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Farinacciella ramalhoi, n. gen., n. sp., a larger foraminifer from the Kimmeridgian-lower Tithonian of the Neo-Tethyan realm

Antonietta Cherchi [1], Rajka Radoičić [2], Rolf Schroeder [3]

[1] *Dipartimento di Scienze Chimiche e Geologiche, Università degli Studi di Cagliari, via Trentino 51, 09127 Cagliari, Italy*
[2] *7 Jula 38/VI, 11000 Beograd, Serbia*
[3] *Forschungsinstitut Senckenberg, Senckenberg-Anlage 25, D-60325 Frankfurt am Main, Germany*
Corresponding author: acherchi@unica.it

ABSTRACT - A new larger foraminifer *Farinacciella ramalhoi* , n. gen., n. sp., from the Upper Jurassic of several regions of the Neo-Tethys is described: Mount Vojnik (Crna Gora/Montenegro), Lepini and Aurunci Mountains (Latium, Italy), Murcia province (Spain) and Arrabida area (Portugal).The test of this dimorphic calcareous microgranular taxon is made up of two morphologically and structurally different stages of growth: the probably megalospheric forms exhibit a juvenile conical stage with trochospirally arranged chambers. This is followed by a compressed adult stage with a cuneiform to ?reniform-circular outline. The juvenile stage in the centre of the large discoidal microspheric forms, which is made up of irregularly coiled chambers, is followed by predominantly annular chambers. *Farinacciella ramalhoi*, which is placed in the family Valvulinidae Berthelin, 1880, was previously assigned by several authors to *Kilianina lata* Oberhauser, 1956, but differs clearly from this taxon.

Keywords: Taxonomy; Larger foraminifera; Upper Jurassic; Neo-Tethys.

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1. INTRODUCTION

The Upper Jurassic shallow-water deposits of the Neo-Tethyan carbonate platforms are generally very rich in larger benthic foraminifera, which are often very important as biostratigraphic markers. An overall review of the biostratigraphic distribution of larger Upper Jurassic foraminifera in the Mediterranean region was presented by Bassoullet (1997, p. 302); further, more regional, studies were given by various other authors (e. g. Velić, 2007 for the Karst Dinarides, SE Europe; Tash et al., 2008 for the Bolkar Mountains, southern Turkey).

The current study of the new taxon *Farinacciella ramalhoi* is mainly based on a sample from Mount Vojnik (Crna Gora/Montenegro), but also takes into consideration material from some other regions of the Neo-Tethys (Fig. 1). The material from Mount Vojnik is deposited in the Forschungsinstitut Senckenberg (Cherchi-Schroeder collection), Frankfurt am Main, Germany.

2. PROVENANCE AND AGE OF THE STUDIED MATERIAL

2.1. Mount Vojnik (Crna Gora / Montenegro)

The description of *Farinacciella ramalhoi* is mainly based on material (Nr. 07228), which was collected in 1965 by Rajka Radoičić about 22 km north of the town of Nikšić.

The locality is called Toplo Prisoje, and is situated on the northwestern spurs of Mount Vojnik (sheet Nikšić 1:100,000; coordinates: 42°57'59"/18°55'37"). The material was retrieved near the Mićović house on the border of the old road leading from the fluvioglacial Brezna polje to Lipova Ravan, in limestones cutting a jurassic succession (Radoičić, 1989). The studied sample is a beige micritic limestone containing micritic intraclasts and small biserial foraminifera. Stratigraphically, it comes from the "*Clypeina jurassica* Zone", which was assigned by Radoičić (in Farinacci and Radoičić, 1964, p. 273) to the Kimmeridgiano superiore e Portlandiano. Farinacci (1996, p. 215) dated the interval with *Clypeina jurassica* from Mount Vojnik as lower Tithonian.

