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On some *Salpingoporella* species from the Lower Cretaceous of Dinaric karst

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ABSTRACT

In this paper a new species Salpingoporella tari *n.sp. is established, found in a sample of Barremian intraclastic grainstone. It is similar to* S. annulata *(LORENZ) and* S. grudii *(RADOIČIĆ), but visibly more robust. It has few branches per whorl, and the whorls being spaced far apart. The branches are laterally compressed at their distal ends, therefore being vertically elongated. New finding of* Salpingoporella cemi *(RADOIČIĆ) gave the new data on the variability of the shape of its branches, and on the precise stratigraphic position of the investigated localities. Besides,* Salpingoporella patruliusi *BUCUR is illustrated, this being its first find outside Monti Apuseni (south Carpathians) and its geographic range thus encompassing also the Dinarides. Also, a large observed number of specimens of* Salpingoporella muehlbergii *(LORENZ) with ramified thallus makes that feature both its species-specific and generic characteristic. Quite strongly varying values of various biometric parameters, depending on the position on the thallus in one and the same specimen, raises serious questions as to their reliability and usefulness as a distinguishing factor in comparing both the specimens of one and the same species and of species of the same genus.*

Keywords: Dasycladales, *Salpingoporella*, taxonomy, biogeography, Lower Cretaceous, Dinarides, Croatia

1. INTRODUCTION

In the course of investigations carried out by the Croatian Geological Survey within the frames of various scientific and economic assignments in the area of the Dinaric Karst in Croatia, samples for micropalaeontological analyses are also being collected. Sporadic finds of abundant algal remains enable detailed specialized research, directed to more detailed stratigraphic positioning and analysis, better knowledge of biogeographic distribution, grouping of characteristic fossil assemblages, and establishing new taxa or emendation of the existing ones, respectively. This is also the purpose of this paper. We shall analyse some species of the dasyclad genus *Salpingoporella*: establish a new species *S. tari*, describe and illustrate *S. cemi* (RADOIČIĆ) and *S. patruliusi* BUCUR, and report on abundant finds of *S. muehlbergii* showing branching thallus.

2. DESCRIPTION OF ALGAL TAXA

Salpingoporella cemi (RADOIČIĆ, 1968) RADOIČIĆ, 1975

(Pls. I–II; Pl. III, Figs. 1–8)

1968 *Pianella cemi* n. sp. – RADOIČIĆ, p. 189, pls. 9–11

1975 *Salpingoporella cemi* (RADOIČIĆ) – RADOIČIĆ, p. 277

2006 *Salpingoporella cemi* (RADOIČIĆ) – CARRAS, CONRAD & RADOIČIĆ, p. 469 (complete synonymy), pl. II, figs. 1–5

The species was originally described as *Pianella cemi* n. sp. (RADOIČIĆ, 1968). Later RADOIČIĆ (1975) designated the lectotype and transferred species to the genus *Salpingoporella*. This alga has not been known from the area of the Dinaric Karst in Croatia, and with the new findings in the Limska Draga (West Istria) and Biokovo Mt. (Dalmatia) the knowledge of Upper Neokomian microfossil association in this area is improved.

Some new data can be added on the previous descriptions of this species. Cylindrical, unramified, thallus is characterized by thick walls built of mosaic calcite derived by heteroaxial transformation of, probably, primary aragonitic skeleton. Along the margins of the skeleton tiny, short-prismatic, calcite crystals are developed, whereas the remainder of the skeleton is filled up with middle- to coarse-grained mosaic calcite cement. Skeletal walls are delineated with very thin micritic lining of constant thickness. Inner surface of skeleton is even and smooth. Outer surface of skeleton was originally, probably, also smooth, but in the thin sections available it is secondarily eroded and only fragmentarily preserved in individual sections (Pl. I, Fig. 2; Pl. II, Figs. 4–6, 8). It is generally characterized by open pores of distally widened branches (Pl. I, Figs. 5, 7; Pl. II, Figs. 4, 6). Central cavity usually occupies 25–30% of the total diameter. *Salpingoporella cemi* is characterized by simple, comparatively large, phloiophorous branches with visibly widened distal ends, arranged in clear whorls and with alternating position in consecutive whorls (Pl. I, Fig. 4). Though being generally of the phloiophorous shape, when comparing the sections of several individuals, the branches show a variation in their shapes, due to either a more or less regular gradual widening towards the distal ends (Pl. I, Fig. 3; Pl. II, Figs. 2, 6–7; Pl. III, Figs. 2, 3, 5–7), or an abrupt widening in the distal third of their length (Pl. I, Figs. 7, 8; Pl. II, Fig. 24; Pl. III, Fig. 2) that may sometimes come nearer to the vesiculiferous type. In the relation to the longitudinal axis, the branches are subhorizontal or slightly directed upwards, as was already stated in original description of this species (RADOIČIĆ, 1968). One confusing specimen from this article (RADOIČIĆ, 1968, pl. IX, fig. 6) suggest the articulation (annulation) of the skeleton, while particular branches suggest metaspondility (?), so it may be interpreted as species *Falsolikanella danilovae* (RADOIČIĆ).

Sporadic occurrence of rather unclear rounded structures within the distal widenings of the branches (Pl. II, Figs. 8–9; Pl. III, Figs. 1, 5) may indicate the existence of cysts, whereupon the species should belong to the cladosporous type of the dasycladal algae (family Triploporellaceae).

Dimensions in mm (n = 26):

Outer thallus diameter (D)	0.92–1.68
Inner thallus diameter (d)	0.34–0.64
Relation d/D	0.243–0.452
Length of branches (l)	0.30–0.54
Proximal diameter of branches (p_p)	0.05–0.10
Distal diameter of branches (p_d)	0.12–0.39
Distance between neighboring whorls (h)	0.12–0.20
Number of branches per whorl (w)	10–14

Salpingoporella cemi (RADOIČIĆ) seems to be less common then other species of this genus. New findings comprise few specimens from Limska Draga and island Mljet, and large number of well preserved specimens in sample KJ-8 from the Biokovo Mt. All these finds come from the same stratigraphic level: terminal part of the Neocomian deposits. This conclusion is based upon the monitoring of occurrences and disappearances of particular species in the accompanying assemblage. Biokovo Mt. locality is an outcrop located on the cut-off of mountain road leading to Sv. Jure peak (1762 m), described in detail by SOKAČ (2007). The sample with *S. cemi* contains also numerous *Humiella catenaeformis* (RADOIČIĆ) and *Clypeina*? *solkani* CONRAD & RADOIČIĆ (Pl. III, Fig. 9), together with rare *Salpingoporella annulata* (LORENZ). This assemblage is also characterized by the first occurrence of the significant foraminiferal species *Campanelulla capuensis* DE CASTRO, which has a fairly well defined Upper Hauterivian – Lower Barremian stratigraphical range. According to our present knowledge, whereas *H. catenaeformis* and *S. annulata* do not exceed the Hauterivian-Barremian boundary in the Dinarides, the first occurrence of *C. capuensis* falls into the Upper Hauterivian, and thus the position of the KJ-8 sample may be reliably defined as Upper Hauterivian. An almost identical assemblage, lacking only *H. catenaeformis* (which, so far, does not seem to occur in the NW Dinarides) but enriched with *Falsolikanella danilovae* (RADOIČIĆ) occurs in the Limska Draga samples (L-77 and L-78), just below a short lasting emersion which marks the Neocomian-Barremian boundary. At described localities findings of *S. cemi* lie bellow the first appearance of *Salpingoporella melitae* RADOIČIĆ.

