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RARE AND REMARKABLE FORAMINIFERA OF THE CARIBBEAN SEA

by

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When studying samples from the Virgin Islands area, some new Foraminifera were found, together with other species of which little was known about their internal structure and taxonomic status.

Most specimens came from samples W of St. Croix, collected by TH. MORTENSEN at about 17.5°N 64°W, depths about 200 and 300 m. These samples are very rich in benthonic Foraminifera, but relatively poor in planktonic species all of which are relatively small and with very thin tests. This material contained many specimens already described in previous publications (e.g. HOFKER 1956, 1972 and 1976).

The material studied has been deposited in the collections of the Netherlands Geological Survey at Haarlem, Netherlands.

Family ASTRORHIZIDAE Brady, 1881

Subfamily RHIZAMMININAE Rhumbler, 1895

Genus **Hyperammina** Brady, 1878

Hyperammina constricta n. sp.

(Fig. 1)

Test consisting of several oval chambers with short neck in between . Adherent on shells of Pteropoda, hence the often irregular shape due to the form of the substratum. The oval to elongate oval chambers have a thin wall consisting of very fine sand grains cemented together by a yellowish to brownish organic matter, characteristic of *Hormosina carpenteri* Brady, but in the latter species the chambers are distinctly pear-shaped; *H. carpenteri* was removed to the genus *Hyperammina* by me in 1972 (p. 49, pl. 13 figs. 6–11). At their end the chambers show an aperture with slightly protruding border and each chamber is fastened on this short neck and not as in *Hormosina*, where the chambers at their bases surround this neck. These apertures may be situated at the end of a chamber, but they occur in some chambers more at the side of a chamber, thus giving rise to a change in the direction of growing, just as is seen in *Hormosina normani* Brady.

To my knowledge this species has not yet been described. It may be allied to *Ammoflintina* Earland, as well as to *Aschemonella* Brady.

Several specimens, most of them broken, in the sample W of St. Croix, depth 300 m.

Family VALVULINIDAE Berthelin, 1880

Subfamily Cymbaloporinae Chapman & Parr, 1936

Genus **Polysiphotrocha** Seiglie, 1964

Polysiphotrocha siphonata Seiglie

(Fig. 2)

Polysiphotrocha siphonata Seiglie, 1964, p. 500, pl. 1 fig. 9, pl. 2 figs. 1–5.

Test small, forming a mount of chambers in a kind of spiral around the proloculus which forms the top of the mount (diameter about 0.27 mm), with a total height of 0.06 mm, and with a flange of glassy hyaline material with a breadth of 0.04 mm; as this flange belongs to the test and is strongly adherent to the outer chambers, the whole test has a diameter of 0.38 mm.

Apart from the flange which is colourless and shows a structure of fine irregular ribs in radial position, the test is brownish, hyaline, consisting of tectin only. At the dorsal side the small proloculus (diameter 6μ) is followed by a kind of neck-chamber, three times as long as high; it is followed by a distinct spiral of chambers which are slightly longer than high; the number of these spirally arranged chambers is 11. Then more elongate chambers start, in a long spiral of chambers about three times as long as broad. After this spiral of about 25 chambers irregularities occur giving rise to a more encirkling growth of the chambers which are about four to five times as long as broad at the periphery. The sutures of the chambers are smooth with the surface or somewhat impressed. The walls of the chambers at the dorsal side are smooth, brownish, hyaline, poreless.

At the ventral side only the chambers of the last formed whorl are visible, around the distinct umbilicus in which the central ends of former spirals of chambers may be seen. At this side the chambers are triangularly elongate, with rounded periphery and subacute margin. Each chamber strongly resembles the ventral chambers of *Cymbalopora,* widest at the periphery with often distinct protruding ends, then slightly lobulate at the sides, becoming narrower towards the centre and ending in a kind of siphon opening in the umbilical cavity. Distinct canals in between the chambers run star-like into the umbilical cavity, so that each chamber is separated from the two neighbouring ones.

From aside the test is flatly dome-shaped and the subacute periphery merges into the hyaline flange.

On transverse section the first coils of chambers are separated from the umbilical cavity by their ventral walls; but as soon as the chambers become longer, they open into this cavity which becomes wider towards the base of the test. The dorsal walls are distinctly double, the outer lamella more hyaline than the inner one which is darker coloured by a ferrugeneous colouring substance. The flange at the periphery seems to be the continuation of this outer lamella. The ventral walls are formed only by the inner lamella and thus are monolamellar throughout. The ventral walls are directed obliquely upward in the direction of the umbilical cavity, so that the ventral side of the test becomes slightly concave.

The whole structure of the test, apart from the fact that it is not agglutinated, reminds of that found in the genus *Cymbalopora,* which has been fully described by the author (1951, 1957, 1964). Even the double outer walls and the simple ventral ones are found in *Cymbalopora* also. Most probably the present species is the last descendant of the genus *Cymbalopora* Hagenow, and so the genus *Polysiphotrocha,* differing from *Cymbalopora* in the lack of any agglutination, ought to be placed into the Cymbaloporidae Cushman, not the Trochamminidae as SEIGLIE proposed. It might be a degenerated *Cymbalopora.* The latter genus could be followed from the Lower Cretaceous up into the Upper Paleocene (see HOFKER

1964); the minute size and the lack of agglutination might well explain the gap of our knowledge from Upper Paleocene to Pleistocene. We may conserve the generic name *Polysiphotrocha* Seiglie for species lacking the agglutination, but otherwise it belongs in the close vicinity of *Cymbalopora*.

Family TROCHAMMINIDAE Schwager, 1877

Subfamily TROCHAMMININAE, Schwager, 1877

Genus **Tritaxis** Schubert, 1921

Tritaxis siphonifera (Cushman)

(Fig. 3)

Trochamminella siphonifera CUSHMAN, 1943, p. 95, pl. 15 fig. 18–20.
Tritaxis siphonifera (Cushman) LOEBLICH & TAPPAN, 1964, p. 266, fig. 177; HOFKER 1976, p. 63, fig. 54.

The following remarks may be added to the description of this species.

Tests in the megalospheric specimens mostly ending with three chambers, in some specimens with four also, with dome-shaped dorsal side and flattened to concave ventral side; periphery slightly lobulate and margin subacute. In the microspheric generation ending with four chambers, with generally slightly larger specimens. There seem to be two megalospheric generations, one beginning with a very large proloculus, divided from the next chamber by a straight very thin wall, the embryon being two-chambered; the other generation with smaller proloculus and with three chambers in the embryon, separated from the next chambers by a thicker outer wall. In the microspheric specimens the small proloculus is followed by two whorls of 6 and 5 chambers with thin outer walls. Characteristic is that the outer walls are formed by distinct sand grains intermingled with broken sponge-needles. In the living stage the tests are fastened to the substratum by means of a colourless mass of spongy calcareous substance with much colourless organic matter which is formed by the protoplasm and in which no sand grains or spicules are found; the test walls themselves are cemented with a brownish tectin. This spongy fastening substance fills the umbilical cavity in which the pseudochitinous protruding necks of the apertures open in irregular canals or hollows of the filling substance: the whole ventral side rests on this substance which surrounds the whole periphery of the test with a thin irregular corona, often with tubular openings. Through this spongy substance the protoplasm emerges towards the outer world. A similar substance, but formed by the characteristic spiculae, was observed by DEUTSCH & LIPPS (1976, pl. 1 fig. 3) in *Carterina.* The dorsal walls of *Tritaxis* are thicker than the ventral ones.

Carterina caribbeana n. sp.

(Fig. 4)

The genus *Carterina* belongs to the Trochamminidae with ventral umbilical apertures, such as *Siphotrochammina, Tiphotrocha* and *Tritaxis*. Characteristic are the self-made calcareous spiculae embedded in a brownish cement in the walls.

The morphology of the walls of *Carterina* was recently analyzed by HANSEN & GRÖNLUND (1976), as well as by DEUTSCH & LIPPS (1976); both authors studied *Carterina spiculotesta* (Carter) from the Pacific, from where the genus with its single species was known. They found only one layer of the larger spicules in the test walls.

However, in the Caribbean region a species of *Carterina* was found, just as rarely as it is found in the Pacific. This species shows several characteristics which differ from the type-species: the spicules are fusiform and do not end bluntly and in the dorsal chamber walls there are two layers of these spicules. Moreover, the spicules of the single layer of the ventral walls and of the inner layer of spicules in the dorsal walls are distinctly smaller than those of the outer layer in the dorsal walls. Obviously in the Caribbean a species lives which is different from the Pacific species *C. spiculotesta.*

Single specimens of this new species were found W of St. Croix, depth 150 m, off Thatch Island, 40 m, and on the eastern part of the Saba Bank, 41 m.

The specimens of St. Croix and of Saba Bank show 9 chambers following the proloculus; the larger one from Thatch Island has 15 chambers, the ultimate one already very long, forming one half of the whorl, but all without secondary septa. Possibly the large specimen of *C. spiculotesta* figured by Loeblich & Tappan (1955, pl. 4 fig. 10) is the agamont, and the smaller specimens are the gamonts.

The tests are slightly dome-shaped with somewhat prominent dorsal centre, with all chambers visible at the dorsal side and rounded impressed sutures running backward. The chambers are moderately inflated. At the ventral side only the chambers of the last formed whorl are visible, leaving free a distinct umbilical hollow often partly filled up with a whitish mass of spicules. The ventral side is flattened to slightly concave, the periphery lobulate, the margin subacute to rounded. The apertures of the chambers open into the umbilical cavity and form a crescent slit with thickened border.

