STUDIES ON THE FAUNA OF CURAÇAO AND OTHER CARIBBEAN ISLANDS: No. 127.

THE FORAMINIFERA OF PISCADERA BAY, CURAÇAO

by

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SYSTEMATICS

INTRODUCTION

Piscadera Bay is situated 4 km West of Willemstad, Curaçao, between two limestone hills which have a height of about 100 m. It is a drowned river system, the entrance of which is almost completely blocked by a bar of coral debris reaching to about 2 meters above sea level. The following parts may be easily distinguished: 1) the Boca or "Outer Bay." 2) the "Entrance," and 3) the bay proper or "Inner Bay" (see map, Fig. 147).

The Boca or "Outer Bay" is about 200 m wide and 6 m or less deep until (about 100 m off-shore) it reaches the outside border of a coastal platform which rapidly falls to several hundred meters. This sandy Boca is not only submitted to a turbid tidal flow of water from the Inner Bay, but, moreover, suffers from the increasing influence of man which has changed the underwater landscape in various ways.

The "Entrance" of the bay proper is narrow and has been subjected to many changes in the course of time. In 1962 the connection between the inner and outer part of the Bay – which at that time was only about 7 m^2 in profile – was widened to about 45 m^2. Tidal differences are small, averaging about 30 cm only, but nevertheless sufficient for clouding the clear waters of the Boca when the tide is going out.

The "Inner Bay" covers an area of about 0.6 km^2 and has an average depth of 3–4 meters, with a maximum of about 7 (see map, Fig. 147). Because of the steepness of the shores, which along its eastern and western slopes consist of limestone rock, the vegetation of *Rhizophora* is rather poor. This in contrary to the growth on the mangrove roots, which shows an often embarassing wealth of organisms, which flourish in these turbid and eutrophic waters. When the tide is coming in, which happens once a day for some hours, in a small area around the inlet only, the water may be called transparent. The bottom of the Inner Bay is very muddy – which is another reason why the fauna of the inland bay is so different from that of the Boca.

The temperature of the water rarely drops below 26°C and never surpasses 30°C. Precipitation averages only about 500 mm per year. The rain falls usually in irregular showers which may considerably reduce the salinity of the northern bays for a short time.

At the time the samples of Foraminifera on which this study is based were sampled – October 1963 to January 1964 – a sewer poured its water in the northern-most part of the Bay, not exceeding 1000 m^3 a day. This sewage was purified rather thoroughly, so bacteria could be found only in the immediate neighbourhood of the pipe, and their amount was very low when compared with urban waters, for instance.

Since 1959 the hydrology of the Bay was studied by SHELL CURAÇAO in order to control the influence of this sewage. In the first half of 1962 a hydrological survey was made by the Caribbean Marine Biological Institute (DE KOCK & WILDE, 1964).

Cl′ usually varies from 19.2–22.5‰, which is 1–3‰ higher than in the open sea; the lowest value measured was 16‰.

The pH is the Inner Bay is also constant: 7.7–8.1, with an average of 8. Near the sewer it drops to 7.5.

Free phosphate is 0.98–2.60 μ grat/l, much higher than in the open sea (0–0.05 μ grat/l). Total phosphorus content is high: 1.1–3.5 μ grat/l. So there must be a high fertility in the bay proper, possibly caused by the sewage.

The water in the Inner Bay is very turbid: a Secchi-disc disappears at 35–50 cm, whereas in front of the Boca it disappears at 25–50 m. Only part of this turbidity may be caused by suspended matter of organic origin. Another part may originate from the "diabase" dust, blown into the water by the Eastern trade wind or forwarded by rain water.

From the contents of chlorophyll (to 0.6–3.9 mg/m^3) and carotenoids (to about ⅓ of that value) in the water, it appears that the amount of phytoplankton is rather high. The planton consists of Cyanophyceae, Clorophyceae, Diatomaceae, Copepoda and other small crustaceans. Consequently the oxygen-oscillation is small, the saturation percentage being from 81‰–127‰; in shallow parts near the Entrance, where a dense vegetation of algae and *Thalassia* is present, it may eventually rise to 210‰. On the other hand, near the sewage pipe it may drop to values like 60‰ and even less.

The salinities of the Inner Bay are lower than those measured by PARKER c.s. (1953) in the San Antonio Bay of the Gulf of Mexico (34‰), but much higher than the typical brackish water in the former Zuiderzee in Holland (HOFKER, 1954, about 14‰). BRADSHAW (1961) found that cultures of *Streblus tepida* Cushman lived well in salinities from 34–15‰.

The presence of the CARMABI-laboratory forms an opportunity to study life-cycles and life-conditions of living Foraminifera present in the neighbourhood; the author's studies on living *Streblus flevensis* Hofker in its natural environment (1930, 1954) showed the importance of studies of Foraminifera in their normal conditions, compared with results from laboratory experiments. Therefore, on my request, Dr. WAGENAAR HUMMELINCK gathered many samples in the Piscadera Bay with the apparatus described by me in 1930a (p. 367, fig. 1), fixing the samples in alcohol. In this way the protoplasm was preserved and could be demonstrated by means of the method described by me in 1930 (p. 279–283); this method gives much more reliable results than that proposed by WALTON (1952) with rosa-bengal, for the latter also stains protoplasmatic contents in the tests, not belonging to the Foraminifer itself.

The following living species could be traced with certainty:

Nouria polymorphinoides — Boca = Outer bay
Elphidiononion discoidale — Boca
Schlumbergerina areniphora — Boca
Puteolina pseudodiscoidea — Boca
Valvotextularia candeiana — Boca
Cymbaloporetta squammosa — Boca
Asterigerina carinata — Boca
Streblus parkinsonianus — Boca
Triloculina trigonula — Boca and Inner bay
Nonionella grateloupii — Boca
Quinqueloculina bidentata — Boca
Quinqueloculina quadrilateralis — Boca and Entrance of bay
Elphidiononion poeyiana — Inner bay
Streblus compactus — Inner bay

This means that in the CARMABI we have the opportunity to study many living Foraminifera, often occurring in large quantities, belonging to quite different groups, none of which have yet been studied as to their life-cycle. They ought not to be brought in the laboratory and studied there. Laboratory-conditions are always abnormal; but the near vicinity of the laboratory gives us the possibility to study them in their natural environment during the whole year by taking samples once a week and studying them, together with the surrounding sea floor contents, for short periods in the laboratory.

DISTRIBUTION

Several of the Foraminifera from the Boca, coagulated in alcohol whilst alive, showed a green colour of their protoplasm, due to the chlorophyl of their hosts; this was found in *Asterigerina carinata, Puteolina pseudodiscoidea* and *Streblus parkinsonianus*. On the other hand, *Nonionella grateloupii, Elphidiononion poeyianum* and *Streblus compactus* did not show this greenish discoloration; probably they do not have Zooxantellae. Maybe, the mud-living species do not have commensalism, for there is a great difference in faunae of the localities in which the sea floor mainly consists of coral-sand, and those of a muddy bottom. Obviously the composition of the bottom is of great influence on the foraminiferal fauna. Moreover, as already stated in the author's paper on the tidal zone of the area, the occurrence of *Rhizophora* also forms an environment in which a special fauna of Foraminifera may develop (e.g. *Trochammina inflata*).

However, the rich *Rhizophora*-fauna of Foraminifera as found in many other localities within reach of open sea, could not be found in the inner bay; only in the outer bay *Trochammina inflata* was typical for this fauna; in the inner bay only in some localities with *Rhizophora, Miliolinella labiosa* was observed; but the other typical species (*Pseudoeponides anderseni, Discorynopsis aquayoi, Articulina sagra, Rotorbinella* cf. *mira*) were absent everywhere in the bay.

We may conclude from the distribution chart (Table 1), that station 1453 (cf. Fig. 147) is the locality richest in species. The stations 1453–1463 are those of Boca and entrance; they have faunae which show 35–7 species, some of them only found in the Boca. Samples from 1464–1471B were taken in the bottleneck of the bay; the number of species here decreases, from 8–3; in the inner bay we find mostly mud-samples, in which the number of individuals may be very large, the number of species decreasing once more from about 6–1 (but for 1473 with 9). A paleontologist may conclude a brackish environment, though this is not the case (Cl′ = 20.5‰); it may be that the muddy environment turns the scale here, just as in the Boca the chalky environment does, which in the bottleneck more and more changes into muddy sand. The uniformity of salinity, pH, etc. in the whole area turns our attention to the environment of the sea floor.

It is a remarkable fact that in the bay itself, the fauna gives the impression of a dwarf fauna, once again said by paleontologists to be an indication of low salinity (that of the Gulf of Mexico is about 32‰).

Several species found in the Piscadera Bay were not found in the tidal zone of the Antilles, described in 1964:

Nouria johnsoni Cushman
Massilina inaequalis Cushman
Schlumbergerina areniphora Munier-Chalmas
Triloculina trigonula (Lamarck)
Triloculina cultrata (Brady)
Puteolina bradyi (Cushman)
Bolivina spatuloides Hofker
Siphogenerina costata Schlumberger
Nonionella grateloupii (d'Orbigny)
Elphidiononion discoidale (d'Orbigny) (another species mentioned in 1964 as such)
Siphonina pulchra (Cushman)
Sphaerogypsina globulus (Reuss)

whereas *Puteolina* (*Sorites?*) *pseudodiscoidale* is a new name.

It may be that these species were not found in the tidal zone as the water investigated here was somewhat deeper. This certainly is the reason for the common occurrence of many planktonic individuals in the Boca of the bay; they have been described and analysed in the paper on Foraminifera of the slope West of Barbados (*Studies fauna Curacao 31, 1969*) and do not belong to the real fauna, as they have their source in the open sea; it was remarkable that all individuals have thin tests and were relatively small, similar to those found in the upper part of the plankton. Obviously only those individuals of planktonic species which lived in the upper layer of sea water reach the coast. They were:

Globigerina triloba Reuss (not the forms known as *G. sacculifera* Brady)
Globigerina eggeri Rhumbler
Globigerina rubra d'Orbigny (forms without the bulla)
Globorotalia menardii (d'Orbigny)

The samples are stored in the collections of the Geological Survey of the Netherlands, Haarlem.

LIST OF LOCALITIES

according to P. WAGENAAR HUMMELINCK's sampling of Piscadera Baai, Curaçao

Sta.	Locality	Date	Depth in m	Substrate
1453	Boca, E	3.I.1964	3–4	sand; patches of algae such as *Padina, Dictyota, Udotea* and *Galaxaura.*
1454	Boca, centre	2.I.1964	4	sand.
1455	Boca, centre, W	2.I.1964	3–4	sand.
1456	Boca, W	2.I.1964	3	sand.
1457	Boca, E	5.I.1964	1–2	sandy bottom with pebbles and coral debris; *Dictyota, Hypnea, Laurencia.*
1458	Boca, W	5.I.1964	1–2	muddy sand with rock and coral debris; scarce vegetation, *Laurencia, Hypnea.*
1459	Boca, beach	1.I.1964	0–½	pebbles.
1460	Boca, NW	14.XII.1963	0–½	from *Rhizophora* on sandy bottom.
1461	Boca, NW	14.XII.1963	0–½	from *Rhizophora* on sand.
1463	Entrance, W	14.XII.1963	0–½	from *Rhizophora* in muddy sand.
1464	Entrance, E	28.XI.1963	0–½	from *Rhizophora* in muddy bottom.
1465	near Entrance	11.XII.1963	0–½	from *Rhizophora* in sandy mud with *Thalassia.*
1466	near Entrance, SE Inner Bay	17.XII.1963	0–1	from *Rhizophora* in mud.
1467	SE part, E	29.XI.1963	2	muddy sand; almost no vegetation.
1467A	SE part	29.XI.1963	4	mud; no vegetation.
1467B	SE part, W	29.XI.1963	2	sandy bottom; almost no vegetation.
1467C	SE part, N	25.X.1963	5	sandy mud; almost no vegetation.
1468	SE part, NE	18.XII.1963	0–1	from *Rhizophora* on rocky shore.
1469	SE part, NW	18.XII.1963	0–1	from *Rhizophora* on sandy rock.
1470	S part	31.X.1963	0–½	from buoy; among ascidians, mussels, anemones, sponges and barnacles.
1471	S part	25.X.1963	5–6	sandy mud; no vegetation.

Sta.	Locality	Date	Depth in m	Substrate
1471A	S part, E	29.XI.1963	2	sandy mud; poor vegetation with *Dictyota*.
1471B	S part, W	29.XI.1963	2	muddy sand; sponges, ascidians, no vegetation.
1473	Centre, SW	13.XII.1963	0–½	from *Rhizophora* on rocky shore; oysters, ascidians, etc. with *Acanthophora*.
1474	Centre, SW	13.XII,1963	2	sandy mud.
1474A	Centre, S	29.XI.1963	4	mud; no vegetation.
1474B	Centre, SE	29.XI.1963	2	sandy mud; almost no vegetation.
1475	Centre, SE	13.XII.1963	0–1	from *Rhizophora*; oysters, ascidians, etc., almost no algae.
1477	Centre	31.X.1963	0–½	from buoy; among ascidians, worms, barbacles, etc., few algae.
1478	Centre	25.X.1963	5	mud; no vegetation.
1478A	Centre, NW	29.XI.1963	5–6	mud; no vegetation.
1478B	Centre, NE	2.XI.1963	4–5	mud; no vegetation.
1479	N part, SW	11.XII.1963		from *Rhizophora*; oysters, barbacles, etc., with a poor vegetation.
1480	N part, SW bay	30.X.1963	5	muddy sand; almost no vegetation.
1480A	N part, SW bay	30.X.1963	2	muddy sand; *Dictyota*.
1483	N part, S	25.X.1963	4	mud; no vegetation.
1483A	N part, centre	25.X.1963	3–4	mud; no vegetation.
1484	N part, centre	2.XI.1963	0–½	from buoy; among sponges, oysters, ascidians, anemonies, with *Ulva*.
1485	NE part	11.XII.1963	0–1	from *Rhizophora* in muddy sand; oysters, ascidians, sponges, *Acanthophora*.
1486	NE part, bay	30.X.1963	3–4	sandy mud; no vegetation.
1486A	NE part, bay	25.X.1963	2	muddy shell debris; *Caulerpa*.
1487	NE part, bay	25.XI.1963	0–1	from *Rhizophora* on muddy gravel oysters, ascidians, etc., with almost no algae.
1488	N part	25.VII.1962	0–1	from *Rhizophora* [L. J. v.d. Steen] *Acantophora*.
1489	N part, islet	25.XI.1963	0–1	from *Rhizophora* on muddy bottom; sponges, etc., *Caulerpa*.
1490	N part, islet	30.X.1963	2	muddy; sponges, etc., poor *Caulerpa*.
1492	NW part, bay	29.X.1963	1	muddy, debris; *Ulva*.
1493	NW part, bay	25.XI.1963	0–1	from *Rhizophora* on muddy sand; oysters, worms, etc., some *Ulva*.
1494	NW part, bay	29.X.1963	1–2	muddy sand; *Thalassia, Ulva, Caulerpa*.

Sta.	Locality	Date	Depth in m	Substrate
1495	NW part, bay	29.X.1963	2	sandy mud, *Thalassia, Acanthophora, Ulva.*
1496	NW part,bay	30.X.1963	3	mud, no vegetation.
1497	N part, NW	25.XI.1963	0–1	rock debris, muddy; *Ulva.*
1498	N part, NW	25.XI.1963	0–1	from *Rhizophora* on muddy bottom; oysters, barnacles; *Ulva* with *Caulerpa.*
1499	N part, NW	26.X.1963	1–2	sandy mud; *Ulva* and *Caulerpa.*
1500	N part, N	25.X.1963	1½	sandy mud; *Ulva.*
1500A	N part, N	16.X.1963	2	muddy; mussels, snails, *Caulerpa* and *Enteromorpha.*
1502	N part, N	25.X.1963	1½	mud; no vegetation.
1620	Boca, piling	14.X.1967	0–1	from iron and wooden poles, sponges, serpulids, etc.
1621	N part of Inner Bay, islet	26.IX.1967	0–1	from *Rhizophora* on muddy sand; oysters, etc.

SYSTEMATICS

Nouria johnsoni Cushman — Figs. 1–4

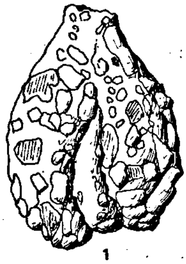
Nouria johnsoni CUSHMAN, 1935, p. 2, pl. 1 fig. 5–6.
Proteonina comprima PHLEGER & PARKER, 1951, p. 2, pl. 1 fig. 1–3.

Test compressed, more or less pyriform, consisting of several chambers, mostly two or three, agglutinated with sand grains of different size, on the outside smoothly finished, but on the inside more irregular. The grains, often consisting of shell particles, are cemented together by finer grains and form one single layer as is

Fig. 1–4. *Nouria johnsoni* Cushman. — Curaçao, sta. 1453: 1, from aside; 2, apertural face; 3, young specimen (all three × 35); 4, transverse section through young specimen (× 70).

Fig. 5–9. *Massilina inaequalis* Cushman. – Curaçao, sta. 1453: 5, apertural face; 6–8, specimen from four sides (all four × 22); 9, transverse section (× 170).