***Salpingoporella tari* n. sp.**
(Pl. IV)

Derivation of name: The species has been named after the cove and village Tar in west Istria, where the sample with that alga has been collected during a reconnaissance campaign.

Type locality: Istria, south-southwest of the village Tar, on the road toward the Nova Vas (Fig. 1). Geographic coordinates are: x = 5016.701 (λ=45°17’11“), y = 5391.911 (φ= 13°37’19“).

The sample-yielding outcrops were situated in an excavation for water pipes along the road, but small isolated and karstified outcrops can also be found in the surroundings, scattered within plowed fields. Outcrops are characterized by stromatolitic and grain-supported intra-pelsparitic limestones with algal fragments. The algal bearing microfacies is an intraclastic-algal grainstone. Algae can be found also within the grains. The sedimentary environment may be interpreted as shallow subtidal with slow carbonate deposition.

Holotype: Longitudinal-tangential section figured in Pl. IV, Fig. 3, thin section TAR-1. Isotypes are illustrated by other, variously oriented, sections, figured in the same plate (Pl. IV). The type material is stored at the authors’ collection in the Croatian Geological Survey. Five thin sections have been made of one sample.

Diagnosis: Alga has relatively robust cylindrical skeleton, made from mosaic calcite. It is characterised by pronouncedly spaced whorls of phloiophorous branches. Branches are laterally compressed in distal part that resulted in their vertical elongation and makes vertical and horizontal cross-sections of branches significantly different. In the horizontal cross-sec-

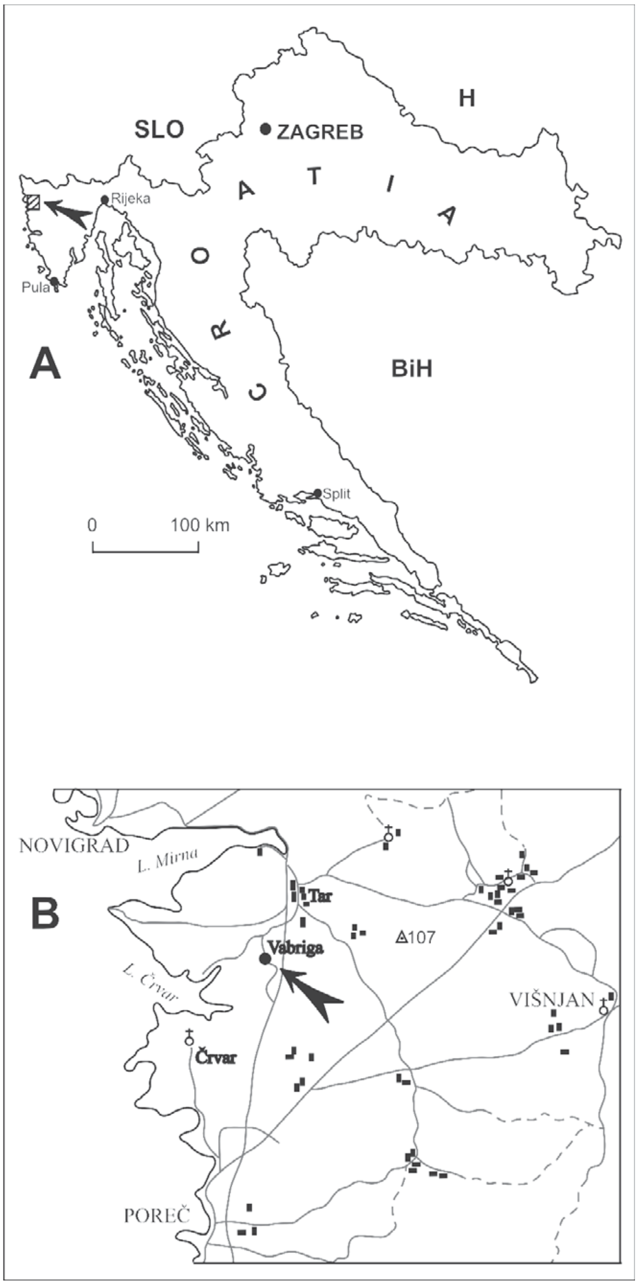

Figure 1: A) General position of the type locality of *Salpingoporella tari* n. sp. B) Simplified topographic map of the type locality. Arrow point to the outcrop of sample TAR–1.

tion, branches by their exit from the central cavity gradually and regularly widen. In longitudinal and parts of oblique sections, depends of the section plane, after the first third or half of their length, branches more or less abruptly widen, attaining funnel-like shape. At the outer surface upper and lower edges of vertically elongated branches are in mutual contact that, in respect to the size of pores, favours destruction of the surface of calcareous envelope.

Dimensions in mm (n = 12):

Outer thallus diameter (D)	0.58–0.88
Inner thallus diameter (d)	0.15–0.38
Relation d/D	0.259–0.438
Distance between neighbouring whorls (h)	0.24–0.40
Length of branches (l)	0.24–0.30
Proximal diameter of branches (p_p)	0.04–0.10
Distal diameter of branches in horizontal section (p_{dh})	0.10–0.12
Distal diameter of branches in vertical section (p_{dv})	0.15–0.38
Number of branches per whorl (w)	8–12

Description: Comparatively small cylindrical skeleton is built up of medium-grained mosaic calcite with a thin micritic margin. Outer surface of skeleton is originally characterized by large cavities of branches' pores, but is often additionally uneven due to destruction of partitions between distal parts of pores and diagenetic processes. The inner surface is delineated by an even, sometimes slightly wavy, thin line, perhaps indicating sporadic constrictions and swellings of the main cell (Pl. IV, Figs. 3–5, 9). Beside the visible variation of the inner diameter (d), the difference between the smallest and the largest value of the d/D relation may be due to the varying outer diameter (D), as a result of a more or less progressing destruction of the outer surface.

