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CONTRIBUTIONS TO THE KNOWLEDGE OF THE MIOCENE FORAMINIFERA FROM ROMANIA: SUPERFAMILY NODOSARIACEA (FAM. NODOSARIIDAE AND VAGINULINIDAE)

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Abstract. The present paper is an attempt for a comprehensive study on the calcareous foraminifera from the Superfamily *Nodosariacea* found by the authors in the marine Middle Miocene deposits from Romania. Their description is accompanied by illustrations, either SEM photographs or drawings. A short biostratigraphical description of the Middle Miocene from Romania accompanies the systematic descriptions of the foraminiferal species.

Keywords: Nodosariacea, Middle Miocene, Romania

INTRODUCTION

The present paper is an attempt for a comprehensive study on the calcareous foraminifera from the Superfamily *Nodosariacea* found by the authors in the marine Middle Miocene deposits from Romania. Their description is accompanied, as much as possible, by illustrations, either SEM photographs, or drawings where the electron microscope scanning cannot evidence the morphological characters observable by transparency.

The superfamily *Nodosariacea* is well represented in the foraminiferal communities from the Langhian (equivalent of the Upper Karpatian? and Moravian) and Lower Serravallian (equivalent of the Wielician and Kossovian from the Carpathian area). The beginning of the marine Middle Miocene in the investigated area is characterized by a marine invasion of East Mediterranean origin with mainly planktonic foraminifera, and exceptionally a very poor benthos made up of species typical for the distal shelf facies (e. g. *Cylindroclavulina rudis* (COSTA) with agglutinating planktonic foraminifera tests, as well as numerous protochoncs and juvenile stages of ostreids, probably *Pycnodonte navicularis*).

Unlike the Mediterranean area, the nodosariids from the Carpathian area (Central Paratethys) became almost extinct in the lower part of the Wielician and, mostly in the Kossovian. The causes leading to the extictions within this group, but generally of the foraminiferal assemblages, were the major paleogeographical changes within the Paratethys, which resulted from the tectonical activity (the uplift of the Carpathian range, and the associated major folding), as well as from the global climate cooling during the Late Langhian. At the level of the Wielician a salinity crisis was recorded (as well as the extiction of the east mediterranean organisms), concomitently with a break in the connections with the Mediterranean. The marine faunas subsequently developed are endemic (or still considered endemic), but with boreal influences.

The great diversity of the investigated group had determined Grill (1941) to use it for the biozonation of the Lower "Tortonian" (= Langhian) from the Vienna Basin. Here, the mentioned author separated a level “rich in marine faunas, with a strong development of the lagenids with Planulina wuellestorfi” named “The Lanzendorf Fauna”, and another level with “ marine fauna with strong development of the lagenids, *Robulus cultratus*”, covered by a level “with marine faunas with *Spiroplectammina carinata* and few lagenids”

The first two "levels" were subsequently named "Lower Lagenide Zone" and "Upper Lagenide Zone" (Papp & Turnovsky, 1953). These zones are still in use as an alternative to the planktonic foraminifera zonation.

The Lower Lagenide Zone is characterized by the following *Nodosariidae* species: *Planularia cassis* (FICHTEL & MOLL,), *P. dentata* (Karrer), *Lenticulina clypeiformis* (d’ORB.), *Lenticulina cultrata* (d’ORB.), *Spincterules anaglyptus* LOEBLICH & TAPPAN, *Annulofrondicularia anularis* (D’ORB.), *Frondicularia sculpta* KARRER, *Vaginulina margaritifera* (BATSCH), and also by the presence of the species *Cylindroclavulina rudis* (COSTA), *Fontbotia wuellerstorfi* (SCHWAGER), *Uvigerina macrocarinata* PAPP & TURNOVSKY, *U. uniserialis* JEDL., *Sphaerogypsina globula* (REUSS), *Planostegina costata* (d’ORB.).

The Upper Lagenide Zone is, generally, coincident with a great diversification of the benthonic foraminifera. Here, besides the disappearance of some species as *S. anaglyptus, P.cassis, P. dentata, F. sculpta*, a part of the benthos mentioned for the Lower Lagenide Zone still exists, to which numerous lenticulinids are added (*Planularia auris* DEFR., *Spincterules ariminensis* (d'ORB.), *S. curvicosta* (SEGUENZA) etc.).

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1. THE STRATIGRAPHY OF THE MARINE MIDDLE MIOCENE FROM THE CENTRAL PARATETHYS

On the teritory of Romania, the marine Middle Miocene is developed in two facies: Carpathian and Pannonic (Popescu, 1987).

The Pannonic facies is developed in the northern and western areas of the country (e. g. Baia Mare, Silvaniei, Borod, Beius, Zărand, Timis, Caransebes, Mehadia, Bahna basins), forming the eastern border of the Pannonian Domain.

The Carpathian facies is well developed in the Transylvanian Depression and in the connected intermountain basins (Sacaramb, Almasu Mare, Streiul Inferior), in the Maramures Basin and at the outside of the Carpathians.

Although there are many arguments for the existence of large communication passages, the lithostratigraphic succesions in the two sedimentation areas significantly differ. Thus, lithological complexes with large areal development in the Carpathian domain (the "horizon with chemical precipitation deposits", "radiolarian shales" and "Spirialis marls") are missing in the pannonian area. The almost independent evolution of the two basins also resulted in some peculiarities in the succesion of the faunal assemblages. Examples in this regard are the *Wieliczka type faunas* and the level with siliceous faunas and floras from the Lower Kossovian, present only in the carpathian area.

We have to underline the fact that the evolution of the planktonic foraminifera is, with few exceptions, identical in both areas. Thus, the candorbulinas, the most important group for the Middle Miocene biostratigraphy, are present with similar stratigraphic distributions in both areas. Some differences in the biozonations proposed by other authors reflect either the imprint of some local peculiarities or their subjectivism. Moreover, the plankton evolution from the Central Paratethys at the level of the Lower and Middle Badenian (as the Badenian was subdivided by Papp et al, 1978) is identical with the plankton evolution in the mediterranean area (Iaccarino, 1985).

1.1. Lithostratigraphy

One of the widest used litho and biostratigraphical subdivisions of the subcarpathian marine Middle Miocene deposits is due to Gr. Popescu (1951) and Fl. Olteanu (1951), who separated four "horizons" named (1) the Globigerina tuffs, (2) the salt breccia, (3) the radiolarian shales, and (4) the Spirialis marls. With some exceptions, these "horizons" were recognized in the whole extracarpathian area, Transylvania and Maramures. Some "horizons" already had local names or were subsequently assigned to local or regional formal lithostratigraphic units.

The name Globigerina marls, currently used to designate the marly deposits from the base of the Badenian, was used by Fuchs (1894), Murgoci (1907), Macovei (1909), Mrazec (1910) for the western Oltenia deposits. The other names of "horizons" are also currently used, although when they cannot be cartographically separated different authors preferred using new lithostratigraphic units names.

1.2 Biostratigraphy of the marine Middle Miocene deposits from Romania

The main biostratigraphic units are based on planctonic foraminifera and calcareous nannoplankton, cosmopolitan microorganisms, which allow long distance correlations.

In parallel with the main biozonation, a biostratigraphic zonation based on other groups of organisms can be used (e.g. benthic foraminifera), but with a local or at most a regional value. In the present paper we shall present a biostratigraphic zonation based on planctonic foraminifera, and alternately on benthic foraminifera.

1.2.1. Planktonic foraminifera

1.2.1a Globigerina ottnangensis/ Candorbulina glomerosa Zone

Type: Interval Zone (IZ)

Author: here defined

Age: Burdigalian

Definition: biostratigraphic interval between the first appearance of the species *G. ottnangensis* and the first appearance of the species *Candorbulina glomerosa*.

Remarks: for the same stratigraphic interval the Globoquadrina dehiscens dehiscens Zone (Cati et al., 1968) was used. It is characterized by abundent *Globigerinoides triloba* specimens.

1.2.1b Candorbulina glomerosa / Candorbulina universa Zone

Type: Interval Zone (IZ)

Author: here defined

Age: Langhian

Type locality: Greceanca, Buzau County

Definition: interval between the first appearance of the species *C. glomerosa* and the first appearance of the species *Orbulina suturalis* (= *Candorbulina universa*).

1.2.1c Candorbulina universa / Globoturborotalita druryi Zone

Type: Interval Zone

Author: here defined

Age: Langhian

Type locality: Prahova Valley, at Campinita

Definition: interval between the first appearance of the species *Candorbulina universa* and the first occurrence in Paratethys of the species *Globoturborotalita druryi*.

Remarks: this zone is approximately equivalent

with the Upper Lagenids Zone defined by Papp & Turnovsky, 1953.

1.2.1d Globoturborotalita druryi/ Velapertina Zone

Type: Interval Zone

Author: here defined

Age: Uppermost Langhian - Lower Serravallian (Wielician)

Type locality: Zlagnita Valley, Caransebes

Definition: stratigraphic interval between the first occurrence in Paratethys of the species *G-ita druryi* and the first appearance of the species of the genus *Velapertina*.

1.2.1e Velapertina Zone

Type: Total Range Zone

Author: Popescu, 1975

Age: Kossovian

Type locality: Valea Morilor (western Oltenia)

Definition: interval between the appearance and the extinction of the genus Velapertina.

Remarks: within this interval the species *Globigerina tarchanensis, Velapertina iorgulescui, V. indigena* and *V. luczkowskae* are frequent, as well as a rich fauna of endemic foraminifera characteristic for the zone. This zone could be divided into two subzones: Velapertina iorgulescui Subzone in the lower part and Velapertina indigena Subzone in the upper part.

1.2.2 Alternate biozones

Usually, in such cases are used fossil groups that can be a substitute for the main fossil groups or can increase the degree of biostratigraphic detail for a certain stratigraphic interval. Thus, Papp & Turnovsky (1953) proposed the use of uvigerinas, a group with a rapid evolution.

