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Taxonomy and stratigraphy of an algal assemblage in Palaeogene deposits of the northern foothills of Mt. Biokovo (Southern Croatia)

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ABSTRACT

A rich algal assemblage at the Kozica locality, in the northern foothills of Mt. Biokovo, contains, among other forms, *Praturlonella salernitana* BARATTOLO. In addition, the descriptions of *Clypeina bucuri* BARATTOLO & ROMANO and *C. lucana* BARATTOLO & ROMANO are updated, and the originally described *Clypeina teakolarae* RADOIČIĆ et al. has been tentatively transferred to the genus *Falsolikanella* GRANIER as *Falsolikanella*? *teakolarae* n. comb. *Falsolikanella*? *macropora* n. sp. is described, characterized by probable metaspondyle growth of clearly phloiophorous branches, differentiated individually into a narrow stalk and very long, markedly widened, outer part. Based on the algal assemblage as a whole, together with benthic and planktonic foraminifers, the stratigraphic position of the algal-bearing level has been defined as Ypresian (lowermost Eocene).

Keywords: Calcareous algae (Dasycladales), taxonomy, stratigraphy, Eocene, Dinarides, Croatia

1. INTRODUCTION

Rare discoveries of dasyclad algae in the lower part of Palaeogene deposits along the coastal region of the Karst Dinarides in Croatia, are limited to several localities, according to the data published so far, either as a result of random sampling or samples being handed over to the authors by colleagues. Initial finds from southern Dalmatia are mentioned in RADOIČIĆ's (1974) description of *Actinoporella kukoci* from the Tri Luke locality on the island of Korčula, supposedly of Palaeocene age. Later, RADOIČIĆ (1995) reconsidered the stratigraphic position of beds with *A. kukoci* and rare fragments of *Praturlonella salernitana* BARATTOLO on Korčula and the neighbouring Pelješac peninsula. She concluded, on the basis of the accompanying foraminiferal assemblage and its occurrence at the other localities (Apennines, Istria), that it was Middle-to-Late Eocene in age, and not older than the Middle Lutetian. Later still, RADOIČIĆ (2004) reports on the rich algal assemblage (more than 20 species) in a sample from the Pločice locality, (the area of Konavle, SE of Dubrovnik), coming from a calcareous-dolomitic zone, ascribed previously to the Maastrichtian–Danian stratigraphic range. The author stresses the significance of that find and, though lacking the analysis of the stratigraphic column, concludes, on the basis of the algal assemblage, on its Danian age, this being as yet the oldest documented Palaeogene strata in this area.

In the course of field investigations carried out during biostratigraphic analysis of foraminiferal assemblages in the Jurassic and Cretaceous carbonate platform deposits of the Croatian Dinarides (VELIĆ, 2007), a section cutting through

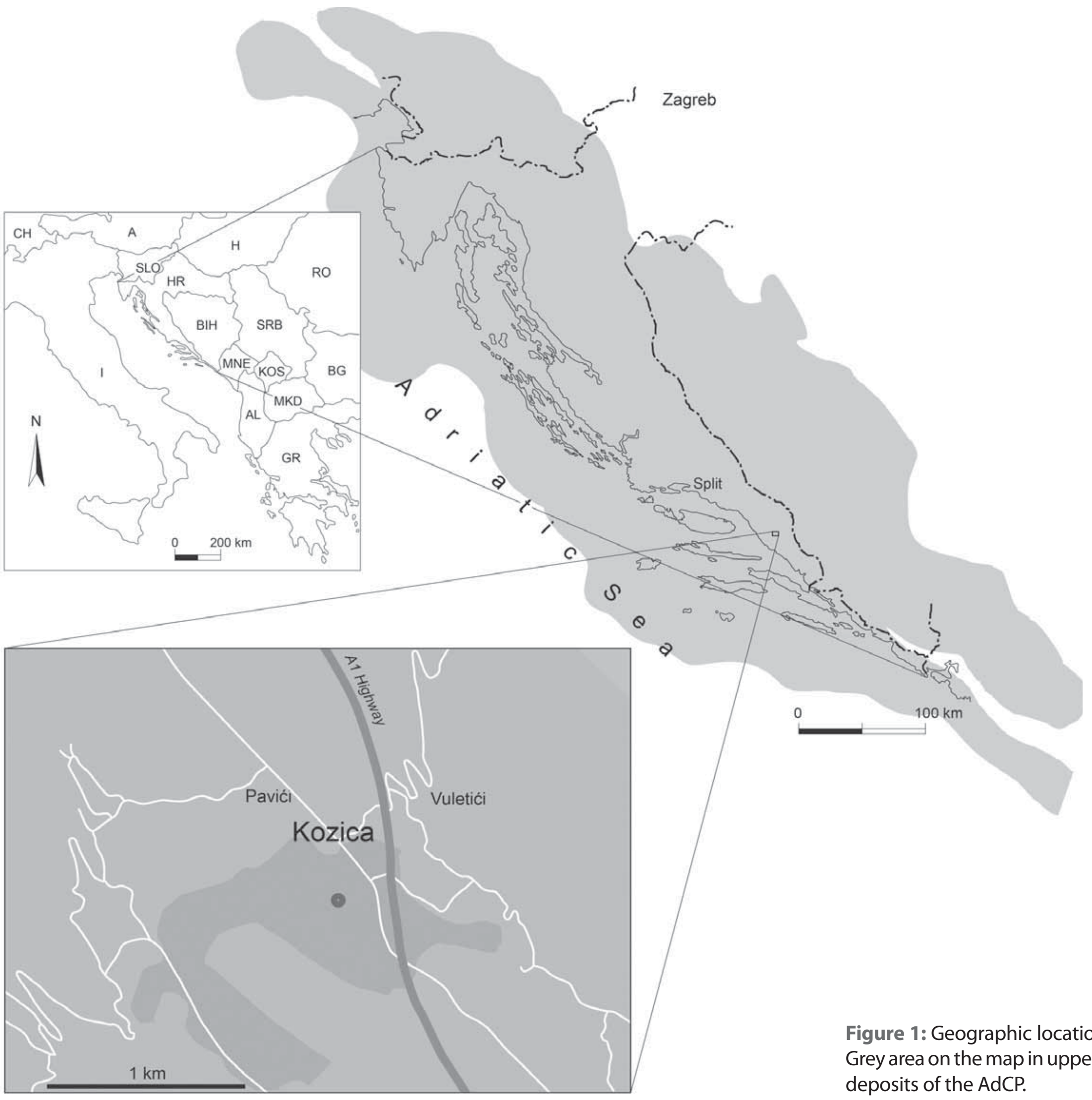


Figure 1: Geographic location of the Kozica locality. Grey area on the map in upper right corner represents deposits of the AdCP.

the Upper Cretaceous–Palaeogene transition in the northern Biokovo area, near the village of Kozica (Fig. 1), has been identified and sampled. In the first beds of the transgressive Palaeogene, fragments and rare sections of dasyclad algae were observed, providing the impetus for more detailed investigations and the collection of more material, in order to perform better taxonomic determination and to establish more firmly the stratigraphic position of the algal remains. The first results revealed a rich algal assemblage quite similar to that described by BARATTOLO (1978) and BARATTOLO & ROMANO (2002), with the addition of some other forms described below.

A large number of thin-sections yielded more data, which enabled better definition of some morphological characteristics of the previously established species, as well as the erection of new ones, which raised problems in the relationship between the genera *Praturlonella* and *Falsolikanella*. A comparatively rich foraminiferal association, partly contained in the algal-bearing samples and partly acquired from successive overlying beds, enabled a more reliable definition of the stratigraphic position of the Kozica algal assemblage.

2. STRATIGRAPHIC POSITION OF THE ALGAL-BEARING DEPOSITS IN THE KOZICA STRATIGRAPHIC COLUMN

The ancient Adriatic Carbonate Platform (AdCP) disintegrated into several blocks during the Late Cretaceous (see e.g. VLAHOVIĆ et al., 2005; KORBAR, 2009 and references therein) which emerged at different times due to synsedimentary tectonics as the Adria microplate began to collide with Europe. Besides the faulted blocks, a thick sequence of predominantly shallow-marine Mesozoic carbonate deposits was gently folded into broad structures, representing the precursors for the formation of deeper-marine basins during the Palaeogene.

Uplifted Mesozoic carbonates were covered by the sea during the Eocene (some Palaeocene carbonates were deposited only at the NW and SE tips of the platform), resulting in a sequence of Foraminiferal limestones accumulated in carbonate ramp environments (ĆOSOVIĆ et al., 2004, 2008). The succession of these deposits indicates gradual deepening, resulting in different foraminiferal assemblages depending on changing water depth and energy. Continued tectonic deformation caused basin deepening, and while carbonate facies gradually retreated towards shallower areas, in deeper parts they were gradually replaced by the so-called Transitional Beds – "Globigerina" marls with crabs and glauconite, and so-called flysch deposits – an alternation of carbonate sandstones and variable amounts of siliciclastic material (transported into the basin from surrounding shallower areas) and autochthonous marly deposits.

Dasyclad algae described here have been discovered in the lowermost part of the Eocene foraminiferal limestones deposited on karstified Upper Cretaceous limestones (Fig. 2).

2.1. Cretaceous deposits

The deposits in the area of Kozica represent the upper part of a more or less continuous succession of strata, which in this part of Biokovo comprise a stratigraphic range from the Middle Jurassic to the Eocene.

Upper Cretaceous deposits underlying the Foraminiferal limestones with dasyclad algae represent typical shallow-marine deposits of the AdCP. These are skeletal–peloid wackestones to packstones, rarely mudstones, grainstones or floatstones/rudstones containing rich assemblages of benthic foraminifera and rudists. Approximately 60 m below the K/T boundary, the last occurrence of the very common benthic foraminifera *Keramosphaerina tergestina* STACHE has been discovered; stratigraphic range of this species is Late Santonian–Early Campanian. In the topmost 60 m *Pseudorhapydionina mediterranea* (DE CASTRO) and *Murgella lata* (LUPERTO-SINNI) which continued from older deposits are accompanied by other important index forms, *Nummofallotia cretacea* (SCHLUMBERGER) (Pl. XIX, Fig. 6), and *Calveziconus lecalvezae* CAUS & CORNELLA (Pl. XIX, figs. 7–10). On the basis of such an assemblage, the uppermost part of the Cretaceous deposits is definitely Campanian in age.

Cretaceous rocks were heavily karstified during the long emergent phase before transgression in the Eocene, resulting in a morphologically very dissected relief infilled by limestones containing the studied algae.

2.2. Eocene Foraminiferal limestones

This succession of Eocene Foraminiferal limestones generally corresponds to the typical succession in the Karst Dinarides (ĆOSOVIĆ et al., 2004 and references therein), containing units named by the most common benthic foraminifera: miliolid limestones, alveolinid limestones, nummulitid lime-

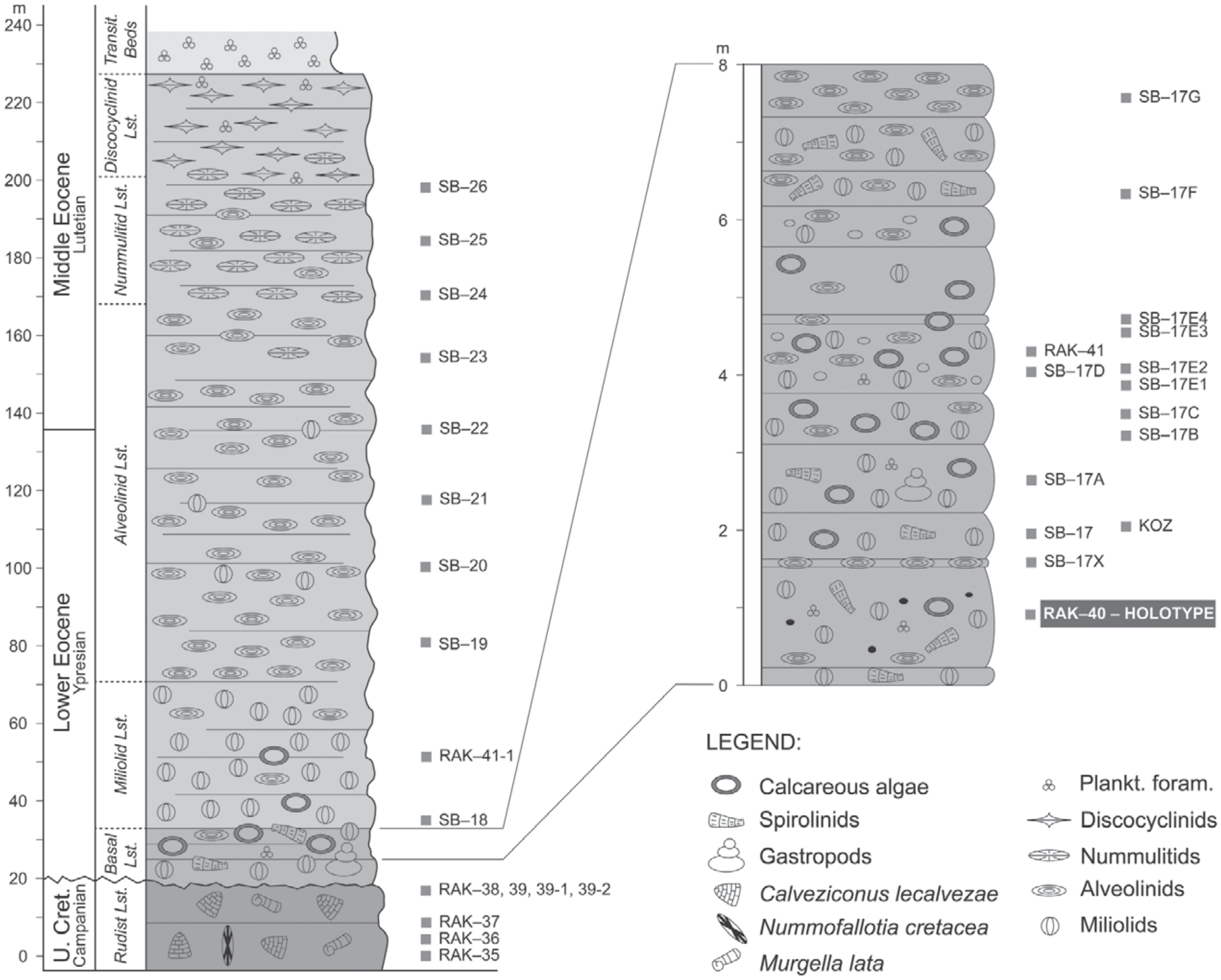


Figure 2: Stratigraphic column of the Kozica locality.

stones and discocyclinid limestones. In the lowermost part they comprise basal transgressive deposits, both in the study area and beyond.

The basal transgressive unit, (discorbid and ostracod bearing limestones) is the most important part of the Eocene succession for this study, because the described dasyclad algae occur there. These limestones infill the lowermost parts of the palaeorelief within the karstified Cretaceous limestones, so their thickness may vary from zero to a couple of tens of metres. In the studied profile they are about 15 m thick. Since these strata were deposited during an oscillating transgression, i.e. repeated small-scale transgressions and regressions of the sea, emersion breccia levels with small black pebbles are occasionally observed. In addition, infrequent deposits occur, showing open-marine influences (including rare planktonic foraminifera *Acarinina* sp. and *Igorina broedermanni* (CUSHMAN & BERMÚDEZ) indicating a Lower Eocene age – Vlasta Premec-Fućek, pers. comm.). The most common lithology is the alternation of brown micritic limestones and brown wackestones and packstones with variable amounts of benthic foraminifera (frequent small foraminifera including *Epistomaria* sp., *Discorbis* sp., small miliolids, unidentified rotaliids, *Chrysalidina* sp., *Spirolina* sp., and rare alveolinids), the studied dasyclad algae (that occur mostly in this part of the succession), bivalves and gastropods. Most beds are rich in organic matter as a consequence of deposition in a low-energy, restricted environment, and in places charophytes are seen.

The basal limestones are conformably overlain by limestones commonly composed of a vertical succession of several units, which are relatively easily recognized according to their fossil content. The oldest unit, the miliolid limestones, overlie the basal Eocene limestones (or directly Cretaceous limestones if the basal unit is missing), and originated in very restricted shallow-marine environments. Larger miliolids (*Spirolina* sp., *Periloculina dalmatina* DROBNE; Pl. XIX, figs. 3–4) outnumber agglutinated conical taxa (*Chrysalidina* sp., *Cribrobulimina* sp.), alveolinids (*Alveolina decastroi* SCOTTO DI CARLO, *A. cremae* CHECCHIA–RISPOLI, *A. pinguis* HOTTINGER, *Glomalveolina (Alveolina) minutula* REICHEL, etc.; Pl. XIX, figs. 1–2, 4–5), and smaller benthic foraminifera including *Medocia blayensis* PARVATI and unidentified rotaliids. The sediments were deposited in inner platform settings during the late Ypresian (Cuisian; DROBNE, 1977, 1985; DROBNE et al., 2011), corresponding to the Shallow Benthic Zone (after SERRA-KIEL et al., 1998) SBZ 11.

They are followed by alveolinid limestones deposited in shallow-marine environments with higher energy, more or less above the fair-weather wave base, and nummulitid limestones deposited in deeper parts of the carbonate ramp, where storm influence caused continuous reworking and transport, indicating differentiation in an inner ramp setting up to the early Lutetian (SBZ 13). Such a stratigraphic age is also confirmed by an assemblage of planktonic foraminifera within the nummulitid limestone: *Acarinina primitiva* (FINLAY), *Planorotalites pseudoscitula* (GLAESSNER), *Globigerinatheka kugleri* (BOLLI, LOEBLICH & TAPPAN), *Catapsydrax unicavus* BOLLI, LOEBLICH & TAPPAN, *Subbotina eocaena* (GÜMBEL), and *S. yeguaensis* (WEINZIERL & APPLIN) (Vlasta Premec-Fućek, pers. comm.).

The deepest facies belt of the Foraminiferal limestones is characterized by deposition of discocyclinid limestones, overlain by the Transitional beds ("Globigerina" marls with crabs and glauconite) and flysch, i.e. basinal deposits with common turbidite layers. Due to the significant synsedimentary tectonics and local relief, facies belts migrated through time at different rates, and therefore in different areas litho- and biofacially similar units may be of different age.

3. ALGAL ASSEMBLAGE OF THE KOZICA LOCALITY

In the northern foothills of Mt. Biokovo, along the Cretaceous–Palaeogene boundary, south of the main Vrgorac–Zagvozd road, basal transgressive Palaeogene sediments are sporadically preserved in shallow depressions in the Cretaceous palaeorelief. They contain, in addition to scarce planktic and benthic foraminifera, frequent, sometimes rich, remains of dasyclad algae. Among numerous fragments and sections of visibly articulated dasyclad thalli of various dimensions, different degrees and types of calcification, and various state of preservation, two groups of mutually more or less similar forms can be generally distinguished, each characterized by some common characters.

The first group includes the remains of small specimens of segmented, weakly calcified thalli, whorls visibly separated, with individually positioned acrophorous to phloiophorous branches, visually reminiscent of *Clypeina*-type morphology. Within that group, two forms can be recognized and taxonomically identified as belonging to previously described species, namely *Clypeina bucuri* BARATTOLO & ROMANO and *Clypeina lucana* BARATTOLO & ROMANO.

The second group includes visually similar forms which have in common a more or less regular widening and narrowing of the central cavity reflecting the articulated skeleton with the visibly spaced whorls bearing groups of branches, regardless of whether this is the result of their common point of origin or only an appearance due to different inclinations of individual branches of the same whorl. Typically phloiophorous, branches are differentiated into a stalk and a swollen outer part. The interspaces between the steeply upward oriented branches of the same whorls are heavily calcified, giving rise to conical bodies, resulting in the entire skeleton having the appearance of a vertical row of inversely positioned cones.

Within the extremely abundant material of this group, three, possibly four, forms can be distinguished, based on differences in shape of the same type of branches, more pronounced values of some biometric parameters, the direction of growth of variably inclined branches, the type of calcitic structure of the skeletal remains, and of questionable euspondylity or metaspondylity. One form has been attributed, (though with some doubts on the generic affiliation), to the previously described species *Praturlonella salernitana* BARATTOLO, whereas the three remaining forms are ascribed to the metaspondyle genus *Falsolikanella* GRANIER. Based on their mutual morphological differences, as well as on whether calcification occurred within or outside the cell membrane, and the type of calcitic structure (granular or fibrous) in the preserved parts of the skeleton, one species within that group can be determined as the recently described *Clypeina teakolarae* RADOIČIĆ, JURKOVŠEK & JOVANOVIĆ, with the revised generic attribution. However, another can be described as a new species, *Falsolikanella*? *macropora* n. sp., whereas the third can be determined at generic level only, as *Falsolikanella*? sp., due to the insufficient number of illustrative sections.

The authors are aware of the possibility, that the defining, delimitation, and/or ascribing of particular sections to the above mentioned taxa may, in some cases, appear doubtful and, from the viewpoint of acceptability, may be questioned or even repudiated. In addition to the unavoidable author's subjectivities, other reasons may include the supposed similarity of some sections previously ascribed to the same taxon, and issues of ontogeny. It is also possible, that the original description may have contained some errors which were then unrecognised only becoming apparent when some taxa were separated and described later. Therefore, it seems useful to redefine some morphological characteristics, emphasizing, in particular, their significance for the clearer separation and identification of taxa described. Besides, the obvious similarity between species ascribed to different genera revisits the questions on the *Praturlonella/Falsolikanella* relationship.

The following analysis of various genera and species from the algal assemblage of the northern Biokovo foothills (the Kozica locality) is based upon numerous sections contained in about 150 thin-sections, made either from a single sample or from several samples derived from the same or closely situated levels (Fig. 2), collected during several visits to the locality.

Clypeina bucuri BARATTOLO & ROMANO 2002
(Pls. I–III)

Synonymy:

2002 *Clypeina bucuri* n. sp.– BARATTOLO & ROMANO, p. 41–69, Pl. 1, figs. 1–22, Pl. V, figs. 1–8.

Remarks: Rare remains of the species, originally described by BARATTOLO & ROMANO (2002), are restricted to the area of its type locality in scattered outcrops of the Lower–Middle Eocene (VECCHIO et al., 2007) Trentinara Formation in the central and southern Apennines of Italy. The age of the Clypeina-bearing interval within the Trentinara Formation is defined as Ypresian (Lower Eocene) by BARATTOLO & ROMANO (2002) and VECCHIO et al. (2007). New Karst Dinaridic examples, with numerous and well preserved sections at the Kozica locality, enable re-examination and increase understanding of its morphological characteristics in order to more precisely define its stratigraphic position.

During re-examination of this species and its differences from contemporaneous taxa, the analysis of morphotypes as elaborated by BARATTOLO & ROMANO (2002), which eventually produced descriptions of two new *Clypeina* species, i.e., *C. bucuri* and *C. lucana*, is not included here. Therefore the species will be analyzed separately, partly repeating and partly, when necessary, supplementing the primary description, with their distinguishing characteristics and the limits of tolerable variations.

