

Nummulitidi e Ortofragmine

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A) NUMMULITIDS

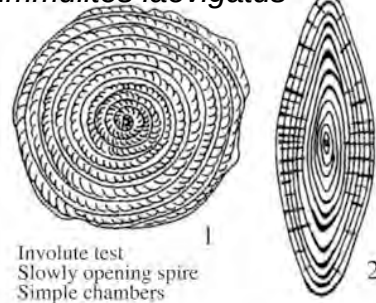
- Nummulitid genera
- *Nummulites*: architecture of the test
- Fundamentals: Schaub (1981) monograph
- Morphology
- Taxonomically significant characters
- Systematics: just two examples

Nummulitid genera



Suborder **Rotaliina** Delage & Hérouard, 1896
Superfamily **Nummulitacea** de Blainville, 1827
Family **Nummulitidae** de Blainville, 1827

Nummulites laevigatus



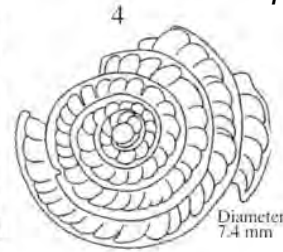
Involute test
Slowly opening spire
Simple chambers

Diameter
of part
vertical
section
15.3 mm

3

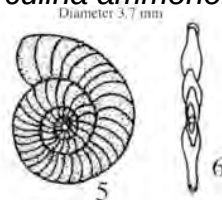
Evolute test
Slow & regularly opening spire
Simple chambers

Assilina spira



Diameter
7.4 mm

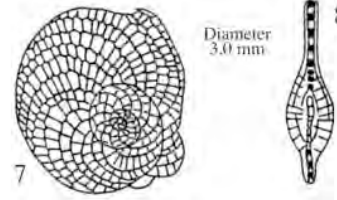
Operculina ammonoides



Diameter 3.7 mm

Evolute test
Rapidly opening spire
Simple chambers

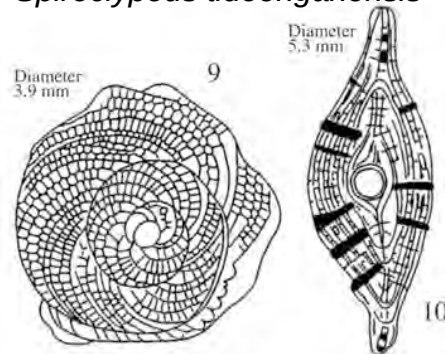
Heterostegina depressa



Diameter
3.0 mm

Maturo-evolute test
Rapidly opening spire
Divided into chamberlets

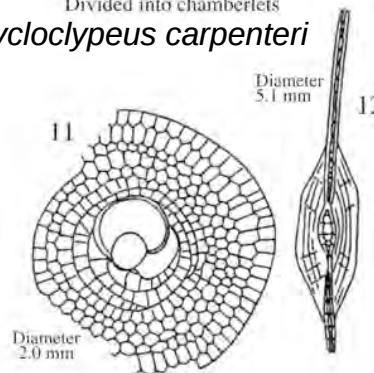
Spiroclypeus tidoenganensis



Diameter
3.9 mm

Evolute test
Rapidly opening spire
Divided into cubicula

Cycloclypeus carpenteri

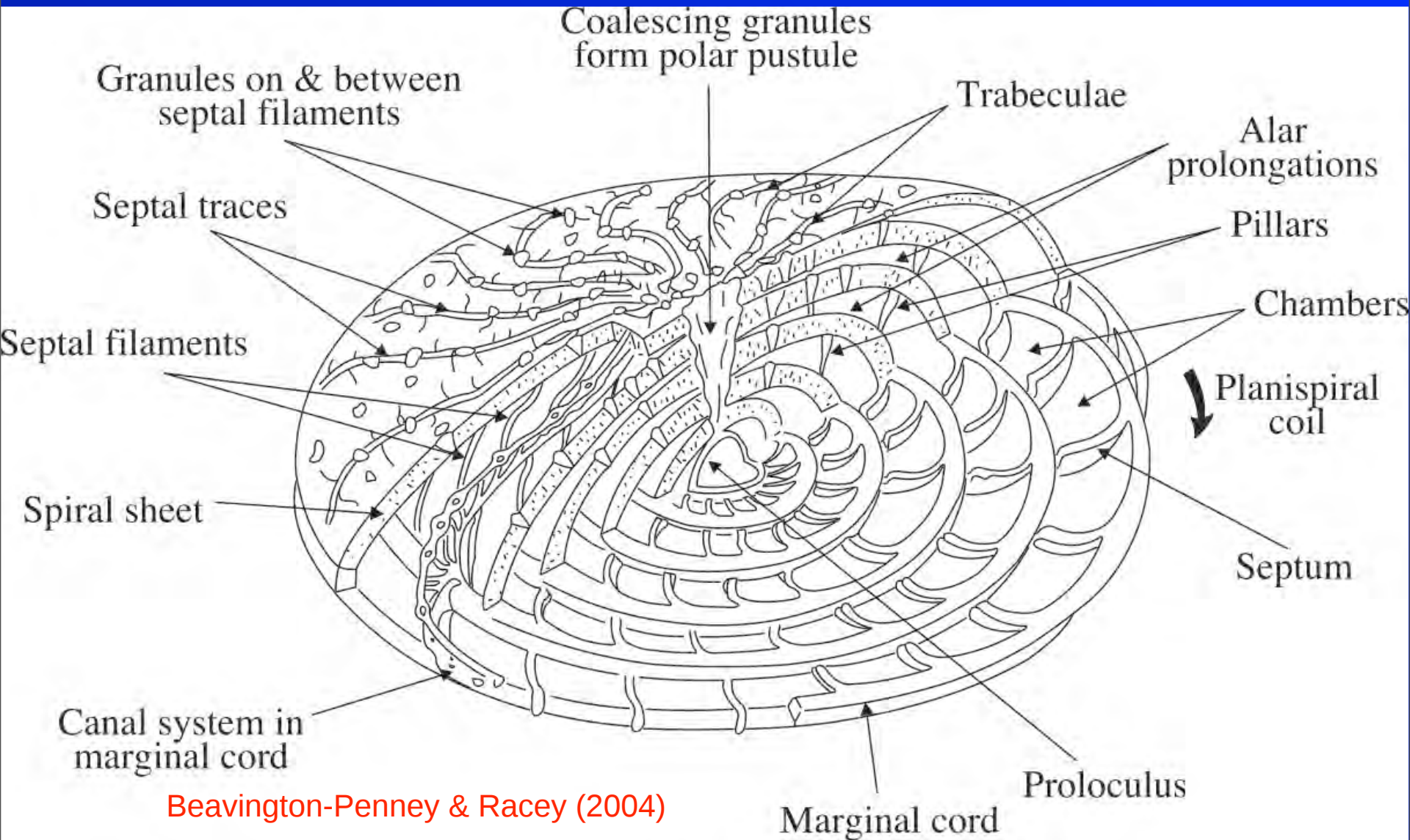


Diameter
2.0 mm

Evolute test
Rapidly opening spire, becoming annular
Divided into chamberlets

Beavington-Penney
& Racey (2004)

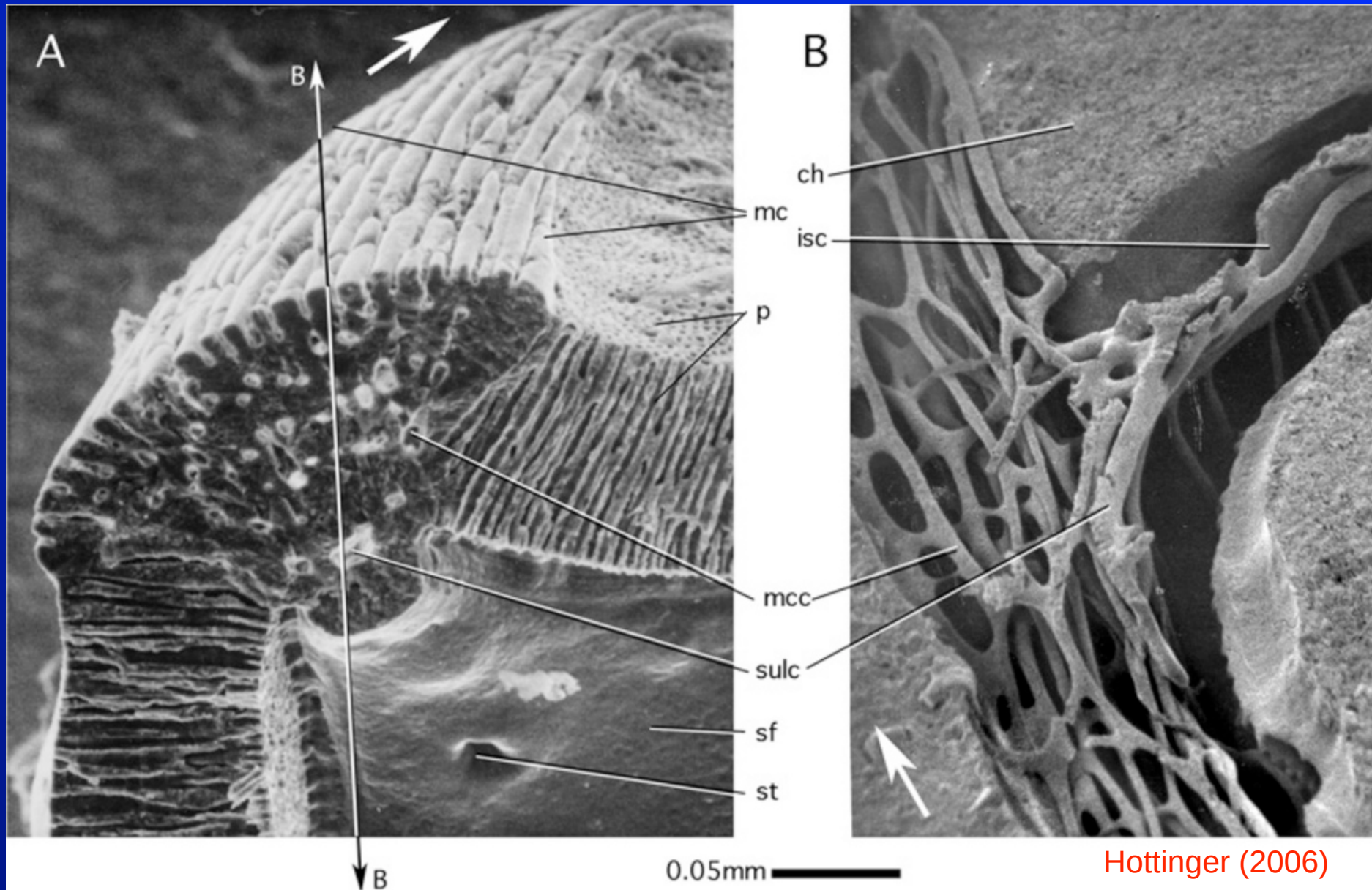
Nummulites: architecture of the test



Nummulites: architecture of the test



Canal system



Fundamentals: Schaub (1981) monograph



Schweizerische Paläontologische Abhandlungen Mémoires suisses de Paléontologie Memorie svizzere di Paleontologia

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Vol. 104, 1981

Hans Schaub

Nummulites et Assilines de la Téthys paléogène.
Taxinomie, phylogénèse et biostratigraphie

Editions Birkhäuser Bâle

Table des matières

Avant-propos	6
Sommaire	7
Abstract	7
Zusammenfassung	7
Introduction	9
Première partie: Généralités	11
Sur la morphologie de la coquille des Nummulites et des Assilines	11
Principes de description	24
Méthodes de préparation et de figuration	24
Sur les règles élémentaires de taxinomie	25
Sur l'orthographe des noms transcrits	25
Quelles espèces sont décrites?	26
Terminologie stratigraphique	26
Biozones à Nummulites	26
Sur l'évolution des Nummulites et des Assilines	27
Sous-genres du genre <i>Nummulites</i>	28
Deuxième partie: Gisements à Nummulites et leur stratigraphie	32
I. Alpes	32
1. Alpes suisses	32
a) Nummulitique de Nappes helvétiques de la Suisse centrale orientale ..	32
b) Nummulitique de Nappes helvétiques de la Suisse centrale occidentale	34
c) Séries de Flysch pennins	34
Problème des Nummulites dans le Flysch, Schlierenflysch, Gurnigel-	
flysch	34
d) Nummulites du Flysch subalpin	35
2. Alpes bavaroises	37
a) Nummulitique du Kressenberg et environs	37
b) Sonthofen	37
3. Alpes autrichiennes	38
a) Sudhelvétique à l'Ouest du Mattsee	38
b) Calcaire du Waschberg	38
c) Carinthie: Guttaring (Sonnberg), Sittenberg	38
4. Alpes françaises	38
a) Alpes Maritimes et Basses Alpes: La Mortola	38
b) Localités types de Nummulites priaboniennes: Château-Garnier, Al-	
lons, Faudon	38
c) Châtelard-les-Bauges	40
II. Aquitaine	40
1. Aquitaine occidentale	40
a) Chalosse de Montfort	39
b) Bas-Adour et les basses vallées des Gaves	41
c) Biarritz	43
d) Gan et ses environs	43
2. Hautes-Pyrénées	44
a) Ossun	44
b) Orignac	45
3. Petites Pyrénées	45
a) Aurignac	47
b) Le Quillet	47
c) Environs de Fabas et Cérizols	47
d) Moulin Las Linques à l'Ouest de Montberaud	47
4. Aquitaine orientale	48
a) Couiza et ses environs	48



Reproductive dimorphism

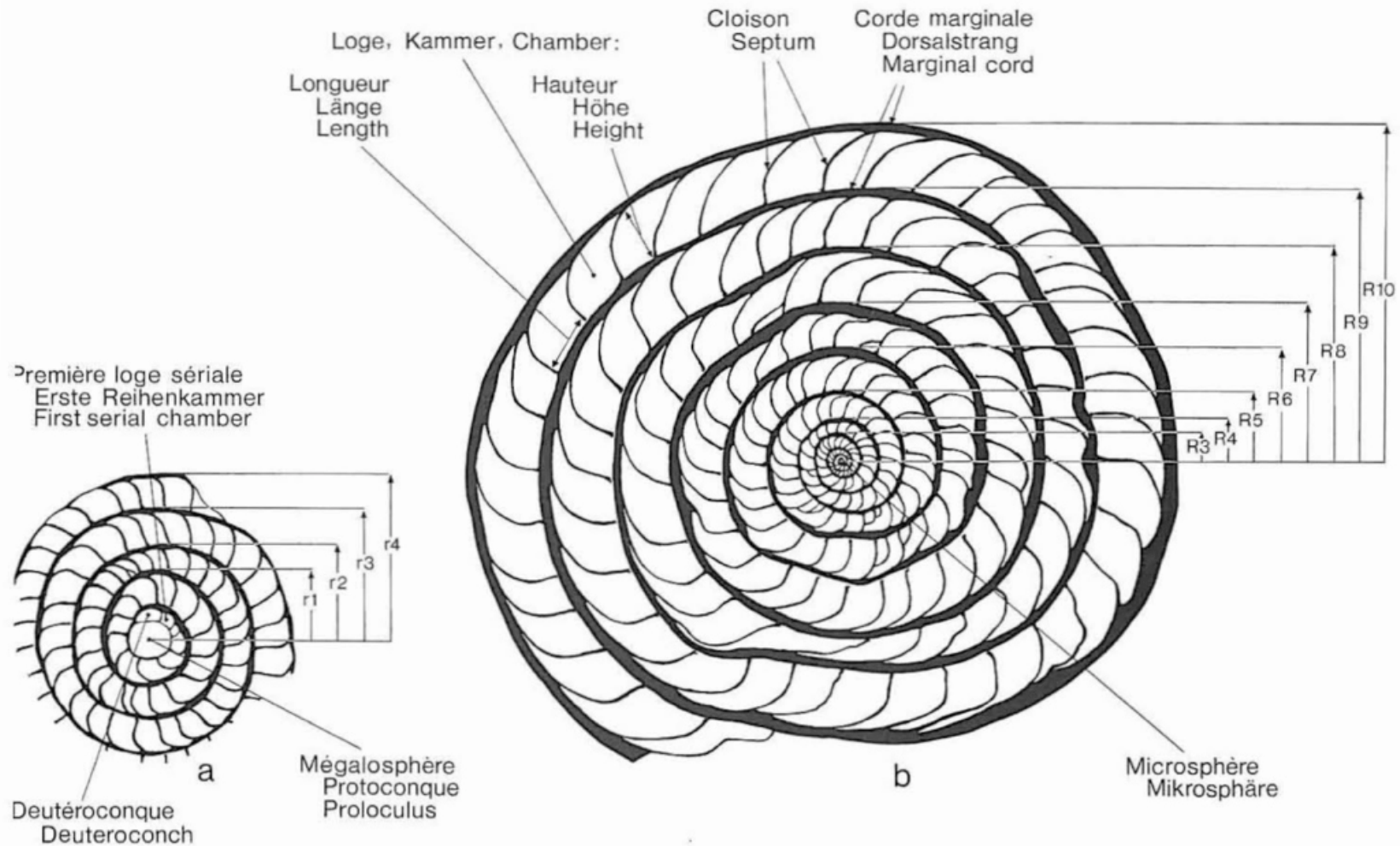


Figure 17a, b. Sections équitales de *Nummulites pustulosus* DOUVILLÉ, forme A (a) et B (b). 10x, terminologie. (Parfois, la corde marginale est appelée «corde dorsale».)

r_1, r_2, r_3, r_4 sont les rayons de la spire à 1, 2, 3, 4 tours, mesurés à partir du centre de la mégalosphère.

$R_3, R_5, R_7 \dots R_{11}$ sont les rayons de la spire à 3, 5, 7 ... 11 tours, cotés comme ordonnées dans les diagrammes de spire, figure 19.

$r_3, R_5, R_7 \dots R_{11}$ Radien der Spiralen mit 3, 5, 7, ... 11 Umgängen, in den Windungsdiagrammen der Figur 19 als Ordinaten eingetragen.

$r_3, R_5, R_7 \dots R_{11}$ radii of the spire with 3, 5, 7 ... 11 whorls, ordinates in the diagrams of figure 19.



Reproductive dimorphism



Taxonomically significant characters



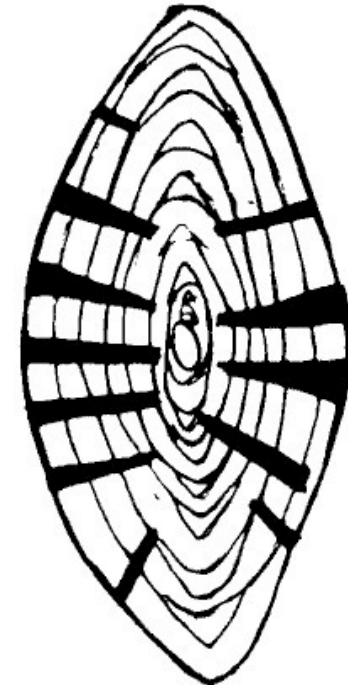
External: **diameter/thickness**

Nummulites partschi



Axial

Nummulites burdigalensis



Axial

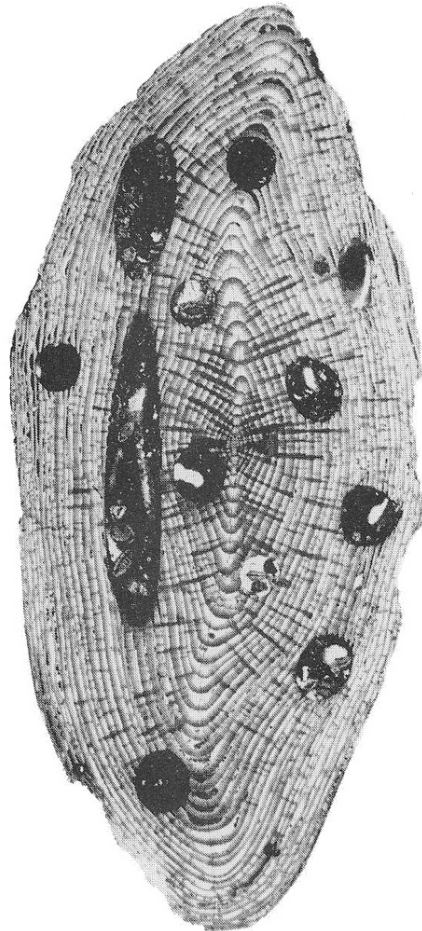
Racey (1995)

Taxonomically significant characters

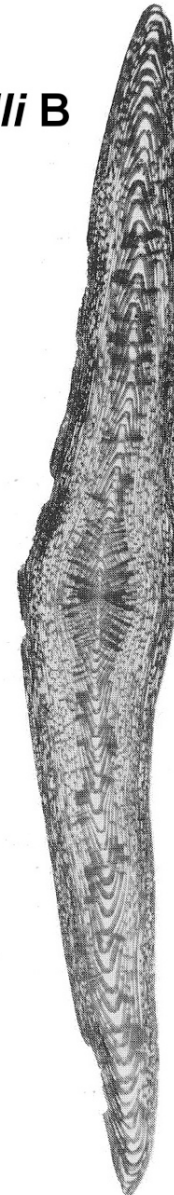


External: **diameter/thickness**

N. perforatus B



N. lyelli B



Kleiber (1991)

Taxonomically significant characters



External: surface ornamentation

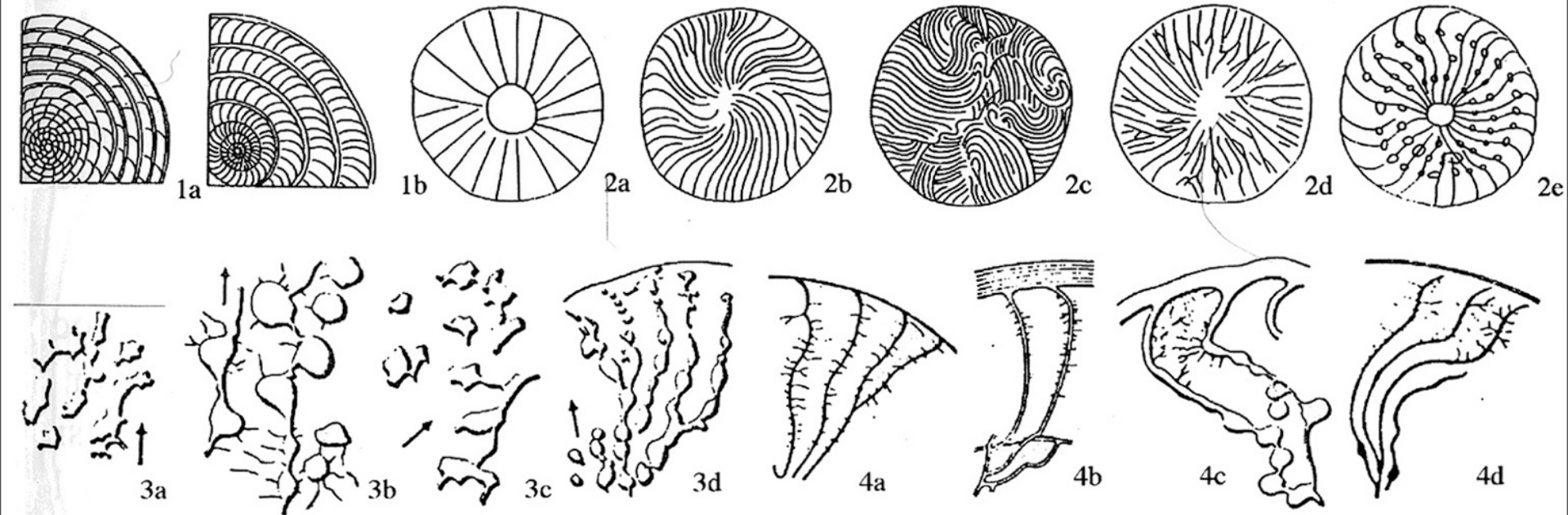


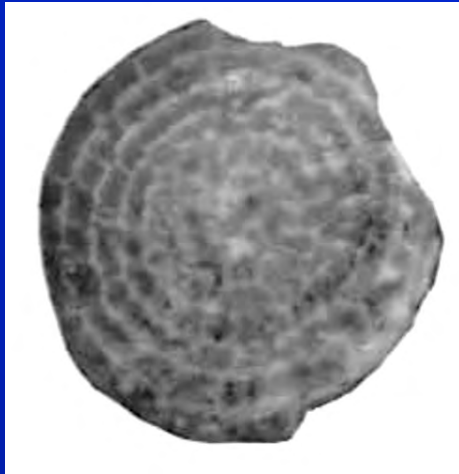
FIGURA 8.17. Ornamentación de los nummulítidos; 1: forma de las camarillas: alargadas longitudinalmente (1a) o radialmente (1b); forma de las alineaciones de las mallas: rectas-radiales (2a), sigmoidales (2b), meandriformes (2c), reticuladas (2d) y con pústulas (2e); 3a, b, c y d: forma de pústulas o gránulos (pseudopoligonales, ovalados, vesiculares); 4a, b, c y d: forma de trabéculas transversales. Dibujos de Blondeau (1972) y Haynes (1981).