Fig. 10–17. *Schlumbergerina areniphora* Munier-Chalmas. – Curaçao, sta. 1453: 10–12, from three sides (× 22); 13, end of last formed chamber with the porous closing plate; 14, frontal view of closing plate (both × 70); 15, transverse section (× 70); 16, another specimen (× 22); 17, longitudinal section through same specimen (× 70).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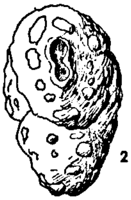
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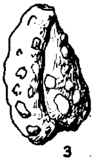
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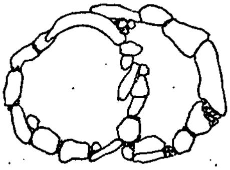
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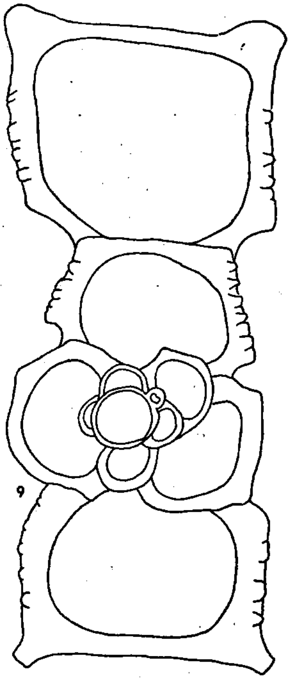
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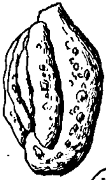
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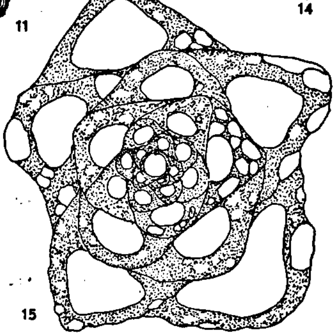
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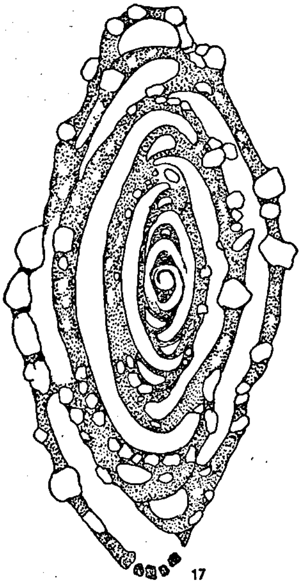
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the case in *Reophax*. Small specimens consist of only two chambers, larger specimens often of three chambres. The last formed chamber has the aperture on a short neck and the aperture consists of an elongate fissure. Young specimens resemble *Proteonina* as the sutures of the chambers are nearly invisible. The tests are very fragile and brittle, especially in young specimens.

As to the test wall, the species has to be placed in the neighbourhood of *Reophax*, where LOEBLICH & TAPPAN (1964, p. 220) also placed it, creating a separate family, Nouriidae.

The species was common in Sta. 1453; I found it also in a sample off Habana, Cuba, received from BERMÚDEZ. There is no doubt, from the figures as well as from the description, that *Proteonina comprima* Phleger & Parker from the Gulf of Mexico is the same species; it seems that it does not reach full development there, since only the young specimens in 1453 attain the length of 0.6 mm, as given by PHLEGER & PARKER, whereas the specimens from better environments (Boca of the Piscadera-Bay; off Habana, Cuba) attain their full size of about 1.0 mm.

The specimens from Sta. 1453 are alive, as several tests showed protoplasm.

Valvotextularia candeiana (d'Orbigny)

Textularia candeiana D'ORBIGNY, 1839, p. 143, pl. 1 fig. 25–27.
Valvotextularia candeiana (d'Orbigny), HOFKER, 1956, p. 34–35, pl. 2 fig. 13–30; 1964, p. 72, fig. 193–196.

This species was already described and analysed. In the Piscadera Bay area it occurred only in the Boca, in coral sands; Sta. 1453–1458.

Trochammina inflata (Montagu)

Nautilus inflatus MONTAGU, 1808, p. 81, pl. 18 fig. 3.
Rotalina inflata (Montagu), WILLIAMSON, 1858, p. 50, pl. 4 fig. 93–94.
Trochammina inflata (Montagu), CARPENTER, PARKER & JONES, 1862, p. 141, pl. 11 fig. 5; HOFKER, 1964, p. 15, fig. 1.

This species, described already in 1964 and then regarded as a typical inhabitant of the *Rhizophora* life-association, once more was found here only among Rhizophores, in the Sta. 1461 and 1463, at the entrance of the bay, but not in the bay itself.

Spiroloculina antillarum d'Orbigny

Spiroloculina antillarum D'ORBIGNY, 1839, p. 166, pl. 9 fig. 3–4; HOFKER, 1964, p. 19, fig. 5–7.

This species was analysed in 1964. — It was found in the Sta. 1453, 1458, 1467B, 1468, 1469, 1471, 1471A, 1474B, 1478B, 1483, always in several specimens.

Spiroloculina ornata d'Orbigny

Spiroloculina ornata D'ORBIGNY, 1839, p. 137, pl. 12 fig. 7; HOFKER, 1964, p. 21, fig. 8.

This species, remarkably, was restricted to some stations in the Inner Bay, viz. 1475, 1478, 1478A and 1486A, always in single specimens. It seems to prefer a muddy environment here.

Quinqueloculina polygona d'Orbigny

Quinqueloculina polygona D'ORBIGNY, 1839, p. 98, pl. 12 fig. 21–23; HOFKER, 1964 p. 22, fig. 13.

Several specimens were found in sample 1453, but not elsewhere.

Quinqueloculina bidentata d'Orbigny

Quinqueloculina bidentata D'ORBIGNY, 1839, p. 197, pl. 12 fig. 18–20; HOFKER, 1964, p. 23, fig. 14–17.

This agglutinated species was commonly found in both micro- and megalospheric forms in several samples from the Boca and was living with certainty in Sta. 1453; moreover, it occurred, mostly only in the A-form, in several localities of the entrance and in only one of the bay proper, viz. 1474B. So the species seems to be restricted to the localities with coral sand and with muddy sand, avoiding mud — Sta. 1453–1458, 1460, 1464, 1467, 1471, 1471B, 1474B.

Quinqueloculina quadrilateralis (d'Orbigny)

Triloculina quadrilateralis D'ORBIGNY, 1839, p. 173, pl. 9 fig. 14–16; HOFKER, 1964, p. 24, fig. 18.

This species is one of the commonest in the area. It was found in many sandy localities of the Boca and the Entrance, but also occurred in the muddy parts, even in the northern part of the Inner Bay, viz. Sta. 1499. It was abundant in Sta. 1453, where it was found living with certainty. — Sta. 1453–1455, 1457–1461, 1463–1465, 1467A, 1469, 1471, 1471A, 1473, 1474B, 1478A, 1485–1486A, 1499 and 1620.

Quinqueloculina lamarckiana d'Orbigny

Quinqueloculina lamarckiana D'ORBIGNY, 1839, p. 189, pl. 11 fig. 14–15; HOFKER, 1964, p. 22, fig. 10–12.

This species with its longitudinal striae, was found in several localities in the Boca, in the neck and in the proper bay, but scattered. Especially in the Inner Bay the specimens remained very small, and it may be that here in reality they belong to *Quinqueloculina poeyana* d'Orbigny, though it is also possible that *Q. poeyana*, is a form of *Q. lamarckiana*, as found in more muddy localities. Such forms were mentioned by PARKER, PHLEGER & PEIRSON, 1953, p. 12, pl. 2 fig. 15–17 from Antonio Bay, Texas. The walls are much thinner than in the actual *Q. lamarckiana.* — Sta. 1453, 1454, 1460, 1461, 1465, 1467B, 1469, 1471A, and in the *poeyana*-form in Sta. 1479, 1480, 1496 and 1500A.

Quinqueloculina oblonga (Montagu)

Vermiculum oblongum, MONTAGU, 1803, p. 522, pl. 4 fig. 9.
Triloculina oblonga (Montagu), TERQUEM, 1875, p. 358, pl. 5 fig. 22–24; HOFKER, 1964, p. 25, fig. 31–32.

Small elongate specimens may belong here; they occurred in many samples of the narrow Entrance as well as in the Inner Bay, mostly in muddy environment; they are very thin-walled. Whether they are identical to the British species is not certain. — Sta. 1456, 1459, 1465, 1466, 1467, 1467A, 1471, 1471A, 1473, 1474, 1483 1490, 1493–1495, 1497, 1500, 1500A, 1502 and 1620.

Pyrgo subsphaerica (d'Orbigny)

Biloculina subsphaerica D'ORBIGNY, 1839, p. 162, pl. 8 fig. 25–27.
Pyrgo subsphaerica (d'Orbigny), BERMÚDEZ, 1935, p. 172; HOFKER, 1964, p. 31, fig. 34–35.

This species was only found in Sta. 1453 and 1454, in coral sand.

Miliolinella labiosa (d'Orbigny)

Triloculina labiosa D'ORBIGNY, 1839, p. 157, pl. 10 fig. 12–14.
Miliolinella labiosa (d'Orbigny), HOFKER, 1964, p. 29, fig. 24–26.

This thin-walled species was found in the Boca, the narrow Entrance, and in some of the localities among *Rhizophora* in the Inner Bay. Common on Rhizophora-roots. — Sta. 1453, 1455, 1459–1461, 1463, 1464, 1466 (very common), 1467B, 1468, 1469, 1473, 1474B, 1475 and 1620.

Massilina inaequalis Cushman Fig. 5–9

Massilina inaequalis CUSHMAN, 1921, p. 72, pl. 17 fig. 12–13; 1929, p. 38, pl. 7 fig. 6.

CUSHMAN's description runs: Test much elongate, in the adult spiroloculine, from one side very much excavate, the other nearly plane, early chambers quinqueloculine, later ones spiroloculine, chambers very elongate, irregularly quadrate in transverse section, the peripheral side broader than the inner ones, one of the sides angled, the other straight; surface polished, shiny but with numerous fine, linear depressions breaking the evenness of the surface; aperture rounded, apertural end of the test somewhat projecting; color glistening white. Length 1.5 mm; breadth 0.65 mm; thickness 0.30 mm.

On transverse section a megalospheric specimen shows the characteristics of *Massilina*: first coil of chambers quinqueloculine, second one triloculine, followed by biloculine (or spiroloculine) chambers. The depression on one side is caused by indentations of the chamber walls, whereas the finer structure of the test is caused by more hyaline irregularities in the test walls. The proloculus has a tubular neck chamber.

The species was found by CUSHMAN at the north coast of Jamaica. I had it sent to me from off Habana, Cuba. *Massilina inaequalis* never occurs abundantly, and only two specimens were found at Sta. 1453. Whether the form, mentioned and figured by GRAHAM & MILITANTE from the Philippines, is the same species, is not certain; the figures show a much broader form (1959, p. 36, pl. 3 fig. 13–14).

Schlumbergerina areniphora Munier-Chalmas Fig. 10–17

Miliolina alveoliniformis BRADY, 1879, p. 268; 1884, p. 181, pl. 8 fig. 15–20.
Massilina alveoliniformis (Brady), MILLET, 1898, p. 609, pl. 13 fig. 5–7; HOFKER, 1933, p. 102–105, fig. 21–22; 1968, p. 20.
Quinqueloculina alveoliniformis (Brady), CUSHMAN, 1917, p. 43.
Schlumbergerina alveoliniformis (Brady), CUSHMAN, 1929, p. 36, pl. 7 fig. 2 (var. *occidentalis* Cushman).
Ammomassilina alveoliniformis (Millet), CUSHMAN, 1933, p. 32, pl. 3 fig. 5.
Schlumbergerina areniphora Munier-Chalmas, HOFKER, 1968, p. 20, pl. 4 fig. 16–24.

In 1933 the author already suggested that *Miliolina alveoliniformis* Brady and *Massilina alveoliniformis* Millet should be two geographic forms of the same species; in 1968 this was proved on sections of both forms. Sections now made of CUSHMAN's form *occidentalis* from the Caribbean show that also this form found in the Caribbean belongs to the same species and once again is a geographic form of *Schlumbergerina alveoliniformis.*

Test elongate, fusiform, consisting of many long chambers built in a more or less irregular quinqueloculine arrangement, in very advantageous circumstances in the end forming chambers in one single plane as in *Massilina*, but in less favorable circumstances forming only the initial part of the test, consisting of the quinqueloculine arranged chambers.

Obviously circumstances in the Caribbean are less favorable, and so the tests remain smaller than the "*Schlumbergerina*" as found in the tropical Pacific. The aperture is very peculiar, consisting of a plate with many small openings (cribrate plate, as found in *Miliola* and in *Hauerina*). The walls of the first sets of chambers are porcellaneous, those of later chambers bear irregular sand grains in the calcareous brownish walls.

It might be possible that CUSHMAN's var. *occidentalis* has to be given the status of a species, as all specimens begin with 5–6 chambers around the proloculus, whereas in the Pacific form there are generally 8 chambers.

The species was found by CUSHMAN (1929, p. 36) "in shallow-water, coral-reef conditions." In Piscadera Bay it was found abundantly in Sta. 1453, depth 3.5 m, among coral sand.

Triloculina trigonula (Lamarck) Figs. 18–23

Miliola trigonula LAMARCK, 1804, p. 351, No. 3; 1807, pl. 17 fig. 4.
Triloculina trigonula D'ORBIGNY, 1826, p. 299, No. 1, pl. 16 fig. 5–9; Modèles, 1826, No. 93.
Miliolina trigonula (Lamarck), WILLIAMSON, 1885, p. 84, pl. 7 fig. 180–182.
Triloculina trigonula (Lamarck), CUSHMAN, 1929, p. 56, pl. 12 fig. 10–11; pl. 13 fig. 1–2.

CUSHMAN suggests, that the many forms described from recent sources might not be the same species as described by LAMARCK from the Lutetian of Paris. The length of the species given by him as 1 mm is much larger than the specimens found in the samples of the Piscadera Bay; these never exceed 0.5 mm and are mostly much smaller. However, the specimens resemble the figures given by BRADY very much, but in his tranverse section BRADY (1884, pl. 3 fig. 15–16) gives thick walls, whereas the specimens from Curaçao all have extremely thin walls.

Test oval, three chambers with rounded angles, visible from the outside. In apertural view the test is slightly triangular, but far less than seen in *T. tricarinata*, due to the rounded angles of the chambers and the convexity of the chamber walls. The sutures are distinct, slightly depressed, the surface of the test is smooth and shining. Aperture rounded with a distinct bifid tooth.

On transverse section a megalospheric specimen showed the trilocular arrangement of the chambers throughout.

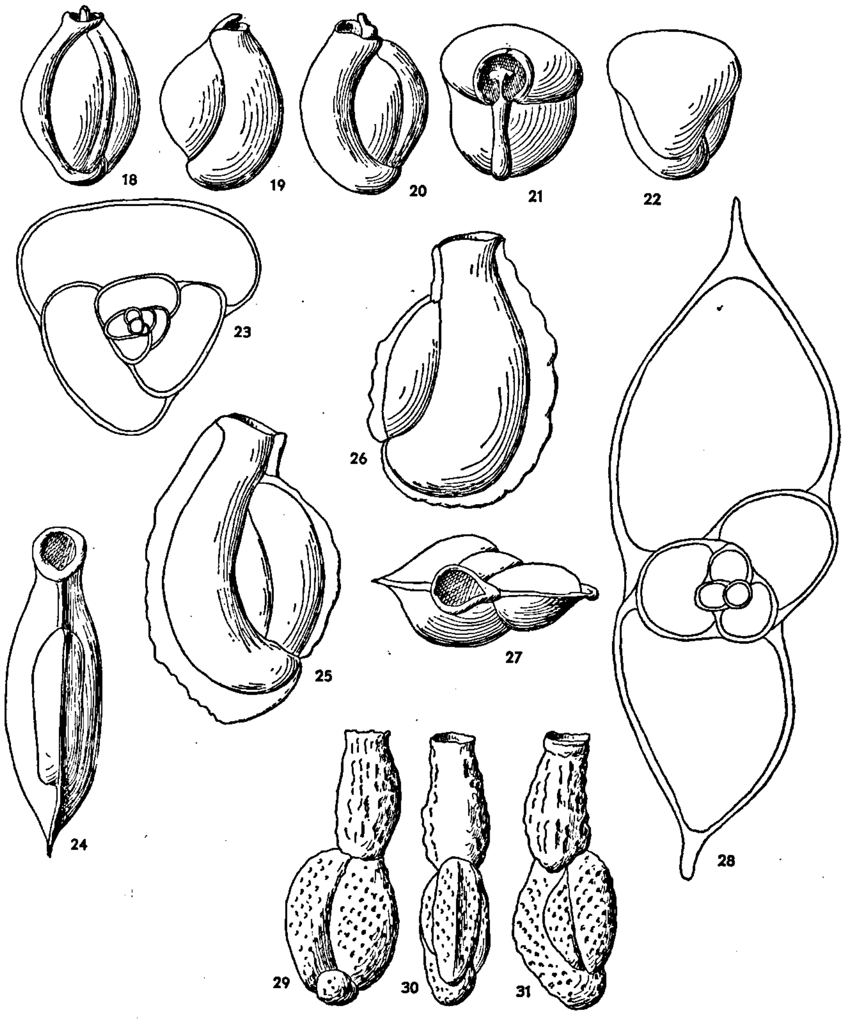


Fig. 18–23. *Triloculina trigonula* (Lamarck). – Curaçao, sta. 1453: 18–20, from three sides; 21–22, apertural and end views (all × 35); 23, transverse section (× 70).
Fig. 24–28. *Triloculina cultrata* (Brady). – Curaçao, sta. 1478a: 24–26, side views; 27, apertural face (all × 70); 28, transverse section (× 170).
Fig. 29–31. *Triloculina carinata* d'Orbigny. – Curaçao, sta. 1453: Specimen with abnormal end-chamber, from three sides (× 22).

