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Taxonomic Review of Some Barremian and Aptian Calcareous Algae (Dasycladales) from the Dinaric and Adriatic Karst Regions of Croatia

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Key words: Calcareous algae (Dasycladales), Biostratigraphy, Taxonomy, Lower Cretaceous, Dinaric-Adriatic karst, Croatia.

Ključne riječi: vapnenačke alge (Dasycladales), biostratigrafija, taksonomija, donja kreda, dinaridski-jadranski krš, Hrvatska.

Abstract

Selected species of the following dasyclad genera, deriving from Barremian and Aptian deposits of the Adriatic and Dinaric karst, are elaborated: *Salpingoporella*, *Acroporella*, *Actinoporella*, *Clypeina* and *Praturlonella*. A new genus, *Piriferella*, is established. Descriptions of the following *Salpingoporella* species are completed with newly established characteristic features and illustrated with appropriate sections: *Salpingoporella muehlbergii*, *S. melitae*, *S. hispanica*, *S. hasi*, *S. urladanasi*, and *S. dinarica*. In addition, the following new species are described: *S. verrucosa*, *S. heraldica*, and *S. polygonalis*. *Apinella jafrezoi*, the type species of the genus *Apinella*, is considered to be a younger synonym of *Salpingoporella hispanica*. *Actinoporella podolica* and *Acroporella radoicicae* are commented upon. *Praturlonella danilovae* is illustrated. *Selliporella dalmatica* and *Likanella pejovicae* have been transferred to *Praturlonella*. Because the problematic *Halicoryne nerae* has also been transferred to the genus *Praturlonella* (with it's inadequate diagnosis and description), a new diagnosis and more complete description of this species is given. *Clypeina*? *solkani* is illustrated by Barremian specimens and *Clypeina gigantea* n.sp. from the Lower Barremian of Mljet Island is described. Beside the type-species, *Piriferella spinosa*, the species hitherto labelled *Clypeina somalica*, or *Similiclypeina somalica*, has also been transferred to the new genus *Piriferella*.

Sažetak

Iz bogatog materijala fosilnih vapnenačkih alga (Dasycladales) prikupljenih u naslagama barema i apta dinarskog i jadranskog krša obrađene su neke vrste rodova: *Salpingoporella*, *Acroporella*, *Actinoporella*, *Clypeina* i *Praturlonella*, a uspostavljen je rod *Piriferella*. Kod već poznatih vrsta roda *Salpingoporella*: *S. muehlbergii*, *S. melitae*, *S. hispanica*, *S. hasi*, *S. urladanasi* i *S. dinarica*, uz ilustrativne fotografije presjeka različitih orjentacija izvršene su dopune opisa i navedene novo uočene značajke. Opisane su nove vrste ovog roda: *S. verrucosa*, *S. heraldica i S. polygonalis*. Rod i vrsta *Apinella jafrezoi* smatra se mladim sinonimom *S. hispanica*. Komentirane su vrste *Actinoporella podolica i Acroporella radoicicae*. Od vrsta roda *Praturlonella* ilustrirana je *P. danilovae*. Rodu su pribrojene *Selliporella dalmatica* i *Likanella pejovicae*, a s obzirom da je osporena *Halicoryne nerae* prebačena u rod *Praturlonella* s neadekvatnom dijagnozom i opisom, to je dana nova dijagnoza i dopuna opisa ove vrste. Uz vrstu *Clypeina*? *solkani* prikazanu baremskim primjercima opisana je *Clypeina gigantea* n.sp. iz donjeg barema otoka Mljeta. Novom rodu *Piriferella*, uz tipsku vrstu *Piriferela spinosa*, pribraja se i vrsta *P. somalica* do sada nejasne taksonomske klasifikacije, prethodno označena kao *Clypeina somalica* odnosno *Similiclypeina somalica*.

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1. INTRODUCTION

Long-lasting investigations of Mesozoic deposits carried out by the author and numerous colleagues in the Dinaric and Adriatic karst regions of Croatia have resulted, among other things, in an abundant collection of fossil material. Among this, calcareous algae (Dasycladales) rank as, perhaps, the foremost constituent of the fossil assemblages in general, with regard to both their diversity and abundance of specimens, in particular stratigraphic horizons.

The analysis of this material enabled the definition of precise stratigraphic position and/or range for many of the mentioned species, owing to the position of algal-bearing samples in the stratimetrically logged sections, as well as answering a number of taxonomic questions owing to the abundance and good preservation of the material, which can be illustrated by appropriate sections. In the Mediterranean realm, the fossil Dasycladales have been the subject of numerous palaeontologic and biostratigraphic investigations, presented in numerous papers by different authors. However, the primary descriptions are often based on scarce and/or poorly preserved material (which sometimes shows different features and thus implying heterogeneity), accompanied by few and inadequate illustrations - sometimes even one section of a fragment with blurred characteristics has been used as the basis for establishing a new species or the alleged revision of an existing one. Such bad practice has resulted in inadequate knowledge about particular taxa, unsound establishing of taxa, alleged characteristic features resulting from the subjective interpretation of the author, unjustified increase in the number of new taxa, and frequent transferring of individual species to another genus without sound arguments ("n.comb."). Besides, several species, or groups of species, of the same genus (e.g., *Salpingoporella*) may show similarly shaped ramifications (branches) which can produce sections that may appear similar or almost identical for two or three species, leading to confusion in identification by less experienced workers. This implies that the original descriptions often lack adequate illustrations; whereas many are accompanied by too few characteristic sections, some of the sections illustrated are not species-characteristic and many belong to two or more species (this may depend sometimes on very slight differences in the plane, or "depth", of the section). The most obvious errors occur when the identification of a species is based on - or, at least, results from - its stratigraphic position. An even more serious problem lies in the intraspecific variation which can be more or less pronounced and can affect the shape of the branches (most frequently, the shape of the pores at their distal end), number of branches per whorl, and - most frequently - the range of dimensions. All this produces the dilemma of which differences should be treated as intraspecific variations and which are species-characteristic. Sometimes, admittedly, we are dealing with continuous ranges of forms whose end members, however, do show clear differences. From a pragmatic point of view, problematical identifications and confusion of taxa have serious consequences with regard to their stratigraphic usefulness and reliability, though, in my opinion, these parameters still seem to stay quite firmly, at least on a local to regional scale. Of course, stratigraphic ranges are always subject to change, but the new data should be based on indisputable identification and precise and well documented evidence of stratigraphic position. All that has been mentioned above represents but a small fraction of the unsolved questions in the study of fossil algae, all of which concentrate on, or can ultimately be reduced to, the establishing of valid and unequivocally adopted criteria for identification.

Perhaps the tone of this paper may sometimes sound polemic or unduly critical. My intention was, however, to clarify the taxonomy by completing the hitherto existing descriptions of some taxa, to support my claims by unequivocal sections (therefore the somewhat larger number of illustrations - a fact that was obviously missing in many earlier papers), to correct some incorrect interpretations, to describe some taxa in the manner I consider correct, to delimit their stratigraphic ranges in the Dinaridic and Adriatic karst areas, and to explain some of my reflections on the validity of the new taxa and the criteria of their establishing and recognition.

2. SYSTEMATIC DESCRIPTIONS

Genus *Salpingoporella* PIA in TRAUTH, 1918

The generic diagnosis by PIA (in TRAUTH, 1918) has been completed by CONRAD (1969) and summarized by SCHINDLER & CONRAD (1994). To this, the following addition should be added: Species with branched thallus, or showing a tendency toward branching, are also included in the genus.

Salpingoporella muehlbergii (LORENZ, 1902) PIA in TRAUTH, 1918

Pl. I, Figs. 1-13; Pl. XX, Figs. 4B, 5B

Selected synonymy:

1902 *Diplopora Mühlbergii* n.sp.- LORENZ, p. 52-54, Figs. 3-6, ?Fig. 7

1918 *Salpingoporella muehlbergii* (LORENZ) n.gen., n.comb.- PIA in TRAUTH, p. 211-213, Fig. 4a

1978 *Salpingoporella muehlbergii* (LORENZ) - BUCUR, p. 95, Pl. 8, Fig. 5

1978 *Salpingoporella muehlbergii* (LORENZ) - DRAGASTAN, BUCUR & DEMETER, p. 22-23, Pl. 2, ?Fig. 4; Pl. 8, Fig. 1 pars; Pl. 9, Fig. 3, non Figs. 1, 4, ?Fig. 2; Pl. 11, Fig. 4 pars

1978 *Salpingoporella muehlbergii* (LORENZ) - CONRAD & PEYBERNES, p. 69-83, Pl. 2, Fig. 10

1978 *Salpingoporella muehlbergii* (LORENZ) - VELIĆ & SOKAČ, p. 319-334, Pl. 2, Fig. 2

1979 *Salpingoporella muehlbergii* (LORENZ) - PEYBERNES & CONRAD, p. 743-751, Pl. 1, Figs. 6-7

1980-1981 *Salpingoporella muehlbergii* (LORENZ) - BUCUR, p. 55, Pl. 1, Figs. 7-8, non Fig. 6; Pl. 2, ?Figs. 1-2

1984 *Salpingoporella muehlbergii* (LORENZ) - LUPERTO-SINNI & MASSE, p. 341, Pl. 38, Figs. 3-4

1985 *Salpingoporella muehlbergii* (LORENZ) - BUCUR, p. 83, Pl. 4, Fig. 2

1989 *Salpingoporella muehlbergii* (LORENZ) - DRAGASTAN, p. 13-14, Pl. 5, ?Fig. 5, Fig. 6, non Fig. 7

1989 *Salpingoporella muehlbergii* (LORENZ) - CONRAD & MASSE, p. 283, Pl. 2, Fig. 6

1993 *Salpingoporella muehlbergii* (LORENZ) - BUCUR, I. COCIUBA & M. COCIUBA, p. 34-38, Pl. 1, Figs. 9, 11-14

1993 *Salpingoporella muehlbergii* (LORENZ) - SOTÁK & MIŠÍK, p. 403, Pl. 10, Figs. 1-6

1994 *Salpingoporella muehlbergii* (LORENZ) - BODROGI, BÓNA & LOBITZER, p. 233-248, Pl. 1, ?Fig. 8; Pl. 16, non Fig. 6; Pl. 17, Fig. 8 pars

This is a frequently mentioned and figured species. The emended description and the designation of a neotype was given by CONRAD (1970). In the descriptions of this species the phloiophorous shape of the ramifications has been emphasized: tubular in the proximal part and funnel-shaped at the distal end. The distal widenings are supposed to be mutually touching outside the calcareous envelope. The shape of the distal widening depends, according to CONRAD (1970), on the *h* and *w* values; specimens with slightly flattened ramifications, such as figured by PRATURLON & RADOIČIĆ (1967, Figs. 1a-d, 5), have also been included within the species.

The specimens studied and illustrated in this paper (Pl. I, Figs. 1-13), which I consider to be typical representatives of the species, show a comparatively long proximal tubular part of the branches, which retains about an equal diameter in both longitudinal and transverse sections until it attains the outer surface of the calcareous envelope. The comparatively high *h* value between the alternately arranged whorls, as well as the small number of ramifications per whorls (*w*), gives the appearance of widely spaced ramifications in deeper tangential sections. The outer (distal) part of the branches, where they abruptly widen, is rarely preserved, and where present, appears more square-shaped than rhombic. The differences with other contemporaneous *Salpingoporella* species in the Barremian deposits appear more visually pronounced than expected from simplified and generalized descriptions and comparison of individual dimensional values. Among numerous sections obtained from several localities in both the Adriatic (including the islands) and Dinaric karst regions, two sections have been studied which suggest the existence of a branching thallus (Pl. I, Fig. 6).

According to the observations gathered up to the present, the first occurrence of this species in the Adriatic and Dinaridic karst regions is exceptionally and rarely associated with *Campanelulla capuensis* (DE CASTRO), the latter being generally considered to have a stratigraphic range corresponding to the Upper Hauterivian and Lower Barremian. In this case too, *S. muehlbergii* is accompanied by numerous dasyclads characteristic of the Barremian algal assemblage. Its upper limit (last occurrence) is also the first occurrence of *Palorbitolina lenticularis* (BLUMENBACH). Thus, taking into account both the position of all samples with this species in the analyzed (logged) sections and the associated algal assemblage, the stratigraphic range of *S. muehlbergii* in the Adriatic and Dinaridic karst regions is considered to correspond to the Barremian.

Salpingoporella melitae RADOIČIĆ, 1967

Pl. II, Figs. 6-13; Pl. III, Figs. 1-2; Pl. XIX, Fig. 7; Pl. XX, Figs. 2B, 3B.

Selected synonymy:

1967 *Salpingoporella melitae* n.sp.- RADOIČIĆ, p. 121-126, Figs. 1-2, Pl. 1-4

1975 *Salpingoporella melitae* RADOIČIĆ - DRAGASTAN, p. 61, Pl. 86, Fig. 1

1976 *Salpingoporella melitae* RADOIČIĆ - CONRAD & PEYBERNES, p. 191, Figs. 13 b, h

1978 *Salpingoporella melitae* RADOIČIĆ - DRAGASTAN, BUCUR & DEMETER, p. 23-25, Pl. 7, Fig. 3; Pl. 12, Figs. 1-2; Pl. 14, ?Fig. 3.

1978 *Salpingoporella melitae* RADOIČIĆ - VELIĆ & SOKAČ, p. 319, Pl. 1, Figs. 8-10

1980-1981 *Salpingoporella melitae* RADOIČIĆ - BUCUR, p. 53-55, Pl. 1, Figs. 1-5

1984 *Salpingoporella melitae* RADOIČIĆ - LUPERTO-SINNI & MASSE, p. 341, Pl. 38, Figs. 2, 7-8

1987 *Salpingoporella melitae* RADOIČIĆ - RADOIČIĆ, Pl. 1, Fig. 6 pars; non Fig. 7, Fig. 8

1989 *Salpingoporella melitae* RADOIČIĆ - CONRAD & MASSE, p. 283, Pl. 2, ?Fig. 12

1989 *Salpingoporella melitae* RADOIČIĆ - DRAGASTAN, p. 13, Pl. 5, ?Fig. 3, Fig. 4

1992 *Salpingoporella melitae* RADOIČIĆ - MANCINELLI, p. 9, 13, Pl. 4, Figs. 2, 12, non Fig. 11

1993 *Salpingoporella melitae* RADOIČIĆ - BUCUR, I. COCIUBA & M. COCIUBA, p. 35-38, Pl. 1, Fig. 16

1994 *Salpingoporella melitae* RADOIČIĆ - BODROGI, BÓNA & LOBITZER, p. 233-288, Pl. 1, Fig. 6, non Fig. 7; Pl. 17, Fig. 11

The sufficiently detailed original description (RADOIČIĆ, 1967) clearly defines this species as a rather large-sized alga, with a spacious axial cavity and densely arranged alternating whorls of ramifications. The author emphasized the funnel-shaped pores with a comparatively long tubular proximal part (Pl. II, Figs. 7, 13). The distal part of the ramifications is abruptly widened and transversally flattened, i.e., horizontally elongated, producing an elongated-rhombic shape (Pl. II, Fig. 7; Pl. III, Fig. 1). Deeper tangential sections, cutting the proximal part of the branches, show widely spaced rounded pores in alternating arrangement (whorls are not tightly compressed), whereas the shallower tangential sections show the abruptly widened pores, mutually touching on the surface. Typical, well-developed, specimens clearly show their rhombic appearance in shallow tangential sections cutting through the distal part of the branches. The corners of the more or less elongated rhombs are clear and sharply delineated (Pl. II, Fig. 7; Pl. III, Fig. 1), but inwards the corners become more blurred and the rims more rounded. Because this species includes specimens with highly variable dimensions (*D*, *d*), the above mentioned characteristic features should be used as the primary criterion for a safe and reliable species identification.

