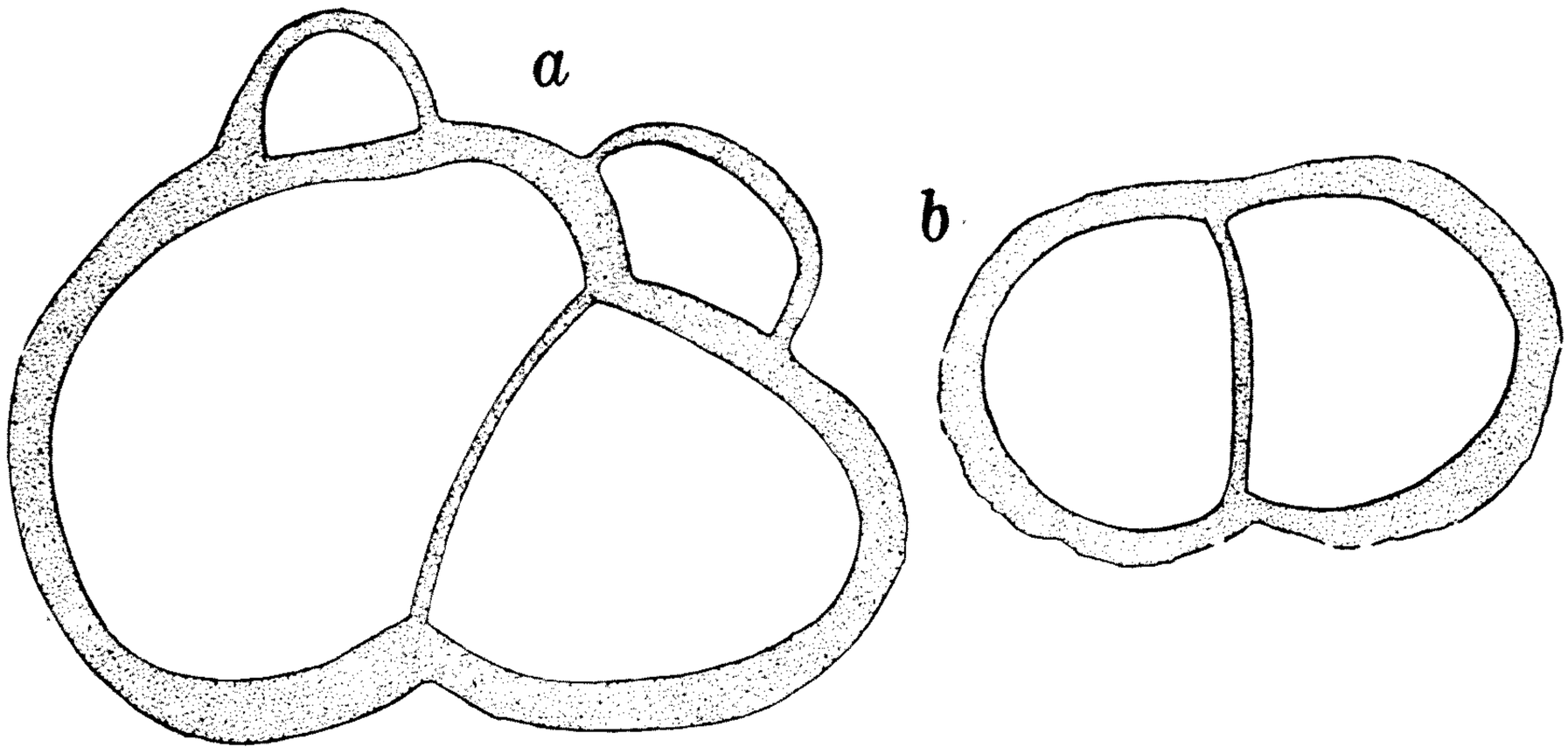

FIG. 6.—*Lepidocyclina canellei* Lemoine and R. Douvillé var. *yurnagunensis*, new variety. × 50. *a*, embryonic chambers, several in number and irregular in size (*Pliolepidina*). *b*, showing embryonic chambers of a specimen where these chambers are equal in size (*Isolepidina*). Specimens from station 7548, 2 miles south of Yurnaguna, Cuba.

Lepidocyclina schlumbergeri Lemoine and R. Douvillé.

Lepidocyclina schlumbergeri Lemoine and R. Douvillé, Soc. géol. France, Paléont., vol. 12, Mém. 32, p. 14, plate 1, fig. 10; plate 2, fig. 6; 1904.

The following is a description of this species:

Test large, compressed, lenticular, thickest in the central region, from which it gradually thins out toward the periphery, somewhat flexuous and slightly saddle-shaped; surface fairly smooth or somewhat finely granular, the granules

representing the ends of the small pillars; surface often uneven, due to the raised peripheral walls of the lateral chambers.

Vertical section shows the general shape, thin, gently curving from the center to the periphery, slightly curved; the pillars numerous and comparatively small, a very few larger pillars in the central region, vertical columns of lateral chambers with numerous low, flattened chambers making up each column.

Horizontal section shows hexagonal chambers, but more numerous equatorial ones with the outer wall convexly curved, walls rather thick.

Diameter 25 to 35 mm.

Lemoine and Douvillé regard this as a mutation of *L. dilatata*. They record this species, especially from Spain at four localities in Andalusia, at Baèna, and Pont du Guadalquiver (Puente Viejo), and at Sella and Peñaguila, province of Alicante, stages not given. It was collected by O. E. Meinzer in Cuba at the following stations: 7512, Ocujal; 7518, south side near west end, Los Melones Mountain; 7522, Mogote Peak; 7543, limestone outcrop, east side of Yateras; and by N. H. Darton at 7664, north slope of La Piedra, northeast of Jamaica, northeast of Guantánamo.

Lepidocyclina parvula, new species.

(Plate 3, Figures 4 to 7.)

The following is a description of this species:

Test lenticular, circular, central region thickened, gradually diminishing in breadth toward the periphery, which has a thin flange-like border, surface fairly smooth.

Vertical section showing the general form of the species; equatorial chambers gradually increasing in size toward the periphery, where they may be 4 to 5 times as high as long; outer surface slightly convex, chambers of the central region in section nearly square; lateral chambers 8 to 10 in a vertical column in the central region, and thence gradually diminishing in number until near the periphery there may be but a single layer of the lateral chambers, central portion with definite pillars, largely confined to this region.

Horizontal section shows the usual form of the equatorial chambers for this genus, the embryonic chambers either subequal or with one slightly larger than the other. In the section illustrated on plate 3, figure 4, a peculiar condition of these chambers is shown, where the two embryonic chambers have a series of chambers, apparently coiled about them. This is an unusual character in this genus.

Diameter 5 mm.

Type specimen (U. S. N. M. No. 328191) from U. S. G. S. station 6862, from lower bed at Hodge's Bluff, Antigua, T. W. Vaughan, collector. It is very abundant in material from certain layers at this locality. This species also occurs at station 6854, Rifle Butts, Antigua.

Lepidocyclina morgani Lemoine and R. Douvillé.

(Plate 11, Figures 1 to 3; Text-fig. 7.)

Lepidocyclina cf. marginata H. Douvillé, Soc. Géol. France Bull., ser. 3, vol. 18, p. 1001, 1900.
Lepidocyclina morgani Lemoine and R. Douvillé, Soc. Géol. France, Paléont., vol. 12, Mém. 32, p. 17, plate 1, figs. 12, 15, 17; plate 2, figs. 4, 12; plate 3, fig. 2; 1904.

The following is a description of this species:

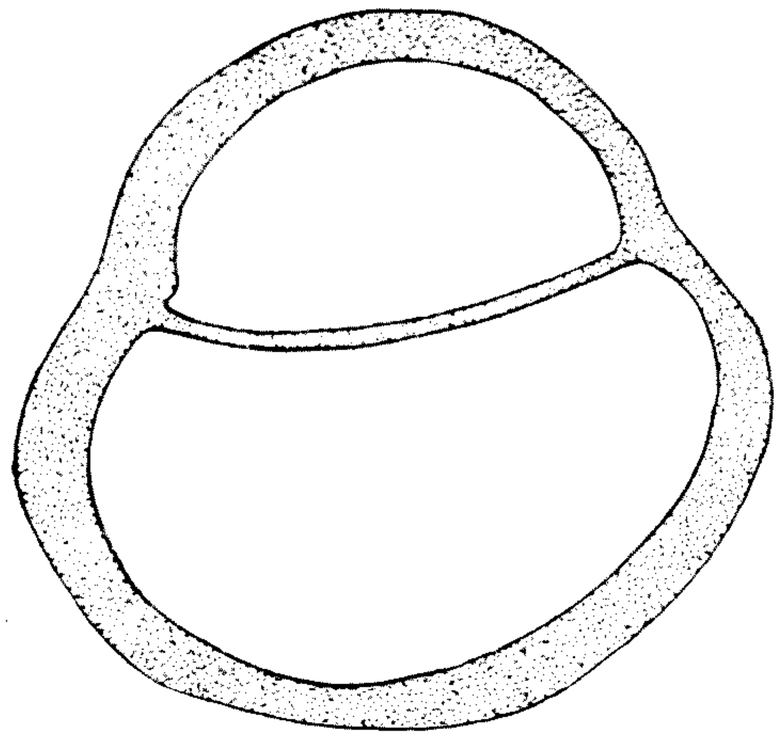

FIG. 7.—*Lepidocyclina morgani* Lemoine and R. Douvillé. Embryonic chambers. × 35. Specimen from station 7543, limestone outcrop, east side of Yateras, Cuba.

Test small, discoidal, much thickened in the central portion, from which it tapers rather rapidly to the subacute periphery; central protuberant portion with a series of large pustules ranging from 5 to 12 or more in number, of which one is usually central, surface reticulate between the pustules; the margins stellate; periphery of the test thin and slightly reticulated by the walls of the equatorial chambers.

Vertical sections show the general form and curvature of the surface of the test, the few pillars in the central region rapidly increasing in diameter toward the surface of the test; lateral chambers with the outer wall convex, averaging about three times as wide as high; in the central region with as many as 10 chambers in the vertical columns; equatorial chambers not increasing rapidly in height; height of those at the periphery not more than double that of those near the center.

Horizontal sections show the embryonic chambers, which are unequal, the larger one partially surrounding the smaller, as in the subgenus *Nephrolepidina* of H. Douvillé and the equatorial chambers more or less diamond-shaped, as in that subgenus. In other specimens the outer wall of the chamber is convex.

Diameter 2 to 5 mm.

Distribution.—Specimens seemingly identical with this species were found at the following stations in Cuba: 7513, limestone, outcrop where Palmer Trail joins Ocujal Trail; 7516, west end, Los Melones Mountain; 7543, limestone outcrop, east side of Yateras; 7554, south of El Jigue, 5 miles above mouth of Yateras River on west side, collected by O. E. Meinzer. Specimens, the sections of which are imperfect, but probably belonging to *L. morgani*, were obtained by O. E. Meinzer at station 7519, limestone from drift near top of landslide next north of Los Melones, and 7522, Mogote Peak. The specimens whose exteriors are figured were obtained by N. H. Darton at station 7664, north slope, La Piedra, northeast of Jamaica, northeast of Guantánamo, Cuba.

Lemoine and R. Douvillé record this species from four localities in Aquitaine (Abesse, Mimbaste, Saint-Etienne-d'Orthe, and Le Mandillot), from four localities in Spain (Baéna, Pont du Guadalquiver, Sella, and Peñaguila), and from Madagascar. The stage is indicated as Aquitanian but not definitely given.

It is a very distinctive species, and the Cuban specimens seem to differ in no essential characters from those figured by Lemoine and Douvillé.

Lepidocyclina marginata (Michelotti).

(Plate 12, Figures 1, 2.)

Nummulites marginata Michelotti, Soc. Ital. Sci. Mem., vol. 22, p. 297, plate 3, fig. 4, 1841.
Lepidocyclina marginata Lemoine and R. Douvillé, Soc. Géol. France, Paléont., vol. 12, Mém. 32, p. 16, plate 1, fig. 7; plate 2, figs. 7, 9, 11, 20; plate 3, figs. 3, 8, 9, 13; 1904.

The following is a description of this species:

Test of small or medium size, lenticular, thickest in the central region, thence tapering gradually to the periphery, which in the adult forms a thin flange around the thicker central portion; central portion with numerous prominent pustules, rather evenly placed and of good size, representing the outer end of the pillars; flange smooth, except for roughness caused by weathering.

Vertical section shows the general shape already noted, the numerous pillars giving an undulate outline to the central thickened region, pillars rather crowded at the center, but separating toward the periphery, increasing very rapidly in diameter in the first quarter or third of their length, thence keeping about the same diameter to the surface; lateral chambers in single columns between the pillars, equatorial band of chambers rather narrow and thin, increasing in height toward the periphery.

Horizontal section shows the equatorial chambers to be in general hexagonal, occasionally with the peripheral portion convexly curved; the lateral chambers also hexagonal, especially in the central region, where they are compressed by the pillars.

Diameter up to 12 or 15 mm., usually less.

Distribution.—Lemoine and R. Douvillé record this species from Rosignano, Montferrat, Piémont, and Colli Torinesi, Turin, Italy, and from Pont du Guadalquiver and Baéna, Andalusia, Spain, stage not given. It was collected at the following stations in Cuba by O. E. Meinzer: 7512, Ocujal; 7513 ?, orbitoidal limestone, outcrop where Palmer Trail joins Ocujal Trail; 7518, south side near west end, Los Melones Mountain; 7519, orbitoidal limestone, from drift near top of landslide next north of Los Melones; 7521, limestone, top of Mogote Peak; 7522 ?, Mogote Peak; 7543, limestone outcrop, east side of Yateras; and by N. H. Darton at station 7664, north slope of La Piedra, northeast of Jamaica, northeast of Guantánamo.

Lemoine and R. Douvillé had only the microspheric form of the species, but the Cuban material has megalospheric specimens. The embryonic chambers are rather thick-walled and unequal in size.

Lepidocyclina sumatrensis (H. B. Brady).

(Plate 12, Figures 3, 4.)

Orbitoides sumatrensis H. B. Brady, Geol. Mag., ser. 2. vol. 2, p. 536, plate 14, fig. 3, 1875; Jaarb. Mijn. Ned.-Oost.-Indie, vol. 7, pt. 2, p. 165, plate 2, fig. 3, 1878; Newton and Holland, Ann. Mag. Nat. Hist., ser. 7, vol. 3, p. 259, plate 10, figs. 7 to 12, 1899.
Lepidocyclina sumatrensis Jones and Chapman, in Andrews, A Monograph of Christmas Island, London, p. 244, plate 20, fig. 6, 1900; Newton and Holland, Journ. Coll. of Sci., Imp. Univ. Tokyo, vol. 27, art. 6, p. 11, plate 1, fig. 7, 1903; Lemoine and R. Douvillé, Soc. géol. France, Paléont., vol. 12, Mém. 32, p. 18, plate 1, fig. 14; plate 2, fig. 15; plate 3, fig. 6; 1904.

The following is a description of this species:

Test small, discoidal, thickened in the central portion, from which it tapers gradually to the subacute periphery, central protuberant portion more or less

pustulate throughout, but these protuberant spots of small size and covering the larger part of the area more or less evenly; surface otherwise smooth; periphery thin.

Vertical sections show the general form and curvature of the test, pillars entirely lacking, lateral chambers with the outer surface convex, three or four times as wide as high; 6 to 10 chambers in a vertical column.

Horizontal sections show the embryonic chambers, which are unequal, the larger curved about the smaller semicircular one; equatorial chambers irregularly hexagonal.

Diameter 2 to 5 mm.

Distribution.—*L. sumatrensis* was obtained in Cuba by O. E. Meinzer at the following stations: 7513, limestone outcrop where Palmer Trail joins Ocujal Trail; 7516, west end Los Melones Mountain; 7519, limestone from drift near top of landslide next north of Los Melones; 7543, limestone outcrop, east side of Yateras; 7554, south of El Jigue, 5 miles above mouth of Yateras River on west side; and by N. H. Darton at 7664, north slope of La Piedra, northeast of Jamaica, northeast of Guantánamo.

This species was described by Brady from Sumatra. It is recorded elsewhere in the East from Formosa and the East Indies, and Lemoine and R. Douvillé record it from Rosignano, Montferrat, Piémont, Italy; Baéna, Pont du Guadalquiver, Peñaguila, and Sella, Spain; and Saint-Etienne-d'Orthe and Mandillot, near Dax, France, probably Aquitanian in age.

In the Cuban material it occurs usually in company with *L. morgani*, and in this connection it is interesting to note that both species are given by Lemoine and R. Douvillé from all four of the stations in Spain and from three of the four stations in France.

This species may easily be distinguished from *L. morgani* by its lack of pillars. The pustulate appearance of *L. sumatrensis* is due to the convex surface of the lateral chambers, those of adjacent columns being of unequal height at the surface.

Lepidocyclina crassata, new species.

(Plate 11, Figures 4, 5.)

The following is a description of this species:

Test of medium size, lenticular, comparatively thick in the center, thence tapering toward the sides; central portion convex, changing to a concave curve toward the periphery; surface irregularly pustulate, especially where somewhat weathered.

Vertical section shows the general shape, convex at the center and broadly rounded, thence thinning rapidly toward the periphery, where the surface is concave, to the rather poorly developed peripheral border; height or thickness of the test about one-third the diameter. Embryonic chamber large and very thick-walled, often showing 1 or 2 accessory chambers, also thick-walled and rather conspicuously perforate; young specimens show that for a time the embryonic chamber is the greater part of the test. Equatorial band of chambers rather large, even at the beginning, the outer wall convex and coarsely perforate. Lateral chambers comparatively thick-walled, several times as broad as high, somewhat lenticular in section, highest in the middle; thence

their height decreases toward the sides. A comparatively small number of pillars in the central part originating in the wall of the embryonic chamber and extending to the periphery.

Horizontal section shows that the equatorial chambers are regularly hexagonal and fairly thick-walled, and that those of successive annuli are of very different sizes.

Diameter up to 9 mm.; height up to 3 mm. or more.

FIG. 8.—Sections of embryonic chambers of *Lepidocyclina crassata*, new species, showing variation in position of two or more divisions, and the comparatively thick outer wall. × 25. Specimens from limestone from drift near top of landslide next north of Los Melones, Cuba.

Type specimen, section (U. S. N. M. No. 328192) from station 7513, orbitoidal limestone, outcrop where Palmer Trail joins Ocujal Trail, Cuba. Specimens are also numerous in material from 7512, Ocujal; 7519, orbitoidal limestone, from drift near top of landslide next north of Los Melones; 7521, limestone, top of Mogote Peak, Cuba. All the specimens were collected by O. E. Meinzer.

L. crassata is very heavy and thick-walled and in section may be easily distinguished from any other Cuban or West Indian species of *Lepidocyclina*.

Lepidocyclina subraulinii, new species.

(Plate 11, Figures 6, 7; Plate 12, Figures 5, 6.)

The following is a description of this species:

Test circular, much thickened in the central portion, which occupies about one-third the diameter of the test; peripheral portion much flattened, thin; thick central portion irregularly papillate, peripheral portion smooth, showing almost no tendency to become saddle-shaped.

Vertical section shows the general thickness, the central lenticular body, and the thin periphery; central portion with very numerous pillars, increasing in diameter toward the surface; lateral chambers crowded between the pillars, very numerous in the vertical columns and much wider than high; equatorial chambers increasing in diameter toward the periphery, the outer margin convex and with a series of fine pores.

Horizontal section shows the equatorial chambers, which are polygonal; the outer margin strongly convex; pillars subpolygonal, with the lateral chambers making irregular polygonal meshes between them, toward the periphery the lateral chambers making up the entire test as the pillars decrease in number.

Diameter up to 24 mm.; thickness in center 4.5 mm.

Type specimen (U. S. N. M. No. 328193) from station 3478, Nuevitas, Cuba, collected by A. C. Spencer. Other specimens apparently this species occur at 7666, Sierra Guaso, northeast of Guantánamo, collected by N. H. Darton.

In diameter and general shape *L. subraulinii* suggests *L. raulinii* Lemoine and R. Douvillé from Saint-Géours-en-Maremmes, Landes, France, and Columbres, Province of Santander in Spain, but it differs in that it has very definite pillars and a papillose surface at the center. The age of the European material of *L. raulinii* is not definitely given.

Lepidocyclina perundosa, new species.

(Plate 11, Figure 8.)

The following is a description of this species:

Test very much curved in two directions, so that at points 180° from one another the two planes of each set are nearly parallel to one another and nearly at right angles to those of the other set, strongly "saddle-shaped," surface smooth when well preserved, but usually somewhat cancellate, due to erosion.

