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NOTE DU LABORATOIRE DE PALEONTOLOGIE DE L'UNIVERSITE DE GENEVE, No 1, JUILLET, 1978

PAUL BRONNIMANN¹⁾

1978



Recent benthonic foraminifera from Brasil. Morphology and ecology.
Part III.

Notes on *Asterotrochammina* BERMÚDEZ and SEIGLIE.

Abstract :

Asterotrochammina camposi, n.sp., and *Asterotrochammina sinuosa*, n.sp., are reported from the very shallow waters of the Campos shelf, Brasil, which lie under the influence of the cold water Falkland (Malvin) current. The definition of the genus *Asterotrochammina* BERMÚDEZ and SEIGLIE, 1963, is emended and the following species are referred to this taxon : *A. delicatula* BERMÚDEZ and SEIGLIE (type species), *A. kellestae* (THALMANN), *A. propria* (CUSHMAN), and the new species *A. camposi* and *A. sinuosa*.

The present paper represents the continuation of the writer's studies on Recent trochamminids from the Campos shelf, Brasil, in the area defined by Long. S 21°30'/22°30' and Lat. W 40°30'/41°30' (location map see text-fig.1 in BRÖNNIMANN and BEURLEN, 1977a) (BRÖNNIMANN and BEURLEN, 1977a, b, c; BRÖNNIMANN, 1979, in press).

In the course of the examination by scanning photographs and optical sections of the here described *Asterotrochammina camposi*, n.sp., and *Asterotrochammina sinuosa*, n.sp., it became necessary to revise and emend the definition of the genus *Asterotrochammina* BERMÚDEZ and SEIGLIE, 1963, which does not possess secondary umbilical chambers as stated in BERMÚDEZ and SEIGLIE's original definition. On the other hand, its type species *A. delicatula* BERMÚDEZ and SEIGLIE is characterized by invaginations of the umbilical intercameral sutures and chamber walls. The same type of invagination exists also in *Remaneica helgolandica* RHUMBLER, 1938, the type species of *Remaneica* RHUMBLER, 1938, and in *Remaneica plicata* (TERQUEM), 1875 [= *Patellina plicata* TERQUEM] in addition to invaginations or secondary septal structures developed by the spiral intercameral sutures and which are absent in *Asterotrochammina*. Both *Remaneica* and *Asterotrochammina* are here placed into the subfamily Remaneicinae LOEBLICH and TAPPAN, 1964, which is characterized by infoldings of the chamber wall.

Family Trochamminidae SCHWAGER, 1877
Subfamily Remaneicinae LOEBLICH and TAPPAN, 1964.

Type genus: *Remaneica* RHUMBLER, 1938. Recent. North Sea.

Asterotrochammina BERMÚDEZ and SEIGLIE, 1963, emended herein.

Type species : *Asterotrochammina delicatula* BERMÚDEZ and SEIGLIE, 1963. Recent, Caribbean Sea.

Emended definition : Test a very low, spirally flat convex, umbilically shallow concave trochospire consisting of axially strongly compressed chambers. Radial sutures on spiral side without invaginations or secondary septa as found in *Remaneica* RHUMBLER, those on umbilical side with invaginations. Aperture consisting of a primary interiomarginal, umbilical, subperipheric opening and a secondary, umbilical, axial-sutural, backward and axially directed opening, similar to but not identical with the secondary axial-sutural opening of *Polystomamina* SEIGLIE. Primary openings covered by successive chambers, secondary openings, arranged in a low trochospire within the axial depression, remain uncovered and functional. Embryonic chamber a large axially compressed ellipsoid body in center of axial depression. "Puffermasse" may be developed and test may be attached. Walls single-layered, agglutinated and imperforate.

Remarks : *Asterotrochammina* was described by BERMÚDEZ and SEIGLIE in BERMÚDEZ and CHARLTON RIVERO (1963, p. 323, fig. 28A) from the very shallow brackish waters of the Gulf of Carioca, Venezuela, as having secondary umbilical chambers similar to those occurring in *Asterigerina*. The new genus was compared with *Trochammina* PARKER and JONES, 1859, and with *Tiphotrocha* SAUNDERS, 1957, which are both devoid of such chambers. Recently, SEIGLIE and BERMÚDEZ (1977, p. 301, 302, pl. 1, fig. 1-4) redescribed *Asterotrochammina* with the aid of scanning photographs of its type species collected in the very shallow waters (1.5 to 5 m depth) off the Puerto Rican coast E of San Juan, and found that secondary umbilical chambers are, in fact, not developed. However, they reported that the umbilical sides of the chambers show 3 lobules, called umbilical, middle and marginal

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lobule. SEIGLIE and BERMÚDEZ did not further elaborate on the validity of the genus *Asterotrochammina* nor on the relationship of this taxon with other trochamminid genera and placed it into the subfamily Remaneicinae LOEBLICH and TAPPAN, 1964, together with *Remaneica* RHUMBLER, 1938, and *Rotaliammina* CUSHMAN, 1924, merely stating that "They (*Asterotrochammina* and *Rotaliammina*) are morphologically closer to *Remaneica* than to any other genus of the family Trochamminidae". This statement is not supported by the comparative analysis of the morphology of *Remaneica*, *Asterotrochammina* and *Rotaliammina*. In fact, the writer's work on the types and other material of these 3 genera shows that only *Remaneica* and *Asterotrochammina* can be placed into the Remaneicinae. *Rotaliammina* does not possess any sutural invaginations nor does it have a primary and a secondary aperture of the kind found in *Asterotrochammina*. Further, it has been noted that the invaginations are either absent in early ontogenetic stages or then only weakly developed whereas they arrive at their maximum development in the final ontogenetic stages. This is true for the representatives of *Asterotrochammina* (only umbilical invaginations) and of *Remaneica* (umbilical and spiral invaginations). The infolding of the chamber wall is a most characteristic feature and distinguishes *Remaneica* and *Asterotrochammina* from all other in their general morphological appearance similar trochamminids. In both *Remaneica* and *Asterotrochammina*, the embryonic chamber is a large axially compressed ellipsoid body in the center of the axial depression.

Besides the type species *A. delicatula*, *Asterotrochammina* contains also *A. kellettae* (THALMANN), 1932 [= *Trochammina peruviana* CUSHMAN and KELLETT, 1929], *A. propria* (CUSHMAN), 1944, and the here described *A. camposi* BRÖNNIMANN, n.sp., which all have invaginations of the umbilical chamber wall and the same apertural features as found in *A. delicatula*. It is of interest to note that neither the drawing of the holotype of *Trochammina peruviana* CUSHMAN and KELLETT (1929, pl. 1, fig. 8) nor that of *Trochammina propria* CUSHMAN (1944, pl. 2, fig. 11) show the umbilical invaginations which however were seen by the writer on the type material deposited in the U.S. National Museum. In the type descriptions reference was made to a "sinuous lobed condition" in the case of *T. peruviana* and to "a distinct raised lobe at the peripheral portion" in that of *T. propria*. Also placed in *Asterotrochammina* is a rather rare species associated in the samples from the Campos shelf with *A. camposi*, n.sp., for which the name of *A. sinuosa*, n.sp., is herein proposed.