However, the distal ends of the ramifications can be variously shaped and/or deformed. Beside the rather typical sections (Pl. III, Figs. 1, 2), specimens can be found that show a more or less pronounced divergence in the distal shape of the pores (Pl. II, Fig. 9), in which case they appear to represent an intermediate form between *S. melitae* and some other species of that genus (perhaps *S. hasi* or *S. urladanasi)*. Thus we are faced with the dilemma of how much of divergence should be regarded as being within the range variation of the species and alternatively, which differences should be treated, taken together, as sufficient for the establishment of a new taxon.

S. melitae occurs as the most abundant species, both singly and in assemblages with *S. muehlbergii*, *S. biokovensis*, *S. hispanica*, *S. dinarica*, *Praturlonella danilovae*, *Actinoporella podolica*, *Clypeina*? *solkani*, *Clypeina* sp. and other algal and, more rarely, foraminiferal species. According to our observations in the Adriatic and Dinaric karst regions, its first occurrence coincides with the last occurrence of *Campanelulla capuensis* DE CASTRO. The latter species being characteristic of the Upper Hauterivian - Lower Barremian, this would therefore correspond to the Lower Barremian. The last occurrence of *S. melitae* is just bellow the first occurrence of *Palorbitolina lenticularis* (BLUMENBACH), as is also the case with *S. muehlbergii*. Only one sample, derived from Mt. Velika Kapela, contains *S. melitae* associated with *P. lenticularis*, which reliably defines its Barremian age.

Salpingoporella hispanica CONRAD & GRABNER, 1975

Pl. V, Figs. 1-8, part. Figs. 9-11

Selected synonymy:

1975 *Salpingoporella hispanica* n.sp.- CONRAD & GRABNER, p. 30-39, Figs. 2-6

1979 *Salpingoporella hispanica* CONRAD & GRABNER - PEYBERNES & CONRAD, p. 946-748, Pl. 2, Fig. 1: ?*S*. cf. *hispanica*; Pl. 2, Fig. 2

1980-1981 *Salpingoporella hispanica* CONRAD & GRABNER - BUCUR, p. 53-54, Pl. 2, Figs. 3-4

1986 *Apinella hispanica* (CONRAD & GRABNER, 1975) n.comb. - GRANIER, MICHAUD & FOURCADE, p. 804-806, not figured

1986 *Apinella jaffrezoi* n.sp. - GRANIER, MICHAUD & FOURCADE, p. 804-807, Fig. 2, Pl. 1, Figs. a-j; Pl. 2, Figs. a-j

1991 *Salpingoporella* aff. *S. hispanica* CONRAD & GRABNER - KUSS & CONRAD, p. 876, Figs. 4, 14

1992 *Salpingoporella hispanica* CONRAD & GRABNER - MANCINELLI, p. 9, 12-13, Pl. 3, Figs. 1-5

1993 *Salpingoporella hispanica* CONRAD & GRABNER- BODROGI, CONRAD & LOBITZER, p. 64-66, Pl. 2, Figs. 7-10

1994 *Salpingoporella hispanica* CONRAD & GRABNER - BODROGI, BÓNA & LOBITZER, Pl. 6, Figs. 1-2

In their original description, CONRAD & GRABNER (1975) emphasized the small number (w=4) of short, shallow calcified ramifications, arranged in alternating consecutive whorls, with a calcareous skeleton consisting of thin-walled, hyaline, calcite. The reconstruction (CONRAD & GRABNER, 1975, Fig. 7) shows the connecting pores between the ramifications and the axial cavity to be situated in the middle of the proximal part of the ramifications, which means that the ramifications regularly swell in both upward and downward directions and have a short and thinly calcified partition between each and every ramification and a slight terminal bulbous swelling. This has led the authors to interpret the distal ends of the ramifications in shallow tangential sections as square-shaped, which however should be regarded as the personal interpretation. Moreover, it was just this difference that was used by GRANIER et al. (1986) as the basic difference for establishing their new genus and species *Apinella jaffrezoi* GRANIER et al., in which the connecting pore is shifted downward and the ramification itself is vertically flattened at its distal end and has a hexagonal contour.

The specimens from the Barremian of Cres Island that are illustrated in the present paper (Pl. V, Figs. 1-8) and labelled *Salpingoporella hispanica* do in fact, by their key characters, strongly diverge from CONRAD & GRABNER's (1975, Fig. 7) reconstruction. Instead, they show the connecting pore shifted downward (Pl. V, Figs. 3, 6, 8, 11) and a hexagonal contour of the distal pore openings (Pl. V, Fig. 2), those being the characteristics that make them identical to the specimens described as *Apinella jaffrezoi*. This, however, shows that reconstructions, no matter how nice they may appear (and how welcome, in certain cases, they really are), represent nothing more than the authors' interpretation and thus may be misleading in certain cases. Some minimal differences between the Kimmeridgian specimens from Mexico and our Barremian specimens do exist; firstly the extreme dimension values, though these values, for the most part of their ranges, do overlap; secondly, there is a minor difference in the widening of the axial cavity between the branch-bearing whorls, which is more pronounced in the Kimmeridgian specimens (GRANIER et al., 1986, Pl. 1, Fig. a; Pl. 2, Fig. b) than in some of the Barremian specimens (Pl. V, Fig. 3). However, this feature is not a regular characteristic: in some specimens it is missing and therefore cannot be accepted as a valid criterion for species-specific differentiation. On the contrary, the above mentioned list of identical features seems to confirm the identity between the Kimmeridgian specimens from Mexico and the Barremian specimens of the Mediterranean realm, indicating that *Apinella jaffrezoi* should be considered a younger synonym of *Salpingoporella hispanica*. Herewith, the latter species acquires an extended stratigraphic range.

An summary, the establishment of the genus *Apinella*, based on the reduced degree of calcification and the number and shape of the ramifications - being broadly elongated above a short and eccentrically situated connecting pore in *Apinella* - does not seem justified for the following reasons:

1) The apparently reduced degree of calcification can directly depend on the more pronounced swelling of the ramifications, particularly if that swelling occurs abruptly from the very base;
2) The superficial calcification may only be an artefact of preservation and a consequence of the external destruction of the thin partitions between the ramifications (visible in the illustrations of GRANIER et al., 1986, where the partitions between the ramifications sometimes appear longer and sometimes almost completely reduced, i.e. destroyed by secondary processes);
3) The reduced number of ramifications can be a direct consequence of their shape and mode of widening, whether from their very base or more distally, and of the degree of transverse compression (horizontal flattening). There are a number of *Salpingoporella* species with a varying number of ramifications, e.g., 5-11 in *S. muehlbergii*, 8-12 in *S. annulata*, 5-7 in *S. katzeri*, 5-7 in *S. hasi*, etc. In general, those *Salpingoporella* species which have transversally compressed (= horizontally flattened) ramifications do also have a smaller number of ramifications. Therefore, it follows that the delimiting number of ramifications for the genera *Apinella* and *Salpingoporella* would be 4 and 5, respectively.
4) The shape of the ramifications - broadly elongated above the short, narrow, and eccentrically situated connecting pore - is only more strongly pronounced in *S. hispanica*, while also present - though more slightly developed - in *S. katzeri*. This latter species, however, was not included in the genus *Apinella*. Also, in the original description of *S. katzeri* there is no mention of the branches being strongly swollen upward and the connecting pore remaining at the level of the lower ramification rim (Pl. X, Figs. 10-12). The eccentrically situated connecting pore also occurs in the genus *Triploporella* and according to my personal observations is also present in *Palaeodasycladus mediterraneus* PIA, which, however, does not question the generic and species-specific attribution of the mentioned forms. Instead, it is an indication of the variation within a genus and, even, within a species.

An conclusion, it may be said that the lack of characteristic features that would unequivocally differentiate *Apinella* from *Salpingoporella* indicates that *Apinella* should be considered to be a younger synonym of *Salpingoporella*, as has already been clearly stated by BODROGI et al. (1993). The large geographic distance between Mexican and European finds, as well as the considerable difference in their stratigraphic position (Mexico: Kimmeridgian; Europe: Barremian), do not alone seem to justify the establishment of a new taxon (there is also the possibility of migrations, common ancestor, etc.).

Stratigraphic position: In spite of the large number of samples collected from Jurassic and Cretaceous beds from all over the Dinaric karst area in Croatia, the finds of this species remain rare. It has been unequivocally identified at only two locations: in the Barremian algal assemblage on the Mljet Island and in Barremian deposits of the Cres Island, where it is associated with *S. hasi* (specimens illustrated in Pl. V, Figs. 1-11). As a result of its rare occurrence, the definitive establishment of its stratigraphic range remains open, though the two hitherto known localities both are of Barremian age.

Salpingoporella verrucosa n.sp.

Pl. VI, Figs. 1-15

Origin of the name: The species has been named after the wart-like protrusions on the outer surface of the calcareous envelope which mark the terminations of the distal ends of the ramifications (Latin *verruca* = wart).

Type locality: Island of Mljet, road-cut on the road Sobra - Babino Polje, about 2 km from Sobra (17°36'00"E and 42°44'02"N, Fig. 1).

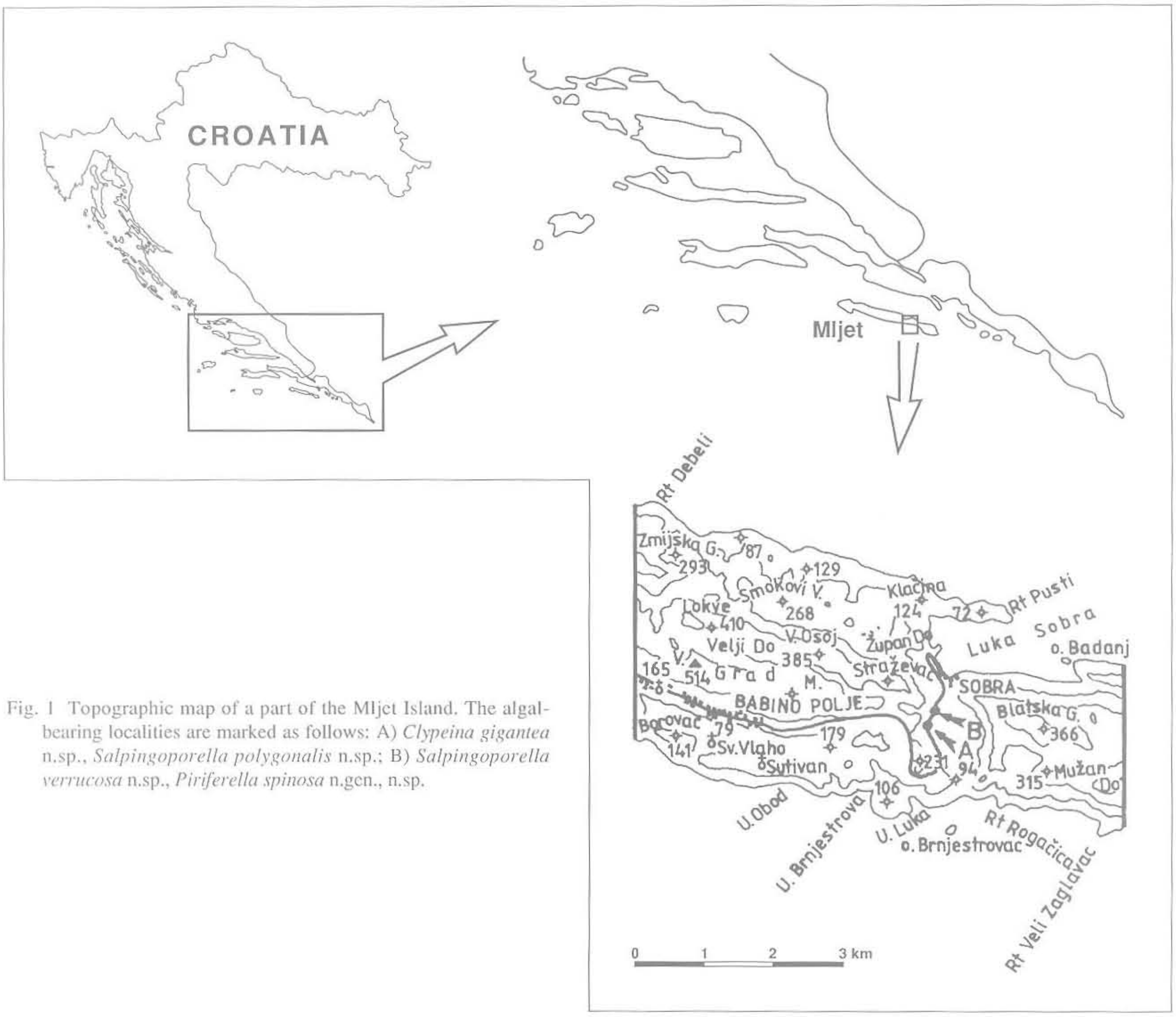

Fig. 1 Topographic map of a part of the Mljet Island. The algal-bearing localities are marked as follows: A) *Clypeina gigantea* n.sp., *Salpingoporella polygonalis* n.sp.; B) *Salpingoporella verrucosa* n.sp., *Piriferella spinosa* n.gen., n.sp.

Type stratum: Well-bedded, light coloured, bioturbated algal wackestones with casts and moulds of green algae and gastropods. The environment of sedimentation is defined as within peritidal zone, with sporadic emersions into the vadose zone.

Holotype: Slightly oblique, almost longitudinal, section figured in Pl. VI, Fig. 4, slide Mg-81/8. All slides containing the material of the new species are stored at the Institute of Geology, Zagreb.

Diagnosis: *Salpingoporella* with rare, alternating, phloiophorous ramifications with bulging (convex) outer surface, covered with a thin calcareous sheet.

Description: The cylindrical calcareous envelope is composed up of coarse-grained, blocky, light yellowish calcite. The outer surface is covered by alternating wart-like bulges, which represent the distal ends of the ramifications. The inner surface of the axial cavity is straight and sharply delineated. The axial cavity most

Dimensions in mm:	total range	most frequently
Maximum observed length (L)	2.04	
Outer thallus diameter (D)	0.38-0.72	0.44-0.64
Inner thallus diameter (d)	0.20-0.32	0.24-0.30
The d/D relationship	34-59%	40-50%
Distance between whorls (h)	0.14-0.24	
Length of the branches (l)	0.12-0.20	
Maximum ramification diameter (p)	0.06-0.10	
Number of branches per whorl (w)	6-8	
Inclination of branches (α)	cca 15°	

Table 1 Dimensions of *Salpingoporella verrucosa* n.sp.

frequently comprises 40-50% of the total diameter, depending on whether it is measured at the level of the bulges or in between, where the outer surface appears slightly depressed.

Simple, undivided, phloiophorous branches communicate with the axial cavity by means of short and tiny connecting pores (channels) and broaden slightly and continuously from their very base toward their distal ends. The branches reach the surface and end in wartlike protrusions that are covered by thin calcareous membranes. The calcareous envelope appears to be attenuated outward, which along with the ramification, produces a star-shaped transverse section at the level of whorls (Pl. VI, Fig. 14). The ramifications are directed slightly upward, at an angle of about 15°.

Similarities and differences: *Salpingoporella verrucosa* belongs to the group of *Salpingoporella* species, in which the ramifications are neither longitudinally nor transversally compressed, giving in tangential sections a rounded pore regardless of where it is cut (i.e., in both deep and shallow tangential sections). It differs from other species of this group by the coarse-grained mosaic calcite of the calcareous envelope, a very small number of ramifications per whorl, and a comparatively large distance between the whorls, the latter features giving the impression of pores being situated few and far between on the outer surface. The endings of the pores on the outer surface make bulging, wartlike protrusions, which give this alga its characteristic appearance.