Vertical section difficult to obtain on account of the very much doubly curved shape of the test, but shows no pillars; the lateral chambers about three times as long as high; central chamber large; equatorial chambers increasing gradually in size toward the periphery, their height and breadth about equal.

Horizontal section, which from the shape of the test can be at best only fragmentary, shows equatorial chambers roughly triangular, with the outer surface convexly curved.

Diameter 8 to 12 mm.

Type specimen, section (U. S. N. M. No. 328194) from station 3478, Nuevitas, Cuba, collected by A. C. Spencer.

This is a very sellæform species about one-half the size of *L. undosa* Cushman from Antigua.

Lepidocyclina antillea, new species.

(Plate 3, Figure 3.)

The following is a description of this species:

Test compressed, circular, rather evenly biconvex, lenticular, central portion highest, thence gradually thinning toward the periphery, central area strongly papillate, remainder of surface less strongly so.

Vertical section shows equatorial chambers gradually increasing in height toward the periphery, those of the central region measuring less than 0.1 mm., those of the periphery as much as 0.5 mm. in height; outer wall of the equatorial chambers very squarely truncated.

Lateral chambers not numerous in the central thickened region, with only 6 or 7 chambers in a column, and this number is gradually reduced toward the periphery. Central region and the whole test in lesser degree marked by very heavy and numerous pillars, greatest width near the outer end, thence gradually tapering toward the center, outer ends rounded, forming the papillæ of the surface. In the central region the surface area occupied by the pillars is greater than that taken up by the lateral chambers.

In the horizontal section, or at least in the somewhat broadly oblique section, the equatorial chambers are of the curved *Lepidocyclina* form instead of the more typical hexagonal shape.

Diameter of the test averages about 5 mm.

Type specimen (U. S. N. M. No. 328195) from U. S. G. S. No. 6897, from St. Bartholomew, Leeward Islands, from conglomerate and sand-

stone below upper limestone bed, Anse Ecaille side of point between Anse Ecaille and Anse Lizard; T. W. Vaughan, collector; specimens apparently weathered out from the matrix are abundant. Also from 6897*b*, point between Colombier Point and bay next to St. Jean Bay. Hand specimens showing sections of this heavy-pillared species are abundant in a hard cherty material, No. 6902, southeast section of southwest side of island near Négre Point, altitude 360 feet; and 6903, N. 67° E. from summit of Négre Point, across low saddle-back of point, elevation 220 feet. All the above are from St. Bartholomew.

This species is related in many ways to *Lepidocyclina macdonaldi* Cushman from Panama, in the white limestone at David. The general vertical section is much more heavily pillared in *L. antillea*, although the figured specimen, not being exactly central, shows this much less strongly than in many of the weathered sections in hand specimens.

Lepidocyclina gigas, new species.

(Plate 1, Figures 3 to 5; Plate 5, Figure 4.)

The following is a description of this species:

Test large, flattened, somewhat lenticular, circular in outline, central portion slightly umbonate, thence gradually thinning toward the periphery, which is bluntly angular; surface generally flat and smooth, occasionally slightly undulating.

Vertical section shows the equatorial chambers increasing somewhat in height from the central area toward the periphery, the peripheral end of each chamber slightly convex toward the exterior; lateral chambers broad and low, in vertical columns, usually from 7 to 10 chambers in each column in the central portion of the test outside the umbonal region, thence gradually decreasing in number toward the periphery. There are pillars developed at irregular intervals, but these are few in number and of very small diameter.

Horizontal sections show the hexagonal equatorial chambers, the annular rows of which are very uneven in size.

Diameter of largest specimens up to 80 mm. or more.

Type specimen (U. S. N. M. No. 328196) from Antigua, Leeward Islands, U. S. G. S. No. 6862, from lower bed at Hodge's Bluff; T. W. Vaughan, collector. Specimens from this locality are numerous and very fine. Poorer material, but apparently specifically the same, occurs at 6854, Rifle Butts, and 6857, southwest side of Wetherell Mill, both from Antigua.

This species is very near to *L. elephantina* Munier-Chalmas, but the two early chambers in the two species do not seem to be at all alike, those of *L. elephantina* being very dissimilar in size and shape, while those of *L. gigas*, as far as made out, seem to be much more nearly equal, as is usual in American species of *Lepidocyclina*.

This is a very fine, large species, abundant at the type station.

Lepidocyclina undulata, new species.

(Plate 3, Figures 1*a*, 2, 8, 9; Plate 15, Figure 5.)

The following is a description of this species:

Test of large size, slightly papillate, lenticular, the umbonate region scarcely if at all raised, whole test undulate or saddle-shaped, often bent nearly double.

Vertical sections of this species show pillars very constant but of small diameter scattered throughout the central half of the test and a few toward the peripheral portion; equatorial chambers fairly high and with a series of 6 to 8 rather large perforations in the peripheral wall of each; lateral chambers thick-walled and rather large, comparatively few, usually not more than 6 in a vertical column.

Diameter in the largest specimens apparently exceeding 100 mm. when complete.

Type specimen (U. S. N. M. No. 328197) from Antigua, Leeward Islands, U. S. G. S. No. 6863, High Point, collected by T. W Vaughan. Specimens are abundant at this station. Other material from Antigua apparently referable to this species is from No. 6858, Wetherell Point; 6874, Blizzard's Mill; (?) 6880, west side Otto's estate, west side of Golden Grove road; 6881, from bluffs on north side of Willoughby Bay; and 6942, bowlders on south side of Monk's Hill, Falmouth.

This seems to be the largest known species of *Lepidocyclina*, being larger than *L. elephantina*. The material here figured (plate 3, figs. 1, 2; plate 14, fig. 5) from 6869 and 6881 are for the most part composed of other species, but a few large specimens apparently referable to this are shown with the others.

Lepidocyclina undosa, new species.

(Plate 2, Figure 1, *a*.)

The following is a description of this species:

Test of medium size, much compressed, strongly undulate or saddle-shaped, not at all umbonate, thin throughout, surface slightly granulate, otherwise smooth, where worn usually netted by the walls of the chambers.

Vertical section showing apparently an entire absence of pillars throughout, equatorial chambers nearly square in section, walls straight, lateral chambers very numerous, low and broad, very thin-walled, 12 to 15 in a vertical column in the thicker portions of the test.

Horizontal sections showing typical hexagonal equatorial chambers.

Diameter up to 25 mm. or more.

Type material (U. S. N. M. No. 328198) from Antigua, Leeward Islands, U. S. G. S. No. 6869, Long Island, Antigua. The species is very abundant in this material, making up a large proportion of the rock-mass. Specimens are associated with *Heterostegina*.

This may be distinguished from other species of *Lepidocyclina* by its saddle-shaped test, the flat, non-umbonate center, the finely netted surface in worn specimens, and the absence of pillars in the vertical section with the thin-walled chambers.

Lepidocyclina favosa, new species.

(Plate 3, Figures 1, 2, *b*; Plate 15, Figure 4.)

The following is a description of this species:

Test of medium size, compressed, strongly undulate or saddle-shaped, the central portion umbonate, much curved, thick; the remainder of the test thin and flange-like; central umbonate mass with an ornamentation of polygonal areas formed by raised ribs; remainder of test fairly smooth but irregularly eroded in most cases.

Vertical section with numerous distinct pillars in the umbonate region, broad at the exterior and narrowing to a point near the equatorial chambers, flattened peripheral portion with few indistinct pillars.

Diameter 15 to 18 mm. for typical specimens.

Type specimens (U. S. N. M. No. 328199) from Antigua, Leeward Islands, U. S. G. S. No. 6881, from bluffs on north side of Willoughby Bay.

This is a very strikingly ornamented species and hardly likely to be mistaken for any other, especially with its very strong saddle-shape in addition. It was not seen in any material from the other Antigua stations, but is very abundant at this station, as the photograph (plate 3, fig. 1) will show.

MILIOLIDÆ.

Spiroloculina species (?).

(Plate 5, Figures 9 and 12.)

A section showing longitudinally a specimen of *Spirolculina* and an oblique section of a similar specimen are reproduced on plate 5, figure 9. This is from U. S. G. S. No. 6949, Simson Bay Point, St. Martin, Leeward Islands. In this material, in which specimens of *Orbitolites* are abundant, specimens of *Spiroloculina* are frequent, but as they show only in section, it is not possible accurately to determine them specifically. In a section from U. S. G. S. No. 6966, southwest shore of Crocus Bay, Anguilla, there is a transverse section of a *Spiroloculina* with convex periphery and concave faces (plate 5, fig. 12), but whether it is the same species as that from St. Martin is problematical. The associated species at each locality are very different, however, as the abundant genus in St. Martin is *Orbitolites*, while in Anguilla it is *Heterosteginoides*.

Quinqueloculina agglutinans d'Orbigny.

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

Occasional very typical specimens occur at Zone H, Rio Cana, and at Bluffs 2 znd 3, Cercado de Mao, Santo Domingo. It may be noted that these specimens are almost exactly like the figures given by d'Orbigny rather than those of recent material given by later authors.

Quinqueloculina cuvieriana d'Orbigny.

Quinqueloculina cuvieriana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 190, plate 11, figs, 19 to 21, 1839.

A few specimens with the typical ornamentation of the species occurred at Zone I, Rio Cana, and Bluff 2, Cercado de Mao, Santo Domingo. These are almost exactly like the Cuban monograph figures, but very different from the figures assigned to this species by later authors.

Quinqueloculina auberiana d'Orbigny.

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

Very typical specimens occur in material from Zone H, Rio Cana, and Bluffs 2 and 3, Cercado de Mao, Santo Domingo. These are more closely like the original figures of the type than of later figures of other authors.

Specimens are rare in the Bowden marl of Jamaica, but are very typical, like the Santo Domingo specimens, and like the original figures given by d'Orbigny in his Cuba monograph.

Typical specimens also occur in the Miocene of the Panama Canal Zone and Virginia.

Quinqueloculina pulchella d'Orbigny.

Miliolina pulchella (d'Orbigny) H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 174, plate 6, figs. 13, 14, 1884.

A few specimens with characteristic ornamentations occur at Zones H and I, Rio Cana, and Bluffs 2 and 3, Cercado de Mao, Santo Domingo.

Quinqueloculina gualteriana d'Orbigny.

Quinqueloculina gualteriana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 186, plate 11, figs. 1 to 3, 1839.

Specimens seemingly identical with this species as figured by d'Orbigny occur at Zones H and I, Rio Cana, and there are questionable specimens from Bluff 3, Cercado de Mao, Santo Domingo; but they are rare, two being the most from any one station.

Quinqueloculina species cf. Q. kerimbatica (Heron-Allen and Earland).

(Plate 13, Figure 5.)

Miliolina kerimbatica Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, p. 574, plate 43, figs. 13 to 23, 1915.

Large specimens seemingly identical with the recent species described by Heron-Allen and Earland from the Kerimba Archipelago off the southeastern coast of Africa occur both at Bluffs 2 and 3, Cercado de Mao, Santo Domingo. In their size, shape, and peculiar type of coarse, irregularly reticulate ornamentation these fossil specimens are strikingly like the recent African-Indian Ocean specimens. The same

species occurs abundantly in the recent Philippine material, and Millett records it from the Malay Archipelago under the name *Miliolina parkeri*. This is a rather interesting distribution, corresponding somewhat with what Vaughan has shown for some genera of corals now extinct in the West Indies, but found living in the Indo Pacific.

Quinqueloculina parkeri (H. B. Brady) var. bowdenensis, new variety.

(Plate 14, Figure 6.)

The following is a description of this variety:

Variety differing from the typical mainly in the reduced amount of the ornamentation, which in the variety consists of several short obliquely transverse ridges confined to the periphery of the test, which is bluntly angled.

Length 0.5 mm.

Type specimen (U. S. N. M. No. 328200) from the Miocene Bowden marl, Jamaica.

The typical form of the species is known from the East Indian region and the Red Sea.

Quinqueloculina species (?).

(Plate 5, Figure 8.)

A single section of a portion of a specimen of *Quinqueloculina* was noted in a section from U. S. G. S. No. 6966, southwest shore of Crocus Bay, Anguilla, 30 to 50 feet above sea-level. From what is present this is apparently a smooth, angular species, but nothing further can be made of its specific determination.

Triloculina tricarinata d'Orbigny.

(Plate 14, Figure 4.)

Triloculina tricarinata d'Orbigny, Ann. Sci. Nat., vol. 7, p. 299, 1826.
Miliolina tricarinata H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 165, plate 3, figs. 17 *a*, *b*, 1884.

A single specimen of this tricarinate species was found in the Bowden marl from Bowden, Jamaica. It is not sharply carinate, but the aperture is very characteristic.

Triloculina brongniartiana d'Orbigny.

Triloculina brongniartiana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 176, plate 10, figs. 6 to 8, 1839.

A few finely striate specimens from the Bowden marl, Bowden, Jamaica, are very similar to the figures of this species given by d'Orbigny from Cuba. In the *Challenger* Report, Brady refers this species with a question to the later name *T. boueana* of d'Orbigny, but the two seem to be distinct and the fossil specimens under consideration are certainly very close to *T. brongniartiana*. Brady's reference to their

being "young examples, in a Triloculine condition" is erroneous, as the young of *Triloculina* is quinqueloculine in the microspheric form at least, while the young of *Quinqueloculina* is quinqueloculine in both forms, microspheric and megalospheric. Our specimens, too, are larger than those figured by Brady as *T. boueana*.

Triloculina fichteliana d'Orbigny.

Triloculina fichteliana d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 171, plate 9, figs. 8 to 10, 1839.

A single specimen referred to this species was found in the material from Bluff 3, Cercado de Mao, Santo Domingo.

Biloculina species.

Two small specimens of *Biloculina* were found in the material from Bluff 3, Cercado de Mao, but are not in condition to identify them specifically. A single small specimen was also found in marl from station 3461, gorge of Yumurí River, Matanzas, Cuba, collected by T. W. Vaughan. Specimens referred to *B. bulloides* d'Orbigny were obtained from the Miocene of the Panama Canal Zone and from Florida.

Vertebralina cassis d'Orbigny.

Vertebralina cassis d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 51, plate 7, figs. 14, 15, 1839.

From the material from Zone H, Rio Cana, Santo Domingo, a single specimen was obtained. It is of the form figured by d'Orbigny as *V. cassis* and has the typical ornamentation, although somewhat eroded.

Vertebralina striata d'Orbigny.

(Plate 14, Figure 3.)

Jones and Parker record this species in their list of Foraminifera from the Bowden marl, Jamaica. I have found a single specimen in my material, figured here.

Peneroplis pertusus Forskål var. discoideus Flint.

Peneroplis pertusus var. *discoideus* Flint, Ann. Rep. U. S. Nat. Mus., 1897, p. 304, plate 49, figs. 1, 2, 1899.

These specimens from Bluff 3, Cercado de Mao, Santo Domingo, are identical with this peculiar variety described by Flint from the shallow water of Key West Harbor, Florida.

Peneroplis pertusus Forskål variety.

A single specimen from Bluff 3, Cercado de Mao, has the typical form of *Orbiculina adunca*, but, as the chambers throughout seem to be undivided, the specimen is a true *Peneroplis*.

Orbiculina adunca (Fichtel and Moll).

Orbiculina adunca (Fichtel and Moll) d'Orbigny in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 64, plate 8, figs. 8 to 16, 1839.

Specimens of this common West Indian species occur at Zones H and I, Rio Cana, and Bluffs 2 and 3, Cercado de Mao, Santo Domingo.

Orbiculina compressa d'Orbigny.

(Plate 7, Figure 6.)

Orbiculina compressa d'Orbigny, in De la Sagra, Hist. Fis. Pol. Nat. Cuba, "Foraminifères," p. 66, plate 8, figs. 4 to 7, 1839; Jones, Parker, and H. B. Brady, Crag Foram., Pal. Soc., vol. 19, p. 21, plate 3, fig. 43, 1866; Hill, Bull. Mus. Comp. Zoöl., vol. 34, p. 147, 1899.

The following is a description of this species:

Test flattened, circular or elliptical in outline, early chambers spiral, soon extending back to make a crosier-formed test, after which by further elongations the chamber ends meet and form annuli; wall calcareous, smooth, apertures circular openings about the peripheral wall.

Diameter up to 3 mm.

This species is not uncommon in the Bowden material from Jamaica, but is frequently broken, due to the thin, entirely calcareous test and the weakness that easily develops along the sutural lines. In Hill's list of the species identified by Doctor Bagg both *O. compressa* and *O. adunca* are given. Among the specimens I have seen there is none that is the typical thick form of *O. adunca;* but all are thin, flattened, and develop annuli very early, and, therefore, are typical *O. compressa.*

Orbitolites (Sorites) duplex Carpenter.

(Plate 5, Figures 9, 10.)

The material from U. S. G. S. No. 6949, Simson Bay Point, St. Martin, numerous specimens of a medium-sized *Orbitolites.* Vertical sections of material from this station are shown on plate 5, figure 9. As a rule the specimens are much like *O. duplex* in section. According to Douvillé, current conceptions of *Orbitolites* need much revision. The true *Orbitolites,* with *O. complanata* as the type, from the Eocene of the Paris Basin, seems to be not found living at the present time. A portion of a horizontal section from U. S. G. S. No. 6894, southwest side of Crocus Bay, Anguilla, shows a few chambers in which the connections between the adjacent chambers seem much more like those in *Sorites* Ehrenberg, which, according to Douvillé, includes the recent species *O. marginata* and *O. duplex.* The fossil *Orbitolites* need a careful revision from a study of carefully sectioned material.

Specimens very similar to the above occur at the following stations in Cuba, collected by T. W. Vaughan: 3440, northeast part of Santiago, in marl on hillside; 3443, northeast part of Santiago, marl at foot of hills, and 3446, first deep cutting on railroad east of La Cruz, near Santiago.

Orbitolites complanata (Lamarck) variety.

Orbitolites complanata (Lamarck) H. B. Brady, Rep. Voy. *Challenger*, Zoology, vol. 9, p. 218, plate 16, fig. 1, 1884.

The form of *O. complanata*, very abundant in a fine sandy material from Bluff 3, Cercado de Mao, Santo Domingo, differs from the ordinary form of this species in being thinner, more like *O. duplex*, but with the multiple chambers of *O. complanata;* the apertures, however, occur in a very narrow band along the center of the peripheral face. These characters are very constant.

Alveolina species (?).

(Plate 5, Figure 14.)

A single specimen, apparently a longitudinal section of *Alveolina* occurs in sectioned material from U.S.G.S. No. 6949, Simson Bay Point, St. Martin, Leeward Islands. It occurs with abundant *Orbitolites*.