Molina (2004)

Taxonomically significant characters



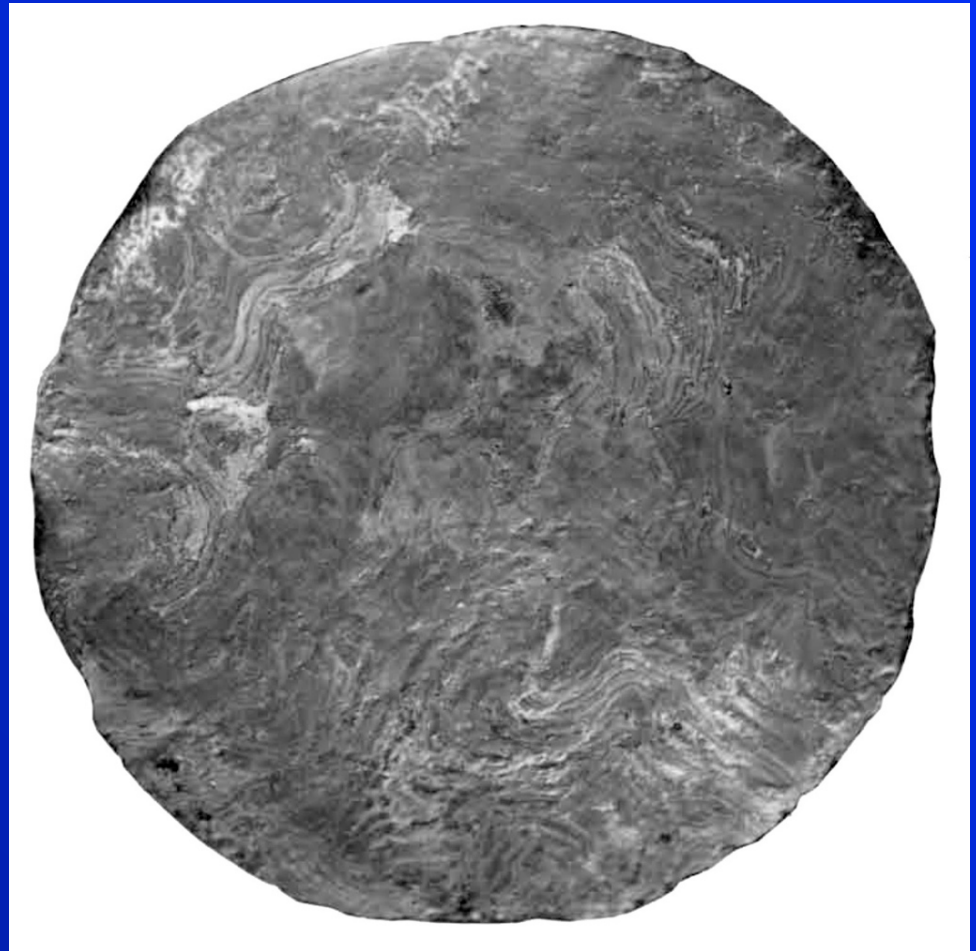
External: surface ornamentation



N. fabianii



N. globulus



Schaub (1981)

N. perplexus

Taxonomically significant characters



Equatorial section: spire pattern

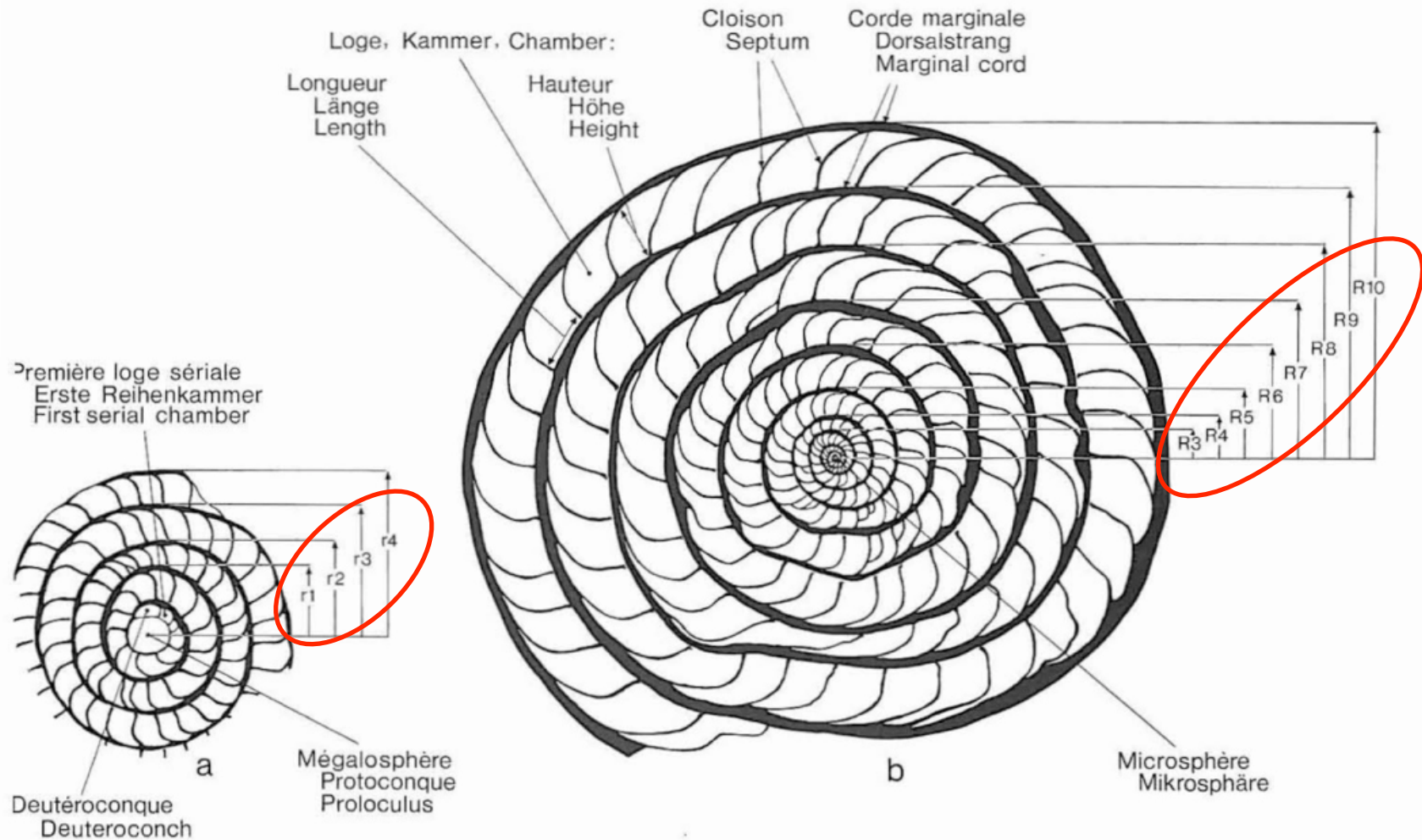


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Schaub (1981)

Taxonomically significant characters



Equatorial section: spire pattern

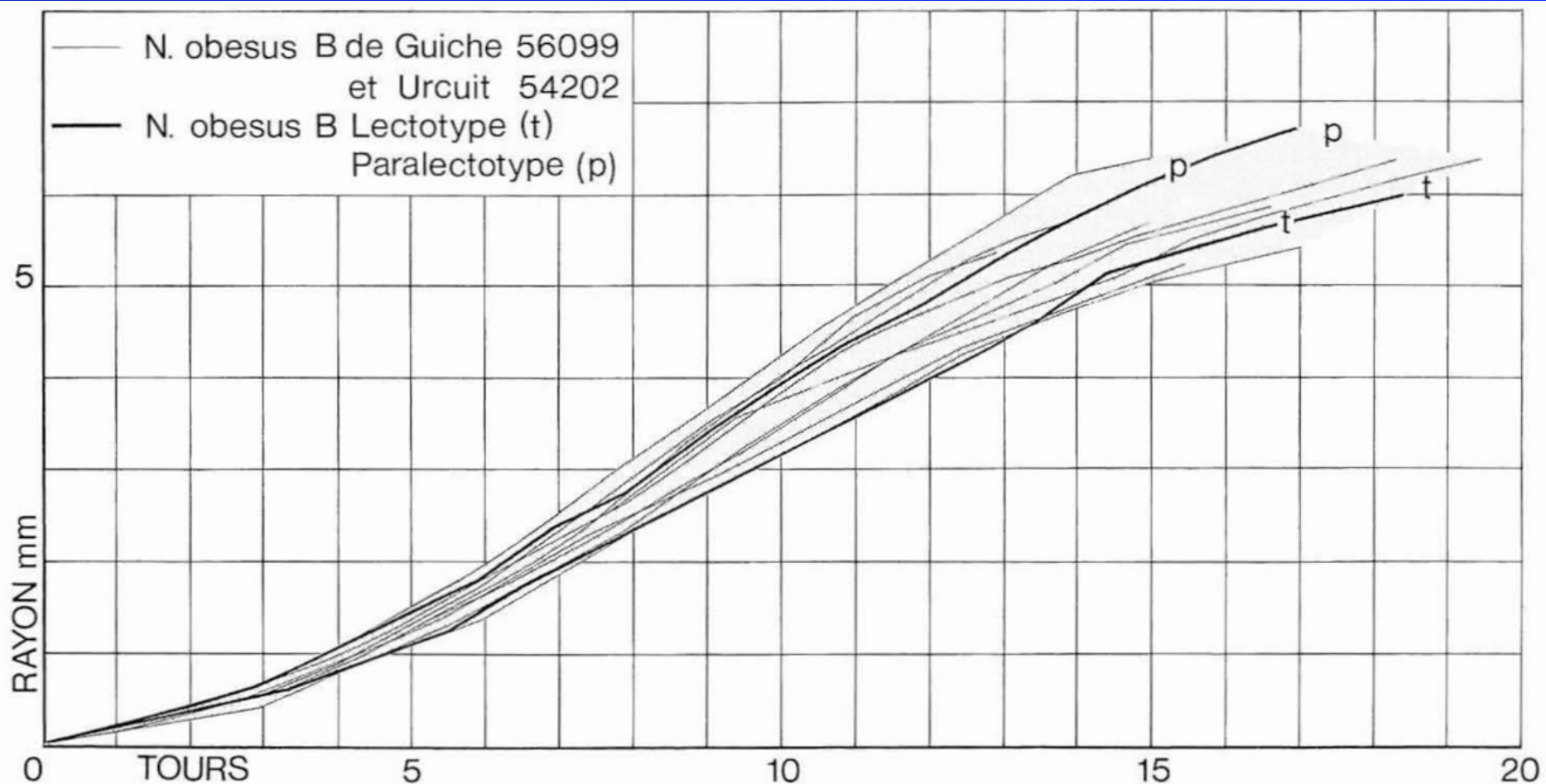
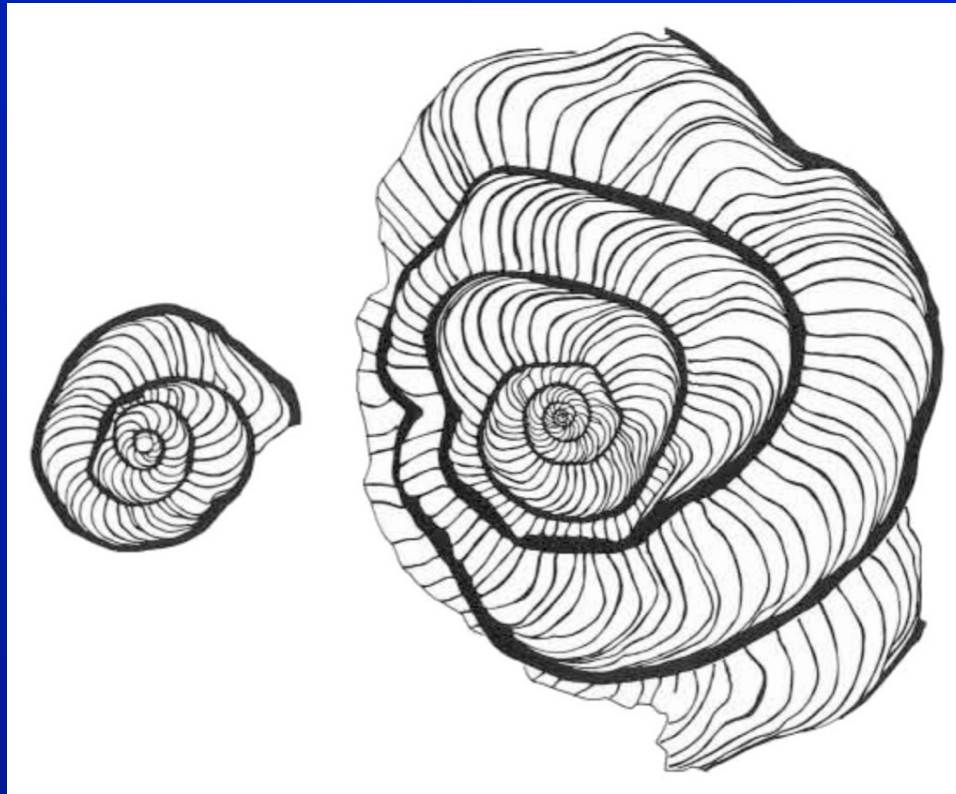


Figure 19. Diagrammes de spire de dix exemplaires de *N. obesus* du Lutétien inférieur d'Urcuit et de Guiche (Pyrénées atlantiques), collection H. Schaub, et de deux exemplaires types (lectotype «t» et paralectotype «p») de la collection d'Archiac, afin de montrer ce que nous entendons par un «champ occupé par les diagrammes».

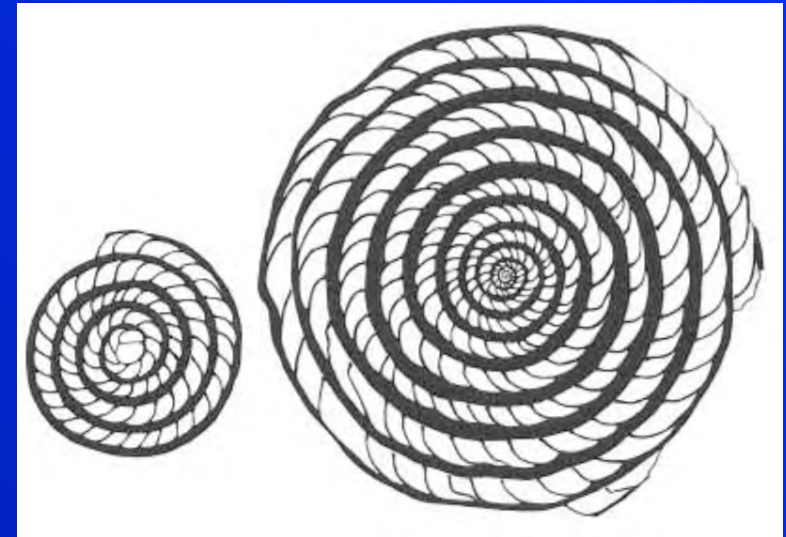
Taxonomically significant characters



Equatorial section: spire pattern



N. irregularis



N. rotularius

Taxonomically significant characters



Equatorial section: marginal cord

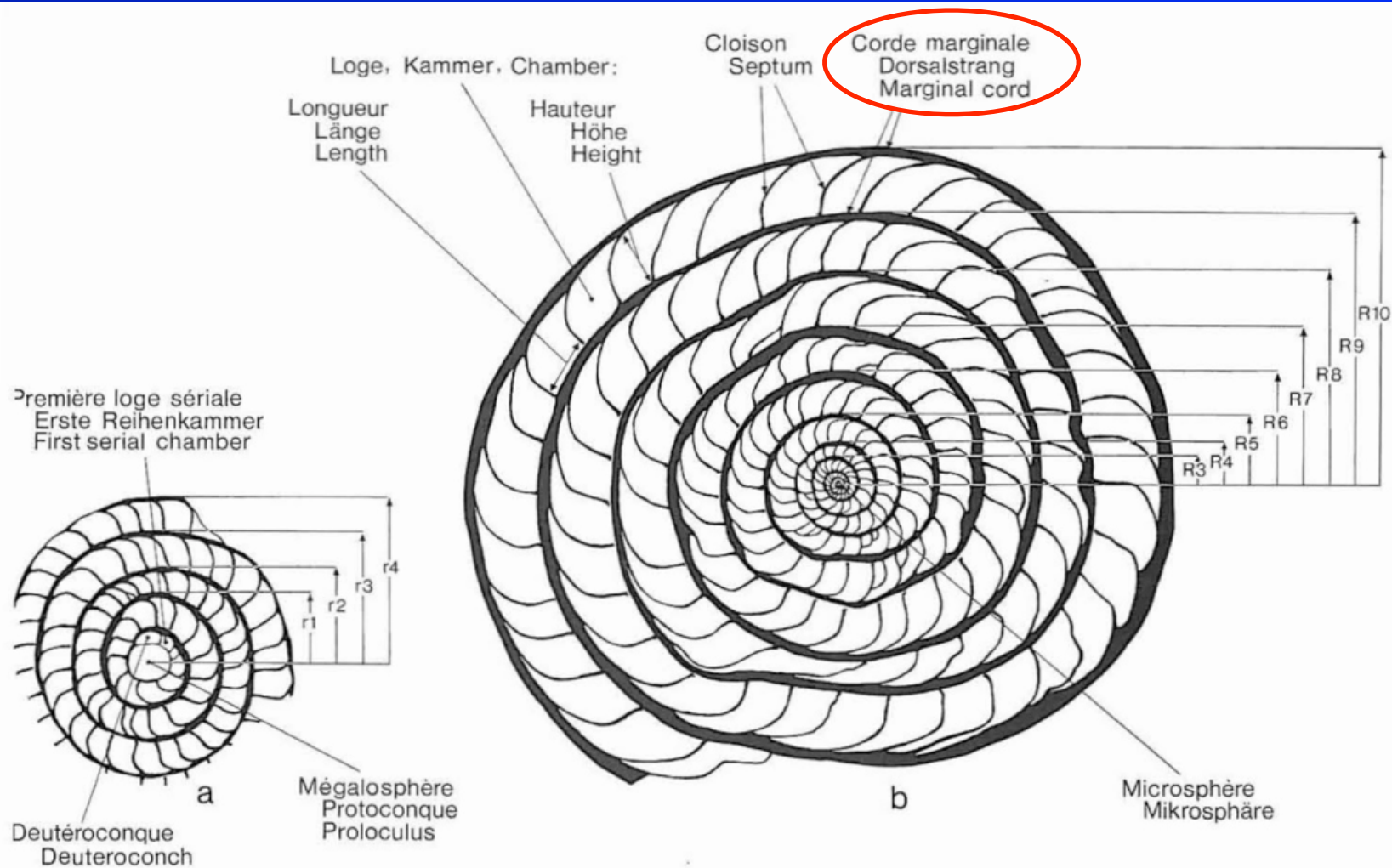


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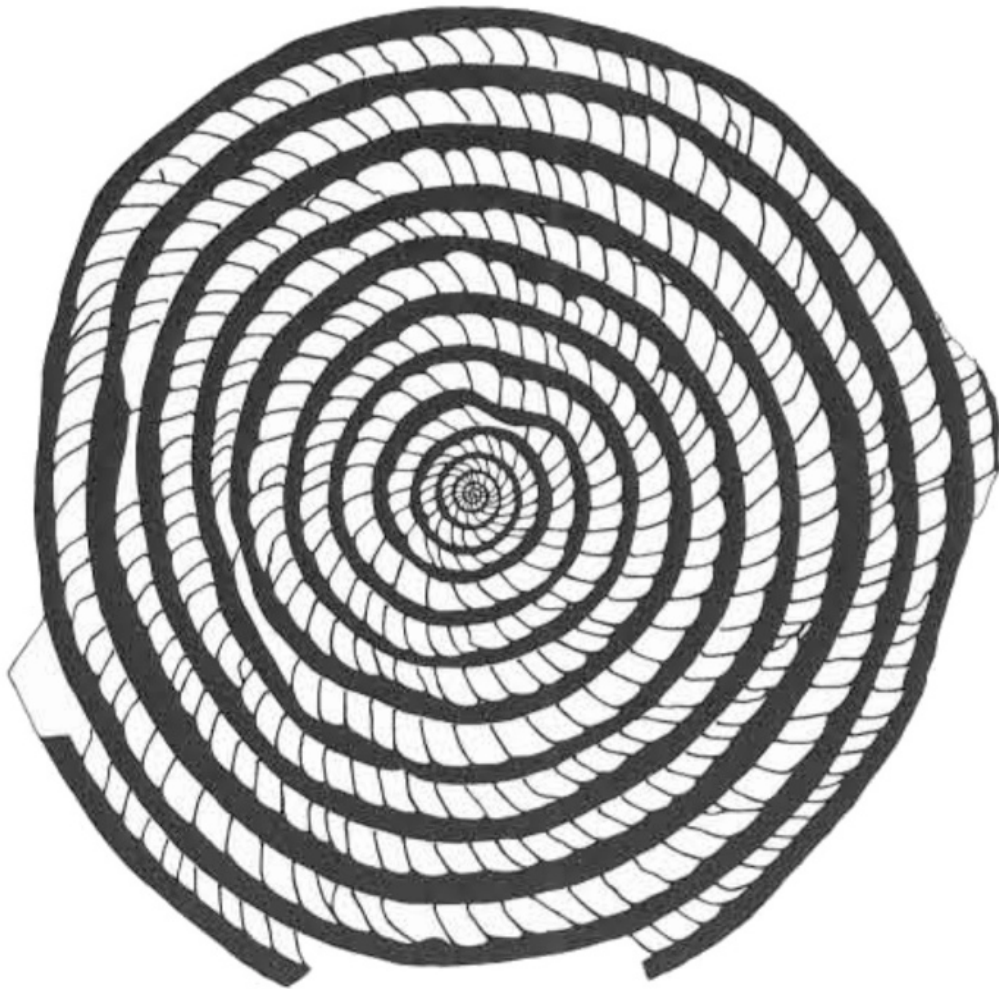
4: $R_3, R_5, R_7 \dots R_{11}$ radii of the spire with 3, 5, 7 ... 11 whorls, ordinates in the diagrams of figure 19.

