مقرر الحفريات الدقيقة

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مدرس المقرر

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Key for the description of ostracode

1- Orientation of the carapace

2- External surface features.

A- Lateral View

1- Outline ..

2- Overlap.

3- Maximum length & Maximum height.

4- Dorsal margin (Dorsum)

5- Cardinal angle .

6- Ventral margin

7- Anterior margin “end”.

8- Posterior margin “end”

9- Caudal process.

B- Dorsal View

1- Outline.

2- Maximum width “thickness”.

C- Ornamentation “Sculpture”

1- Ribs & Riblets.

2- Ridges.

3- Inflation.

4- Eye spot “eye tubercles”

5- Reticulation.

6- Muscle region. .

7- Sulcaation & Lobation.

8- Alate “Wings”

9- Punctation.

10- Denticles.

11- Nodes.

12- Tubercels.

13- Depression & Elevation.

14- Spines.

3- Internal Features.

1- Marginal zone.

2- Hinge.

a-Types of hinge

b-Bars

c- Crooves

d-Teeth

e- Sockets

3- Muscle scars.

4- Inner lamella & line of concrescence.

5- Vestibule.

6- Selvage.

SYSTEMATIC PALAEONTOLOGY

Subclass Ostracoda Latreille 1806

Order Podocopida Muller 1894

Suborder Olatycopina Sars 1866

Family Cytherellidae Sars 1866

Genus *Cytherella* Jones 1849

Type species : *Cytherina evata* Roemer 18400

1 – *Cytherella lagenalis* Marliere

pl. 1, figs. 1–2, 4–5

Description :External features :

Outline: in lateral view subrectangular with perfect symmetrically rounded end margins and almost parallel longitudinal margins.

Overlap: The larger right valve overlaps left valve all around, only slightly anteriorly, equally strong otherwise.

Surface slightly depressed behind anterior margin initiating a margin rim.

In dorsal view carapace wedge–shaped.

Maximum thickness slightly in fronts of posterior end at about four fifth of length in females or along the straight posterior outline in males.

2– Cyhterella piacabucuensis *NEUFVILLE*

pl. 1 figs. 7–12

Description :External features :

Outline in lateral view subrectangular with symmetrically rounded extremities and bluntly convex right dorsum, left dorsum concave just before the middle.

Overlap: The larger right valve overreaches left valve all around the margin, especially in the middle of dorsum.

Elevation: A dorsal depression in front of the middle divides the surface curvature into a flatter anterior and an inflated posterior part.

Ornamentation: Surface smooth or with an anterior marginal rim and ornamented by punctuations which leaves small subcentral area free. Carapace in dorsal view pear–shaped.

Maximum thickness behind the centre. Anterior rim, subcentral depression and overlap of right valve before the middle are clearly developed.

3 - *Cytherella* sp.1

pl. 1, figs. 3, 6

Description : External features :

Outline in lateral view subrectangular, end margins symmetrically rounded.

Dorsal margin: Dorsum of both valves angularly convex behind the middle, ventral margin straight. Anteriorly a weak rim is developed.

Overlap: The larger right valve outreaches the left valve all around the margin except for a narrow central posterior region.

Ornamentation: Surface punctation leaves the central two quarters almost free. In dorsal view the carapace has an oval outline.

The maximum thickness behind the centre.

Genus *Cytherelloidea* Alexander 1928

Type species : *Cytherella williamsoniana* Jones 1849

4 – *Cytherelloidea ghorabi* BASSIOUNI and LUGER 1990

pl. 1, fig. 13-14, 6

Description : External features :

Outline: subrectangular

Margin ;with symmetrically rounded anterior margin and almost straight, vertical posterior margin; longitudinal margins subparallel, converging slightly to the posterior, ventral margin concave, especially in the right valve.

Surface ornamentation consists mainly of strongly developed ribs and occasional depressions along them. The marginal rib is only developed anteriorly and posteriorly. The sigmoidal dorsal rib begins behind the anterior marginal rib at about one third of the length and branches at a thickness just before it joins the posterior marginal rib; the lower branch is weak and borders a dorsocentral depression ventrally. The middle rib just below valves mid-point, is well developed and occupies only the central part of the valve without reaching the marginal ribs.

5 – *Cytherelloidea rotundoornata* BASSIOUNI and LUGER 1990

pl. 1, figs. 17-18

Description : External features :

Outline :Carapace rectangular in lateral view

Margin: with symmetrically rounded anterior margin, subparallel longitudinal margins and slightly curved posterior margin.

Greatest height anteriorly.

Ornamentation consists of ribs and very fine punctation concentrated next to the ribs. Marginal rib better developed anteriorly, weaker dorsally, central rib joined to the marginal rib posterodorsally and posteroventrally by riblets, posterodorsal connection thickened. Occasionally the central rib is interrupted anteroventrally.

External features :

Muscle scars: The "feather-shaped" muscle scars are situated on a protuberance and consist of 5-6 pairs. The central rib and the posterodorsal thickening are internally marked by depression.

Suborder Podocopina Sars 1866

Superfamily Bairdiacea Sars 1866

Family Bairdiidae Sars 1866

Genus *Bairdia* Sars 1866

Type species : *Bairdia curtus* MC' coyn 1844

***6- Bairdia ilaroensis* REYMENT and REYMENT**

pl. 1, fig. 15

Description : External features :

Outline: Carapace large with typical Bairdioid outline, left valve oval, regularly rounded all over the margin.

Margin: with the anterior margin more broadly rounded than the posterior and the dorsal margin stronger convex than the ventral margin.In the smaller right valve the dorsal margin consists of three parts, bluntly to very smoothly joined to each other. The ventral part of the anterior margin and the upper part of the posterior margin are faintly concave. Some specimens show denticulation on the ventral half of anterior as well as posterior margin.

Overlap: Left valve overreaches right valve all around the margin except caudal process.

In dorsal view outline is oval with the maximum thickness just behind the centre, contact line slightly sigmoidal.

***18-Cytheroptern toshkaensis* BASSIOUNI and LUGER 1990**

pl. 7, figs. 10-12, 14-15.

Description : External features :

Outline: Small carapace in lateral view suboval.

Maximum length at mid height,

Maximum height at mid length.

Dorsal margin convex, gently sloping posteriorly.

Anterior margin broadly rounded, anteridisally slightly oblique.

Ventral margin straight in anterior and convex in posterior part, there rapidly converging to the posterior end.

Posterior margin narrowly rounded, caudal process only weakly developed. Alae gently curved backwards in anterior part, almost straight in posterior part and perpendicularly rejoining the carapace at about two thirds of length.

Ornamentation consists of a dorsal rib and surface pits. The dorsal rib is short, straight obliquely developed on the posterodorsal of valve; it begins immediately below the dorsal margin, shortly behind the middle and ends in front of the caudal process. Space in between dorsal ridge and dorsal margin covered by fine pore-pits. Surface pits are most strongly developed on the middle third of valve. Valve alae as well as the lateral surface sulcate, sulcus beginning more or less vertically at the lower third of carapace, reaching the border of ala, there almost rectangularity bent in posterior direction along the margin of ala. Carapace in dorsal view hexagonal with compressed, tapering ends, alae almost rectangularity set-off. Maximum width at posterior end of alae.

Genus *Eucytherua* Muller 1894

Type species : *Cythere complexa* Brady 1866

19 – *Eucytherura hassanieni* BASSIOUNI and LUGER 1990

pl 7, figs. 16-19

Description : External features :

Outline: Small, tumid carapace subquadrangular in lateral view with short caudal process.

Maximum length subdorsal,

Maximum height at well developed, anteriorly shifted, glassy eye-tubercle;

Maximum width along the ventrolaterally ridged truncation.

Anterior margin subtruncate, with oblique upper part, longitudinal margins subparallel, posterior margin narrowly rounded, with ocncave, short upper part and a steeply dipping, longer lower part, smoothly joined with ventral margin.

Ornamentation consists of a relatively coarse, strong reticulation with pentagonal and hexagonal reticules, fine, lamellar dorsal rib and a ventral ridge. The latter begins behind anterior margin, very small extension in front of posterior end; a short lamellar riblet below this ridge extends on ventral surface from anterior margin to centre pf carapace and

surrounds mouth region. Carapace in dorsal view oval, tumid, with very short, compressed extremities, maximum width just behind the middle.

External features :

Marginal zone rather broad with few marginal pore-canals.

Hinge in the right valve with strongly conical end teeth and a smooth furrow in between, left valve with end sockets, which are open internally. Muscle pattern not seen.

Sexual dimorphism : Clear assumed males longer and thinner than females.

20 – *Eucytherura* sp. 1

pl. 7, figs. 20-21

Description : Only one left and one right valve of this species are found in the present material.

External features :

Outline :The small quadrangular carapace has subdrosal compressed caudal process.

Anterior margin almost vertical anteroventrally, anterodorsally oblique.

Dorsal margin straight.

Ventral margin overreached by ventral rib.

Posterir margin narrowly rounded, with a concave upper part.

Ornamentation consists of reticulation, a double ventral ridge, riblets and a reticulate node a front of the posterior

Cardinal angle.

Reticulation polygonal, more or less arranged in vertical rows, leaving anteriorly a very narrow area and posteriorly the caudal process smooth. A marginal rib, running parallel to anterior margin a short distance behind, joins eye tubercle with ventral ridge. This ridge borders the carapace ventrolaterally and is paralleled laterally by another riblet, both extend from anterior margin to posterior carapace truncation and have the enclosed area reticulated, with a coarse, hexagonal reticule at the posterior end. A similar reticule borders the posterodorsal strong node, which is otherwise finely reticulate.

Internal features :

Hings of right valve consists of a crenulate furrow with elongated, Jobed end teeth; hinge of left valve complimentary.

Genus *Martinicythere* BASSIOUNI 1969d

Type species : *Martinicythere samalutensis* BASSIOUNI 1969d

25- Martinicythere praesamalutensis BASSIOUNI and LUGER 1990

pl. 9, figs. 3, 5-12

Description : External features :

Outlin: Medium-sized carapace in lateral view subrectangular.

Maximum length median,

Maximum height at eye tubercle.

Anterior margin broadly rounded.

Dorsal margin straight, weakly inclined posteriorly.

Ventral margin almost straight, weakly indented on right valve, gently rising posteriorly.

Posterior margin broadly rounded by the left valve, slightly concave above middle of height by the right valve, metting the dorsal margin almost rectangularity.

Ornamentation: Sculpture composed of strong concentric reticulation, few spines and differently developed ribs : ventral rib well developed sometimes slightly set-off and culminating in a spine pointing to the posterior; anterior marginal rib with about seven very small pore-cones; posterior marginal riblet carrying six to seven spines on its lower part; dorsal rib weak, carrying a row of about six small tubercles and ending ina more prominent spine pointing posteriorly. Subcentral tubercle prominent.

Eye-spot very prominent.

Outline in dorsal view suboval in males, subhexagonal in females.

26 – *Phalcocythere cultrata* (Apostolescu)

pl. 9, figs. 13-20

Description : **External features** : See Apostolescu (1961, p. 816).

Internal features : Hingement of right valve consists of a knob-like anterior tooth, a postjacent socket followed by an almost smooth groove and an elongated posterior tooth. Muscle scar pattern not observed.

Sexual dimorphism : Not very well developed, carapaces of males appear to be relatively longer and less high in lateral view than females and not as swollen in dorsal view.

26\ - *Phalcocythere ventrolamellata* BASSIOUNI and LUGER 1990

pl. 10, figs. 1-9

Description : **External features** :

Outline: carapace subrectangular in lateral view.

Maximum height at the well developed eye-tubercle at about one fourth of total length,

Maximum length central.

Anterior margin broadly rounded, with two rows of fine denticles, subangularly attached to the straight, posteriorly inclined dorsal margin. Ventrally the anterior margin merges in a sharp, lamellar rib which immediately curves around the mouth and smoothly joins posterior margin. This margin is broadly rounded in left valve, with a slight dorsal concavity in right valve; it is ornamented by six denticles, of which the uppermost is very fine and marks the posterodorsal angular corner. Eye-tubercle prominent. Anterior and posterior marginal ribs present. Surface ornament consists of concentrically arranged reticulation and two ridges, of which the dorsal is only marked through differently developed spines, arranged in a flat arch. Posterior end of this rib marked by a strong warty spine, situated in front of the posterodorsal corner. Ventrolateral ridge seldom lamellar, usually broken, fragmentary, ending in a strong spine at about three quarters of total length.

Reticulation concentrically arranged around the generally weakly developed muscle **********. Differently developed pore-conuli mark most of the cross points of reticule walls.

Overlap: valves of almost equal size, outline in dorsal view oval with compressed ends.

Internal features :

Marginal zone moderatly wide, line of concrescence and inner margin coincide.

Selvage well developed, almost marginal in the left and almost central in the right valve, here bordered exteriorly by a deep contact groove. Marginal pore canals simple and numerous, about 27 anteriorly and 12 posteriorly, reaching the mouth concavity. Hinge of right valve consisting of a high, knob-like posterior tooth.

Hinge of left valve complementary.

Sexual dimorphism : Present, assumed males little longer and narrower than females.

Family Loxoconchidae Sars 1925

Genus *Loxoconcha* Sars 1866

Typt species : *Cythere rhomboidea* Fischer 1855

27 – *Loxoconcha blanchenhorni* BASSIOUNI and LUGER 1990

pl. 10, figs. 10-11, 13-14

Description : **External features** : The rhomboidal, centrally inflated carapace has the maximum height slightly in front of centre.

Inflation: ventrally truncate.

Anterior margin builds a smooth arch which is anteroventrally gradually attached to straight ventral margin.

Posterior margin subtriangular with rounded apex above mid-height.

Eye tubercle: glassy.

Ornamentation:

punctuation coarse on the most inflated central part, finer to the extremities, with pits more or less parallel arranged to the outline.

Outline in dorsal view perfectly oval with depressed ends, maximum width central.

Internal features :

Marginal Zone: Equally wide anteriorly and posteriorly, less wide ventrally. Line of concrescence and inner margin separated along free margin, except along mouth concavity, vestibulum narrow. Radial pore canals straight, few, about 9 anteriorly and 6 poseriorly.

Selvage: Rather strong, subperipheral in right valve. Hinge typical for the genus.

Sexual dimorphism : Present, assumed males longer and thinner than females, consequently their dorsal margin is straight and punctuation rather elongate with tendency to be arranged in almost longitudinal rows. Maximum thickness in males behind centre.

28 – *Loxoconcha saharaensis* BASSIOUNI and LUGER 1990

pl. 10, figs. 12, 15-18

Description : External features :

Outline:Carapace of medium size, subrectangular,

maximum length immediately above central line,

maximum height almost constant along subparallel part of longitudinal margins.

Anterior margin obliquely rounded,

Dorsal margin slightly convex, obtusely attached to end margins.

Posterior margin rounded upwards, without building a clear caudal process.

Ventral margin straight, centrally overreached by the lateral inflation.

Eye-spots clear, glassy.

Ornamentation consists of reticulation, in females longitudinally arranged in upper half, in lower half slightly arched, finer to the extremities, leaving the marginal area almost smooth. In males reticulation in the centre is a coarse network without preferred orientation, becoming longitudinally arranged to the margins, especially posteriorly. In dorsal view the tumid carapace has an oval outline with the maximum thickness slightly behind the middle in females and in the posterior quarter in males.

Overlap :Valves of equal size.

Internal features : As for the genus.

Sexual dimorphism : Clear, assumed males are longer and lower than females (see also description).

29 – *Loxoconcha* sp 1

pl. 11 figs. 1–2, 4–5

Description : External features :

Outline in lateral view subrectangular with subparallel longitudinal margins and rounded end margins,

Maximum height at about one sixth of total length,

Maximum length above centre.

Anterior margin broadly rounded, becoming straight upwards, smoothly attached to the straight dorsal margin,

Ventral margin broadly rises rapidly to the rounded posterior end.

The lateral inflation overhangs the middle of ventral outline and is posteriorly rather truncate.

Eye–tubercle relatively small.

Ornamentation consists of reticulation and the ventrolateral side is acutely incurved, building a sharp posteroventral kell.

Reticulation builds a network with a tendency to concentrate around the ventral inflation.

Carapace in dorsal view ovoid with slightly compressed ends,maximum width in posteriorthird.

Internal features : Not accessible.

Sexual dimorphism : Assumed males longer and lower than females.

Genus *Nigeroloxoconcha* Reyment 1963

Type species : *Nigeroloxoconcha oniseguni* Reyment 1963

30 – *Nigeroloxoconcha aegyptiaca* BASSIOUNI and LUGER 1990

pl. 11, figs. 7–12

Description : External features :

Outline: Medium sized carapace in lateral view suboval, twice as long as high. \

Maximum length at medium height,

Maximum height at eye–spot at about on forth of length.

Anterior margin broadly rounded, slightly oblique in the upper half.

Dorsal margin straight or hardly arched.

Ventral margin straight on anterior half, convex and converging to posterior end on posterior half.

Posterior margin acutely rounded, slightly pointed.

Overlape Right valve faintly overhangs left valve along dorsal margin, left valve faintly oveerhangs right valve in posteroventral part of carapace. Carapace swelling culminates ventrally and is gradual anteriorly, rather set–off posteriorly.

Ornamentation of varying intensity on different specimens from different samples, consisting of fine to medium reticulation, strongly and coarsely developed on the median to medioventral part of valve.

Anterior and posterior marginal areas smooth.

Eye-spot larg, elongated, only faintly elevated. Carapace in dorsal view suboval with gently tapering ends, maximum width in front of the middle.

Internal features : Hinge simple, adont, with a long smooth bar in left valve and a groove in right valve, which is only slightly enlarged anteriorly. Selvage restricted to the posterior three quarters of ventral margin, submarginal. Muscle scars not seen. Inner margin and line of concrescence separate, vestibules reach almost the mouth atrium, marginal pore canals few, up to seven on each side of mouth incurvature are observed.

Genus *Paijenborchella* Kingma 1948

Type species : *Paijenborchella iocosta* Kinma 1948

36 – *Paijenborchella? Deserta* BASSIOUNI and LUGER 1990

pl. 13, figs. 1-6

Description : External features :

Outlin: Carapace small, subtriangular in lateral view.

Anterior margin broadly rounded,

Posterior margin acutely rounded with short caudal process.

Longitudinal margins converging posteriorly, dorsum straight, ventrum concave and slightly overeached by ventral inflation. Marginal areas slightly compressed.

Maximum length central,

Maximum height at about one fourth of length below eye-spot. Sulcus in front of the middle, weakening downward. The net-like reticulation is coarse at the middle, becoming finer to the margins. It is subconcentrically arranged anteriorly and in longitudinal rows posteriorly. Ornamentation Lateral surface truncate or slightly incurved ventrally, surface inflation accentuated posteroventrally, however, without forming a marked ridge. Carapace in dorsal view hexagonal, interrupted by sulcus; marginal areas equally compressed.

Internal features : Hardly accessible, only at a broken left valve the posterior part of a smooth median bar and the adjoining elongate socket can be observed.

Sexual dimorphism : Pronounced, the assumed males are longer and lower than the assumed females and are furthermore almost rectangular in outline.

37 – *Paraschizocythere hirsutonodosa* El-Sweify

pl. 13, figs. 7-11

Description : External features :

Outlin: Carapace small, rectangular in lateral view.

Maximum length central,

Maximum height at eye-tubercle behind the anterior quarter.

Triangular posterior margin symmetrically bent, joining angularly dorsal margin and smoothly ventral margin.

The lateral margins are outreached by dorsal and ventral ridges respectively.

Anterior margin broadly rounded, tending to be oblique anteriodorsally.

Ornamentation consists mainly of pore-cones on an irregularly reticulate background, a ventral rib and short riblets. Most prominent is the pore-cone in front of posterior cardinal angle and the cone marking the end of ventral rib. Both cones are strengthened by short riblets. The carapace is slightly sulcate between the strongly developed eye-tubercle and the posterior cone, with scattered small pore-cones in between; otherwise, differently develop pore-cones are irregularly distributed on surface. Ventral ridge begins at anterior margin above the anteroventral arch, dips posteriorly to overreach ventral margin below eye-tubercle in left valve and the margin centre in right valve, then becomes straight and horizontal until it reaches the above mentioned posteroventral pore-cone. A short marginal riblet begins in front of eye-tubercle and fades out before reaching a horizontal, short central riblet. Reticulation on left valve differs slightly from that of right valve. In dorsal view the rugged outline has a general oval shape with the maximum width at the posterior third of carapace.

Internal features : Marginal zone moderately broad, narrow vestibulum developed antero- and posteroventrally. Subperipheral selvage well developed. Hinge amphidont/schizodont, in right valve with stepped anterior tooth, in which the proximal part is weakly subdivided, adjacent socket posteriorly open, followed by a crenulated groove and elongated crenulated posterior tooth. Muscle scars not seen.

Sexual dimorphism : Males longer and lower than females.

38 – *Paraschizocythere bifaciefera* BASSIOUNI and LUGER 1990

pl. 13, figs. 12-18

Description :External features :

Outline: Small carapace pear-shaped in lateral view with a remarkably tapering posteerior half.

Maximum length slightly centre, maximum height behind the eye-tubercle at about one third of length. The upward oblique anterior margin is ventrally rounded and smoothly joined to the ventral margin. This margin is straight and horizontal anteriorly, stepped in the middle, and converges steeply to the narrowly rounded, upward slightly concave posterior margin.

Dorsal margin straight, obtusely fused to end margins.

Overlap: left valve outreaches right valve very weakly posterodorsally, otherwise, both valves of equal size.

Ornamentation on right and left valve only slightly different. It consists of a rough reticulation and irregular ribs.

Reticulation fine in front of a row of posteriorly steeply dipping reticule-walls, which are straight and aligned in right and wavy and vague on left valve, joining the rounded, flat eye-tubercle and the ventral rib above mouth region. Posterior to this line the reticulation is coarse, with the reticule walls unevenly developed, giving the reticulation a rough appearance. The caudal process is marked by a hexagonal, coarse reticule. Dorsal rib sinous, therefore, only occasionally outreaching dorsal margin, beginning at eye-tubercle and ending ahead of the posterodorsal corner. Middle rib is oblique, also sinous, beginning at anterior margin below its centre and ending in the reticulation slightly behind the muscle region. This is differently reticulated onn both valves. Ventral rib beings anteroventrally, is slightly projecting and arched, behind the centre it rises abruptly, sending a pointed protrusion and ending below centre on posterior margin. In dorsal view the six-sided compressed carapace has an irregular outline, with the top area, between the extremities of dorsal ribs, almost smooth.

Internal features : Marginal zone broad, with a subpripheral strong selvage in the left valve. Line of concrescence and inner margin almost coinciding, except anteroventrally. Marginal pore-canals of moderate number, straight, simple, about 12 anteriorly (some are false), concentrated anterventrally, posteriorly 6.

Hinge strong, amphidont/schizodont, in right valve with the anterior tooth stepped, its proximal conical part is very weakly divided by a very faint furrow. The middle furrow is weakly denticulate with a very flat socket anteriorly, the posterior tooth oval and subdivided. Hinge of left valve complimentary. Muscle region not clear.

Sexual dimorphism : Clear, assumed males longer than assumed females.

Subfamily Trachyleberidinae SYLVESTER-BRADLEY 1948

Genus Trachyleberis BRADY 1898

TYPE species : *Cythere scabrocuneata* BRADY 1880

39 – *Trachyleberis gagaensis* BASSIOUNI and LUGER 1990

pl. 14, figs. 5, 9-14

Description : External features :

Outline: Carapace in lateral view subrectangular.

Anterior margin broadly rounded.

Posterior margin bluntly triangular with centrally situated apex, in right valve slightly concave in its upper slope and pointed.

Longitudinal margins sloping posteriorly. Ventral margin centrally overreached by the ventrolateral carapace inflation. Eye tubercle present, ventrally supported by a short riblet. Anterior and posterior margin denticulate, especially ventrally, where a double row of tubercle is developed, anteriorly small and numerous, posteriorly strong and few. Marginal rim accentuated by a bordering depression anteriorly and posteriorly. Muscle node warty. Ornamentation: Surface especially behind muscle node covered by nodes, which are mostly connected by fine riblets as a part of weak reticulation. A ventral rib is marked by four aligned nodes. Reticulation is vague towards the extremities.

Carapace in dorsal view oval with compressed marginal areas, maximum width at about two thirds of total length.

Internal features : Marginal zone broad, inner margin and line of concrescence coincide. Marginal pore canals straight, numerous. Selvage moderately deveeloped, peripheral, anteriorly attached to the distal step of anterior tooth.

Hinge and muscle scars as for the genus.

Sexual dimorphism : Present, assumed males longer and thinner than females.

Genus *aegyptiana* BOUKHARY, DAMOTTE and MOHAMED 1982

Type species : *Aegyptiana abutarturensis* BOUKHARY, DAMOTTE and MOHAMED 1982

***40- Aegyptiana anguloreeticulata* BASSIOUNI and LUGER 1990**

pl. 15, figs. 10-17

Description : External features :

Outline :Carapace of medium size, in lateral view sub- rectangular.

maximum height at moderately developed eye-spot at about one fourth of length.

Anterior margin broadly rounded, slightly oblique poseterodorsaly.

Dorsal margin weakly arched, weakly sloping posteriorly.

Ventral margin very slightly concave in mouth region, gently joining posterior margin.

Posterior margin rounded and meeting dorsal margin in an obtuse angle.

Ornamentation consists of angular to subangular reticulation. Angular area behind the eye-tubercle is also reticulate.

Reticulation more or less concentrically arranged parallel to the margins. Subcentral tubercle only hardly marked through weaker reticulation. Anterior and posterior margins with small cones on their lower thirds. Carapace in dorsal view almost oval.

maximum width behind the middle, inflation reaching end margins gradually.

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تحت طائفة الاستراكودا

تعتبر الحفريات الدقيقة التى تنتمى الى تحت طائفة الاستراكودا هامة فى تاريخ الطبقات ومضاهاتها ولا يتفوقها فى الاهمية من مجموعات الحفريات الدقيقة (Microfossils) إلا رتبة الفورامينفرا . فهذه الحفريات نظراً لدقة اصدافها توجد كاملة وفى اعداد كبيرة فى المقطوعات (Cuttings) و الجسات (Cores) المستخرجة من الآبار التى تدق للبحث عن البترول او المعادن الأخرى.

والاستراكودا واسعة الانتشار ؛ تعرف من الكامبرى حتى الحديث . والكثير من انواعها ذو امتداد زمنى محدود . وتستعمل حفريات الاستراكودا فى تأريخ وتقسيم جميع الطبقات وخاصة فى تعيين البيئات القديمة التى ترسب فيها الصخور .

ويتراوح طول الاستراكودا من 0,5 مم الى 1 سم وإن كان معظمها لا يزيد طوله 2 سم .

وتعيش الاستراكودا فى الماء المالح او النصف مالح والعذب ومنها ما هو قاعى فى معيشته و منها هائم , وتعرف معظم الاستراكودا القاعية من البيئات الساحلية الضحلة .

ويتميز الاستراكودا بأن له صدفة كيتينية جيرية ذات مصراعين . وينمو الحيوان كما فى بقية المصليات بواسطة الانسلاخ (Ecdysis) , اذ يلفظ الحيوان صدفته فى فترات معينة ثم ينمو سريعاً وهو عار تماماً ثم يبدأ فى بناء صدفة جديدة أكبر من الاولى التى لفظها. ولذلك توجد اصداف الانسلاخ (Instard) الصغيرة لأى نوع من الاصداف الكاملة النمو لهذا النوع فى الرواسب القديمة . وفى العادة تختلف اصداف إناث الاستراكودا عن ذكورها فى الحجم .

وتحتوى الصدفة على حيوان حلقى قشرى له سبعة ازواج من الزوائد قرون الاستشعار الذين تحولا لكى ستعملا فى العوم والحركة .

وللاستراكودا عيون هى فى الانواع الحديثة بداخل الصدفة ولكن فى بعض اصداف الاستراكودا القديمة التى تعرف فى الحقب الباليوزوى تترك العين أثراً (eyespot) على خارج الصدفة.

ويولى مصرعاً الاستراكودا الى يمين ويسار . وهذان المصرعان يرتبطان بواسطة عضلات ضامة عرضية (Transvers adductors) .

وتترك هذه العضلات على باطن الصدفة آثاراً مميزة ذات اهمية تصنيفية كبيرة . ويخترق مصراع الاستراكودا عدد من الثقوب تعرف بالقنوات العمودية (Pore caoals) كما يخترقه أيضاً بعض القنوات الضماعية (Radial canals) تمتد طولياً أو شعاعياً كحزوز ناحية الجزء البطنى للمصراع .

وتتركب الصدفة من طبقتين واحدة خارجية سميكة كيتينية ومقواة بحبات من الجير وهذا الجزء فى الطبقة هو فى الحفريات وتسمى الحافة الحرة من هذا الجزء بالحافة الخارجية (outer margin or flang) اما الحافة الداخلية الاخرى فتسمى بالحافة الداخلية (Inner

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2 (margin or duplicture اما الخط الذى تتحد فيه الطبقتان فيسمى بخط الالتحام (line of concrescence) .ومن اهم مميزات صدفة الاستراكودا المفصلة (hinge) التى يعيش حولها المصراعان وهناك ثلاثة انواع اساسية للتعشيق (شكل 163).

1- نوع يتم فيه التعشيق بدون اسنان وفجوات وإنما بواسطة تركيب طويل ينمو من احد المصراعين مغلفاً الجزء الظهرى للمصراع المقابل او داخلاً فيه كما فى عائلات (cytherellidiidae) .

2- نوع يتم فيه التعشيق بواسطة اسنان وفجوات كما فى عدد من اجناس العائلة (cytheridae).

3- نوع مختلط يتم فيه التعشيق بواسطة ركوب او دخول مصراع فى الآخر مع وجود اسنان او وجود فجوات كما فى اجناس آخرى من عائلة (cytheridae).

الزخرفة :

يكون مصراع الاستراكودا مزخرفاً فى العادة وإن كان بعضها أملساً وتختلف الزخرفة من نوع الى اخر وقد تكون فى شكل طيات وانخفاضات كبيرة قد تقسم المصراع الى فصوص (lobes) او قد تكون فى شكل نقوش دقيقة موزعة على كل مصراع . ويمكن تقسيم انواع النقوش الى ما يأتى : (شكل 164) .

4- الفصوص : وهى تظهر على بعض الاصداف نتيجة وجود طية كبيرة تمتد من الجانب الظهرى الى الجانب البطنى فى منتصف المصراع وهى تقابل المنخفض (sulcus) الذى تلتصق عليه العضلات . وهناك بعض الانواع التى قد تنقسم اصدافها الى عدد اكبر من الفصوص عن طريق وجود اكثر من طية واحدة.

5- الجيوب (pouche) : وهذه ارتفاعات بيضاوية او نصف كروية توجد عادة على صدفة الانثى فى ناحيتها البطنية ويظن انها كانت تحمل الصغير قبل ان يترك الام .

6- الاجنحة (Alae) : وهى تركيبات طويلة فى الناحية الخلفية البطنية لعدد كبير من الاجناس البالوزوية والميزوزوية.

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7- الاحزمة (carinae) : وهى احزمة تدور حول الحافة البطنية لكل مصراع وقد تكون مشرشرة (crenulate) او مسننة .

8- الاشولك والعقد (spines and nodes) : وتعرف فى عدد من الاصداف الباليوزوية .

9- النقوش والزخارف العامة التى تحدد شكل الصدفة العام وفيها يكون المصراع املساً او مثقباً (punctuate) او شبكياً (reticulate) او غير ذلك .

تولية الصدفة :

تولية الصدفة عملية اساسية لحسن وصف النوع ويمكن إتخاذ الادلة الآتية لمعرفة الأمام والخلف للمصراعين الايمن والايسر (شكل 165) :

1- الصدفة ذات الشكل الانسيابى : فإذا كان للصدفة ناحية مدببة عند النظر إليها جانبياً فهذه الناحية خلفية إذا كان لها اجنحة فناحيتها المدببة ، عند النظر إليها من الناحية الظهرية أمامية وإذا كانت لها اشواك او بروزات زخرفية اخرى فإنها فى العادة تتجه الى الخلف .

2- إذا نظر الى الصدفة من ناحيتها الظهرية فإن جزئها العريض يعتبر خلفياً.

3- عندما يكون هناك إختلاف فى توزيع الزخارف والنقوش على الصدفة ففى العادة يكون الجزء قليل النقوش امامياً

MANUAL

OF

PLANKTONIC FORAMINIFERA

BY

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Royal Dutch/Shell Group, The Hague, The Netherlands

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CONTENTS

PREFACE

The use of planktonic Foraminifera as guide fossils is generally accepted today. Their abundance in open marine environments, and the short stratigraphic ranges of many species, make this group of Foraminifera one of the most suitable and reliable tools for detailed biostratigraphic investigations. The planktonic Foraminifera, of practical use in biostratigraphy, first occur during the Early Cretaceous. They continue on a world-wide scale, and in a rapid succession of species, to the Recent.

During the last twenty years an ever-increasing flow of publications has appeared on this subject. Among the great number of new species and subspecies described, many proved to be useful guide fossils, others turned out to be synonyms and many cannot be recognized by other workers in this field. A number of varying classifications on the supra-specific level have also been proposed in recent years. This demonstrates that there still is disagreement on the genetic and phylogenetic relations of the planktonic Foraminifera. Furthermore, authors in general do not hold the same views on the definitions of species. Such diverse treatment of this stratigraphically important group of Foraminifera is bound to lead to considerable confusion. As a result, it has become almost impossible for the industrial palaeontologist to judge all published data on their merits, a task which, in addition, is not rendered any easier by their being distributed over a large and scattered number of publications. In 1960, it was decided to compile a manual that would provide a selection of clearly defined species to enable the operational palaeontologists of the Royal Dutch/Shell Group to make effective use of planktonic Foraminifera in obtaining more precise and uniform stratigraphic results. A growing interest in this manual outside the Group induced the Bataafse Internationale Petroleum Maatschappij N.V. to give permission for the publication of this work.

It should be mentioned that no particular published classification of genera has been followed here. Many classifications have been published and in view of the new vistas opened by the scanning electron microscope we may certainly expect the introduction of others in the near future. However, the principles put forward in the outstanding publications of Bolli, Loeblich and Tappan (1957) and Banner and Blow (1959) have been largely adopted. The use of subspecific names has been abandoned in order to improve communication between palaeontologist and geologist. In principle, the idea behind this work was to enable the user to arrive at a quick and reliable age determination of his planktonic faunas. Therefore, the complex family Heterohelicidae, for example, is not included in this manual, nor are species of uncertain stratigraphic range or those which are difficult to recognize.

Special attention has been paid to the illustrations of the species. Planktonic Foraminifera are often abundant in carbonate rocks, where they can only be studied in thin section. For this reason, a figure of an axial section of each species has been provided. In addition, thin sections of hard rocks showing typical planktonic assemblages have been included where it is thought they would be useful.

It should be realized that the distribution of planktonic Foraminifera is controlled by several factors, one of the most important of which is the climatic influence. The foraminiferal zonation, consisting of 48 zones, proposed in this manual is only valid for tropical and sub-tropical environments. This restriction is most strongly manifested

in the Upper Miocene–Recent interval, during which time the tropical and sub-tropical belt contracted.

The writer thanks the Management of the Bataafse Internationale Petroleum Maatschappij N.V. (Royal Dutch/Shell Group), for permission to publish this manual. He is indebted to Dr. C. W. Wagner, the originator of the project. Many thanks are due to Prof. Dr. H. M. Bolli, who has given valuable advice and assistance with the preparation of the original B.I.P.M. manual between the years 1960–1966. The writer is particularly grateful to Mr. W. Geluk, who made all the photographs and to Mr. M. van Dugteren whose excellent drawings are such an important contribution to this work. Mrs. Th. M. Jansen and Mrs. A. M. Anjema should be mentioned for their skill and patience during the preparation of thin sections of isolated planktonic specimens. Finally the writer wishes to express his thanks to Miss W. Mostert who typed the manuscript.

The Hague, March 1971

KEY TO THE MESOZOIC GENERA

I Test trochospiral

A Primary aperture umbilical, with tegilla
- 1 with keel(s) — *Globotruncana* CUSHMAN, 1927
- 2 without keel(s) — *Rugoglobigerina* BRONNIMANN, 1952

B Primary aperture extraumbilical-umbilical, with sutural supplementary apertures
- 1 with keel — *Rotalipora* BROTZEN, 1942
- 2 without keel — *Ticinella* REICHEL, 1950

C Primary aperture extraumbilical-umbilical, bordered by a narrow lip or spatulate flap
- 1 with keel — *Praeglobotruncana* BERMUDEZ, 1952
- 2 without keel
  - a. chambers globular to ovate — *Hedbergella* BRONNIMANN and BROWN, 1958
  - b. later chambers clavate to radial-elongate — *Clavihedbergella* BANNER and BLOW, 1959

II Test in early portion trochospiral, later stage planispiral
Aperture extraumbilical, tending to become equatorial

1 chambers elongated, with a hollow bulb-shaped or spine-like extension in the equatorial plane — *Schackoina* THALMANN, 1932

2 chambers elongated; some or all chambers of the last whorl with two, or occasionally more, hollow bulb-shaped extensions on each side of the equatorial plane — *Leupoldina* BOLLI, 1957

III Test planispiral

Primary aperture equatorial bordered by a lip, with relict apertures
- 1 with keel — *Planomalina* LOEBLICH and TAPPAN, 1946
- 2 without keel
  - a. chambers subglobular to ovate — *Globigerinelloides* CUSHMAN and TEN DAM, 1948
  - b. chambers radial-elongate — *Hastigerinoides* BRONNIMANN, 1952

DESCRIPTIONS OF THE MESOZOIC GENERA

Genus *Clavihedbergella* BANNER and BLOW, 1959

Reference BANNER, F. T. and BLOW, W. H., 1959: The classification and stratigraphical distribution of the Globigerinaceae. — Palaeontology, 2 (1):18.

Type species *Hastigerinella subcretacea* TAPPAN, 1943.

Diagnosis Test low trochospiral, biconvex, umbilicate; periphery rounded and deeply lobulate, no keel or poreless margin.
Wall finely perforate, surface smooth to hispid.
Chambers of the first whorls globular to ovate, chambers of the last whorl clavate to radial-elongate.
Sutures radial, straight to curved.
Aperture an interiomarginal, extraumbilical-umbilical arch, with a narrow bordering lip or spatulate flap.

Remarks *Clavihedbergella* has been proposed by BANNER and BLOW (1959) as a subgenus of *Praeglobotruncana*; it is here raised to generic status.

Genus *Globigerinelloides* CUSHMAN and TEN DAM, 1948

Reference CUSHMAN, J. A. and TEN DAM, A., 1948: *Globigerinelloides*, a new genus of the Globigerinidae. — Contr. Cushman Lab. Foram. Res., 24:42.

Synonymy *Biglobigerinella* LALICKER, 1948: Journ. Paleontol., 22:624.
Bitheinella SIGAL, 1956: Soc. Géol. France, C. R. Somm., 3:35.

Type species *Globigerinelloides algeriana* CUSHMAN and TEN DAM, 1948.

Diagnosis Test planispiral, biumbilicate, involute to partly evolute; lobulate in outline, with no indication of keel or poreless margin.
Wall perforate, surface smooth or roughened.
Chambers rounded to ovoid, may be somewhat elongated in specimens tending to become evolute.
Sutures depressed, straight to curved or sigmoid.
Primary aperture an interiomarginal equatorial, broad, low arch bordered by a prominent lip, with lateral umbilical portions of successive apertures remaining open as supplementary relict apertures, each with a remnant of the bordering lip.

Genus *Globotruncana* CUSHMAN, 1927

Reference CUSHMAN, J. A., 1927: An outline of a re-classification of the Foraminifera. — Contr. Cushman Lab. Foram. Res., 3 (1):91.

Synonymy *Rosalinella* MARIE, 1941: Mém. Mus. Hist. Nat. Paris, n. ser., 12:237.
Bucherina BRONNIMANN and BROWN, 1956: Eclog. Geol. Helvetiae, 48 (2-1955):557.
Rugotruncana BRONNIMANN and BROWN, 1956: Eclog. Geol. Helvetiae, 48 (2-1955):546.
Marginotruncana HOFKER, 1956: Neues Jahrb. Geol. Paläontol., Abh., 103 (3):319.
Abathomphalus BOLLI, LOEBLICH and TAPPAN, 1957: Bull. U.S. Nat. Mus., 215:43.
Globotruncanita REISS, 1957: Contr. Cushman Found. Foram. Res., 8 (4):136.
Helvetoglobotruncana REISS, 1957: Contr. Cushman Found. Foram. Res., 8 (4):137.

Type species *Pulvinulina arca* CUSHMAN, 1926.

Diagnosis Test trochospiral, biconvex, spiroconvex or umbilicoconvex; wide umbilicus; periphery rounded to angular with a single keel, or truncate with a double keel; keels may be beaded.
Wall perforate, surface smooth, rugose or beaded.
Chambers ovate, hemispherical, angular-rhomboid or angular-truncate.
Sutures on both the spiral and umbilical side curved or radial, depressed or elevated; they may be limbate and beaded.
Primary aperture interiomarginal, umbilical, covered by extensions from the chambers (tegilla), which form an imperforate complex umbilical cover plate with accessory infralaminal and intralaminal apertures.

Genus *Hastigerinoides* BRONNIMANN, 1952

Reference BRONNIMANN, P., 1952: Globigerinidae from the Upper Cretaceous (Cenomanian-Maestrichtian) of Trinidad, B.W.I. — Bulletin of American Paleontology, 34 (140):52.

Synonymy *Eohastigerinella* MOROZOVA, 1957: Dokl. Acad. Sci. U.R.S.S., 114:1109.

Type species *Hastigerinella alexanderi* CUSHMAN, 1931.

Diagnosis Test planispiral, biumbilicate, stellate in appearance.
Wall perforate, surface smooth, pitted or finely hispid.
Chambers in early stage globular, later chambers radial-elongate, much produced, tapering or clavate.
Sutures radial, depressed.
Primary aperture an interiomarginal, equatorial arch, bordered above by a prominent lip; the lateral umbilical portions of successive apertures may remain open as supplementary relict apertures, each with a remnant of the bordering lip.

Genus *Hedbergella* BRONNIMANN and BROWN, 1958

Reference BRONNIMANN, P. and BROWN, N. K., 1958: *Hedbergella*, a new name for a Cretaceous planktonic Foraminiferal genus. — Journal of the Washington Academy of Sciences, 48 (1):15-17.

Synonymy *Hedbergina* BRONNIMANN and BROWN, 1955: Eclogae Geologicae Helvetiae, 48 (2):529.

Type species *Anomalina lorneiana* D'ORBIGNY var. *trocoidea* GANDOLFI, 1942.

Diagnosis Test trochospiral, biconvex, umbilicate; periphery rounded, with no indication of keel or poreless margin.
Wall finely perforate, surface smooth to hispid or rugose.
Chambers globular to ovate.
Sutures depressed, radial, straight to curved.
Aperture interiomarginal, an extraumbilical-umbilical arch bordered above by a narrow lip or spatulate flap; in forms with a broad open umbilicus the successive apertural flaps may remain visible, presenting a serrate or scalloped border around the umbilicus.

Genus *Leupoldina* BOLLI, 1957

Reference BOLLI, H. M., 1957: The Foraminiferal Genera *Schackoina* THALMANN, emended and *Leupoldina*, n. gen. in the Cretaceous of Trinidad, B.W.I. — Eclogae Geologicae Helvetiae, 50 (2):275.

Type species *Leupoldina protuberans* BOLLI, 1957.

Diagnosis Test in the early stage slightly trochospiral, later planispiral.
Wall perforate, smooth, pitted or hispid.
Chambers in the early part globular to subglobular, in the last whorl elongate; some or all chambers of the last whorl have two or occasionally more tubulospines with bulb-shaped extensions (mostly broken off), symmetrically arranged on each side of the equatorial plane.
Sutures radial, depressed.
Aperture an interiomarginal, equatorial arch in the early stage; ultimate chamber with two interiomarginal, umbilical apertures, one on each side of the chamber.

Genus *Planomalina* LOEBLICH and TAPPAN, 1946

Reference LOEBLICH, A. R. and TAPPAN, H., 1946: New Washita Foraminifera. — Journal of Paleontology, 20 (3):257.

Type species *Planulina buxtorfi* GANDOLFI, 1942.

Diagnosis Test planispiral; biumbilicate, involute to partly evolute, lobulate in outline with a distinct keel.
Wall finely perforate, surface smooth.
Chambers angular-rhomboid.
Sutures curved, elevated, beaded in the first part of the last whorl.
Primary aperture an interiomarginal, equatorial arch bordered by a distinct lip, with the opening extending back at either side to the septum at the base of the chamber, the lateral umbilical portions of successive apertures remaining open as supplementary relict apertures, each with a remnant of the bordering lip.

Genus *Praeglobotruncana* BERMUDEZ, 1952

Reference BERMUDEZ, P. J., 1952: Estudio sistematico de los Foraminiferos rotaliformes. — Venezuela, Minist. Minas Hidrocarb., Bol. Geol., 2 (4):52.

Synonymy *Rotundina* SUBBOTINA, 1953: Trudy Vses. Neft. Naukno-Issledov. Geol. — Razved. Inst., n. ser., 76:165.
Globotruncanella REISS, 1957: Contr. Cushman Found. Foram. Res., 8 (4):135.

Type species *Globorotalia delrioensis* PLUMMER, 1931.

Diagnosis Test trochospiral, biconvex to spiroconvex, umbilicate; periphery rounded to subangular, with a moderate keel in the early stages, commonly progressively less prominent in the later development. This keel may be beaded.
Wall finely perforate, surface smooth to hispid or partly nodose.
Chambers ovate to subangular.
Sutures on the spiral side radial or curved, depressed to raised, sometimes thickened or even beaded, on the umbilical side depressed and radial.
Aperture interiomarginal, a relatively high and open extraumbilical-umbilical arch bordered above by a narrow lip or spatulate flap; in forms with a broad open umbilicus the successive apertural flaps may remain visible, presenting a serrate or scalloped border around the umbilicus.

Genus *Rotalipora* BROTZEN, 1942

Reference BROTZEN, F., 1942: Die Foraminiferengattung Gavelinella nov. gen. und die Systematik der Rotaliiformes. — Sveriges Geologiska Undersökning, Avh., ser. C, no. 451, 36 (8):32.

Synonymy *Thalmanninella* SIGAL, 1948: Rev. de l'Inst. Français du Pétrole et Annales des Combustibles liquides, 3 (4):101.

Type species *Rotalipora turonica* BROTZEN, 1942.

Diagnosis Test trochospiral, biconvex to planoconvex, umbilicate; periphery angular with a single keel, which is mostly beaded.
Wall perforate, smooth to ornamented with calcareous ridges or knobs both on the spiral and on the umbilical side.
Chambers angular-rhomboid.
Sutures on the spiral side curved, depressed to elevated, may be limbate and beaded, on the umbilical side radial to slightly curved, depressed to elevated, and sometimes limbate and beaded, especially in the first part of the last whorl.
Primary aperture interiomarginal, extraumbilical-umbilical, with an imperforate flap which fuses with the preceding ones; a single secondary sutural aperture per suture with a bordering lip.

Genus *Rugoglobigerina* BRONNIMANN, 1952

Reference BRONNIMANN, P., 1952: Globigerinidae from the Upper Cretaceous (Cenomanian-Maestrichtian) of Trinidad, B.W.I. — Bull. Amer. Paleontol., 34 (140):16.

Synonymy *Plummerella* BRONNIMANN, 1952: Bull. Amer. Paleontol., 34 (140):37.
Plummerita BRONNIMANN, 1952: Contr. Cushman Found. Foram. Res., 3 (4):146.
Triuitella BRONNIMANN, 1952: Bull. Amer. Paleontol., 34 (140):56.
Kuglerina BRONNIMANN and BROWN, 1956: Eclog. Geol. Helvetiae, 48 (2-1955):557.

Type species *Globigerina rugosa* PLUMMER, 1926.

Diagnosis Test trochospiral, biconvex, umbilicate; periphery rounded to angular, rarely with a pseudokeel.
Wall perforate, surface typically rugose with numerous large pustles which may coalesce into distinct ridges, radiating from the midpoint of each chamber on the periphery, or much produced peripherally into spinelike extensions, more rarely smooth.
Chambers spherical, hemispherical, radial-elongate or (rarely) angular in the later portion.
Sutures radial to slightly curved on the spiral side, radial on the umbilical side, generally depressed throughout, in the later portion of the test sometimes elevated and limbate.
Primary aperture interiomarginal, umbilical, covered by extensions from the chambers (tegilla), which form an imperforate complex umbilical cover plate with accessory infralaminal and intralaminal apertures.

Genus *Schackoina* THALMANN, 1932

Reference THALMANN, H., 1932: Die Foraminiferengattung *Hantkenina* CUSHMAN, 1924 und ihre regional-stratigraphische Verbreitung. — Eclogae Geologicae Helvetiae, 25 (2):289.

Type species *Siderolina cenomana* SCHACKO, 1896.

Diagnosis Test in the early portion trochospiral, later stage becoming nearly or completely planispiral.
Wall finely perforate, smooth or finely hispid.
Chambers in the trochospiral part subglobular, in the planispiral part radially elongate, with a bulb-shaped extension (mostly broken off-as final part of a tubulospine) in the equatorial plane.
Sutures straight, radial, depressed.
Aperture an interiomarginal arch or slit, extraumbilical, tending to become equatorial; may be bordered by a lip.

Genus *Ticinella* REICHEL, 1950

Reference REICHEL, M., 1950: Observations sur les *Globotruncana* du gisement de la Breggia (Tessin). — Eclogae Geologicae Helvetiae, 42 (2):600.

Type species *Anomalina roberti* GANDOLFI, 1942

Diagnosis Test trochospiral, biconvex to planoconvex, umbilicate; periphery rounded, lacking keel or poreless margin.
Wall perforate, surface smooth or partly pustulate.
Chambers ovate to subglobular.
Sutures on spiral side curved, depressed to elevated, on umbilical side slightly curved to radial, depressed to flush.
Primary aperture interiomarginal, extraumbilical-umbilical, with an imperforate flap which fuses with the preceding ones; a single sutural aperture per suture with a bordering lip.

DESCRIPTIONS OF THE MESOZOIC ZONES
(ALBIAN–MAASTRICHTIAN)

The zonal scheme of the Middle to Late Cretaceous interval presented in this work has been compiled from local zonations published for Trinidad and North Africa, and from the Royal Dutch/Shell Group's exploration studies in such areas as Tunesia, Italy, West Pakistan and West Irian. As our knowledge of the taxonomy and the distribution of the Early Cretaceous planktonic Foraminifera is still rather fragmentary, this zonation commences in the Albian.
Chart 1 shows the zonation together with local zonations from Trinidad, north Africa and the U.S. western Gulf coastal plain and, additionally, a tentative correlation with the classic European stages and the Gulf Coast divisions. This biostratigraphic zonation, based as it is upon commonly occurring, characteristic planktonic organisms, is considered to be as near to a time-stratigraphic subdivision as is currently possible. The proposed zonation is meant to be a general framework; if local conditions allow, and if such is found desirable, the zones may be still further subdivided. A short definition of the zones is given below:

1 **Ticinella roberti** zone (Partial-range zone)
This zone is exclusively based on the presence of *T. roberti* but with the absence of *Rotalipora*.

2 **Rotalipora subticinensis** zone (Partial-range zone)
This zone is defined as that part of the range of *R. subticinensis* prior to the first appearance of *Globigerinelloides breggiensis* and *R. ticinensis*. *Ticinella roberti* occurs together with *R. subticinensis*, but it ranges above and below the zone.

3 **Globigerinelloides breggiensis** zone (Total-range zone)
Rotalipora ticinensis first appears together with the zonal guide fossil at the base of the zone, but continues into the younger zones. *R. subticinensis* ranges into the lower part, while *Ticinella roberti* ranges beyond the zone. *Hedbergella washitensis* may be present in the uppermost part, while *Planomalina buxtorfi* is not yet present.

4 **Planomalina buxtorfi** zone (Partial-range zone)
P. buxtorfi first appears at the base of the zone, but may not be restricted to it, as questionable occurrences are reported from the lower part of the *Rotalipora appenninica* zone. Such questionable occurrences in the *R. appenninica* zone are also reported for *Ticinella roberti*, which ranges all the way up from the *T. roberti* zone. *R. ticinensis* and *Hedbergella washitensis* occur in the zone but are not restricted to it.
Globigerinelloides breggiensis becomes extinct at the lower boundary of the zone. The top of the zone is defined by the first appearance of *R. appenninica* and *Praeglobotruncana stefani*.

5 **Rotalipora appenninica** zone (Partial-range zone)
The zone is defined as that part of the ranges of *R. appenninica* and *Praeglobotruncana stefani*, which occur before the first appearance of *R. greenhornensis*. *Hedbergella*

washitensis extends upward into this zone, but its presence in the uppermost part remains doubtful. *R. ticinensis* is known to extend into the lower part of the zone; the occurrences of *Planomalina buxtorfi* and *Ticinella roberti* in this lower part are questionable.

6 **Rotalipora greenhornensis** zone (Partial-range zone)
This zone is defined as that part of the range of *R. greenhornensis* below the first appearance of *R. cushmani*.

7 **Rotalipora cushmani** zone (Total-range zone)
In contrast to the zone's guide fossil, the even more characteristic *R. reicheli* is limited to the middle and upper parts of the zone. The latter species may therefore constitute a marker for the middle and upper part of the *R. cushmani* zone. Other species ranging into but becoming extinct within the zone are *R. appenninica* and *R. greenhornensis*.

8 **Globotruncana helvetica** zone (Total-range zone)
G. imbricata starts together with the guide fossil at the base of the zone, but continues throughout the overlying one. *G. schneegansi* appears slightly above the base of the zone, while *G. sigali* begins only in its upper part; both species continue into overlying zones.
The fact that *Rotalipora* and the Globotruncanidae have never been reported occurring together underlines the importance of the boundary between the *R. cushmani* zone and the *G. helvetica* zone.

9 **Globotruncana schneegansi** zone (Partial-range zone)
That part of the range of the zonal marker, which extends above the top occurrence of *G. helvetica* and below the base occurrence of *G. concavata* constitutes the zone. Furthermore, the top of the zone is marked by the extinction of *G. imbricata*. *G. sigali* may often be abundant throughout this interval, but is not restricted to it. The following species make their first appearance in successively higher levels in the zone: *G. renzi*, *G. angusticarinata*, *G. coronata*, *G. fornicata* and *G. primitiva*.

10 **Globotruncana concavata** zone (Total-range zone)
Forms occurring throughout the zone but not restricted to it are *G. angusticarinata*, *G. coronata* and *G. fornicata*. Forms which become extinct in the basal part are *G. schneegansi*, *G. primitiva* and possibly *G. renzi*. *G. sigali* ranges higher up within this zone. *G. lapparenti* first appears in the lower part, *G. carinata* in the upper part.

11 **Globotruncana carinata** zone (Partial-range zone)
That part of the range of the zonal marker, which extends above the top occurrence of *G. concavata* and below the base occurrence of the single-keeled *G. elevata* and *G. stuartiformis* constitutes the zone. The zonal assemblage includes the longer-ranging *G. angusticarinata*, *G. coronata*, *G. fornicata*, *G. lapparenti* and *G. bulloides*.

12 **Globotruncana elevata** zone (Partial-range zone)
The lower boundary of the zone is characterized by the first appearance of the single-keeled *G. elevata* and *G. stuartiformis*. The upper boundary of the zone coincides with the first occurrences of *G. calcarata* and *G. arca*. Its basal part is well marked by the co-occurrence of *G. elevata* and *G. carinata*.
G. ventricosa, *G. conica* and probably *Praeglobotruncana citae* first appear in the lower part, while *G. angusticarinata* and probably *G. coronata* become extinct in the upper part of the zone.
G. fornicata, *G. lapparenti* and *G. bulloides* are also present throughout the zone.

13 **Globotruncana calcarata** zone (Total-range zone)
Occurring with the characteristic guide fossil but not restricted to this zone are

G. fornicata, *G. lapparenti*, *G. bulloides*, *G. stuartiformis*, *G. conica* and *Praeglobotruncana citae*.
G. arca enters at the base of the zone but continues into the overlying ones. Such species as *G. falsostuarti* and *G. stuarti* make their first appearance immediately after the extinction of *G. calcarata*.

14 **Globotruncana stuartiformis** zone (Concurrent-range zone)
This zone is defined as the range overlap of *G. stuartiformis*, *G. bulloides*, *G. stuarti* and *G. falsostuarti*. The absence in this zone of *G. calcarata*, *G. gansseri*, *G. contusa*, *G. gagnebini* and *Rugoglobigerina rotundata* is an important negative feature.

15 **Globotruncana gansseri** zone (Partial-range zone)
This zone is defined as that part of the range of *G. gansseri* prior to the first appearance of *G. mayaroensis* and *Rugoglobigerina scotti*. *G. contusa*, *G. gagnebini* and *Rugoglobigerina rotundata* make their first appearance at the base of the zone, but range throughout the overlying *G. mayaroensis* zone. Other characteristic forms occurring in the zone, but not restricted to it, include *G. conica*, *G. arca*, *G. stuarti*, *Praeglobotruncana citae*.

16 **Globotruncana mayaroensis** zone (Total-range zone)
In addition to the zonal marker, *Rugoglobigerina scotti* is also restricted to this interval. Other characteristic forms, although not limited to the zone, are *G. conica*, *G. stuarti*, *G. contusa*, *Praeglobotruncana citae* and *Rugoglobigerina rotundata*.
G. gansseri and probably *G. arca* become extinct within this zone.
The entire family Globotruncanidae disappears at the top of the zone.