Small asterotrochamminas with only one single umbilical invagination close to the group of species described by RHUMBLER (1938) as *Trochammina squamata astrifica*, and by HÖGLUND (1947) as *Trochammina stellata*, *Trochammina labiosa*, and by WILLIAMSON (1858) as *Trochammina ochracea* may also belong to *Asterotrochammina*. Also the form illustrated by LEVY, MATHIEU, POIGNANT, ROSSET-MOULINIER and ROUVILLOIS (1974, pl. 1, fig. 8) and named *Trochammina squamata adaperta* RHUMBLER, with a single and deep invagination in the umbilical chamber wall, seems to belong to *Aste-*

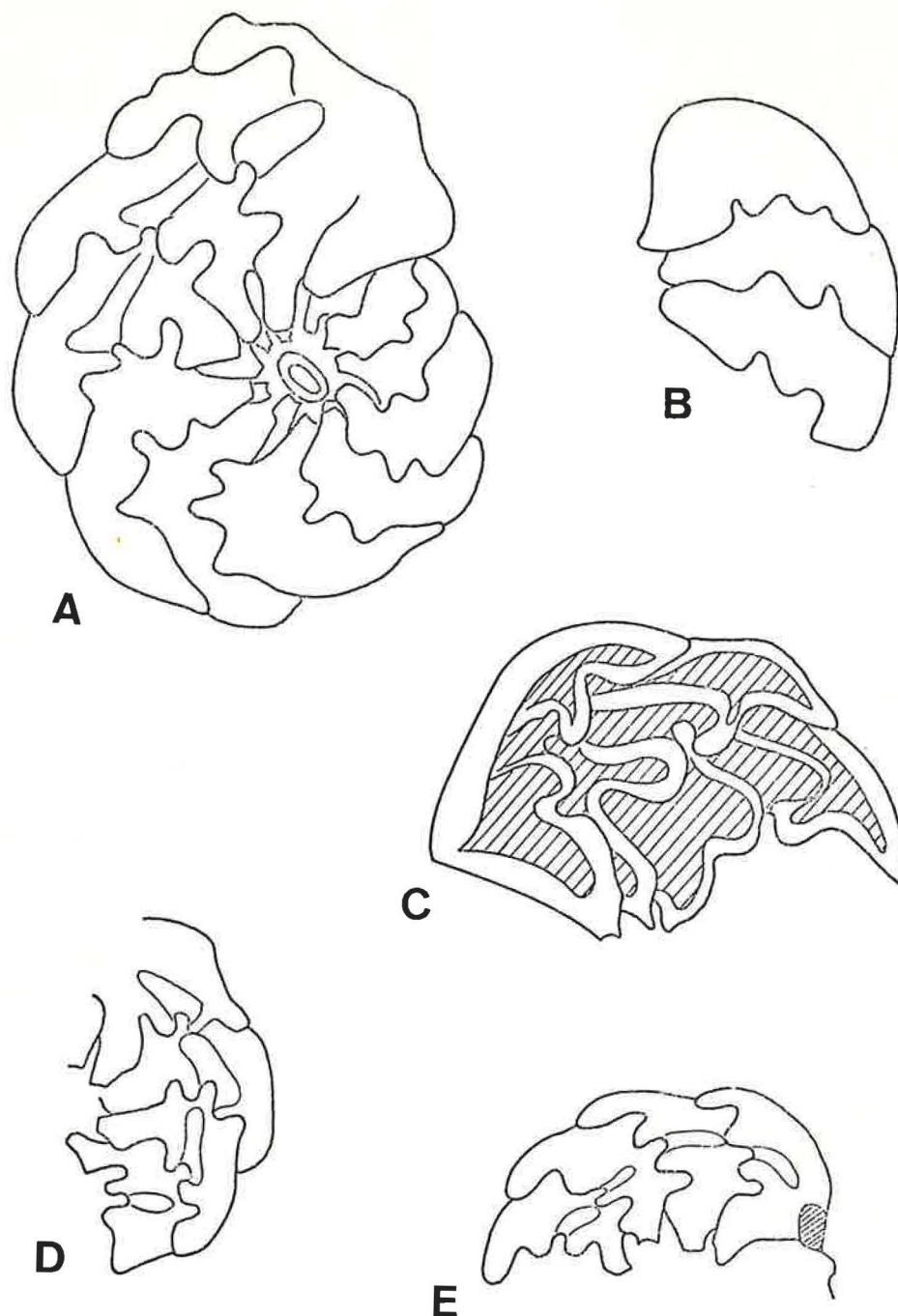
rotrochammina. However, only a revision of the type material of this group of small and low trochospiral trochamminas will permit to establish their morphological characters and their taxonomic relationships.

Asterotrochammina camposi BRÖNNIMANN, n.sp.

Pl. 1, Fig. 1-11; Pl. 2, Fig. 3-5;
Pl. 3, Fig. 1-4; Pl. 4, Fig. 1-4.
Text-fig. 1, 2.

Type specimen : The holotype of *Asterotrochammina camposi*, n.sp., is the specimen illustrated by the spiral and umbilical sides, pl. 1, fig. 8 and 10. It is from the Campos shelf, Brasil, sample PM-3-3, depth about 15 m. The maximum diameter of the holotype is about 240 μ and its axial height about 35 μ . The species is named for Dr. Carlos Walter Marinho CAMPOS, Rio de Janeiro, Brasil.

Morphological description of the holotype : The very low trochospire consists of about 36 chambers arranged in not quite 4 whorls, with 12 chambers in the final volution. The ultimate chamber is peripherally damaged, but, as can be seen in the illustration of the umbilical side, pl. 1, fig. 10, the rim of the small, rounded, subperipheric primary aperture is intact. The chambers are axially strongly compressed and peripherally rounded. There is no keel formation. In spiral view, pl. 1, fig. 8, the radially elongate chambers are separated from each other by depressed oblique intercameral sutures which run tangentially to the well defined spiral suture. The chambers do not overlap. Their oblique arrangement in respect to the spiral suture and the fact, that a newly formed chamber touches the preceding one only on about 1/2 to 1/3 of its periphery produces a serrate outline which seems to be a typical feature of *A. camposi*, n.sp. The final chambers measure about 110 μ in length and 30 to 40 μ in maximum height. The shallow concave umbilical side, as illustrated by pl. 1, fig. 10, is much different from the flat convex spiral side. A small and shallow subcircular axial depression of about 50 to 60 μ maximum diameter is defined by the pointed axial extensions of the chambers of the final volution. In contrast to the spiral side, the chambers strongly overlap umbilically on each other. The umbilical intercameral sutures are characterized by 3 invaginations of which the middle one is the largest and extends in form of a deep elongate dell into the umbilical wall. These invaginations define 4 more or less distinct chamber lobules. In the early chambers of the ultimate whorl, the invaginations are not as important than in its later portion and it is probable that the invaginations are absent or less developed in the early ontogenetic stages. In their adult expression, the number and depth of invaginations are believed to be of specific significance. The apertural features are exposed on the umbilical side. Each chamber has 2 apertures, a primary interiomarginal one in a subperipheric position, and a secondary one in an axial-sutural position, opening backward and axially under the tunnel-like extension of the chamber wall. The secondary openings are arranged in a low trochospire within the axial depression. In the holotype, the embryonic chamber is masked by a cover of sediment. The single-layered and imperforate walls are ag-



Text-fig. 1

Asterotrochammina camposi BRÖNNIMANN, n.sp.