2.2. Lepini and Aurunci Mountains (Latium, central Italy)

Farinacciella ramalhoi was found in a sample collected on the southern slope of Mount Ardiacara (Lepini Mountains, southern Latium; sheet 389 Anagni 1:50,000), at a height of 800 m. A thin section (Nr. 163) of this sample, which is stored in the collections of the ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale, Rome) contains

Fig. 1 - Location of studied material containing *Farinacciella ramalhoi* : 1) Mount Vojnik (Crna Gora/Montenegro); 2) Lepini Mountains (Latium); 3) Aurunci Mountains (Latium); 4) Jumilla (Murcia province); 5) Arrabida region (Lisbon).

some specimens of this new taxon (one of which is set out in Pl. 3, Fig. 1 of the present paper). Alberti et al. (1975) and Chiocchini et al. (1976) dated this sample as lower Tithonian (*Clypeina jurassica* Biozone).

The occurrence of *Farinacciella ramalhoi* was also proved in the Aurunci Mountains (southern Latium). A calcarenite thin section, published by Chiocchini and Mancinelli (1977, Pl. 20, Fig. 2), contains numerous specimens of this taxon (Pl. III, 2-3 of the present paper), which were determined by these authors as *Kilianina lata* Oberhauser. An exact locality was not provided. In their stratigraphic distribution chart IV, Chiocchini and Mancinelli placed this form at the lower/upper Kimmeridgian boundary (=topmost *Kurnubia palastiniensis*/lowermost *Clypeina jurassica* Biozones).

2.3. North of Jumilla (Murcia province, eastern Spain)

In his unpublished doctoral thesis, Fourcade (1970, p. 87-89) presented a detailed description of the upper Jurassic of this region. About 7 km north of the village of Jumilla, he described the Las Puntillas-Peñarrubia section, which was subdivided into the following lithostratigraphic units (from bottom to top):

1) Alternation of sublithographic limestone and grey marly limestone (60 m), overlain by lithographic limestone with *Alveosepta jaccardi* (20 m). According to Fourcade, this unit corresponds to the early Kimmeridgian of the region of Caudete (Albacete province), yielding *Ataxioceras* sp.

2) Dolomites with "phantoms" of oncolites (150 m).

3) Light-beige limestone with *Nautiloculina oolitica*, *Alveosepta jaccardi* and *Kurnubia jurassica*: "une association classique du Kimméridgien" (10 m).

4) Oolitic limestone "à fond cristallin" (=oosparite) (4 m).

Apparently, from this unit, Fourcade figured a thin section, exhibiting a large "Foraminifère indéterminé" (1970, Pl. 37, Fig. 9), which we assign to *Farinacciella ramalhoi* (this paper Pl. III, 4).

2.4. South of Lisbon (Portugal)

In his doctoral thesis, Ramalho (1971, Pl. 18, Figs. 7-8; Pl. III, 8-9 in this paper) under the name "Lituolidae, gen. et sp.?", presented two sections of a large foraminifer, which undoubtedly belong to *Farinacciella ramalhoi*. They come from the lower part (approx. 50 m) of Zone D of the Tranca Section (east of Cape Espichel, Arrabida region) (Ramalho, 1971, p.128), which is comprised of compact beige limestone containing *Pseudocyclammina* gr. *parvula-muluchensis* and *Kurnubia palastiniensis*. Ramalho assigned this unit to the "Kimmeridgien p.p.".

Unfortunately, the two specimens, which were kindly sent by Prof. Ramalho to one of us (R.S.) in 1978, were lost during their transport by post.

3. SYSTEMATIC PALAEONTOLOGY

Class Foraminiferida Eichwald, 1830
Superfamily Lituolacea de Blainville, 1825
Family Valvulinidae Berthelin, 1880
Farinacciella n. gen.
Type species: *Farinacciella ramalhoi* n. sp.

Derivation of name: In memory of Anna Farinacci, Professor at the Dipartimento di Scienze della Terra, SAPIENZA, Università di Roma.