Schaub (1981)

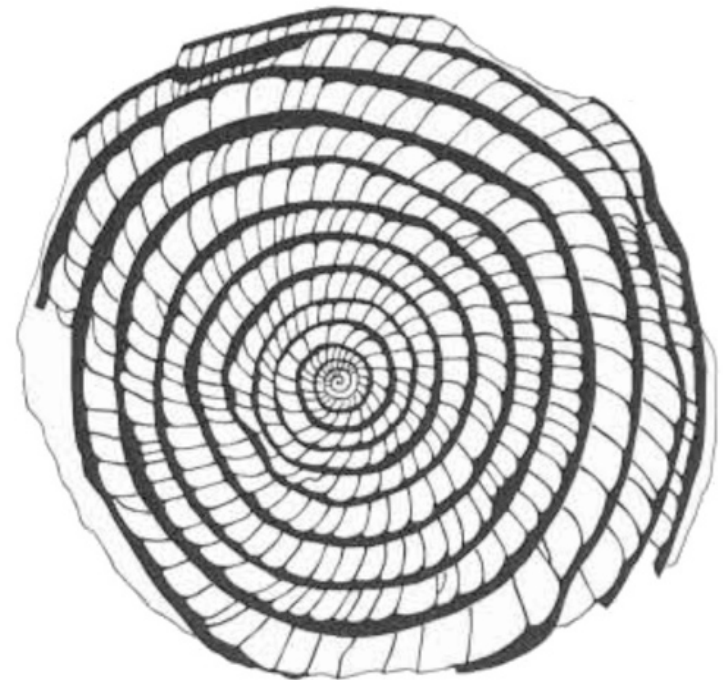
Taxonomically significant characters



Equatorial section: **marginal cord**



N. atacicus



N. obsoletus

Taxonomically significant characters



Equatorial section: septa and chamber shape

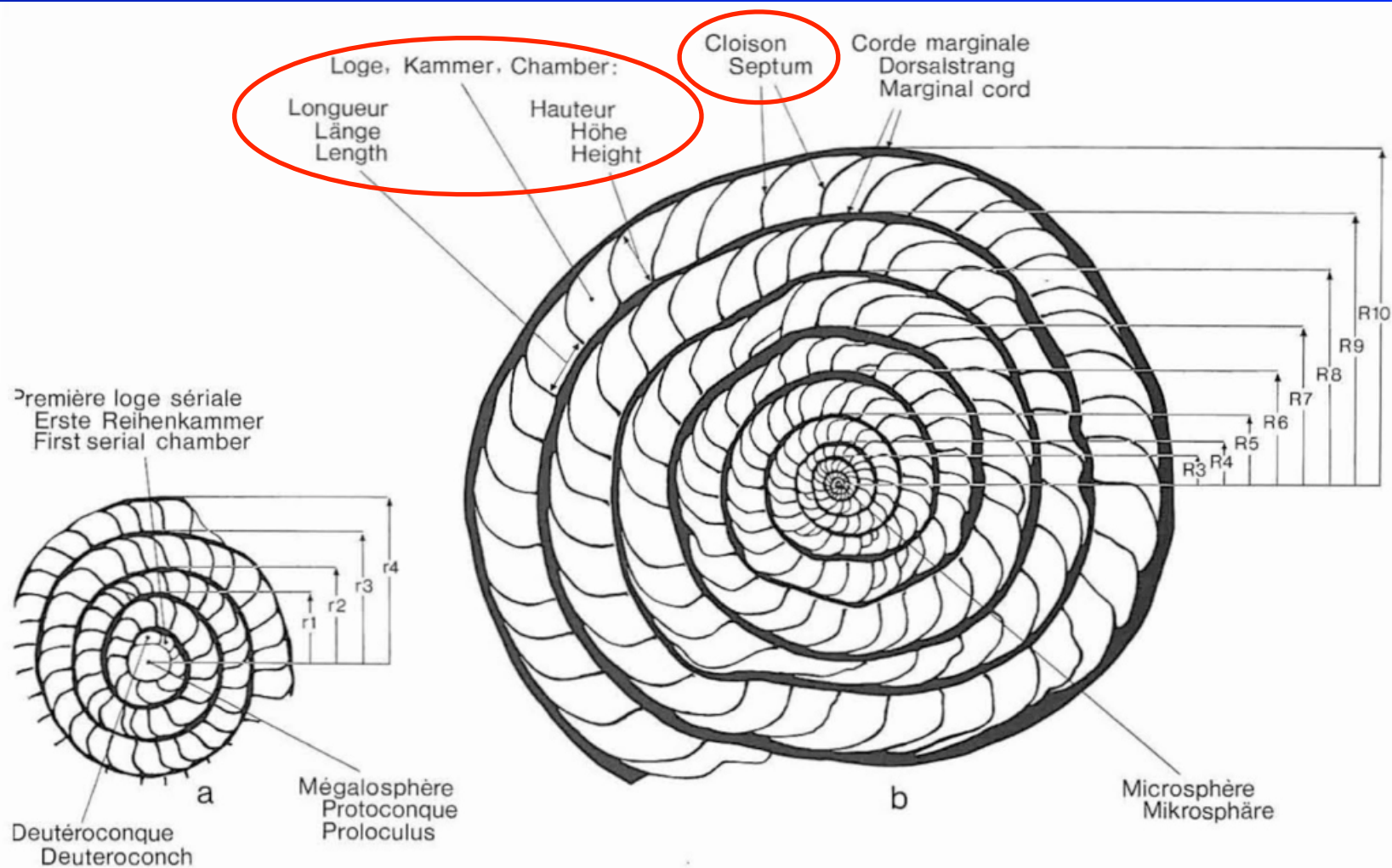


Figure 17a, b. Sections équatoriales de *Nummulites pustulosus* DOUVILLÉ, forme A (a) et B (b). 10×, terminologie. (Parfois, la corde marginale est appelée «corde dorsale».)

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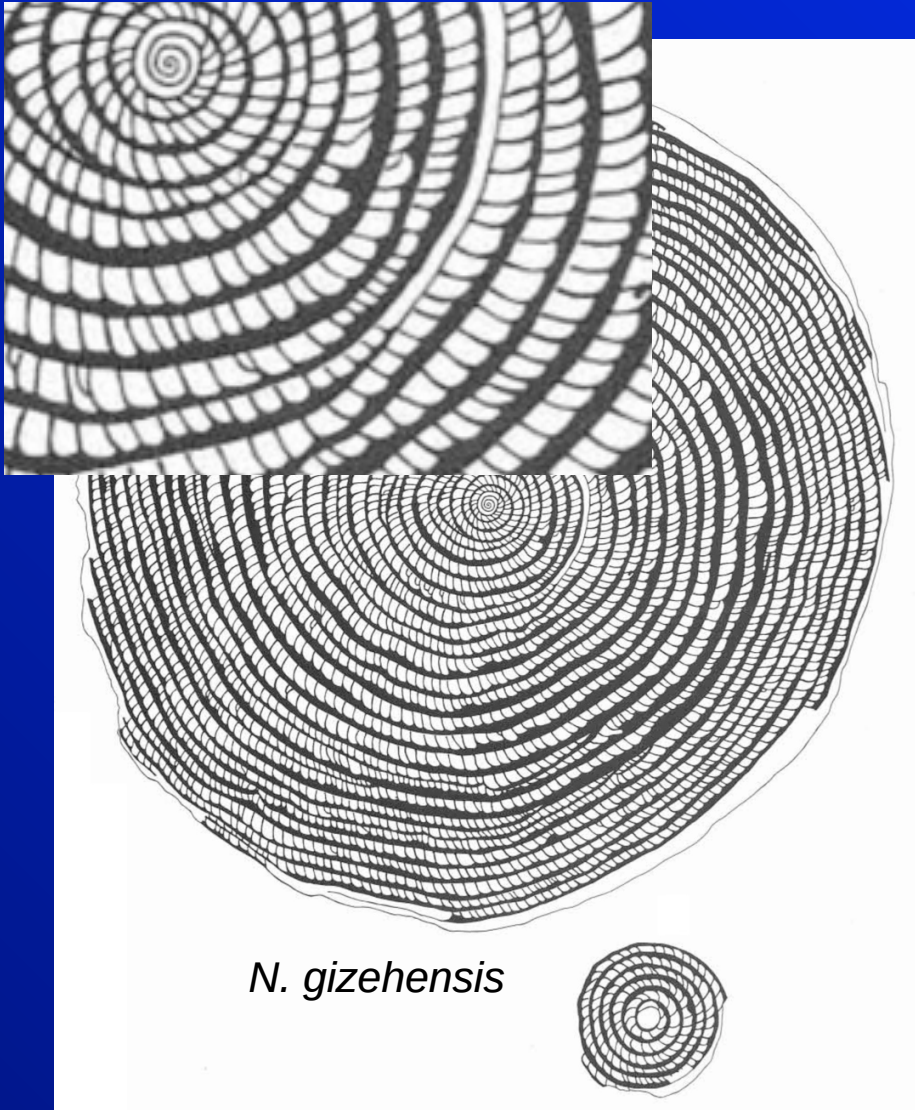
$R_3, R_5, R_7 \dots R_{11}$ radii of the spire with 3, 5, 7 ... 11 whorls, ordinates in the diagrams of figure 19.

Schaub (1981)

Taxonomically significant characters



Equatorial section: **septa and chamber shape**



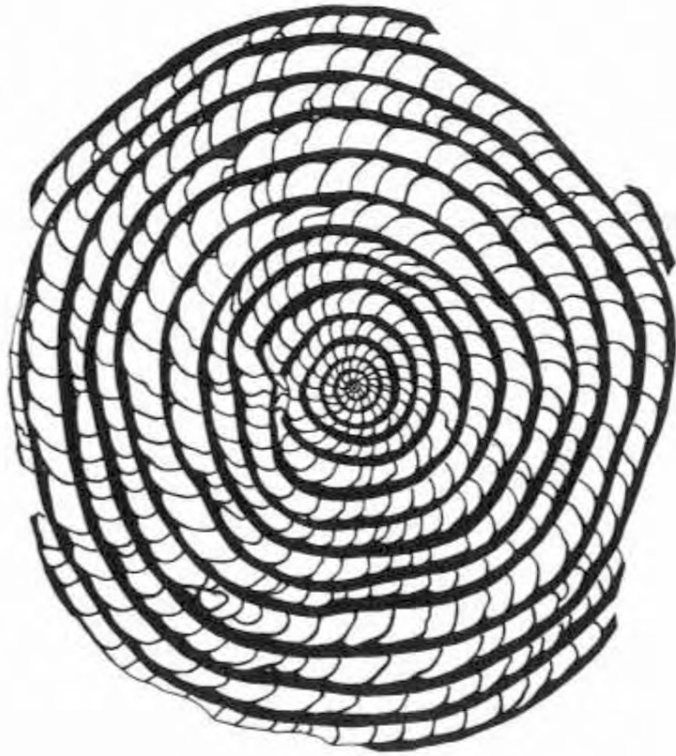
Schaub (1981)



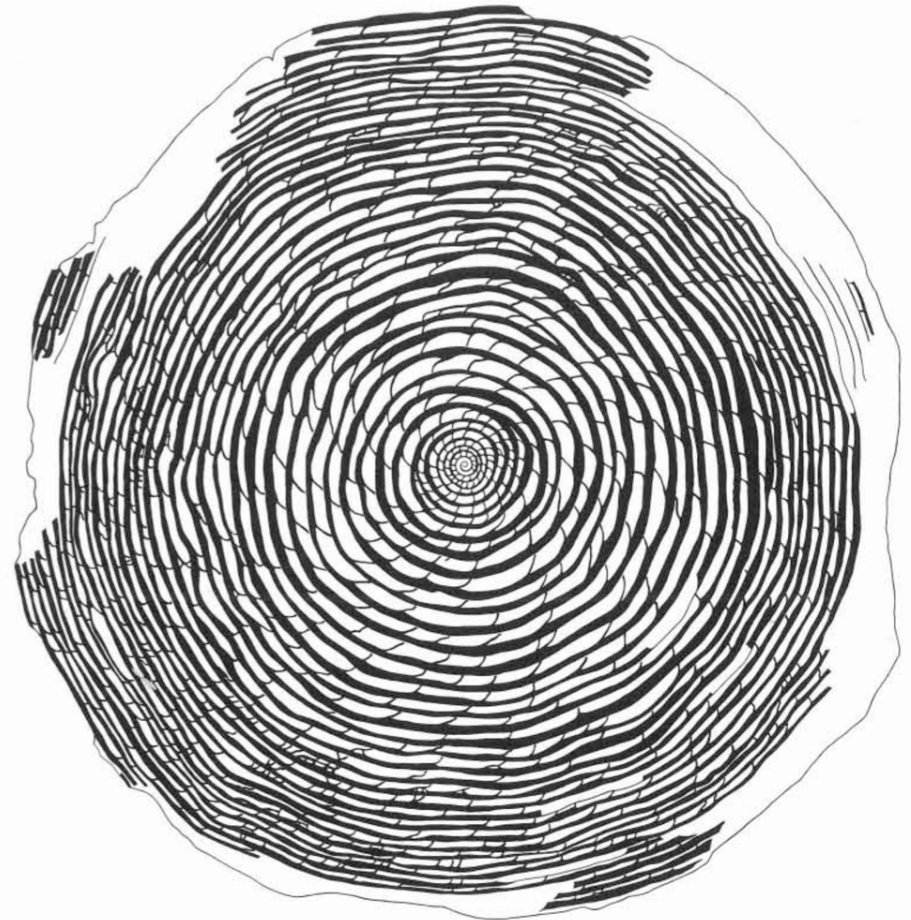
Taxonomically significant characters



Equatorial section: **septa and chamber shape**



N. laevigatus



N. brongniarti



Taxonomically significant characters



Equatorial section: proloculus diameter (A)

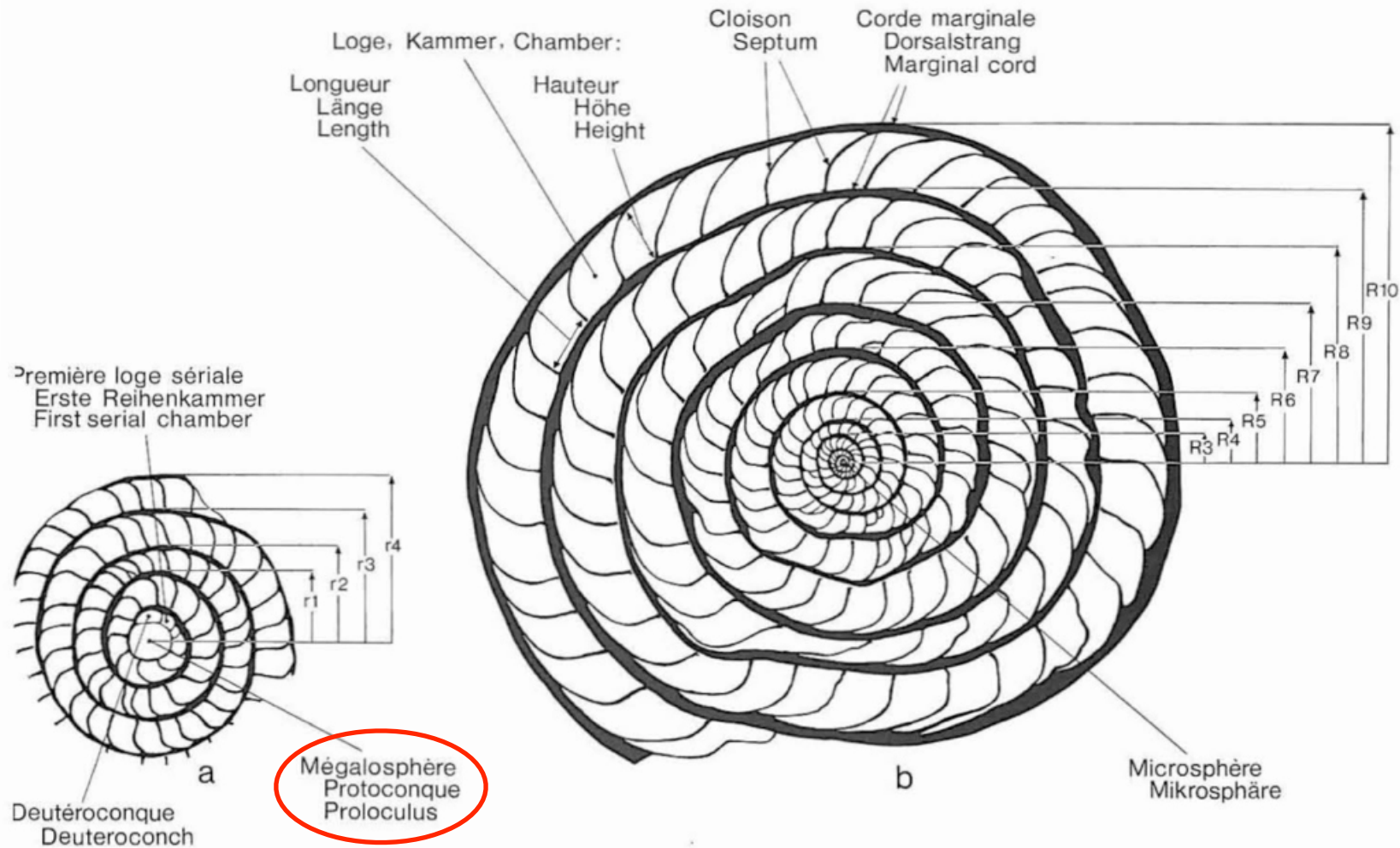


Figure 17a, b. Sections équatoriales de *Nummulites pustulosus* DOUVILLÉ, forme A (a) et B (b). 10×, terminologie. (Parfois, la corde marginale est appelée «corde dorsale».)

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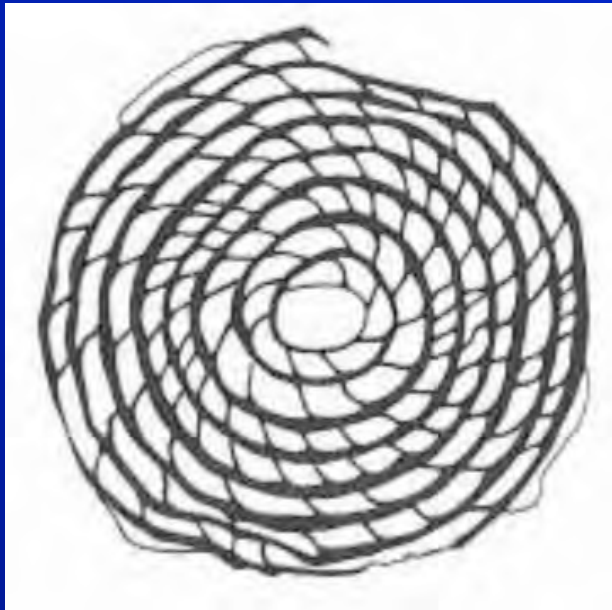
r_1, r_2, r_3, r_4 radii of the spire with 1, 2, 3, 4 whorls, measured from the center of the mégalosphère.