Stratigraphic position: *Salpingoporella verrucosa* n.sp. occurs in an interval of well-bedded fossiliferous mudstones and fossiliferous peloid and oncoidal wackestones with several intercalations of intraformational, marl-cemented breccia which testifies to repeated shallowing and local emersion (Fig. 2). That interval comprises about 30-40 m of strata beneath the algal-bearing level and about 30 m above it, and corresponds, as a whole, to deposition in restricted shoals with frequent oscillations and excursions into very shallow subtidal and intertidal zones. These strata contain *Salpingoporella muehlbergii* (LORENZ), *S.* aff. *cemi* RADOIČIĆ, *S. melitae* RADOIČIĆ, *S. hispanica* CONRAD & GRABNER, *Salpingoporella dinarica* RADOIČIĆ, *Salpingoporella* sp. ex gr. *genevensis-hasi*, *Acroporella radoicicae* PRATURLON, *Praturlonella danilovae* (RADOIČIĆ), *P. nerae* n.sp., *Piriferella spinosa* n.sp., and *Actinoporella podolica* (ALTH), most of which occur in the same sample with *S. verrucosa* n.sp. Based on the above mentioned algal assemblage, and the superpositional location of the sample in the higher part of the column, which has well-defined boundaries (Fig. 2), the age of the *S. verrucosa* bearing beds at the type locality may be established as Upper Barremian.

Lithologically, the entire Barremian sequence is characterized by textural and structural features which are, according to TIŠLJAR (1986), typical of rhythmic sedimentation ranging from gradual shallowing to restricted shoal or from the subtidal to the lower intertidal and the vadose zone, respectively. In vertical sequence, this is manifested by the transition from a homogeneous micrite/pelmicrite into fenestral micrite/pelmicrite with eroded upper bedding planes and/or vadose features, and sometimes even tidal channels.

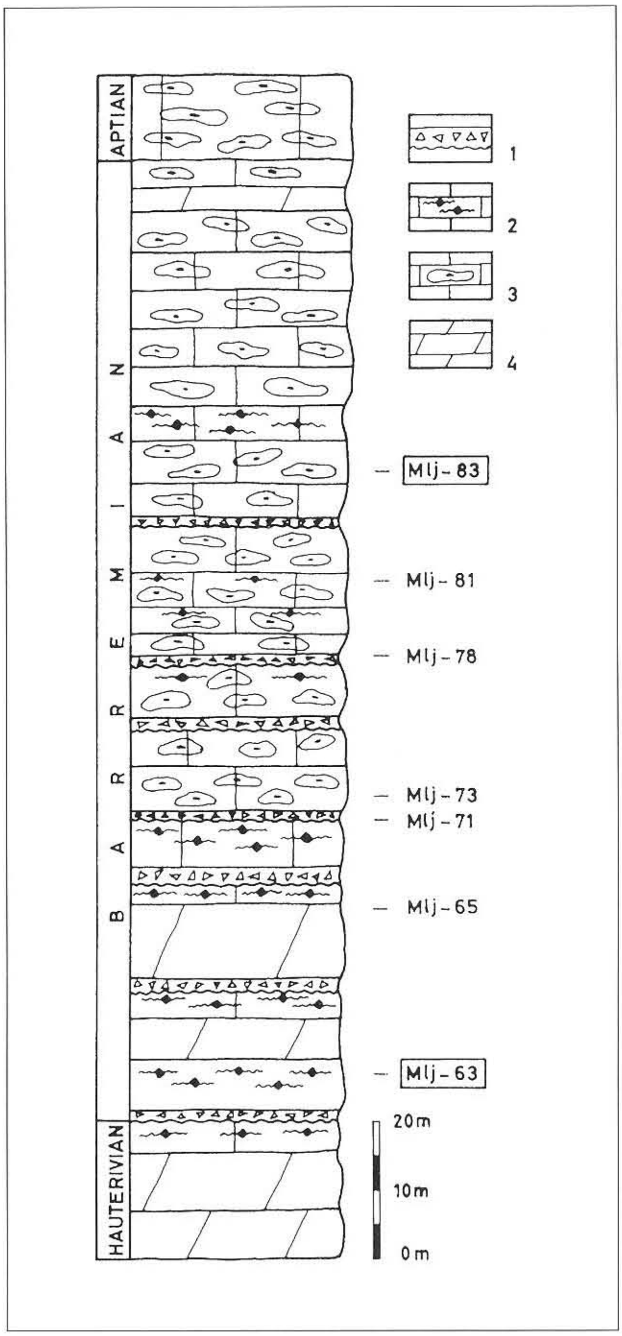

Fig. 2 Detailed lithofacies column of the type-locality of *Clypeina gigantea* n.sp., *Salpingoporella polygonalis* n.sp., *Salpingoporella verrucosa* n.sp. and *Piriferella spinosa* n.gen., n.sp. Legend (facies types after TIŠLJAR & VELIĆ, 1991): 1) Facies of supratidal and/or temporary emersions: soft pebble conglomerates and emersion breccias - facies type K-1; 2) Facies of intertidal to shallow subtidal limestones: LLH stromatolites, fenestral mudstones to pelletal wackestones - facies type K-2; 3) Facies of lagoons and restricted shoals: mudstone/wackestone and onkolites - facies type K-3; 4) Facies of late diagenetic dolomites - facies type K-5; Mlj-63 - Mlj-83: sample designation.

Salpingoporella heraldica n.sp.

Pl. VII, Figs. 1-18

Origin of the name: In tangential sections, this alga shows an alternation of dark and light squares, reminiscent of the Croatian coat of arms.

Type locality: Island of Korčula, road-cut toward Prižba, about 50 m from the cross-road in Brna Village (16°51'30"E and 42°54'29"N, Fig. 3).

Type stratum: Well-bedded brown algal-peloidal grainstone. The sample was collected during a field reconnaissance campaign and had been taken at random. Therefore no detailed lithological analysis can be given. However, according to the general geological history of the area, the age can be inferred as being transitional Barremian-Aptian, and the environment as a peritidal-tidal bar.

Holotype: Tangential section figured in Pl. VII, Fig. 5, slide Br-3A/28. All slides containing the new species are kept at the Institute of Geology, Zagreb.

Diagnosis: A *Salpingoporella* with large axial cavity and funnel-shaped, alternating ramifications, which in tangential sections appear square-shaped, producing the characteristic chequered appearance.

Description: A comparatively small dasyclad alga with a cylindrical, sometimes gently curved thallus. The calcareous envelope, similar to many other species of this genus, is composed up of yellowish, crystalline calcite. The axial cavity is bordered by a smooth surface, perforated by comparatively large pores at the beginning of the ramifications. The outer surface also appears to be smooth, but the outer terminations of the ramifications are possibly slightly convex.

The ramifications are simple, undivided, arranged into regular alternating whorls. They are orientated perpendicular to the axial cavity and appear short, which may be a consequence of a destroyed outer surface. The ramifications start with a comparatively wide pore in relation to the total size - and widen regularly and uniformly toward the distal end (Pl. VII, Figs. 16-18), retaining at the same time a square contour, regardless of the depth of the tangential section (Pl. VII, Figs. 3, 5-6, 10). The alternation in shallow tangential sections of approximately equal dark squares of the pores and light, calcitic squares of the skeleton produces the character-

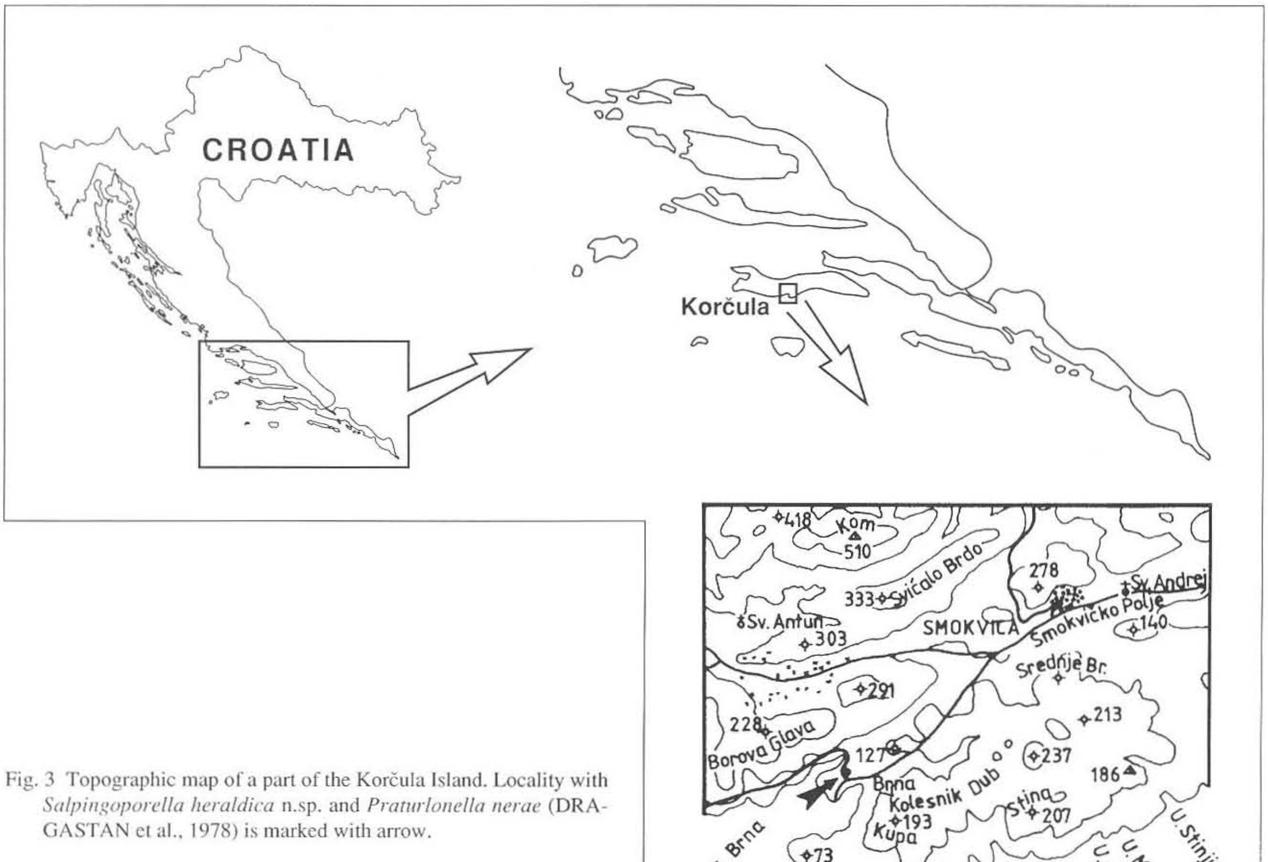

Fig. 3 Topographic map of a part of the Korčula Island. Locality with *Salpingoporella heraldica* n.sp. and *Praturlonella nerae* (DRAGASTAN et al., 1978) is marked with arrow.

Dimensions in mm:	total range	most frequently
Outer diameter (D)	0.35-0.68	0.54-0.64
Inner diameter (d)	0.25-0.39	0.34-0.39
The d/D relationship (d/D)	50-70%	50-60%
Distance between consecutive whorls (h)	0.04-0.05	0.05
Length of ramifications (l)	0.09-0.12	
Diameter of ramifications (p)	0.05-0.09	
Number of ramifications per whorl (w)	11-14	

Table 2 Dimensions of *Salpingoporella heraldica* n.sp.

istic chessboard pattern (or the Croatian coat of arms). This appearance is strengthened by the fact that the dark squares of the pores almost touch one another at their corners, which emphasizes both the diagonal and the quadrangular pattern (Pl. VII, Figs. 3-5). This fact was the reason for choosing a tangential section as the holotype.

Similarities and differences: *Salpingoporella heraldica* n.sp. is clearly distinguished from other *Salpingoporella* species, i.e. from those in which the distal parts of the ramifications are either longitudinally or transversely compressed. If the distal ends of the pores are compressed, they produce a hexagonal, rhombic, rectangular, or more rarely, quadrangular (square) pattern on the outer surface. In those species in which the pores in cortical sections appear square-shaped, the pores in deeper tangential sections appear more or less rounded, as distinct from *S. heraldica*, in which the pores retain their square shape regardless of the whether we are dealing with shallower or deeper tangential sections. By its general dimensions, *S. heraldica* belongs to the group of rather small Salpingoporellae. By its size (dimensions), the d/D relationship, and the number of branches per whorl, *S. heraldica* comes quite close, or even overlaps, with the corresponding values for *S. dinarica*. However, it clearly differs from the latter by the coarse-grained calcite in the calcareous envelope, square pore opening in the tangential sections, pronounced diagonal pattern in pore arrangement, etc. Other species from the same group, i.e. *S. istriana*, *S. johnsoni*, *S. sellii* etc., are characterized by phloiophorous ramifications that do not show either longitudinal or transverse compression. The differences with regard to these species concern the dimensions, number and shape of branches, etc. (see Table 3).

Concerning the question of how far the dimensional values (measured elements) and their proportions should be taken into consideration as significant criteria, the original data should be considered first, provided the species is recognized as valid. Later data often relate to incorrect identifications and are often additionally biased because of the small number of measured sections (whose specific, and sometimes even generic, attribution is frequently problematical), which renders any statistical interpretation questionable.

Stratigraphic position: *Salpingoporella heraldica* n.sp. has been found in a random sample, which makes a more precise definition of its stratigraphic position and environmental setting impossible. The sample in question shows some characteristic features which indicate a peritidal-tidal bar environment, as similar features occur in samples collected from logged sections, in the same or stratigraphically close horizons, in the study area. The same sample also contains the following microfossils: *Triploporella bacilliformis* SOKAČ (the same sample is also the "type specimen"), *T. marsicana* PRATURLON, *T. uragielliformis* CONRAD & PEYBERNES, and *Praturlonella nerae* n.sp. The occurrence of rare *Palorbitolina lenticularis* (BLUMENBACH) in the immediately overlying deposits indicates a terminal Barremian or, possibly, basal Aptian age.

Salpingoporella polygonalis n.sp.

Pl. III, Figs. 3-10; Pl. IV, Figs. 1-17

1994 *Salpingoporella urladanasi* CONRAD, PEYBERNES & RADOIČIĆ - BODROGI, BÓNA & LOBITZER, Pl. 17, Fig. 4.

Origin of the name: The name of the species is derived from the irregular, polygonal pores as they appear in shallow tangential sections.

Type locality: Island of Mljet, road-cut at the Sobra - Babino Polje road, about 2.15 km before Sobra, 150 m away from the locality of *S. verrucosa* (17°36'00"E and 42°44'02"N, Fig. 1).

Type stratum: Well-bedded, light-coloured, bioturbated algal wackestones with casts and moulds of dasyclad algae and gastropods (Fig. 2). Bioturbations are filled with pelloidal grainstone and small benthic foraminifera. The sedimentary environment may be defined as shallow subtidal.

Holotype: Oblique section figured in Pl. III, Fig. 3, slide Mlj.- 63/68. All slides of this species are kept at the Institute of Geology, Zagreb. In total, about 25 differently oriented sections have been examined.

Diagnosis: A *Salpingoporella* with large, alternating, ramifications, that are funnel-shaped from the very base, distally thickened and horizontally flattened, which show an irregular, rhombic-hexagonal to elliptically polygonal pattern, with an indication of distal splitting. The calcareous wall is composed of very coarse-grained, heavily weathered and recrystallized calcite.