Diagnosis: test free, microgranular. Juvenile stage of the probably megalospheric, high conical specimens are made up of trochospirally arranged chambers. Adult stage at the first flat cuneiform, later ?reniform to disc-shaped. Arcuate chambers subdivided by a median wall into two lateral parts, which are divided into lateral chamberlets by lateral partitions. Conditioned by the cross-wise oblique stolon system, these partitions alternate in position from one chamber to the next. The juvenile stage

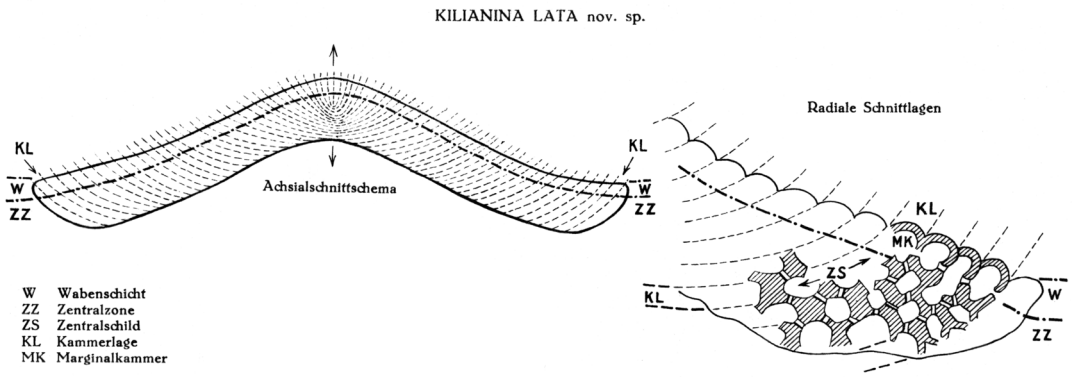

Fig. 2 - *Kilianina lata* Oberhauser, 1956. Schematic axial section (left) and structural details (right). For explication of the abbreviations, see text (from Oberhauser, 1956, Fig. 1, modified).

of the disc-shaped microspheric specimens is made up of small, irregularly coiled chambers, followed by a series of predominantly annular chambers. These clearly increase in volume during the ontogenesis, but exhibit the general structural features of the presumably megalospheric specimens.

Farinacciella ramalhoi n.gen., n.sp.
Pl. I, 1-6; Pl. II, 1-2; Pl. III, 1-3, 8-9

1966 [unnamed]. -Radoičić, Pl. 163, Fig. 2.
1970 Foraminifère indéterminé.-Fourcade, Pl. 37, Fig. 9.
1971 "Lituolidae, gen. et sp.?".-Ramalho, p. 159, Pl.18, Figs. 7-8.
1975 *Kilianina lata*. -Alberti et al., biostratigraphic chart.
1976 *Kilianina lata*.-Chiocchini et al., biostratigraphic chart.
1977 *Kilianina lata* Oberhauser.-Chiocchini and Mancinelli, p. 20, Fig. 2; biostratigraphic chart IV.

Derivation of name: Dedicated to Prof. Miguel Ramalho, Geological Museum (National Laboratory of Energy and Geology), Lisbon.

Holotype: Axial section, running at an oblique angle with the median plane. This section (208-1) is stored in the Cherchi-Schroeder collection, Forschungsinstitut Senckenberg, Frankfurt am Main (Germany).

Type locality: Toplo Prisoje, Mount Vojnik (Crna Gora/ Montenegro).

Age: Kimmeridgian-Lower Tithonian.

Material: 16 thin sections, containing approximately 30 specimens.

Diagnosis: See diagnosis of the monotypic genus.

3.1. Description

The specimens of *Farinacciella ramalhoi* from the type-locality are often irregularly bent (Pl. II, 1) and frequently broken, making the interpretation of the random sections difficult.

The calcareous microgranular test is made up of two morphologically and structurally different stages of growth: (1) a juvenile conical stage, and (2) a subsequent adult compressed stage with a cuneiform to ?reniform-circular outline.

1) The juvenile stage (Pl. I, 2, 3) is high conical with an apical angle of approximately 30°. Its height is 0.5 - 0.6 mm and the basal diameter is 0.27-0.3 mm. The proloculus was not observed; it is probably a small globular and undivided chamber located in the tip of the test. The subsequent chambers are trochospirally arranged in up to eight whorls (Pl. I, 2, 3, 6). During the ontogenesis, the chambers enlarge rapidly, attaining a height of up to 0.1 mm in the last whorl. The apertures between two successive chambers are nearly horizontally directed (Pl. I, 6, arrow) or slightly oblique (Pl. I, 4, arrow), which relates to the axis of the test.