1.2.2a Planularia dentata Zone (Calan Assemblage)

Type: Assemblage Zone

Author: here defined

Age: Lower Langhian

Type locality: Calan, left flank of the Strei Valley

Definition: the lower limit is marked by the appearance and proliferation of the species *Spincterules anaglyptus, Planularia dentata, p. lanceolata, P. cassis, Uvigerina uniserialis, U. macrocarinata.* The upper limit is marked by the appearance of the species *Dimorphina ackneriana, Psammolingulina papillosa, Colominella paalzowi, Stellarticulina mutabilis, Amphimorphina haueriana, Lenticulina calcar, Plectofrondicularia digitalis, Uvigerina semiornata, U. pygmaea, Planostegina costata.*

Remarks: the presence of the species Spincterules anaglyptus, Planularia dentata, P. lanceolata or P. cassis is an indication for the fact we are in the Lower Lagenids Zone. The lower limit of the zone is marked by first appearance of one of the mentioned species.

Our zone partially correlates with Candorbulina universa/Globoturborotalita zone or with the lower part of the Popesti Assemblage (Popescu, 1975).

1.2.2b Plectofrondicularia digitalis Zone (Lapugiu Assemblage)

Type: Assemblage Zone

Author: here defined

Age: Langhian

Type locality: Valea Cosului section, Lapugiu de Sus

Definition: the lower limit is marked by the extinction of the species *Planularia dentata*, or by the appearance of the species *Plectofrondicularia digitalis* in the Central Paratethys.

Remarks: the bottom of the zone coincides with the disappearance of the mentioned marker species for the previous zone*. S. anaglyptus* can sometimes be recorded from the upper part of the Lapugiu Assemblage, after the appearance of the first specimens of *P. digitalis*. The genera *Dimorphina* and *Amphimorphina*, as well as *Planostegina*, *Amphistegina*, *Gypsina*, *Sphaerogypsina*, *Uvigerina*, *Nodosaria*, *Dentalina* and *Borelis* proliferate.

1.2.2c Pseudotriplasia minuta / Uvigerina orbignyana Zone (Teliuc Assemblage)

Type: Assemblage Zone

Author: here defined

Age: Wielician

Type locality: Teliuc Quarry section

Definition: the lower boundary is marked by the first occurrence of one or both of the index species.

Remarks: the zone as defined here overlaps the G. druryi/Velapertina Zone. During the stratigraphical interval corresponding to this zone the entire Langhian fauna (mediterranean warm assemblages) had disappeared.

The most frequent species recorded within P. minuta/U. orbignyana Zone are *Globorotalia transsylvanica, Alveolophragmium crassum, Adelosina longirostra, A. schreibersi, Marginulina hirsuta* etc.

1.2.2d Uvigerina bellicostata/pavonitina styriaca Zone (Valea Morilor Assemblage)

Type: Assemblage Zone

Author: here defined

Age: Kosovian

Type locality: Valea Morilor (Colibasi), western Oltenia

Definition: the lower boundary is marked by the appearance of the species *Pavonitina styriaca* and the disappearance of the majority of the warm

mediterranean faunas and the appearance of a fauna with boreal influences (Dumitrica et al., 1975).

Remarks: the zone is equivalent with the lower part of the Velapertina Zone or with the lower part of the Uvigerina bellicostata Zone (Popescu, 1975). Even from the lower part of the zone the first occurences of many species considered as endemic are recorded (*Siphotextularia inopinata, S. flexua, Spiroplectammina scaligera, Textularia pala, Baggatella konkensis, B. gutsulica, Uvigerina brunnensis, U. karreri, U. romaniaca, Globigerina tarchanensis, Globocassidulina oblonga, Cibicidoides ornatus, Hanzawaia crassiseptata*). It is important to underline the fact that, generally, the foraminiferal faunas recorded within this stratigraphic interval lack the species belonging to the superfamily *Nodosariacea*.

1.2.2e Borelis rotella Zone (Buitur Assemblage)
Type: Assemblage Zone

Author: here defined

Age: Uppermost Kosovian (Konkian)

Type locality: Valea lui Ion section (Hunedoara County)

Definition: the lower boundary is marked by the disappearance of the species *Pavonitina styriaca, Globigerina tarchanensis*, and *G. concinna*, and the "explosion" of the species *Borelis rotella*, together with *Nodobaculariella gibbosula, N. foveolata, Affinetrina lauta, Sigmoilinita tenuis, Siphonaperta agglutinata, Triloculina intermedia, Miliolinella selene, Tortonella bondartschuki, Articulina tenella*.

Remarks: this zone is equivalent with the uppermost part of the Kosovian (=Konkian), and is characterized by the proliferation of the foraminifera with porcelanous test. The upper boundary of the zone is marked by the complete disappearance of the marine foraminifera and the appearance of the species *Lobatula dividens*.

SYSTEMATIC DESCRIPTIONS

The description of the foraminifera was made according with the taxonomic classification proposed by Loeblich & Tappan (1988). Where necessary the authors proposed some changes in the classification.

Order **LAGENINA**
Superfamily **Nodosariacea** EHRENBERG, 1838
Family **Nodosariidae** EHRENBERG, 1838
Subfam. **Nodosariinae** EHRENBERG, 1838
Alfredosilvestris ANDERSEN, 1961
Alfredosilvestris armellae n.sp.
(Pl. 1, fig. 3, 4)

Test small, flattened, rectilinear, uniserial; chambers chevron shaped throughout; sutures depresed like an inverted V; surface smooth, depressed centrally along its axis, may have some costae in the initial part; microspheric forms may present a marginal carina; wall calcareous, hyaline; aperture terminal, radiate.

Age: Langhian (Lower Badenian).

Type locality: Archiş (Arad District), Valea Lupoaiei Section.

Remarks: Differs from *A. levinsoni* in beeing compressed throughout, and all chambers chevron shaped. Similar specimens, but differing in less depressed sutures were mentioned by A. Poignant (1983) from “Faluns Bleus” in Aquitaine (France).

Alfredosilvestris levinsoni ANDERSEN, 1961
(Pl. 1, fig. 1, 2)

Alfredosilvestris levinsoni ANDERSEN, 1961, p. 72, pl. 17, figs. 7, 8; Rogl (in Cicha et al., 1998), p. 78, pl. 20, fig. 12.

Test small, slender, uniserial, slightly compressed in early part, later elliptical in cross section; chambers chevron shaped in early part, later inflate; surface smooth; sutures depressed; peripheral margins slightly lobate; aperture terminal, radiate.

Remarks: Our specimens belong to megalospheric form in which chevron shape is less visible.

Grigelis MICKHALEVICH, 1981
Grigelis stipitata (REUSS), 1850
(Pl. 1, Fig. 6)

Nodosaria stipitata REUSS, 1850, p. 366, pl. 46, fig. 4.

Test elongate; chambers ovate, fusiform; sutures straight, depressed, at the base of the succeeding chambers; wall calcareous; surface smooth; aperture terminal, radiate, at the end of a long neck.

Neugeborina POPESCU, 1998.

Test free, rectilinear, uniserial; wall calcareous; elongated-ovate proloculus, sometimes inflated; chambers elongated, cylindrical; surface smooth or ornamented; sutures horizontal, slightly inflated or depressed; aperture teminal, rounded, at the end of an elongated neck, without thickenings.

Type species: *Nodosaria longiscata* d’ Orbigny.

Remarks: The species *Orthomorphina filipescui* Popescu, *Nodosaria gyrata* Mallory, *Nodosaria irregularis* d’ Orb., *Dentalina boueana* d’Orb. belong to this genus, as well as the species described by Neugeboren (1851) from Lăpugiu de Sus as *Nodosaria gracilis*, *N. clavaeformis*, *N. bronniana* (suspected as a synonym of *N. irregularis*), *N. exilis* and *N. nodifera* (suspected as a synonym of *N. longiscata*). This new genus differs from other *Nodosariidae* by the cylindrical shape of the chambers and the characteristic shape of the sutures. It differs from *Orthomorphina* by their elongated cylindrical shape of the chambers, the long apertural neck and the lack of apertural lip.

Neugeborina longiscata (D’ORBIGNY), 1846
(Pl. 4, fig. 19-21)

Nodosaria longiscata D’ORBIGNY, 1846, p. 32, pl. 1, figs. 10-12

Nodosaria nodifera NEUGEBOREN, 1852, p. 42, pl. 1, figs. 20, 21
Nodosaria capillaris NEUGEBOREN, 1852, p. 50, pl. 1, figs. 22-24
Nodosaria exilis NEUGEBOREN, 1852, p. 51, pl. 1, figs. 25, 26
Nodosaria clavaeformis NEUGEBOREN, 1852, p. 53, pl. 1, fig. 38

Test rectilinear, uniserial; surface smooth; chambers elongated, with comparable sizes, sutures straight, with chambers slightly inflated near the sutures (like the bamboo stem); the elongated sack-like proloculus (megaspheric specimens) usually do not fossilize.

Remarks: The intraspecific variability is very large, due to the value of the chamber height/chamber diameter ratio.

Neugeborina boueana (D'ORBIGNY), 1846
(Pl. 1, fig. 7; pl.4, fig. 18)

Dentalina boueana D'ORBIGNY, 1846, p. 47, pl. 2, figs. 4-6
Dentalina trichostoma REUSS, 1850, p. 367, pl. 46, fig. 6
Nodosaria gracilis NEUGEBOREN, 1852, p. 51, pl. 1, figs. 27-29
Nodosaria czjzeckiana NEUGEBOREN, 1852, p. 52, pl. 1, fig. 30
Nodosaria haidingeriana NEUGEBOREN, 1852, p. 52, pl. 1, figs. 31, 32
Nodosaria bronniana NEUGEBOREN, 1852, p. 52, pl. 1, figs. 33-35
Nodosaria bielziana NEUGEBOREN, 1852, p. 53, pl. 1, figs., 36-37

Test slender, rectiliniar, uniserial; initial chamber spherical, the following 5-6 chambers as high as broad, later elongated, slender chambers; surface smooth; sutures indistinct in early portion, then slightly depressed; wall calcareous, finely perforated; aperture rounded at the end of a neck.