DESCRIPTIONS AND ILLUSTRATIONS OF MESOZOIC SPECIES
(arranged in alphabetical order)

Globigerinelloides breggiensis (GANDOLFI)

Reference *Anomalina breggiensis* GANDOLFI, 1942: Ricerche micropaleontologiche e stratigrafiche sulla Scaglia e sul Flysch cretacici dei dintorni di Balerna (Canton Ticino). — Rivista Italiana di Paleontologia, 48, Suppl. Mem. 4:102, pl. III, fig. 6.

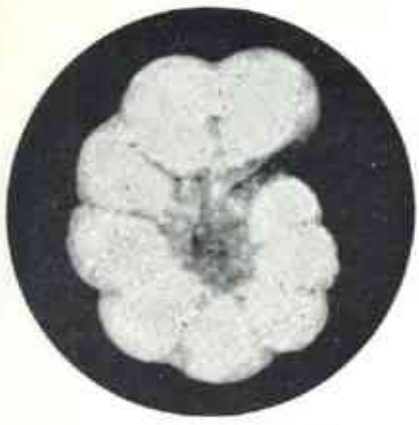
Type locality Gorge of the Breggia River, northeast of Balerna, near Chiasso, Canton of Ticino, southeastern Switzerland.

Diagnosis Test planispiral, biumbilicate, slightly evolute, equatorial periphery lobulate.
Wall perforate, surface of the first chambers of the last whorl more or less pitted.
Chambers oblate, the usually 9 chambers of the last whorl increase regularly and slowly in size.
Sutures distinct, depressed, radial.
Primary aperture interiomarginal, an equatorial broad arch with lateral extensions reaching back at either side into the umbilical area bordered by a lip, of which the umbilical parts may be of considerable size (flap-like), the lateral umbilical portions of successive apertures remaining visible as secondary relict apertures.

Strat. distr. Ranging throughout the *Globigerinelloides breggiensis* zone.

Remarks Locality of figured specimen is Dyr el Kef section, sample 1F 401, W. Tunisia.

Globigerinelloides breggiensis
× 100








Globotruncana angusticarinata GANDOLFI

Reference *Globotruncana linnei* (D'ORBIGNY) var. *angusticarinata* GANDOLFI, 1942: Ricerche micropaleontologiche e stratigrafiche sulla Scaglia e sul Flysch cretacici dei dintorni di Balerna (Canton Ticino). — Rivista Italiana di Paleontologia, 48, Suppl. Mem. 4:127, fig. 46, no. 3.

Type locality Cava della Scabriana, west of Balerna and near the railway line to Lugano, in the vicinity of Chiasso, Canton of Ticino, southeastern Switzerland.

Diagnosis Test low trochospiral, biconvex; equatorial periphery slightly lobulate, with two beaded keels which become very closely spaced and almost smooth in the last chambers.
Wall perforate, surface smooth.
Chambers angular, compressed, somewhat arched and showing a faint imbricate structure on the spiral side; arranged in about 3 whorls, the 6-7 chambers of the last whorl hardly increase in size.
Sutures on spiral side slightly curved, oblique, raised, beaded, on umbilical side curved, marked by beaded sigmoid septal carinae, which partly border the umbilicus.
Umbilicus rather shallow, wide.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Lower part *Globotruncana schneegansi* zone into upper part *Globotruncana elevata* zone.

Remarks Locality of figured specimen is Dyr el Kef section, sample 1F 85, W. Tunisia.

Globotruncana angusticarinata
× 100







Globotruncana arca (CUSHMAN)

Reference *Pulvinulina arca* CUSHMAN, 1926: Some Foraminifera from the Mendez Shale of Eastern Mexico. — Contr. Cushman Lab. Foram. Res., 2:23, pl. 3, fig. 1a-c.

Type locality Near Huiches, Hacienda El Limon, San Luis Potosi, Mexico.

Diagnosis Test low trochospiral, biconvex; equatorial periphery lobulate with a widely spaced double keel, distinctly beaded except in the last portion.
Wall perforate, surface smooth.
Chambers angular with truncate margins, inflated, arranged in $2\frac{1}{2}$-3 whorls; the 6-7 chambers of the last whorl increase moderately in size.
Sutures on spiral side curved, strongly raised, beaded except for the last chambers; on umbilical side slightly curved, depressed to raised.
Umbilicus fairly deep, wide.
Primary apertures interiomarginal, umbilical, covered by a high tegillum.

Strat. distr. Base *Globotruncana calcarata* zone to top *Globotruncana gansseri* zone. Questionable occurrence in the lower part of the *Globotruncana mayaroensis* zone.

Remarks Locality of figured specimen is Dyr el Kef section, sample 2F 223, W. Tunisia.

Globotruncana arca
× 100

Globotruncana bulloides VOGLER

Reference *Globotruncana linnei bulloides* VOGLER, 1941: Ober-Jura und Kreide von Misol (Niederländisch-Ostindien). — Palaeontographica, Suppl. IV, Abt. IV:287, pl. XXIII, figs. 32-39.

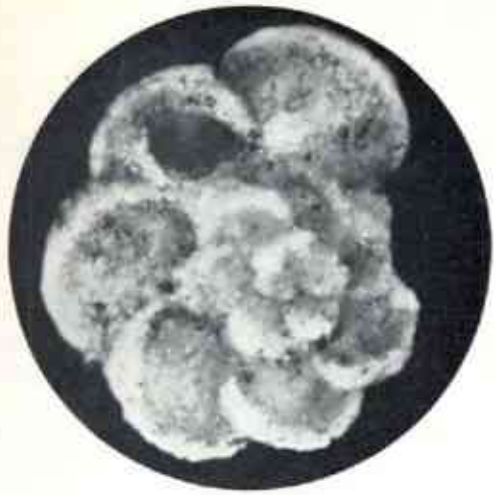
Type locality Island of Misol, east Indonesia.

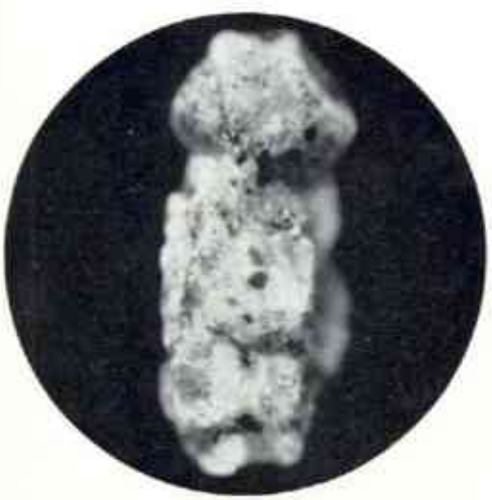
Diagnosis Test very low trochospiral, spiral side almost flat to slightly convex, umbilical side becoming moderately convex; equatorial periphery slightly lobulate to lobulate, with two widely spaced keels, beaded.
Wall perforate, surface a little rugose in the central part of the chambers, last chambers usually smooth.
Chambers subangular, strongly inflated, especially the last ones, arranged in about 3½ whorls; the 6-8 chambers of the last whorl increase regularly in size, showing a distinct imbricate structure on the spiral side.
Sutures on spiral side curved, raised and beaded, the ones between the last three chambers may be depressed, on umbilical side slightly curved, marked by light, weakly sigmoid, septal carinae, partly bordering the umbilicus, which may be vague in the last portion of the test.
Umbilicus shallow, wide.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Upper part *Globotruncana carinata* zone to top *Globotruncana stuartiformis* zone. Questionable occurrence in lower part *Globotruncana carinata* zone.

Remarks Locality of figured specimen is Well N. Nederland 12, sample 315-316m.

Globotruncana bulloides
× 105





Globotruncana calcarata CUSHMAN

Reference *Globotruncana calcarata* CUSHMAN, 1927: New and interesting Foraminifera from Mexico and Texas. — Contr. Cushman Lab. Foram. Res., 3:115, pl. 23, fig. 10a-b.

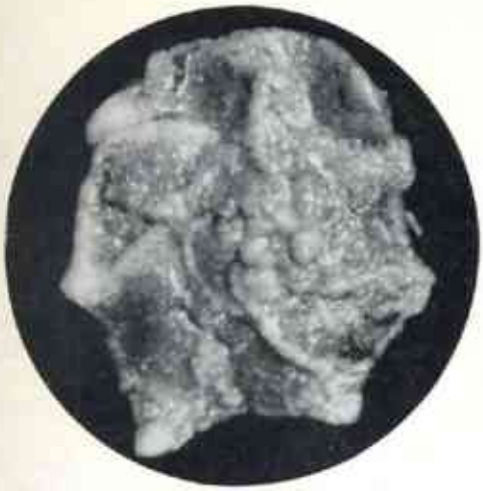
Type locality Cut in G.C. and S.F.R.R. at N.edge of Farmerville, Texas, U.S.A.

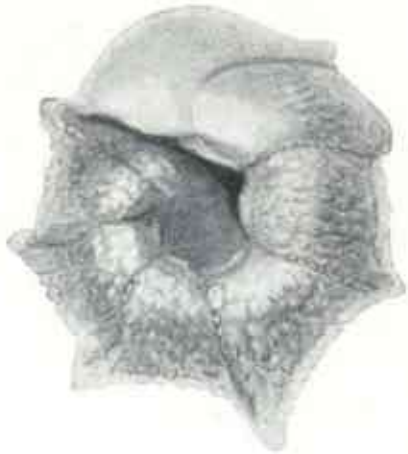
Diagnosis Test very low trochospiral, spiral side almost flat, umbilical side strongly convex; equatorial periphery stellate, except for the last portion which is rounded, with a distinct single keel which is provided with short spines, one per chamber; keel and spines are beaded, at any rate for the greater part.
Wall perforate, surface rugose, except for the last chambers; degree of rugosity decreases gradually.
Chambers subangular, inflated, arranged in about 3 whorls; the 5-7 chambers of the last whorl increase rather irregularly in size.
Sutures on spiral side slightly curved to almost straight, raised, beaded, on umbilical side radial to slightly curved, depressed to slightly raised, occasionally beaded.
Umbilicus deep, rather narrow to fairly wide.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Ranging throughout the *Globotruncana calcarata* zone.

Remarks Locality of figured specimen is sample G 511, W. Tunisia.

Globotruncana calcarata
× 85





Globotruncana carinata DALBIEZ

Reference *Globotruncana (Globotruncana) ventricosa carinata* DALBIEZ, 1955: The genus *Globotruncana* in Tunisia. — Micropaleontology, 1 (2):168, text fig. 8.

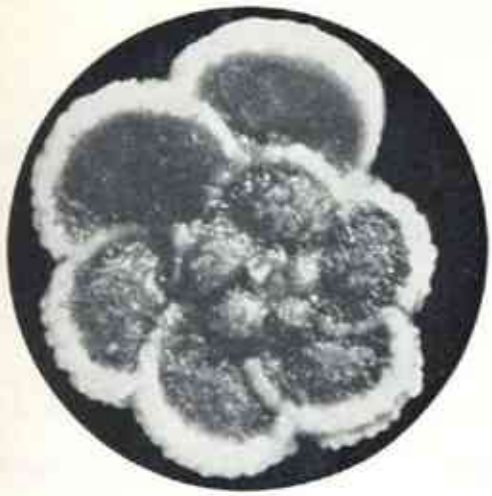
Type locality Le Kef-Mellégue, northwestern Tunisia.

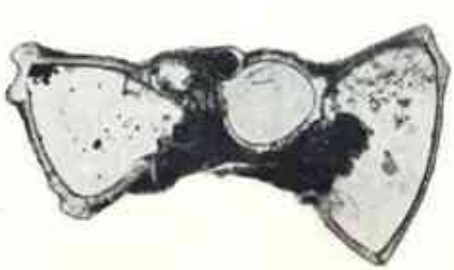
Diagnosis Test very low trochospiral, spiral side most often slightly concave, umbilical side strongly convex; equatorial periphery distinctly lobulate with a rather closely spaced double keel, distinctly beaded, which feature may be absent in the last chamber.
Wall perforate, surface of the first chambers of the last whorl somewhat rugose, last ones smooth.
Chambers angular subconical, moderately inflated, each developing a distinct, usually beaded, carina on top; arranged in $2\frac{1}{2}$-3 whorls, the 5-6 chambers of the last whorl increasing regularly in size.
Sutures on spiral side distinctly curved, in the last whorl raised and beaded, on umbilical side radial, depressed.
Umbilicus deep, wide.
Primary apertures interiomarginal, umbilical, covered by a low tegillum.

Strat. distr. Upper part *Globotruncana concavata* zone into lowermost part *Globotruncana elevata* zone.

Remarks This species is characterized by a keel (carina) developed on top of the umbilical side of each chamber, which feature is not present in *Globotruncana concavata* (BROTZEN). Moreover, the chamber has a tendency to become subconical in shape.
It differs from the much younger *Globotruncana gagnebini* TILEV especially in the concavity of the spiral side.
Less striking are the differences from *Globotruncana lamellosa* SIGAL, which develops the same kind of carina, though not so prominent; the chambers, however, are lower and less steep, and the spiral side is slightly convex.
See also remarks on *Globotruncana concavata* (BROTZEN).
Locality of figured specimen is Dyr el Kef section, sample 2F 139, W. Tunisia.

Globotruncana carinata
× 90





Globotruncana concavata (BROTZEN)

Reference *Rotalia concavata* BROTZEN, 1934: Foraminiferen aus dem Senon Palästinas. — Zeitschrift des Deutschen Palästina-Vereins, 57:66, pl. 3, fig. b.
Globotruncana (Globotruncana) ventricosa WHITE. DALBIEZ, 1955: The genus *Globotruncana* in Tunisia. — Micropaleontology, 1 (2):168, text fig. 7.

Type locality Wadi Madi, on the S. E. flank of Mt. Carmel, Israel.

Diagnosis Test very low trochospiral, spiral side sometimes slightly concave, umbilical side strongly convex; equatorial periphery distinctly lobulate with two closely spaced keels, distinctly beaded except in the last portion.
Wall perforate, surface of the first chambers of the last whorl somewhat rugose, last chambers smooth.
Chambers almost hemispherical, arranged in $2\frac{1}{2}$-3 whorls; the 5-6 chambers of the last whorl increase regularly and usually rapidly in size.
Sutures on spiral side distinctly curved, in last whorl raised and, except in the last chambers, beaded; on umbilical side radial, depressed.
Umbilicus deep, fairly wide.
Primary apertures interiomarginal, umbilical, covered by a low tegillum.

Strat. distr. Ranging throughout *Globotruncana concavata* zone.

Remarks In 1955 DALBIEZ described an "evolutionary series" comprising the following three types:

Globotruncana ventricosa primitiva DALBIEZ
Globotruncana ventricosa ventricosa WHITE
Globotruncana ventricosa carinata DALBIEZ.

After BOLLI's study (1957) of the type material of *Globotruncana ventricosa* WHITE, it appeared that the species and subspecies name *ventricosa* of this group had to be changed to *concavata*, a fact which DALBIEZ himself had already taken into consideration. For practical purposes (see remarks *Globotruncana lapparenti* BOLLI), the following nomenclature is proposed here for the three species concerned:

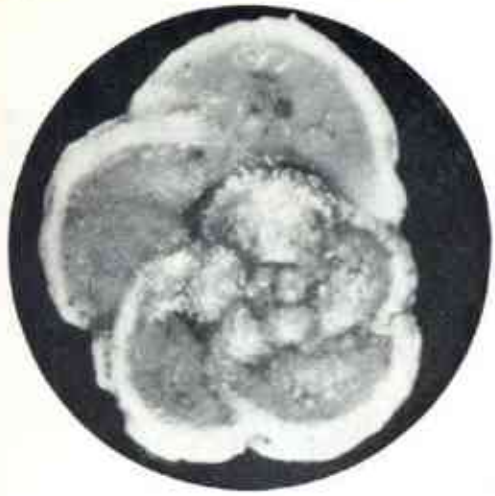
Globotruncana primitiva DALBIEZ
Globotruncana concavata (BROTZEN)
Globotruncana carinata DALBIEZ.

The main differences between *Globotruncana concavata* and the younger *Globotruncana ventricosa* are:

a. the chambers of the former are hemispherical instead of angular.
b. the height of the chambers increases more rapidly.
c. the surface of the first chambers of the last whorl is somewhat rugose instead of smooth.
d. the tegillum is low instead of high.

Globotruncana asymmetrica SIGAL, 1952, is here considered to be a synonym of *Globotruncana concavata*.
Locality of figured specimen is Dyr el Kef section, sample 2F 93, W. Tunisia.

Globotruncana concavata
× 95



Globotruncana conica WHITE

Reference *Globotruncana conica* WHITE, 1928: Some index Foraminifera of the Tampico embayment area of Mexico. — Journal of Paleontology, 2 (4):285, pl. 38, fig. 7.

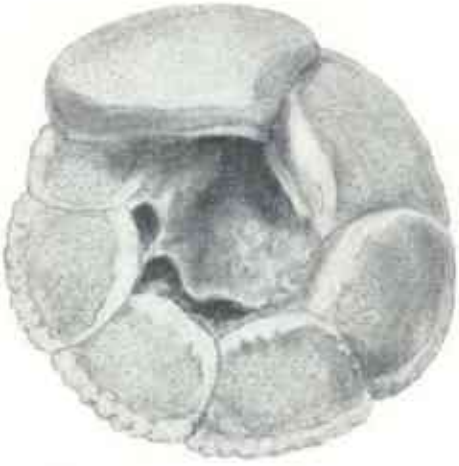
Type locality Two and two-tenths kilometres east of Guerrero, Tampico embayment, Mexico.

Diagnosis Test high trochospiral, spiral side strongly convex, umbilical side slightly convex (almost spiroconvex); equatorial periphery slightly lobulate to almost circular, with one keel, moderately beaded except in the last chambers.
Wall perforate, surface smooth.
Chambers subangular to angular, moderately inflated; arranged in 3½-4 whorls, the 6-8 chambers of the last whorl increasing slowly in size.
Sutures on spiral side curved, raised, beaded except in the last chambers, on umbilical side slightly curved, in first part of the last whorl raised and beaded, in later part flush to slightly depressed.
Umbilicus deep, wide.
Primary apertures interiomarginal, umbilical, covered by a high tegillum.

Strat. distr. Lower part *Globotruncana elevata* zone to top *Globotruncana mayaroensis* zone.

Remarks In the same paper WHITE describes a variety *Globotruncana conica* var. *plicata* as "being fluted or having folds on the dorsal side, causing the outline as seen from above to appear fluted or polygonal". This variety is a synonym of *Globotruncana contusa* CUSHMAN.
Locality of figured specimen is Dyr el Kef section, sample 2F 227, W. Tunisia.

Globotruncana conica
× 95



Globotruncana contusa (CUSHMAN)

Reference *Pulvinulina arca* var. *contusa* CUSHMAN, 1926: Some Foraminifera from the Mendez shale of eastern Mexico. — Contr. Cushman Lab. Foram. Res., 2:23, no figure.

Type locality Near Coco, Hacienda El Limon, San Luis Potosí, Mexico.

Diagnosis Test high trochospiral; spiral side strongly convex, umbilical side flattened to slightly concave (spiroconvex); equatorial periphery polygonal with 2 keels, distinctly beaded, except sometimes in the last chamber.
Wall perforate, surface smooth.
Chambers angular with truncate margins, distinctly concave on the spiral side, which gives the test the appearance of a more or less pyramidal form; arranged in 3½-4 whorls, the 5-7 chambers of the last whorl increasing slowly and rather irregularly in size.
Sutures on spiral side slightly curved to arched, strongly oblique, raised, distinctly beaded, on umbilical side slightly curved to radial, raised and beaded to sometimes depressed in the last chambers of the final whorl.
Umbilicus deep, wide.
Primary apertures interiomarginal, umbilical, covered by a relatively low tegillum.

Ranging throughout the *Globotruncana gansseri* zone and the *Globotruncana mayaroensis* zone.

Strat. distr. Text figure 2 in DE LAPPARENT's publication of 1918 shows a number of sections of different types of *Rosalina linnei* D'ORBIGNY. One of these is defined as a "section de la mutation caliciforme". In fact it is a section of what is now generally thought to be *Globotruncana contusa*.

Remarks Locality of figured specimen is Dyr el Kef section, sample 2F 224, W. Tunisia.

Globotruncana contusa
× 70

Globotruncana coronata BOLLI

Reference *Globotruncana lapparenti coronata* BOLLI, 1944: Zur Stratigraphie der Oberen Kreide in den höheren helvetischen Decken. — Eclogae Geologicae Helvetiae, 37 (2):233, fig. 1, no. 21, 22; pl. IX, figs. 14, 15.

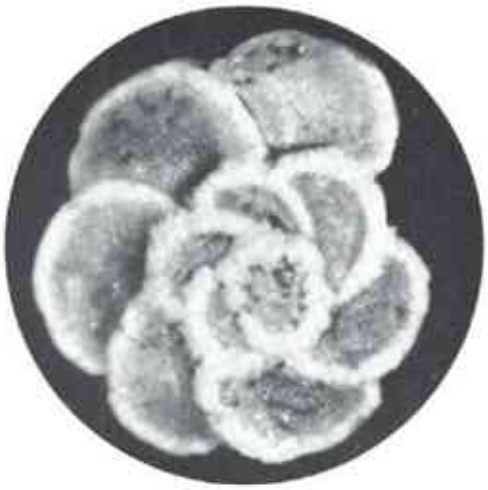
Type locality Between Wildhaus and Voralpsee, Säntis area, northeastern Switzerland.

Diagnosis Test low trochospiral, biconvex; equatorial periphery lobulate with two closely spaced keels, distinctly beaded, at least in the first part.
Wall perforate, surface smooth.
Chambers angular, strongly compressed, arranged in $2^1/_2$-3 whorls; the 5-7 chambers of the last whorl increase regularly in size; early whorls small by comparison.
Sutures on spiral side curved, raised, beaded, on umbilical side curved, marked by beaded sigmoid septal carinae, which partly border the umbilicus.
Umbilicus shallow, wide.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Upper part *Globotruncana schneegansi* zone to upper part *Globotruncana carinata* zone. Questionable occurrences in lower part *Globotruncana schneegansi* zone, uppermost *Globotruncana carinata* zone and *Globotruncana elevata* zone.

Remarks See remarks *Globotruncana lapparenti* BOLLI.
Locality of figured specimen is Dyr el Kef section, sample 2F 139, W. Tunisia.

Globotruncana coronata
× 95



Globotruncana elevata (BROTZEN)

Reference *Rotalia elevata* BROTZEN, 1934: Foraminiferen aus dem Senon Palästinas. — Zeitschrift des Deutschen Palästina-Vereins, 57:66, pl. 3, fig. c.
Globotruncana (Globotruncana) elevata elevata (BROTZEN): The genus *Globotruncana* in Tunisia. — Micropaleontology, 1 (2):169, text fig. 9 a-c.

Type locality Wadi Madi, on the S. E. flank of Mt. Carmel, Israel.

Diagnosis Test very low trochospiral, central part of spiral side slightly convex to convex, spiral side of last whorl flat to slightly concave, umbilical side strongly convex; equatorial periphery lobulate to slightly lobulate, with one keel, moderately beaded except in the last chambers.
Wall perforate, surface smooth.
Chambers subangular to angular, moderately inflated, sometimes slightly overlapping, with a kind of carina on top of each chamber as continuation of the partly raised sutures of the umbilical side; arranged in about 3 whorls, the usually 6-8 chambers of the last whorl increasing regularly in size.
Sutures on spiral side distinctly curved, at least in the last chambers, raised, moderately beaded; on umbilical side slightly curved, in first part of the last whorl raised and beaded, in later part slightly depressed.
Umbilicus deep, wide.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Base *Globotruncana elevata* zone into lower part *Globotruncana calcarata* zone. Questionable occurrence in upper part *Globotruncana calcarata* zone.

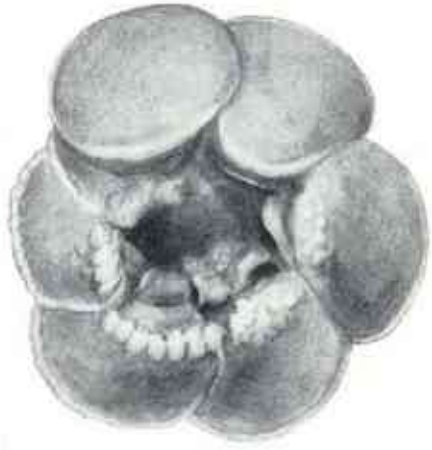
Remarks The *Globotruncana elevata* group is another evolutionary series established by DALBIEZ, containing some single-keeled *Globotruncana* types of the Campanian/Maastrichtian.
DALBIEZ recommended a complete revision of the "group *elevata-rosetta-stuarti*", but in the meantime proposed the following nomenclatural modifications:
stage 1 - *Globotruncana elevata elevata* (BROTZEN),
stage 2 - *Globotruncana elevata stuartiformis* DALBIEZ,
stage 3 - *Globotruncana stuarti* (DE LAPPARENT).
For practical reasons (see remarks *Globotruncana lapparenti* BOLLI) the following nomenclature is proposed here:

Globotruncana elevata (BROTZEN),
Globotruncana stuartiformis DALBIEZ,
Globotruncana stuarti (DE LAPPARENT).

Globotruncana andori DE KLASZ, 1953, appears to be closely related to this group.
Globotruncana rosetta (CARSEY), 1926, may be another species related to the above mentioned group. Its stratigraphic distribution is within the potential range of the group. Locality of figured specimen is Dyr el Kef section, sample 2F 171, W. Tunisia.

Globotruncana elevata
× 65




Globotruncana falsostuarti SIGAL

Reference *Globotruncana falsostuarti* SIGAL, 1952: Aperçu stratigraphique sur la micropaléontologie du Crétacé. — 19e Congrès Géologique International, Monographies Régionales, Ser. 1 (26):43, text fig. 46.

Type locality Not given (probably northern Algeria).

Diagnosis Test low trochospiral, biconvex; equatorial periphery lobulate with two keels, which are fused in the central part of each chamber; beaded, which feature may be absent in the last chambers.
Wall perforate, surface smooth.
Chambers subangular to angular with partly truncate margins, moderately inflated, slightly overlapping, arranged in 3-3½ whorls, the 7-8 chambers of the last whorl increasing regularly and slowly in size.
Sutures on spiral side curved to slightly curved, raised, beaded, on umbilical side curved, raised, beaded, at least for the greater part.
Umbilicus fairly deep, wide.
Primary apertures interiomarginal, umbilical, covered by a high tegillum.

Strat. distr. Ranging throughout *Globotruncana stuartiformis* zone, *Globotruncana gansseri* zone and *Globotruncana mayaroensis* zone.

Remarks The original description of this species is insufficient, but through oral information from the author it appears that the keel pattern, as described above, is the most characteristic feature of the species, and is clearly visible in the author's figure of the holotype. The degree of fusing is variable; the specimen shown here exhibits a lesser degree of fusing of keels than is seen in the holotype.
It is possible that *Globotruncana falsostuarti* may be related to, or even synonymous with, *Globotruncana leupoldi* BOLLI, 1944.
Locality of figured specimen is Dyr el Kef section, sample 2F 218, W. Tunisia.

Globotruncana falsostuarti
× 80

Globotruncana fornicata PLUMMER

Reference *Globotruncana fornicata* PLUMMER, 1931: Some Cretaceous Foraminifera in Texas. — The University of Texas Bulletin, 3101:198, pl. XIII, figs. 4-6.

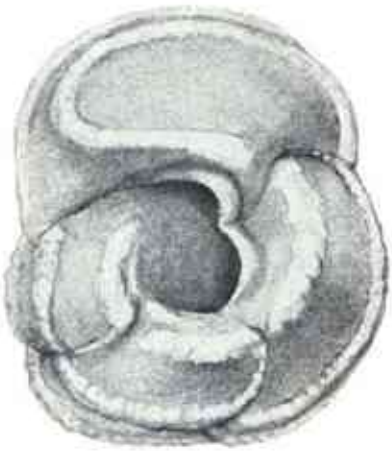
Type locality Station 226-T-8, on right bank of Onion Creek near bridge at Moore and Berry's Crossing, eight and onehalf miles in a straight line southeast of the capital Austin, Travis County, Texas, U.S.A.

Diagnosis Test fairly high trochospiral, biconvex; equatorial periphery slightly lobulate, with two keels, moderately beaded.
Wall perforate, surface smooth.
Chambers angular with truncate margins, long, strongly arched, inflated inner parts on the spiral side, arranged in 2½-3 whorls; the 4-5 chambers of the last whorl increase rapidly in size.
Sutures on spiral side strongly oblique and slightly curved, raised, except for the inner whorl, beaded; on umbilical side strongly curved, depressed to flush, partly marked by beaded continuations of one of the keels.
Umbilicus fairly deep, wide.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Upper part *Globotruncana schneegansi* zone to top *Globotruncana stuartiformis* zone. Questionable occurrence in lower part *Globotruncana gansseri* zone.

Remarks As PLUMMER stated, this species is "easily distinguished from its congeners by its narrow and strongly arched chambers that sweep in strong curves on the dorsal face".
Locality of figured specimen is Dyr el Kef section, sample 2F 171, W. Tunisia.

Globotruncana fornicata
× 120



Globotruncana gagnebini TILEV

Reference *Globotruncana gagnebini* TILEV, 1951: Etude des Rosalines maastrichtiennes (genre *Globotruncana*) du Sud-Est de la Turquie (sondage de Ramandağ). — Publications de l'Institut d'Etudes et de Recherches Minières de Turquie, B (16):50, text fig. 14.

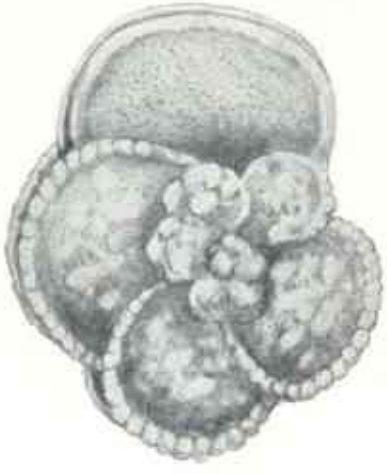
Type locality Well Ramandağ IV, 1,170m, S. E. Turkey.

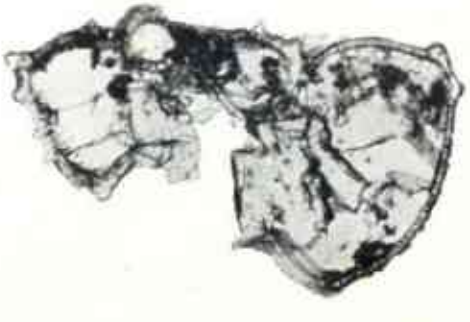
Diagnosis Test very low trochospiral, spiral side flat or slightly convex, umbilical side strongly convex; equatorial periphery distinctly lobulate with two rather closely speced keels which may approach each other or even fuse in the last chamber; beaded, except for the last chamber.
Wall perforate, surface rugose, degree of rugosity decreases towards the last chamber, which is generally smooth; tendency to develop a carina on top of the chambers increases towards the last chamber.
Chambers subangular, inflated on both umbilical side and spiral side, arranged in $2\frac{1}{2}$-3 whorls, the 4-5 chambers of the last whorl increasing rapidly in size.
Sutures on spiral side curved, raised, beaded; on umbilical side radial, depressed.
Umbilicus deep, fairly wide.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Ranging throughout *Globotruncana ganseri* zone and *Globotruncana mayaroensis* zone.

Remarks TILEV describes *Globotruncana gagnebini* as a very variable form. Other illustrated specimens of his species from higher samples of the same well appear to be very similar to or even identical with *Globotruncana lamellosa* SIGAL and *Globotruncana aegyptiaca* NAKKADY.
Locality of figured specimen is well Fahud-1, sample 145', Oman.

Globotruncana gagnebini
× 140





Globotruncana gansseri BOLLI

Reference *Globotruncana gansseri* BOLLI, 1951: The genus *Globotruncana* in Trinidad, B.W.I. — Journal of Paleontology, 25 (2):196, pl. 35, figs. 1-3.

Type locality Subsurface section in the Brighton area near Pitch Lake, southwestern Trinidad.

Diagnosis Test very low trochospiral, spiral side flat, umbilical side strongly convex; equatorial periphery slightly lobulate to almost circular, with one keel, beaded, at least in the first part.
Wall perforate, surface of the umbilical side rugose, degree of rugosity decreases toward the last chambers, which are smooth; surface of the spiral side smooth, except the initial part.
Chambers almost hemispherical, arranged in 2½-3 whorls; the 5-6 chambers of the last whorl increase regularly in size.
Sutures on spiral side curved, raised in the last whorl, lightly beaded; on umbilical side the first ones radial, the last ones slightly curved, depressed.
Umbilicus deep, wide.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Base *Globotruncana gansseri* zone to upper part *Globotruncana mayaroensis* zone.

Remarks *Globotruncana lugeoni* TILEV, 1951 is a synonym of *Globotruncana gansseri*.
Locality of figured specimen is sample St. 1289, Turkey.

Globotruncana gansseri
× 120

Globotruncana helvetica BOLLI

Reference *Globotruncana helvetica* BOLLI, 1945: Zur Stratigraphie der Oberen Kreide in den höheren helvetischen Decken. — Eclogae Geologicae Helvetiae, 37 (2):226, pl. IX, fig. 6.

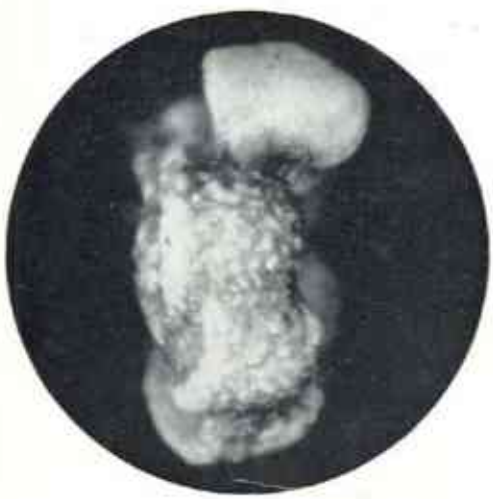
Type locality Sample 952, 15-20 metres above the top of the "Knollenschichten" in the Säntis section, between the meteorological station and the old hotel on the crest of the Säntis Range, Canton of St. Gall, eastern Switzerland.

Diagnosis Test very low trochospiral, spiral side almost flat, inner whorls often slightly raised, umbilical side strongly inflated; equatorial periphery lobulate with one keel, which may be weakened in the last chamber, lightly beaded.
Wall perforate; surface on umbilical side distinctly rugose, the last chamber to a lesser extent; on spiral side lightly rugose.
Chambers hemispherical, arranged in about 3 whorls, the 5-6 chambers increasing regularly in size; on spiral side a tendency to develop an imbricate structure.
Sutures on spiral side curved, raised and beaded, on umbilical side almost radial, depressed.
Umbilicus fairly deep, wide.
Primary apertures interiomarginal, umbilical, covered by a simple, low tegillum.

Strat. distr. Ranging throughout *Globotruncana helvetica* zone.

Remarks Locality of figured specimen is Dyr el Kef section, sample 2F 40, W. Tunisia.

Globotruncana helvetica
× 90



Globotruncana imbricata MORNOD

Reference *Globotruncana imbricata* MORNOD, 1949: Les Globorotalidés du Crétacé supérieur du Montsalvens (Préalpes fribourgeoises). — Eclogae Geologicae Helvetiae, 42 (2):589, text fig. 5, III a-d.

Type locality Middle of Profile III, at about 975 metres above sea level in the Ruisseau des Covayes, on the southeastern slope of the Montsalvens chain, north of Cerniat in the Préalpes fribourgeoises, Switzerland.

Diagnosis Test low trochospiral, spiral side convex, umbilical side becoming concave; equatorial periphery slightly lobulate to lobulate with two beaded keels, which are absent or at least weakened in the ultimate and penultimate chambers.
Wall perforate, surface of the chambers, except the last ones, may be slightly rugose.
Chambers subangular, slightly inflated, arranged in $2\frac{1}{2}$-3 whorls, the 5-6 chambers of the last whorl increasing regularly and slowly in size, showing on the spiral side an imbricate structure (like roof tiles).
Sutures on spiral side curved, raised and beaded, except the one between ultimate and penultimate chamber, which is commonly depressed; on umbilical side radial, depressed.
Umbilicus shallow, fairly wide.
Primary apertures interiomarginal, umbilical, covered by a simple low tegillum.

Strat. distr. Ranging throughout *Globotruncana helvetica* zone and *Globotruncana schneegansi* zone.

Remarks Is is not inadvisable, to allow for a fairly large degree of variation in this species. The variants differ from each other only in minor characteristics, while the most important features—the imbricate structure of the chambers and the typical position of the last chamber—are always present.
From this point of view *Globotruncana imbricata* and *Globotruncana inflata* BOLLI, 1944, may be considered as synonymous. Priority, however, should be given to *Globotruncana imbricata* MORNOD, which has been described from isolated specimens.
Locality of figured specimen is Dyr el Kef section, sample 2F 62, W. Tunisia.

Globotruncana imbricata
× 120

Globotruncana lapparenti BOLLI

Reference *Globotruncana lapparenti lapparenti* BOLLI, 1944: Zur Stratigraphie der Oberen Kreide in den höheren helvetischen Decken. — Eclogae Geologicae Helvetiae, 37 (2):230, text fig. 1, nos. 15, 16; pl. IX, fig. 1.

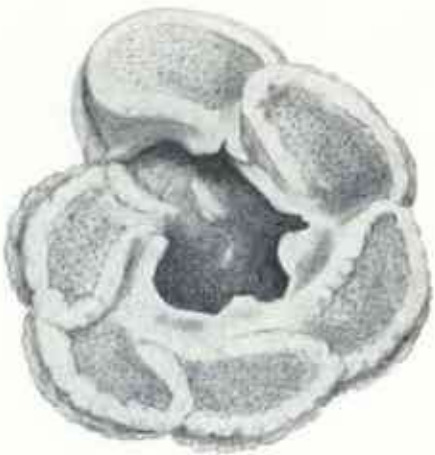
Type locality Sample no. 1384, about 31.5 metres above the base of the Gatter section, Säntis area, northeastern Switzerland.

Diagnosis Test very low trochospiral, spiral side almost flat to slightly convex, umbilical side practically flat; equatorial periphery slightly lobulate to lobulate with two widely spaced keels, beaded.
Wall perforate, surface smooth.
Chambers almost rectangular, may be slightly inflated, arranged in about 3½ whorls, the 5-8 chambers of the last whorl increasing regularly in size.
Sutures on spiral side curved, oblique, strongly raised, beaded; on umbilical side curved, marked by beaded sigmoid septal carinae, which partly border the umbilicus.
Umbilicus fairly shallow, wide.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Lower part *Globotruncana concavata* zone to uppermost part *Globotruncana stuartiformis* zone.

Remarks In 1936, with reference to the species which he had determined and figured as *Globotruncana ventricosa* WHITE, BROTZEN expressed a view which also has a bearing on the *Globotruncana linneiana* (D'ORBIGNY) problem. He said that he could distinguish *Globotruncana linneiana* D'ORBIGNY; *Globotruncana marginata* (REUSS); *Globotruncana canaliculata* (REUSS); *Globotruncana canaliculata* var. *ventricosa* WHITE; and, furthermore, his new species *Globotruncana lapparenti*.
For this last, BROTZEN chose as type species the *Rosalina linnei* D'ORBIGNY group of forms of DE LAPPARENT (1918), consisting of six types, as a result of which the definition of the species is very elastic. (According to BROTZEN, one of the characters in which these six types differ from *Globotruncana linneiana* D'ORBIGNY is in the pattern of the sutures on the umbilical side.)
In 1941 VOGLER made use of a ternary nomenclature, but he, on the other hand, looked upon *Globotruncana linnei* D'ORBIGNY (= *G. linneiana* D'ORBIGNY) as "Grossart".
In 1944 BOLLI also went a step farther and, after removing type 6, "la mutation caliciforme" (= *Globotruncana contusa* (CUSHMAN)), from the group, chose no. 1 of these types of DE LAPPARENT's—viz. the subspecies *Globotruncana lapparenti lapparenti* BOLLI—as "zentrale Typus der Grossart *Globotruncana lapparenti* BROTZEN".
For practical reasons the subspecies *Globotruncana lapparenti lapparenti* BOLLI, 1944, which is described here, is given as the species *Globotruncana lapparenti* BOLLI.
Other amendments of the kind are as follows:
Globotruncana lapparenti bulloides VOGLER, 1941 = *G. bulloides* VOGLER
Globotruncana lapparenti inflata BOLLI, 1944 = *G. inflata* BOLLI (See remarks *G. imbricata*)
Globotruncana lapparenti coronata BOLLI, 1944 = *G. coronata* BOLLI
Globotruncana lapparenti tricarinata (QUEREAU), 1893 = *G. tricarinata* QUEREAU
Locality of figured specimen is Dyr el Kef section, sample 2F 95, W. Tunisia.

Globotruncana lapparenti
× 120



Globotruncana mayaroensis BOLLI

Reference *Globotruncana mayaroensis* BOLLI, 1951: The genus *Globotruncana* in Trinidad, B.W.I. —Journal of Paleontology, 25 (2):198, pl. 35, figs. 10-12.

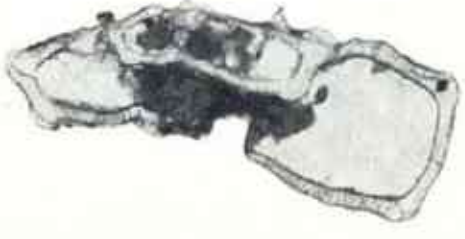
Type locality Subsurface section in the Guayaguayare area, County of Mayaro, southeastern Trinidad.

Diagnosis Test very low trochospiral, spiral side almost flat to slightly convex, umbilical side moderately concave; equatorial periphery lobulate with two beaded keels, of which the one on the umbilical side becomes strongly arched towards the last chamber.
Wall perforate, surface ornamented with fine nodes, including the sidewall between the keels.
Chambers angular-truncate, on umbilical side more inflated than on spiral side, arranged in about 3 whorls, the 4-6 (usually 5) chambers of the last whorl increasing sometimes rapidly in size; on the spiral side a tendency to develop an imbricate structure.
Sutures on spiral side curved, raised and beaded, on umbilical side radial, depressed.
Umbilicus shallow, fairly wide.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Ranging throughout *Globotruncana mayaroensis* zone.

Remarks In 1957 (U.S. Bull. 215) BOLLI, LOEBLICH and TAPPAN introduced the new genus *Abathomphalus*, with *Globotruncana mayaroensis* as its type species. But since the essential generic characteristics are the same as became obvious after several specimens had been thoroughly cleaned preference has again been given to the genus name *Globotruncana*.
Locality of figured specimen is sample 3K 235, W. Tunisia.

Globotruncana mayaroensis
× 80



Globotruncana primitiva DALBIEZ

Reference *Globotruncana (Globotruncana) ventricosa primitiva* DALBIEZ, 1955: The genus *Globotruncana* in Tunisia. — Micropaleontology, 1 (2):168, text fig. 6.

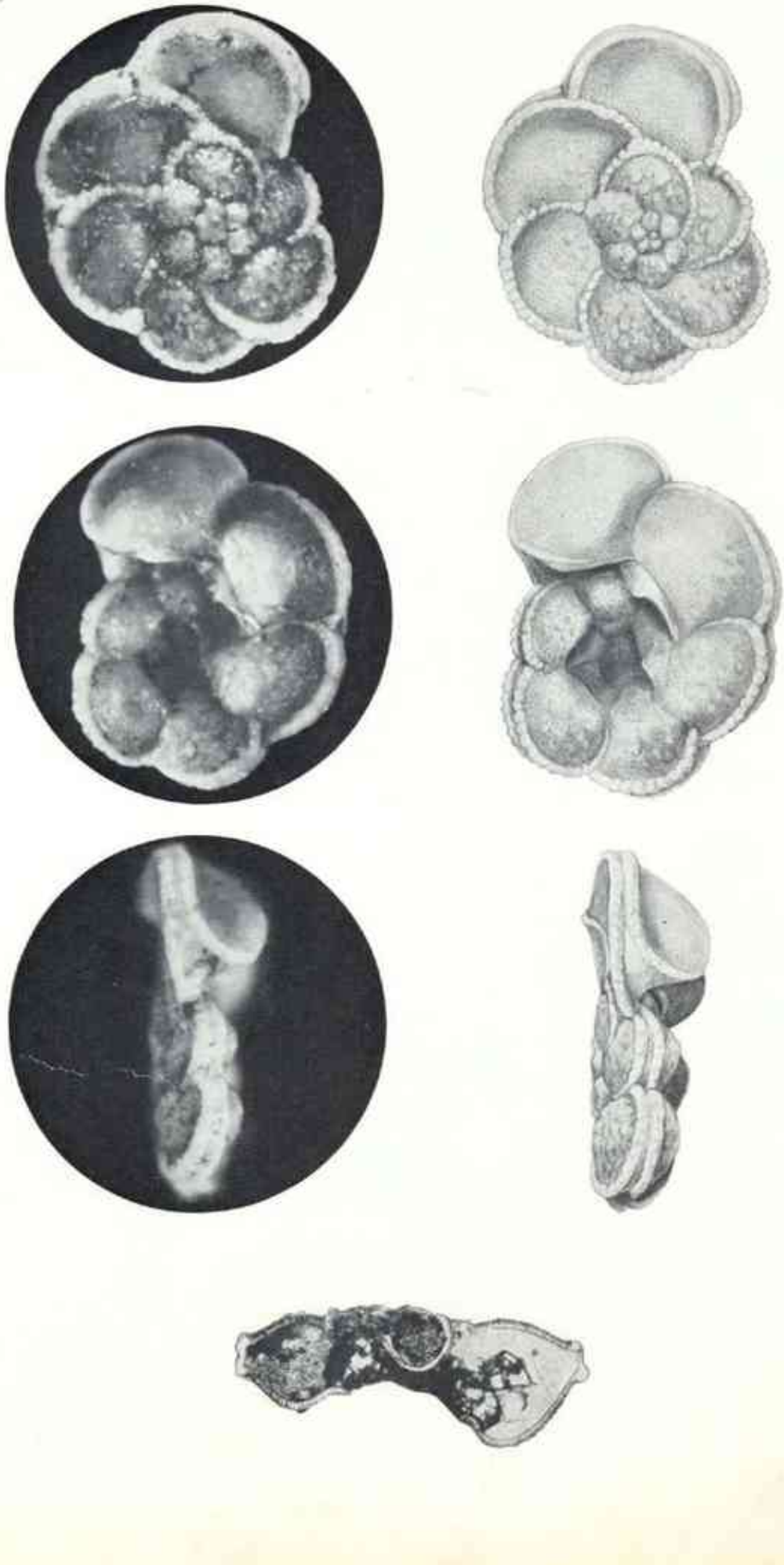
Type locality Le Kef-Mellegue, northwestern Tunisia.

Diagnosis Test very low trochospiral, spiral side almost flat, umbilical side convex; equatorial periphery lobulate with two very closely spaced keels, beaded, which feature may be absent in the last chamber.
Wall perforate, surface of the first chambers of the last whorl somewhat rugose, last chambers smooth.
Chambers subangular, moderately inflated, arranged in about 3 whorls; the (generally 6) chambers of the last whorl increase regularly in size.
Sutures on spiral side distinctly curved, in last whorl raised and beaded; on umbilical side radial, depressed.
Umbilicus shallow, wide.
Primary apertures interiomarginal, umbilical, covered by a low tegillum.

Strat. distr. Upper part *Globotruncana schneegansi* zone and lower part *Globotruncana concavata* zone.

Remarks See remarks *Globotruncana concavata* (BROTZEN).
Locality of figured specimen is sample C 253, W. Tunisia.

Globotruncana primitiva
× 70



Globotruncana renzi GANDOLFI

Reference *Globotruncana renzi* GANDOLFI, 1942: Ricerche micropaleontologiche e stratigrafiche sulla Scaglia e sul Flysch cretacici dei dintorni di Balerna (Canton Ticino). — Rivista Italiana di Paleontologia, 48, Suppl. Mem. 4:124, text fig. 45, pl. III, fig. 1a-c.

Type locality Gorge of the Breggia River, northeast of Balerna, near Chiasso, Canton of Ticino, southeastern Switzerland.

Diagnosis Test low trochospiral, biconvex; equatorial periphery slightly lobulate to lobulate, with two closely spaced beaded keels in early portion of last whorl, last portion (ultimate and occasionally penultimate chamber) with one smooth keel only.
Wall perforate, surface smooth, except on the umbilical side of the first chambers of the last whorl, which may be slightly rugose.
Chambers angular, compressed to slightly inflated, the 5-6 chambers of the last whorl increasing somewhat irregularly in size.
Sutures on spiral side curved to oblique, in last whorl raised and beaded; on umbilical side slightly curved, raised and beaded.
Umbilicus shallow, wide.
Primary apertures interiomarginal, umbilical, covered by a simple low tegillum.

Strat. distr. Almost throughout *Globotruncana schneegansi* zone, questionable occurrence in lower part *Globotruncana concavata* zone.

Remarks *Globotruncana renzi* is probably an intermediate form between *Globotruncana schneegansi* SIGAL and representatives of the "*Globotruncana lapparenti* group".
It may be mentioned that the thin section presented by GANDOLFI on plate X of his paper (1942) is not a *Globotruncana renzi*, but is most probably a section of *Globotruncana imbricata* MORNOD.
Locality of figured specimen is Dyr el Kef section, sample 2F 45, W. Tunisia.

Globotruncana renzi
× 95

Globotruncana schneegansi SIGAL

Reference *Globotruncana schneegansi* SIGAL, 1952: Aperçu stratigraphique sur la micropaléontologie du Crétacé. — 19e Congrès Géologique International, Monographies Régionales, 1 (26): 55, fig. 34.

Type locality Not given (probably northern Algeria).

Diagnosis Test low trochospiral, biconvex; equatorial periphery distinctly lobulate with one bealed keel, which may be weakened and smooth in the last chamber.
Wall perforate, surface slightly rugose.
Chambers angular, the first ones of the last whorl slightly compressed, the last ones slightly inflated; a carina, as continuation of the sutures, may be present on top of all chambers except the last one, arranged in about 3½ whorls; the 5-6 chambers of the last whorl increase somewhat irregularly in size.
Sutures on spiral side curved to oblique, raised, beaded; on umbilical side slightly curved to almost radial, raised and beaded to flush in the first portion of the last whorl, depressed in the last portion.
Umbilicus fairly deep, wide.
Primary apertures interiomarginal, umbilical, covered by a simple, low tegillum.

Strat. distr. Lower part *Globotruncana helvetica* zone into lowermost part *Globotruncana concavata* zone.

Remarks Locality of figured specimen is sample 3K 55, W. Tunisia.

Globotruncana schneegansi
× 70

Globotruncana sigali REICHEL

Reference *Globotruncana (Globotruncana) sigali* REICHEL, 1950: Observations sur les *Globotruncana* du gisement de la Breggia (Tessin). — Eclogae Geologicae Helvetiae, 42 (2):610, pl. 16, fig. 7.

Type locality Sidi Aissa, south of Aumale, Algeria.

Diagnosis Test low trochospiral, biconvex; equatorial periphery moderately lobulate with one slightly beaded keel, which is almost smooth in the last chamber.
Wall perforate, surface smooth.
Chambers angular, compressed; arranged in about 3½ whorls, the 5-7 (usually 6) chambers of the last whorl increasing regularly in size.
Sutures on spiral side raised, beaded, slightly curved to almost straight, oblique, in the last whorl becoming more radial, on umbilical side curved, marked by beaded sigmoid, septal carinae, partly bordering the umbilicus.
Umbilicus shallow, moderately wide.
Primary apertures interiomarginal, umbilical, covered by a simple, low tegillum.

Strat. distr. Uppermost part *Globotruncana helvetica* zone into upper part *Globotruncana concavata* zone.

Remarks Locality of figured specimen is Dyr el Kef section, sample 2F 42, W. Tunisia.

Globotruncana sigali
× 110

Globotruncana stuarti (De Lapparent)

Reference *Rosalina stuarti* De Lapparent, 1918: Etude lithologique des terrains crétacés de la région d'Hendaye. — Mémoires pour servir à l'explication de la carte géologique détaillée de la France: 11, text fig. 4.

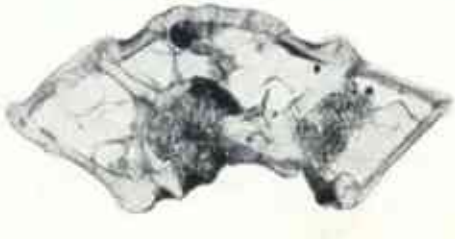
Type locality Pointe Sainte-Anna, Hendaye area, western Pyrenees, France.

Diagnosis Test low trochospiral, biconvex; equatorial periphery slightly lobulate to almost circular, with one beaded keel.
Wall perforate, surface smooth.
Chambers angular, slightly overlapping, with a beaded carina along the umbilical area as continuation of the raised sutures; arranged in about 3½ whorls, the usually 6-7 chambers of the last whorl hardly increasing in size.
Sutures on spiral side straight to slightly curved, raised, moderately beaded; on umbilical side curved, raised, lightly beaded.
Umbilicus deep, wide.
Primary apertures interiomarginal, umbilical, covered by a high tegillum.

Strat. distr. Ranging throughout *Globotruncana stuartiformis* zone, *Globotruncana gansseri* zone and *Globotruncana mayaroensis* zone.

Remarks See remarks *Globotruncana elevata* (Brotzen) and *Globotruncana stuartiformis* Dalbiez.
Locality of figured specimen is sample L 1775, W. Irian.

Globotruncana stuarti
× 65



Globotruncana stuartiformis DALBIEZ

Reference *Globotruncana (Globotruncana) elevata stuartiformis* DALBIEZ, 1955: The genus *Globotruncana* in Tunisia. — Micropaleontology, 1 (2):169, text fig. 10a-c.

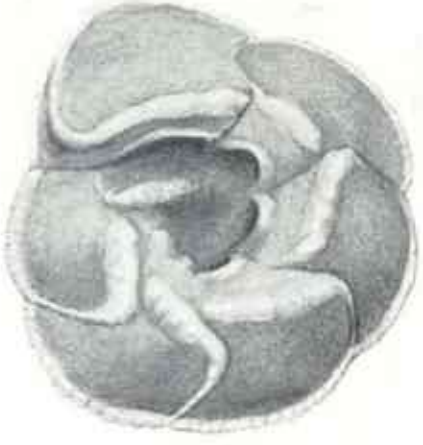
Type locality Le Kef-Mellegue, northwestern Tunisia.

Diagnosis Test very low trochospiral, central part of spiral side slightly convex, spiral side of last whorl almost flat, umbilical side convex; equatorial periphery slightly lobulate to almost circular, with one keel moderately beaded except in the last chamber.
Wall perforate, surface smooth.
Chambers subangular to angular, slightly inflated, often overlapping with a kind of carina on top of each chamber as a continuation of the raised sutures of the umbilical side; arranged in about 3 whorls, the 5-9 (usually 6-8) chambers of the last whorl increasing regularly in size.
Sutures on spiral side slightly curved in the first whorls to almost straight and tangential in the last whorl, raised, moderately beaded, on umbilical side curved, in first part of the last whorl raised and beaded, in later part flush.
Umbilicus deep, wide.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Base *Globotruncana elevata* zone to top *Globotruncana stuartiformis* zone. Questionable occurrence in lower part of *Globotruncana gansseri* zone.

Remarks This species differs from *Globotruncana elevata* (BROTZEN) in the less convex umbilical side, the less distinct central cone on the spiral side, and the contour of the last-formed chambers, which are almost triangular instead of petaliform.
Globotruncana stuarti (DE LAPPARENT) has a more convex spiral side, no central cone, and the contour on the spiral side of the last-formed chambers is trapezoidal.
See also remarks *Globotruncana elevata* (BROTZEN).
Locality of figured specimen is Dyr el Kef section, sample 2F 165, W. Tunisia.

Globotruncana stuartiformis
× 90



Globotruncana ventricosa WHITE

Reference *Globotruncana canaliculata* var. *ventricosa* WHITE, 1928: Some index Foraminifera of the Tampico embayment area of Mexico. — Journal of Paleontology, 2 (4):284, pl. 38, fig. 5a-c.

Type locality Two kilometres northeast of El Barranco on the road to Aldama, Tampico embayment, Mexico.

Diagnosis Test very low trochospiral, spiral side almost flat or slightly convex, umbilical side strongly convex; equatorial periphery lobulate with two fairly widely spaced keels, distinctly beaded, at least in the first portion.
Wall perforate, surface smooth.
Chambers angular, more or less inflated, each developing a carina on top, bordering the umbilicus; arranged in $2\frac{1}{2}$-3 whorls, the 6-7 chambers increase moderately in size, showing on the spiral side a somewhat imbricate structure.
Sutures on spiral side curved, oblique, except the last ones, which become more radial, strongly raised, beaded; on umbilical side slightly curved, flush to depressed.
Umbilicus moderately deep, wide.
Primary apertures interiomarginal, umbilical, covered by a high tegillum.

Strat. distr. Lower part *Globotruncana elevata* zone to top *Globotruncana calcarata* zone. Questionable occurrence in lower part *Globotruncana stuartiformis* zone.

Remarks *Globotruncana ventricosa* might be related to *Globotruncana rosetta* (CARSEY) and *Globotruncana aegyptiaca* NAKKADY.
See remarks on *Globotruncana concavata* (BROTZEN) for differences between this species and *Globotruncana ventricosa* WHITE.
Locality of figured specimen is Dyr el Kef section, sample 2F187, W. Tunesia.