SPECIES	D	d	d/D	h	l	p	$p_{proximal}$	p_{distal}	α	w
Salpingoporella adriatica (GUŠIĆ, 1966)	1.36-2.62	0.26-0.50		0.30-0.35	0.50-2.20			0.20-0.40		20-22
S. annulata CAROZZI, 1953	0.30-0.64	0.10-0.25		0.15-0.20						8-20
S.arabica ELLIOT, 1968	0.31-0.73	0.21-0.47	55-66%							8-10
S. arumaensis OKLA, 1995	2.1-2.8	1.6-1.8		0.20-0.5	0.30-0.5	0.20-0.27				20
S.? atlantica (JOHNSON, 1968)	0.71	0.36-0.375		0.050-0.075			0.025-0.017	0.042-0.055	45°	
S. biokoviensis SOKAČ & VELIĆ, 1979	0.55-0.74	0.12-0.22		0.20-0.34						
*	0.44-0.74	0.10-0.25	16-476%	0.18-0.32	0.22-0.25			0.10-0.32	7-8	
S. bucuri DRAGASTAN, 1989	0.95-1.30	0.25		0.050	0.20			0.10	10-20°	14-16
S. cemi (RADOIČIĆ, 1968)	1.8-1.6	0.44-0.52			0.38-0.48			0.16-0.24		20-25
S. circcassa FARINACCI & RADOIČIĆ, 1991	0.165-0.38	0.06-0.14		0.20-0.5	0.30-0.5	0.20-0.27				20
S. croatica SOKAČ, 1992	0.34-0.92	0.14-0.38		0.12-0.16				0.08-0.12		8-14
frequently	0.42-0.52	0.24-0.28		0.12-0.14				0.08-0.10		12
S. dinarica RADOIČIĆ, 1959	0.24-0.56	0.128-0.40		0.048						8-10(?)
*	0.07-0.48	0.05-0.38	41-47%	0.03-0.06	0.04	0.08-0.12				7-12
S. enayi BERNIER, 1984	0.867-0.950	0.325-0.425	38-44%		0.25-0.275	0.10-0.12				30?
S. etalloni BERNIER, 1984	0.325-0.450	0.1-0.137	28-30%		0.125-0.150	0.05-0.062			70-80°	20?
S.? exilis (DRAGASTAN, 1971)	0.6-0.8	0.2-0.3		0.025-0.030						
S. fluegeli DRAGASTAN, 1978	0.54-1.20	0.25-0.56		0.080-0.25			0.025-0.030	0.090-0.15		10-12
= *Megaporella fluegeli* (DRAGASTAN) 1989	0.60-1.10	0.30-0.56		?			0.025-0.030	0.10-0.15		12
S. genevensis (CONRAD, 1969)	0.6-1.0	0.27-051	45-51%	0.09-0.11						6? 7-9
S. grudii (RADOIČIĆ, 1963)	0.128-0.48	0.064-0.240			0.032-0.120					12-20
S. hasi CONRAD et al., 1976	0.2-1.12	0.1-0.72		0.06-0.13						5-7
*	0.34-0.82	0.20-0.54	41-77%	0.04-0.08	0.12-0.14	0.20-0.24				5-7
S. heraldica n.sp.	0.35-0.68	0.25-0.39	50-70%	0.04-0.05	0.09-0.12	0.05-0.09				11-14
S. hispanica CONRAD & GRABNER, 1975	0.25-0.46	0.16-0.36	66-77%	0.15-0.26						4
*	0.24-0.44	0.17-0.30	64-84%	0.12-0.14		0.14-0.28				4-5
S. humilis (BYSTRICKY, 1967)	0.633-1.183	0.283-0.750	42-68%				0.033-0.050	0.033-0.058		7-12

S. istriana (GUŠIĆ, 1966)	0.25-0.74	0.14-0.41		0.03-0.04	0.06-0.105	0.012-0.05				16-28
S. johnsoni (DRAGASTAN, 1971)	0.20-0.31	0.10-0.15		0.033-0.045	0.05-0.07	0.02-0.04				14-20
S. katzeri CONRAD & RADOIČIĆ, 1978	0.26-0.80	0.10-0.40		0.08-0.16						5-7
S. melitae RADOIČIĆ, 1967	0.48-1.255	0.32-0.960								16?-24
*	0.64-1.68	0.36-1.14	50-68%	0.05-0.08	0.17-0.34	0.19-0.28				14-20
S. milovanovici RADOIČIĆ, 1978	0.070-0.240	0.035-0.112		0.040-0.075						9-15
S. muehlbergii (LORENZ, 1902)	0.2-0.85	0.1-0.3		0.07-0.18						5-11
*	0.28-0.86	0.10-0.54	26-62%	0.08-0.13	0.10-0.20	0.10-0.18				7-8
S. piriniae KARAS & RADOIČIĆ, 1991	?0.180	0.064-0.160		0.064-0.090				10-14		
	0.240-0.530									
frequently	0.350-0.400									
S. patruliusi BUCUR, 1985	1.10-2.30 0.11-0.28	10-24%	0.22-0.28	0.56-1.00		0.040-0.078	0.16-0.31	25-35°	7-9	
S. polygonalis n.sp.	0.82-1.48	0.35-0.74	44-55%	0.14-0.19	0.22-0.35		0.06-0.09	0.14-0.34		10-12
S. polsaki SOKAČ & JELASKA, 1991	0.48-0.72	0.12-0.24	25-30%	0.08-0.11	0.20-0.28			0.12-0.24	20°	9-12
S. praturloni (DRAGASTAN, 1971)	1.2-4.0	0.6-1.6		0.25-0.90	0.07-0.030				20-40	
S. pygmaea (PIA, 1925)	0.43-0.72	0.17-0.26					0.02	0.09		16-19
S. robusta SOKAČ, 1993	0.77-1.44	0.20-0.48	27-30%	0.12-0.24	0.28-0.48	0.15-0.28			8-11	
frequently	0.86-1.10	0.24-0.30		0.15-0.20	0.30-0.40	0.20-0.24				8-9
S. sellii (CRESCENTI, 1959)	0.24-0.44	0.06-0.16		0.018		0.016-0.02				25-27
S. steinhauseri CONRAD et al., 1973	0.26-0.33		35-44%	0.08-0.11					45°	7-8
S. sturi (BYSTRICKY, 1967)	1.611-3.444	0.888-2.222	50-67&	2.27-4.49				0.055-0.166		16?-32?
S. tosaensis (YABE & TOYAMA, 1949)	0.71	0.41				0.05	0.025			50
S. turgida (RADOIČIĆ, 1965)	0.57-2.1	0.22-0.72		0.064-0.13	0.19-0.64		0.032-0.080	0.09-0.19		12-24
S. urladanasi CONRAD et. al., 1977	0.65-1.14	0.17-0.62	33-73%	0.015-0.13					4-8	
*	0.20-0.72	0.10-0.38	30-60%	0.08-0.10	0.11-0.28	0.14-0.24				5-?6
S. ubaiydhi RADOIČIĆ, 1979	0.24-0.65	0.08-0.32		0.050-0.096		0.040-0.090				8-14
S. verticillata (SOKAČ & NIKLER, 1973)	0.45-1.18	0.21-0.56		0.04-0.105	0.15-0.44	0.02-0.05	0.05-0.12		22-30	
S. verrucosa n.sp.	0.38-0.72	0.20-0.32	34-59%	0.14-0.24	0.12-0.20	0.06-0.10				6-8

Table 3 Comparison of the dimensions of genus *Salpingoporella* species. * - Complemented by own data.

Dimensions in mm:	
Outer diameter (D)	0.82-1.48
Inner diameter (d)	0.35-0.74
The d/D relationship	44-55%
Distance between whorls (h)	0.14-0.19
Length of the ramifications (l)	0.22-0.35
Proximal diameter of the ramifications (p_{prox})	0.06-0.09
Distal diameter of the ramifications (p_{dist})	0.14-0.34
Number of ramifications per whorl (w)	10-12

Table 4 Dimensions of *Salpingoporella polygonalis* n.sp.

Description: The massive calcareous skeleton of the cylindrical thallus of the new species is composed up of light grey, very coarse-grained, and variously recrystallized calcite. The outer surface of the calcareous envelope is always damaged, partly destroyed or dissolved, and subsequently recrystallized. That the wall was originally comparatively thick is indicated by rarely preserved, outwardly projecting, thin partitions between the distal ends of the ramifications (Pl. III, Fig. 3; Pl. IV, Figs. 2, 11, 13, 16-17). Axial cavity - measured in the few most complete specimens - occupies only about 30-35% of the total diameter, while more often it appears to be about 50% due to the secondary destruction of the wall. It is delimited by a smooth plane, which in section appears as a clear and sharp regular line (Pl. III, Figs. 6, 9). In some sections, however, the inner surface may be more or less destroyed, too (Pl. III, Figs. 8, 10), as indicated by the appearance of the larger pores of the ramifications.

Simple large (massive) ramifications are arranged alternately in the consecutive whorls. The general shape of the branches is irregular and variable. Starting from a smaller or larger connecting pore, they slightly widen in the first half of their length, after which they abruptly swell (Pl. III, Figs. 3, 6; Pl. IV, Figs. 6, 10), producing a funnel- or bowl-shaped distal part (Pl. IV, Figs. 14-16). In some specimens, the distal swelling is equally well visible in both longitudinal and equatorial sections. However, more often the ramifications are more or less flattened and elongated horizontally (i.e., by vertical compression; Pl. III, Figs. 4, 7, 10), which gives the characteristic irregular and variable pattern in shallow tangential sections. The shape of the distal opening of the pores varies from approximately hexagonal-rhombic (Pl. III, Fig. 3) to elliptical-oval (Pl. III, Figs. 4, 10). In the latter case, the slight tendency towards division of the stretched parts of the primary ramifications may be noticeable. The question of whether the ramifications actually divide distally, as suggested by some sections (Pl. III, Fig. 4; Pl. IV, Figs. 3, 5), must remain open, for the time being. At their very end the branches are closed by a dome-shaped, thin, probably calcareous membrane, as suggested in a few sections (Pl. IV, Fig. 16) in which thin, mutually separated partitions of the adjacent ramifications are preserved, which probably do not touch at the ends. The branches are perpendicular or subperpendicular to the main stem, in some specimens being slightly directed upwards.

The value of D is probably somewhat larger, because the outer surface was partly destroyed in all the sections observed.

In some sections (Pl. III, Figs. 4, 7) small hemispherical recesses in the distal parts of the ramifications' calcareous envelope can be seen. These are similar to, but less well pronounced then those observed in *S. genevensis* in which this feature was supposed to be caused by the imprint of slightly calcified cysts. In *S. polygonalis*, however, this supposition can neither be confirmed nor definitely disproved, though the imprint of slightly calcified cysts into a calcareous wall seem, in this case at least, unlikely. Unequivocal remains of even slightly calcified cysts have not been recognized, however.

Similarities and differences: *Salpingoporella polygonalis* n.sp. can be, in general, ascribed to that group of the *Salpingoporella* species in which the ramifications at their distal ends are horizontally flattened, regardless of what shape they eventually assume - hexagonal, rhombic, quadrangular, or, as in this case, polygonal. The new species is most similar to *S. melitae*, which, indeed, does show a broad variation range, from typical forms (Pl. II, Figs. 6-13; Pl. III, Figs. 1-2) to the such forms that, as the tangential sections cutting through their calcareous walls become progressively deeper, gradually begin to show features intermediate to some other species, e.g. *S. hasi* or *S. genevensis*. Therefore the new species appears most similar to the above mentioned species in the deepest tangential sections (i.e. those cutting the calcareous envelope in its most internal part), where the pores of all the species concerned appear similar, regarding both their arrangement and density. Going outwards, the differences between those species and *S. polygonalis* become progressively more and more pronounced, being most clearly expressed in cortical (i.e., shallowest) tangential sections cutting through the extreme distal part of the ramifications, which in *S. hasi* and *S. genevensis* have a quadrangular, in *S. urladanasi* a more or less deformed quadrangular shape (Pl. IX, Figs. 2, 4-5; Pl. X, Figs. 3-4, 6), and in *S. biokovensis* a square shape, whereas in *S. melitae* the pores appear clearly rhombic and horizontally (transversally) flattened. In *S. polygonalis*, however, the entrance pores of the branches have a larger diameter than in *S. melitae* and the branches irregularly widen distally, which makes them somewhat similar to those in *S. genevensis*, but with differently shaped distal ends. In *S. hasi* the entrance pore is followed by a very short channel, which is, in turn, followed by a bowl-shaped widening, whereas in *S. polygonalis* n.sp. the swelling of the branches is irregular, sometimes even more pronounced (but still uneven) in the distal half of their length. *Salpingoporella polygonalis* clearly differs from *S. katzeri*, in which the branches also swell very rapidly, often being more swollen toward the upper side (Pl. X, Figs. 10-12), with thin partitions between the branches and the more or less pronounced hexagonal to rhombic pattern at the distal ends. In *S. hispanica*, the skeleton is much weakly calcified, the number of branches per whorl is smaller, and the branches also have a more or less pronounced rhombic or hexagonal shape at their ends. In *S. dinarica*, the fibrous calcite, considerably smaller dimensions, the characteristic arrangement of tiny pores in proximal (deeper) tangential sections, and rhombic or completely flattened pores at their distal ends make clear differences to *S. polygonalis*. The differences to numerous other species of this genus, in which the distal ends of the pores are compressed, i.e. flattened vertically, or the branches widen regularly toward their distal ends, giving the more or less rounded pores at the outer surface, are clear and need not be discussed at length.

Stratigraphic position: *Salpingoporella polygonalis* n.sp. has been found in a sample containing a rich algal assemblage, consisting of numerous *Salpingoporella melitae*, *S. muehlbergii*, intermediate forms between *S. melitae* and *S. hasi*, and less numerous *S. hispanica*, *Clypeina*? *solkani*, *Praturlonella danilovae*, *P. pejovicae*, and numerous unidentified dasyclad fragments. The algae are accompanied by the foraminifera *Campanelulla capuensis* (DE CASTRO), *Mayncina bulgarica* HAUG et al., *Vercorsella scarsellai* (DE CASTRO), and others. About 20 m above this sample, in a continuous sequence, *Salpingoporella biokovensis* and *S. urladanasi* have been found. The above mentioned dasyclad assemblage and the position of the algal-bearing sample within the stratigraphic column at the type-locality suggest an Early Barremian age *of S. polygonalis*. Though the above mentioned foraminiferal species occur more frequently in the Upper Hauterivian, they also range into the Lower Barremian and thus do not contradict the proposed Early Barremian age.

Salpingoporella hasi CONRAD, RADOIČIĆ & REY, 1976

Pl. II, Figs. 1-5; Pl. VIII, Figs. 1-10

Selected synonymy:

1976 *Salpingoporella hasi* n.sp.- CONRAD, RADOIČIĆ & REY, p. 99-104, Fig. 2, Pl. 1, Figs. 1-10

?1986 *Salpingoporella* aff. *hispanica* CONRAD & GRABNER - RADOIČIĆ, Pl. 5, Fig. 1

?1991 *Salpingoporella hasi* CONRAD, RADOIČIĆ & REY - KUSS & CONRAD, p. 876, Fig. 4/17

1992 *Salpingoporella hasi* CONRAD, RADOIČIĆ & REY - MANCINELLI, p. 9, 11-12, Pl. 3, ?Fig. 15, non Fig. 16

1994 *Salpingoporella hasi* CONRAD, RADOIČIĆ & REY - BODROGI, BÓNA & LOBITZER, p. 233-243, Pl. 17, Fig. 2

?1994 *Salpingoporella hasi* CONRAD, RADOIČIĆ & REY - SCHINDLER & CONRAD, p. 81, Pl. 6, Fig. 14

Diagnosis: Dasyclad alga with cylindrical thallus and with phloiophorous branches which are, after a short connecting channel, uniformly and clearly bowl-shaped (widened) from their very base. At their distal ends the branches are mutually compressed and horizontally flattened, producing a regular pattern of rectangular, horizontally elongated, pores. Calcareous partitions between the neighbouring branches as well as between the branches of two consecutive whorls, are rather thick proximally and taper distally, passing into thin walls which, in some sections, appear as spines.