Remarks: *N. boueana* is suspected to represent microspherical form of the *N. longiscata.*

Type species described by Neugeboren and included in the synonymy are coming from Lăpugiu de Sus.

Pseudonodosaria BOOMGAART, 1949
Pseudonodosaria brevis (D'ORBIGNY), 1846
(Pl. 1, fig. 5)

Glandulina discreta REUSS, 1850, p. 366, pl. 46, fig. 3
Dentalina brevis D'ORBIGNY, 1846, p. 48, pl. 2, figs. 9, 10

Test small, rectiliniar, uniseriat; chambers globular; surface smooth; sutures deep, horizontal; aperture teminal, radiate.

Remarks: This species has a large intraspecific variability. Neugeboren (1856) described from Lăpugiu de Sus many species. At least the species *G. nitidissima*, *G*. *reussi* and *G. elegans* are suspected to be junior synonyms of *G. discreta*.

P. discreta seems to be in its turn the junior synonym of *D. brevis* D'ORBIGNY (1846, p. 48, pl. 2, figs. 9-10). See also Papp & Schmid (1985), p. 30, pl. 12, figs. 8-11.

Pyramidulina FORNASINI, 1894
Pyramidulina raphanistrum (LINNE), 1758
(Pl. 1, figs. 8, 9)

Nautilus raphanistrum LINNE, 1758, p. 710 (Loeblich & Tappan, 1988)
Nodosaria affinis D'ORBIGNY, 1846, p. 39, pl. 1, figs. 36-39)
Nodosaria bacillum D'ORBIGNY, 1846, p. 40, pl. 1, figs. 40-47
Nodosaria raphanistrum (LINNE). Papp & Schmid, p. 27, pl. 8, figs. 1-6, pl. 9, figs. 1, 2.

Test large, elongate, unisesrial, rectiliniar; chambers globular, increasing regularly in size as added; sutures slightly constricted, horizontal; surface ornamented with large longitudinal costae; aperture terminal.

Remarks: Papp & Schmid (1985) illustrated and described *N. affinis* and *N. bacillum* as synonymous.

Subfam. **Lingulininae** Loeblich & Tappan, 1961
Lingulina D'ORBIGNY, 1826
Lingulina costata D'ORBIGNY, 1846
(Pl. 1, figs. 11, 12)

Lingulina costata D'ORBIGNY, 1846, p. 62, pl. 3, figs. 1-5; Neugeboren, 1856, p. 97; Karrer, 1868, p. 166; Popescu, 1975, p. 68, fig. 6; Papp & Schmid, 1985, p. 36, pl. 92, figs. 1-5.

Remarks: Aberant specimens were described by Tollmann (1954) as *Lingulina costata* subsp. *tricarinata*, later designated as type species for *Tollmannia* SELLIER DE CIVRIEUX & Dessauvagie (fide Loeblich & Tappan, 1985, p. 400). The prominent longitudinal costae should be regarded as a specific feature; *Tollmannia* should be regarded as a junior synonym of *Lingulina*.

Lingulinopsis REUSS, 1860
Lingulinopsis sp.
(Pl. 4, figs. 13-15)

Test small, flattened, lanceolate; chambers uniserial arranged, increasing gradually in size as added; sutures flush, curved; surface smooth; wall calcareous, finelly perforated; peripheral keel bordered by two carinas connectd by transverse walls, tricarinate in cross section; aperture terminal, ovate-elongated, radiate.

Remarks: Rare specimens coming from Lăpugiu de Sus (Valea Coşului Section).

Subfam. **Frondicularіinae** REUSS, 1860
Annulofrondicularia KEIJZER, 1945

Test large, flattened, palmate ovoidal to subtriangular in outline, followed by few encircling early chambers, later chambers very broad, low, not completely surrounding the base, but strongly overlapping at the margins; wall calcareous, perforate; surface smooth to longitudinally striate;

aperture terminal on a short neck.

Annulofrondicularia annularis (D'ORBIGNY), 1846
(Pl. 1, figs. 13, 14)

Frondicularia annularis D'ORBIGNY, 1846, p. 59, pl. 2, figs. 44-47

Test large, flattened, palmate, subtriangular to ovoid in outline; initial chamber globular, followed by broad, low, equitant, arched chambers, first chambers (1,2) having the tendency to cover or encircle the initial chamber; sutures arched to semicircular; wall calcareous; surface ornamented with longitudinal costae, aperture terminal, slightly produced.

Remarks: The specimens coming from Lower Badenian (Langhian) deposits from Transylvania or eastern gulfs of the Pannonian basin differ from the type description and illustration in having no chamber encircling initial globular chamber. This seems to be a particular case. In authors opinion, genus *Annulofrondicularia* Keijzer, 1945 (fide Loeblich & Tappan, 1988) could be a junior synonym of *Frondicularia*.

Frondicularia DEFRANCE, 1826
Frondicularia sculpta KARRER, 1862
(Pl. 1, fig. 15-18)

Frondicularia sculpta KARRER, 1862, p. 442, pl. 1, fig. 2; Karrer, 1868, p. 166.

Frondicularia superba KARRER, 1877, p. 381, pl. 16b, fig. 29

Frondicularia sculpta KARRER var. *seminula* KARRER, 1877, p. 381, pl. 16b, fig. 30a.

Frondicularia sculpta KARRER var. *parvinuclea* KARRER, 1877, p. 381, pl. 16b, fig. 30b.

Test large, flattened, lanceolate to palmate, ovoidal to subtriangular in outline; chambers broad, low, equitant; sutures deep, arched, sometime angled at the midline of the test; surface covered by longitudinal fine costae; aperture terminal, radiate.

Lankesterina LOEBLICH & TAPPAN, 1961
Lankesterina complanata (D'ORBIGNY), 1846
(Pl. 4, fig. 17)

Polymorphina complanata D'ORBIGNY, 1846, p. 234, pl. 13, figs. 25-30

Test palmat, subrhomboidal in outline, compressed; chambers low, increasing rapidly in breadth as added, biserial throughout; sutures depressed; wall calcareous, radial, finely perforated; surface smooth; aperture terminal, radiate.

Remarks. This species occurs in Paratethys in marine Middle Miocene deposits. Very rare in Wielician and Kossovian (Popescu, 1979).

Subfam. **Plectofrondicullariine** CUSHMAN, 1927
Amphimorphina NEUGEBOREN, 1850
Syn. *Nodomorphina*, CUSHMAN, 1927 (type species: *Nodosaria compressiuscula*)

Amphimorphina haueriana NEUGEBOREN, 1850

Amphimorphina haueriana NEUGEBOREN, 1850, p. 127, pl. 4, figs. 13-16.

Nodosaria compressiuscula NEUGEBOREN, 1856, p. 79, pl. 2, figs. 1-7 (non Neugeboren 1851).

Test elongate, straight; early stage compressed, uniserial (in megalospheric forms?), than inflated; aperture radial in early, compressed part of the test, evolving to cribrate in the adult; suture limbate, curved in compressed portion, then depressed; surface smooth; young portion bicarinate, with longitudinal costae in the adult.

Remarks. Neugeboren described this species from Lăpugiu de Sus (Bega Basin, eastern border of the Pannonian Realm). The specimens described and illustrated by Neugeboren in 1851, p. 59, pl. 1, figs. 54-56 represent *Plectofrondicularia digitalis*; the specimens described and figurated in 1856 belong to *Amphimorphina haueriana*. Another synonym species is suspected *Frondicularia mucronata* Karrer (1867, p. 354, pl. 1, fig. 6).

Range. Rare to common in Upper Langhian (N9-N10), in Upper Lagenide Zone in the Eastern Pannonian Realm, rare in Transylvania.

Plectofrondicularia LIEBUS, 1902
Plectofrondicularia digitalis (NEUGEBOREN), 1850
(Pl. 1, fig. 20, 21)

Frondicularia digitalis NEUGEBOREN, 1850, p. 120, pl. 3, fig. 3

Frondicularia affinis NEUGEBOREN, 1850, p. 121, pl. 3, fig. 4

Frondicularia bielziana NEUGEBOREN, 1850, p. 121, pl. 5, fig. 5

Frondicularia rostrata NEUGEBOREN, 1850, p. 122, pl. 3, fig. 7, 8

Frondicularia diversicostata NEUGEBOREN, 1850, p. 122, pl. 3, fig. 7, 8

Frondicularia semicostata NEUGEBOREN, 1850, p. 123, pl. 3, fig. 9

Frondicularia tenuicostata NEUGEBOREN, 1850, p. 123, pl. 3, fig. 10

Frondicularia cultrata NEUGEBOREN, 1850, p. 124, pl. 4, figs. 11a-c

Frondicularia irregularis NEUGEBOREN, 1850, p. 125, pl. 4, figs. 12a-c

Frondicularia pulchella NEUGEBOREN, 1850, p. 119, pl. 3, fig. 1a-d

Frondicularia tricostulata REUSS, 1850, p. 368, pl. 46, fig. 12

Plectofrondicularia digitalis (Neugeboren). Marks, 1951, p. 54, pl. 7, fig. 4; Popescu, 1975, p. 67 , text- fig. 20.

Test free, lanceolat-elongated, compressed; initial part accuminated in microspheric specimens, rounded to slightly tapering in megaspheric ones; tricarinate margins; surface smooth (as in "*pulchella*") or ornamented with longitudinal costae, well developed in the initial part, fading towards apertural end; initial stage biserial (more developed in microspheric specimens), then uniserial, chevron shaped; aperture terminal, radiate.

Remarks. This taxon has a large intraspecific

variability. In 1850, Neugeboren described 11 species (including *F. ackneriana* Neugeboren, p. 120, pl. 3, fig. 2, a teratoid specimen), four of them being included in the synonymy of *F. digitalis* (*affinis*, *bielziana*, *rostrata* and *semicostata*) by the same author (Neugeboren, 1856). Very similar specimens were described from New Zealand (*Plectofrondicularia parri* FINLAY, 1939, p. 516, pl. 68, fig. 4) with large stratigraphical range (from Awamoan to Clifdenian; see also Vella, 1966; van Morkhoven et al., 1986).