Globotruncana ventricosa
× 95

Hedbergella washitensis (CARSEY)

Reference *Globigerina washitensis* CARSEY, 1926: Foraminifera of the Cretaceous of Central Texas. — The University of Texas Bulletin 2612:44, pl. 7, fig. 10.

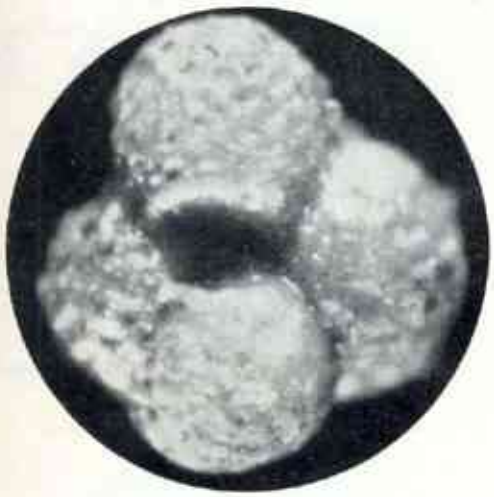
Type locality Shoal Creek at Austin, Travis County, Texas, U.S.A.

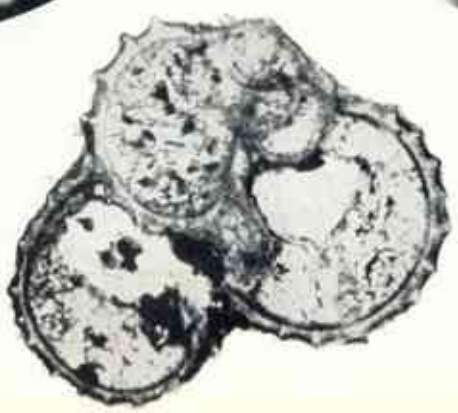
Diagnosis Test low to medium trochospiral; equatorial periphery lobulate to distinctly lobulate.
Wall perforate, surface with coarse reticulations, giving a honeycomb appearance, the elevated ridges leaving deep polygonal pits between them.
Chambers spherical, arranged in about $2\frac{1}{2}$ whorls, the 4-5 chambers of the last whorl increasing irregularly in size.
Sutures distinctly depressed, radial.
Aperture an interiomarginal, rather high arch, nearly umbilical in position, showing a slightly extra-umbilical tendency, bordered by a more or less distinct lip.

Strat. distr. Base *Planomalina buxtorfi* zone to upper part *Rotalipora appenninica* zone. Questionable occurrence in upper part *Globigerinelloides breggiensis* zone and upper part *Rotalipora appenninica* zone.

Remarks Locality of figured specimen is Dyr el Kef section, sample 1F 954, W. Tunisia.

Hedbergella washitensis
× 160





Planomalina buxtorfi (GANDOLFI)

Reference *Planulina buxtorfi* GANDOLFI, 1942: Ricerche micropaleontologiche e stratigrafiche sulla Scaglia e sul Flysch cretacici dei dintorni di Balerna (Canton Ticino). — Rivista Italiana di Paleontologia, 48, Suppl. Mem. 4:103, pl. III, fig. 7.

Type locality Gorge of the Breggia River, northeast of Balerna, near Chiasso, Canton of Ticino, southeastern Switzerland.

Diagnosis Test planispiral, rather deeply biumbilicate, slightly evolute; equatorial periphery lobulate with a distinct keel.
Wall perforate, surface smooth.
Chambers more or less elongated angular-rhomboid; the 9-11 chambers of the last whorl increase regularly in size.
Sutures distinct, strongly curved and raised, early ones beaded to nodose.
Primary aperture interiomarginal, an equatorial arch with lateral extensions reaching back at either side to the septum at the base of the chamber and bordered by a distinct thickened lip, the lateral umbilical portions of successive apertures remaining visible as supplementary relict apertures.

Strat. distr. Ranging throughout *Planomalina buxtorfi* zone.

Remarks The genus *Planomalina* was established in 1946 by LOEBLICH and TAPPAN with the type species *Planomalina aptidoltroba* LOEBLICH and TAPPAN, 1946, which, however, is a synonym of *Planomalina buxtorfi* (GANDOLFI), originally described in 1942 as *Planulina buxtorfi* GANDOLFI.
Most probably *Planomalina? almadevensis* CUSHMAN and TODD, 1948, is also a synonym of *Planomalina buxtorfi* (GANDOLFI).
Locality of figured specimen is Dyr el Kef section, sample 1F 961, W. Tunisia.

Planomalina buxtorfi
× 90

Praeglobotruncana citae (BOLLI)

Reference *Globotruncana citae* BOLLI, 1951: The genus *Globotruncana* in Trinidad, B.W.I. — Journal of Paleontology, 25 (2): 197, pl. 35, figs. 4-6.

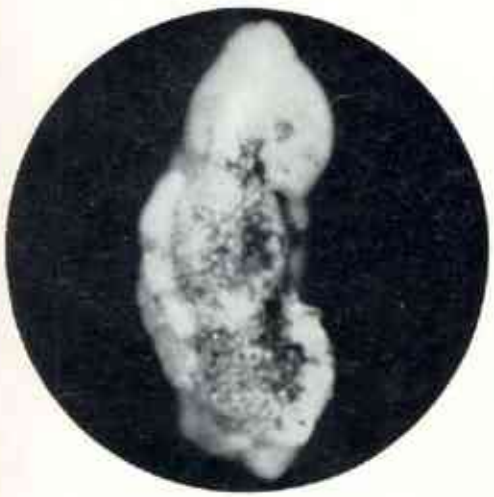
Type locality Outcrop in the river bed south of the bridge near mile post 12.5 on the Guaracara-Tabaquite Road, Lantern Estate, Central Range, Trinidad, B.W.I.

Diagnosis Test low trochospiral, biconvex to slightly spiroconvex; equatorial periphery moderately to distinctly lobulate, with a very moderate keel in the early chambers of the last whorl, which is hardly visible in the last chambers.
Wall perforate, surface mostly smooth; very fine spines may occasionally be present on the surface of the early chambers.
Chambers ovoid to subangular, arranged in 2½-3 whorls; the 4-5 chambers of the last whorl increase regularly in size, showing on the spiral side a slightly imbricate structure. Sutures depressed, on the spiral side curved, on the umbilical side straight and radial. Umbilicus shallow, fairly wide.
Aperture a relatively large, interiomarginal, extraumbilical-umbilical arch bordered by a prominent lip. The umbilical parts of the preceding lips may remain visible.

Strat. distr. Upper part *Globotruncana elevata* zone to top *Globotruncana mayaroensis* zone.

Remarks *Globotruncana havanensis* VOORWIJK, 1937, is closely related to *Praeglobotruncana citae* or even synonymous.
Locality of figured specimen is sample 1K 121, W. Tunisia.

Praeglobotruncana citae
× 160



Praeglobotruncana stephani (GANDOLFI)

Reference *Globotruncana stephani* GANDOLFI, 1942: Ricerche micropaleontologiche e stratigrafiche sulla Scaglia e sul Flysch cretacici dei dintorni di Balerna (Canton Ticino). — Rivista Italiana di Paleontologia, 48, Suppl. Mem. 4:130, pl. III, fig. 4.

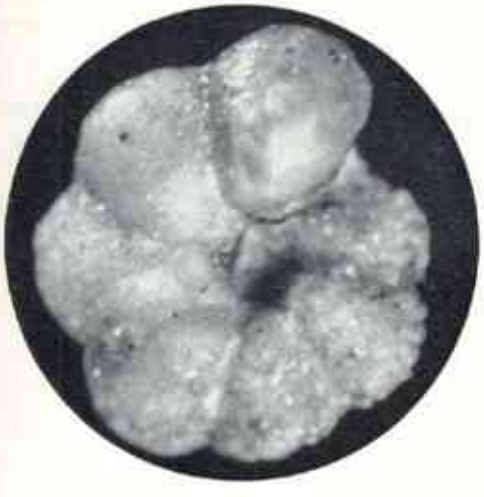
Type locality Gorge of the Breggia River, northeast of Balerna, near Chiasso Canton of Ticino, southeastern Switzerland.

Diagnosis Test trochospiral, biconvex; equatorial periphery slightly lobulate with a nodose keel, which is smooth and less distinct in the last two or three chambers; the nodose keel of earlier whorls remains visible on the spiral side.
Wall perforate, surface of the first chambers of the last whorl moderately nodose, both on the umbilical side and on the spiral side.
Chambers subangular in the early part of the last whorl, the last ones being more rounded and inflated.
Sutures on spiral side gently curved, flush in the early whorls, depressed in the last whorl; on the umbilical side depressed, radial.
Umbilicus narrow, shallow.
Aperture a relatively low, interiomarginal, extraumbilical-umbilical arch, almost extending to the periphery, with a distinct bordering lip. The umbilical parts of the lips of the two or three preceding apertures remain visible.

Strat. distr. Base *Rotalipora appenninica* zone into lower part *Rotalipora cushmani* zone. Questionable occurrence in upper part *Rotalipora cushmani* zone and lowermost part *Globotruncana helvetica* zone.

Remarks It appears that *Praeglobotruncana stephani* and *Praeglobotruncana delrioensis* (PLUMMER) are very close variants. Several authors even regard these species as synonymous; LOEBLICH and TAPPAN (1961) are, on the other hand, of another opinion, and mention some differences.
Locality of figured specimen is Dyr el Kef section, sample 1F 961, W. Tunisia.

Praeglobotruncana stephani
× 115



Praeglobotruncana turbinata (REICHEL)

Reference *Globotruncana stephani* GANDOLFI var. *turbinata* REICHEL, 1949: Observations sur les *Globotruncana* du gisement de la Breggia (Tessin). — Eclogae Geologicae Helvetiae, 42 (2):609.

Type locality Gorge of the Breggia River, northeast of Balerna, near Chiasso, Canton of Ticino, southeastern Switzerland.

Diagnosis Test trochospiral, slightly biconvex to spiroconvex; equatorial periphery slightly lobulate with a nodose keel, which may be smooth and less distinct in the last two chambers; the nodose keel of earlier whorls remains visible on the spiral side.
Wall perforate, surface of the first chambers of the last whorl moderately nodose, both on the umbilical side, and on the spiral side.
Chambers subangular in the early part of the last whorl, the last ones being more inflated.
Sutures on spiral side gently curved, raised and beaded, the last ones may be smooth; on the umbilical side depressed, radial.
Umbilicus fairly wide and deep.
Aperture a relatively low, interiomarginal, extraumbilical-umbilical arch, almost extending to the periphery, bordered by a flap, which may fuse with the preceding flap.

Strat. distr. Lower part *Rotalipora cushmani* zone into upper part *Globotruncana helvetica* zone. Questionable occurrence in uppermost part *Globotruncana helvetica* zone.

Remarks Locality of figured specimen is sample 3K 55, W. Tunisia.

Praeglobotruncana turbinata
× 100







Rotalipora appenninica (RENZ)

Reference *Globotruncana appenninica* RENZ, 1936: Stratigrafische und micropalaeontologische Untersuchung der Scaglia (Obere Kreide-Tertiär) im Zentralen Apennin. — Eclogae Geologicae Helvetiae, 29 (1):20, text fig. 2.

Type locality Profile I, Bottaccione valley, northeastern Gubbio, Italy.

Diagnosis Test low trochospiral, biconvex; equatorial periphery lobulate, with one keel, which is weakly beaded in the early part.
Wall perforate, surface smooth.
Chambers angular-rhomboid, moderately inflated on the umbilical side; a smooth raised edge is present on top of the chambers on the umbilical side as continuation of the sutures; arranged in about 3 whorls, the 6-7 chambers of the last whorl increasing regularly in size.
Sutures on spiral side curved and oblique, raised, may be lightly beaded, especially in the first whorls; on umbilical side radial to gently curved, flush to raised in the early part of the last whorl, depressed in the later part.
Umbilicus fairly deep and narrow.
Primary aperture a fairly low, interiomarginal, extraumbilical-umbilical arch, bordered by a faint lip, which is only visible in the last chamber; single distinct sutural secondary apertures, bordered by a lip, climbing up to the position of the umbilical shoulder, visible in the last chambers only.

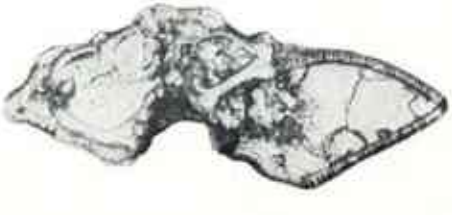
Strat. distr. Base *Rotalipora appenninica* zone into lowermost *Rotalipora cushmani* zone.

Remarks *Rotalipora appenninica* was originally described from thin sections, and at that time this species comprised practically all known single-keeled forms of the Cenomanian.
GANDOLFI (1942) introduced a new species, *Globotruncana ticinensis*, and distinguished a number of varieties which were later given species rank:

Globotruncana appenninica var. α: *Rotalipora balernaensis* (GANDOLFI)
" " var. β: *Praeglobotruncana turbinata* (REICHEL)
" " var. γ: *Rotalipora reicheli* (MORNOD)
" " s.s. or *typica*: *Rotalipora appenninica* (RENZ)

Locality of figured specimen is sample 1K 291, W. Tunisia.

Rotalipora appenninica
× 125



Rotalipora cushmani (MORROW)

Reference *Globorotalia cushmani* MORROW, 1934: Foraminifera and Ostracoda from the Upper Cretaceous of Kansas. — Journal of Paleontology, 8 (2):199, pl. 31, figs. 2a-b, 4a-b.

Type locality Sec. 31, T. 21S, R. 31W., Hodgeman County, Kansas, U.S.A.

Diagnosis Test low trochospiral, biconvex; equatorial periphery lobulate to distinctly lobulate, with a weakly beaded narrow keel, which is mostly smooth in the last chambers.
Wall perforate, surface slightly rugose on both sides.
Chambers angular-rhomboid, strongly inflated on both sides; a three-sided thickened ridge may be present on top of the last chambers on the umbilical side, where the inflation is most prominent; arranged in about 2½ whorls, the 5-6 chambers of the last whorl increasing rather rapidly in size.
Sutures on spiral side curved, raised and weakly beaded in last whorl, depressed in initial whorls; on umbilical side radial, depressed.
Umbilicus fairly wide and deep.
Primary aperture a high, interiomarginal, extraumbilical-umbilical arch, bordered above by a distinct lip, only visible in the last chamber; a single elongated, well developed sutural secondary aperture bordered by a lip is present on the umbilical shoulder of each chamber.

Strat. distr. Ranging throughout *Rotalipora cushmani* zone.

Remarks The following species are considered synonyms:
Rotalipora turonica BROTZEN, 1942
Globotruncana alpina BOLLI, 1945
Globotruncana (Rotalipora) montsalvensis MORNOD, 1949
Locality of figured specimen is Neuweidgraben, sample 1,395m, Ammergau Mountains, southern Germany.

Rotalipora cushmani
× 90

Rotalipora greenhornensis (MORROW)

Reference *Globorotalia greenhornensis* MORROW, 1954: Foraminifera and Ostracoda from the Upper Cretaceous of Kansas. — Journal of Paleontology, 8:199, pl. 31, fig. 1.

Type locality Sec. 31, T. 21S., R. 22W., Hodgeman County, Kansas, U.S.A.

Diagnosis Test low trochospiral, biconvex; equatorial periphery slightly lobulate to almost circular with a very lightly beaded to smooth keel.
Wall perforate, surface usually smooth but may be somewhat nodose in the first chambers of the last whorl.
Chambers angular-rhomboid, arranged in $2\frac{1}{2}$-3 whorls; the 6-8 chambers of the last whorl increase regularly and slowly in size.
Sutures on spiral side curved to slightly curved, oblique, but may become more radial between the last chambers, strongly raised, lightly beaded; on umbilical side curved, marked by lightly beaded septal carinae with periumbilical lengthenings, the septal carinae may be absent between the last two or three chambers.
Umbilicus deep, rather narrow to fairly wide.
Primary aperture a relatively high interiomarginal, extraumbilical-umbilical arch, bordered by a lip as part of an imperforate flange projecting from the chamber wall into the umbilicus which fuses with the flanges of the preceding chambers; a single sutural secondary aperture bordered by a rim is visible near the umbilical shoulder of most chambers.

Strat. distr. Base *Rotalipora greenhornensis* zone to upper part *Rotalipora cushmani* zone.

Remarks *Thalmaninella brotzeni* SIGAL and *Rotalipora globotruncanoides* SIGAL, both described in 1948 from Algerian material, are considered to be synonyms of *Rotalipora greenhornensis*.
Locality of figured specimen is Dyr el Kef section, sample 2F 10, W. Tunisia.

Rotalipora greenhornensis
× 75

Rotalipora reicheli (MORNOD)

Reference *Globotruncana (Rotalipora) reicheli* MORNOD, 1949: Les Globorotalidés du Crétacé supérieur du Montsalvens (Préalpes fribourgeoises). — Eclogae Geologicae Helvetiae, 42 (2): 583, text fig. 5, IVa-c.

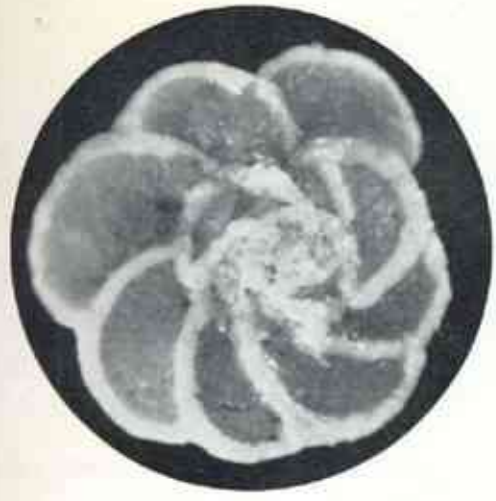
Type locality Upper part of Profile III, at about 985 metres above sea level, in the Ruisseau des Covayes, on the southeastern slope of the Montsalvens chain, north of Cerniat, in the Préalpes fribourgeoises, Switzerland.

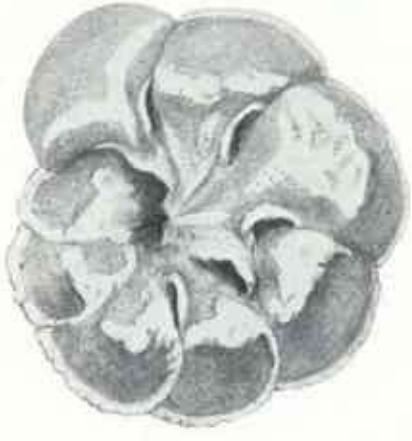
Diagnosis Test low trochospiral, central part of spiral side convex, spiral side of last whorl flat to concave, umbilical side strongly convex, especially the last chambers; equatorial periphery slightly lobulate with a beaded keel, which becomes narrow and smooth in the last chambers.
Wall perforate; surface smooth, except the umbilical shoulders in the later portion of the test, which may be rugose.
Chambers angular to subangular, last ones becoming strongly inflated and steep on umbilical side; a nodose raised edge is present on top of the chambers on the umbilical side as continuation of the sutures; arranged in about 3 whorls, the 6-8 chambers of the last whorl sometimes increasing irregularly in size.
Sutures on spiral side oblique and curved, raised, distinctly beaded, especially in the first whorls; on umbilical side gently curved to radial, raised in the early portion of the last whorl, depressed in the later portion.
Umbilicus wide and fairly deep.
Primary aperture a high interiomarginal, extraumbilical-umbilical arch, bordered by a lip as part of an imperforate flange projecting from the chamber wall into the umbilicus which fuses with the flanges of the preceding chambers; a single distinct sutural secondary aperture bordered by a rim is present near the umbilical shoulder of each chamber.

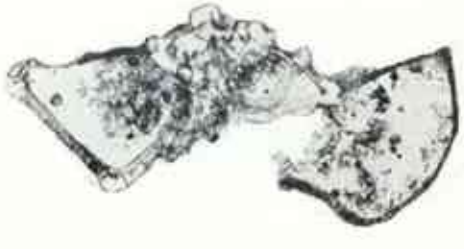
Strat. distr. Ranging throughout upper part *Rotalipora cushmani* zone, extending a little into the lower part of this zone.

Remarks Locality of figured specimen is Dyr el Kef section, sample 1F 601, W. Tunisia.

Rotalipora reicheli
× 90







Rotalipora subticinensis (GANDOLFI)

Reference *Globotruncana ticinensis* GANDOLFI var. α, 1942: Ricerche micropaleontologiche e stratigrafiche sulla Scaglia e sul Flysch cretacici dei dintorni di Balerna (Canton Ticino). — Rivista Italiana di Paleontologia, 48, Suppl. Mem. 4:114, pl. II, fig. 4
Globotruncana (Thalmaninella) ticinensis subticinensis GANDOLFI, 1957: Notes on some species of *Globotruncana*. — Contr. Cushman Found. Foram. Res., VIII:59, pl. 8, fig. 2.

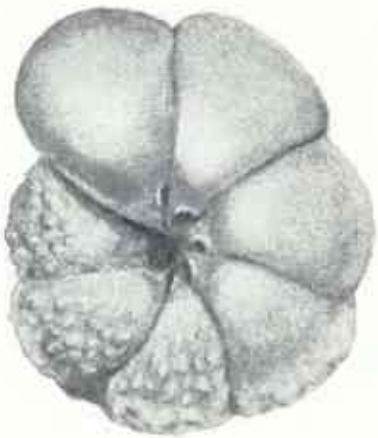
Type locality Gorge of the Breggia River, northeast of Balerna, near Chiasso, Canton of Ticino, southeastern Switzerland.

Diagnosis Test low trochospiral, biconvex; equatorial periphery slightly lobulate to almost circular, with a faint keel, which is nodose in the early part.
Wall perforate; on the spiral side, surface of the chambers of the inner whorls and of the first three or four chambers of the last whorl distinctly nodose; on the umbilical side, surface of the first three or four chambers distinctly nodose.
Chambers angular in the penultimate whorl, subangular in the early part of the last whorl, the last ones becoming rounded and inflated.
Sutures on spiral side slightly curved, depressed, on umbilical side radial, depressed.
Umbilicus shallow, relatively narrow.
Primary aperture an interiomarginal, extraumbilical-umbilical arch bordered by a lip only visible in the last chamber; single sutural secondary apertures bordered by a faint rim, always situated on the umbilical side of and below the umbilical shoulders, are fairly distinct in the last chambers only.

Strat. distr. Ranging throughout the *Rotalipora subticinensis* zone and the lower part of the *Globigerinelloides breggiensis* zone.

Remarks Locality of figured specimen is Dyr el Kef section, sample 1F 936, W. Tunisia.

Rotalipora subticinensis
× 160



Rotalipora ticinensis (GANDOLFI)

Reference *Globotruncana ticinensis* GANDOLFI, 1942: Ricerche micropaleontologiche e stratigrafiche sulla Scaglia e sul Flysch cretacici dei dintorni di Balerna (Canton Ticino). — Rivista Italiana di Paleontologia, 48, Suppl. Mem. 4:113, pl. II, fig. 3.

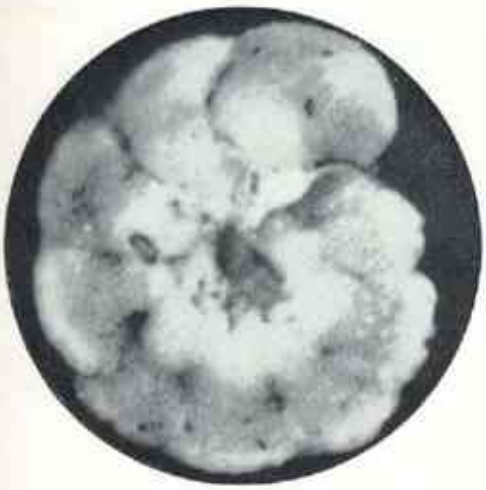
Type locality Gorge of the Breggia River, northeast of Balerna, near Chiasso, Canton of Ticino, southeastern Switzerland.

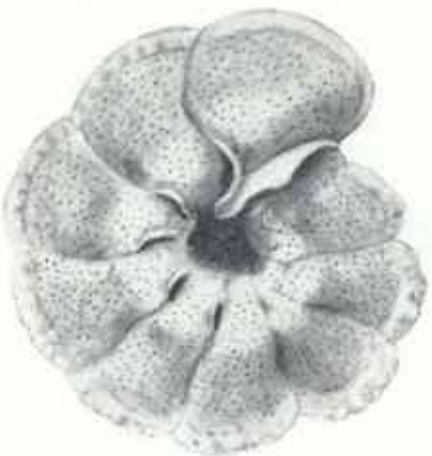
Diagnosis Test low trochospiral, biconvex; equatorial periphery slightly lobulate to almost circular, with a beaded keel which may be smooth in the last chamber.
Wall perforate, surface smooth.
Chambers angular, rather compressed; arranged in $2\frac{1}{2}$-3 whorls, the 7-8 chambers of the last whorl increasing slowly in size.
Sutures on spiral side curved, moderately oblique, raised, lightly beaded; on umbilical side radial to gently curved, raised to flush in the early part of the last whorl, depressed in the later part.
Umbilicus fairly wide and shallow.
Primary aperture a fairly high, interiomarginal, extraumbilical-umbilical arch bordered by a lip, only visible in the last chamber; single sutural secondary apertures, bordered by a rim, always situated under the umbilical shoulders, are distinct in the last chambers only.

Strat. distr. Base *Globigerinelloides breggiensis* zone into lower part *Rotalipora appenninica* zone.

Remarks Locality of figured specimen is sample G 731, W. Tunisia.

Rotalipora ticinensis
× 135





Rugoglobigerina rotundata BRONNIMANN

Reference *Rugoglobigerina rugosa rotundata* BRONNIMANN, 1952: Globigerinidae from the Upper Cretaceous (Cenomanian-Maestrichtian) of Trinidad, B.W.I. — Bulletin of American Paleontology, 34 (140): 34, pl. 4, figs. 7-9.

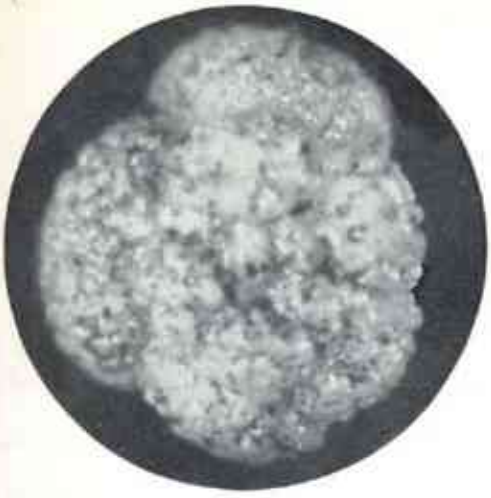
Type locality Trinidad Leaseholds Ltd. Catalogue nos. 155591-155594, subsurface samples from the Guayaguayare area, southeastern Trinidad, B.W.I.

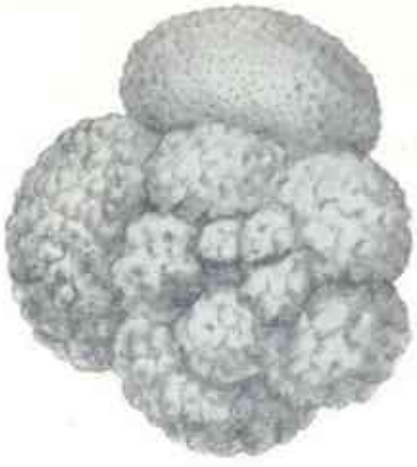
Diagnosis Test starts low trochospiral, followed in the adult by a higher whorl; equatorial periphery lobulate.
Wall perforate, surface rugose with numerous densely placed pustules, decreasing in size towards the last chamber.
Chambers spherical, truncate towards the apertures; arranged in about 2½ whorls, the 5-6 chambers of the last whorl increasing moderately in size.
Sutures depressed, on the spiral side straight to slightly curved, on the umbilical side straight.
Umbilicus fairly wide, deep.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

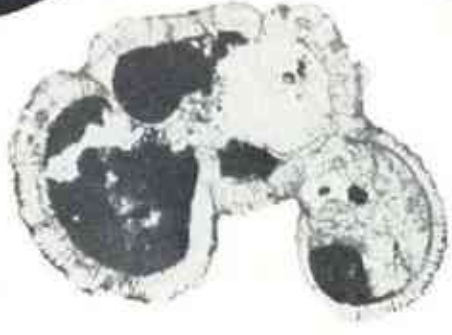
Strat. distr. Ranging throughout *Globotruncana gansseri* zone and *Globotruncana mayaroensis* zone.

Remarks Locality of figured specimen is sample 1K 117, W. Tunisia.

Rugoglobigerina rotundata
× 115







Rugoglobigerina rugosa (PLUMMER)

Reference *Globigerina rugosa* PLUMMER, 1926: Foraminifera of the Midway formation in Texas. — The University of Texas Bulletin, 2644:38, pl. II, fig. 10a-d.

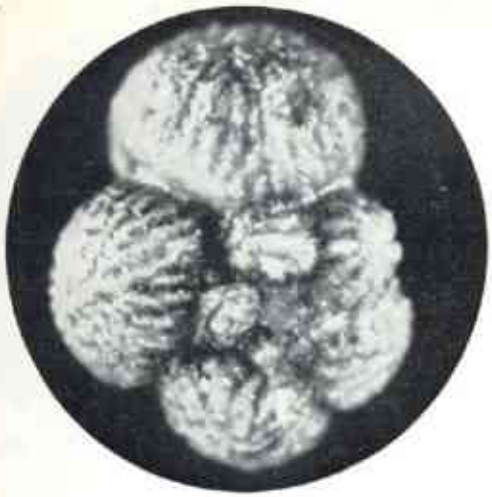
Type locality From bank of Walker Creek, 6 miles N. 15° E. of Cameron, Milam County, Texas, U.S.A.

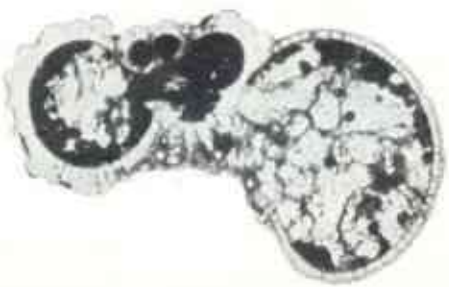
Diagnosis Test low trochospiral, equatorial periphery distinctly lobulate.
Wall perforate, surface of the chambers of the last whorl rugose with numerous large pustules which often coalesce into distinct ridges, radiating from the midpoint of each chamber on the periphery.
Chambers spherical, truncate towards the apertures; arranged in about 2½ whorls, the 4-6 chambers of the last whorl increasing rapidly in size.
Sutures depressed, on the spiral side straight to slightly curved, on the umbilical side straight.
Umbilicus wide, fairly deep.
Primary apertures interiomarginal, umbilical, covered by a tegillum.

Strat. distr. Upper part *Globotruncana calcarata* zone to top *Globotruncana mayaroensis* zone. Questionable occurrence in upper part *Globotruncana elevata* zone and lower part *Globotruncana calcarata* zone.

Remarks Locality of figured specimen is Well Guayaguayare 163, core sample 5588'-5598', Trinidad, B.W.I.

Rugoglobigerina rugosa
× 110





Rugoglobigerina scotti (BRONNIMANN)

Reference *Trinitella scotti* BRONNIMANN, 1952: Globigerinidae from the Upper Cretaceous (Cenomanian-Maestrichtian) of Trinidad, B.W.I. — Bulletin of American Paleontology, 34 (140): 57, pl. 4, figs. 4-6.

Type locality Trinidad Leaseholds Ltd. Catalogue nos. 155591-155594, subsurface samples from the Guayaguayare area, southeastern Trinidad, B.W.I.

Diagnosis Test very low trochospiral, spiral side almost flat, umbilical side moderately convex; equatorial periphery lobulate.
Wall perforate, surface of the chambers strongly rugose (pustules and ridges), except the last one, which is mostly smooth.
Chambers of the initial whorls and the first chambers of the last whorl are subglobular, graduâlly increasing in size, the last chambers becoming flattened on the spiral side and abruptly enlarged, about twice as large as the penultimate ones; arranged in $2\frac{1}{2}$-3 whorls, the last whorl consisting of 5-6 chambers.
Sutures depressed, on the spiral side strongly curved, on the umbilical side relatively straight to slightly curved. Some specimens show elevated sutures between the last chambers on the spiral side, in which case an indistinct pseudo-keel may be present.
Umbilicus fairly wide.
Primary apertures interiomarginal, umbilical, covered by a delicate tegillum.

Strat. distr. Ranging throughout *Globotruncana mayaroensis* zone.

Remarks Locality of figured specimen is Dyr el Kef section, sample 2F 228, W. Tunisia.

Rugoglobigerina scotti
× 160

Ticinella roberti (GANDOLFI)

Reference *Anomalina roberti* GANDOLFI, 1942: Ricerche micropaleontologiche e stratigrafiche sulla Scaglia e sul Flysch cretacici dei dintorni di Balerna (Canton Ticino). — Rivista Italiana di Paleontologia, 48, Suppl. Mem. 4:100, pl. II, fig. 2.

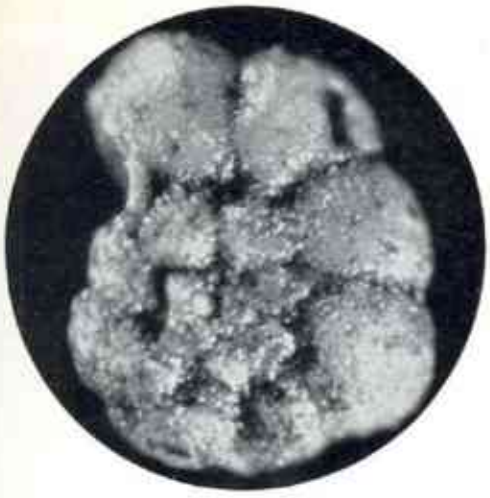
Type locality Gorge of the Breggia River, northeast of Balerna, near Chiasso, Canton of Ticino, southeastern Switzerland.

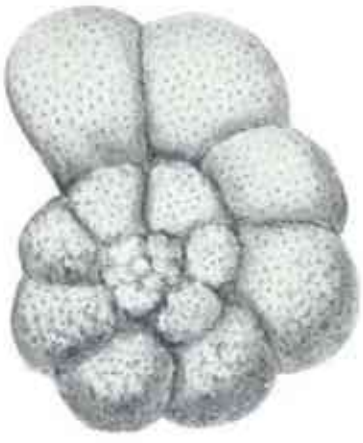
Diagnosis Test low trochospiral, the last evolution may be in a higher whorl; equatorial periphery lobulate.
Wall perforate, surface of the early chambers somewhat rugose, later chambers of the last whorl smooth.
Chambers subglobular, especially somewhat flattened on the spiral side, arranged in $2^1/_2$-3 whorls, the usually 8 chambers of the last whorl increasing gradually in size.
Sutures depressed, gently curved on the spiral side, nearly straight and radial on the umbilical side.
Umbilicus fairly wide.
Primary aperture a low, interiomarginal, extraumbilical-umbilical arch bordered by a lip as part of an imperforate flange projecting from the chamber wall into the umbilicus, fusing with the flanges of the preceding chambers; sutural secondary apertures bordered by rims are present near the umbilical margin.

Strat. distr. Ranging throughout *Ticinella roberti* zone to top *Planomalina buxtorfi* zone. Questionable occurrence in lower part *Rotalipora appenninica* zone.

Remarks Locality of figured specimen is Dyr el Kef section, sample 1F 932, W. Tunisia.

Ticinella roberti
× 115





MESOZOIC ASSEMBLAGES IN THIN SECTIONS OF HARD ROCKS

Figure 1 — Foraminiferal wackestone with *Ticinella roberti* (GANDOLFI) and *"Ticinella" lorneiana* (D'ORBIGNY). × 25
Sample Bn 103 of a section between Probbico and San Lorenzo, Marches-Umbria area, Italy.
Ticinella roberti zone.

Figure 2 — Foraminiferal wackestone with *Rotalipora subticinensis* (GANDOLFI). × 17
Sample Bn 306 of the Monte Torre section, Marches-Umbria area, Italy.
Rotalipora subticinensis zone.

Figure 3 — Foraminiferal wackestone with *Globigerinelloides breggiensis* (GANDOLFI) and *Rotalipora ticinensis* (GANDOLFI). × 20
Sample Bn 307 of the Monte Torre section, Marches-Umbria area, Italy.
Globigerinelloides breggiensis zone.

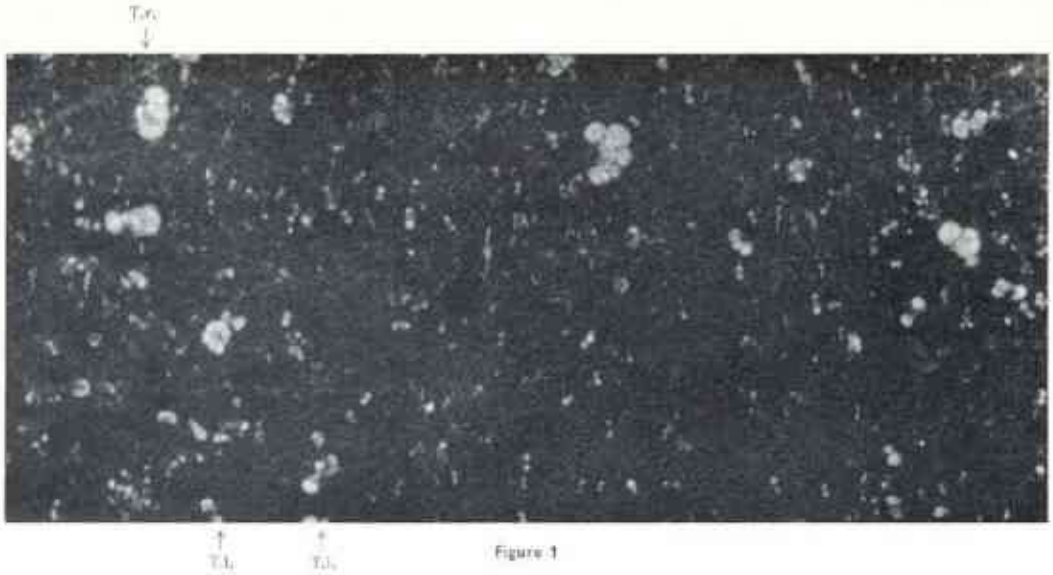


Figure 1

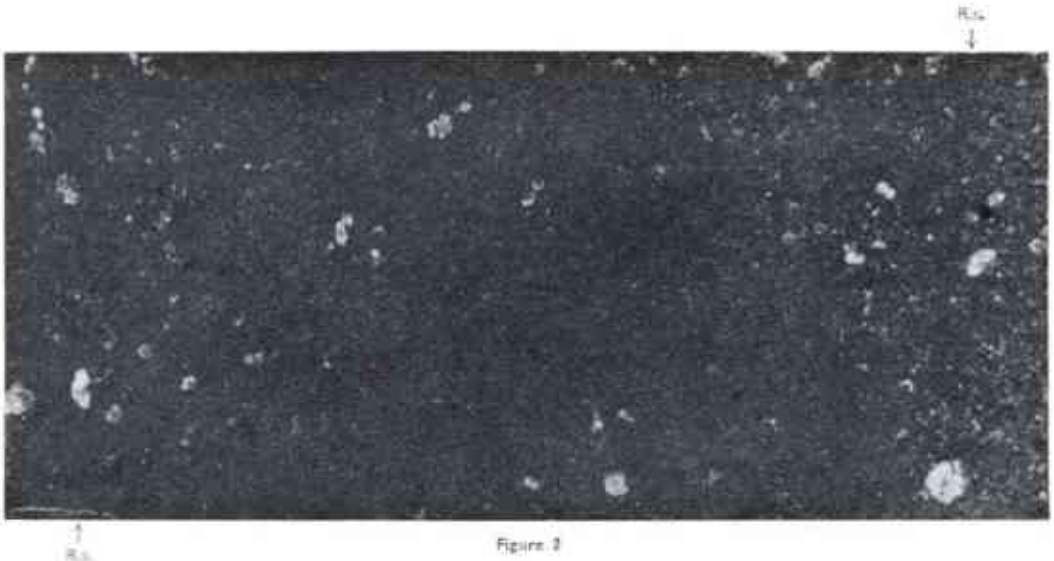


Figure 2

Figure 3

Figure 4 — Foraminiferal wackestone with *Planomalina buxtorfi* (GANDOLFI). × 22.5
Sample Bn 309 of the Monte Torre section, Marches-Umbria area, Italy.
Planomalina buxtorfi zone.

Figure 5 — Foraminiferal wackestone with *Rotalipora appenninica* (RENZ) and *Praeglobotruncana stephani* (GANDOLFI). × 18
Sample Bn 252 of the Gubbio section, Marches-Umbria area, Italy (near type locality of *Rotalipora appenninica*).
Rotalipora appenninica zone.

Figure 6 — Foraminiferal wackestone with *Rotalipora cushmani* (MORROW). × 17
Sample Ni 799 of the Murree Brewery section, near Quetta, W. Pakistan.
Rotalipora cushmani zone.

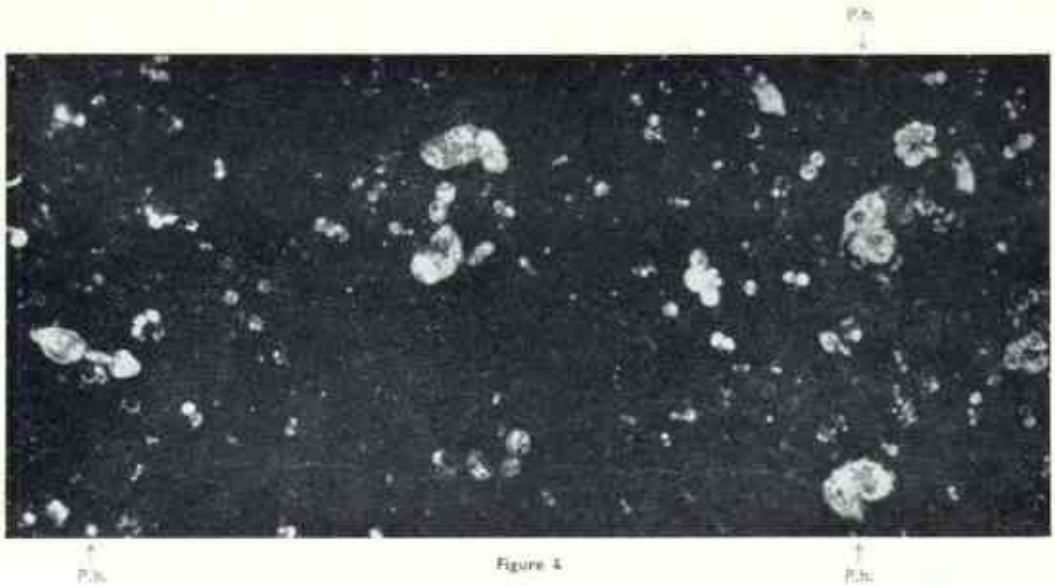


Figure 4

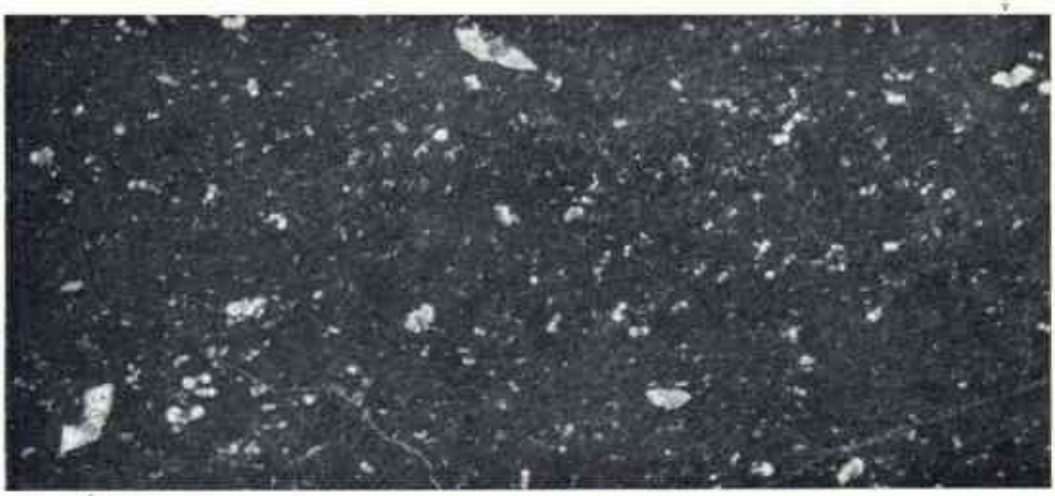


Figure 5

Figure 6

Figure 7 — Foraminiferal wackestone with *Globotruncana helvetica* BOLLI, *Globotruncana imbricata* MORNOD and *Praeglobotruncana turbinata* (REICHEL). × 18
Sample Sc. 1010 of the Peromanda section, Loralai area, W. Pakistan.
Globotruncana helvetica zone.

Figure 8 — Foraminiferal wackestone with *Globotruncana imbricata* MORNOD and double-keeled globotruncanas. × 20
Sample Sc. 1015 of the Peromanda section, Loralai area, W. Pakistan.
Globotruncana schneegansi zone.

Figure 9 — Foraminiferal wackestone with *Globotruncana concavata* (BROTZEN). × 18
Sample Sc. 1512 of the Dilkuna section, Loralai area, W. Pakistan.
Globotruncana concavata zone.

Figure 7

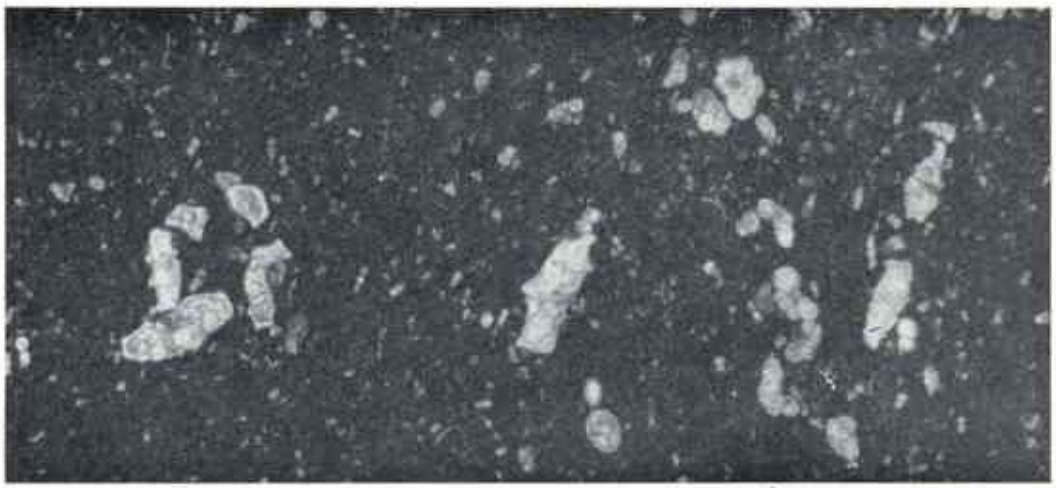


Figure 8

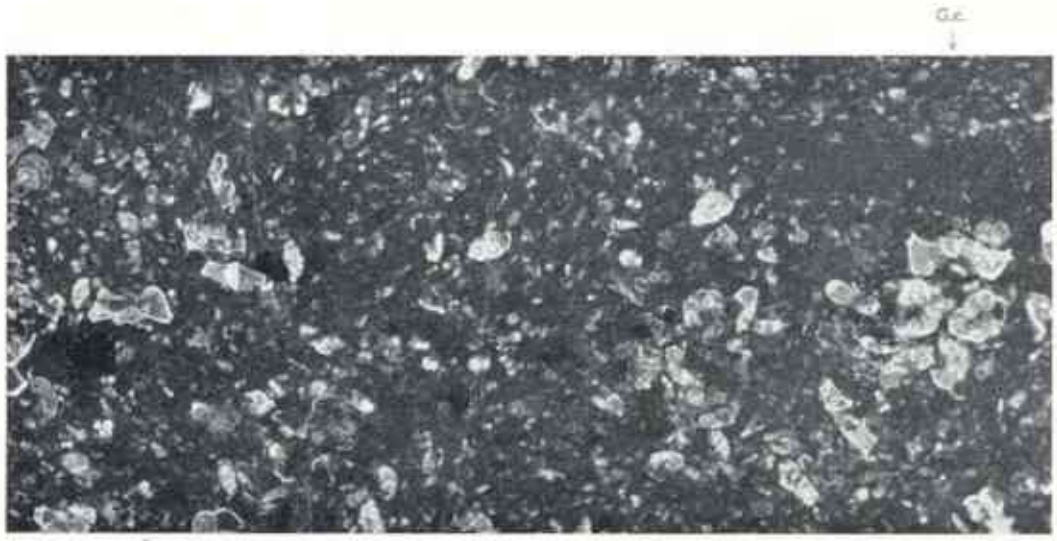


Figure 9

Figure 10 — Foraminiferal wackestone with *Globotruncana carinata* DALBIEZ. × 20
Sample Sc. 1417 of the Sembar section, Loralai area, W. Pakistan.
Globotruncana carinata zone.

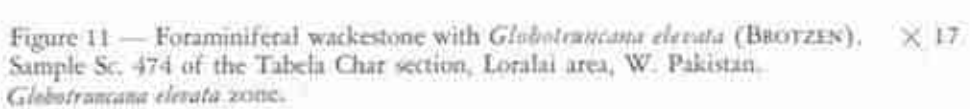


Figure 11 — Foraminiferal wackestone with *Globotruncana elevata* (BROTZEN). × 17
Sample Sc. 474 of the Tabela Char section, Loralai area, W. Pakistan.
Globotruncana elevata zone.

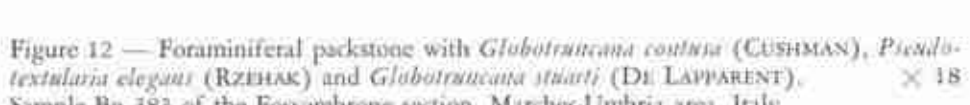


Figure 12 — Foraminiferal packstone with *Globotruncana contusa* (CUSHMAN), *Pseudotextularia elegans* (RZEHAK) and *Globotruncana stuarti* (DE LAPPARENT). × 18
Sample Bn 383 of the Fossombrone section, Marches-Umbria area, Italy.
Globotruncana gansseri zone – *Globotruncana mayaroensis* zone.