2) The boundary between the juvenile and the adult stage, which is marked by a short white line in Pl. I, 1-4 and 6, is very sharp. It is characterized by a clear decrease of the chamber lumina and a reduction of the test diameter, which then gradually increases and widens again.

The first part of the adult stage is made up of a rectilinear series of arcuate chambers, which rapidly increase in breadth and form a compressed cuneiform test (thickness: 0.25 mm) with a more or less triangular outline (Pl. I, 5). Subsequently, the adult stage of larger specimens (more than 4 mm wide; Pl. II, 1, 2) may at first be flabelliform, and then ?reniform to discoidal.

In the median plane of the adult stage, the chambers are entirely subdivided into two equal lateral parts by a median wall (mw in Pl. II, 1, 1a; 2, long arrow). This wall, cut at a low angle with respect to the median plane, appears as a dark area near to the left border of Pl. II, 1.

The lateral parts of the chamber, comprising the space on both sides of the median wall, are subdivided at regular intervals into lateral chamberlets by lateral partitions (lc and lp in Pl. II, 1a). These partitions merge with the median wall and alternate in position from one chamber to the next (Pl. I, 5), conditioned by the cross-wise oblique stolon system. The stolons are arranged in two rows, located in the back part of the chamberlets on both sides of the median wall (Pl. II, 1a, arrows). Cross-sections of lateral chamberlets are more or less triangular (Pl. I, 5), but elliptical in their external part immediately below the chamber wall (Pl. II, 2, short arrows). The lateral

chamberlets are not subdivided by secondary partitions.

Two sections are of special interest, and very probably belong to an only discoidal specimen that is 8 mm in diameter. These were presented as "Lituolidae, gen. et sp. ?" by Ramalho (1971, Pl. 18, Figs. 7-8; Pl. III, 8, 9 in the present paper). We interpret this specimen as a microspheric form of *Farinacciella ramalhoi*. The juvenile stage in the centre of the axial section (Pl. III, 9; sector A) is made up of small and irregularly coiled chambers, forming a central protuberance on one side of the disc. This stage is followed by a series of chambers, subdivided by a median wall (sector B). The stolons, arranged in a single row, are located in the back part of the chamberlets (Pl. III, 9, short arrows). The corresponding sector in the oblique section (Pl. III, 8) shows the typical structural pattern of *Farinacciella ramalhoi*: a cross-wise oblique stolon system conditioning the alternating position of lateral partitions in successive chambers. The last ontogenetic stage (sector C) is characterized by a clear increase in chamber volume and a more complex stolon system (Pl. III, 9, long arrows).

A section through a strongly bent specimen of *Farinacciella ramalhoi* from the Kimmeridgian of Jumilla (Murcia province, Spain), figured by Fourcade (1970, p. 37, Fig. 9; Pl. III, 4 in the present paper), shows two lateral growths branching off at nearly right angles (marked by arrows). Hottinger and Caus (1982, Pl. 1, Fig. 4) observed similar growth in *Ilerdorbis decussatus*, which is a large agglutinated discoidal foraminifer from the Campanian of the Lleida province (Spain), comparing them with supplementary structures that occur "often in recent soritids living in tidal pools where salinity and temperature rise temporarily to extreme values" (p. 816).

4. DISCUSSION

A thin section, published by Chiocchini and Mancinelli (1977, Pl. 20, Fig. 2), shows numerous specimens of a larger foraminifer determined as *Kilianina lata* (Oberhauser, 1956). Some of them, which have been re-figured by us (Pl. III, 2, 3), clearly belong to *Farinacciella ramalhoi*. Figure 2 represents an oblique section, showing the median wall and the two lateral parts. In Plate III, 3, the right arrow points to a high conical juvenile stage of this species, which is made up of trochospirally arranged chambers and is followed by some chambers of the adult stage. The triangular section of the second specimen (left arrow) runs parallel to the surface of the cuneiform adult stage.