Description: In agreement with the original description (BARATTOLO & ROMANO, 2002) of the heterogeneous algal assemblage, sections of fragmented, articulated, generally small and weakly calcified algal thalli were ascribed to this species. A relatively regular cylindrical skeleton appears articulated (segmented), as a result of abrupt circular constrictions, situated at regular intervals along the thallus of individual specimens (Pl. I, figs. 1, 8). Thus the entire skeleton appears as a row of vertically stacked cylinders, in some cases slightly claviform, mutually separated by constrictions and sometimes visibly connected by short necks (Pl. I, fig. 8). The length of individual segments appears to be constant in the same specimens (probably, because of the small number of preserved sections), but differs in different individuals. In Tables 1–3 of BARATTOLO & ROMANO (2002), the lengths of individual segments in specimens from different samples vary as follows: Table 1: 0.35–0.55; Table 2: 0.28–1.00; Table 3: 0.20–0.80, giving, summarily, approximate ratios of 1:2 to 1:4. Measurements of the present specimens range from 0.58–1.80, in an approximate 1:3 ratio. The central cavity is enclosed, all along the thallus length, by a very thin calcareous envelope with smooth inner and outer surfaces. The thickness of the calcareous envelope varies from 0.025–0.12 mm, most frequently 0.04–0.08 mm, being always constant in the same specimen. Exceptionally, in a small number of longitudinal sections, tapering may be noticed (Pl. I, fig. 2). This is relatively more frequent in the lower part of a segment, in the zone of constrictions and connections between the upper and lower cylindrical segments (Pl. I, figs. 3, 7–10), connected to the strengthened (thickened) upper part of the lower article (Pl. I, fig. 8). This is probably the reason why the skeleton frequently breaks apart into separate cylindrical segments. The regular appearance of cylindrical tubes is sometimes disturbed by slight swellings of the central cavity in some segments, manifested on the outside by a slight bulge of the outer surface, perhaps only on one side of the calcareous envelope (Pl. I, fig. 2).

Examples of well preserved specimens enable some supplements to the original description (BARATTOLO & ROMANO, 2002) to be made. This refers primarily to the position of the whorls, shape and calcification of the branches. The existence of only primary branches is corroborated by this material. They are situated in one-rowed whorls, mostly (but not exclusively) in the upper part of the lower segment where it becomes narrower and connects to its upper neighbour. In this zone, up to three closely spaced whorls are developed (Pl. I, figs. 1, 7). Characteristically, in longer segments, a separate whorl can also be developed in their central part, between the upper and lower constrictions (Pl. I, figs. 2, 4–5). Some transverse sections, where the central cavity is regularly circular in shape, show unevenly distributed branches in the same level, indicating their asymmetric arrangement in the whorl (Pl. II, fig. 8 part; Pl. III, figs. 11–12). These features had not been reported in the first description of this species (BARATTOLO & ROMANO 2002, Fig. 8). Also, such irregular distribution of the whorls in some segments makes the correlation of the biometric parameter *h* insignificant. Thin, weakly calcified walls surrounding the cylindrical articles continue outwards along the soft tissue of the branches, thus forming a thin calcareous envelope along the entire branch length. In some specimens, stronger calcification may be observed only at the base of the branches, surrounding the outgoing small channel where the article's envelope extends along the branch (Pl. I, figs. 1, 4 part, 7; Pl. II, figs 1–2 part, 6, 10). As the branch envelope tapers toward the end of the branch, immediately above the strengthened part, this is the critical place where the branches break off and therefore complete, or mostly preserved branches are extremely rare (Pl. I, fig.4; Pl. II, fig. 10; Pl. III, figs. 1–2, 4). The breaking of branches, generally leaving only the proximal part visible, together with the tapering of the branch envelope toward the distal end, led to the illusion of apparently non-calcified distal parts of the branches (BARATTOLO & ROMANO, 2002). However, several sections with longer branches preserved (Pl. I, figs. 4–5; Pl. II, figs. 3, 10; Pl. III, figs. 1, 7) enable a better understanding of their shape and inclination with regard to the horizontal plane. After leaving the connection to the central cavity through small outlet channels, the branches visibly and abruptly swell at the base (Pl. III, figs. 11–12) and retain the same diameter up to the distal end (Pl. II, figs. 3–10). Thus the branches can be classified as belonging to the acrophorous type, as already stated by BARATTOLO & ROMANO (2002). The scarcity of the whorls, their different inclination, and various planar cross sections mean that it is impossible to ascertain whether even the longest branches (as illustrated) represent their true maximum length.

The branch inclination of 55–70º with regard to the central axis, as mentioned in the original description (BARATTOLO & ROMANO, 2002), agrees with our observations concerning the part of the branches on the highest whorl in the zone where the cylindrical segment narrows. Our sections, however, show greater variation of the angle between the growth direction of branches and the horizontal plane of section, depending on the distance between the consecutive whorls and their position on the segment. The branches in the whorls situated in the lower and central parts of individual segments can be horizontal, sub-horizontal, and even slightly downturned (Pl. I, figs. 4–6; Pl. II, fig. 10; Pl. III, figs. 2, 11).

As the present material shows some previously unknown features, it is necessary to present an **emended diagnosis** of *Clypeina bucuri* BARATTOLO & ROMANO:

Thallus composed of connected weakly calcified cylindrical segments, as a result of circular constrictions and expansion of the central cavity at regular intervals along every individual specimen. Branches of the acrophorous type, individually calcified along their entire length and situated in up to three closely spaced whorls in the level of upper constriction of each segment. Asymmetric arrangement of branches in the whorl is also possible. In longer segments, separate whorls can also be developed between the upper and lower constrictions. Inclination of the branches depends on the position of the whorl. Branches of the upper whorls are usually more inclined relative to the lower ones that can be sub-horizontal or even slightly down turned.

Clypeina lucana BARATTOLO & ROMANO 2002
(Pls. IV–V)

Synonymy:

1979. *Praturlonella salernitana* BARATTOLO.– CHIOCCHINI et al., Pl. 2, figs. 2, 9?, 11–12.

1994. *Praturlonella salernitana* BARATTOLO.– CHIOCCHINI et al., Pl. XXXVII, figs. 9–11.

?pars 1995. *Praturlonella salernitana* BARATTOLO.– RADOIČIĆ, Pl. III, figs. 1–9.

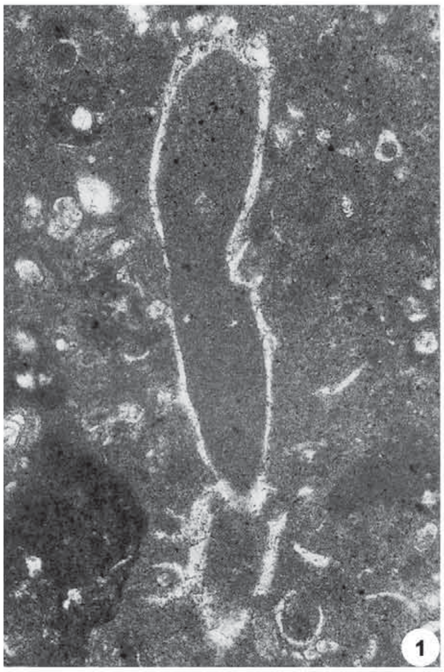
2002. *Clypeina lucana* n. sp. – BARATTOLO & ROMANO, p. 41–69, Pl. II, figs. 9–12, Pls. III–VI, Pl. VII, fig. 1 part; Pl. IV, figs. 1–2.

Remarks: Diagnosis is almost identical to that of *Clypeina bucuri* BARATTOLO & ROMANO. *Clypeina lucana* BARATTOLO & ROMANO was mainly established on the statistical analysis of biometric parameters, uniting morphotypes M2 and M3, although in reconstructions of both species (BARATTOLO & ROMANO, 2002, Figs. 8, 19), morphological differences including the shape of articles and straight or bent laterals are clearly visible. However, comparison of the given statistical parameters for the sections of *C. bucuri* contained in several samples (BARATTOLO & ROMANO, 2002, tables 1–3), does not reveal mutually significant differences; also, the differences are neither visible

Plate I

1–10 *Clypeina bucuri* BARATTOLO & ROMANO, x54.

1 Longitudinal–oblique section of three connected segments, slide SB–17E1/1.
2 Longitudinal section of a segment with branches visible in different parts, slide SB–17E1/2.
3 Longitudinal section of a segment with branches in the upper constriction, slide RAK–40A/7.
4 Longitudinal–oblique section of two segments with distinctly different positions of the branches, section RAK–40A/34.
5 Longitudinal section of a segment with branches visible in the level of upper constriction and in its middle part, slide RAK–40A/36.
6 Oblique section of a segment with branches visible in two levels, slide RAK–40B/3.
7 Longitudinal–oblique section of two connected segments; visible position of the branches in two or three close whorls, slide RAK–40A/5.
8 Longitudinal section of two connected segments with branches in the levels of upper constrictions, slide RAK–40A/10.
9–10 Longitudinal sections of isolated segments, fig. 9, slide RAK–40B; fig. 10, slide RAK–40A/3.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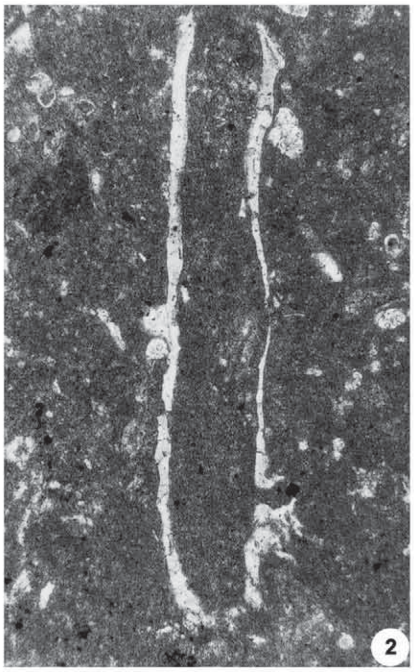
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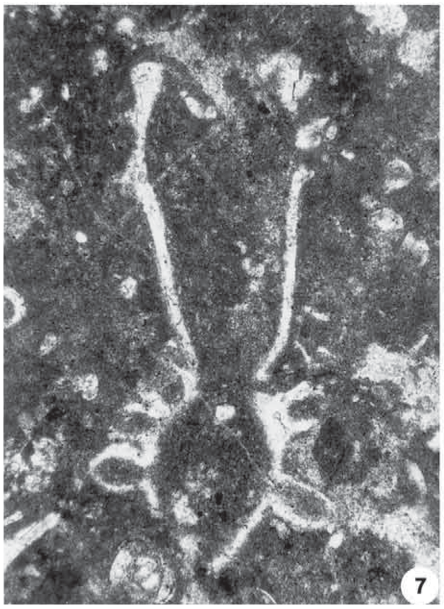
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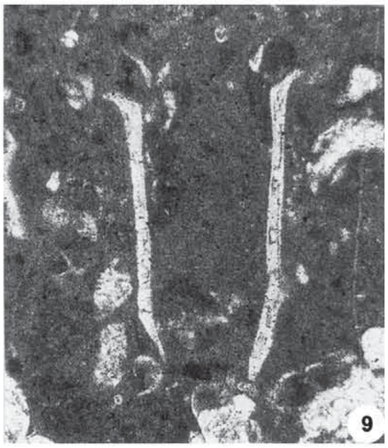
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in comparison with the values of the same parameters in *C. lucana* (BARATTOLO & ROMANO, 2002, table 4). Furthermore, either the values of individual parameters in one species are within the range of values of the same parameters for another species (see the tables mentioned above), or the numerical value of one parameter does not agree with the given interpretation and the visual impression gained by the photomicrographs (e.g., parameters with approximately the same or even greater values in *C. bucuri* than in *C. lucana*; although *C. lucana* is more heavily calcified, which is also supported by the visual impression in sections of the same magnification; see Pl. II, figs. 9–12 and Pls. III–IV in BARATTOLO & ROMANO, 2002). Evidently, the heterogeneous material the authors had at their disposal, supported by the similarity between various sections, did not allow clear expression of the descriptive differences or establishment of distinguishing features for the two species, *C. bucuri* and *C. lucana*. The same difficulty has been a problem here creating the frequent dilemma as to which species a particular section should be ascribed, which led to the further, and probably more important question of whether determination of two species was justified in the first place. As the sections illustrated in Plates IV–V also belong to an association of heterogeneous fragments, but are derived from the same sample, or adjacent samples from the same bed of the basal transgressive Eocene deposits, the mutual replacement or mix-up of these species is irrelevant for the identification of stratigraphic position. Nevertheless, their taxonomic validation based solely on the statistical analysis of selected biometric parameters remains questionable. Therefore we directed our attention to the sections of morphologically *Clypeina*-like forms which at least partly diverge from those presented with the description of *C. lucana*. Within the variability range, expressed by the fluctuation of dimensions of individual specimens, the shape of the thallus, shape of the branches and their inclination, only a few sections have been ascribed to *C. lucana* which at least partly enabled the completion and re-definition of the original description of *C. lucana* to be clearer.

Description: The variably calcified skeleton, composed of gray, sparry calcite (Pl. IV, figs. 3–4, 6–9; Pl. V, figs. 1–2, 4, 8), shows a generally cylindrical shape to the original thallus, with signs of apparent articulation. This articulation is the result of periodic swelling and constrictions of the central cavity, which is constant (spaced at regular intervals) in individual specimens. The calcareous envelope is comparatively thin, of constant thickness in individual specimens, but varies in thickness from specimen to specimen. It envelops the central cavity rather uniformly, closely following the swellings and constrictions and becoming thicker at the level of whorls, where it extends outward, along the branches (Pl. IV, figs. 1, 4; Pl. V, fig. 1). Thus the thallus consists of a succession of consecutive segments, which may be longer or shorter, more barrel-shaped (Pl. IV, fig. 1), or more cylindrical (Pl. V, fig. 1), mutually joined by constrictions. In some specimens, the calcareous envelope appears to slightly thin out towards the lower end of the upper segment, without breaking the connection with the lower segment.

A single-row of whorls are situated, as a rule, in the top part of the segment, immediately below the constrictions, bear only primary branches, which widen slightly, more or less visibly, going from the proximal to the distal end. Depending on how strongly the branches widen from the base to the outer end, their shape varies from nearly acrophorous (Pl. IV, fig. 1) to more pronouncedly phloiophorous (Pl. V, figs. 1–10). Due to a larger number of branches in a whorl and their swelling, the envelopes of the neighbouring branches are in mutual contact, thus forming a deeper or shallower bowl, depending on how steeply the branches are inclined (Pl. IV, figs. 1–4; Pl. V, fig. 1). The outer rim of such a bowl is slightly undulating, as a result of individually closed tops of branches (Pl. V, fig. 10). Inclination, i.e. the angle between the growth direction of branches and the horizontal plane, is the same for branches of the same whorl and is also more or less consistent for the branches of other whorls on one specimen; in separate individuals it can be slightly different. Very rarely, a slightly variable inclination can be noticed in neighbouring branches within the same whorl (Pl. IV, fig. 1, the fifth segment from the bottom), which make such sections visually similar to *Praturlonella salernitana* BARATTOLO.

Differential characteristics of *Clypeina bucuri* BARATTOLO & ROMANO and *Clypeina lucana* BARATTOLO & ROMANO

Analysis of the primary descriptions of these species (BARATTOLO & ROMANO, 2002), questioned whether their differentiation was firstly possible and secondly purposeful.

Plate II

1–3, 4b, 5–7; 8b , 9–10 *Clypeina bucuri* BARATTOLO & ROMANO; 4a, 8a *Praturlonella salernitana* BARATTOLO

1 Transverse, slightly oblique sections, slide RAK–40A/8, x54

2 a) Transverse section, b) longitudinal section of a segment, slide SB–17E1/3, x54

3 Oblique section, slide RAK–40A/8, x54

4 a) *Praturlonella salernitana* BARATTOLO – fragment of an oblique section; b) *Clypeina bucuri* BARATTOLO & ROMANO – transverse section, slide SB–17–1, x22

5 Different sections, slide SB–17B1/1, x54

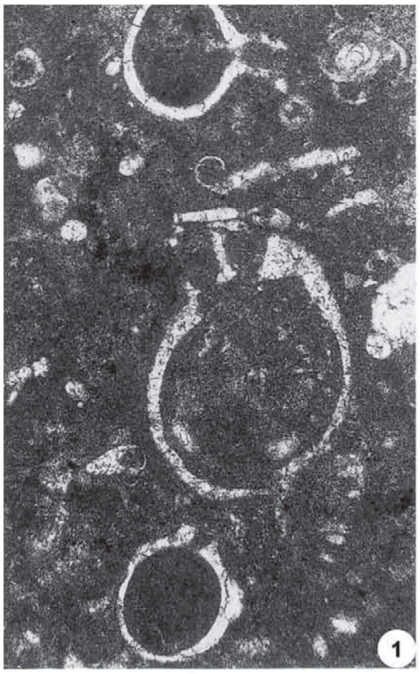
6 Oblique section of a segment, slide SB–17E1/1, x54

7 Transverse, slightly oblique sections, slide RAK–40A/5, x54

8 a) *Praturlonella salernitana* – fragment of an oblique section; b) *Clypeina bucuri* – transverse sections, slide SB–17B/1, x22

9 Oblique section, slide SB–17B/1, x54

10 Transverse section, slide RAK–40B/2, x54.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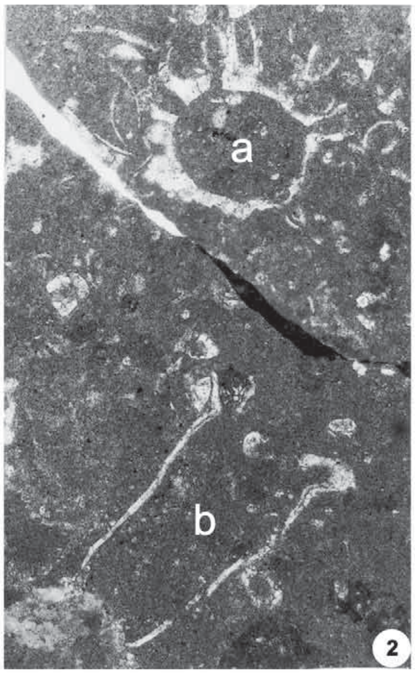
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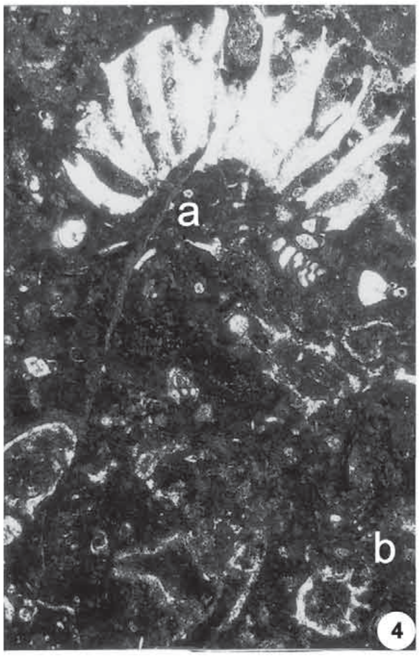
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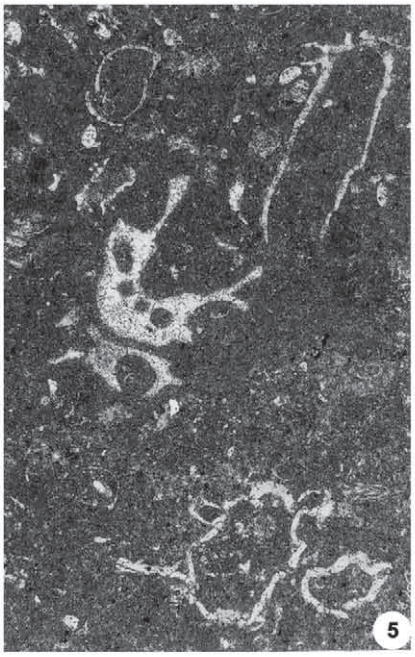
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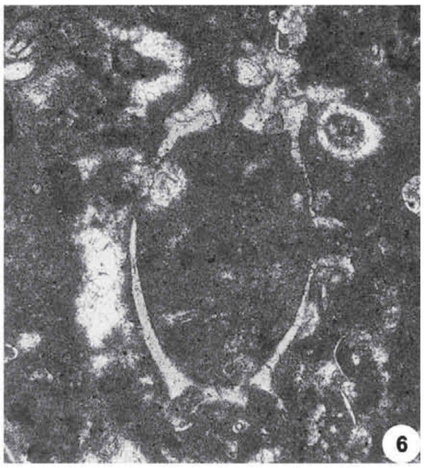
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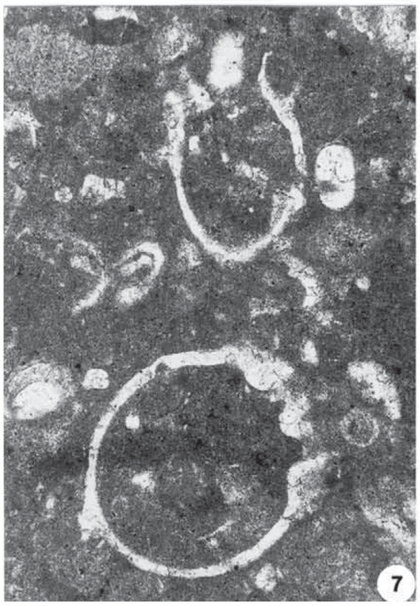
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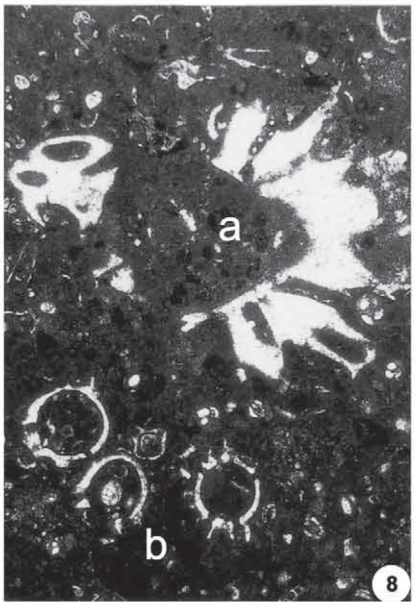
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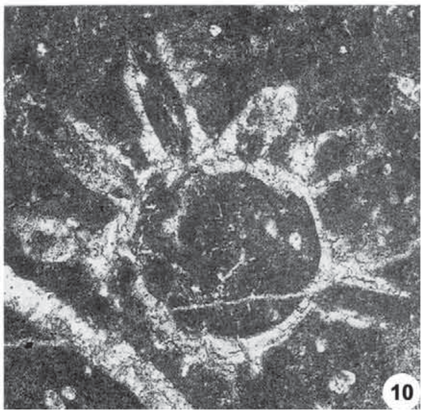
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This was based on the diagnoses of these two species in the original description, as well as the minor differences in their biometric parameters, together with the partial correspondence or overlapping within the variation ranges of some parameters. However, in spite of the similarity of their generally small dimensions, segmented (articulated) and weakly calcified thallus, and whorls with acrophorous to phloiophorous branches, some new characteristics, mentioned above, enable their specific determination and individual evaluation to be based on the following differential characteristics:

Dimensions in mm:		*Clypeina bucuri*	*Clypeina* gr. *lucana*
Length of individual segments	L art	0.50–1.50 (11)	0.35–0.77 (8)
Outer diameter at the level of whorls	D	0.58–0.59 (18)	0.76–1.70 (16)
Inner diameter at the level of whorls	d	0.20–0.50 (21)	0.15–0.68 (16)
Relation inner/outer diameter at the level of whorls	d/D	23–57% (16)	15–41% (15)
Outer diameter of thallus between the whorls	D′	0.24–0.58 (12)	0.35–0.73 (6)
Inner diameter of thallus between the whorls	d′	0.15–0.39 (12)	0.24–0.48 (6)
Relation inner/outer diameter between the whorls	d′/D′	47–76% (12)	45–83% (6)
Distance between whorls	h	–	0.40–0.68 (6)
Length of branches	l	0.19–0.48 (18)	0.28–0.82 (10)
Diameter of branches	p	0.04–0.5 (18)	0.10–0.24 (12)
Thickness of calcareous envelope of thallus	s	0.025–0.12 (27)	0.05–0.10 (8)
Number of branches in whorl	w	7–12	14–16
Inclination of branches	α	0–50°	30–60°

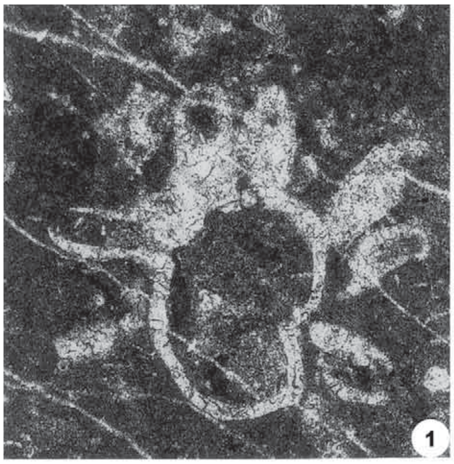
n = number of measurements (in parentheses)

Thus in *C. bucuri* we see a greater length of segments and more variability in the comparison of different individuals. Segments sometimes show a slightly claviform shape, which has not been observed in *C. lucana*. In addition, *C. bucuri* is characterized by uniformly shaped branches of a more acrophorous type, whereas in *C. lucana* the shape of branches varies from nearly acrophorous to a more commonly expressed phloiophorous type, which depends on the intensity of their gradual swelling from the proximal to the distal end. The essential difference between the two species relates to the number of whorls and their mutual relationship within the same segment. *C. bucuri* has, in the upper constricted part of the lower whorl, two to three closely spaced whorls with fewer (than C. *lucana*) fully individualized branches, clearly separated from one another. The branches in each of the closely spaced whorls have different inclinations, the branches of the highest whorl being more steeply inclined than the branches in the lower whorls. In contrast, *C. lucana* has, in the top part of the constrictions, only one whorl with more branches (than in *C. bucuri*) of uniform inclination. Because of their larger number and gradual widening going from the proximal to the distal end, the branches in *C. lucana* are in mutual contact and thus form a more or less shallow or deep bowl, depending on the inclination of branches (this feature also occurs frequently in other *Clypeina* species). Calcareous enveloping (closing) of the distal ends of individual branches gives an undulating rim of the bowl. In contrast to *C. lucana*, (with one whorl of branches in the upper constricted part of the lower segment), *C. bucuri* has, as previously mentioned in that position, two to three whorls which sometimes are developed, in longer segments, also in parts of the segments between the lower and upper constrictions. In conclusion, *C. bucuri* is more weakly calcified and comprises forms with more uniform characters, whereas *C. lucana*, based both on illustrations in the original descriptions (BARATTOLO & ROMANO, 2002, pls. III–VII) and present sections ascribed to that species (Pls. IV–V), includes more heterogeneous material, with pronounced variability in comparison to different sections which unite, under the same denominator, some common but variable characteristics. Therefore it seems preferable not to use species-specific determination of that species, but to include such variable sections within the frames of the *Clypeina lucana* group.