Figure 10

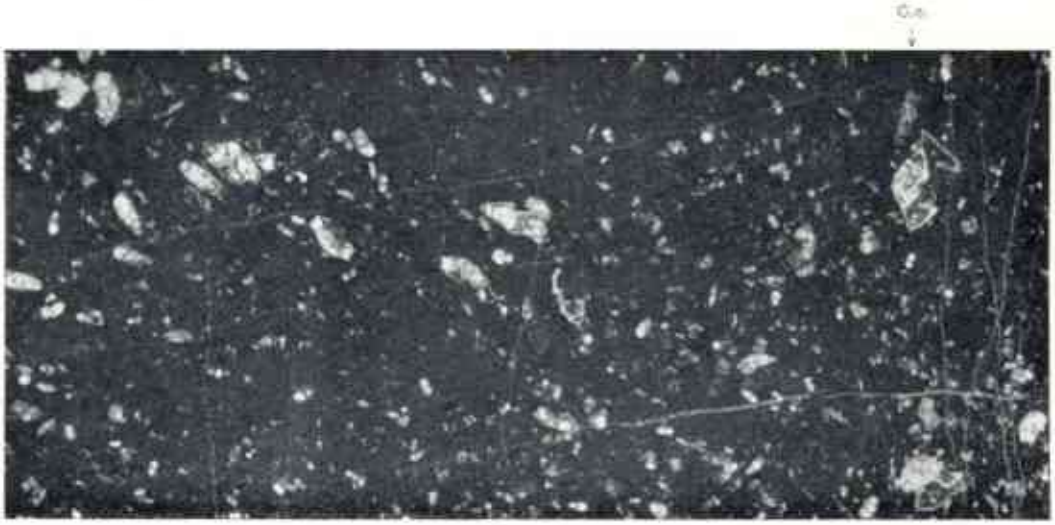


Figure 11

Figure 12

TRINITY p. p.
FREDERICKS-BURG
WASHITA
WOODBINE
EAGLE FORD
AUSTIN
TAYLOR
NAVARRO
TENTATIVE CORRELATION WITH GULF COAST CRETACEOUS
(After U. S. Nat. Mus. Bull. 215, p. 22)
ALBIAN p. p.
CENOMANIAN
TURONIAN
CONIACIAN
SANTONIAN
CAMPANIAN
MAASTRICHTIAN
TENTATIVE CORRELATION WITH EUROPEAN STAGES
Ticinella roberti (GANDOLFI)
Rotalipora subticinensis (GANDOLFI)
Globigerinelloides breggiensis (GANDOLFI)
Rotalipora ticinensis (GANDOLFI)
Hedbergella washitensis (CARSEY)
Planomalina buxtorfi (GANDOLFI)
Rotalipora appenninica (RENZ)
Praeglobotruncana stephani (GANDOLFI)
Rotalipora greenhornensis (MORROW)
Rotalipora cushmani (MORROW)
Praeglobotruncana turbinata (REICHEL)
Rotalipora reicheli (MORNOD)
Globotruncana helvetica BOLLI
Globotruncana imbricata MORNOD

RANGE CHART, ZONATION AND CORRELATION WITH EXISTING ZO

Questionable occurrence

GENERA	
Globotruncana	Globotruncana sigali REICHEL
Globotruncana	Globotruncana renzi GANDOLFI
Globotruncana	Globotruncana angusticarinata GANDOLFI
Globotruncana	Globotruncana coronata BOLLI
Globotruncana	Globotruncana fornicata PLUMMER
Globotruncana	Globotruncana primitiva DALBIEZ
Globotruncana	Globotruncana concavata (BROTZEN)
Globotruncana	Globotruncana lapparenti BOLLI
Globotruncana	Globotruncana carinata DALBIEZ
Globotruncana	Globotruncana bulloides VOGLER
Globotruncana	Globotruncana elevata (BROTZEN)
Globotruncana	Globotruncana stuartiformis DALBIEZ
Globotruncana	Globotruncana ventricosa WHITE
Globotruncana	Globotruncana conica WHITE
Praeglobotruncana	Praeglobotruncana citae (BOLLI)
Rugoglobigerina	Rugoglobigerina rugosa (PLUMMER)
Globotruncana	Globotruncana calcarata CUSHMAN
Globotruncana	Globotruncana arca (CUSHMAN)
Globotruncana	Globotruncana stuarti (DE LAPPARENT)
Globotruncana	Globotruncana falsostuarti SIGAL
Globotruncana	Globotruncana gansseri BOLLI
Rugoglobigerina	Rugoglobigerina rotundata BRÖNNIMANN
Globotruncana	Globotruncana contusa (CUSHMAN)
Globotruncana	Globotruncana gagnebini TILEV
Globotruncana	Globotruncana mayaroensis BOLLI
Rugoglobigerina	Rugoglobigerina scotti (BRÖNNIMANN)
Globotruncana	Globotruncana h
Globotruncana	Globotruncana s
Globotruncana	Globotruncana c
Globotruncana	Globotruncana c
Globotruncana	Globotruncana e
Globotruncana	Globotruncana c
Globotruncana	Globotruncana s
Globotruncana	Globotruncana g
Globotruncana	Globotruncana m
Rotalipora	Rotalipora greenh
Rotalipora	Rotalipora cushm
Rotalipora	Rotalipora apparen
Planomalina	Planomalina buxto
Globigerinelloides	Globigerinelloides
Rotalipora	Rotalipora subtici
Ticinella	Ticinella roberti

WITH EXISTING ZONATIONS

CHART 1

Globotruncana gagnebini TILEV	Globotruncana mayaroensis BOLLI	Rugoglobigerina scotti (BRÖNNIMANN)	GENERAL ZONATION	LOCAL ZONATIO: TRINIDAD (BOLLI, 1957 and 1959)	NORTH AFRICA (DALBIEZ, 1955)	WESTERN G (PES
			Globotruncana mayaroensis	Globotruncana mayaroensis	Globotruncana contusa	Globotruncana contusa - stuartiform
			Globotruncana gansseri	Globotruncana gansseri		
			Globotruncana stuartiformis	Globotruncana lapparenti tricarinata	Globotruncana arca	Globotruncana fornicata - stuartiform
			Globotruncana calcarata		Globotruncana elevata	
			Globotruncana elevata	Globotruncana stuarti		
			Globotruncana carinata	Globotruncana fornicata	Globotruncana ventricosa	Globotruncana bulloides
			Globotruncana concavata	Globotruncana concavata		
			Globotruncana schneegansi	Globotruncana renzi	Globotruncana schneegansi	Marginotruncana renzi
			Globotruncana helvetica	Globotruncana inornata	Globotruncana helvetica	Marginotruncana helvetica
			Rotalipora cushmani		Upper Rotalipora	Rotalipora s.s.
			Rotalipora greenhornensis		Middle Rotalipora	
			Rotalipora appenninica	Rotalipora appenninica appenninica	Lower Rotalipora	
				Globigerina washitensis		
				Rotalipora ticinensis ticinensis		
			Planomalina buxtorfi		Thalmanninella	Hedbergella washitensis
				Praeglobotruncana rohri		
			Globigerinelloides breggiensis			
			Rotalipora subticinensis			
			Ticinella roberti		Ticinella	

pp. 105–110

ALBIAN-MAASTRICHTIAN

S

I. S. A.

F COASTAL PLAIN

GNO, 1967)