The type-material of *Kilianina lata* comes from the Kimmeridgian of the western Taurides (southern Turkey) (Oberhauser, 1956). Altiner et al. (1988) established a biozone of the same age in the eastern Taurides, which is characterized by this species and *Clypeina jurassica* (Tash et al., 2008). In eastern Spain, *Kilianina lata* was recorded by Fourcade (1968, not figured) from the Kimmeridgian of the Caroch Massif (Valencia province), and 1970 (Pl. 4, Fig. 2) from Cerron de Fuente–Alamo (Albacete province). However, this latter determination requires a revision based on the study of supplementary material.

Oberhauser (1956) interpreted *Kilianina lata* as an orbitolinid foraminifer, using in his description the structural terms introduced by Henson (1948). The low conico-concave holotype (1956, Pl. 1, Fig. 2), with a diameter of 6.5 mm and a height of 0.5 mm, is made up of broad annular "chamber layers" (KL in Fig. 2 of this paper). Unfortunately, the juvenile stage of the holotype is destroyed, but a somewhat oblique subaxial section (1956, Pl. 1, Fig. 5; Pl. III, 5 of this paper) suggests a high conical initial stage. The chamber layers are subdivided into: a thin, external zone of relatively large, undivided "marginal chamberlets" (MK), forming together the "Wabenschicht" (W [=honeycomb layer]); and a broad internal "central zone" (ZZ) composed of "central shilds" (ZS). Random sections through the central zone (Oberhauser, 1956, Pl. 1, Figs. 1, 3, 5; Pl. III, 5-7 of this paper) reveal a subdivision of each chamber layer by vertically directed partitions, alternating from one layer to the next, conditioned by a cross-wise oblique stolon system (Fig. 2, right part). We presume that partitions of each chamber layer form as an entire reticulate structure, which is thus very distinct from the corresponding structures (median wall, lateral partitions) that subdivide the chambers of *Farinacciella ramalhoi*.

The assignment of the species lata to the genus *Kilianina* is still problematic. The high conical *Kilianina blancheti* (Pfender, 1935), being the type-species of this genus, exhibits a short initial stage, which is made up of trochospirally arranged chambers (Foury and Vincent, 1967). In contrast, the juvenile stage of the holotype of *Kilianina lata* is destroyed. Furthermore, the disposition of the first chambers in the initial stage of the already mentioned subaxial section (Oberhauser, 1956, Pl. 1, Fig. 5; Pl. III, 5 in this paper) is unclear.