Plate III

1–14 *Clypeina bucuri* BARATTOLO & ROMANO, x54.

1	Oblique section, slide SB–17–2.
2	Transverse section, slide RAK–40A/9.
3	Oblique section, slide SB–17B/1.
4	Oblique section, slide RAK–40A/7.
5	Oblique section of a segment, slide RAK–40A/8.
6	Transverse, slightly oblique section, slide SB–17–2/1.
7	Transverse section, slide RAK–40A/7.
8	Longitudinal section of a segment, slide RAK–40A/2.
9	Oblique section, slide RAK–40B/2.
10	Oblique section, slide RAK–40A/10.
11–14	Transverse sections, fig. 11, slide RAK–40A/35; fig. 12, slide RAK–40A/8; fig. 13, slide RAK–40A/5; fig. 14, slide RAK–40B/2.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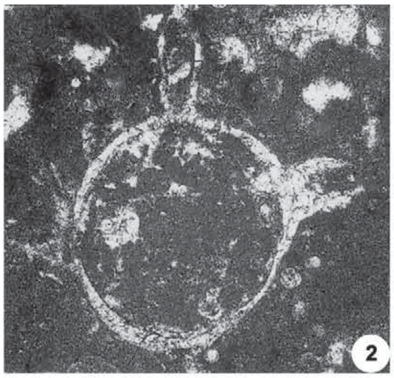
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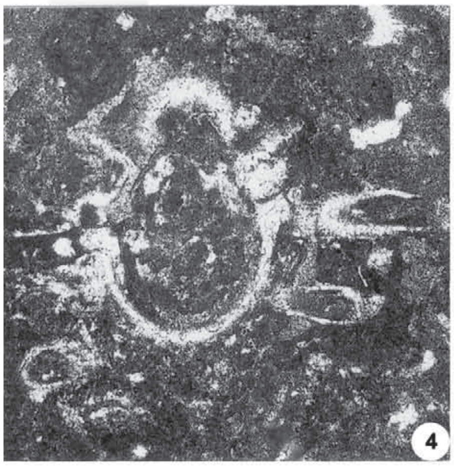
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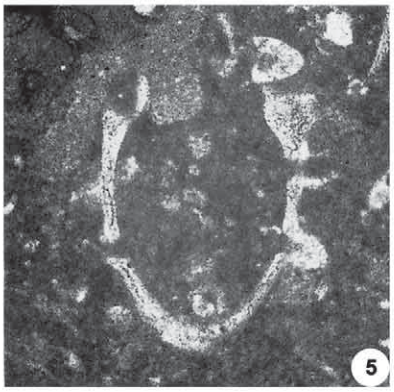
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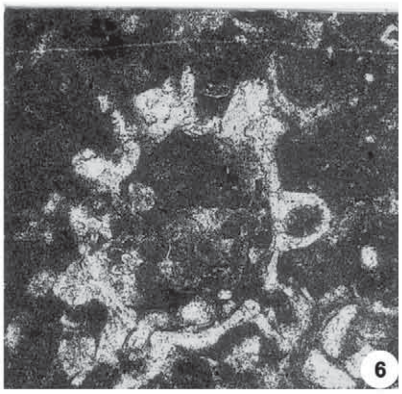
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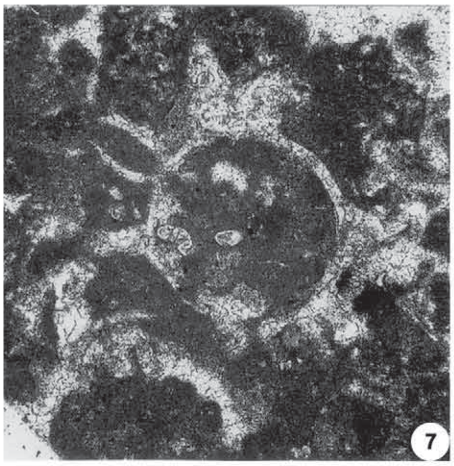
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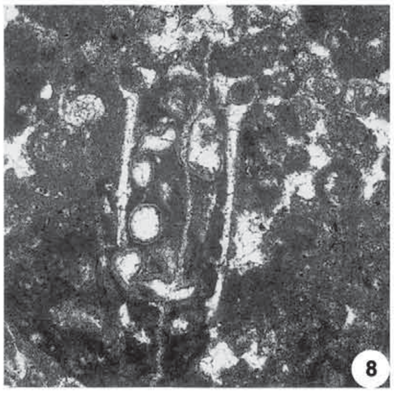
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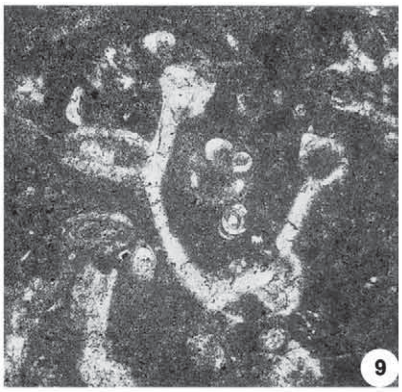
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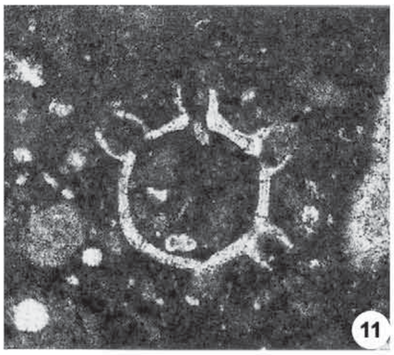
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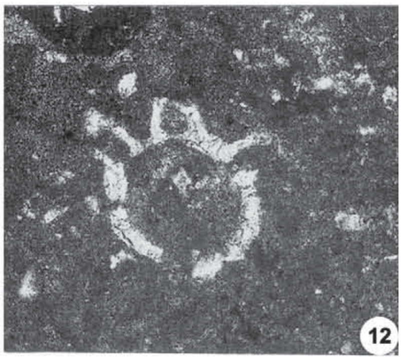
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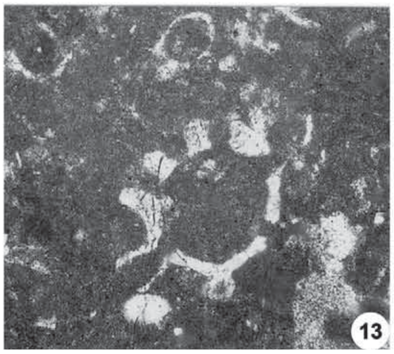
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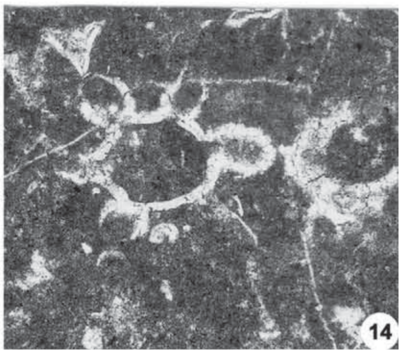
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Relationship between the genera *Praturlonella* BARATTOLO 1978 and *Falsolikanella* GRANIER 1986

Before proceeding to the description of mutually similar species included in the second group within the algal assemblage at the Kozica locality ascribed to the genera *Praturlonella* and *Falsolikanella,* it seems necessary to re-evaluate some dilemmas regarding the authors' criteria and their interpretations in the original descriptions, in order to clarify the relationship between these genera, and assess the possibly doubtful taxonomic validity of *Falsolikanella*.

The genus *Praturlonella* was established by BARATTOLO (1978), based on the morphological characteristics and author's interpretation of the species *Praturlonella salernitana*. The species' euspondility was interpreted as having single-rowed, well-spaced whorls, bearing undivided, individually situated, phloiophorous branches, variously inclined within the same whorl. The description of genus and species is illustrated by numerous sections (BARATTOLO, 1978, pls. I–XIX) of heterogeneous material regarding the dimensions of the thallus, different shape of branches, existing or non-existing differences in the inclination of neighbouring branches in the same whorl, being interpreted as different growth stages of the thallus. All this results in a broad range of visual diversity and some sections originally ascribed to *P. salernitana* may appear doubtful, possibly belonging to the subsequently described *Clypeina lucana* BARATTOLO & ROMANO (2002), i.e., the sections in BARATTOLO (1978, pl. III, figs. 1–3, 5; pl. V, fig. 4; pl. IX, fig. 8). Discussion of the relationship between the genus *Praturlonella* and the later established *Falsolikanella* GRANIER, 1986, suggests that when ascribing individual species to either of the two, the main question refers to the primary starting point of branches, i.e., whether they are euspondyle or metaspondyle. GRANIER (1986, 1987) established the metaspondyle genus *Falsolikanella*, diagnostically defined by vestibules in the proximal part of the branches, having the function of a primary branch which bears the tuft of fertile secondaries.

GRANIER & BERTHOU (1994) established the genus *Milanovicella* and Table 1 illustrated differences between similar genera *Draconisella*, *Falsolikanella*, *Likanella*, *Milanovicella*, *Praturlonella* and *Selliporella*. Euspondyl genera are differentiated on the basis of one-row (*Praturlonella*), two-row (*Milanovicella*) or three-row (*Draconisella*) whorls of phloiophorous branches, or three-row whorls of trichophorous (fusiformes) branches (*Likanella*). Metaspondyl genera with one-row whorls are differentiated on the basis of growth of the tuft of the trichophorous branches from the short branch (= vestibule) of the first order (*Selliporella*) or the tuft of the phloiophorous (piriform) branches from the vestibule (*Falsolikanella*).

Repeated analysis of the distinguishing characteristics of these genera and their mutual relationships (e.g. SOKAČ, 1996), resulted in the transference of particular species from one genus to the other. SCHLAGINTWEIT (1990) transferred *Likanella hammudai* RADOIČIĆ to *Falsolikanella*, in order for it to be later transferred by ENSSLIN & SCHLAGINTWEIT (1999) to the *Milanovicella.* KUSS & CONRAD (1991) assigned the same species to the genus *Praturlonella*, but KUSS (1994) denied this combination and accepted the primary determination of *Likanella hammudai* as the only correct one.

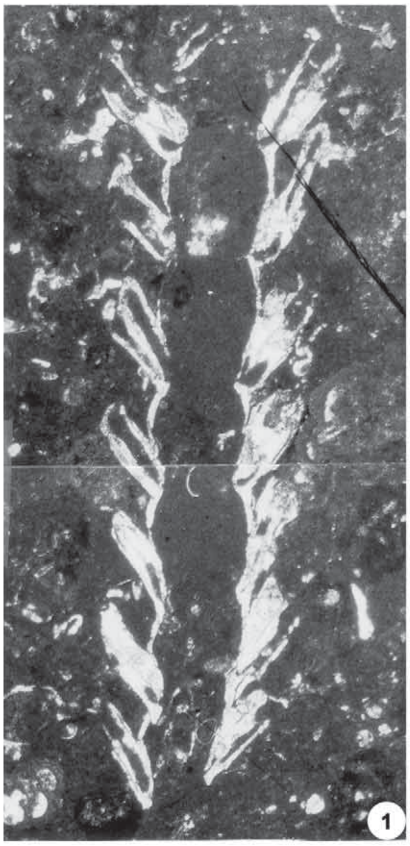
Thus, on establishment of *Praturlonella*, the previously described *Likanella danilovae* RADOIČIĆ (1969) was included into that genus, only to be later (GRANIER et al., 1999) transferred once more to *Falsolikanella*. Similarly, *Halycorine nerae*, originally described by DRAGASTAN et al. (1978), was transferred by BUCUR (1993) first into *Praturlonella*, and later into *Falsolikanella* (BUCUR et al., 2000).

All these examples clearly show that the generic determination at some time was influenced by the various approaches of different authors, based mostly on personal appraisal. Reasons for this may include the difficulty of obtaining adequate sections, cutting through the starting point of the base of a branch, as a result of the shape of the thallus, the large distance between the whorls situated at the constricted parts of the thallus, the smaller number of branches and their large mutual distance within the same whorl (in metaspondyle types), very short and slightly developed primary branches, or vestibule (in metaspondyle types), and possible destruction of the inner wall, which considerably obstructs the insight into the point of origin of the branches. Some sections illustrated by BARATTOLO (1978, pl. VII, fig. 4, upper right; pl. X, fig. 2 left side, fig. 5, lower whorl, fig. 6 left side; pl. XI, figs. 1, 6; pl. XII, fig. 2, right side, upper and middle whorl; pl. XIII, fig. 4, upper whorl, left side) indicate a supposed questionable metaspondylity. The same feature is suggested by the frequent occurrences of shallow sags on the inner wall of the central cavity at the level of the origin

Plate IV

1, 2b, 3–4, 5b, 6–10 *Clypeina* gr. *lucana* BARATTOLO & ROMANO; 2a, 5a *Praturlonella salernitana* BARATTOLO; 2c *Clypeina bucuri* BARATTOLO & ROMANO.

1 Longitudinal section, slide SB–17E1/1, x22.
2 a) *Praturlonella salernitana* – fragment; b) *Clypeina* gr. *lucana* – oblique section; c) *Clypeina bucuri* – oblique section, slide SB–17B/1, x22.
3 Transverse, slightly oblique section, slide RAK–40A/33, x34.
4 Longitudinal section, slide SB–17–1, x34.
5 a) *Praturlonella salernitana* – longitudinal section; b) *Clypeina* gr. *lucana* – transverse–oblique section, slide SB–17B/1, x22.
6 Transverse section, slide KOZ–8, x54.
7 Longitudinal section – reflected light, sample SB–17E2, x 18.
8 Longitudinal section, slide B–17C3/3, x22.
9 Transverse section, slide SB–17C/3, x34.
10 Transverse, slightly oblique section, slide SB–17E1/2, x34.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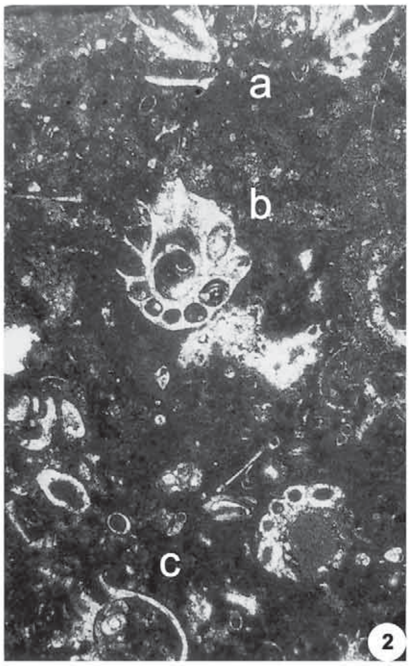
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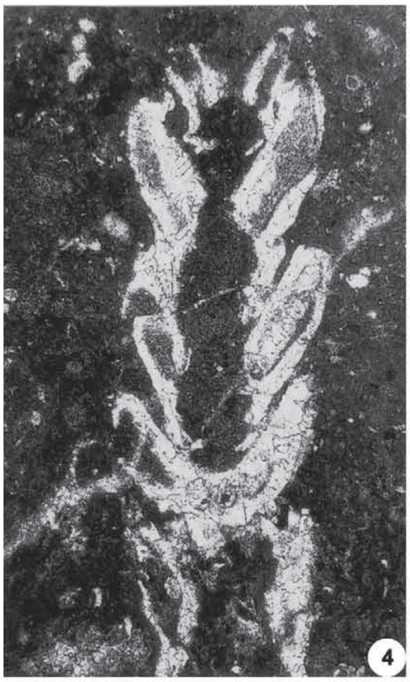
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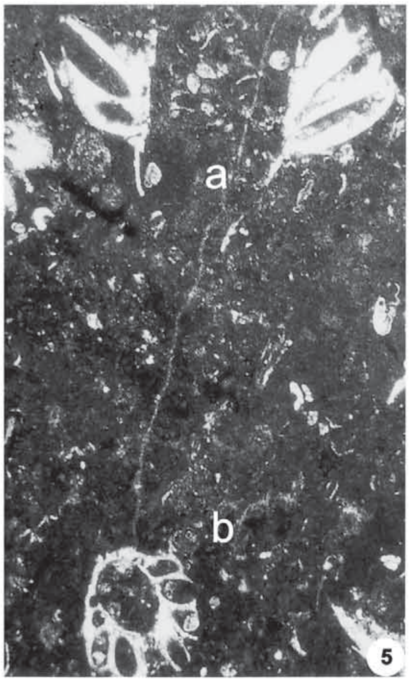
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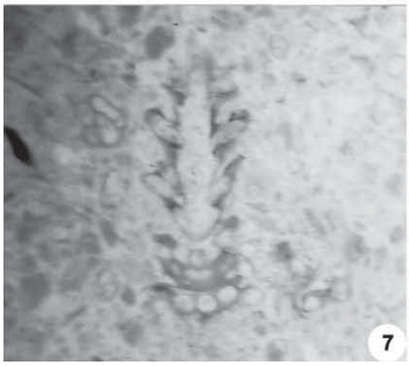
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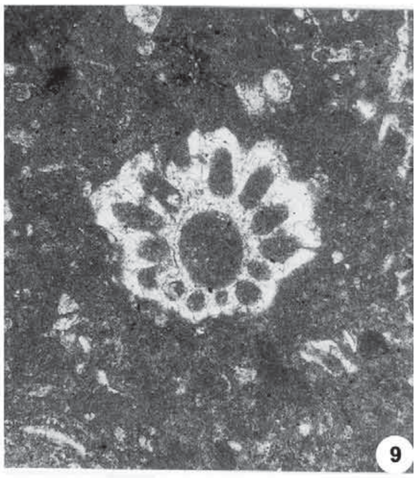
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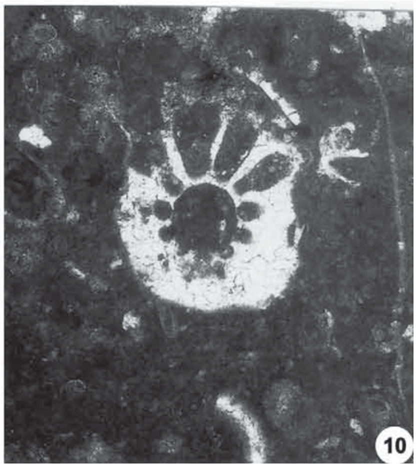
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of the branches. However, despite comments above and some doubts regarding the possible metaspondylity of that genus, for the time being we have no clear and unquestionable indications as the basis for a supplemented or new (emended) interpretation of the present diagnosis of *Praturlonella*, which remains valid regardless of possible priority changes. However, possible metaspondylity of the genus *Praturlonella* would question the continued existence of *Falsolikanella*. These questions should be answered by further investigation and analysis of new sections of the type material of *P. salernitana*. They are only some of the dilemmas which arose during the elaboration of this second group of the Kozica algal assemblage and which may contribute to the understanding that close and similar forms, visually almost identical in some morphological characters, may be attributed to different genera, and even to different tribes. The impression is that an earlier error which cannot be corrected with valid arguments but which leads into an illogical and probably unjustified taxonomic classification is being compounded.

***Praturlonella salernitana* BARATTOLO 1978**

(Pls. VI–VIII)

Taking in account the aforementioned dilemmas, and in agreement with the original description, we have ascribed the sections illustrated in Plates VI–VIII to *Praturlonella salernitana* BARATTOLO.

This species is characterized by a cylindrical thallus with successively alternating, in regular intervals, short constrictions and longer widened parts of the central cavity resulting in the articulated appearance of the thallus, described by BARATTOLO (1978) as a necklace of pearls.

The calcified thallus is composed of light gray, mosaic calcite. The intensity of calcification is remarkable, but variable from specimen to specimen, depending on the length of a segment (distance between the whorls) and the inclination of branches in a whorl. In shorter segments (articles) with less steeply inclined branches, the width increases and the height of the conical part, formed by calcitic fillings in the interspaces between the branches of the same whorl decreases, resulting in a more massive calcitic skeleton (Pl. VII, figs. 3, 8). In longer segments and more steeply inclined branches, the width of conical parts is smaller but their mutual distance is larger and the thickness of the calcareous wall gradually decreases downwards, giving the general impression of weaker calcification (Pl. VI, fig. 1; Pl. VII, figs. 2, 4).