Material. Numerous specimens were recorded from Lăpugiu de Sus and Coştei. It should be underlined that in all our material an initial "planispiral stage" was not observed in any of the studied specimens as Marks (1951) did.

Range. In Paratethys, this species was recorded from Upper Langhian (N9-N10), in Upper Lagenide Zone. Common in eastern Pannonian Realm, rare in Transylvania. The types included in synonymy come from Lăpugiu de Sus, Hunedoara district.

Plectofrondicularia monacantha (REUSS), 1850
(Pl. 1, fig. 22; pl. 4, figs. 10, 11)

Frondicularia monacantha Reuss, 1850, p. 368, pl. 46, fig. 14

Test flattened, ovate, short biserial in early stage, later uniserial; sutures limbate; aperture terminal, radiate; initial part may have a spine.

Remarks. This species was provisional attributed to the genus *Plectofrondicularia*. The cornuspirin disposition of the first two chambers, as well as the lack of the biserial stage suggest its belonging to a new genus within the family. A close species was described by Karrer (1877, p. 380, pl. 16b, fig. 25) under the name *Frondicularia medelingensis*, species we suspect as a junior synonym.

Range. Middle Miocene (Langhian). Recorded from the eastern border of the Pannonic Depression and in Transylvania.

Proxifrons VELLA, 1963
Proxifrons lapugyensis (NEUGEBOREN), 1856
(Pl. 2, fig. 2)

Frondicularia lapugyensis NEUGEBOREN, 1856, p. 93, pl. 5, figs. 1, 2
Frondicularia laevigata KARRER, 1868, p. 167, pl. 4, fig. 3
Frondicularia semicosta KARRER, 1877, p. 380, pl. 16b, fig. 26
Frondicularia interrupta KARRER, 1877, p. 380, pl. 16b, fig. 27
Frondicularia raricosta KARRER, 1877, p. 381, pl. 16b, fig. 28

Test compressed, lanceolate; initial chamber globular followed by 3-4 biserial chambers, later uniserial, chevron-shaped chambers, increasing gradually in size as added; peripheral margins acute; sutures obscure in the initial part, later arched, depressed; surface smooth or with longitudinal costae, median costa more developed; aperture terminal, rounded, obscurely radiate.

Remarks. Species with large intraspecific variability. Differs from *P. interrupta* (Karrer) in less developed margianl keel and smooth surface (except for the initial part).

Proxifrons interrupta (KARRER), 1877
(Pl1, fig 23; pl. 2, fig. 1)

Frondicularia interrupta KARRER, 1877, p. 380, pl. 16b, fig. 27

Remarks. Species close to *P. lapugyensis* (Neug.). Differs in the more carinate margins and more costate surface than in *P. lapugyensis*.

Family **Vaginulinidae** REUSS, 1860
Subfam. **Lenticulininae** CHAPMAN, PARR & COLLINS, 1934
Dimorphina D'ORBIGNY, 1826
Dimorphina akneriana (NEUGEBOREN), 1851
(Pl. 1, fig. 19; pl. 2, fig. 3)

Marginulina akneriana NEUGEBOREN, 1851, p. 133, pl. 5, figs. 15, 16
Dimorphina akneriana (NEUGEBOREN), Popescu, 1975, p. 50, text-fig. 11

Test elongated, slightly compressed, lenticular to elliptical in section; early chambers planispiral, involute, later uncoiled, rectiliniar; sutures curved, smooth in the coiled part, orizontal and depressed in the rectiliniar stage; surface smooth; aperture terminal, radiate, at the end of a short neck, on the dorsal side.

Remarks. *D. akneriana* has a large intraspecific variability. In the species synonymy are also the species described by Neugeboren as *M. variabilis*, *M. carinata*, *M. erecta*, *M. intermedia*.

Lenticulina LAMARCK, 1804

Test planispirally coiled, lenticular, biumbonate, with umbonal boss; periphery angled to carinate; sutures straight, curved, radial or oblique, limbate, flush or elevated and nodose; wall calcareous, hyaline, perforate, radiar, secondarily lamellar; aperture radiar or slit-like at the peripheral angle, may be slightly produced.

Lenticulina armata (NEUGEBOREN), 1872
(Pl. 2, fig. 6; pl. 4, fig. 31)

Robulina armata NEUGEBOREN, 1872, Arch. Veer. Siebenburg. Landeskunde, N. F. 10, heft 2, p. 282, pl. 2, figs. 6, 7 (fide Ellis & Messina)

Remarks. Neugeboren illustrated as holotype an atypical specimen, an extrem intraspecific variant. topotypical material proves that the majority of the specimens has less developed carinal spines but very densely serrate. The test is similar to *L. calcar*, differing in more chambers on the last whorl (7-9). Another related species is *L. formosa* (Cushman) which has more chambers on the last whorl (10-12).

Our material comes from Lăpugiu de Sus and Coştei (Bega Basin), from Upper Langhian.

Lenticulina evae MOLCIKOVA, 1979
(Pl. 2, fig. 7)

Lenticulina evae MOLCIKOVA, 1979. p.147, pl. 17, figs. 1,2

Remarks. Species oval in outline, with peripheral keel and sutural tubercular ornamentation; the last sutures are slightly depressed.

Range. Rare in Middle-Upper Langhian.

Lenticulina carinata (RZEHAK), 1886
(Pl. 4, fig. 28, 29)

Cristellaria angulata (REUSS) var. *carinata* RZEHAK, 1886, p. 807, pl. 1, fig. 15

Lenticulina carinata (RZEHAK). Molcikova, 1978, p. 137, pl. 7, figs. 1-3, text-fig. 8

Remarks. The species is rare in our material. It was recorded only from the Uppermost Langhian from the eastern border of the Pannonian Depression.

Lenticulina americana (CUSHMAN), 1918
(Pl. 4, fig. 26, 27)

Cristellaria americana CUSHMAN, 1918, p. 50, pl. 10, figs. 5, 6

Lenticulina americana (CUSHMAN). Molcikova, 1978, p. 129, pl. 1, fig. 1, text-fig. 2.

Lenticulina vortex (FICHTEL & MOLL), 1798
(Pl. 2, fig. 8)

Nautilus vortex FICHTEL & MOLL, 1798, p. 33, pl. 2, figs. d-i

Lenticulina vortex (FICHTEL & MOLL). Rogl & Hansen, 1984, p. 30, pl. 2, figs. 3, 4

Remarks. Test similar with *L. imperatoria* from which differs in the absence of the umbilical thickening.

Range. Miocene (in Paratethys).

Lenticulina kittlii (RZEHAK, 1886)
(Pl. 2, fig. 9, 10)

Cristellaria kittlii RZEHAK, 1886, (Die Foraminiferenfauna der Neogenformation der ungebung von Mahr.-Ostrau. Naturw. Ver. Brunn., Verh., 1886, Bd. 24 (1885), p. 107, pl. 1, fig. 11 (fide Ellis & Messina).

Test free, involute, with tendences to uncoil or uncoiled in the adult stage; sutures distinct, thickened, sometimes with small tubercules; peripheral margin slightly angular; aperture characteristic for the genus.

Remarks. The species occures especially in the lower part of the Lower Badenian, in pelitic facies. Rare. It resembles *L. josephina* (d. Orb.), but differs by the lower number of chambers.

Lenticulina convergens (BORNEMANN), 1855
(Pl. 2, fig. 11)

Cristellaria convergens BORNEMANN, 1855 (Zeitschr. Deutsch. Geol. Ges., 7) p. 327, pl. 13, figs. 16, 17 (fide Ellis & Messina)

Lenticulina convergens (BORNEMANN). Molcikova, 1978, p. 141, pl. 11, figs. 1-3, text-fig. 10.

Lenticulina clericii (FORNASINI), 1895
(Pl. 2, fig. 12)

Cristellaria clericii FORNASINI, 1895 (fide Ellis & Messina)

Cribrorobulina clericii (FORNASINI). Dieci, p. 35, pl. 3, fig. 5; Molcikova, 1978, p.161, pl. 24, figs. 2-4

Remarks. The presence in the adult stage of the small openings around the slit opening on the apertural face; in young stages the aperture is typical for the genus.

Range. Miocen-Recent.

Lenticulina clypeiformis (d' ORBIGNY), 1846
(Pl. 2, fig. 13, 15)

Robulina clypeiformis d' ORBIGNY, 1846, p. 101, pl. 4, figs. 23, 24.

Lenticulina clypeiformis (d' ORBIGNY). Papp & Schmid, 1985, p. 43, pl. 31, figs. 1-5

Large species (more than 2 mm); test flattened, with a hyaline elevation in the umbilical area, almost hemispherical, characteristic for the species.

The species is typical for the Lower Moravian from Paratethys (Lower Lagenide Zone). It was recorded from the Northern Transylvania and from the eastern border of the Pannonian Depression.

Mesolenticulina McCULLOCH, 1977

Differs from *Lenticulina* by lacking an umbilical central boss, periphery rounded to subacute, peripheral outline slightly lobate sutures strongly arched, weakly depressed; aperture radiate, at dorsal angle.

Mesolenticulina helene (KARRER), 1877
(Pl. 2, fig. 14)

Cristellaria helene KARRER, 1877, p. 385, pl. 16b, fig. 42

Remarks. Rare species, recorded from the Upper Moravian from Coştei.

Mesolenticulina moravica (KARRER), 1864
(Pl. 2, fig. 16, 17)

Cristellaria moravica KARRER, 1864, p. 707, pl. 2, fig. 9; Karrer, 1868, p. 169

Remarks. Species also mentioned by Karrer (1868, p. 169) from Coştei. We recorded it at Coştei and Lăpugiu from the Upper Lagenide Zone.

