Geologia Croatica	58/2	119–131	1 Fig.	1 Tab.	4 Pls.	ZAGREB 2005

Linoporella vesiculifera n.sp., A New Calcareous Alga (Dasycladales) from the Upper Barremian of Mt. Biokovo (Karst Dinarides, Croatia)

Branko **SOKAČ**

Key words: Calcareous alga, Dasycladales, Genus *Linoporella*, Taxonomy, Lower Cretaceous (Barremian), Dinarides, Croatia.

Abstract

According to all the main characteristics, the new species belongs to the genus *Linoporella*. At the species-specific level, *Linoporella vesiculifera* n.sp. is characterized by visibly widened distal ends of the secondary branches, which gives a vesiculiferous appearance to the outer surface of the thallus. The distal widenings are spherically or conically shaped and open outwards in a funnel-like form. A short review of the taxonomic validation of some *Linoporella* species is also given. The new species is derived from the Barremian deposits of Mt. Biokovo (central Dalmatia, Croatia).

1. INTRODUCTION

The sample KJ–18 contains a rich algal assemblage, which has already been the subject of previous investigations (SOKAČ, 2004; SOKAČ & GRGASOVIĆ, 2004). Among numerous sections of various taxa, listed below under the section on stratigraphic position, the species ascribed by JAFFREZO et al. (1978) to *Suppiluliumaella polyreme* ELLIOTT has also been identified. In about 250 thin-sections made from this sample, this species is represented by over 100 differently oriented sections, some being in a very good state of preservation. These sections show all the main morphological characteristics typical of the genus *Linoporella* STEINMANN, 1899, but at the same time allow the new species to be determined, because of many well-pronounced species-specific characters. The algal-bearing sample derives from the Barremian part of the Lower Cretaceous sequence, described as megafacies K_3 by TIŠLJAR et al. (2002), and characterized by an alternation of peritidal–tidal flat, pelletal and stromatolitic limestones, forming shallowing-upward cycles, laterally with carbonate sand bars and with vadose features at the top of each cycle. More detailed lithofacies and biofacies characteristics of this part of the analyzed column (containing the sample KJ–18) can be found in the papers by TIŠLJAR et al. (2002), SOKAČ (2004), and SOKAČ & GRGASOVIĆ (2004).

Croatian Geological Survey, Sachsova 2, PO Box 268, HR-10000 Zagreb, Croatia; e-mail: amartek@hgi-cgs.hr

2. TAXONOMIC DESCRIPTION

Genus *Linoporella* STEINMANN, 1899, emend. BASSOULLET et al., 1978, emend. BARATTOLO, 1991

Linoporella vesiculifera n.sp.

Pls. I–IV

Synonymy

1978 *Suppiluliumaella polyreme* ELLIOTT.– JAFFREZO, POISSON & AKBULUT, p. 85–86, pl. 3, figs. 1, 4, 7; pl. 4, fig. 5?; pl. 5, fig. 5.

Origin of the name: The species is named because of the wineskin-shaped ends of the secondary laterals which give a vesiculiferous appearance to the outer surface of the thallus.

Type locality: Mt. Biokovo, in a road cut situated approximately in the middle between the Vošac mountain hut and the Sv. Jure peak (1762 m), Fig. 1. Coordinates: x=6423980, y=4798490.

Type stratum: The sample with the new alga belongs to the level of light brown, well-bedded, more or less karstified limestone, with bed thickness ranging from 0.3 to 1.2 m. The microfacies types are fenestral, skeletal- and oncoid-bearing, intraclastic grainstone and skeletal–peloidal packstone. The allochems include irregular intraclasts, small pellets, micritized skeletons of benthic foraminifera and gastropods, and, less commonly, oncoids, skeletons and bioclasts of dasycladacean algae, and centripetally micritized shell bioclasts. The lithological succession is represented by an alternation of mudstone, algal and foraminiferal wackestone, and sporadic occurrences of skeletal–intraclastic grainstone.

Holotype: Oblique section in thin section KJ–18/155, figured in Pl. 2, Fig. 2. Isotypes are represented by variously oriented sections, figured in Pl. 1, Pl. 2, Figs. 1,