Schaub (1981)

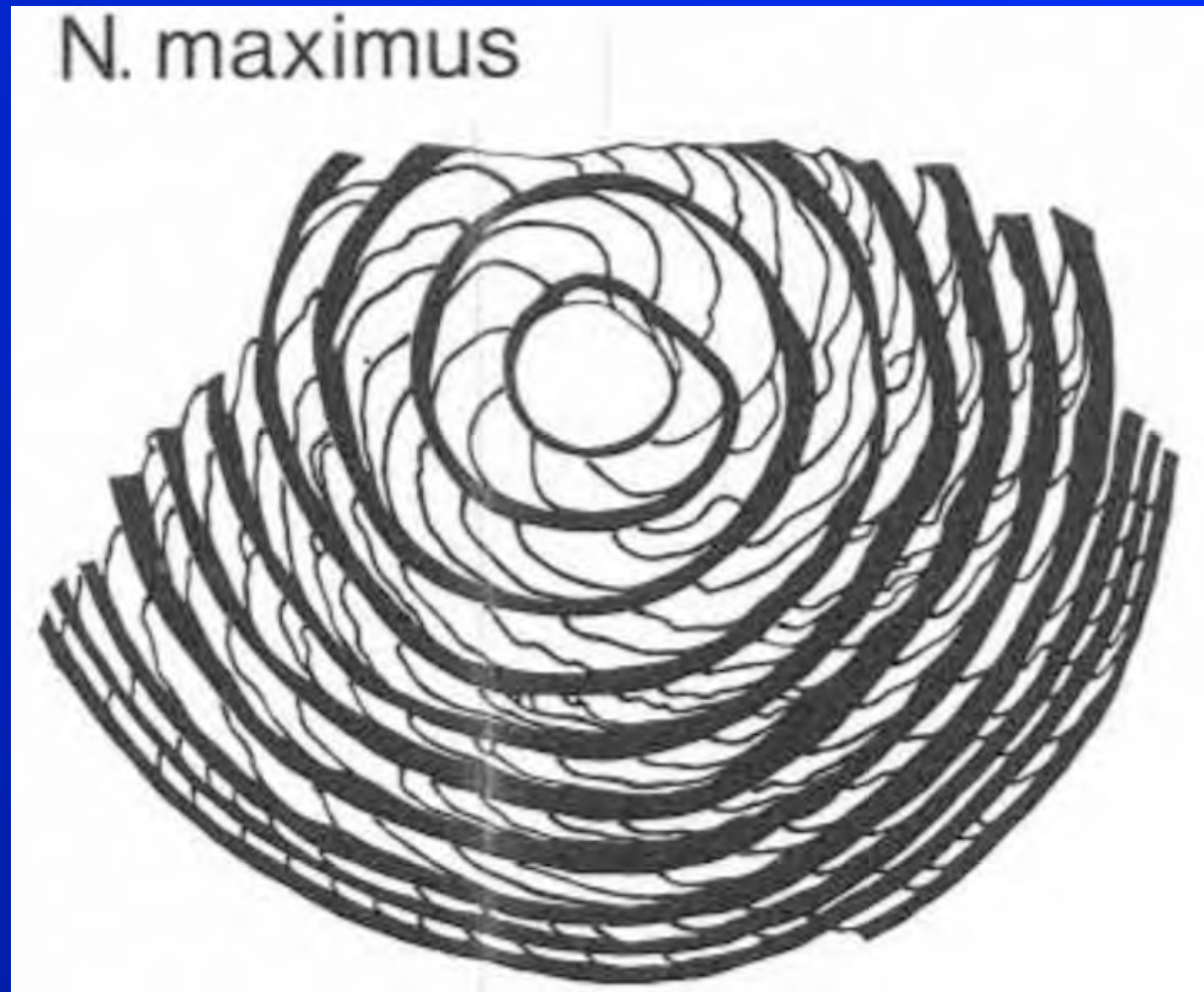
Taxonomically significant characters



Equatorial section: **proloculus diameter (A)**



N. perforatus



Schaub (1981)

Systematics: just two examples



Troisième partie: Description systématique	73
A. Genre <i>Nummulites</i>	73
1. Quatre petites <i>Nummulites</i> de l'Ilerdien inférieur	73
2. Groupe de <i>Nummulites burdigalensis</i>	77
Racine commune du groupe de <i>N. burdigalensis</i>	78
Phylum de <i>Nummulites perforatus</i>	82
Rameau de <i>Nummulites biedai</i>	90
Rameau de <i>Nummulites aturicus</i>	94
Rameau de <i>Nummulites lehneri</i>	97
Rameau de <i>Nummulites uranensis</i>	98
Rameau de <i>Nummulites verneuili</i>	101
2 espèces du groupe <i>burdigalensis</i> , <i>incertae sedis</i>	105
3. Groupe de <i>Nummulites partschi</i>	106
Phylum de <i>Nummulites partschi</i>	107
3 autres espèces du groupe <i>partschi</i>	113
2 spécimens d'espèces inconnues du groupe <i>partschi</i>	114
Sur « <i>Nummulites defrancei</i> » d'ARCHIAC & HAIME	115
Rameau de <i>Nummulites gizehensis</i>	115
Précurseurs du groupe de <i>N. partschi</i>	117
Descendants sans piliers de <i>N. praecursor</i>	120
4. Phylum de <i>Nummulites leupoldi</i>	121
5. Phylum de <i>Nummulites fabianii</i>	124
6. Phylum de <i>Nummulites rotularius</i>	130
7. Phylum de <i>Nummulites discorbinus</i>	133
8. Phylum de <i>Nummulites beaumonti</i>	135
9. Groupe de <i>Nummulites globulus</i>	137
Rameau de <i>Nummulites minervensis</i>	141
Phylum de <i>Nummulites nitidus</i>	144
Phylum de <i>Nummulites pustulosus</i>	149
10. Phylum de <i>Nummulites garnieri</i>	152
11. Groupe de <i>Nummulites striatus</i>	153
12. Groupe de <i>Nummulites laevigatus</i>	155
Phylum de <i>Nummulites puschi</i>	155
Phylum de <i>Nummulites brongniarti</i>	168
Rameau de <i>Nummulites carpenteri</i>	175
13. Phylum de <i>Nummulites spirectypus</i>	177
14. Phylum de <i>Nummulites irregularis</i>	179
15. Phylum de <i>Nummulites distans</i>	181
16. Phylum de <i>Nummulites pratti</i>	189
B. Genre <i>Operculina</i>	193
Sous-genre <i>Assilina</i>	193
1. Groupe d' <i>Assilina spiri</i>	193
2. Groupe d' <i>Assilina exponens</i>	206
Phylum d' <i>Assilina exponens</i>	206
Rameau d' <i>Assilina reicheli</i>	215
Bibliographie	219
Index alphabétique des espèces	229
Index alphabétique des localités	233
Tableaux 1-18	238

Schaub (1981)

Systematics: just two examples



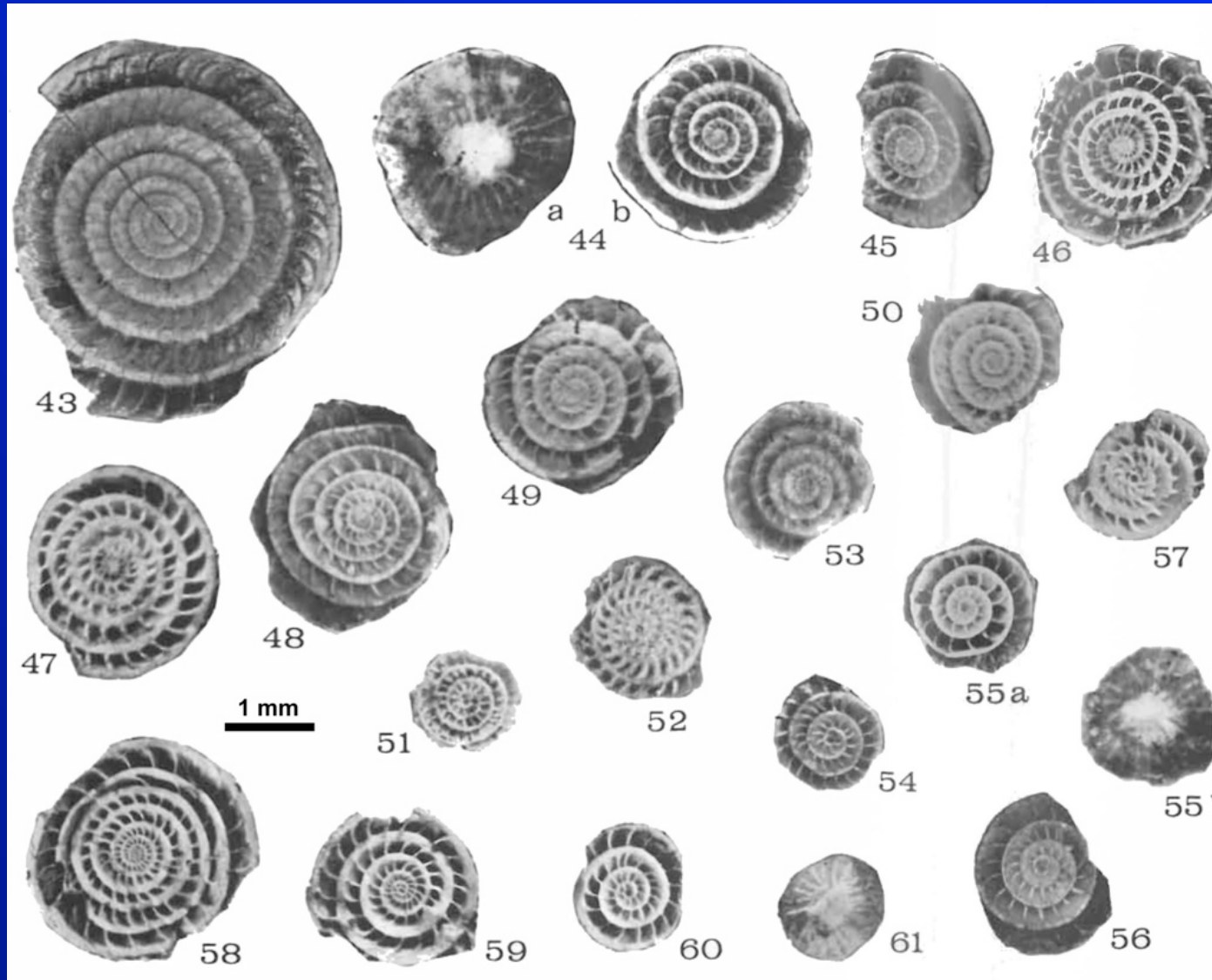
N. burdigalensis group:

- Test inflated
- Septal filaments thin, with several pillars, concentrated towards the poles of the test
- Spire quite slowly growing towards the periphery, in the more advanced species with a characteristic tripartition (B forms)
- Marginal cord more or less developed
- Septa straight or slightly curved, inclined, chambers usually isometric or higher than long
- Proloculus diameter 150 to 2200 μm

Systematics: just two examples



N. burdigalensis group:



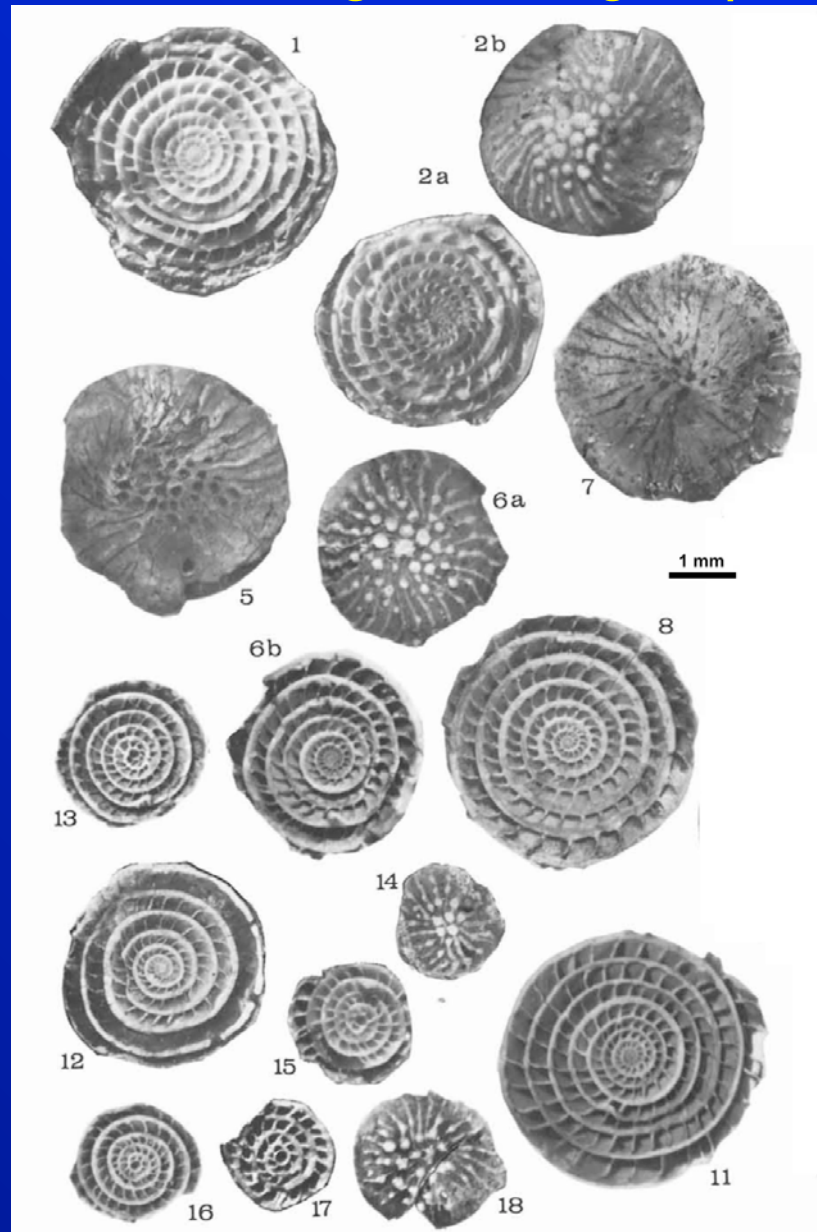
Schaub (1981)

The roots: *Nummulites solitarius* (SBZ 5-6)

Systematics: just two examples



N. burdigalensis group:



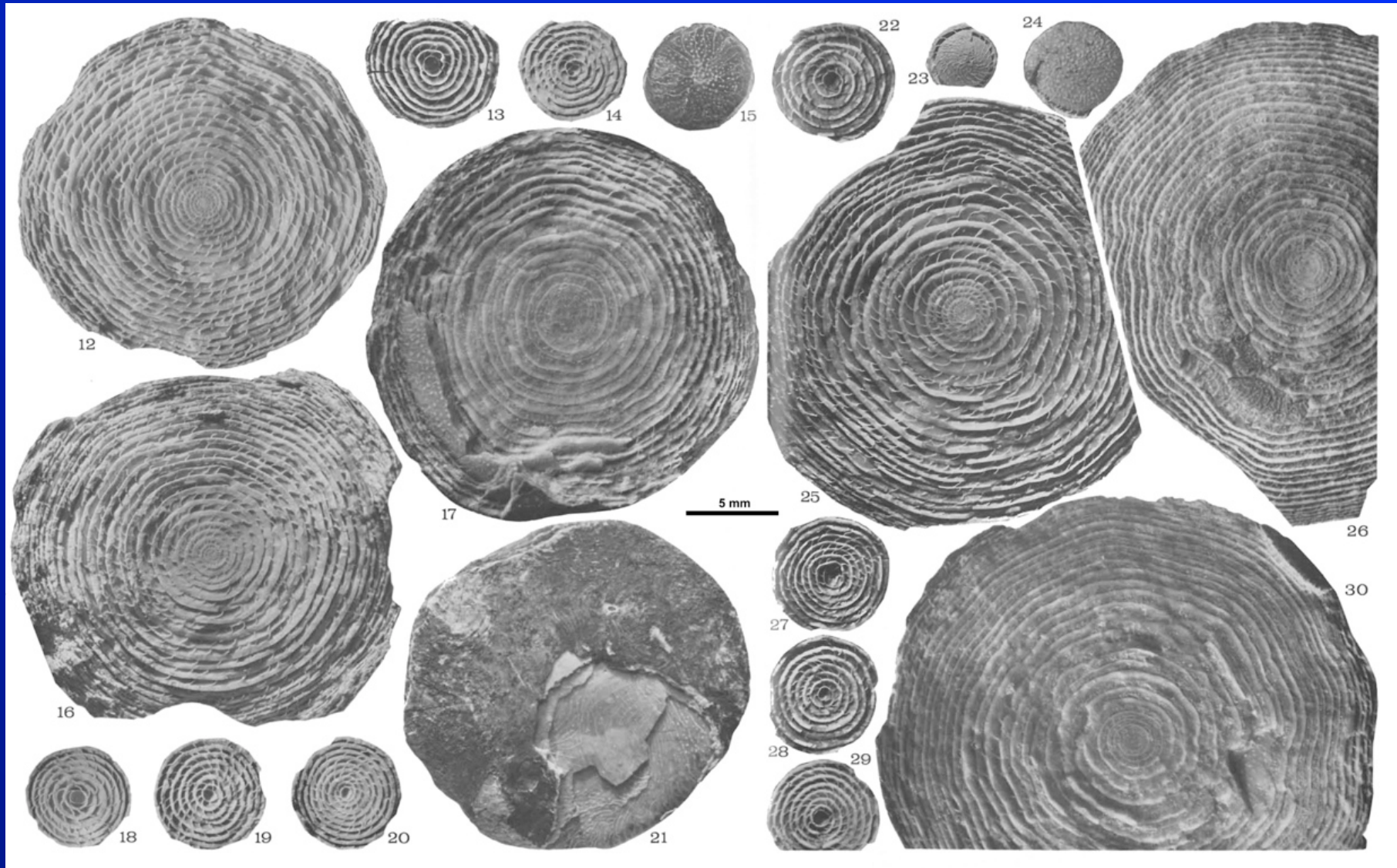
Nummulites burdigalensis
(SBZ 10)

Schaub (1981)

Systematics: just two examples



N. burdigalensis group:



Schaub (1981)

Nummulites aturicus (SBZ 16)

Systematics: just two examples



N. burdigalensis group:

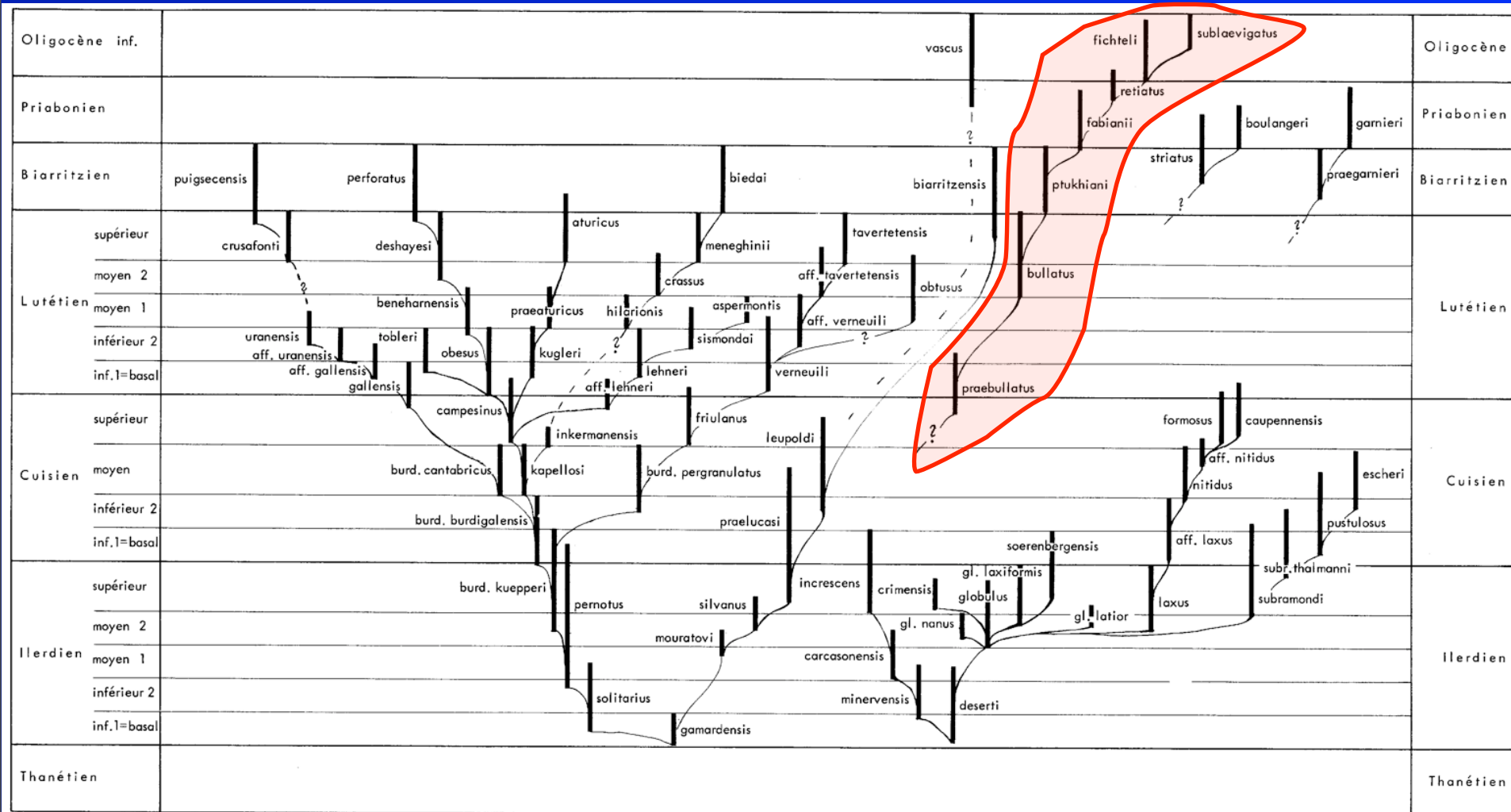


Schaub (1981)

Nummulites perforatus (SBZ 17)



