

SOME FORAMINIFERS OF THE GENUS *REOPHAX* AND
DESCRIPTION OF A NEW GENUS¹

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I. ABSTRACT

Reophax caribensis, sp. nov., is described. It is provided with a friable test composed of poorly cemented grains, generally laminar, and lives in shallow waters. It is compared with similar species, especially with *R. dentaliniformis* Brady.

Glaucoammima, gen. nov., is described and included in the family Lituolidae. The type species is *Reophax trilateralis* Cushman. This foraminifer is very variable in shape and lives on the outer submarine shelves of the Caribbean Sea. The test is composed of well cemented grains, mainly of glauconite, calcite, or dark minerals, or a combination of these.

II. INTRODUCTION

During the summers of 1966 and 1967, staff members of the Puerto Rico Nuclear Center made sampling collections on the insular platform between Guanajibo and Añasco Bay, off the west central coast of

Puerto Rico. At some stations, a great number of specimens of two arenaceous foraminifers of the genera *Reophax* and *Glaucoammima*, gen. nov., were found. The morphological characteristics of these foraminifers have never been clearly described and their distribution is related to interesting characteristics of the environment in which they live. The purpose of the work is to study their morphology, pointing out differences and affinities with other similar species, and their most significant relationships with the environment. The characteristics of some similar species have been revised.

Reophax is a foraminifer genus of very simple form, constituted of a linear series of chambers. This, along with the agglutinated walls, makes it difficult to establish specific differences. The evaluation of morphological characteristics requires a study of the population. This type of study may also contribute to the knowledge of the ecology of the species.

The authors are indebted to Dr. Ruth Todd of the U. S. Geological Survey and Drs. Richard Cifelli and Martin L. Buzas, for the facilities given to George A. Seiglie at the U. S. National Museum. Thanks are due also to Mrs. Vilma Román de Vega and to Frank G. Lowman of the Puerto Rico Nuclear Center for translating the manuscript into English.

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III. LOCATIONS

Most of the foraminifers used in this study were found off the central west coast of Puerto Rico at the outer edge of Mayagüez Bay. Station 49: 18° 12' 42" N. latitude, 67° 11' 10" W. longitude, 13 meters depth. Station 69: 18° 13' 30" N., 67° 12' 15" W., 76 meters depth. Station 66: 18° 13' 10" N., 67° 13' 05" W., 128 meters depth. Station 95: 18° 13' N., 67° 12' 45" W., 74 meters depth.

Station 12-6315 is located to the north of Los Testigos Islands, off the eastern coast of Venezuela, 11° 29' N. and 63° 11' W., 73 meters depth.

Atlantis station 2695, off the north Cuban coast is located at 23° 24' N. and 81° 06' 30" W., 1107 meters depth.

IV. SYSTEMATICS

Family HORMOSINIDAE

Genus *Reophax* Montfort, 1808

Reophax arayaensis Bermúdez and Seiglie

Text figure 34

Reophax scorpiurus Montfort. CUSHMAN, 1920, U. S. Natl. Mus. Bull. 104, pl. 1, fig. 5 (not figs. 6 and 7) (in part not Montfort, 1808).
Reophax arayaensis BERMÚDEZ and SEIGLIE,

1963, Univ. Oriente, Oceanogr. Inst., Bol., v. 2, p. 146, pl. 1, figs. 1-3.