The species occurs in the whole bay, but has its largest specimens in Sta. 1453. Common or abundant in Sta. 1453, 1464, 1467A, 1478B, 1483, less common or rare in Sta. 1454, 1458, 1460, 1461, 1463, 1465, 1467, 1469, 1471, 1471A, 1473, 1474A–1475, 1478, 1478A, 1479, 1480, 1483A, 1486–1487, 1490, 1494–1496, 1500A.

Triloculina cultrata (Brady) Fig. 24–28

Miliolina cultrata BRADY, 1881, p. 45; 1884, p. 161, pl. 5 fig. 1–2.
Quinqueloculina cultrata (Brady), CUSHMAN, 1917, p. 54, pl. 21 fig. 1; PARKER, PHLEGER & PEIRSON, 1953, p. 12, pl. 2 fig. 7–8.

Test small, very much compressed. Surface dull, white, opaque. The last formed chambers show (at their margin) a strongly developed keel, which is not seen in less adult specimens, as the more initial chambers do not have this keel. Last formed chambers in one plane. Aperture open, rounded, or slightly lozenge-shaped, without tooth and with a somewhat thickened border, on a neck of the last formed chamber. On transverse section the megalopheric form shows a triloculine arrangement throughout; the chamber walls are very thin.

Though PARKER c.s. (1953) believed that "some specimens show a triloculine stage but the majority are quinqueloculine," this is impossible; no *Quinqueloculina* is known which begins as a true *Triloculina*; the reverse is plausible: many *Triloculina*-species are known which show a quinqueloculine initial stage in the microspheric forms.

The species is known from shallow bays (San Antonio Bay in Texas, bays in Trinidad), and, moreover, from the Pacific, where GRAHAM & MILITANTE (1959) described it from shallow muddy bays in the Philippines. In the Piscadera Bay it was found in the samples 1473, 1478A and 1486A, on muddy bottom.

Triloculina carinata d'Orbigny Fig. 29–31

Triloculina carinata D'ORBIGNY, 1839, p. 179, pl. 10 fig. 15–17; HOFKER, 1964, p. 25, fig. 20.

In some specimens the last formed chamber suddenly leaves the triloculine arrangement and grows out in the long axis of the test, thus resembling tests of *Articulina*; the ornamentation on such chambers consists of elongate grooves and thus is different. The meaning of these abnormal specimens is not yet clear.

This species with its remarkable ornamentation of pits in a lozenge-shaped pattern was only found in Sta. 1453.

Articulina paucicostata Cushman

Articulina paucicostata CUSHMAN, 1944, p. 14, pl. 3 fig. 13–14; HOFKER, 1964, p. 36, fig. 43–48.

One specimen found in Sta. 1453.

Cornuspirammina antillarum (Cushman)

Nubecularia antillarum CUSHMAN, 1922, p. 58, fig. 7–8.
Cornuspirammina antillarum (Cushman), CUSHMAN, 1928, p. 158; HOFKER, 1964, p. 31, fig. 36.

One broken specimen on part of shell in Sta. 1457.

Puteolina protea (d'Orbigny) Fig. 32–39

Peneroplis proteus D'ORBIGNY, 1839, p. 61, pl. 7, fig. 1–2.
Puteolina protea (d'Orbigny), HOFKER, 1952, p. 452–455, fig. 41; 1964, p. 51, fig. 153–146.

This species shows a high variability in form, comparable with that found in *Peneroplis pertusus* Forskål. It can easily be distinguished from *Puteolina bradyi* by its involute first chambers. The microspheric generation consists only of the involute first chamber, whereas in the megalospheric forms the later chambers become flaring or evolute; annular chambers are never found. *Puteolina bradyi* has evolute initial chambers and a thinner, more compressed test. In a dry state *P. protea* can easily be dinstinguished from young specimens of *Puteolina* (*Sorites?*) *pseudodiscoideus* by the much whiter tests of the latter. The lense-like pustules on the surface of the test of *P. protea* are minute.

Common in Sta. 1453, and rare in 1454–57 and 1459.

Puteolina bradyi (Cushman) Fig. 40–45

Peneroplis planatus CUSHMAN, 1921, p. 75, pl. 18 fig. 9 (not FICHTEL & MOLL).
Peneroplis bradyi CUSHMAN, 1930. pl. 14 fig. 8–10.
Puteolina bradyi (Cushman), HOFKER, 1952, p. 450–452, fig. 36–37.

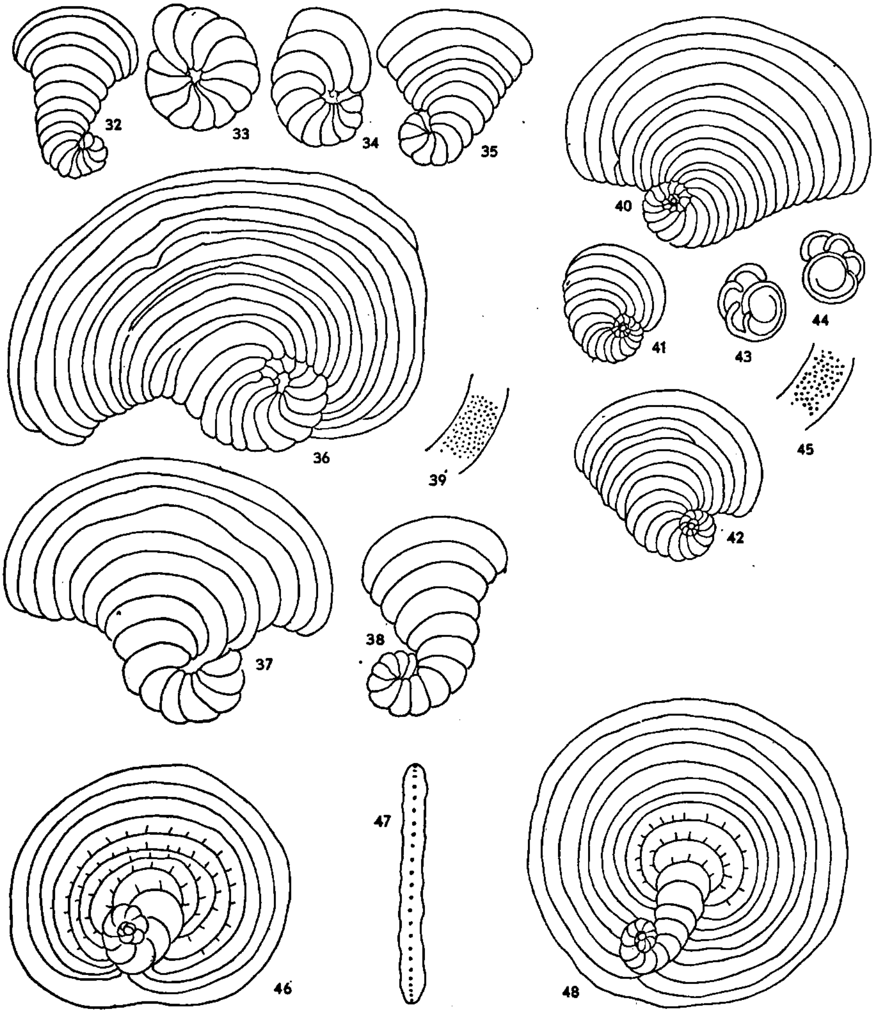


Fig. 32–39. *Puteolina protea* (d'Orbigny). – Curaçao, sta. 1453: 32–38, several variants (× 70); 30, part of wall with ornamentation (× 170).
Fig. 40–45. *Puteolina bradyi* (Cushman).–Curaçao, sta. 1453: 40–42, three specimens (× 70); 43–44, two initial parts clarified (× 170); 45, part of wall (× 170).
Fig. 46–48. *Puteolina* (*Sorites?*) *pseudodiscoidea* nov. spec. – Curaçao, sta. 1453: 46 & 48, specimens with "normal" annular end-chambers; 47, apertural face with round apertures in one series (all × 70).

The species differs from the former one in the much more compressed and thinner test, the evolute initial spiral and the fact that all specimens are of the flaring type, not showing the high variation in outer form. Till now only megalospheric specimens were found; the proloculus is followed by a well-developed neck-chamber. It was not found in the material of the tidal zone (HOFKER, 1964) and thus seems to occur in somewhat deeper water; it was found by the author in samples off Santa Cruz, depth 150 fathoms and CUSHMAN mentions it from 5–20 fathoms. Sta. 1453, where it was not uncommon, is 3.5 m deep, it was rare in Sta. 1620, also in the Boca.

Puteolina (Sorites?) pseudodiscoidea nov. spec. Figs. 49–58

Puteolina (*Sorites?*) *discoidea* (non Flint), HOFKER, 1964, p. 49, fig. 87–99, 110.

The figures published by FLINT, 1879 (pl. 49 fig. 1–2) show a species with a first spiral of chambers of three coils, whereas the species described in 1964 has a spiral of no more than two coils in the megalospheric form. Moreover, FLINT's fig. 2 shows a species without any secondary septa in the chambers. The specimens found in the outer part of Piscadera Bay (Sta. 1453) show distinct septa in the chambers following the spiral, though these septa are imperfect with very large openings. The species begins in the megalospheric generation with the proloculus followed by a neck-chamber; then follows a spiral with undivided chambers, succeeded by the more flaring ones which may in the end become annular, as in "*Peneroplis*" *discoideus* Flint.

In Sta. 1453, where hundreds of specimens were gathered, variability is very large. There are circular tests with only a small number of undivided chambers following the spiral, and others which show a set of many undivided chambers arranged in an uncoiling row following the spiral, before flaring chambers are formed. Many specimens never form annular chambers, as the flaring chambers, when meeting at the other side, do not fuse. Moreover, many specimens form a spiral of which the axis runs perpendicular to that of the later flat test, or they form a very long uncoiling set of chambers after the spiral (of up to 12 and more undivided chambers) before flaring chambers with secondary septa are built. It would be worth while to investigare whether or not outer circumstances caused this variability.

The transverse section proves that I, in 1964, erroneously described the initial chambers as involute; only the thick outer walls of the initial chambers may overlap the proloculus. In later chambers the aperture consists of a single row of small rounded openings.

The species differs from "*Sorites*" *orbitolitoides* Hofker in the much broader chambers, the less developed septa, and the initial spiral which is shorter; moreover, "*S.*" *orbitolitoides* is only found in greater depths, whereas *P. pseudodiscoidea* occurs in shallow water.

The species seems to be living in the Boca of the Piscadera Bay, where living specimens may be found abundantly on larger algae. Sta. 1453, 1454, 1457.

Puteolina (Archaias) angulata (Fichtel & Moll)

Nautilus angulatus **Fichtel & Moll, 1798, p. 113, pl. 22 fig. a–e.**
Puteolina **(*Archaias*)** ***angulata*** **(Fichtel & Moll), Hofker, 1952, p. 461–463, fig. 49–51; 1964, p. 42–43, fig. 58–62, 71–76, 100–108, 111–113.**

Curiously enough this species appeared to be absent in the rich sample 1453; it was found in the stations 1454–1457. *P. angulata* is a typical dweller of coral sand. The abundance of *Puteolina pseudodiscoidea* possibly caused the absence of *P. angulata*.

Hauerina bradyi Cushman

Hauerina compressa **Brady (not d'Orbigny), 1884, p. 190, pl. 11 fig. 12–13.**
Hauerina bradyi **Cushman, 1917, p. 62, pl. 23 fig. 2; Hofker, 1964, p. 61, fig. 166–167.**

The species was found in the stations 1453, 1454 and 1460, and is thus restricted to sandy bottom.

Neoalveolina pulchra (d'Orbigny)

Alveolina pulchra **d'Orbigny, 1839, p. 70, pl. 8, fig. 19–20.**
Borelis pulchra **(d'Orbigny). Bermúdez, 1935, p. 192.**
Neoalveolina pulchra **(d'Orbigny), Hofker, 1952, p. 111–115, fig. 58–60; 1964, p. 55, fig. 161.**

The species was found only in some specimens in Sta. 1453, on sandy bottom, near the open sea.

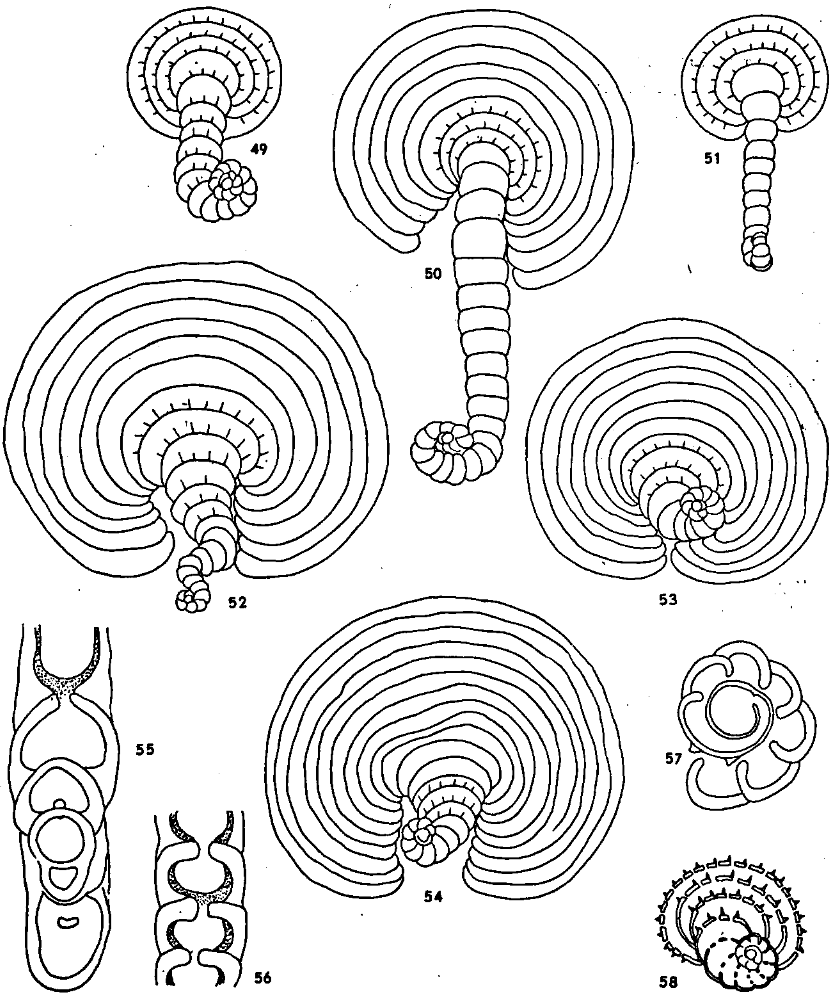


Fig. 49–58. *Puteolina* (*Sorites?*) *pseudodiscoidea* nov. spec. – Curaçao, sta. 1453: 49–54, "abnormal" specimens which do not form annular end-chambers (× 70); 55, initial part in transeverse section with in one chamber a divisional septum; 56, part of transverse section through chambers with divisions (both × 125); 57, initial part of horizontal section (× 125); 58, part of horizontal section with the foramina and the incomplete divisional septa (× 70).

Dendritina elegans d'Orbigny Fig. 59

Peneroplis elegans D'ORBIGNY, 1839, p. 61, pl. 7 fig. 1, 2; HOFKER, 1951, p. 228–230, fig. 3–5; HOFKER, 1964, p. 56, fig. 149–155.

Some specimens consist of an elongate row of cylindrical chambers which very much resemble those known as *Monalysidium politum* (Chapman); however, the ornamentation on the walls does not consist of longitudinal striae, as in real *M. politum* (HOFKER, 1951, p. 238, fig. 18) but of rows of fine pustules, typical for *Dendritina elegans*. I already described specimens of this form in 1951 (p. 230, fig. 4b). CUSHMAN (1930, p. 45) when mentioning *Monalysidium politum* from the Caribbean region possibly refers to these abnormal forms of *Dendritina elegans*. It seems to have been mixed up by CUSHMAN (1930, l.c., p. 35) with *Peneroplis pertusus* Forskål, which species, however, does not occur in the Caribbean.

The species was found abundantly in Sta. 1453, and, moreover, rarely in 1458, 1459, 1460, 1464, 1467B and C, and in 1471A. It occurs commonly in coral sand, and penetrates but rarely in the muddy inner part of Picadera Bay.

Bolivina lanceolata Parker

Bolivina lanceolata PARKER, 1954, p. 514, pl. 7 fig. 17–20.
Bolivina (Loxostoma) lanceolata Parker, HOFKER, 1956, p. 64, pl. 7 fig. 1–7; 1964, p. 78, fig. 209.

This species was found, always in a few specimens, in Sta. 1453, 1458, 1467, 1467B and 1621. It seems to be restricted to sandy environment.

Bolivina spatuloides Hofker Fig. 60

Bolivina spatuloides HOFKER, 1956, p. 66, pl. 7 fig. 8–11.

A small, slender species with pores restricted to the proximal parts of the chamber walls, which was found in one single specimen in Sta. 1453.