CONTRIBUTIONS TO THE GEOLOGY AND PALEONTOLOGY OF THE WEST INDIES

Prepared under the Direction of

THOMAS WAYLAND VAUGHAN

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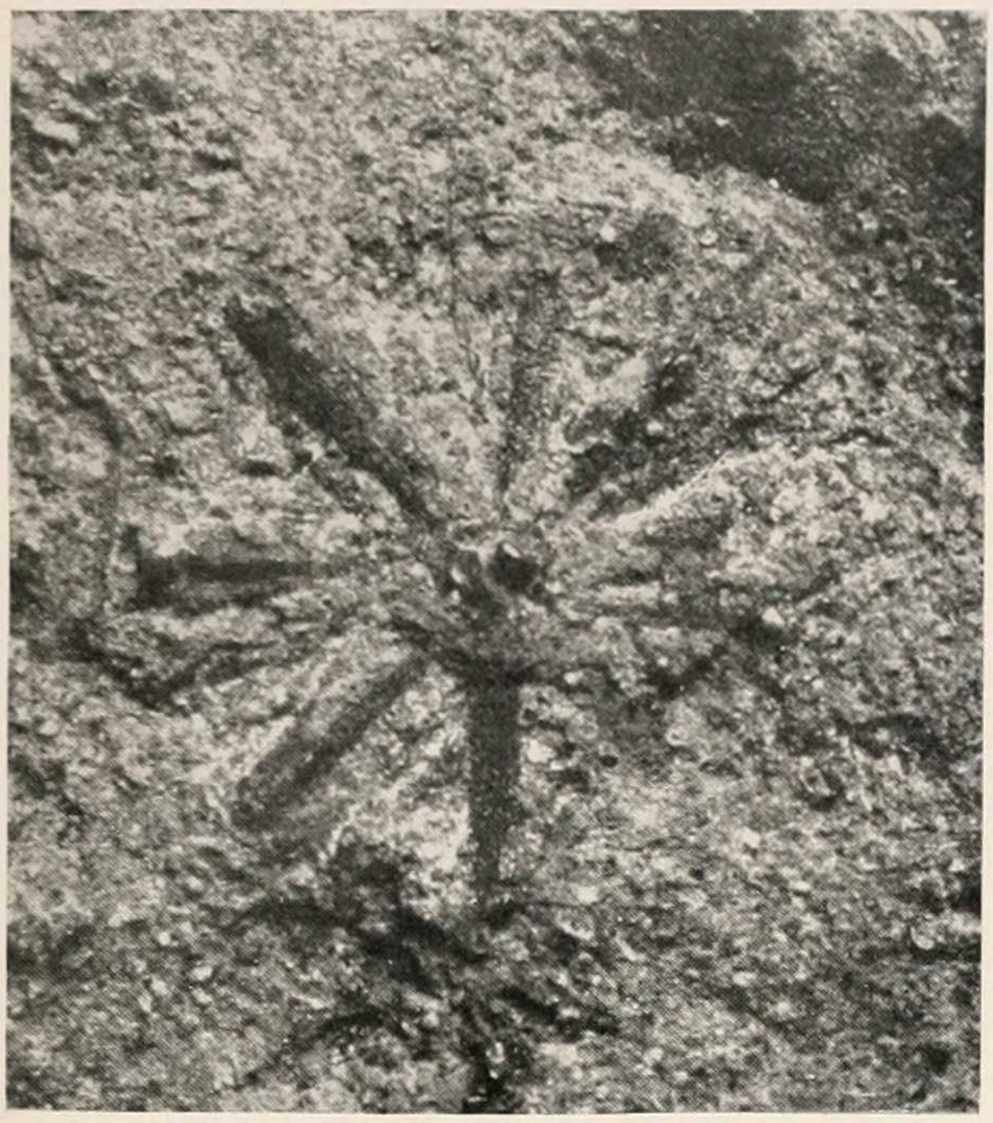
WASHINGTON, 1919



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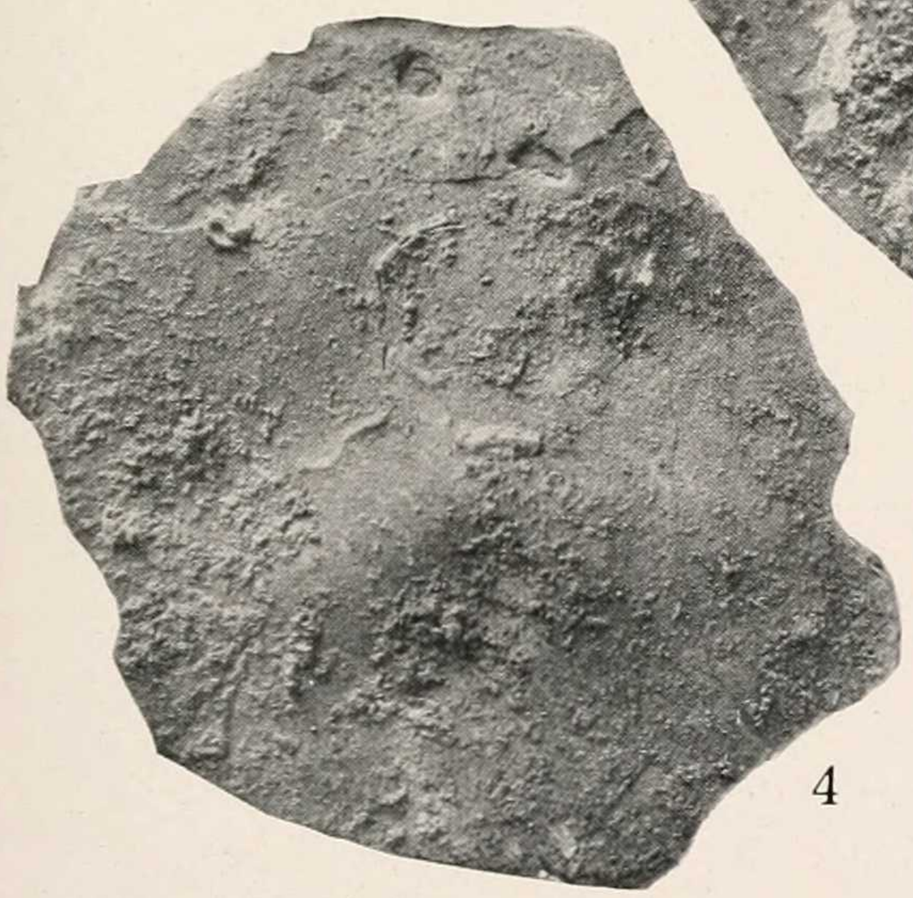

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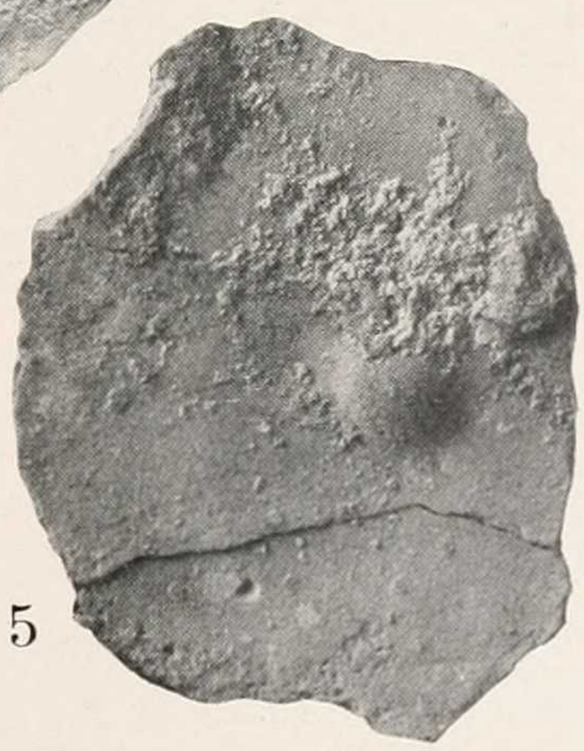

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1. *Orthophragmina antillea*, n. sp. Type specimen, × 4. Radiating ribs and central umbonal mass only shown.
2. *Orthopragmina marginata*, n. sp. Type specimen, × 4. Upper marginal portion of specimen broken away.
3. *Lepidocyclina gigas*, n. sp. Type specimen, 0.8 natural size. Specimen incomplete.

4 and 5. *Lepidocyclina gigas*, n. sp. Two smaller specimens from type locality, 0.8 natural size.

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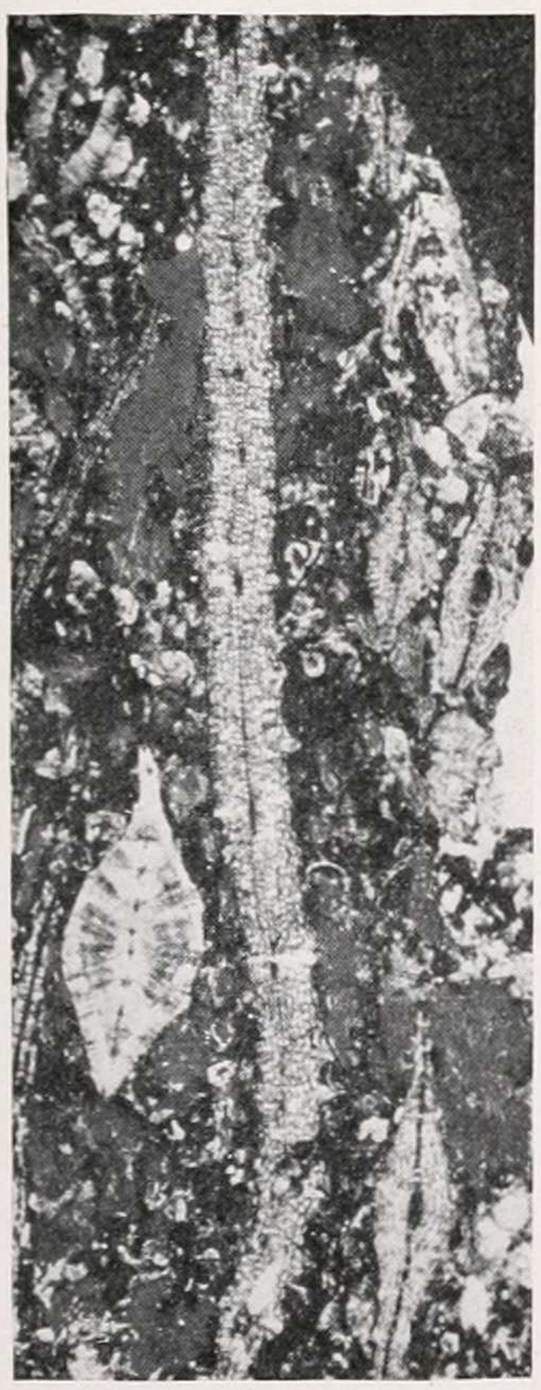

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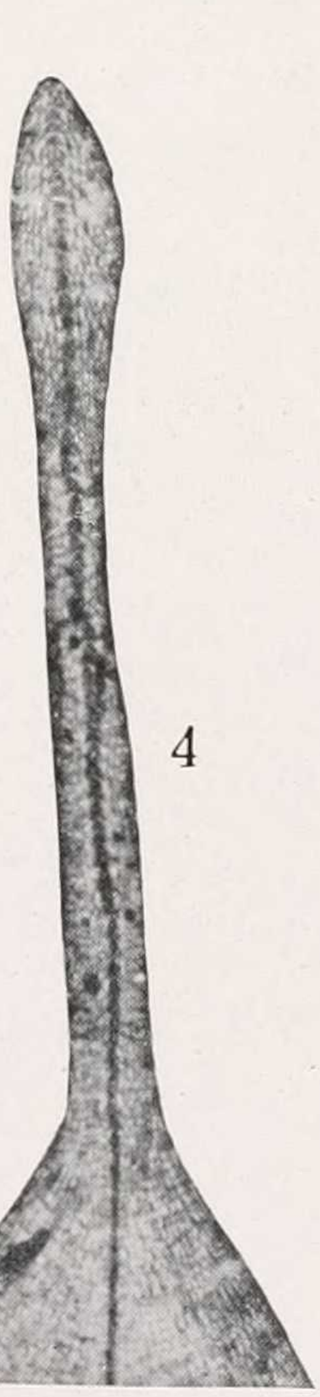

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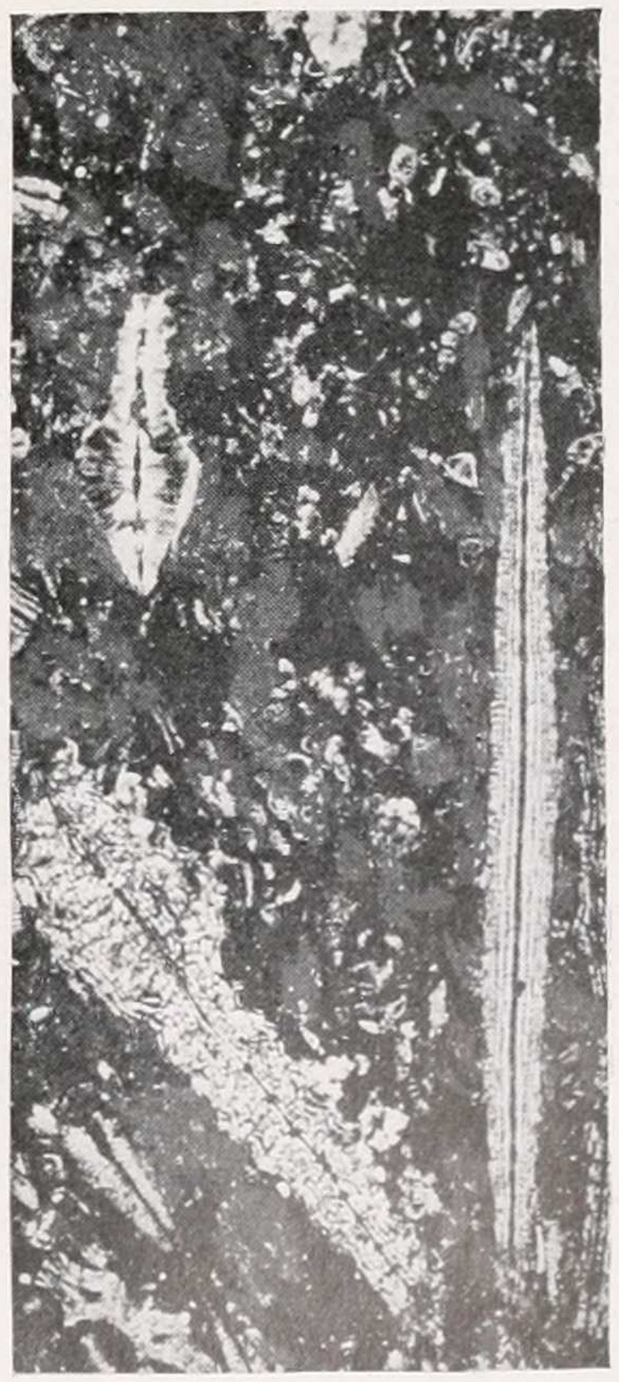

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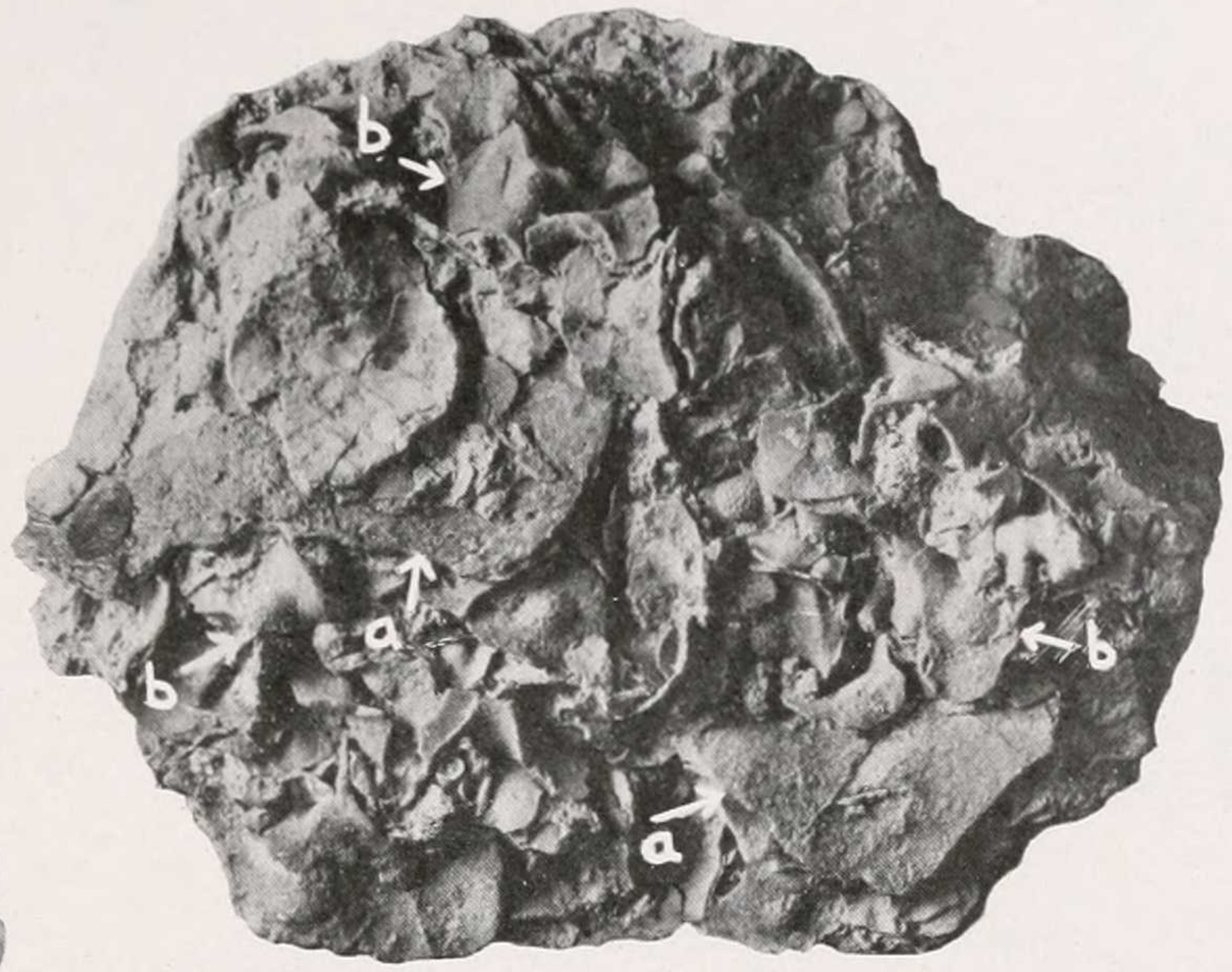
1. Rock specimen, 0.8 natural size, made up largely of (*a*) *Lepidocyclina undosa*, n. sp., and (*b*) *Heterostegina antillea*, n. sp.

2 and 3. Vertical sections of *Orthophragmina antillea*, n. sp. × 16.

4. Vertical section of part of central umbonal portion and peripheral flange and thickened periphery of *Orthophragmina marginata*, n. sp. × 16.



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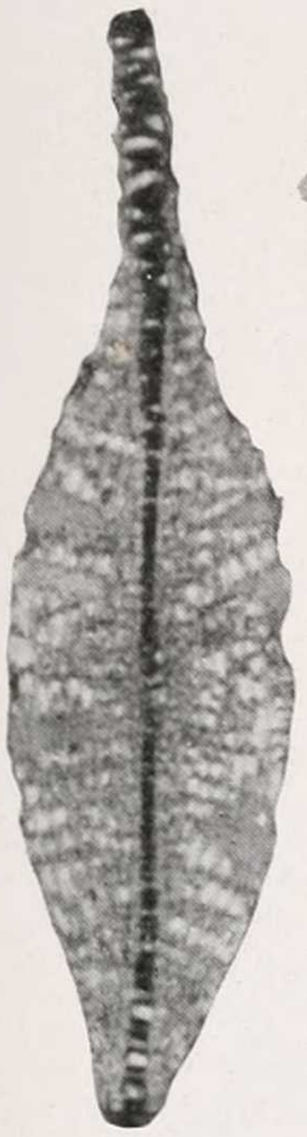

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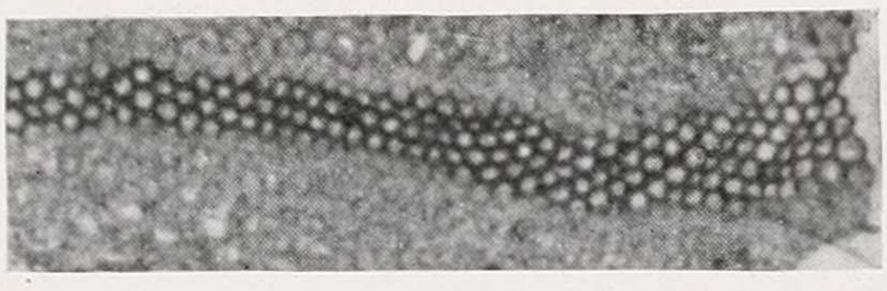