Typical phloiophorous, comparatively large, branches are arranged into regular, clearly separated whorls (Pl. IV, Figs. 1, 3, 6, 9–10). Going outwards from the main cell toward the outer part of the thallus, where they are laterally compressed and vertically elongated, the branches widen up irregularly. Because of that, the shape of their pores within the skeleton is different in horizontal section from that in vertical section. In transverse sections, going outwards from the central cavity, they widen slowly, gradually, and in a relatively regular manner (Plate IV, Figs. 21–25). In longitudinal oblique sections, depending on the plane of sectioning, they appear generally funnel-shaped, and the abruptly widen after the first third or about the half of their total length (Pl. IV, Figs. 3–4, 7, 12–13, 20). The arrangement of pores of the consecutive whorls, as well as their possible mutual touching on the outer surface, cannot be clearly seen. A few oblique sections passing into the tangential ones (Pl. IV, Figs. 9, 11, 15) reveal the true shape of the branches, showing the circular transverse section in their proximal part whereas more distally they become laterally compressed and vertically elongated, giving, in transverse sections, a shape of a vertical rectangle with rounded edges. The branches in neighboring whorls probably stayed one above the other, very closely or even touching each other, as indicated in oblique (Pl. IV, Figs. 3–4, 7) and tangential sections (Pl. IV, Figs. 6, 9, 15).

Similarities and differences: *S. tari* n. sp. belongs to that group of not numerous *Salpingoporella* species that are characterized by vertically flattened and elongated distal part of the branches, due to their being horizontally compressed. By its general characteristics, *S. tari* n. sp. is most similar to *S. annulata* CAROZZI and *S. grudii* (RADOIČIĆ).

With regard to *S. annulata* (CAROZZI, 1953), the new species is considerably larger, contains less branches per whorl (8–12, most frequently 8–10), and has distinctly more spaced out whorls. The new species lacks pseudoannulation, men-

PLATE I

Salpingoporella cemi (RADOIČIĆ, 1968) RADOIČIĆ, 1975; x34

1 Fragment of tangential section, KJ-8/4.

2–9 Different oblique sections. Fig. 2, KJ-8/2; Figs. 4–5, 7, KJ-8/1; Fig. 6, KJ-8/10; Fig. 8, KJ-8/5; Fig. 9, KJ-8/9.

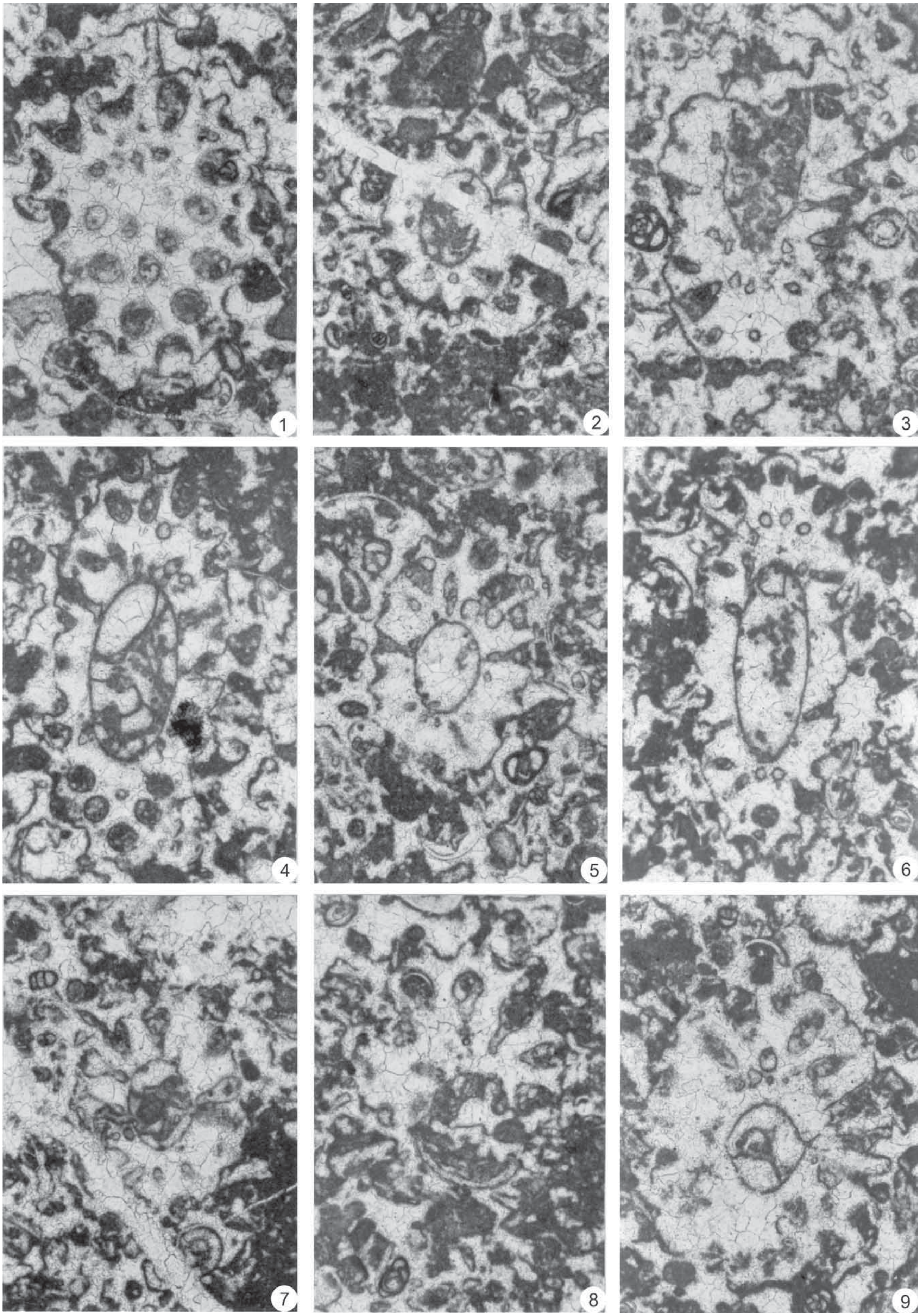
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PLATE II

Salpingoporella cemi (RADOIČIĆ, 1968) RADOIČIĆ, 1975; x34

1–5, 9 Different oblique sections. Fig. 1, KJ-8/8; Fig. 2, KJ-8/13; Fig. 3, KJ-8/12; Fig. 4, KJ-8/7; Fig. 5, KJ-8/11; Fig. 9, KJ-8/16.

6–8 Transverse sections. Figs. 6–7, KJ-8/18; Fig. 8, KJ-8/17.