Salpingoporella hasi CONRAD et al. was originally described from the Upper Albian and Middle Cenomanian of Kosovo, Serbia, and from Portugal on the basis of several, rather atypical, poorly preserved sections and some heavily recrystallized fragments, which, when scrupulously compared with each other, show some differences. This suggests that the description includes material belonging to different forms, or, alternatively, that the species is characterized by the pronounced variability of some of its characteristic features. This is perhaps the reason that this species is seldom mentioned and even less frequently illustrated. Its age has been most frequently restricted to the Albian-Cenomanian. The inadequately defined differences between the strongly similar features of the related *S. genevensis* - *S. hasi* - *S. urladanasi* species, lead to frequent misidentifications in which Barremian specimens are mostly identified as *S. genevensis* or sometimes *S. hispanica* (RADOIČIĆ, 1986, Pl. V, Fig. 1) or just related to *S. hasi* (CONRAD & PEYBERNES, 1976, Fig. 13 d, e) and Cenomanian species are without reservations assigned to *S. hasi*.

In the original description of *S. hasi* (CONRAD et al., 1976), the authors mention the possibility of the consecutive whorls not always being in mutual contact but, instead, the incomplete calcification between the whorls produces a more or less deeply incised wedge-shaped depression. This feature is regarded as being species-specific. To my mind, however, this feature is doubtful, if present at all (i.e. in some sections it seems to be either lacking, or unobservable; e.g. CONRAD et al., 1976, Pl. 1, Figs. 4, 5, 7 - transverse, slightly oblique section), in others, expressly mentioned, sections it is unclear (op. cit., Fig. 2, Pl. 1, Figs. 1, 6, 10), and even in the reconstructions (op. cit., Fig. 1) it is not clearly defined. Therefore as this feature is not mentioned in the diagnosis but only in the description, the above mentioned diagnosis of this paper essentially agrees with the original one. However, despite the questionable value of this feature, the validity of *S. hasi* as an independent species is beyond question.

The randomly collected sample RC-1 from Barremian deposits of the Cres Island yielded numerous, well-preserved sections that, when compared with some of the published material of *S. hasi* (CONRAD et al., 1976, Pl. 1) and despite some newly discovered morphologic details, can be unequivocally assigned to *S. hasi*. The newly discovered characteristic are possibly the result of better preservation of this material and, as such, are inadequate for the establishment of a new taxon. They do however, make possible minor additions to the description of *S. hasi* in order to better differentiate *S. hasi* from *S. genevensis* and *S. urladanasi*, which, in some sections, may indeed appear very similar to be almost indistinguishable from *S. hasi*.

The comparatively large, horizontally flattened, ramifications in *S. hasi* show the following specific feature, visible in transverse sections: following a short connecting pore, or channel (exceptionally the channels entering the axial cavity can be slightly longer), the ramifications abruptly and uniformly widen, forming a bowl-shaped (Pl. II, Figs. 2-4) or funnel-shaped (Pl. VIII, Figs. 8, 10) swelling toward the exterior and at the same time retaining their original shape, with no significant deformations (Pl. VIII, Figs. 2-3). The transversely cut branches (i.e., in longitudinal and/or tangential sections) fully correspond to the reconstruction given by CONRAD et al. (1977, Fig. 4, section A-A') for *S. urladanasi*. The calcareous walls between the ramifications of the same whorl are thick only in their proximal parts, but due to the abrupt swelling of the ramifications, the walls soon became very thin partitions (Pl. VIII, Figs. 7, 9), which in better preserved specimens appear as spines (Pl. VIII, Fig. 7). This is never observed in *S. genevensis* or *S. urladanasi*, and this is also the main diagnostic difference from *S. genevensis*: in *S. hasi* the ramifications widen abruptly and uniformly in the horizontal plane with thinly calcified partitions between their distal ends, whereas in *S. genevensis* the ramifications are more robust, more irregular and with a larger connecting pore, but are also horizontally flattened. If we compare some previously published sections of *S. genevensis* (e.g., CONRAD, 1969, Figs. 1-9; DRAGASTAN, 1989, Pl. 6, Figs. 1-6) with the transverse oblique and longitudinal sections of *S. hasi* in this study (Pl. II, Figs. 1-5; Pl. VIII, Figs. 1-10), the above mentioned differences become clear enough to justify the validity of *S. hasi*. In tangential sections, however, the differences are not so well identifiable and therefore such sections cannot be used for species-level identification between *S. hasi* and *S. genevensis*. The differences with *S. urladanasi*, in which the branches, in their proximal part, also often appear very similar, or sometimes even identical, to those of *S. hasi*, will be discussed with *S. urladanasi*.

In connection with *S. hasi*, let us briefly discuss the relationship between *S. hasi* and *S. carpathica* DRAGASTAN (1969), with reference to some partial similarities in longitudinal sections between the two species. This should be done in spite of the fact that *S. carpathica* probably should be considered invalid or, at least, doubtful, being established on poorly preserved and heavily recrystallized material. CONRAD (1970) first mentioned that the specimens figured by DRAGASTAN (1969, Pl. 1, Figs. 1-6) probably belong to *S. muehlbergii* (LORENZ), which was accepted by BASSOULLET et al. (1978). Certain sections figured by DRAGASTAN (1969, Pl. 1, Figs. 1-2 and possibly Fig. 4) possibly do belong to *S. muehlbergii*, whereas the sections in Pl. 1, Figs. 3, 5-6 are inadequate for correct identification owing to poor preservation and heavy recrystallization. For this reason and because Fig. 2 was designated as the holotype by Dragastan, it is clear that *S. carpathica* cannot be accepted as a valid species. Despite this, *S. carpathica* is continuously mentioned in Rumanian papers. DRAGASTAN (1975, p. 62, Pl. 81, Fig. 3 and Pl. 82, Figs. 1, 3) reconsidered *S. carpathica* and introduced two sections from the same slide as hypotypes. However, no new data were given because the figured sections consist of fully recrystallized specimens that do not allow greater insight into species-specific features, which should have facilitated the identification of the new species. This also applies to later illustrations figured by DRAGASTAN et al. (1978, Pl. 8, Fig. 2) and DRAGASTAN (1978, Fig. 2f; Pl. 4, Fig. 9), respectively. In DRAGASTAN (1978), there is a contradiction between a figured section (Pl. 4, Fig. 9), which shows horizontally compressed and flattened branches, and the reconstruction (p. 112, Fig. 2f) in which the branches are shown as being compressed laterally (i.e., elongated along the growth axis of thalus). The renewed description by DRAGASTAN (1989, p. 14-15) gives no support for the validity of this species. The illustrated specimens (Pl. 5, Figs. 8-13) include a great deal of the already published material of problematical value, including the holotype (Pl. 5, Fig. 9 = Pl. 1, Fig. 2 in DRAGASTAN, 1969), which CONRAD (1970) already identified as belonging to *S. muehlbergii* - an opinion with which the author fully agrees. As this is the only transverse section of *S. carpathica* which unequivocally shows 5 ramifications in a whorl, the statement of *S. carpathica* having 4 (5) branches per whorl (DRAGASTAN, 1969, 1989) also appears invalid. The remaining sections (DRAGASTAN, 1989, Pl. 5, Figs. 10-12) are too poorly preserved for adequate comparison, particularly with the section figured in Pl. 5, Fig. 13, which belongs to an unidentified form, but different from that (or those) figured in Pl. 5, Figs. 10-12. According to all that has been said above - particularly with regard to the incorrectly designated holotype (DRAGASTAN, 1969, Pl. 1, Fig. 6 = DRAGASTAN, 1989, Pl. 5, Fig. 8) - the question remains which characteristics are relevant for distinguishing *S. carpathica* from other closely related and/or similar species.

In conclusion, it may be said that *S. carpathica* does not seem to fulfil the requirements for being accepted as a valid species. More generally, the ever increasing uncritical acceptance of new species or new combinations, which are not adequately documented, disturbs and practically (though not formally) invalidates regular taxonomy and leads to confusing and overburdened synonymy. Of course, mistakes are normal in any activity, including research, and in future research they are normally corrected. However, the problem arises when the alleged correction of mistakes is carried out on the same (inadequate) material, without new discoveries, and we should ask ourselves the following question: which criteria were used by the author in the original description and which in a later revision. Therefore, as aforementioned and in order to avoid future confusion, it is strongly suggested and recommended that the establishing of a new taxon, or the revision of an existing one, of fossil Dasycladales should be accompanied not only by illustration of the type specimen but also of several, variously oriented, sections which should clearly show the essential distinguishing features of the new taxons and, thus, complement the information obtained from the type specimen (or section, respectively). In this way, the subjective, often speculative, interpretation of the author should be successfully eliminated.

Salpingoporella urladanasi CONRAD, PEYBERNES & RADOIČIĆ, 1977

Pl. IX, Figs. 1-13; Pl. X, Figs. 1-9

Selected synonymy:

1977 *Salpingoporella urladanasi* n.sp. - CONRAD, PEYBERNES & RADOIČIĆ, p. 73-82, Pl. 1, Figs. 1-7

1979 *Salpingoporella urladanasi* CONRAD, PEYBERNES & RADOIČIĆ - PEYBERNES & CONRAD, p. 746-748, Pl. 2, Fig. 3

1986 *Apinella urladanasi* (CONRAD, PEYBERNES & RADOIČIĆ) n.comb. - GRANIER, MICHAUD & FOURCADE, p. 801-807

1989 *Hensonella urladanasi* n.comb.(CONRAD PEYBERNES & RADOIČIĆ) - MASSE, p. 281

1993 *Salpingoporella urladanasi* CONRAD, PEYBERNES & RADOIČIĆ - BODROGI, CONRAD & LOBITZER, p. 66-67, Pl. 3, Fig. 1

1994 *Salpingoporella urladanasi* CONRAD, PEYBERNES & RADOIČIĆ - BODROGI, BÓNA & LOBITZER, p. 233-248, Pl. 10, Fig. 8; Pl. 17, non Fig. 4

From the original description of this species (CONRAD et al., 1977), the following characteristics contained in the diagnosis should be emphasized: Phloiophorous ramifications arranged in dense whorls, transversally compressed, giving a honeycomb-like pattern, communicate with the axial cavity through narrow, round pore. Calcareous partitions between the branches in a whorl are bent toward the periphery in the same direction, but in alternating directions in consecutive whorls. Distal swelling of the branches is interpreted as resulting from the imprints of cysts. The calcareous envelope is built of spathic calcite which extends to the axial cavity, which is lined by a thin dark layer composed of small, radially arranged crystals. In the description, the opposite direction of the inclination of partitions in the adjacent whorls is mentioned, and emphasized in the reconstruction (CONRAD et al., 1977, Fig. 4C), though it is not clearly visible in the holotype (op. cit., Pl. 1, Fig. 1). In the description, there is also the following statement: the calcareous envelope fills the entire space between the ramifications, though a specimen from Spain is mentioned, in which the envelopes of the branches do not touch at their ends. However, regardless of what is stated in the diagnosis, the reconstruction presented with *S. hasi* CONRAD et al. (1976, Fig. 1) and *S. urladanasi* CONRAD et al. (1977, Fig. 4) show a remarkable similarity in their longitudinal sections, whereas the transverse sections are too simplified (schematic), being obviously based on one set of transverse sections in slides whereas another set, different from the first set, have been neglected, e.g. the reconstruction of the transverse section of *S. hasi* (CONRAD et al., 1976, Fig. 4) seems to be based on the transverse section figured in Pl. 1, Fig. 2, whereas another transverse section, which gives a different picture (Pl. 1, Fig. 7) seems to be neglected; however, it is similar to the section A-A' in the reconstruction of *S. urladanasi* (CONRAD et al., 1977, Fig. 4). However, the above mentioned transverse section (CONRAD et al., 1976, Pl. 1, Fig. 2) possibly belongs to *S. melitae* RADOIČIĆ. Nevertheless, in spite of considerable similarities between the two species and frequent dilemmas concerning their identification, the validity of the two species is confirmed by the available material, where both species are abundantly represented and their differences become evident. Numerous, well-preserved sections ascribed to *S. hasi* (Pl. II, Figs. 1-5; Pl. III, Figs. 1-10) and *S. urladanasi*, respectively (Pl. IX, Figs. 1-13; Pl. X, Figs. 1-9) make possible the visualisation and definition of some features essential for their discrimination, which were not mentioned in the respective original descriptions.

The calcareous envelope of *S. urladanasi*, in contrast to that of *S. hasi*, is built of coarse-grained, yellowish calcite, identical in colour as that observed in *S. dinarica* (these two species are associated in the material deriving from Mt. Dinara and thus can be directly compared). In *S. urladanasi*, however, the texture of calcite is clearly blocky, i.e. mosaic-like, whereas in *S. dinarica* it is radial-fibrous. As already stated in the original diagnosis (CONRAD et al., 1977), some specimens of *S. urladanasi* may show a very thin, sometimes somewhat darker layer lining the axial cavity (Pl. IX, Figs. 1, 3). In present material it is difficult to tell whether that layer is composed of mosaic-like or radial crystals. This feature has already been the subject of discussion (CONRAD & VAROL, 1990; SIMMONS et al., 1991) and was also mentioned by BODROGI et al. (1993). Such peculiarities in the structure of the skeleton of *S. urladanasi* may, among other things, serve as additional distinguishing features for separating this species from *S. hasi* on the one hand and from *S. dinarica* on the other. The origin of this feature, however, remains open for further investigation.

The outer surface is covered with protrusions of ramifications with their own envelopes extending from the middle of their length to the distal end (Pl. IX, Figs. 10, 12-13; Pl. X, Figs. 2, 3 pars, 5). This is the reason for the occurrence of wedge-like incisions in the skeleton and mutually unconnected, deformed quadrangular patterns in superficial tangential (cortical) sections resulting from individual, mutually separated ramifications from the same whorl or from adjacent whorls (Pl. IX, Figs. 11-13). These features are mentioned by CONRAD et al. (1976) as being characteristic of *S. hasi*, but they could not be observed in the available material, nor do they seem to be visible in the original illustrations. Furthermore, the available material seems to exclude the presence of such features in *S. hasi* (Pl. VIII, Figs. 2-3, 6A). Alternatively, in *S. urladanasi* the separate calcareous envelopes of adjacent branches clearly show the wedge-shaped intrusions between the branches that sometimes penetrate deep into the proximal part of the skeleton (Pl. IX, Figs. 12-13). In cases when the envelopes in *S. urladanasi* are in mutual contact, the thickness of the partitions between the ramifications doubles (Pl. IX, Figs. 2-4; Pl. X, Figs. 4 pars, 6), which is not the case in *S. hasi*. The fused envelopes disappear deeper within the calcitic mass between the proximal part of the ramifications (Pl. IX, Figs. 2, 7-8), and thus the difference between *S. hasi* and *S. urladanasi* also disappears. In *S. urladanasi*, the horizontally flattened branches may be deformed distally to various extents, which can be seen in transverse and tangential sections. Thus, in transverse sections, the branches may be abruptly and uniformly swollen, forming a bowl-shape widening following the short and narrow pore (channel), similar to *S. hasi* (Pl. X, Figs. 8-9), or they may be irregularly swollen with one side more inflated than the other (Pl. IX, Fig. 11 pars; Pl. X, Fig. 1A), or they may be funnel-shaped, with gradual widening. Sometimes, in specimens with irregularly swollen ramifications, the channels that connect the ramifications with the axial cavity are directed obliquely to the axial cavity (in the horizontal plane, i.e. in transverse section), i.e. they are not perpendicular to the inner surface (Pl. X, Fig. 8). A particularly pronounced deformation of the branches, emphasized in the original description (CONRAD et. al., 1977) as a primary species-specific characteristic, concerns the shape of their distal ends in tangential sections. This shape in *S. urladanasi* can vary from a comparatively regular rectangle (Pl. IX, Fig. 5) to a rectangle squeezed in the middle like a bow-tie (Pl. IX, Fig. 4), sometimes with more strongly stretched corners on one side, reminiscent of the longitudinal section of a femur (Pl. IX, Fig. 6; Pl. X, Fig. 4). The partitions between the branches of the same whorl may be vertical to subvertical (Pl. IX, Fig. 5) in less deformed branches, or oblique, inclined to the same side. This can also be the case in the adjacent whorls, or else, as has been stated in the original description, the inclination can be reversed in adjacent whorls (Pl. X, Fig. 4 pars). The intensity of deformation of the ramification's distal ends varies from individual to individual and even in the same individual. The varying extent of deformation of the ramifications in *S. urladanasi* proves it to be of secondary origin and thus neither this feature can not always be used as absolutely reliable for specific determination. Therefore, it is not considered likely that the distal swellings of ramifications are due to imprints of cysts, or rather, there are no indications for such an interpretation.