Nonionella grateloupii (d'Orbigny) Fig. 63–70

Nonionina grateloupii D'ORBIGNY, 1826, p. 294, No. 19; 1839, p. 46, pl. 6, fig. 6–7.
Nonion grateloupii (d'Orbigny), CUSHMAN, 1930, p. 10, pl. 3 fig. 9–11, pl. 4, fig.1–4; PHLEGER & PARKER, 1931, p. 11, pl. 5 fig. 18.

This species has been described as *Nonion* because the last formed chambers are nearly symmetrical with a symmetrical median slit-like aperture; but the description by CUSHMAN (1930) was incorrect, when he wrote: "Test planispiral, bilaterally symmetrical, mostly involute, in peripheral view the sides nearly parallel, periphery rounded."

Sections reveal that the test is utterly asymmetrically built; moreover, the test very much resembles that of *Nonionella*, with its thin granular walls and very densely placed pores. It is a *Nonionella* in which the last formed chambers become somewhat symmetrical. The elongate test with the later chambers strongly broadening, points to *Nonionella*, or what has been described as such. LOEBLICH & TAPPAN (1964, p. 746, fig. 612, 4–7) proposed to place such forms under the name of *Florilus* Montfort; yet, we must bear in mind that during many years such forms have been described as *Nonionella*, though the genotype of that genus is, according to the same writers, a rare and abnormal form (*Valvulineria*?), indicated as genotype of *Nonionella* by CUSHMAN. In the same region, the Caribbean, a somewhat similar form occurs in deeper water, identified by the author as *Nonionella atlantica* Cushman, and described as such by CUSHMAN himself as a *Nonionella* (1947, p. 90, pl. 20 fig. 4–5). This form, described by the author from off Santa Cruz (St. Croix), 150–500 fathoms deep, differs only from the form described here from Piscadera Bay in having an asymmetrical aperture (HOFKER, 1956, p. 134–135, fig. 7, pl. 19 fig. 8–16). It is very likely that the different surroundings were the cause of the difference in structure, for otherwise the two "species" *grateloupii* and *atlantica* do not differ in any respect.

It might be that the environment of Piscadera Bay caused the last formed chambers to be somewhat more symmetrical; not-fully outgrown specimens of *N. grateloupii* from Piscadera Bay are identical to *N. atlantica* from St. Croix.

As in many other species of *Nonionella-Floridus* (the name *Floridus* seems to be superfluous), the author observed typical tooth-foramina to the right and the left of the apertural opening (foramen), similar to those found in *Nonion* and in *Elphidium*, but the toothplates do not form septal flaps. They form toothplate canals running over the axial base of each chamber, and peculiar lips which form the irregular calcitic bosses covering the umbilical areas of the tests. This is so in the type-species of *Nonionella, N. asterizans*. Often fine canals run through these bosses from the toothplate canal toward the outer surface. The toothplate canals, the outgrowths of the toothplates and these fine canals are also found in thin transverse and tangential longitudinal sections through *Nonionella grateloupii* (see Fig. 66–70).

This species was very common in Sta. 1453, and occurred in a few specimens in several stations in the Boca and the Inner Bay, where they remain small. — Sta. 1453, 1454, 1459, 1474A, 1478, 1478B, 1483, 1487, 1490 and 1496.

Elphidiononion poeyanum (d'Orbigny)

Polystomella poeyanum d'Orbigny, 1839, p. 55, pl. 6 fig. 25–26.
Elphidium poeyanum (d'Orbigny), Cushman, 1930, p. 25, pl. 10 fig. 4–5.
Elphidiononion poeyanum (d'Orbigny), Hofker, 1956, p. 141–142, pl. 21 fig. 8–18; 1964, p. 110–111, fig. 266–269.

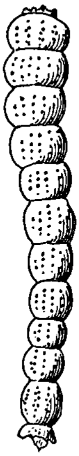
Elphidiononion poeyanum was not found in samples with coral sand only; it occurred in the entrance of Piscadera Bay and more abundantly in the muddy samples of the inner bay, especially in locality 1486A and 1487. The specimens here are mostly small, but distinct. Cushman mentions its abundance in depths from 2,5 to 7 fathoms; Hofker found it very common at a depth of 500 fathoms. It was mentioned from the tidal zone of many Caribbean islands by Hofker, 1964. In Piscadera Bay the species was common in localities with *Rhizophora*. — Sta. 1461, 1465–1467B, 1469, 1471A, 1473, 1474, 1478, 1478B, 1485–1487, 1490, 1495, 1496, 1500, 1500A, 1502 and 1621.

Elphidiononion discoidale (d'Orbigny) Fig. 71–84

Polystomella discoidale d'Orbigny, 1839, p. 56, pl. 6 fig. 23–24.
Elphidium discoidale (d'Orbigny), Cushman, 1930, p. 22, pl. 8 fig. 8–9.
Elphidiononion discoidalis (d'Orbigny), Bermúdez, 1956, p. 178.
not *Elphidium discoidale*, Hofker, 1964, p. 111, fig. 272.

In 1964 the author described some specimens which he believed attributable to *E. discoidale* (d'Orbigny). But this description does not agree with that, given by Cushman. They seem to belong to another very small species, with walls pierced by fine pores and with true retral processes, the walls of which are also pierced by pores: possibly some variety of *Elphidium advenum* (Cushman) or a new species.

In the material of the Boca of the Piscadera Bay, a rather common species was found which, with certainty, belongs to what CUSHMAN described as *Elphidium discoidale* (d'Orbigny). The type-figure given by D'ORBIGNY is not exact enough to be certain that the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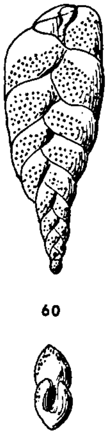
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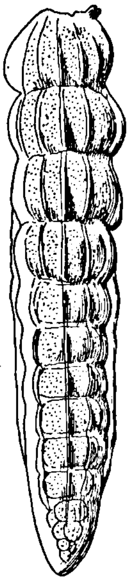
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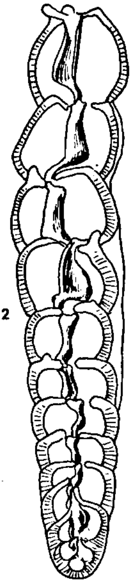
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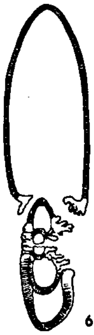
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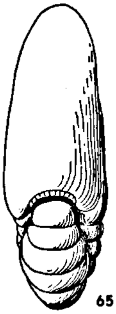
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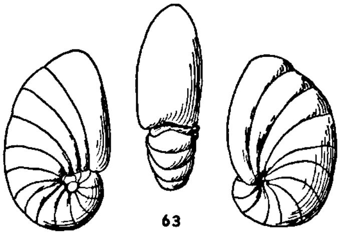
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Fig. 59. ***Dendritina elegans*** **d'Orbigny. – Curaçao, sta. 1453: Part of specimen with very slender test, resembling *Monalysidium politum* (Chapman) (× 70).**

Fig. 60. ***Bolivina spatuloides*** **Hofker. – Curaçao, sta. 1453: Side view and apertural face (× 70).**

Fig. 61–62. ***Siphogenerina costata*** **Schlumberger. – Curaçao, sta. 1454: Total test and longitudinal section (× 70).**

Fig. 63–65. ***Nonionella grateloupii*** **(d'Orbigny). – Curaçao, sta. 1453: 63, outgrown specimen from three sides (× 70); 64, apertural face with slit-like aperture (× 70); 65, longitudinal section, showing the asymmetrical arrangement (× 70).**

species described by that author as *N. discoidale*, from Cuba, is the same; but in material sent to me by Bermúdez from off Havana, specimens were found in abundance, which belong to the species described by Cushman, and which are identical to the specimens I found in the Boca of the Piscadera Bay, Sta. 1453.

Cushman's description runs: Test of medium size for the genus, somewhat compressed, margin slightly lobulate, sides convex in peripheral view, umbilical regions each with a large rounded boss, in peripheral view protruding strongly beyond the outline of the test; chambers only slightly inflated, distinct, averaging about 10 in number in the last-formed coil; sutures slightly depressed, somewhat broadening towards the inner end, marked also by the retral processes which are short, and 10 to 12 in number; wall smooth, very distinctly perforate, umbos of clear shell material, nearly transparent with numerous coarse tubules; aperture composed of several small, rounded openings at the base of the apertural face. Diameter 0.65 mm; thickness 0,30 mm.

Actually, however, no retral processes exist: massive tecta of hyaline, poreless shell substance are formed intermittantly from the proximal wall of a chamber to the wall of a former one, covering partly a sutural groove of which the inner wall is formed by the septal flap of the toothplate: the so-called sutural openings between the successive tecta are in reality the openings of the canal formed by the groove at the suture. These characteristics, together with the very distinct pores in the walls, are the main characteristics of *Elphidiononion*. Loeblich & Tappan (1964, p. 635) synonymized *Elphidiononion* Hofker with *Criboelphidium* Cushman & Brönnimann; *Cribroelphidium*, however, is based on extra areal foramina on the apertural face and that characteristic is also found in the type species of *Elphidium*, *E. macellum* (Fichtel & Moll); consequently *Criboelphidium* becomes a synonym of *Elphidium* which is characterized by true retral processes with pores in their outer walls. These processes are hollow outgrowths of the chamber lumina. So *Elphidiononion* has to be maintained for those species which show massive, poreless, tecta over the sutural groove which was originally given as the characteristic of *Elphidiononion*, type species *Polystomella poeyanum* d'Orbigny, also from the Caribbean region.

In *Elphidiononion discoidale* the apertural face generally does not show the row of apertural openings at its base, seen in the septa of former chambers; obviously these openings are formed secondarily; the same may be said about the areal openings in the septa, also found in *E. poeyanum*. The only openings found in the apertural face of an undamaged test are the two toothplate-foramina at the basal angles of the face. They give access to a true toothplate canal which may be followed in superficial tangential horizontal sections. This canal gives rise to the sutural canal formed by the septal flap of the toothplate; at the angle formed by toothplate canal and septal flap canal, an opening in the toothplate is found connecting the canal with the lumen of the chamber itself; this opening may be homologous with a protoforamen. The septal flaps of both sides, running suturally over the distal chamber wall of the former chamber, are narrow and communicate with each other at the marginal angle of each chamber, so that in horizontal central sections the toothplate and the sutural canal is also found at the margin. In transverse section the canals through the umbilical filling can be followed; they originate in the toothplate canals which together form two spiral canals at the outer bases of the chambers. Moreover, the toothplate canals are very wide and are strengthened by solid pillars, which can easily be seen when the last formed chamber with its thin walls, not thickened secondarily, is cut by the section.

Elphidiononion discoidale is a species typical for the Caribbean Sea; it is known from not too shallow water and occurs only in Sta. 1453, depth 3.5 m, where it is common, and in 1620.

Siphogenerina costata Schlumberger Fig. 61–62

Siphogenerina costata SCHLUMBERGER, 1883, p. 118, fig. B; HOFKER, 1956, p. 84, pl. 10 fig. 1–3.

In 1951 (p. 232) the author stated that the genus *Rectuvigerina* MATHEWS (1945, p. 588–606) cannot be separated from *Siphogenerina* Schlumberger, as species exist, such as *Rectuvigerina raphanus* (Parker & Jones), which have the microspheric generation with triserial initial part, whereas the A_1-generation has a biserial initial part and the A_2-generation an uniserial test throughout. In 1956 I showed that the species found in the Recent in the Caribbean region has very few costae and shows a triserial initial part in the mega-

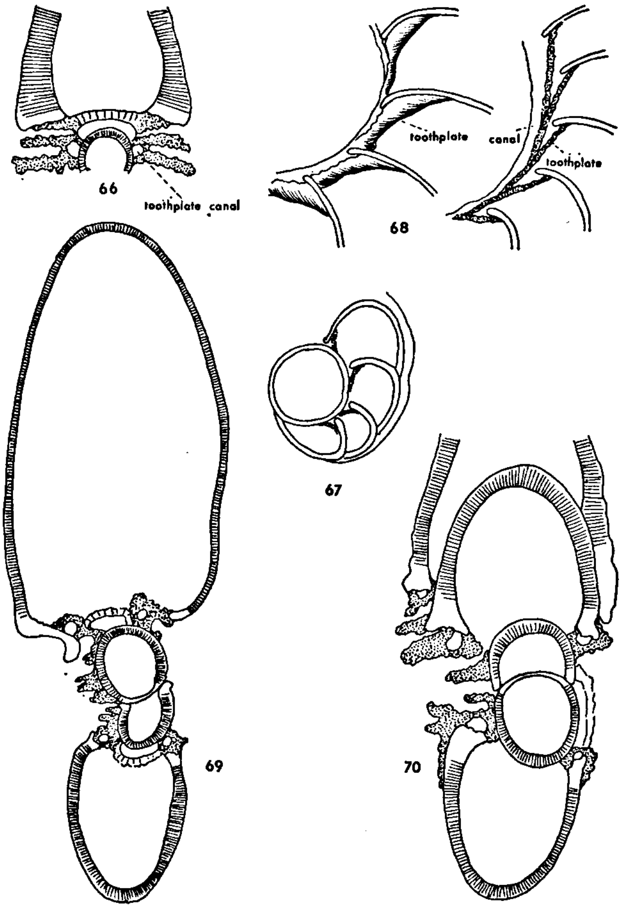

Fig. 66–70. *Nonionella grateloupii* (d'Orbigny). – Curaçao, sta. 1453: 66, part of transverse, not totally median section, showing the toothplates and the toothplates canals; 67, initial part of horizontal section with toothplates; 68, two successive horizontal sections, showing toothplates, and toothplate canal; 69–70, transverse sections through two small specimens, showing toothplates and toothplate canals (all × 170). – t.pl. = toothplate (granular); t.pl. can. = toothplate canal.

lospheric generation; the characteristics are those found in *S. costata* Schlumberger and MATHEWS states that this species may be different from *R. raphanus* (Parker & Jones) which, according to MATHEWS, has a biserial initial stage in the microspheric generation.

In 1951 the author united all species beginning with a biserial stage in the "genus" *Rectobolivina*, stating, however, that that genus is polyphyletic and thus is not a biological entity. In 1951 I showed that the question about *Siphogenerina* could only be solved by means of the arrangement of toothplates. In true *Siphogenerina*, obviously derived from uvigerinid forefathers, the toothplates in the uniserial part of the test are placed at angles of 120° in the successive chambers, whereas in the real biserial species belonging to "*Rectobolivina*," the toothplates are arranged at angles of 180°, which proves that they are derived from bolivinid ancestors. Obviously SCHLUMBERGER's *S. costata*, the genotype of *Siphogenerina* Schlumberger, with 6–7 costae around the test and the last formed chambers with depressed sutures, belongs to the group with triserially arranged chambers in the initial part, which, as I showed in 1956, have the form of chambers of Uvigerinidae.

In 1964 LOEBLICH & TAPPAN (p. 569) once again tried to tackle the problem; they stated that *Siphogenerina costata* Schlumberger differs from *Rectuvigerina raphanus* (Parker & Jones), which latter species was designated by CUSHMAN as the genotype of *Siphogenerina*, erroneously believing that both species were synonyms. They maintained *Rectuvigerina* Mathews, but, when one compares their descriptions of the genera *Rectuvigerina* and *Siphogenerina*, it is obvious that they are identical.

Therefore I have here described the species, found in the Caribbean Sea, as *Siphogenerina costata* Schlumberger.

Test elongate, length 1 mm and even more, in the megalospheric generation beginning with a triserial stage, containing about 3 whorls of chambers with protruding necks, as in *Uvigerina* (*Euuvigerina*). Then a long series of uniserial chambers starts, with only slightly depressed horizontal sutures in the main part (caused by secondary thickenings of the outer test walls) and in the end with more depressed sutures. Over the whole test longitudinal distinct costae are formed which are not interrupted by the sutures. The chambers of the uniserial part following the triserial one, are distinctly broader than long, whereas the last formed chambers with the more depressed sutures are nearly as long as broad. The transverse section is circular.

This species occurred in Sta. 1453, 1454, 1463, 1469, 1474A and 1474B, but only in a few specimens.

Neoconorbina orbicularis (Terquem)

Rosalina orbicularis TERQUEM, 1876, p. 75, pl. 9 fig. 4.
Discorbina orbicularis (Terquem), BRADY, 1884, p. 647, pl. 88 fig. 4–8.
Neoconorbina orbicularis (Terquem), HOFKER, 1956, p. 171–174, pl. 26 fig. 4–8; 1964, fig. 211–212.

A few specimens in Sta. 1453 and 1459.

Siphonina pulchra Cushman Fig. 85

Siphonina pulchra CUSHMAN, 1919, p. 42, pl. 14 fig. 7; HOFKER, 1956, p. 120–122, pl. 16 fig. 1–8.

Fig. 71–84. *Elphidiononion discoidale* (d'Orbigny). – Curaçao, sta. 1453: 71–72, specimen from two sides; 73, apertural face, showing that the rounded apertures are not yet formed and that the only openings are the ends of the toothplate canals; 74, tangentially sectioned specimen of Fig. 73, proving that the septum of the former chamber shows not only the toothplate canal openings, but also a row of rounded openings at the base and several areal openings, as is typical for many species of Elphidiononion (all × 70). 75–76, parts of sutures with the tecta which are not hollow and thus are no retral processes (× 170); 77, transverse section, showing the toothplates, the toothplate canals, and the canals through the umbilical plug originating from the toothplate canals (× 70); 78, part of tangential transverse section, showing the toothplates and the sutural canal covered by massive tecta (× 170); 79, part of section Fig. 77, showing the complicated toothplate forming pillars in the toothplate canal and the septal flap of the toothplates (× 170); 80, part of transverse tangential section, showing tecta over the sutural canals and the sutural openings of this canal (× 170); 81, horizontal tangential section, showing the septa, the septal flaps and openings running from the lumen of the chambers to the sutural canals; 82, the section more towards the centre of the test, showing the toothplate canals forming the spiral canal, and the septal flaps in more initial chambers; 83, part of horizontal section, showing sutural opening and septal flap and the larger areal apertures in the septum; 84, part of the same section, now showing a tectum over the suture with the septal flap, enclosing the sutural canal (all × 170).