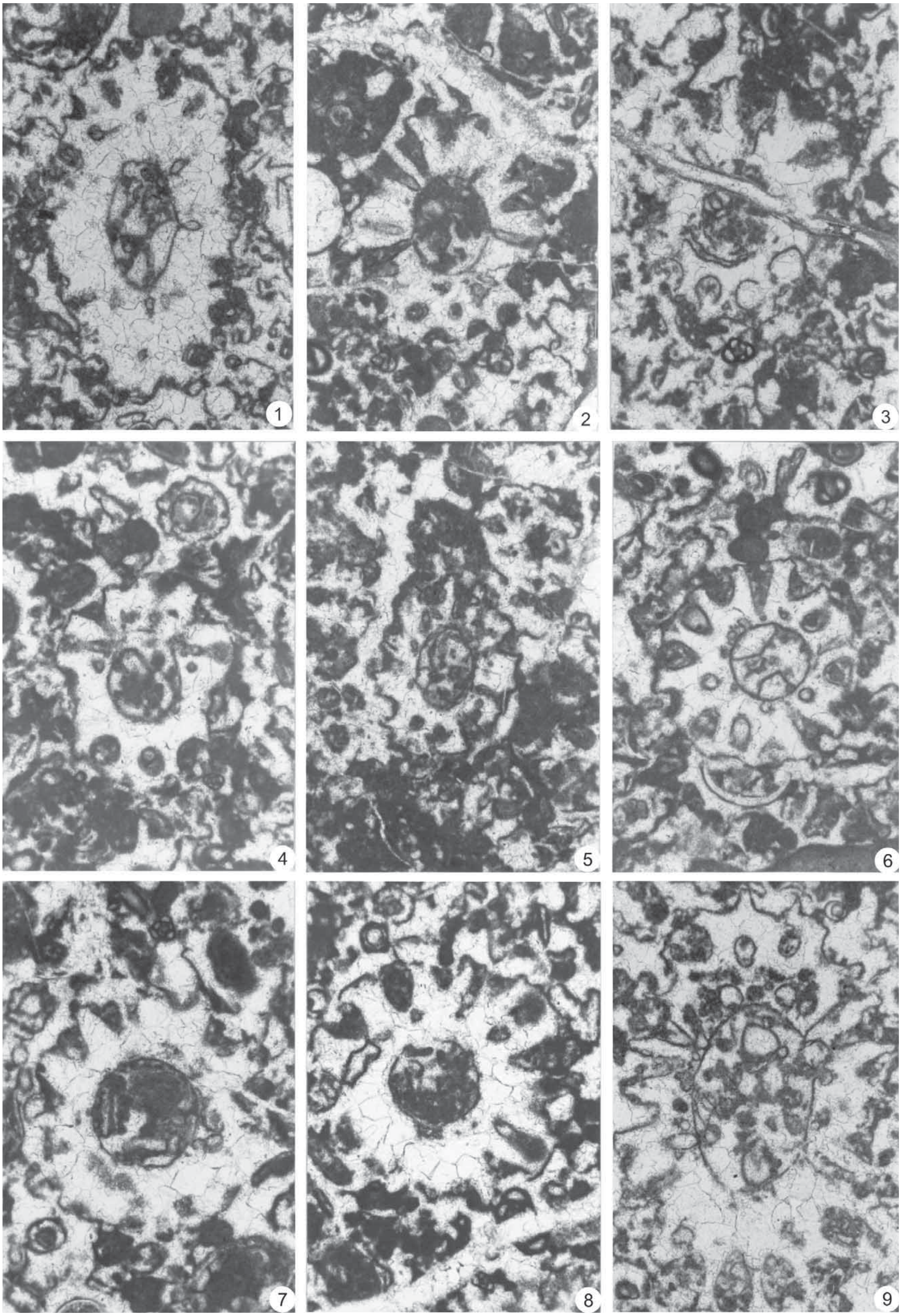
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PLATE III

1–8 *Salpingoporella cemi* (RADOIČIĆ, 1968) RADOIČIĆ, 1975; x34

1 Fragment of tangential section, KJ-8/15.

2–4, 7–8 Different oblique sections. Figs. 2–3, KJ-8/16; Fig. 4, L-77/7; Figs. 7–8, L-77.

5–6 Transverse sections. Fig. 5, L-77/3; Fig. 6, L-77/2.

9 *Clypeina*? *solkani* CONRAD & RADOIČIĆ, 1971

9 Oblique section, KJ-8/12, x34.

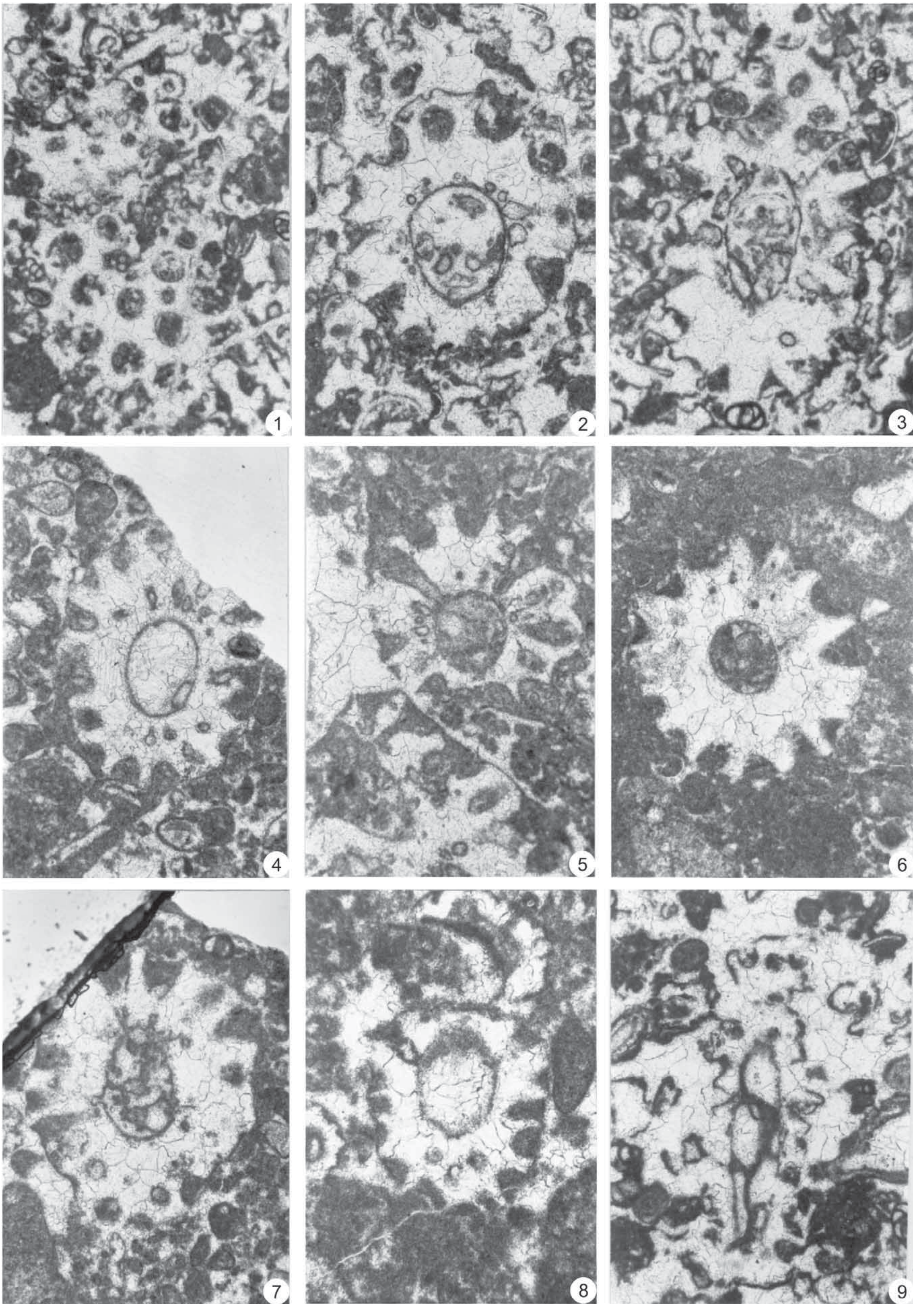
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PLATE IV