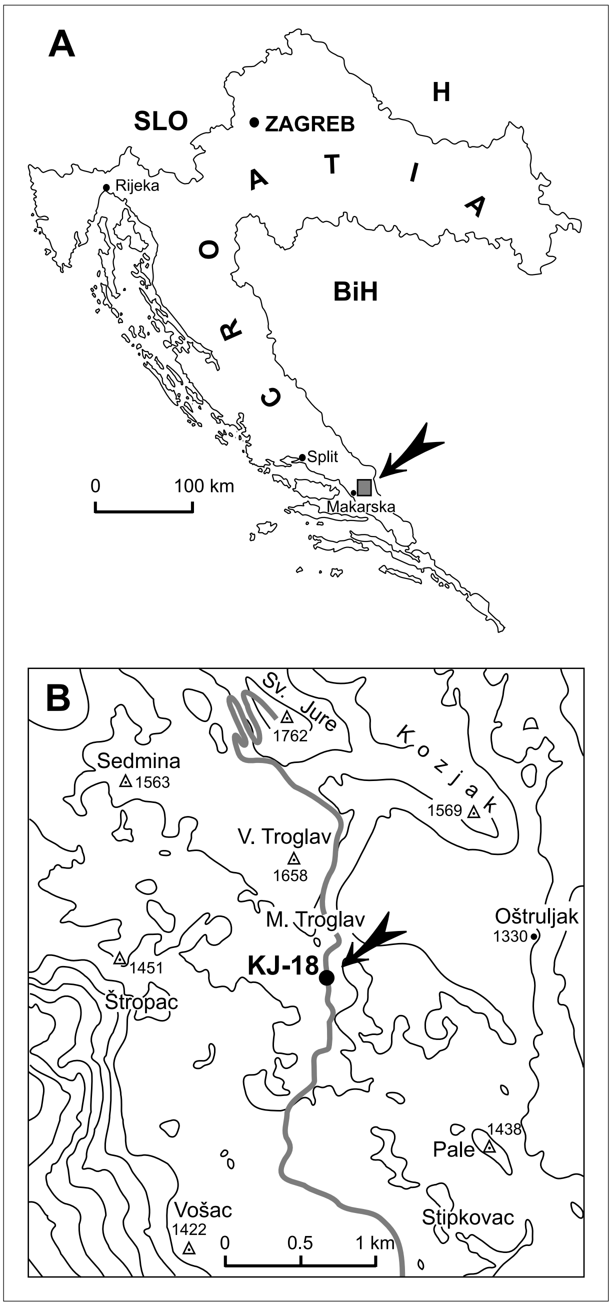

Fig. 1 (A) General location of the sample KJ–18 locality in the Croatian territory. (B) Simplified map of the area of the central Biokovo Mt., type locality of *Linoporella vesiculifera* n.sp.

3–8, and Plates 3 and 4. The original material is kept at the Croatian Geological Survey (former Institute of Geology), Zagreb.

Diagnosis: The species is characterized by a cylindrical thallus bearing euspondyle primary laterals. Laterals are clearly divided into primaries and secondaries. Each phloiophorous primary lateral bears a tuft of 3 secondaries, which have strongly widened distal ends. These distal widenings form gentle bulges of wineskin-shaped chamberlets (vesicles) with funnel-shaped, outward opened, endings on the outer surface, which give the species its most typical characteristic.

Description: The thallus is cylindrical, unbranched, with a clearly delineated, even, inner edge (Pl. II, Figs. 2, 4, 8). The outer surface is characterized by small bulges of the bubble-shaped distal ends of the secondary laterals, with the outward opened, funnel-shaped terminations (Pl. I, Figs. 4, 6, 8; Pl. II, Figs. 1–3). In specimens with a well-preserved inner edge, e.g. those figured in Pl. II, Figs. 6, 8 and Pl. III, Figs. 1, 5, 8, the axial cavity occupies about 30–40% of the total diameter of the thallus. The calcareous skeleton is composed of secondary mosaic calcite.

The species is clearly euspondyle: primary laterals are arranged into regularly distributed rows of whorls, which are clearly visible in longitudinal and oblique sections (Pl. I, Fig. 2; Pl. IV, Fig. 4), and, as a radial arrangement of laterals, in transverse sections (Pl. IV, Fig. 9). The laterals are bipartite, clearly divided into primaries and secondaries. The primaries are generally phloiophorous: slender, and more or less clearly widened distally (Pl. I, Figs. 1, 3). In some cases, their distal widenings acquire a bulbous, head-like shape (Pl. II, Fig. 5), or, depending on where the secondaries branch off, a shallow Y-like shape (Pl. IV, Fig. 8). Large cavities (pores) of the primaries' distal swellings facilitate a more intense destruction of the central zone of the calcareous envelope, which produces visible fissures in circular and oblique sections (Pl. I, Fig. 8; Pl. III, Figs. 5, 7; Pl. IV, Figs. 6, 9, 10). The primaries are directed upwards, more or less inclined to the main axis at an angle of 18–45°. In adjacent whorls, the laterals are arranged alternately, with minor irregularities (Pl. II, Fig. 4; Pl. IV, Fig. 4). Three secondaries grow out from the distal ends of the primary laterals (Pl. I, Fig. 7; Pl. III, Fig. 6), though, sometimes, a fourth secondary may perhaps occur. From their starting point, secondary branches diverge from one another and, though generally directed upwards, some laterals of the same tuft may acquire a horizontal position or are bent even slightly downwards (Pl. III, Fig. 1). Going outwards, they become slightly club-shaped, similar to the primaries, to widen abruptly into wineskin-shaped or conical swellings in the last (distal) third (Pl. I, Figs. 4, 6, 8; Pl. II, Figs. 1–3). Immediately below the outer surface a zone (layer) of densely packed, alternately arranged, vesicle-shaped chamberlets are produced by these distal swellings of the secondaries (Pl. I, marginal part of Fig. 4), which, in turn, give rise to slight bulges on the outer surface (Pl. II, Fig. 2; see marginal part of the calcareous envelope), producing a surface covered with warts. The wart-like surface results in weaker calcification, making the outer surface liable to erosion, which may reach down to the base of the distal swellings. The result is a very different aspect of the section (Pl. I, Figs. 1–3; Pl. III, Fig. 1, upper part of the picture). In many descriptions of dasyclad algae, the question was often raised of whether the pores were open or closed on the surface. In this species, regardless of whether the distal swellings are more or less spherical or conical, they bear on their tops funnel-shaped constrictions,