Peculiar are the spicules which are fusiform with pointed ends (and not with blunt ends as in the Pacific species) and consist of monocrystals with the c-axis in the length of the spicules. There are three kinds of spicules: One form is very small, length 8 μ, filling up the spaces in between the larger spicules. A second group of spicules is much larger, forming the monolamellar walls of the ventral side and the inner wall-lamella of the dorsal side, and generally placed perpendicular to the periphery, in both sides; generally they are 33–50μ long (in the Pacific species there is only one layer of spicules in the dorsal chamber walls). The largest spicules are found in the outer layer of the dorsal walls; they are situated more or less parallel to the periphery and have in the more initial chambers a length of 58–66 μ and in the large end-chambers of the larger individuals of 66–92 μ. These spicules in the outer dorsal layer are mostly directed parallel to the periphery; they are glassy and colourless but are embedded in a brownish cement. In the largest individual the protoplasm has been preserved; it contains scattered spicules which may be formed by the protoplasm, as supposed by many authors, though not yet proven.

The occurrence of two layers of agglutinated substance in the Trochammidae is not uncommom. It is found in *Trochammina inflata* (Montagu) (HOFKER 1976, p. 61 fig. 46); in *Tr. paleocenica* HOFKER (1976a, pl. 2 fig. 6–8); in *Tr. globeriniformis* (Parker & Jones) (HOFKER 1976, p. 63, fig. 53). It is not restricted to the Trochamminidae, as these two layers of agglutination were also found in *Hormosina normani* Brady, *H. mortenseni* Hofker and *H. ovicula* Brady (HOFKER 1972). In all these instances the inner layer consists of fine grains, whereas the outer one contains larger particles, just as is found in *Carteria caribbeana.*

Family VALVULINIDAE Schwager, 1877

Subfamily VERNEUILININAE Cushman, 1911

Genus **Gaudryina** d'Orbigny, 1839

Gaudryina parvula (Cushman)

(Fig. 5)

Textularia parvula CUSHMAN, 1922, p. 11, pl. 6 fig. 1, 2; HOFKER, 1976, p. 53, fig. 36.

This is a slender and small species with rounded chamber sutures, more or less globular chambers which are numerous. Walls very finely agglutinated on a brownish tectin lamella. Aperture sutural, rounded, with a slight dent or lip. In megalospheric specimens the chambers following the proloculus (of medium size) are biserially arranged throughout. However, in the sample W of ST. CROIX, 180 m deep, two microspheric specimens were found. Following the minute proloculus two sets of triserial chambers are visible, followed by a long set of biserial chambers. So in the megalospheric generation the species is a *Textularia,* but for the dent, but in the microspheric one it is a *Gaudryina*; as the microspheric generation, being diploid, shows the typical characteristics of the genus, the species is a *Gaudryina*. The number of biserial sets of chambers in the microspheric generation is 17, whereas in the megalospheric one it is 10–14.

The species was found by CUSHMAN in 13°34'N, 81°21'W; 28° 45'N, 86°26'W; 14°20'N, 63°10'W. The St. Croix sample was about 17°30'N, 64°W; as to my knowledge no other localities were mentioned by authors, the species seems to be restricted to the eastern part of the Caribbean.

Remarks. This species gives one of the answers at the question from which group of Foraminifera the genus *Textularia* derived. In the Foraminifera during evolution the diameter of the proloculus increases; in *Spiroplectammina* the number of chambers decreases with the increase of the diameter of the proloculus and thus probably some species of *Textularia* derived from *Spiroplectammina*. *Gaudryina parvula* shows that the megalospheric generation is a *Textularia*, whereas the microspheric generation is a *Gaudryina*; so some species of *Textularia* may derive from *Gaudryina*. It may be worth while to study both generations of species known as *Textu-*

HÖGLUND (1947, p. 176, pl. 13 fig. 1, text fig. 154–155, 161) found a minute species of *Textularia* which he named *T. tenuissima* Earland and which he compared with CUSHMAN's species *T. parvula*; it is, however, not the same species, as the texture of the walls shows without doubt; but HÖGLUND showed that in *T. tenuissima* the (possibly megalospheric) generation shows a triserial initial part, with the proloculus at one side of the two following chambers. The bulk of his specimens had a proloculus of 10 μ diameter; these specimens may well be microspheric.

Family LITUOLIDAE de Blainville, 1825

Subfamily HAPLOPHRAGMOIDINAE Maync, 1952

Genus Cribrostomoides Cushman, 1910

Cribrostomoides spiculiferus n. sp.

(Fig. 6)

Test slightly oval, compressed, longest diameter about 0.6 mm, breadth about 0.5 mm, thickness 0.2 mm. Periphery slightly lobulate, margin rounded to slightly subacute. Chambers strongly overlapping on both sides, nearly reaching the centre, involute, with rounded ends. Sutures on both sides radiate and nearly straight, very slightly impressed. Colour greyish to slightly brownish, chamber walls consisting of broken sponge-spicules. These spicules are arranged on the sides of the chambers more or less radiate from the centre, but near to the margin they are arranged in the direction of the periphery. Aperture near the suture of the apertural face, marginal, with protruding lip all around, slit-like. On section the test is coiled in a flat spiral, the septa are straight. Septa and spiral chamber walls are constructed with several layers of spiculae, septa show the same thickness as found in the outer peripheral walls. The thickened lips of the apertures consist of small particles of broken spiculae also, but here with more fine cement than is found in the walls. No inner pseudochitinous lammella could be detected.

This rare species was found in two localities: W of ST. CROIX, about 17°,5'N and 64°W, depth about 300 m; near THATCH ISLAND, about 18°N and 63°W, depth about 30 m.

There is, to my belief, no other species of *Cribrostomoides* known with a test consisting of sponge-spicules; hence the name.

Suborder MILIOLINA Délage & Hérouard, 1896. – Superfamily MILIOLACEA Ehrenberg, 1839.

Family NUBECULARIIDAE Jones, 1875

Subfamily PLANISPIRINELLINAE Wiesner, 1931

Genus **Cornuloculina** Burbach, 1886

Cornuloculina inconstans (Brady)

(Fig. 7)

Hauerina inconstans BRADY, 1879, p. 268.
Ophthalmidium inconstans (Brady) BRADY, 1884, p. 189, pl. 12 fig. 5, 7–8; FLINT, 1897, p. 302, pl. 47 fig. 3.
Cornuloculina inconstans (Brady) BURBACH, 1886, p. 497; LOEBLICH & TAPPAN, 1964, p. 440, fig. 340, 3–7; HOFKER, 1976, p. 94, fig. 95.

Only one Atlantic species belongs to the genus *Cornuloculina* Burbach. There are species known from the Jurassic which in outer characteristics resemble this species; they show a proloculus followed by a long spiral, suceeded by several chambers which form one half to one third of a coil and which seem to be separated from each other by a "plate". However, such Jurassic specimens, known as *Ophthalmidium northamptonensis* Wood & Barnard have quite a different, finer, structure, as was demonstrated by PAZDROWA (1958, p. 153). She showed that in the Jurassic species each chamber has its own inner wall and that two flaps of the walls are growing left and right from the rim of a former chamber and are loosely fastened at the outer walls of that chamber. So, there is no "plate" between two adjacent coils, but the two walls with the rim of the former chamber. This structure is typical for *Ophthalmidium* and could be ascertained by the present author in Recent *Ophthalmidium acutimargo* Brady (HOFKER, 1977, pl. 2 fig. 6, section).

However, transverse section through *Cornuloculina inconstans* (Brady) shows quite a different structure. The large proloculus is followed by the *Cyclogyra*-chamber in the megalospheric specimen, forming at least two whole coils. This chamber does not have a separate inner wall but its outer wall rests on the outer wall of the former coil. Then the chambers with pointed rims start, however adjacent chambers do not form two covering flaps, but the rim is broadened into a typical plate in between two adjacent chambers. In this way the description by LOEBLICH & TAPPAN (1964, p. 448) is quite correct for this genus: "chambers somewhat loosely coiled, those of adjacent whorls being separated by thin plate".

This shows that *Cornuloculina* has nothing in common with *Ophthalmidium* and that it is incorrect to place it in the subfamily Ophthalmidinae Wiesner, 1920, as LOEBLICH & TAPPAN did. The Subfamily Planispirinellinae Wiesner, 1931, however, is available for this genus *Cornuloculina* Burbach; it may also be removed to the subfamily *Cyclogyrinae* Loeblich & Tappan, 1961.

The outer characteristics of *Cornuloculina inconstants* (Brady) were described by me in 1976.

Family ROBERTINIDAE Reuss, 1850

Genus **Robertina** d'Orbigny, 1846

Robertina subcylindrica (Brady)

(Fig. 8)

Bulimina subcylindrica BRADY, 1884, p. 404, pl. 50 fig. 16; MILLET, 1900, p. 277, pl. 2 fig. 6.

Robertina subcylindrica (Brady), CUSHMAN & PARKER, 1936, p. 95, pl. 16 fig. 10; CUSHMAN, 1942, p. 9, pl. 3 fig. 14; CUSHMAN & PARKER, 1947, p. 75, pl. 18 fig. 13; BARKER, 1960, p. 102, pl. 50 fig. 16.

Test minute, length 0.42 mm, elongate, slender, with nearly parallel sides, slightly compressed (greatest breadth 0.17 mm, thickness 0.14 mm). Apical and antapical ends rounded, as last formed chambers are very long and surround the intial chambers. Sutures smooth with the surface, distinct, and chambers not inflated. Walls very thin, translucent, very finely and densely porous, without pore-fields. Aperture a narrow elongate slit parallel to the axis of the test. Toothplate with single side-opening through which one observes the canal running to the opposite junction of sutures and ending with a triangular opening which is closed by a poreless and somewhat irregular secondary calcareous lump. The toothplate forms at the sides of the last formed chambers a loop-like suture. The whole toothplate is not so complicated as found in the genus *Robertinoides*.