Abathomphalus mayaroensis

Globotruncana gansseri

Rugotruncana subcircumnodifer

Globotruncana elevata

Archaeglobigerina blowi

Globotruncana fornicata

Marginotruncana concavata

Whiteinella archaeocretacea

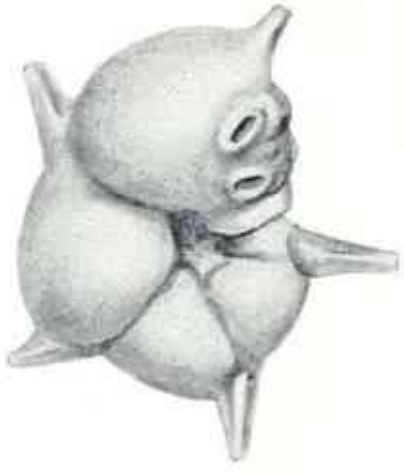
Marginotruncana sigali

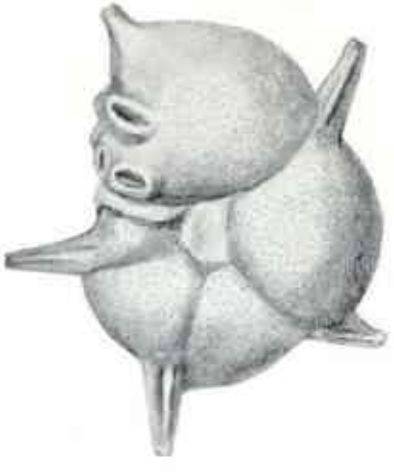
Rotalipora cushmani - greenhornensis

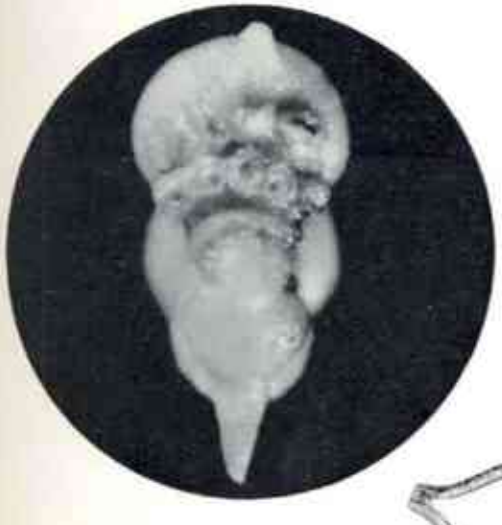
Rotalipora evoluta

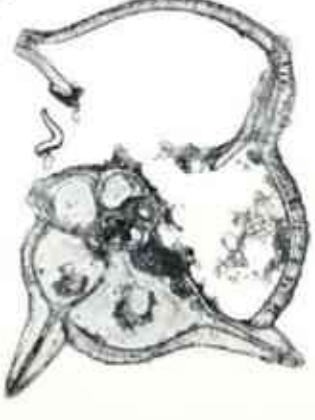
G 59,439/1

Cribrohantkenina bermudezi
× 90

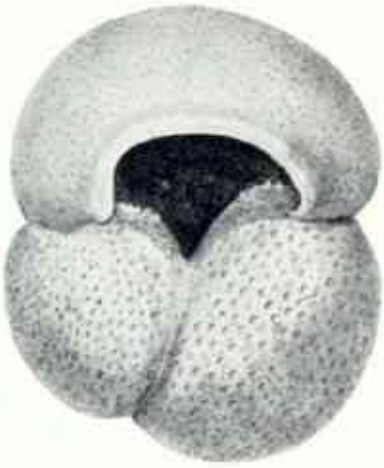


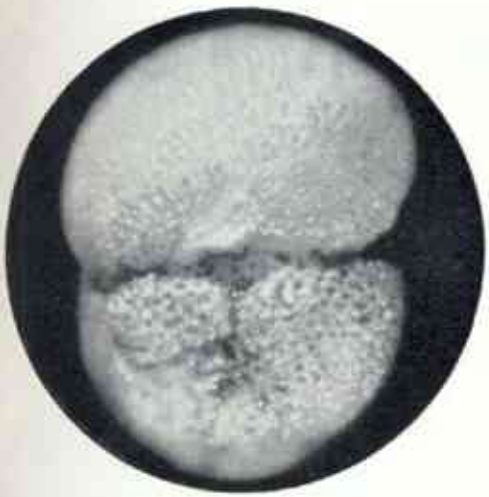


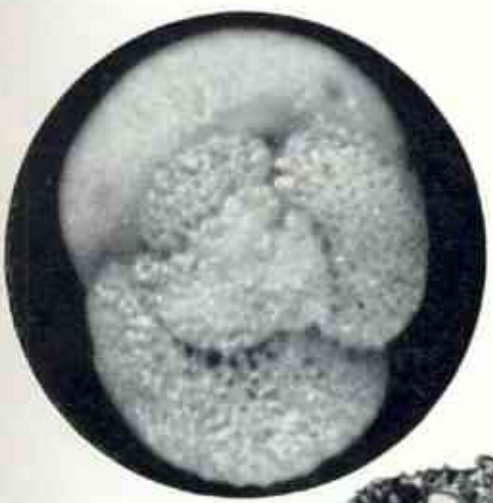




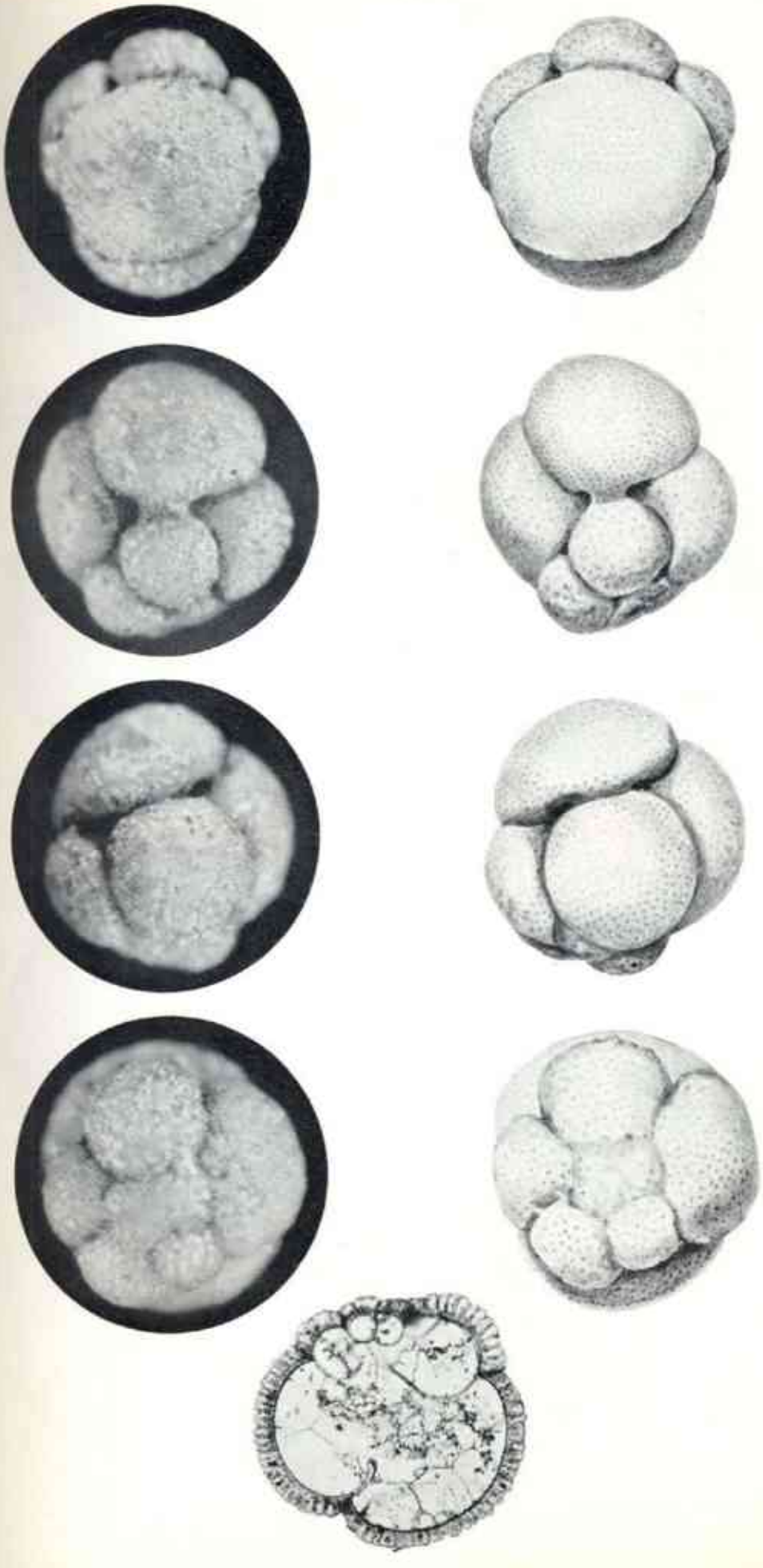
Globigerapsis index
× 120



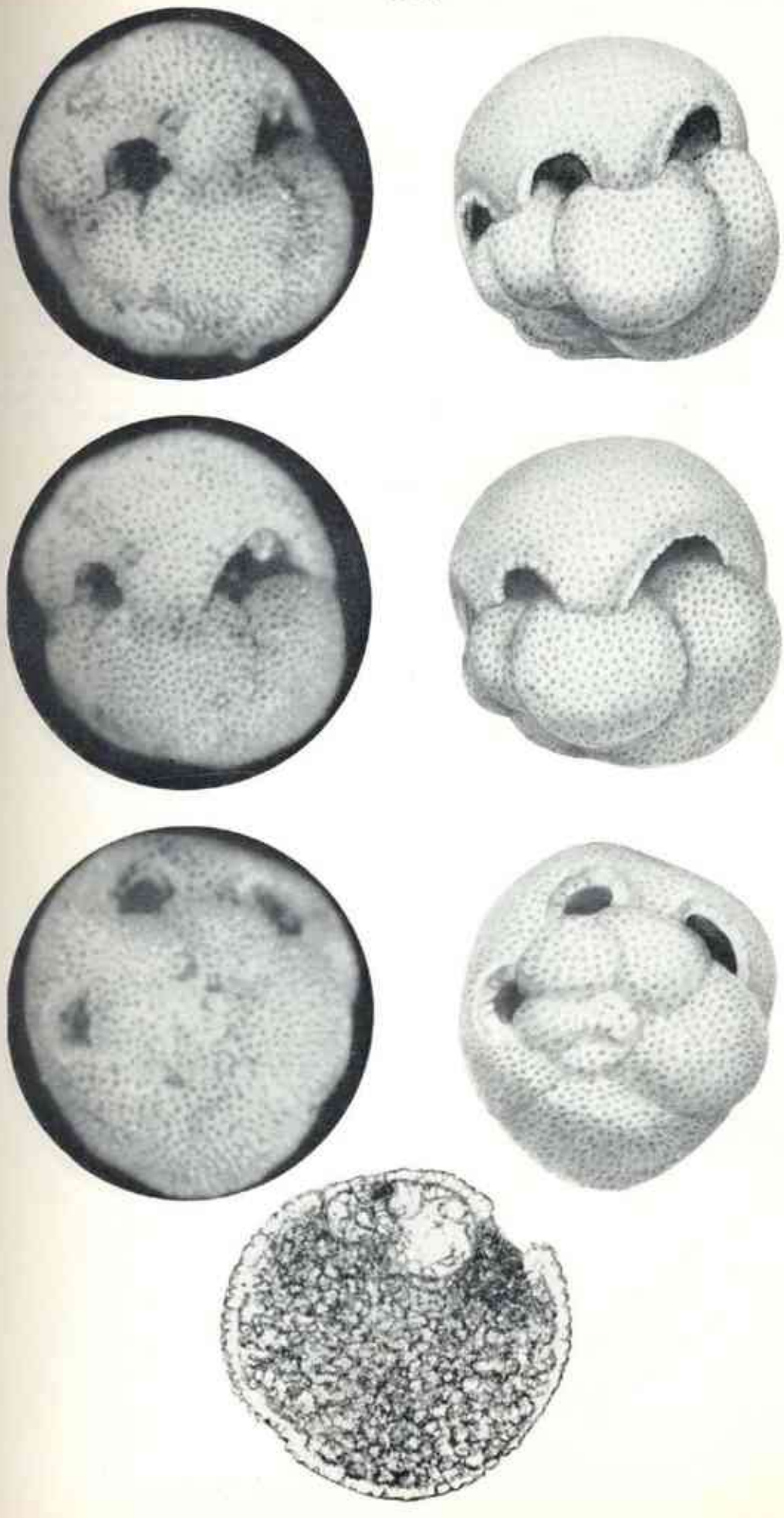




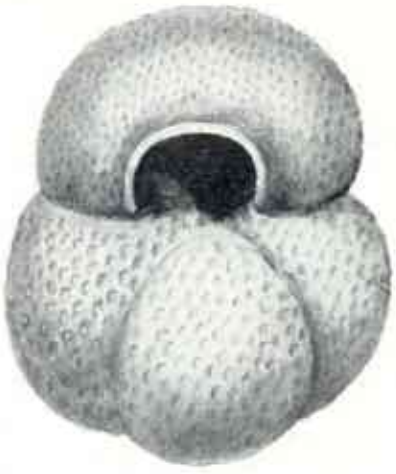
Globigerapsis kugleri
× 70



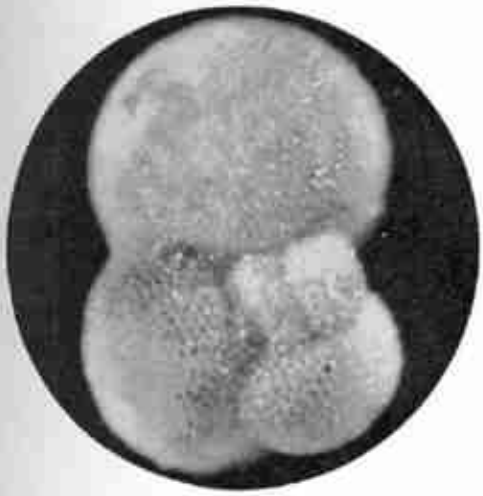
Globigerapsis mexicana
× 150

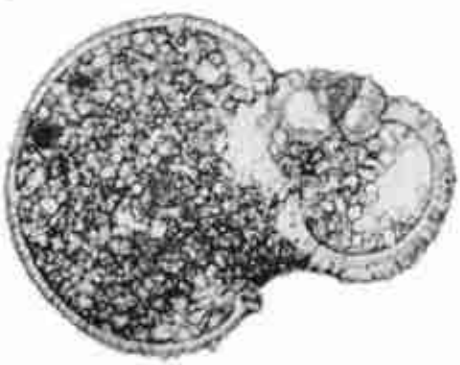


Globigerina ampliapertura
× 220

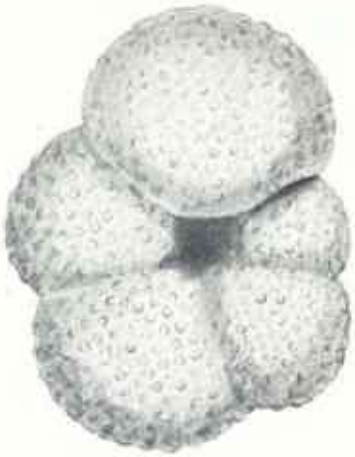


Globigerina bowerí
× 135

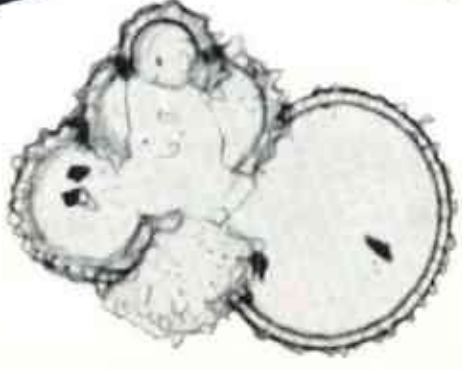




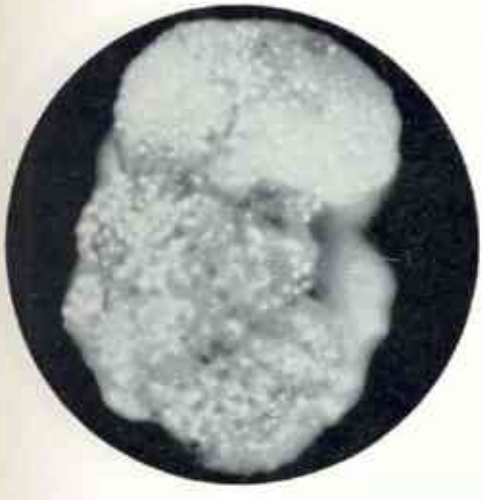
Globigerina collactea
× 220

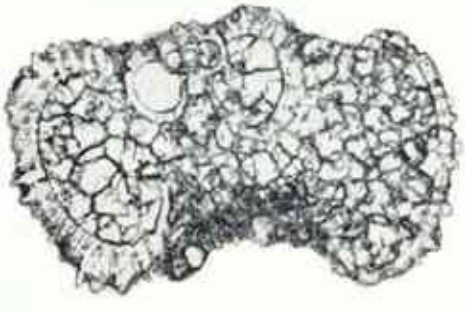


Globigerina daubjergensis
× 400

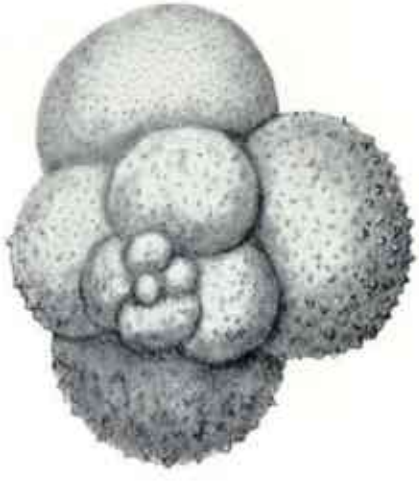


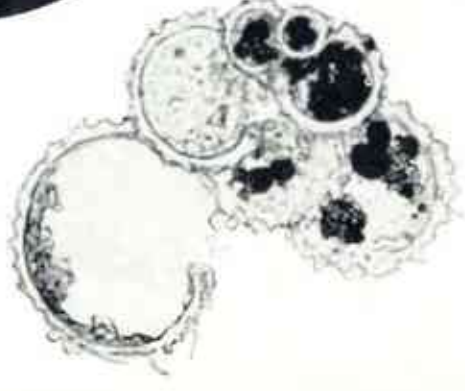
Globigerina gravelli
× 200



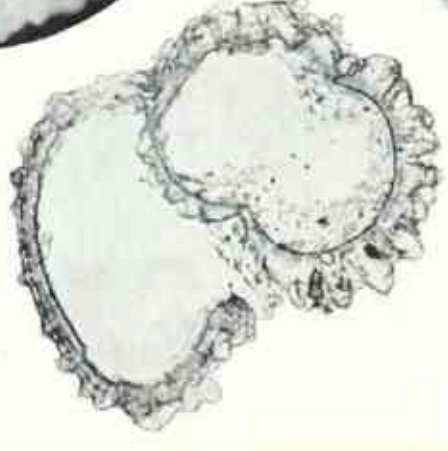


Globigerina ouachitaensis
× 250

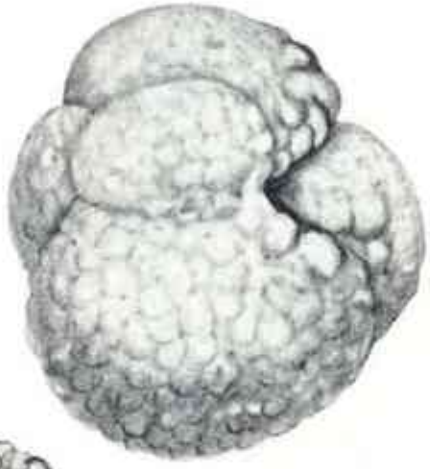


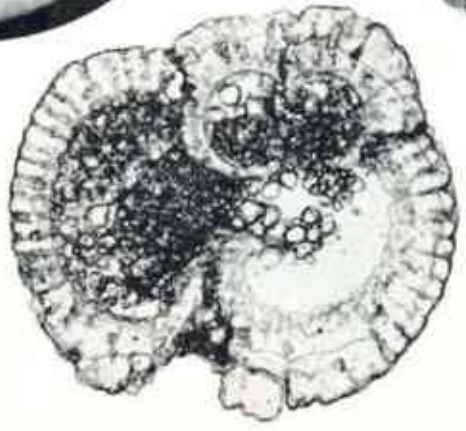


Globigerina primitiva
× 220

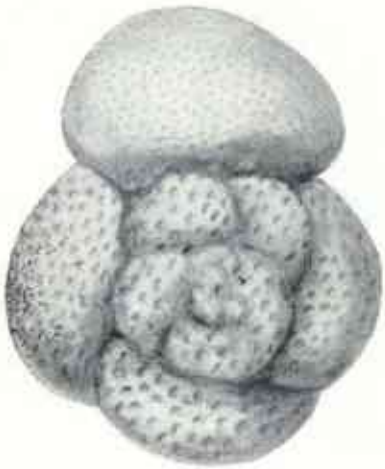


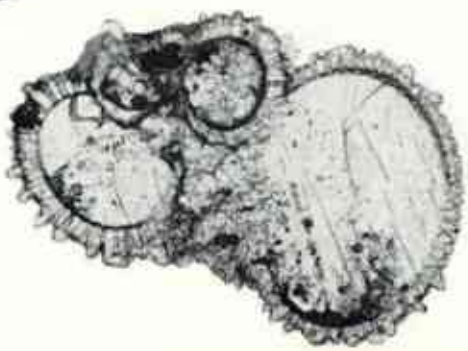
Globigerina senni
× 160



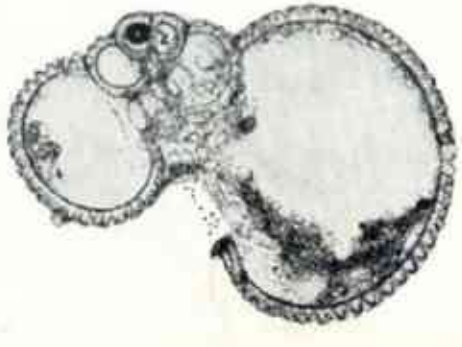


Globigerina soldadoensis
× 150

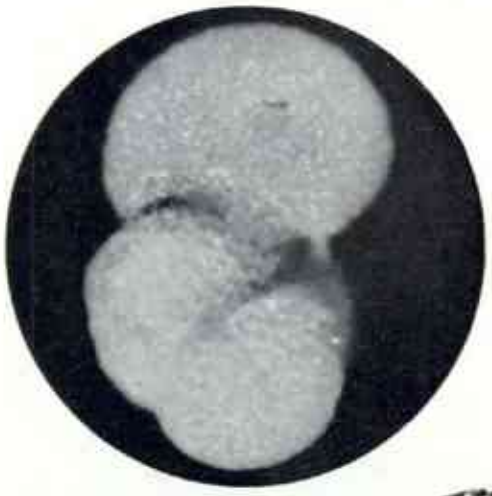


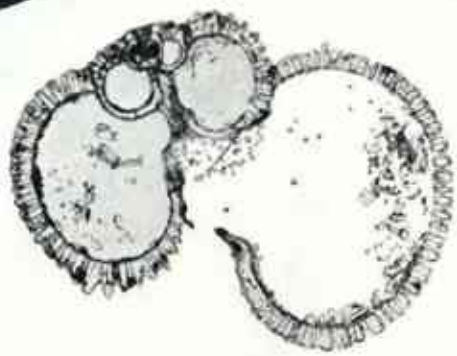


Globigerina triloculinoides
× 160

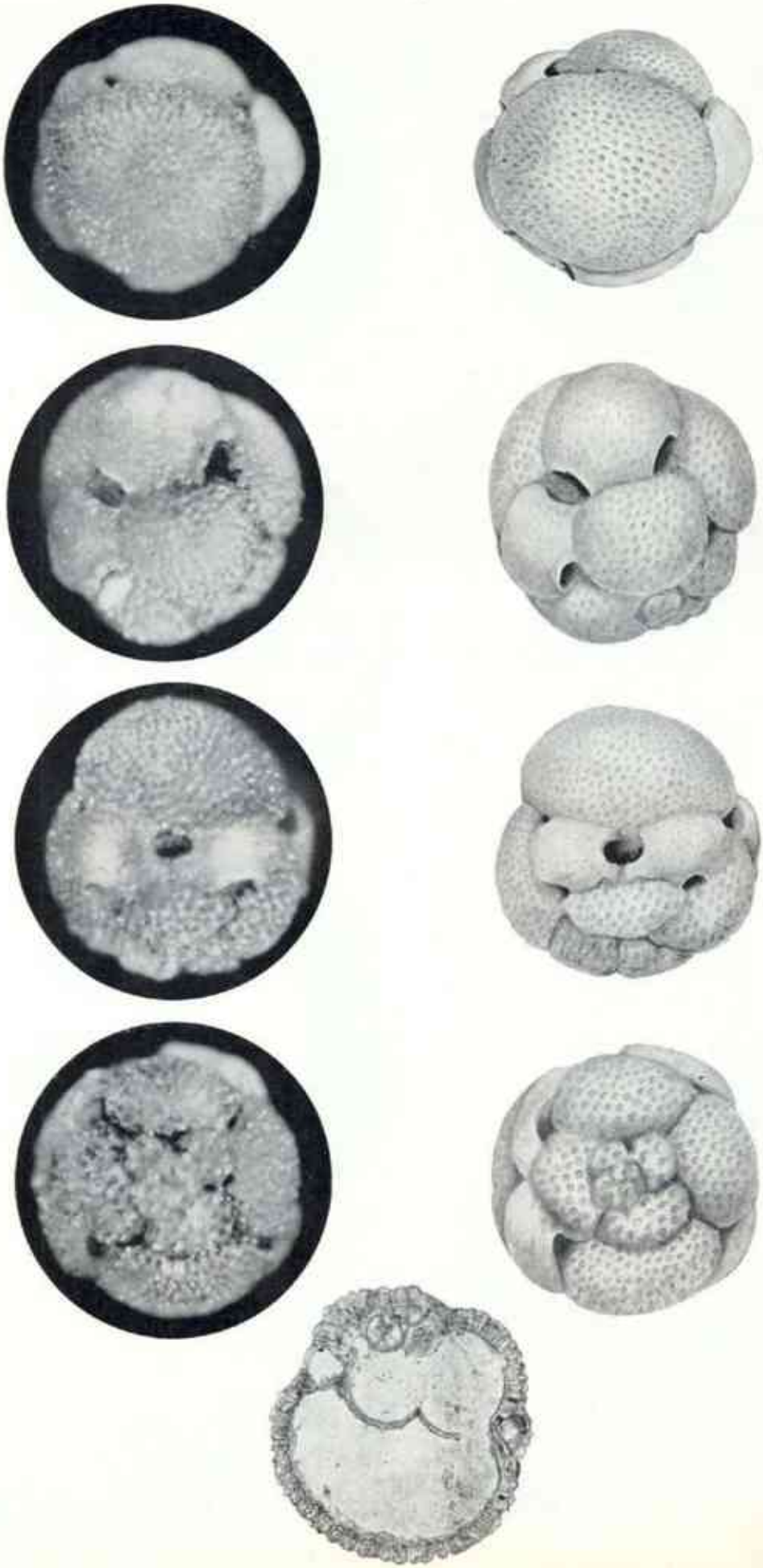


Globigerina yeguaensis
× 140

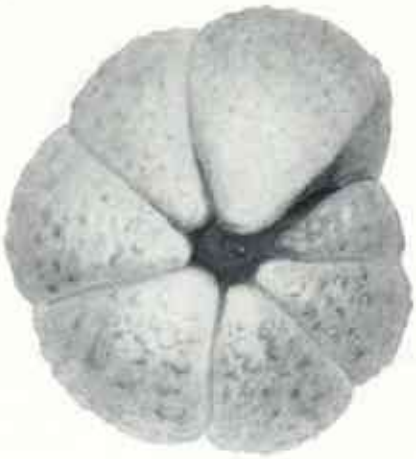




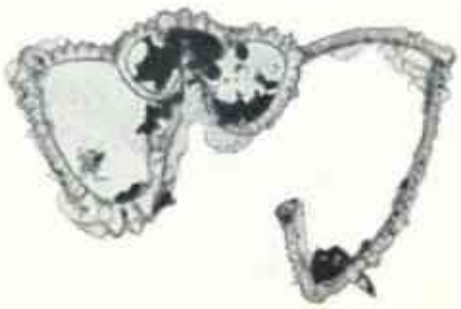
Globigerinatheka barri
× 130



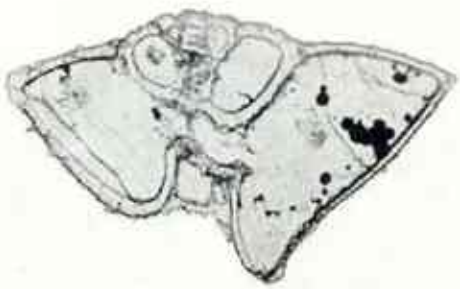
Globorotalia abundocamerata
× 135

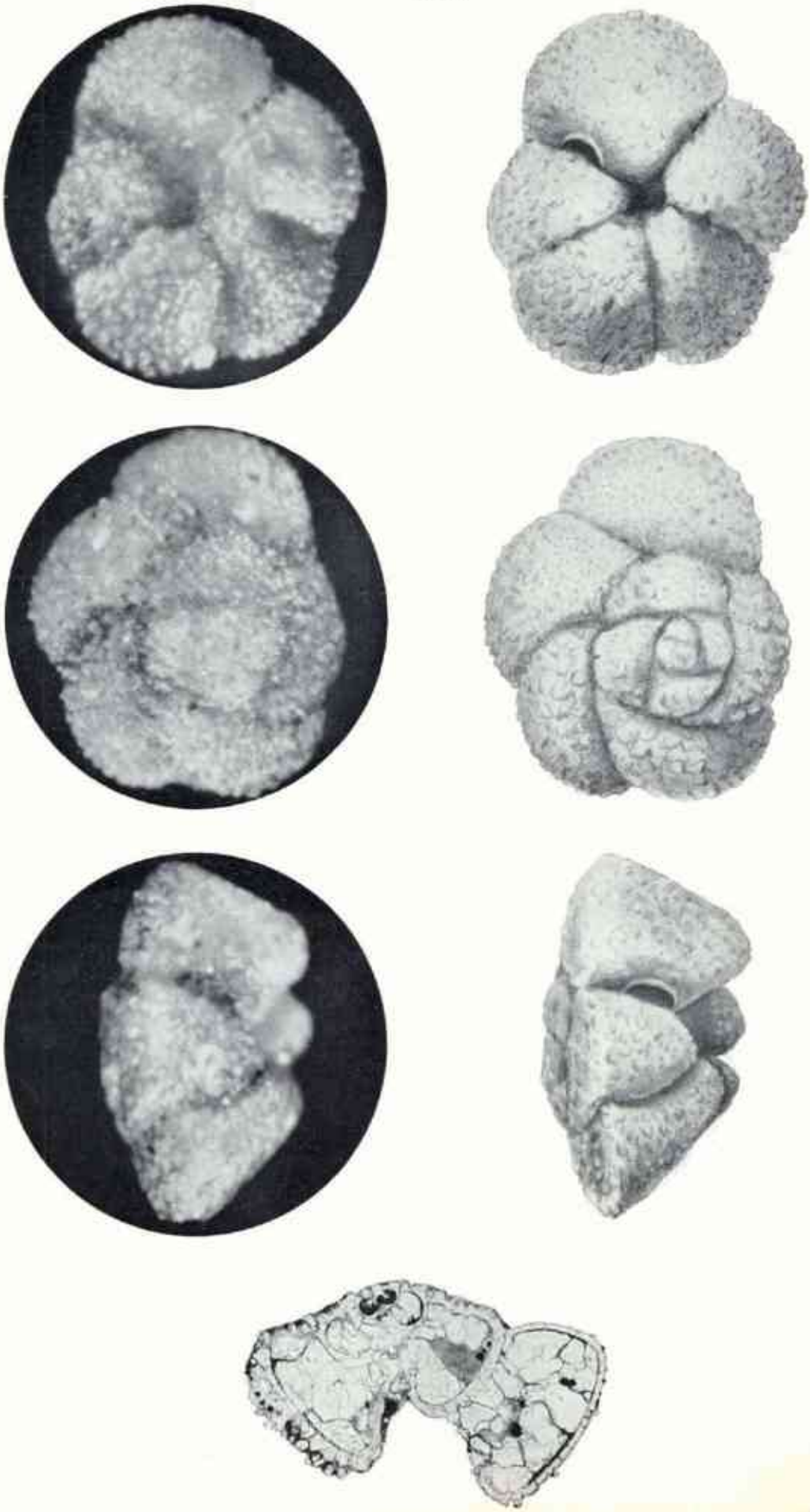


Globorotalia acqua
× 160

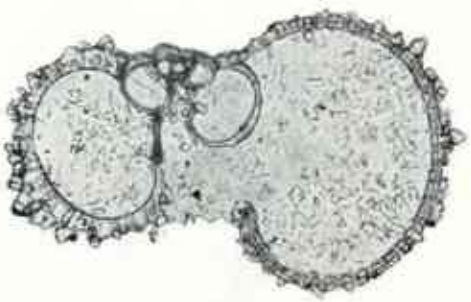


Globorotalia angulata
× 130

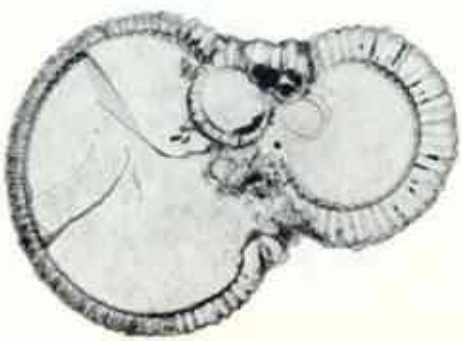


Globorotalia aragonensis
× 105

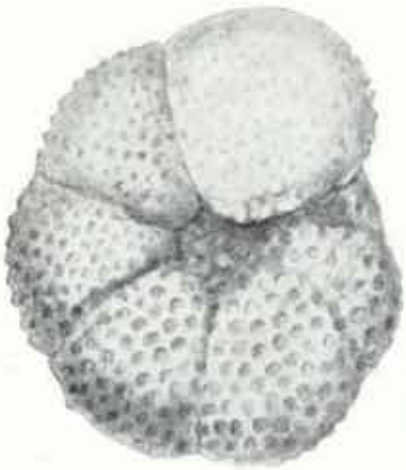
Globorotalia aspensis
× 150

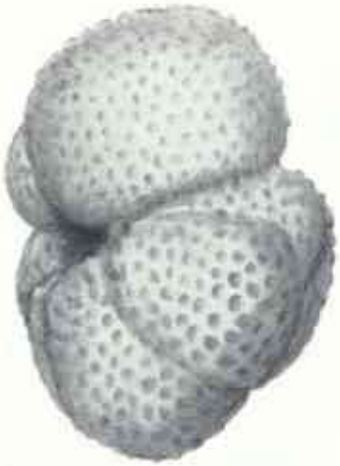


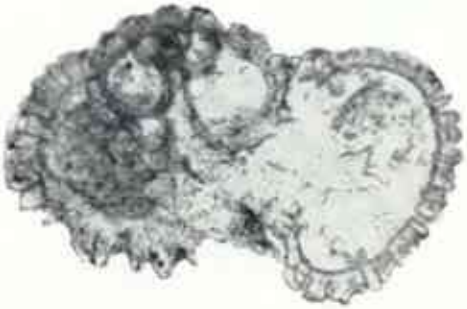
Globorotalia bolivariana
× 180



Globorotalia broedermanni
× 240







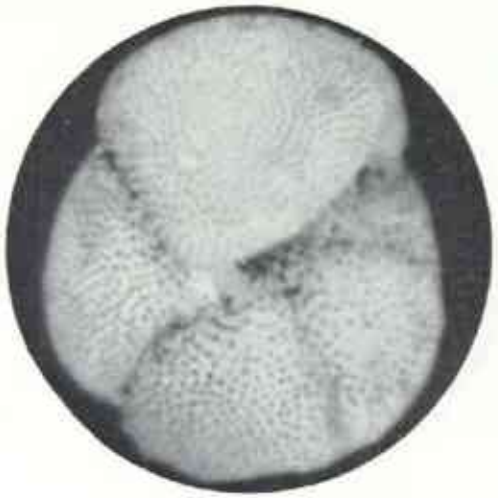
Globorotalia bullbrooki
× 180

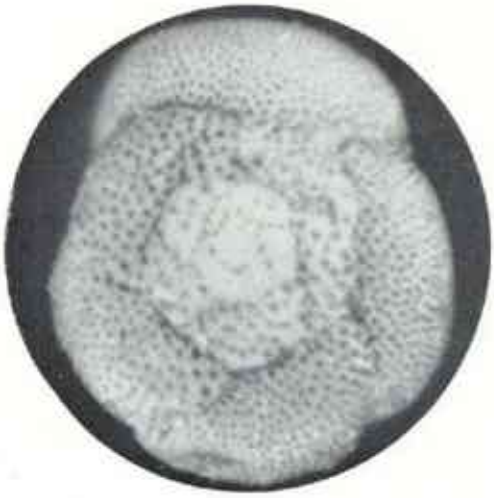


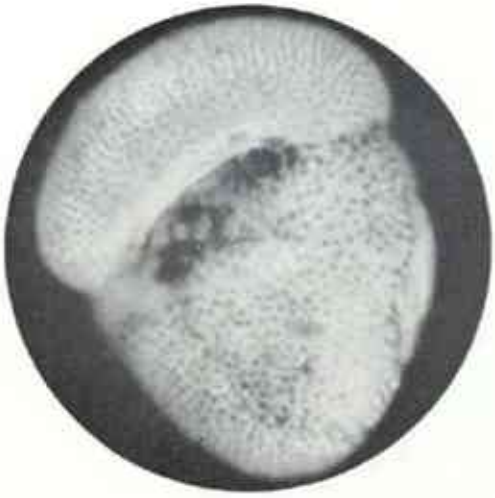


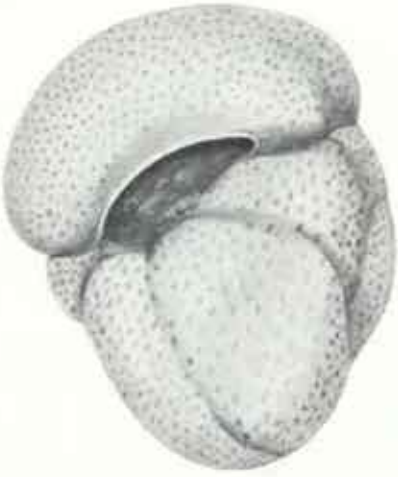


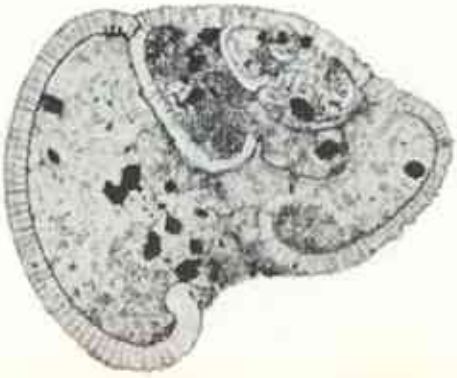
Globorotalia centralis
× 160



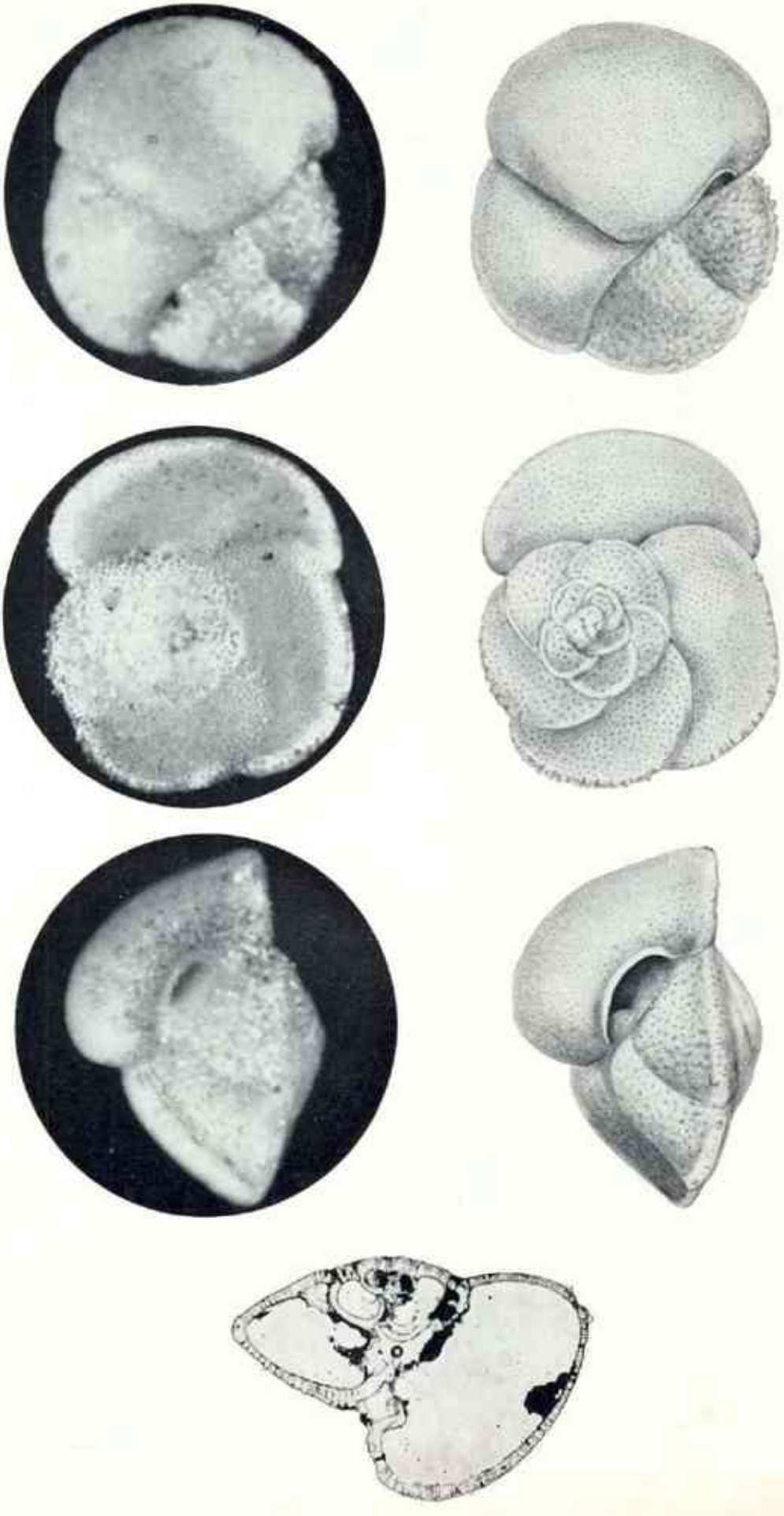




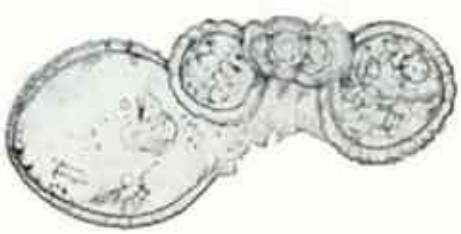




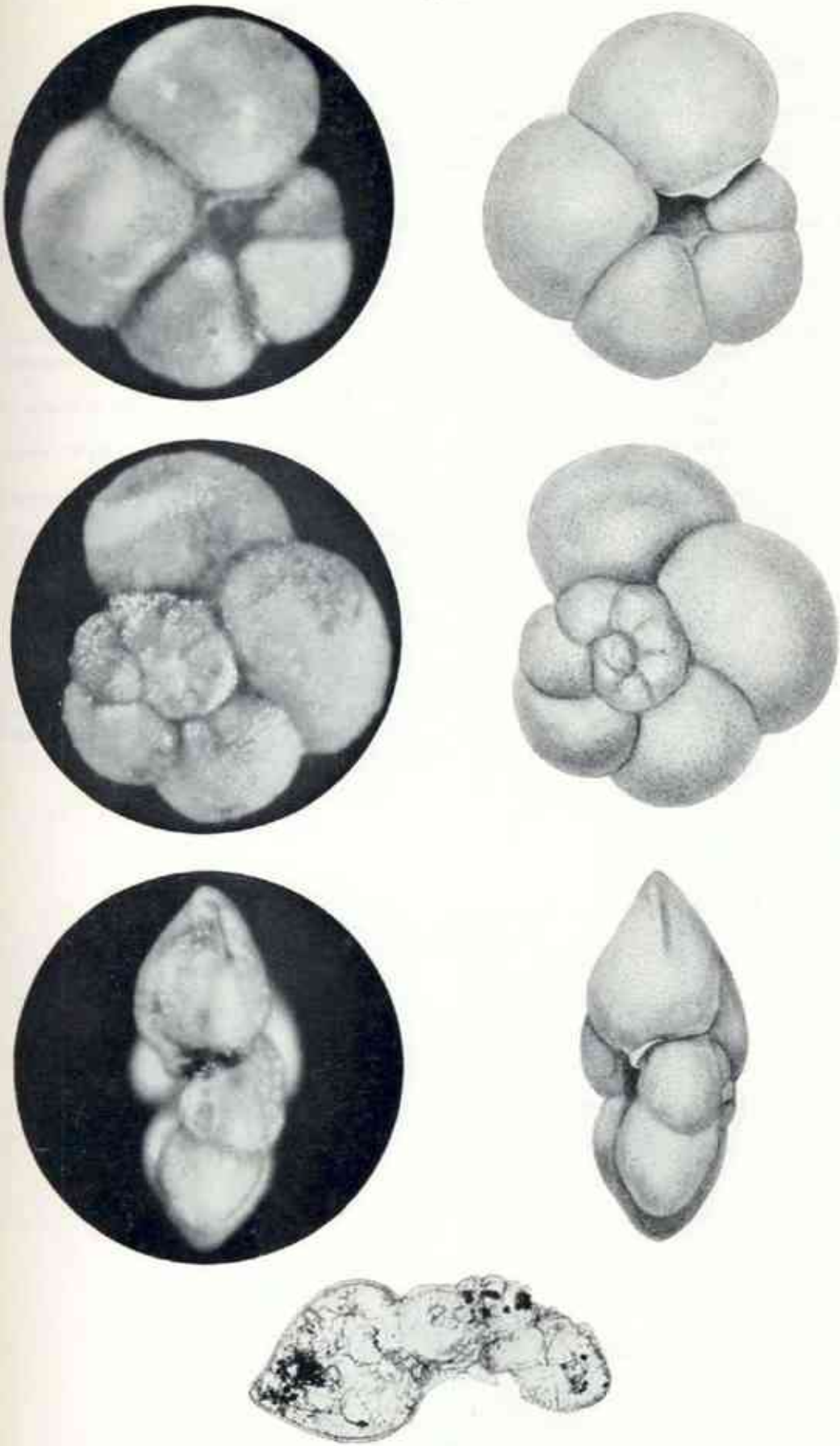
Globorotalia cerroazulensis
× 130



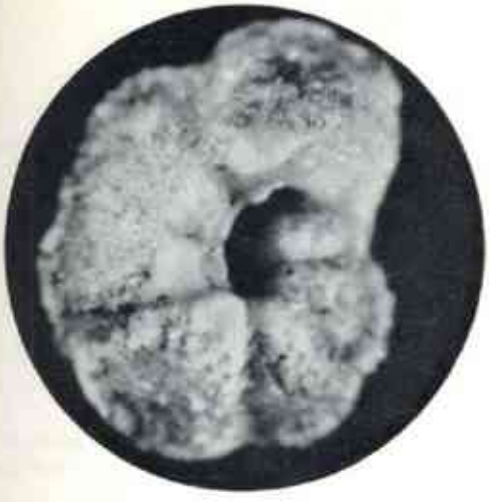
Globorotalia compressa
× 240

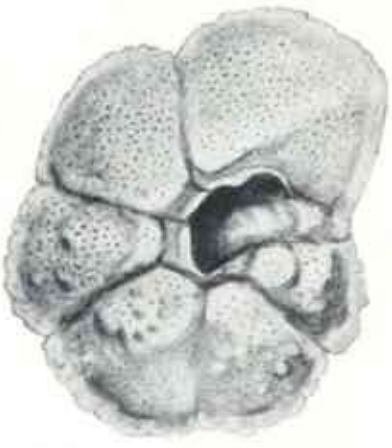


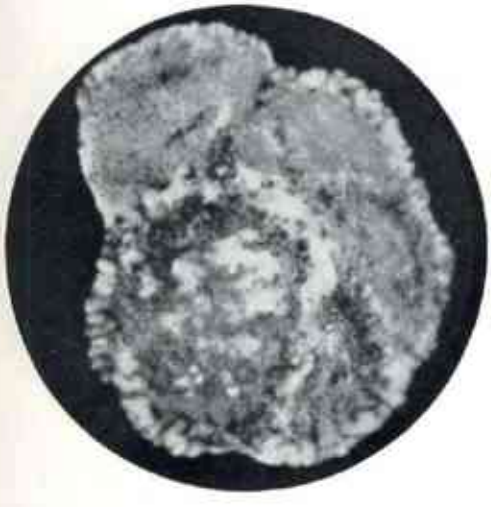
Globorotalia ehrenbergi
× 185



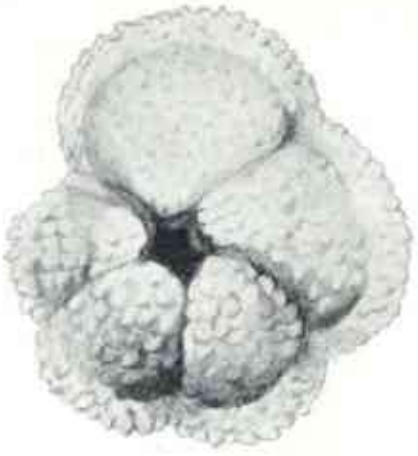
Globorotalia formosa
× 95



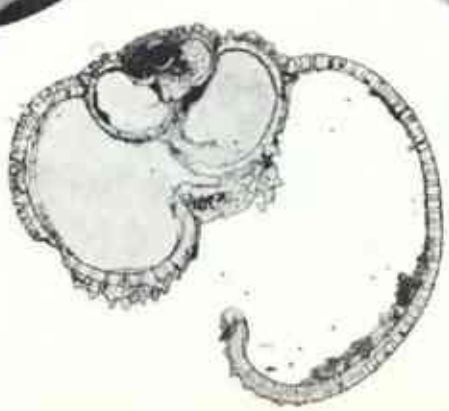




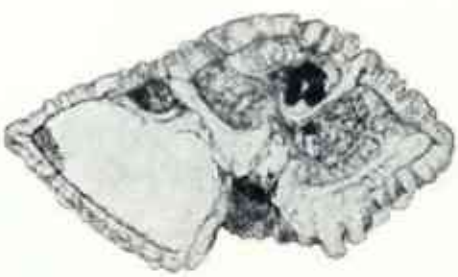
Globorotalia gracilis
× 135



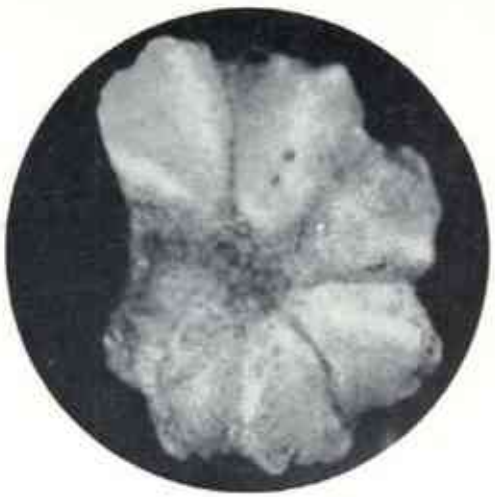
Globorotalia increbescens
× 150

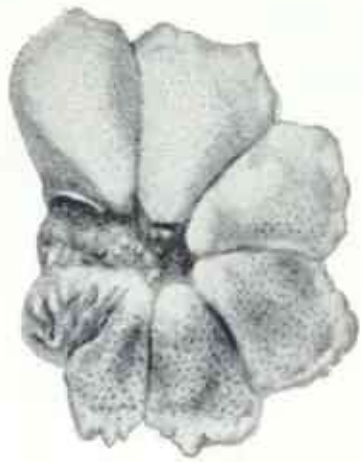


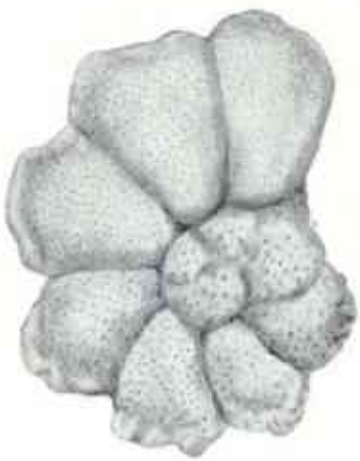
Globorotalia laevigata
× 180



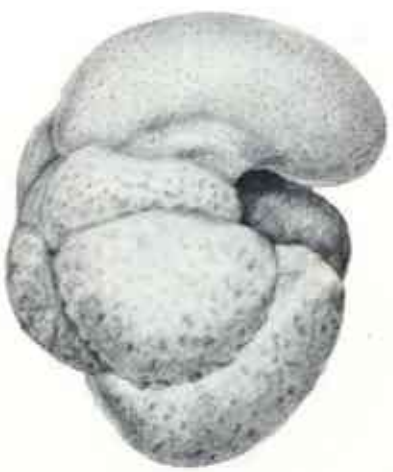
Globorotalia lehneri
× 120



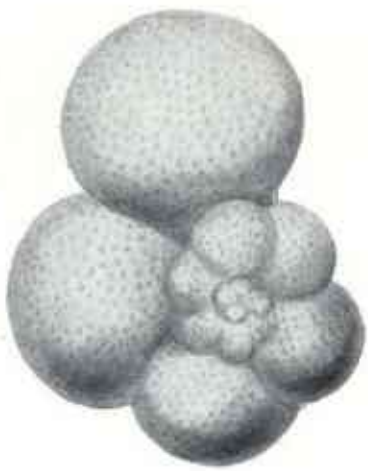


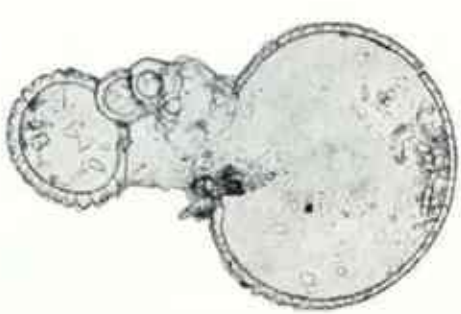


Globorotalia mckannai
× 190

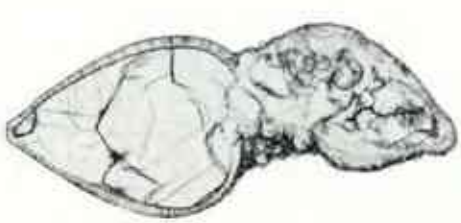


Globorotalia pseudobulloides
× 170

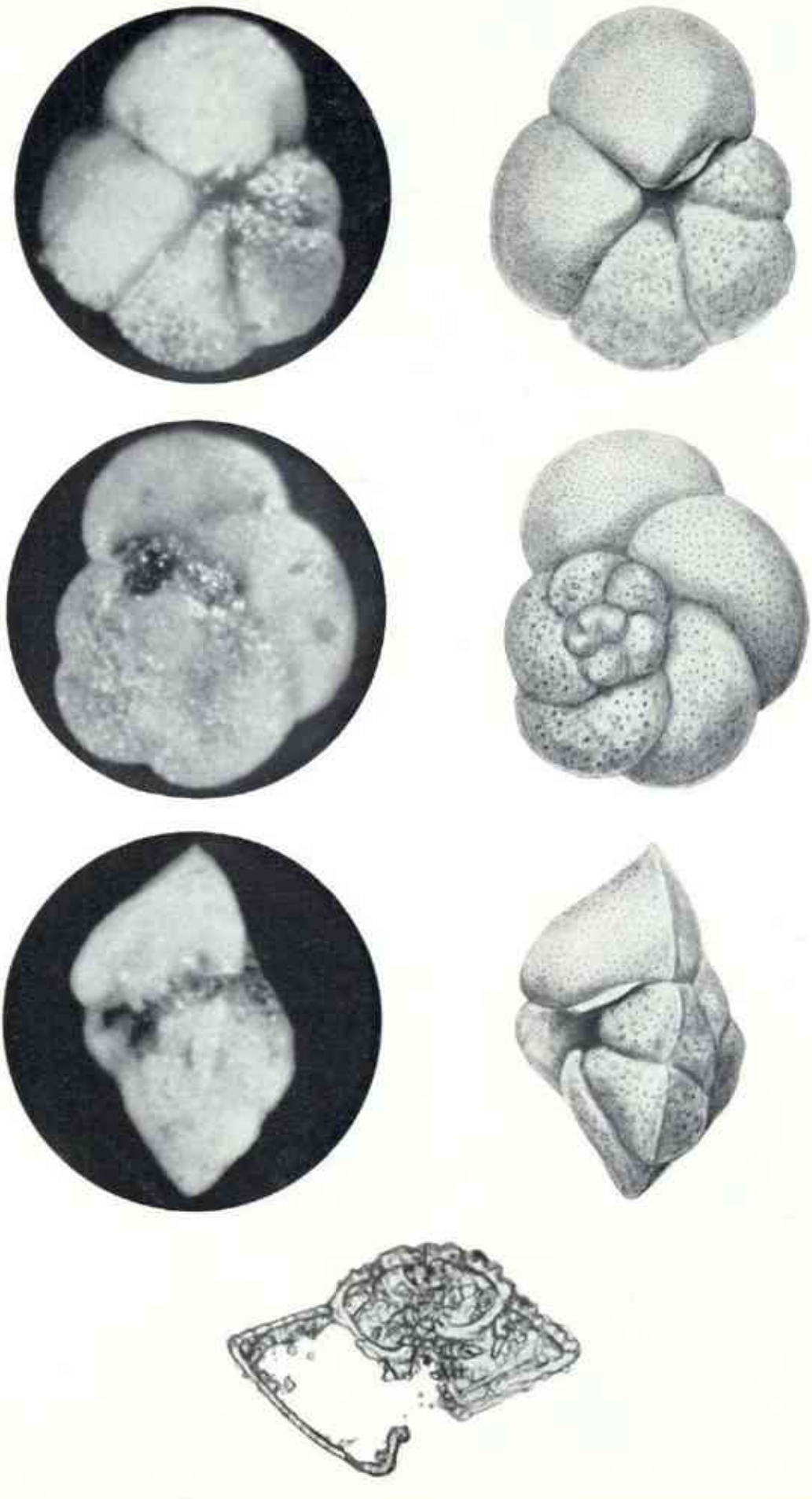




Globorotalia pseudomenardii
× 160

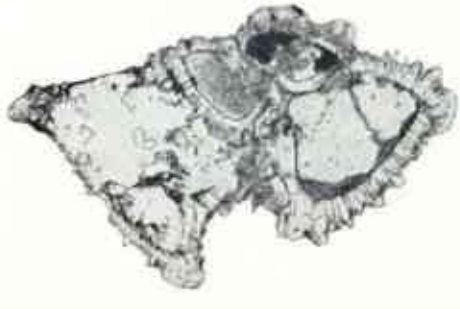


Globorotalia pusilla
× 280

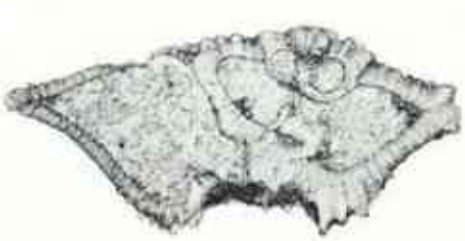


Globorotalia renzi
× 300

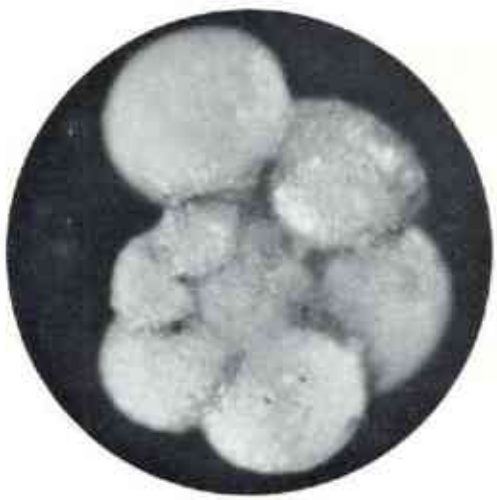
Globorotalia rex
× 150

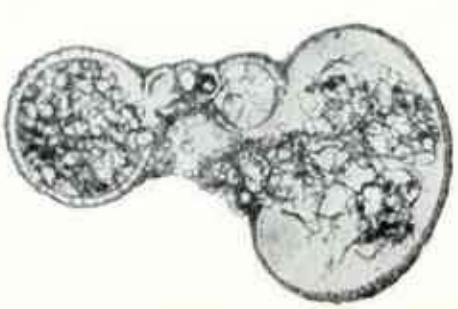


Globorotalia spinulosa
× 140

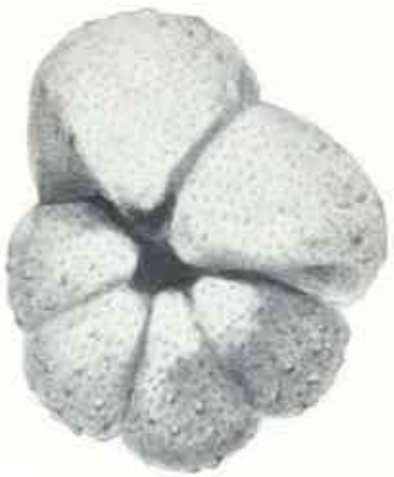


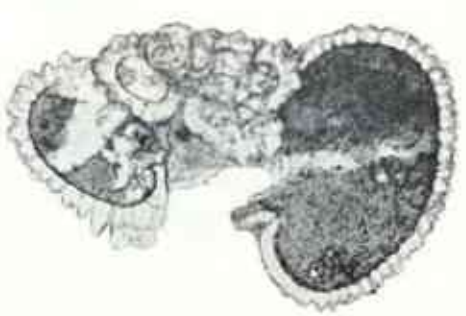
Globorotalia trinidadensis
× 160



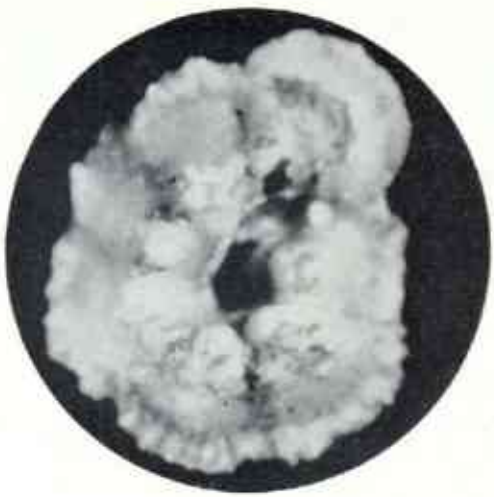


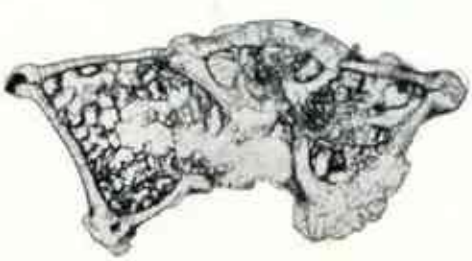
Globorotalia uncinata
× 190





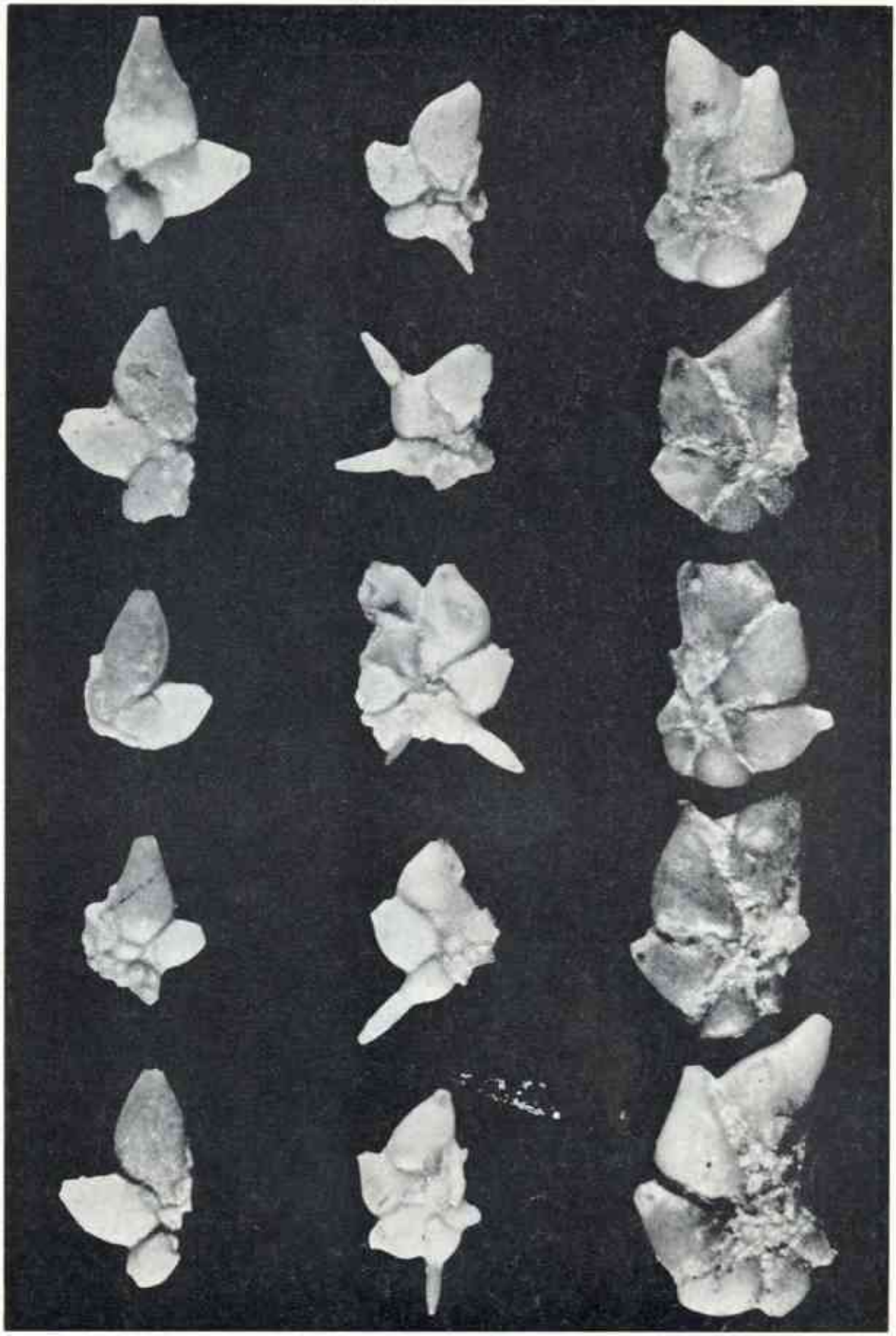
Globorotalia velascoensis
× 110

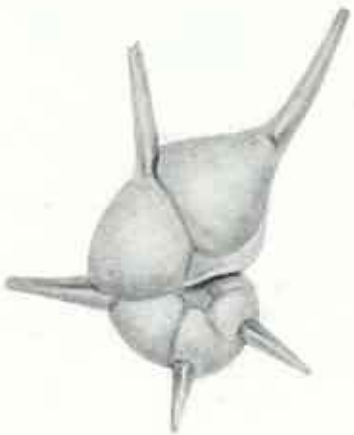


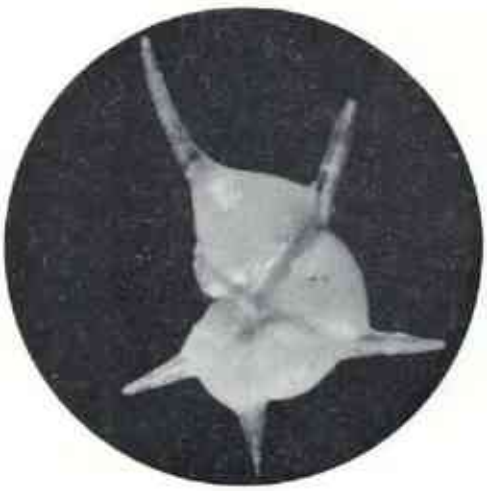


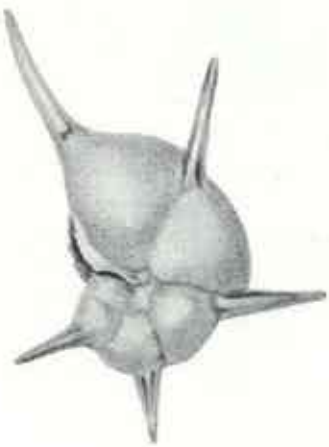
Globorotalia wilcoxensis
× 120

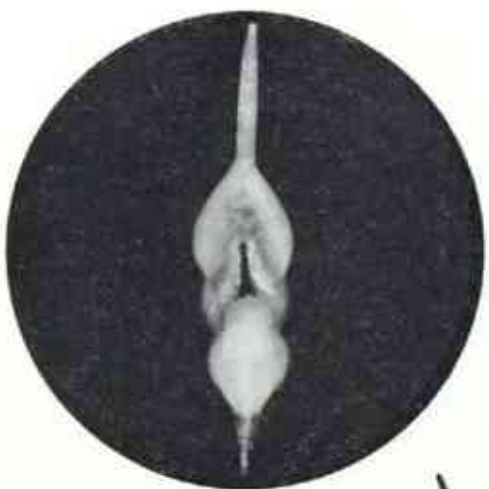
× 45



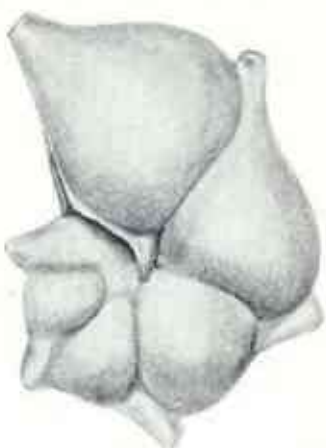


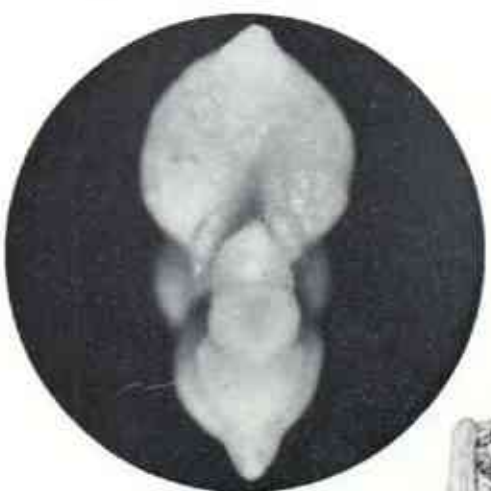




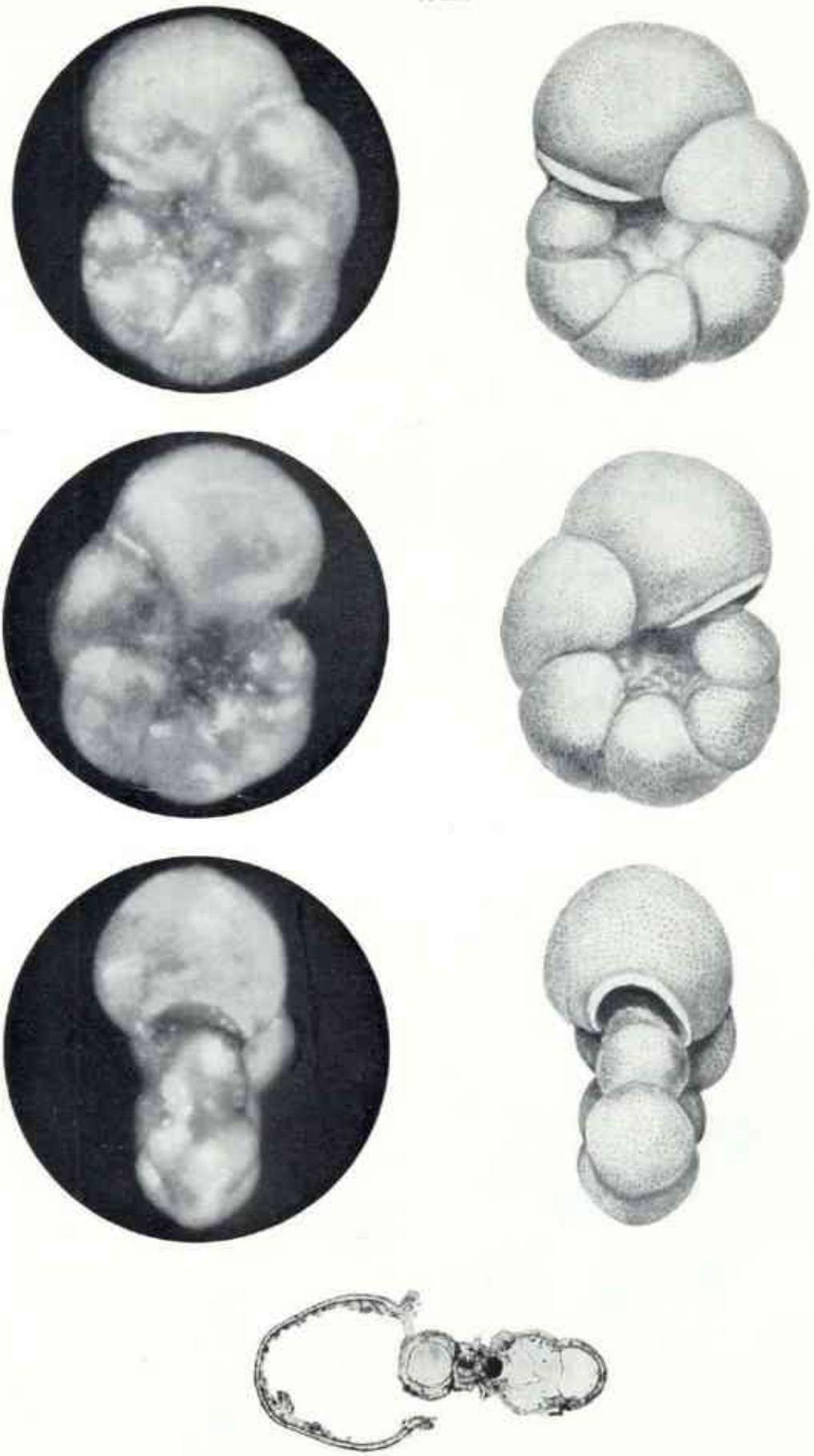


Hantkenina brevispina
× 75



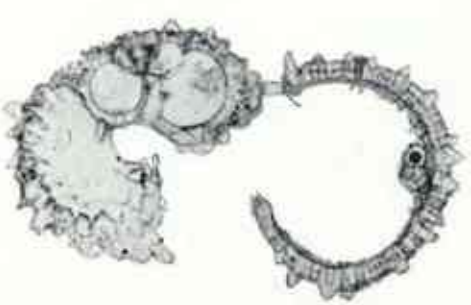


Hastigerina micra
× 240

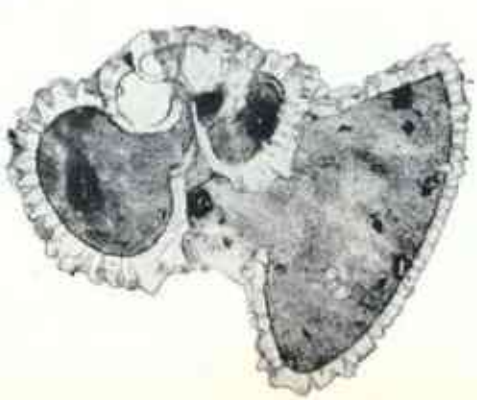


Orbulinoides beckmanni
× 90

Truncorotaloides rohri
× 150



Truncorotaloides topilensis
× 140



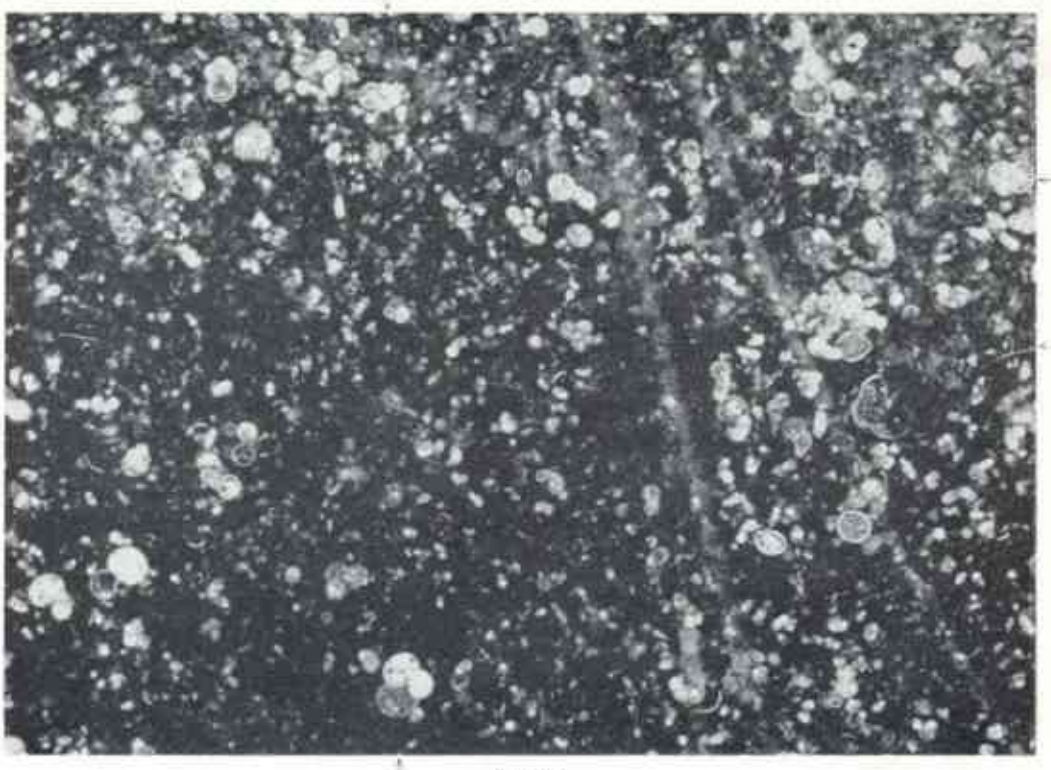


Figure 13

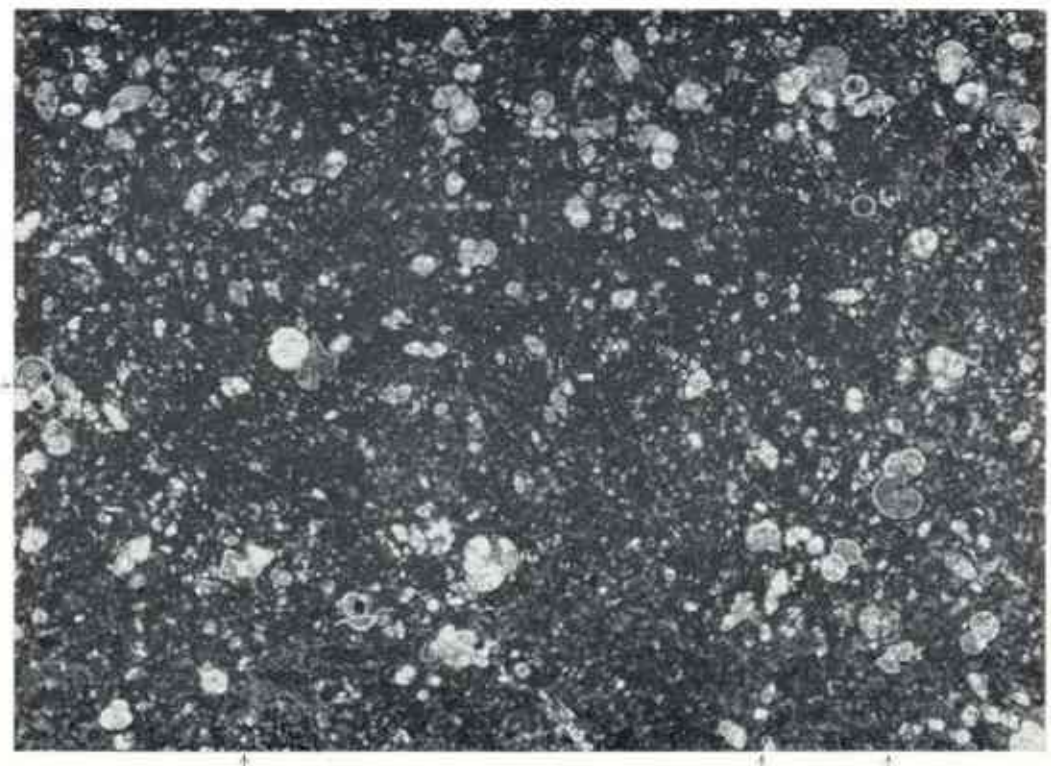
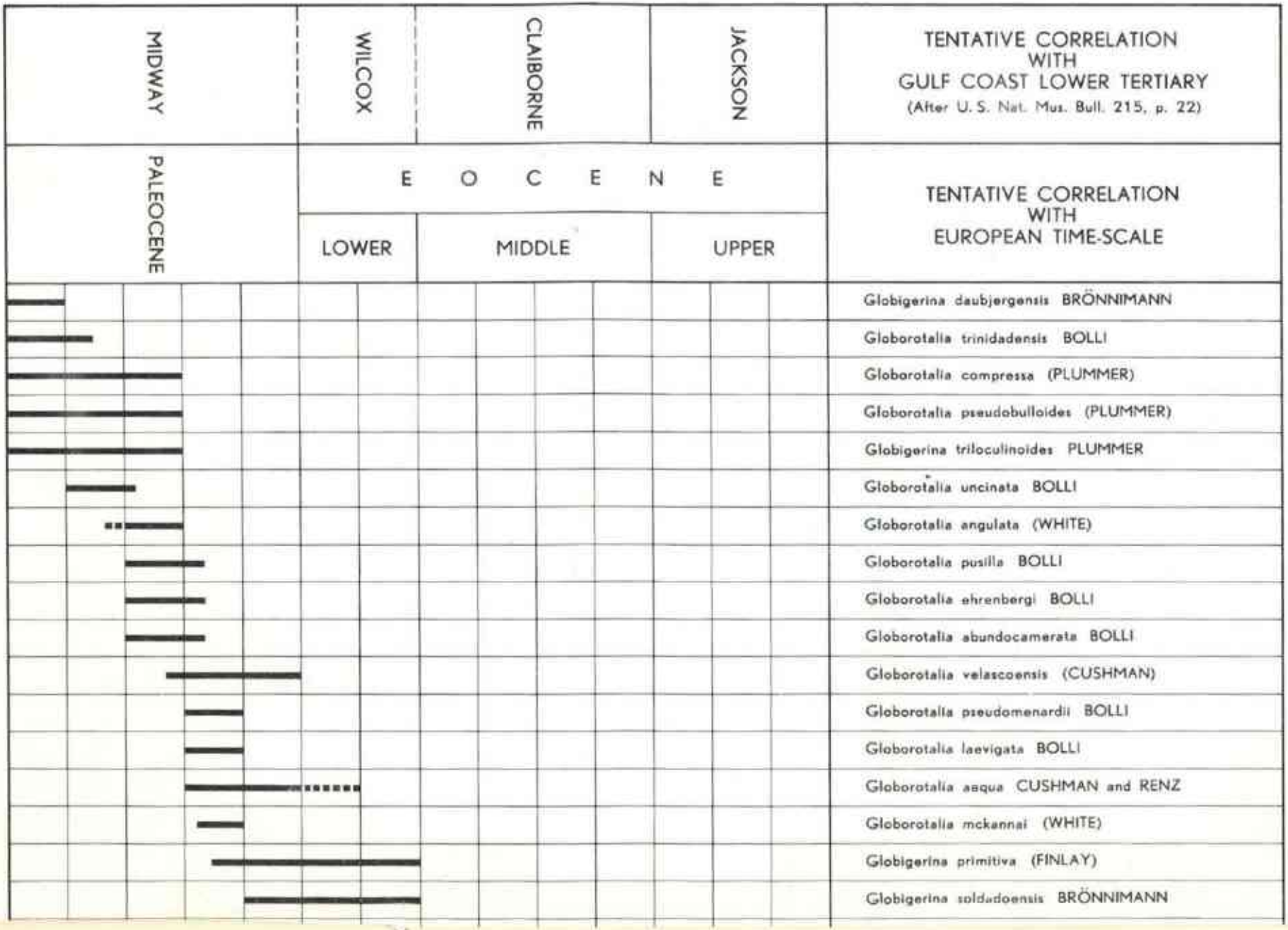
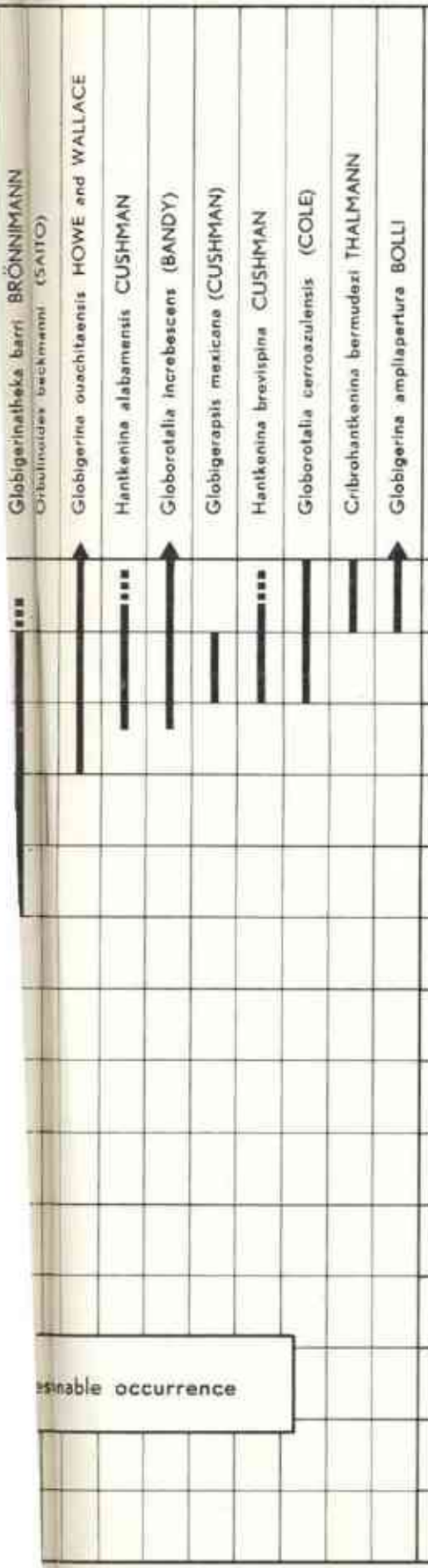


Figure 14


MIDWAY
WILCOX
CLAIBORNE
JACKSON
TENTATIVE CORRELATION WITH GULF COAST LOWER TERTIARY
(After U. S. Nat. Mus. Bull. 215, p. 22)
PALEOCENE
E O C E N E
LOWER
MIDDLE
UPPER
TENTATIVE CORRELATION WITH EUROPEAN TIME-SCALE
Globigerina daubjergensis BRÖNNIMANN
Globorotalia trinidadensis BOLLI
Globorotalia compressa (PLUMMER)
Globorotalia pseudobulloides (PLUMMER)
Globigerina triloculinoides PLUMMER
Globorotalia uncinata BOLLI
Globorotalia angulata (WHITE)
Globorotalia pusilla BOLLI
Globorotalia ehrenbergi BOLLI
Globorotalia abundocamerata BOLLI
Globorotalia velascoensis (CUSHMAN)
Globorotalia pseudomenardii BOLLI
Globorotalia laevigata BOLLI
Globorotalia aequa CUSHMAN and RENZ
Globorotalia mckannai (WHITE)
Globigerina primitiva (FINLAY)
Globigerina soldadoensis BRÖNNIMANN

RANGE CHART, ZONATION AND CORE

RRELATION WITH EXISTING ZONATIONS



GENERAL ZONATION	ZONATION PROPOSED BY BLOW, 1969		
Globorotalia cerroazulensis	Cribrohantkenina inflata	P.16	Gl
Globigerapsis mexicana	Globigerapsis mexicana	P.15	Gl
Truncorotaloides rohri	Truncorotaloides rohri / Globigerinita howei	P.14	Tru
Orbulinoides beckmanni	Orbulinoides beckmanni	P.13	Po
Globorotalia lehneri			Gl
Globigerapsis kugleri			Gl
Globorotalia bullbrooki			Ha
Globorotalia formosa - aragonensis			Gl
Globorotalia rex			Gl
Globorotalia velascoensis			Gl
Globorotalia pseudomenardii			Gl
Globorotalia angulata			Gl
Globorotalia uncinata			Gl
Globigerina daubjergensis			Gl

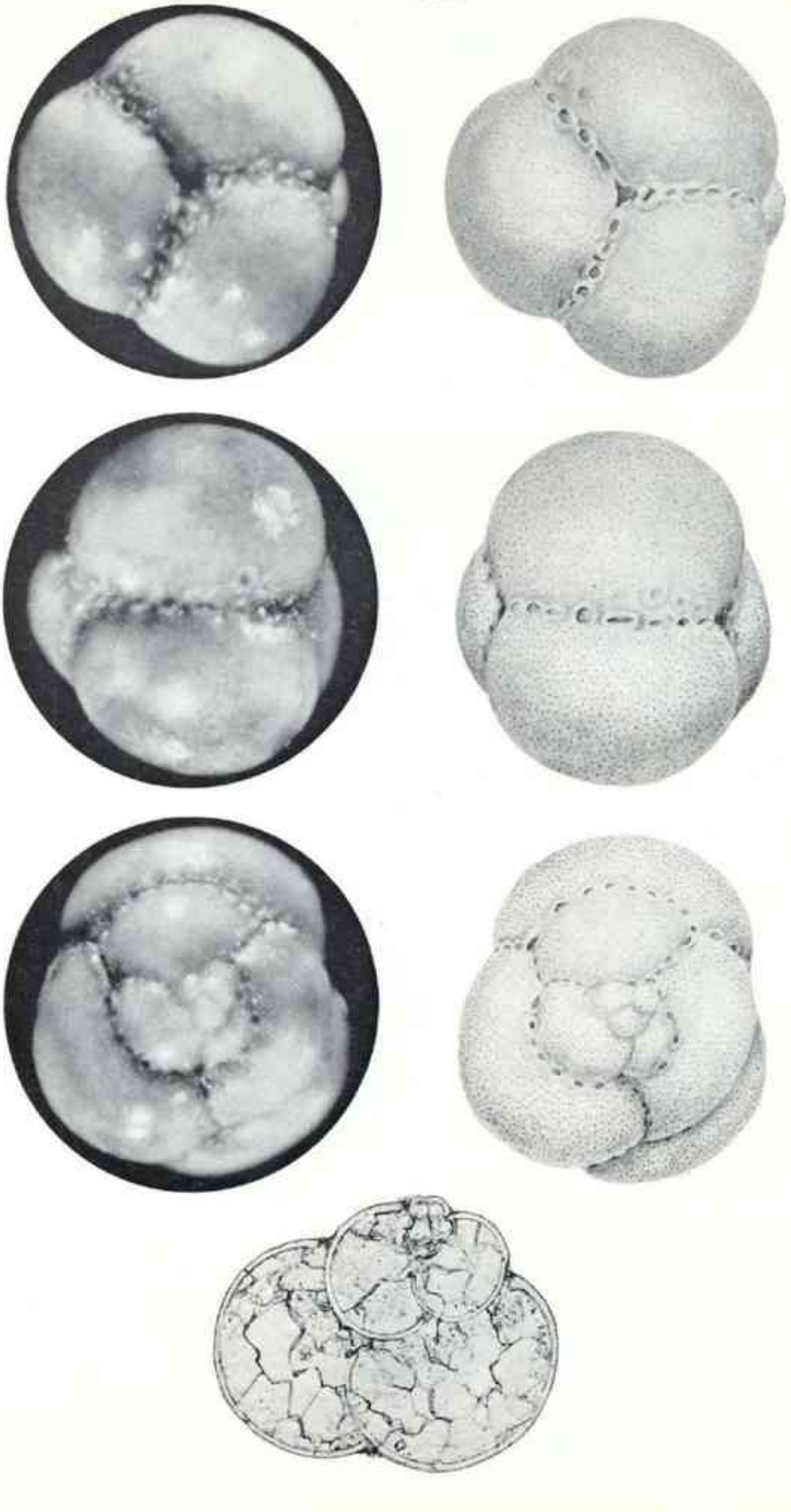
CHART 2 PALEOCENE-EOCENE

L O C A L Z O N A T I O N S

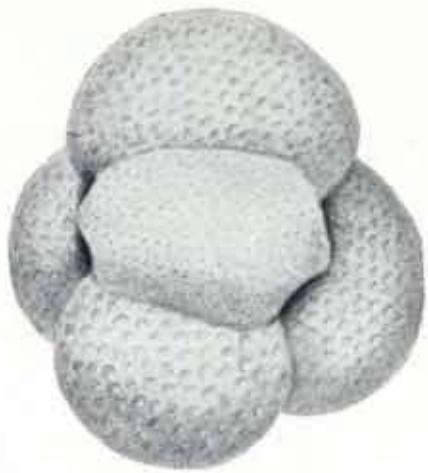
TRINIDAD (BOLLI, 1957)	ITALY (BOLLI and CITA, 1960)	EGYPT (BECKMANN, EL HEINY, KERDANY, SAID and VIOTTI, 1969)
borotalia cocoaensis	NO DATA AVAILABLE	Cribrohantkenina danvillensis / Globorotalia cerroazulensis
bigerapsis semiinvoluta		Globigerapsis semiinvolutus
ncorotaloides rohri		Truncorotaloides pseudodubius
ticulasphaera mexicana		Porticulasphaera mexicana
borotalia lehneri		Globorotalia lehneri
bigerapsis kugleri		Globigerapsis kugleri
tkenina aragonensis / Globorotalia palmerae	Hantkenina aragonensis	Globorotalia bullbrooki
borotalia aragonensis	Globorotalia formosa formosa - aragonensis	Globorotalia aragonensis
borotalia formosa formosa		Globorotalia formosa formosa
orotalia rex	Globorotalia rex	Globorotalia subbotinae
borotalia velascoensis	Globorotalia velascoensis	Globorotalia velascoensis
borotalia pseudomenardii	Globorotalia pseudomenardii	Globorotalia pseudomenardii
borotalia pusilla pusilla	Globorotalia pusilla pusilla	Globorotalia angulata
borotalia uncinata	Globorotalia uncinata	Globorotalia uncinata
borotalia trinidadensis	Globorotalia trinidadensis / Globigerina daubjergensis	Globorotalia trinidadensis / Globigerina pseudobulloides

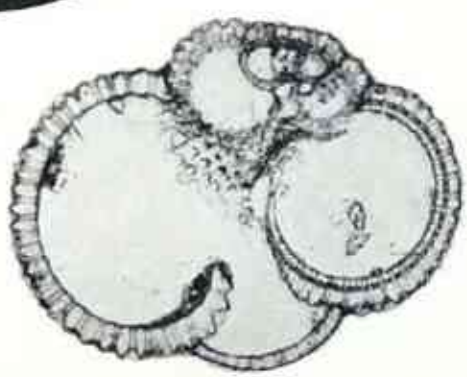
Globorotalia wilcoxensis CUSHMAN and PONTON