	L. capriotica			*L. taurica*	*L. gigantea*		*L. elliotti*	*L. kapelensis*	*L. svilajaensis*		*L. parva*	*L. spissa*	*L. vesiculifera*
	OPPENH. 1889	STEINM. 1889	BARATTOLO 1991	PCELINCEV 1925	CAROZZI 1955	FARINACCI & RADOIČIĆ 1991	PRATURLON 1965	SOKAČ & VELIĆ 1976	SOKAČ & VELIĆ 1976	FARINACCI & RADOIČIĆ 1991	DIENI et al. 1985		
AGE	**Tithonian**		**Neocom.**	**Lower Kim.**	**Port.**	**Late Jurass. Early Creta.**	**Generally Alb.**	**Tithonian**	**Upper Jurass. Lower Cretac.**	**Late Jurass. ?Early Creta.**	**Palaeocene**		**Barremian (Upper Barremian)**
L	4			14			5	14		1.10			7.2
D	1.5	1.5-4	1.0-3.1	3.2	1.2-1.75		0.8-1.3	2.22-2.59	2.03-2.78	0.67-2.75	0.620-0.655	0.847-0.887	1.36-2.32
d		1	0.34-1.6		0.8-1.2		0.4-0.5	1.0-1.40	0.73-1.18	0.66-0.77	0.322-0.327	0.316-0.378	0.40-0.96
d/D											0.49-0.53	0.37-0.43	0.284-0.428
h	1	0.23	0.06-0.10				0.15-0.25	0.45-0.55	0.37-0.45	0.32-0.44	0.158	0.100	0.08-0.20
l		0.6	0.08-0.23				0.2-0.4	0.40-0.60	0.25-0.37	0.275-0.37	0.085	0.192	0.24-0.40
p		0.1	0.03-0.07				0.03-0.05	0.07-0.10	0.10-0.17	0.08-0.11	about 0.023	about 0.033	0.06-0.12
l´		0.8	0.30-0.57				0.12-0.2	0.28-0.45	0.37-0.52	0.27-0.32	0.079	0.079	0.20-0.40
p´		0.7	0.03-0.05				0.02-0.04	0.04-0.07		0.05-0.06			0.05-0.11
px								0.10-0.19					0.10-0.18
l˝			0.09-0.20										
p˝			0.04-0.07										
w			17-44	30	30-40	about 24	15-20	35-40?	28-35	20-26 up to 30	14		25-30
w´	4-5		2-5	4		?4	4	4	4-5*				3-?4
w˝			2-3										
α							60-80°	60-80°		50-60			20-45

Table 1 Correlation of biometric parameters of different species of the *Linoporella* genus. All dimensions are given in millimetres. Legend: L – maximum observed length; D – outer diameter of the calcareous skeleton; d – inner diameter of the calcareous skeleton; d/D – relationship between inner and outer diameter of the calcareous skeleton; h – distance between whorls; l – length of primary laterals; p – diameter of primary laterals; l' – length of secondary laterals; p' – diameter of secondary laterals; px – diameter of the distal ends of secondary laterals; l" – length of tertiary laterals; p" – diameter of tertiary laterals; w – number of primary laterals per whorl; w' – number of secondaries

which open outward (Pl. I, Figs. 6, 8; Pl. II, Figs. 1–3). These funnel-shaped openings on the distal ends of bubble-like (vesiculiferous) chamberlets may indicate the existence of trichoblast tufts; some of which, if well-preserved, may be mistakenly interpreted as third-order laterals (Pl. II, left part of Fig. 4). The distal swellings may be supposed to have functioned as depositories of cysts, which would imply the cladosporous affinity of that species, but this cannot be proven with certainty.

Somme comments on the diagnosis and the emended diagnoses of the genus *Linoporella* STEINMANN: The main characteristics of the genus *Linoporella* were given by PIA (1927). Later, they were emended three times by three different groups of authors, as follows:

BASSOULLET et al. (1978): "Cylindrically shaped thallus, made up of primary and secondary branches, arranged in whorls. Secondary branches present themselves in a bunch, with a slender diameter in relation to their length. Primary and secondary branches are more or less oblique to the main axis and lengthened; they are sometimes slightly thickened at their distal end."

DIENI et al. (1985) made the above diagnosis more complete: "Secondary branches bear tufts of short tertiary branches. Calcification normal, around primary and secondary branches, rare and weak around the tertiary branches."

BARATTOLO (1991) added more detail to the above diagnosis in stating that "The tertiary branches are phloiophorous in shape and form a cortex. Reproductive organs were probably placed inside the central stem (endosporate-type)."

Thus, going from the above quotations, the main question, despite indisputable agreements, centers on the interpretation of the existence of the third-order laterals. DIENI et al. (1985) base their amendment on the interpretation of the distal widenings of the secondaries, that, in their opinion, indicate the existence of the tertiary laterals and even expand such an interpretation by also applying it to other *Linoporella* species, namely *L. elliotti* PRATURLON and *L. kapelensis* SOKAČ & NIKLER. BARATTOLO (1991), unfortunately, failed to support his amendment with adequate sections (photographs). BUCUR et al. (1995, pl. X, fig. 8) figured a *Linoporella* n.sp. 1 with a tangential–longitudinal section of a skeleton fragment, and in the caption of the figure mentions the existence of the R3 laterals, which form the distal cortex. However, the analysis of that section does not appear to provide a reliable argument proving the unquestionable existence of the R3 laterals; what does appear unquestionable are the widenings of the distal ends of the secondary laterals, visible in a part of the longitudinal section. This is also indicated by larger pores in the lower part of the tangential section, at the same time without the pores that would indicate the existence of the R3 laterals. In the present material, sections figured in Pl. I, Figs. 4, 6, 8, and Pl. II, Figs. 1–3, 8, with clearly visible distal widenings and outward oriented funnel-shaped endings in the secondaries, as exit points for the trichoblasts, make the existence of true third-order laterals highly unlikely. The oblique section figured in Pl. II, Fig. 4 (left centre of the picture), where one sole lateral, as opposed to the above examples, may be interpreted as suggesting two small excrescences as a possible third row of laterals, seems to be an exception rather than a rule and thus cannot be taken as proof of the existence of the third-order laterals. The sections figured in Pl. I, Figs. 1–3, 5, 7, Pl. II, Fig. 5, and Pl. III, Figs. 1–3, 5, 8, in which the outer surface of the thallus is not completely preserved and which lack the distal ends of the secondaries, showing only open widenings, also prove that the interpretation of the third-order laterals, at least in these cases, cannot be based on a firm foundation.

Finally, the original diagnosis, with the main characteristics as given by PIA (1927), together with the amendments given by BASSOULLET et al. (1978), seems fully sufficient to enable the valid attribution of *L. elliotti* PRATURLON, *L. svilajensis* SOKAČ & VELIĆ, *L. kapelensis* SOKAČ & NIKLER, as well as the later described Palaeogene species *L. parva* DIENI et al. and *L. spissa* DIENI et al., to the genus *Linoporella*. Therefore, the question of the existence of the third-order laterals, which need not be eliminated, is not decisive for the taxonomic classification, more so, as the alleged existence of the tertiary laterals rests upon the authors' interpretation but lacks visible and reliable proof. As to the amendment given by BARATTOLO (1991), it cannot be competently commented on, as the author unfortunately failed to give any illustrations of sections that would have documented his amendment.