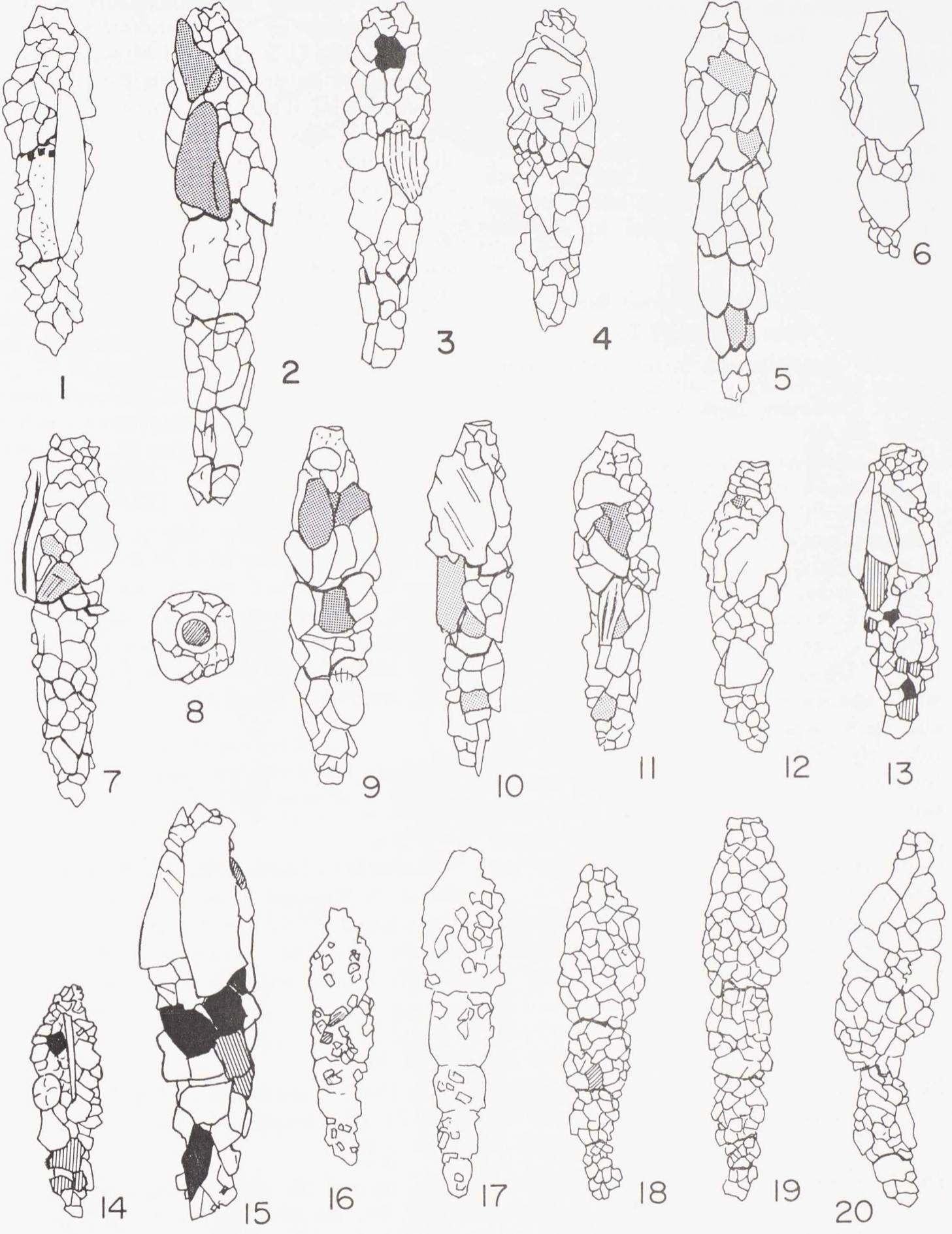
Remarks.—This species has some apparent similarities to *Glaucammmina trilateralis* (Cushman) [= *Reophax trilateralis* Cushman]. However, *Reophax arayaensis* is a true *Reophax*, totally uniserial. Secondly, the first chamber is in the narrower part of the test, which is tapering; this does not occur in *Glaucammmina trilateralis*. Thirdly, *Reophax arayaensis* lives in shallow waters, generally from 18 to 37 meters depth. The specimens referred by Cushman (1920) to *R. scorpiurus* are from Montego Bay, Jamaica, at 18 meters depth, (text figure 34). The habitat of *Glaucammmina trilateralis* is discussed below.

The transverse section of this foraminifer is triangular; however, it is not due to the disposition of the chambers, but rather to the form of the grains that adhere to the test. The grains are tabular and of relatively large size. The foraminifers of the genus *Reophax* that affix tabular or laminate grains to their tests, generally have a polygonal transverse section. The polygonal section is more resistant mechanically than is the triangular one.

→

TEXT FIGURES 1-20

- 1-12 *Reophax caribensis*, sp. nov. Sta. 49, Mayagüez Bay, depth 13 meters; 1) paratype, length 0.96 mm; 2) holotype, length 1.36 mm; 3-12 paratypes; 3) length 1.03 mm; 4) length 0.88 mm; 5) length 1.10 mm; 6) length 0.51 mm; 7) length 1.04 mm; 8) apertural view; 9) length 0.98 mm; 10) length 0.97 mm; 11) length 0.90 mm; 12) length 0.81 mm.
- 13,14 *Reophax caribensis*, sp. nov. Gulf of Paria, Trinidad, depth 4 to 33 meters; Cushman Coll., USNM 64754; 13) length 0.87 mm; 14) length 0.68 mm (figured also by Todd and Brönnimann, 1957, pl. 1, fig. 19).
- 15 ? *Reophax caribensis*, sp. nov. Gulf of Mexico, depth 55 meters; Cushman Coll., USNM; length 1.21 mm (figured also by Phleger and Parker, 1951, pl. 1, fig. 6).
- 16 *Reophax caribensis*, sp. nov. USNM 641393; schematic drawing, length 1.04 mm (figured also by Buzas, 1965, pl. 1, fig. 1).
- 17 *Reophax dentaliniformis* Brady. Gulf of California, depth 285 meters; USNM 643347; schematic drawing, length 1.39 mm (figured also by Phleger, 1964, pl. 1, fig. 1).
- 18,19 *Reophax dentaliniformis* Brady. *Albatross* Sta. 2550, Atlantic Ocean, depth 1980 meters; USNM 10174; 18) length 1.28 mm; 19) length 1.49 mm.
- 20 *Reophax dentaliniformis* Brady. *Albatross* Sta. D 2189, Atlantic Ocean, depth 1097 meters; USNM 10160; length 1.49 mm.