N. fabianii 'phylum':



Systematics: just two examples



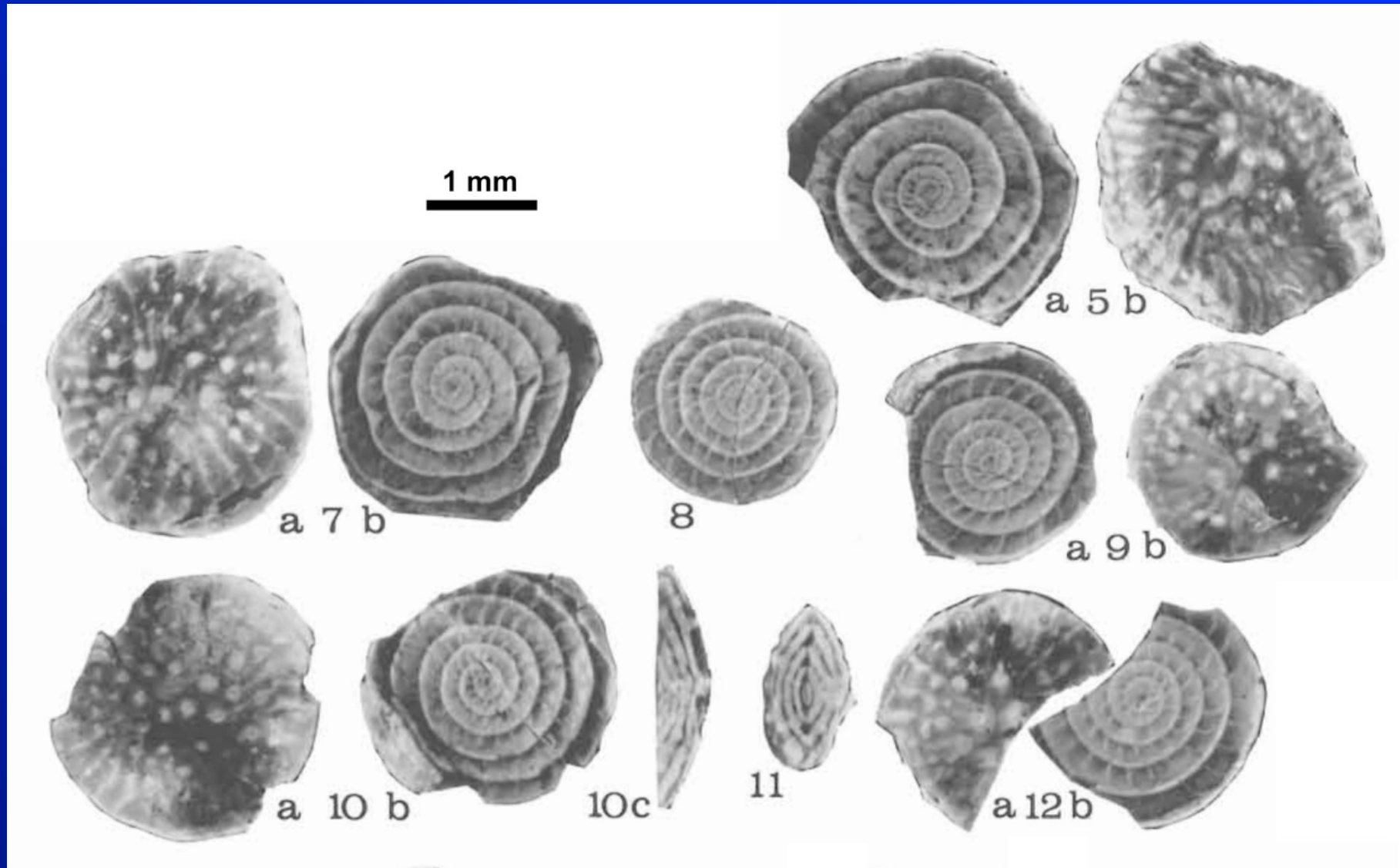
N. fabianii 'phylum':

- Test inflated to flattened
- Septal filaments radial, merging with the pillars to create a characteristic reticulated pattern
- Spire quite slowly growing towards the periphery
- Marginal cord more or less developed
- Septa usually straight or slightly curved, perpendicular or slightly inclined, chambers isometric to longer than high
- Proloculus diameter 80 to 360 μm

Systematics: just two examples



N. fabianii 'phylum':



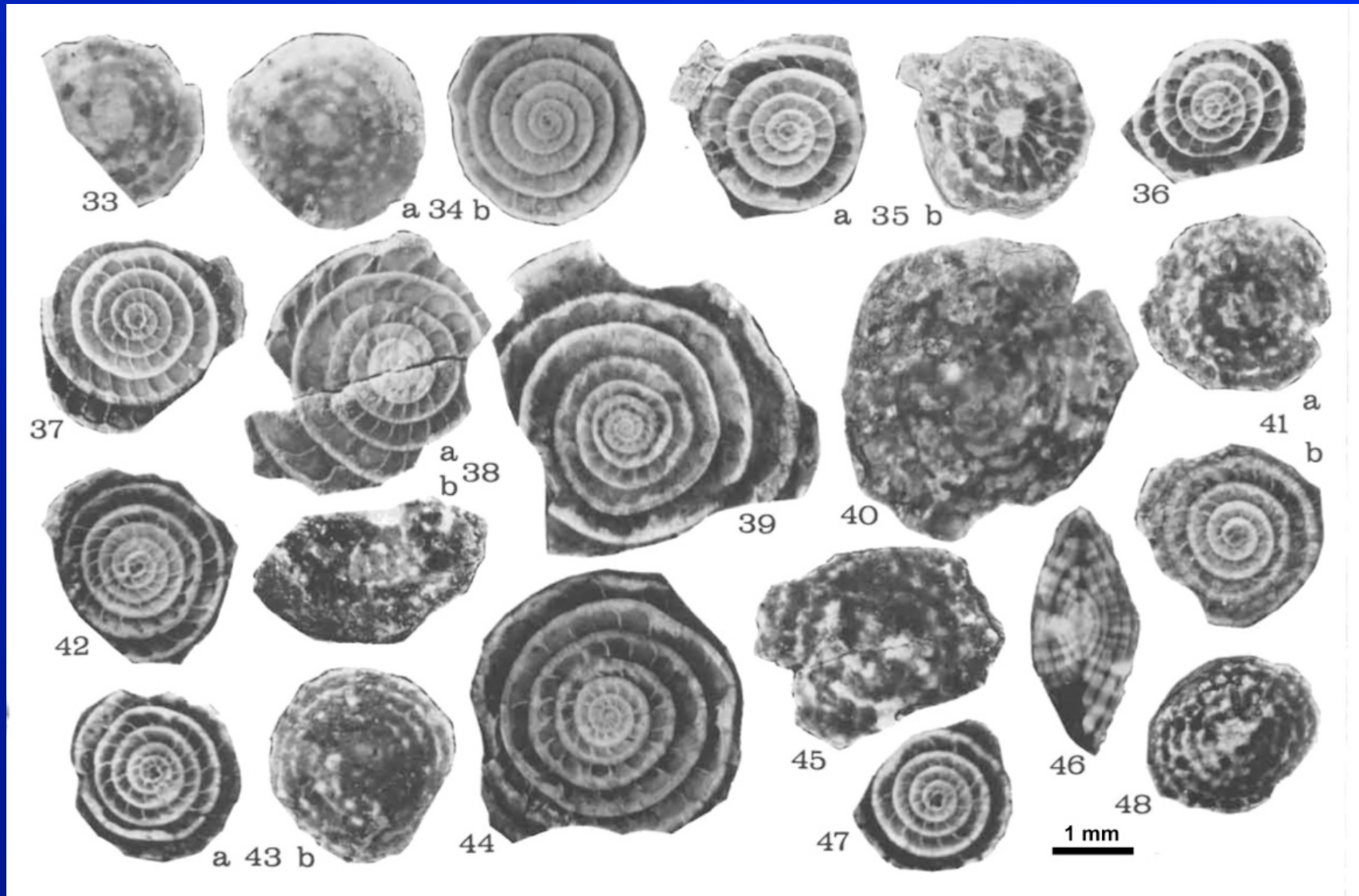
Schaub (1981)

The roots: *Nummulites bullatus* (SBZ 15-16)

Systematics: just two examples



N. fabianii 'phylum':



Schaub (1981)

Nummulites "ptukhiani" (SBZ 17-18)

Systematics: just two examples



N. fabianii 'phylum':

*Nummulites
fabianii*
(SBZ 19-20)

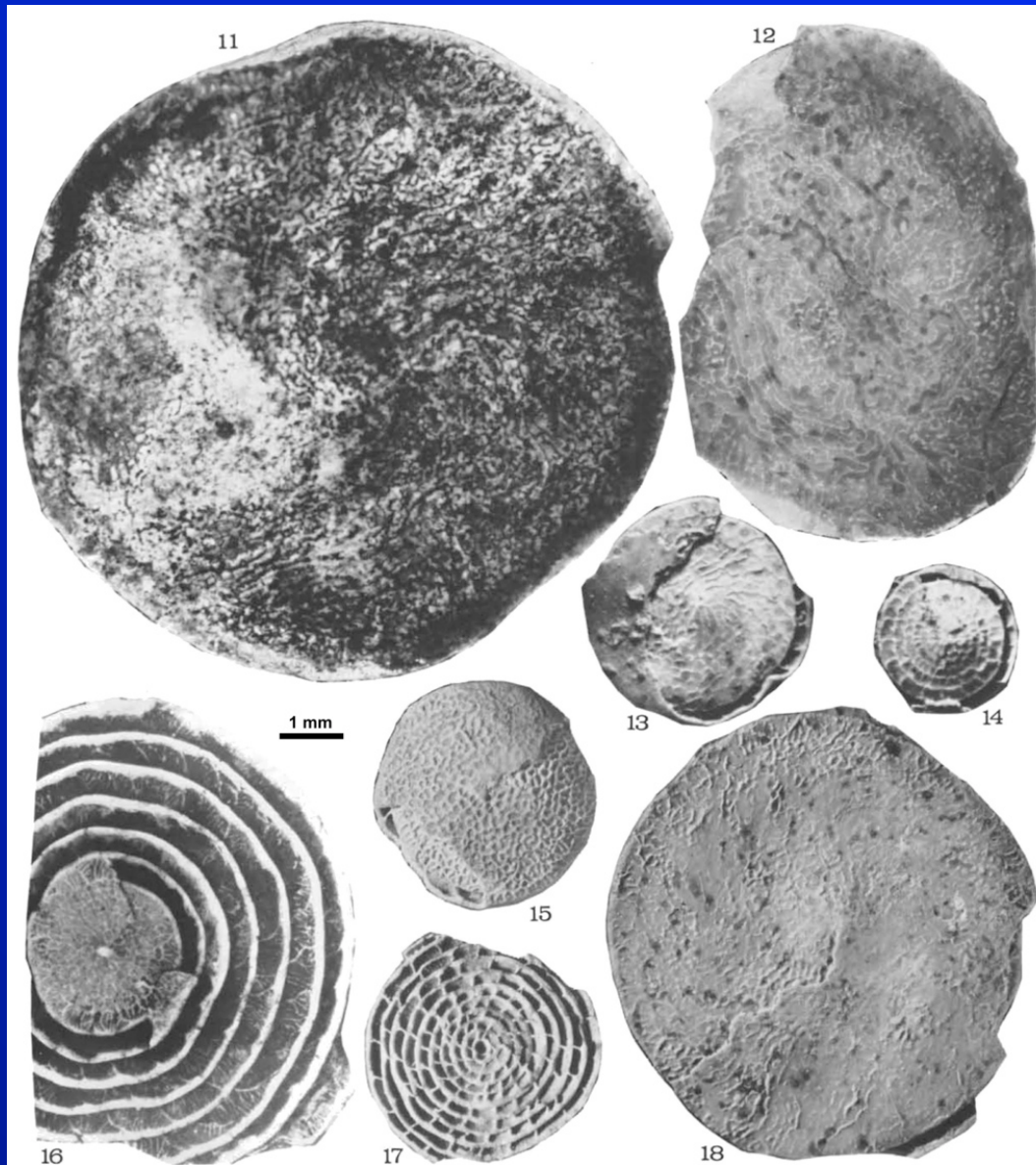


Schaub (1981)

Systematics: just two examples



N. fabianii 'phylum':



Nummulites fichteli
(SBZ 21-23)

Schaub (1981)



B) ORTHOPHRAGMINIDS

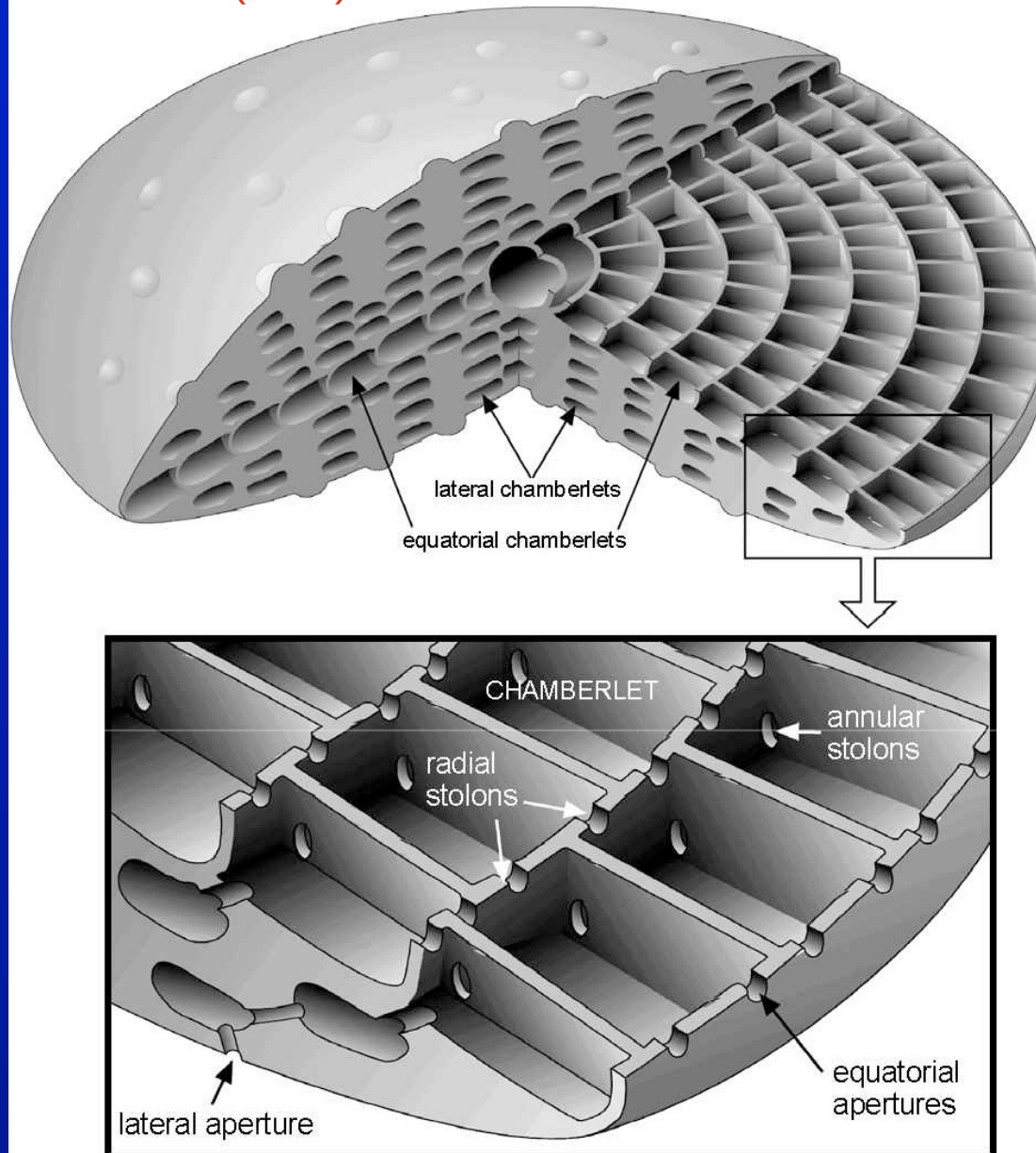
- Orthophragminids: architecture of the test
- Fundamentals: Less (1987) monograph
- Taxonomically significant characters
- Systematics: 3 genera and 2 morphotypes

Orthophragminids: architecture of the test



ORTHOPHRAGMINID

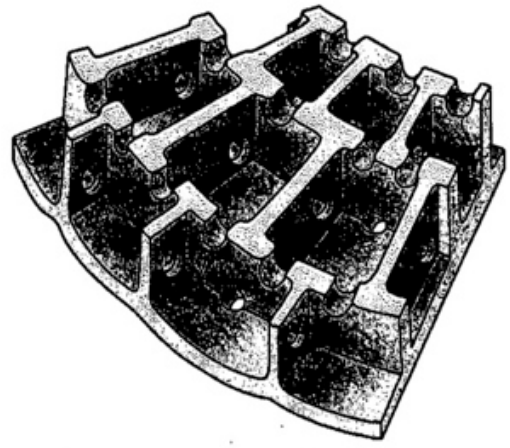
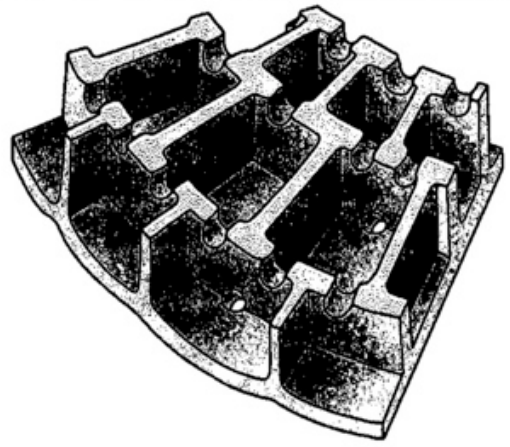
Ferrández (2002)



Orthophragminids: architecture of the test



Family **Discocyclinidae** Galloway, 1928

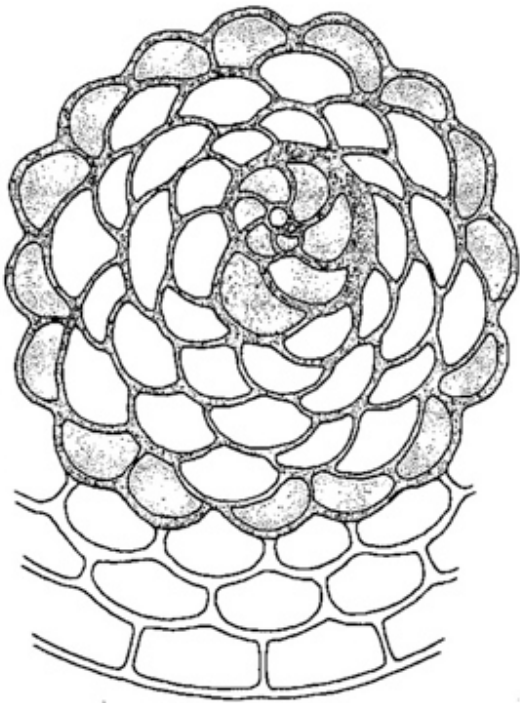
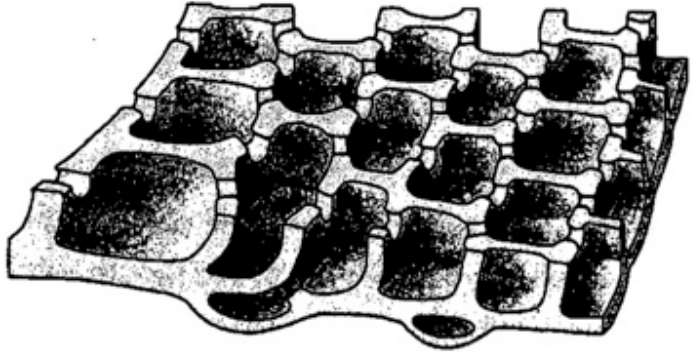
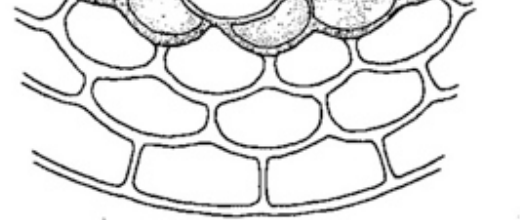
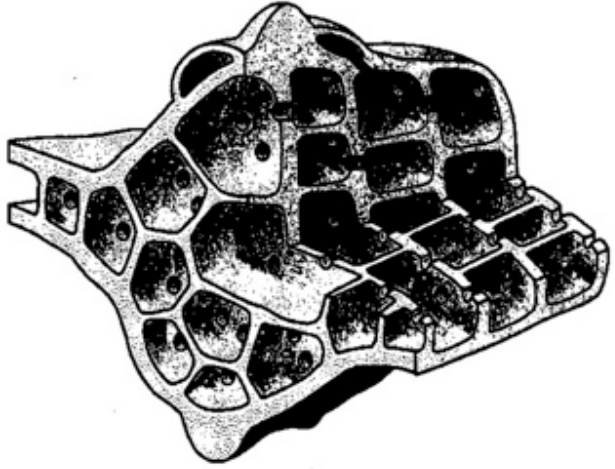
FAMILY	GENUS	MICROSPHERIC NEPIONT	EQUATORIAL CHAMBERLETS / STOLON SYSTEM
DISCOCYCLINIDAE	<i>Discocyclina</i>		 Radial, annular, and oblique stolons
	<i>Nemkovella</i>	Spiral simple chambers ↓ Subdivided falciform chambers	 Radial, and oblique stolons. No annular stolons

Ferràndez (1998)

Orthophragminids: architecture of the test



Family **Orbitoclypeidae** Brönnimann, 1945

ORBITOCLYPEIDAE	<i>Orbitoclypeus</i>		
	<i>Asterocyclina</i>	Spiral chambers with stellar structure ↓ Isolated chamberlets (orbitoidal growth) 	 Radial, and oblique stolon. No annular stolons Equatorial layer axially subdivided within ribs.