Similarities and differences: The main characteristics – cylindrical, unbranched thallus, slender primary branches arranged in distinct whorls, and bearing a tuft of distally swollen secondaries – of *Linoporella vesiculifera* n.sp. are all characteristic features of the genus *Linoporella* (PIA in HIRMER, 1927; emend. BASSOULLET et al., 1978). Though a relatively small number of species have been ascribed to that genus, some still remain inadequately known, which, as already pointed out by PRATURLON (1965), makes a thorough comparison difficult. The earliest described species, *Linoporella capriotica* (OPPENHEIM), for which the measurement values have been more fully presented by BARATTOLO (1991), and *L. taurica* PCELINCEV, remain inadequately and poorly illustrated and, thus, difficult to identify with certainty. Not only that, but, as pointed out by BASSOULLET et al. (1978), *L. taurica* and the form described as *Macroporella gigantea* by CAROZZI (1955) should be considered to be younger synonyms of *L. capriotica*. In contrast, FARINACCI & RADOIČIĆ (1991) proposed the emendation and validation of Carozzi's species, with a more complete diagnosis, as *Linoporella gigantea*. They based their opinion on comparison with the illustrations of *Linoporella capriotica* as given by OPPENHEIM under the name of *Triploporella capriotica* (OPPENHEIM, 1889, pl. XIX, fig. 7; pl. XX, figs. 11–11c) and of those by STEINMANN (1899, p. 148–149, fig. 13). However, the illustrations given by those authors represent drawings, i.e. graphic interpretations of the external aspect of the thallus and of a fragment of a tangential–oblique section (on which the genus *Linoporella* was established), except for a very unclear section in Steinnmann's pl. XX, fig. 11b. Therefore it is deemed necessary to take up the original description of *Macroporella gigantea,* which was established by CAROZZI (1955, p. 43, fig. 7) on the basis of drawings (graphic illustrations), of variously oriented sections and only one inadequate photograph of a tangential–oblique section of a fragment (of the skeleton), which really does not enable an objectively more adequate description.

As for *Linoporella taurica* PCELINCEV, it too is represented (in the original description), by only one tangential–oblique section of a skeletal fragment (PCELINCEV, 1925, pl. 2, fig. 5), which, as is also the case with previous examples, does not enable incontestable conclusions to be drawn. In this species, the third-order branches have not been mentioned, but it was said to have tiny spores, mostly situated within the distal ends of the channels of the primary laterals.

Measurements given with the descriptions of the aforementioned species are not only incomplete, but are also largely unreliable, being based on drawings (reconstructions), and therefore cannot be accepted with certainty. Therefore the revalidation of the form ascribed to *Linoporella gigantea* (CAROZZI) by FARINACCI & RADOIČIĆ (1991) is also not based on well founded data which would have enabled an objective comparison. For the time being, short of new finds, all three forms – *L. capriotica*, *L. taurica* and *L. gigantea* – remain inadequately known and it seems justifiable to consider the *taurica* and *gigantea* species as younger objective synonyms of *L. capriotica,* as has been proposed by BASSOULLET et al. (1978). Therefore, the comparison of *Linoporella vesiculifera* n.sp. is objectively possible only with those forms ascribed to the genus *Linoporella*, the morphological characteristics and biometrical parameters of which are unequivocally known. These are: *L. kapelensis* SOKAČ & NIKLER, *L. elliotti* PRATURLON and *L. svilajensis* SOKAČ & VELIĆ. *L. vesiculifera* n.sp. differs from the Tithonian *L. kapelensis* by several measurement values. The outer diameter of the new species is, on average, one third smaller than in *L. kapelensis* or, exceptionally, its largest value may just barely reach the minimum value of *L. kapelensis.* The same relationships hold true for the inner diameter. In the new species, the distance between neighbouring whorls (h) is much smaller and seldom reaches half of the distance in *L. kapelensis.* Also, the laterals in *L. kapelensis* are much more steeply directed upwards. Further differences concern the number of branches in a whorl, which in *L. vesiculifera* n.sp. are one third smaller (24–30) than in *L. kapelensis*. With regard to *L. svilajaensis,* the measurement values of the new species are approximately in the same relationship as mentioned above with regard to *L. kapelensis*. An obvious difference between *L. vesiculifera* and the two aforementioned species, as well as in *L. elliotti*, concerns the number of secondary laterals, which is 3 in the new species, as distinct from 4–5 in other species. Distal ends of the secondary laterals in the new species are strongly wineskin-shaped, with visible short, funnel-shaped openings at the tops, which support the assumed growth of tufts of thin tertiary assimilatory filaments. Similarly, PRATURLON (1965) has also assumed the existence of tertiary laterals in *L. elliotti*, based on clearly and visibly widened distal ends of the secondary laterals, that are, in that species, more distinctly club-shaped. The Palaeogene species, *L. parva* DIENI et al. and *L. spissa* DIENI et al., are distinctly smaller, in addition to other differences with the older species, as mentioned in the original description (DIENI et al., 1985, p. 14–15). In these species the question of tertiary laterals also remains open, though their existence may be assumed on the basis of distal widenings on the ends of the secondaries (DIENI et al., 1985, figs. 7A–B), which may be considered to represent their distal wineskin-shaped swellings. The new species is distinguished from all other species by a clearly developed cortical layer of wineskin-shaped vesicles (“chamberlets”; Pl. I, Figs. 4, 6, 8; Pl. II, Figs. 1–2, 6), which is, however, prone to easy destruction and therefore is lacking in many specimens (Pl. I, Figs. 1–2; Pl. III, Figs. 1–2). Another species-specific characteristic of the new species is the sporadic occurrence of fissures cutting through the central part of the calcareous envelope, i.e. in the zone (layer) of more or less swollen distal ends of the primary laterals. This feature, however, is not present in all specimens, or may be only fragmentarily developed. The first figured sections of *L. vesiculifera* in JAFFREZO et al. (1978, pl. III, figs. 1?, 4, 7: pl. IV, fig. 5?; pl. V, fig. 5) have been ascribed to *Suppiluliumaella polyreme* ELLIOTT. However, the new species differs from *S. polyreme,* according to the original description, and the sections illustrated (ELLIOTT, 1968, pl. 95, figs. 1–5), by the shape of the primary laterals, which are, in *S. polyreme*, represented by a long and slender stalk, with a pronounced and abrupt distal swelling from which 4–5 rounded cylindrical (phloiophorous) secondaries grow out, as graphically represented by SOKAČ & NIKLER (1973, table I).