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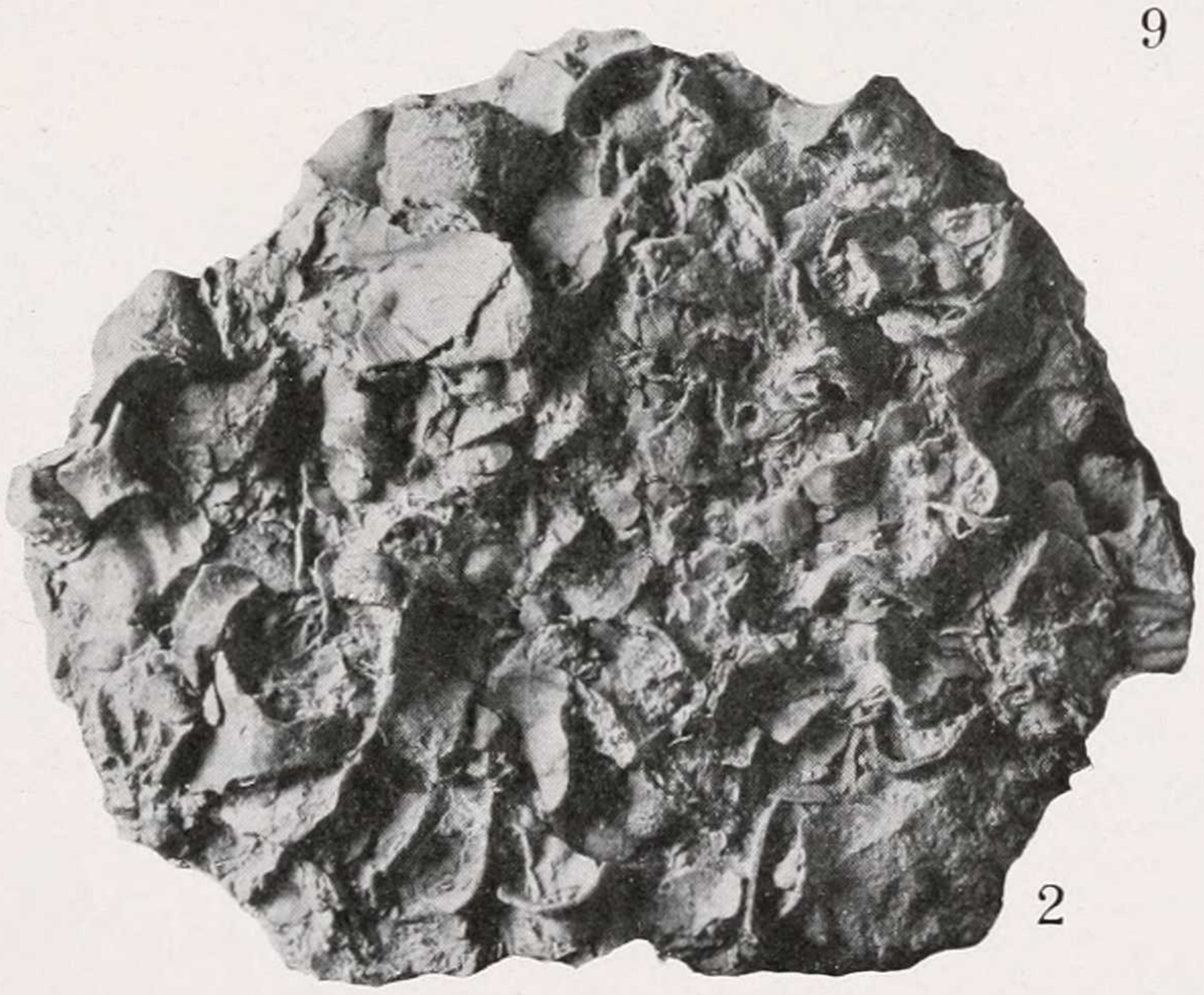

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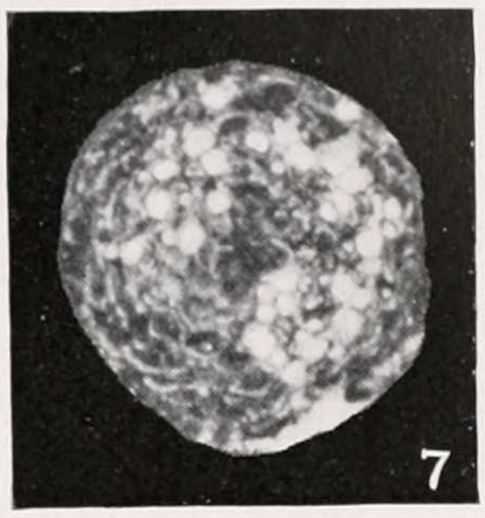
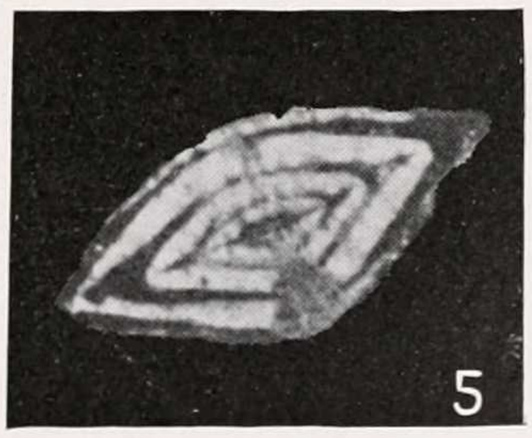
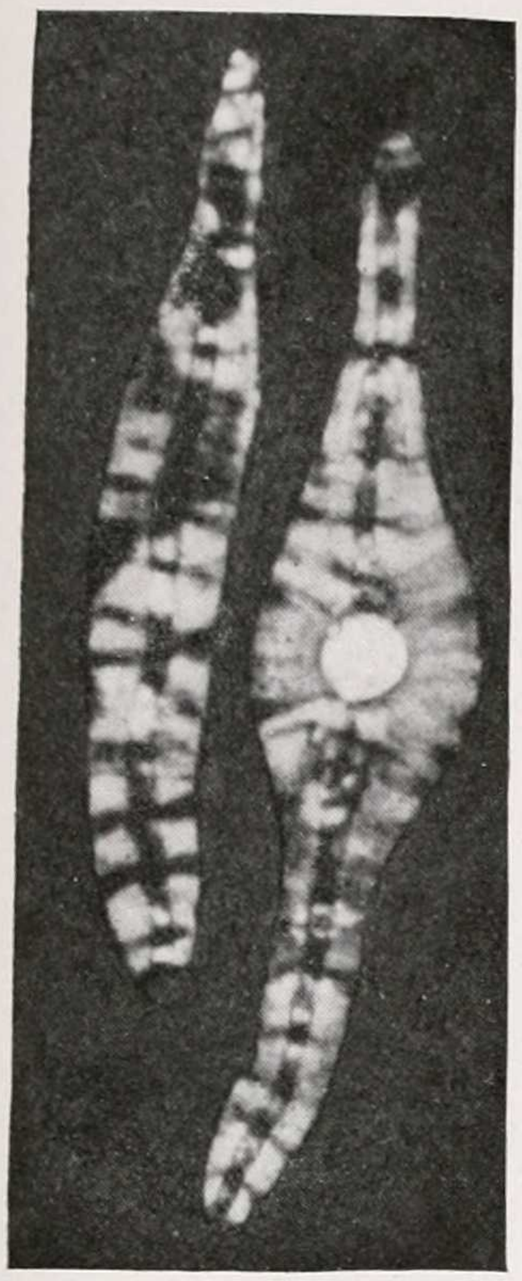
1, Rock specimen, 0.75 natural size, made up largely of (*a*) *Lepidocyclina undulata*, n. sp., (*b*) *L. favosa*, n. sp.
2. Reverse of specimen shown in fig. 1.
3. *Lepidocyclina antillea*, n. sp. Vertical section. × 15.
4. *Lepidocyclina parvula*, n. sp. Section somewhat oblique, showing two slightly unequal early chambers, with few chambers following a trace of a spiral arrangement. × 15.
5, 6, 7. *Lepidocyclina parvula*, n. sp. Vertical or slightly oblique sections showing equatorial and lateral chambers. Figs. 5 and 6, × 15; fig. 7, × 7.5.
8. *Lepidocyclina undulata*, n. sp. Portion of horizontal section. × 7.5.
9. *Lepidocyclina undulata*, n. sp. Portion of vertical section. × 7.5.





1. *Nummulites antillea*, n. sp. Photograph of type specimen. × 5. Specimen somewhat eroded, showing traces of chamber walls.
2. Section of portion on *N. antillea*, n. sp. × 20. At upper right hand are few equatorial chambers of *Orthophragmina antillea*, n. sp.
3. *Nummulites parvula*, n. sp. Accidental weathered specimen. × 8.
4, 5, and 6. Vertical section of *N. parvula*, n. sp. × 20. Figure 4 also shows a vertical section of a portion of *Orthophragmina antillea*, n. sp., through two radial ribs.
7. *Gypsina globulus*, Reuss. Transverse section. × 20.



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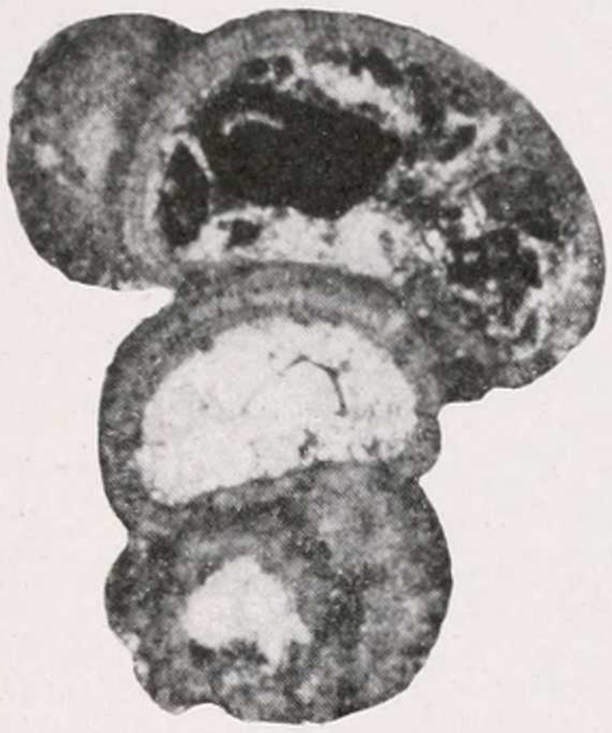

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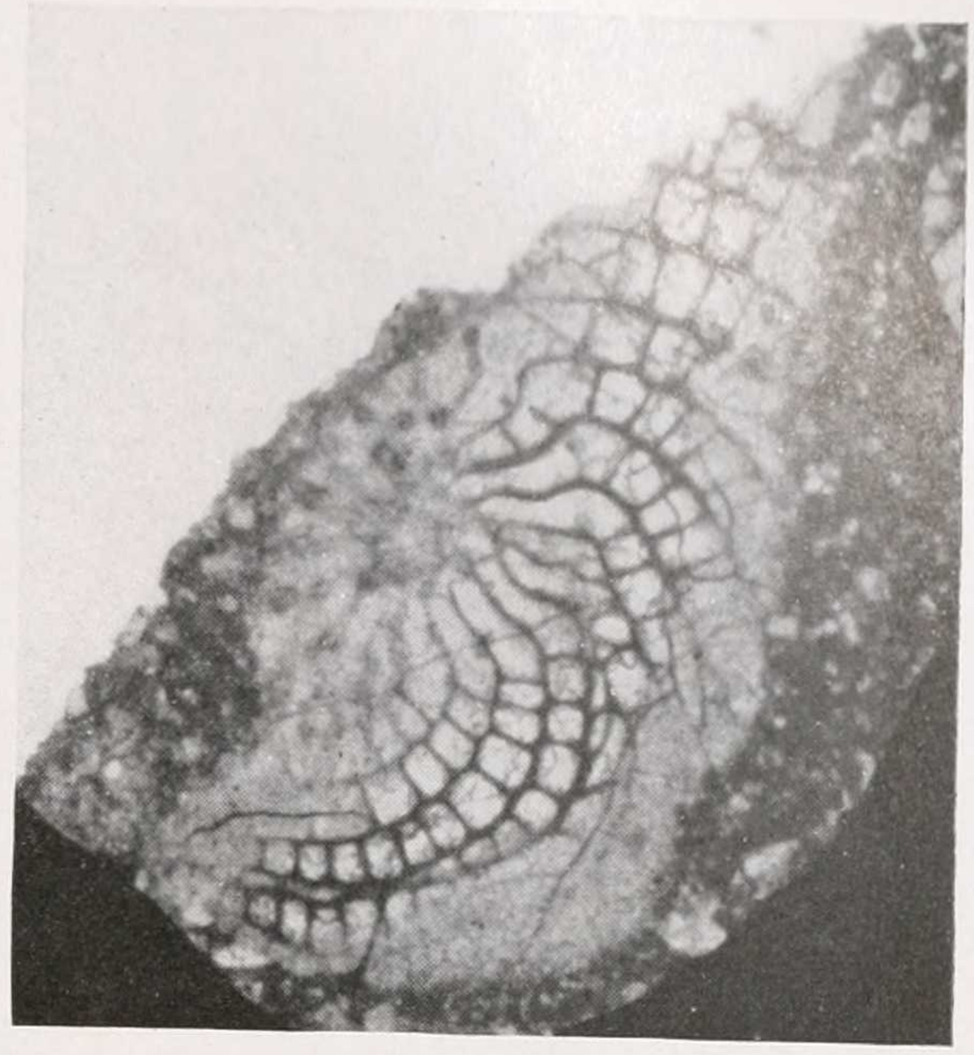

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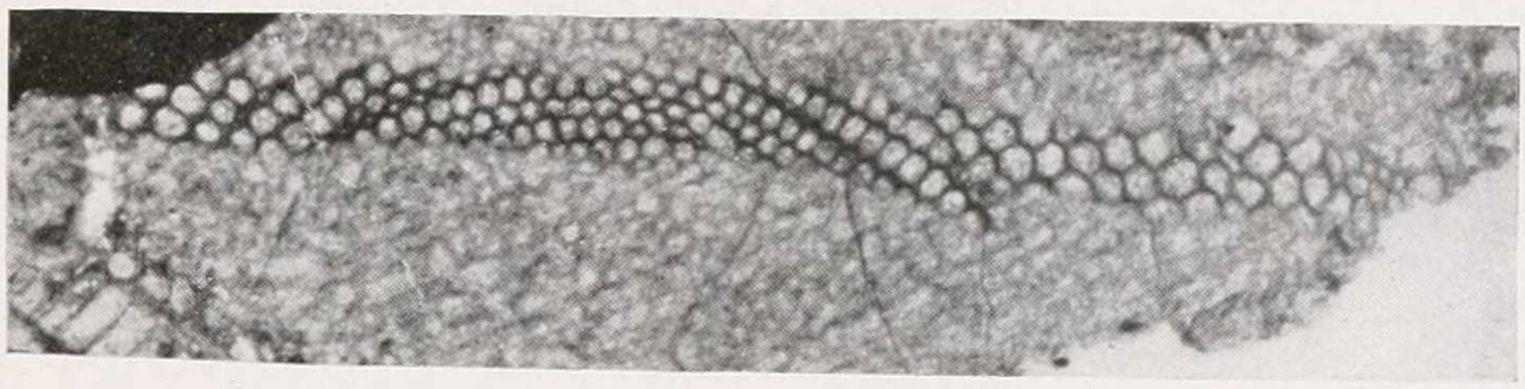

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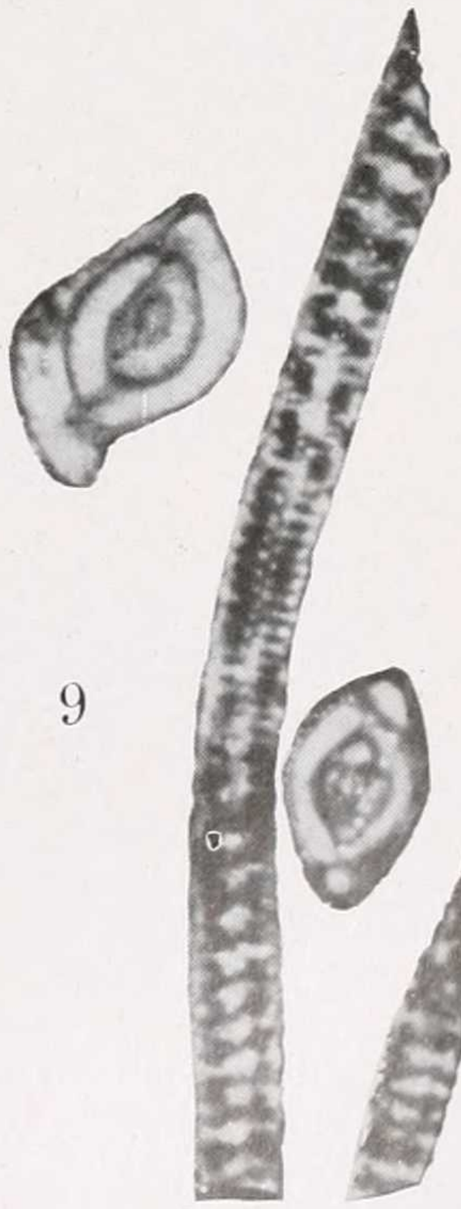

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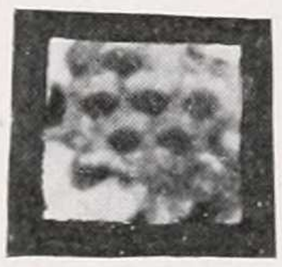

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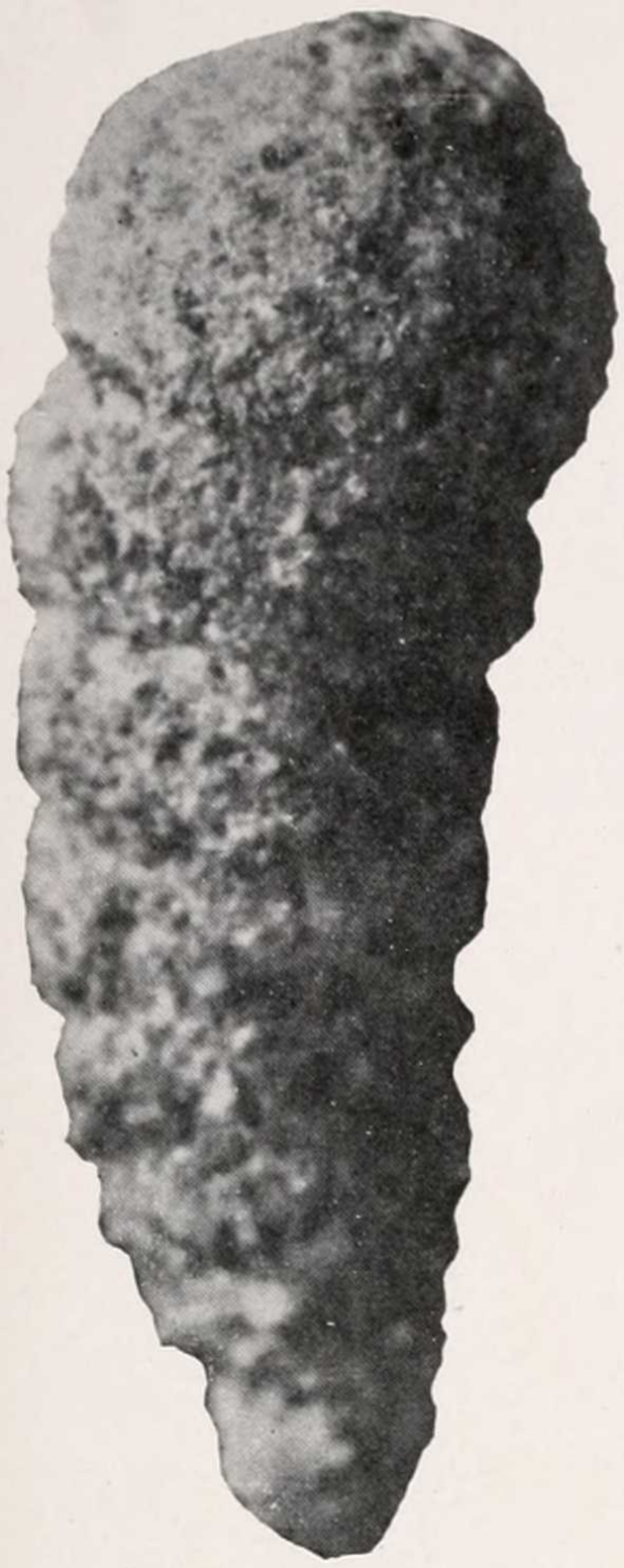
13

1. *Heterostegina antillea*, n. sp., vertical sections, one through the proloculum. × 20.
2. Oblique section of *H. antillea*, n. sp., showing some of the chamberlets. × 20.
3. *Carpenteria proteus*, n. sp., section through several chambers. × 20.
4. *Lepidocyclina gigas*, n. sp., section through a portion of the hexagonal chambers. × 20.

5 and 6. *Heterosteginoides antillea*, n. sp. × 20.

7. *Textularia* sp. Longitudinal section. × 20.
8. *Quinqueloculina* sp. Incomplete transverse section. × 20.
9. *Spiroloculina* sp. Section of two specimens, also vertical sections of *Orbitolites* (*Sorites*) *duplex* Carpenter. × 20.
10. Horizontal section through a few chambers of *Orbitolites duplex* Carpenter. × 20.
11. *Nonionina* sp. Section, × 20, from Station 6884, Anguilla.
12. *Spiroloculina* sp. Transverse section. × 20.
13. *Globigerina* sp. Section. × 20.
14. *Alveolina* sp. Section. × 20.