Regardless of the original descriptions of *S. hasi* and *S. urladanasi* and the accompanying reconstructions, all data based on the abundant available material suggest that the differences between the two species can be specified as follows: In *S. hasi* the ramifications are more or less regular and in transverse sections (= in horizontal plane), after a short channel, abruptly and regularly widen into a bowl- or funnel-like shape. The calcitic mass between the proximal part of the ramifications within a whorl abruptly thins distally, giving, in better preserved specimens, the appearance of spines. Such distally thin partitions make it impossible to accommodate uncalcified hollow spaces (recesses) between the ramifications and thus prevent the individualization of ramifications at their outer ends. On the contrary, in *S. urladanasi* the calcitic mass between the ramifications of the same whorl also becomes thinner, but halfway out (or in the outer third), and sometimes even earlier, it splits into two separate calcareous envelopes of the distally individualized branches. As a consequence of this, there are uncalcified wedge-shaped recesses which sometimes may reach deeply into the proximal part of the skeleton (Pl. IX, Figs. 12-13). In *S. hasi*, the partitions between the ramifications of the same whorl and of the adjacent whorls are regular and in the outer tangential section half as thick as in *S. urladanasi*, in which they are often separated from each other with deep uncalcified, wedge-shaped insertions. The partitions between the ramifications in *S. hasi* being this thin, make it impossible for the ramifications to bulge out on the outer surface. Therefore the ramifications were probably covered by an uncalcified membrane, in contrast to *S. urladanasi* in which the protruding ramifications are evidently covered with a calcareous envelope composed of the same calcite as the proximal part of the skeleton (Pl. X, Fig. 2).

Stratigraphic position: In spite of the fact that unequivocal finds of *S. urladanasi* - as defined in this paper - are not very numerous, its total range in the region of the Dinaric Karst in Croatia can now be reliably determined due to its lowest (oldest) occurrence on the island of Mljet and its highest (youngest) occurrence on Mt. Dinara. On Mljet, *S. urladanasi* has been found associated with *Salpingoporella biokovensis*, in a sample situated 20 m above the rich algal assemblage also containing *Campanelulla capuensis* (DE CASTRO), which indicates the Lower Barremian age (see the description of *Clypeina gigantea*). On the other hand, on Mt. Dinara, the sample with *S. urladanasi* is situated 25 m above the assemblage consisting of *Salpingoporella dinarica* RADOIČIĆ, *Acroporella radoicicae* PRATURLON, *Orbitolina (Mesorbitolina) minuta* DOUGLASS, *Sabaudia minuta* (HOFKER), *Nezzazata simplex* OMARA, *Debarina hahounerensis* FOURCADE, and *Vercorsella scarsellai* (DE CASTRO) (foraminiferal identifications by I. VELIĆ). About 15 m above the bed with *S. urladanasi*, the first *Orbitolina (Mesorbitolina) texana* (RÖMER) occur, and pass upward into a typical Albian microfossil assemblage. Therefore the total range of *S. urladanasi*, in the region of the Dinaric and Adriatic Karst, can be defined, for the time being, as Barremian-Aptian.

Salpingoporella dinarica RADOIČIĆ 1959

Pl. XI, Figs. 1-10; Pl. XII, Figs. 1-13; Pl. XIII, Figs. 1-8; Pl. XIV, Figs. 1-9

Selected synonymy:

1959 *Salpingoporella dinarica* n.sp. - RADOIČIĆ, p. 33-42, Pl. 3-5

1960 *Hensonella cylindrica* n.gen., n.sp. - ELLIOT, p. 229-230, Pl. 8, Fig. 1

1982 *Hensonella* - LUPERTO-SINNI & MASSE, p. 870, Figs. 12 d-e

1983 *Salpingoporella dinarica* RADOIČIĆ - CONRAD, PEYBERNES & MASSE, p. 93-94, Pl. 6, Figs. 6 pars, 12 pars

1984 *Hensonella* sp. (gr. *dinarica*) - LUPERTO-SINNI & MASSE, p. 340, Pl. 33, Figs. 7-8

1985 *Hensonella dinarica* (RADOIČIĆ) - MASSE, p. 719

1987 *Salpingoporella dinarica* RADOIČIĆ - RADOIČIĆ, p. 73-79, Pl. 1, Figs. 5 pars, 6 pars

1989 *Salpingoporella dinarica* RADOIČIĆ - DRAGASTAN, p. 13, Pl. 5, Figs. 1-2.

1989 *Hensonella dinarica* (RADOIČIĆ) - MASSE, p. 281, not figured

1989 *Hensonella dinarica* (RADOIČIĆ) - MASSE & LUPERTO-SINNI, p. 32, not figured

1990 *Salpingoporella dinarica* RADOIČIĆ, 1959 (alias *Hensonella cylindrica* ELLIOTT, 1960, alias *Hensonella dinarica*) - CONRAD & VAROL, p. 206, Fig. 9

1991 *Salpingoporella dinarica* RADOIČIĆ - KUSS & CONRAD, p. 874 - 876, Fig. 4.15

1991 *Hensonella dinarica* (RADOIČIĆ) - SIMMONS, EMERY & PICKARD, p. 955-959, Fig. 1 A-C

1992 *Salpingoporella dinarica* RADOIČIĆ - MANCINELLI, p. 9, 13, Pl. 1, Fig. 10

1993 *Hensonella* gr. *dinarica* (RADOIČIĆ) - LUPERTO-SINNI & MASSE, p. 300, Pl. 4, Figs. 8-10

1994 *Salpingoporella dinarica* RADOIČIĆ, 1959 - SCHINDLER & CONRAD, p. 77, Pl. 2, Figs. 9-11; Pl. 4, Fig. 16

This is a very well-known species, which occurs frequently and abundantly in the areas surrounding the Mediterranean and the Middle East (i.e. the southern Tethyan margin). It was originally described as a small alga with cylindrical thallus, rather broad axial cavity, and comparatively thin walls (RADOIČIĆ, 1959). The simple, undivided, phloiophorous ramifications are characteristically arranged into a quincunx pattern, and are horizontally flattened at the distal ends, where the pores assume an elongated-rhombic pattern. A species-specific characteristic is that the calcareous envelope consists of radial-fibrous calcite and is lined on the inside by a thin dark layer of microcrystalline calcite. These two characteristic features were used by ELLIOTT (1960) for the establishment of his new genus and species *Hensonella cylindrica* (Problematica, Annelida?). Later, however, ELLIOTT (1968) considered it to be a younger synonym of *Salpingoporella dinarica*. Since then, many authors have discussed the species (e.g., LUPERTO-SINNI & MASSE, 1982, 1984; CONRAD & VAROL, 1990; SIMMONS et al., 1991; SCHINDLER & CONRAD, 1994), mainly due to the two peculiar features mentioned above, which were considered uncharacteristic of the Dasycladales. SIMMONS et al. (1991) have summarized the previous discussions and, basing their conclusions on the results obtained by cathodoluminiscence and microprobe analysis, have concluded that the calcareous envelope of *S. dinarica* was composed of primary low-Mg calcite and that this was its original structure, no matter how highly unusual this was for the dasyclads and how different from the other *Salpingoporella* species. For this reason they ascribed this species to *Hensonella*, as has previously been done by LUPERTO-SINNI & MASSE (1982, 1984). The truth is, that almost all sections of this form show a more or less pronounced radial-fibrous calcitic wall structure. This structure is in general, better displayed in specimens in which the pores of the ramifications are only slightly visible (see, for instance, ELLIOTT, 1960, Pl. 8, Fig. 1; SCHINDLER & CONRAD, 1994, Pl. 2, Figs. 9-11 and the sections in the present paper, e.g., Pl. XI, Fig. 1). However, this is not a rule without exception, though the reverse is also often true (Pl. XI, Figs. 4-6; Pl. XII, Figs. 6-7). In the majority of the observed specimens, the axial cavity and the surrounding space are filled with coarse-grained blocky calcite cement or the surrounding sediment (Pl. XI, Figs. 6, 8, 10; Pl. XII, Fig. 1).

However, in spite of the fact that the walls of *S. dinarica* are almost always composed of radial-fibrous, yellowish calcite, there are a few exceptions to this rule, too. Consider, for instance, sections figured in Pl. XII, Figs. 11, 13, in which the fibrous calcite is partly or fully replaced by microcrystalline calcite identical to that of the surrounding sediment. The outer and inner surfaces of the calcareous envelope are marked by a thin layer of yellowish calcite. This phenomenon should probably be considered as a consequence and result of diagenetic processes. Also, there are a few sections in which the radial-fibrous calcite grows upon the thin, dark, microcrystalline layer inside the axial cavity, filling it partly (Pl. XII, Figs. 1, 5) or wholly (Pl. XII, Figs. 8 pars, 19). The same radial-fibrous calcite also occurs, though more rarely, on the outer surface. In such cases, too, it is separated from the calcareous wall itself by a thin dark layer probably of microcrystalline calcite (Pl. XII, Figs. 5, 10). The development of this radial-fibrous calcite, which is certainly of secondary origin and synchronous with the blocky calcite cement in the axial cavity, may be thought of as a consequence of overgrowth (i.e. syntaxial rim cement). This indicates that during diagenesis the axial cavity may be partly or wholly filled with either (a) surrounding lime mud (Pl. XI, Fig. 7), (b) secondary blocky calcite cement, or (c), more rarely, radial-fibrous calcite (Pl. XIII, Figs. 5, 9-10). Eventually, both within the axial cavity and on the external surface of the skeleton, synchronously and in the same environment, blocky (granular) and radial-fibrous calcite develops, and thus the question arises why in some cases there is an overgrowth (if indeed it is), and in others there is not.

The thin dark inner layer has been noticed by all workers who have dealt with this species, beginning with the original description by RADOIČIĆ (1959). ELLIOTT (1968) stressed the primary organic nature of this layer and SIMMONS et al. (1991) stated that it could be interpreted as a primary organic membrane, about 0.012-0.018 mm thick, that lines the calcareous envelope on the inside. CONRAD & VAROL (1990) also consider this layer in *S. dinarica* to be of primary origin. In the available material (Pl. XII, Figs. 1-2, 5, 10; Pl. XIII, Figs. 1-4), two types of dark microcrystalline layer can be distinguished, which differ as a result of the time and origin of their growth. The first type may be more or less clearly visible but is always present, lining the inner surface of the calcareous wall and being in immediate contact with the radial-fibrous calcite of the wall. The primary origin of this layer and its function during the life of the alga, as assumed by CONRAD & VAROL (1990: "in vivo"), is confirmed by the existence of the pores in the layer, which are visible in tangential sections (Pl. XIII, Figs. 1-2). The second type includes the very dark microcrystalline layer that may be unevenly developed (i.e. being of various thickness) and while lacking in some specimens, in others it may be more pronounced than the first type. This layer originated during early diagenesis, probably as a result of biological activity of microbial organisms or by accretion of organic mucus on the algal skeletal remains (this is the third or the fourth possibility mentioned by CONRAD & VAROL, 1990). It can develop both on the outside and the inside of the calcareous envelope; in the first case it occurs as a thin layer (of variable thickness) either wholly "encrusting" the skeletal remain, or only in part; it is usually only developed on some specimens within a sample. The second case, i.e. when this layer is developed on the inside of the calcareous envelope, is shown in Pl. XII, Figs. 1-2, 5, 10. Sometimes the outer layer visibly destroys the outer surface of the calcareous envelope and penetrates deeply into the radial-fibrous calcite, reaching, in some cases, the axial cavity (Pl. XII, Fig. 2). It may be clearly and sharply delimited toward the surrounding sediment (Pl. XII, Figs. 1-2, 5), or it may pass gradually into the surrounding sediment, forming a darkened zone around the algal skeleton (Pl. XI, Figs. 8, 10). When developed in the axial cavity, it can partly cover the primary dark microcrystalline layer (Pl. XII, Fig. 10). It is more frequently developed inside the axial cavity, either as an uninterrupted zone (Pl. XII, Fig. 1) or fragmentarily (Pl. XII, Fig. 5), if the axial cavity has already been partly filled, in which case it interrupts the growth of the second generation calcite cement within the axial cavity (Pl. XII, Fig. 5), be it radial-fibrous or blocky. In this case, the narrow zone of the primary dark microcrystalline layer is sharply delineated as a regular oval (depending on the obliquity of the section), which is lighter than the irregular secondary microcrystalline zone and darker than the light calcite of the skeleton and the first generation of the secondary calcite cement (radial-fibrous or blocky), which always fills the central part of the axial cavity (Pl. XII, Fig. 1).

Among numerous samples containing *S. dinarica*, there are only two samples (both Aptian in age, one from the Dugi otok Island and the other from the Mali Lošinj Island), that, in addition to typical specimens, also contain a few sections which show the tendency of a branching thallus and, even more rarely, some sections in which the branching of the thallus is clearly developed, similarly to some recent genera (VALET, 1968). The tendency of the branching thallus is displayed by longitudinal splitting of the axial cavity and can be seen in transverse and oblique sections with more or less pronounced extensions of the inner surface into a fold directed toward the centre of the axial cavity. The initial formation of this fold appears, in some sections, like a denticle (Pl. XIV, Fig. 5). If the extension of the fold is more pronounced and proceeds from both opposing sides, it leads to a partial (Pl. XIII, Fig. 6) or complete splitting of the axial cavity into two parallel (Pl. XIII, Figs. 6-7) or slightly divergent (Pl. XIV, Figs. 3, 6-7) tubular cavities which are, still, connected by a common calcareous envelope (Pl. XIV, Figs. 1, 7); that is, the independent branches are not yet fully formed. Precisely this fact led to the supposition of two specimens tightly pressed together, in which the calcareous envelopes along the contact were supposed to be partly or completely dissolved. However, this is refuted by the existence of sections that show the single calcareous envelope, in which the characteristic arrangement of the pores (well visible in tangential sections) was retained and which, by its mere diameter, cannot accommodate two individuals (Pl. XIII, Fig. 3; Pl. XIV, Fig. 8). The longitudinal section figured in Pl. XIII, Fig. 5, clearly shows the branching of an initially tubular thalus, which continues to grow with two slightly divergent, independent branches, each with its own calcareous envelope.