Ferràndez (1998)



geologica hungarica

FASCICULI INSTITUTI GEOLOGICI HUNGARIAE
AD ILLUSTRANDAM NOTIONEM GEOLOGICAM
ET PALAEONTOLOGICAM

SERIES PALAEONTOLOGICA

FASCICULUS 51

INSTITUTUM GEOLOGICUM HUNGARICUM
BUDAPESTINI, DECEMBER, 1987



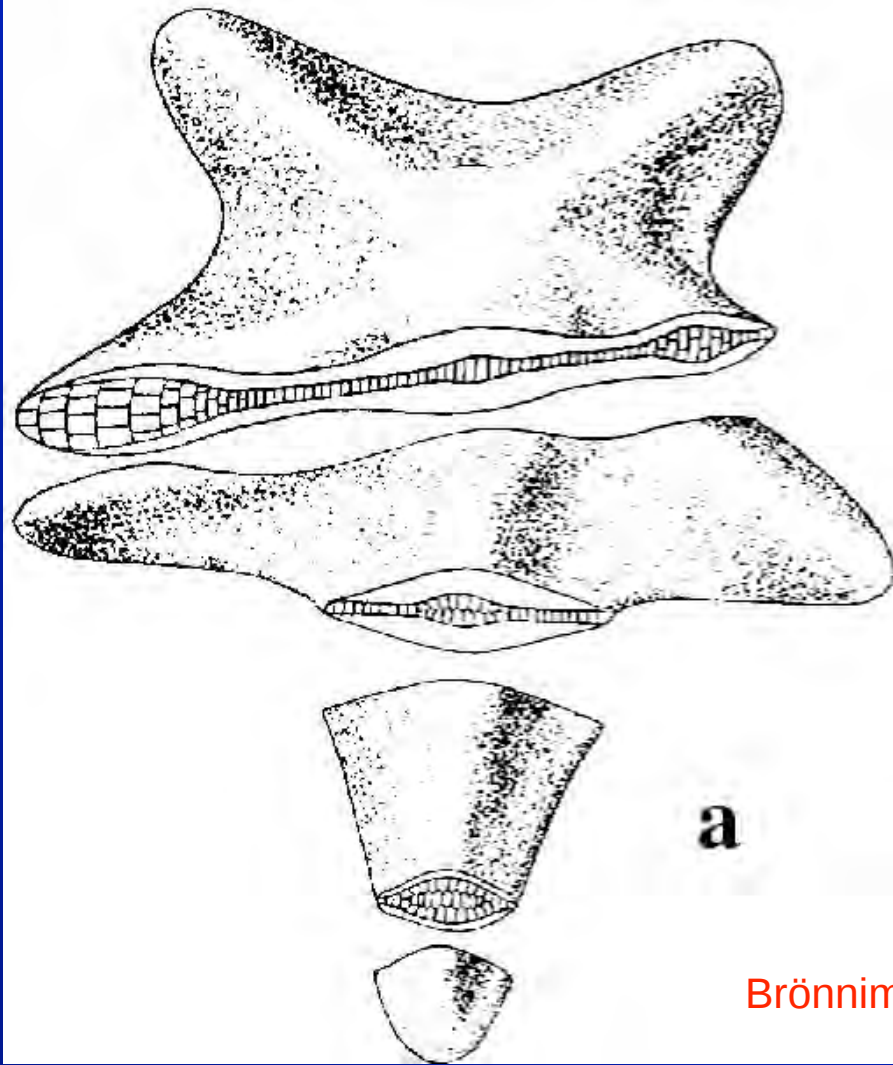
Nyugat-Aquitánia	37
Gan — GA populáció	37
Le Porge — LP populáció	38
Horsarrieu — HX populáció	38
Saint-Barthélémy — SB populáció	39
Caupenne — JG populáció	39
Couches de Nousse (Gibret — GN populáció és Nousse — NC populáció)	39
Montfort — FM populáció	40
Angoumé — AM populáció	40
Cauneille — CM populáció	40
Siest — SO populáció	41
Az eurázsiai Orthophragminák rétegtana	42
Az Orthophragminák paleobiogeográfiája	46
Néhány megjegyzés az Orthophragminák ökológiájához	47
Irodalom	254
A taxonnevek betűrendes mutatója	260
Az Orthophragmina-populációk vizsgálati eredményei	264
A belső szerkezeti ábrázolt Orthophragmina-egyedek méretei	274
Fényképtáblák	283

Introduction	51
The history of Orthophragmina research	53
Morphology of Orthophragminae	55
The juvenarium of forms "B"	56
The juvenarium of forms "B" of Discoeyclinidae	56
The juvenarium of forms "B" of Asteroeyclinidae	57
The megalospheric (A) embryo	58
Chambers around the embryo (auxiliary chambers)	62
The equatorial chambers	64
The stolon system of the chambers	64
The shape of cycles (s.c.)	65
The growth pattern of the annuli (g.p.)	66
The shape of the equatorial chambers	67
The equatorial layer in the axial section	67
The axial section of the embryo	67
The equatorial chambers in the axial section	68
Lateral chambers and pillars	68
Lateral chambers and pillars in the axial section	69
Lateral chamber-network and pillars on the test surface (rosette)	69
The test shape (habitus)	70
Taxonomic division of Orthophragminae and their determination	72
The system of Orthophragmina families and genera	72
The relations of Orthophragminae	73
The main features of the evolution of the Eurasian Orthophragminae	75
The determination of Eurasian Orthophragminae	76
Strategy of the investigation of Orthophragminae	84
The method of preparation	84
The method of photographing	84
The localities of the examined samples	86
Crimean peninsula	86
Bakhchisarai stage (populations OS, CR, CP, PA, PF and partially population NA)	86
Simferopolian stage (partially the population NA and the populations NF, DA, DF and PO)	89
Bodrakian stage (BO population)	89
Bulgaria (Dikilitash — DK population)	91
Hungary	91
Western Gerecse	91
Dunaszentmiklós (population DM)	92
Neszmély (population NT)	92
Southern Bakony Mts (the vicinity of Ajka — population AJ)	94

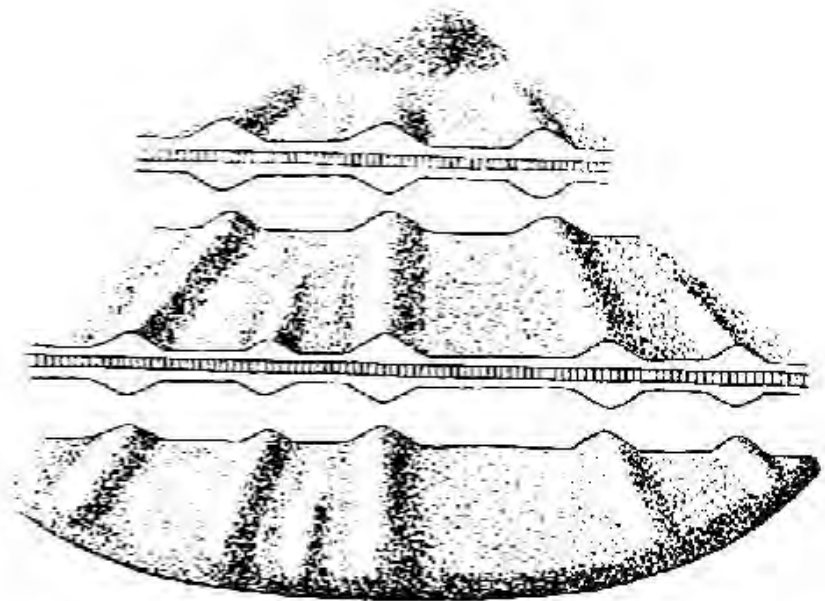
Taxonomically significant characters



External: test shape



a



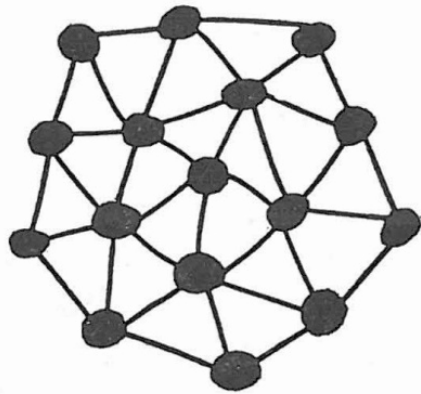
b

Brönnimann (1945)

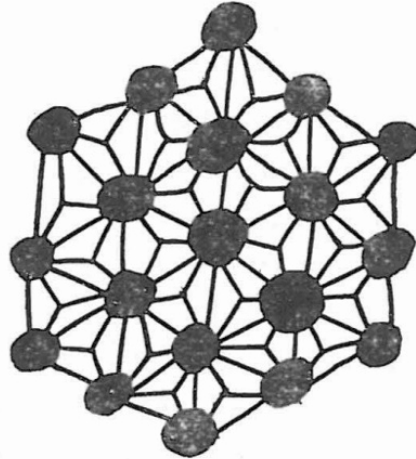
Taxonomically significant characters



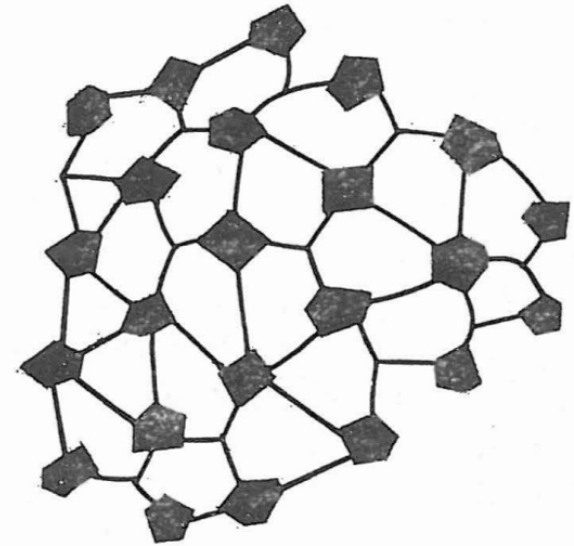
External: surface ornamentation (the “rosette”)



„*Discocyclina*”



„*marthae*”



„*chudeaui*”

15. ábra. Az Orthophragminák főbb rozetta típusai

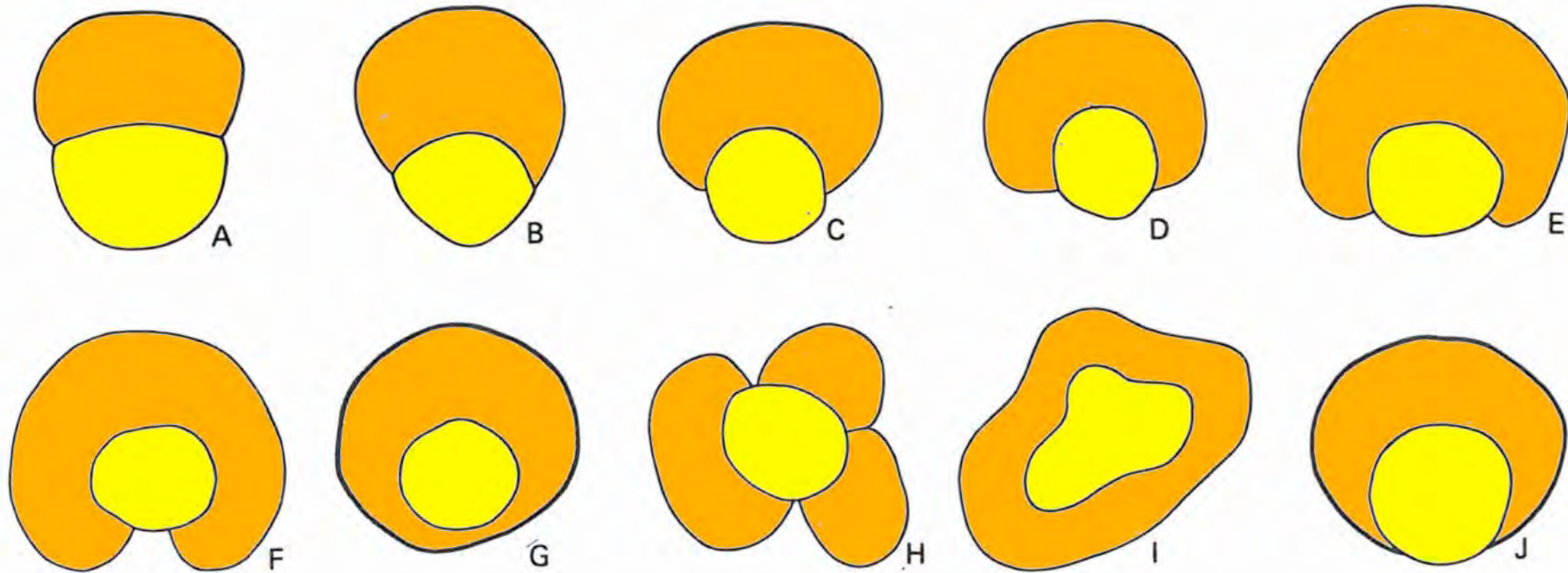
Fig. 15. Main rosette types of Orthophragminae

Less (1987)

Taxonomically significant characters



Equatorial section: Embryo type



5. ábra. Az Orthophragminák A-generációinak különböző típusú embriói

A = isolepidin, B = semi-isolepidin, C = nephrolepidin, D = semi-nephrolepidin, E = trybliolepidin, F = umbilicolepidin, G = excentrilepidin, H = polylepidin, I = centrilepidin, J = eulepidin

Fig. 5. Various embryo types of the "A" generation Orthophragminae

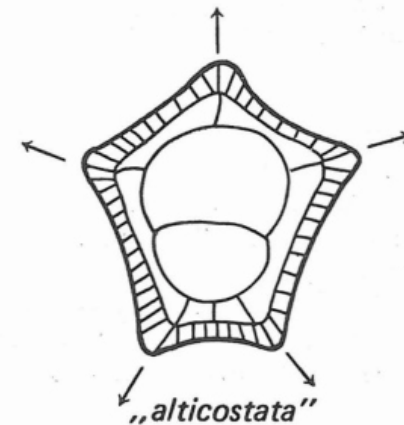
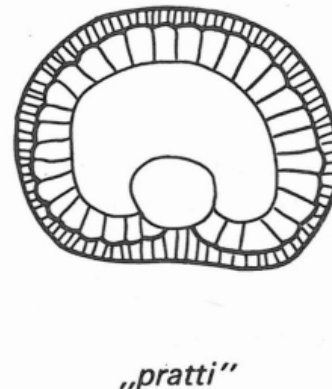
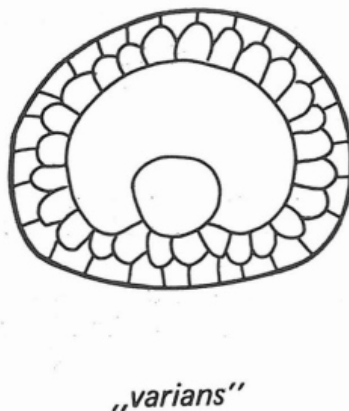
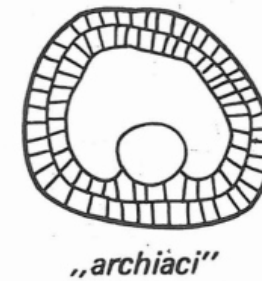
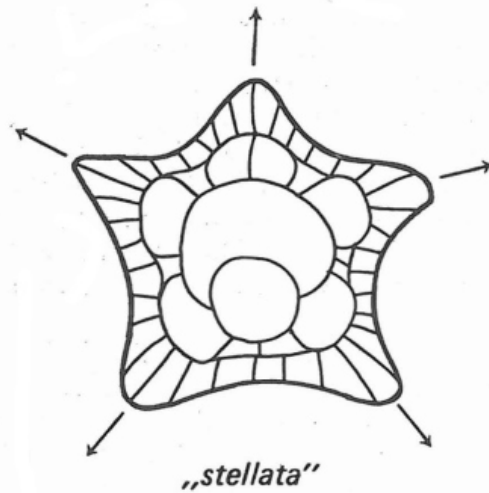
A = isolepidine, B = semi-isolepidine, C = nephrolepidine, D = semi-nephrolepidine, E = trybliolepidine, F = umbilicolepidine, G = excentrilepidine, H = polylepidine, I = centrilepidine, J = eulepidine

Taxonomically significant characters



Equatorial section: **Adauxiliary chambers**

Less (1987)



8. ábra. Az Orthophragminák A-generációinak különböző típusú adauxiliáris kamrái

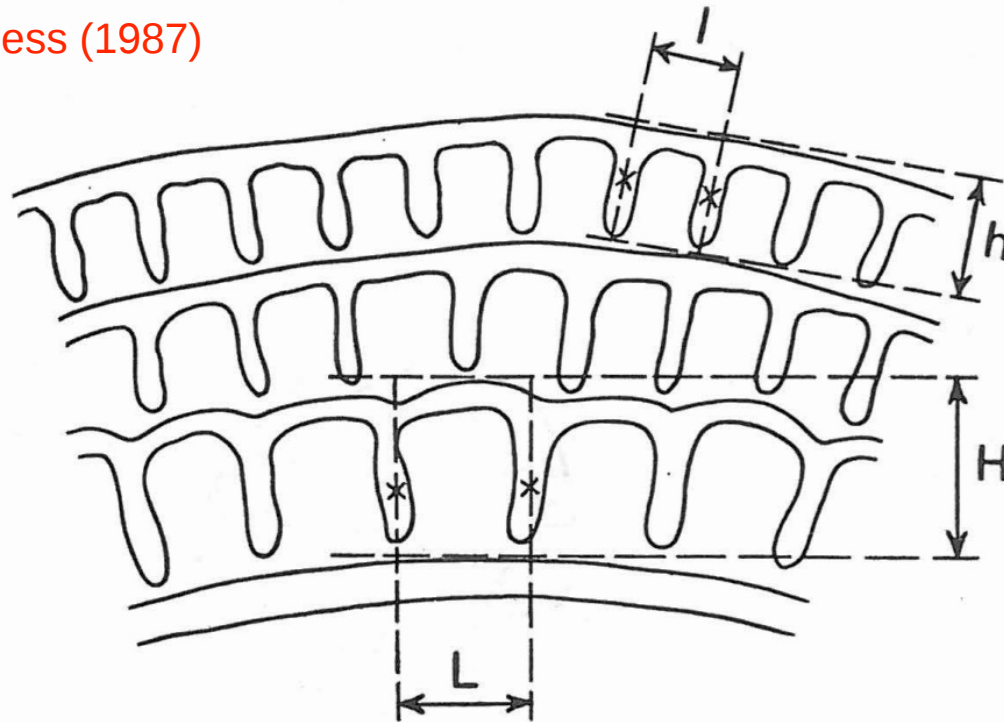
Fig. 8. Various type adauxiliary chambers of “A” generation Orthophragminae

Taxonomically significant characters



Equatorial section: chambers height and width

Less (1987)



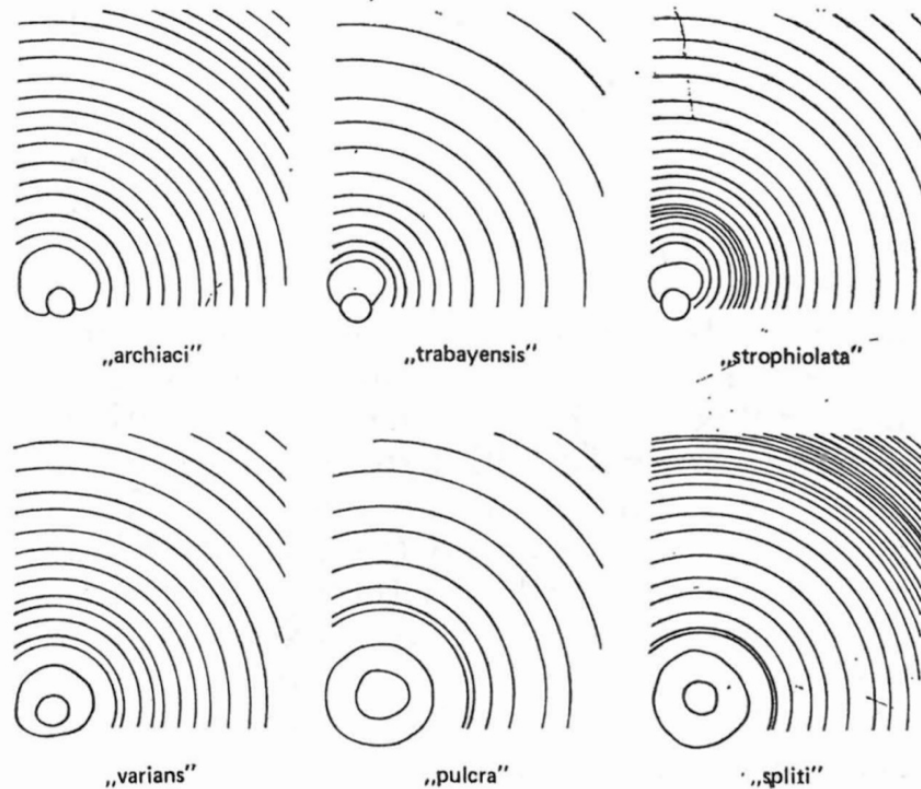
9. ábra. Az adauxiliáris és equatoriális kamrák szélességének (L és l) illetve magasságának (H és h) mérési metodikája

Fig. 9. Mensuration method of the width (L , l) and height (H , h) of the adauxiliary and equatorial chambers respectively

Taxonomically significant characters

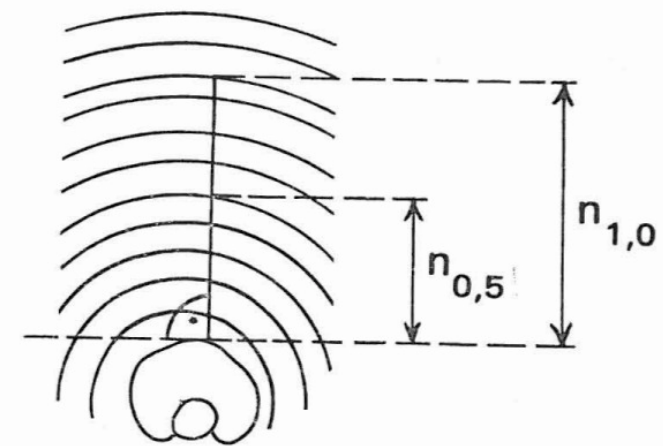


Equatorial section: annuli growth pattern



12. ábra. Az equatoriális kamrák ciklusai növekedési jellegének (g. p.) különböző típusai az Orthophragmináknál

Fig. 12. Various type growth patterns (g. p.) of the annuli in the case of Orthophragminae



13. ábra. Az embrió szélétől számított 0,5 illetve 1,0 mm-re eső equatoriális kamraciklus-szám ($n_{0,5}$ ill. $n_{1,0}$) mérése

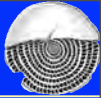
Fig. 13. Determination of the number of annuli within a 0.5 mm wide and a 1.0 mm wide stripe ($n_{0.5}$ and $n_{1.0}$ respectively) measured from the edge of the embryo