TEXT FIGURES 1-20

Reophax sp. cf. *R. pilulifer* Brady

Text figures 32, 33

Remarks.—Some specimens of this foraminifer have certain similarities to *Reophax dentaliniformis* Brady. It may be observed that the illustrated specimens have very globular chambers and the test is much larger and more solid than those of the specimens generally assigned to *R. dentaliniformis*.

Reophax dentaliniformis Brady

Text figures 17-20

Reophax dentaliniformis BRADY, 1881, Quart. Jour. Micr., v. 21, p. 49; BRADY 1884, Rept. Voy. Challenger, Zool., v. 9, p. 293, pl. 30, figs. 23, 24.

Remarks: At present, it is not possible to include a complete synonymy of this species with certainty, therefore only a reference to the original description is made. In that description the most significant specific characteristics are: "slightly ventricose segments, texture somewhat coarsely arenaceous . . . and not very rough externally." Brady (1884) pointed out that it is a deep water species and his illustrated specimens also show depressed sutures and grains of relatively uniform size. He explained that "under this name the denteline-like modifications of *Reophax scorpiurus* have been grouped together." This is a vague expression because many *Reophax* species are dentaliniform.

Specimens of *Reophax dentaliniformis* illustrated by Cushman (1920) are similar to Brady's figure. These specimens may be

grouped together morphologically with a great number of *R. dentaliniformis* deposited in the U. S. National Museum. Three of them are illustrated in this paper in text figures 18-20. The most important characteristics of this morphological group are: slightly curved or straight test, elongated chambers slightly ventricose, depressed sutures and agglutinated material consisting of grains of more or less uniform size, relatively coarse but with the surface not very rough.

Most of the specimens from the *Albatross* stations in the Atlantic Ocean mentioned by Cushman (1920) were examined by G. A. Seiglie in the U. S. National Museum. From these stations, the following ones contain specimens that are undoubtedly *R. dentaliniformis*: D2160, D2212, D2679, D2562, D2392, D2111, D2115, D2039, D2231, D2018, D2550. Their depths range from 300 to 3730 meters. Most of the specimens from the shallower stations should be included in other species. Many stations have specimens that could be considered as *Reophax subfusiformis* Earland or in the group of *R. scorpiurus* Montfort.