In spite of two unique features, the thallus of this alga is composed of low-Mg calcite (SIMMONS et al., 1991) and there is a thin dark inner layer of microcrystalline calcite (which is also rare in other dasyclad species), I am, for the time being, not inclined to change its taxonomic classification, i.e. to remove it from the genus *Salpingoporella*. If we accept the taxonomic emendation, this would mean giving greater importance to a new parameter - the primary calcitic mineralogy of the skeleton - whose physiologic role and biologic significance are far from clear, and rejecting, in turn, the clear morphologic criteria that have served us well in the hitherto established classification of the dasyclad algae (shape and arrangement of ramifications, etc.). These morphologic criteria are strikingly similar to those in other *Salpingoporella* species. Besides, there is the newly discovered feature of the branching thallus, obviously not so rare in this species, and tentatively indicated even in the type species, *S. muehlbergii* (Pl. I, Fig. 6).

The stratigraphic range, geographical distribution, and environmental preferences of this species have been frequently commented upon, as is evidenced by an exceptionally abundant synonymy (BASSOULLET et al., 1978, and this paper). In the Dinaric and Adriatic Karst areas it occurs in various facies types of the shallow water carbonates, frequently associated with other calcareous algae, benthic foraminifera (both "large" and "small"), corals, bivalves, etc. Therefore, contrary to what has been stated by SIMMONS et al. (1991), in my opinion it cannot be considered as being characteristic of particular kinds of environments. It occurs most abundantly in micritic limestones of protected Upper Barremian and Aptian lagoons. Its oldest occurrence in investigated area is in the Valanginian of western Istria (Pl. XI, Fig. 1), where in a continuous lithostratigraphic succession, it occurs not far above the first occurrences of *Epimastopora cekici* RADOIČIĆ and *Triploporella neocomiensis* RADOIČIĆ, which are considered to be most common in the Lower and Middle Valanginian. Thus, the total stratigraphic range of *S. dinarica* in the Adriatic and Dinaridic karst areas can be interpreted as from the Middle (or more likely, Upper) Valanginian, up to and including the Albian. Its lower boundary thus coincides with the data given by CONRAD & VAROL (1990) and SCHINDLER & CONRAD (1994).

There is still another phenomenon which seems worth mentioning in connection with this alga: the comparatively frequent occurrence of characeans associated with *S. dinarica* or, very abundantly, in layers immediately below or above the beds with *S. dinarica*. In western Istria, in the Middle-Upper Valanginian, *S. dinarica* is associated with a peculiar type of characean (Pl. XIV, Figs. 10-13), which has so far not been observed in the younger (Barremian-Aptian) deposits of that area. Maybe such characeans can be cautiously used as an indication of the Valanginian age of the otherwise barren deposits, at least in a geographically restricted area.

Genus *Praturlonella* BARATTOLO, 1978

Praturlonella nerae (DRAGASTAN, BUCUR & DEMETER, 1978) BUCUR, 1993

Pl. XV, Figs. 1-19

?1978 *Halicoryne nerae* n.sp. - DRAGASTAN, BUCUR & DEMETER, p. 28, Pl. 12, Figs. 5-6

1993 *Praturlonella nerae* (DRAGASTAN, BUCUR & DEMETER) n.comb. - BUCUR, p. 103, Pl. 8, Fig. 1, ?Figs. 2-12

1993 *Likanella*? sp. - MASSE, p. 316, Pl. 2, Fig. 8

1993 *Praturlonella danilovae* (RADOIČIĆ) - SOTÁK & MIŠÍK, p. 403, Pl. 6, Fig. 8

This species, first described as *Halicoryne nerae* by DRAGASTAN et al. (1978) was later transferred to *Praturlonella* by BUCUR (1993). In the original description of *Halicoryne nerae* (DRAGASTAN et al., 1978), the authors described oval-ellipsoid bodies, giving their dimensions (length, width, number and diameter of cysts), which represented an inadequate description of these fragments. Therefore MIŠIK (1987) considered their assignment to *Halicoryne* as doubtful. Among all the sections figured by BUCUR (1993, Pl. 8, Figs. 1-12), only one section of a segment (op.cit., Pl. 8, Fig. 1) is clear enough, whereas other sections (op.cit., Pl. 8, Figs. 2-12) cannot be identified with certainty with the section figured on his Pl. 8, Fig. 1. Moreover, the difference is also visible when the dimensions of cysts in DRAGASTAN et al. (1978) are compared with the values of "p" (both on distal and proximal ends) given by BUCUR (1993). In spite of some visual similarity between the sections figured by BUCUR (1993, Pl. 8, Figs. 3-12) and those in the present paper (Pl. XV, Figs. 1-19), only a problematical comparison is possible and the present author is not convinced that we are dealing with the same fossil form. The question is, among other things, how can 95% of the sections figured by BUCUR (1993) represent tangential(?) sections through isolated segments, whereas almost 100% of sections studied here (Pl. XV, Figs. 1-19) show the more or less complete algal skeleton, regardless of the orientation. However, independent of these considerations, the assignment of *Halicoryne nerae* (DRAGASels, or slightly below the whorls, appears slightly narrower. *P. nerae* is also distinctly smaller than *P. jordanica* KUSS & CONRAD, from which it also differs by the shape of the ramifications and the number of rows of ramifications within a ring. *P. hammudai* (RADOIČIĆ), which has recently been assigned to *Falsolikanella* (SCHLAGINTWEIT, 1990) and was originally described from heavily recrystallized material (RADOIČIĆ, 1975, Pls. 1-2), shows a similar height of calcified rings (segments), according to KUSS & CONRAD (1991), this however being the sole similarity. The difference is most evident in the d/D values, which are distinctly larger in *P. nerae*.

A great visual similarity which, in some sections, amounts to an impression of total likeness, exists between *P. nerae* and Carboniferous *Windsoporella radiata* MAMET & RUDLOFF. Comparison between the illustrated sections of *W. radiata* (MAMET & RUDLOFF, 1972, Pl. 3, Figs. 18-25) and *P. nerae* (Pl. XV, Figs. 1-19) reveals an identical skeletal form, arrangement of ramifications within the calcified rings and their direction of growth diverging both upward and downward from the horizontal plane, and also slight widening of the central cavity at the levels of whorls, all these features being essentially the same as in *P. nerae*. The differences concern the much smaller dimensions of *W. radiata* and the pattern of ramifications, which, according to MAMET & RUDLOFF (1972), are grouped into bundles of four issuing from a common basis, or constitute a bunch of a ramified primary branch, respectively (see MAMET & RUDLOFF, 1972, Fig. 3). This last statement, however, remains speculative, with regard to the author's assertion that the calcification of the ramification's envelope occurs no sooner than from their departure point, and thus the existence of common departure point, i.e. the primary ramification, is made doubtful. This doubt is further strengthened by sections figured by MAMET & RUDLOFF (1972, Pl. 3, Fig. 18, Fig. 22: left side of the upper ring, Fig. 23: left side of the lower ring), where one gets the impression of ramifications issuing separately from the axial cavity, similarly as can be seen in some sections of *P. salernitana* figured by BARATTOLO (1978, e.g. Pl. 5, Figs. 10, 12, 14; Pl. 7, Figs. 1, 3, 4, etc.). However, being uncertain does not necessarily mean that the interpretation of Mamet and Rudloff is impossible; therefore the objectivisation of this possible and significant difference between *Windsoporella* and *Praturlonella* should be a matter for further research on the type-species of *Windsoporella*. If, on the other hand the main characteristics of *Windsoporella* are proven to be identical with those of the later established *Praturlonella*, the question of the validity of the genus *Praturlonella* arises. However, the large time span separating two taxa with identical characteristic features, suggests agreement with KOCHANSKY-DEVIDÉ & GUŠIĆ (1971) who mentioned several instances of the repeated occurrences of similar and/or (almost) identical forms and other characteristics in the course of evolution of the Dasycladales without implying their generic unity, which would also seem a likely explanation for the *Windsoporella/Praturlonella* situation, implying that the two genera do not belong to the same lineage. Thus *Praturlonella* would remain a valid genus.

Stratigraphic position: The remains of this alga have been found in a randomly collected sample during geological reconnaissance of the central part of Korčula Island. Therefore it is impossible to assess its full stratigraphic position and its age can only be determined on the basis of the accompanying microfossils, which include *Triploporella baciliformis* SOKAČ, *T. marsicana* PRATURLON, *Salpingoporella heraldica* n.sp., and *Cylindroporella ivanovici* (SOKAČ). In addition, the algal-bearing sample lies immediately (probably about 2-3 m) below the first finds of *Palorbitolina lenticularis* (BLUMENBACH), suggesting that the stratigraphic position of the algal-bearing sample is top Barremian or maybe Lower Aptian.

Praturlonella dalmatica (SOKAČ & VELIĆ, 1978) n.comb.

1978 *Selliporella dalmatica* n.sp. - SOKAČ & VELIĆ, p. 231-234, Pls. 6-9.

1982 *Likanella*? *danilovae* RADOIČIĆ (p.parte and aff. *danilovae*) - CONRAD, p. 2.

Considering its generic attribution and taxonomic validity, this species was considered by CONRAD (1982) to be a younger synonym of *Praturlonella danilovae* (RADOIČIĆ) or, at least, partly similar to it. The most recent quotation (SCHINDLER & CONRAD, 1994) also includes the possibility of assigning *S. dalmatica* to *Praturlonella*. Our illustrated material (SOKAČ & VELIĆ, 1978, Pls. 6-9) shows some hitherto insufficiently emphasized features which make it possible to distinguish this form from P. *danilovae* and to validate it taxonomically as *Praturlonella dalmatica* (SOKAČ & VELIĆ) n.comb. As can be seen from Table 6, the differences between *P. danilovae* and *P. dalmatica* include the larger height of the rings, larger variation range of the d/D ratio, smaller and more variable ramification length, and possibly smaller number of ramification rows in a ring in *P. danilovae*. Another difference, which has not been adequately emphasized to date, and cannot be observed from numerical values alone, concerns the shape of the ramifications: in *P. danilovae* they are clearly fractured at their distal end (RADOIČIĆ, 1968, Pl. 1, Figs. 2-3; Pl. 2, Figs. 1, 3; Pl. 3, Figs. 2-4; Pl. 4, Fig. 4; Pl. 5, Fig. 4), which is not visible in *P. dalmatica* (SOKAČ & VELIĆ, 1978, Pls. 6-9). The latter has clearly phloiophorous branches, gradually widening from the base toward their distal end. Besides, in *P. danilovae* the tightly compressed ramifications diverge both upward and downward from the horizontal plane (RADOIČIĆ, 1968, Pl. 1, Figs. 1-3; Pl. 3, Fig. 3; Pl. 6, Figs. 1, 5 and Pl. XVI, Figs. 13-14 in this paper), whereas in *P. dalmatica* the ramifications

	Praturlonella danilovae (RADOIČIĆ, 1968)	*Praturlonella salernitana* BARATTOLO, 1978	*Praturlonella pejovicae* (RADOIČIĆ, 1969) n.comb.	*Praturlonella adriatica* (SOKAČ &VELIĆ, 1978) n.comb.	*Praturlonella jordanica* (KUSS & CONRAD, 1991)	*Praturlonella nerae* (DRAGASTAN et al., 1978)
Height of segments **H**	● 0.95-1.45	● Hs 0.5-1.4		● 0.75-0.80	● 0.7-1.2	0.24-0.48
Diameter of thallus in the level of segments **D**	● 1.10-2.40	● Ds 1.3-2.2	● 1.2-3.04	● 1.60-2.25	● 1.48-2.00	◆ 0.36 0.44-0.92
Diameter of thallus between segments **D'**	● 0.40-0.75		⇨ **0.48-0.62**	● 0.55-0.84		
Diameter of central cavity **d**		● di 0.6-1.0	● 0.29-0.72		● 0.52-0.79	◆ 0.18 0.19-0.40
Relation inner/outer diameter **d/D**	○ 15-35%		⇨ **24-38%**	⇨ **22-32%**	● 35-40%	32-48%
Distance between whorls or groups of whorls **h**			● 0.40-0.72			0.29-0.64
Height of thallus between two segments **h'**	● 1.45-1.60	● Hi 0.2-1.0		● 0.37-0.43		
Length of ramifications **l**	○ 0.33-0.73		⇨ **0.58-0.68**	● 0.69-0.82	● 0.52-0.62	◆ 0.079-0.095 0.14-0.35
Diameter of ramifications (distal) $\mathbf{p}_{(distal)}$	● 0.16-0.30		● 0.19-0.32	● 0.18-0.25 ?-0.40	● 0.20-0.59	◆ 0.031-0.047 0.05-0.13
Diameter of ramifications (proximal) $\mathbf{p}_{(prox.)}$	○ 30-35 μ				● 35-70μ	◆ 0.012 0.025-0.07
Number of ramifications per segment	● 60-100	● 50-70(?80)	● 30-52	⇨ **75-120**	● cca. 40	cca. 50
Number of horizontal rows per segment	○ min. 2		2	3-4	● min. 4	3

Table 6 Dimensions of *Praturlonella nerae* compared with dimensions of some other *Praturlonella* species. Dimensions for *Praturlonella salernitana* refer to adult specimens. Legend:

● dimensions from original description;
○ completed after KUSS & CONRAD (1991);
⇨ completed according to my own material;
◆ after BUCUR (1993).

are, in general, obliquely directed upward by varying angles (similar as in *P. salernitana*) and often bent like an arch toward the exterior (SOKAČ & VELIĆ, 1978, Pl. 6, Figs. 1-2; Pl. 7, Figs. 1-3), so that sometimes only the distal ends of the lowest row of ramifications can be situated below the horizontal plane, i.e. below the level of the lowest row of branches (SOKAČ & VELIĆ, 1978, Pl. 6, Fig. 2 pars; Pl. 8, Fig. 1 pars). The differences in the direction of ramification growth result in the different shape of the calcareous rings-segments, which is ball-shaped in *P. danilovae* (see reconstruction in BARATTOLO, 1978, Fig. 18), in contrast to *P. dalmatica* where it can be envisioned as being rather bowl-shaped. All the above mentioned differences seem to be sufficiently clear to support the validity of *P. dalmatica*.

The stratigraphic position of this species corresponds approximately to the Barremian stage, though the small number of finds requires further research.

Praturlonella pejovicae (RADOIČIĆ, 1969) n.comb.

Pl. XVII, Figs. 8-14

Selected synonymy:

1969 *Clypeina pejovici* n.sp. - RADOIČIĆ, p. 71-84, Figs. 1-3

1978 *Likanella pejovicae* (RADOIČIĆ) n.comb. - BASSOULLET et al., p. 145, Pl. 5, Figs. 1-2

1978 *Selliporella pejovicae* (RADOIČIĆ) n.comb. - SOKAČ & VELIĆ, p. 231, not figured

1986 *Clypeina pejovicae* RADOIČIĆ - RADOIČIĆ, p. 54, not figured

1993 *Likanella pejovicae* (RADOIČIĆ) - BUCUR, p. 103, not figured

1993 *Falsolikanella pejovicae* (RADOIČIĆ) - DRAGASTAN & BUCUR, p. 17

In the original description of *Clypeina pejovicae* it was emphasized that this species has whorls consisting of two alternating rows of ramifications, which gradually and regularly widen toward their arched distal ends (RADOIČIĆ, 1969, Fig. la-c, Fig. 2g, i, Fig. 3a-d). Two alternative possibilities have been put forward for the existence of two rows of branches: first, that the fertile ramifications form two consecutive whorls, and second, that we are dealing with one whorl with numerous ramifications, arranged into two rows, which was considered by RADOIČIĆ (1969) to be a more likely alternative. Based on the second possibility - two rows of branches within a whorl - BASSOULLET et al. (1978, p. 145) assigned this species to *Likanella* as *Likanella pejovicae* (RADOIČIĆ) n.comb., basing their decision on what was then generally thought to represent basic features of the genus *Likanella*. Radoičić later (RADOIČIĆ, 1986) maintains its assignment to *Clypeina* and thinks there are no reasons to transfer it to *Likanella*, though she does not give any argument to support her opinion. Rare finds of this species, which are, moreover, limited to the Dinaric Karst region, seem to be the reason for the general neglect of this species and its exclusion from comparative treatments. In the establishment of *Praturlonella*, BARATTOLO (1978) assigned to the new genus *Likanella*? *danilovae* RADOIČIĆ, but fails to mention *Likanella pejovicae*, in spite of the similarity between the two species. KUSS & CONRAD (1991) also fail to mention *L. pejovicae* in their comparative table that accompanies the description of *Praturlonella jordanica*. All this indicates the fact that *P. pejovicae* is considered, by the majority of workers, as being inadequately known and of unclear systematic position.