Taxonomically significant characters



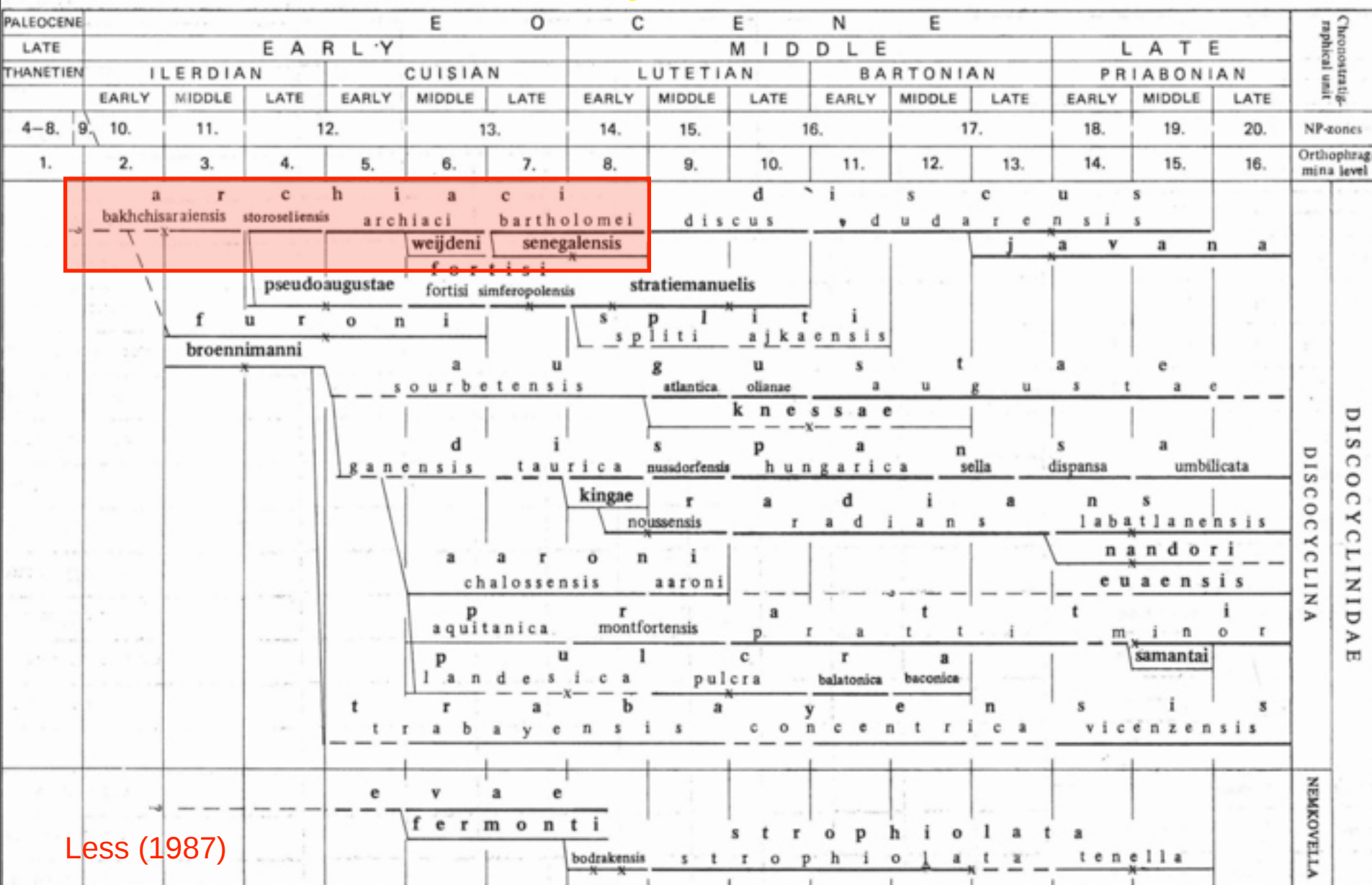
Az Orthophragminák határozótáblázata
Table for the determination of Orthophragminae

Taxa			Shape and sur- face of the test	Type of the rosette	The equatorial section of the forms "A"									
					The embryo			The adauxiliary chambers			The equatorial chambers			
					Charac- teristic type	$\bar{P}$ (μm)	$\bar{D}$ (μm)	Charac- teristic type	Number ($\bar{N}$)	$\bar{H}$ (μm)	Charac- teristic width (1-in μm)	The cycles		$\bar{n}_{0.5}$
									Shape (s.c.)	Growth pattern (g.p.)				
Discoyclina	archiaci	bakhchisaraiensis	d	D	q (n)	125—165	220—280	a	19—25.5	45—65	35—45	k	a	10.5—13.0
		staroseliensis	d	D	q (t)	155—185	280—350	a	23—28	50—60	35—40	k	a	10.0—11.0
		archiaci	d	D	t (q)	180—240	350—500	a	26—36	55—72	35—45	k	a	8.0—10.5
		bartholomei	d	D	t	230—450	500—900	a	35—55	55—90	35—45	k	a	7.0—9.5
	furoni		d	D	q	105—155	180—300	a	16—24	40—55	30—40	k	a	10.0—13.0
	discus	discus	d	D	u	470—600	900—1200	a—p	65—95	100—135	35—45	k	a (p)	5.0—5.8
		dudarensis	d	D	u—x	510—750	1200—1950	p (a)	78—95	100—165	35—50	k	p (a)	4.5—5.8
	weijdeni		d	D	t (q)	220—290	400—520	a (p)	40—48	80—90	25—35	k	a (p)	6.5—7.5
	senegalensis		d	D	t—q	225—415	500—730	p	29—35	60—78	35—45	k	p (t)	6.3—10.0
	javana		d	D	p	420—650	930—1400	p	55—90	125—180	35—40	k	p	4.0—5.5
	pseudoaugustae		d	D	p	220—350	460—670	a	35—50	55—70	35—45	k	a	8.0—9.5
	fortisi	fortisi	d	D	c	290—450	600—800	a	50—65	70—95	40—45	k	a	5.5—8.5
		simferopolensis	d	D	c	400—500	800—950	a (p)	55—77	78—90	35—50	k	a	6.5—8.0
	stratiemanuelis		d	D	c	420—620	870—1150	p (a)	53—80	70—200	35—50	k	p (a)	4.7—7.5
	spliti	spliti	d	D	c	350—450	800—1200	a—p	50—70	80—100	35—45	k	y	6.0—7.5
		ajkaensis	d	D	c	500—650	1200—1440	p (a)	80—90	115—150	35—45	k	y	5.8—6.6
	broennimanni		d	D	n (s)	55—80	90—130	a	8—13	27—45	20—30	k	t	13.0—16.0
	augustae	sourbetensis	d	D	n—s	60—90	90—125	a	7—11.5	25—40	25—30	k	t—s	12.0—18.0
		atlantica	d	D	n (q)	70—107	125—160	a	11—15.5	30—40	25—30	k	s (t)	12.5—16.5
		olianae	d	D	q (n)	90—115	160—200	a	15—20	35—50	25—30	k	s	12.0—16.0
		augustae	d	D	q (n)	100—130	200—250	a	18—25	33—60	25—30	k	s (p)	11.0—15.0
	knessae		b	D	n	60—90	115—180	a	12—16	32—50	20—25	k	t—s	12.0—15.0



Systematics: 3 genera and 2 morphotypes

Discoidal *Discocyclina*: *D. archiaci* line:



Systematics: 3 genera and 2 morphotypes



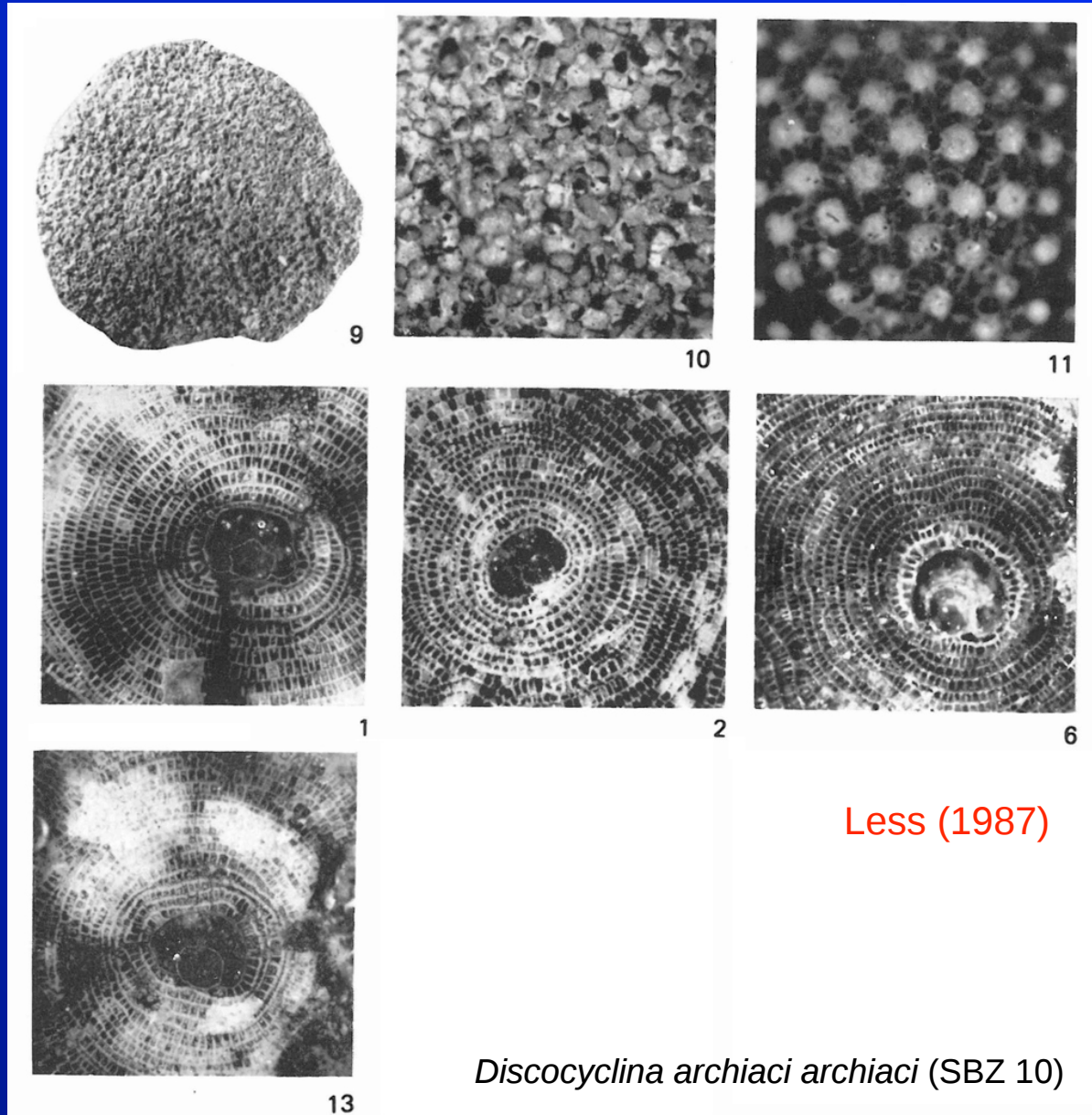
Discoidal *Discocyclina*: *D. archiaci* line:

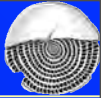
- Middle-sized to large, flattened, with usually distinct umbo, frequently saddle-shaped
- “Discocyclina” type rosette
- Trybliolepidine to semi-nephro and umbilicolepidine embryo
- Aduaxiliary chambers of the “archiaci” type
- Growth pattern of “archiaci” type
- Diameter of protoconch 125 to 450 μm , deuteroconch 220 to 900 μm

Systematics: 3 genera and 2 morphotypes



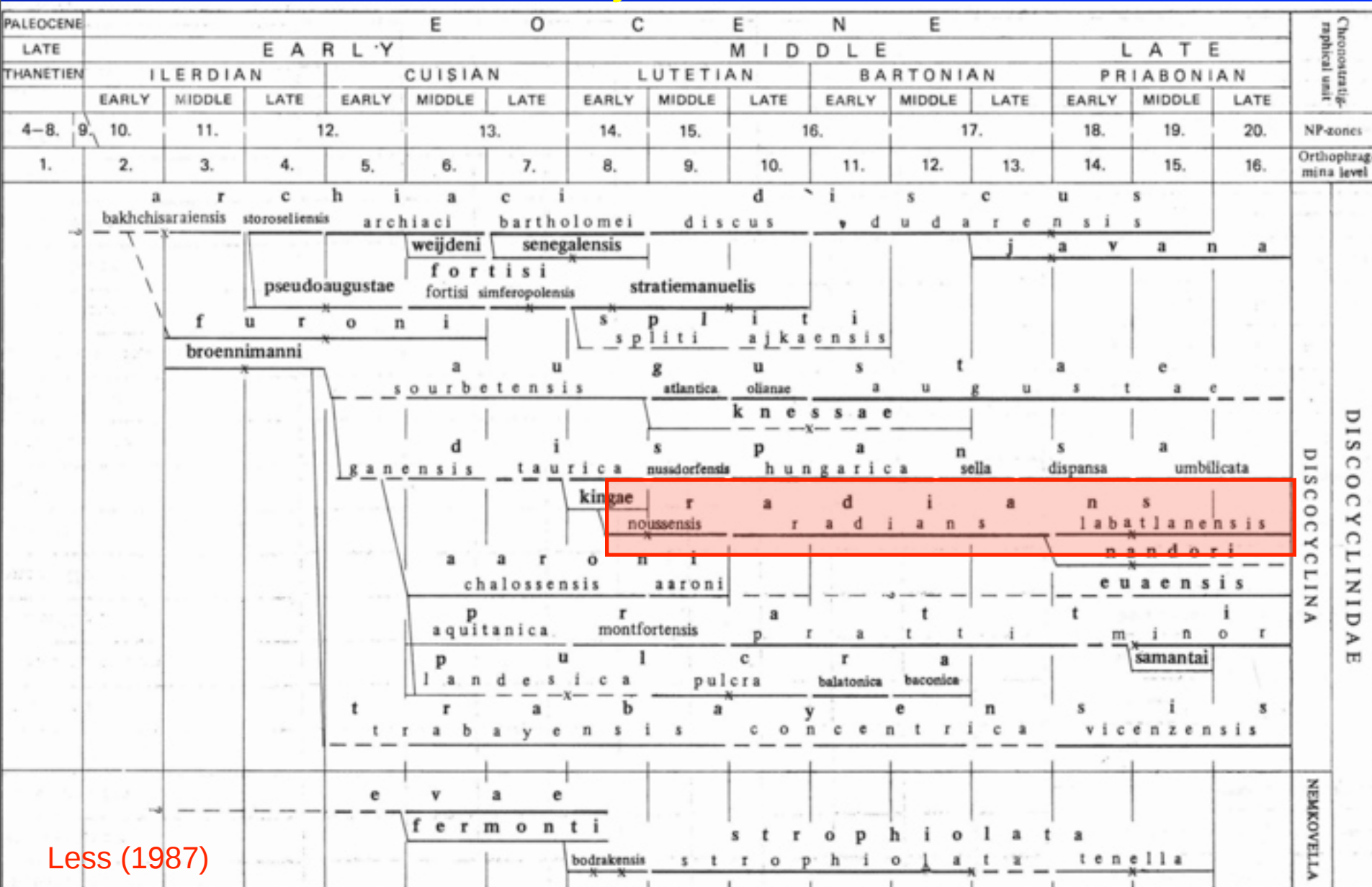
Discoidal *Discocyclus*: *D. archiaci* line:





Systematics: 3 genera and 2 morphotypes

Ribbed *Discocyclina*: *D. radians* line:



Less (1987)

Systematics: 3 genera and 2 morphotypes



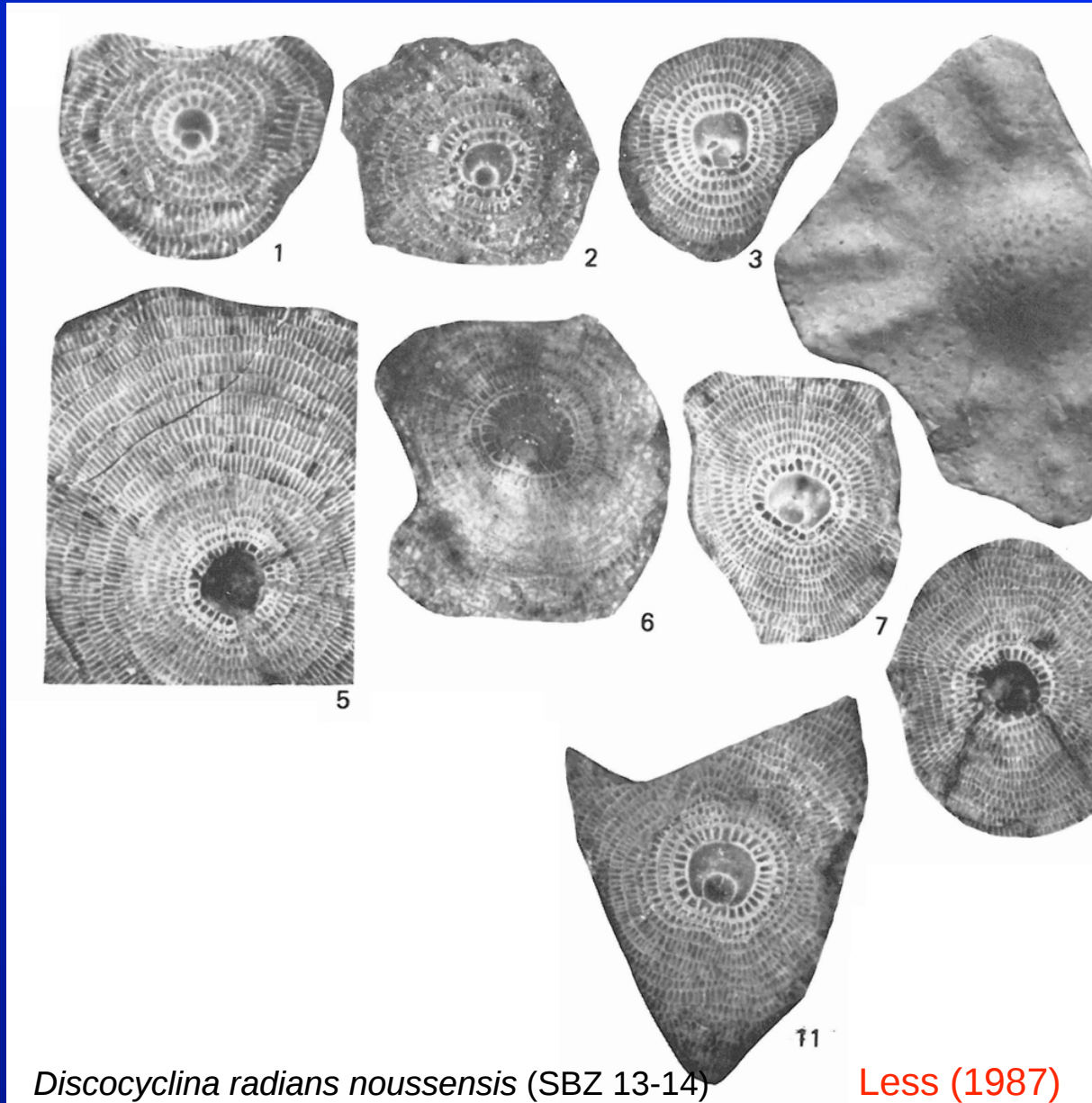
Ribbed *Discocyclina*: *D. radians* line:

- Medium to large-sized, ribbed forms, with usually 12 to 16 radial ribs
- “Discocyclina” type rosette
- Trybliolepidine to semi-nephrolepidine embryo
- Adauxiliary chambers of the “pratti” type, with characteristically thick walls
- Growth pattern of “pulcra” type
- Diameter of protoconch 100 to 285 μm , deuteroconch 175 to 540 μm

Systematics: 3 genera and 2 morphotypes

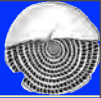


Ribbed *Discocyclusina*: *D. radians* line:



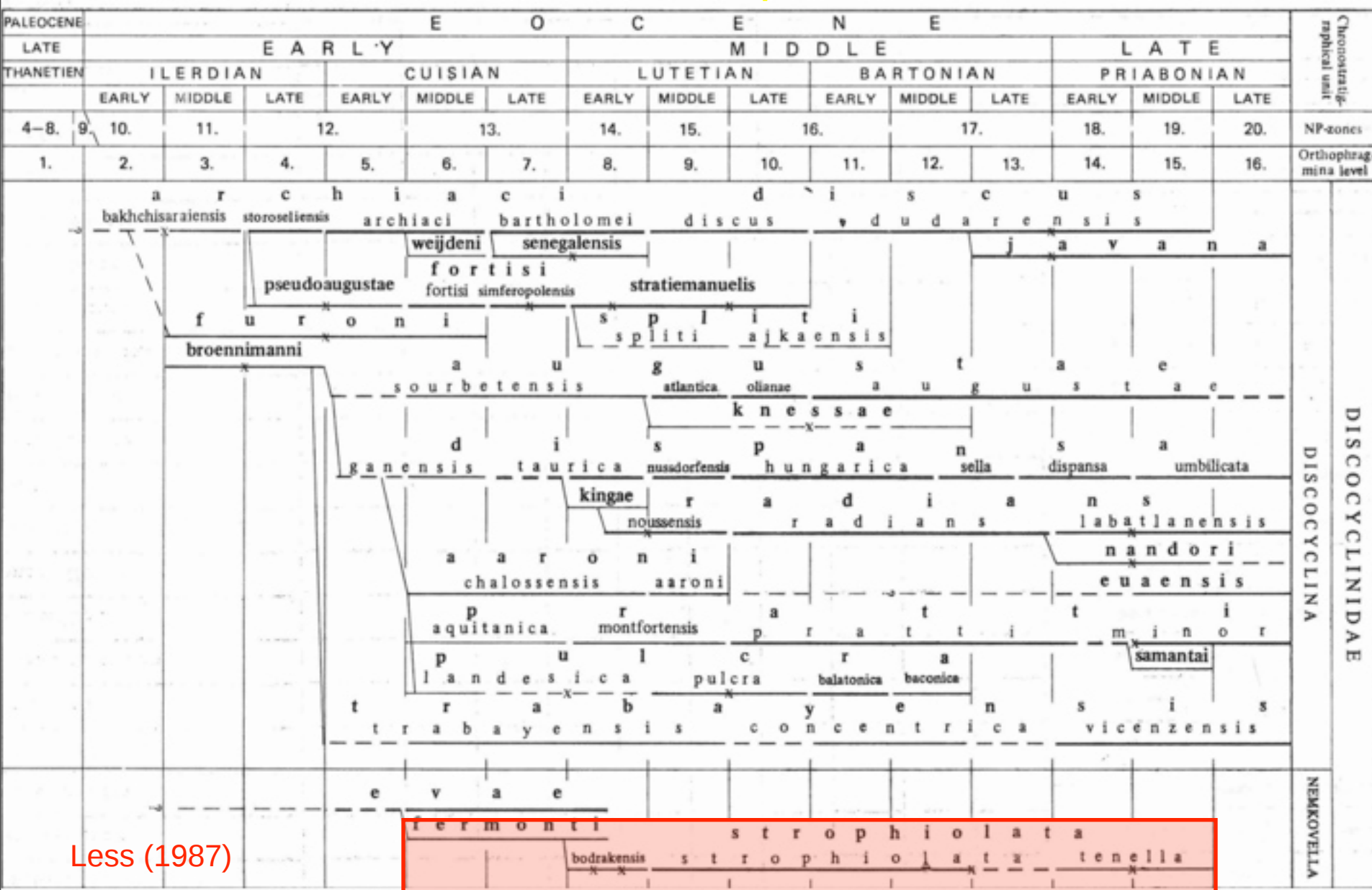
Discocyclusina radians noussensis (SBZ 13-14)