Reophax sp. A

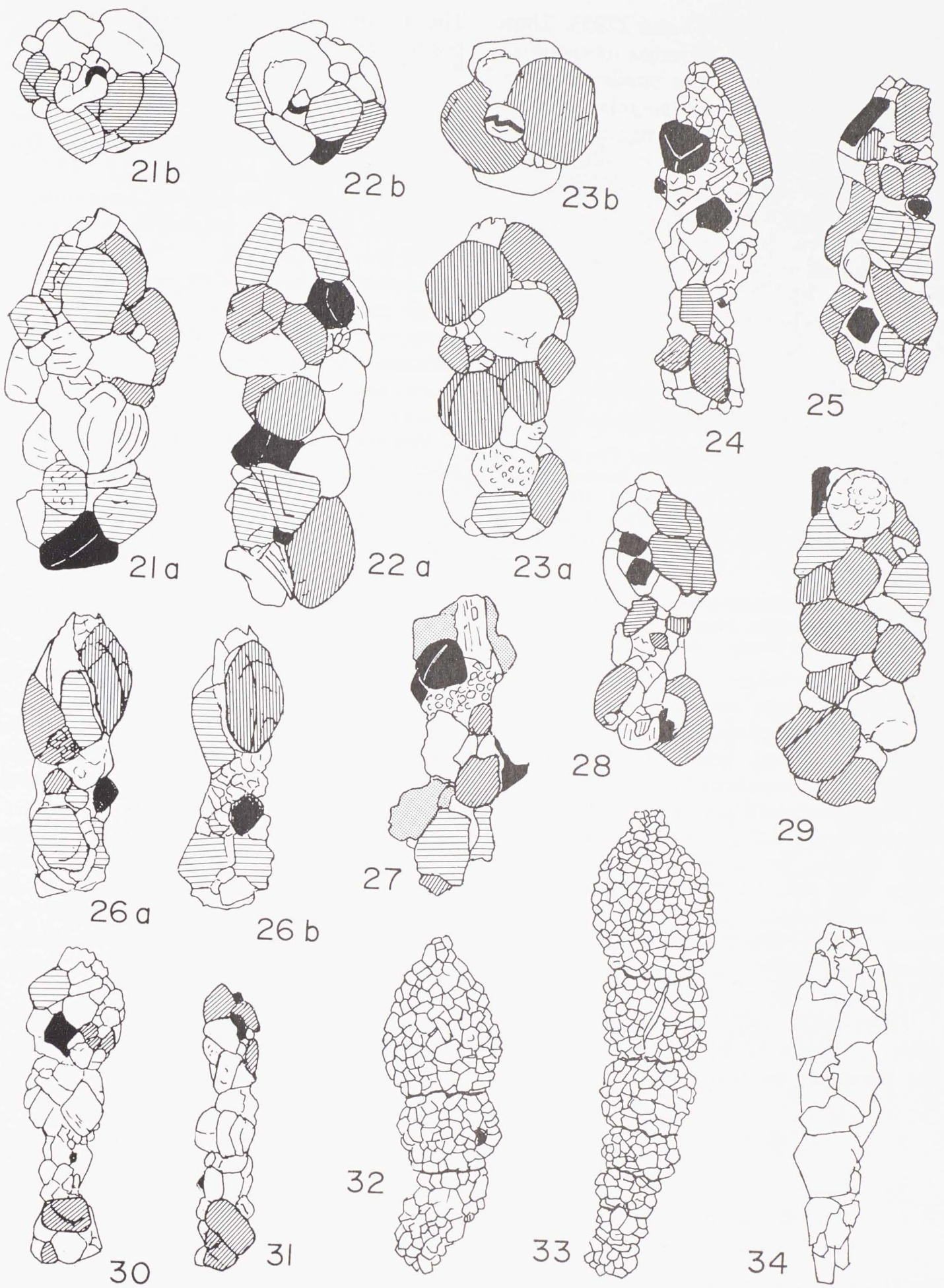
Reophax dentaliniformis Brady. CUSHMAN, 1948, Cushman Lab. Foram. Res., Spec. Publ. no. 23, pl. 2, figs. 11, 12 (not Brady, 1884).

Remarks.—This species is represented in the U. S. National Museum by some specimens found off Greenland. They correspond to the Cushman Collection nos. 60067, 60217, 60355, and 59974 and U. S. Na-

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TEXT FIGURES 21-34

- 21-23 *Glaucammmina trilateralis* (Cushman). Sta. 12-6315 northwest of Los Testigos Banks, western Venezuela, depth 73 meters; 21 a-b) length 1.47 mm; 22 a-b) length 1.56 mm; 23 a-b) length 1.29 mm.
- 24-31 *Glaucammmina trilateralis* (Cushman). Sta. 66 and 69, at 128 meters and 76 meters respectively, close to Mayagüez Bay; 24) sta. 69, length 1.36 mm; 25) sta. 66, length 1.19 mm; 26 a-b) sta. 66, length 1.19 mm; 27) sta. 69, length 1.23; 28) sta. 69, length 1.17 mm; 29) sta. 66, length 1.29 mm; 30) sta. 66, length 1.27 mm; 31) sta. 66, length 1.18 mm.
- 32,33 *Reophax* sp. cf. *R. pilulifer* Brady. *Albatross* sta. D5637, Pacific Ocean, depth 1280 meters; Cushman Coll. 278; 32) length 2.74 mm; 33) length 3.76 mm.
- 34 *Reophax arayaensis* Bermúdez and Seiglie. Montego Bay, Jamaica, depth 18 meters; Cushman Coll. 66921; length 1.48 mm.



TEXT FIGURES 21-34

tional Museum nos. 27967 and 27953. These specimens constitute a different morphological species: the test is of a smaller size, the chambers are shorter and irregular, and the surface is relatively more corrugated than in *Reophax dentaliniformis*. The illustrations by Cushman (1948) do not show the most important characteristics of the species.

A specimen from the Neny Fjord in Antarctica illustrated by Cushman (1945, Proc. Amer. Phil. Soc., v. 89, pl. figs. 6, 7) as *R. dentaliniformis* is very similar to *R. sp. A*, but the chambers are more inflated.

Reophax caribensis, sp. nov.

Plate 1, figs. 5a-b; text figures 1-16

Reophax dentaliniformis Brady. PHLEGER and PARKER, 1951, Geol. Soc. America, Mem. 46, p. 2, pl. 1, fig. 1 (not Brady, 1884).

Reophax dentaliniformis Brady. TODD and BRONNIMANN, 1957, Cushman Found. Foram. Res., Spec. Publ. 3, p. 32, pl. 1, fig. 19 (not Brady, 1884).