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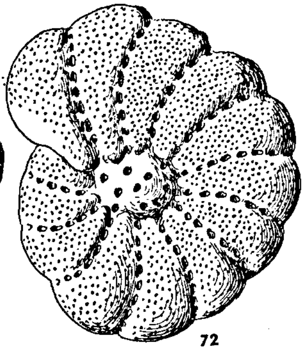
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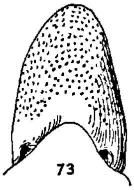
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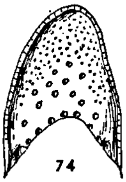
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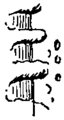
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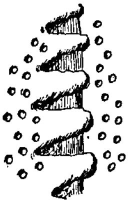
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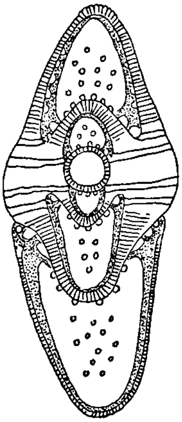
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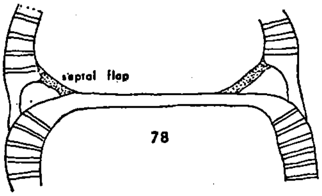

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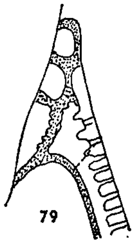
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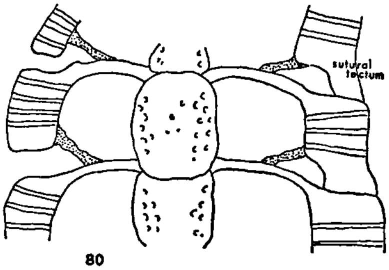

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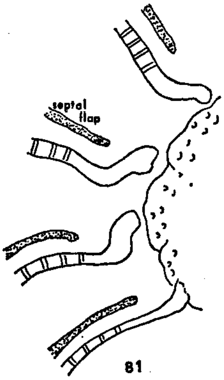

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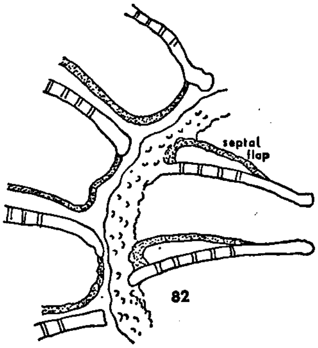

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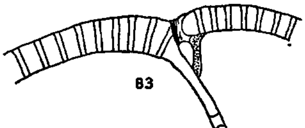
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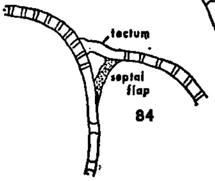

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Test rounded, lenticular, with distinct carina on which rows of pores open. All chambers visible dorsally, only those of the last formed whorl on the ventral side; sutures smooth to the surface. Aperture on a short neck, with thickened border and only ventrally from the margin, oval, in direction of margin. Pores large, distinct, at the dorsal side on the margin and mostly in the distal part of the wall; at the ventral side pores along the sutures.

Usually the species occurs in shallow water, more rarely in deep water. – In Piscadera Bay a few specimens were found in Sta. 1453.

Eponides repandus (Fichtel & Moll) Fig. 86

Nautilus repandus FICHTEL & MOLL, 1798, p. 35, pl. 3 fig. a–d.
Eponides repandus (Fichtel & Moll) MONFORT, 1808, p. 127; HOFKER, 1969, p. 139–143, fig. 452–461.

The specimen found in the collection of FICHTEL & MOLL in the Museum at Vienna leaves no doubt about the validity of this species; it was, therefore, unnecessary for LOEBLICH & TAPPAN (1964, p. 678, fig. 544, 1) to designate a neotype.

Test slightly oval to round, lenticular. All chambers visible dorsally, with rounded sutures bending backward. Ventrally only the chambers of the last formed whorl visible, with slightly depressed sutures. Aperture a slit from centre to near the periphery. No umbilical hollow, the chambers reaching the centre. Margin acute to sub-acute, without pores. Pores very fine.

The records given by CUSHMAN (1931, p. 51) show that in the Caribbean *Eponides repandus* is generally found in somewhat deeper water. West of Barbados the species occurred abundantly at a depth of 100 m, but in the outer part of Piscadera Bay several specimens were found in the stations 1454, 1455 and 1457, in depths of 2–4 m.

Rotorbinella rosea (d'Orbigny)

Rotalia rosea D'ORBIGNY, 1826, p. 272, Modèles no. 36; 1839, p. 82, pl. 3 fig. 9–11.
Truncatulina rosea (d'Orbigny), BRADY, 1884, p. 667, pl. 96 fig. 2.
Rotorbinella rosea (d'Orbigny), BERMÚDEZ, 1952, p. 75.
Parrella rosea (d'Orbigny), HOFKER, 1956, p. 122, pl. 14 fig. 5–9.
Rotorbinella rosea (d'Orbigny), HOFKER, 1964, p. 109, fig. 263–265.

This species occurred in the outer bay, always in scattered specimens. It is typical for coral sand environment. Sta. 1453–1455 and 1458.

Discopulvinulina floridana (Cushman)

Discorbis floridanus CUSHMAN, 1922, p. 30, pl. 5 fig. 11–12.
Rosalina floridana (Cushman), PARKER, 1954, p. 52, pl. 8 fig. 19–20.
Discopulvinulina floridana (Cushman), HOFKER, 1964, p. 81, fig. 213.

Common in Sta. 1453 only; present in 1459 and 1620.

Asterigerina carinata d'Orbigny Fig. 87–104

Asterigerina carinata D'ORBIGNY, 1839, p. 118, pl. 5, fig. 25; pl. 6, fig. 1–2; CUSHMAN, 1931, p. 77, pl. 15 fig. 4–5; HOFKER, 1951, p. 443–445 (sub *Amphistegina*); BRÖNNIMANN, 1951, p. 469–474; HOFKER, 1959, p. 250–251, fig. 4–7; HOFKER 1956, p. 175–178, pl. 26 fig. 13–23; HOFKER, 1964, p. 88, fig. 222–223.

Dorsal side flat to slightly convex, ventral side much more convex, margin slightly keeled with poreless keel, sharp. Test nearly circular. At the dorsal side all chambers are visible, with sutures slightly curved backward, distinctly oblique, not depressed, and spiral suture distinct, confluent with the carina. In the megalospheric generation the proloculus and the next chamber form the embryon (proto- and deuteroconch). Pores fine, distinct, densely placed, very regular. At the ventral side sutures nearly radial, but each suture covered by lozenge-shaped "stellar chambers" (or secondary chamberlets), which are nearly flush with the surface and with only very slightly depressed sutures. These "supplementary chamberlets" nearly reach the periphery. At the area proximal to the ventral aperture the ventral side may be covered by pustules arranged in lines or costae parallel to the margin. Pores of the secondary chamberlets of the same density and width as those found in the ventral chamber walls.

The species was found abundantly in the outer part of the Piscadera Bay, especially in Sta. 1453, and rarely in some localities in the entrance of the bay itself. In 1453 many of the specimens were collected alive, greenish in colour when preserved. Coloured with Haidenhain's haematoxyline, the protoplasm was seen filled with zoöxantellae.

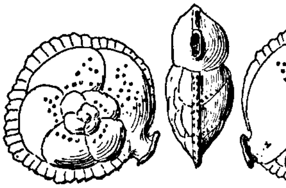
It is obvious that the life cycle of this species, living in large quantities so near to the CARMABI, may be very easily studied. — Sta. 1453, 1459, 1463 and 1465.

In the enormous material at hand consisting of wholly undamaged specimens, the finer structure of the test could be studied in many sections (Fig. 88–104). In 1951 and 1956 the author suggested that each stellar chamber must be part of the following main chamber seen from the ventral side, and that both chamberparts were formed simultaneously. Moreover, I stated that the peculiar thin septum dividing the main chamber from the stellar chamber should be a toothplate. In 1959 I believed to be able to see these toothplates, on horizontal sections seen from the dorsal side, as lips curved towards the ventral side. This may be right for *Asterogerinoides*, but only partly so for *Asterigerina carinata*, as here parts of these lips are in reality the poreless parts of the apertural faces bending downward. This error in the case of *A. carinata* was pointed out by REISS (1963, p. 61); but it is in so far true, that the septal flap of the toothplate partly runs inside the ventral part of the apertural face. BRÖNNIMANN (1951) believed to have found several stages of the development of the stellar chamber; however, in the large quantity of material now at hand of living and undamaged specimens, nothing of the stages described by him could be refound.

In cases where the last formed chamber, which may have a very thin wall, is damaged, the main chamber may have completely vanished and the "stages" figured by BRÖNNIMANN may then be traced. This observation by BRÖNNIMANN led him to assume that the stellar chambers are formed independently of the main chambers, that the original aperture is divided by a septum forming the first upper wall of the stellar chamber, and that the whole dorsal wall of the latter is formed before a following main chamber is built. This erroneous conclusion seems to have led to the description of the Asterigerinidae by BARKER (1964, p. 592): "Primary chambers showing slit aperture on inner side of last formed chamber, secondary chambers with loop-shaped aperture leading into primaries, growth of these two series thus alternating."

Much better is the description given by REISS (1963), where he says: "Toothplates always present in all chambers, almost completely subdividing the latter into two distinct parts, running obliquely from about the middle of the septum towards the lower part of the distal face, attached to both, as well as to the axial and lateral chamber walls along the distinct toothplate sutures. "Compartments" are thus formed: one produced by the toothplate and the umbilical parts of the distal and lateral chamber walls which does not communicate directly with the interior, but with the remainder of the chamber which composes the second compartment and to which the aperture is confined. Communication is made possible between the compartments by incomplete attachment of the toothplate. Intercameral foramina ("cut" by the attachment of the toothplate) put in communication all compartments of consecutive chambers."

The term "cut" used by REISS obviously is reminiscent of BRÖNNIMANN's study; the term is incorrect, however, and this error must be sought in the fact that REISS did not observe the "loop-shaped" structure of the foramen of the "stellar chambers" as described by BARKER. Loop-shaped foramina invariably point to protoforamina, as I have stated so many times. In 1959 (p. 248, fig. 1) I showed that the "slit-like apertures" of *Asterigerina* are distinctly foramina composita, viz. foramina, composed of a protoforamen found axially, and a deuteroforamen, found marginally, divided by a lip. In the new material at hand this observation could be ascertained; if the apertural face of the last formed undamaged chamber is observed obliquely so that the poreless part of the face is seen in an horizontal plane, the two foramina may be distinguished easily, and the protoforamen, found just at the angle where the foramen of the main chamber reached the "stellar chamber," is "loop-shaped" and is seen to run into the "stellar-chamber." In thin-walled clear specimens the distal wall of the loop-shaped protoforamen is seen to be bordered by the toothplate, running to the inside of the chamber; as in all toothplates, it is formed by granular material, distinctly distinguishable by a brownish or greyish colour from the outer wall which is hyaline. On tangential transverse section through the test this loop-shaped protoforamen may be seen in the "wall" (toothplate) of the ventral stellar "chamber." The toothplate then forms the inner and ventral border of the loop, as is the case with all toothplates connected to a protoforamen. It is thus incorrect to speak of a wall (toothplate of the stellar chamber cutting through the axial part of the aperture of the chamber); the toothplate, forming a funnel beginning at the protoforaminal part of the foramen compositum, runs inward into



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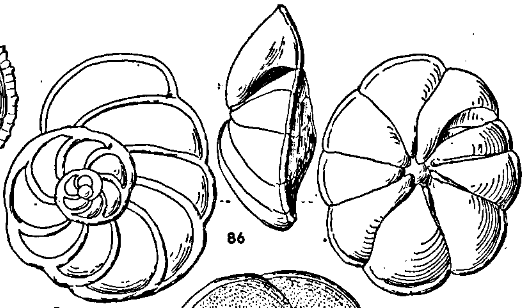

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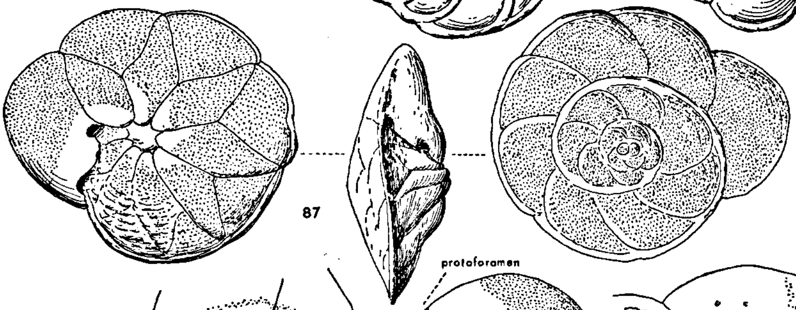

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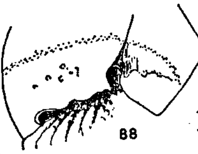

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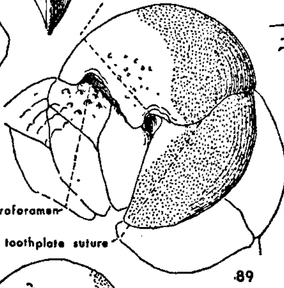

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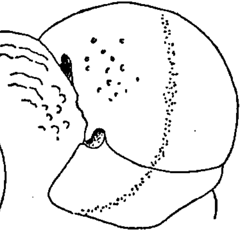

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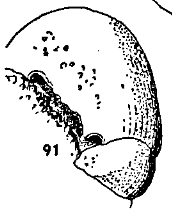

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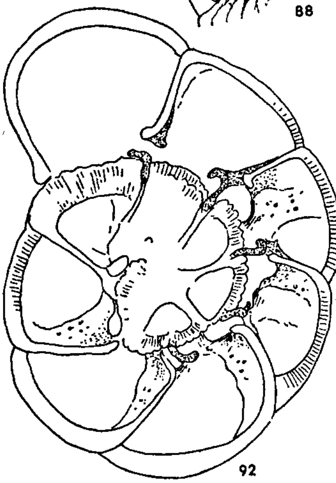

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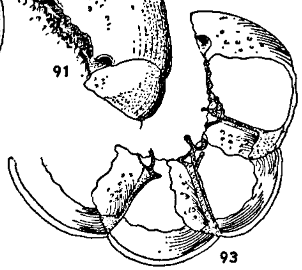

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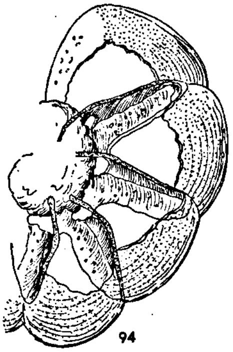

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the chamber, dividing the "main chamber" from the "stellar chamber," and, as found in all toothplates, finds its origin in the protoforamen which is loop-shaped, as is to be expected.

On transverse section this funnel of the toothplate forms the "hook," found axially from the septum where it ends in the border of the deuteroforamen. From this hook a broad septal flap originates which partly covers the outside of the poreless septum (former apertural face) of the foregoing chamber and also forms the division between the "main chamber" and the "stellar chamber," forming the dorsal roof in this chamber-part. In this way the toothplate runs from the ventral wall of the former coil to the ventral wall of the chamber, curved and twisted, forming the division between the two parts of the chamber. With the funnel the toothplate runs from the protoforaminal part of the foramen compositum of the former chamber towards the protoforamen of the next chamber. The funnel which is open at one side, forms the communication between the two chamberparts. So, obviously, the last formed "stellar chamber" is the ventral part of the last formed main chamber, just as is found in the genus *Rotalidium*.

The structure differs from that of *Asterorotalia* in the opening of the "stellar" chamber which is near the margin in *Asterorotalia*; in *Asterigerina* it is closed here. That the wall at the ventral side of the main chamber and that of the "stellar" chamber in reality forms one single wall with the toothplate-suture between, as described by REISS, may also be seen in the arrangement of the pores which continues from main chamber into stellar chamber. The peculiar hooks of the toothplates, seen in horizontal section, the transverse

Fig. 85. *Siphonia pulchra* Cushman. – Curaçao, sta. 1453: Test from three sides (× 35).

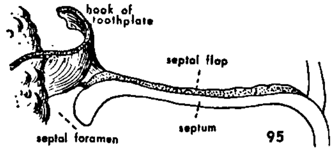
Fig. 86. *Eponides repandus* (Fichtel & Moll). – Curaçao, sta. 1454: Test from three sides (× 35).