This species was described primarily from the coast of Pernambuco, Brazil; with the equatorial stream it may easily spread to the Caribbean region, where it is extremely rare. It was found in one single specimen in a sample W of St. Croix, depth 300 m.

The present author (1956, p. 128) analysed another somewhat commoner species of this group, *Robertinoides bradyi* Cushman & Parker from the same sample. The difference between the two genera, *Robertina* and *Robertinoides* is easily found in the single aperture of *Robertina* and the double one (aperture plus toothplateforamen) in *Robertinoides*. *Robertina* was first mentioned by D'ORBIGNY in 1846, p. 202; *Robertinoides* was erected by HÖGLUND, in 1947, p. 222. The genus *Robertina*, the genus with simple aperture and relatively simple toothplate, is known from the Eocene on, whereas *Robertinoides* appears for the first time in Miocene times. The apertural conditions of *Robertinoides bradyi* are given here for comparison (Fig. 9).

Superfamily DISCORBACEA Ehrenberg, 1838

Family DISCORBIDAE Ehrenberg, 1838

Subfamily DISCORBINAE Ehrenberg, 1838

Genus **Patellina** Williamson, 1858

Patellina altiformis Cushman

(Fig. 10)

Patellina advena Cushman var. *altiformis* CUSHMAN, 1933, p. 87, pl. 9 fig. 8; CUSHMAN, TODD & POST, 1954, p. 357, pl. 89 fig. 1; TODD 1965, p. 8, pl. 1 fig. 1.
Discobolivina corrugata (not Williamson), HOFKER 1956, p. 170, pl. 25 fig. 25–29, pl. 26 figs. 1–3.

Test small, high-domed, with pointed inititial part, with numerous biserial chambers and highly complicated septa. The small proloculus at the top (diameter about 16 μ) is followed directly by the biserial chambers, or, when smaller, by three of them. No distinct spiral neck-chamber following the proloculus. At the ventral side the two visible chambers form the S-like thickened parts near the umbilical cavity which are actually the ends of the toothplates. These rise up into the chamber-lumina and form, with their flaps, the septa which have a more or less rounded opening and are striving upward near to the outer walls. There are primary septa with double walls, which run into the cavity of the chambers to about the middle of them, and secondary septa wich are much smaller. Of these there are 3 to 4 in between the primary septa, thus forming a complicate septal pattern.

Whereas in *Patellina corrugata* each lobe of the chambers ends into a pore at the periphery of the chamber, here there are many secondary canals formed by the septa ending with about three rows of pores in each chamber wall. Each primary septum is formed by two walls emerging from the inner part of a chamber from a thickened granular part of the toothplate-flap, striving upward; the secondary septa surround three rows of tubuli, ending in the thin-walled pore-tubuli.

The species was found in 5 specimens in the sample W of St. Croix in a depth of about 200 m. Hitherto it was described only from the Pacific, Fiji, Marshall Islands, depth 40–50 fathoms.

Remarks on the genus Patellina

In 1956 I described the inner structure of *Patellina* as formed by a toothplate. The investigations by Berthold (1976) affirm this view: he showed that the peripheral septa are formed in connection with the lip and the column found at the aperture, and independent from the ventral wall; there are indications that toothplates are not only formed within the protoplasm but before the growing of the outer wall starts. The forming of peripheral septa as parts of toothplates is not restricted to *Patellina*; it was observed by Reyment (1959, p. 20, figs. 8, 4–6, 11–12) in *Afrobolivina* and by me in 1951 (p. 66) in *Millettia tessellata* (Brady). Moreover, toothplate foramina suggesting coarse pores are found in *Pseudorotalia* (Hofker, 1971, p. 31, pls. 73–74) and in the Polystomellinidae.

The oldest known species of *Patellina* is *P. subcretacea* Cushman. In this species the proloculus is followed by a short neck-chamber succeeded by 3–5 trochoidally arranged chambers with septa, after which the biserial chambers start. The septal tubuli in the later chambers are more complex than in *Patellina corrugata*; they are elongate, and secondary shorter septa of two kinds are intercalated. The tubuli end in distinct, rounded toothplate-foramina with distinct borders. On transverse sections the general inner structure is that of *Patellina corrugata*.

In *Patellina corrugata*, a typical shelf-dweller, the tubuli formed by the septa of the toothplate-flap could be studied on successive sections beginning at the periphery. The ventral wall and the sides of the tubuli are formed by the toothplate as can be seen from the granular structure of the inner walls of the tubuli; the proximal end of the septa is strengthened by this granular wall also. The septa are double, as they are formed by folds of the toothplate-flap. Berthold (1976) believed to see rows of pillars instead of septa; I never observed them, and his figure 40, pl. 7 (protoplasmic filling of a chamber) does not show them either; however, it may be that in the inner part of the chambers columns may appear. Transverse sections show the basal septal flap at the inside of the ventral wall, at least in the tubuli. The connection between the umbilical column of the toothplate and the peripheral septa is very distinct in these sections.

Genus **Tretomphalus** Moebius, 1880

The history of a systematic problem

1839. D'ORBIGNY describes and figures his *Rosalina bulloides*; he figures one specimen with *Rosalina*-like initial part with bulla (pl. 3 figs. 2–3, 5) and one with *Cymbaloporetta*-like initial part (fig. 4) from Cuba.

1872. CARPENTER, PARKER & JONES describe *Cymbalopora bulloides* (d'Orb.), p. 216, as a form of *Cymbalopora* with bulla; obviously they found only the *Cymbaloporetta*-form.

1880. MOEBIUS creates the name *Tretomphalus* with *Rosalina bulloides* d'Orbigny as type-species; his figures show the *Rosalina*-type. However, a young specimen of *Cymbalopora poeyi* d'Orbigny shows the structure of the *Cymbaloporetta*-type without bulla, as they are often found; from Mauritius.

1882. GOËS considers the species to be modified *Discorbina* (p. 106, pl. 8 fig. 262–263); it is the *Rosalina*-like form which is figured here.

1884. BRADY found in the material of the Challenger Expedition only specimens belonging to the *Cymbaloporetta*-group. The specimens figured on pl. 102 of his report were named by him *Cymbalopora* (*Tretomphalus*) *bulloides* (d'Orbigny).

1902. EARLAND describes a specimen of the *Cymbaloporetta*-type as *Cymbalopora bulloides* (d'Orbigny) and for the first time shows the two walls in the bulla, the outer wall with small and large pores, the inner wall much thinner, without pores, and designs it as a float-chamber; he discovers the internal tube opening into this float-chamber.

1903. MILLET describes from the East Indies an interesting variety with wrinkled outer wall of the bulla (p. 697, pl. 7 fig. 4); this form was named *Cymbalopora milletti* by HERON-ALLEN in 1915.

1915. HERON-ALLEN is certain that the feature of a large balloon-chamber "is assumed at certain stages of their life-history by certain species of the genera *Discorbina* and *Planorbulina*" (= *Cymbalopora*) (p. 252). These two forms are a large and relatively robust form (fig. 35 a–c) and a small and more delicate one (fig. 35 d). He proposes for the robust form the name *Cymbalopora milletti.* The small form is in its coiled part indistinguishable from *Discorbina concinna* Brady (fig. 49), whereas *C. milletti* is invariably acervuline (fig. 50). Both species he describes as *Cymbalopora,* however.

1915. HERON-ALLEN & EARLAND describe from the Kerimba Archipelago the two forms of *Cymbalopora bulloides* d'Orbigny (p. 688–689); here too the two forms resemble *Discorbina* resp. *Cymbalopora.*

1934. CUSHMAN describes the genus *Tretomphalus* Moebius without noticing the two different forms and gives new species names to forms all belonging to the *Cymbaloporetta*-type: *T. pacificus, T. atlanticus, T. planus* and *T. grandis.*

1943. CUSHMAN creates *Tretomphalus myersi* for specimens sent to him by MYERS and mentions a study by MYERS on this species.

1943. MYERS describes the life-cycle of the *Rosalina*-form of *Tretomphalus.*

1952. BERMÚDEZ (p. 102) denies, obviously, the presence of a *Rosalina*-like species as he brings the genus *Tretomphalus* not only into the Cymbaloporidae but described the genus as "Concha en la primera etapa trocoide, el jóven cómo *Cymbaloporetta* o *Cymbaloporella,* en el adulto se desarrolla una cámara grande que hace las veces da flotador". It is obvious, however, that this view is erroneous, since in 1943 MYERS had proven that all specimens with bulla are adult ones.

1956. HOFKER describes *Cymbaloporetta bulloides* (d'Orbigny) from the Caribbean Sea with two forms, one with 10–20 chambers in the rotaline part, the other with 26–32 chambers. (The first form now is known as *C. plana,* the second one as *C. milletti*)

(p. 188, pl. 28 figs. 3–10). He found no real differences between the specimens with 3 (*T. atlanticus*) and with 4 chambers at the base of the rotaline parts. He stressed the fact that in *Cymbaloporetta bradyi* two forms are found, one with less chambers than in the other one (p. 187) He points out that the forms with bulla have the same structure as found in *Cymbaloporetta bradyi* and *C. tabellaeformis*.

1960. BARKER, revising the names of the figures published by BRADY brings them to *Tretomphalus planus*, *T. milletti* and *T. atlanticus*, which seems to me correct, for the time being.

1964. LOEBLICH & TAPPAN figure only the *concinna*-form as *Tretomphalus bulloides* D'ORBIGNY (p. 585, fig. 459, 2–3 and fig. 461, p. 287). The other group is not mentioned by LOEBLICH & TAPPAN. The genus is placed into the subfamily Discorbinae Ehrenberg, in which *Neoconorbina* Hofker is placed also. It is said that *Tretomphalus* is the only pelagic species, monolamellar as in *Discorbis*; *Cymbaloporetta* is placed in the family Cymbaloporidae and is said to be bilamellar.