[?] *Reophax dentaliniformis* Brady. BUZAS, 1965, Smithsonian Misc. Coll., v. 149, no. 1, p. 1-89 (? not Brady, 1884).

Description.—Test free, medium size, elongated, straight, spindle-shaped, with the first portion tapering. Four to six chambers slightly elongated, generally more or less polygonal in transverse section on account of the agglutinated grains of laminar shape. Sutures hardly distinguishable. Agglutinated wall formed by grains of very irregular shape and size, frequently laminar, mainly the largest ones; cementing material so scarce that the test is very fragile. Rounded aperture at the end of a short neck. Length 0.51 mm to 1.36 mm.

Types.—The holotype is represented by plate 1, figures 5a, b, and by text figure 2; the paratypes by text figures 1, and 3-12.

The holotype and four paratypes are deposited at the U. S. National Museum, Washington D.C., and the other paratypes are at the Department of Geology, University of Puerto Rico, Mayagüez, Puerto Rico.

Type locality.—Station 49, Mayagüez Bay, Puerto Rico west coast, 18° 12' 42" N. latitude and 67° 11' 10" W. longitude, at 13 meters depth. The bottom sediments consist of gray silt and clay.

Associated foraminifers.—*Reophax caribensis* constitutes approximately 50% of the fauna of living foraminifers. The other more abundant living foraminifers are *Florilus grateloupianus* (d'Orbigny) and *Fursenkoina pontoni* (Cushman).

Remarks.—Nearly 100 specimens of *Reophax caribensis*, sp. nov., were separated from part of a sample from the type locality. All of them are relatively uniform in size. Only one slightly curved specimen was observed, all the others are straight.

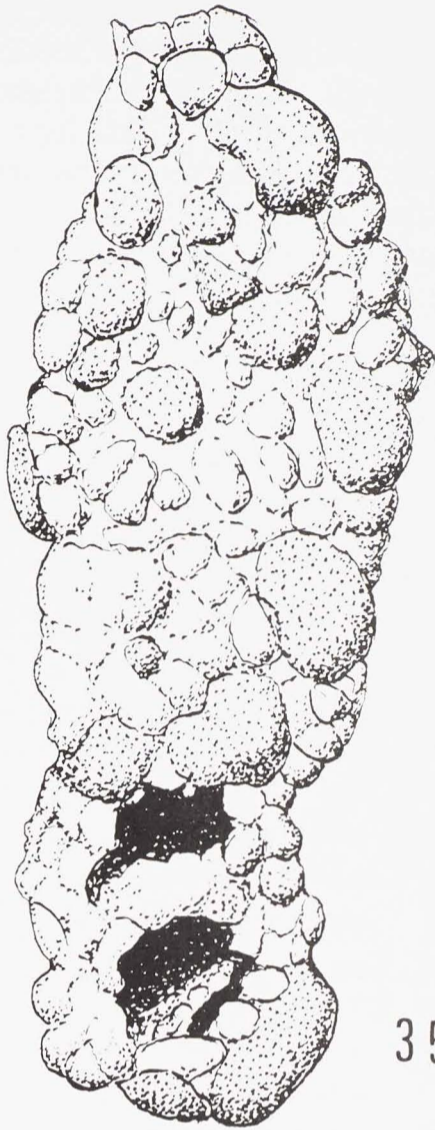
The scarcity of cementing material between the grains makes the tests very fragile and they break easily if the sample is heated for drying purposes. The tests cannot be transported from the shelf to deeper waters without destruction. *Reophax dentaliniformis* was reported by Brady (1884) and later by Cushman (1920) as a deep water foraminifer.

Reophax caribensis, sp. nov., is differentiated from *R. dentaliniformis* by its smaller size, non-ventricose chambers, poorly defined sutures, agglutinated material of very irregular size and shape, frequently laminar, and ecologic preference, as it lives in shallow waters.

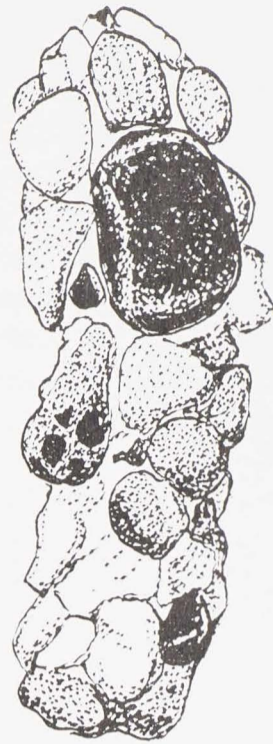
It differs from *R. arayaensis* by its smaller size. The test has finer grains, chambers relatively shorter and they are not triangular