Less (1987)



Systematics: 3 genera and 2 morphotypes

Nemkovella: *N. strophiolata* line:



Less (1987)

Systematics: 3 genera and 2 morphotypes



Nemkovella: *N. strophiolata* line:

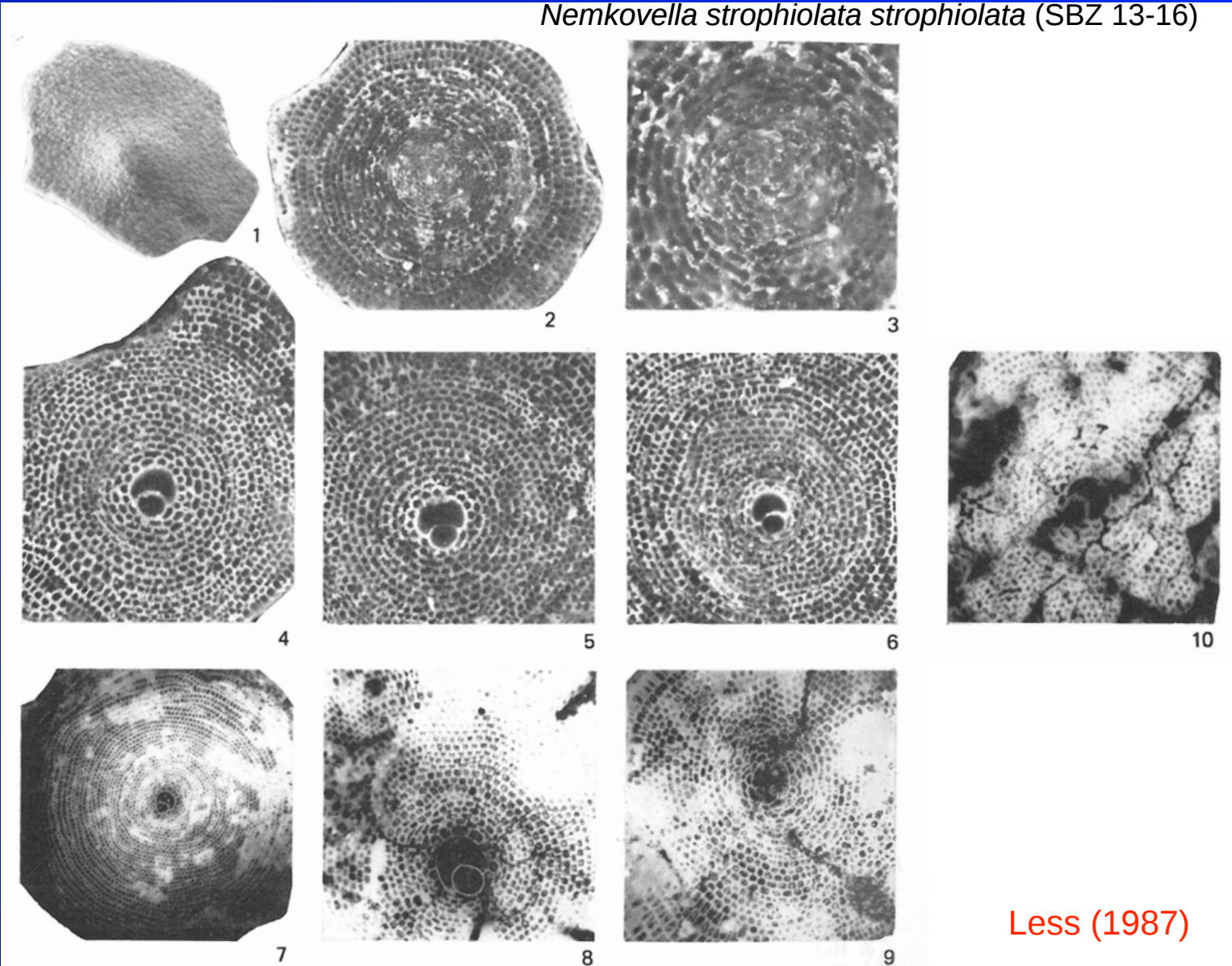
- Small-sized, flattened forms
- “Discocyclus-chudeaui” type rosette
- Nephro- to semi-isolepidine embryo
- Auxiliary chambers of the “varians” type, wide and low
- Growth pattern of “strophiolata” type
- Diameter of protoconch 45 to 160 μm , deutoconch 65 to 250 μm

Systematics: 3 genera and 2 morphotypes



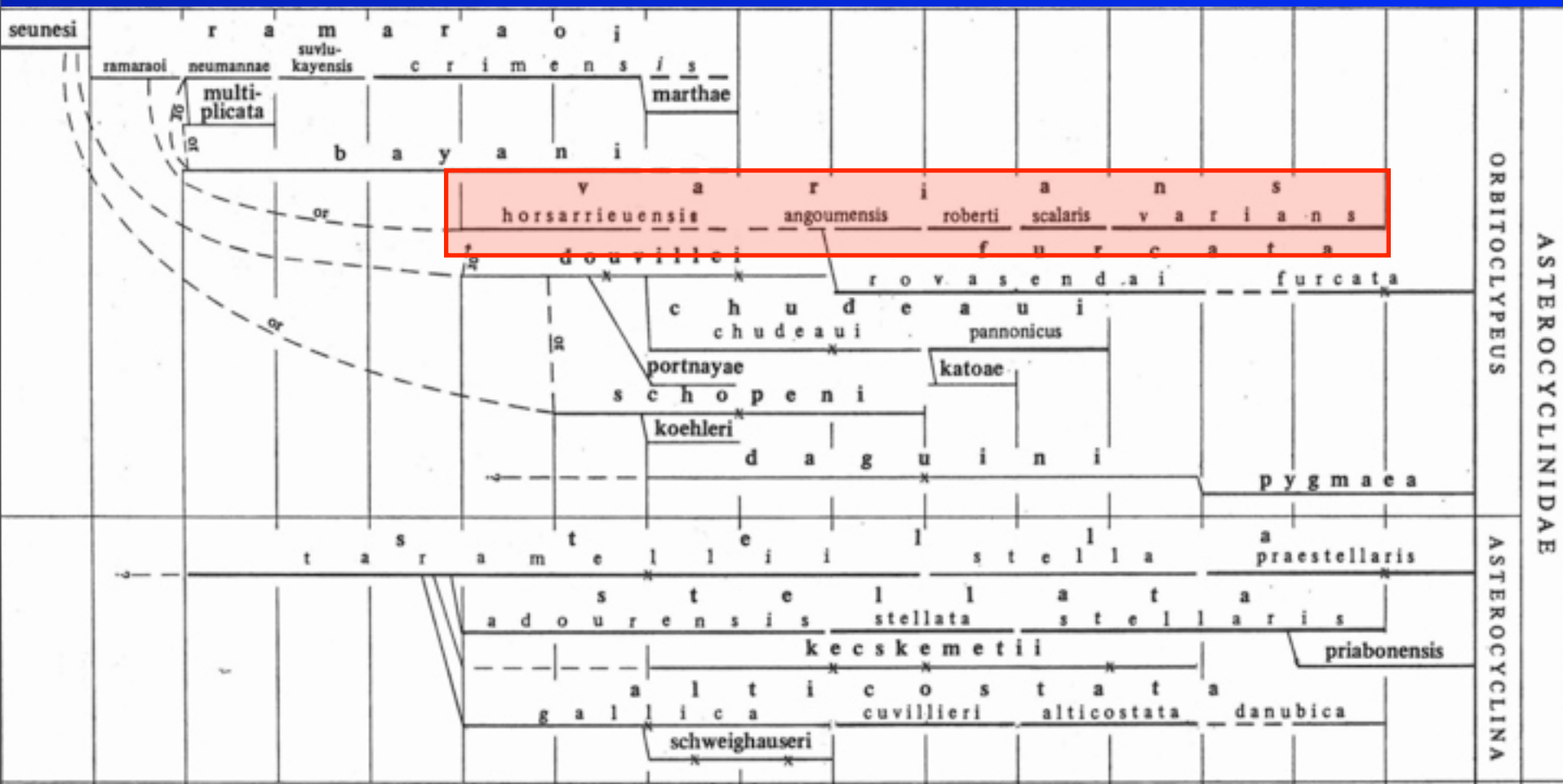
Nemkovella: *N. strophiolata* line:

Nemkovella strophiolata strophiolata (SBZ 13-16)



Less (1987)

ASTEROCYCLINIDAE	A
ORBITOCLYPEUS	A



Less (1987)

Systematics: 3 genera and 2 morphotypes



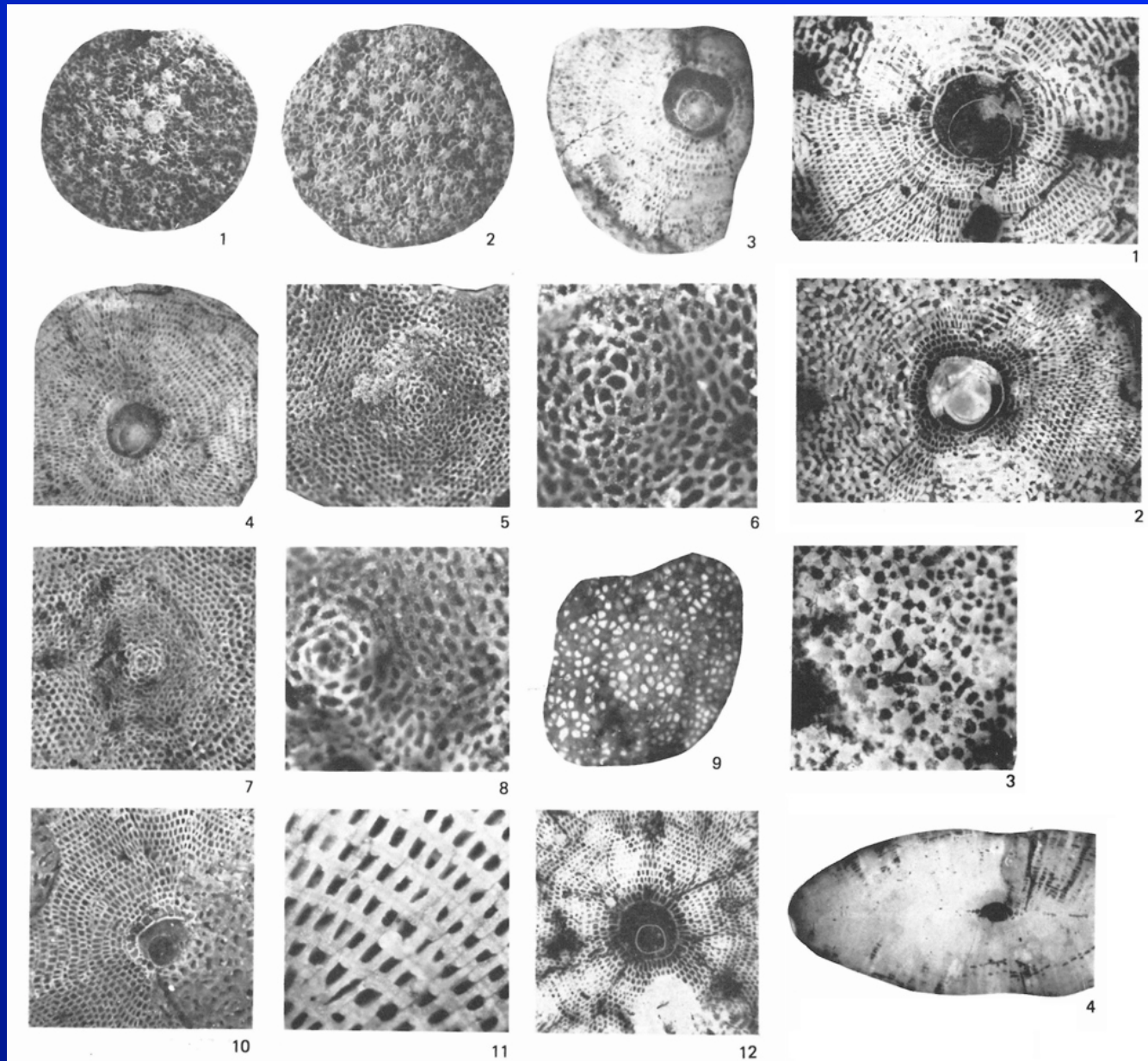
Orbitoclypeus: *O. varians* line:

- Small to medium-sized, more or less inflated forms
- “Marthae” type rosette
- Excentri- to eulepidine embryo
- Aduaxiliary chambers of the “varians” type
- Growth pattern of “varians” type, undulated cycles with 6 to 8 main waves
- Diameter of protoconch 75 to 300 μm , deuteroconch 140 to 580 μm

Systematics: 3 genera and 2 morphotypes



Orbitoclypeus: *O. varians* line:



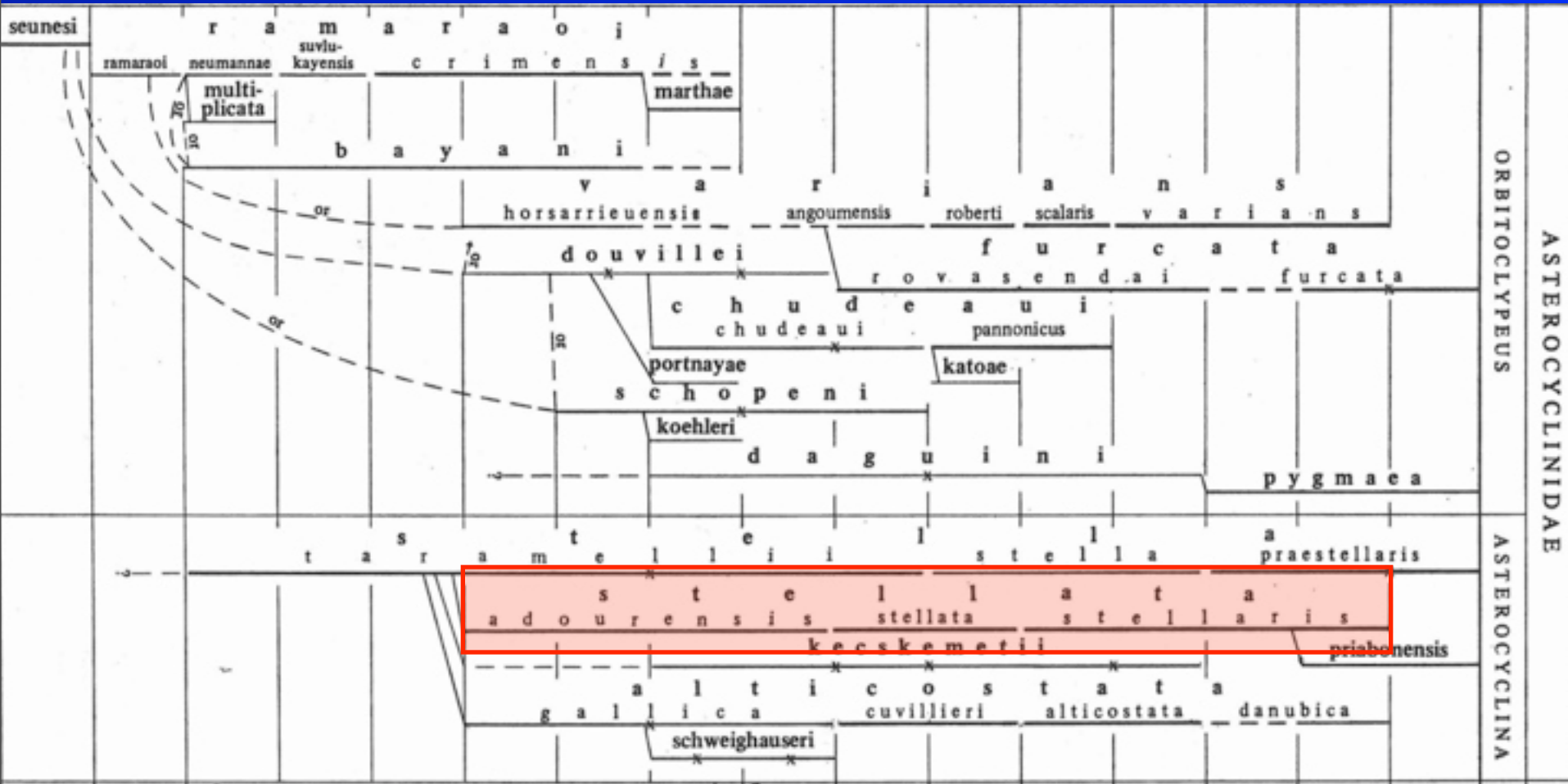
Less (1987)

Orbitoclypeus
variens variens
(SBZ 18-20)

Systematics: 3 genera and 2 morphotypes



Asterocyclina: *A. stellata* line:



Less (1987)

Systematics: 3 genera and 2 morphotypes



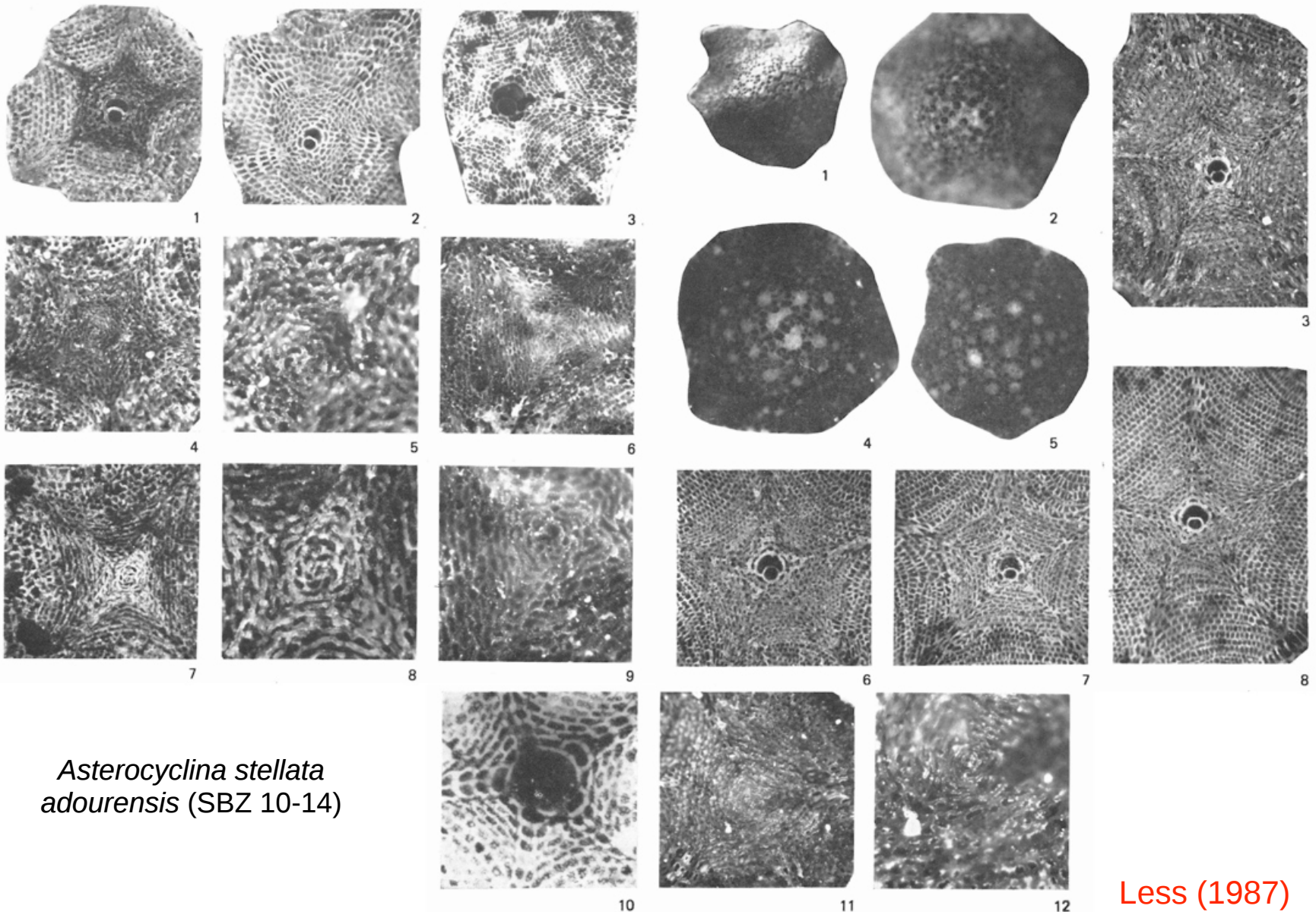
Asterocyclina: *A. stellata* line:

- Small-sized, mostly inflated, asteroidal forms with 5 (rarely 6) rays
- “Marthae” type rosette
- Semi-iso- to nephrolepidine embryo
- Adauxiliary chambers of the “varians” type, tending to the “stellata” type
- Asteroidal cycles with 5 (rarely 6) rays
- Diameter of protoconch 60 to 220 μm , deuteroconch 90 to 300 μm

Systematics: 3 genera and 2 morphotypes



Asterocyclina: *A. stellata* line:



Less (1987)