1965. SLITER found in a culture of *Rosalina globularis* d'Orbigny some individuals with bulla. So he believes that *Tretomphalus* is not a genus but only a stage of the life-cycle and is in this way synonymous with *Rosalina*.

1965. DOUGLAS & SLITER come to the conclusion that there are two groups of species with bullae, the one with a *Rosalina*-like coiled part, the other with a *Cymbaloporetta* part, and that they should be named *Rosalina bulloides* (d'Orbigny) and the other group *Cymbaloporetta*; however, they believe that the agamont of the first species is *Rosalina globularis*, whereas it is certain that HERON-ALLEN was right in supposing that it is *Rosalina* (= *Neoconorbina*) *concinna* Brady. DOUGLAS & SLITER mention, moreover, that all these species are bilamellar whereas it is certain that they are monolamellar.

1965. TODD mentions three species of *Tretomphalus* from the Pacific: *T. concinnus* (the *Rosalina*-like species), *T. milletti* and *T. planus*. She believes that *T. milletti* was a species created by HERON-ALLEN & EARLAND in 1915; however, it was named so by HERON-ALLEN alone in 1915, p. 252.

1971. TODD describes a fauna with *Tretomphalus* from the Pacific (Midway); she believes that *T. concinnus* is the megalospheric form, *planus* and *grandis* are transitional forms between megalo- and microspheric (thus being A_1-generations), whereas *milletti* is the microspheric form of one species; they all are treated by her as varieties of *Tretomphalus bulloides* (d'Orbigny). In her reference list she does not mention the papers by HERON-ALLEN, 1915 and HOFKER, 1956.

ANALYSIS OF THE FORMS IN A SAMPLE W OF ST. CROIX, W.I., DEPTH 180–300 M.

First of all: All the forms or species found in the possession of a bulla must be gamonts, comparable with megalospheric tests of other Foraminifera. So TODD's supposition that the different "variations" found are microspheric (*milletti*-form), A_1-generations (*planus* and *grandis*) of A_2-generation (*concinna*-form) cannot remain upright. All are gamonts, producing microspores that are haploid. The fusion of two microspores gives rise to the microspheric proloculus of an agamont, producing embryons by means of fission, as MEYERS proved. LE CALVEZ (1950) showed that gamonts often are what he calls + and —, and that the microspores of a + and a — individual fuse, not + with +, or — with —. If this difference is expressed also in the test-form, the number of so-called species is reduced × ½. In the case of *Cymbaloporetta*-forms often two distinguishable forms are found with bullae, as I proved already in 1956. There are two forms in the *plana*-group, viz. a form with 4 chambers at the base of the chambered part (*plana*) and a form with 3 chambers in its base (*pacifica* or *atlantica*) There are specimens of the *milletti*-group with a short dome of coiling chambers and only 5 chambers at the base and forms with a high dome and 6 chambers at their base. In the *concinna*-group there are specimens with bulla which are small and have 9 chambers in the coiled part and larger specimens with 12 chambers in the coiled part. So probably we have here an expression of the + and — individuals, or, better, of ♂ and ♀ individuals. In the *concinna*-group the small coiled parts resemble more or less *Rosalina globularis* d'Orbigny, whereas the larger specimens with more chambers look like *Neoconorbina concinna* (Brady) with its long end-chambers. Both, however, belong to the same form of *Neoconorbina* as they have in the coiled part chambers with toothplates. Since in this sample only one specimen was found with the characteristics of *Tretomphalus grandis* Cushman, it could not be indentified with certainty.

We thus may distinghuish two genera and at least four species:

a – *Tretomphalus bulloides* (d'Orbigny); as there are no other species of the *Neoconorbina*-like group known which produce a generation with bulla, *Tretomphalus* is a well-established genus;

b – *Pseudotretomphalus planus* (Cushman); as there is no form known of the type-species of *Cymbaloporetta*, *C. squammosa* (d'Orbigny), with a bulla-generation, the idea of HOFKER and of DOUGLAS & SLITER to call this group *Cymbaloporetta* seems to be erroneous;

c – *Pseudotretomphalus milletti* (Heron-Allen);

d – *Pseudotretomphalus grandis* (Cushman); the specific status is somewhat uncertain.

Pseudotretomphalus is close to *Cymbaloporetta*, and the agamont may be a form which is not distinguishable from *Cymbaloporetta bradyi* (Cushman).

Tretomphalus bulloides (d'Orbigny)

(Fig. 11)

Rosalina bulloides D'ORBIGNY, 1839, p. 104, pl. 3, fig. 2–3, 5 (not 4).
Tretomphalus bulloides (d'Orbigny) MOEBIUS, 1880, p. 98, pl. 10 fig. 6–9.
Discorbina bulloides (d'Orbigny) GOËS, 1882, p. 106, pl. 8 fig. 262–263.

Test beginning with a *Neoconorbina*-like coiled part, ending in the gamonts with a smooth bulla. There are two forms in this bulla-bearing generation, one small, with 9 chambers in the coiled part which gradually increase in size, and a larger form, with 12 chambers in the coiled part in which the last formed chambers are very long with length nearly half a coil. Initial chambers brownish coloured, walls thin, monolamellar, with very fine pores at the dorsal side, and a relatively large proloculus; in the agamont, which never shows a bulla, the ventral side has a broad belt of pores, also fine, in the middle of each chamber wall. At the dorsal side the slightly impressed sutures are strongly rounded, at the ventral side of the coiled part with proto- and deuteroforamen and in between them a well-developed tenon, as in *Neoconorbina*. Coiled part always much smaller than the balloon-chamber. The side-wall of this chamber shows the fine pores as found in the coiled chambers, the ventral wall lacks these pores but here large pores have developed without any trace of thickened borders. In the centre of the ventral wall of the balloon there is a distinct round opening of the internal sipho, which is formed by the outer wall of the balloon and penetrates the wall of the float-chamber. The protoforamen which is small, is connected with a sigmoidally formed toothplate which runs up towards the deuteroforamen of a formed chamber, as found in *Neoconorbina* but never in *Rosalina*. The whole form of the coiled part very much points to a close relation to *Neoconorbina concinna* (Brady).

As only one species of this genus is known, *Tretomphalus myersi* Cushman being a synonym of *T. bulloides*, the characteristics of the species are those of the genus. The balloon-chamber occurs only in the gamonts of the species and possibly *Neoconorbina concinna* is the agamont.

Family CYMBALOPORETTIDAE Cushman, 1928

Genus **Pseudotretomphalus** n. gen.

Type-species: *Tretomphalus planus* Cushman.

Test of the gamont with ventral bulla (balloon-chamber); within this chamber a float-chamber with thin wall without any pores;

outer wall of balloon-chamber with ventral central internal tube opening into the float-chamber, more or less distinct fields of fine pores in the sides of the balloon and with many large rounded openings with thickened border at the ventral side of the balloon. In some species the float-chamber is a simple sphere, in other species it shows several lobes, the number of which corresponds with the number of end-chambers of the *Cymbaloporetta*-part of the test. This *Cymbaloporetta*-part begins with a spiral of about 12 chambers, after which chambers are added in acervuline succession, with an open foramen towards the central umbilical hollow; these chambers communicate with the foregoing and the next chamber by dorsally placed crescent-formed foramina, so that they each have three foramina. The float-chamber does not communicate in either way with the central umbilical cavity, but the space between this float-chamber and the outer balloon-chamber does. The ventral septa of the acervuline chambers are simple, poreless and continue in the poreless inner layer of the outer walls. The outer walls thus are double, consisting of the inner poreless wall going over into the septa and a thicker outer lamella in which the pores of the chambers are found; these pores are coarser than those found in *Tretomphalus* and resemble those found in *Cymbaloporetta.* It may be, that the wall of the float-chamber within the balloon-chamber is homologous with the inner poreless wall and the poreless septa of the acervuline chambers; the difference is found in the fact that there is a distinct space between the balloon-chamber and the float-chamber, which space is filled up with protoplasm and in which later the microspores assemble. Seen from the ventral side, with last-formed acervuline chambers wholly having the structure of those of *Cymbaloporetta,* but for the central open umbilical cavity(which in the type-species of *Cymbaloporetta, C. squammosa* is closed by a plate formed by the central lobes of the chambers) in ventral view these chambers are somewhat triangular, with two slit-like foramina at the sutures and the third opening towards the central cavity; the ventral walls are poreless.

The agamonts are unknown, but may be *Cymbaloporetta bradyi* (Cushman).

Pseudotretomphalus planus (Cushman)

(Fig. 12–13)

Tretomphalus bulloides (d'Orbigny) var. *planus* CUSHMAN, 1924, p. 36, pl. 10 fig. 8.
Tretomphalus planus CUSHMAN, 1934, p. 94, pl. 11 fig. 11, pl. 12 fig. 18–22; CUSHMAN, TODD & POST 1954, p. 364, pl. 90 fig. 17–18.
Tretomphalus bulloides (d'Orbigny) *planus* form, TODD 1971, p. 166, pl. 1 fig. 1–2, 4.
Tretomphalus atlanticus CUSHMAN, 1934, p. 86, pl. 11 fig. 3, pl. 12 fig. 7.
Tretomphalus pacificus CUSHMAN, 1934, p. 93, pl. 11 fig. 7, pl. 12 fig. 8–12.

Test low, flattened at top and bottom. Initial part coiled with flat spiral, after which some acervuline chambers are added. Suture-line between initial part and balloon-chamber straight; initial part slightly broader than the balloon-chamber so that it protrudes all around. Pores of initial stage distinct and somewhat scattered, those at the sides of the flattened balloon finer. At the base of the balloon the protruding round openings are found in the centre, surrounding the central internal tube. Float-chamber with three to four lobes.