Neolenticulina McCULLOCH, 1977

Neolenticulina peregrina (SCHWAGER), 1866
(Pl. 2, fig. 20-22; pl. 3, fig. 1)

Cristellaria peregrina SCHWAGER, 1866, p. 245, pl. 7, fig. 89

Lenticulina peregrina (SCHWAGER). Barker, 1960, pl. 68, figs. 11-16

Test small, lenticular, oval-elongated, surrounded by a thin carina, involute, 4-5 chambers on the last whorl, later uncoiled; wall calcareous; aperture terminal, radiar or, in adult specimens, as multiple

rounded openings at the end of small tubes.

Remarks. Brady reffered this species to *Cristellaria variabilis* Reuss (1850, p. 369, pl. 46, figs. 15, 16) and transffered by Cushman (1923) to *C. peregrina*. It is possible that *Cristellaria variabilis* is a senior synonym of *C. peregrina*. Reuss' illustration is inadequat; in our material coming from a region near the topotypical area there were found specimens looking exactly like Reuss' illustration.

Range. Miocene (in Paratethys).

Spincterules de MONTFORT, 1808

Spincterules anaglyptus LOEBLICH & TAPPAN, 1988

(Pl. 2, fig. 18, 19)

Nautilus calcar var. γ FICHTEL & MOLL, 1798, p. 73, pl. 11, figs. g, h.

Nautilus calcar var. δ FICHTEL & MOll, 1798, p. 73, pl. 11, figs. i, k.

Nautilus calcar var. ι FICHTEL & MOLL, 1798, p. 77, pl. 13, figs. a, b.

Robulina echinata d' ORBIGNY, 1846, p. 100, pl. 4, figs. 21, 22

Robulus echinatus (d' ORBIGNY). Vasicek, 1951, p. 170 (26), pl. 1, fig. 2; Koreczne-Laky, 1968, p. 158, pl. 10, fig. 8.

Lenticulina echinata (d' ORBIGNY). Popescu, 1975, p. 52, text-fig. 12; Molcikova, 1978, p. 145, pl. 15, figs. 3, 4; pl. 6, fig. 1

Lenticulina costata (FICHTEL & MOLL). Rogl & Hansen, 1984, p. 38, pl. 9, figs. 1, 2; Papp & Schmid, 1985, p. 42, pl. 30, fig. 4-7.

Lenticulina rostrata (MONTFORT). Rogl & Hansen, 1984, p. 53, pl. 16, figs. 1, 3, text-fig. 19.

Spincterules anaglyptus LOEBLICH & TAPPAN, 1988, nom.nov., p. 407, pl. 449, figs. 7, 8.

This species is common in Lower Badenian; it was recorded from Lagenide Zone (Lower Lagenide Zone – see Molcikova (1978) or mentioned only in Upper Lagenide Zone – see Papp & Schmid (1985). In Romania *S. anaglyptus* was recorded in Transylvania (Popescu, 1975 – mentioned as *L. echinata* d'Orb.) in Lower Lagenide Zone at Lăpugiu de Sus, Coştei, Caransebeş. These basins belong to the eastern Pannonian Basin.

Spincterules ariminensis (d' ORBIGNY), 1825

(Pl. 3, fig. 2)

Robulina ariminensis d' ORBIGNY, 1825 (tab. des Ceph.), p. 123, no. 15 (nomen nudum); d'Orbigny, 1846, p. 95, pl. 4, figs. 8, 9.

Robulus arminensis (d' ORBIGNY). Marks, 1951, p. 42; Koreczne-Laky, 1968, p. 70, pl. 10, fig. 13.

Lenticulina ariminensis (d' ORBIGNY). Molcikova, 1978, p. 132, pl. 3, figs. 2, 3; Papp & Schmid, 1985, p. 41, pl. 28, figs. 1-3.

Taxon very rarely recorded only in Caransebeş Basin and in Bega Basin, in Upper Langhian (Upper Lagenide Zone). Characteristic for this species is the depressed umbilicus, 5 to 6 chambers on the last whorl, concentric well developed costae, deep sutures, slightly curved and keeled periphery. It differs from *S. curvicostata* (Seg.) by the lower number of chambers on the last whorl (7, 8 to *S. curvicostata* instead of 6, 7) and the absence of the marginal spines.

Following the stratigraphic distribution of the species *S. anaglyptus, S. curvicostata* and *S. ariminensis* one can notice that the first mentioned species appears in the Lower Lagenide Zone, the next in the upper part of the Lagenide Zone and the species *S. curvicostata* in the Pseudotriplasia minuta/Uvigerina orbignyana Zone.

Spincterules curvicosta (SEGUENZA), 1880

(Pl. 3, fig. 3)

Robulina echinata CZJZEK, 1847 (non d'Orbigny, 1846), p. 141, pl. 12, figs., 24, 25.

Robulina echinata var. *curvicosta* SEGUENZA, 1880, R. Acc. Lincei, Cl. Sci. Fis. Mat. Nat., ser. 3, vol. 6 (fide Ellis & Messina).

Remarks. *Spincterules curvicosta* recalls *S. anaglyptus* by the presence of the carinal spines, but differs in the ornamentation similar with *S. ariminensis*.

Rare in the Upper Langhian.

Subfam. **Marginulininae** Wedekind, 1937

Amphicoryna SCHLUMBERGER, 1881

Amphicoryna spinicosta (d' ORBIGNY), 1846

(Pl. 3, fig. 6, 11, 12)

Nodosaria spinicosta d' ORBIGNY, 1846, p. 37, pl. 1, figs. 32, 33.

Nodosaria spinosa NEUGEBOREN, 1852, p. 56, pl. 1, fig. 45.

Nodosaria badenensis (d' ORBIGNY). Papp & Schmid, 1985, p. 26, pl. 7, figs. 1-3.

Remarks. The species described by Neugeboren (*Nodosaria spinosa*) is a synonym of the species *A. spinicostata*. The obvious spines, disposed longitudinally, sometimes like costae, could suggest a different species. Our specimens are perfectly alike Neugeboren's.

Amphicoryna hispida (d' ORBIGNY)

(Pl. 3, fig. 7, 8)

Nodosaria hispida d' ORBIGNY, 1856, p. 367, pl. 1, figs. 24, 25.

Nodosaria asperula NEUGEBOREN, 1852, p. 58, pl. 1, figs. 40, 41.

Amphicoryna venusta (REUSS), 1850

(Pl. 3, fig. 9)

Nodosaria venusta REUSS, 1850, p. 367, pl. 46, fig. 5.

Nodosaria reussiana NEUGEBOREN, 1852, p. 58, pl. 1, fig. 46.

Remarks. It is very possible that the species described by Neugeboren as *Nodosaria elegans* (1852, p. 57, pl. 1, fig. 53) and *N. schrabergana* (1852, p. 55, pl. 1, fig. 42) are synonyms of the species *A. venusta*.

Amphicoryna ehrenbergiana

(NEUGEBOREN), 1852
(Pl. 3, fig. 4, 10)

Nodosaria ehrenbergiana NEUGEBOREN, 1852, p. 58, pl. 1, figs. 50-52.
Nodosaria inconstans NEUGEBOREN, 1852, p. 38, pl. 1, figs. 6, 7.
Nodosaria variabilis NEUGEBOREN, 1852, p. 58, pl. 1, figs. 47-49.

Marginulina d' ORBIGNY, 1826
Marginulina hirsuta d' ORBIGNY, 1826
(Pl. 3, fig. 24-27)

Marginulina hirsuta d' ORBIGNY. d'Orbigny, 1846, p. 69, pl. 3, figs. 17, 18; Papp & Schmid, 1985, p. 37, pl. 22, figs. 1-7.

Subfam. **Vaginulininae** Reuss, 1860
Planularia DEFRANCE, 1826
Planularia lanceolata (d' ORBIGNY), 1946
(Pl. 3, fig. 13-17)

Cristellaria lanceolata d' ORBIGNY, 1846, p. 89, pl. 3, figs. 41, 42.
Cristellaria semiluna d' ORBIGNY, 1846, p. 909, pl. 3, figs. 43, 44.
Planularia lanceolata (d' ORBIGNY). Papp & Schmid, 1985, p. 40, pl. 26, figs. 1-7.

Species often recorded from the Lower Lagenide Zone. A close species, a possible senior synonym, is *Orthoceras auris* Soldani (1791) from which differs only by some elements of test ornamentation (the costae that follow the margin of the test are denser and stronger to *auris*.

Planularia cassis (FICHTEL & MOLL), 1798
(Pl. 3, fig. 20-23; pl. 4, fig. 24, 25)

Nautilus cassis var. α FICHTEL & MOLL, 1798, p. 95, pl. 17, figs. a-d.
Nautilus cassis var. ε FICHTEL & MOLL, 1798, p. 95, pl. 18, figs. a-c.
Planularia antillea (Cushman, 1923) var. *ostraviensis* VASICEK, 1951, p. 174, pl. 1, figs. 7-8.
Planularia cassis (FICHTEL & MOLL). Rogl & Hansen, 1984, p. 61, pl. 22, figs. 3-6; text-figs. 23, 24; Papp & Schmid, 1985, p. 41, pl. 27, figs. 4-6.

Test large, planspiral, biconvex, biumbonate, inflated in the initial part; initial chambers involutely coiled, increasing gradually in size, then evolute in the adult, surrounded by a thin, well developed, translucid keel; sutures limbate, somewhat curved, elevated, especially in the umbonal area, ornamented with a well developed median slit.

Remarks. This species as well as "*Lenticulina" clypeiformis* have a particular, intermediate generic position. Initial part is a clear *Lenticulina*, while the last part can be assigned to *Planularia*.

Range. This species apperas only in the lower part of the Lagenide Zone, accompanied by Planularia dentata, another large species.

Planularia dentata (KARRER), 1867
(Pl. 3, fig. 18, 19)

Cristellaria dentata KARRER, 1867, p. 348, pl. 1, fig. 1.
Planularia dentata (KARERR). Vasicek, 1951, p. 170, text-fig. 2 (1-6), pl. 1, fig. 3.

The species is characterized by a well developed carina, toothed in the early part of the test. Taxon frequently recorded from the lower part of the Lagenide Zone, representing one of the first benthic calcareous foraminifers to appear above the globigerina marls from the base of Badenian.