Candeina nitida
× 105

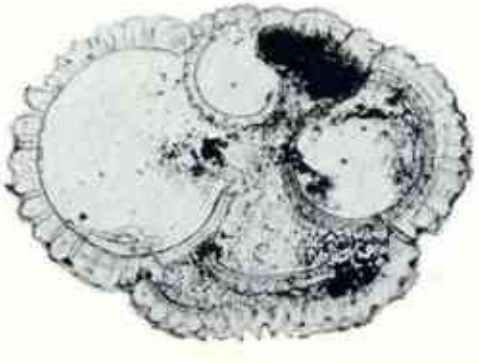


Catapsydrax dissimilis
× 130

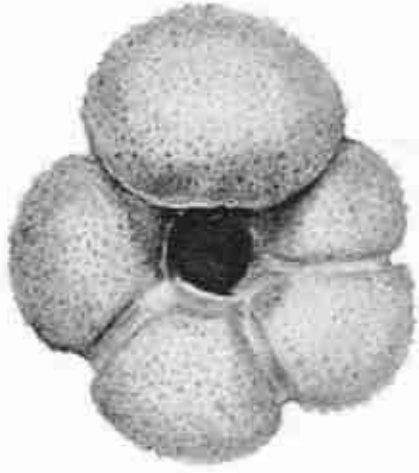


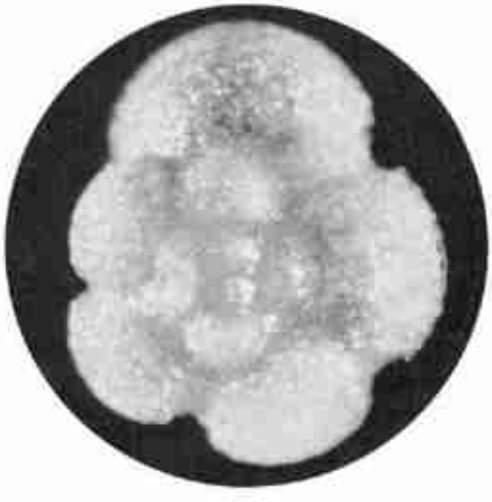


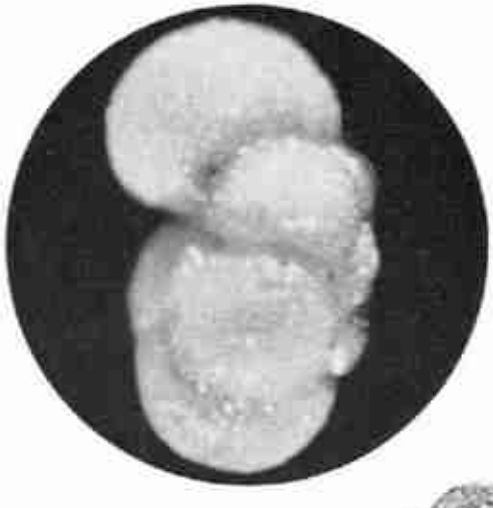
Catapsydrax stainforthi
× 130

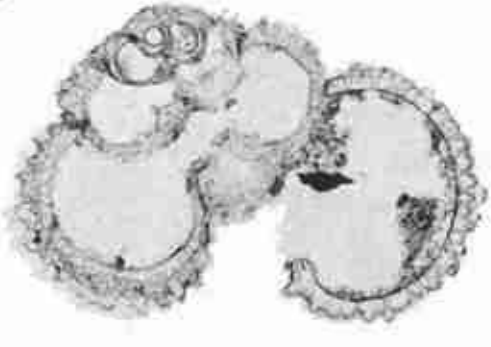


× 210

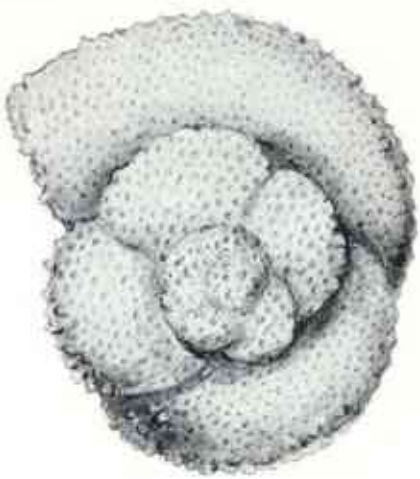


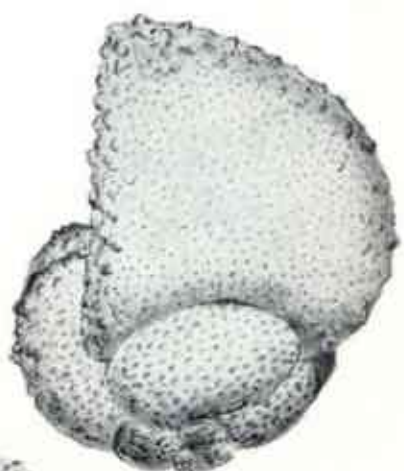


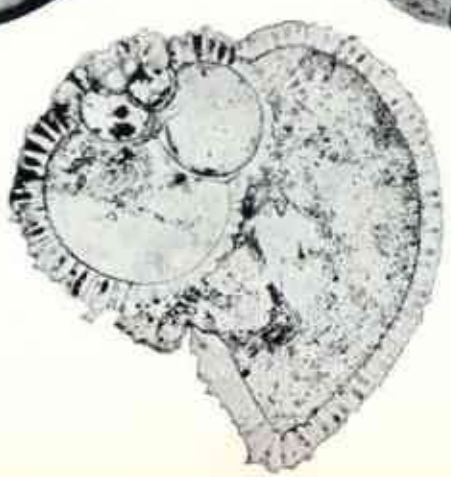




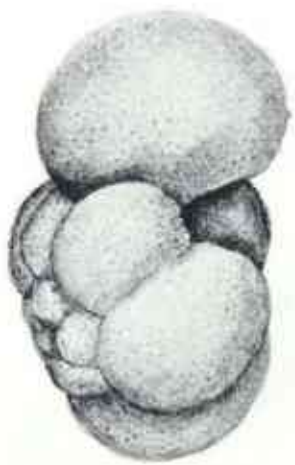
Globigerina binaiensis
× 120

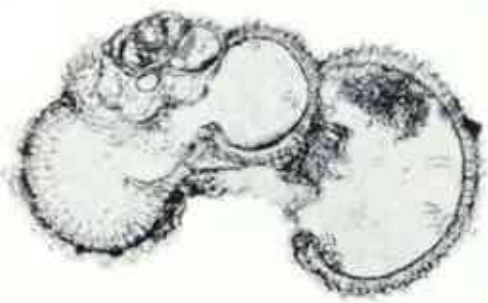




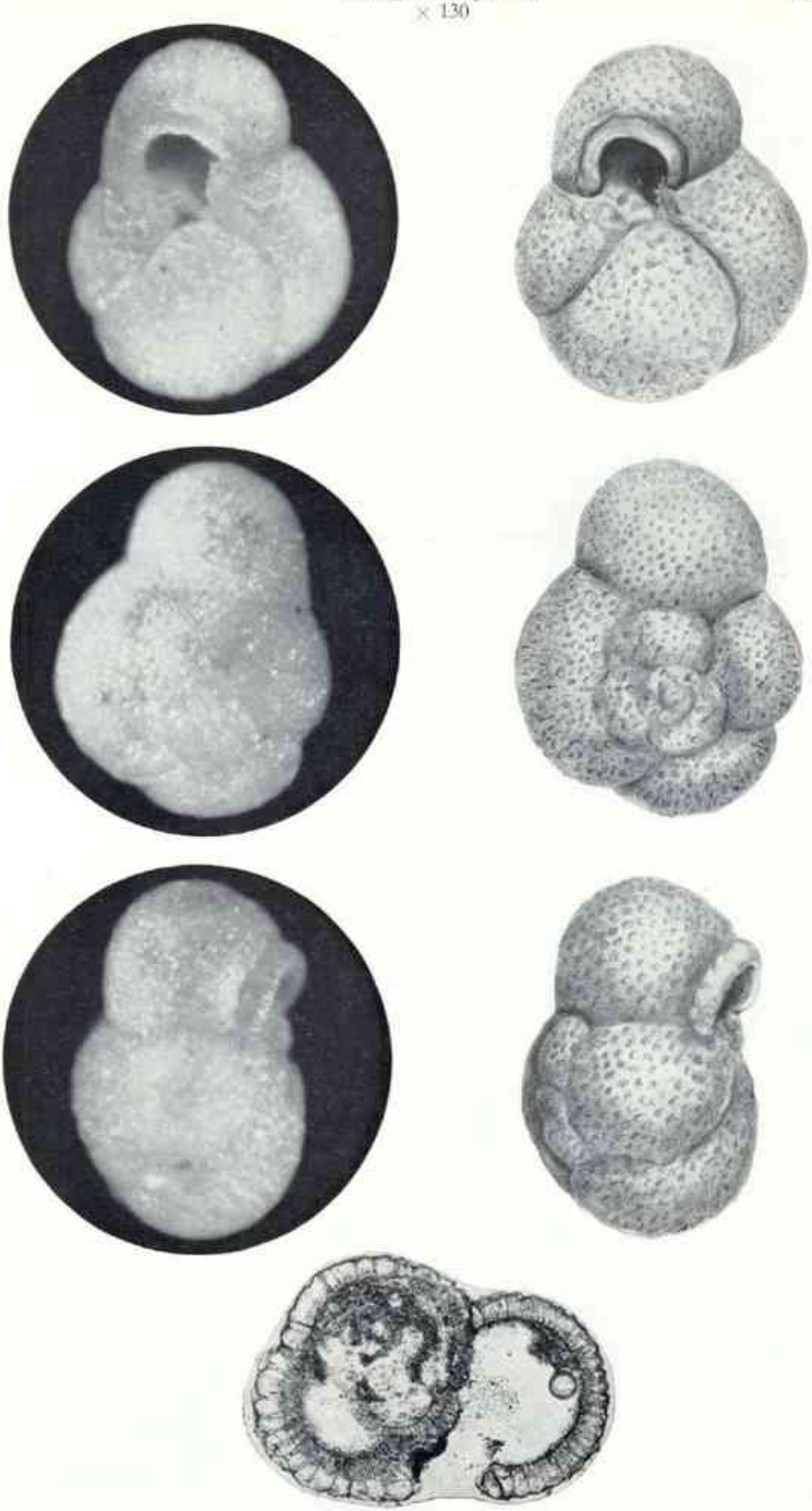


Globigerina ciperoensis
× 190





Globigerina nepenthes
× 130

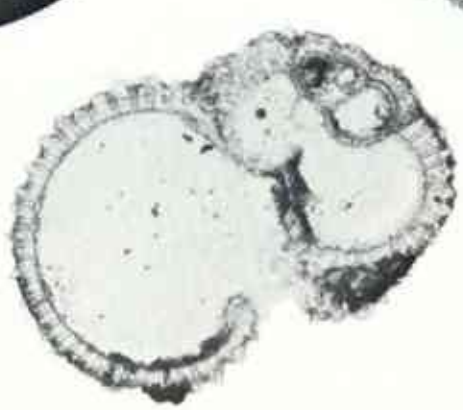


Globigerina praebulloides
× 135

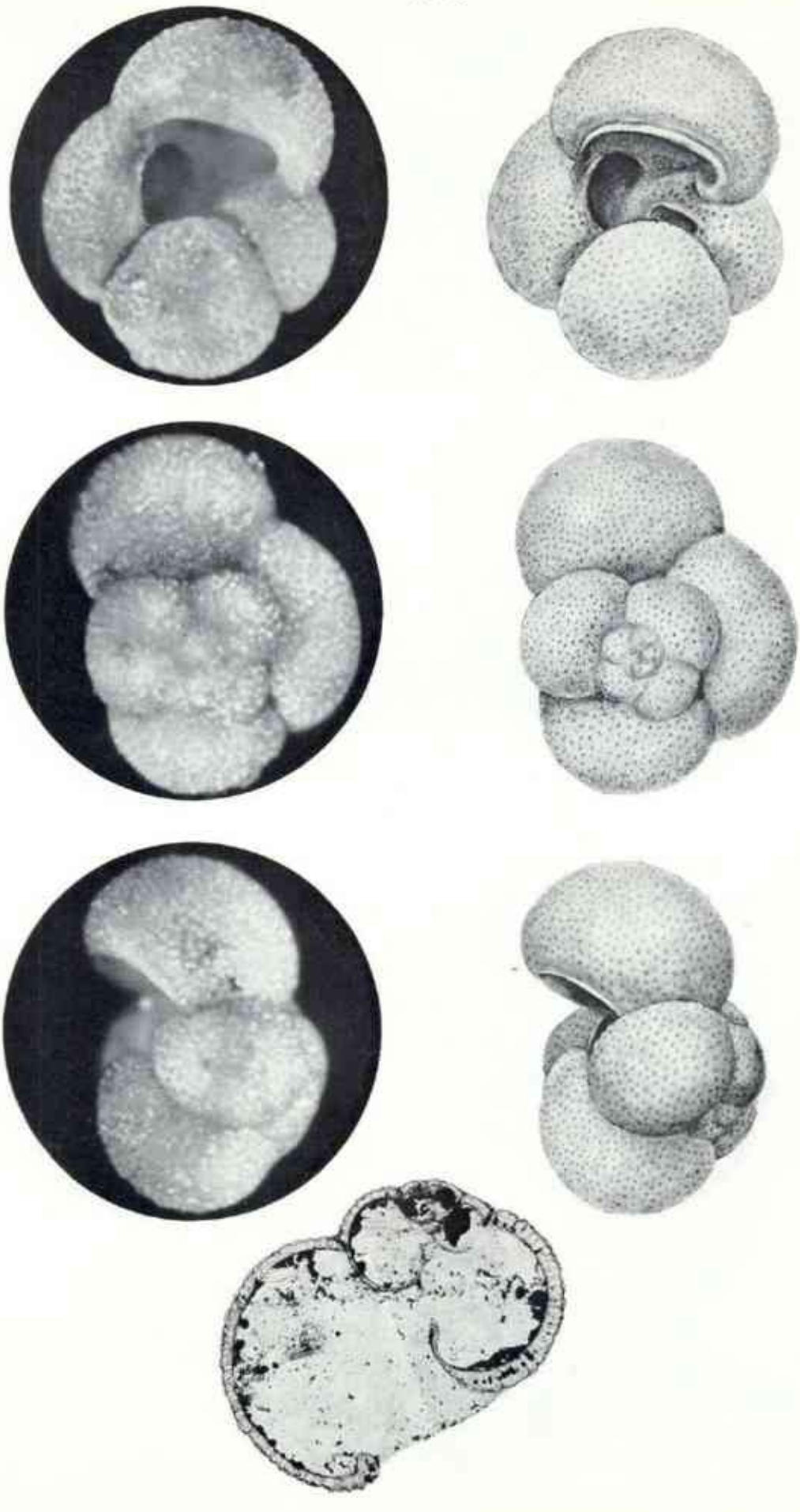




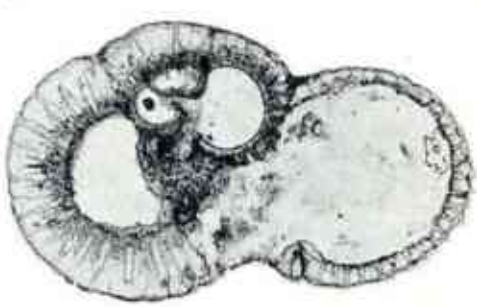




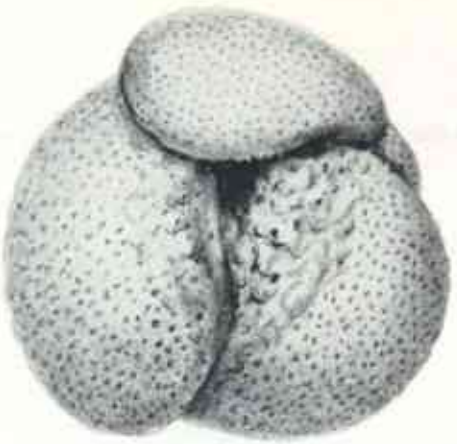
Globigerina riveroae
× 150

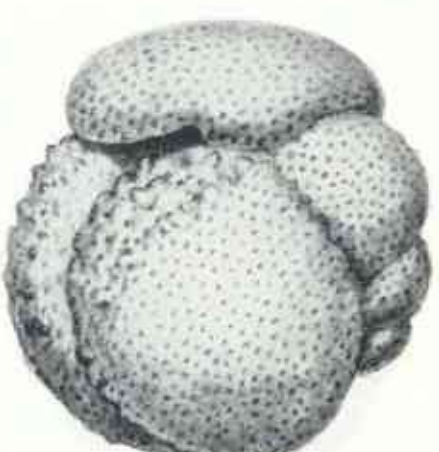


Globigerina seminulina
× 130

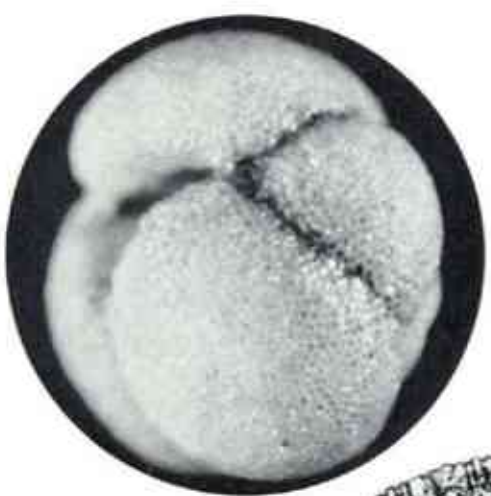


Globigerina tripartita
× 100

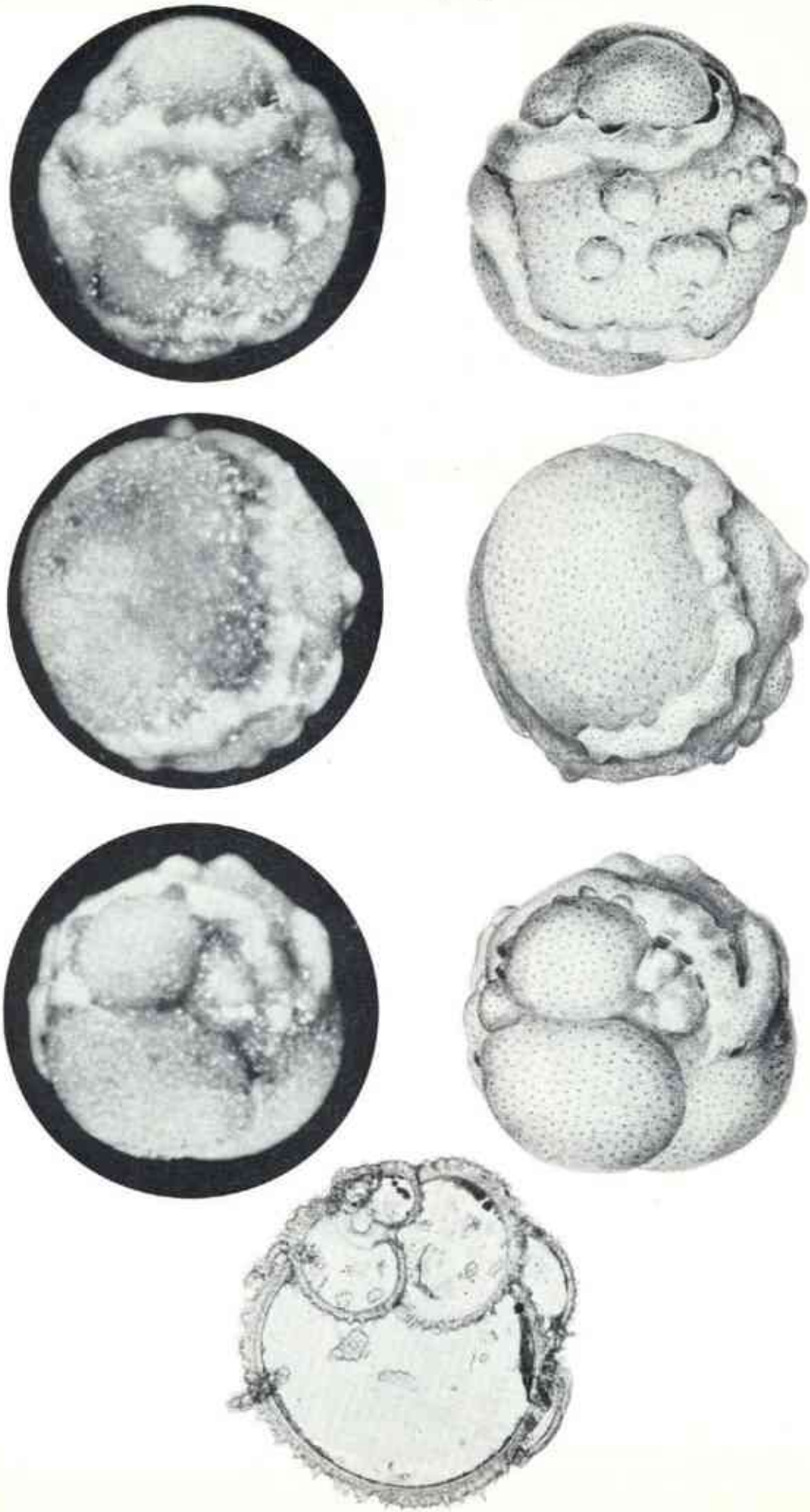




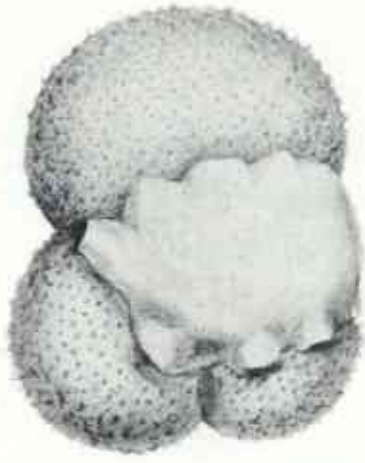
Globigerina venezuelana
× 90

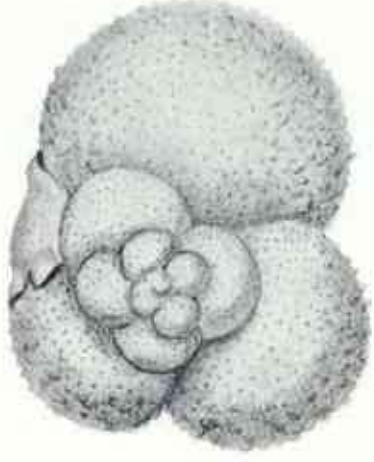


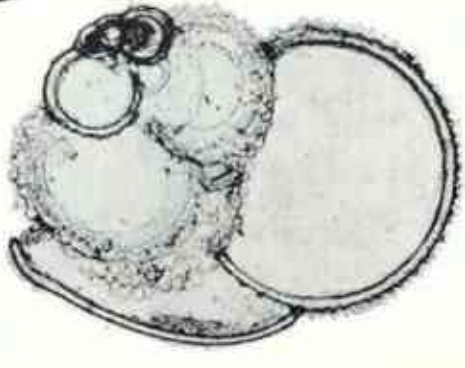
Globigerinatella insueta
× 130



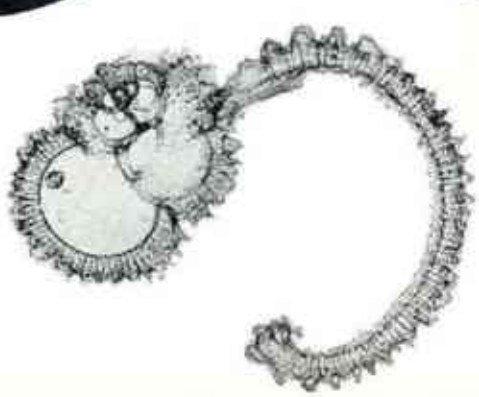
Globigerinita naparimaensis
× 240



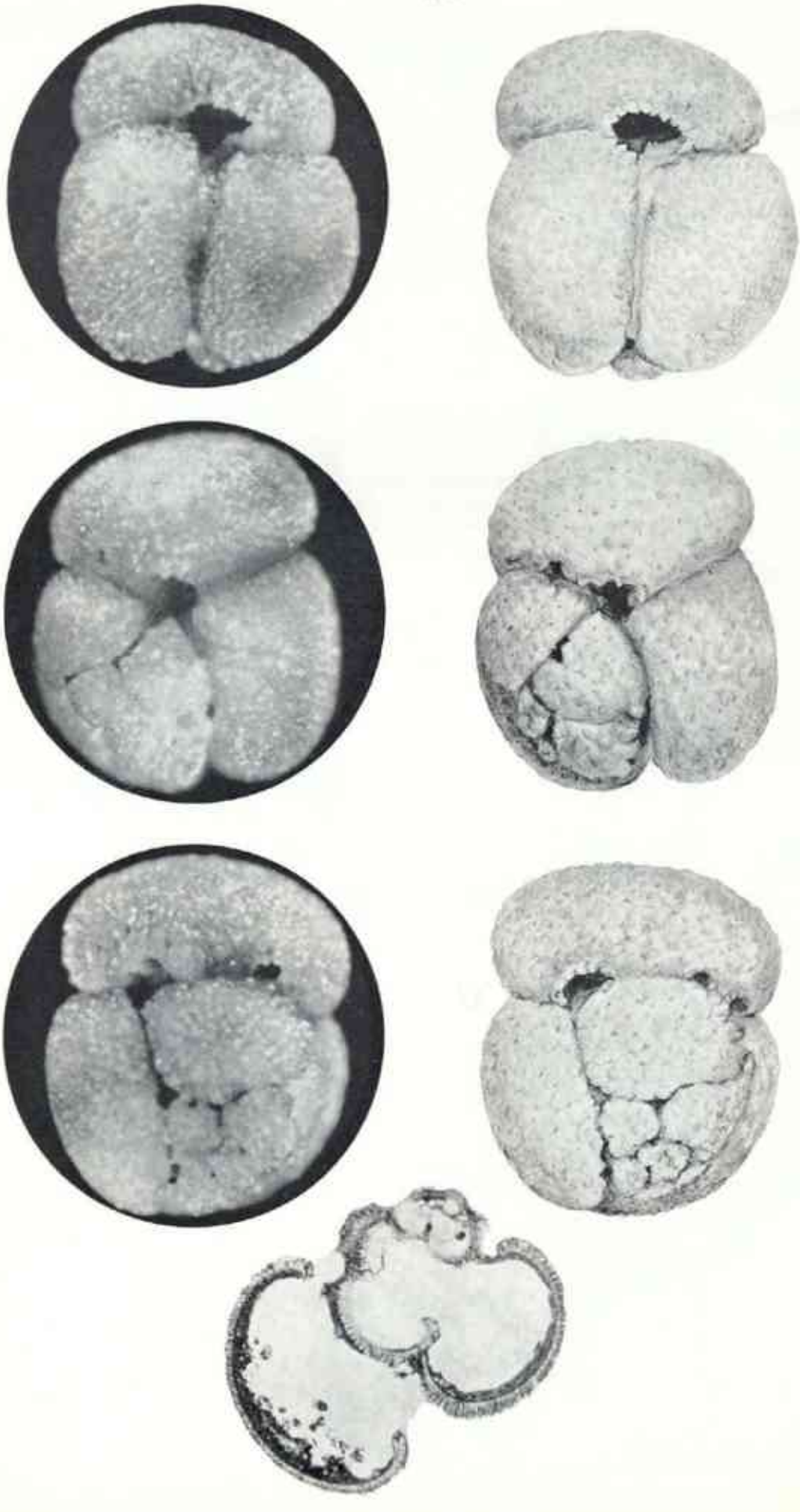




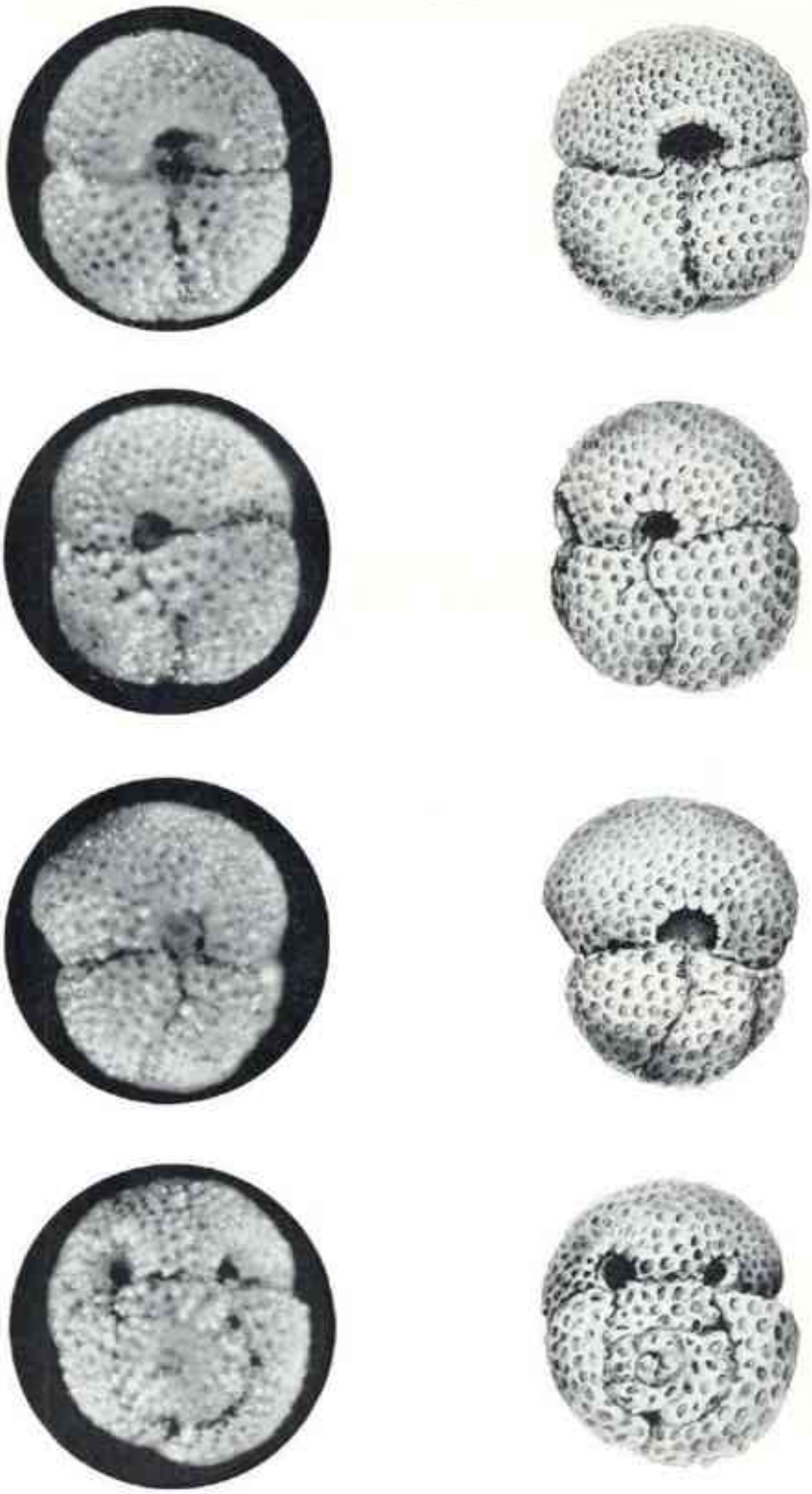
Globigerinoides altiaperturus
× 110



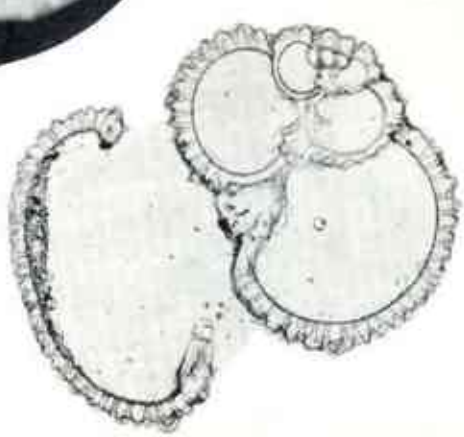
× 70



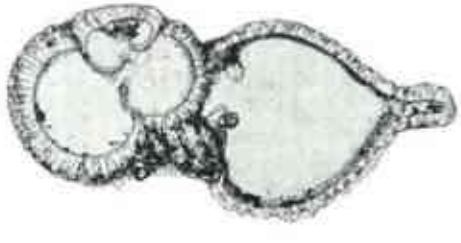
Globigerinoides diminutus
× 220



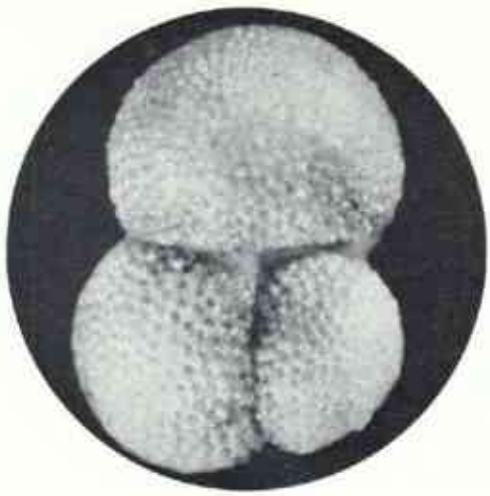
× 130

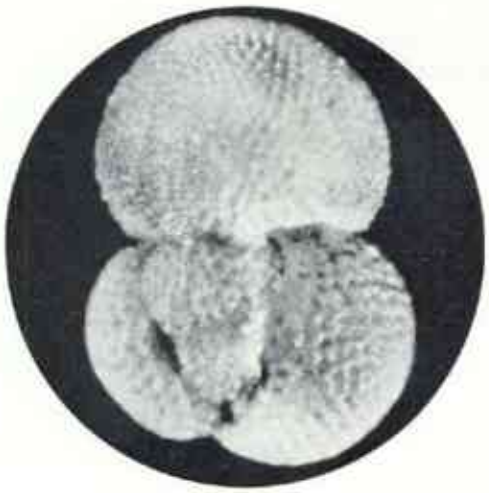


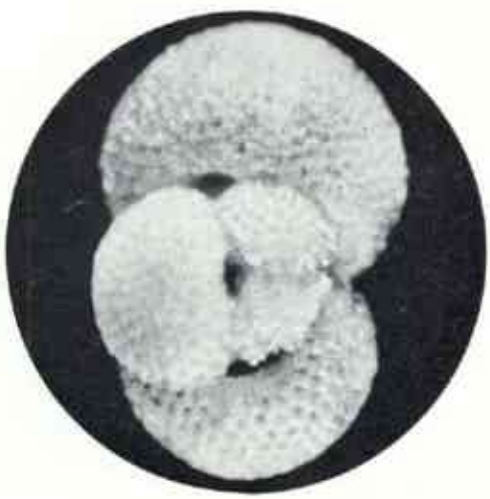
Globigerinoides fistulosus
× 50

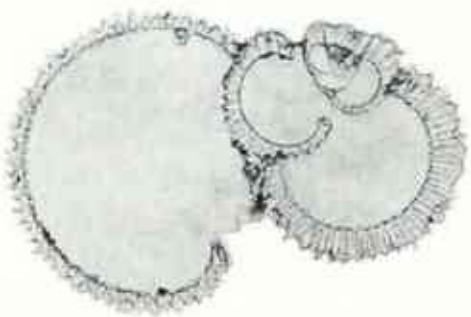


× 95

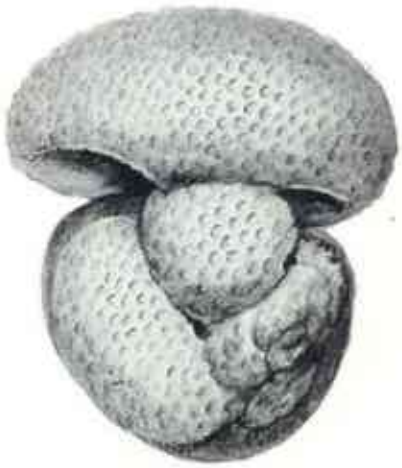


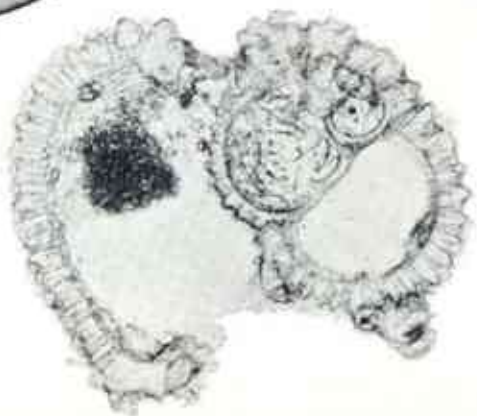




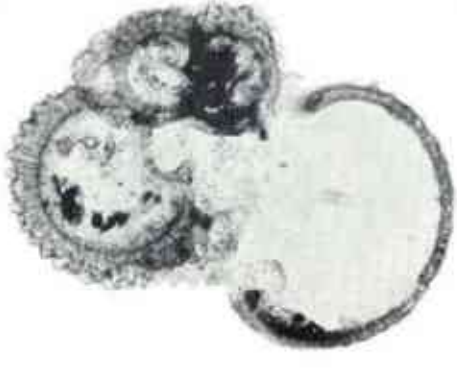


Globigerinoides obliquus
× 130

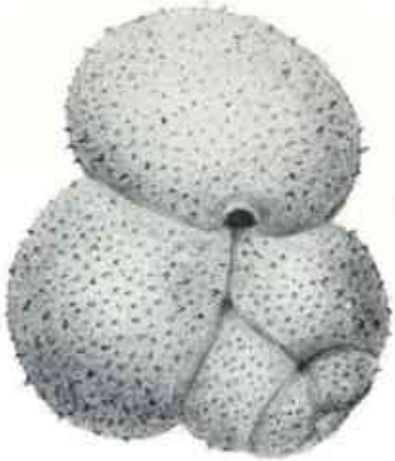




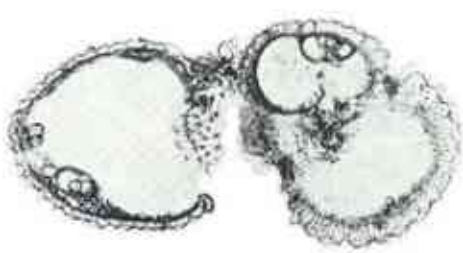
Globigerinoides primordius
× 120



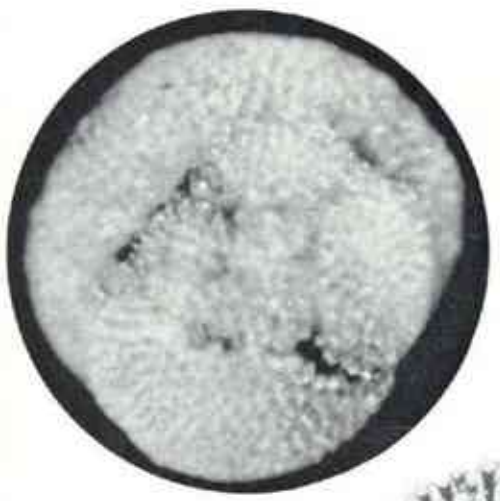
Globigerinoides ruber
× 140



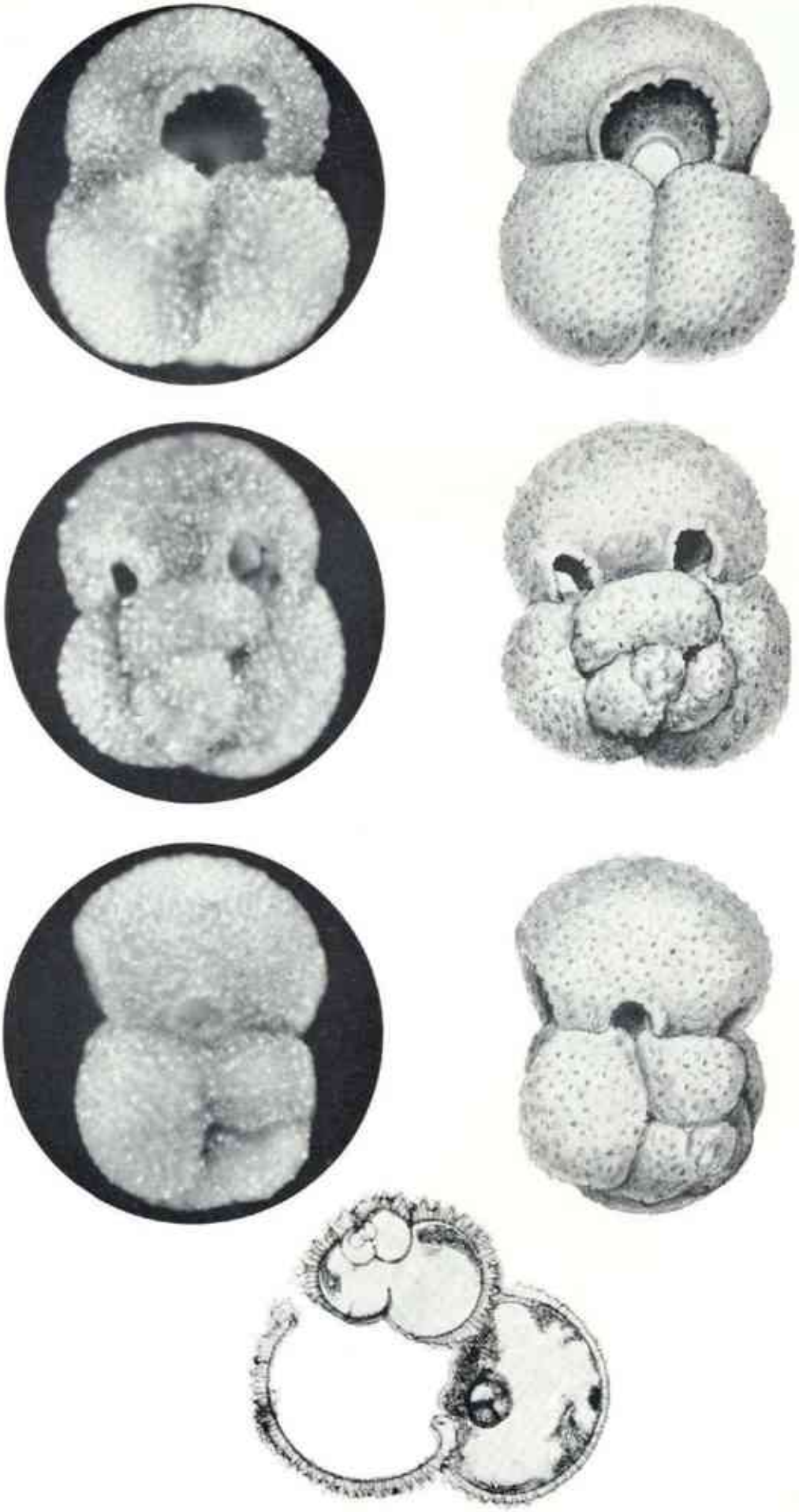
Globigerinoides sacculiferus
× 105



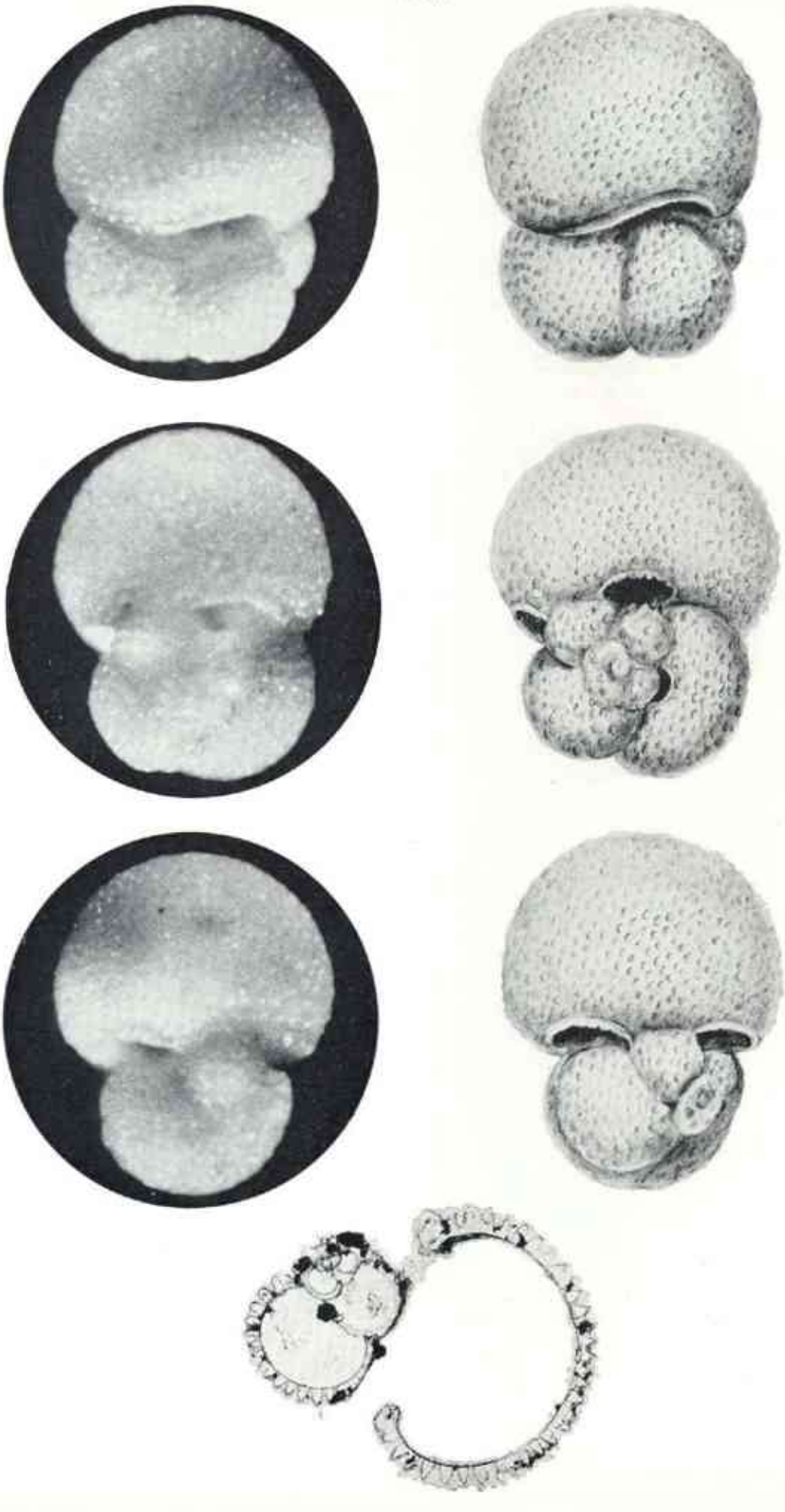
× 140



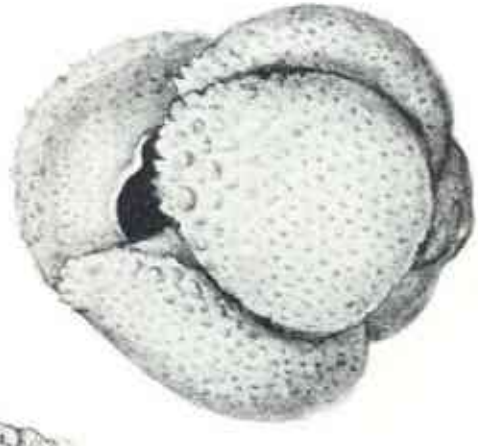
× 160



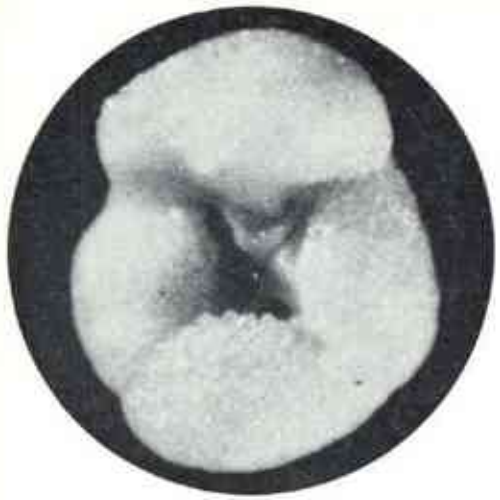
Globigerinoides trilobus
× 135

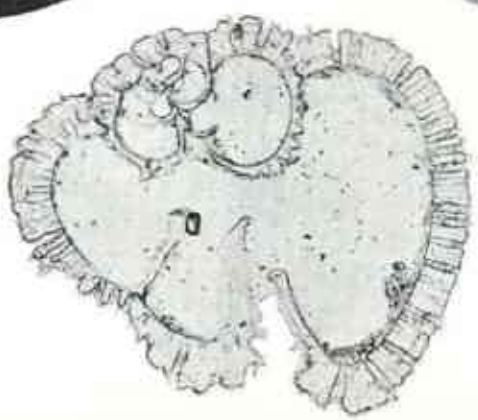


Globoquadrina altispira
× 110

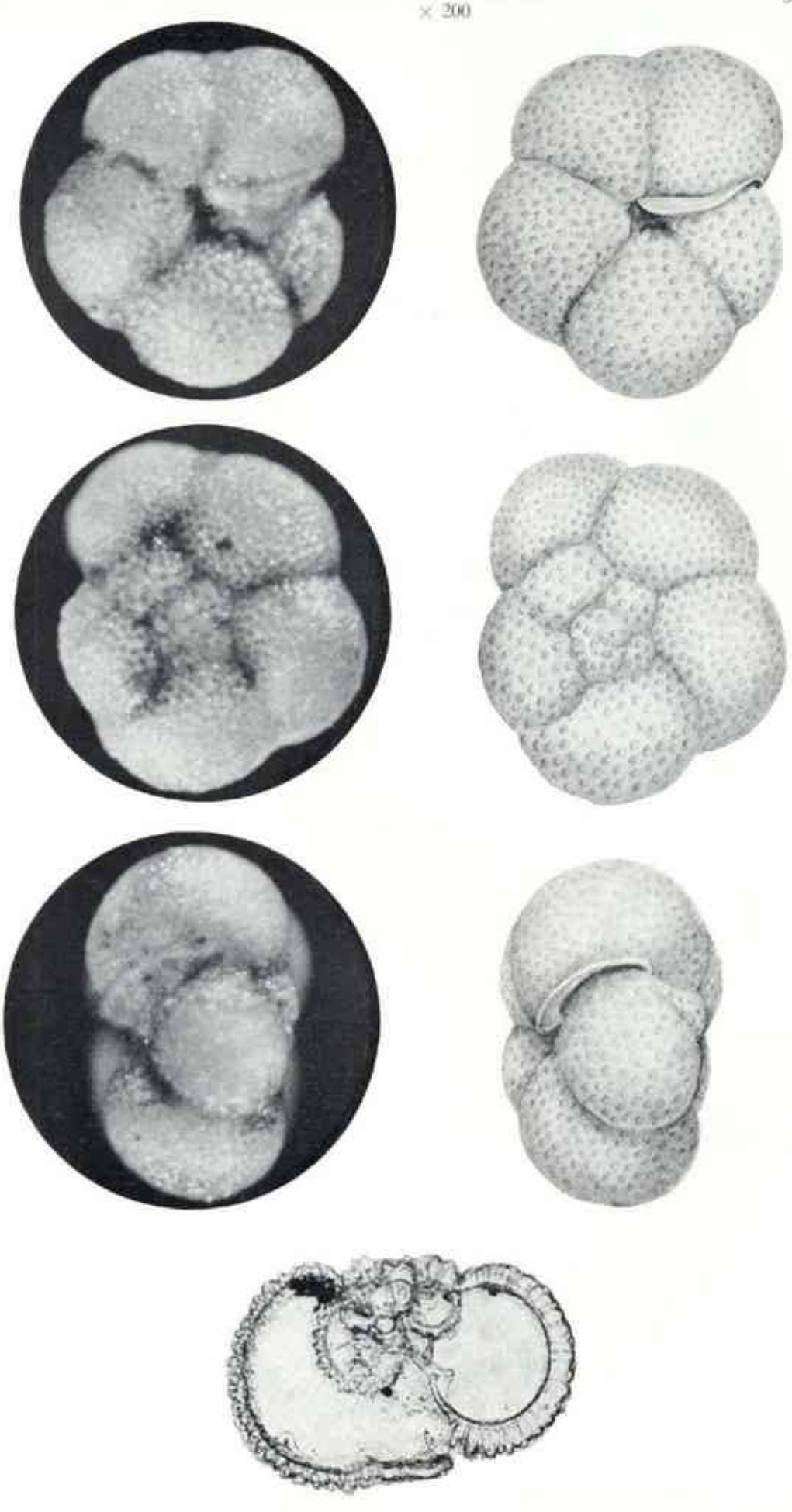


Globoquadrina dehiscens
× 125

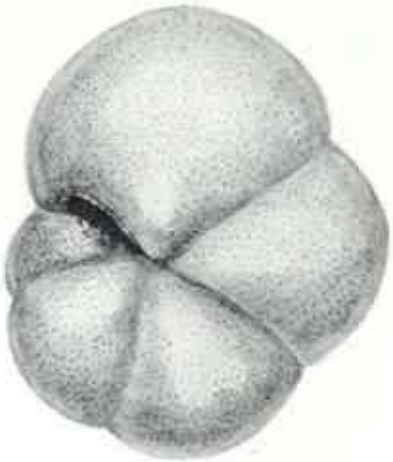




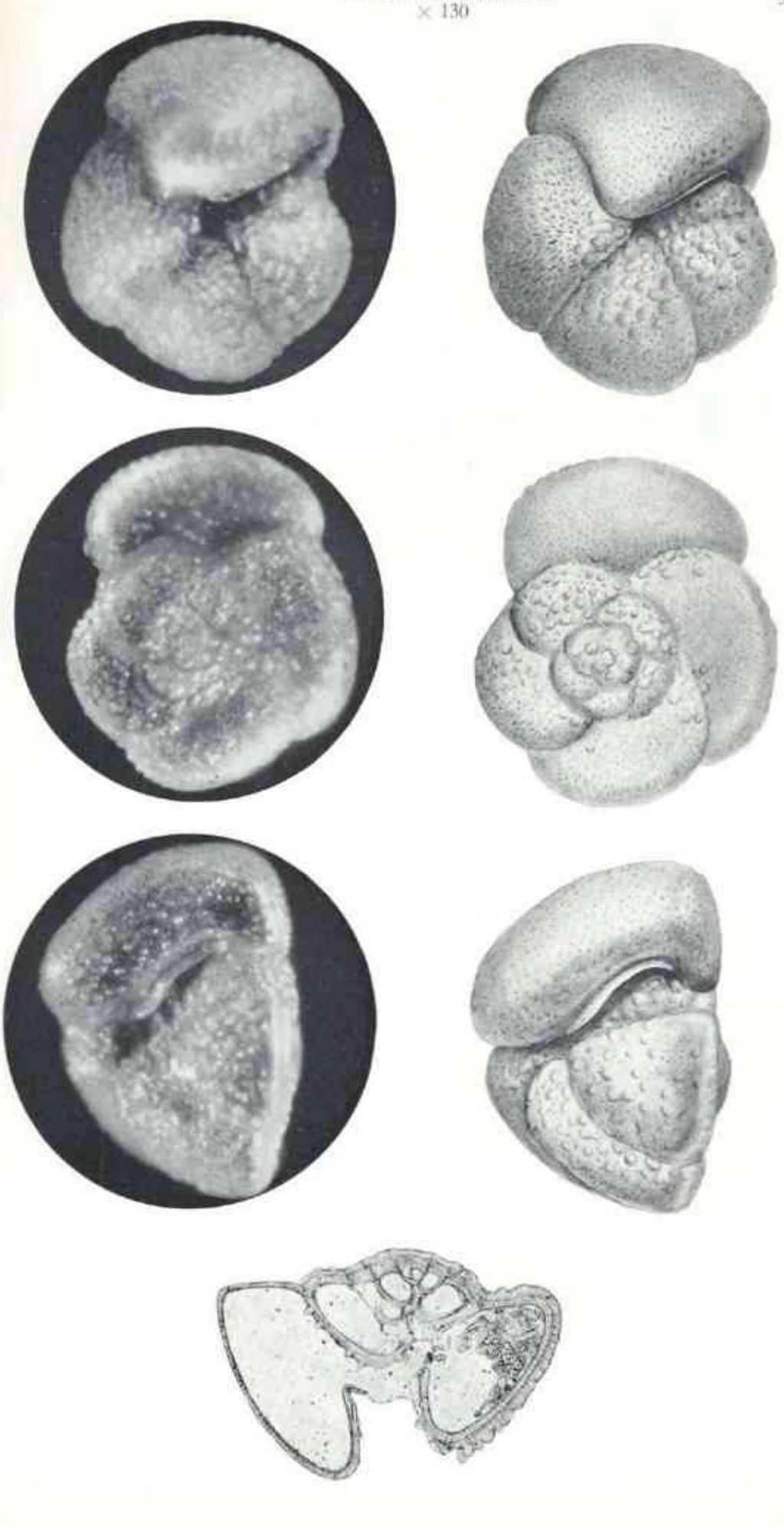
Globorotalia acostaensis
× 200



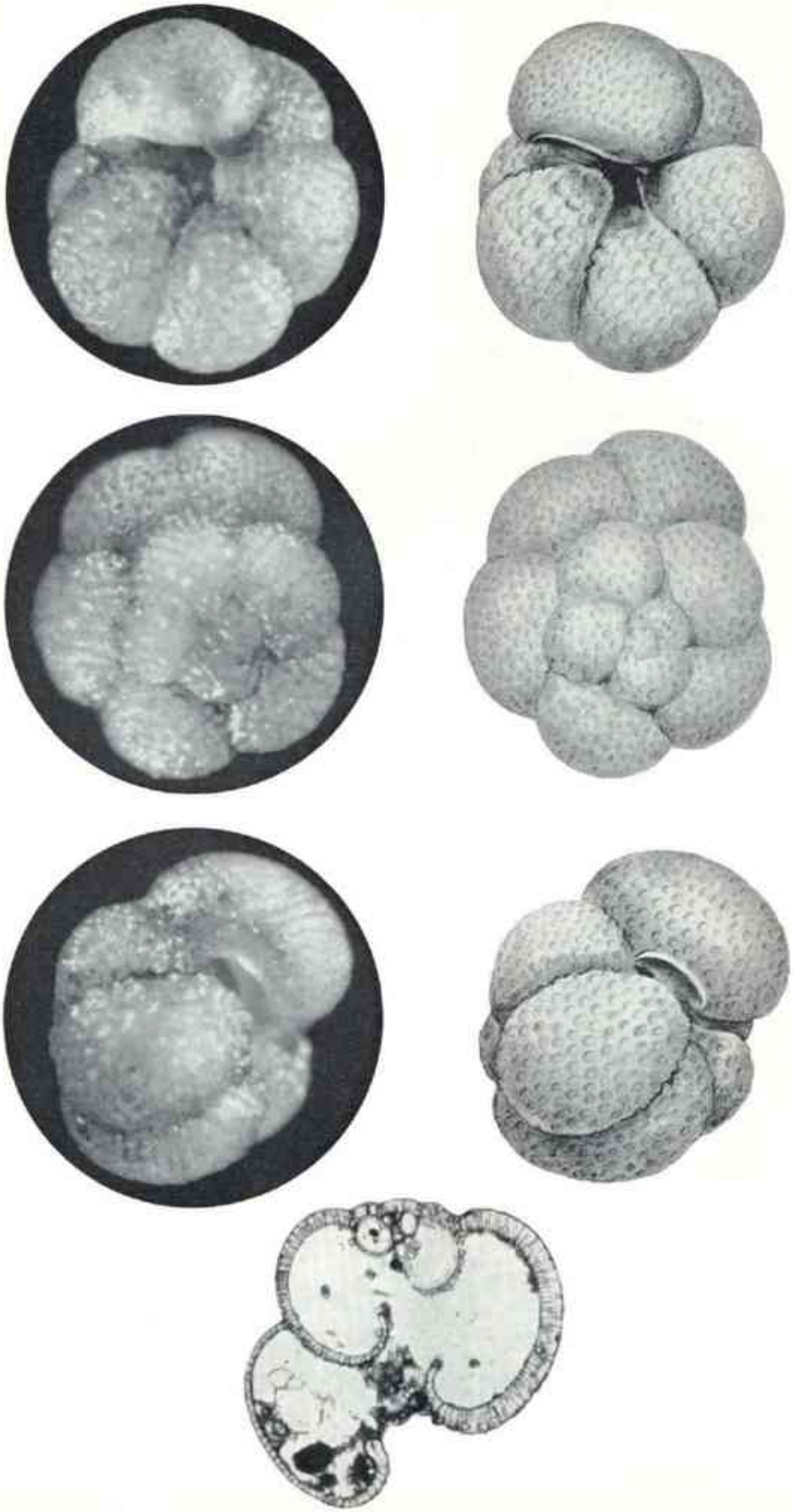
Globorotalia archeomenardii
× 180



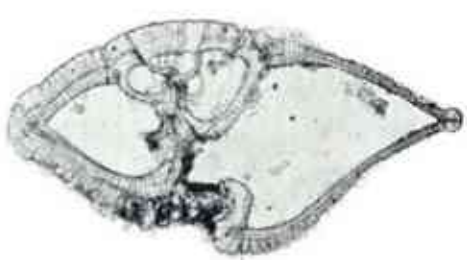
Globorotalia crassaformis
× 130



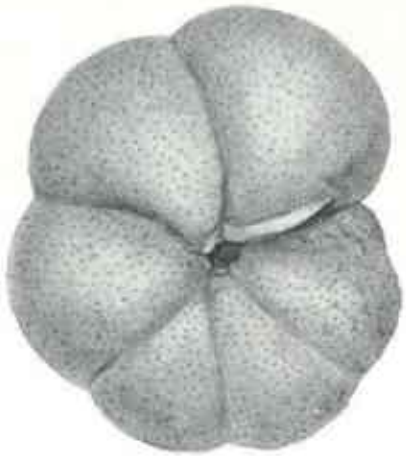
× 130

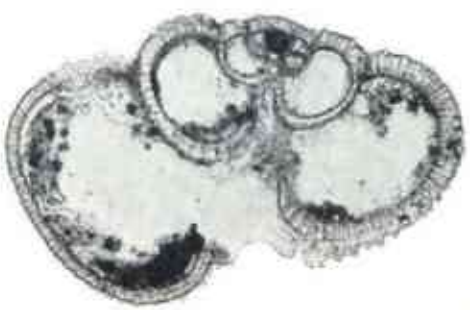


× 100



Globorotalia kugleri
× 220

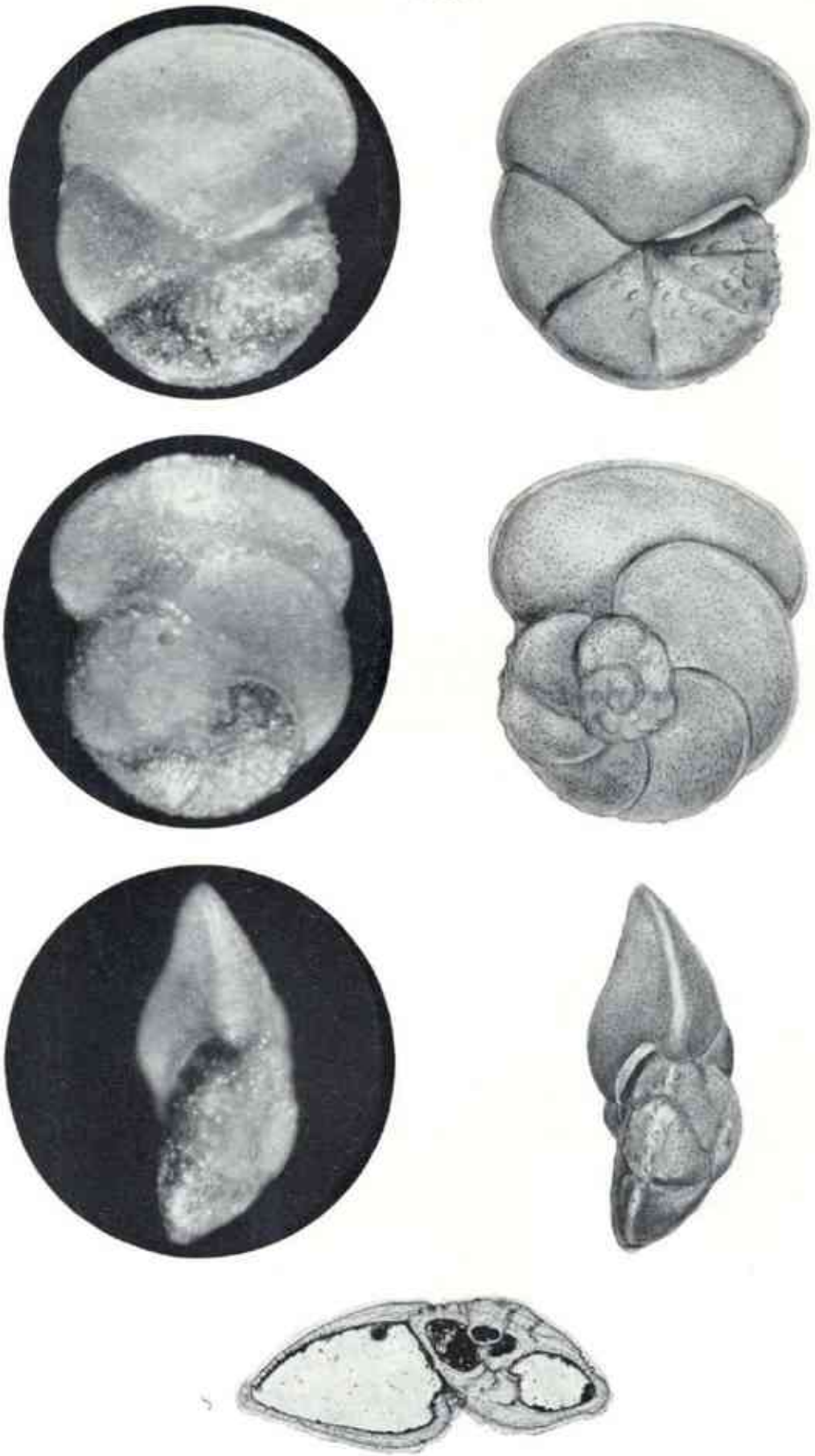




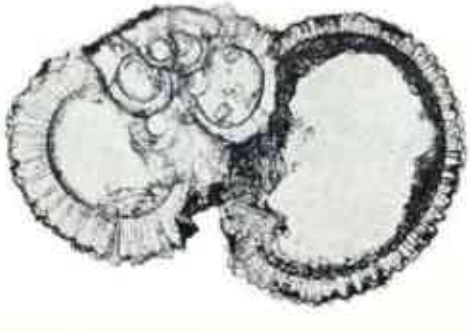
× 185

Globorotalia lobata
× 130

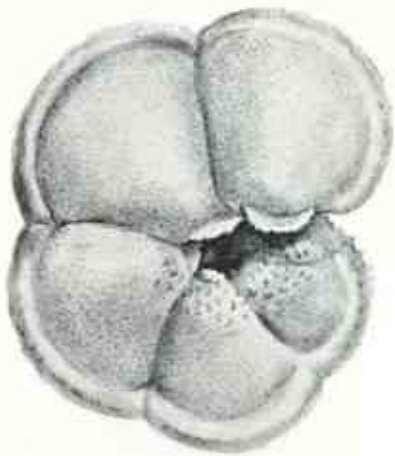
× 135

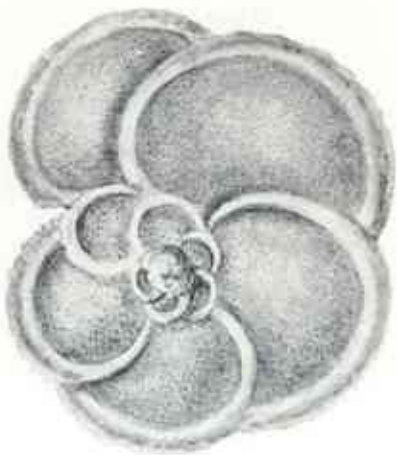


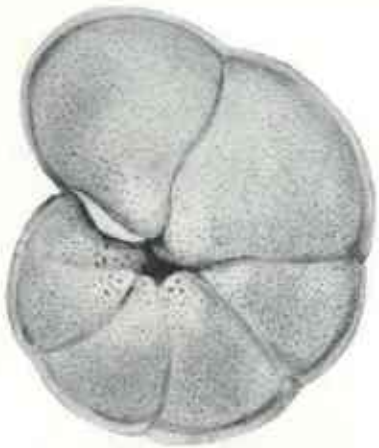
Globorotalia mayeri
× 160



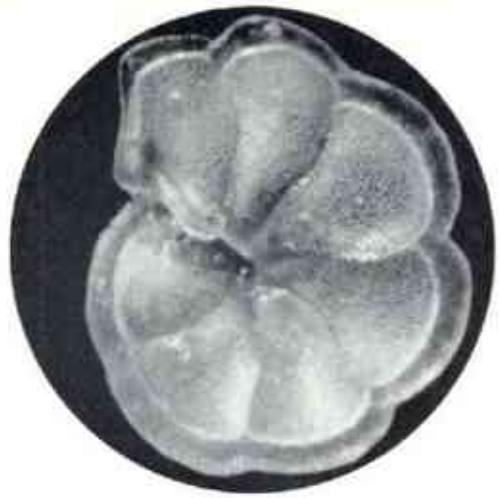
Globorotalia menardii
× 60



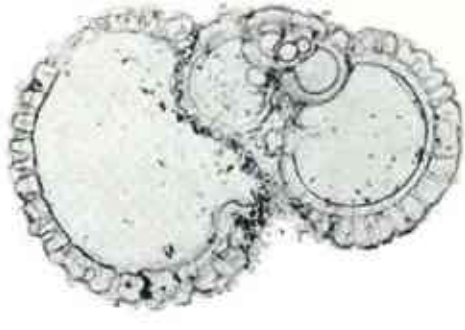




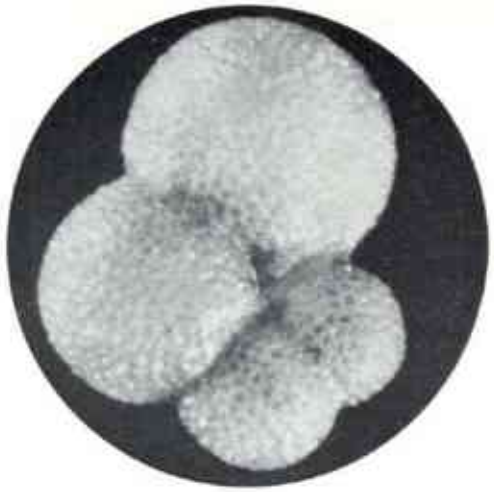
Globorotalia multicamerata
× 90

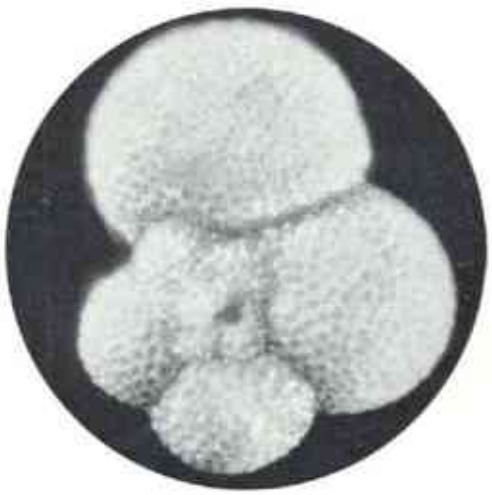


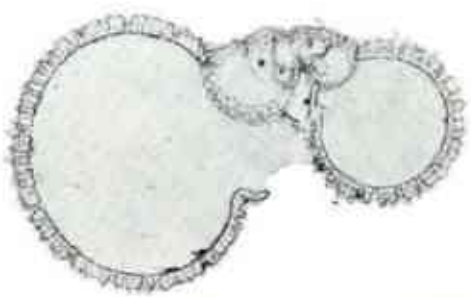
Globorotalia nana
× 180



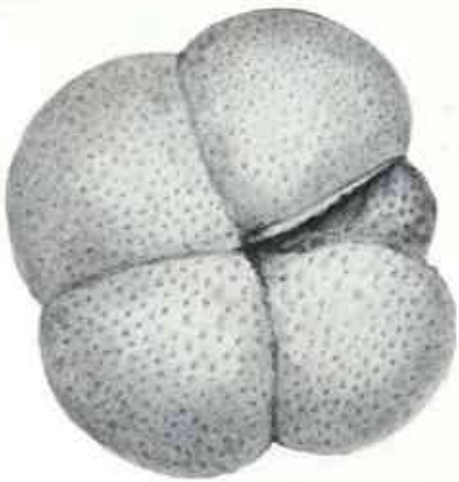
Globorotalia obesa
× 125

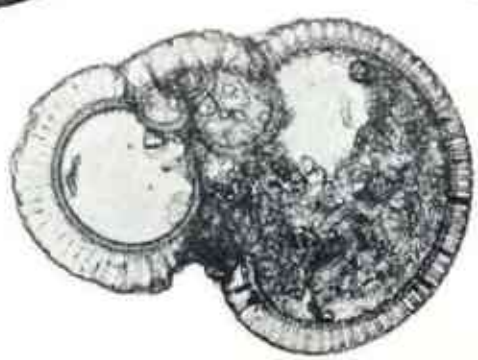




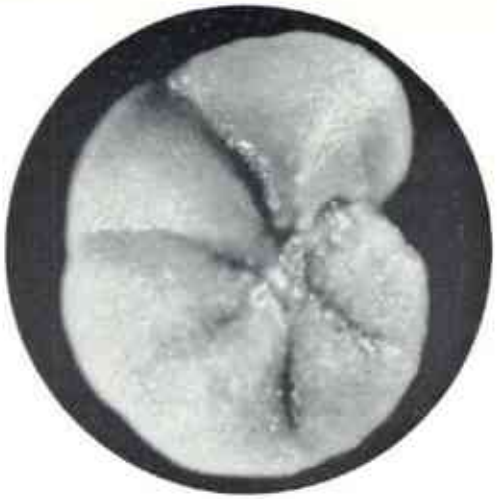


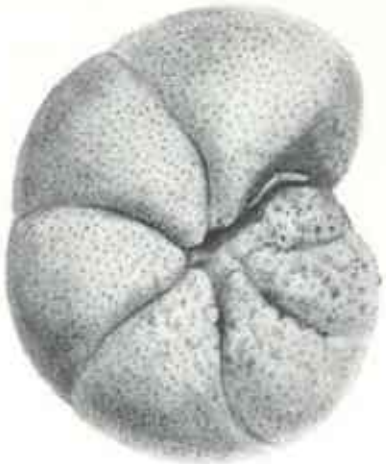
Globorotalia opima
× 130





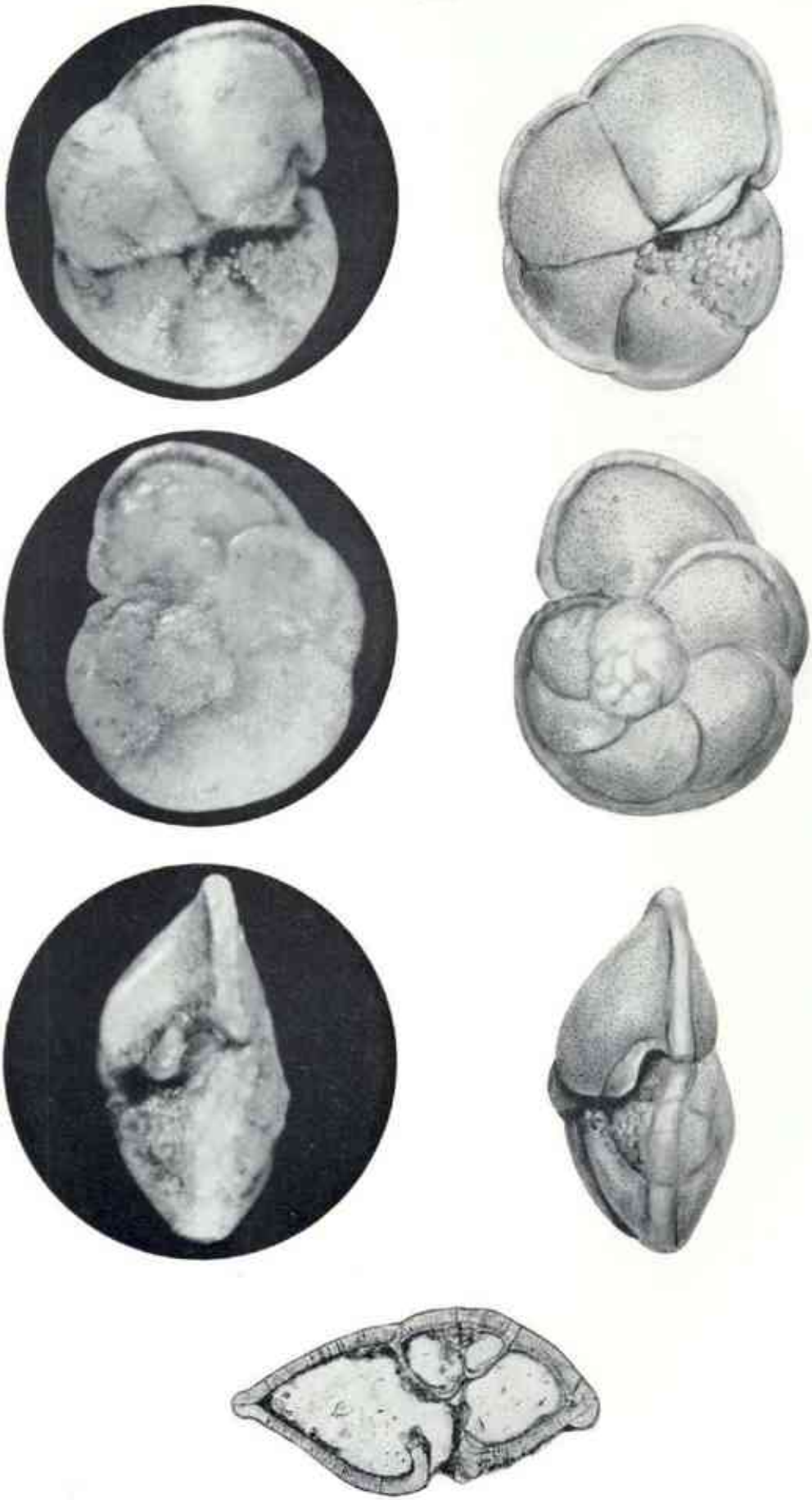
Globorotalia peripheroacuta
× 135



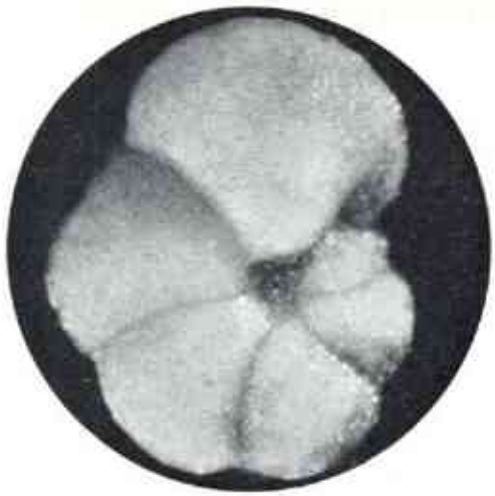


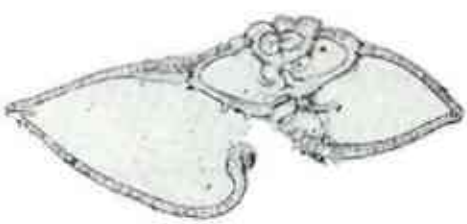
× 150

× 90



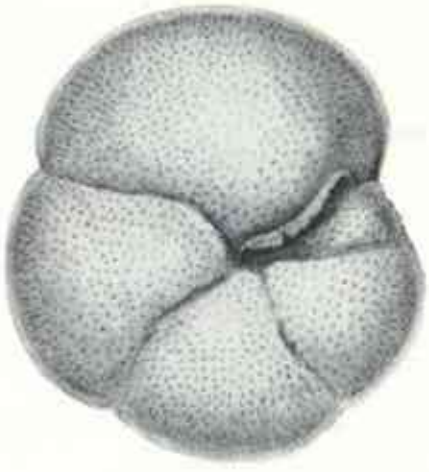
× 120



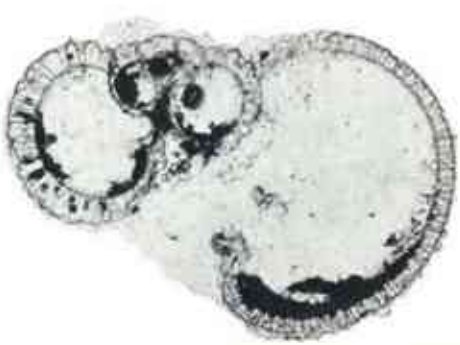


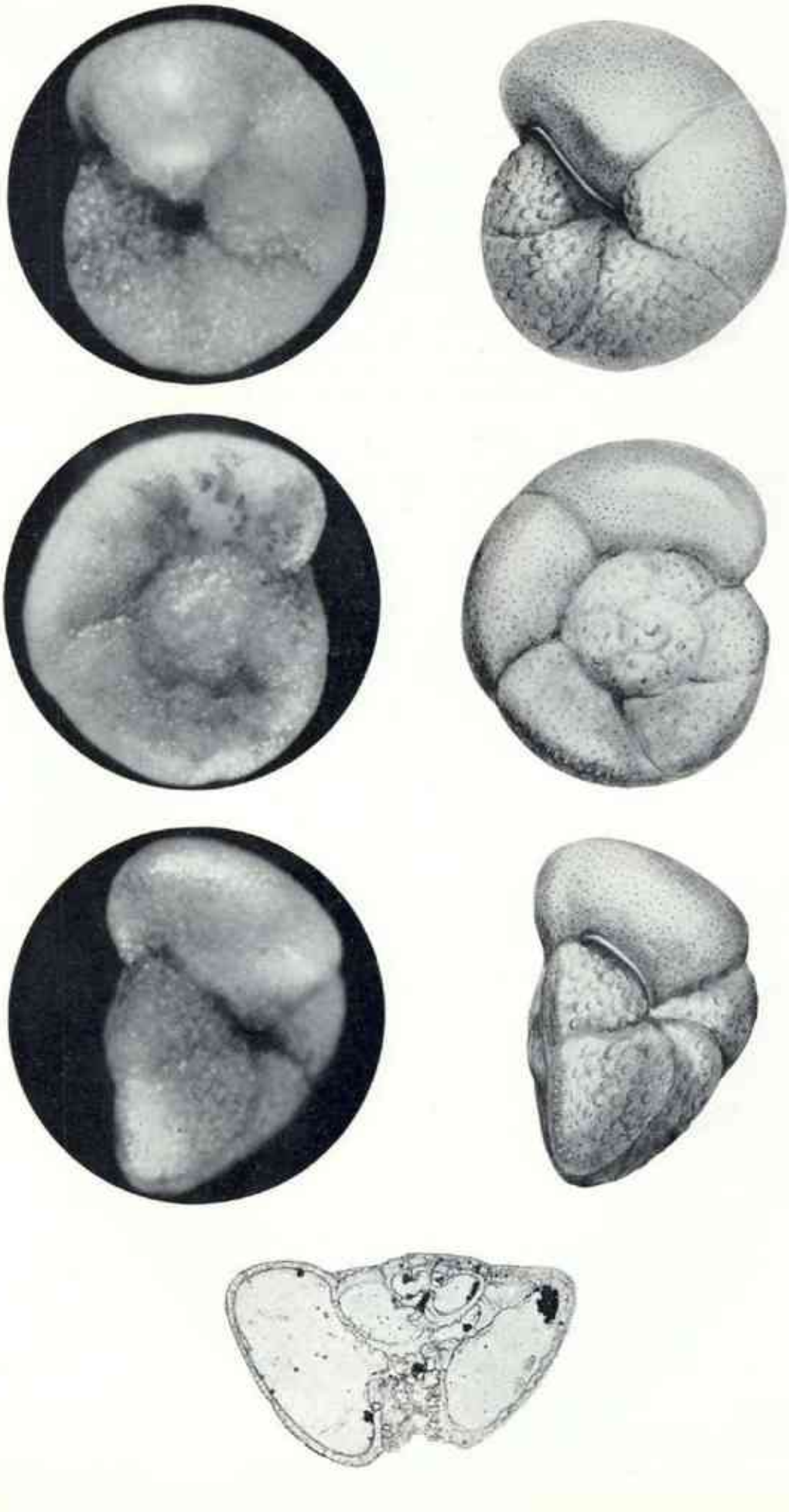
Globorotalia pseudomiocenica
× 185

Globorotalia scitula
× 120

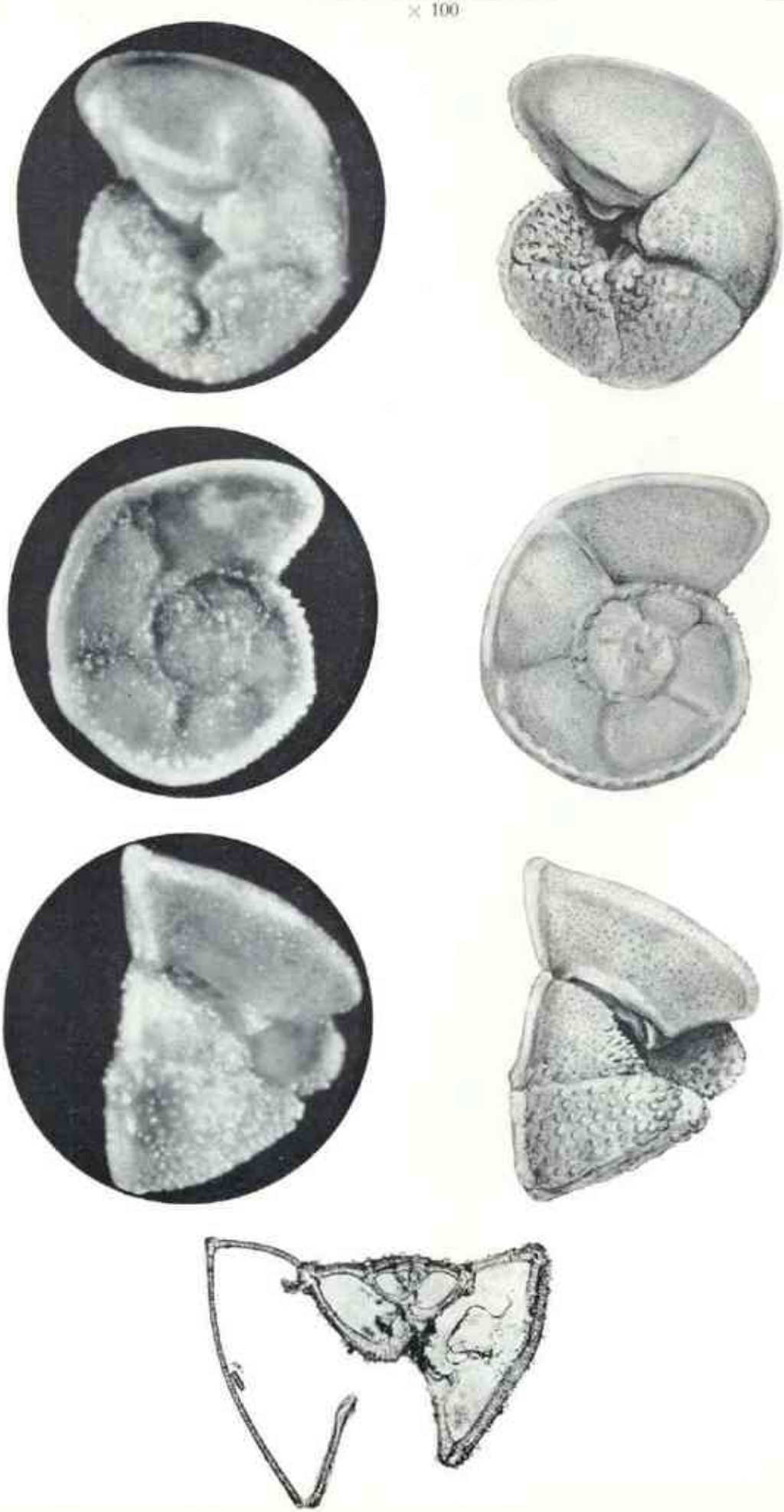


Globorotalia siakensis
× 150

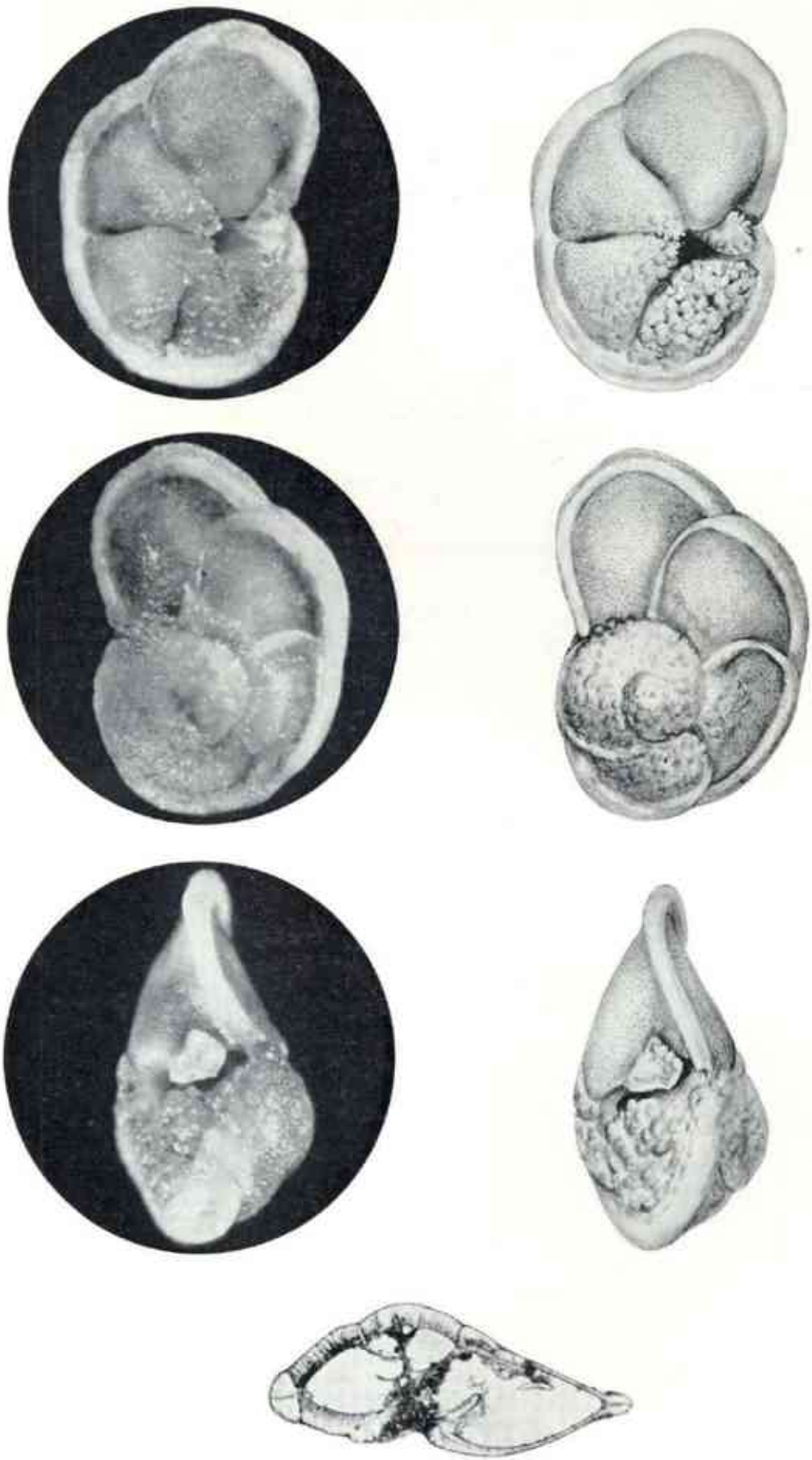




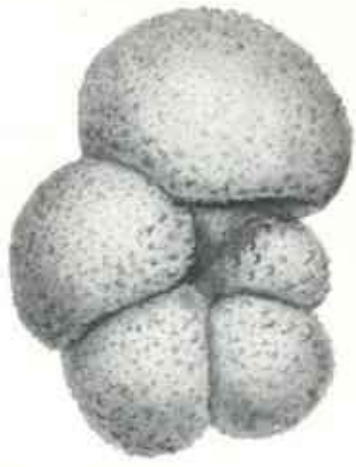
Globorotalia truncatulinoides
× 100

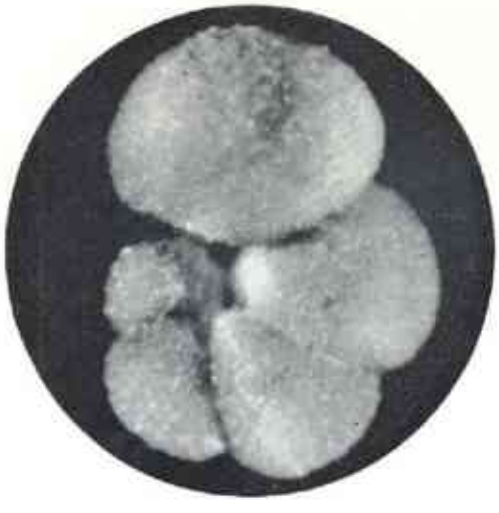


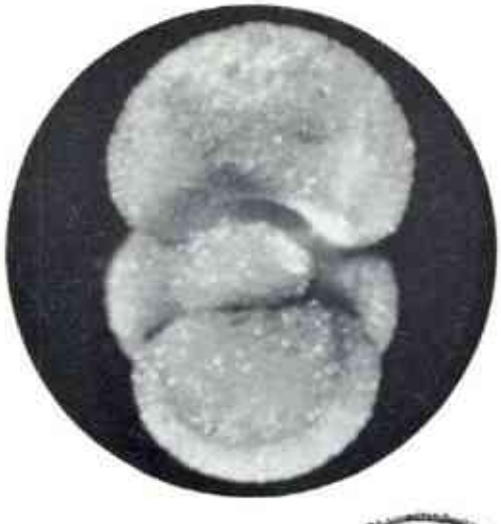
× 55

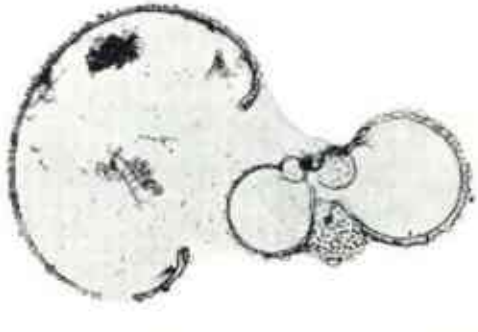


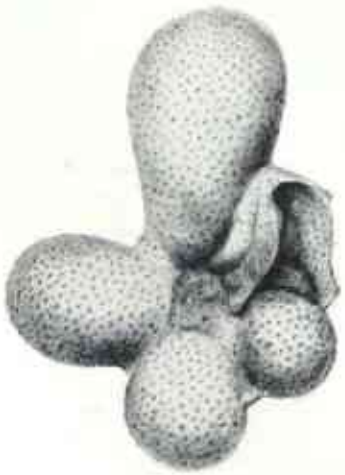
× 55



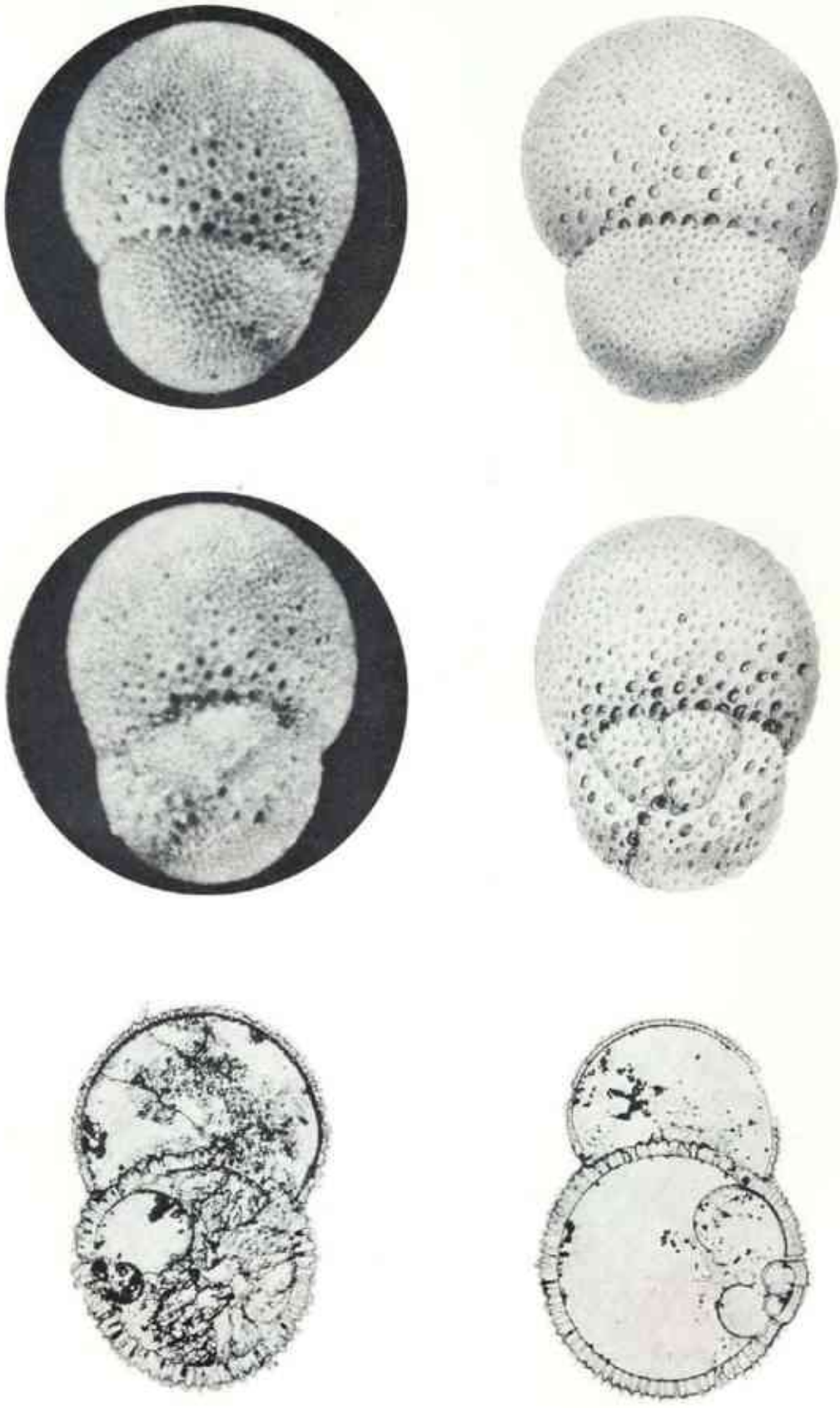




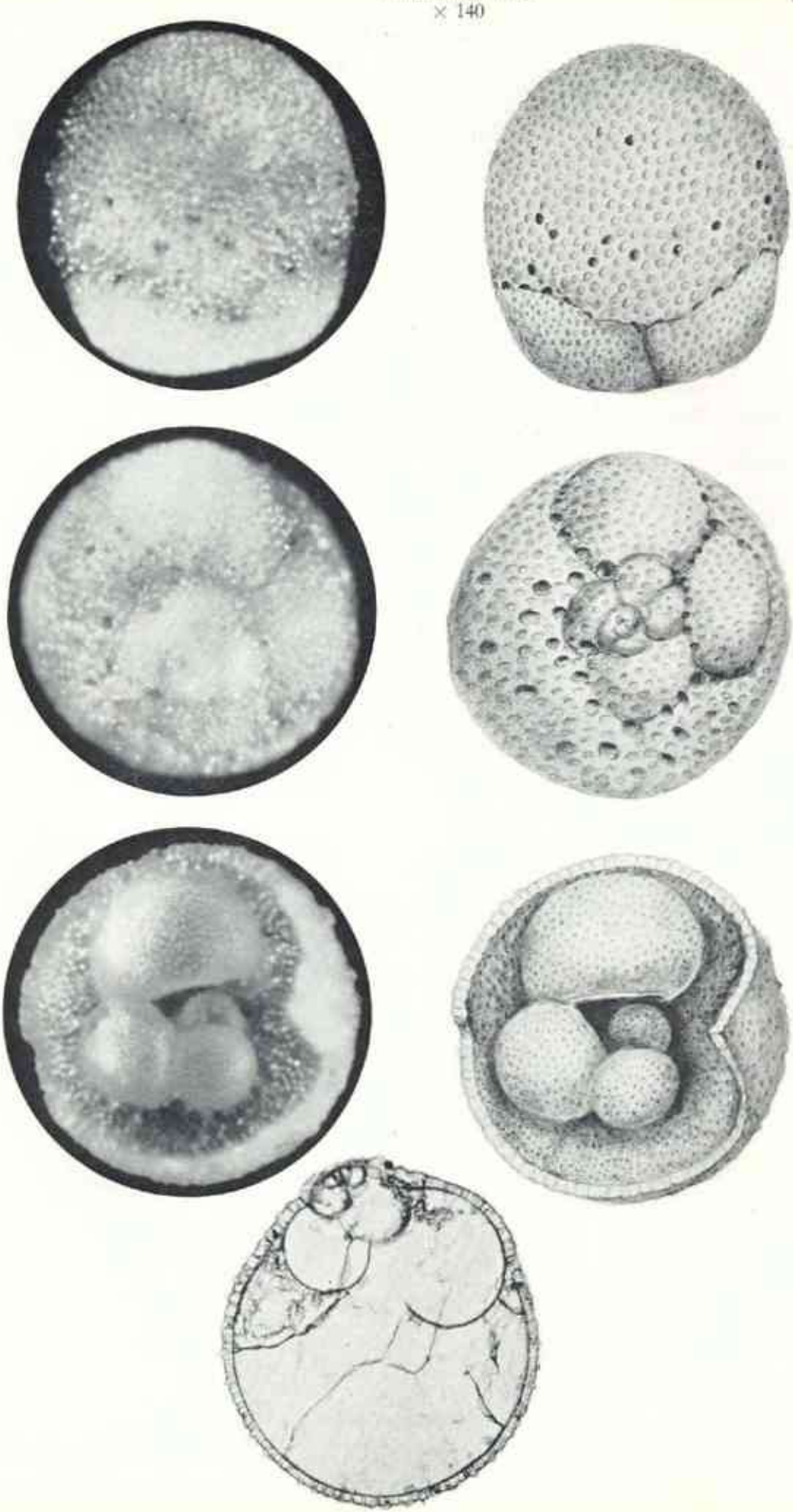




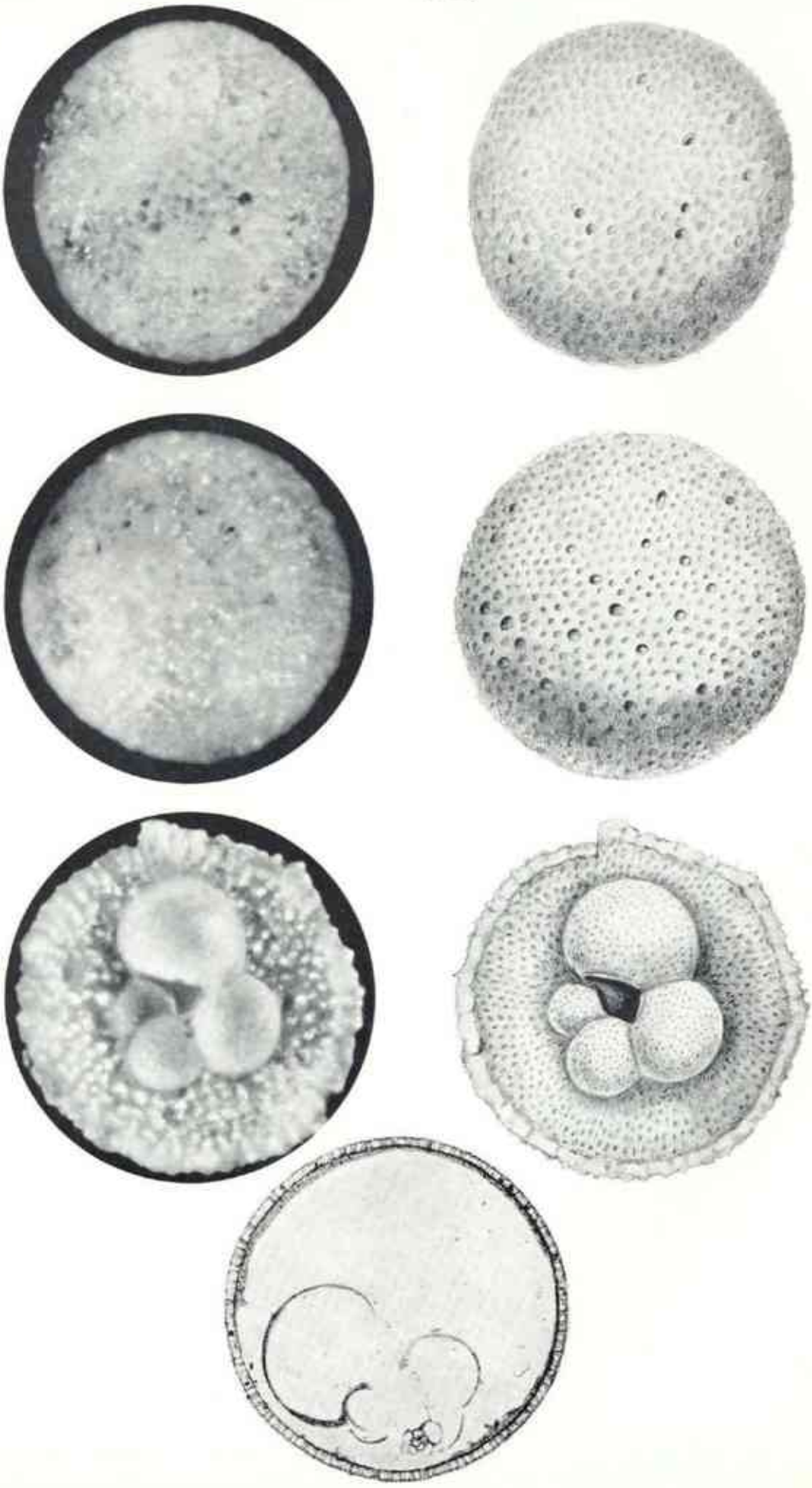
Orbulina bilobata
× 95



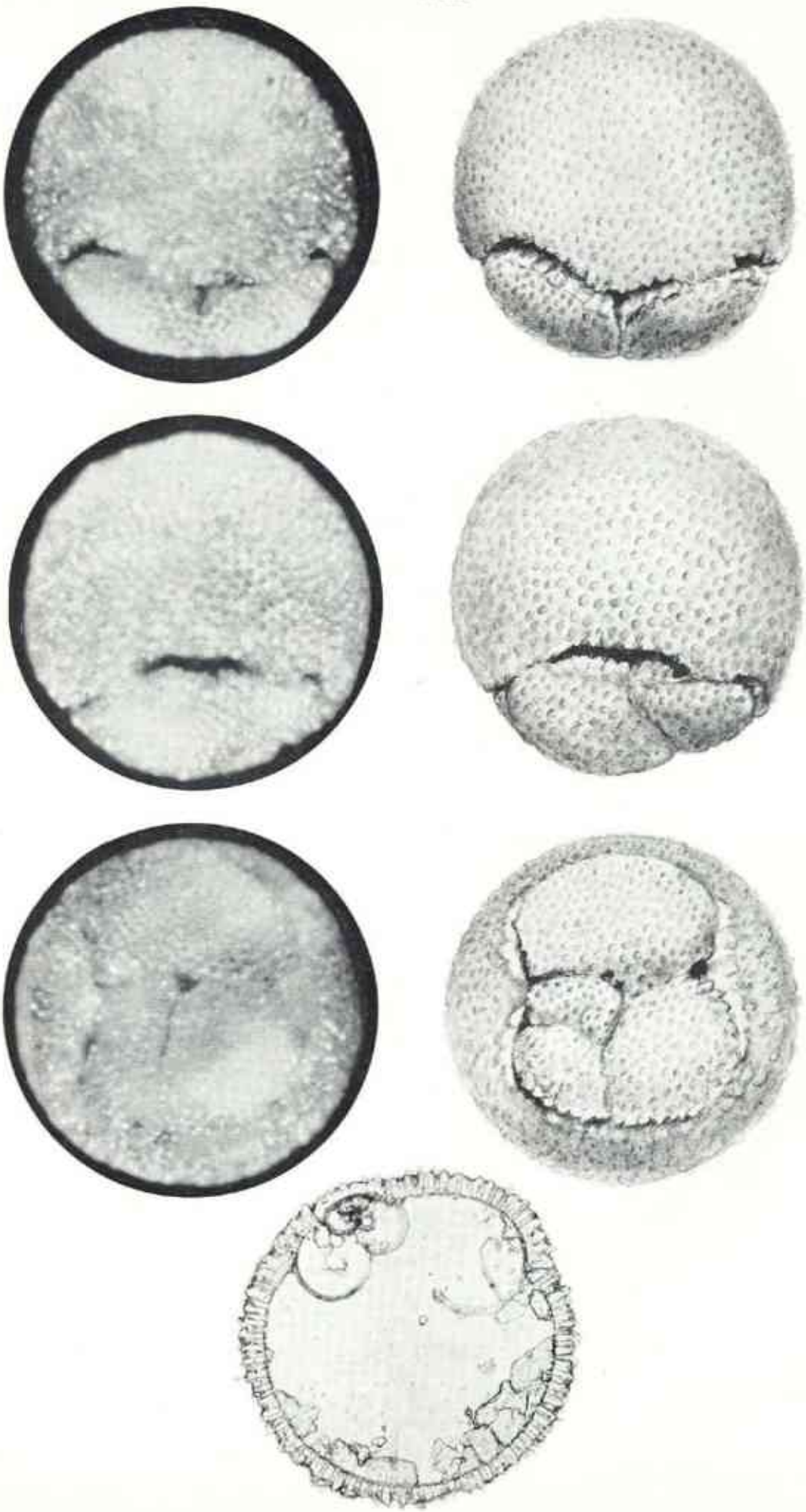
Orbulina suturalis
× 140



Orbulina universa
× 150

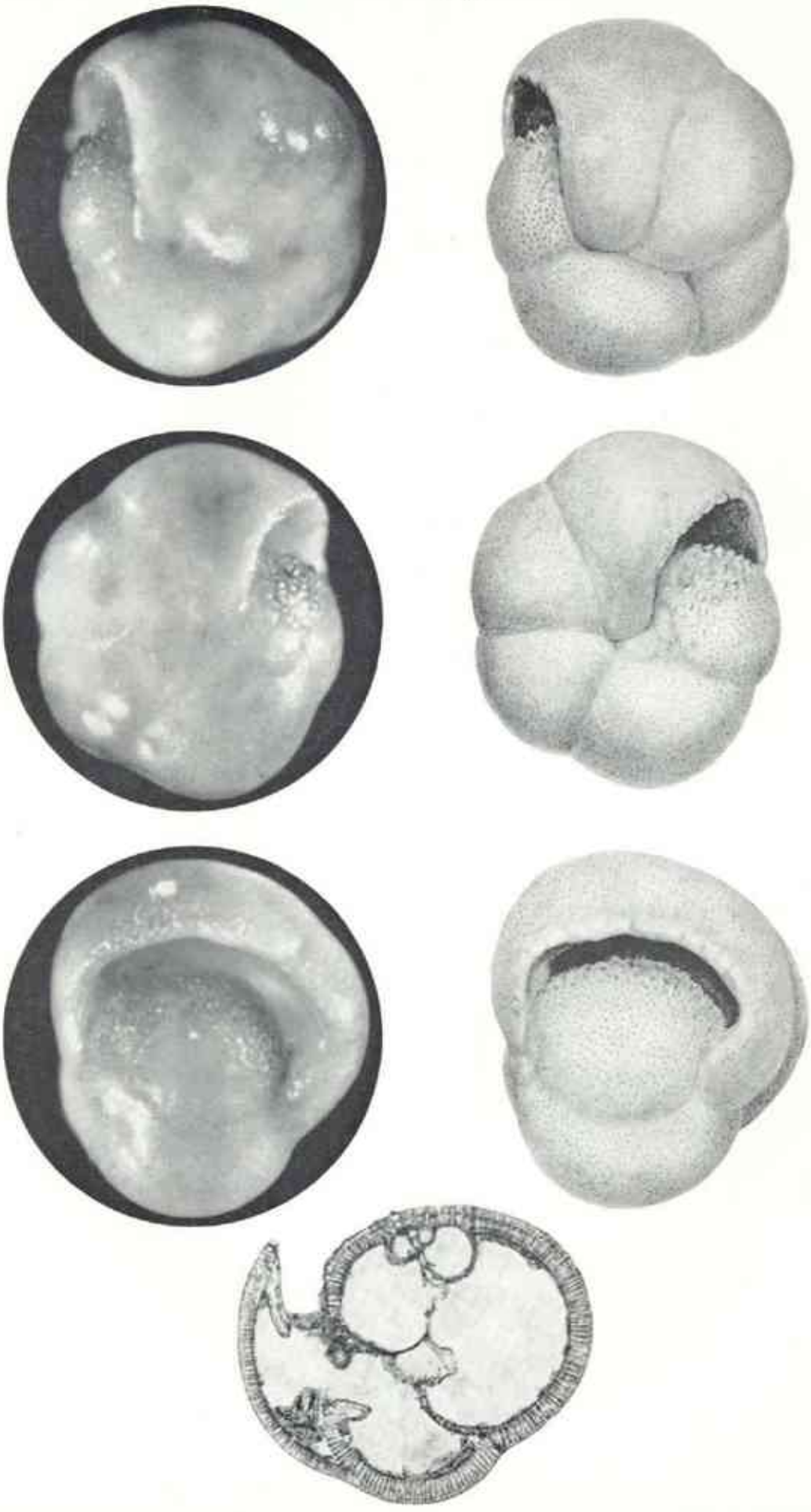


Praeorbulina glomerosa
× 135



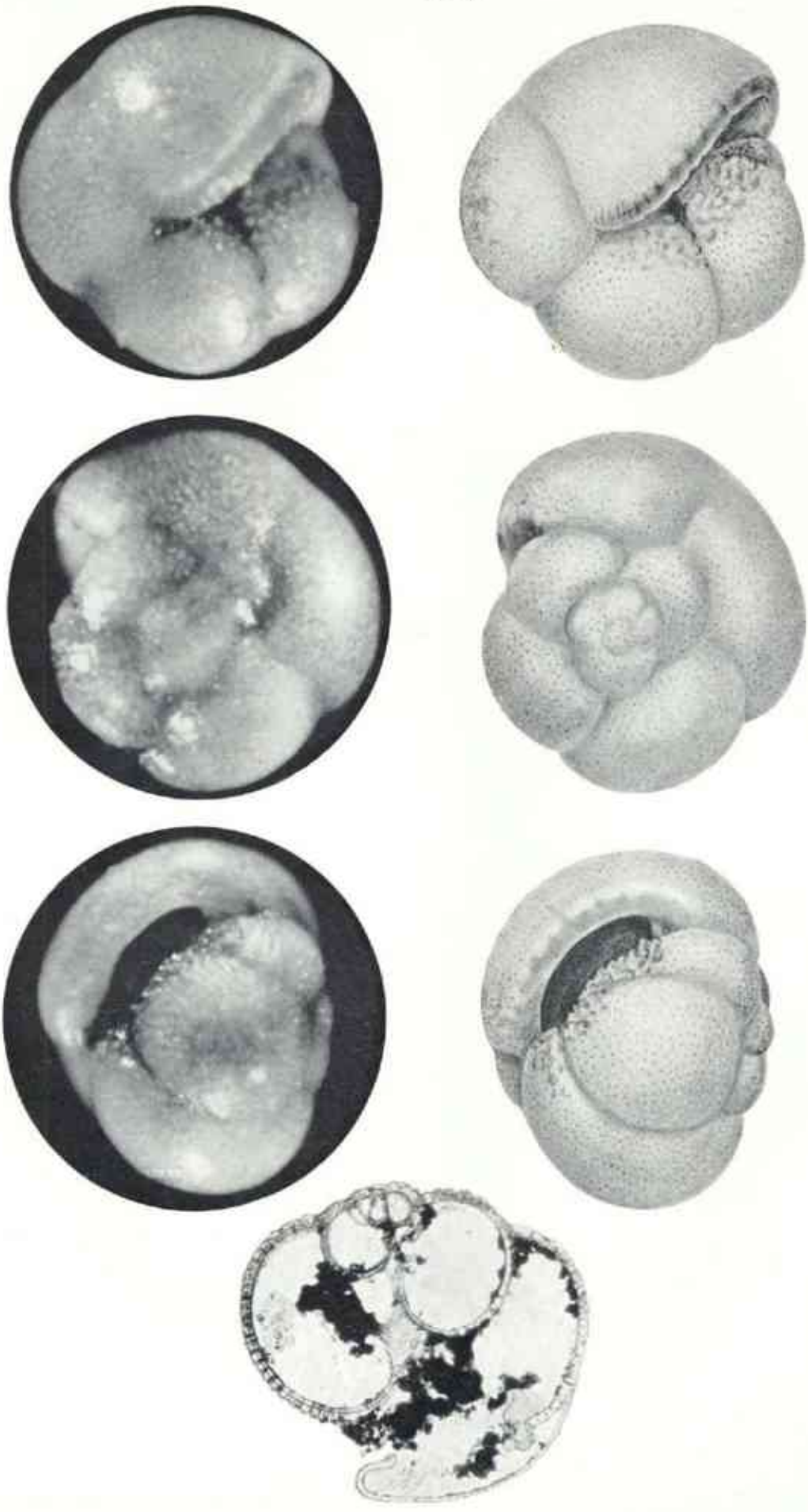
Praeorbulina transitoria
× 120

× 80

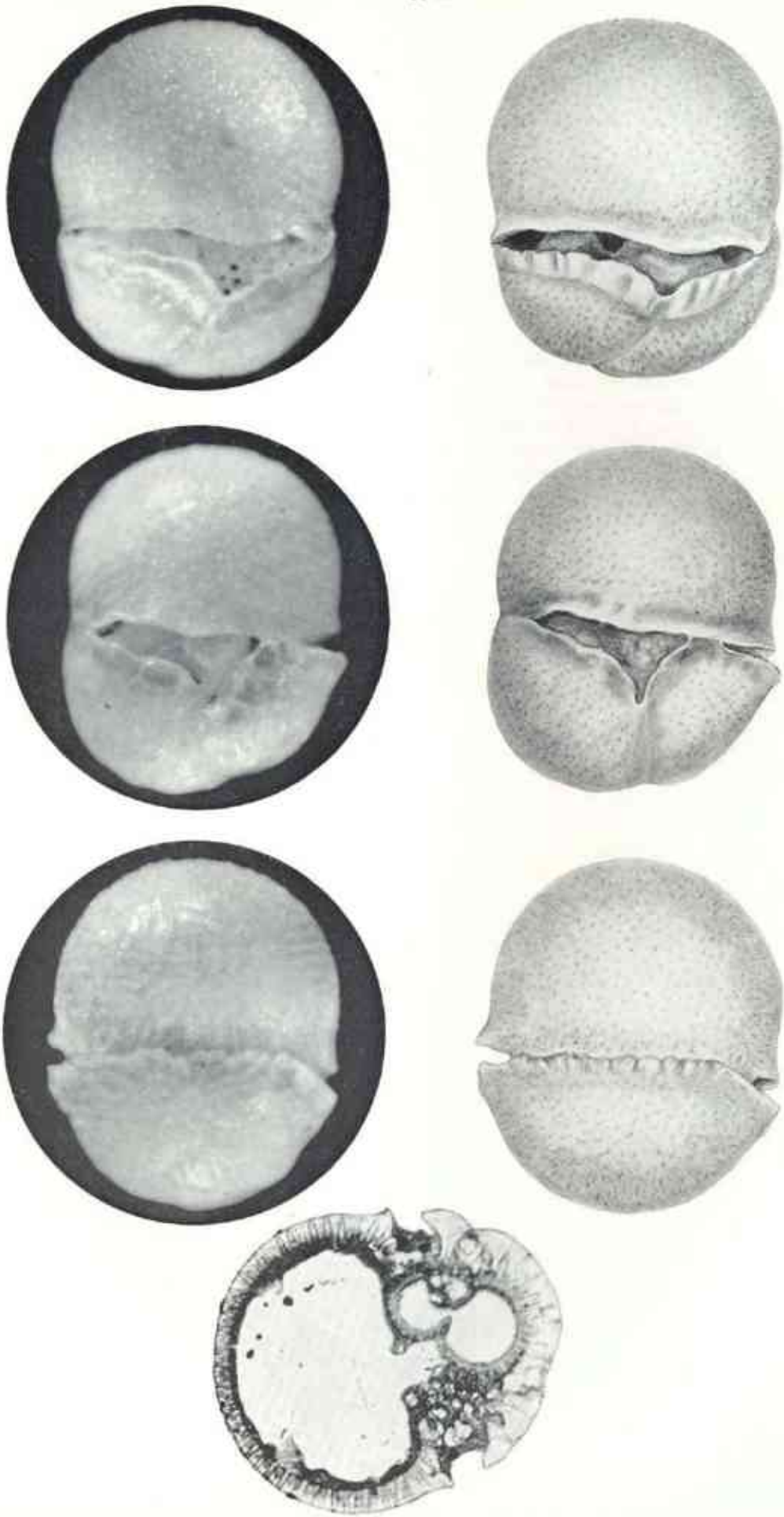


Pulleniatina praecursor
× 150

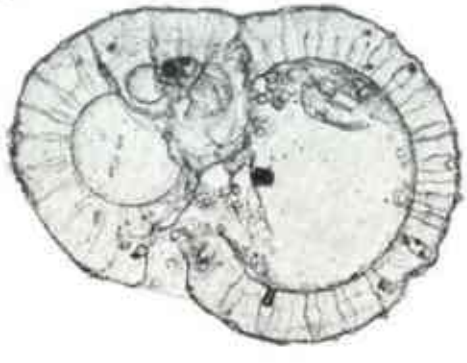
Pulleniatina primalis
× 170



× 85



Sphaeroidinella subdehiscens
× 125



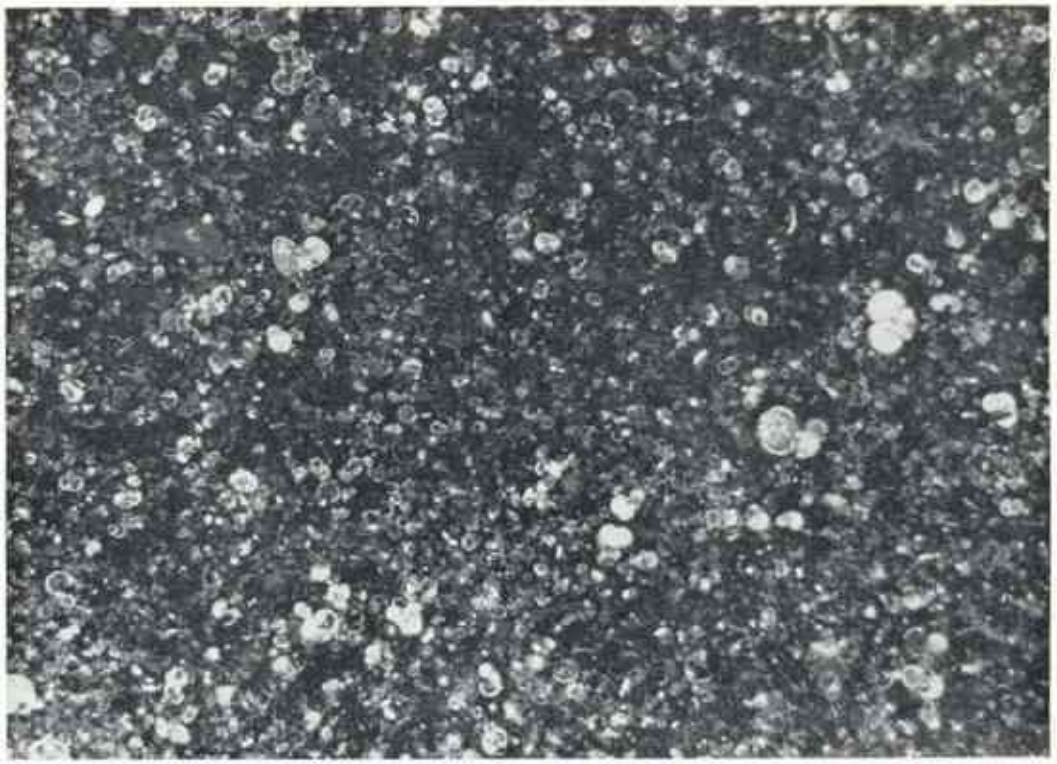


Figure 19

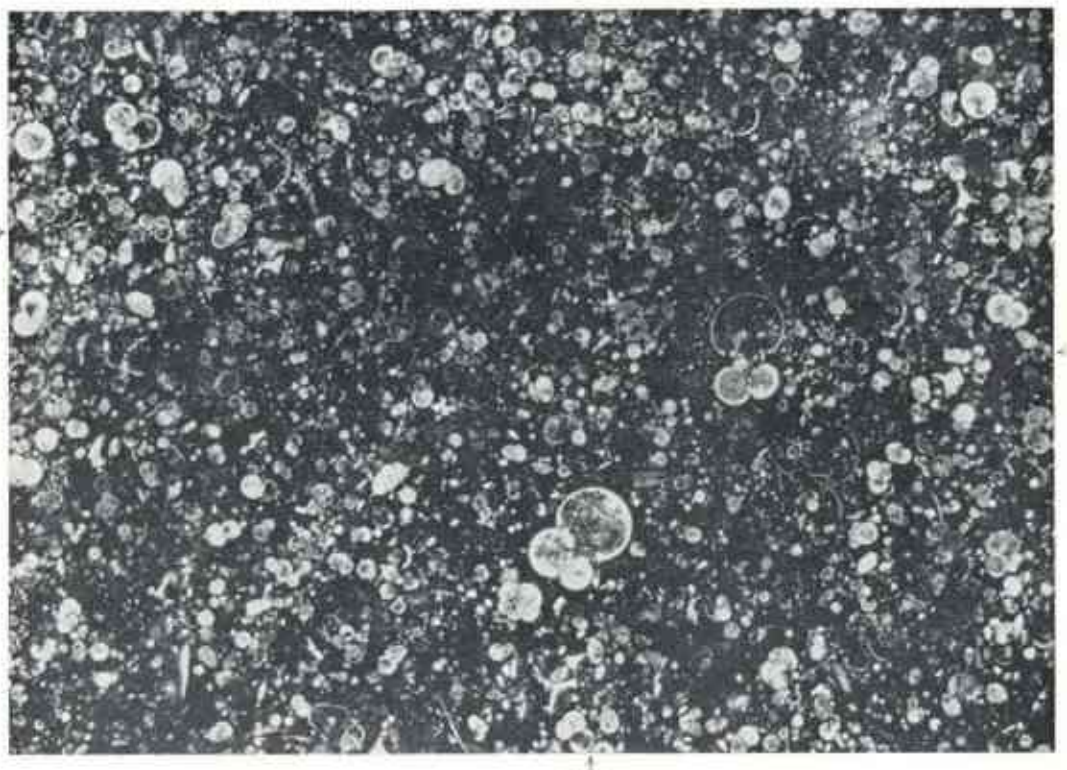


Figure 20

Figure 21

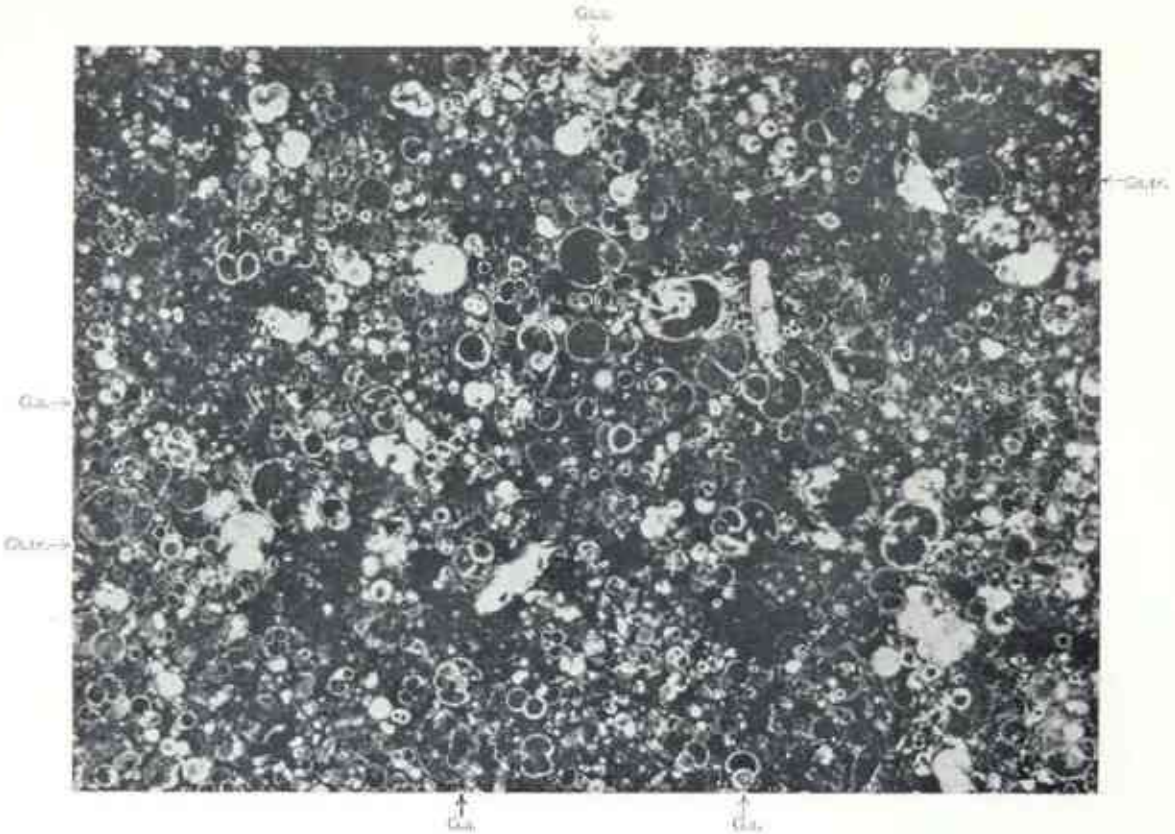


Figure 22

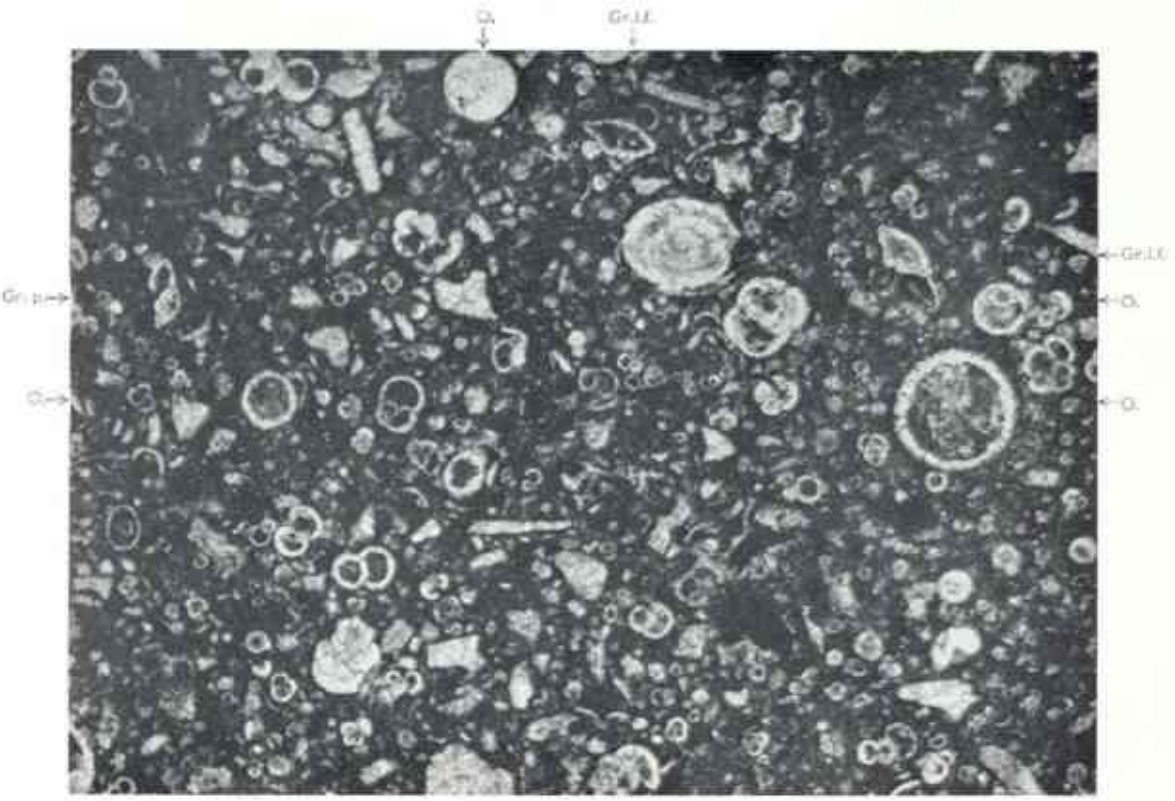


Figure 23

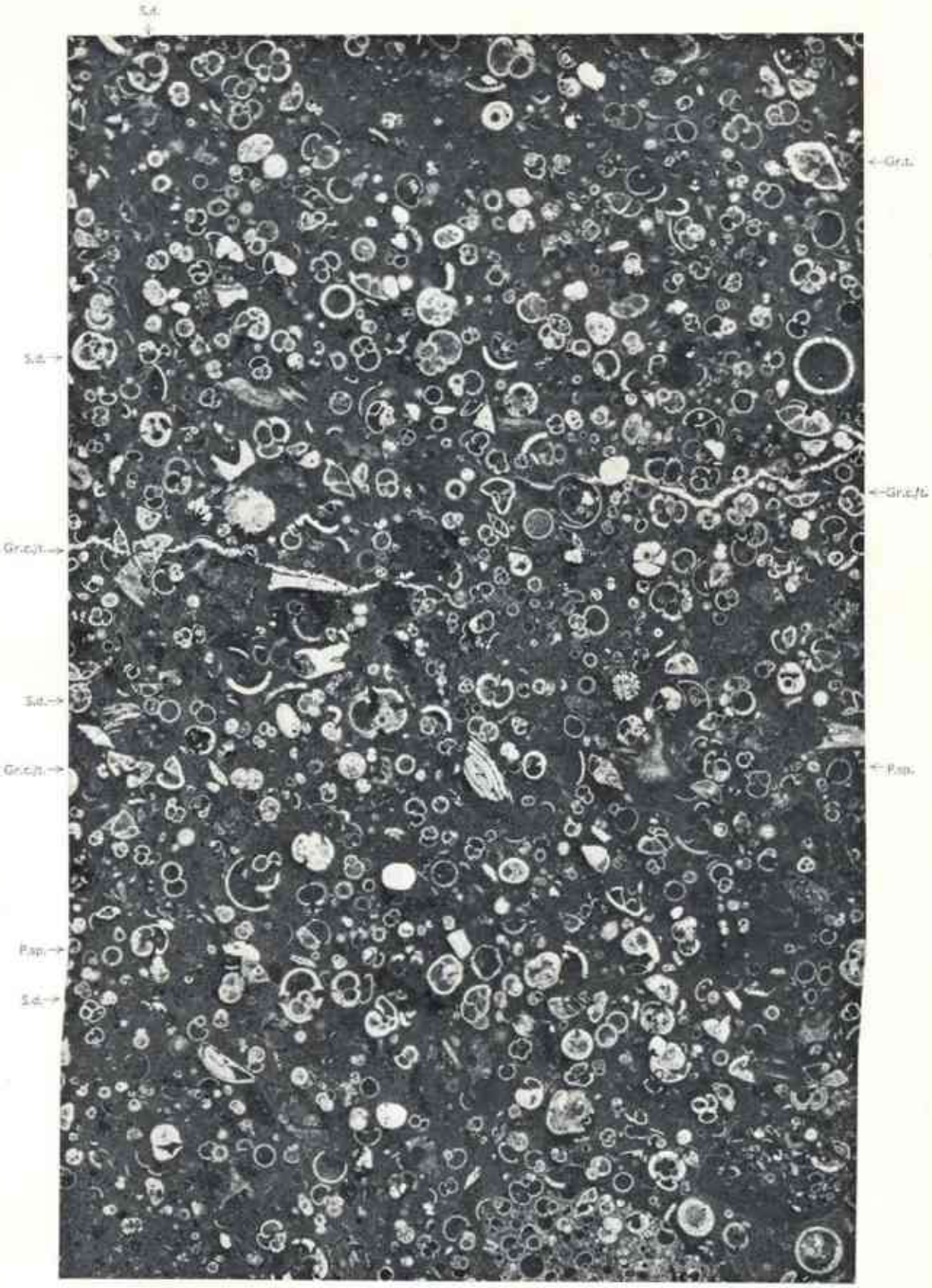
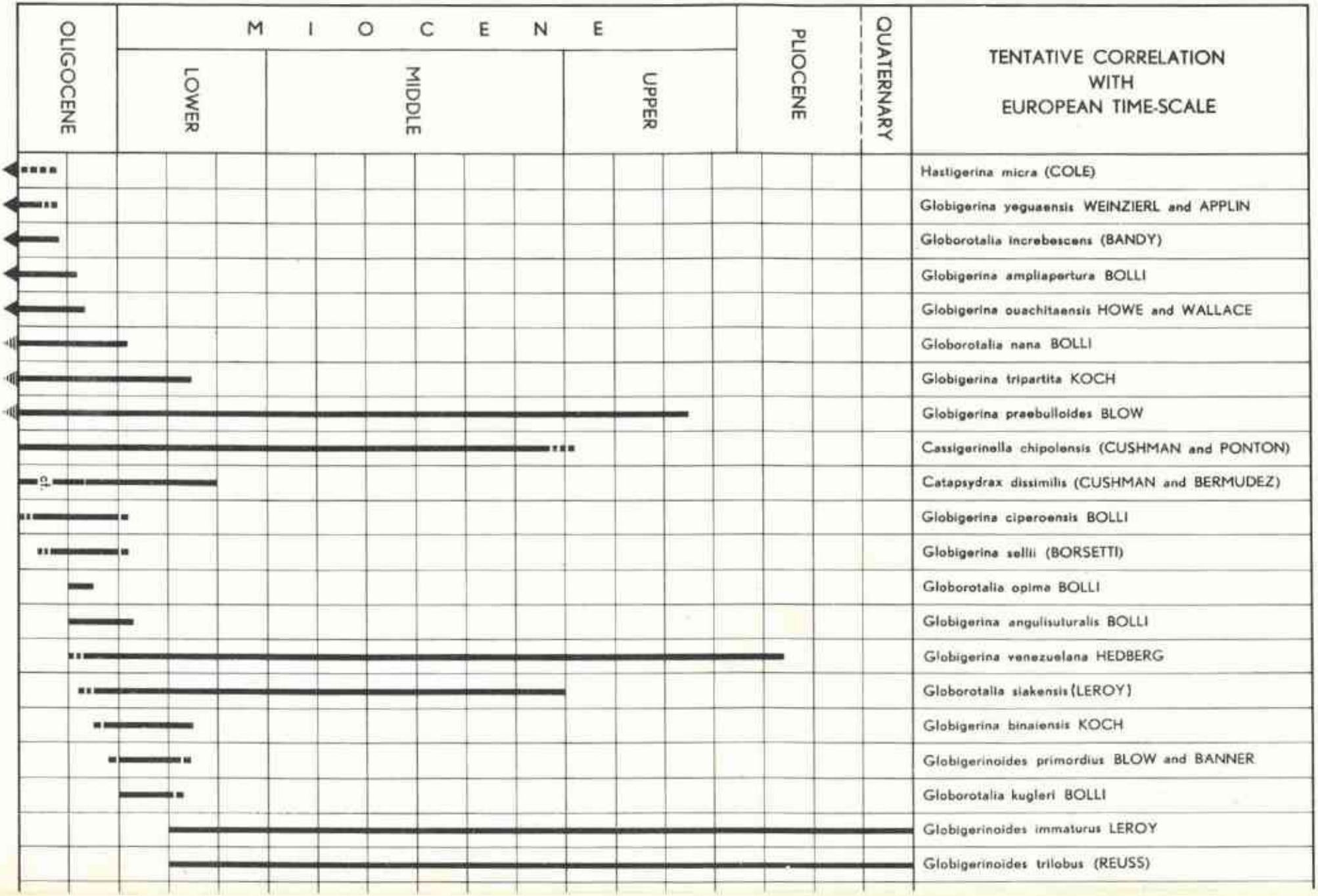
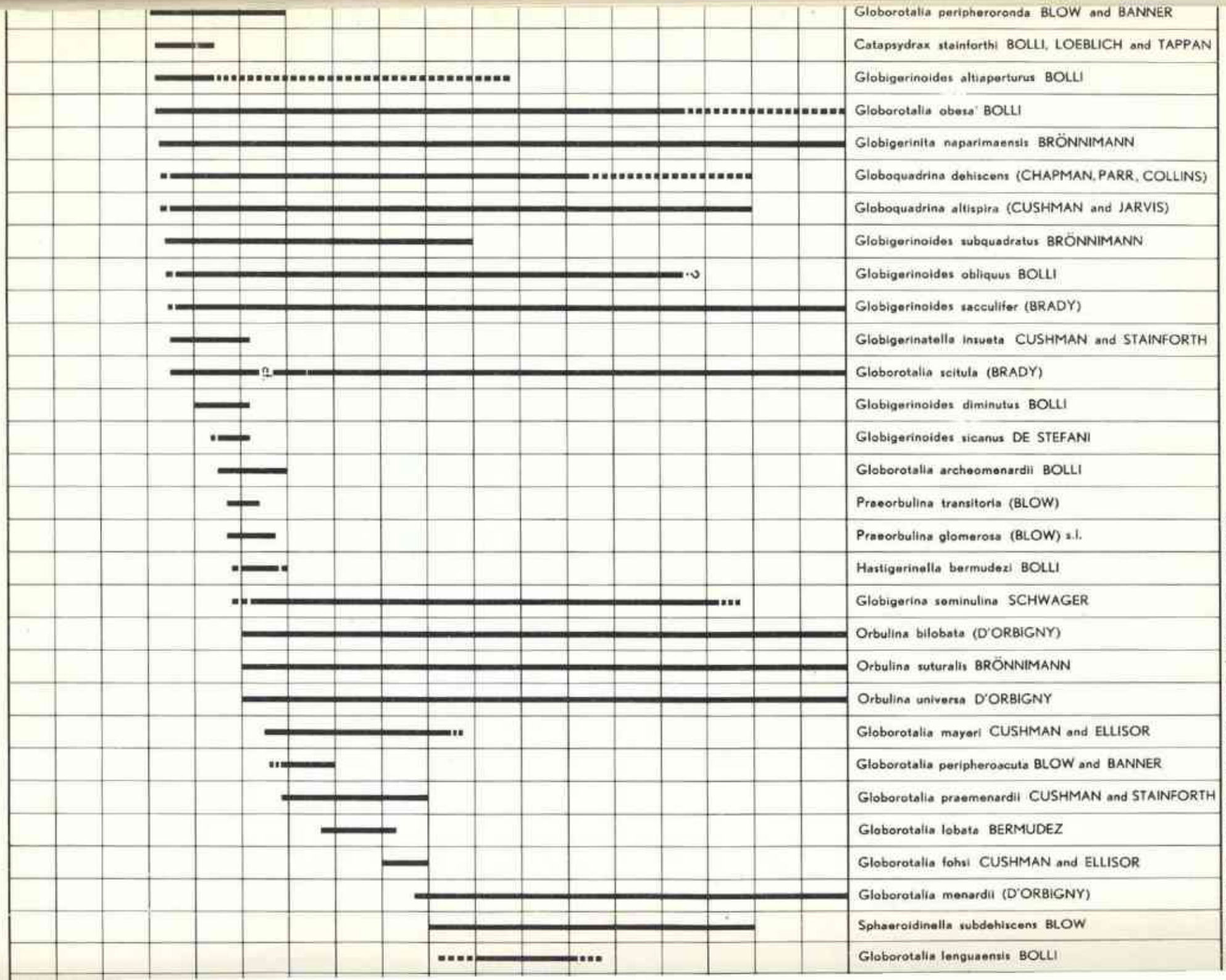


Figura 34


OLIGOCENE
MIOCENE
LOWER
MIDDLE
UPPER
PLIOCENE
QUATERNARY
TENTATIVE CORRELATION WITH EUROPEAN TIME-SCALE
Hastigerina micra (COLE)
Globigerina yeguaensis WEINZIERL and APPLIN
Globorotalia increbescens (BANDY)
Globigerina ampliapertura BOLLI
Globigerina ouachitaensis HOWE and WALLACE
Globorotalia nana BOLLI
Globigerina tripartita KOCH
Globigerina praebulloides BLOW
Cassigerinella chipolensis (CUSHMAN and PONTON)
Catapsydrax dissimilis (CUSHMAN and BERMUDEZ)
cf.
Globigerina ciperoensis BOLLI
Globigerina sellii (BORSETTI)
Globorotalia opima BOLLI
Globigerina angulisuturalis BOLLI
Globigerina venezuelana HEDBERG
Globorotalia siakensis (LEROY)
Globigerina binaiensis KOCH
Globigerinoides primordius BLOW and BANNER
Globorotalia kugleri BOLLI
Globigerinoides immaturus LEROY
Globigerinoides trilobus (REUSS)



RANGE CHART, ZONATION AND CORRELATIO

CORRELATION WITH EXISTING ZONATIONS

Globorotalia menardii (D'ORBIGNY)
Sphaeroidinella subdehiscens BLOW
Globorotalia lenguaensis BOLLI
Globigerina nepenthes TODD
Hastigerina aequilateralis (BRADY)
Globorotalia pseudomiocenica BOLLI and BERMUDEZ
Globorotalia acostaensis BLOW
Candeina nitida D'ORBIGNY
Globigerinoides extremus BOLLI
Globorotalia plesiotumida BLOW and BANNER
Globorotalia dutertrei (D'ORBIGNY)
Pulleniatina primalis BANNER and BLOW
Globorotalia miocenica PALMER
Globorotalia multicamerata CUSHMAN and JARVIS
Globorotalia margaritae BOLLI and BERMUDEZ
Globorotalia tumida (BRADY)
Globigerinoides conglobatus (BRADY)
Globigerinoides ruber (D'ORBIGNY)
Globigerina riveroae BOLLI and BERMUDEZ
Globorotalia crassaformis (GALLOWAY and WISSLER)
Sphaeroidinella dehiscens (PARKER and JONES)
Pulleniatina praecursor BANNER and BLOW
Globigerinoides fistulosus (SCHUBERT)
Pulleniatina obliquiloculata (PARKER and JONES)
Globorotalia tosaensis TAKAYANAGI and SAITO
Globorotalia truncatulinoides (D'ORBIGNY)

Questionable occurrence

Globiger
Globiger
Globorot
Globiger
Globiger
Globorot
Globorot
Globorot
Globorot
Globiger
Globorot
Globorot
Globorot
Globorot
Globorot
Globoqu
Globorot
Globorot

IN T P

CHART 3 OLIGOCENE-RECENT

GENERAL ZONATIONS

ROPOSED HIS MANUAL	PROPOSED BY BOLLI 1966	PROPOSED BY BLOW 1969	
alia truncatulinoides	Globorotalia truncatulinoides	Globigerina calida calida – Sphaeroidinella dehiscens excavata	N.23
		Globorotalia (G.) truncatulinoides truncatulinoides	N.22
alia tosaensis		Globorotalia (T.) tosaensis tosaensis tosaensis and Globorotalia (G.) multicamerata – Pulleniatina obliqueloculata obliqueloculata	N.21 and N.20
drina altispira	Globoquadrina altispira altispira – Globorotalia truncatulinoides		
	Globoquadrina altispira altispira	Sphaeroidinella dehiscens dehiscens – Globoquadrina altispira altispira	N.19
alia margaritae	Globorotalia margaritae	Globorotalia (G.) tumida tumida – Sphaeroidinellopsis subdehiscens paenedehiscens	N.18
alia dutertrei	Globorotalia dutertrei	Globorotalia (G.) tumida plesiotumida	N.17
alia acostaensis	Globorotalia acostaensis	Globorotalia (T.) acostaensis acostaensis – Globorotalia (G.) merotumida	N.16
alia menardii	Globorotalia menardii	Globorotalia (T.) continuosa	N.15
alia siakensis	Globorotalia mayeri	Globigerina nepenthes – Globorotalia (T.) siakensis	N.14
inoides rul adratus	Globigerinoides ruber	Sphaeroidinellopsis subdehiscens subdehiscens – Globigerina druryi	N.13
alia fohsi	Globorotalia fohsi robusta	Globorotalia (G.) fohsi	N.12
alia lobata	Globorotalia fohsi lobata	Globorotalia (G.) praefohsi	N.11
alia peripheroacuta	Globorotalia fohsi fohsi	Globorotalia (T.) peripheroacuta	N.10
alia peripheroronda	Globorotalia fohsi barisanensis	Orbulina suturalis – Globorotalia (T.) peripheroronda	N.9
natella insueta	Praeorbulina glomerosa	Globigerinoides sicanus – Globigerinatella insueta	N.8
	Globigerinatella insueta	Globigerinatella insueta – Globigerinoides quadrilobatus trilobus	N.7
inoides trilobus	Catapsydrax stainforthi	Globigerinatella insueta – Globigerinita dissimilis	N.6
	Catapsydrax dissimilis	Globoquadrina dehiscens praedehiscens – Globoquadrina dehiscens dehiscens	N.5
alia kugleri	Globorotalia kugleri	Globigerinoides quadrilobatus primordius – Globorotalia (T.) kugleri	N.4
na angulisuturalis	Globigerina ciperoensis ciperoensis	Globigerina angulisuturalis	N.3 (= P.22)
	Globorotalia opima opima	Globigerina angulisuturalis – Globorotalia (T.) opima opima	N.2 (= P.21)
na ampliapertura	Globigerina ampliapertura / Cassigerinella chipolensis / Hastigerina micra	Globigerina ampliapertura	N.1 (= P.19/20)

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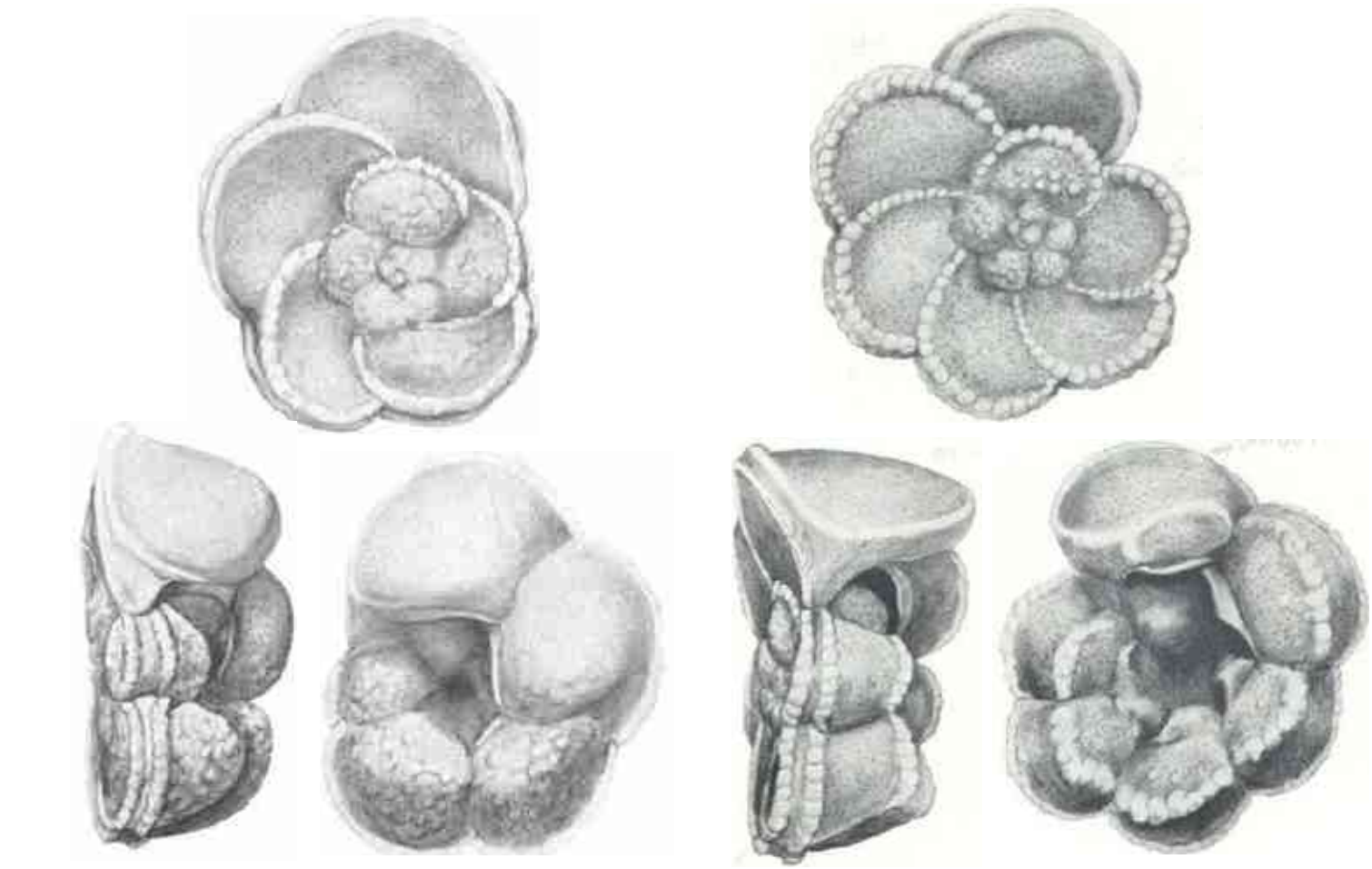
Description (After Postuma, 1971)		Globotruncana concavata	Globotruncana carinata
Test		Very low trochospiral	
Spiral side		Slightly concave	Most often slightly concave.
Umbilical side		Strongly convex	
Equatorial perphery		Distictly lobulated to almost circular	Distinctly lobulate
Keels		Closely spaced double keels, distinctly beaded, absent in the last portion.	Closely spaced double keels, distinctly beaded, absent in the last chamber.