The generic attribution of some species ascribed to the genus *Linoporella*, e.g. *Linoporella*? *buseri* RADOIČIĆ and *Linoporella*? *lucasi* CROS & LEMOINE was already questionable in the original descriptions (as indicated by question-marks put after the generic name), though they were included by GRANIER & DELOFFRE (1993) in their list of *Linoporella* species. However, SOKAČ (2001) ascribed *L.*? *buseri* to the genus *Palaeodasycladus*, and BASSOULLET et al. (1978) stated that *L.*? *lucasi* has globular terminations of primary laterals, which is in contrast with their elongated shape in *Linoporella* and brings it closer to the genus *Dissocladella*. This also outlines the differences between those species and the new species, and also emphasizes their equivocal taxonomic position.

Stratigraphic position: *Linoporella vesiculifera* n.sp. is present with numerous sections in the rich algal assemblage in the Upper Barremian limestones of Mt. Biokovo. A detailed description of lithofacies and biofacies is given in the papers by SOKAČ & GRGASOVIĆ (2004) and SOKAČ (2004). The algal assemblage accompanying the new species in the sample KJ–18 contains the following, more or less abundant, species: *Salpingoporella muehlbergii* (LORENZ), *S. verticillata* (SOKAČ & NIKLER), *S. patruliusi* BUCUR, *S. dinarica* RADOIČIĆ, *Cymopolia velici* SOKAČ & NIKLER, *“Praturlonella” dalmatica* (SOKAČ & NIKLER), *Cylindroporella lyrata* MASSE & LUPERTO SINNI, *Biokoviella robusta* (SOKAČ), *B. gusici* SOKAČ, *Triploporella ?sarda* JAFFREZO et al., *Korkyrella texana* (JOHNSON), and rare *Neomeris cretacea* STEINMANN and *Suppiluilumaella polyreme* ELLIOTT. Benthic foraminifera are, in general, rarer and stratigraphically insignificant, but the first occurrence of *Palorbitolina lenticularis* (BLUMENBACH) immediately above the algal assemblage is important, as it certainly defines the age of the entire algal assemblage, including the new species, as being Middle–Late Barremian. Another locality with *Linoporella vesiculifera* n.sp., in southwest Turkey (Antalya region – JAFFREZO et al., 1978), though quite distant, belongs to a level with an identical shallow water carbonate fossil assemblage, thus suggesting the possibility of its occurrence in other carbonate platform environments of southern Tethys.

Acknowledgement

This paper is based on samples that were collected by several colleagues who participated in the field work on Biokovo Mt., and I am particularly grateful to Đuro BENČEK and Ivo VELIĆ. I would like to thank Josip TIŠLJAR for his sedimentological analysis and lithofacies interpretation. I am especially grateful to the reviewers, Marc A. CONRAD and Felix SCHLAGINTWEIT, who critically read the manuscript, indicated some errors, and provided useful remarks that clearly improved the presentation. I have to admit that with regard to some of their suggestions considering the hitherto diagnosis of the genus *Linoporella*, I decided to retain a critical attitude, in order to provoke and support future investigation.

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PLATE I

Linoporella vesiculifera n.sp.

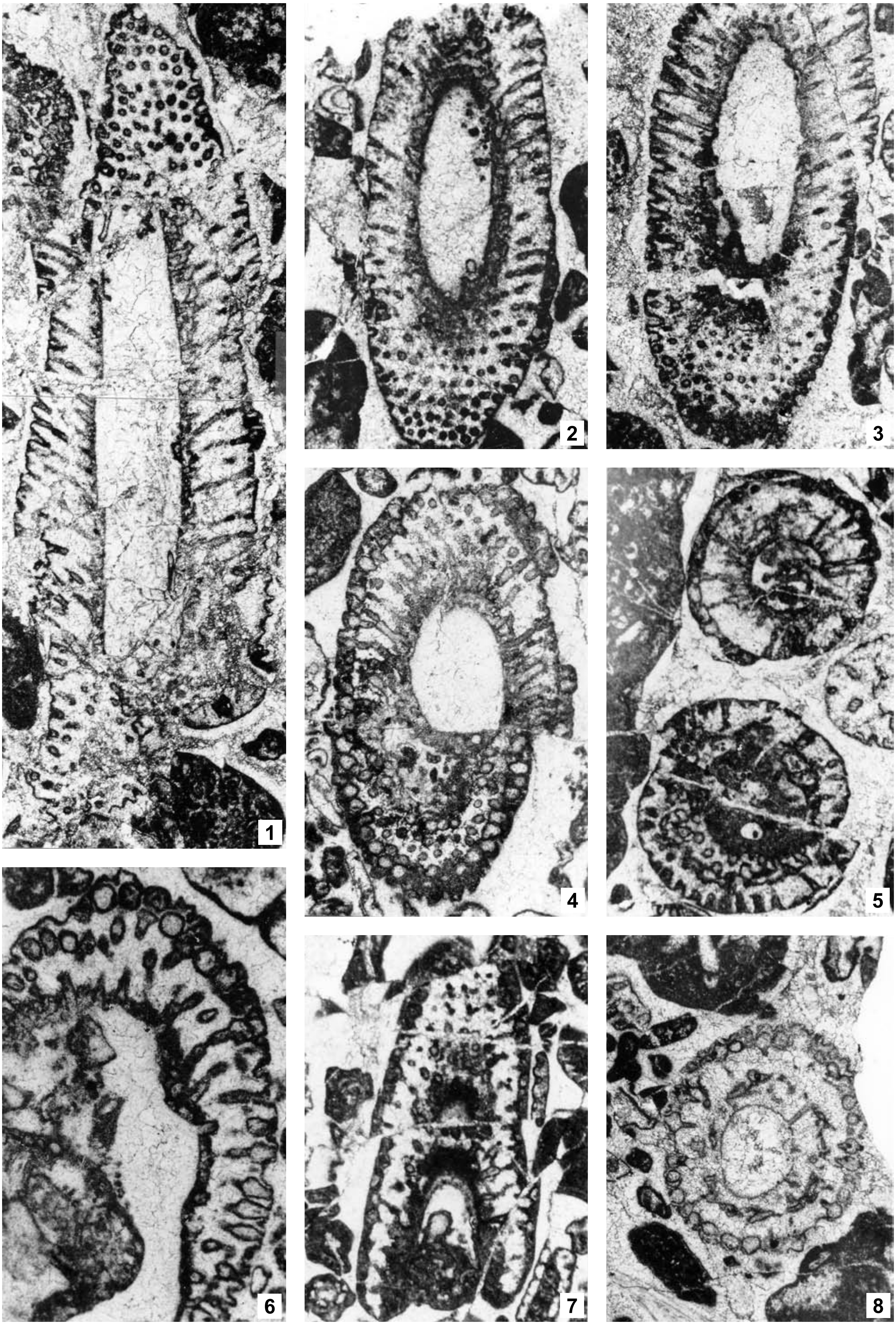
1–4 Oblique sections showing the well preserved peripheral (cortical) zone of wineskin-shaped swellings at the distal ends of secondary branches (Fig. 4). Fig. 1, KJ–18/110; Fig. 2, KJ–18/92; Fig. 3, KJ–18/132; Fig. 4, KJ–18/132; x22.