According to the original description (BARATTOLO, 1978), the species is euspondyle. The branches are arranged in one-row, quite widely spaced whorls, situated in the top part of the lower segment, at the transition from the widened to the constricted part, immediately below the maximum constriction. Clearly individual, phloiophorous branches within a whorl are variously inclined toward the surface of the thallus, giving an impression (in longitudinal and oblique sections) of being grouped into bundles, resulting, in transverse sections, in 2–3 circular rows of pores. The number of branches in a whorl and their more or less steep inclination varies, depending on the growth stage of the thallus (BARATTOLO, 1978). A smaller number of branches and their lesser inclination in younger growth stages increases in the adult stages. Each phloiophorous branch differentiates into a relatively long stalk and a shorter, widened distal part, which is, in BARATTOLO's (1978, figs. 9–13) reconstruction, represented as a shallow bowl. In our sections (Pl. VII, fig. 1; Pl. VIII, fig. 1), the distal widening is more like a shorter or longer cylindrical swelling with rounded edges.

The point of origin of the branches and their mutual relationship in the proximal part are not completely clear. In our opinion, euspondyle interpretation remains questionable. This doubt might be supported by the fact that the genus *Praturlonella* has only two species, in contrast to the numerous, morphologically very similar species ascribed to the metaspondyle genus *Falsolikanella,* the number of which is steadily increasing.

***Falsolikanella*? *teakolarae* (RADOIČIĆ, JURKOVŠEK & JOVANOVIĆ, 2011) n. comb.**

(Pls. IX–XI; Pl. XVIII, Figs. 1–4)

Synonymy:

2011. *Clypeina teakolarae* sp. nov. – RADOIČIĆ, JURKOVŠEK & JOVANOVIĆ, p. 13–30, text-figs. 4–6, Pls. I–VI.

Sections of this species also occur in the Kozica algal assemblage. Their analysis, based on sections figured in plates IX–XI, revealed some newly registered morphological features of the thallus, type of branches and their shape

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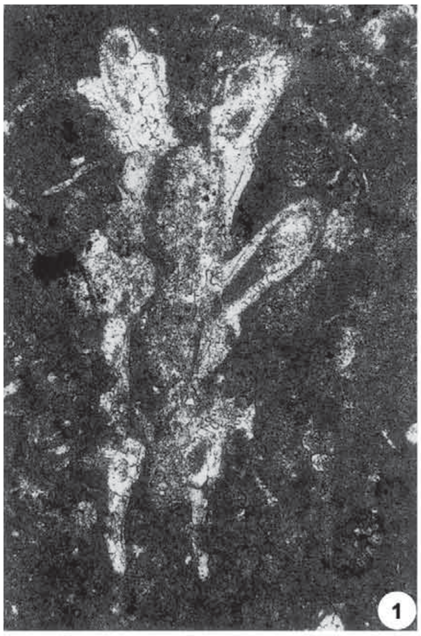
Plate V

1–10 *Clypeina* gr. *lucana* BARATTOLO & ROMANO.

1	Longitudinal section, slide RAK–40A/34, x42.
2–3	Transverse, slightly oblique section, fig. 2, slide SB–17B, x52; fig. 3, slide KOZ–6, x22.
4	Oblique section, slide KOZ–5, x54.
5	Transverse section, slide RAK–40A/23, x52.
6	Transverse, slightly oblique section, slide SB–17C2, x52.
7.	Transverse section, slide KOZ–19, x22.
8	Transverse–oblique section, slide ROK–40a/1, x52.
9	Tangential–oblique section, slide SB–17E2/18, x22.
10	Transverse–oblique section, slide SB–17C3/3, x34.
11	*Neomeris* sp. – oblique section, slide KOZ–15, x22.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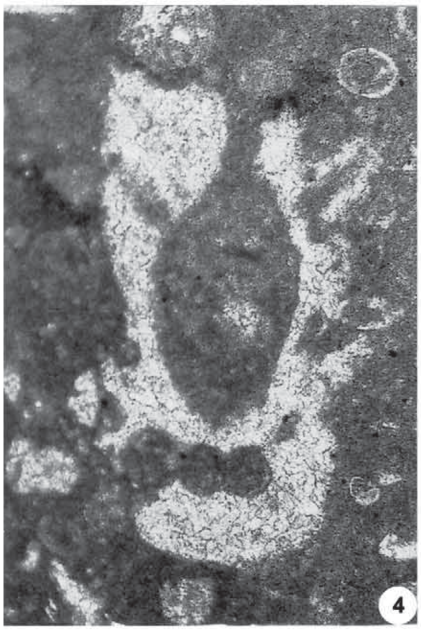
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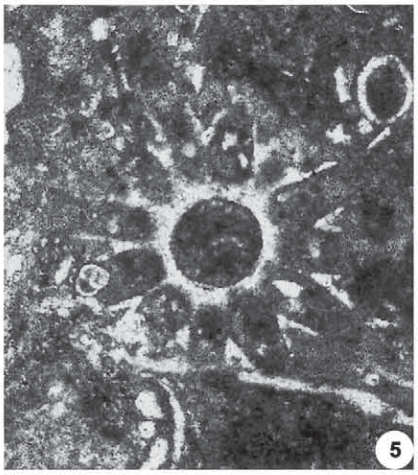
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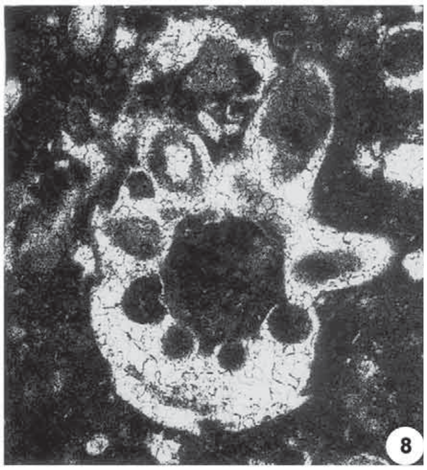
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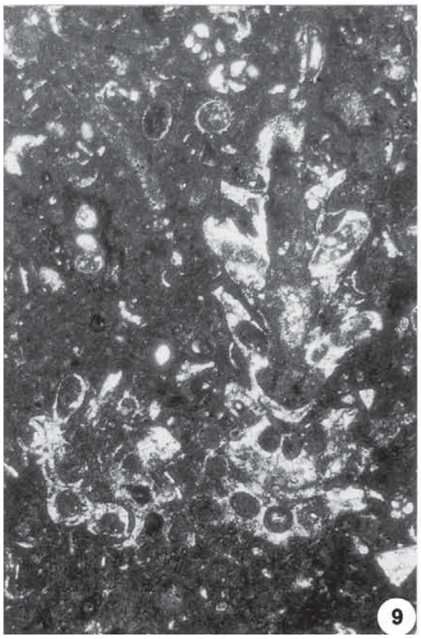
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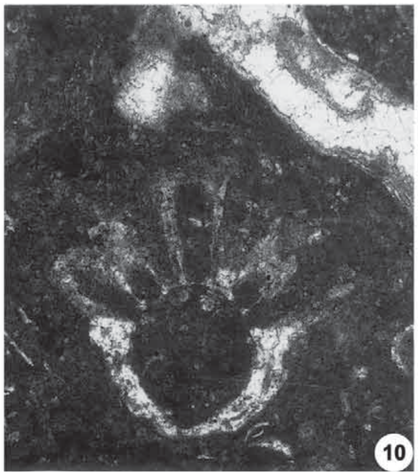
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and arrangement, which makes a generic revision necessary, i.e., its tentative attribution to *Falsolikanella* GRANIER, as well as an addition to the original description.

Dimensions in mm

Maximum observed length of thallus	L	5.4
Length of individual segments	Lart	0.9 (2)
Outer diameter at the lowest part of whorls	D	1.35–2.52 (9)
Inner diameter at the level of whorls	d	0.44–1.20 (9)
Relation inner/outer diameter	d/D	0.263–0.476 (9)
Outer thallus diameter between the whorls	D′	0.62–1.10 (7)
Inner thallus diameter between the whorls	d′	0.52–1.00 (4)
Relation inner/outer diameter between the whorls	d′/D′	0.804–0.966 (4)
Distance between whorls	h	0.76–1.44 (3)
Length of branches	l	0.48–0.96 (3)
Length of branch's stalk-axial cavity	lpr	0.72–0.83 (5)
Length of the branch's distal part	ldi	?0.26 (1)
Average diameter of branch in calcified part	p	0.24–0.34 (5)
Thickness of branch's hyaline envelope	ss	0.05–0.10 (9)
Diameter of branch's distal part	pdi	up to 0.37 (4)
Thickness of thallus wall between the whorls	s	0.04–0.06 (3)
Number of branches per whorl (assumed)	w	?5–8
Number branches in a bundle (assumed)	w′	?4–6
Total number of branches in a whorl	w″	?ca. 50
Inclination of branches	α	20°–70°

n = number of measurements (in parentheses)

Description: Thallus has a generally cylindrical shape, characterized by the relatively regular alternation of short intervals of slight narrowing and longer intervals of widening (swelling) of the central cavity, resulting in an indistinctly segmented shape (Pl. IX, fig. 1; Pl. X, figs. 2–3). Each segment bears, in its upper part, whorls of assumed metaspondyle branches (Pl. IX, figs 1–2; Pl. XI, figs. 7–9). The tufts of branches belong to distinctly separated whorls, the mutual distance of which depends on the length of individual segments, as seen in tangential or more or less oblique sections. They appear as wreaths of double, triple, or irregularly distributed envelopes of individual branches in the neighbouring tufts of the same whorl. At the same time, this rules out the possible existence of doubled independent whorls (twin-whorls; RADOIČIĆ et al., 2011), which has never been reported in *Clypeina*, and is not compatible with the generic diagnosis (BASSOULLET et al., 1978).

The appearance of the whorls is the result of a characteristic calcification pattern, restricted to the branches, which CONRAD & VAROL (1990) described as the "intracellular calcification developed *in vivo*". The vitreous branch's envelopes are characterized by a yellowish colour and distinctly developed radial calcitic structure (Pl. IX, figs. 4–7; Pl. X, figs. 4–5, 7; Pl. XVIII, figs. 1, 4), which often may be destroyed by subsequent recrystallization. Neighbouring whorls of metaspondyle branches are connected into a coherent thallus by a very thin inter-whorl membrane, which is very weakly calcified so that it is most frequently erased or only preserved as fragments, thus being barely visible as an interrupted outline (Pl. IX, figs. 1–2; Pl. X, figs. 2–3). In some sections, the membrane becomes more strongly pigmented with iron oxides during fossilization and thus becomes more easily visible due to its brownish-reddish colour (Pl. XVIII, figs. 2–3) which is often dispersed as blotches into the surrounding sediment.

Individual branches within a tuft are distinctly phloiophorous. Their common point of origin is vaguely marked by insufficient calcification or only weak mineralization, so it is only assumed to be shaped as a slight bulge of the central cavity (vestibule). This is indicated by the longitudinal sections of individual whorls (Pl. IX, fig. 2; Pl. XI, figs. 7–8, marked by arrow) or proximal tangential (cortical) sections (Pl. XI, fig. 10) with distinctly grouped pores, outlined by a thin margin. The possibility of a non-calcified or only weakly mineralized point of origin of the branches is also indicated by very thin envelope in their proximal part (Pl. XI, fig. 4, marked by arrow). The vitreous, fibrous calcitic envelope of each individual branch thickens toward its central part, reaching a maximum thickness (Pl. XI, figs. 5–6, marked by arrow) and gradually tapering distally, so that the top parts of the branches, open to the exterior, are not, or are only rarely and fragmentarily, preserved. The increasing thickness of the calcification within the branch's membrane pushes back the soft tissue, shaping it into a massive spindle-shaped stem, and, further outward, lacking the calcification, into a broad, open calyx (Pl. XI, fig. 6), looking, as a whole, like a chalice. The oval-shaped space inside the branch probably functioned as gametangium, i.e. the species is cladosporous. The fact that the outer parts of the branches remain uncalcified during life is indicated by the post-mortem input of particles of the surrounding sediment into the remaining branch's cavity, with visible grain-size differentiation, i.e., with particles of decreasing diameter going from proximal to the distal end, the latter being most frequently infilled by muddy sediment (Pl. XI, fig. 4).

The number of branches within a tuft cannot be defined with certainty, but is estimated to be 4–6. The variability of their number is suggested by tangential sections of individual whorls, in which the ring-like sections of vitreous branch's envelopes of neighbouring branches appear in alternating positions in two (Pl. IX, fig. 7; Pl. X, figs. 4, 7) or three (Pl. IX, figs. 6, 8; Pl. XI, fig. 4) rows, sometimes seemingly in irregular arrangement. Depending on the number of branches within a tuft and their individual robustness, the neighbouring branches may be well spaced, i.e., mutually separated (Pl. X, fig. 5), or, more often, more or less tightly pressed one to another and slightly irregularly compressed (Pl. IX, figs. 7–8). Because of this, their generally ovoid forms appear in transverse sections of branches as more or less regular ring-shaped (Pl. X, figs. 4–5 part) or, more rarely, as indistinctly angular (Pl. IX, figs. 5, 7 part), envelopes. The direction of growth of branches is generally upwards, their inclination varying from sub-horizontal up to more or less steeply inclined, depending on the degree of divergence between the branches of the same tuft.

Similarities and differences: In spite of the general similarity between all *Falsolikanella* species, concerning their thallus morphology, resulting from the distribution of widely spaced whorls with metaspondyle branches, characteristic calcification pattern depending on the direction of growth and number of branches in the form of a row of beads (*F. danilovae*; *Falsolikanella*? sp. – Pl. XVIII, figs. 8–9), lower or higher, more or less regular rings (*F. campanensis*, *F. nerae*), and inversely assembled conical bodies (*F.*? *teakolarae, F.*? *macropora* n. sp.), all species have some species-specific characters which make their distinction possible. These concern their dimensions, shape of branches (though all generally being of the phloiophorous type), intensity and pattern of calcification (intracellular or extracellular), and structure of calcite (grainy or radial).

Falsolikanella? *macropora* n. sp.

(Pls. XII–XVII; Pl. XVIII, Figs. 5–7)

Origin of name: The species is characterized by characteristically large pores, visible in variously oriented sections cutting through the outer parts of the branches.

Type locality: northern foothills of Mt. Biokovo, near the village of Kozica, 100 m south of the main Zagvozd–Vrgorac road. Geographical coordinates: λ = 43°15’31.3’ N; φ = 17°13’21.2’ E (Fig. 1).

Type stratum: grey-brownish bioclastic wackestone/packstone containing dasyclad and mollusc bioclasts. Matrix is micritic with rare peloids, containing scattered debris of planktonic foraminifera, and in the lower part of the bed, rare black-pebbles. These deposits were accumulated in the shallow-marine environment characterized by oscillating transgression over the Cretaceous palaeorelief, therefore comprising a remarkable mixture of elements indicating short-lasting emergence and open-sea influences. According to both large benthic foraminifera and planktonic foraminifera, the studied deposits are Ypresian in age (Lower Eocene).

Holotype: Oblique section, contained in thin-section from sample RAK–40A, labelled RAK–40A/11, figured in pl. XIII, fig. 5. Isotypes are represented by numerous, variously oriented sections, figured in pls. XII–XVII. Original material is deposited in the Branko Sokač collection of holotypes and isotypes with the Croatian Geological Survey, Zagreb.

Diagnosis: Thallus with well calcified whorls, characterized by more or less distinctly pronounced, successive regular widenings (swellings) and narrowings (constrictions) of the central cavity, giving the appearance of a row of connected, cylindrical or barrel-shaped, segments. The species is metaspondyle, of the cladosporous type. Whorls of assumed metaspondyle branches are situated in the top, constricted parts of individual segments. The common point of origin of a branch tuft is marked by a shallow depression on the inner wall (vestibule) or an extremely short branch. Each tuft contains several phloiophorous branches, clearly differentiated into a stem and an outer, clearly swollen (inflated) outer part.

Dimensions in mm:

Maximum observed length of thallus	L	8.7
Length of individual segments	Lart	0.86–1.67(11)
Outer diameter at the lowest part of whorls	D	1.70–4.80(32)
Inner diameter at the level of whorls	d	0.36–1.30(30)
Relation between and outer diameter at the whorl level	d/D	0.230–0.384(27)
Outer thallus diameter between the whorls	D′	0.58–2.18(11)
Inner thallus diameter between the whorls	d′	0.38–1.45(16)
Relation inner/outer diameter between the whorls	d′/D′	0.655–0.912(10)
Distance between whorls	h	0.86–1.95(14)
Length of branches	l	0.96–1.95(21)
Length of branch’s stalk-proximal part	lpr	0.24–0.67(25)
Length of the branch’s distal (swollen) part	ldi	0.60–1.45(23)
Diameter of branch’s stalk-proximal part	ppr	0.06–0.12(28)
Diameter of the branch’s swollen (distal) part	pdi	0.20–0.48(30)
Thickness of thallus wall between the whorls	s	0.07–0.11(14)
Number of branches per whorl (assumed)	w	?6–8
Number branches in a bundle (assumed)	w′	?5–7
Total number of branches per whorl (assumed)		?about 50
Inclination of branches	α	0°–70°

n = number of measurements (in parentheses)

Description: The new species is represented by the generally cylindrical shape of the skeleton, featuring a more or less pronounced regular alternation of successive constrictions and swellings of the central cavity, resulting in an apparent segmentation of mutually connected segments. Individual segments between the whorls may have a cylindrical shape (Pl. XIV, fig. 5; Pl. XV, fig. 2) or be more barrel-shaped (Pl. XV, fig. 1). Variable calcification of the thallus reflects its outer morphology. The more massive calcification at the level of the whorls in a segment is the result of a more massive calcification in the proximal part of the branches, where there is more space between the stalks of the neighbouring branches in a whorl (Pl. XIV, figs. 2, 5; Pl. XV, figs. 1–2). Outer parts of the whorls are characterized by distal swellings of branches and are therefore weakly calcified, the calcification consisting of thin envelopes of branches being pressed close to each other (Pl. XIII, figs. 1, 3, 6; Pl. XV, fig. 6; Pl. XVI, figs. 3, 7; Pl. XVII, figs. 1–2, 4–5, 10). The parts of the thallus between the whorls are equally weakly calcified, with only a thin calcareous envelope (Pl. XIV, figs. 5, 9; Pl. XV, figs. 1–2), which causes the fragility of the skeleton and therefore the rare occurrence of longer skeletal fragments. The main feature distinguishing this species from the morphologically similar *Falsolikanella*? *teakolarae* (RADOIČIĆ et al.) is that the calcareous skeleton is composed of light gray, fine- to medium-grained, sparitic mosaic calcitic infilling of the spaces between the branches (Pl. XIII, fig. 1; Pl. XIV, figs. 1–2). The inner surface of the central cavity is clearly and regularly delineated, in contrast to the eroded outer surface, with alternating calcified ring-like cones with bundles of branches, steeply inclined upwards and therefore most frequently covering the thin envelopes in the internodal parts of the thallus.

Another important characteristic of the new species is its metaspondylity, this being the key feature, along with some morphological characteristics, for its assignation, however questionable, to the genus *Falsolikanella* (for the relationship between the genera *Praturlonella* and *Falsolikanella* see above). The whorls are situated in the constricted, top part of the segments. The metaspondyle point of origin of the group (tuft) of branches is rare and difficult to observe in sections, due to their position in the constricted part of the thallus, their small number per whorl, and the distance between the consecutive whorls. It is manifested by shallow recesses in the inner side of the calcareous envelope (Pl. XIII, figs. 1, 8; Pl. XV, fig. 1; Pl. XVI, figs. 1, 10; Pl. XVII, figs. 9, 11 – marked by arrows), short, indistinctly defined stalk (Pl. XIV, figs. 5, 8–9 – marked by arrows), or it is indirectly indicated by connection and concentration of pores in tangential sections (Pl. XIV, fig. 1; Pl. XVII, fig. 12 – marked by arrow). A tuft of individual phloiophorous branches, clearly differentiated into a thin, proximal stalk and an elongated and swollen terminal part, grows out of such a common point of origin. In their initial part, the stalks of the branches can be directed into different directions, sometimes even downturned, but going outwards they become more steeply directed upwards, with a general tendency of growing upwards. After the first 1/3 of its length, the branch abruptly widens into a distinctly swollen outer part with reduced calcification, consisting only of thin envelopes of branches. Due to their distal swellings, the branches become pressed closely to one another which results in their variable shape in longitudinal sections (Pl. XII fig. 9; Pl. XIII, figs. 1–3, 5; Pl. XIV, figs. 3, 6; Pl. XVI, fig. 7). This visual variability can be partly due to the different position of the plane of section, but it is confirmed by variously and irregularly shaped pores, (ranging from oval to polygonal), in distal tangential (cortical) sections (Pl. XV, fig. 6; Pl. XVI, fig. 3). Weak calcification in the distal region and the abrasion of the outer surface makes determination of the full length of the branches and the insight into their terminations questionable. The absence of transverse sections with clearly visible points of origin of the bundles of branches, leaves open the question of their exact number in a whorl; this, as well as the number of branches per bundle, can only be approximated on the basis of how much space they occupy.

The variable angle of inclination results in the variable direction of growth of individual branches within the same bundle. Thus, the lowest branches in a tuft may be variously bent downwards or upwards in the proximal part (stalk), becoming horizontal (Pl. XIV, figs. 4, 10) or more or less steeply inclined in the distal part.

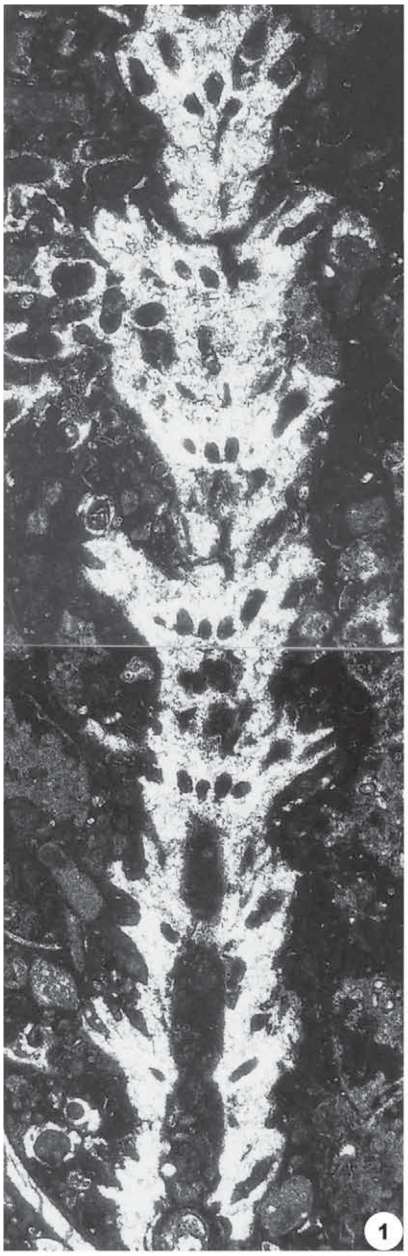
The species is cladosporous, with rarely visible recrystallized cysts, regularly arranged in the swollen part of a branch (Pl. XVI, fig. 7 – marked by arrow).