TEXT FIGURES 35-40

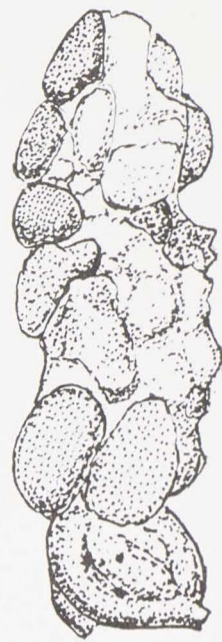
- 35 *Glaucammmina trilateralis* (Cushman). *Atlantis* Sta. 2981, off the north coast of Cuba; length 2.21 mm; orifice made with hydrochloric acid to show arenaceous septa and slightly twisted spiral.
- 36,37 *Glaucammmina trilateralis* (Cushman). Sta. 108, off the Caribbean coast of Panamá, 8° 50' N. lat., 77° 25' W. long., depth 82 meters; 36) length 1.48 mm; 37) length 1.27 mm.
- 38-40 *Glaucammmina trilateralis* (Cushman). 18° 31' 05" N. lat., 62° 02' 15" W. long., to 18° 30' 30" N. lat., 66° 04' 05" W. long., depth 466-549 meters; paratypes, USNM 26182; 38) length 1.11 mm; 39) length 1.36 mm; 40) length 1.48 mm.



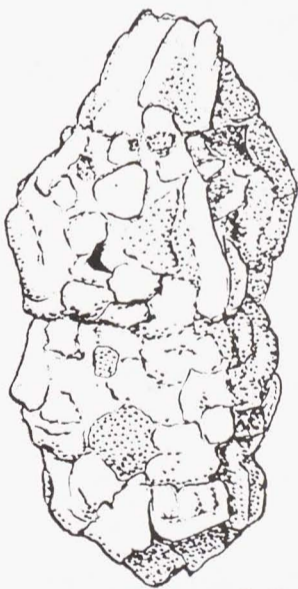
35



36



37



38



39



40

TEXT FIGURES 35-40

in transverse section. The sutures of *R. arayaensis* are more compressed, and the test is more massively built and less fragile.

Reophax scorpiurus Montfort is a problematic species. Many authors do not agree which species represents Montfort's original figure (see Hoeglund, 1947). In any case, the morphological groups generally accepted as *R. scorpiurus* are very different from *R. caribensis*, sp. nov.

Specimens of this species were reported off Trinidad by Todd and Brönnimann (1957, plate 1, fig. 19) two of which are illustrated in this paper in text figures 13 and 14.

Phleger and Parker (1951) illustrated a specimen of *Reophax* from the Gulf of Mexico, refigured here in text figure 15, that is somewhat similar to this species, nevertheless it is relatively thicker than the specimens from the Caribbean Sea.

Seiglie (1967, figures 1 and 2) illustrated two specimens of *Reophax* from a sample to the northwest of Margarita Island, Venezuela, as *R. sp. aff. R. hispidulus* Cushman that looks like *R. caribensis*, but is differentiated by a longer neck provided with a lip.

Family LITUOLIDAE

Glaucammmina, gen. nov.

Type species: *Reophax trilateralis*

Cushman, 1935.

Description.—Medium size test, elongated, first portion of test is thick, then it becomes narrower and then enlarges again. First chambers may be spiral, possibly the

initial ones trochospiral, then triserial-uniserial or just uniserial; transverse section may be square-shaped, then triangular and then oval, triangular throughout, triangular and then oval, or irregular due to the irregular shape of the grains; the last chambers usually more or less compressed. Agglutinated wall, grains usually rather coarse; sutures in some cases poorly defined, but generally not distinguishable; septa agglutinated. Aperture is an elongated slit at the end of the neck in the last chamber.

Remarks.—The initial coarser portion of the test in this genus is similar to that of *Ammoscalaria* Hoeglund, 1947, but in this latter genus it is compressed and planispiral. The thickness of the first portion in *Glaucammmina* suggests that it is trochospiral, although the agglutinated septa that separate the chambers are easily crumbled making it difficult to observe the arrangement of the initial chambers. In plate 1, figure 11, and in text figure 35, the arrangement of the chambers may be observed.

This new genus differs from the genus *Ammoscalaria* in that it does not have secondary pseudochitinous septa; and it differs from *Triplasia* Reuss in that the triangular specimens are not uniserial.

The forms of the genus *Flabellamminopsis* Malecki, 1954, are similar to those of *Glaucammmina*, gen. nov., but the former differs from the latter in having pronounced sutures. It is not triserial in any stage of development and its walls are pseudo-labyrinthic.