All from dredge sample PM-3-3, Campos shelf, about 15 m deep.

A - E Umbilical views of entire test (A) and of fragments (B-E) showing the 3 invaginations of the umbilical sutures.

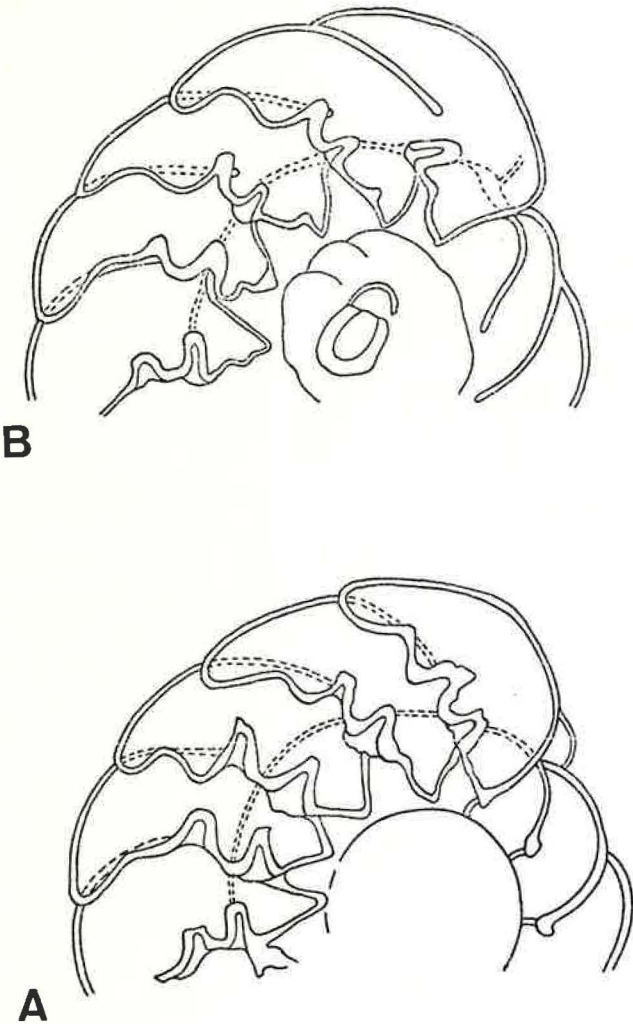
In the specimen C, the umbilical walls exhibit collapse features (hatched areas), and in the specimen E the subperiphric interiomarginal, rounded primary aperture is indicated by hatching.

All the drawings are of specimens photographed in a clearing liquid.

A, B, C 275x.

D, E 165x.

glutinated. However, there is a marked difference between the agglutination of the spiral and the umbilical sides. The agglutinate of the spiral side consists of a mosaic of mostly plate-like quartz flakes which are held together by very little minutely granular organic cement. The quartz flakes are neatly joined to form a rather smooth mosaic. In contrast, the umbilical side shows a finely granular agglutinate embedded in much red-brownish organic cement. The lack of a rigid agglutinate on the umbilical side is reflected by the usually collapsed umbilical chamber walls leaving thickened rims along the periphery and the invaginations where the walls are doubled-up. The overall color of the test is yellow brown.



Text-fig. 2

Asterotrochammina camposi BRÖNNIMANN, n.sp.

Both drawings are from the same specimen seen in umbilical view. It is from dredge sample PM-3-3, Campos shelf, about 15 m deep.

A represents the optical section across the axial depression and lies in part in the plane of the primary apertures of the final whorl.

B is in the plane of the embryonic chamber.

A, B 275x.

Morphological description of paratypes :

Some of the numerous specimens of *A. camposi*, n.sp. from sample PM-3-3 have been illustrated by scanning photographs on pl. 1, fig. 1-7, 9, 11 and on pl. 2, fig. 1, 6, 7 and some have been examined in a clearing liquid. Photographs and drawings of optical sections are illustrated by pl. 3 and 4 by text-fig. 1 and 2.

a. *Soanned spooimeno*

The overall morphological features of the illustrated paratypes are those of the holotype. The maximum diameter of the tests ranges from about 150 to 260 μ . The shallow axial depression is about 1/3 to 1/4 of the maximum diameter of the test. The outline of the test as seen in spiral/umbilical view is subcircular to somewhat ellipsoid and distinctly serrate.

The trochospire is made up of 30 to 40 chambers arranged in 3 to 4 volutions and the final volution consists of 10 to 13 radially elongate chambers. The central portion of the smoothly finished spiral side is usually flat, in some individuals slightly depressed. The color of the test is red to yellow-brown.

In none of the specimens, including the rare ones found attached to a substratum, occurs the "Toga-artige Puffersubstanz" in the sense of RHUMBLER (1938).

The primary apertural features are better preserved in the paratypes than in the holotype. The specimens illustrated by pl. 1, fig. 6 and 7 show clearly the relatively small, rounded subperipheral interiomarginal primary aperture which remains invariably on the umbilical side. The aperture is somewhat twisted and surrounded by a thickened rim. The specimen illustrated by pl. 1, fig. 6 and the detail of its axial depression pl. 2, fig. 1, afford a good view of the numerous secondary apertures arranged in a low gradually enlarging trochospire. They are very small in the early part of the test, about 2 to 3 μ in diameter, and become rather large, up to 130 μ in the final stage. They occur in a sutural-axial position and at least the adult ones open at the same time axially and backwards under the tunnel-like, often truncated and backward lifted axial tips of the chambers.

The center of the axial depression is occupied in the paratypes illustrated by pl. 1, fig. 1, 2, 6, 9, 11 and pl. 2, fig. 1, 6, by a large axially compressed ellipsoid body, the embryonic chamber. Its wall is virtually without agglutinate and therefore commonly deformed by collapse features. The 3 invaginations of the umbilical intercameral sutures are as in the holotype. The

amplitude increases in the course of ontogeny. The large middle invagination extends throughout the final whorl in form of a deep depression into the umbilical wall. The biological significance of these structures is unknown but it is obvious that they even more reduce the already small chamber lumina. RHUMBLER (1938, p. 194) thought that the invaginations in the case of *Remaneica helgolandica* RHUMBLER made the test more resistant in the moveable biotope where this species lives attached to sand grains. There do not occur any openings along the undulating umbilical intercameral sutures.