Similarities and differences: *Falsolikanella*? *macropora* n. sp. is visually close to, and by some morphological characters similar to the contemporaneous *Praturlonella salernitana* BARATTOLO (1978). Descriptively, their basic difference, *Praturlonella salernitana* being euspondyle and *Falsolikanella*? *macropora* n. sp. being metaspondyle, is possibly the result of different authors' interpretations – and seems problematic for their clear and certain generic and species-specific determination, which explains the present dilemma in designation of the generic assignment of the new species, indicated by a question-mark). Therefore, in distinguishing the two species and establishing the new species (*F.*? *macropora*), we must confine ourselves to different values of biometric parameters and some specific morphological characteristics. Apart from a general similarity regarding the apparent segmentation in the outer shape of the skeleton and the position of whorls on the thallus, the values of individual biometric parameters are twice or even three times larger in *F.*? *macropora* n. sp. than in *P. salernitana*. Despite the fact that the length of branches in *P. salernitana* has not been stated, visual comparison clearly shows their considerably larger length in *F.*? *macropora*, this being so in spite of the seemingly longer stalk in *P. salernitana*, regarding, proportionally, the total dimensions of the thallus. Other visible

Plate VI

1–6 *Praturlonella salernitana* BARATTOLO, x22.

1 Longitudinal–tangential section, slide KOZ–19.
2 Longitudinal section, slide KOZ–13.
3 Oblique section, slide KOZ–21.
4 Longitudinal, slightly oblique section, slide KOZ–14.
5 Longitudinal–tangential section, slide KOZ–27.
6 Tangential–oblique section, slide KOZ–21.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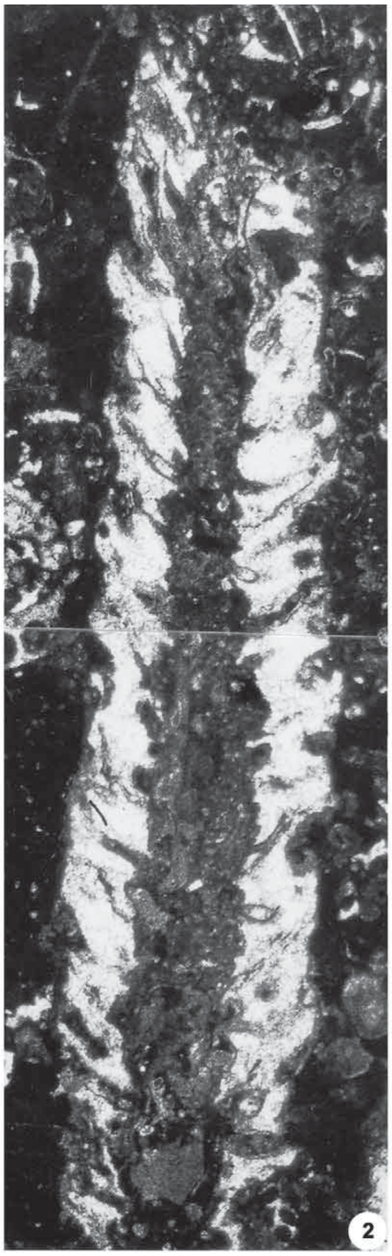
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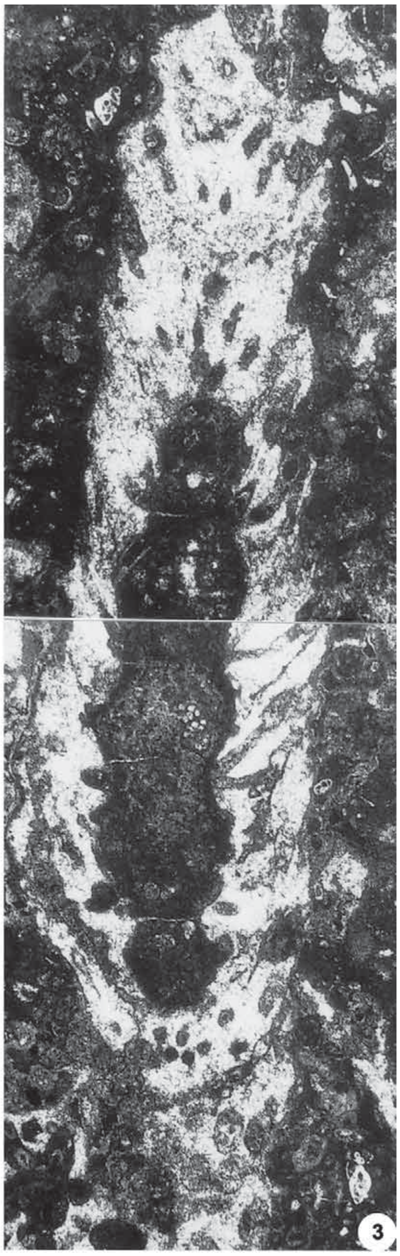
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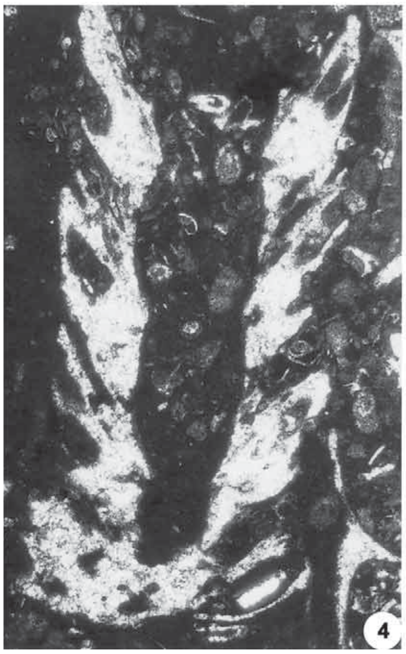
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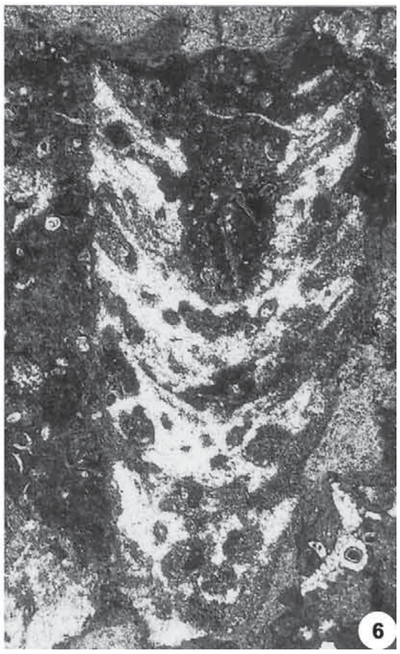
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differences include the shape of the distal swellings, which are considerably larger (being both longer and wider) in *F*.? *macropora*. The lack of sections cutting through the peripheral part of the branches (cortical sections) in the original description of *Praturlonella salernitana* BARATTOLO (1978, pls. I–XIX), regardless of the author's interpretation (BARATTOLO, 1978, text-figs. 9–13), does not allow reliable insight into the similarities and differences in the outer peripheral (cortical) parts of the thallus of the two species. Therefore it appears justified to emphasize that in *F*.? *macropora* the distal swellings of the branches are 2 to 3 times longer than the stalk, have an elongated cylindrical to irregularly elliptical shape, a tapering or else swollen outer termination, more or less deformed, and result in oval, triangular, or irregularly polygonal very large pores, having different diameters in the same level of transverse sections. The fragmentary tangential sections illustrated in BARATTOLO (1978, Pl. XVI, figs. 3, 6) are somewhat confusing, as the questions of how the distal ends of the branches in *P. salernitana* are shaped, or whether those sections possibly belong to the new species coming from the same stratigraphic level remain.

Falsolikanella? *macropora* is similar to the contemporaneous *F*.? *teakolarae* (RADOIČIĆ et al.) in the shape of thallus and in some biometric parameters, but differs clearly from it by pronounced extracellular calcification, which forms the skeleton, consisting of a fine- to medium-grained grey sparitic matrix with mosaic texture. *Falsolikanella*? *macropora* is distinguished from *F. danilovae* (RADOIČIĆ) and *F. nerae* (DRAGASTAN et al.) by its larger size, (including all measured dimensions), the morphology of the skeleton, and growth direction and shape of the branches. Almost the same differences apply to *Falsolikanella campanensis* (AZEMA & JAFREZZO), which is characterized by a smaller number of branches in a tuft, their intracellular calcification and their being open at the distal end.

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Plate VII

1–8 *Praturlonella salernitana* BARATTOLO.
1 Oblique section, slide KOZ–16, x22.
2 Longitudinal section, slide KOZ–7, x22.
3 Longitudinal–tangential section, slide SB–17E1/2, x22.
4 Longitudinal–oblique section, slide KOZ–13, x22.
5 Longitudinal section, slide SB–17B1, x34.
6 Tangential section of a whorl, slide KOZ–6, x22.
7 Oblique–longitudinal section, slide KOZ–23, x22.
8 Tangential–longitudinal section, slide KOZ–18, x22.


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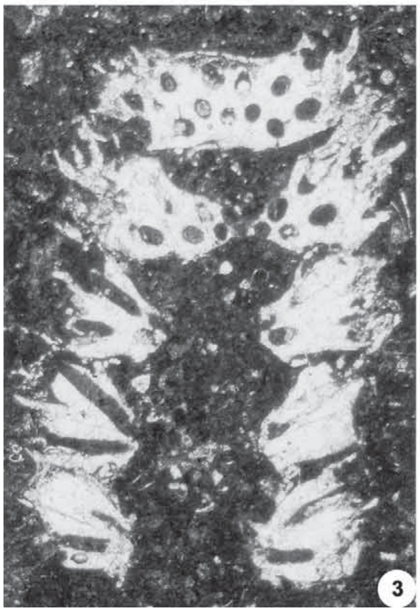
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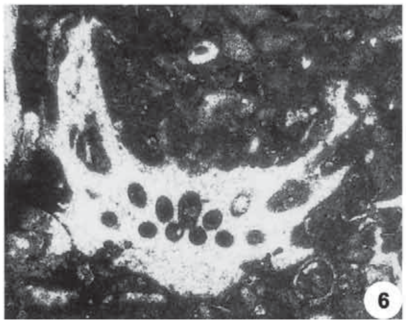
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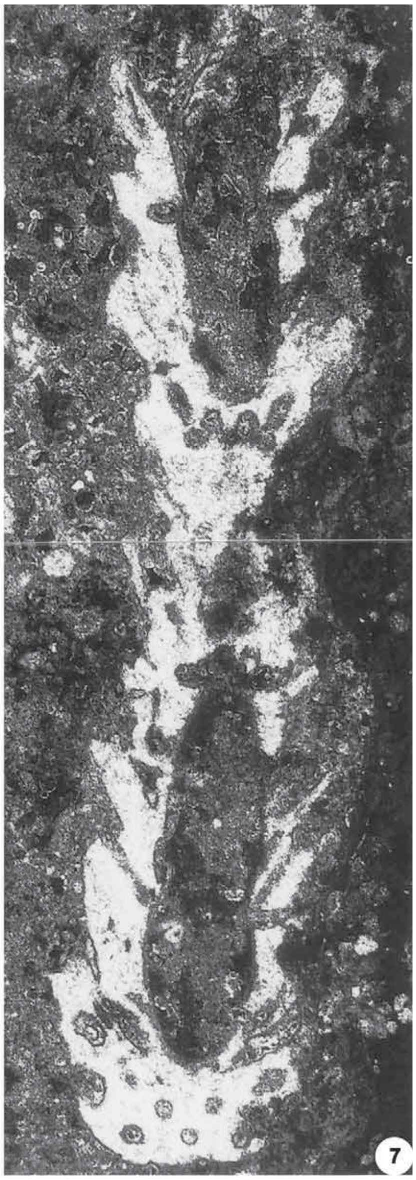
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Plate VIII

1–11 *Praturlonella salernitana* BARATTOLO, x22.

1	Oblique–tangential section, slide SB–17–2/1
2, 3, 6	Oblique sections, fig. 2, slide SB–17–1/2; fig. 3, slide KOZ–4; fig. 6, slide SB–17E1/3.
4, 7	Tangential sections, fig. 4, slide KOZ–1; fig. 7, slide KOZ–29.
5, 8–11	Transverse, slightly oblique sections, fig. 5, slide KOZ–27; fig. 8, slide KOZ–2; fig. 9, slide KOZ–24; fig. 10, slide SB–17B2/9; fig. 11, slide KOZ–5.


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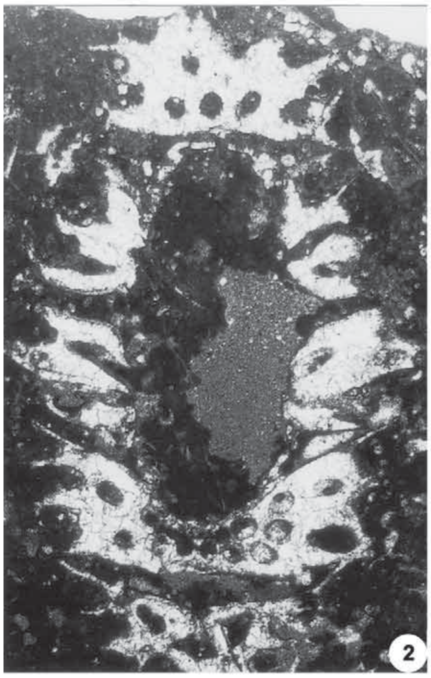
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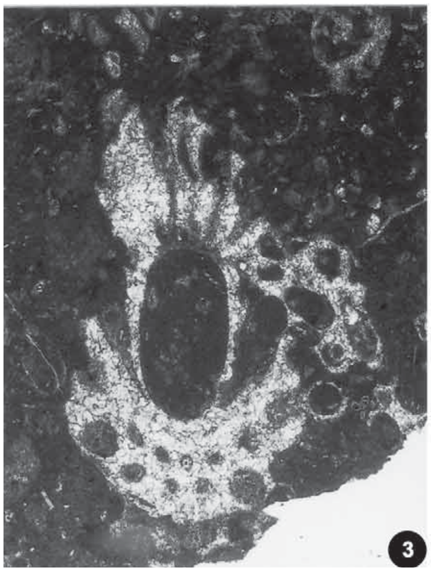
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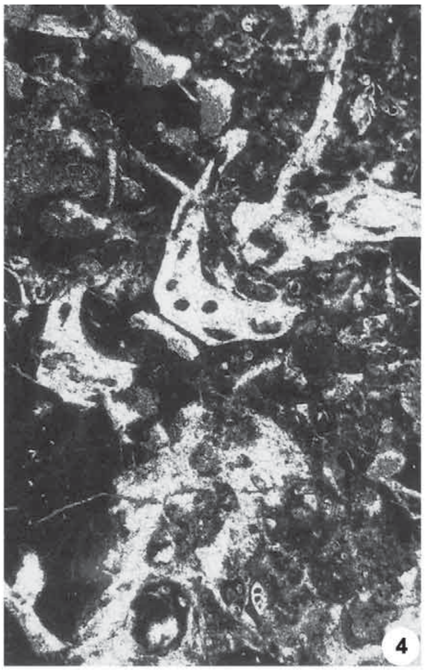
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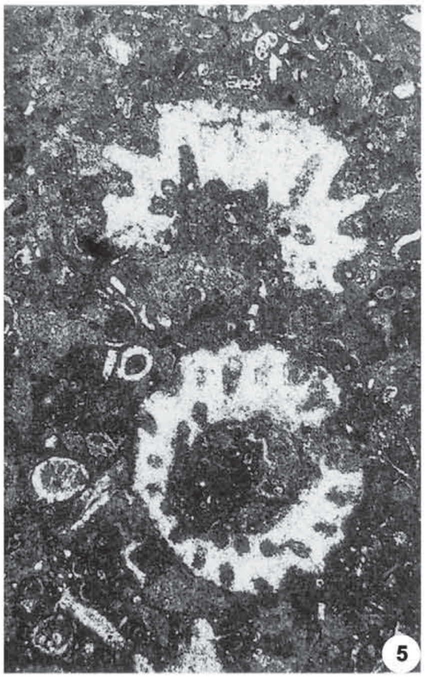

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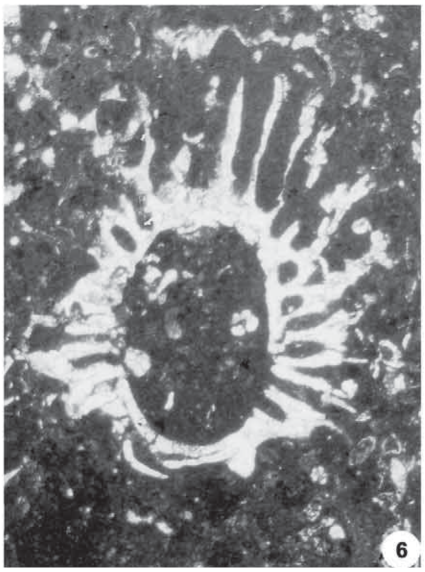
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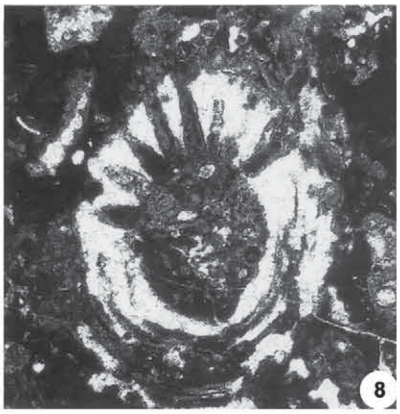
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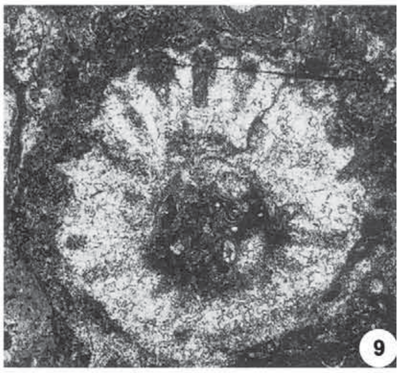
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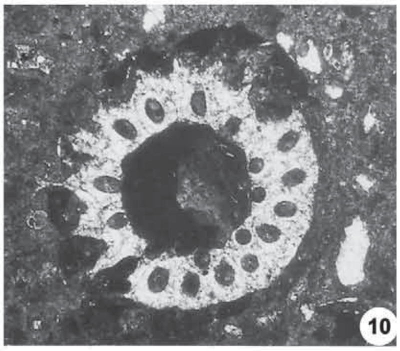
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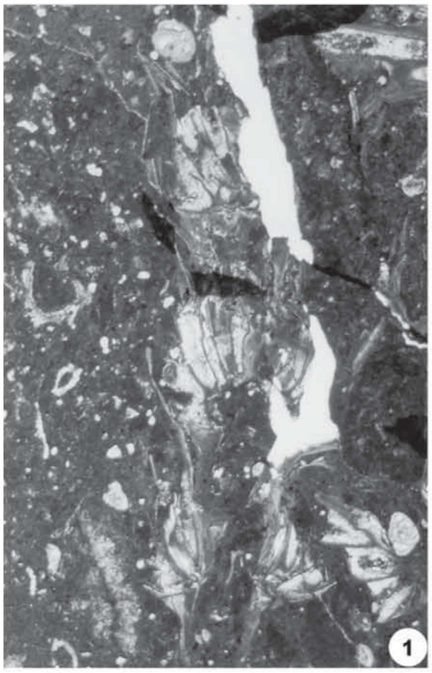
Plate IX

1–8 *Falsolikanella*? *teakolarae* (RADOIČIĆ et al.) n. comb.
1 Longitudinal section, slide SB–17E2/1, x17.
2 Longitudinal, partly tangential section, slide SB–17E2/1, x22.
3 Tangential–oblique section, slide SB–17E2, x22.
4 Oblique section, slide SB–17E2/3, x22.
5 Tangential–oblique section, slide SB–17E2, x34.
6 Tangential section of two whorls, slide SB–17E2/3, x22.
7–8 Tangential sections, fig. 7, slide SB–17E2/2, x34; fig. 8, slide SB–17E2, x34.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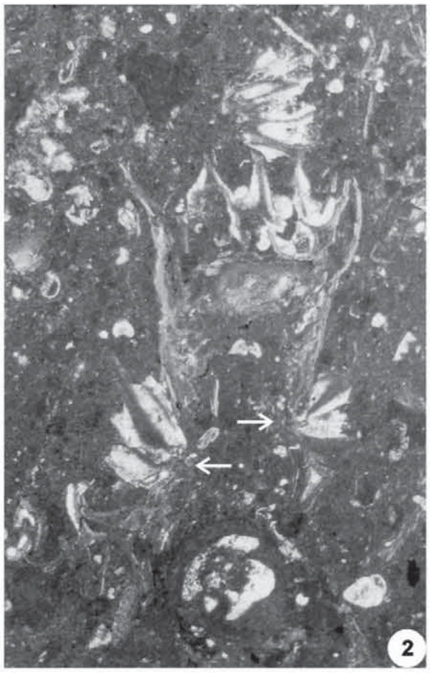
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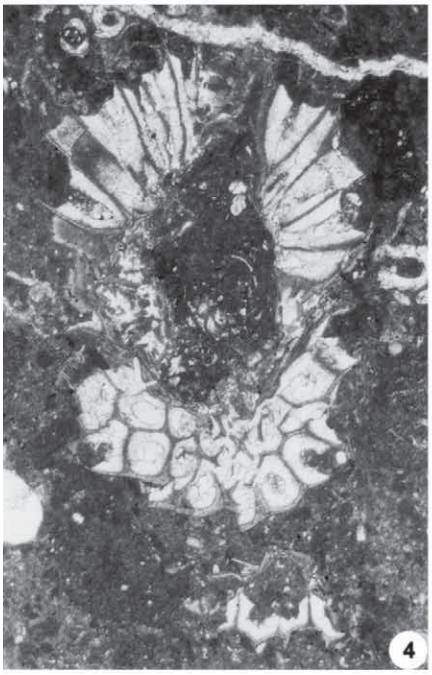
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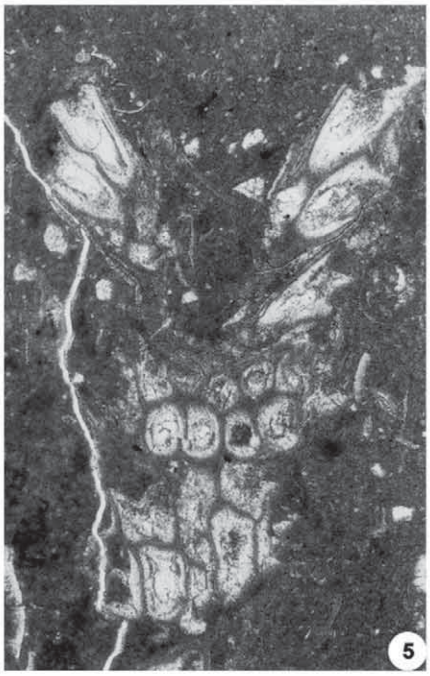
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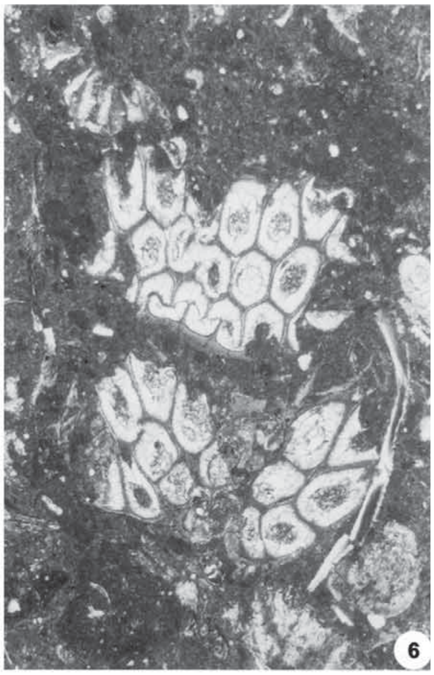
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Plate X

1–9 *Falsolikanella*? *teakolarae* (RADOIČIĆ et al.) n. comb.
1 Tangential–oblique section, slide SB–17E2/3, x34.
2 Longitudinal section, slide SB–17E2/2, x17.
3 Longitudinal–oblique section, slide SB–17E2/1, x17.
4 Tangential section, slide SB–17E2/1, x34.
5 Oblique section, slide SB–17E2/2, x34.
6 Oblique section, slide SB–17E2/2, x22.
7 Tangential–oblique section of two whorls, slide SB–17E2, x34.
8 Transverse, slightly oblique sections in the whorl level, slide B–17E2/1, x22.
9 Oblique section, slide SB–17E2/3, x22.