PLATE 1

- 1-4,8 *Glaucammmina trilateralis* (Cushman). Sta. 95, Mayagüez Bay, depth 74 meters; 1) length 1.43 mm; 4) length 180 mm; 8) length 1.21 mm.
- 5a-b *Reophax caribensis*, sp. nov. Sta. 49, Mayagüez Bay depth 13 meters; holotype, length 1.36 mm.
- 6a-b,7,9 *Glaucammmina trilateralis* (Cushman). *Atlantis* Sta. 2995, off the north coast of Cuba, depth 1107 meters; 6a-b) length 2.25 mm; 7) length 2.10 mm; 9) length 1.88 mm.
- 10a-b-c, 11,12 *Glaucammmina trilateralis* (Cushman). *Atlantis* Sta. 2963, off the north coast of Cuba, depth 348 meters; 10a-b-c) length 1.84 mm; 11) length 1.43 mm, the orifices shown in the figure were made by dissolving the wall with hydrochloric acid, each orifice corresponds to a different chamber; 12) length 1.89 mm.

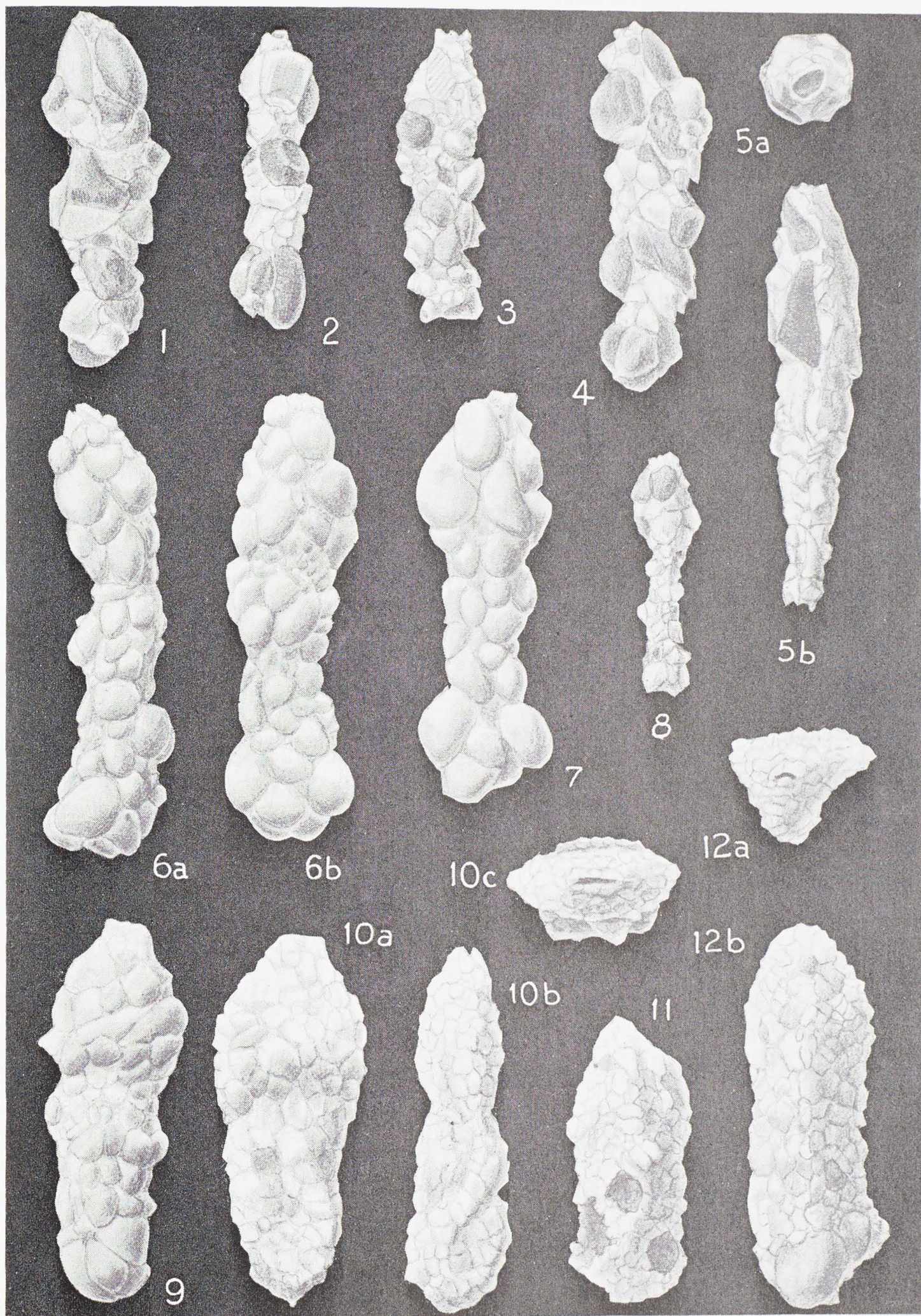


PLATE 1

Glaucammmina trilateralis (Cushman)

Plate 1, figs. 1-4, 6-12;
text figures 21-31, 35-40

Reophax trilateralis CUSHMAN, 1935 Smithsonian Misc. Coll, v. 91, no. 21, p. 91, pl. 1, figs. 1-4.