Wall		Perorate, surface of the first chambers of the last whorl somewhat rugose, last ones smooth.	Perorate surface of the first chambers of the last whorl somewhat rugose, last ones smooth.
Chambers		Almost hemispherical	Angular subconical, moderately inflated, each developing a distinct usually beaded carina on top.
whorls		About 2.5-3 whorl, the 5-6 chambers of the last whorl increasing regularly and usually rapidly insize.	About 2.5-3 whorls the 5-6 chambers of the last whorl increasing regularly in size.
Sutures		On spiral side distinctly curved, in the last whorl raised except the last chamber, on umbilical side beaded, radial, depressed	On spiral side distinctly curved in the last whorl raised and beaded, on umbilical side radial, depressed.
Umilicus		Deep, fairly wide	Deep, wide
Primary apeartures		Interiomarginal, umbilical covered by a tegillum.	Interiomarginal, umbilical covered By a low tegillum.
Age	Zone name	Globotruncana concavata zone	Globotruncana carinata zone
	Zone type	Total-range zone	partial-range zone
	Zone defintion	FO of G.concavata to the LO of G.concavata	LO of G.concavata to the FO of G.elevata
	Zone time	Early Santonian	Late Santonian



Description, (After Postuma, 1971)		Globotruncana elevata	Globotruncana calcarata
Test		Very low trochospiral	
Spiral side		Central part is slightly convex to convex, spiral side of the last whorl flat to slightly concave	Almost flat
Umbilical side		Strongly convex.	
Equatorial perphery		Lobulated to slightly lobulated.	Stellate except for the portion which is rounded.
Keels		One equatorial keel, moderately beaded except in the last chamber	Distinct single keel which is provided with short spines one per chamber. Keel and spines are beaded at any rate of the greater part.
Wall		Perforate, surface smooth	Perforate surface rugose except for the last chamber degree of rugosity decreases gradually.
Chambers		Subangular to angular moderately inflated sometimes slightly overlapping with a kind of carina on top of each chamber as continuation of the partly raised sutures of the umbilical side.	Subangular inflated
Whorls		About 3 whorls, the usually 6-8 chambers of the last whorl increasing regularly in size	About 3 whorls, the 5-7 chambers of the last whorl increase rather irregularly in size.
Sutures		In spiral side distinctly curved in first part of the last whorl raised and beaded in later part slightly depressed.	On spiral side, slightly curved to almost straight On umbilical side, radial to slightly curved depressed to slightly raised occasionally beaded.
Umilicus		Deep wide	Deep rather narrow to fairly wide.
Primary apeartures		Intermarginal, umbilical covered by a tegilum	
Age	Zone name	Globotruncana elevata zone	Globotruncana calcarata zone
	Zone type	Partial -range zone	Total -range zone
	Zone defintion	FO of G.elevata to the LO of G.calcarata	FO of G.calcarata to the LO of G.calcarata
	Zone time	Early Campanian	Late Campanian

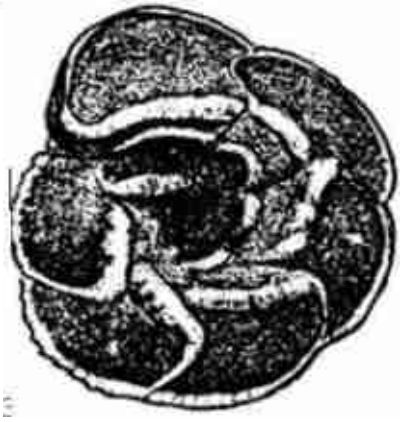





Description (After Postuma, 1971)		Globotruncana stuartiformis	Globotruncana gansseri
Test		Very low trochospiral	
Spiral side		Central part slightly convex, spiral side of the last whorl almost flat	Flat
Umbilical side		Convex	Strongly convex
Equatorial perphery		Slightly lobulated to almost circular	Slightly lobulate to almost circular
Keel		One keel moderately beaded in the last chamber	Closely spaced double keels, distinctly beaded, absent in the last chamber.
Wall		Perforate, surface smooth	Perforate, surface of the umbilicus side Rugose. Degree of rugosity decreases toward the Last chambers,which are smooth,surface of the spiral side smooth except the initial part
Chambers		Subangular slightly inflated often overlapping with a kind of carina on top of each chamber as acontineouation of the raised sutures of the umbilical side.	Almost hemispherical
Whorls		About 3 whorl, the 5-9 usually(6-8) chambers of the last whorl increasing regularly in size.	About 2.5 -3 whorl, the 5-6 chambers of the last whorl increase regularly in size.
Sutures		On spiral side, slightly curved in the first whorl to alomost straight and tangential in the lastwhorl. On umbilical side, raised, moderately beaded in first part of the last whorl curved. in later part flush raised and beaded.	On spiral side, curved, raised in the last whorl. On umbilical side, slightly beaded, the first ones radial the last ones, slightly curved depressed.
Umilicus		Deep wide	
Primary apeartures		Interomarginal, umbilical covered by a tegillum.	
Age	Zone name	Globotruncana stuartiformis zone	Globotruncana gansseri zone
	Zone type	Concurrent -range zone	partial-range zone
	Zone defintion	LO of G.calcarata to the FO of G.ganseri	FO of G. gansseri to the FO of G.mayaroensis
	Zone time	Early Mastrichtian	Middle Mastrichtian



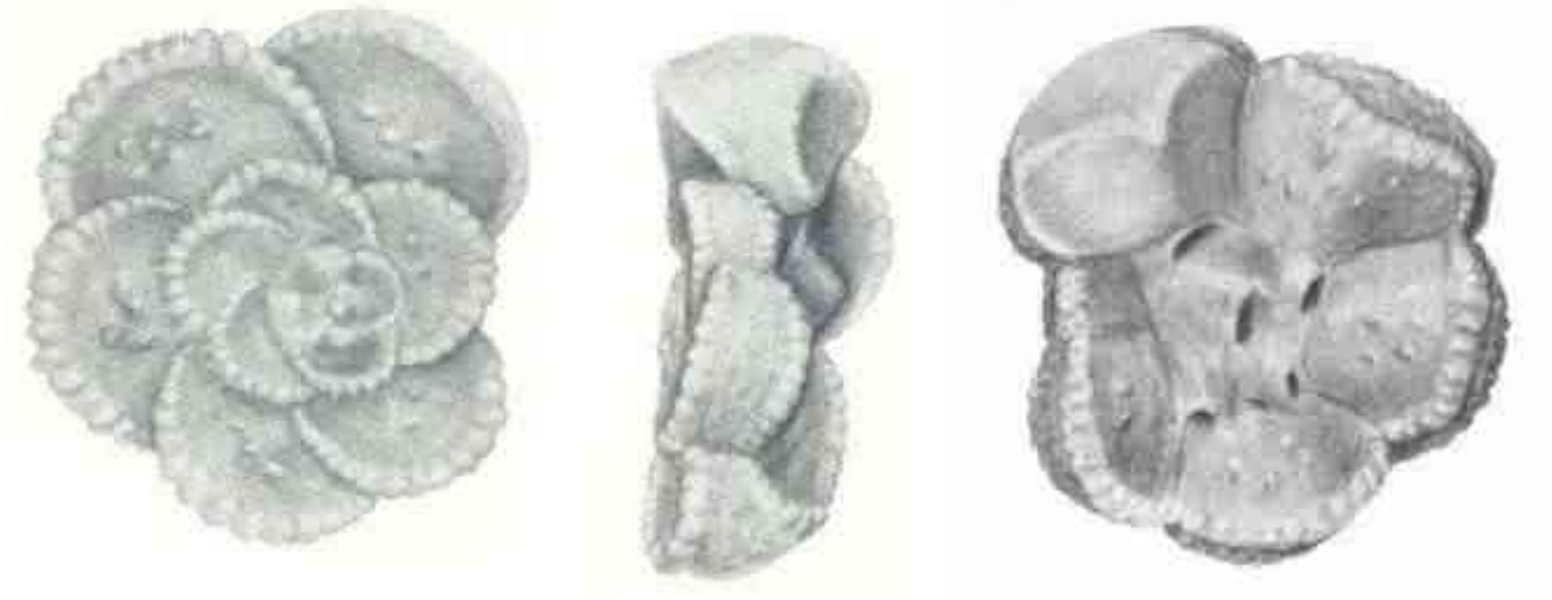





Description of the index fossils of the planktonic foraminiferal zones of of the Maastrichtian to Santonian ages

(According to J. A. POSTUMA, 1971)

Description (After Postuma, 1971)		Globotruncana mayaroensis
Test		Very low trochospiral
Spiral side		Almost flat to slightly convex
Umbilical side		Moderately concave
Equatorial perphery		Lobulated
Keels		Two beaded keels of which the one on the umbilical side becomes strongly arched towards the last Chamber
Wall		Perorate surface ornamented with fine nods, including the side wall between the keels
Chambers		Angular truncate on umbilical side more inflated??????
Whorls		About 3 whorls, the 4-6 (usually 5) chambers of the last whorl increasing sometimes rapidly in size, on the spiral side atendency to develop an imbricate structure
Sutures		On spiral side, curved raised and beaded, on umbilical side radial depressed
Umilicus		Shallow fairly wide
Primary apeartures		Intermarginal, umbilical covered by a tegillum.
Age	Zone name	Globotruncana mayaroensis zone
	Zone type	Total - range zone
	Zone defintion	FO of G. mayaroensis to the LO of G. mayaroensis
	Zone time	Late Mastrichtian



قبيلة : الأوليات Phylum

تحتوى قبيلة الأوليات على يطفو على البحر: والكثير منها يعيش على القاع أو سابحاً فى الماء المالح أو النصف مالح أو العذب عشرات من الأنواع التى تعيش فى كل بيئة .. فوق الجبال وفى الوديان .. وفى التربة وفى أنسجة ودماء الأحياء المختلفة .. بعضها.

طائفة جذريات الأقدام أو الريزيودا (Sarcodina or Rhizpoda)

بالرغم من تعدد أشكال القبيلة فإن رتبتين فقط ينتميان الىها هما: الفورامينفرا (Foraminifera) والراديولاريا (Radiolaria) و.. وهما اللتان يبنيان نوعاً أو أخر من الأصداف المكونة من السيليكا فى الراديولاريا، ومن الجير أو الكيتين فى الفورامينفرا..وتتميز الطائفة: بأنها تتحرك بواسطة أقدام كاذبة (Pseudopodia) غير ثابتة الشكل، تمتد من البروتوبلازم :–فى رتبة الفورامينفرا تتشابك مع بعضها البعض، عندما تنمو من البروتولازم.... فى رتبة الراديولاريا فإن أقدامها الكاذبة مقواه بواسطة محور هيكلى لكل منها.

رتبة الفورامينفورا (Order Foraminifera)

هى رتبة ذات أهمية خاصة نظراً :

1) انتشار بقايا أصدافها (Tests) فى **الكثير من الصخور الرسوبية** .

2) عدداً كبيراً من أنواعها **محدودة الانتشار الزمنى** .. أى حفريات عمرها قصير (حفريات مرشدة) يعتمد عليها فى تحديد عمر الطبقات.

3) **واسعة الانتشار جغرافيا** .. فتساعد فى عملية مضاهات الطبقات.

4) **صغيرة الحجم** ، يبلغ متوسط قطر معظم أصدافها حوالى 0,1.. لذا يمكن إخراجها كاملة .. وبأعداد كبيرة فى المقطوعات (Cattings) أو الجسات (Cores) التى تستخرج من الآبار التى تدق للبحث عن البترول أو المعادن الأخرى .. هى فى غاية الأهميةفى الدراسات التحت سطحية (Subsurface).

وتحتل أبحاث الفورامينفرا مساحة كبيرة فى الدوريات العلمية لعلوم الجيولوجيا والتاريخ الطبيعى وبالرغم من هذا الاهتمام

الصدفـــة

تعتبر الصدفة أهم ظاهرة للفورامينفرا بالنسبة لأخصائى الحفريات إذ أنها تمثل البقايا المادية الوحيدة للحيوان القديم، فدراستها على هذا يجب أن تكون كاملة وجيدة .. وعلى النحو التالى:

الشكل : وتتخذ صدفة الفورامينفرا أشكالاً متعددة ..فى نوعين:

اولهما: وحيدة الحجرة (Monothalamous) وهذه الحجرة قد تكون: كروية أو بيضية أو أنبوبية أو نجمية.

ثانيهما: متعددة (Polythalamous) الحجرات: معظم الأنواع لها أصداف مكونة من حجرات– وهنا كما سبق ذكره يكون النمو على فترات منتظمة ، وتضاف الحجرة بعد الحجرة فى تنظيم .. يختلف من نوع إلى نوع ..

* **الدرز (Suture).** فى العادة يظهر حز الحاجز الذى يفصل الحجرة عن التى تليها **من الخارج**، .. وقد يكون الدرز غائراً عن سطح الصدفة (Depressed) وقد يكون بارزاً (Limbate).

1) طرق تنظيم حجرات الصدفة

تضاف الحجرات الواحدة بعد الأخرى فى **نظم سته** أساسية.. على النحو التالى:

أولهـا: المتسلسلة :

1) **وحيد التسلسل:** * المستقيم (Uniserial rectilinear فى خط مستقيم .. * المنحنى (Curved uniserial).

2) **عديد التسلسل :** * ثنائية أو ثلاثية أو كثيرة التسلسل (Bi – Tri – or – Polyserial) . حين تضاف الحجرات فى صفين أو ثلاثة أو أكثر.

3) **الحجرات المتراكبة :** وقد يحدث فى حالة الأصداف وحيدة التسلسل أو ثنائيتها عند اضافة الحجرة الجديدة أن تغلف هذه الحجرة القديمة إما جزئياً أو كلياً.

ثانيهما : النظام المليوليدى :

حين تضاف الحجرات حول محور عرضى بدلاً من محور طولى (كما فى السابق) وذلك بإضافة حجرتين أو ثلاث أو خمس : بحيث تفصل الواحدة عن الأخرى بزاوية قدرها 180 ، 120 ، 72 درجة على التوالى وتسمى الأصداف حينئذ ثنائية ، ثلاثية أو خماسية الحجرات (Bi– tri or quinqueloculine)

وتعرف طريقة التنظيم الفريدة هذه فى عائلة ال (Miliolidae) وقد يحدث تحوير فى هذه الطريقة كما فى عائلة (Polymorphinidea) بحيث لا يصبح المحور العرضى الذى يحدث حوله لف الحجرات فى مستوى واحد بل يدور هو نفسه ويصبح فى مستويات متعددة .

ثالثهم : اللف فى مستوى واحد افقى (Planispirally coiled) : فى اغلب عائلات الفورامينفرا – حين تضاف الحجرات الواحدة وراء الأخرى فى لفات (Whorls) :

1) اللف المفتوحة (Evolute) : إذا ظهرت كل الحجرات من الخارج .. وفى العادة تكون لهذه الصدفة سرة فى وسطها (Umbilieus) .. فإذا ملئت هذه السرة بمواد ثانوية غريبة سميت بالكعبرة (Umbo).

2) اللف المطوى (Involute) : إذا لم تظهر كل الحجرات من الخارج .. بل ظهرت فقط حجرات اللفة الأخيرة التى طوت حجرات اللفات السابقة بداخلها .

رابعهم : ألف الحلزوني (Heliecodal or Trochoidal) : حين تضاف الحجرات فى مستويات متعددة بحيث تصبح فى النهاية كالحلزون. وهذه الأصداف تسمى حلزونية (Heliecodal or Trochoidal) .. ويعتبر ارتفاع الحلزون .. وعدد لفاته .. وعدد الحجرات فى كل لفة .. والشكل الخارجى له .. يعتبر صفات هامة للصدفة ذات قيمة تصنيفية كبيرة. وفى العادة يكون جانب من الصدفة ، سواء الجانب البطنى (Ventral) أو الجانب الظهرى (Dorsal) مفتوحاً والجانب الآخر مطوياً على التوالى.

خامسهم : **الانواع المختلطة** يتغير نظام الحجرات مع نمو الحيوان نفسه :

1) فبينما يكون ثلاثى التسلسل فى جنينه يتغير الى ثنائى التسلسل فى طوره الكامل كما فى جنس (Gaudryina)

2) قد يتغير النظام من لاف فى مستوى واحد الى ثنائى التسلسل كما فى جنس (Spiroplectamnina)