Salpingoporella tari n.sp.; x32

1,7, 9–11, 13, 16–19 Different oblique sections. Figs. 1, 9, 17–19, TAR-1; Fig. 4, 7, 11, 13, 16, TAR-1/3; Fig. 10, TAR-1/4.

2–4 Longitudinal-oblique sections. Holotype on Fig. 3, TAR-1. Fig. 2, TAR-1/4, Fig. 4, TAR-1/3.

5, 8, 12, 20 Longitudinal sections. Fig. 5, TAR-1/4; Fig. 8, TAR-1; Fig. 12, TAR-1/2; Fig. 20, TAR-1/1.

6, 14 Oblique-tangential sections. Fig. 6, TAR-1/1; Fig. 14, TAR-1/3.

15 Fragment of tangential section, TAR-1.

21–25 Transverse sections. Fig. 21, TAR-1/4, Fig. 22, TAR-1/1; Figs. 23–24, TAR-1/2; Fig. 25, TAR-1/13.


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tioned in *S. annulata*. In *S. annulata*, the branches are very thin in their proximal part, as distinct from *S. tari* in which they are larger and, in horizontal section, uniformly broaden toward outer ends. Because of *S. grudii* being very similar to *S. annulata* (possible synonym), the differences to *S. annulata* apply also to *S. grudii* (RADOIČIĆ, 1962). With regard to *S. croatica* SOKAČ, which, according to our opinion, cannot be considered synonymous with *S. annulata* as proposed by CARRAS et al. (2006), the new species differs by very different shape of the branches. In *S. tari*, the distal ends of the branches are laterally compressed and vertically elongated, whereas in *S. croatica* the branches widen relatively uniformly toward exterior, somewhat more strongly only in the very distal parts (SOKAČ, 1992, pl. I, figs. 18, 21), thus giving a more or less circular shape of the pores in tangential sections (SOKAČ, 1992, pl. II, fig. 1).

There exists also some similarity in oblique and longitudinal sections between the new species and *S. biokoviensis* SOKAČ & VELIĆ. The difference exists in the shape of the branches, which in *S. biokoviensis* gradually and uniformly become wider in both horizontal and vertical sections, resulting in more or less quadrangular pores in tangential sections (SOKAČ & VELIĆ, 1980), as distinct from *S. tari*, where the pores are only laterally compressed, thus gradually widening only in transverse sections, and abruptly widen in transversal sections.

There is a confusing similarity, but oly in cross sections, with *Clypeina? solkani* CONRAD & RADOIČIĆ, while in oblique and logitudinal sections the difference is obvious. *Clypeina? solkani* has articulated thallus and uniformly widened branches, in contrary to *S. tari* n. sp. that has simple cylindrical thallus and pronounced widening and vertical elongation of the branches.

Stratigraphic position: *Salpingoporella tari* n. sp. comes from a randomly collected sample, which, except for numerous variously oriented sections of that alga, did not contain any other fossil remains, which would possibly have enabled a direct determination of its stratigraphical position. Therefore we have analysed the fossil contents of the samples coming from isolated and scattered neighboring outcrops, which, however, cannot give reliable indications of the precise stratigraphic position of the sample analysed. There are some outcrops of stromatolitic and pelsparitic limestones not very far apart that yielded *Salpingoporella melitae* RADOIČIĆ, followed by locally heavily limonitized skeletal biosparites and these, in turn, being probably overlain by *Bacinella* biomicrites which, in the sequence, contain also rare *Palorbitolina lenticularis* (BLUMENBACH). Generally, the distribution of outcrops in the surrounding area and their rather scarce fossil content indicate the statigraphic position of that species as being possibly Upper Barremian. In Istria, the transition to the Aptian is characterized by a change in depositional system, with sudden regional deepening of sedimentary environment and sedimentation of thick-bedded and massive *Bacinella*-floatstones, known as "Yellow Istrian" ("*Giallo d'Istria*") architectural-building stone (VELIĆ et al., 1989, 2003; VLAHOVIĆ et al., 2003).

***Salpingoporella patruliusi* BUCUR, 1985**
(Pl. V; Pl. VI, Figs. 1–4)

1985 *Salpingoporella patruliusi* n. sp. – BUCUR, p. 81–84, text-fig. 1, pls. I–III
1992 *Salpingoporella patruliusi* BUCUR, 1985 – BUCUR, p. 449–450, text-fig. 1
1999 *Salpingoporella patruliusi* BUCUR – BUCUR, pl. II, figs. 1–10
2001 *Salpingoporella patruliusi* BUCUR – POP & BUCUR, pl. VIII, fig. 9
2001 *Salpingoporella patruliusi* BUCUR – BUCUR & COCIUBA, p. 122, pl. 2, figs. 1–3
2007 *Salpingoporella patruliusi* BUCUR – SOKAČ, p. 84, pl. III, figs. 1–3

This species was validly described and well illustrated, accompanied also by a graphic reconstruction, by BUCUR (1985, text-fig. 1, pls. I–III,). A renewed description with illustrations has also been published by BUCUR (1992). According to the original diagnosis (BUCUR, 1985), the species is characterized by relatively large cylindrical thallus, unbranched and unsegmented, with a narrow stipe, and phloiophorous branches arranged in alternating whorls. The branches are tilted with respect to the stipe and are surrounded by a relatively thick calcareous sheath. In their distal portion the branches are compressed, showing a rhombic, less commonly polygonal outline. Calcification around branches gives an outline of relatively thick envelope bordered by a thin micritic line. Terminal parts of branches are not calcified.

So far, this species has been known only from the region of Monti Apuseni (southern Carpathians) and thus, this being its first find outside the area mentioned, it represent a broadening of its are of distribution into the Dinarides. In our material, the species is present, though by not numerous sections, in an otherwise rich algal assemblage in the sample KJ-18, which has already been mentioned several times previously (SOKAČ, 2004, 2005; SOKAČ & GRGASOVIĆ, 2004). The Dinaridic specimens (Pl. V; Pl. VI, 1–4) do not show any new remarkable characteristics. The thick calcareous sheath, enveloping the branches as mentioned by BUCUR (1985), composed of sparite and surrounded by a darker line of micrite, is hardly distinguishable and present in only a few specimens (Pl. V, Fig. 4; Pl. VI, Fig. 4). One gain an impression, that this sporadically present feature, as a possible consequence of quicker or slower calcification spreading out from the rim of the branch membrane into the space between the branches, is not always fully completed leaving the remaining space to be subsequently filled up by micrite.