The illustrated paratypes show the same difference in the agglutination between the spiral and the umbilical sides as the holotype. The umbilical peripheral rims of the chambers exhibit where damaged a granular sponge-like texture (pl. 2, fig. 6, 7). These damaged walls probably represent the places where the test was attached to a substratum.

b. Specimens examined in a clearing liquid

Optical sections of specimens photographed in a clearing liquid are illustrated on pl. 3 and 4. Text-fig. 1 and 2 are drawbgs after optical sections.

Umbilical side : Optical sections seen from the umbilical side are illustrated by pl. 3, fig. 1-4 and by text-fig. 1, 2. Pl. 3, fig. 1 and 2 are optical sections of the same specimen and fig. 3 and 4 are from different specimens. That of fig. 1 is on a higher level than that of fig. 2 which is in the plane of the primary apertures of the final volution. The purpose of these optical sections is to show the undulating umbilical intercameral sutures with the 3 invaginations and 4 chamber lobules, the overlap of the umbilical chambers (fig. 1), and the relationship between invaginations and primary apertures (fig. 2). The interiomarginal primary aperture lies exactly between the strong middle and the inner invagination. Fig. 2 shows more distinctly than fig. 1 the elongate half moon-like outline of the chambers with their pointed axial extensions. The optical sections of pl. 3, fig. 3 and fig. 4 are from different specimens and lie even deeper than that of fig. 2 but still in the plane of the apertures of the final whorl. They do not exhibit anymore the invaginations of the intercameral sutures but the shape of the chambers, the positions of the primary apertures and in fig. 4 the large ellipsoid, thick-walled proloculus in the center of the axial depression. In the drawings after photographs of text-fig. 1, not only the invaginations of the intercameral sutures of different individuals are shown but also the strong dells formed on the umbilical chamber walls by the strongest invaginations. In text-fig. 1C, the hatched areas represent collapsed umbilical chamber walls. The optical sections of text-fig. 2 are from the same specimen.

Spiral side : Optical sections seen from the spiral side are illustrated by pl. 4, fig. 1-4. Pl. 4, fig. 1 and 2 and fig. 3 and 4 respectively are from the same specimen. Fig. 1 and 3 are on the highest level across the embryonic chamber and fig. 2 and 4 lie deeper in the level of the primary interiomarginal apertures. The proloculus is cut in the plane of its aperture toward the deuterolocus. Its thick wall

is transparent and has a somewhat angular outline suggesting the positions of the early apertures. There are only a few minute foreign elements in form of dark grains in the prolocular wall, that is the agglutinate is virtually absent. The proloculus, including the walls, measures about 20 to 25 μ in length and 15 to 20 μ in width. The wall is 4.5 to 5 μ thick. In Table 1 are listed the prolocular dimensions in microns of 6 specimens. The size of the embryonic chambers differs only very little from one specimen to the other.

Diameter of Test	Proloculus			
	Length (including wall)	Width	Thickness of wall	Aperture to- ward deute- rolocus
225	22	20	5	5
250	23	20	5	6
235	25	20	5	6
175	25	20	5	5
200	20	15	4.5	5
200	25	20	5	5

Table 1

In contrast to the prolocular wall those of the smaller deuterolocus and following chambers of the innermost volution are much thinner and contain much more agglutinate, essentially dark brown grains, making the walls darker in optical section. The deuterolocus wall is about 1-2 μ thick. The primary deuterolocus aperture is an interiomarginal opening of about 3 μ diameter. The septa of the deuterolocus and following chambers bend forward over the aperture with a thickened lip-like extension. The septa are all single-layered. The "double septa" reported by RHUMBLER (1938) in *Remaneica helgolandica* possibly refer to the invaginated secondary septa developed in this species along the spiral intercameral sutures and which are absent in *Asterotrochammina*. The amount of agglutinate increases rapidly with growth and the septa of the second volution exhibit numerous granular inclusions. In none of the above described paratypes was there any indication of the presence of "Puffsubstanz" in the sense of RHUMBLER (1938). In fact, it seems that *A. camposi*, n.sp., when it attached itself to a substratum it did this by glueing the rather thick peripheral border to it without secreting a finely granular covering substance as in *Remaneica* and in *Rotaliammina*. When the attached specimen was removed, the peripheral border of the test was damaged exposing the granular sponge-like texture of the interior of the peripheral wall (see pl. 2, fig. 6, 7).

Relationship with other asterotrochamminas : *Asterotrochammina camposi*, n.sp., differs from *A. delicatula* BERMUDEZ and SEIGLIE by the larger tests, the greater number of chambers per whorl, and the serrated outline as seen in umbilical/spiral view. It resembles *A. delicatula* by the same number of invaginations in the adult stage and by the same apertural and embryonic features (see SEIGLIE and BERMUDEZ, 1977, pl. 1, fig. 2, 4). Further, both species occur in very shallow marine water, but *A. camposi*, n.sp., in moderately cold to cold and *A. delicatula* in warm water. *A. camposi*, n.

sp., differs from the accompanying *A. sinuosa*, n.sp., by the greater number of chambers per whorl, the much stronger umbilical invaginations in the adult stage, and by 3 not only 2 invaginations. *A. kellestae* (THALMANN) has also 3 but much more narrow and deeper invaginations than *A. camposi*. *A. propria* (CUSHMAN) is characterized by a single deep oblique invagination in the peripheral portion of the umbilical wall. The apertural features of both *A. kellestae* and *A. propria* seem to be the same as those in *A. camposi*.

Asterotrochammina sinuosa
BRÖNNIMANN, n.sp.

Pl. 2, Fig. 1,2,6-8
Text-fig. 3.