Occurrence: Western Getic Depression (Breznița), Banat (Lăpugiu de Sus), Lower Strei Basin (Călan, Cinciş), Popeşti (Cluj).

Vaginulina d' ORBIGNY,
Vaginulina margaritifera (BATSCH), 1791
(Pl. 3, fig. 28; pl. 4, figs. 1-3)

Nautilus (Orthoceras) margaritiferus BATSCH, 1791, Conch. Seelands, 4, fig. 12 (fide Ellis & Messina).
Vaginulina badenensis d'Orbigny, var. NEUGEBOREN, 1856, p. 98, pl. 5, fig. 7.
Vaginulina brukenthali Neugeboren, 1856, p. 98, pl. 5, fig. 10.
Vaginulina margaritifera (BATSCH). Brady, 1884, p. 332, pl. 26, fig. 16.
Vaginulina legumen Vasicek (non Linne), 1951, p. 28, pl. 1, fig. 4, text-fig. 5 (nr. 1-6); Popescu, 1975, p. 64, pl. 93, figs. 6, 7.

Remarks. The species has a very large intraspecific variety manifested by ornamentation and general aspect. Usually, the microspheric specimens are more pointed, and the sutures between the initial chambers are very inclined relatively to the margins, while the initial part of the megaspheric specimens is rounded, and the first sutures almost horizontal. Characteristic for the species is the flattened aspect of the test, the very prominent sutures and the presence of caudal spines.

Vaginulinopsis SILVESTRI, 1904
Vaginulinopsis pedum (d' ORBIGNY), 1846
(Pl. 4, fig. 5)

Marginulina pedum d' ORBIGNY, 1846, p. 68, pl. 3, figs. 13, 14.
Marginulina variabilis NEUGEBOREN, 1851, p. 133, pl. 5, figs. 10-14.
Vaginulinopsis pedum (d' ORBIGNY). Papp & Schmid, 1985, p. 37, pl. 21, figs. 5-9.

Test elongate, slightly compressed, lenticular to ovate in section; early chambers planispiral, involute, later uncoiled, rectilinear; sutures curved, flush in the coiled portion, horizontal, depressed in the rectilinear part; surface smooth; aperture terminal, radiate, produced, at the dorsal angle.

Remarks. This common species in the Lower Badenian deposits from Paratethys was assigned by authors to *Dimorphina*. The position of the aperture near the dorsal face is the only feature which differs from *Dimorphina*. In our material occur some specimens in which the aperture is in the same position as in *Dimorphina* - so the assignement of this species to *Vaginulinopsis* instead of *Dimorphina* is questionable.

V. pedum has a large intraspecific variability. This is the reason for describing this species under different

names (*Marginulina ackneriana* NEUG., *M. carinata* NEUG., *M. erecta* NEUG., *M. intermedia* NEUG. – in Neugeboren, 1851, p. 33-35, pl. 5, figs. 10-19.).

Saracenaria DEFRANCE, 1824

Saracenaria arcuata (d' ORBIGNY), 1846
(Pl. 4, fig. 6)

Cristellaria arcuata d' ORBIGNY, 1846, p. 87, pl. 3, fig. 34-36; Karrer, 1868, p. 169.

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PLATES

PLATE I

Figs.1, 2. *Alfredosilvestris levinsoni* Andersen. Upper Langhian (Upper Lagenids Zone).Valea Lupoaia section, Archiş, Arad district. Lateral views. Bar, 100 µm.
Figs. 3, 4. *Alfredosilvestris armellae* n.sp. Upper Langhian (Upper Lagenids Zone).Valea Lupoaia section, Archiş, Arad district. Lateral views. Bar, 100 µm. Fig. 4, holotype; fig. 3, paratype.
Fig. 5. *Pseudonodosaria brevis* (d'Orbigny). Upper Langhian (Upper Lagenids Zone). Valea Gemini section, Coştei, Timiş district. Lateral view. Bar, 100 µm.
Fig. 6. *Grigelis stipitata* (Reuss). Upper Langhian (Upper Lagenids Zone). Valea Viilor section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 300 µm.
Fig. 7. *Neugeborina boueana* (dOrbigny). Upper Langhian (Upper Lagenids Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 300 µm.
Fig. 8, 9 *Pyramidulina raphanistrum* (Linne). Langhian. Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral views. Bar 300 µm.
Figs. 10. *Pseudonodosaria abbreviata* (Neugeboren). Upper Langhian (Upper Lagenid Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 100 µm.
Figs. 11, 12. *Lingulina costata* d'Orbigny. Langhian (Lower Lagenid Zone). Cariera Popeşti section, Popeşti, Cluj district. Lateral views. Bar, 300 µm.
Fig. 13, 14 *Annulofrondicularia annularis* (d'Orbigny). Langhian (Lower Lagenid Zone). Cariera Popeşti section, Popeşti, Cluj district. Lateral view. Bar, 300 µm.
Figs. 15 -18. *Frondicularia sculpta* Karrer. Langhian (Lower Lagenid Zone). Cariera Popeşti section, Popeşti, Cluj district. Lateral views. Bar, 300 µm.
Fig. 19 *Dimorphina akneriana* (Neugeboren). Upper Langhian (Upper Lagenid Zone). Valea Viilor section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 100 µm.
Figs. 20, 21 *Plectofrondicularia digitalis* (Neugeboren). Langhian. Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 300 µm.

Fig. 22 *Plectofrondicularia monachanta* (Reuss). Upper Langhian (Upper Lagenid Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 300 µm.
Figs. 23 *Proxifrons interrupta* (Karrer). Upper Langhian (Upper Lagenid Zone).Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral views. Bar 300 µm.

PLATE II

Fig. 1 *Proxifrons interrupta* (Karrer). Upper Langhian (Upper Lagenid Zone).Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral views. Bar 300 µm.
Fig. 2 *Proxifrons lapugiensis* (Karrer). Upper Langhian (Upper Lagenid Zone).Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 300 µm.
Fig. 3 *Dimorphina akneriana* (Neugeboren). Upper Langhian (Upper Lagenids Zone). Valea Viilor section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 300 µm.
Fig. 4-6 *Lenticulina armata* (Neugeboren). Upper Langhian (Upper Lagenid Zone).Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral views. Bar 300 µm.
Fig. 7 *Lenticulina evae* Molcikova. Upper Langhian (Upper Lagenid Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 300 µm.
Fig. 8 *Lenticulina vortex* (Fichtel & Moll). Upper Langhian (Upper Lagenid Zone).Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Umbilical view (lateral). Lateral view. Bar 300 µm.
Fig. 9, 10 *Lenticulina kittlii* (Rzehak). Upper Langhian (Upper Lagenids Zone). Valea Viilor section, Lăpugiu de Sus, Hunedoara district. Lateral views. Bar, 500 µm.
Fig. 11 *Lenticulina convergens* Bornn. Upper Langhian (Upper Lagenids Zone). Borehole 13, Caransebeş, Timis district. Lateral view. Bar 100 µm.
Fig. 12 *Lenticulina clericii* (Forn.). Upper Langhian (Upper Lagenid Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Umbilical view (lateral). Bar 100 µm.
Fig. 13, 15 *Lenticulina clypeiformis* (d'Orbigny). Langhian (Lower Lagenid Zone). Cariera Popeşti section, Popeşti, Cluj district. Lateral views. Bar, 500 µm.
Fig. 14 *Mesolenticulina helene* (Karrer). Langhian (Lower Lagenid Zone). Cariera Popeşti section, Popeşti, Cluj district. Lateral view. Bar, 300 µm.
Fig. 16, 17 *Mesolenticulina moravica* (Karrer). Upper Langhian (Upper Lagenid Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Fig. 2, lateral view; fig. 3, edge view. Bars 500 µm.
Fig. 18, 19 *Spincterules anaglyptus* (Loeblich & Tappan). Langhian (Lower Lagenid Zone). Cariera Popeşti section, Popeşti, Cluj district. Lateral view. Fig. 18, bar, 300 µm; fig. 19, bar, 500 µm.
Fig. 20-22 *Neolenticulina peregrina* (Schwager). Langhian (Lower Lagenid Zone). Valea Zlăgniței, Balta Sărată, Timiş district. Lateral views, bars, 100 µm; fig. 22, detail of the aperture, bar, 30 µm.