The here illustrated specimens from Mt. Biokovo are in general somewhat larger, thus having somewhat larger values of biometric parameters in relation to those from the type locality (Table 1). These differences in dimensions appear not important and seem to be well within the presumed variation range, when comparing specimens coming from localities situated so far apart from each other.

Beside the sections that can be reliably ascribed to *S. patruliusi* BUCUR, we have noticed several transverse sections

Table 1: Comparison of biometrical parameters of specimens *S. patruliusi* BUCUR originating from the type locality in Monti Apuseni and of those from Mt. Biokovo (n = 11). Dimensions are in mm.

Locality	L	D	d	d/D	h	l	l	pl	w	α
Apuseni	5.12	1.10–2.30	0.11–0.24	0.10–0.24	0.22–0.28	0.56–1.00	0.16–0.31	0.040–0.78	7–9	25–35
Biokovo	8.9	1.26–2.66	0.40–0.85	0.182–0.354	0.20–0.24	0.74–1.24	0.24–0.44	0.09–0.15	9–14	20–40

(Pl. VI, Figs. 5–8) which, in spite of some similarities with *S. patruliusi*, clearly differ from it. Because of their scarcity and poor preservation we found it useful to enumerate some of their characteristics similar to *S. patruliusi*: narrow central cavity in relation to relatively large value of the outer diameter, clearly euspondyle (verticillate) arrangement of phloiophorous branches, very clearly expressed distal broadening of the branches, two or three rows of pores in the same plane of section with their diameters increasing going towards the outer rim. Such arrangement of pores, with their maximum widening in the outermost circle, which corresponds to one of the lower whorls, is indicative of small distance between neighboring whorls and oblique position of branches, declining from the longitudinal growth axis under an angle of 30–40° and possible downwards bending in the peripheral part. With regard to *S. patruliusi*, there are more branches per whorl, which, in the available sections, can reasonably be estimated at 20–30. Based on the features defined and supposed above, these sections can be ascribed, with necessary caution, to an as yet undescribed *Salpingoporella* form. In spite of several unknowns, illustrations of that species can perhaps be useful as being indicative of the stratigraphic position of deposits with such remains in cases of new finds without better stratigraphic indicators.

Stratigraphic position: In the original description (BUCUR, 1985), the stratigraphic position of *S. patruliusi* is defined as being in the lower level of the Pachyodont limestone, whose total range is Barremian – Lower Aptian. In a later report and illustration (POP & BUCUR, 2001), the species is mentioned in the assemblage whose stratigraphic position is more reliably defined by *Palaeodictyoconus arabicus* as Upper Barremian. The stratigraphic position and lithological characteristics of the algal-bearing deposits which yielded the algal-rich sample KJ-18 from Mt. Biokovo have been reported and discussed in earlier papers (SOKAČ, 2004, 2005, 2007; SOKAČ & GRGASOVIĆ, 2004; TIŠLJAR et al., 2002). According to all data available so far, based on the rich fossil assemblage from the same sample, this find, too, can be defined as Upper Barremian.

Salpingoporella muehlbergii (LORENZ, 1902) PIA, 1918
(Pl. VI, Figs. 9–11; Pl. VII)

The type species of the genus *Salpingoporella*, found at numerous localities in the Perrimediterranean region, in the Dinarides is regularly present in the more or less rich algal assemblage whose range is within the Barremian. The renewed description of that species, along with the emendation of the genus *Salpingoporella*, has been given by CONRAD (1970), and once more, very succinctly, by BASSOULLET et al. (1978). In those descriptions, an unramified and unsegmented thallus was emphasized as one of the main characteristics. SOKAČ (1996, pl. I, fig. 6), however, figured one section of a branching thallus of that species, and several more branching thalli of *Salpingoporella dinarica* RADOIČIĆ, and, based on that, proposed an amendment of the generic diagnosis, including the ramified thallus. CARRAS et al. (2006), both in their amendment of the generic diagnosis and in the description of *S. muehlbergii* (LORENZ), not mentioned that feature. In discussing the generic diagnosis, they stated that the exceptionally observed ramified thallus in *S. dinarica* and *S. muehlbergii*, among many normal specimens (cylindrical tubes), may be teratogenous or result of a wound. Disregarding the frequency and the cause, the observed ramifying thallus in the type species, as a subsequently established feature, should be included in the generic characteristics.

Today it appears quite unbelievable that the first find of a ramified thallus in the type species came only after its numerous finds and more than centennial presence in the literature and, moreover, to be recorded by just one section. Therefore we continued to record its finds, directing our research onto samples exceptionally rich with its sections and trying to find new and more numerous specimens with branched thallus. Several new sections, though, admittedly, still not very numerous in relations to the number of thin sections available (250), were found and reported in the previously mentioned sample KJ-18 (SOKAČ, 2004, 2005; SOKAČ & GRGASOVIĆ, 2004). The new sections show without any doubt the presence of ramified thalli in *S. muehlbergii* and open the possibility of redefining the values of the biometric parameters and their reliability in the comparative analysis, which was the prime goal of this discussion anyway.

Dimensions in mm (n = 11):
In the lower part of the thallus, below the branching:
D = 0.53–1.06
d = 0.28–0.76
d/D =0.514–0.843
In the lower part of the branched parts of thallus:
D’ = 0.36–0.76
D’ = 0.16–0.24
d/D = 0.230–0.555

The fact that a comparatively small number of visibly ramified thalli has been observed, as well as their long-lasting absence from the literature, cannot be taken as a proof of their being an exceptionally rare feature in that alga, but, rather, as a result of random sectioning, representing always only one plane of section. In spite of a comparatively small number of suitable sections, in which the outer and inner diameters of both the unbranched and the branching part of the thallus can be measured in one specimen, the mentioned values are twice as large in the unramified part of the thallus (D, d) than in the

PLATE V

Salpingoporella patruliusi BUCUR, 1985

1 Tangential-longitudinal section. KJ-18/1, x17.

2 Tangential-oblique section. KJ-18/39, x14.

3 Longitudinal section. KJ-18/150, x22.

4–6 Oblique-tangential sections. Fig. 4, KJ-18/91; Fig. 5, KJ-18/57; Fig. 6, KJ-18/159; x22.