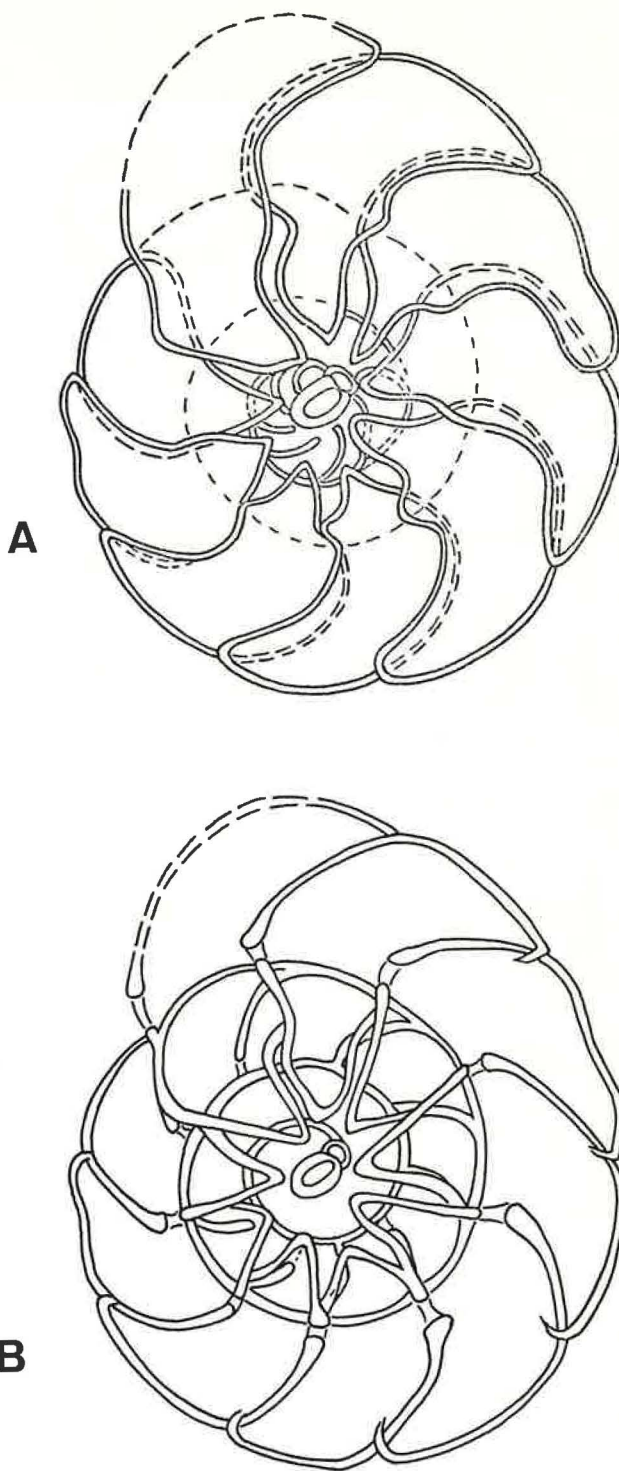
Type specimen : The holotype of *Asterotrochammina sinuosa*, n.sp., is the specimen illustrated by the scanning photographs of the umbilical and spiral sides on pl. 2, fig. 1,2. It is from the Campos shelf, sample PM-3-3, depth about 15 m. The maximum diameter of the test is about 235 μ and its axial height about 50 μ . The name of the new species is derived from the sinuous appearance of the umbilical intercameral sutures.

Morphological description of the holotype : The test is a low, spirally flat convex, umbilically very shallow concave trochospire. Its outline, as seen in umbilical/spiral view is subcircular, and only very weakly serrated. The test, as seen in side view, is much compressed and its periphery rounded. The trochospire is made up of about 30 chambers arranged in 3 to 3½ volutions. The final whorl consists of 9 gradually in size increasing chambers. The chambers are axially strongly compressed. The spiral side is almost flat over its axial portion. The early chambers are indistinguishable. The later ones, on the other hand, well defined by distinct intercameral and spiral sutures. The chambers do not overlap along the intercameral sutures which are oblique and curved.

The umbilical side shows only the chambers of the final volution which are halfmoon-shaped with pointed tips toward the small axial depression of 25 to 30 μ diameter. The tips of the chambers are well separated from each other giving the axial depression its characteristic stellate outline. Each chamber overlaps strongly on the preceding one. The intercameral sutures are distinct sinusoid lines with 2 shallow invaginations, stronger developed in the final than in the early portion of the ultimate volution. The aperture of each chamber consists of a primary, umbilical interior marginal, subperipheric rounded opening and a secondary umbilical, axial-sutural, backward and axially directed opening.

The secondary openings occur under the tunnel-like axial tips of the umbilical chamber walls which are backwards upward tilted.

The primary openings are covered by the successively formed chambers, the secondary openings remain uncovered and most probably functional. Within the narrow axial depression some of the previously formed secondary openings can be



Text-fig. 3

Asterotrochammina sinuosa BRÖNNIMANN, n.sp.

Both drawings are from the same specimen seen in umbilical view. It is from dredge sample PM-3-3, Campos shelf, about 15 m deep.

A is the optical section in the plane of the peripheral portions of the umbilical chambers.

B is the optical section somewhat deeper than A in the plane of the primary apertures of the final volution.

A, B 310x.

seen where they are arranged in a very low trochospire. The large compressed ellipsoid embryonic chamber is not clearly visible in the center of the axial depression. However, it has been observed in paratypes.

The single-layered and imperforate walls are agglutinated. As in *A. camposi*, n.sp., there is a marked difference between the agglutination of the spiral and umbilical sides. The surface of the spiral side is a smoothly finished mosaic of quartz flakes of varying size, cemented by little organic substance. The umbilical side, on the other hand, shows in the central portion a granular and toward the periphery a denser larger sized agglutinate which gradually leads to the quartz flake mosaic of the spiral side. The amount of organic cement on the umbilical side is greater than on the spiral side resulting in less rigid umbilical walls and occasionally in collapse features. The color of the test is yellow-brown. Although this species lived most probably attached to some sort of substratum, there is no indication of the presence of "Puffersubstanz" in the sense of RHUMBLER (1938).

Morphological description of paratypes : The umbilical sides of 3 paratypes are illustrated by scanning photographs pl. 2, fig. 6-8, and from an other paratype, photographed in umbilical view in a clearing liquid, the drawings of text-fig. 3 have been made. The morphology of the test of the 3 scanned paratypes with a maximum diameter of 200 to 230 μ is the same as described for the holotype. The number of chambers of the final whorl varies from 8 to 10. The well separated pointed axial tips of the umbilical chamber walls produce the characteristic stellate shape of the shallow and small axial depression which measures from 25 to 35 μ across. The sutural incisions are up to 35 μ deep and up to 7 μ wide. The umbilical sides of the illustrated paratypes are locally damaged and where the wall texture is exposed it is of the same sponge-like granular appearance as in *A. camposi*, n.sp. The optical sections of a paratype with 9 chambers in the final whorl and 200 μ maximum diameter as seen in umbilical view, are illustrated by text-fig. 3A, B. The one of text-fig. 3A is from a higher umbilical position exhibiting the disposition of the sinusoid umbilical intercameral sutures than that of text-fig. 3B which lies deeper, in the plane of the primary apertures of the final whorl.

Relationship with other asterotrochamminas : *Asterotrochammina sinuosa*, n.sp., differs from *A. camposi*, n.sp., by the sinusoid umbilical intercameral sutures with 2 shallow invaginations, the smaller number of chambers in the final whorl, the characteristic small stellate axial depression, and the very weakly serrate outline. From *A. delicatula* BERMÚDEZ and SEIGLIE, *A. kellestae* (THALMANN) and *A. propria* (CUSHMAN) it differs by the form of the umbilical intercameral sutures and the number of invaginations. The stellate axial depression is close to that of "*Trochammina labiosa* HOEGLUND, 1947, but form and arrange-

ment of the chambers as seen on the spiral side are much different in *labiosa* and *sinuosa*. As mentioned before, the trochamminids described by HOEGLUND (1947) and RHUMBLER (1938) need to be reexamined. They may belong to *Asterotrochammina*. This is already suggested by the large ellipsoid embryonic chamber of "*Trochammina squamata astrifica* RHUMBLER, "*Trochammina stellata* HOEGLUND and "*Trochammina labiosa* HOEGLUND. Hoeglund's species possess also the primary and secondary apertures as they are developed in *Asterotrochammina*.