5 Transverse sections, KJ–18/223, x22.

6 Fragment of an oblique section with visible cone-shaped widenings at the distal ends of secondary branches. KJ–18/56, x34.

7 Fragment of an oblique section passing into a tangential one. Outer zone of vesicles is partly preserved. In the tangential part of the section (upper part of the figure) the growth of three secondaries may be perceived. KJ–18/217, x22.

8 Transverse, somewhat oblique sections, with a well preserved peripheral zone of vesicles. On the outer side of individual vesicles short tubular extensions can be observed, open toward the exterior. KJ–18/208, x22.



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Manuscript received June 1, 2005.

Revised manuscript accepted November 11, 2005.

PLATE II

Linoporella vesiculifera n.sp.

1–2 Oblique section; holotype – Fig. 2. The section shows the main characteristics of the species: well-developed and clearly visible peripheral zone of vesicles, with their short tubular, outward open extensions on their outer sides, and slight depressions between the vesicles that give rise to their swellings on the outer surface of the thallus. In the central part of the calcareous envelope the incipient development of a fissure can be observed at the level of branching of the primaries. KJ–18/155, x22.

3 Fragment of an oblique section with the preserved outer part of the calcareous envelope and only secondary branches visible. KJ–18/109, x34.

4–5 Oblique sections. In Fig. 4, the distal zone of the vesicles is completely eroded, in Fig. 5 it is partly preserved. Fig. 4, KJ–18/208; Fig. 5, KJ–18/78, x22.

6 Longitudinal–tangential section. The peripheral zone of vesicles is clearly visible. KJ–18/66, x22.

7 Oblique section of a specimen with more strongly club-shaped primary branches.

8 Transverse section with a clearly visible fissure in the central part of the calcareous wall and the peripheral zone of wineskin-shaped distal swellings of the secondaries. KJ–18/77, x22.

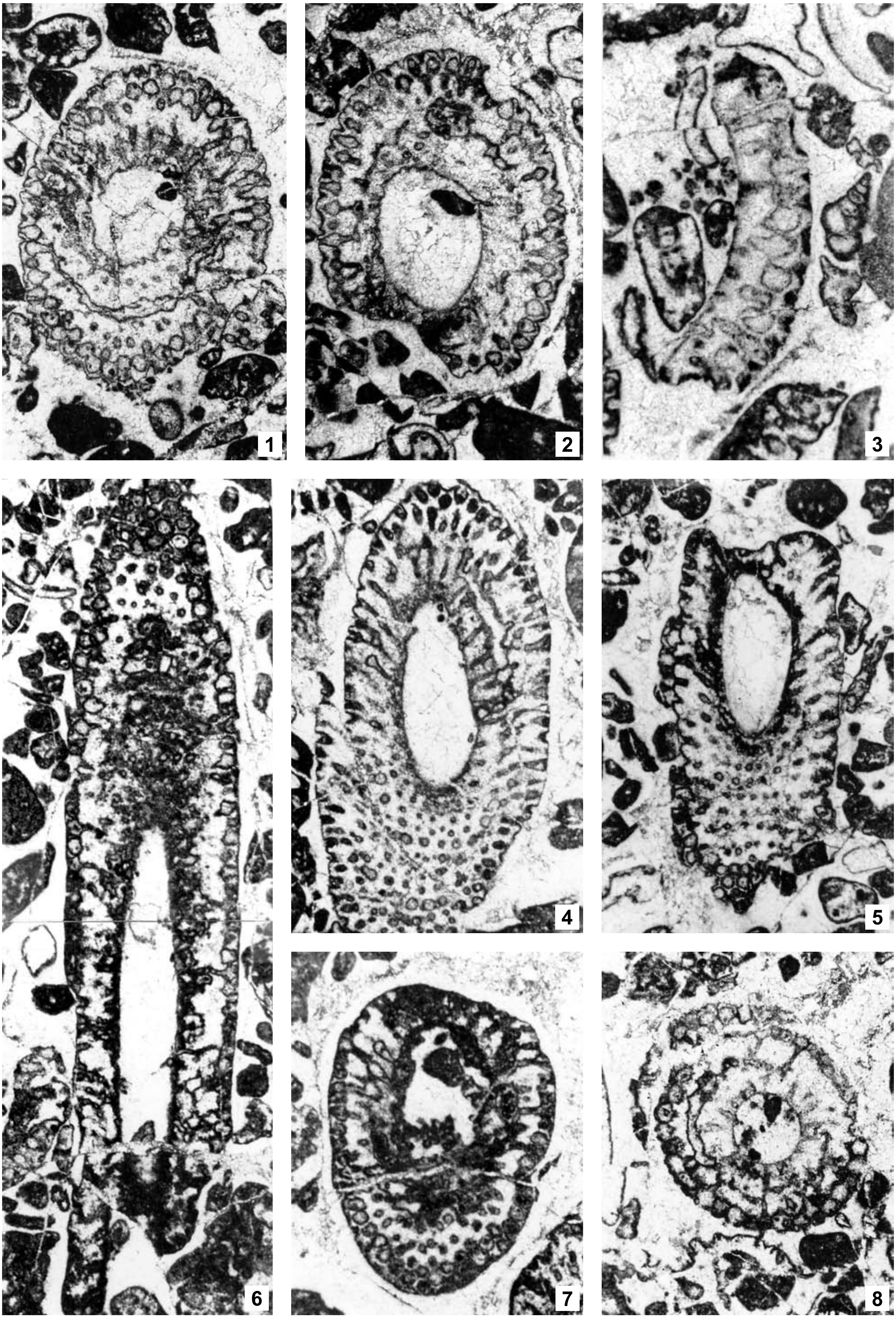
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PLATE III