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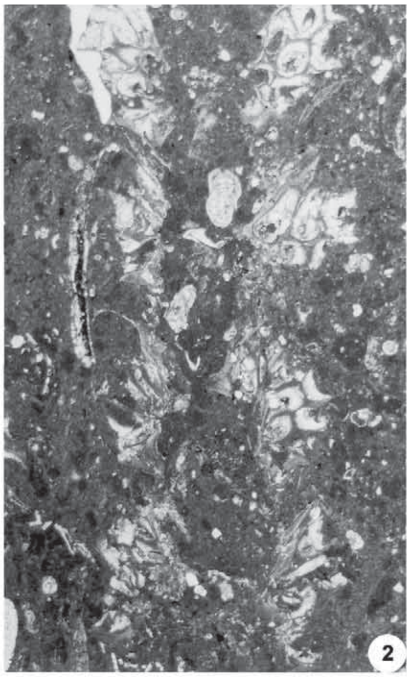
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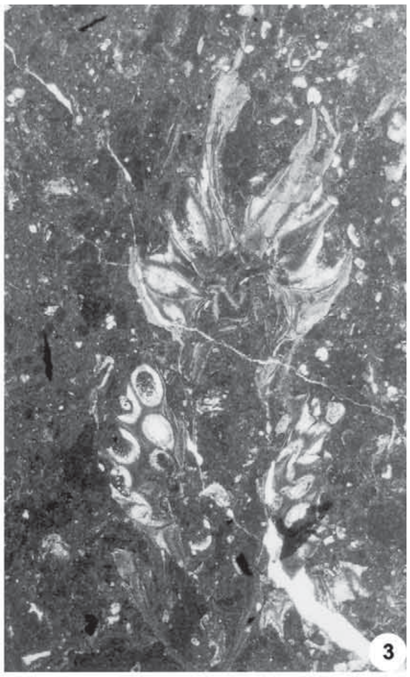
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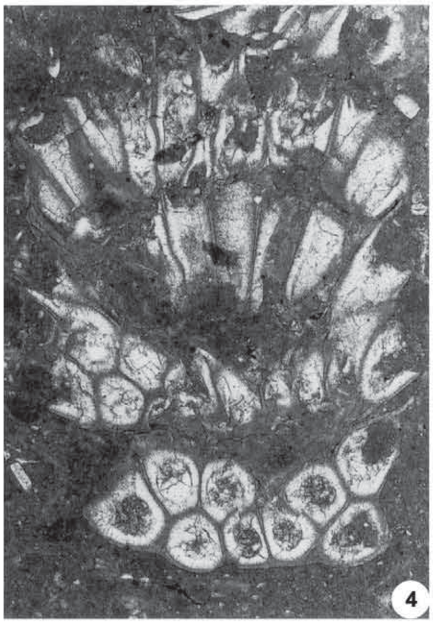
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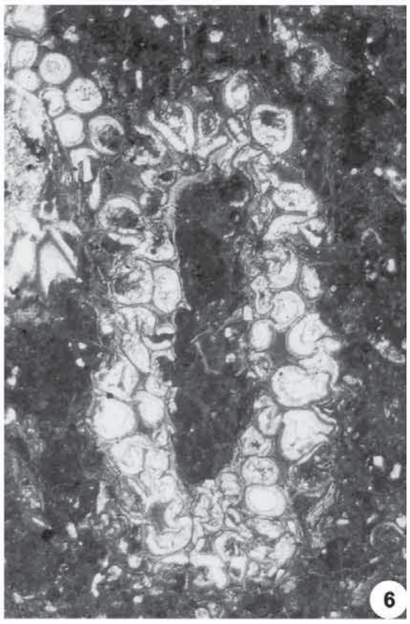
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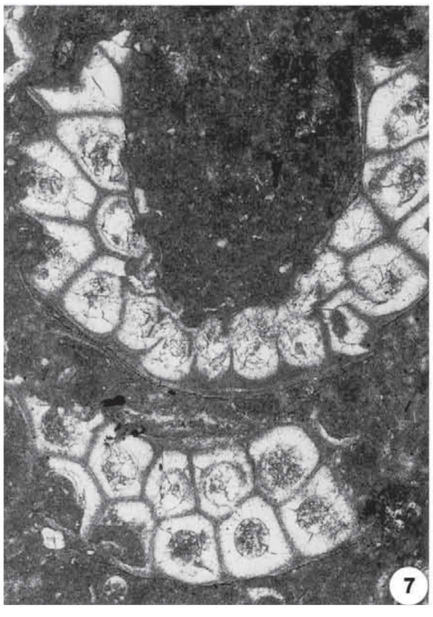
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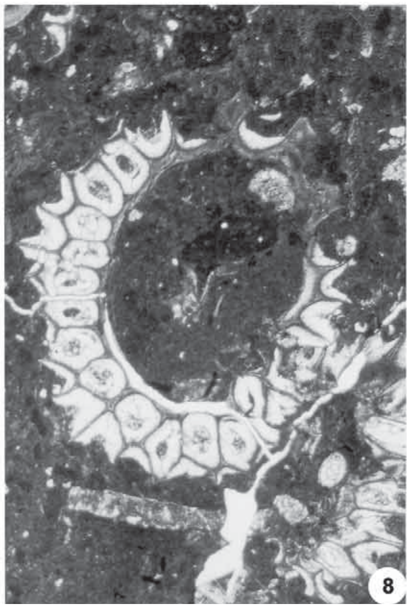
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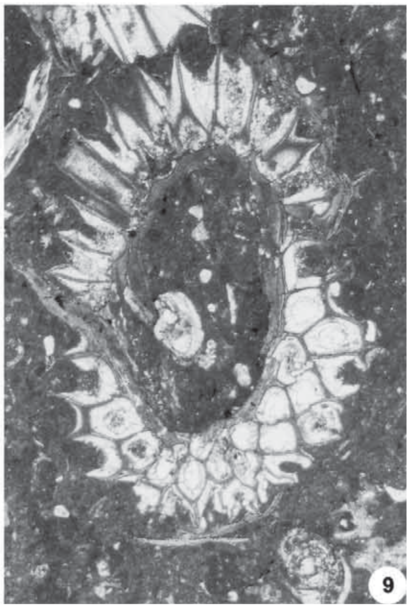
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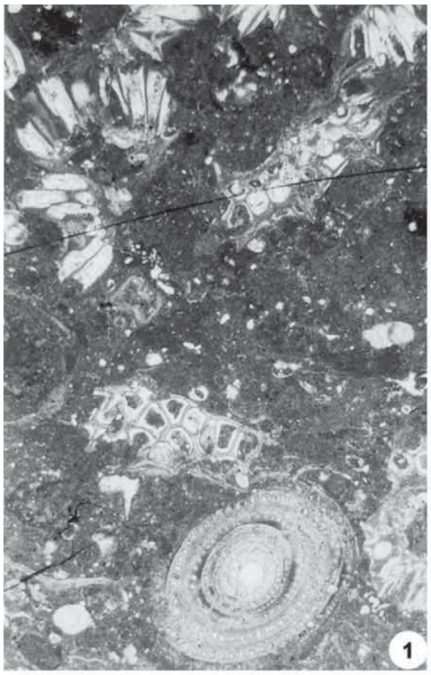
Plate XI

1–12 *Falsolikanella*? *teakolarae* (RADOIČIĆ et al.) n. comb.
1 Fragments of differently oriented sections, as well as section of *Alveolina* sp., slide SB–17E2/4, x14.
2 Oblique section in the whorl level, slide SB–17E2/3, x34.
3 Fragments of differently oriented sections, slide SB–17E2/4, x22.
4–5 Tangential sections of branches from the one whorl, slide SB–17E2/2, x34.
6 Longitudinal sections of separate whorls, slide SB–17E2/2, x34.
7–8 Longitudinal sections of separate whorls, fig. 7, slide SB–17E2/3; fig. 8, slide SB–17E2, x22.
9 Tangential section of a whorl, slide SB–17E2/1, x22.
10 Tangential section of the proximal part of a whorl, slide SB–17E2, x22.
11–12 Tangential–oblique sections of branches from the same whorls, fig. 11, slide SB–17E2/1; fig. 12, slide SB–17E2/4, x34.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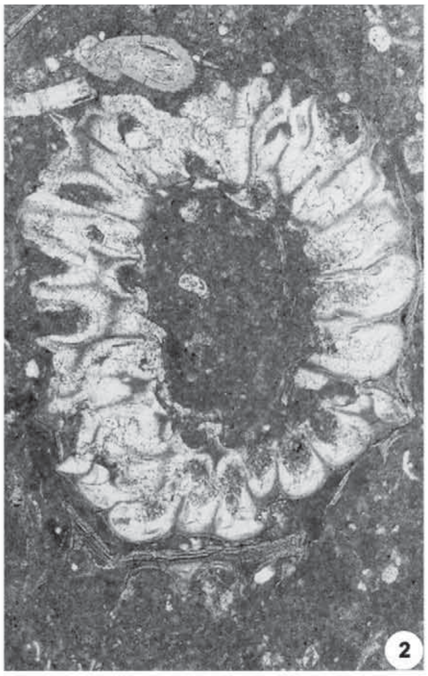
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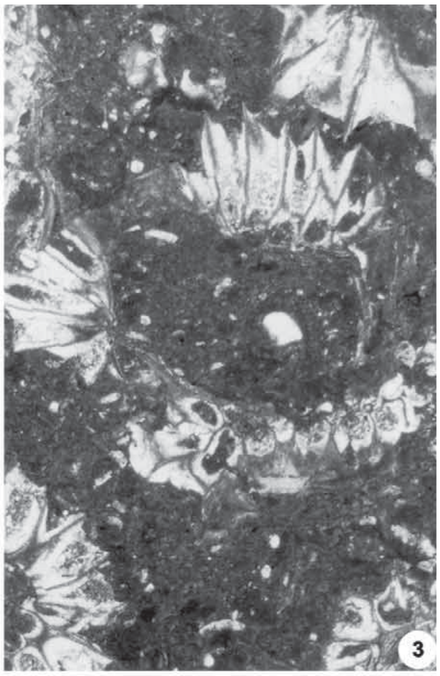
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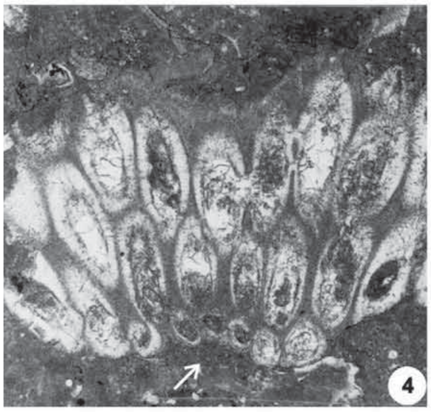
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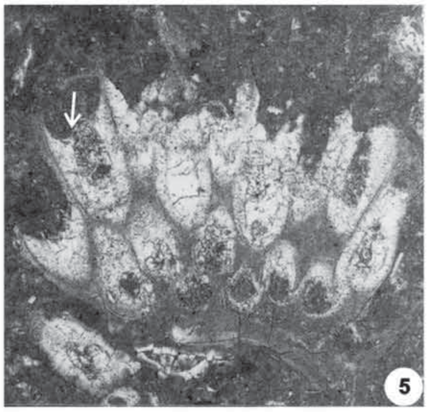
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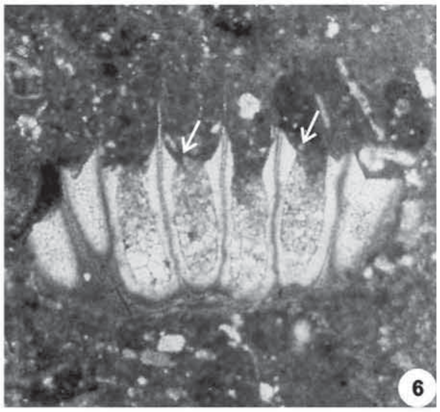
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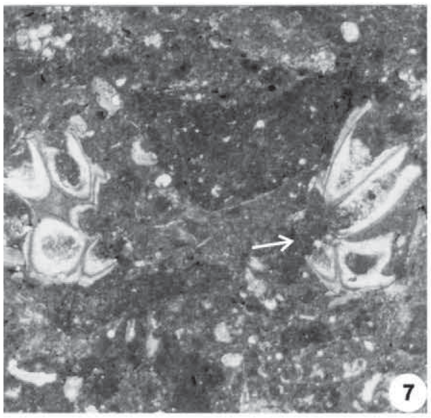
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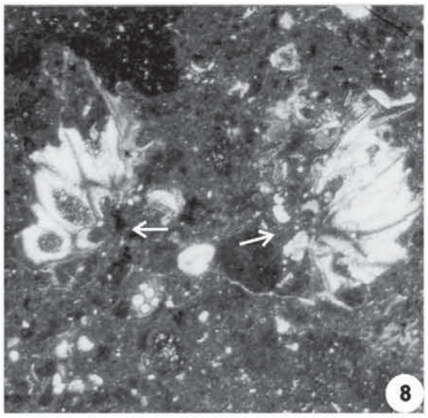
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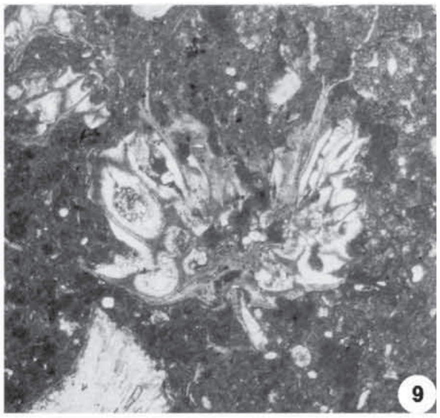
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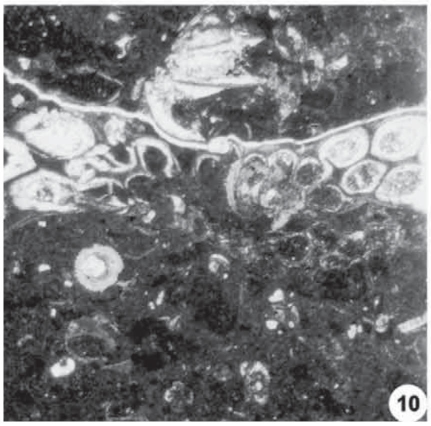
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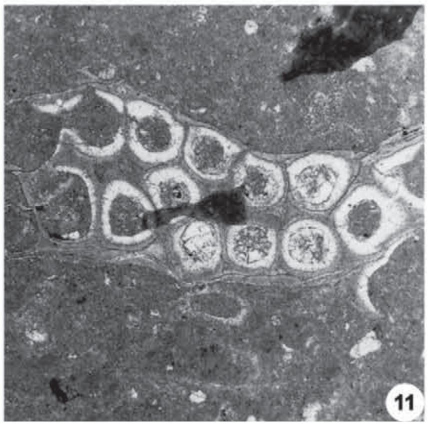
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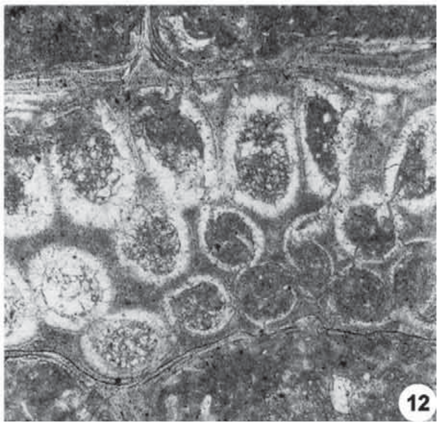
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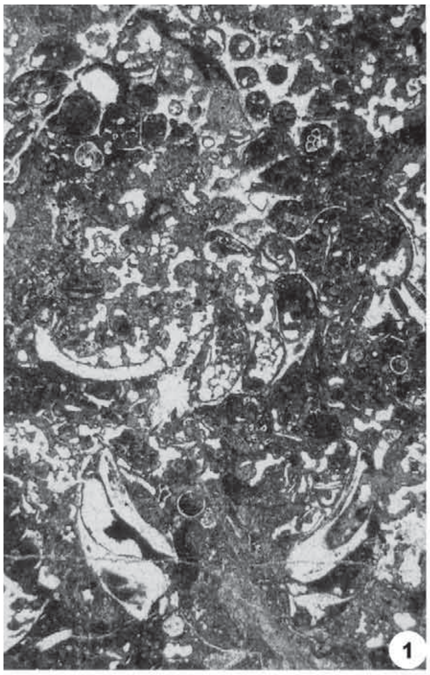
Plate XII

1–2, 3a, 4–5, 6a, 7–8, 9a *Falsolikanella*? *macropora* n.sp. 3b *Praturlonella salernitana* BARATTOLO. 6b, 9b *Clypeina lucana* BARATTOLO & ROMANO. 6b *Clypeina bucuri* BARATTOLO & ROMANO.

1 Fragments of different sections, slide RAK–40A/19, x14.
2 Oblique section, slide RAK–40A/23, x14.
3 a) *Falsolikanella*? *macropora* n.sp.; b) *Praturlonella salernitana* BARATTOLO – transverse sections, slide RAK–40A/8, x17.
4 Oblique sections at the whorl level, slide RAK–40A/25, x14.
5 Transverse sections at the whorl level, slide RAK–40A/25, x14.
6 a) *Falsolikanella*? *macropora* n.sp.; b) *Clypeina lucana* BARATTOLO & ROMANO and *Clypeina bucuri* BARATTOLO & ROMANO – transverse sections, slide RAK–40A/14, x14.
7 Fragment of an oblique section at the whorl level, slide RAK–40A/11, x 14.
8 Oblique section at the whorl level, slide RAK–40A/4, x 22.
9 a) *Falsolikanella*? *macropora* n.sp. – fragment of an oblique section; b) *Clypeina lucana* BARATTOLO & ROMANO – transverse, slightly oblique section, slide RAK–40A/27, x17.



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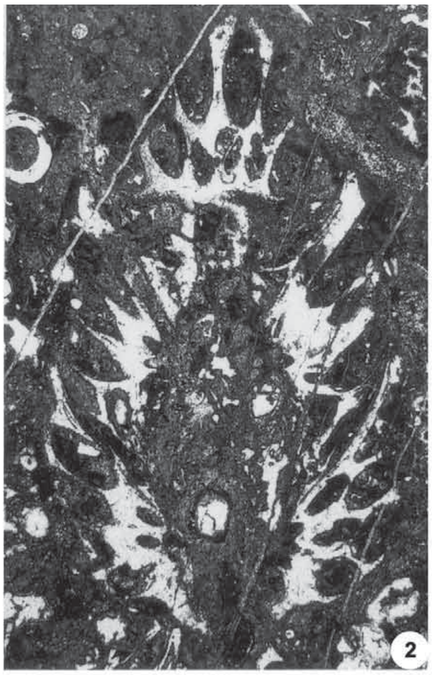

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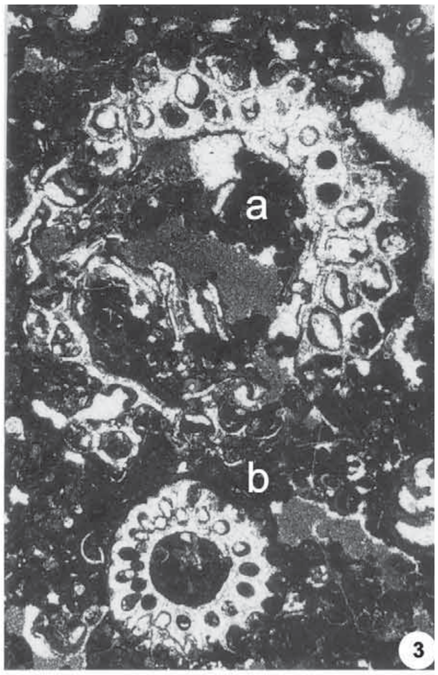

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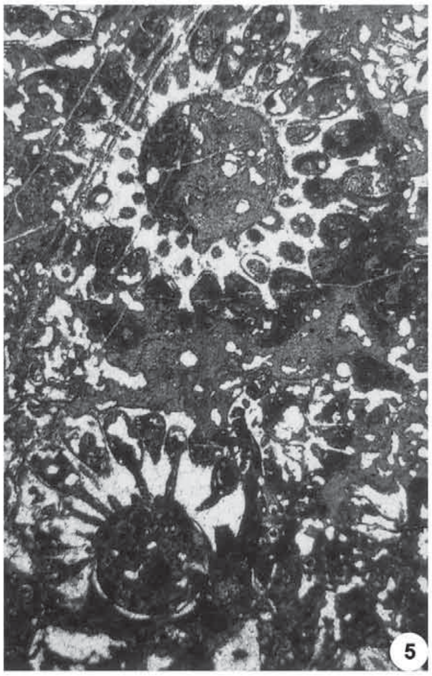

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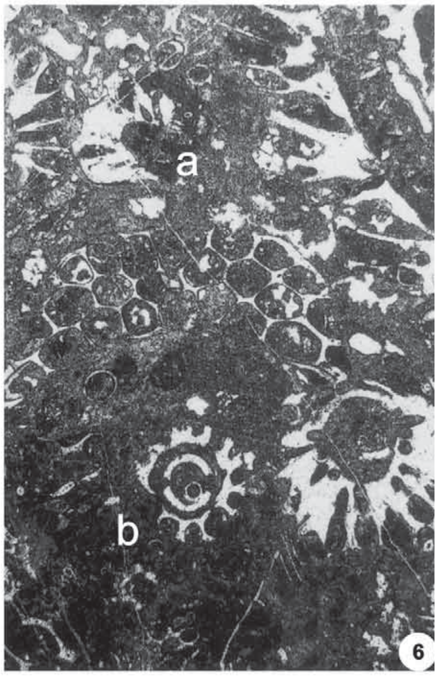

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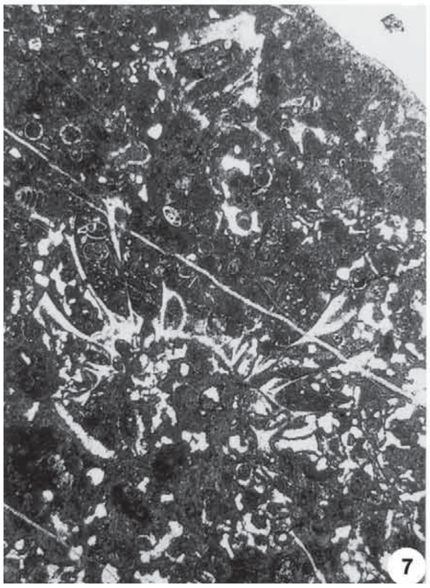