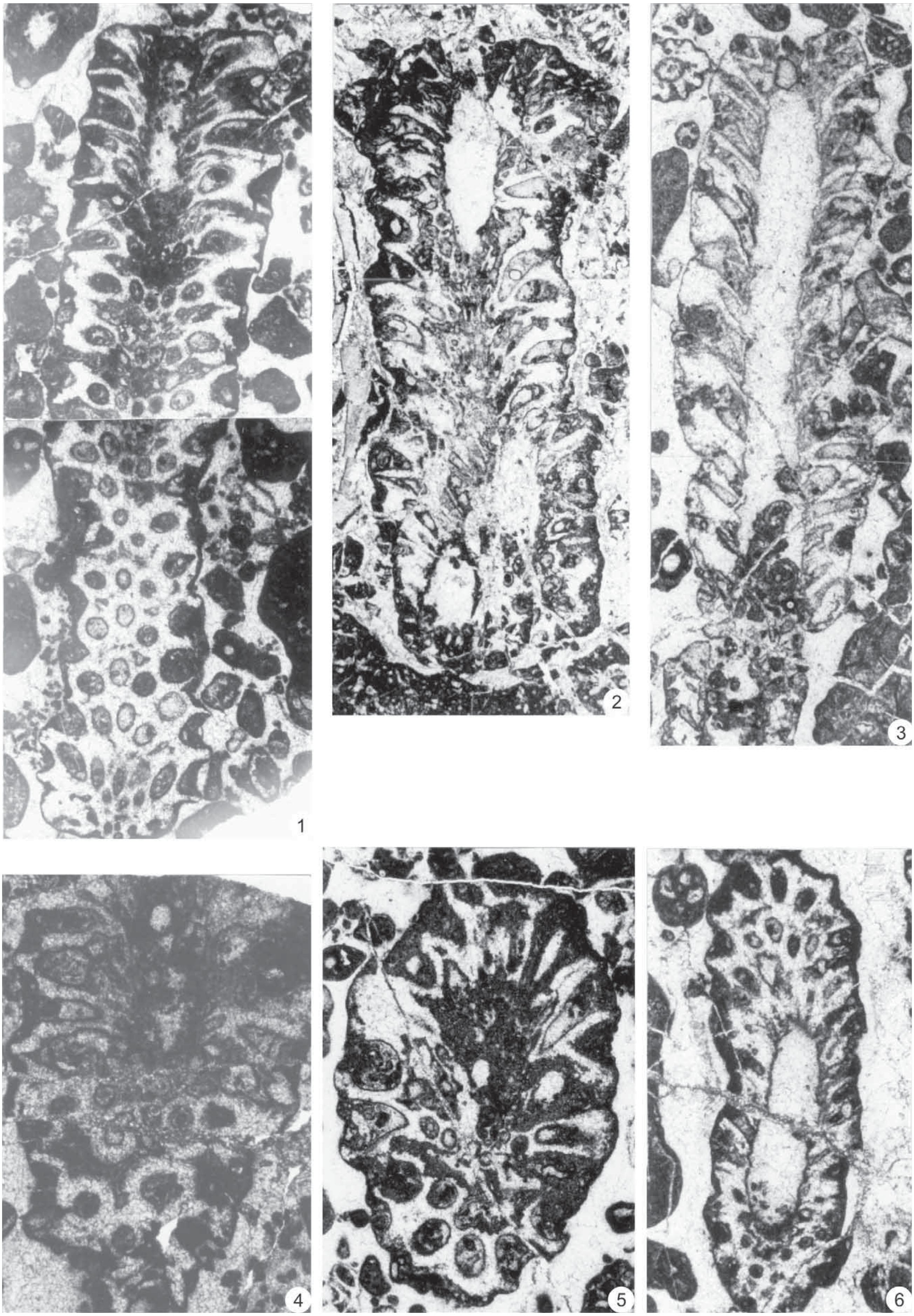
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PLATE VI

1–4 *Salpingoporella patruliusi* BUCUR, 1985

1 Oblique section. KJ-18/62, x17

2–4 Transverse sections. Fig. 2, KJ-18/39; Fig. 3, KJ-18/19; Fig. 4, KJ-18/160; x22

5–8 ?*Salpingoporella* sp.

5–8 Transverse sections. Fig. 5, KJ-18/1, x22; Fig. 6, KJ-18/1, x17; Fig. 7, KJ-18/28; x22; Fig. 8, KJ-18/30, x22

9–11 *Salpingoporella muehlbergii* (LORENZ) with ramified thallus

9 Oblique section. KJ-18/30, x34

10–11 Longitudinal sections of secondary branches of the thallus. Fig. 10, KJ-18/9; Fig. 11, KJ-18/5; x22.