Linoporella vesiculifera n.sp.

1 Oblique–tangential section with clearly visible slender primary branches that divide into the secondaries. In the lower part of the picture, the peripheral zone of wineskin-shaped vesicles is partly preserved. KJ–18/111, x22.

2–3 Oblique sections. Fig. 2, KJ–18/130; Fig. 3, KJ–18/63; x22.

4 (A) Transverse section of *Cylindroporella lyrata* MASSE & LUPERTO SINNI; (B) Transverse section of *Linoporella vesiculifera* n.sp. KJ–18/155, x22.

5 Oblique section with clearly visible formation of fissures in the central part of the calcareous envelope (left part of the figure). KJ–18/218, x22.

6 Fragment of a tangential section. In the upper part of the figure, tufts of three secondary branches are visible. KJ–18/126, x34.

7–8 Oblique sections. In Fig. 7, at the level of branching of the primaries, a secondary circular fissure formed in the middle part of the calcareous wall is clearly visible. Figure 8 is an integral section with a visible peripheral zone of wineskin-shaped widenings of the secondaries. Fig. 7, KJ–18/102; Fig. 8, KJ–18/228, x22.

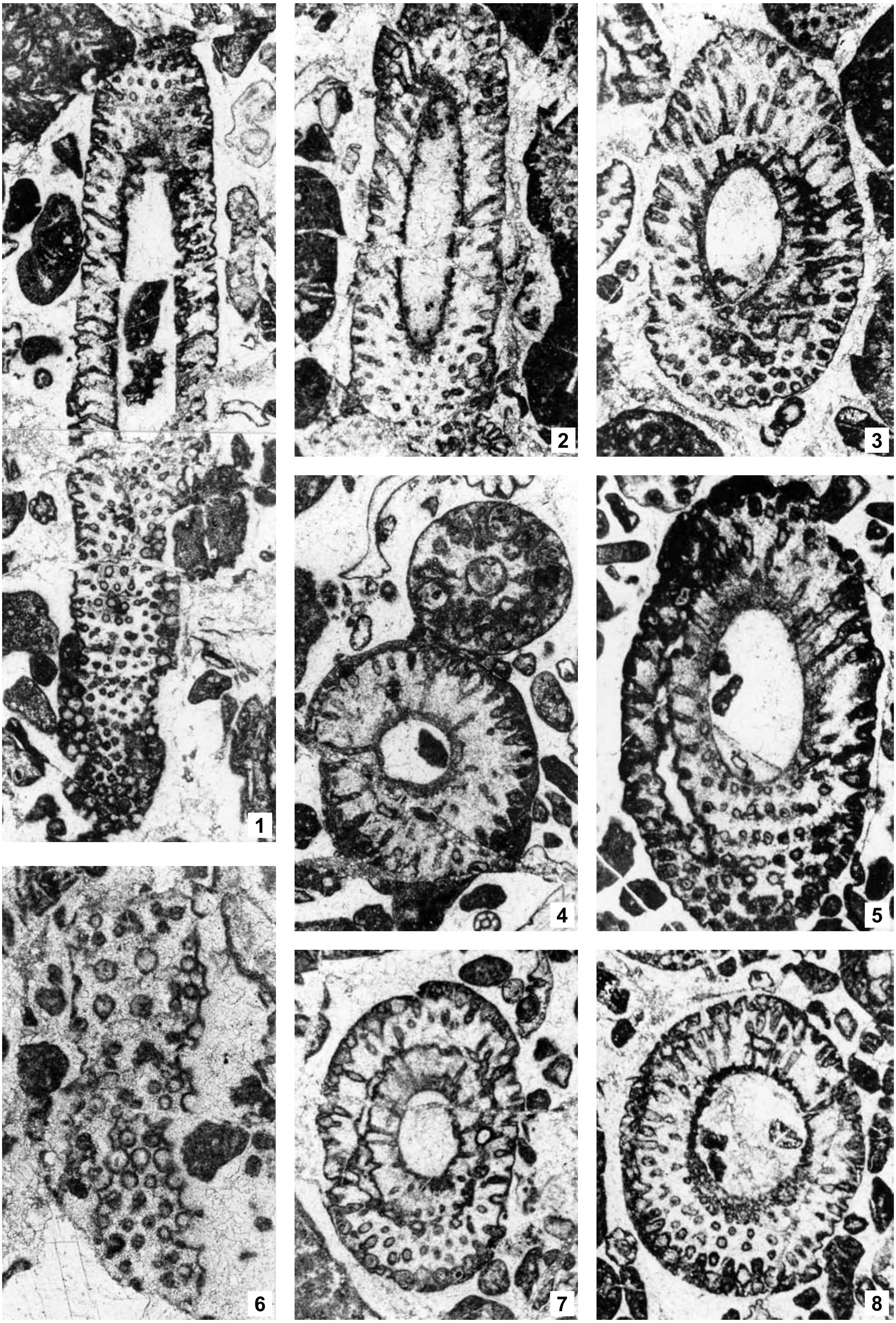
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PLATE IV