Specimens with three chambers at the base of the initial stage are known as *Tretomphalus atlanticus* and *T. pacificus*. As the name *planus* was created in 1924, the other two in 1934, the species should be called *P. planus* (Cushman).

Pseudotretomphalus milletti (Heron-Allen)

(Fig. 14–15)

Cymbaloporus bulloides d'Orbigny, MILLET 1903, p. 697, pl. 7 fig. 4.
Cymbaloporus milletti HERON-ALLEN, 1915, p. 253, pl. 16 fig. 36; HERON-ALLEN & EARLAND 1915, p. 689, pl. 51 fig. 32–35.
Tretomphalus milletti Heron-Allen, CUSHMAN, 1924, p. 36, pl. 11 fig. 4; 1934, p. 87, pl. 11 fig. 4–5, pl. 12 fig. 1–5; TODD, 1965, p. 39, pl. 18 fig. 2.
Cymbalopora (*Tretomphalus*) *bulloides* (d'Orbigny) BRADY, 1884, p. 638, pl. 102 fig. 9.
Tretomphalus bulloides (d'Orbigny) *milletti* form, TODD, 1971, p. 167, pl. 1 fig. 3, 5–6.

Initial stage beginning with a spiral of chambers, followed by several rows of acervuline chambers, high-domed. Suture with balloon-chamber continuous and straight. Balloon-chamber flattened at its base, often even slightly concave in its centre. Balloon- and float-chambers somewhat wrinkled by 5 or 6 longitudinal dints and along these dints the larger rounded protruding openings are placed in a kind of rows, so that these openings are not confined to the ventral centre but are visible at the sides of the balloon also. The 5 or 6 lobes of the float-chamber correspond with the 5 or 6 end-chambers of the acervuline stage. These chambers have the ventral walls as described in *P. planus*. There are two distinct groups of specimens: those with 5 chambers in the basal set of acervuline chambers have a lower dome than those with 6 chambers.

The agamonts are unknown but they may be some species of *Cymbaloporella*. Typical is that the initial spiral is found excentrical from the top.

Pseudotretomphalus grandis (Cushman)

(Fig. 16)

Tretomphalus grandis CUSHMAN, 1934, p. 95, pl. 11 fig. 10, pl. 12 fig. 23–24.
Tretomphalus bulloides (d'Orbigny) *grandis* form, TODD 1971, p. 167.

Test large, after the first set of spirally arranged chambers the acervuline chambers are very irregular, so that the suture between these chambers and the balloon-chamber is interrupted. Balloon-chamber and the whole test are often sidelong compressed. The float-chamber consists of several partitions of lobes which are very irregular in form. The rounded openings at the base of the balloon-chamber are very large with distinct rims and heaped around the tiny opening of the internal tube. Whereas the pores of the acervuline part are very distinct, those of the flanks of the balloon-chamber are very fine and scattered; they lack at the part in which the rounded openings are found.

We do not know much about this rare species.

Though the features of the gamonts are well-distinguishable in the species of this genus, we do not know much about the agamonts. It is highly probable that some forms known as *Cymbaloporetta* or *Cymbaloporella* are the agamonts but it is unlikely that the type-species of *Cymbaloporetta* is also an agamont. Further study of the living specimens is our only hope to clear up this problem.

Family SIPHONINIDAE Cushman, 1937

Genus **Siphoninella** Cushman, 1927

Siphoninella soluta (Brady)

(Fig. 17)

Truncatulina soluta BRADY, 1884, p. 670, pl. 96 fig. 4.
Siphoninella soluta CUSHMAN, 1927, p. 77, pl. 16 fig. 13; 1931, p. 71, pl. 14 fig. 5; HOFKER, 1956, p. 118, pl. 15 fig. 25–27.

In 1956 I described a microspheric specimen of this rare species, from the Recent known only from the Caribbean Sea. It was found W of ST. CROIX, depth 800 m. In the same area, but now from 180 m deep, two other specimens were found, both megalospheric .One was a young specimen, the other is an adult one, showing three evolute chambers. As in literature always the figures published by BRADY are reproduced, this specimen may add some knowledge about this rare species. The test is distinctly less compact and more slender than the microspheric specimen and the rows of large pores with short necks, found in the microspheric specimen are lacking here. The elongate necks of the alternating pores along the periphery of the coiled part are more developed and have crenulated and spinous borders. In the end-chamber of this megalospheric specimen several large pores are found in the dorsal, flattened side, but not in a row. Typical is that the dorsal or spiral side is flat, whereas the ventral side shows inflated chambers which partly overlap more initial chambers. In the coiled part the large pores are restricted to the margin. At the dorsal side the apertures with their distinct necks and lips can be seen as they form part of the outer walls; at the ventral or inflated side they are not seen. Each apertural neck shows an inner proximal flange; this flange may be a rest of a toothplate. Length of the outgrown specimen 0.5 mm, breadth of the coiled part 0.25 mm, of the evolute part 0.20 mm, thickness of the test about 0.10 mm. Diameter of the proloculus of the microspheric form, described in 1956, was 21 μ, that of the megalospheric form figured here about 50 μ.

Family CANDEINIDAE Cushman, 1927; Barker, 1967

(= Subfamily CANDEINIDAE Cushman, 1927; Lips, 1966)

Genus **Globigerinita** Brönnimann, 1951

Type-species: *Globigerinita naparimaensis* Brönnimann (= *Globigerina glutinata* Egger).

Globigerinita glutinata (Egger)

(Fig. 18–19)

Globigerina glutinata EGGER, 1893, p. 371, pl. 13, fig. 19–21; RHUMBLER 1911, p. 148, pl. 29 fig. 14–16, pl. 33 fig. 20, pl. 34 fig. 1 (possibly not fig. 25a); TAKAYANAGI & SAITO 1962, p. 86, pl. 27 fig. 13–17.
Tinophodella ambitacrena LOEBLICH & TAPPAN, 1957, p. 114, fig. 2–3; 1964, p. 679, fig. 543, 6.
Globigerinita naparimaensis BRÖNNIMANN, 1951, p. 16–18, textfig. 1–14.
Globigerinita incrusta AKERS, 1955, p. 655, pl. 65 fig. 2A.D.
Globigerinoides parkerae BERMÚDEZ, 1961, p. 1232, pl. 10 fig. 10–11.
Globigerinita glutinata (Egger) PARKER, 1962, p. 246, pl. 9 fig. 1–16; 1967, p. 146, pl. 17 fig. 2–5.
Globigerinita glutinata (Egger) *flparkerae* BRÖNNIMANN & RESIG, 1971, p. 1303, pl. 23 fig. 1–4, pl. 50 fig. 6, text fig. 15.

Test trochoid, initial part five-chambered in case of small proloculus, four to three chambers if proloculus is larger. Last formed coil formed by three to four chambers. Last formed chamber longer than high. In the forms from the Miocene and Pliocene the umbilicus may be open, in later forms it is more or less gradually closed; the aperture is umbilical and provided with a thickened border; in some tests it may be divided in two parts by a kind of dent which is attached to a former chamber wall. Individuals may or may not have a secondary dorsal aperture of the last formed chamber at the conjunction with two former chambers. In rare specimens also the pre-ultimate chamber may show a small dorsal aperture. Bullae may be present or absent; they may cover the umbilical aperture and, in most cases, may run over parts of the ventral sutures; they may be bulbous and show small sutural openings at the walls; some bullae may close dorsal apertures also. The walls of the chambers are very thin in the ultimate chamber and may be gradually thickened in older chambers; they do not show any layering and consequently a primary organic membrane is absent. The walls are provided with numerous small pustules which may be nearly absent in the last formed chambers and gradually become larger in the older chambers; young pustules have a triangular base. The pores are densely placed and very fine (diameter less than 1 μ). When chambers become older the pustules cover the underlying pores; in older chambers pores are found in between the pustules only. The walls of the bullae may have pustules also, but remain extremely thin. The pores do not widen towards the surface. In the initial chambers the small apertures show a distinct dent or rim at one side, possibly a reduced toothplate. The direction of coiling is very variable in the different samples.

Found in tropical, subtropical and temperate seas, Miocene to Recent.

Genus **Candeina** d'Orbigny, 1839

Candeina nitida d'Orbigny, 1839

(Fig. 20)

Candeina nitida D'ORBIGNY, 1839, p. 108, pl. 2 fig. 27–28, type-species of *Candeina*; HOFKER 1956, p. 99, pl. 12 fig. 10–17; 1969, p. 103, fig. 267–276.

The test begins with about 5 chambers encircling the proloculus, followed by 3 chambers in the next whorl. All of these chambers have primary umbilical apertures with narrow but distinct rims, and a distinct dent at one side which may be the reduced toothplate; in the initial whorl with 3 chambers the apertures miss this dent and are more open, semicircular. Then 3 or more chambers are added which do not have the umbilical aperture but a row of small apertures at their sutures. Such chambers are normally designed as "bullae" and there is no reason not to do that here also, the more, since in many specimens, recent and fossil, the author observed smaller chambers covering the sutural openings of these bullae and once again possessing several openings at their sutures, they certainly should be described as bullae (the same is found in the Miocene species *Globigerinatella insueta* Cushman & Stainforth, also belonging to the Candeinidae). So the forming of bullae is only increased in *Candeina.* Walls of older chambers may be thickened, but without forming lamellation. Bullae may have the form of large chambers, but in outgrown specimens they may become much smaller and resemble small globular bullae. The walls of the bullae remain thin.

Candeina nitida is known from the Upper Miocene on; in the Pleistocene and the Recent it may be common.