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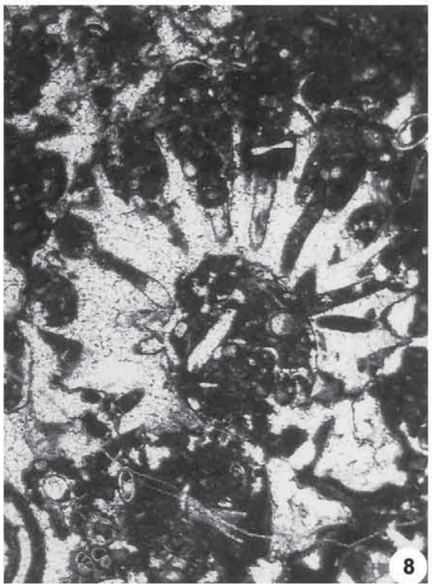

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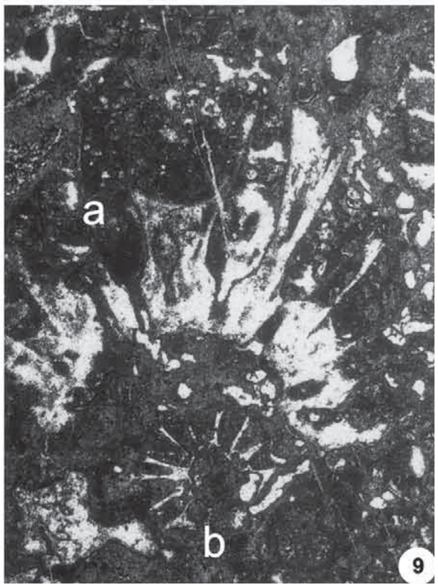

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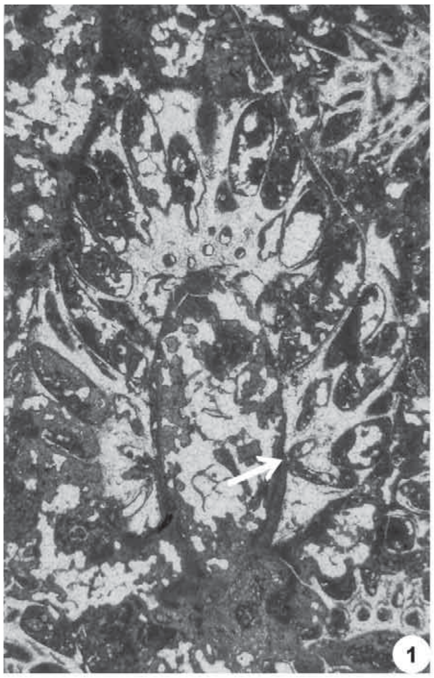
Plate XIII

1–8 *Falsolikanella*? *macropora* n. sp.
1 Oblique section, slide RAK–40A/11, x14.
2 Oblique section, slide RAK–40A/14, x14.
3 Transverse–oblique section, slide RAK–40A/19, x14.
4 Transverse–oblique sections, slide RAK–40A/29, x14.
5 Oblique section, Holotype, slide RAK–40A/11, x14.
6 Parts of transverse–oblique sections, slide RAK–40A/21, x14.
7 Oblique section of a part of the whorl, slide KOZ–27, x 34.
8 Oblique section, slide RAK–40A/19, x 17.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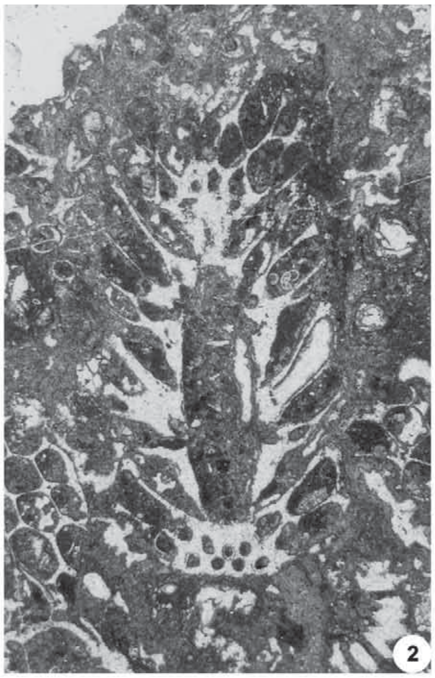
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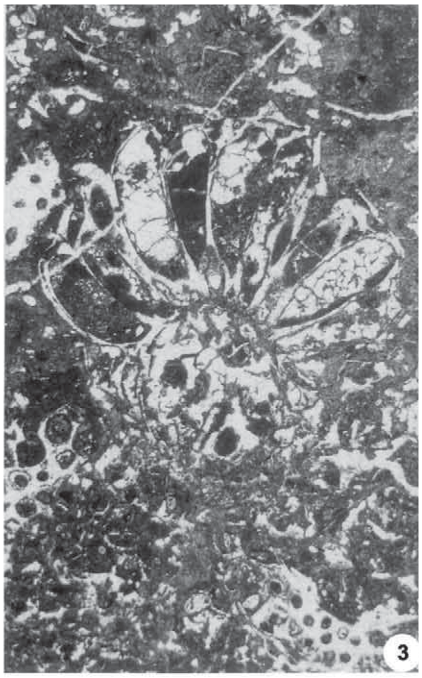
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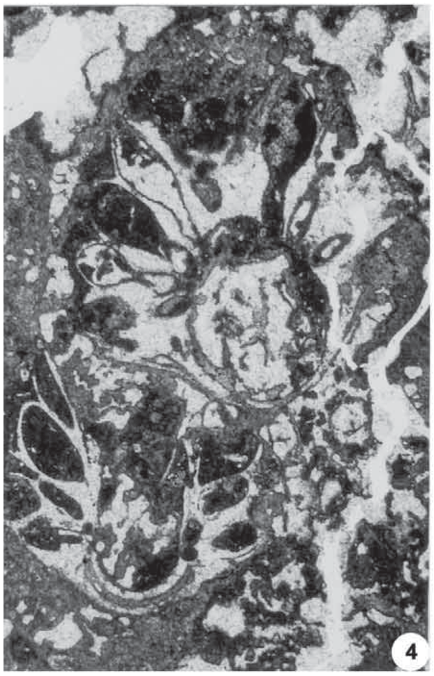
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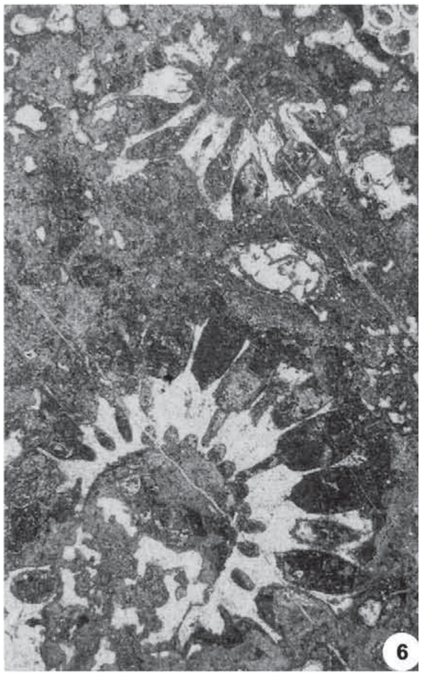
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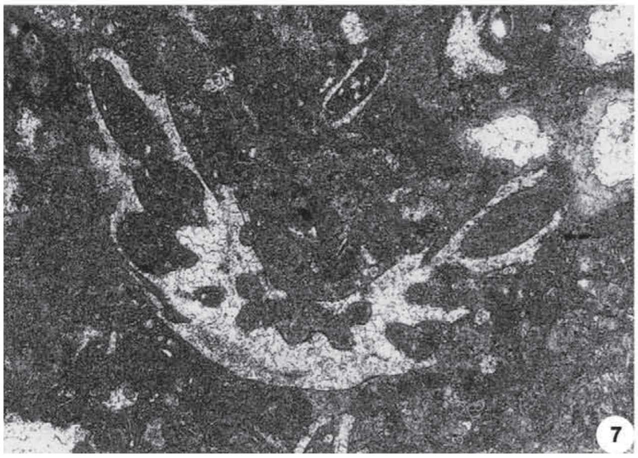
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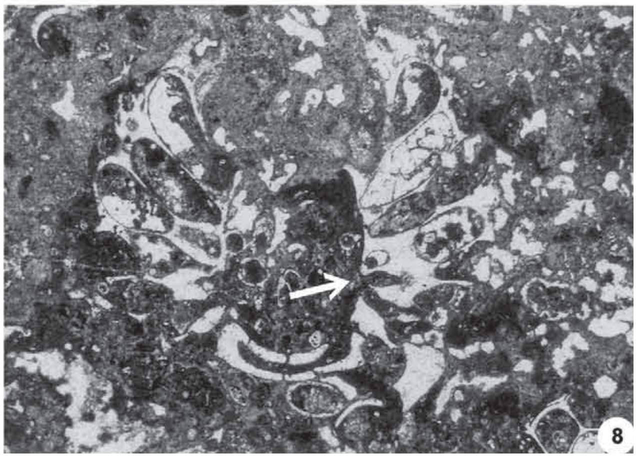
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Plate XIV

1–11 *Falsolikanella*? *macropora* n. sp.

1–2	Tangential sections, fig. 1, slide KOZ–6; fig. 2, slide KOZ–10, x34.
3, 6–7, 10–11	Oblique sections of separate whorls, fig. 3, slide KOZ–1; fig. 6, slide RAK–40A/2; fig. 7, slide SB–17C2/6; fig. 10, slide RAK–40A/4; fig. 11, slide RAK–40A/2, x22.
4	Oblique section, slide SB–17C2/4, x22.
5	Longitudinal section, slide SB–17C2/4, x22.
8	Longitudinal section, in the upper part fragment of a tangential section, slide KOZ–6, x34.
9	Longitudinal section, slide SB–17C2/4, x 22.


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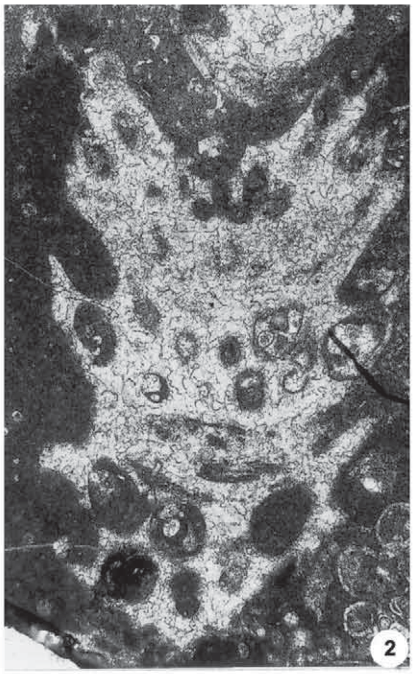
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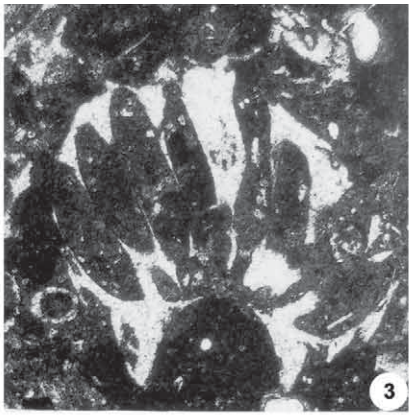
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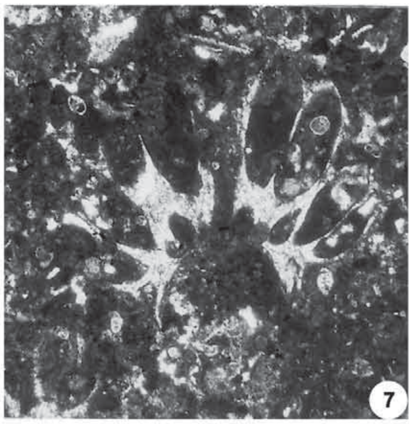
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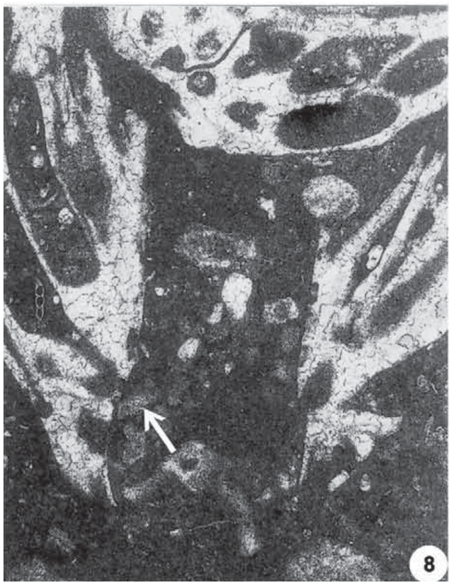
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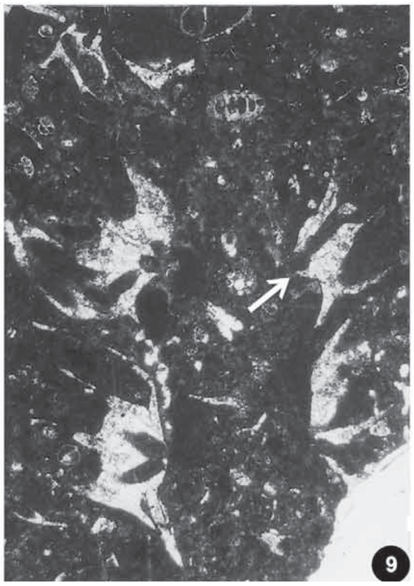
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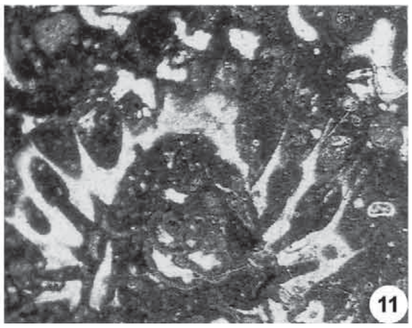
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Plate XV

1–6 *Falsolikanella*? *macropora* n. sp.
1 Longitudinal–tangential section, slide KOZ–28, x22.
2 Oblique section, slide SB–17E2/6, x17.
3 Deep tangential section, slide KOZ–23, x22.
4 Oblique–tangential section, slide KOZ–12, x22.
5–6 Tangential sections, fig. 5, slide KOZ–11, x22; fig. 6, slide SB–17C2, x17.


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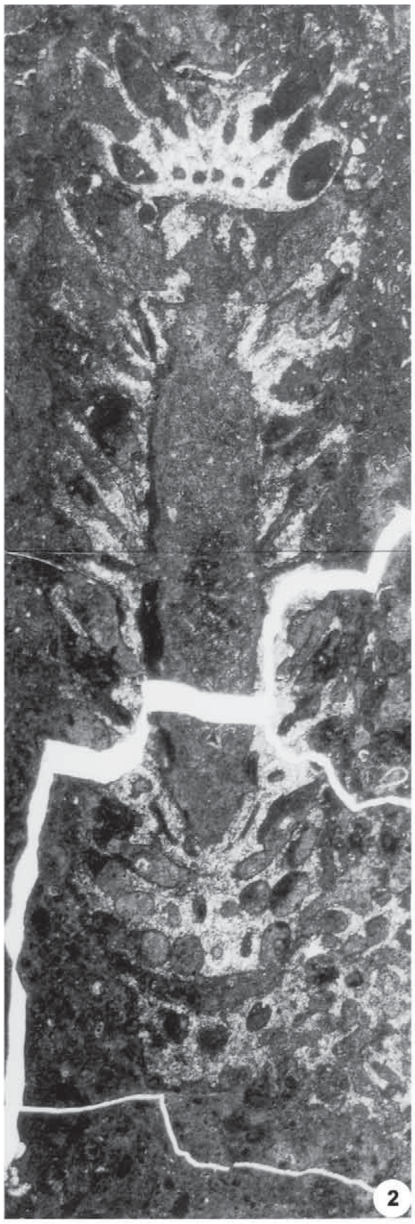
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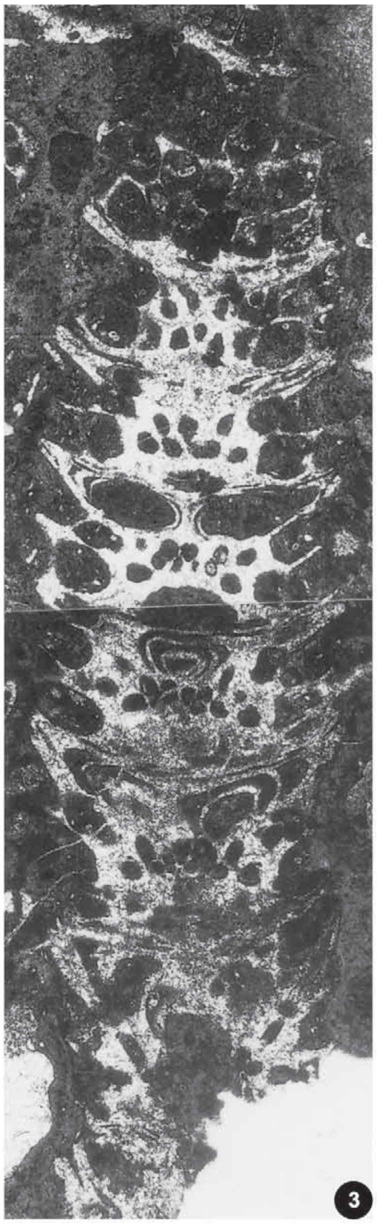
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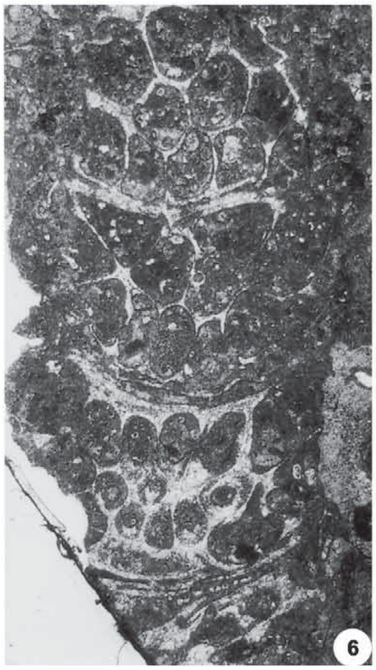
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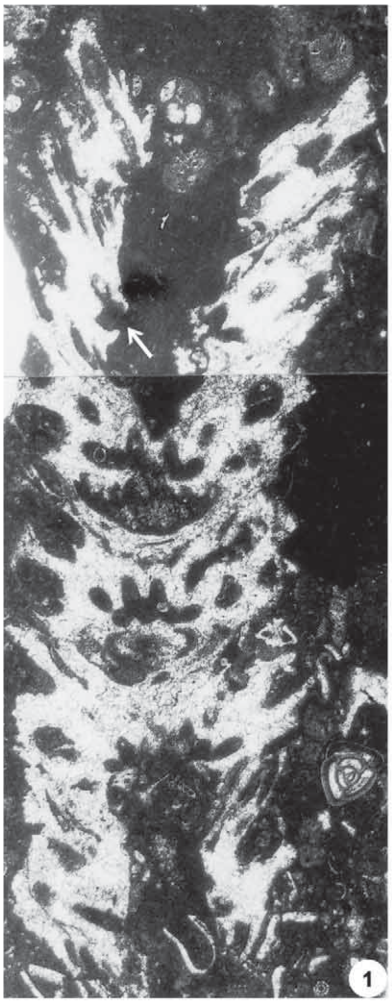
Plate XVI

1–10 *Falsolikanella*? *macropora* n. sp.
1 Longitudinal, partly deep tangential section, slide KOZ–15, x22.
2 Parts of transverse sections at the level of a whorl, slide SB–17C2, x17.
3 Tangential section of the distal part of the thallus, slide SB–17C2/6, x22.
4 Transverse section, slide SB–17C2/6, x22.
5 Transverse section, slide SB–17C2/3, x17.
6 Oblique section, slide SB–17B2/6, x17.
7 Oblique section of part of a whorl, slide SB–17C2/2, x17.
8 Transverse section at the whorl level, slide SB–17B2/4, x22.
9 Part of the oblique section at the whorl level, slide SB–17C2/6, x22.
10 Longitudinal section at the whorl level, slide SB–17C2/6, x22.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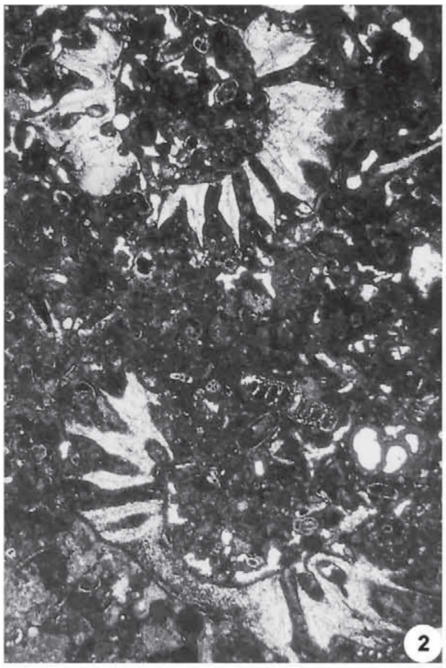
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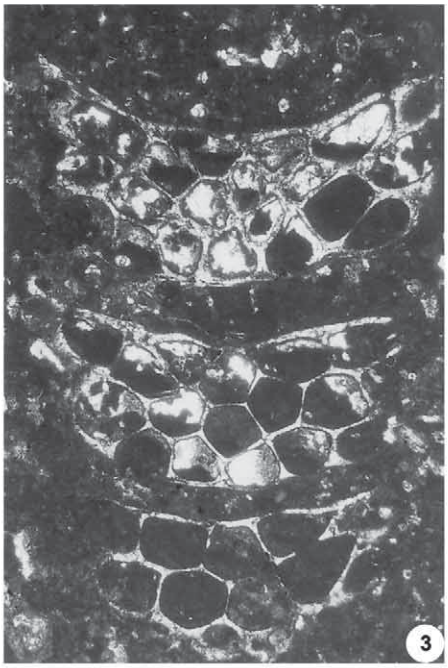
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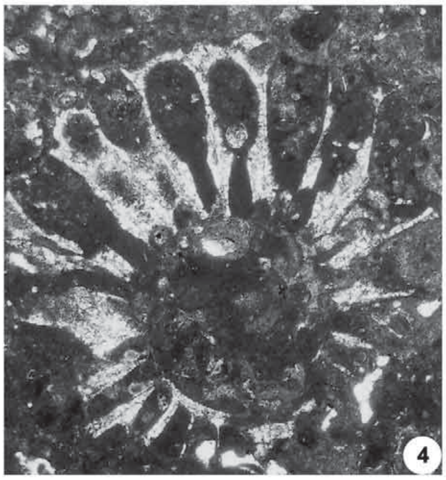
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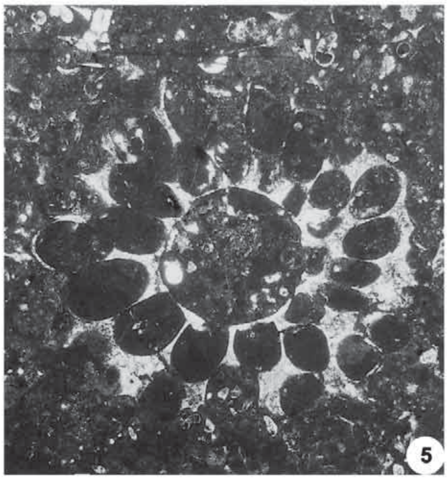
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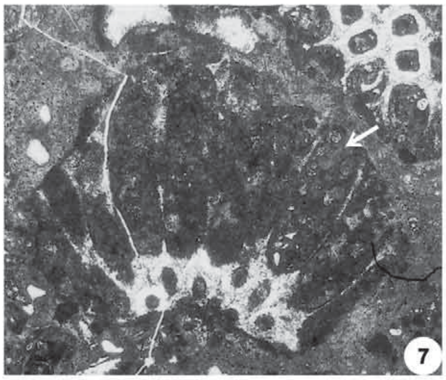
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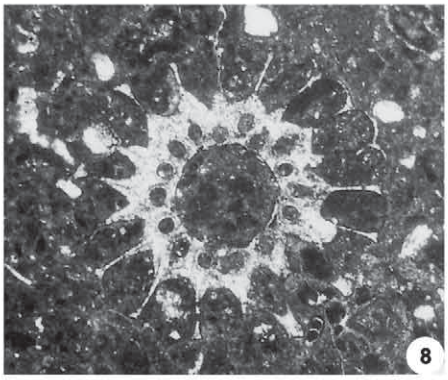
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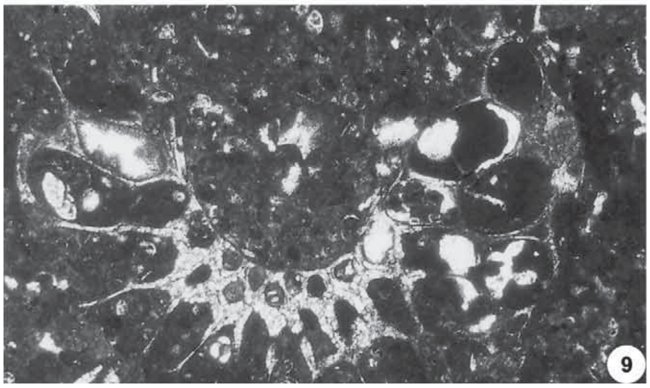
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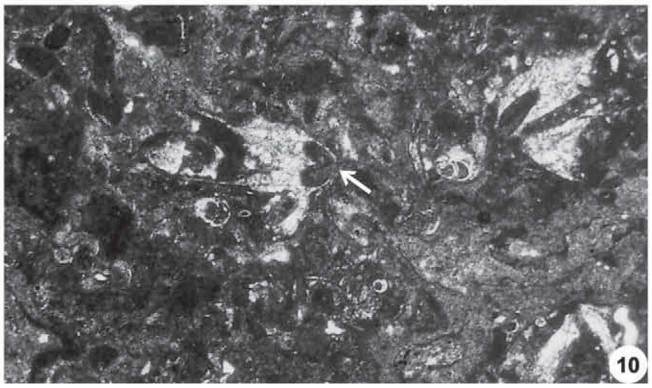
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Plate XVII