Ecology : *Asterotrochammina sinuosa*, n.sp., and *A. camposi*, n.sp., occur both in the same very shallow water sample from the Campos shelf which lies under the cold water influence of the antarctic Falkland (Malvin) current.

Acknowledgments

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EXPLANATIONS TO THE PLATES

Plate 1

Asterotrochammina camposi BRÖNNIMANN, n.sp.

Holotype : Fig. 8 and 10.

All from dredge sample PM-3-3, Campos shelf, about 15 m deep.

Fig. 1 300x.

Fig. 2,4,6 240x.

Fig. 3,5,7 350x.

Fig. 8 340x. Same specimen as Fig. 10.

Fig. 9 210x.

Fig. 10 210x. Same specimen as Fig. 8.

Fig. 11 320x.

Plate 2

Fig. 1,2,6,8 *Asterotrochammina sinuosa* BRÖNNIMANN, n.sp.

Holotype : Fig. 1 and 2.

All from dredge sample PM-3-3, Campos shelf, about 15 m deep.

Fig. 1, 6,8 320x.

Fig. 2 230x.

Fig. 3-5 *Asterotrochammina camposi* BRÖNNIMANN, n.sp.

All from dredge sample PM-3-3, Campos shelf, about 15 m deep.

Fig. 3 310x. Same specimen as Fig. 5.

Fig. 4 570x. Detail of Pl. 1, Fig. 6.

Fig. 5 1230x. Same specimen as Fig. 3.

Plate 3

Asterotrochammina camposi BRÖNNIMANN, n.sp.

All from dredge sample PM-3-3, Campos shelf, about 15 m deep.

Fig. 1, 2 Same specimen in umbilical view. 500x.

Fig. 1 Optical section in the plane of the peripheral umbilical walls.

Fig. 2 Optical section in the plane of the primary apertures of final whorl.

Fig. 3 Fragment of specimen in umbilical view.

Optical section in the plane of the primary apertures. 710x.

Fig. 4 Specimen in umbilical view.

Optical section in the plane of the primary aperture but deeper than Fig. 2 (the embryonic chamber is already cut). 590x.

Plate 4

Asterotrochammina camposi BRÖNNIMANN, n.sp.

All from dredge sample PM-3-3, Campos shelf, about 15 m deep.

Fig. 1, 2 Same specimen in spiral view. 520x.

Fig. 3, 4 Same specimen in spiral view. 520x.

Fig. 1,3 Optical sections in the plane of the embryo.

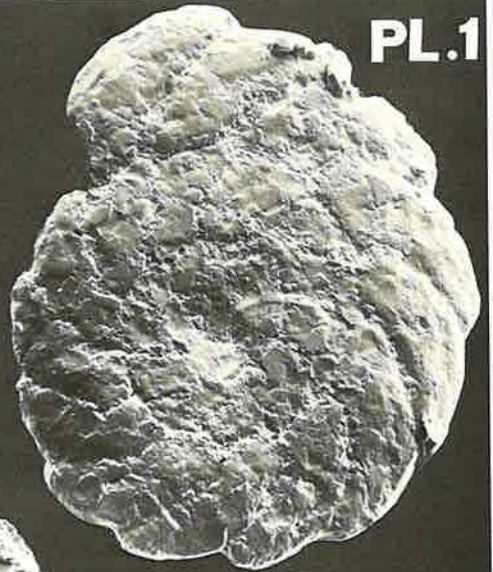
Fig. 2,4 Optical sections below the embryo across the axial depression showing the axially pointed tips of the chambers and the primary apertures of the final volution.