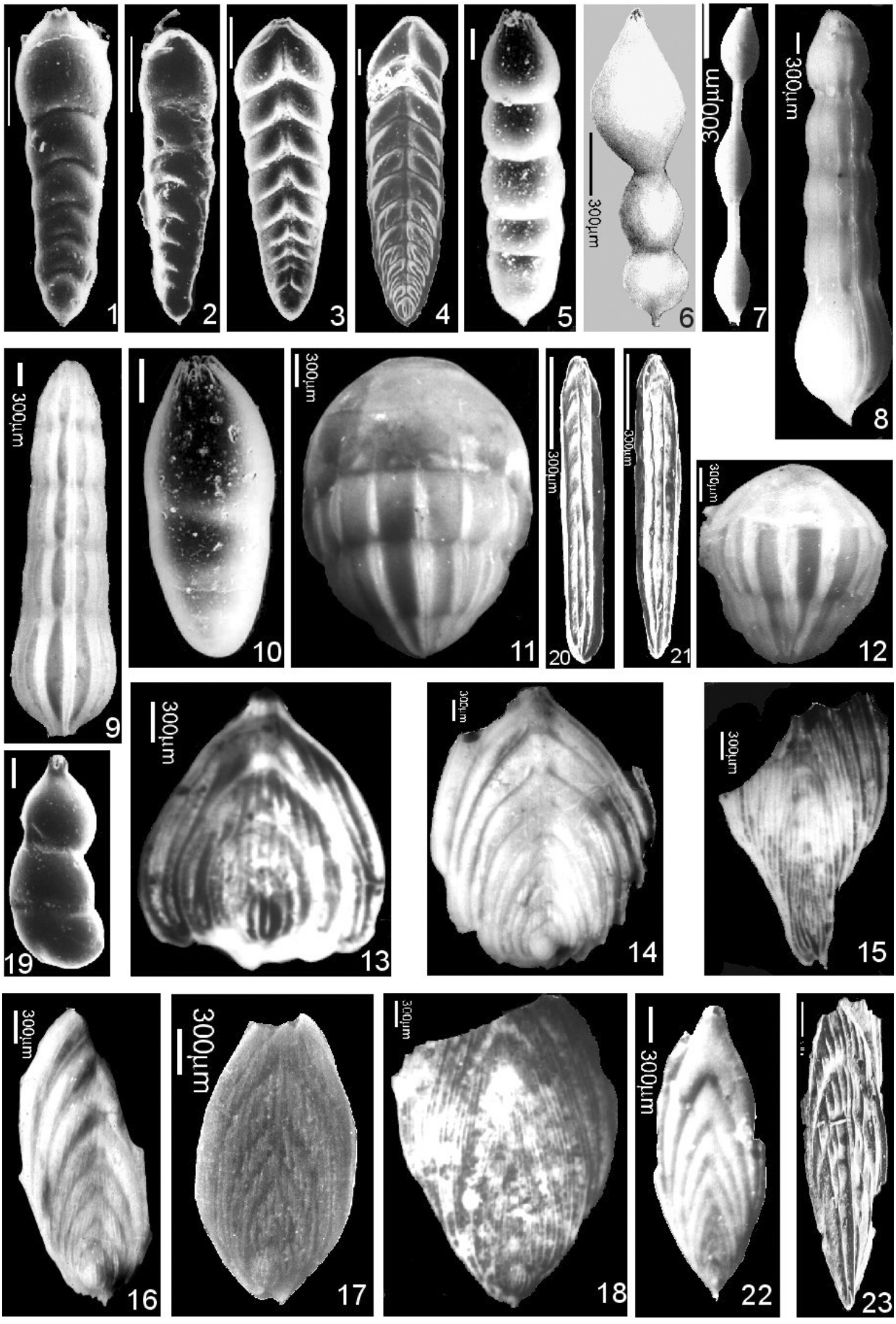
PLATE III

Fig. 1 *Neolenticulina peregrina* (Schwager). Langhian (Lower Lagenid Zone). Valea Zlăgniței, Balta Sărată, Timiş district. Lateral view, bars, 100 µm.
Figs. 2 *Spincterules ariminensis* (d'Orbigny). Wielician (Pseudotriplasia minuta/Uvigerina orbignyana Zone). Balta Sărată borehole, Timiş district. Lateral view. Bar, 100 µm.
Fig. 3, 5 *Spincterules curvicosta* (Seguenza). Wielician (Pseudotriplasia minuta/Uvigerina orbignyana Zone). Balta Sărată borehole, Timiş district. Lateral view. Bar, 100 µm.
Fig. 4, 10 *Amphicoryna inconstans* (Neug.). Upper Langhian (Upper Lagenid Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral views. Bar 100 µm.
Fig. 6, 11, 12 *Amphicoryna spinicosta* (d'Orbigny). Upper Langhian (Upper Lagenid Zone). Lateral views. Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Bar 100 µm.
Figs. 7, 8. *Amphicoryna hispida* (d'Orb.). Upper Langhian (Upper Lagenid Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 100 µm.
Fig. 9. *Amphicoryna venusta* (Neugeboren). Upper Langhian (Upper Lagenid Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 100 µm.
Fig. 13-17 *Planularia lanceolata* (d'Orbigny). Langhian (Lower Lagenid Zone). Cariera Popeşti section, Popeşti, Cluj district. Lateral view. Bar, 300 µm.
Fig. 18, 19 *Planularia dentata* (Karrer). Langhian (Lower Lagenid Zone). Umbilical view. Left bank of Strei River, Călan, Hunedoara district. Lateral views. Bar, 300 µm.
Fig. 20-23 *Planularia cassis* (Fichtel & Moll). Langhian (Lower Lagenid Zone). Cariera Popeşti section, Popeşti, Cluj district. Lateral views. Bar, 300 µm.
Figs. 24-27 *Marginulina hirsuta* d'Orbigny. Upper Langhian (Upper Lagenid Zone). Valea Zlăgniței section, Balta Sărată, Timiş district. Figs. 24, 26, 27 lateral views; fig. 25, apical detail of the fig. 24. Bars, 100 µm.

Fig. 28 . *Vaginulina margaritifera* (Batsch). Upper Langhian (Upper Lagenid Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar: fig.6, 100 µm.