Family GLOBOROTALIIDAE Cushman, 1927

Subfamily GLOBOROTALIINAE Cushman, 1927

Genus **Globorotalia** Cushman, 1927

Globorotalia punctulata (d'Orbigny)

(Fig. 21–26)

Globerigerina punctulata D'ORBIGNY, 1826, p. 277, No. 8 (nomen nudum); FORNASINI 1898 (1899), p. 210, fig. 5.

Globigerina puncticulata DESHAYES, 1832, p. 170 (not figured but described; refers to D'ORBIGNY'S species); BARBIERI, 1971, p. 10–12, textfig. 3, 5–6 (with D'ORBIGNY'S figures from the Planches inédites).

Globorotalia (Truncorotalia) oceanica CUSHMAN & BERMÚDEZ, 1949, p. 43, pl. 8, fig. 13–15.

Globorotalia punctulata (d'Orbigny), PHLEGER, PARKER & PEIRSON, 1952, p. 20, pl. 4 fig. 8–12; CIFELLI & SMITH, 1970, p. 40, pl. 6 fig. 3.

Turborotalia puncticulata (Deshayes) BERMÚDEZ, 1961, p. 1327, pl. 18 fig. 3, 6; GRADSTEIN 1974, p. 68, pl. 5 fig. 1–6.

Not: BANNER & BLOW 1960, *Globigerina puncticulata* Deshayes, p. 15, pl. 5 fig. 7.

Test small, larger diameter between 0.30 and 0.35 mm. Dorsal side nearly flat or slightly convex in the central part; margin subacute, without keel but always with a poreless rim. Ventral side strongly convex but with a deepened umbilicus which is very narrow. 4–4½ chambers visible in the last formed whorl. Last formed chambers at the dorsal side elongate, with rounded sutures; ventral sutures impressed and radiating from the centre, straight. Chambers at the ventral side highest near the centre. Pores small but distinct. At the ventral side, in some cases at the dorsal side also, surface pustulate; this obviously was the reason why D'ORBIGNY called the species *punctulata* (the name given by DESHAYES obviously is a clerical error (*puncticulata*). Especially at the ventral side the pustules are distinct and often sharp. Aperture an open crescent more or less in the middle of the ventral suture, with a thickened border, small. Sections reveal that in the last two whorls at least the poreless rim of the margin is present. Most chambers have layered walls, but specimens with last formed chamber having the primary calcareous lamella only also occur. The pores are relatively fine, diameters from 2.5–3.3 μ. Pustules always in between the pores.

Recent and Pleistocene, possibly also Pliocene (BARBIERI, 1971, p. 20, table).

BARBIERI (1971) for the first time pointed out that the lectotype described and figured from a slide in the d'Orbigny-collection by BANNER & BLOW (1960) cannot be the species meant by D'ORBIGNY in the figure from the inedited plates and with the name *Globigerina punctulata*, and well-described but not figured by DESHAYES (1832). As with so many other preparations supposed to be mounted by D'ORBIGNY it was a set of specimens obviously mounted by another person, either DESHAYES (but not likely) or TERQUEM. Studying good material from the beach of Rimini, from which locality D'ORBIGNY had his species, and from which the mentioned material of D'ORBIGNY's preparation was labelled to occur, the present author is convinced that two species are found in Rimini. The species taken by BANNER & BLOW for *G. punctulata* d'Orbigny is the commoner one and has been figured by FORNASINI (1899, p. 5, pl. 1 fig. 1–3) as *Globigerina inflata* d'Orbigny. FORNASINI placed in the synonymy *Globigerina punctulata* d'Orbigny; yet, FORNASINI's fig. 1 undoubtedly is *Globigerina punctulata*, whereas his figures 2 and 3 are undoubtedly *Globigerina inflata* d'Orbigny. Typical for *punctulata* is, as DESHAYES pointed out. "la loge la plus grande est percée inférieurement d'une très-petite ouverture ronde", whereas the numerous, relatively small specimens of *Globigerina inflata* in the type-locality are characterized by a much larger aperture and have a much more rounded margin (see also GRADSTEIN, 1974, pl. 5 fig. 1–6). Obviously the person (TERQUEM?) who later sought in the Rimini material of D'ORBIGNY to replace damaged specimens of *G. punctulata*, placed some of them on the original glass plate. What BANNER & BLOW described and figured as lectotype of *G. punctulata* d'Orbigny was one of these specimens of *G. inflata* d'Orbigny, and this lectotype thus became a synonym of *G. punctulata*, thus, as pointed out by BARBIERI, creating a great confusion. Real *G. punctulata* d'Orbigny is relatively rare in beach material of Rimini, and all specimens obtained from this locality by me were obviously fossil from late Tertiary origin. Yet, *G. punctulata* is found in Recent seas also and I had them from the Caribbean Sea and from Recent material from the West coast of Africa. CIFELLI & SMITH observed it in material obtained from the Atlantic in plankton nets (1971). AKERS & DORMAN (1964, p. 19, pl. 13 fig. 20–22) found it in the Pleistocene; GRADSTEIN (1973, p. 93) believed the *G. punctulata*-lectotype by BANNER & BLOW to belong to the *inflata*-group also. TODD (1961, p. 121–122), having read the paper by BANNER & BLOW (1960) strongly opposed to the forming of new lectotypes in that paper; she argued that it is not the object of the Rules of Zoological Nomenclature to confuse the nomenclature by old names, nor to make new lectotypes of them when there remains doubt as to the certainty that these lectotypes are identical with the species a former reknown zoologist established long ago.

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Fig. 1. *Hyperammina constricta* n. sp., W. of St. Croix, V.I., depth 300 m. – Several tests, some attached, one with protoplasm; longitudinal section × 66; the other figures × 33.

Fig. 2. *Polysiphotrocha siphonata* Seiglie, St. Croix, 180 m. – Whole test from three sides, one median transverse section and one section tangentially ground; all figures × 200.

Fig. 3. *Tritaxis siphonifera* (Cushman), St. Croix, 360 m. – Central part of microspheric specimen; ventral side of small megalospheric specimen; dorsal side of microspheric specimen; all × 66.

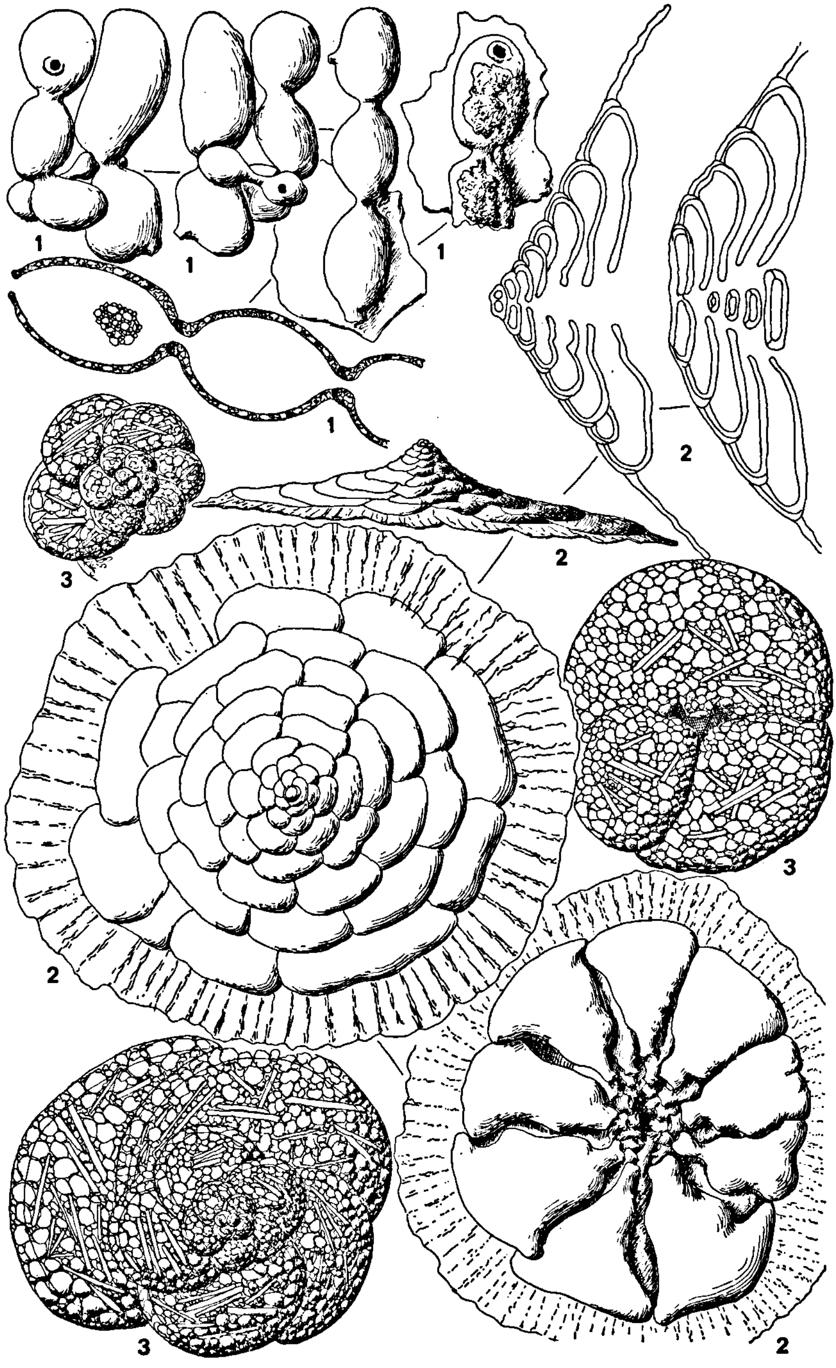
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Fig. 3. (cont.). *Tritaxis siphonifera* – Transverse section of attached test, with the spongeous attaching material; × 66.