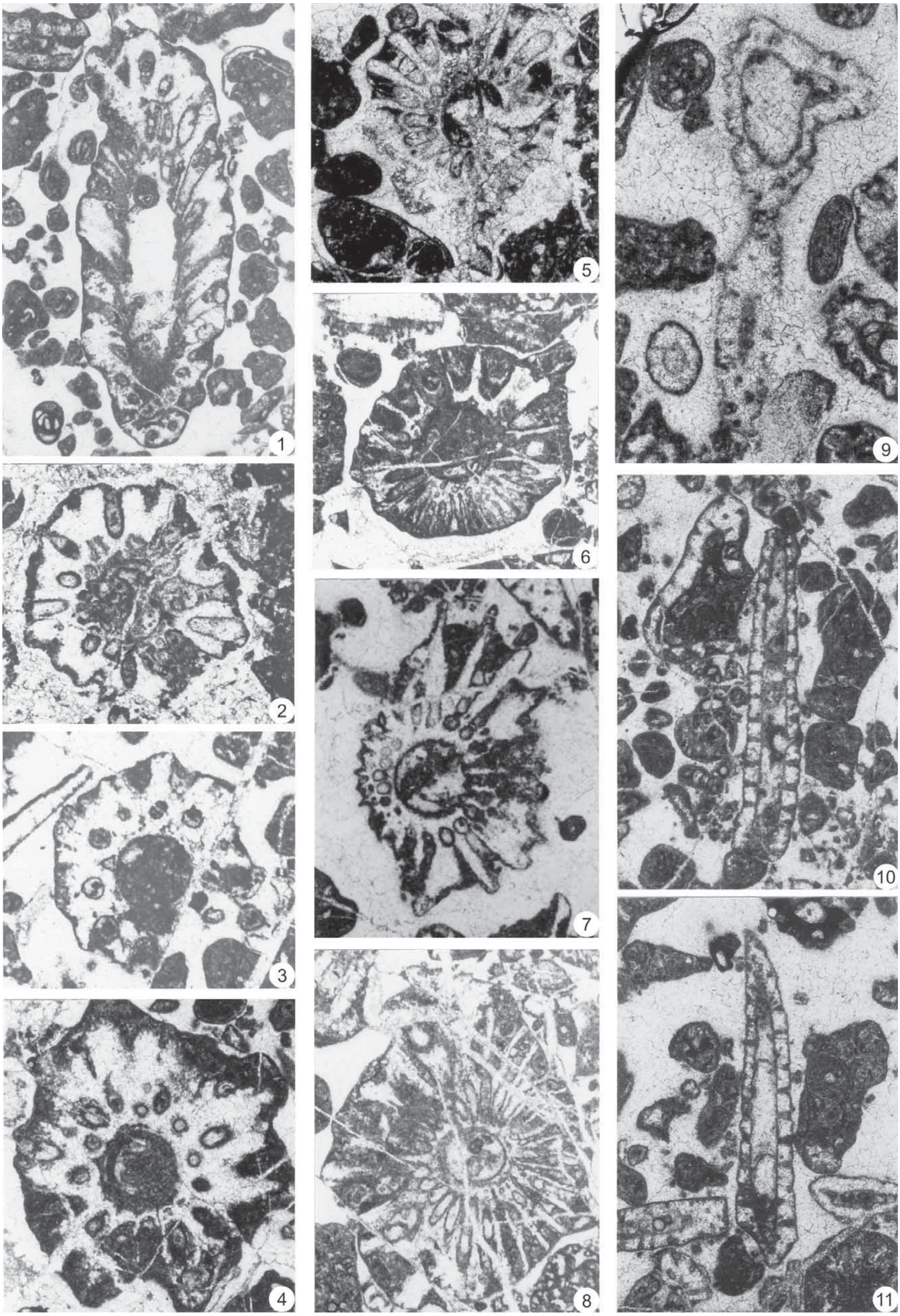
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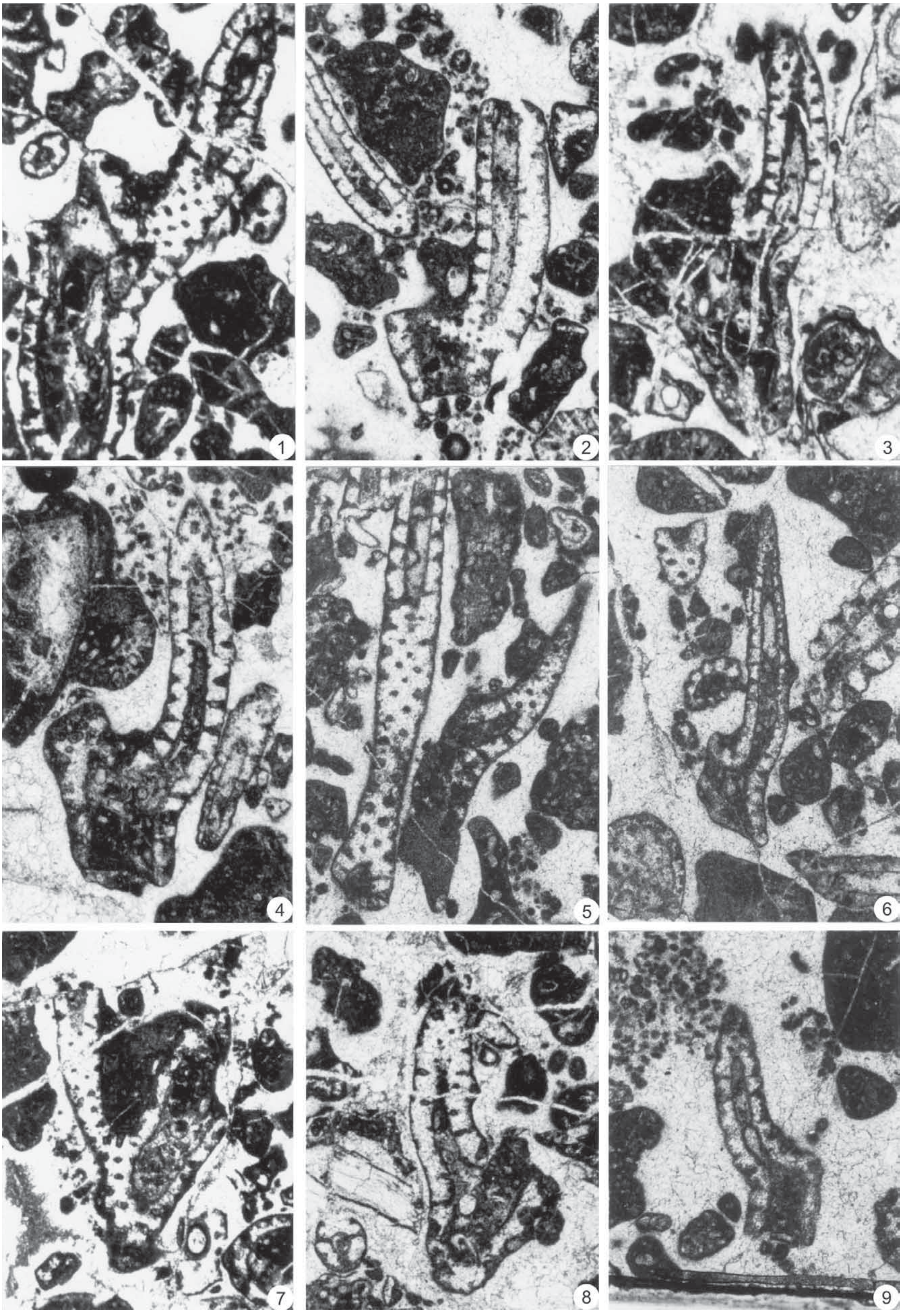
PLATE VII

Salpingoporella muehlbergii (LORENZ, 1902) with ramified thallus, x22

1–9 Different sections of ramified thalus, partly only secondary branches of the thallus (Figs. 5, 6). Fig. 1, KJ-18/18; Fig. 2, KJ-18/54; Fig. 3–4, KJ-18/1; Fig. 5, KJ-18/30; Fig. 6, KJ-18/5; Fig. 7, KJ-18/175; Fig. 9, KJ-18/28.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ramified part (D', d'). This suggests the possibility that different dimensions of identically oriented sections in the same sample do not, at least partly, reflect varying dimensions between different specimens, but are taken at different places in more-less equally large specimens. Further on, the frequently encountered wildly differing D and d values of similarly oriented sections in the same sample makes us believe that ramified thalli are in fact much more frequent than could be concluded from a few sections where the branching is clearly visible. An additional confusion into analysis and discussion of biometric parameters and their comparison is brought in by comparatively numerous sections with distinctly small values, which we suppose derive from top parts of the branches, in which, of course, their thinning towards the top is reflected in both smaller D and d (or, to be more precise, D' and d') values and the reduced thickness of the calcareous envelope (SOKAČ, 1996, pl. I, fig. 4; this paper Pl. VI, Figs. 10–11, Pl. VII, Fig. 6), which, then, also gives different values for some other parameters (l, p).

From all that has been mentioned above, it can be concluded that the application of comparative analysis of biometrical parameters in fossil dasyclad algae, especially in the genus *Salpingoporella*, leaves open a lot of uncertainties and open questions and therefore requires caution in bringing out conclusions.

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