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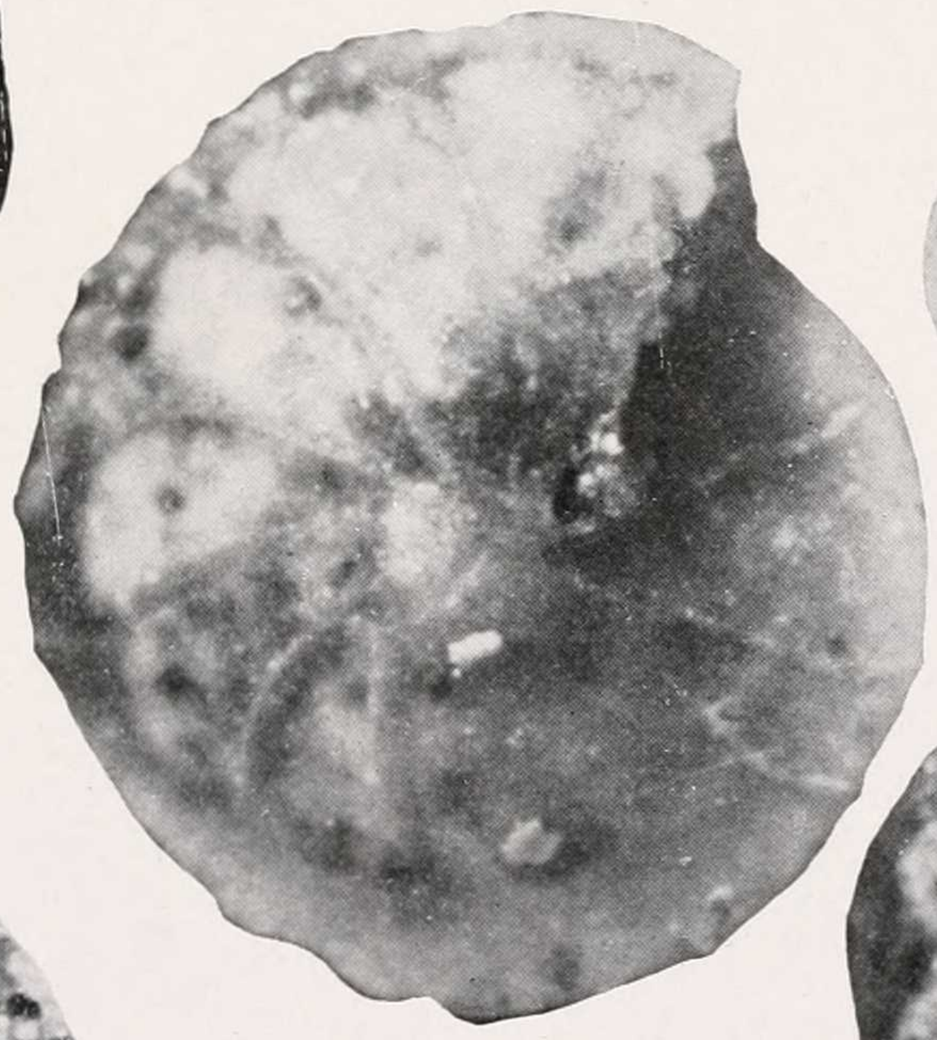

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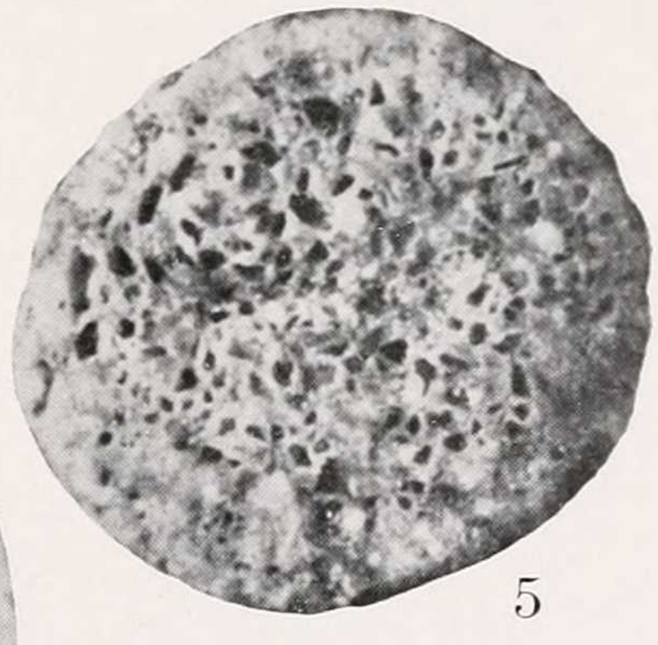

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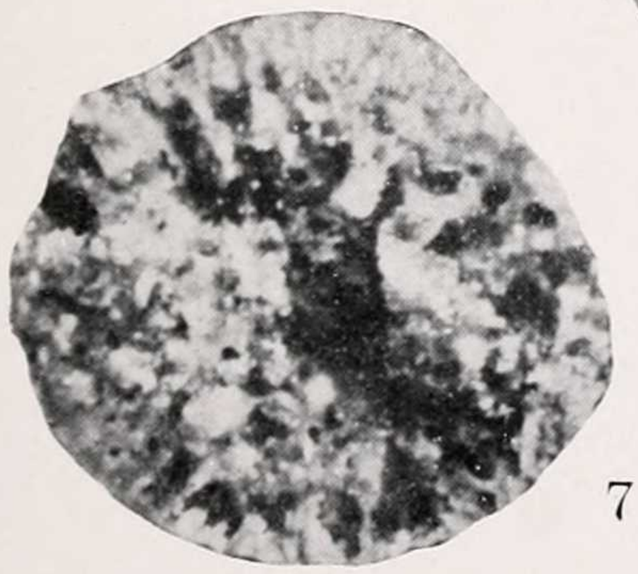

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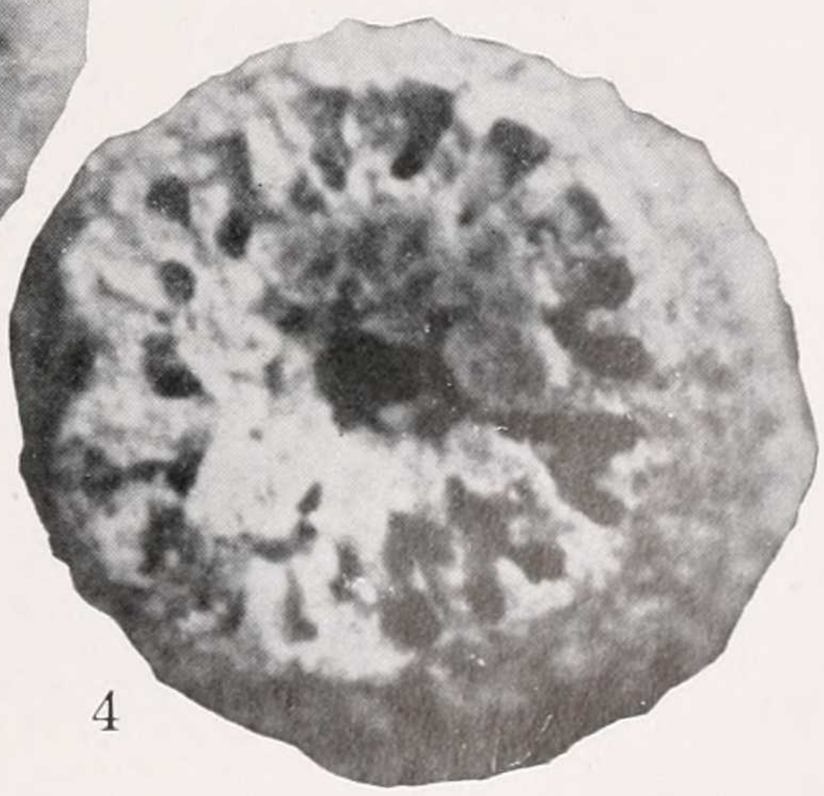

4

1, 2, and 3. *Haplostiche dubia* var. *intermedia*, n. var. × 15.
4. *Haplostiche dubia* var. *intermedia*, n. var., horizontal section, showing divisions of the interior. × 20.
5. *Textularia barrettii* Jones and Parker, end view. × 20.
6. *Textularia barrettii* Jones and Parker, front view. × 20.
7. *Textularia barrettii* Jones and Parker, horizontal section, showing irregular labyrinthic interior.
8. *Cristellaria calcar* var. *aspinosa*, n. var. × 20.
All specimens from the Bowden marl.

3

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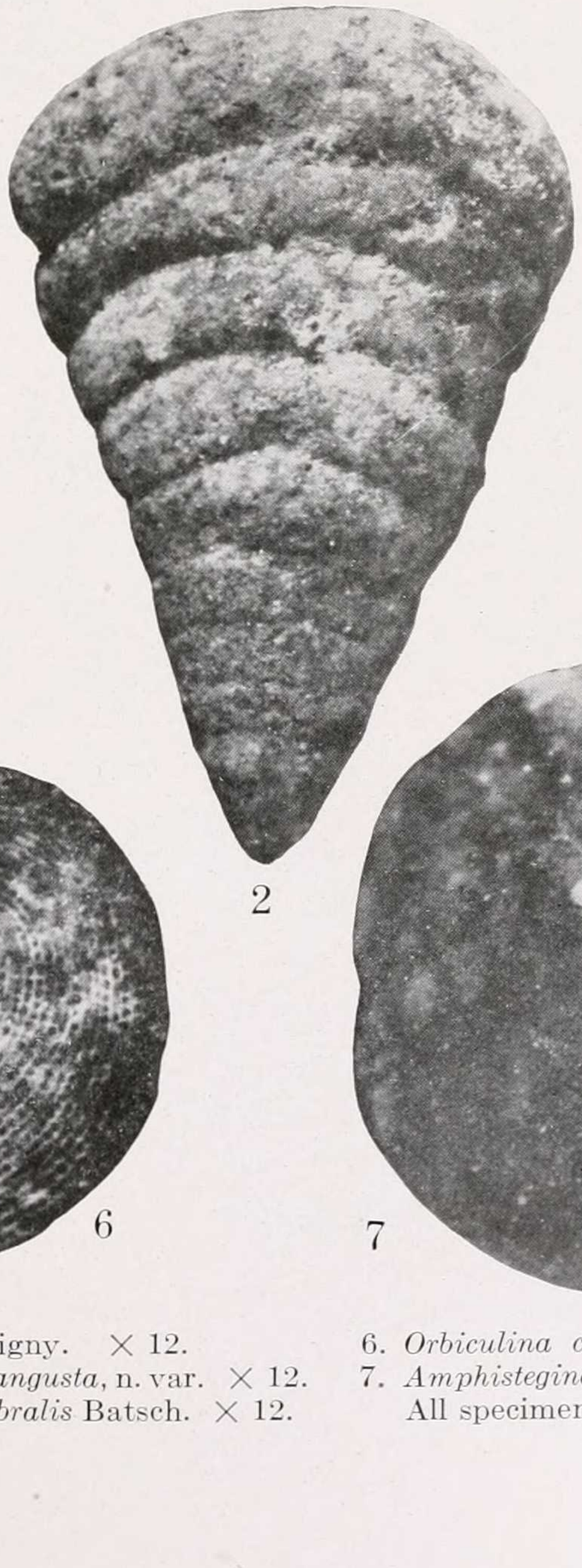

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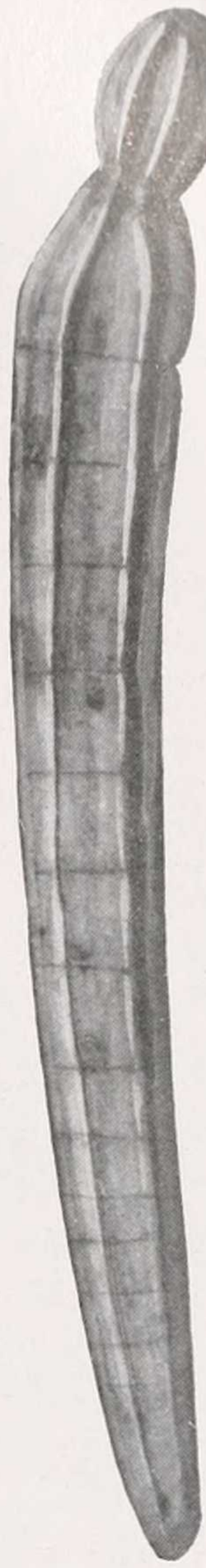

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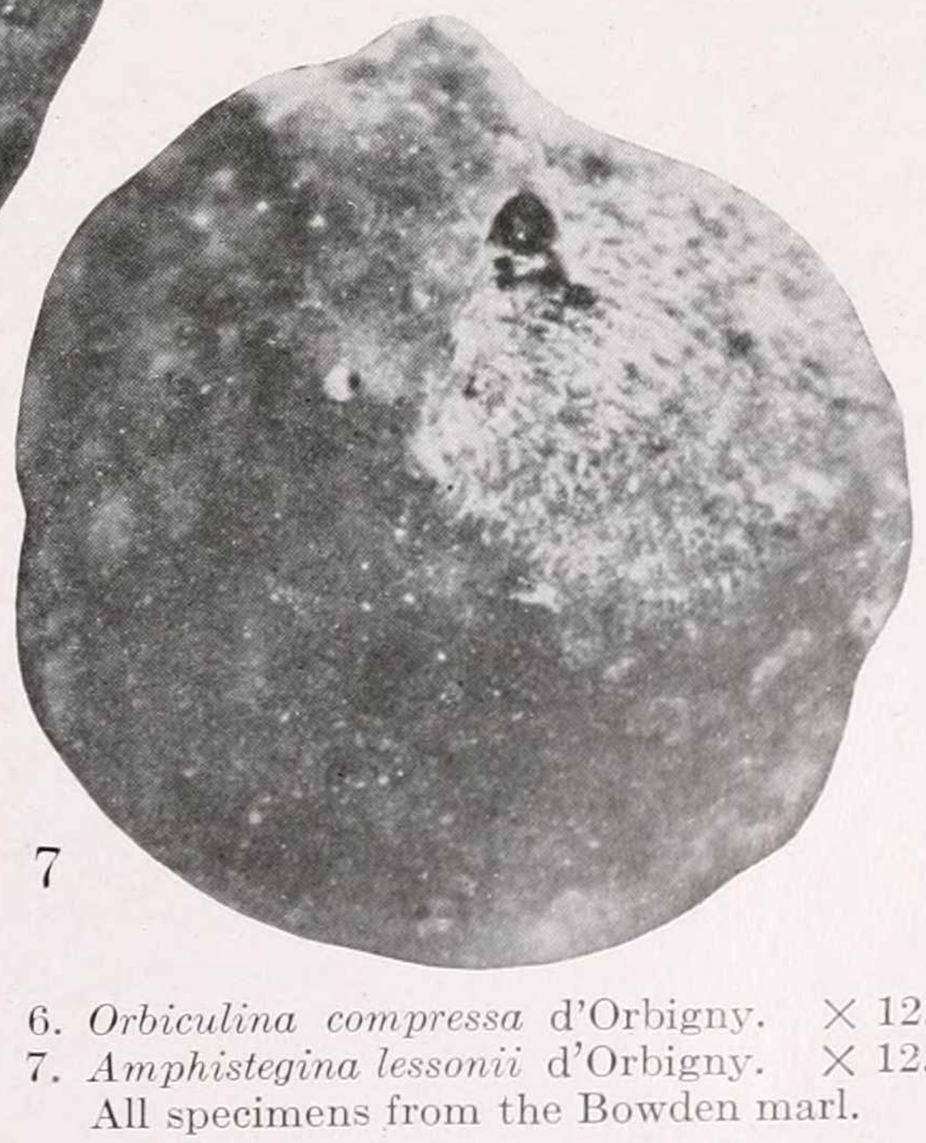
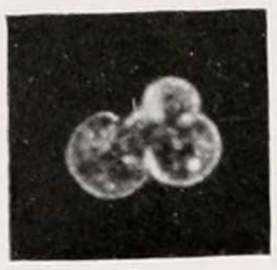


7

1. *Cuneolina pavonia* d'Orbigny. × 12.
2. *Cuneolina pavoniva* var. *angusta*, n. var. × 12.
3, 4, and 5. *Nodosaria vertebralis* Batsch. × 12.
6. *Orbiculina compressa* d'Orbigny. × 12.
7. *Amphistegina lessonii* d'Orbigny. × 12.
All specimens from the Bowden marl.



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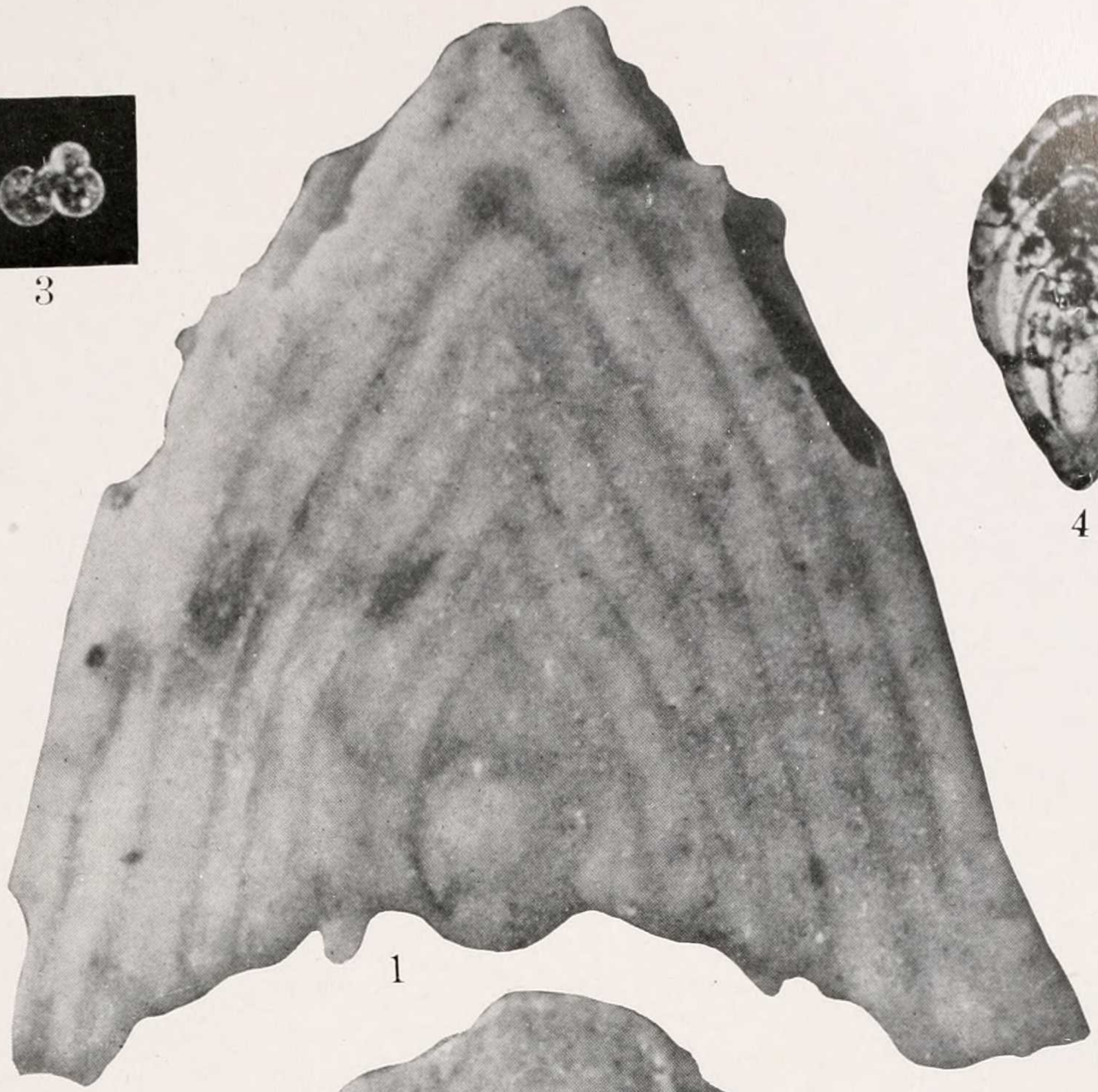

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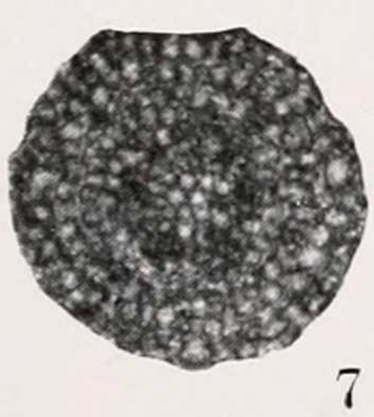

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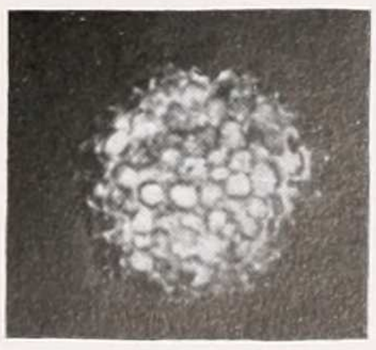

8

1. *Frondicularia alata* d'Orbigny. × 13. From Bowden marl.
2. *Cristellaria bowdenensis*, n. sp. × 13. From Bowden marl.
3. *Globigerina* sp.? × 18. Cuba, Station 7664.
4. *Polymorphina* sp.? × 18. Cuba, Station 7664.
5. *Nonionina* sp.? × 18. Cuba, Station 6117.
6. *Rotaliform* species. × 18. Cuba, Station 7513.
7. *Linderina* sp.? × 18. Cuba, Station 3448.
8. *Linderina* sp.? × 18. Cuba, Station 7666.