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4



5



6



7



9



8



10



11



1



2



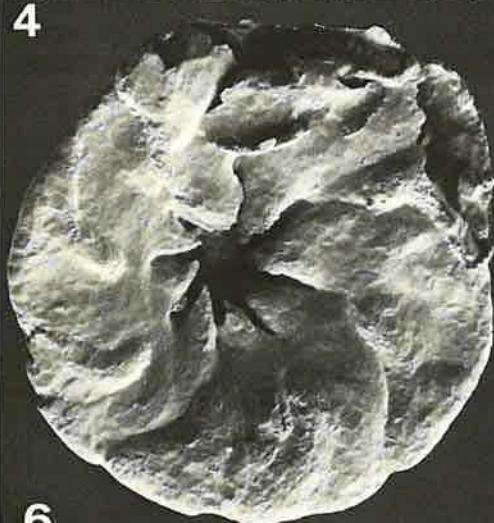
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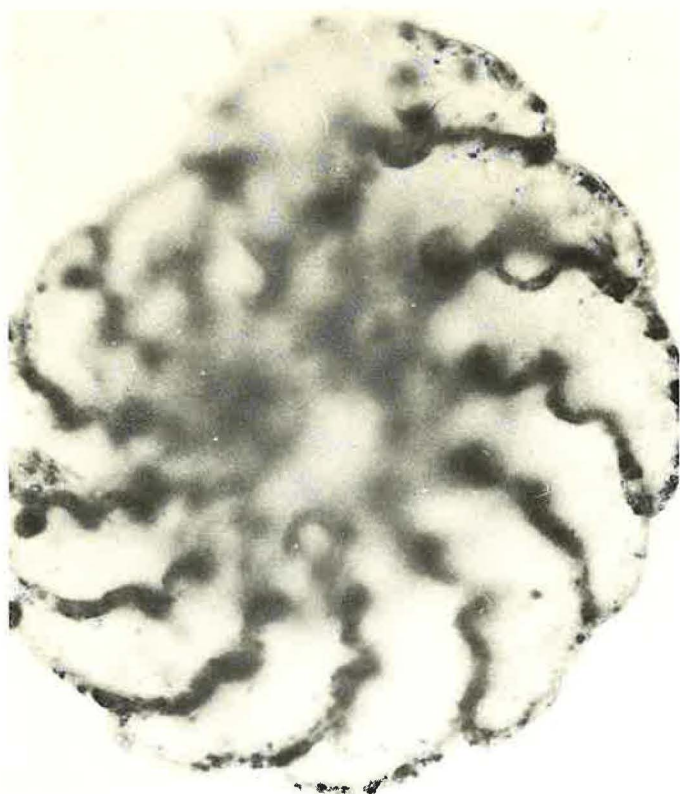
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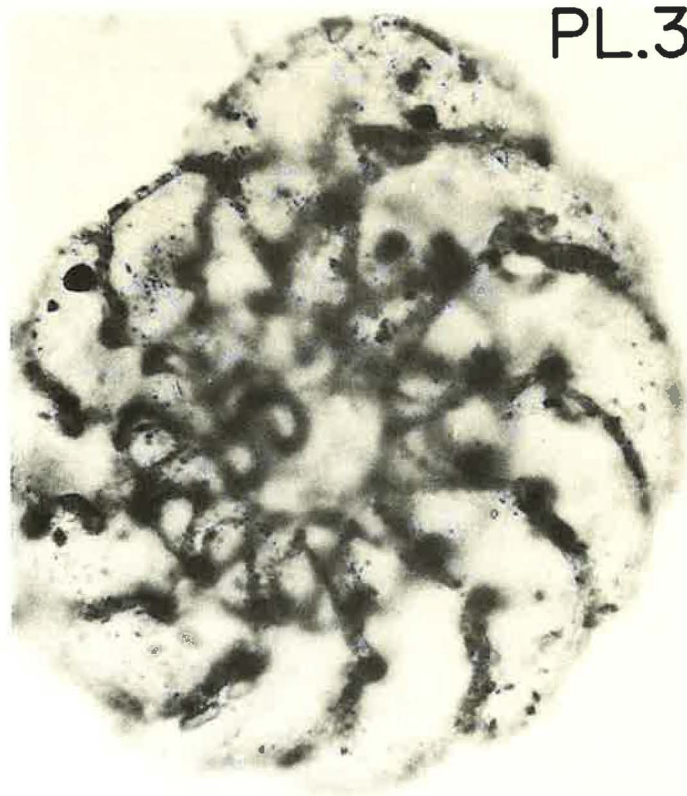
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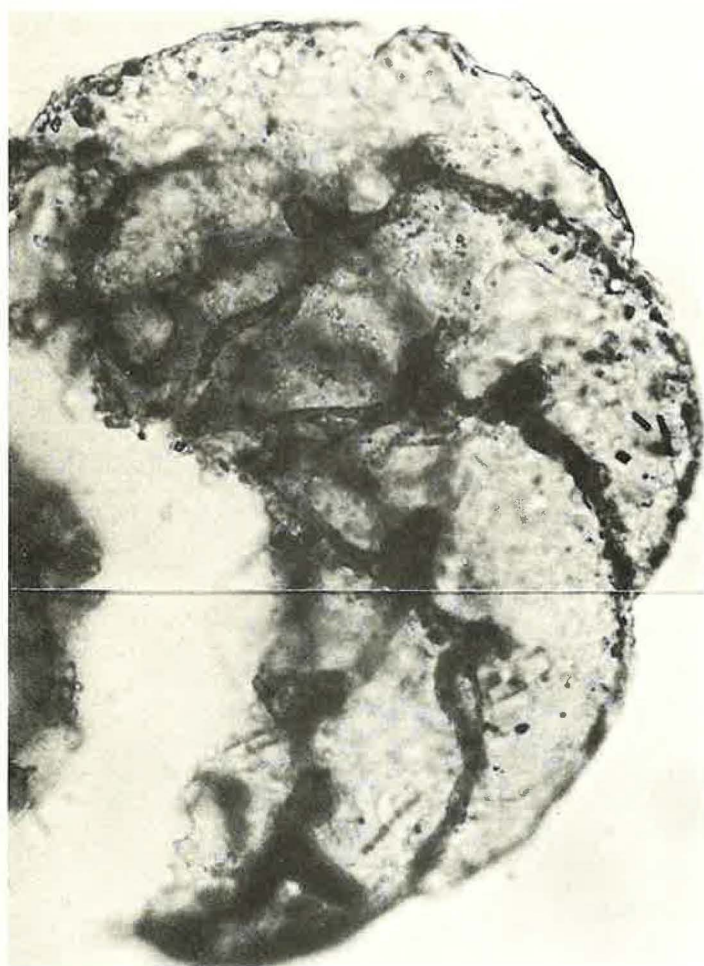
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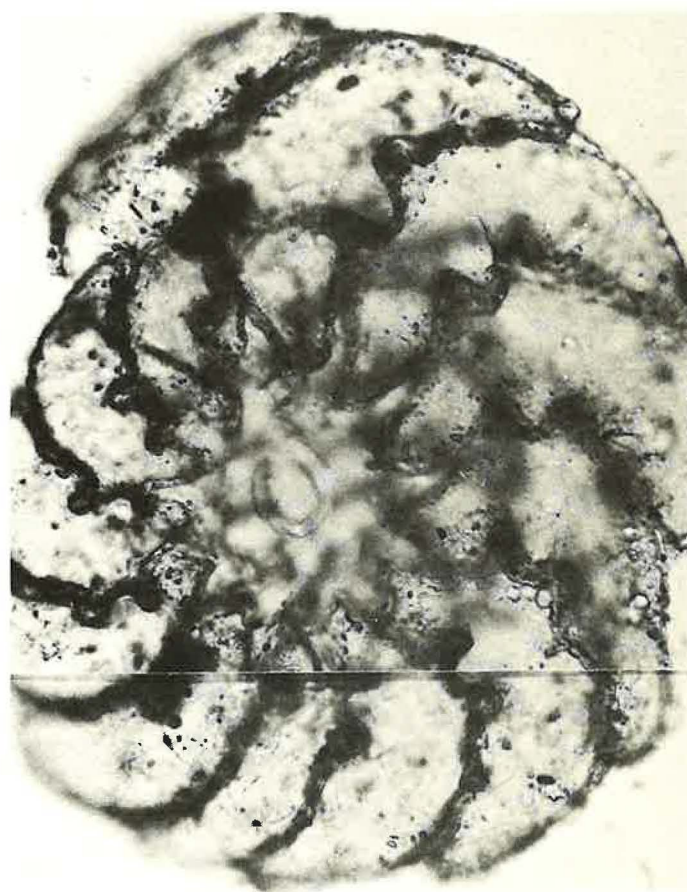