Description.—Test medium size; rounded, oval, square or triangular in transverse section. Early portion one large chamber or trochospiral, then it may be triserial and then uniserial or just uniserial; chambers relatively few, when uniserial there are two or three chambers after the early portion; sutures slightly depressed and only distinguishable in the uniserial part. Agglutinated wall coarsely arenaceous, formed by calcite grains or by glauconite pellets or by dark minerals, rarely other minerals; well-cemented. The opening is an elongated slit, generally at the end of a short neck. Length 1.00 to 2.27 mms.

Remarks.—This species is extraordinarily variable in shape, partly due to the diverse arrangement of the chambers. The forms based on this arrangement have been mentioned in the species description. The other factor that influences the shape is the grains of agglutinated material. Three main forms of this species were recognized and are described below.

The first form is constituted mainly of calcite grains. This is the nature of the specimens originally described by Cushman (1935). They are relatively smaller in size than the other two forms. The triangular and square section in the tests of the first type may be clearly seen on account of the small size of the grains (plate 1, figures 10-12).

The second form is constituted of glauconite pellets of relatively large size, in such a way that the transverse section is distorted (plate 1, figures 6 and 7; text figures 35-37). The specimen shown in plate 1, figure 9, is formed in part by calcite grains and by glauconite pellets.

The third form is mainly constituted of very coarse grains of dark minerals. Puerto Rican specimens contain grains of olivine, magnetite and pyroxene (plate 1, figures 1-4, 8, and text figures 24-31). The specimens from Venezuela (text figures 21-23) have coarse grains of dark minerals, some

quartz and also glauconite; the last chamber is not compressed.

Living specimens were found in Puerto Rico between 50 and 80 meters depth.

The specimens illustrated in this paper were deposited in the U. S. National Museum, Washington, D. C.

Localities and geological significance.—This species has been found on the outer shelf of Puerto Rico in front of the bays of Mayagüez and Añasco and on the Cabo Rojo shelf at more than 20 stations, constituting up to 30% of the total population of benthonic foraminifers. The writers have also found specimens on the outer continental shelf of Venezuela, Colombia and Panamá. Some localities are mentioned in detail with the description of the figures. One of the writers has also examined specimens of this species in the U. S. National Museum, Cushman Coll. No. 14021 (as *Reophax scorpiurus* Montfort), from the China Sea, 14° 20' 23" N. latitude and 120° 34' 15" E. longitude, at 51 meters depth.

The specimens described originally by Cushman (1935), off the north coast of Puerto Rico, and the specimens from *Atlantis* station 2963 and 2995, off the north Cuban coast, were found between 348 and 1108 meters depth. However, the Greater Antilles submarine slopes drop rapidly to depths of hundreds of meters and the foraminifers from the outer shelf are easily transported to the deeps. The specimens illustrated in plate 1, figures 6, 7 and 8, found at 1107 meters depth, are composed of oxydized glauconite pellets, and it is known that glauconite is formed on the platforms. Thus it is very probable that the foraminifers attached the glauconite grains to the test when they were on the platform, being transported later to deeper waters.

It is important to mention that this species has been found on the platforms of Puerto Rico, Venezuela, Colombia and Panamá in places also suitable for the formation of glauconite. Mild anaerobic conditions and scarce sedimentation are necessary for the formation of glauconite. This explains the abundance of dark minerals in the tests and the scarcity of quartz, as this mineral is usually abundant where a high rate of continental sedimentation occurs. The presence of calcite grains also relates this fora-

minifer to areas of scarce sedimentation, such as the outer platform in front of the Caribbean reefs that produce carbonate sediments. In the Puerto Rican outer platform these foraminifers are found in Pleistocene sediments, also implying a low rate of Recent sedimentation.

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December 29, 1969

RECENT BOOKS

INTRODUCTION TO PALEOLIMNOLOGY, by C. C. Reeves Jr. Published by Elsevier Publishing Company, Amsterdam, London and New York, 1968, xii + 228 pp., \$18.00

This book is the eleventh in the series, *Developments in Sedimentology*. Its purpose is to summarize the methods gathered from various disciplines applicable to the study of "fossil" lake basins, to popularize the study

of ancient lake basins, and to emphasize their importance as indicators of paleoclimatology. Part one deals with the description of lake basins and their origin; part two, with the lake basins during water occupancy; and part three, with the paleolake basins, their distribution, cause and recognition, the Pleistocene chronology, and methods of determining and dating paleoclimatic parameters in ancient lake basins. —H.C.S.