Fig. 87–94. *Asterigerina carinata* d'Orbigny. – Curaçao, sta. 1453: 87, test from three sides; 88–91, last-formed chamber with its "secondary chamberlet" and the foramen compositum, seen in oblique position, showing the protoforamen and the deuteroforamen, four different specimens; 92, horizontal section, slightly oblique, with the toothplates and the hooks of the toothplates; 93–94, two tangential horizontal sections, seen from the dorsal side, the latter not so deep as the former (all × 70).

sections of the funnels, are also found in the genus *Streblus*, and the whole structure of the toothplate of *Asterigerina* resembles that of *Streblus*, *Asterorotalia* and *Rotalidium*. As the latter two genera also show the sharp poreless margin, this resemblance is the more striking. The difference with *Streblus* c.s. seems to be, that in *Asterigerina* the main part of the septal flap is free and running through the lumen of each chamber, whereas in *Streblus* it is found covering the inside of the ventral wall. In *Pseudorotalia*, strongly allied to *Streblus*, the septal flap partly loses hold of the outer wall, to form the peculiar canal system below the suture.

In 1959 (p. 249) the author already showed that the toothplate forms the poreless wall between main chamber and stellar chamber and that it encloses the protoforamen; I suggested that this toothplate must be homologous with that of *Reinholdella* and all other Biforaminata. I then believed that *Asterigerina* might be a *Globorotalia* with stellar chambers. Though I have showed in several papers that the lip at the aperture of *Globorotalia* is a toothplate and that *Globorotalia* has also formed a foramen compositum, the resemblance of the toothplate of *Asterigerina* with that of *Streblus* and allied genera also points to *Streblus*. It is obvious, that the ventral porous wall of the stellar chambers closes the protoforamen to the outside; this also is the case in *Asterorotalia* and in *Rotalidium*, as well as in *Reinholdella*. It is not very likely that the genus *Asterigerina* is allied to *Discorbis*, for this genus has a much more primitive toothplate.

Fig. 95–104. ***Asterigerina carinata*** d'Orbigny. – Curaçao, sta. 1453: 95–97, part of successive horizontal sections, showing the structure of toothplate and septal flap (× 170); 98, not totally central transverse section (× 125); 99–101, three sections through the toothplate in transverse section, successive (99 × 125, 100–101 × 170); 102, test with tangential transverse section showing left chamber with septal foramen, toothplate and its ventral part, the so-called secondary chamberlet, and left the protoforamen of the secondary chamberlet (× 70); 103, a slightly deeper section, showing the toothplate conditions (× 170); 104, another tangential transverse section, showing the chambers with their "chamberlets" and the toothplates between; in the chamber C–C′ the dorsal part of the foramen compositum (deuteroforamen, forming the septal foramen of the "main chamber") and the protoforaminal part of the foramen compositum with the toothplate between with its septal flap; in the chamber B–B′ the toothplate with its "hook" (× 125).



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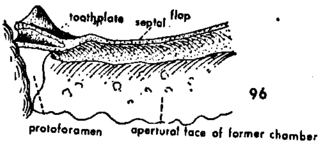

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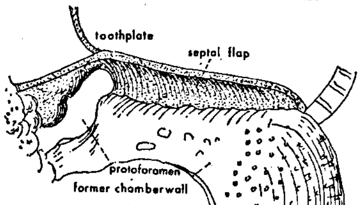

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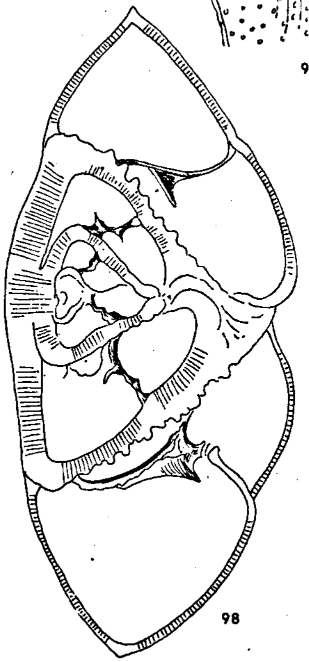

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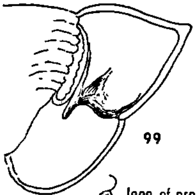

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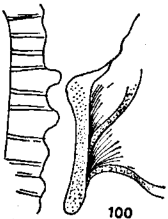

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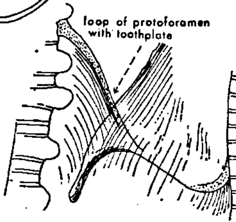

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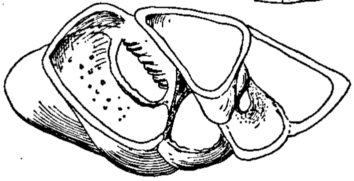

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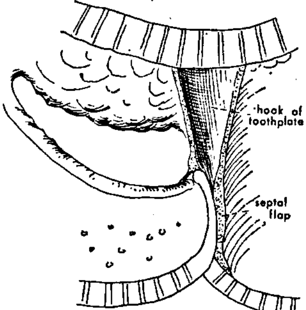

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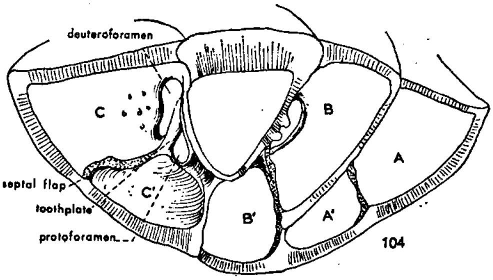

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Amphistegina gibbosa d'Orbigny

Amphistegina gibbosa D'ORBIGNY, 1839, p. 120, pl. 8 fig. 1–3; HOFKER, 1964, p. 88 fig. 224–226.

Found only in samples from Sta. 1454, 1455 and 1458.

Streblus advenus (Cushman) Fig. 105–113

Discorbina rosacea BRADY (non d'Orbigny), 1884, p. 644, pl. 87 fig. 1.
Discorbis advena CUSHMAN, 1922, p. 40; 1931, p. 13, pl. 2 fig. 8.
Streblus advenus (Cushman), HOFKER, 1964, p. 97, fig. 237–238.

Test rounded; dorsal side slightly convex, ventral side somewhat concave. Dorsally all chambers visible, last-formed whorl having about 6; sutures distinctly curved, slightly depressed. Peripheral margin rounded, lobulate. At the ventral side only the chambers of the last formed whorl visible, with strongly depressed radial sutures. Each chamber shows a broad and flattened tenon, smoothly finished, poreless, mostly with the inner part bent backward towards the distinct protoforaminal indentation of the proximal chamber suture. Umbilical cavity large, without filling. Wall extremely thin especially in the later chambers. Pores very fine, dorsally leaving the angle between the chamber suture and the spiral suture free, ventrally the areas around the protoforamen and the tenon do not show pores. Aperture a crescent-shaped opening or, in a newly formed last chamber, without this opening; in older chambers this opening forms the septal foramina. The apertural face is poreless. Test small, diameter not over 0.45 mm.

Transverse sections reveal the toothplates in the chambers running from the ventral border of the septal foramina towards the opposite poreless tena; they are extremely thin. On horizontal section the hooks of the toothplates are thin but distinct, opening to a short funnel formed by the septal flap which runs for a short time along the septum. These funnels beneath the hook of the toothplates open into the protoforamina. All 12 specimens gathered were megalospheric, 4 of them coiling to the right and 8 to the left.

Found only in Sta. 1453, where it was common.

Streblus compactus Hofker   Fig. 114–137

Streblus compactus Hofker, 1964, p. 99, fig. 242–243.

Test small, rounded, convex on both sides, with slightly lobulate periphery. Chambers 7–8 in the last whorl in the megalospheric specimens, and about 10 in the microspheric generation. Sutures at the dorsal side hyaline and distinctly raised. Pores fine and densely placed. Margin rounded to strongly rounded. At the ventral side sutures radiate. Tena and central parts of sutures ornamented with raised bosses which are formed into short, often branched spines; these spines are also found in the poreless parts around the narrow protoforamina at the proximal suture of each chamber, which in older chambers are overgrown by the spines. The tena almost completely cover the umbilical cavity which becomes small. Pores at the ventral chamber walls fine and dense, but not found in the tena and around the protoforamina. Aperture a crescent at the ventral distal suture of the last formed chamber. Length (diameter) up to 0.55 mm, thickness 0.20–0.30 mm.

On horizontal sections the hooks of the toothplates are very thin; the toothplates form funnels at the protoforamina and form with their flaps the proximal walls of the chambers at the sutures, thus resembling the toothplates found in *Asterorotalia*. The walls of the flaps have fine but distinct knobs on their inner surfaces. The chamber walls are very thin at the margin.

In transverse section the test shows its bulky form with dorsal and ventral sides convex. Dorsally the walls of the central part are secondarily thickened. As the apertural face misses the pores around the aperture, the ventral parts of the septa are poreless. The tena are thick, especially in older chambers and form on their ventral sides very peculiar knobs and spines which often bifurcate. In the septal walls the large septal foramina are surrounded at their ventral borders by the toothplates which run towards the ventral tena, forming the funnels, and over the septa. These toothplates form the large flaps with their scattered bosses and pustules. The funnels of the toothplates are twisted and curved.

Many of the populations of *Streblus compactus* of the Piscadera

Bay show an irregular distribution of the last formed chambers at the ventral sides of the individuals. These globular chambers number from one to four and are comparable with the "bullae" found in so many planktonic species which are found especially in the Tertiary and the Recent, but also occur in the Upper Cretaceous in *Globigerina*. These "bullae" in *S. compactus* may cover large parts of the umbilical cavities, as found in the "genus" *Catapsydrax* among the planktonic groups. As yet the meaning of these "bullae" is unknown and they occur in *S. compactus* only in megalospheric specimens; in planktonic *Globigerina rubra* they have been found only in the microspheric specimens. The walls of these irregular chambers in *S. compactus* are extremely thin, like those of the "bullae" of the planktonic species.

All microspheric specimens of *S. compactus* coil to the right, as is found in so many other planktonic and benthonic Foraminifera. The megalospheric specimens may coil to the right or to the left, in the following proportions:
St. 1496 : left coiling 67%; right coiling 33% (105 specimens)
St. 1483A: left coiling 63%; right coiling 37% (120 specimens)
St. 1478A: left coiling 63%; right coiling 37% (88 specimens)
St. 1478B: left coiling 71%; right coiling 29% (98 specimens)
A statistic study, giving the ratio between proloculus-diameter of megalospheric specimens, total number of chambers in the tests and the direction of coiling in individuals from St. 1483A shows that right coiling specimens tend to possess a larger proloculus, and that these specimens tend to have a smaller number of chambers. Obviously right coiling acts as a factor which stunts growth. It is remarkable that in *S. compactus* (as in other species of *Streblus*) the microspheric specimens, with coiling to the right, are not the largest specimens.

A graph of the proloculus-diameters of 153 specimens of St. 1483A shows two tops, one at 50 μ (45 specimens) and a second one at 81 μ (Fig. 137). Should one be inclined to gather all megalospheric specimens in one generation, one will observe a variation-curve which is highly unsymmetrical; such a curve is most unsatisfactory. Splitting the curve in two, slightly overlapping ones, the assymmetry disappears and two curves result, one with the top at 50 μ

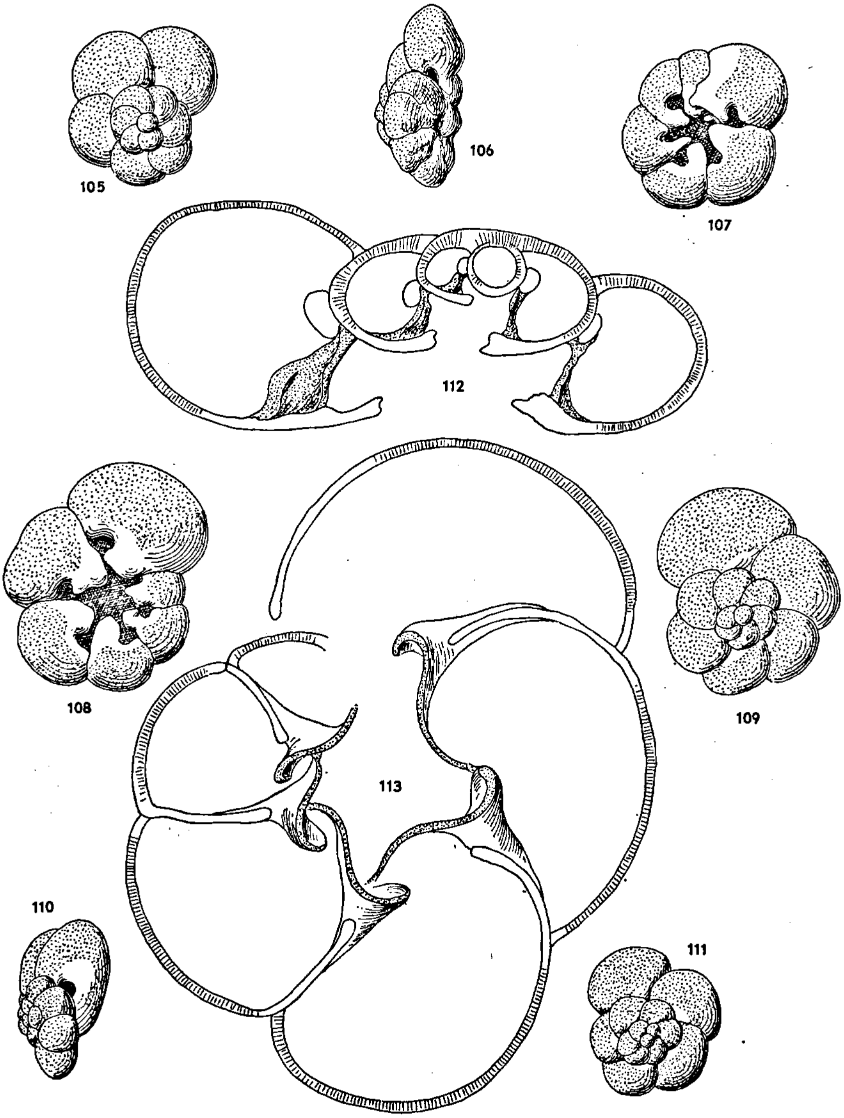


Fig. 105–113. *Streblus advenus* (Cushman). – Curaçao, sta. 1453: 105–107, specimen from three sides, coiling to the right; 108–109, specimen from two sides, coiling to the left; 110–111, small specimen coiling to the left (all × 70); 112, transverse section with the granular toothplates (× 125); 113, horizontal section showing the simple septa and the toothplates with septal flaps along the septa (× 170).

and the variation-boundaries at 37.5 μ and about 68.6 μ and the second curve with top at 81 μ and the variation-boundaries at about 62 μ and 100 μ. Obviously the A_1-generation with smaller megalospheric proloculi is the commoner generation, whereas the

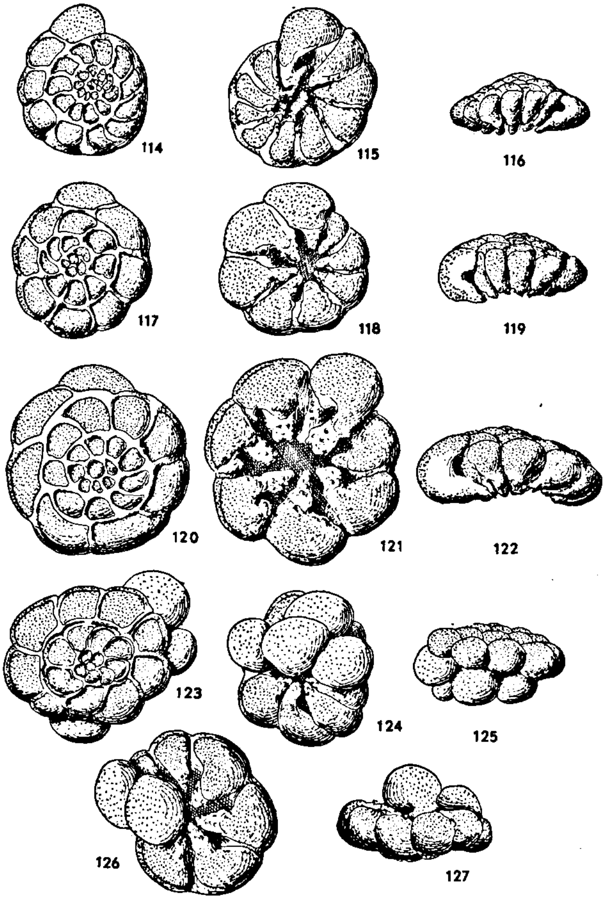


Fig. 114–127. *Streblus compactus* Hofker. – Curaçao, sta. 1483A: 114–116, microspheric specimen from three sides, coiling to the right; 117–119, megalospheric specimen from three sides, coiling to the left; 120–122, specimen of megalospheric generation coiling to the right; 123–125, specimen with four bulla-like extra chambers at the ventral side, from three sides; 126–127, specimen with two extra chambers from two sides (all × 35).

A_2-generation is much less abundant, at least at St. 1483A on 25.X.1963.

Living specimens have been observed in Sta. 1467, 1467B, 1469, 1478A (many), 1478B (many), 1480, 1480A, 1483, 1483A (many), 1485 (many), 1486 (many), 1486A (many), 1490, 1496 (many), 1500 and 1502. Moreover, possibly not-living specimens in samples from Sta. 1620, 1461, 1465, 1466, 1467A, 1467C, 1470, 1471 (many), 1471A, 1471B, 1473, 1474, 1474A, 1474B, 1475, 1477, 1479, 1484, 1487 (many), 1488, 1489, 1492, 1495, 1498, 1499, 1500A, 1621.