PLATE IV

Fig. 1-3 *Vaginulina margaritifera* (Batsch). Upper Langhian (Upper Lagenid Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral views. Bars: fig.1 , 300 µm; fig. 2, 3, 100 µm.
Fig. 4 *Marginulina semituberculata* (Karrer). Upper Langhian (Upper Lagenid Zone). Lateral view. Valea Gemini section, Coştei, Timiş district. Lateral view. Bar 100 µm.
Figs. 5 *Vaginulinopsis pedum* (d'Orbigny). Langhian (Lagenid Zone). Valea Viilor section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 300 µm.
Fig. 6 *Saracenaria arcuata* (d'Orbigny). Upper Langhian (Upper Lagenid Zone). Valea Gemini section, Coştei, Timiş district. Lateral view. Bar 100 µm.
Fig. 7, 8 *Amphicoryna proxima* (Silvestri). Upper Langhian (Upper Lagenid Zone). Lateral views. Fig.7, detail of the apertural neck. Valea Gemini section, Coştei, Timiş district. Lateral view. Bar 100 µm.
Fig. 9 *Percultozonaria* sp. Upper Langhian (Upper Lagenid Zone). Valea Gemini section, Coştei, Timiş district. Lateral view. Bar 100 µm.
Fig. 10, 11 *Plectofrondicularia monacantha* (Reuss). Upper Langhian (Upper Lagenid Zone). Valea Gemini section, Coştei, Timiş district. Lateral views in transmited light. Bar 100 µm.
Fig. 12 *Proxifrons lapugyensis* (Karrer). Upper Langhian (Upper Lagenid Zone). Valea Gemini section, Coştei, Timiş district. Lateral view in transmited light. Bar 100 µm.
Figs. 13-15 *Lingulinopsis* sp. Upper Langhian (Upper Lagenid Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Figs. 13, 14 lateral views: fig. 15, edge view. Bars, 50 µm.
Fig. 16 *Laevidentalina soluta* (Reuss). Kossovian (Velapertina Zone). Valea lui Ion section, Buitur, Hunedoara district. Lateral view; bar, 100 µm.
Figs. 17 *Lankesterina complanata* d'Orbigny. Kossovian (Velapertina Zone). Valea lui Ion section, Buitur, Hunedoara district. Fig. a, lateral view; b, apertural view. Bar, 30 µm.
Fig. 18 *Neugeborina boueana* (d'Orbigny). Upper Langhian (Upper Lagenids Zone). Valea Coşului section, Lăpugiu de Sus, Hunedoara district. Lateral view. Bar 300 µm.
Fig. 19-21 *Neugeborina longiscata* (d'Orbigny). Upper Langhian (Upper Lagenid Zone). Valea Gemini section, Coştei, Timiş district. Lateral views. Bar 100 µm.
Fig. 22 *Laevidentalina* sp. 1. Upper Langhian (Upper Lagenid Zone). Valea Gemini section, Coştei, Timiş district. Lateral view. Bar 100 µm.
Fig. 23 *Laevidentalina* sp. 2. Upper Langhian (Upper Lagenid Zone). Valea Gemini section, Coştei, Timiş district. Lateral view. Bar 100 µm.
Figs. 24, 25 *Planularia cassis* (Fichtel & Moll). Langhian (Lower Lagenid Zone). Cariera Popeşti section, Popeşti, Cluj district. Fig. 24, lateral view; fig. 25, edge view. Bars, 300 µm.
Figs. 26, 27 *Lenticulina americana* (Cushman). Langhian (Lower Lagenid Zone). Valea Cosului section, Lapugiu de Sus. Fig. 26, lateral view; fig. 27, edge view. Bars, 300 µm.
Figs. 28, 29 *Lenticulina carinata* (Rzehak). Upper Langhian (Upper Lagenid Zone). Valea Gemini section, Coştei, Timiş district. Fig. 28, lateral view; fig. 29, edge view. Bar 100 µm.
Fig. 30 *Lenticulina calcar* (Linne). Langhian (Lower Lagenid Zone). Valea Cosului section, Lapugiu de Sus. Lateral view. Bar, 300µm.
Fig. 31 *Lenticulina armata* (Neugeboren). Langhian (Lower Lagenid Zone). Valea Cosului section, Lapugiu de Sus. Lateral view. Bar, 300µm.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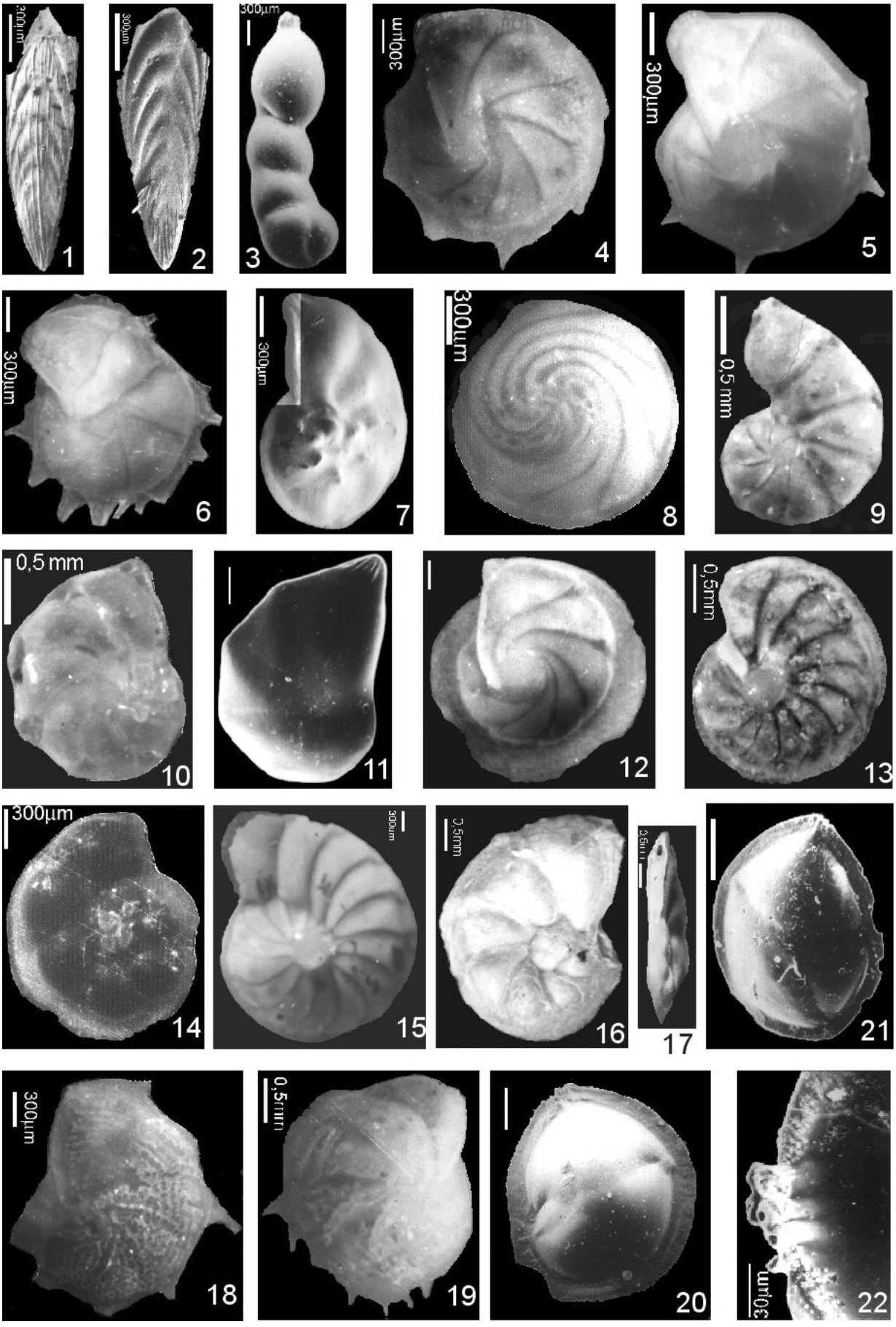
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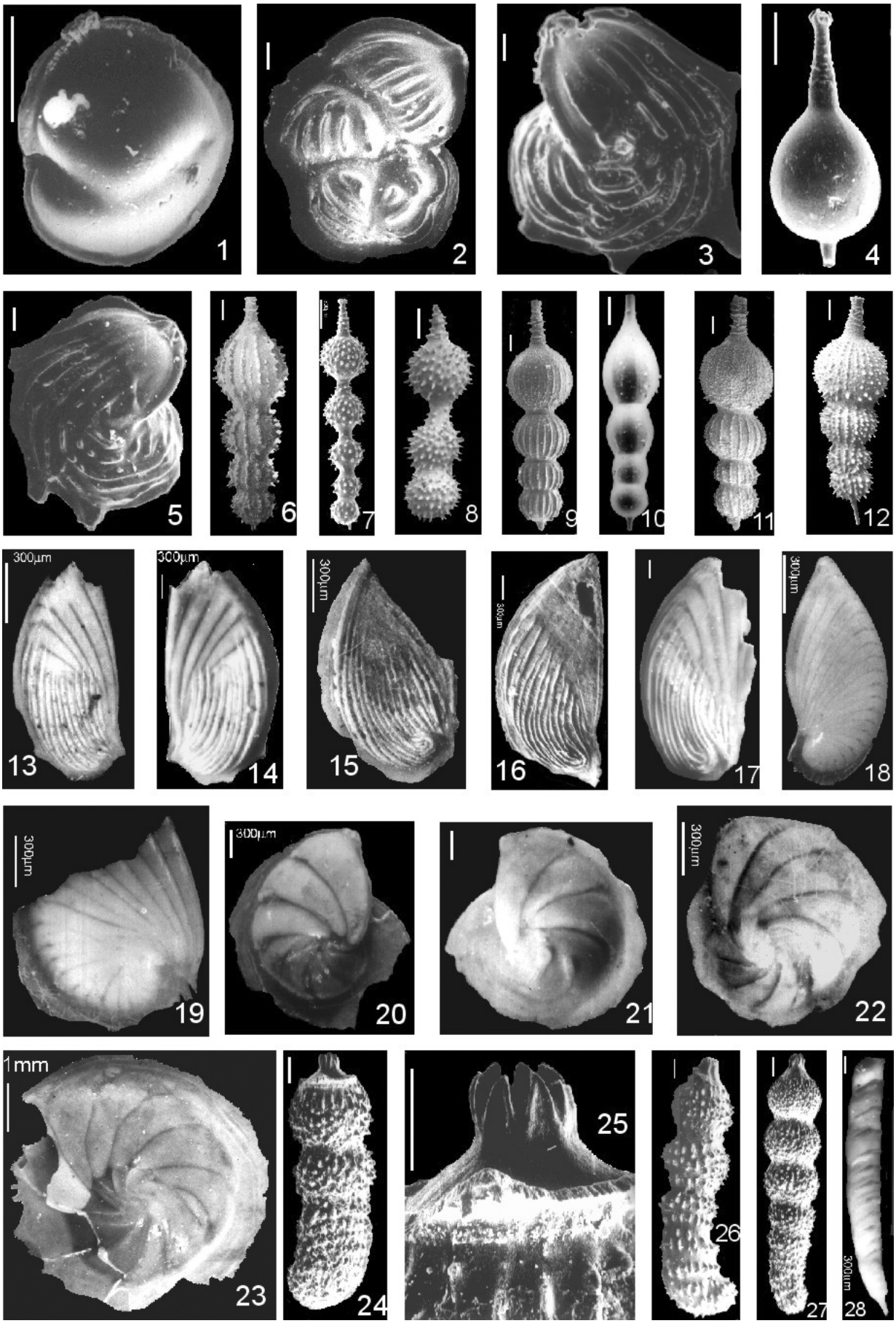
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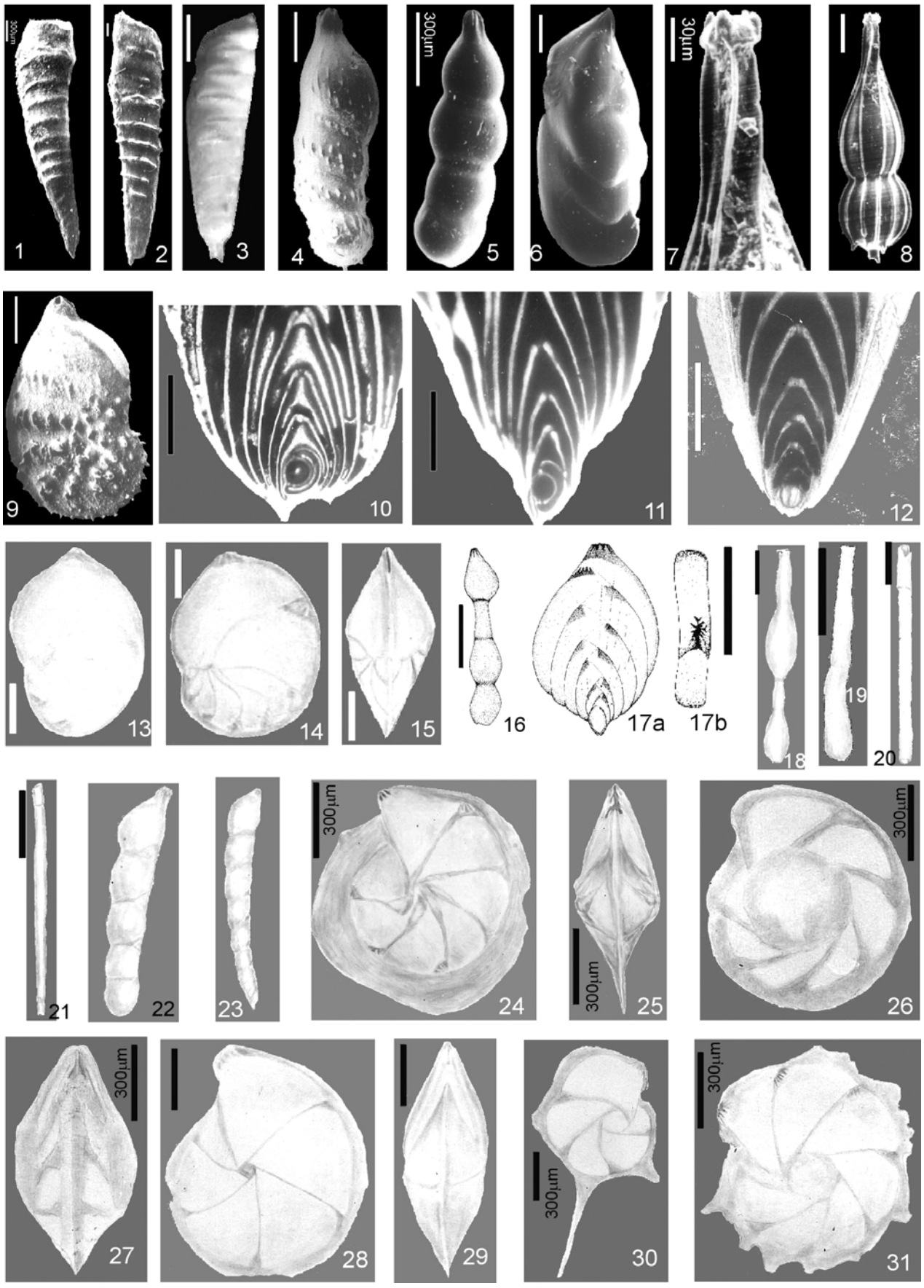
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