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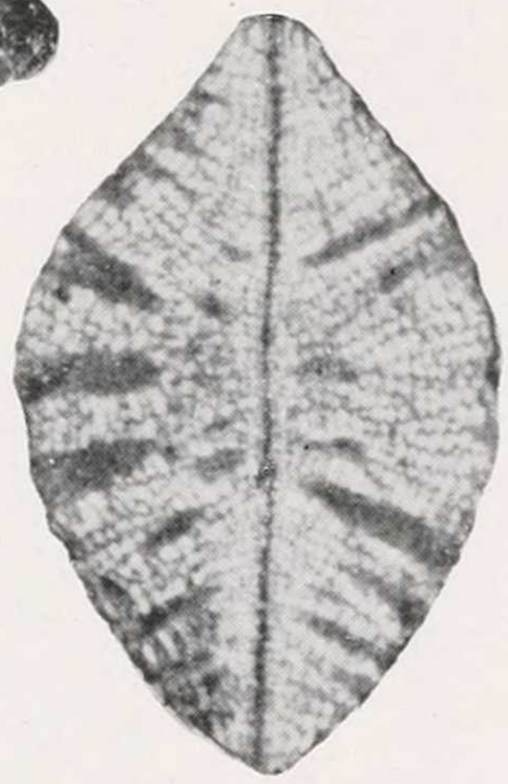

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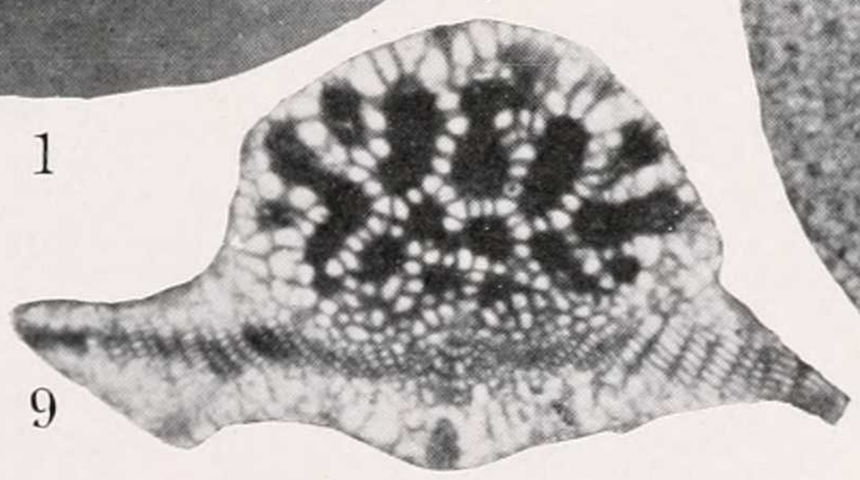

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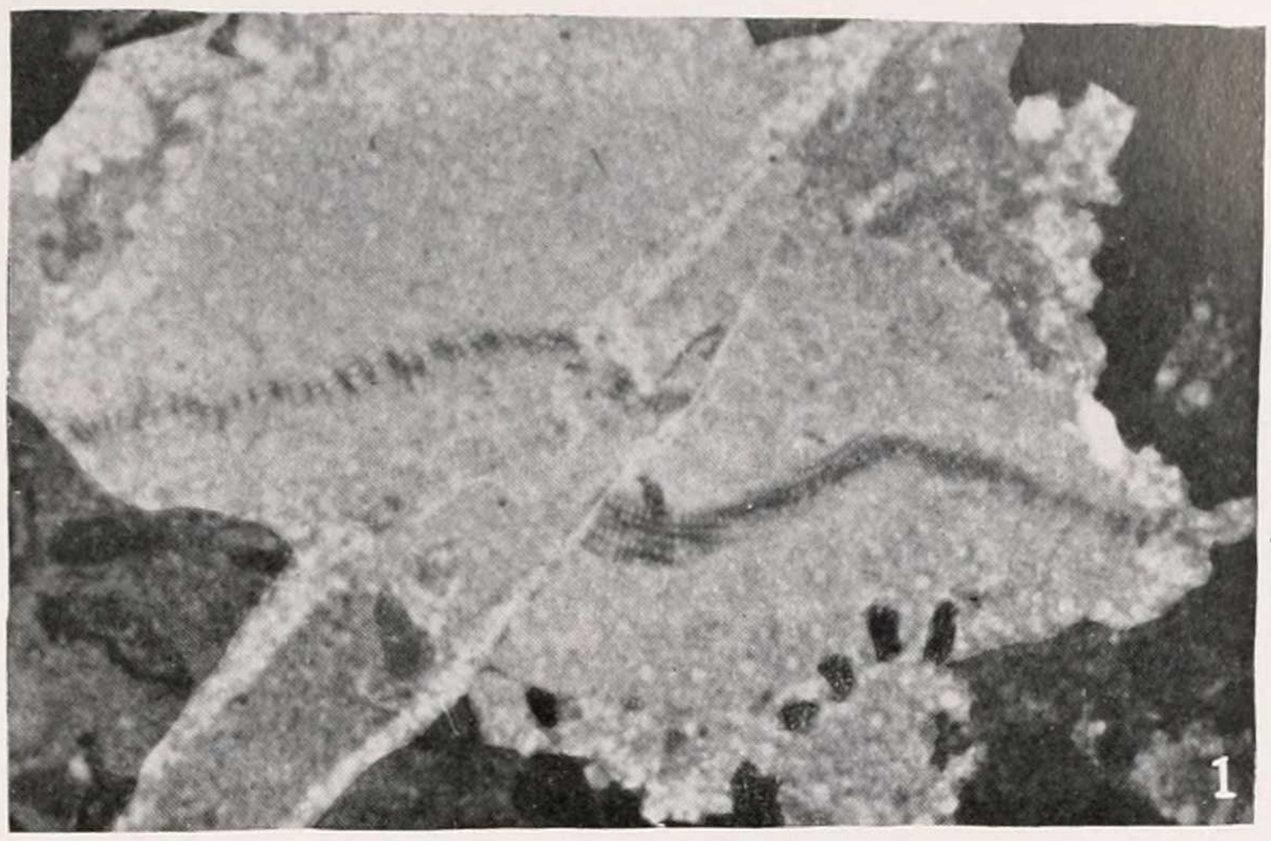
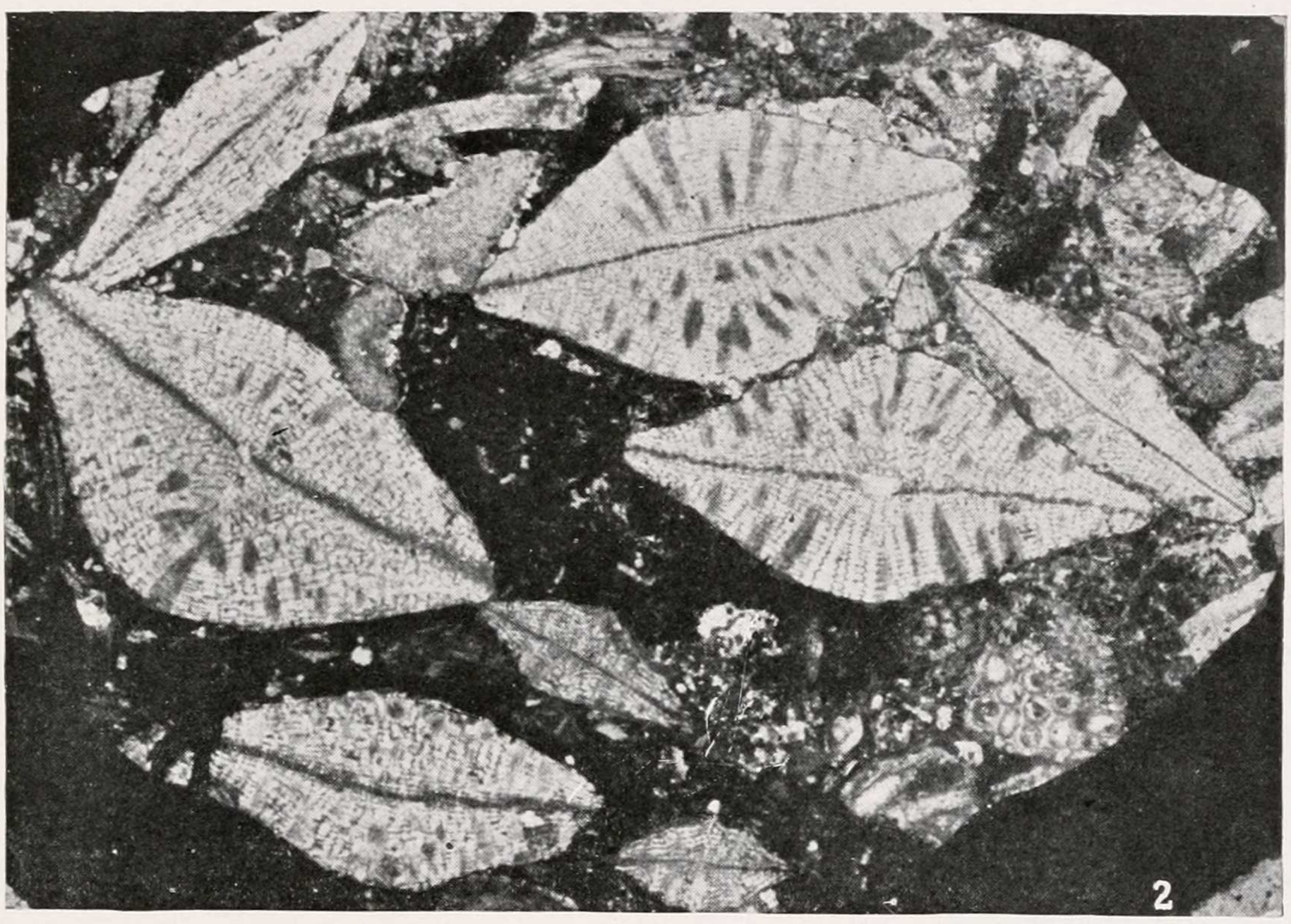
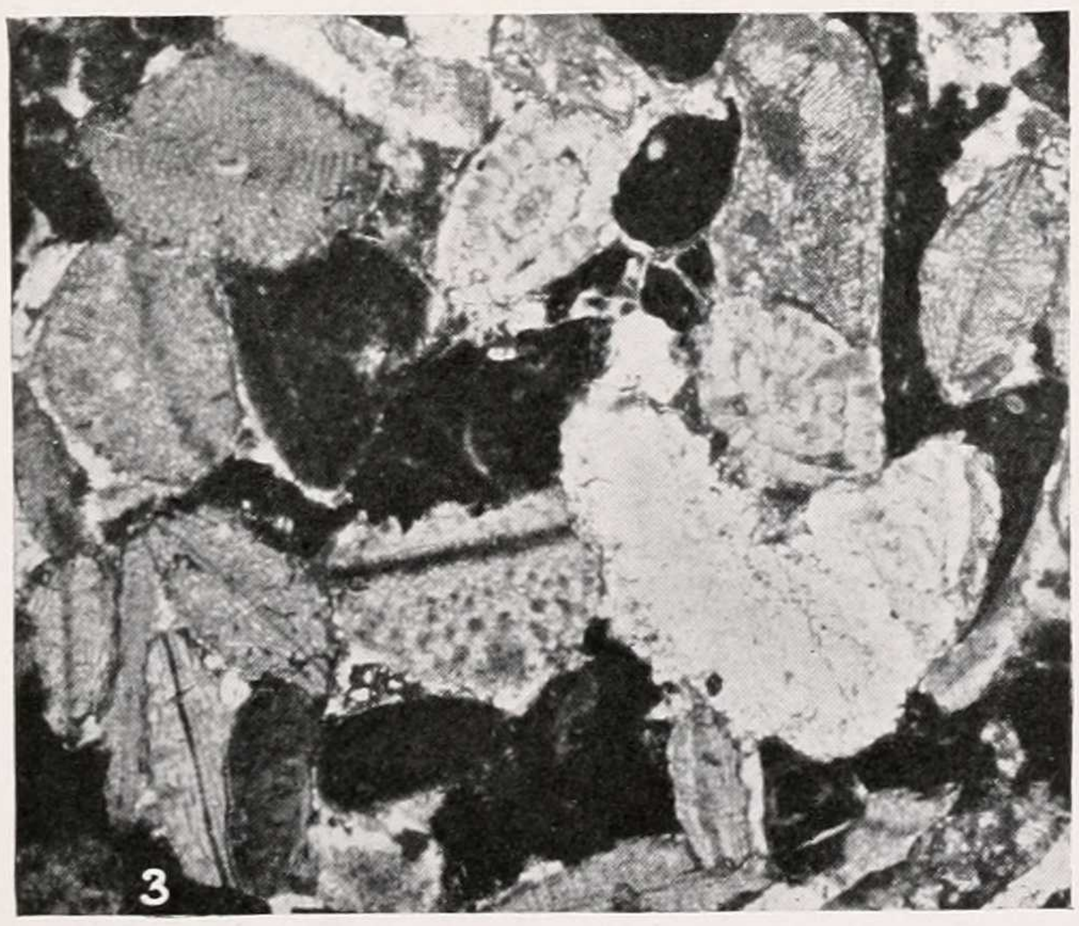
7

1. *Gypsina globulus* var. *pilaris* H. B. Brady. Exterior × 15. From Bowden marl.
2. *Gypsina globulus* var. *pilaris* H. B. Brady. × 15. Section from Bowden marl.
3. *Orthophragmina cubensis*, n. sp. Vertical section. × 20. Cuba, Station 3448.
4 and 5. *Orthophragmina crassa*, n. sp. Vertical sections. × 20. Cuba, Station 6122.
6. *Orthophragmina pustulata*, n. sp. Exterior. × 20. Cuba, Station 3478.
7. *Orthophragmina pustulata*, n. sp. Slightly oblique section, showing equatorial chambers, pillars, and lateral chambers, × 20. Cuba, Station 3667.
8. *Orthophragmina sculpturata*, n. sp. Vertical section. × 20. Cuba, Station 3478.
9. *Orthophragmina sculpturata*, n. sp. Oblique section, showing rectangular, elongate, equatorial chambers, large pillars with a single series of lateral chambers, between. × 20.







1. *Orthophragmina pustulata*, n. sp. Oblique section. × 16. Cuba, Station 3448.
2. Section of rock from Cuba, Station 6125, showing vertical sections of *Orthophragmina crassa*, n. sp. (large), *O. cubensis* (small at bottom), and *O. subtaramellei*, at right. × 16.
3. Section of rock from Cuba, sections of *Orthophragmina cubensis*. × 16.
4. Section of rock from Cuba, Station 3476, showing several sections of *Orthophragmina cubensis*, n. sp. on right and one of *O. crassa*, n. sp. on left.

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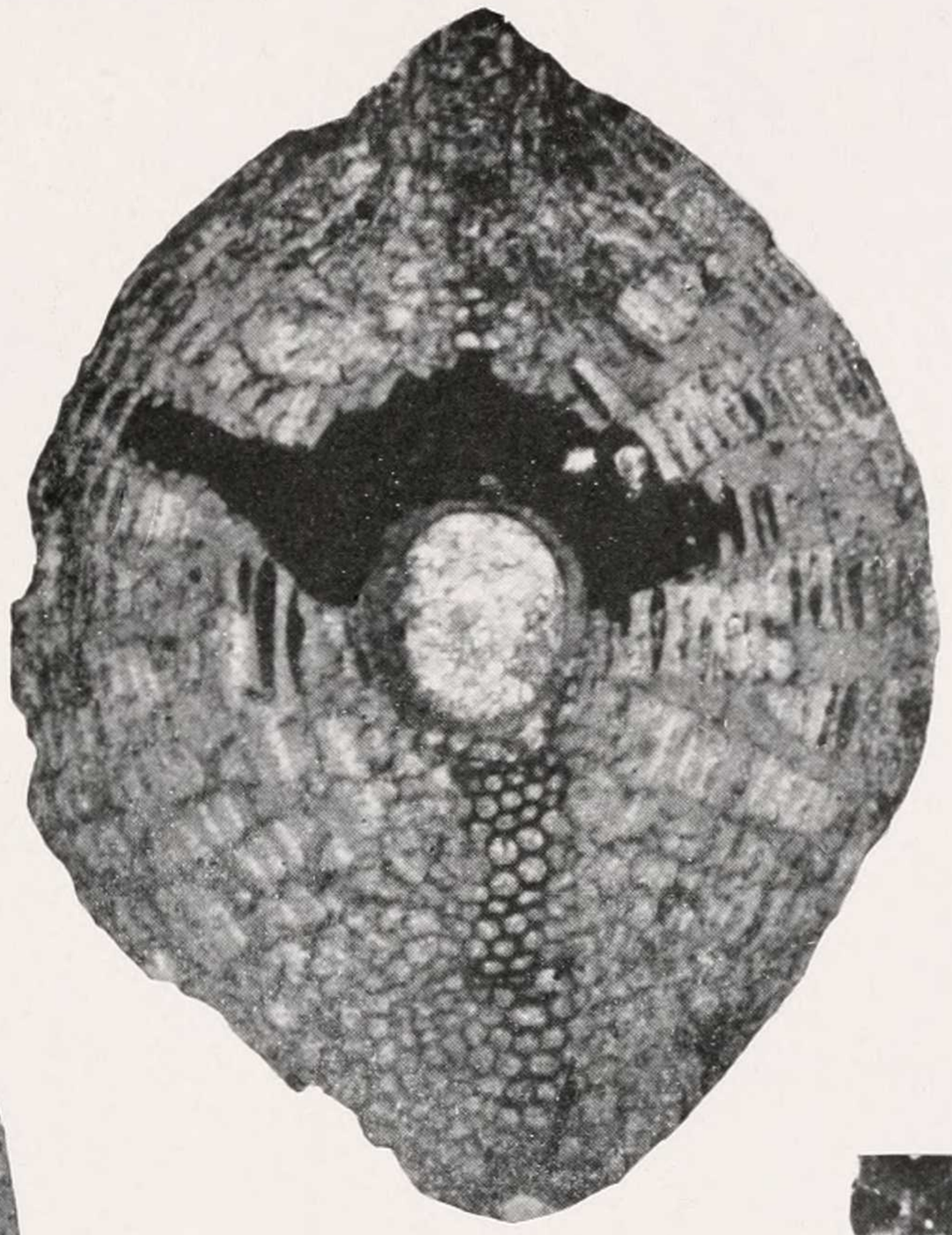

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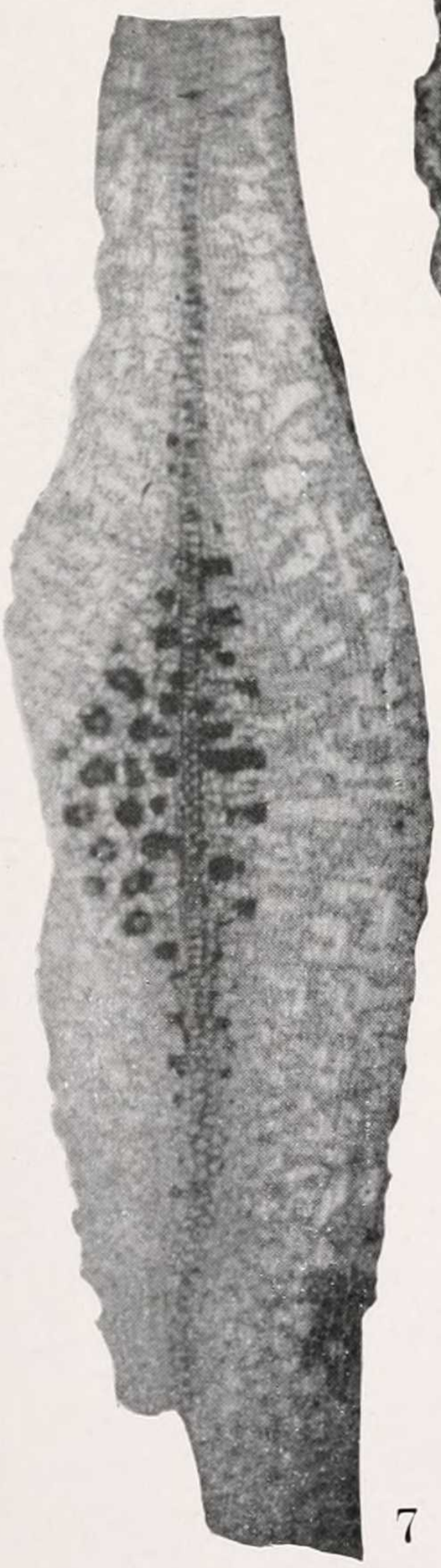