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PLATES

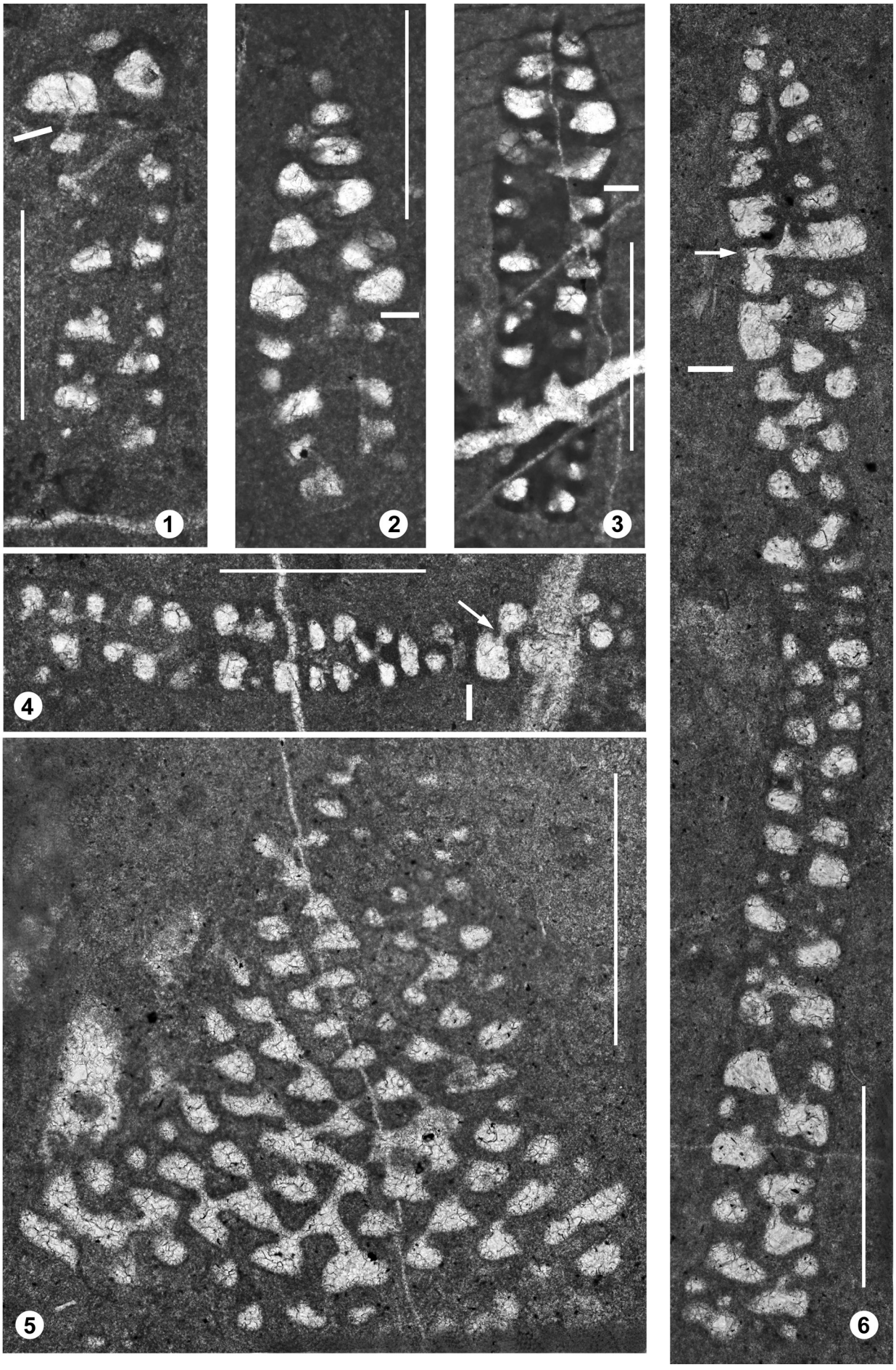
Plate I - *Farinacciella ramalhoi* n. gen., n. sp., Mount Vojnik (Crna Gora/Montenegro).

1-4: Subaxial sections of young specimens. The boundary between the juvenile and adult stage is marked by a short line. The arrow in fig. 4 points to an aperture (1: 208-19, 2: 208-12, 3: 208-18, 4: 208-8).

5: Section of the adult stage running at low angle parallel to the median plane (208-5).

6: Holotype. Section running at an oblique angle with the median plane. The arrow points to an aperture. Boundary between the juvenile and adult stage is marked by a horizontal line.