So *Streblus compactus* occurs in the whole basin of the Bay, and especially in the north and central parts, in mud to muddy sand. It will be possible to study the living species in its habitat.

The number of chambers decreases with the increase of the diameter of the proloculus (Fig. 134).

When we take $\frac{\text{diameter of test}}{\text{number of chambers}}$ as an index for the average length of the chambers, we find that the average length of chambers increases with the diameter of the proloculus; this means that the volume of the proloculus determines the volume of the chambers (Fig. 133).

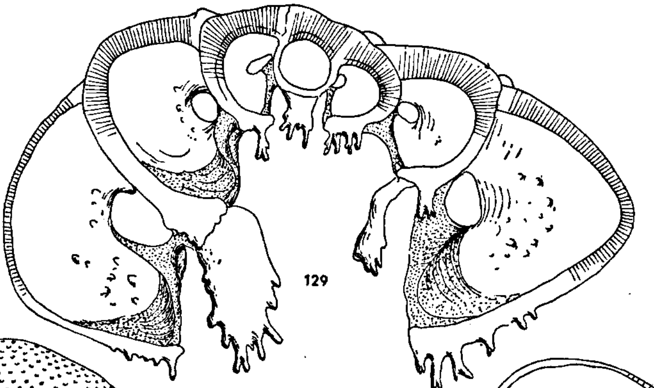
The number of chambers increases with the diameter of the test (Fig. 135).

The diameter of the test decreases with the increase of the proloculus and thus the larger tests have smaller proloculi (Fig. 136).

This all agrees with what has been found by the author in other species of Foraminifera. The microspheric proloculus has an average diameter of 12 μ; the number of chambers in outgrown specimens is up to 30 in the microspheric generation, whereas in the megalospheric generation it is about 20–24 in outgrown specimens.

Microspheric specimens are easy to detect, though they are rare, by the number of chambers in the last formed coil, as stated previously.

In some of the (fixed) samples small muddy globules were found which contained a specimen of *Streblus compactus*. It may be that these globules were cysts, in which the forming of plasmodiospores took place, as the author stated for *Streblus flevensis* HOFKER (1930).



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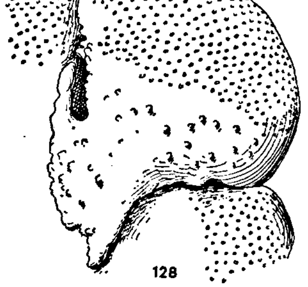

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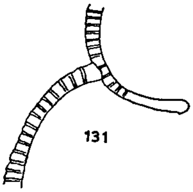

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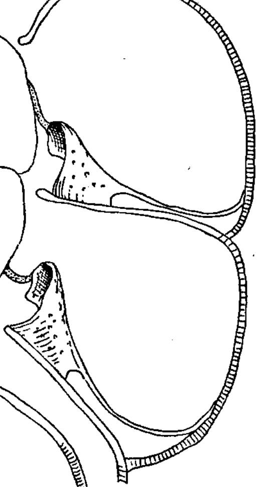

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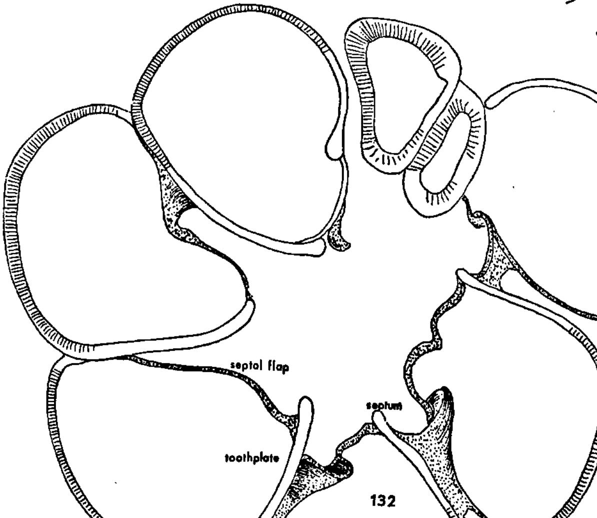

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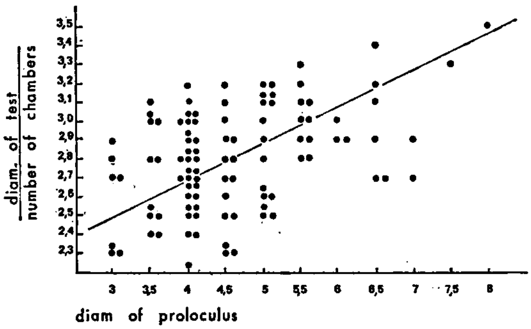

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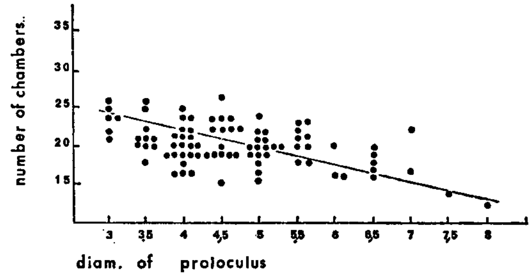

Fig. 133. *Streblus compactus*. – Curaçao, sta. 1483A: Correlation between the factor diameter of test (in mm × 100) : number of chambers (L/K) and the diameter of the proloculi (in mm × 200). The correlation is positive.

Fig. 134. *Streblus compactus*. – Curaçao, sta. 1483A: Correlation between number of chambers and diameter of proloculi (in mm × 200). The correlation is negative.

Fig. 128–132. *Streblus compactus* Hofker. – Curaçao, sta. 1483A: 128, last formed chamber from the ventral side, with tenon between protoforamen and deuteroforamen (× 170); 129, transverse section with the granular toothplates and the strongly built ventral ornamentation on the tena (× 125); 130, part of horizontal section with the two last formed chambers with the septa and the toothplates with their septal flaps not fully attached to the septa; 131, part of horizontal section with the walls of two adjacent chambers attaching; 132, horizontal section, showing the toothplates with their septal flaps (granular) (all three × 170).

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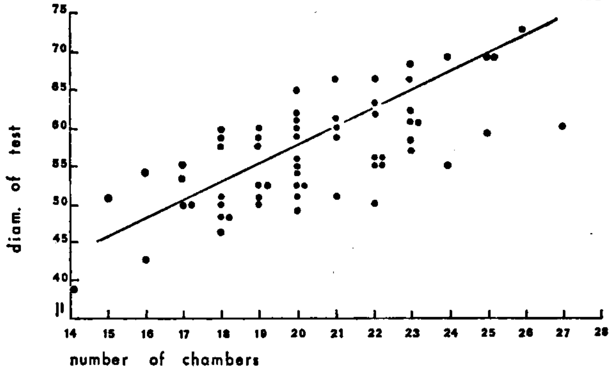

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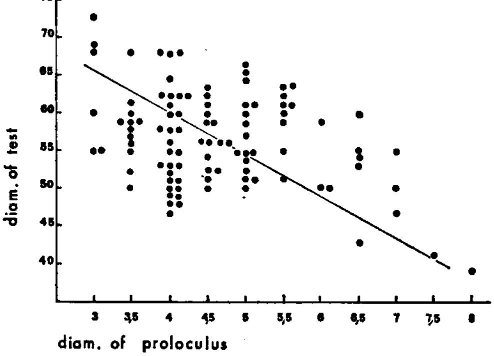

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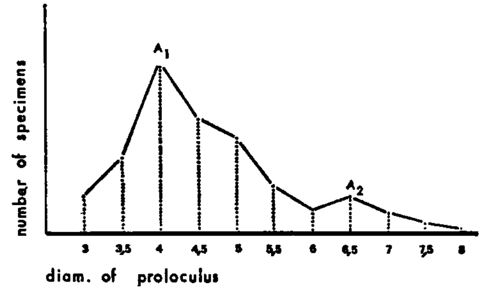

Fig. 135. *Streblus compactus.* – Curaçao, sta. 1483A: Positive correlation between diameter of tests (in mm × 100) and number of chambers.

Fig. 136. *Streblus compactus.* – Curaçao, sta. 1483A: Negative correlation between diameter of tests (in mm × 100) and diameter of proloculi (in mm × 200).

Fig. 137. *Streblus compactus.* – Curaçao, sta. 1483A: Graph showing the numbers of specimens with a certain diameter of proloculus (in mm × 200). The rare microsperic specimens are not taken into consideration. There are two A-generations.

Streblus parkinsonianus (d'Orbigny) Figs. 138–143, 146

Rosalina parkinsonianus d'Orbigny, 1839, p. 99, pl. 4 fig. 25–27.
Streblus parkinsonianus (d'Orbigny), Hofker, 1964, p. 95, fig. 234.

Test stout, thick, circular. Dorsal side often strongly convex, ventral side often nearly flat, margin rounded, porous. At the dorsal side of the only known megalospheric form all chambers visible, with distinct but not depressed sutures bending backwards. The chamber sutures are nearly straight. Pores fine, leaving the sutures free. About 10 chambers in the last formed whorl, total number of chambers from 12 to 26, with a top at 22. Proloculus clearly visible, inner diameter from 50 to 200 μ, with top at 112–125 μ.

At the ventral side only the chambers of the last formed whorl visible, with radiate sutures which are distinctly depressed and open towards the centre. This centre is filled by a hyaline calcitic knob which runs from the proloculus to the surface of the ventral side. Protoforamina not visible at the sutures, opening into the open part of the sutures. Tena large, without pores, smooth surface. Only a triangular part of the ventral chamber wall pierced by the fine pores. Surface of the whole test smooth and shining, in most cases with a slightly brownish colour.

In transverse sections the toothplates may be clearly seen at the axial part of each chamber, running from the axial border of the septal foramen towards the thickened tenon, and forming flaps along the ventral chamber walls. In horizontal sections the hooks of the toothplates are distinct and relatively thick, forming axial openings of the funnels formed by the toothplates; these funnels run ventrally from the septal foramina along the poreless septa and form proximal coatings of these septa and ventrally the septal flaps.

Among 111 specimens measured, no microspheric specimens were observed.

46% of the tests coil to the right and 56% to the left.

If young specimens are not considered, there exists a slight correlation between number of chambers and diameter of proloculus, such that the number of chambers increases with a decrease of the diameter of the proloculus (Fig. 146).

The species was very abundantly found, with living specimens, in Sta. 1453, 1463 and 1467B; it more rarely occurred in 1458, 1460, 1465, 1467, 1467C, 1471A, 1471B, 1473 and 1474A. Contrary to *Streblus compactus*, *S. parkinsonianus* is restricted to calcareous sand or muddy chalky sand and consequently does not occur in the centre of the bay where muddy sediments exist. Sta. 1453 yielded many living specimens. It should be possible to study the life-cycle of this species in its natural environment in this locality.

Cymbaloporetta squammosa (d'Orbigny)

Rotalia squammosa D'ORBIGNY, 1826, p. 272, no. 8; 1839, p. 91, pl. 3 fig. 12–14.
Cymbaloporetta squammosa (d'Orbigny), CUSHMAN, 1931, p. 83, pl. 16 fig. 4; HOFKER, 1956, p. 188–189, pl. 28 fig. 11–20; 1964, p. 84, fig. 215.

This species occurred mostly in the flat form in all stations of the Boca, and in a few in the most southern part of the Inner Bay. It is a typical coral sands dweller. – Sta. 1453–1461, 1464 and 1467.

Planorbulina acervalis Brady

Planorbulina acervalis BRADY, 1884, p. 657, pl. 92 fig. 4; HOFKER, 1964, p. 85, fig.216.

Found only in the sandy Boca and at the Entrance, Sta. 1453, 1554, 1457, 1458, 1460, 1461 and 1464.

Homotrema rubrum (Lamarck)

Millepora rubrum LAMARCK, 1816, p. 202.
Polytrema rubra (Lamarck), DUJARDIN, 1841, p. 258–259.
Homotrema rubrum (Lamarck), HICKSON, 1911, p. 445–447, pl. 30, 32; HOFKER, 1964, p. 86–87, fig. 220–221.

In the sandy bottom of the Boca, Sta.1453–1459, mainly in damaged specimens.

Sphaerogypsina globulus (Reuss) Figs. 144–145

Ceriopora globulus REUSS, 1848, p. 33, pl. 5 fig. 7.
Gypsina globulus (Reuss), BRADY, 1884, p. 717, pl. 101 fig. 8.
Sphaerogypsina globulus (Reuss), GALLOWAY, 1933, p. 309.

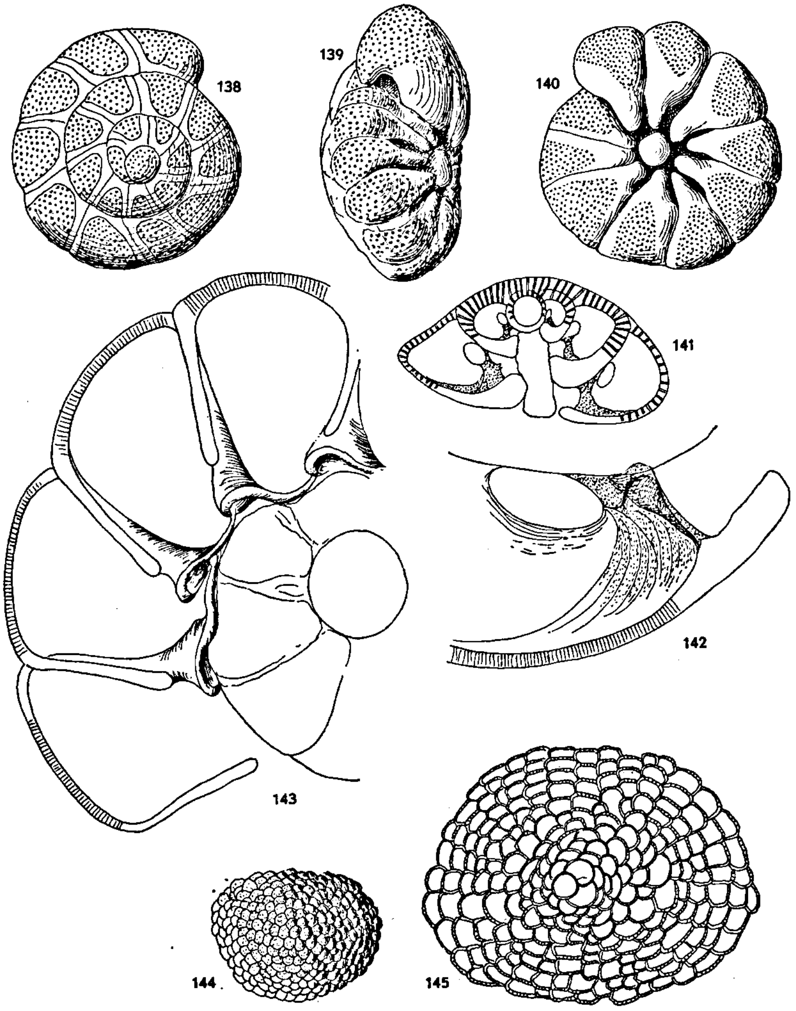

Fig. 138–143. *Streblus parkinsonianus* (d'Orbigny). – Curaçao, sta. 1453: 138–140, test from three sides (× 70); 141, transverse section with toothplates (granular) (× 70); 142, part of section Fig. 141 with toothplate and its septal flap (× 170), the toothplate adheres to the ventral proximal border of the foramen; 143, part of horizontal section, showing the hooks of the toothplates and the septal flaps (× 125). Fig. 144–145. *Sphaerogypsina globulus* (Reuss). – Curaçao, sta. 1454: 154, total specimen (× 35); 145, transverse section through same specimen, showing the protoconch consisting of three chambers (raspberry-type), followed by several layers of irregularly growing chambers which are followed by rows of chambers perpendicular to the surface (× 70).

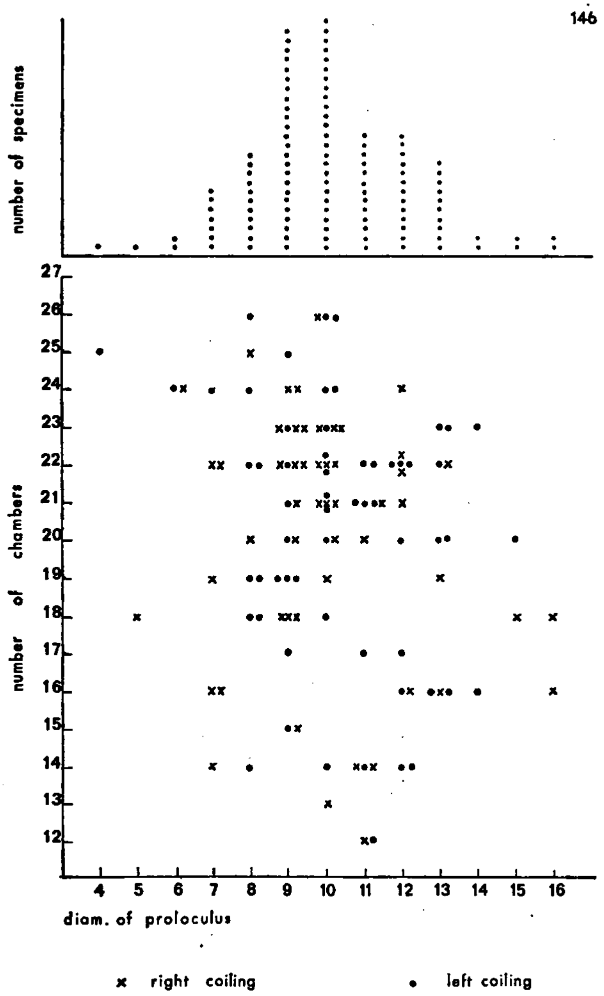

Fig. 146. *Streblus parkinsonianus.* – Curaçao, sta. 1453: Graph showing the correlation between number of chambers and diameter of proloculi (in mm × 200), with only a very slight negative correlation. Right and left coiling specimens are indicated; apparently only a single A-generation exists; microspheric specimens were not observed in this group of 104 specimens.