3) قد يتغير النظام لأكثر من مرة فى تاريخ حياة الفرد (Ontogeny) كما فى جنس (Goesella)

حيث تكون الحجرات كثيرة التسلسل فى مبدأ حياة الفرد ثم تصبح ثلاثية التسلسل فثنائيته فوحيده فى طور الشيخوخة (Gerontic).

سادسهم : الانواع المعقدة : هى ظاهرة خاصة حيث :

1) الحجيرات (Chamberlets) حين تقسم فيها الحجرات

2) التركيب الحلقى (Annular development) حيث تنفرد الحجرات الأخيرة فتلف حول الحجرات السابقة فتكون الحجرات هنا تصبح فى شكل حلقات

3) المكدسة (acervuline) حيث أن بعض الأنواع الجالسة تنمو الحجرات دون نظام فتتكدس فوق بعضها

2) نوع جدار الصدفة

1) **الكيتينى (Chitin):** تبنى صدفتها من الكيتين (Chitin) فقط .. وهذه الاصداف تتحلل عند موت الحيوان ولا تترك ورائها أثراً يهتم به طلاب الحفريات .. ويبدو أن مادة الكيتين من المواد الأولى التى استعملتها الفورامينفرا فى بناء صدفتها لأنها تكون القاعدة التى قد تفرز فوقها مواد كثيرة أخرى مثل الجير أذ يجمع فوقها حبيبات غريبة لتبنى الصدفة .

2) الاصداف الرملية (Arenaceous) أو المجمعة (Aglutinated) : تجمع الحبيبات الغريبة الموجودة حولها، على الاساس الكيتينى للصدفة، ثم تلصقها ببعضها البعض:

* **حبيبات الرمل** .. معظمها يختارها من حوله .. ليبنى بها صدفته . بعضها يختار أى حبيبات حوله .. فى حجم الرمل .. بغض النظر عن تركيبها الكيميائى

* **ليس له أفضليات معينة** .. لا فى حجم الحبيبات ولا فى نوعها ، بل إن التجارب قد دلت على أن بعض الأنواع تبنى صدفتها من برادة الحديد فى غياب حبيبات اخرى .

* **من الثابت ان بعض الانواع عندها أفضليات معينة ثابتة فى** اختيار : نوع .. وحجم .. الحبيبات التى يلصقها فى صدفته : فبعضها يختار حبيبات الميكا وبعضها يختار أشواك الاسفنجيات.

لصق الحبيبات على الصدفة

يتم بواسطة مادة مبطنة من الجير يفرزها البروتوبلازم تظهر " تحت الميكروسكوب " بين الحبيبات: كحبات مزواه (Aagular) ذات قطر يتراوح بين 5،10 ميكرون .. وتكون نسبة المادة اللاحمة هذه قليلة فى بعض الانواع .. ثم تعلو فى انواع أخرى .. حتى انها لتزيد حجمها عن الحبيبات نفسها

3) الاصداف الجيرية (Caleareous) : من المؤلفين من يعتقد انها تطور ثانوى للأصداف الرملية ..بينما تزداد المادة الجيرية اللاحمة زيادة كبيرة حتى يستغنى الحيوان كلية عن الحبيبات الغريبة .

تكون مجموعة كبيرة من الفورامينفرا .. تبدو من شكلها الخارجى كأنها منقسمة طبيعياً الى قسمين كبيرين:

أ) الجيرية الزجاجية (Hyaline): تبدو الصدفة وكأنها لوح من الزجاج يتخلله الضوء دون ان ينعكس ... ومعظمها ذات بلورات من الكالسيت المرتبة ترتيباً شعاعياً (Radiate) .. بمعنى انها منظمة بحيث ان يكون **المحور (ج) عمودياً** على سطح الصدفة .. وبهذا التنظيم يمكن للضوء ان يخترق أو ينفذ خلال جدار الصدفة : فتبدو وكأنها زجاجية – كما يتيح هذا التنظيم – عند عدم تكثفه (Compaetness) – ان يكون للصدفة ثقوب.

ب) الجيرية الفنفورية (Porcelaneous) تبدو انها مكونة من آلاف من حبيبات الكالسيت بلورتها من الرباعى .. ذات قطر لا يزيد عن 1,5 ميكرون ، تبدو هذه الحبيبات وكأن ليس لها تولية (Orientation) خاصة .. وإن كان معظمها **موازياً لسطح الصدفة** ومن هنا انعكاس الضوء من على سطوحها ولمعانها وعدم وجود ثقوب (Perforations) عليها وتعرف الاصداف الفنفورية فى عائلات (Miliodoe و Alveolinidae و Peneropliidae) .

ج) **الزجاجية المحببة (Granulate)** وفى القليل من الاصداف الزجاجية تنظم البلورات المتساوية الابعاد بدون تولية ظاهرة ، ولكنها تتداخل مع بعضها البعض. ونظراً لأن عدداً كبيراً من البلورات فى اى تنظيم جزافى ستكون عمودية او قريبة من العمودية على السطح ، فإن سطح الصدفة يبدو زجاجياً او نصف فنفورى .. نظراً لأن بلورات الكالسيت تبدو تحت الميكروسكوب وكأنها حبيبات متناثرة ومتداخلة –

يعتقد وود (Wood 1948) ان الصدفة الزجاجية المحببة هى: فى تركيبها مثل تركيب الجير اللاحم فى الأصداف الرملية .. وهذا سبب اعتقاده بأنه يجب فصل كل الاصداف الزجاجية المحببة فى مجموعة منفصلة نشأت من الأصداف الرملية عن طريق زيادة الجير اللاحم على حساب الحبيبات الغريبة.

هناك عائلة من الفورامينفرا (Fusulimdae) وهى عائلة منقرضة من عائلات هذه الرتبة .. توجد فى أعداد كبيرة فى أواخر الحقب الباليوزى .. وتنفرد بجدار فريد فى بابه .. يكون من أحد الطرازين الآتيين :-

1- طراز الجدار الفيوسولينى (Fusulinellid) : وفيه يتكون الجدار من:

*** الغلاف الشفاف (Diaphonotheea) : وهو الغلاف الأولى(Protheca): وهو الجدار الأصلى .. يتكون من طبقة من بلورات الكالسيت الشفافة... تعلوها:**

*** الغلاف الراكب (Epithea) : وهو راسب ثانوى يضاف مؤخراً فى حياة الفرد.. تعلوها:**

*** القشرة الأولى : طبقة كيتينية .. وهو مكون من طبقة من بلورات الكالسيت الرقطاء الرمادية اللون**

الملاط (Tectorium) المغبشة تعرفها بإسم الملاط (Tectorium).

وعلى هذا فأى مقطع عرضى فى جدار الحجرات الأولى إنما يتكون من أربعة طبقات. الغلاف الشفاف وفوقه خط غامق هو القشرة وطبقتان من الملاط واحدة علوية وواحدة سفلية.

2- طراز الجدار الشواحارينى (Sehwagerinid) : ويميز أنواع (Fusulinide) المتأخرة من العصر الكربونى والبرمى. ويتكون الجدار هنا من طبقتين اثنتين فقط طبقة داخلية سميكة نسبياً مثقبة واسفنجية الشكل كخلية النحل تعرف بإسم الغلاف المنخلى (Keriotheca) وهذه الطبقة تناظر الغلاف الشفاف فى الأنواع ذات الجدار الفيوسولينى وطبقة خارجية قرنية ورفيعة وتسمى القشرة (Tectum).

3) ثقـوب الصدفـة

وجودالثقوب

تخترق الثقوب الكثير من أصداف الفورامينفرا .. وخاصة الأصداف الجيرية الزجاجية منها.. حيث الثقوب بين بلورات الكالسيت " الشعاعية النظام " وقد أدى ظهور هذه الثقوب بشكل واضح فى الأصداف الجيرية الزجاجية الى الخطأ الشائع وخاصة فى الأدب العلمى القديم. وتسمى هذه الاصداف بالمثقوبة (Perforate) وتسمية الاصداف الجيرية الفنفورية بالاصداف المصمطة (Imperforate).

الواقع أن **الثقوب** توجد فى جميع انواع الاصداف الجيرية الزجاجية .. فالكثير من الاصداف الرملية وكل اطرزة الاصداف الجيرية ذات ثقوب .. من الاصداف الجيرية الفغفورية مثل جنس (Peneroplis) ما تخترقه الثقوب فى الجزء الاول والقديم من الصدفة ثم تصبح الصدفة نفسها بعد ذلك مصمطة .. وقد ادت هذه الملاحظة الى الاعتقاد بأن ثقوب الصدفة نفسها هى خاصية اولية نشأ عنها وتطور منها حالة صموتها وعدم تثقيبها.

وظيفـة الثقوب

لا يعرف بالضبط وظيفة **هذه الثقوب** فهى: لا تخترق الا الجزء الجيرى من الصدفة فقط ويعتقد (Hofker) انها ذات فائدة فى عملية التنفس ...

أنواع الثقوب

1) **الثقوب البدائية (Protopores)** ثقوب رفيعة يبدو انها اكثر بدائية .**2) الثقوب المركبة (Deuteropores)** هى ثقوب كبيرة مكونة من مجموعات من الثقوب الصغيرة وهذه تعرف فى الانواع الحديثة عامة وفى الانواع الجالسة منها بصفة خاصة .

وفى كثير من انواع عائلتى (Nummulitidae , Rotaliidae) توجد اجزاء من الصدفة غير مثقوبة مثل الحواجز ويعتقد وود (Wood) ان هذه الظاهرة لا يمكن اعتبارها اساسية عند تقسيم الفورامينفرا بمعنى ان لا يؤيد فصل هذه الانواع عن مجموعة الاصداف الجيرية الزجاجية لان الثقوب ذات اثر ثانوى فى تركيب الصدفة .

4) فتحة الصدفة (Aperture)

فتحة الصدفة من مميزاتها الهامة إذ انها الطريق الوحيد الذى يوصل البروتوبلازم الى الخارج ومن العجيب ان هناك بعض الأنواع ليست لها فتحة ظاهرة .. ولا يعرف بالضبط حتى الآن كيفية اتصال الحيوان بالخارج .. موقع الفتحة بالنسبة للحجرة الأخيرة وشكلها .. من الظواهر التصنيفية الهامة.

موقـع الفتحة

لأن فتحة الحاجز (Septal foramen) يتأثر موقعها بمعدلات اللف فى الصدفة ...

فان المقصود بموقع الفتحة هنا .. هو موقع فتحة الحجرة الأخيرة .. .. .. وهى على النحو التالى:

اولا الأصداف اللافة :

* متوسطة (Areal) : عندما تكون فى منتصف سطح الحجرة الأخيرة

* حاجزية (Septal or Sutural) فى قاعدة آخر حجرة وتكون ضيقة كالشق.. وهى شائعة فى الأصداف ثنائية التسلسل كما فى جنس (Textularia).

ثانيـا الأصداف اللافة فى مستوى واحد :

* حاجزية جانبية(Exteriomarginal) عندما تبتعد الفتحة الحاجزية عن قاعدة آخر حجرة.. ناحية الطرف العلوى للحاجز

ثالثـا الأصداف الحلزونية :

حاجزية داخلية (Interiomarginal) :.. قد تنتقل الى الخارج .. وتكون:

* إضافية جانبية (Supplemantary) عندما يوجد للصدفة أكثر من فتحة واحدة . مثل: جنس (Mississippina).

* درزية (Sotural) عندما تنطبق الفتحات الإضافية مع الدروز الباطنية .

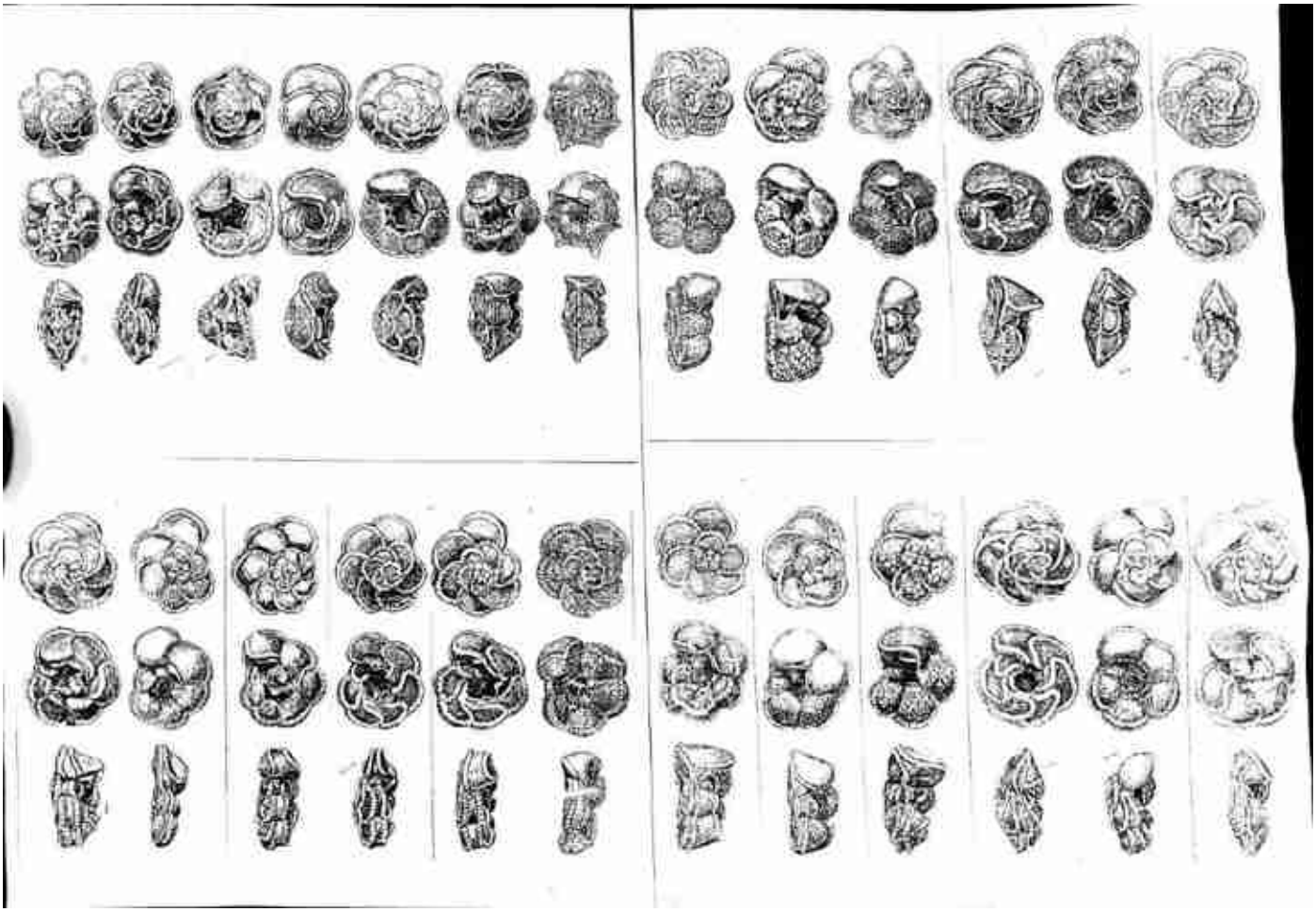
* سربة (Umbilical) هندما تفتح الفتحة الدرزية فى السرة.

* غربالية (Gribrate)هندما تتكون الفتحة من مجموعة كبيرة من الثقوب.. تبدو فى شكل الغربال كما فى جنس (G. Poroeponides .. وحين تنظم الثقوب فى صف أو صفين كما فى جنس (Peneroplis).

رابعـا الأصداف وحيدة التسلسل .. تكون علوية (Terminal) .. كما فى جنس (Nodosaria).

شكل الفتحـة

تتخذ الفتحة أشكالاً متعددة: فقد تكون مستديرة .. طولية مستقيمة ..أو منحنية .. كالشق (Fissurine) .. شعاعية (Radiate) .. ذات شفة (Phyaline) أو كشكل الشولة (Virguline).



قبيلة الأوليات

١- تحتوى قبيلة الأوليات على عشرات من الأنواع التى تعيش فى كل بيئة فوق الجبال وفى الوديان وفى التربة وفى أنسجة ودماء الأحياء المختلفة، وبعضها يطفو على البحر والكثير منها يعيش عيشة قاعية أو سابحاً فى الماء المالح أو النصف مالح أو العذب .

وبالرغم من تعدد أشكالها فإن رتبتين فقط هما الفورامينفرا (Foraminifera) و الراديولاريا (Radiolaria) ينتميان إلى وظيفة جذريات الأقدام أو الريزويودا (Saareodina or Rhizpoda) وهما اللذان يبنيان نوعاً أو أخر من الأصداف المكونة من السيليكا فى الراديولاريا، ومن الجير أو الكيتين فى الفورامينفراوتتميز طائفة جذرييات الأقدام بأنها تتحرك بواسطة أقدام كاذبة (Pseudopodiaa) غير ثابتة الشكل وتمتد من البروتوبلازم وتتميز رتبة الفورامينفرا بأن أقدامها الكاذبة تتشابك مع بعضها البعض عندما تنمو من البروتولازم على العكس الأمبيبات التى لا تتشابك أقدامها الكاذبة أما رتبة الراديولاريا فإن أقدامها الكاذبة مقواه بواسطة محور هيكلى لكل منها .

رتبة الفورامينفورا (Order Foraaminifera)

هى رتبة ذات أهمية خاصة نظراً لانتشار بقايا أصدافها (Tests) فى الكثير من الصخور الرسوبية ولأن عدداً كبيراً من أنواعها محدود الانتشار الزمنى ويكون حفريات مميزة جيدة وكذلك لإمكان إخراجها كاملة وبأعداد كبيرة فى المقطوعات (Cattings) أو الجسات (Cores) التى تستخرج من الآبار التى تدق للبحث عن البترول أو المعادن الأخرى نظراً لصغر حجمها إذ يبلغ متوسط قطر معظم أصدافها حوالى ٠,١ مم وقد ازداد الاهتمام بهذه الرتبة زيادة كبيرة منذ أن أكتشفت فائدتها الكبرى فى مضاهات الطبقات ومحددات أعمارها وخاصة التحت سطحية منها (Subsurface). فزاد عدد المشتغلين بها سواء فى الجامعات أو مراكز أبحاث شركات البترول والتعدين حتى أ،ه ليفوق جميع المشتغلين بالحفريات الأخرى مجتمعه، كما أن هناك مجلتين تكاد أن لا تنشران إلا الأبحاث الخاصة بهذه الرتبة فقط وهما :-

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٢ والجيل اللاشقى يعرف فى الفورامينفرا بإسم الجيل الميكروسفيرى (Microspherie Generation) أو الشكب ب ويرجع تسميته كذلك إلى كون خليته الأول صغيرة بينما يكون حجمه كبيراً. أما الجيل الشقى فيعرف بإسم الجيل الميجالوسفيرى (Megalospherie Generation) أو الشكل أ وهذا يبدأ بخلية كبيرة نوعاً وإن كانت صدفته لا تبلغ حجماً كبيراً . وفى العادة يكون إختلاف شكل صدفتى الجيلين صغيراً ولكن هناك فى بعض أنواع جنس (Nemmulites) اختلاف كبير جداً فى حجم بل وفى تركيب الجيلين، حتى أن قدامى المؤلفين كانوا يصفون الشكلين المختلفين على أنهما نوعين مختلفين تماماً وليسا شكلين لنوع واحد. وقد ظل الحال كذلك حتى أن اقترح (Hantken de la Harpe) فى ١٨٧٩ أن لما كان الشكلين المختلفين يوجدان دائماً مع بعضهما فلابد من اعتبارهما شكلين لنوع واحد. ومما هو جدير بالذكر أنهما قد اقترحا ذلك من ملاحظتهما عن الحفريات القديمة دون أن ينتظرا الملاحظة العلمية الناتجة عن تربية الحيوانات الحية وملاحظة تطور أجيالها.

الصدفة :-

تعتبر الصدفة أهم ظاهرة للفورامينفرا بالنسبة لأخصائى الحفريات إذ أنها تمثل البقايا المادية الوحيدة للحيوان القديم ، فدراستها على هذا يجب أن تكون كاملة وجيدة .