Linoporella vesiculifera n.sp.

1–3 Various oblique sections with clearly visible slender primary branches and a more or less well preserved zone of distal widenings of the secondaries. Fig. 1, KJ–18/205; Fig. 2, KJ–18/212; Fig. 3, KJ–18/132, x22.

4 Tangential section with primary branches arranged into visible whorls; KJ–18/194, x22.

5 Oblique section, KJ–18/134, x22.

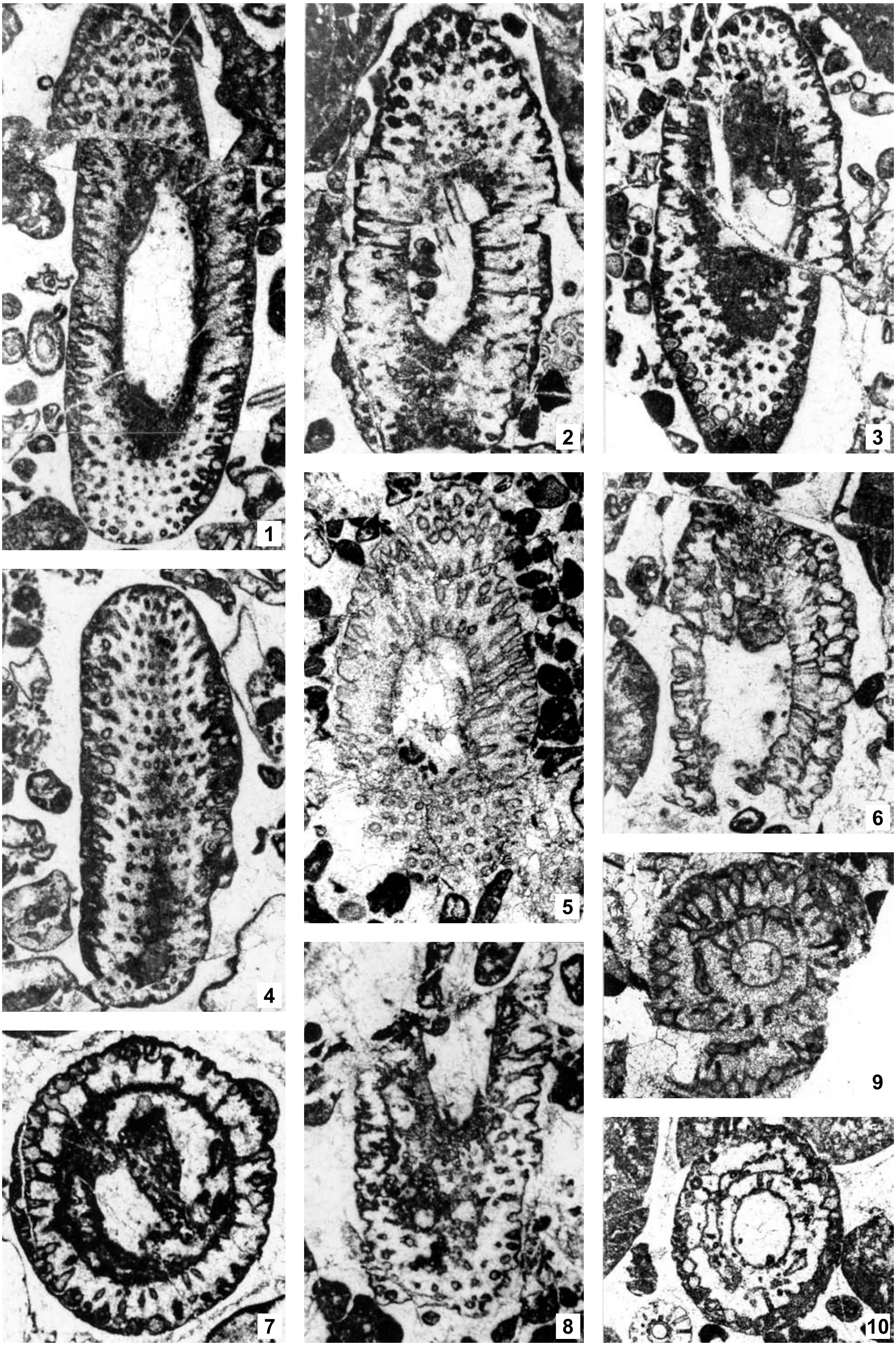
6 Fragment of an oblique section. On the left side, the outer part of the calcareous wall is preserved; on the right side, the formation of the fissure at the level of primary branching is visible. KJ–18/129, x22.

7 Transverse section, with preserved outer part of the calcareous wall (outward from where the primaries branch off into the secondaries). KJ–18/220, x22.

8 Fragment of an oblique–tangential section. KJ–18/148, x22.

9 Transverse section, with visible circular fissure formed at the level in which the primaries branch off, and clearly visible peripheral zone of distal partitions of the secondary branches. The formation of narrow, outwardly directed tubular channels at the distal ends of the “chamberlets” (vesicles) is clearly visible. KJ–18/76, x22.

10 Transverse, slightly oblique section. KJ–18/113, x22.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