Fig. 4. *Carterina caribbeana* (Carter). One small specimen from W. of ST. CROIX, depth 180 m, and one larger specimen off THATCH ISLAND, 40 m. – Whole tests from three sides, × 66; transverse section × 66, with the spiculae in the protoplasm, where they are formed; parts of tests walls in a clarifier, with the small and the large elongate spiculae in between the rounded very small ones, × 200.

Fig. 5. *Gaudryina parvula* (Cushman). W. of ST. CROIX, 300 m. – Megalospheric specimen wholly biserial, microspheric specimen with two sets of triserial chambers. Aperture with distinct dent, × 66.

Fig. 6. *Cribrostomoides spiculiferus* nov. spec. Off ST. CROIX, 800 m. – Test from three sides and horizontal section, × 66; parts of sections of walls and sections of apertures, × 200.

Fig. 7. *Cornuloculina inconstans* (Brady). Off ST. CROIX, 800 m. – Transverse section through megalospheric test, × 200.

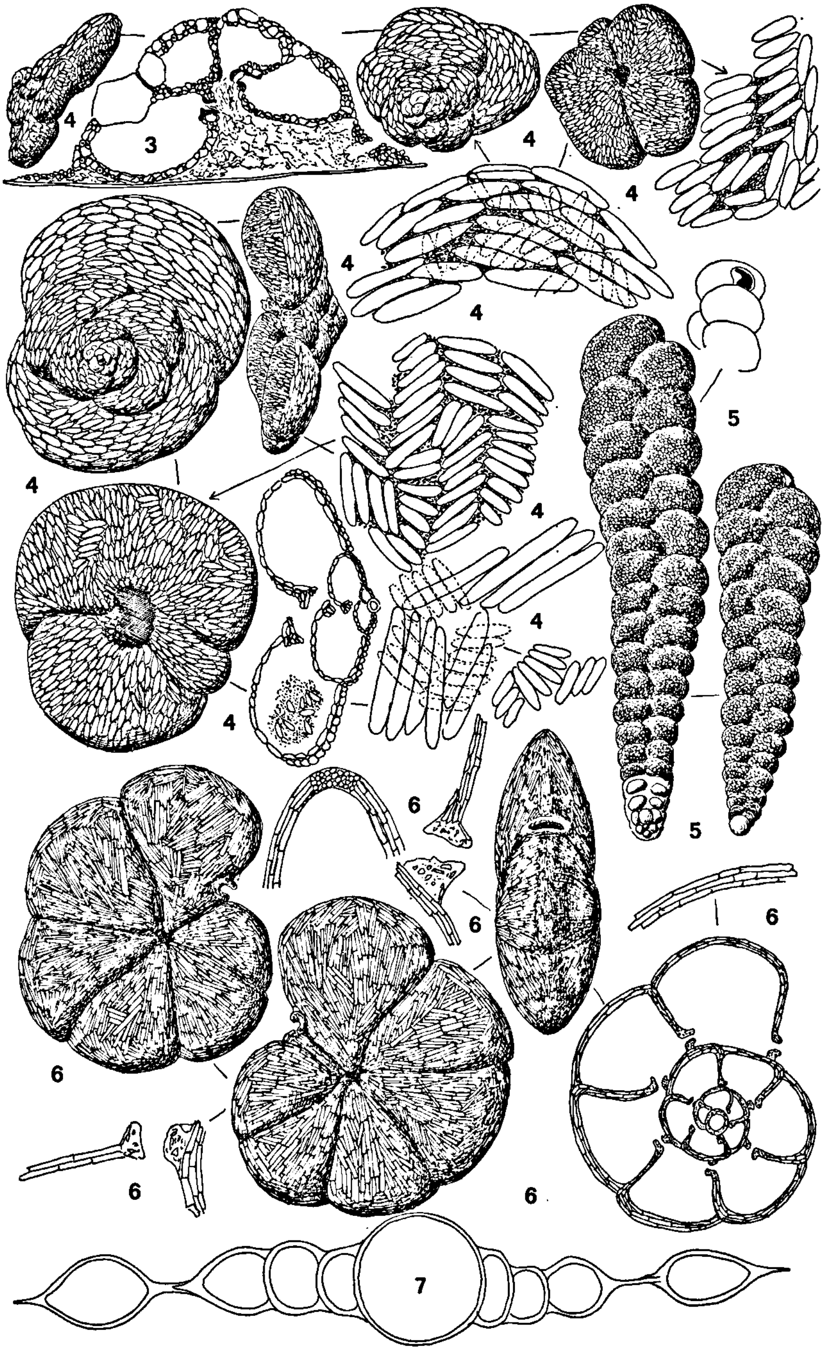
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Fig. 8. *Robertina subcylindrica* (Brady), W. of St. Croix, 300 m. – Test from three sides, dorsal side only in part, with optical sections of toothplates and initial chambers, with the calcareous knob on the triangular dorsal opening of toothplate.

Fig. 9. *Robertinoides bradyi* Cushman & Parker, St. Croix, 180 m. – Apertural part showing the difference with *Robertina*, × 200.

Fig. 10. *Patellina altiformis* Cushman, off St. Croix, 180 m. – Test from aside and ventral side, dorsal side to show the main parts of the toothplates, longitudinal section showing the toothplates and the toothplate flaps, all × 66; initial parts showing that the proloculus is followed directly by biserial chambers, × 600; toothplate with its toothplate-flap forming the secondary septa, from ventral side, × 120; last formed chamber with the tubules ending in the so-called pores in the wall at the dorsal side, all formed by the toothplate-flap, × 200.

Fig. 11. *Tretomphalus bulloides* (d'Orbigny), from W. of St. Croix, 180 m. – The + and — forms of this species, with the loosened "*Rosalina*"-part from the ventral side, and a longitudinal section showing the toothplates proving that it is a *Neoconorbina*; × 66.

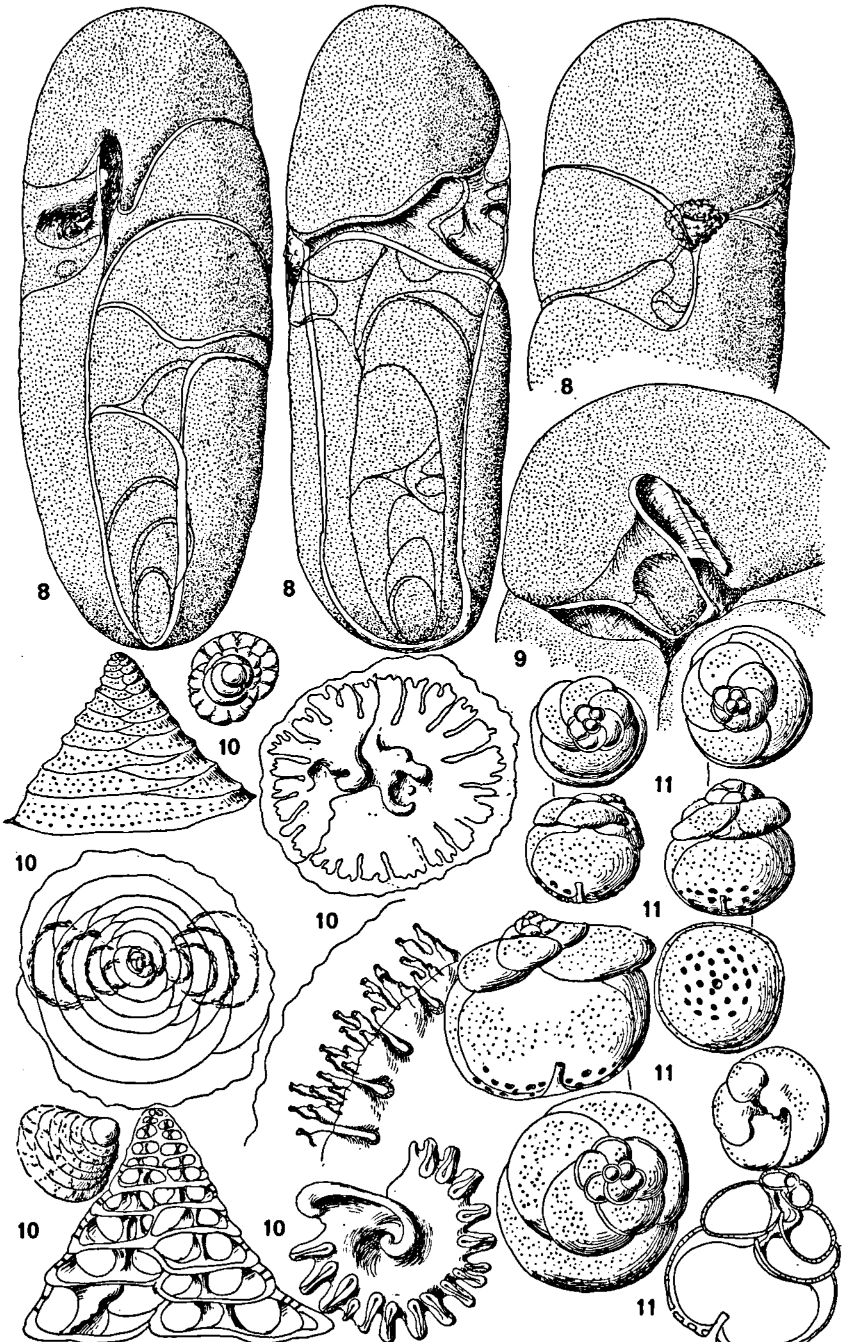
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Fig. 12–13. *Pseudotretomphalus planus* (Cushman), from St. Croix, 180 m. – The (two) + and – forms; the one with 3 chambers at the base of the *Cymbaloporetta* part, the other with 4 end-chambers; × 66 – and with the structure of the sipho of the bulla chamber, × 200.