1–12 *Falsolikanella*? *macropora* n. sp.
1 Oblique section, slide SB–17E2/13, x17.
2, 5, 7, 11 Parts of transverse–oblique sections at the whorl level, fig. 2, slide SB–17E2/13; fig. 5, slide SB–17C3/4; fig. 7, slide SB–17C3/4; fig. 11, slide SB–17C3/4, x22.
3, 6 Oblique sections, fig. 3, slide SB–17E2/5; fig. 6, slide SB–17C3/3, x22.
4, 10 Transverse sections at the whorl level, fig. 4, slide SB–17E2/8; fig. 10, slide SB–17E2/11, x17.
8–9 Transverse, slightly oblique sections, fig. 8, slide SB–17C3/4, x34; fig. 9, slide SB–17C3/3, x22.
12 Tangential section in the proximal part of the whorl, slide B–17E2/17, x22.


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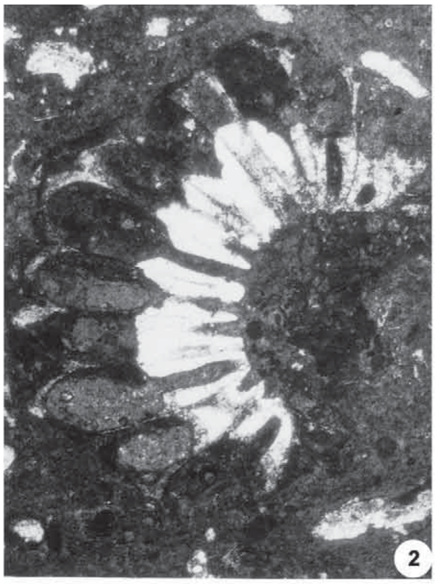
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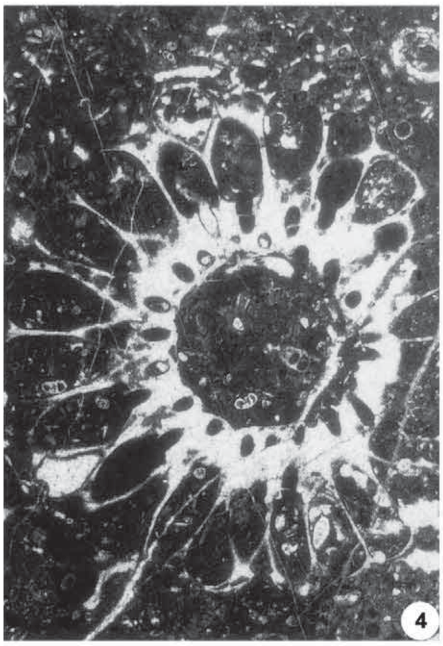
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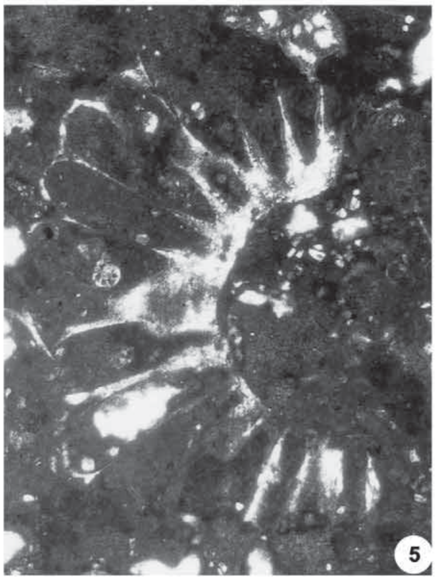
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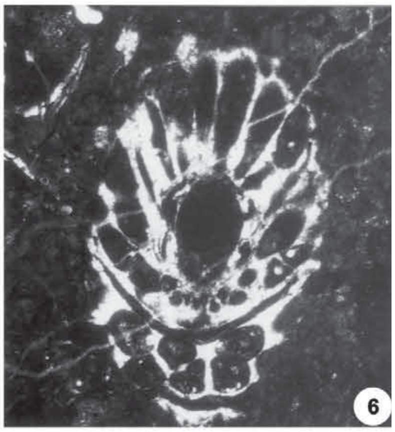
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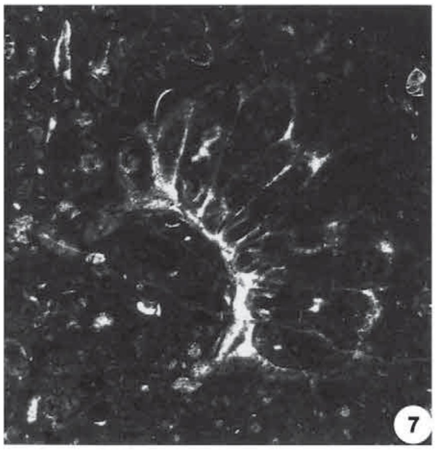
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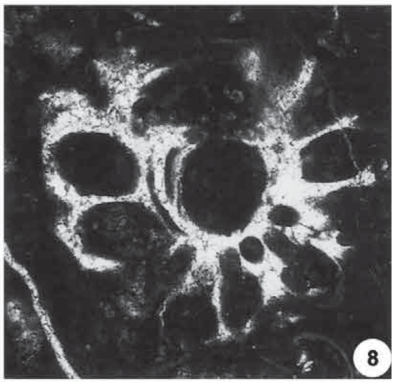
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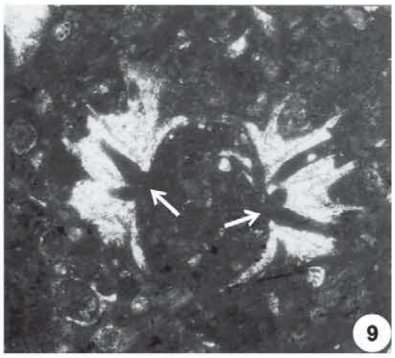
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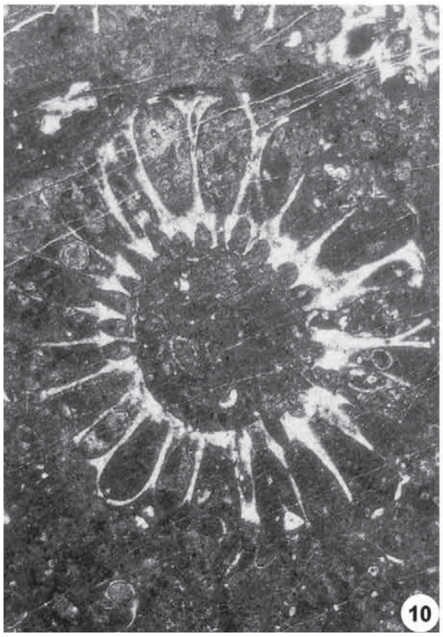
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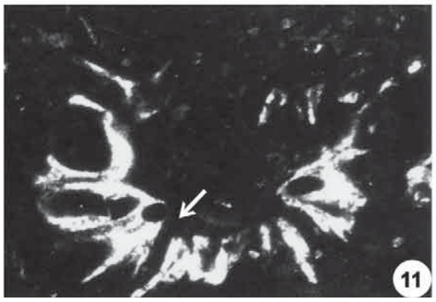
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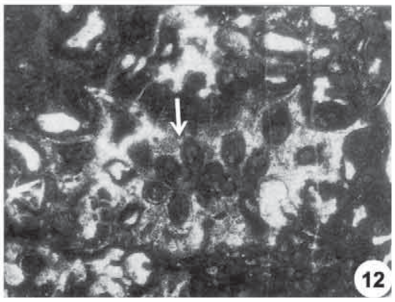
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Plate XVIII

1 *Falsolikanella*? *teakolarae* (RADOIČIĆ et al.) n. comb., oblique section. Yellow colour and the fibrous structure of hyaline calcareous envelope of branches are clearly visible, slide SB–17E2/2, x34.

2–3 *Falsolikanella*? *teakolarae* (RADOIČIĆ et al.) n. comb., oblique–longitudinal section with visible reddish-brownish pigmented outline of the calcareous thallus, slide SB–17E2/1, x22.

4 *Falsolikanella*? *teakolarae* (RADOIČIĆ et al.) n. comb., tangential section of two rows of branches with characteristic fibrous structure of the hyaline calcareous envelope, slide SB–17E2, x34.

5–6 *Falsolikanella*? *macropora* n. sp., fig. 5 – oblique section of the Holotype with light grey to yellowish colour of granular sparite calcareous skeleton; fig. 6 – detail of granular calcareous structure, slide RAK–40A/11, fig. 5 x14, fig. 6 x34.

7 *Falsolikanella*? *macropora* n. sp., Fragment of tangential section with the clearly visible granular structure of the calcareous skeleton, slide SB–17E2/8, x34.

8–9 *Falsolikanella*? sp., oblique–longitudinal sections, fig. 8, slide SB–17E2/16; fig. 9, slide SB–17E2/15, x22.

10–12 *Acicularia* sp., different sections, fig. 10, slide SB–17E2/3; fig. 11, slide SB–17E2, fig. 12, slide SB–17E2/5, x54.


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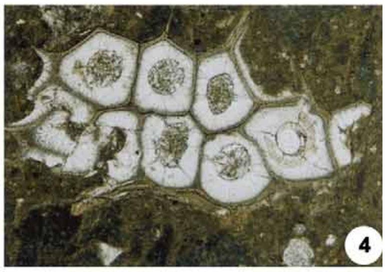
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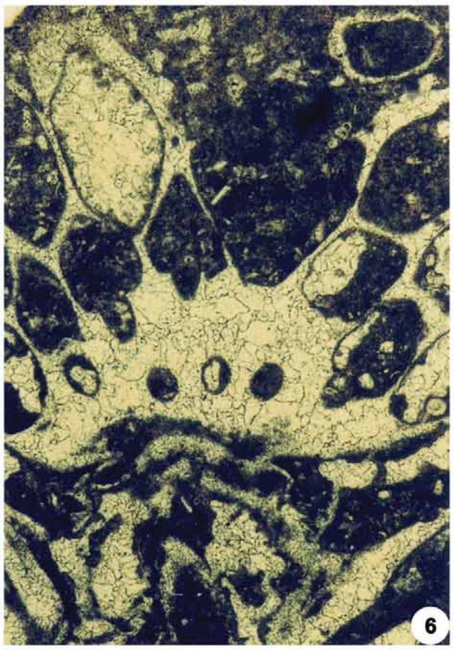
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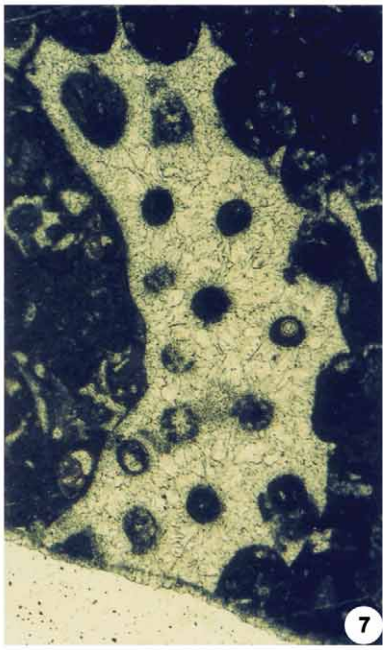
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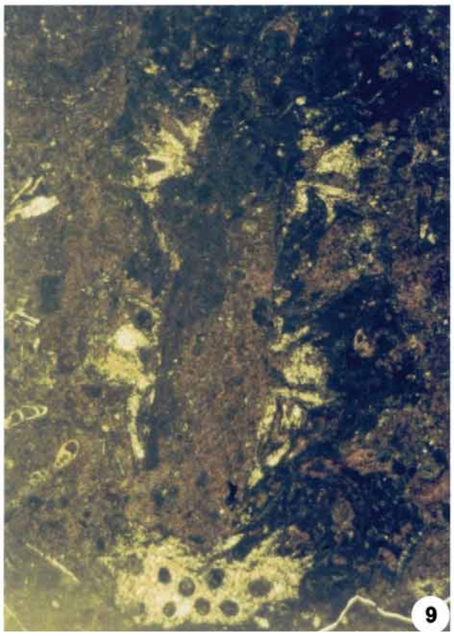
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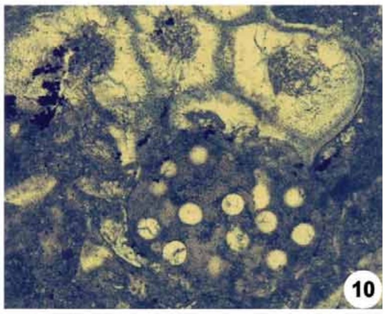
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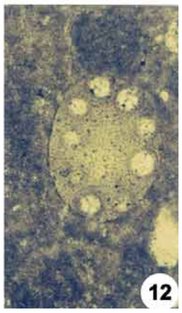
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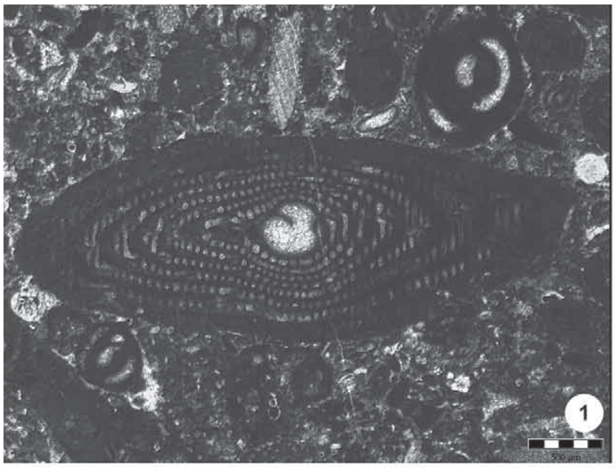
PLATE XIX

1 *Alveolina cremae* CHECCHIA-RISPOLI, axial section (scale = 0.5 mm).
2 *Alveolina pinguis* HOTTINGER, axial section (scale = 0.5 mm).
3 *Spirolina* sp., unidentified miliolids and *Alveolina* sp. with diagenetically altered test walls (scale = 0.5 mm).
4 *Periloculina dalmatina* DROBNE and *Alveolina* sp. (scale = 0.5 mm).
5 *Alveolina* sp., equatorial section with triplet embryonic apparatus showing dissolution of the younger whorls (scale = 0.2 mm).
6 *Nummofallotia cretacea* (SCHLUMBERGER), axial section (scale = 0.2 mm).
7–10 *Calveziconus lecalvezae* CAUS & CORNELLA; 7 and 8 subaxial sections, 9 basal section, 10 oblique section (all scales 0.2 mm).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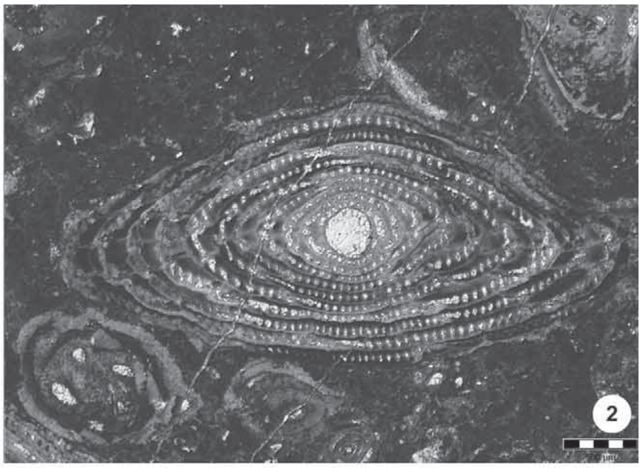
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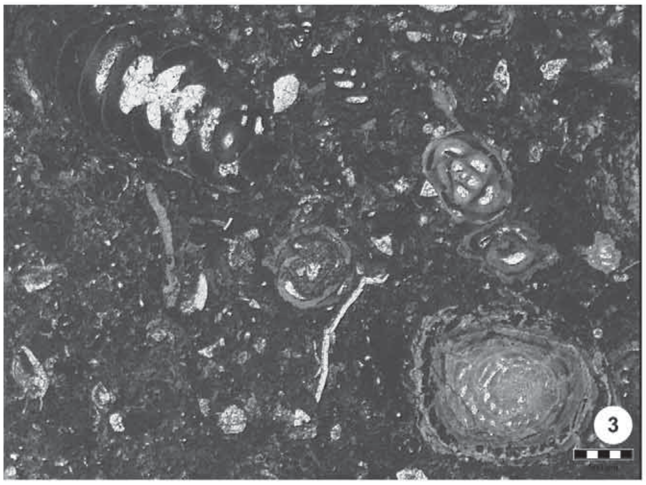
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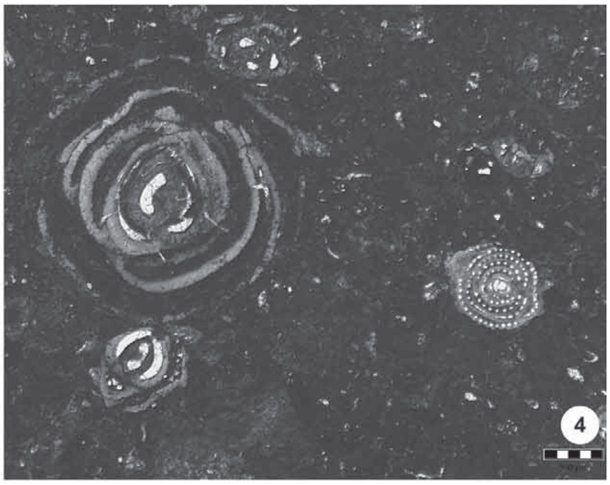
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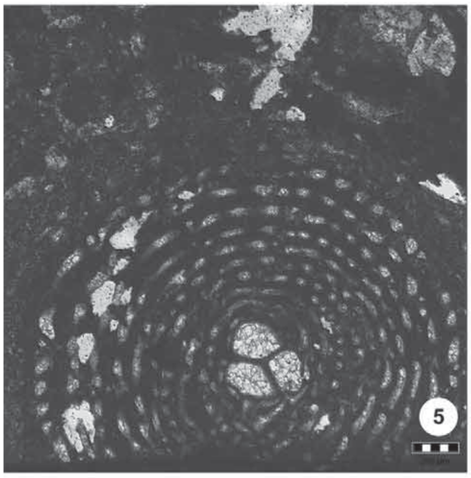
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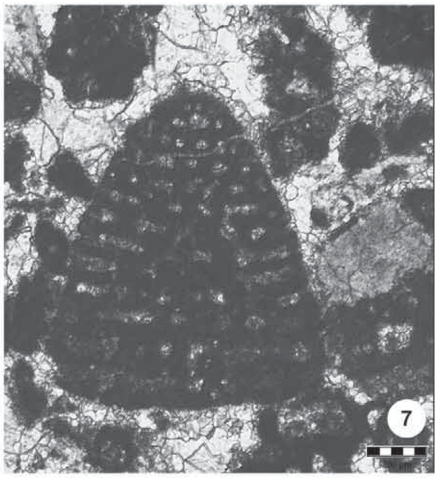
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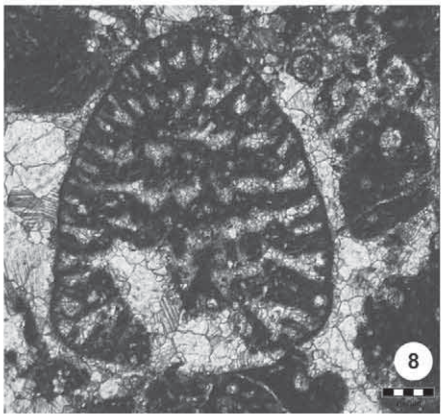
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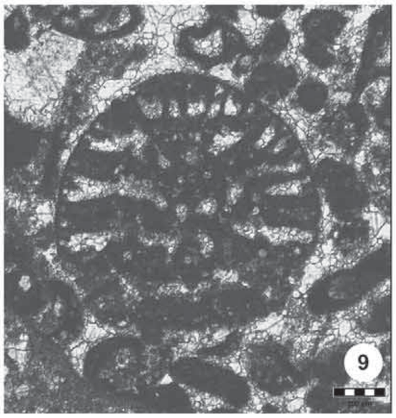
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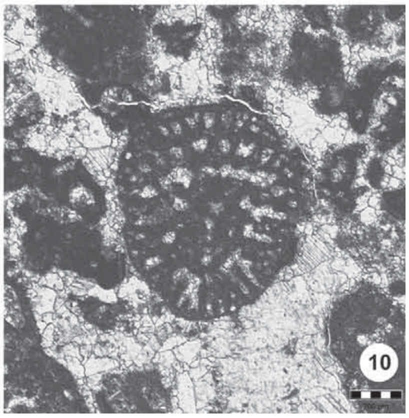
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