Vertical scale bar for all figures: 0.5 mm.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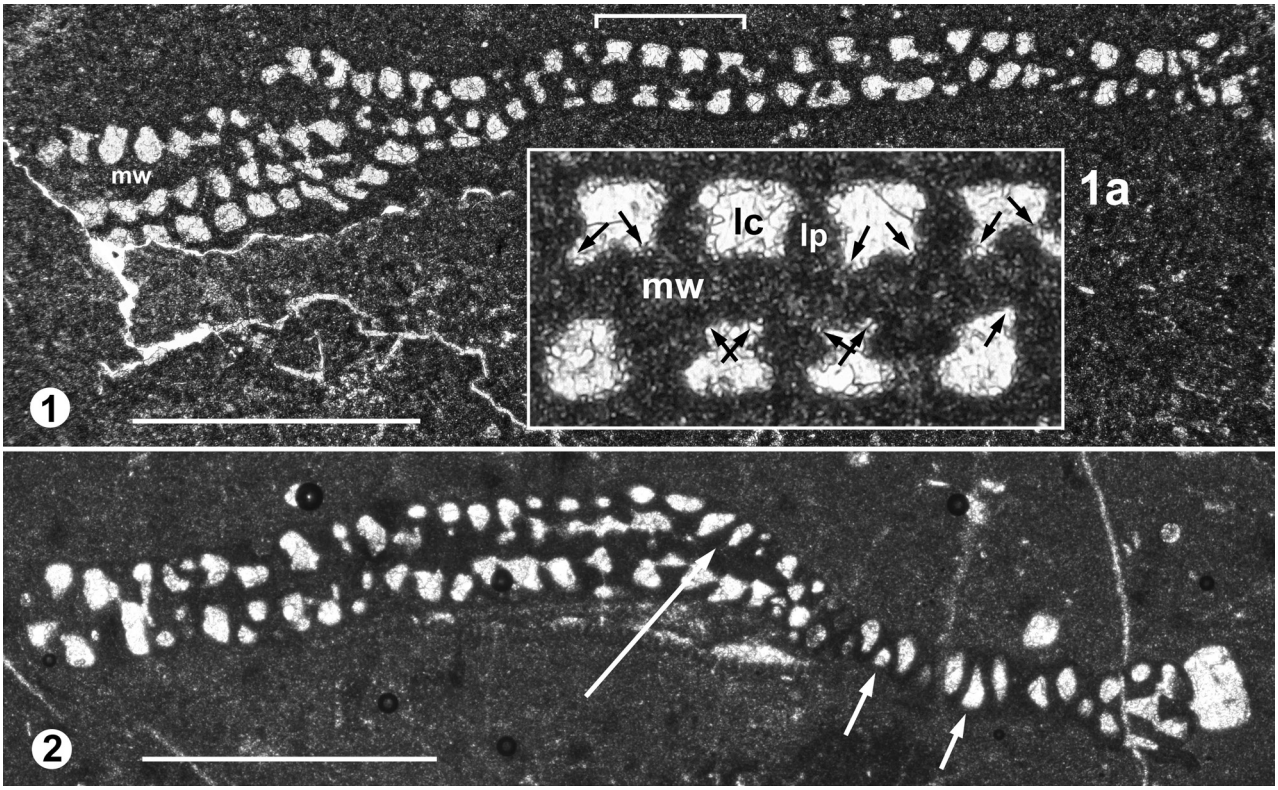


Plate II - *Farinacciella ramalhoi* n. gen., n. sp., Mount Vojnik (Crna Gora/Montenegro).

1: Section of an irregularly bent specimen (208-3). The left part runs at low angle in respect to median plane. The white line at the upper border marks the position of the enlarged section through a part of a chamber (1a), running perpendicularly to the median plane and the growth direction. Abbreviations: mw = median wall; lc = lateral chamberlet; lp = lateral partition. The black arrows point to the direction of stolons. - Scale bar: 1 mm.

2: Oblique section in respect to the median plane (208-10). The long arrow points to the median wall, the short arrows mark the external part of lateral chamberlets. - Scale bar: 1 mm.

Plate III - figs. 1-4, 8-9: *Farinacciella ramalhoi* n. gen., n. sp.; figs. 5-7: *Kilianina lata* Oberhauser, 1956.

1: Oblique section (ISPRA collection, section 163), x30.

2: Shallow tangential section at low angle in respect to median plane (from Chiocchini and Mancinelli, 1977, Pl. 20, Fig. 2) x30.

3: On the left: tangential section of the early adult stage; on the right: axial section of the juvenile stage, followed by some chambers of the adult stage (from Chiocchini and Mancinelli, 1977, Pl. 20, Fig. 2), x30.

4: Strongly bent specimen, showing lateral growth (from Fourcade 1970, Pl. 37, Fig. 9), x25.

5: Oblique subaxial section (from Oberhauser, 1956, Pl. 1, Fig. 5), x12.

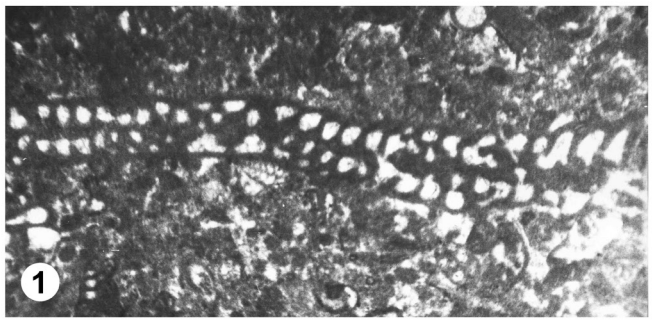
6: Subaxial section (from Oberhauser, 1956, Pl. 1, Fig. 1), x20.