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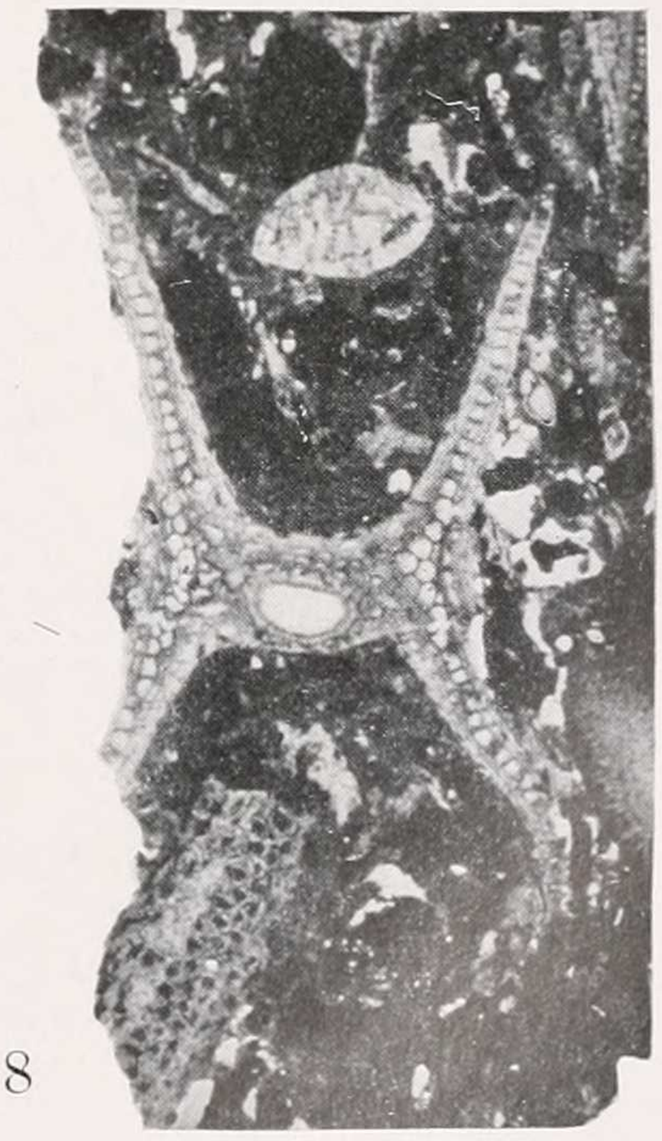
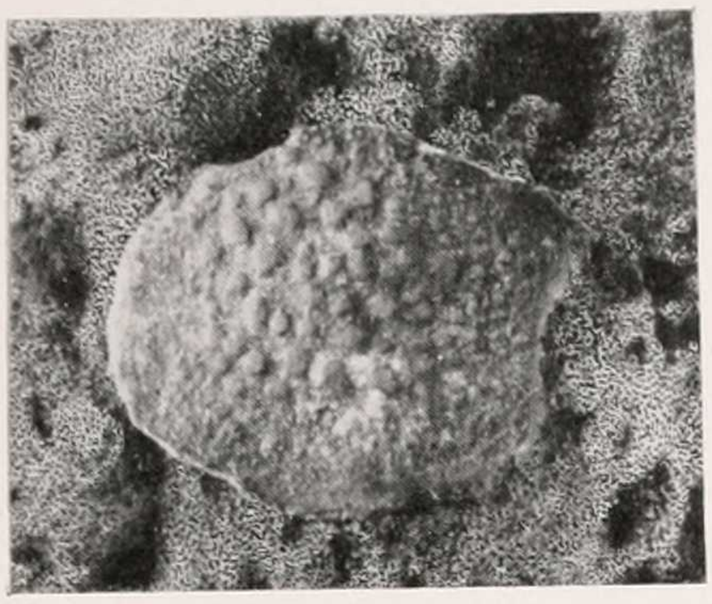


8

1. *Lepidocyclina morgani* Lemoine and R. Douvillé. Exterior. × 6. Cuba, Station 7664.
2. *Lepidocyclina morgani* Lenoire and R. Douvillé. Vertical section. × 16. Cuba, Station 7664.
3. *Lepidocyclina morgani* Lenoire and R. Douvillé. Vertical section. × 16. Cuba, Station 7543.
4. *Lepidocyclina crassata*, n. sp. Vertical section, × 16. Cuba, Station 7513.
5. *Lepidocyclina crassata*, n. sp. Vertical section, young. × 16. Cuba, Station 7521.
6. *Lepidocyclina subraulinii*, n. sp. Exterior. × 4. Cuba, Station 3478.
7. *Lepidocyclina subraulinii*, n. sp. Vertical section. × 8. Cuba, Station 3478.
8. *Lepidocyclina perundosa*, n. sp. section. × 8. Cuba, Station 3478.



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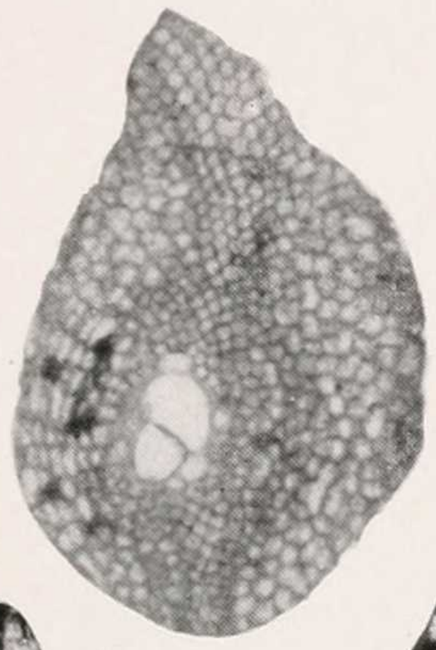

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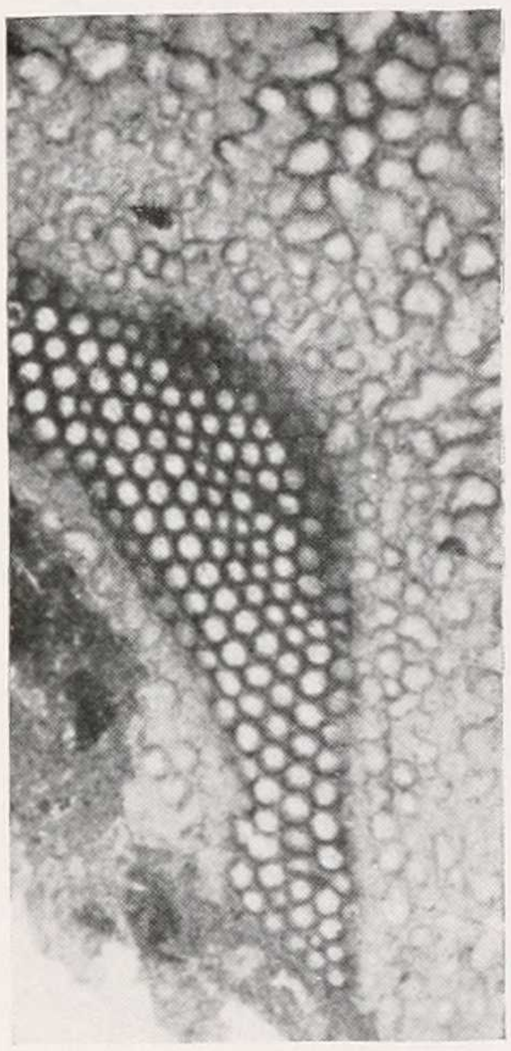

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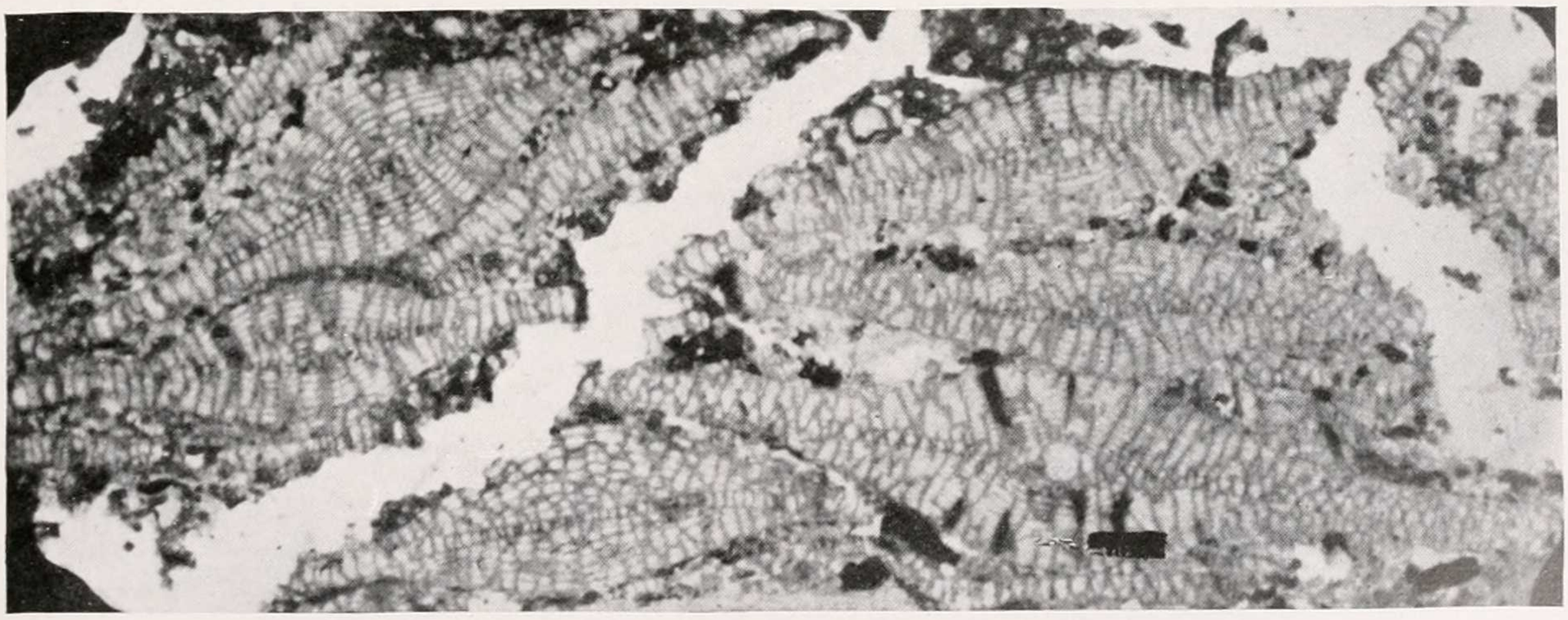
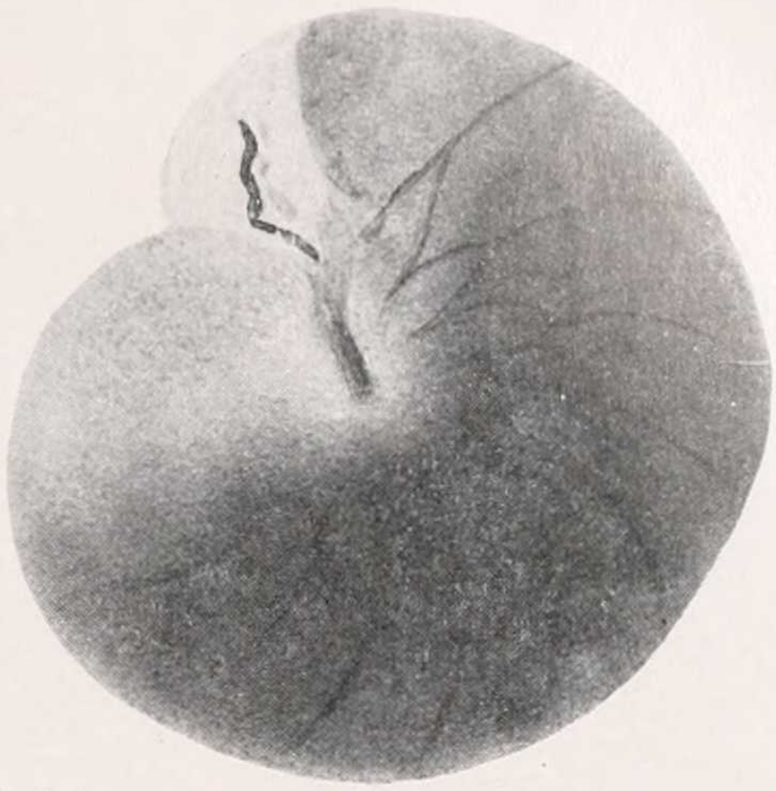


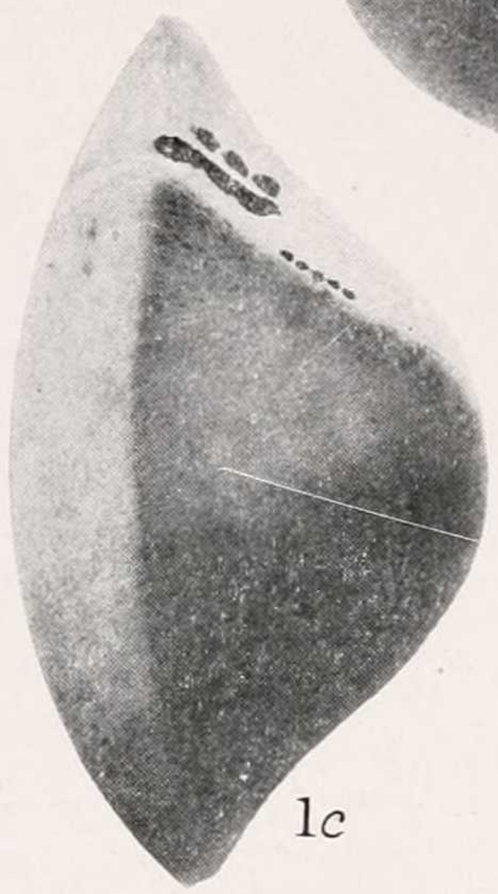
8

1 and 2. *Lepidocyclina marginata* (Michellotti). Exterior. × 4. Cuba, Station 7518.
3 and 4. *Lepidocyclina sumatrensis* (Brady). Vertical sections. × 16. Cuba, Station 7516.
5. *Lepidocyclina subraulinii*, n. sp. Portion of vertical section. × 16. Cuba, Station 7666.
6. *Lepidocyclina subraulinii*, n. sp. Portion of oblique section, showing some of the equatorial and lateral chambers. × 16. Cuba, Station 7666.
7. *Lepidocyclina canvellei* var. *yurnagunensis*, n. var. Portion of horizontal section, showing several embryonic chambers, a portion of equatorial chambers, and at the side the lateral chambers. × 16. Cuba, Station 7548.
8. Rock section showing numerous nearly vertical sections of *Lepidocyclina canellei* var. *yurnagunensis*, n. var. × 16. Cuba, Station 7548.

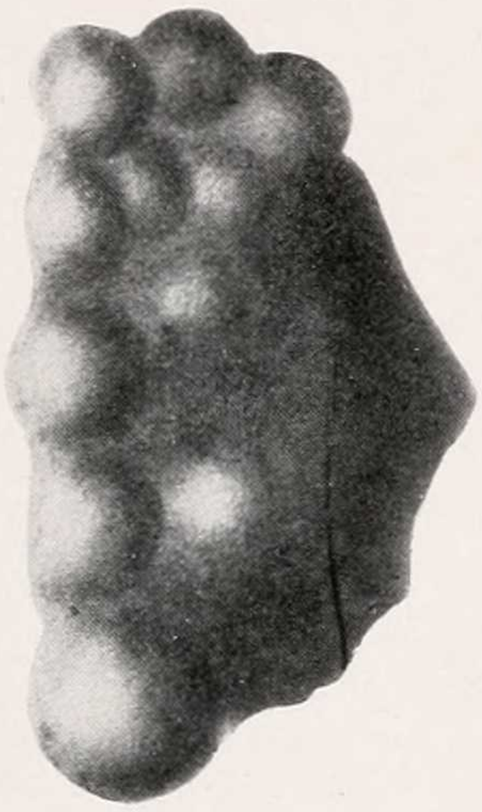
1a



1b



1c



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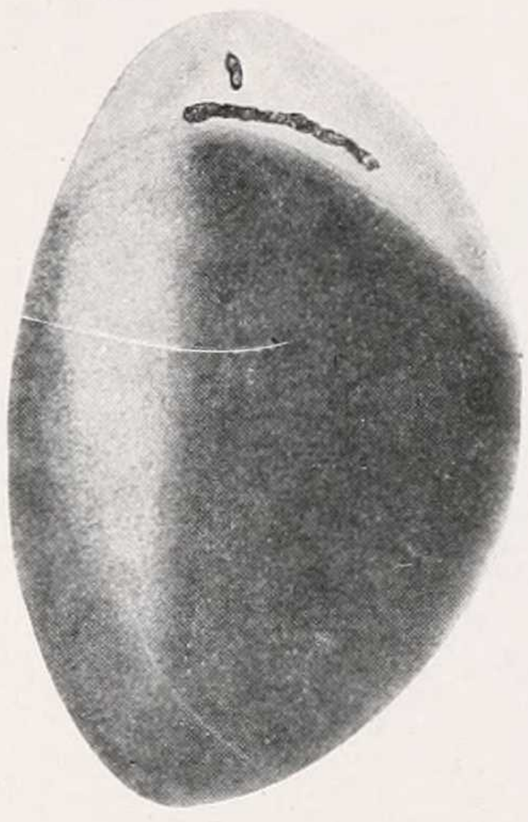

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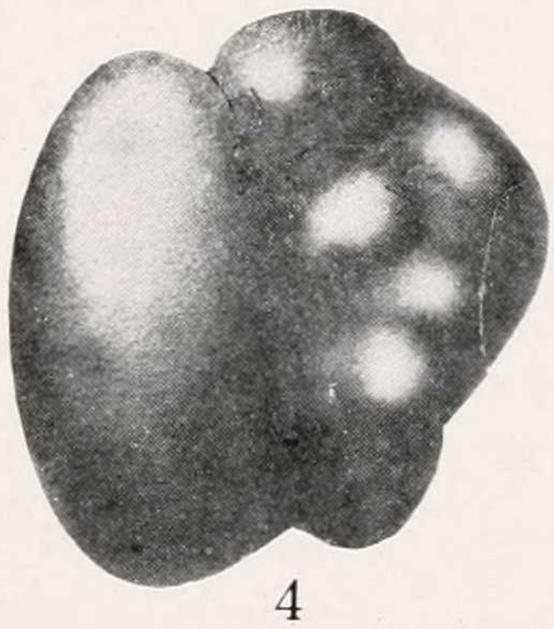

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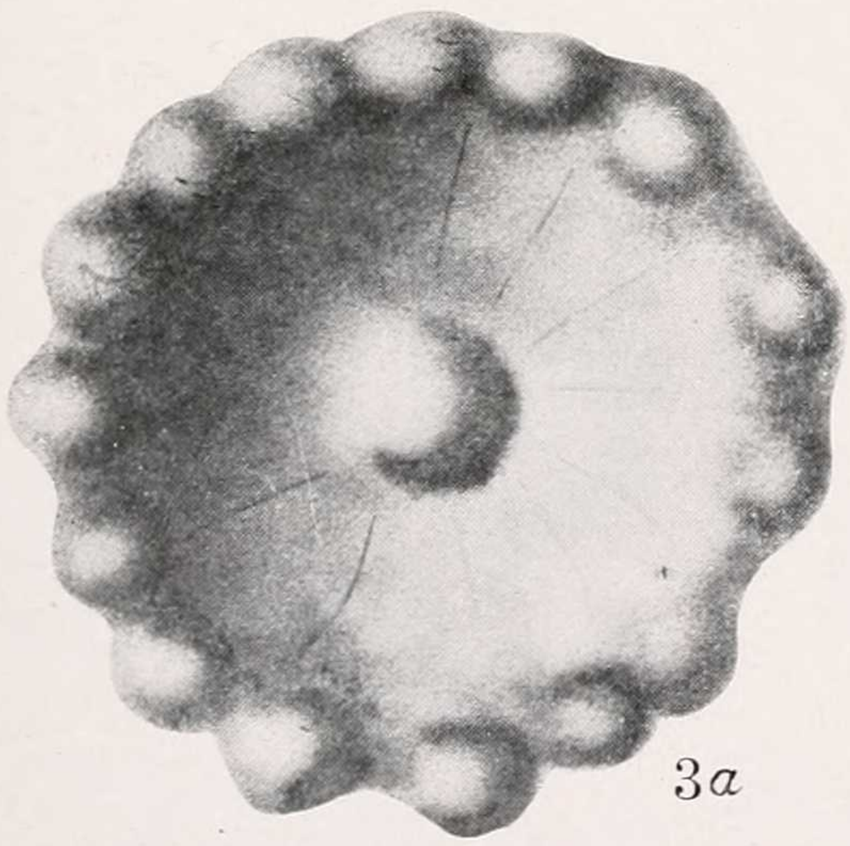