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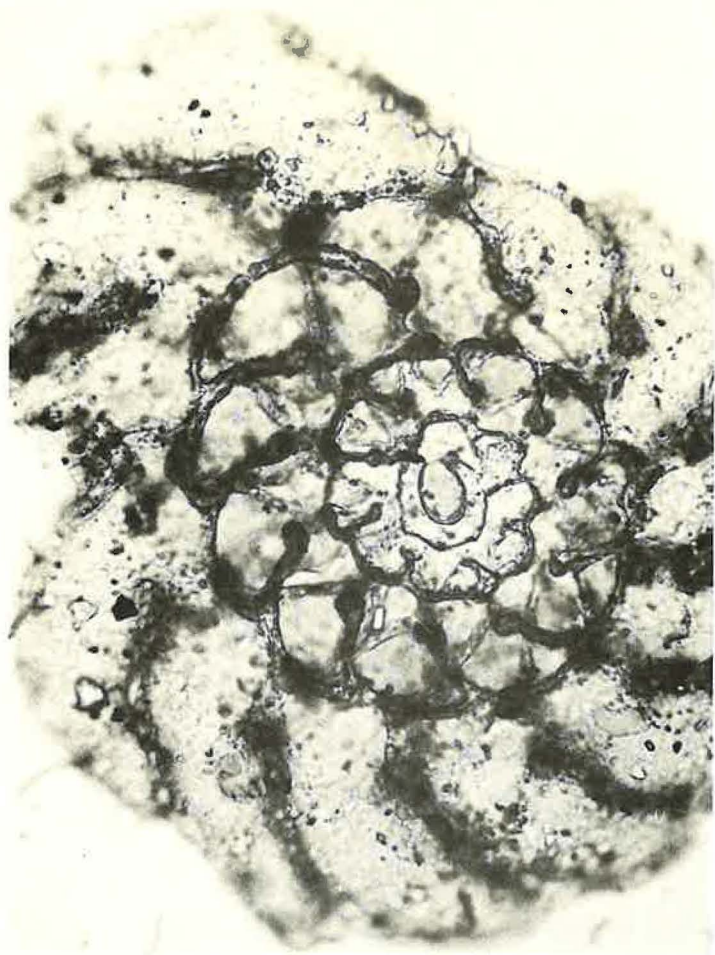
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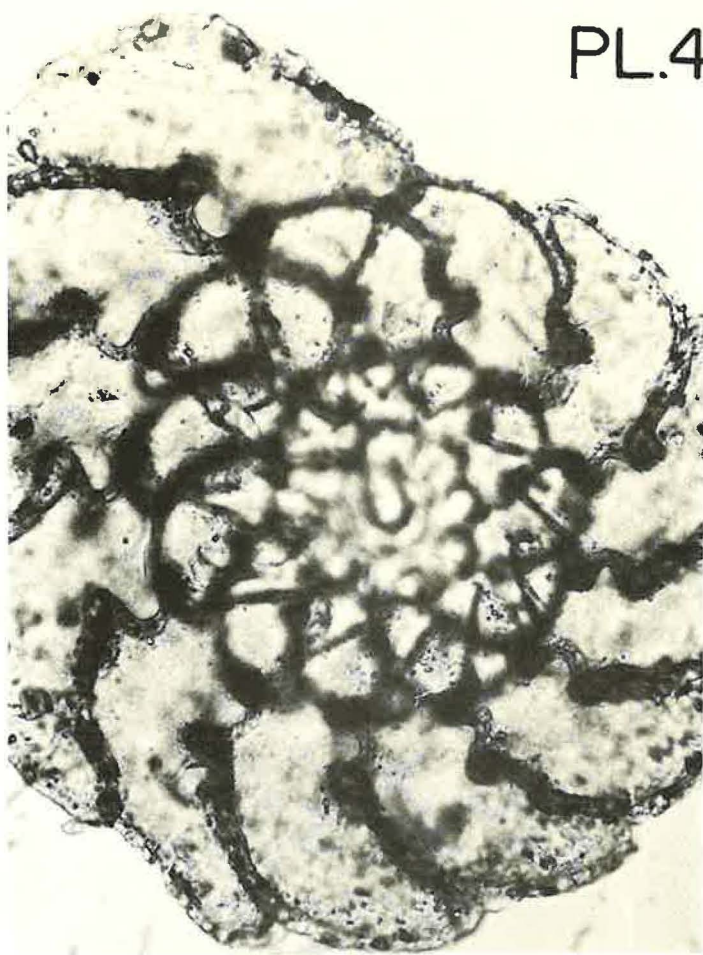
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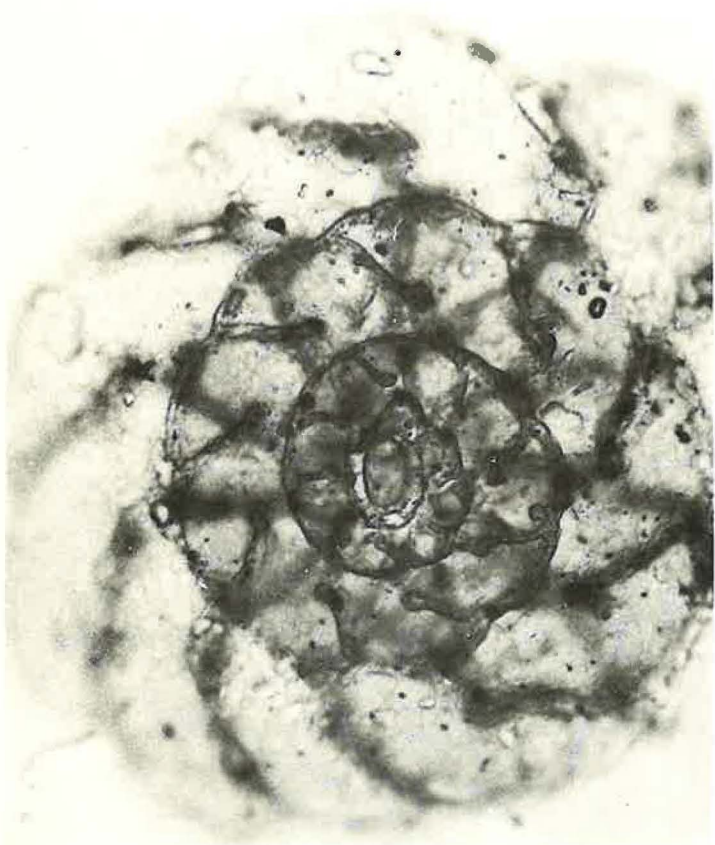
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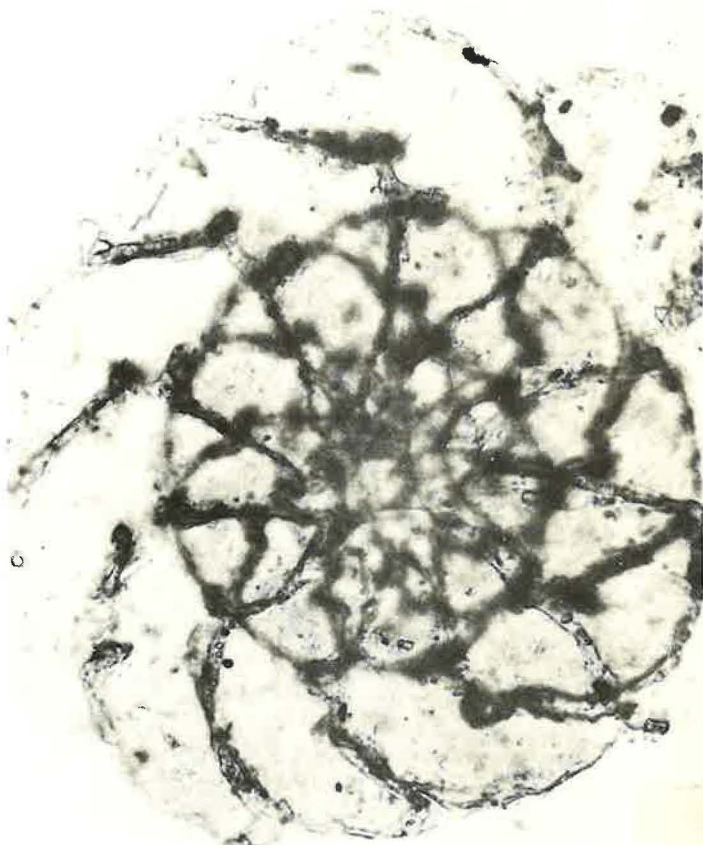
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