7: Subaxial section (from Oberhauser, 1956, Pl. 1, Fig. 3), x20.

8: Oblique section of a microspheric form (from Ramalho, 1971, Pl. 18, Fig. 7), x30.

9: Axial section of a microspheric form (from Ramalho, 1971, Pl. 18, Fig. 8) showing different ontogenetic stages (A-C). Stolons of stage B are arranged in a single row (short arrows), but form a more complex system in stage C (long arrows), x30.

Provenance of the material – 1: Mount Ardiacara (Lepini Mountains, Latium, Italy), 2-3: Aurunci Mountains (Latium, Italy), 4: Jumilla (Murcia province, Spain), 5-7: Western Taurides (Turkey), 8-9: South of Lisbon (Portugal).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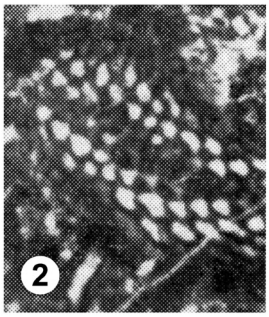
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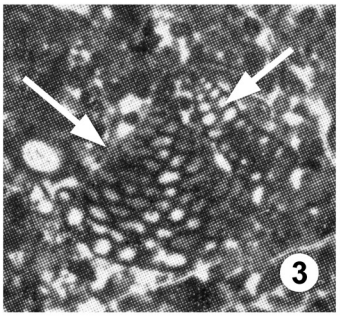
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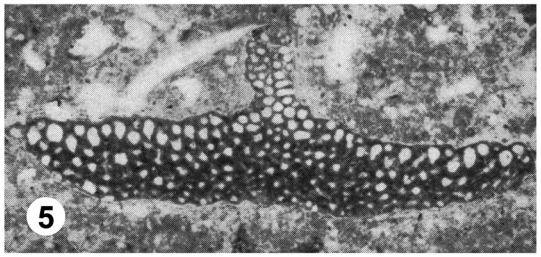
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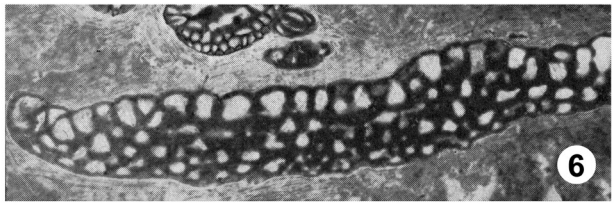
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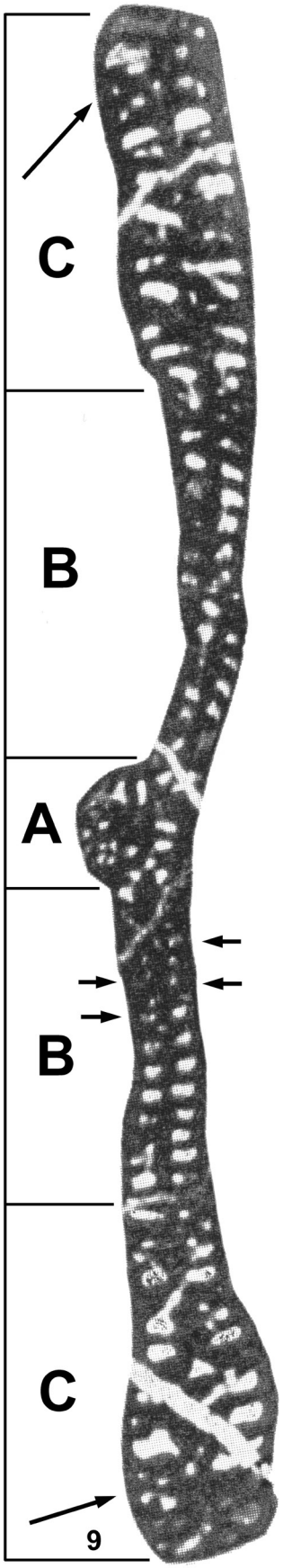
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