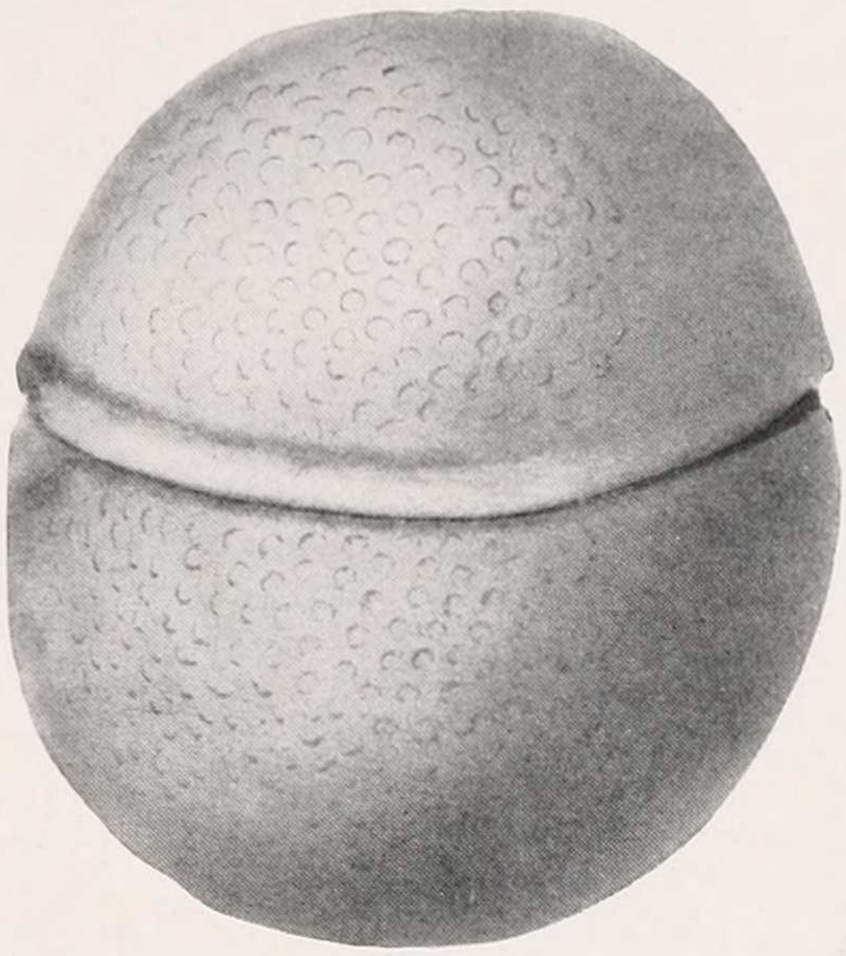
3a

3b

1. *Asterigerina angulata*, n. sp. (*a*) Dorsal view; (*b*) ventral view. × 24. Rio Cana, Zone I .
2. *Asterigerina rodundata*, n. sp. Apertural view. × 24. Rio Gurabo, Zone G.
3. *Asterigerina tuberculata*, n. sp. (*a*) Dorsal view; (*b*) ventral view; (*c*) side view. × 24. Rio Cana, Zone I.
4. *Asterigerina tuberculata*, n. sp. Side view of a more truncate specimen from the same section. × 24.

All specimens from Santo Domingo.

1



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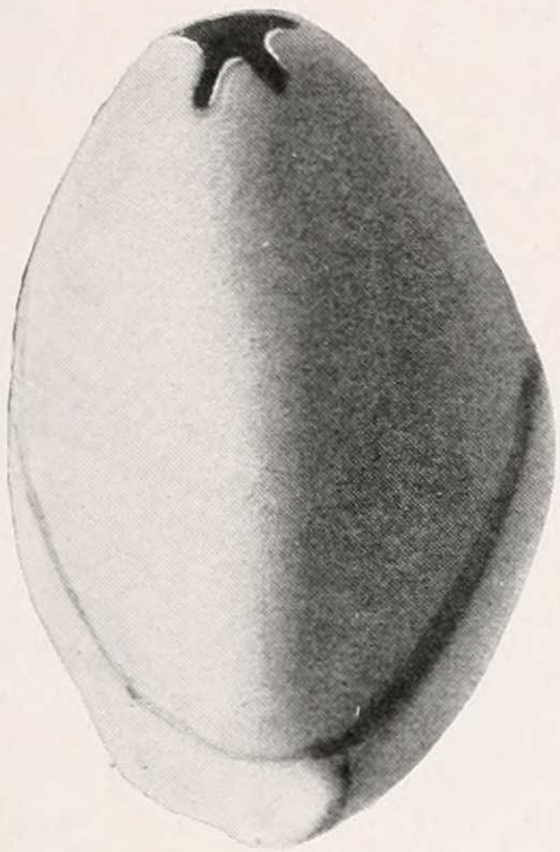

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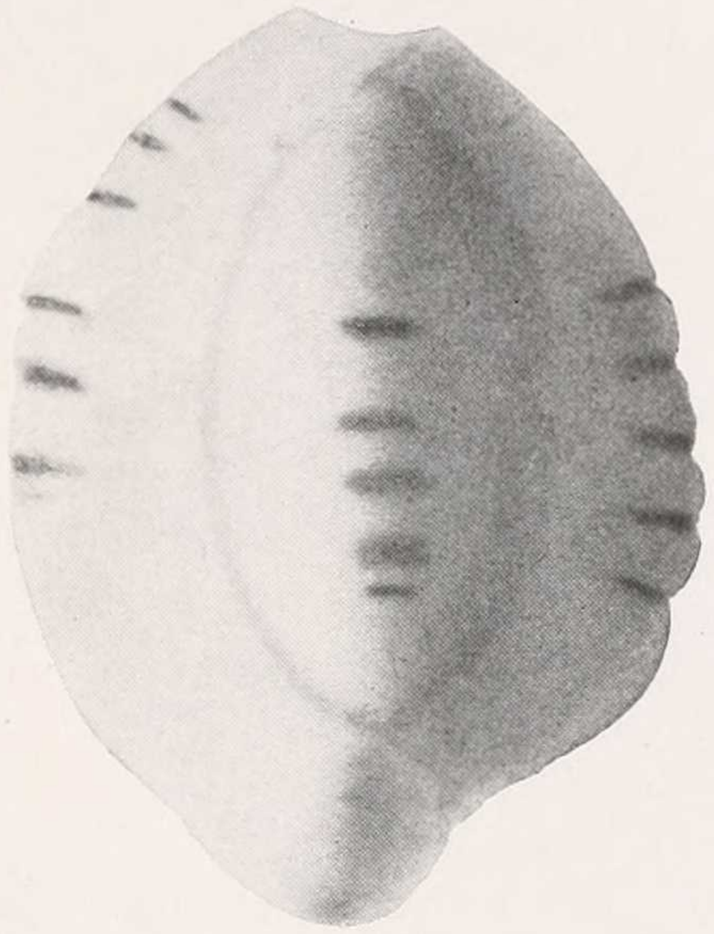

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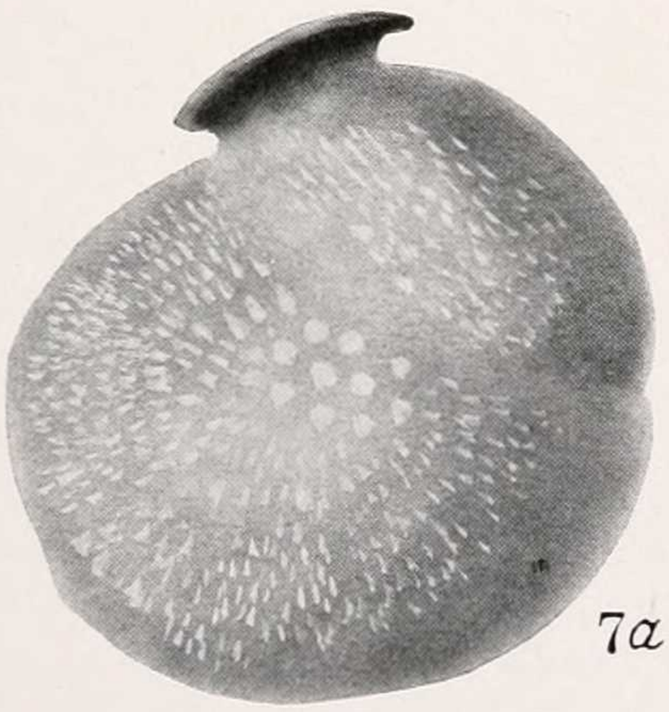
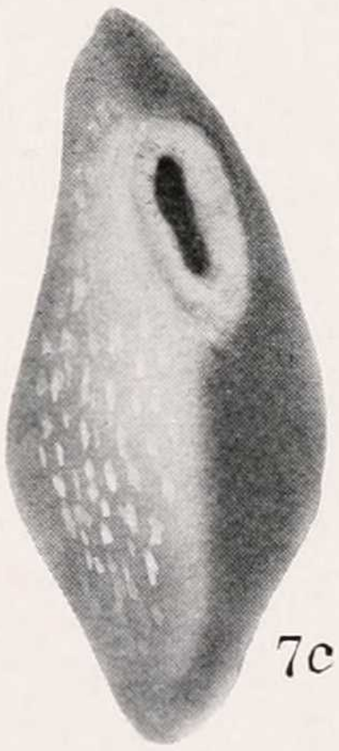


7a



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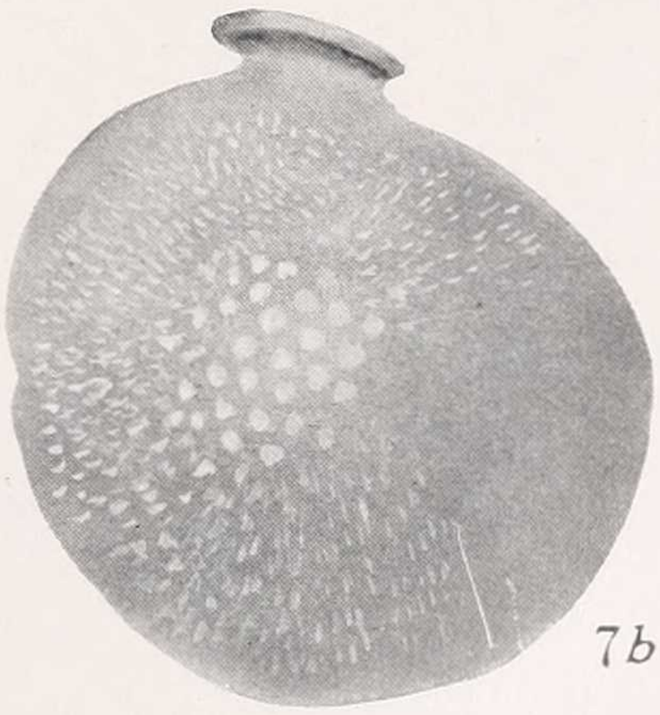
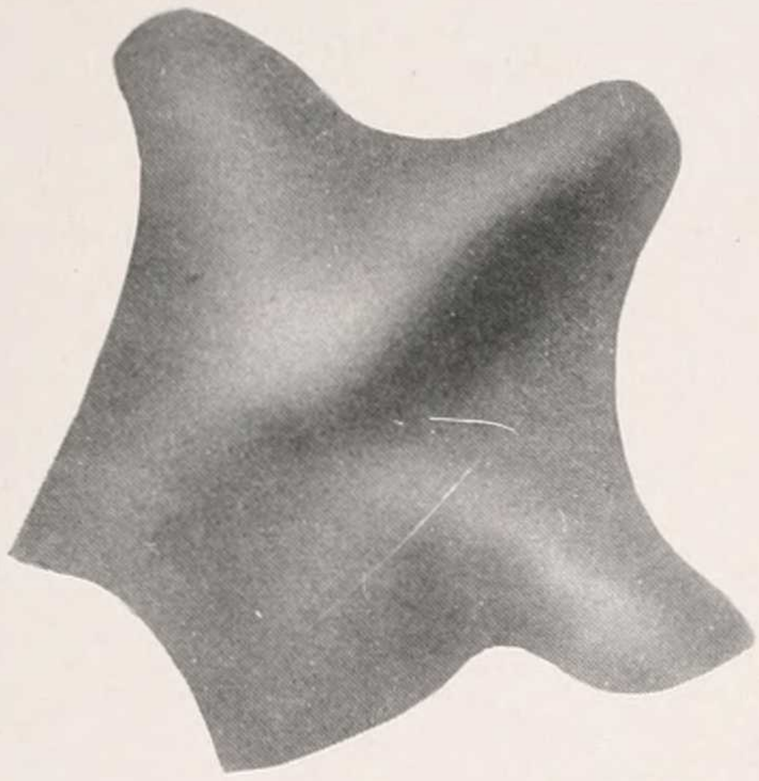


7b

1. *Bolivina lobata* var. *cubensis,* n. var. × 80. Matanzas, Cuba, Station 3461.
2. *Sphæroidina dehiscens* var. *immatura,* n. var. × 40. Bowden marl, Bowden, Jamaica.
3. *Vertebralina striata* d'Orbigny. × 40. Bowden, Jamaica.
4. *Triloculina tricarinata* d'Orbigny. × 40. Bowden, Jamaica.
5. *Quinqueloculina* sp. cf. *Q. kerimbatica* Heron-Allen and Earland. × 24. Bowden, Jamaica.
6. *Quinqueloculina parkeri* var. *bowdenensis,* n. var. × 40. Bowden, Jamaica.
7. *Siphonina pulchra,* n. sp. (*a*) Dorsal view; (*b*) ventral view; (*c*) apertural view. × 40. Matanzas, Cuba, Station 3461.



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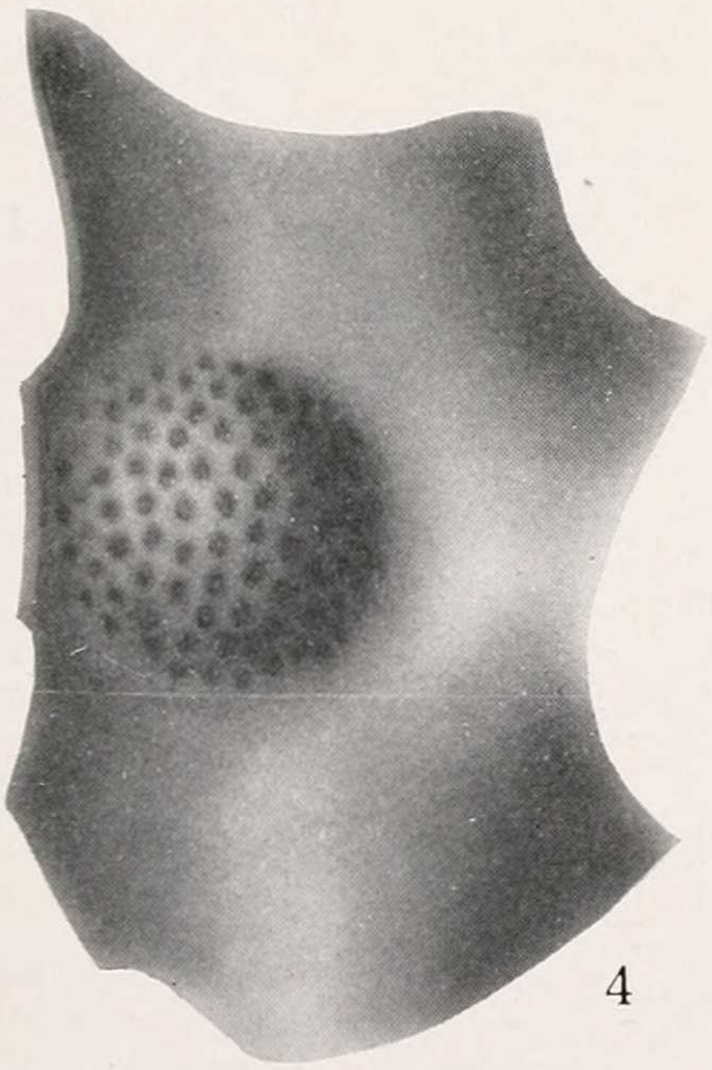

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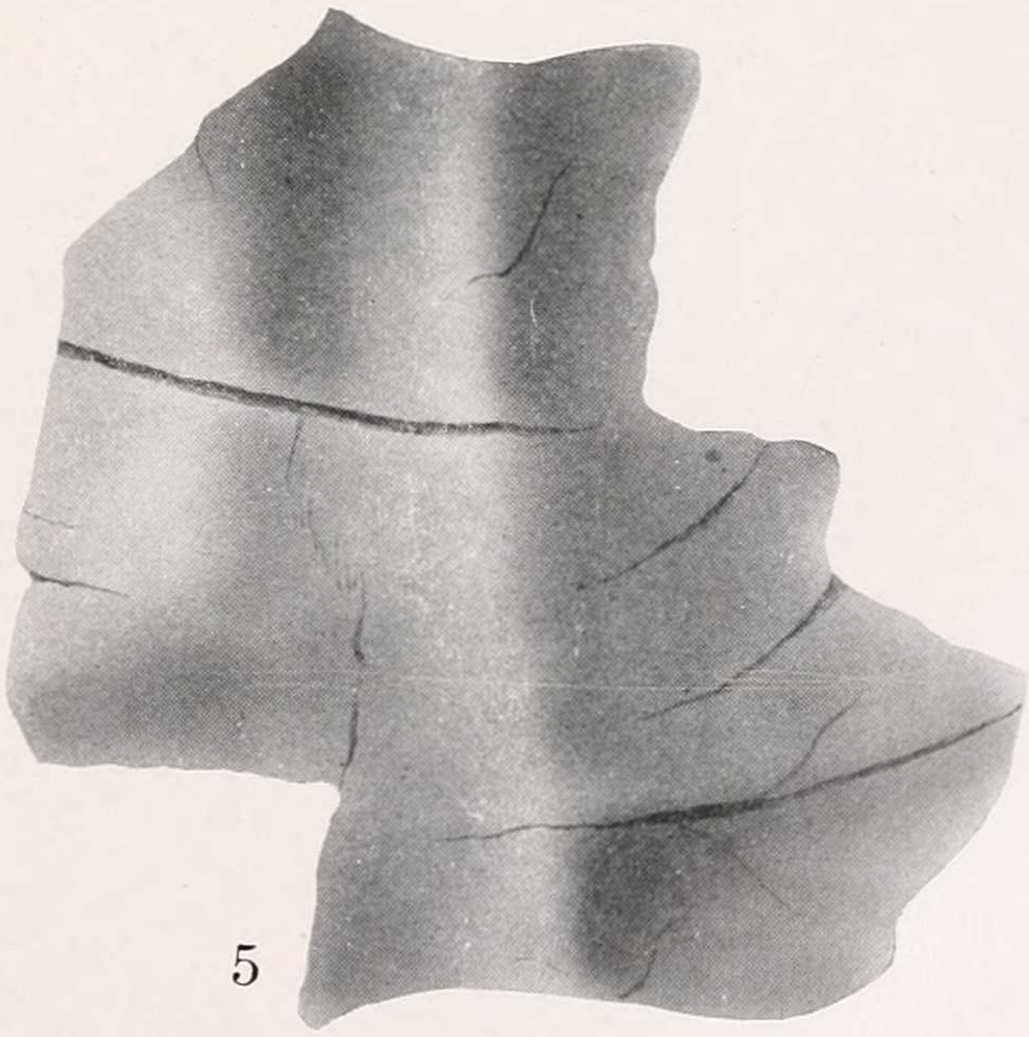

5

1, 2, and 3. *Orthophragmina subtaramellei*, n. sp. 1, 2, more regular pentagonal specimens; 3, irregularly hexagonal specimen. × 32. Specimens from Boston manganese mine, Santiago, Cuba.

4. *Lepidocyclina favosa*, n. sp., showing central pitted and thickened portion and the doubly curved test. × 6.

5. *Lepidocyclina undulata*, n. sp. Fragmentary specimen, showing large size and undulate character of surface, 0.8 natural size.