CUSHMAN (1931, p. 137) expresses some doubt as to the identity of the Recent form with the fossil one, described by REUSS. Topotypic specimens from REUSS' locality showed me that they are certainly identical.

The tests are more or less globular, with a three-chambered embryon in the centre and rows of chambers from that centre to the surface. These chambers are small, connected by pores (only found in the distal walls) and by stolons; the real foramina in the poreless radial walls. The walls mostly consist of inner granular layers, thickened secondarily by more hyaline ones.

The species is relatively rare in the Caribbean area, but occurs in the sandy outer part of Piscadera Bay, Sta. 1454–1456 and 1458.

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Table 1.

Distribution of Foraminifera

according to Hummelinck's
(Stations without Foraminife

The species are arranged so that first those from 1453 are plotted, then those occurring only in the Boca, followed
found in Boca and Inner Bay, and finely

Piscadera Bay	Boca or mouth of Bay											Bottleneck of Bay											
Station numbers arranged from South to North	1453	1454	1455	1456	1457	1620	1458	1459	1460	1461	1463	1464	1465	1466	1467	1467A	1467B	1467C	1468	1469	1471	1471A	1471B
Puteolina bradyi (Cushman)	—	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Massilina inaequalis Cushman	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nouria johnsoni Cushman	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Neoalveolina pulchra (d'Orbigny)	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Quinqueloculina polygona d'Orbigny	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Triloculina carinata d'Orbigny	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Neoconorbina orbicularis (Terquem)	—	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Streblus advenus (Cushman)	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Elphidiononion discoidale (d'Orbigny)	—	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Schlumbergerina areniphora Munier-Chalmas	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Siphonina pulchra Cushman	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Articulina paucicostata Cushman	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Discopulvinulina floridana (Cushman)	—	...	...	...	...	—	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bolivina spatuloides Hofker	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pyrgo subsphaerica (d'Orbigny)	—	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hauerina bradyi Cushman	—	—	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Puteolina pseudodiscoidea n. sp.	—	—	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Puteolina protea (d'Orbigny)	—	—	—	—	—	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Rotorbinella rosea (d'Orbigny)	—	—	—	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Valvotextularia candeiana (d'Orbigny)	—	—	—	—	—	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bolivina lanceolata Parker	—	...	...	...	...	...	—	...	...	...	...	...	...	...	—	...	—	...	...	...	...	...	...
Cymbaloporetta squammosa (d'Orbigny)	—	—	—	—	—	—	—	—	—	—	...	—	...	...	—	...	...	...	...	...	...	...	...
Planorbulina acervalis Brady	—	—	...	...	—	...	—	...	—	—	...	—	...	...	...	...	...	...	...	...	...	...	...
Homotrema rubrun (Lamarck)	—	—	—	—	—	...	—	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Asterigerina carinata d'Orbigny	—	...	...	...	...	...	...	—	...	...	—	...	—	...	...	...	...	...	...	...	...	...	...
Dendritina elegans d'Orbigny	—	...	...	...	...	...	—	—	—	...	...	—	...	...	...	...	—	—	...	...	...	—	...
Siphogenerina costata Schlumberger	—	—	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	—	...	...	...
Streblus parkinsonianus (d'Orbigny)	—	...	...	...	...	...	—	...	—	...	—	...	—	...	—	...	—	—	...	...	...	—	—
Quinqueloculina bidentata d'Orbigny	—	—	—	—	—	...	—	...	—	...	...	—	...	...	—	...	...	...	...	...	—	...	—
Triloculina trigonula (Lamarck)	—	—	...	...	...	...	—	...	—	—	—	—	—	...	—	—	...	...	...	—	—	—	...
Nonionella grateloupii (d'Orbigny)	—	—	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Miliolinella labiosa (d'Orbigny)	—	...	—	...	...	—	...	—	—	—	—	—	...	—	...	...	—	...	—	—	...	...	...
Spiroloculina antillarum d'Orbigny	—	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	—	...	—	—	—	—	...
Quinqueloculina quadrilateralis d'Orbigny	—	—	—	...	—	—	—	—	—	—	—	—	—	...	...	—	...	...	...	—	—	—	...
Quinqueloculina lamarckiana d'Orbigny	—	—	...	...	...	...	...	...	—	—	...	...	—	...	...	...	—	...	...	—	...	—	...
Eponides repandus (Fichtel & Moll)	...	—	—	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Amphistegina gibbosa d'Orbigny	...	—	—	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Puteolina angulata (Fichtel & Moll)	...	—	—	—	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sphaerogypsina globulus (Reuss)	...	—	—	—	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Quinqueloculina oblonga (Montagu)	...	...	...	—	...	—	...	—	...	...	...	...	—	—	—	—	...	...	...	...	—	—	...
Trochammina inflata (Montagu)	...	...	...	...	...	...	...	...	...	—	—	...	...	...	...	...	...	...	...	...	...	...	...
Elphidiononion poeyanum (d'Orbigny)	...	...	...	...	...	...	...	...	...	—	...	...	—	—	—	—	—	...	...	—	...	—	...
Streblus compactus Hofker	...	...	...	...	...	—	...	...	...	—	...	...	—	—	—	—	—	—	...	—	—	—	—
Triloculina cultrata (Brady)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spiroloculina ornata d'Orbigny	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Number of species per station	35	19	12	8	10	8	14	11	10	9	7	7	8	4	8	5	8	3	2	8	6	9	3

IN PISCADERA BAAI, CURAÇAO

sampling in 1963/64.
ra are not mentioned)

— = rare to common
▬ = abundant

by those also occurring in the Inner Bay, then those not occurring in 1453 but found in the Boca, then those
those found only in the Inner Bay.

	Inner Bay																																		
	1470	1474	1474A	1474B	1473	1475	1478	1477	1478A	1478B	1485	1486	1486A	1480	1479	1480A	1483	1487	1488	1483A	1492	1484	1489	1490	1621	1493	1494	1495	1496	1497	1500	1500A	1502	1498	1499
Puteo	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Massi	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nouri	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Neoal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Quinq	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Trilo	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Neoco	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Streb	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Elphi	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Schlu	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sipho	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Artic	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Disco	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Boliv	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pyrgo	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hauer	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Puteo	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Puteo	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Rotor	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Valvo	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Boliv	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...
Cymba	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plano	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Homot	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Aster	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dendr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sipho	...	...	—	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Streb	...	...	—	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Quinq	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Trilo	...	...	—	—	—	—	—	...	—	▬	...	—	—	—	—	...	▬	—	...	—	...	...	...	—	...	...	—	—	—	...	...	—	...	...	...
Nonio	...	...	—	...	...	...	—	...	...	—	...	...	...	...	...	...	—	—	...	...	...	...	...	—	...	...	...	...	—	...	...	...	...	...	...
Milio	...	...	...	—	—	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spiro	...	...	...	—	...	...	...	...	...	—	...	...	...	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Quinq	...	...	...	—	—	...	...	...	—	...	—	—	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—
Quinq	...	...	...	...	...	...	...	...	...	...	...	...	...	—	—	...	...	...	...	...	...	...	...	...	...	...	...	...	—	...	...	—	...	...	...
Eponi	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Amphi	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Puteo	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sphae	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Quinq	...	—	...	...	—	...	...	...	...	...	...	...	...	...	...	...	—	...	...	...	...	...	...	—	...	—	—	—	...	—	—	—	—	...	...
Troch	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Elphi	...	—	...	...	—	...	—	...	...	—	—	—	▬	...	...	...	...	▬	...	...	...	...	...	—	—	...	...	—	—	...	—	—	—	...	...
Streb	—	—	—	—	—	—	...	—	▬	▬	▬	▬	▬	—	—	—	▬	▬	—	▬	—	—	—	—	—	...	...	—	▬	...	—	—	—	—	—
Trilo	...	...	...	...	—	...	...	...	—	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spiro	...	...	...	...	...	—	—	...	—	...	...	...	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1	3	5	7	9	4	4	1	5	5	3	4	6	3	3	1	5	4	1	2	1	1	1	5	3	1	2	4	5	1	3	4	3	1	2

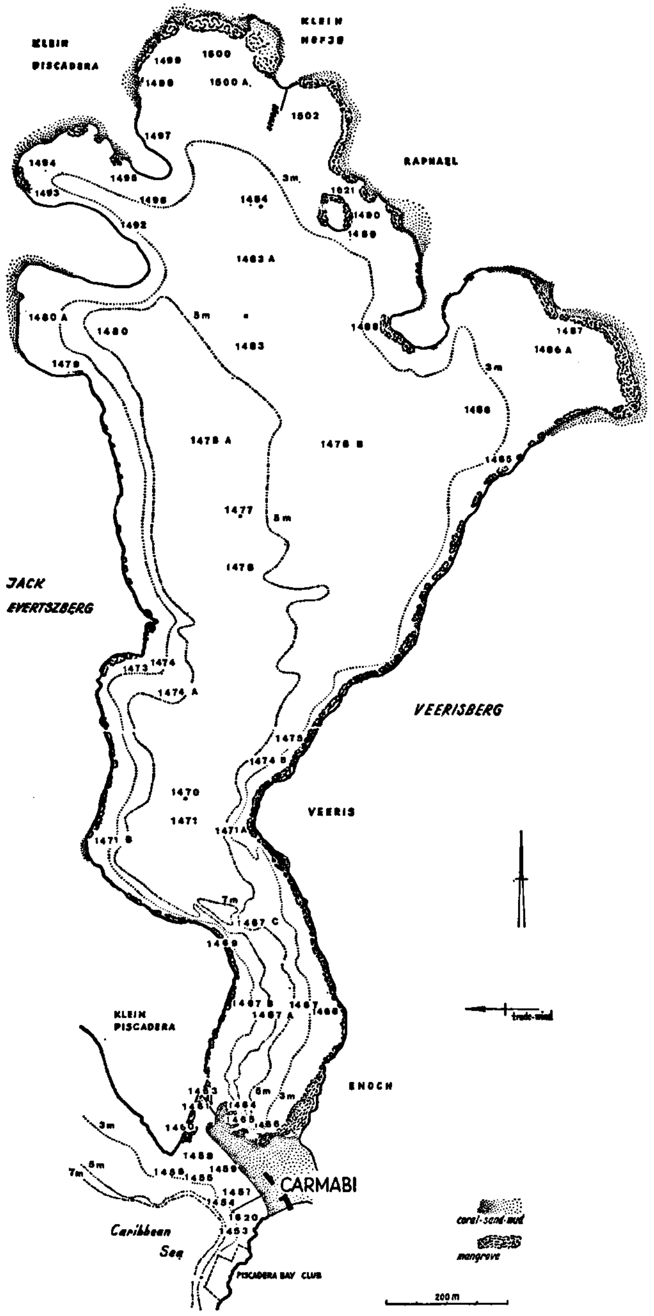

Fig. 147. Sketch map of Piscadera Baai, CURAÇAO, with Station numbers.

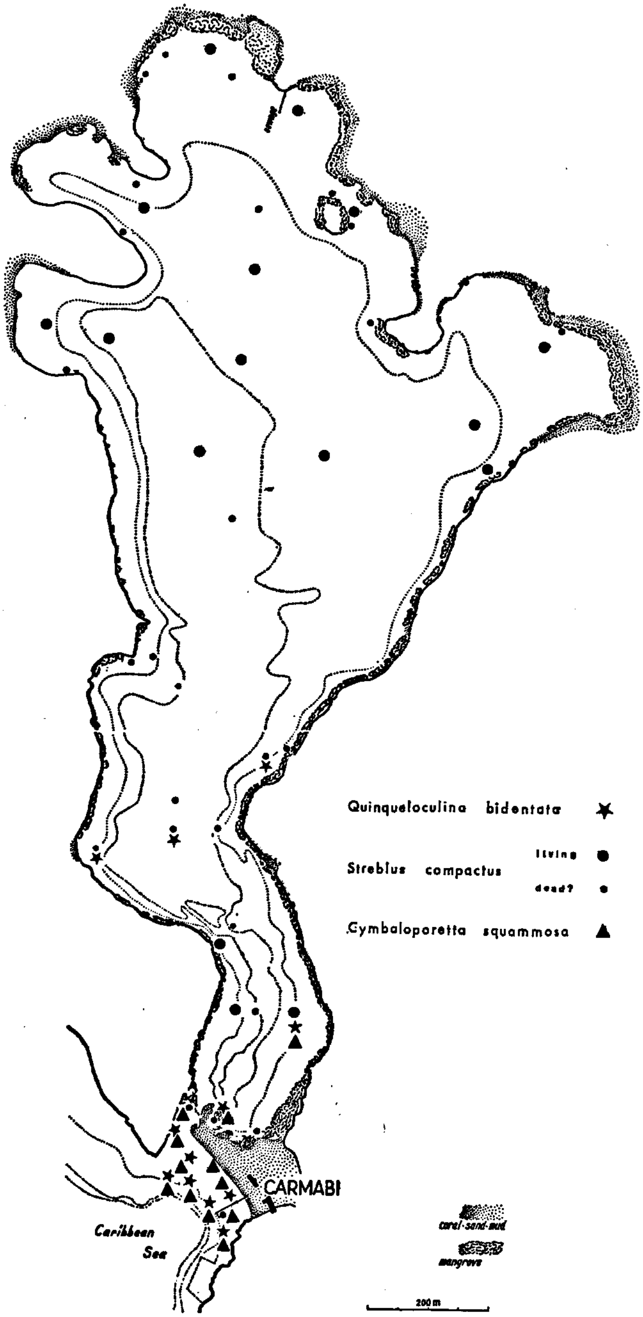

Fig. 148. Distribution of *Quinqueloculina bidentata* d'Orbigny, *Streblus compactus* Hofker, and *Cymbaloporetta squammosa* (d'Orbigny) in Piscadera Bay, CURAÇAO, according to dr. HUMMELINCK's sampling in 1963/64.

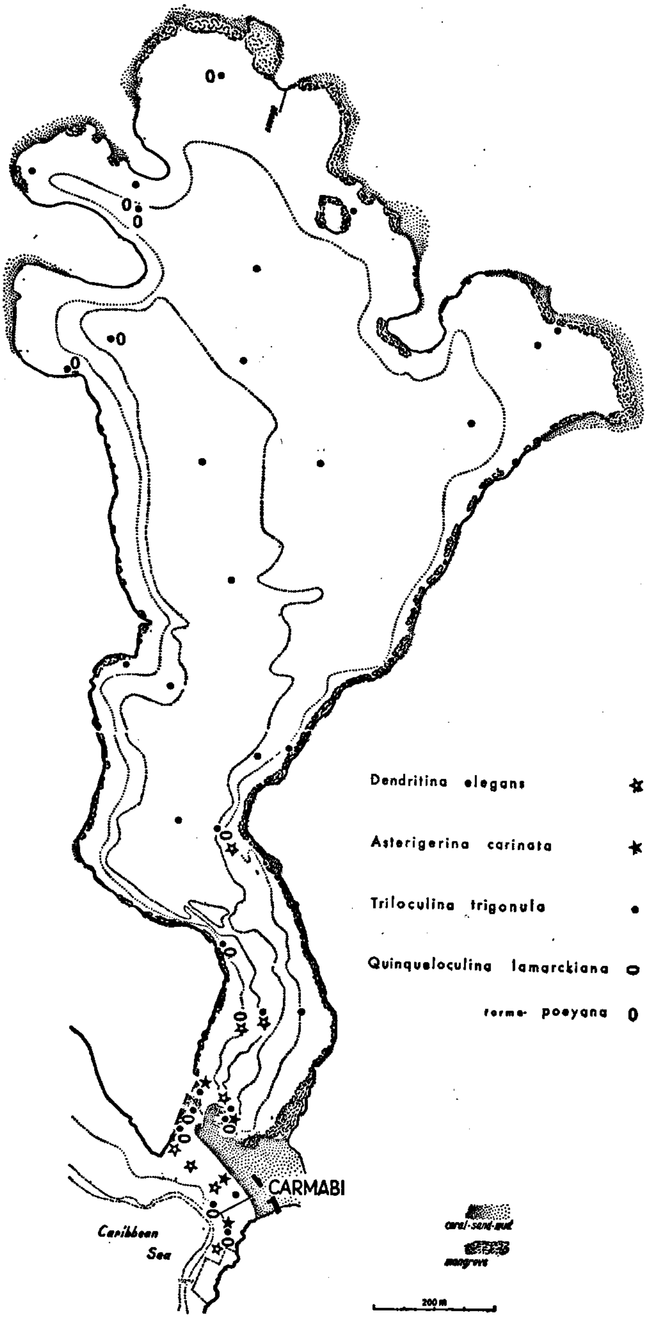

Fig. 149. Distribution of *Dendritina elegans* d'Orbigny, *Asterigerina carinata* d'Orbigny, *Triloculina trigonula* (Lamarck), and *Quinqueloculina lamarckiana* d'Orbigny in Piscadera Bay, CURAÇAO, according to dr. HUMMELINCK's sampling in 1963/64.