Fig. 14–15. *Pseudotretomphalus milletti* (Heron-Allen), St. Croix, 180 m. – The two + and — forms, the one with 5, the other with 6 end-chambers in the *Cymbaloporetta*-part; with a longitudinal section (without toothplates); all × 66; two sections of walls, × 200.

Fig. 16. *Pseudotretomphalus grandis* (Cushman), from St. Croix 180 m. – From three sides, × 66.

Fig. 17. *Siphoninella soluta* (Brady). W of St. Croix, 180 m. – Megalospheric specimen from three sides, × 66.

Fig. 18–19. *Globigerinita glutinata* (Egger). W of St. Croix, 800 m. – 18: Test without bullae, from three sides, × 66; initial part with reduced toothplates at the foramina, × 400 and × 200. – 19: Test with bullae, × 66. The given sections of parts of walls × 400.

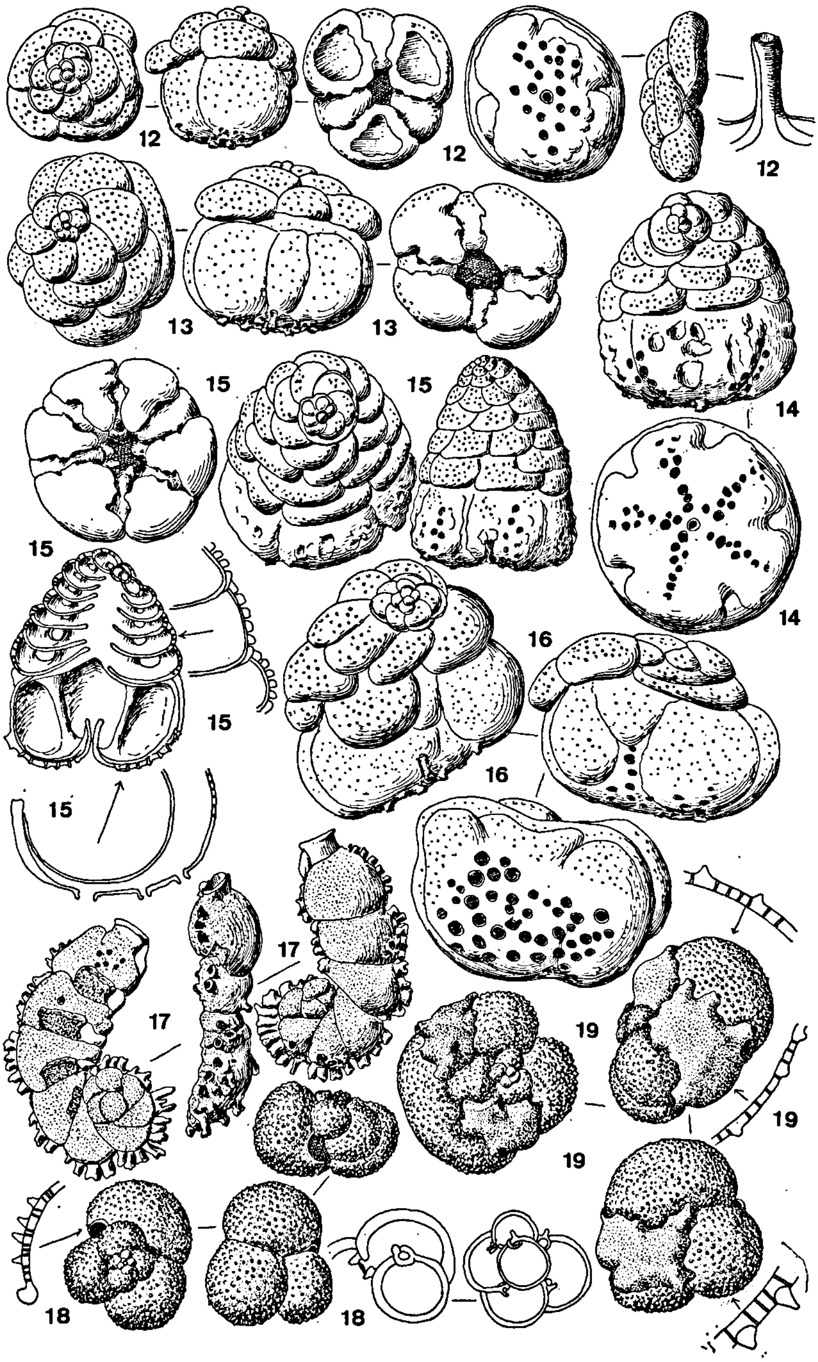

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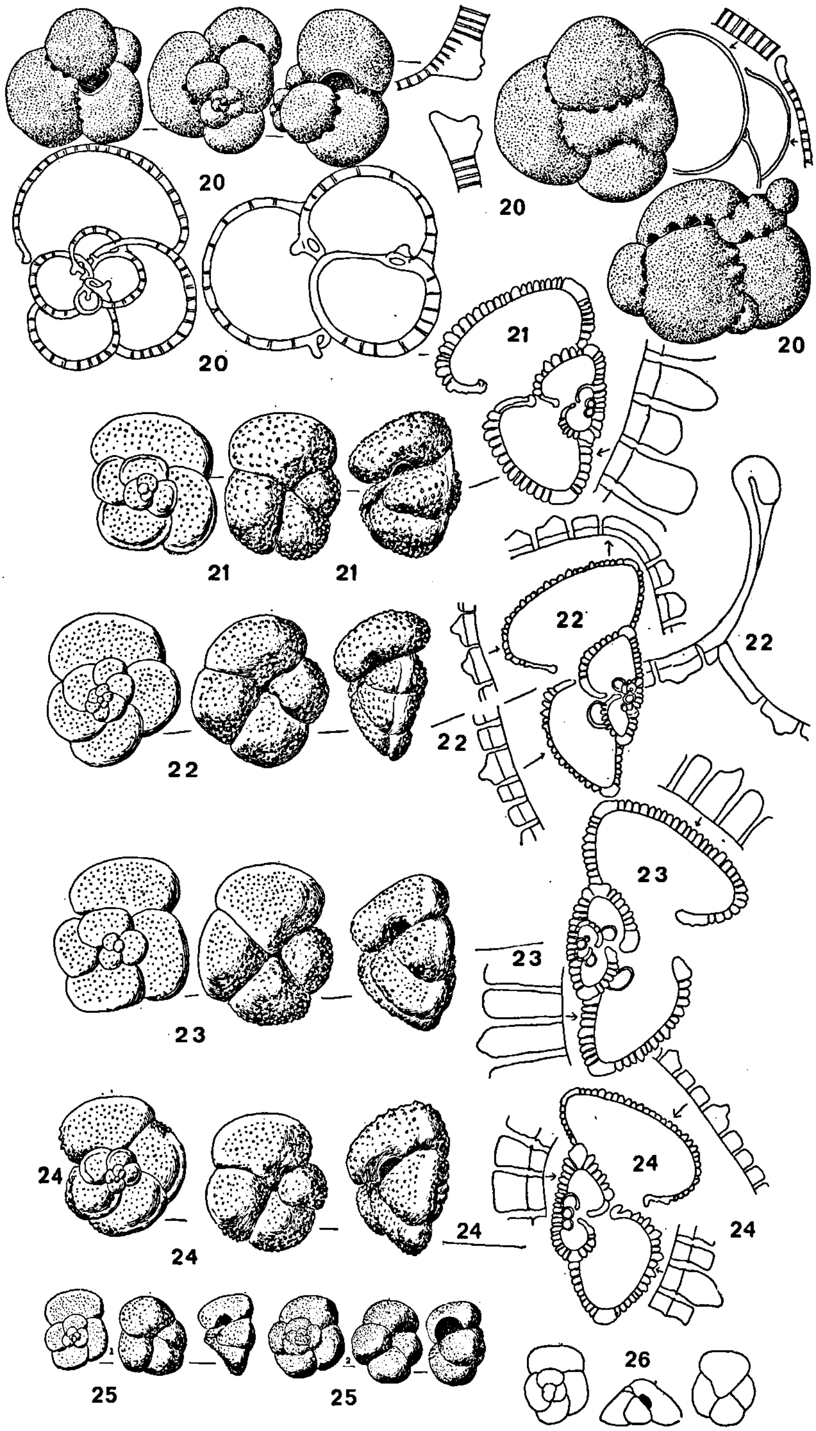
Fig. 20. *Candeina nitida* d'Orbigny. W of St. Croix, 800 m. – Test without bullae, with the initial aperture and secondary sutural openings. From three sides, × 66; initial chambers in section, with the reduced toothplates at the foramina, × 200 and × 400; wall-part at secondary opening, × 400. Other tests with irregular bullae, × 66; section of test wall and bulla; enlargements of wall parts × 400.

Fig. 21–26. *Globorotalia punctulata* (d'Orbigny). – 21: from the type-locality, beach of Rimini, Italy, × 66; transverse section, × 300; section of wall part × 400. – 22: from Gulf of Mexico, Deep Sea Drilling Project, Leg 2, hole 11, B. 1, S. 1, Pleistocene; same indications, one wall part with septum and thickened border of aperture; septum consisting of primary calcareous lamella only. – 23: near the coast of West-Africa; same indications. – 24: from W of St. Croix, depth 180 m, same indications. – 25: the two forms found in the material from the type-locality, beach of Rimini (× 33); to the left: *Globorotalia punctulata* (d'Orbigny), from three sides, to the right: *Globigerina inflata* d'Orbigny, without poreless band at periphery and with the typical large aperture; it was such a specimen which was erroneously taken as the lectotype of *Globorotalia punctulata* (d'Orbigny) by Banner & Blow, 1965. – 26: the species *Globorotalia punctulata* (d'Orbigny) as designed by d'Orbigny in the "planches inedites" with the typical chambers and the small aperture (after Barbieri, 1971, p. 10, fig. 3).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