The main characteristics of this species can be summarized as follows: phloiophorous, club-shaped ramifications; arranged into two rows within a whorl (as in *P. salernitana*; BARATTOLO, 1978, Fig. 13), or, maybe, two tightly compressed whorls (as in *P. danilovae*; BARATTOLO, 1978, Fig. 18); their arrangement along the thallus in widely spaced, clearly pronounced segments; slight downward bending of the lower-row-ramifications and slight upward inclination of the upper-row ramifications. If all these are properly assessed, this species should undoubtedly be assigned to the genus *Praturlonella*. Even more surprising, therefore, is its proposal as *Falsolikanella pejovicae* (RADOIČIĆ) by DRAGASTAN & BUCUR (1993, p. 17), which was done without any relevant argumentation.

The comparison of *P. pejovicae* with *Clypeina onogosti* RADOIČIĆ shows some interesting facts. Sadly, in the original description, *C. onogosti* was illustrated with only two poorly preserved sections (RADOIČIĆ, 1986, p. 54-55, Pl. 3, Figs. 1-2). Moreover, if one compares the two descriptions - RADOIČIĆ (1969) for *C. pejovicae* and RADOIČIĆ (1986) for *C. onogosti* - some identical features may be noticed. In both species the branches are rather swollen from their very base, tubular and slightly widened distally, and with smoothly rounded distal ends. In *P. pejovicae*, the branches are arranged in two rows, whereas *C. onogosti* is said to have individual branches situated either above or below the whorl level as a consequence of too little space around the comparatively narrow axial cavity to accommodate the branches into one level. The same reasoning, however, applies to *P. pejovicae*. In both species, the ramification walls are weakly calcified and, also in both species, the branches are more clearly individualized toward the outer periphery of the skeleton (compare Pl. XVII, Figs. 8-10 in the present paper with RADOIČIĆ, 1986, Pl. 3, Fig. 1).

According to the original descriptions the differences in dimensions seem to be somewhat clearer, though this should not be considered a decisive feature, particularly because the dimensions for *C. onogosti* apparently refer to only one specimen (section). The purely visual impression of two rows ramifications within a whorl in *P. pejovicae* and the tendency to attain such an arrangement in *C. onogosti* does not seem reliable enough for the distinction of these two species, which raises the question of the validity of *C. onogosti*. Doubt is further strengthened by the fact that *C. onogosti* (two specimens?) was derived from the same sample as *P. pejovicae*, *Actinoporella podolica* (ALTH), *Salpingoporella cemi* (RADOIČIĆ), *S. melitae* RADOIČIĆ, *S.* ex gr. *genevensis*, and *P. danilovae*. The same algal association has been identified in the analyzed sample from the Mljet Island (Mlj-63). Beside the illustrated and many other sections of *P. pejovicae* (Pl. XVII, Figs. 8-14), sections visually similar to *C. onogosti* have been observed, which may represent varieties or atypical sections of *P. pejovicae*. However, for the time being, it is only necessary to draw attention to the problem of their delimitation or their identity, respectively, despite the inclination towards the latter solution. The definitive answer to this question must await until a more thorough analysis of more numerous and better preserved sections from the type-locality of *C. onogosti* is done.

Based on this study and the ascertained stratigraphic levels, the total stratigraphic range of *P. pejovicae* corresponds, so far, to the Hauterivian and Barremian stages.

Remarks on the species assigned to the genus *Praturlonella*: Recently GRANIER & BERTHOU (1994) have established the new genus *Milanovicella*, with the most important distinguishing character being the two-rowed whorls of branches arranged at equal distances along the thallus. Now, disregarding (for the moment) the genera *Likanella* and *Draconisella*, the following questions remain: to which genus - *Praturlonella* or *Milanovicella* - should the species described above be assigned? The statement of a species having two-rowed or one-rowed whorls of branches seems for the largest part to be hypothetical, (assumed on the basis of tangential sections, but ones that are too shallow, i.e. do not show the situation near the main stem) and is therefore a reflection of the author's interpretation rather than the facts. Consider the example of *P. nerae*, which will show, I hope, how problematic the question is. Judging by tangential sections alone (Pl. XV, Figs. 5, 11), *P. nerae* can be assumed to have two-fold or three-fold whorls. Other sections, however (Pl. XV, Figs. 15, 18-19), show that at the same level of each of the transverse section presented, two to three rings of pores of branches can be distinguished, cut at different distances from the axial cavity. The inner ring with numerous channelets cutting through the cylinder wall (Pl. XV, Fig. 18) and the inner ring of very tiny pores nearer to the axial cavity (Pl. XV, Fig. 19) show that the number of pores is twice, or even more, the number of large pores that represent the branches of the more distant circle. In contrast to the aforementioned tangential sections, this suggest one row, or at most two(?) densely packed rows, or branches per whorl. Because of all that - i.e., the not firmly established number of rows of branches per whorl - the genus *Praturlonella*, seems, for the time being, sufficient to accommodate all related species with similar characteristics.

Genus *Acroporella* (PRATURLON, 1964) PRATURLON & RADOIČIĆ, 1974

Acroporella radoicicae (PRATURLON, 1964) PRATURLON & RADOIČIĆ, 1974

Pl. XVIII, Figs. 1-20

Selected synonymy:

1964 *Acroporella radoicici* n.gen., n.sp. - PRATURLON, p. 177-179, Figs. 8-11

1974 *Acroporella radoicicae* PRATURLON - PRATURLON & RADOIČIĆ, p. 17-20, Fig. 1a-b, Fig. 2a-d, Fig. 3a-d

1984 *Acroporella radoicicae* PRATURLON - LUPERTO-SINNI & MASSE, p. 339, Pl. 33, Figs. 1-2

1992 *Acroporella radoicicae* PRATURLON - MANCINELLI, p. 9-13, Pl. 6, Figs. 1-5

non 1993 *Acroporella radoicicae* PRATURLON - LUPERTO-SINNI & MASSE, p. 300, Pl. 4, Figs. 11-12

This species was originally described by PRATURLON (1964) as a cylindrical alga with unsegmented skeleton, characterized by simple, undivided, acrophorous ramifications, situated obliquely, and with an alternating arrangement in consecutive whorls. The ramifications are directed upward between of 15-45° from the horizontal plane. Later, PRATURLON & RADOIČIĆ (1974) revised the generic diagnosis, adding that long primary ramifications show incipient branching - "in clusters of button-like secondary twigs" - at the distal ends. However, comparison between the section illustrated in the original description (PRATURLON, 1964, Figs. 8-11) and those illustrated in the revision (PRATURLON & RADOIČIĆ, 1974, Figs. 2-3) shows some additional differences: the calcareous skeleton of the originally depicted specimens shows coarse-grained sparite, which is also the case in sections illustrated by LUPERTO-SINNI & MASSE (1984, Pl. 33, Figs. 1-2), MANCINELLI (1992, Pl. 6, Figs. 1-5), and in the present paper (Pl. XVIII, Figs. 1-20), but it is not visible in the sections illustrated by PRATURLON & RADOIČIĆ (1974). Further, the sections illustrated by PRATURLON & RADOIČIĆ (1974, Figs. 2-3) show an almost ideally regular alternating arrangement of branches in consecutive whorls with constant distance between the whorls, whereas this feature is not so clear by far, nor so constant in the originally described sections (PRATURLON, 1964, Figs. 8-9), or in the sections presented by the above mentioned authors, and, particularly, in the sections figured in the present paper (Pl. XVIII, Figs. 1-5, 9, 13), which clearly show not only irregularly alternating arrangement of branches (Pl. XVIII, Fig. 2) but also variable distance of whorls. Another difference concerns the shape of the

TAN et al.) into the genus *Praturlonella* involved the transference of an inadequate holotype (regardless of the statement in Article 7.2 of the ICBN that the nomenclatorial type, i.e. holotype, is not necessarily the most typical or representative element of a taxon) and, consequently and more important, an inadequate diagnosis. However because the above mentioned Article legalizes such a transfer and accepts the thus transferred taxon as valid, the necessity of a new diagnosis and a new description in accordance with real characteristics of that form appears imminent.

Diagnosis: Small dasyclad alga with cylindrical calcareous envelope consisting of ring-shaped segments bearing phloiophorous ramifications alternating with weakly calcified intervals of the thallus envelope, without ramifications. Densely packed ramifications are tightly compressed within thin calcareous rings, resulting in their inclination into different directions. Inner surface of the central cavity is straight to slightly undulated, slightly widened in the central parts of the branches-bearing calcareous rings.

Description: The new species is based on the analysis of numerous sections of fragments, among which several include longitudinal or tangential sections cutting more than five branch-bearing rings. The existence of these rings is a consequence of calcium carbonate infillings of space left among the ramifications. The ramifications are arranged along the thallus in successive intervals (Pl. XV, Figs. 2A, 4, 14).

The calcareous envelope between the ramifications bearing rings (segments) are very thin and weakly calcified, so that the skeleton is easily breakable. This is probably the main reason that the remains of this alga are mostly represented by single rings and only rarely by skeletal fragments containing 3-4 rings. The inner surface is delineated by a straight to slightly undulated wall. The central cavity is slightly enlarged at regular intervals corresponding to the levels where the ramifications grow out, forming the calcified rings (segments) (Pl. XV, Figs. 9-10).

The undivided, clearly phloiophorous ramifications seem to be situated in whorls consisting of 2-3 tightly compressed rows of ramifications (Pl. XV, Figs. 5, 11, 16), which occur at regular intervals along the thallus. These features, tightly compressed whorls and a comparatively large number of ramifications in a whorl, as well as the widening toward their distal end, give an alternating arrangement of ramifications in consecutive rings and lead to their inclination with respect to the horizontal plane. The existence of 2-3 densely packed whorls is indicated by the section figured in Pl. XV, Fig. 16, where a comparatively broad proximal end of the ramifications can be seen, as well as their mutual contact at the base and the well-visible entrance pores, connecting the ramifications with the central cavity, situated in two closely spaced levels. The same situation is suggested by the transverse section figured in Pl. XV, Fig. 15, which shows a regular circular arrangement of pore of equal-diameter, probably belonging to the same whorl, and, in addition, indicating that the ramifications of one whorl have an approximately equal inclination from the horizontal plane. Also the same is suggested by the tangential section (Pl. XV, Fig. 11) showing three rows of alternately arranged pores in the middle ring. The smaller diameter of the middle-row pores, compared with that of the lower- and upper-row pores, indicates that the middle-row pores correspond to a section of those ramifications which are oriented perpendicularly to the growth direction of thallus. The number of ramifications in a whorl seems to amount to 15-18 and total number of ramifications in a ring (segment) can be estimated to be about 50.

Similarities and differences: *Praturlonella nerae* (DRAGASTAN et al.) is the smallest species of the genus currently described. It differs from *P. danilovae* (RADOIČIĆ) by the dimensions of all measured elements and, particularly, by the shape of ramifications at their distal end, which in *P. danilovae* are more or less distinctly widened (Pl. XVI, Figs. 4, 13-14) or even visibly fractured. Further differences include slight but clearly visible widenings of the central cavity in *P. nerae* at the levels of tightly compressed whorls, which are not present in *P. danilovae*. With regard to the type-species, *P. salernitana* BARATTOLO, *P. nerae* differs, in addition to being distinctly smaller, also by the widenings of the central cavity at the level of whorls, whereas in *P. salernitana* the axial cavity at these lev-

Dimensions in mm:	total range	most frequently
Maximum observed length (L)	2.4	
Outer diameter of branch-bearing segments (D)	0.44-0.92	0.58-0.80
Inner diameter (d)	0.19-0.40	0.20-0.30
The d/D relationship	32-48 %	34-44 %
Distance between two consecutive whorls (h)	0.29-0.64	0.40-0.60
Length of ramifications (l)	0.14-0.34	0.18-0.30
Width of ramifications, distal (p_{distal})	0.05-0.13	0.05-0.10
Width of ramifications, proximal (p_{prox})	0.025-0.07	0.03-0.04
Number of ramifications per whorl (w)	15-18	
Number of ramifications per ring (segment)	about 50	

Table 5 Dimensions of *Praturlonella nerae* (DRAGASTAN et al.).

branches. Sections figured by PRATURLON & RADOIČIĆ (1974, Figs. a-c) show primary branches visibly widening toward the exterior, so that the pore diameter at the distal end is twice the diameter at the proximal end (i.e., the branches are club-shaped), which is visible neither in the originally figured sections (PRATURLON, 1964, Figs. 8-9, 11) nor in the present paper (Pl. XVIII, Figs. 1, 18-20). Both the original and the present material clearly show tubular branches that retain the same diameter all along their length. Also, neither of the above mentioned sections, except those illustrated by PRATURLON & RADOIČIĆ (1974, Figs. 2-3), show secondary ramifications. Oblique and tangential sections, such as those figured in the present paper (Pl. XVIII, Figs. 2, 4), that pass through numerous whorls and cut the branches at various distance from the axial cavity (Pl. XVIII, Fig. 4: the pores situated near the lower tip of the thallus are being cut at their most distal parts), should in all probability show the "clusters of button-like secondary twigs". There is not, however, the slightest sign of their presence. therefore it follows, that the originally described material (as well as that figured by LUPERTO-SINNI & MASSE, 1984, MANCINELLI, 1992, and in the present paper) and the "revised" material (PRATURLON & RADOIČIĆ, 1974) do not belong to the same species. Therefore I accept *Acroporella radoicicae* as it has been described and illustrated in the original description (PRATURLON, 1964). The materials that PRATURLON & RADOIČIĆ (1974) used to "revise" the genus *Acroporella* should probably be treated in connection with the genus *Triploporella*.

A hitherto neglected feature of *A. radoicicae*, which is clearly visible in numerous sections (about 80) in the available material (which has been collected at several localities in the Dinaric Karst area), concerns the fissures, or cracks, of the calcareous envelope. The cracks are best visible at the outer surface, where they are also at their widest, whereas they close toward the interior (but can, in some cases, reach to near the axial cavity). The cracks are irregular, forming either a mosaic-like, polygonal meshwork at the surface that encloses all the pores and thereby contributes to secondary individualization of the ramifications (Pl. XVIII, Fig. 6), or they delimit larger, irregularly shaped fields on the surface (Pl. XVIII, Figs. 1, 2, 13), or are scarcely pronounced at all (Pl. XVIII, Fig. 4). This feature appears to be present also in the tangential part of the holotype section (PRATURLON, 1964, Fig. 8). It is probably a secondary characteristic, acquired during diagenesis, but nevertheless can contribute to the very characteristic appearance of this species.

The stratigraphic range of *A. radoicicae* can be defined as Barremian-Aptian, which seems to be well supported at numerous localities in the Outer Dinarides, as the stratigraphical position of each collected sample is well established.

Genus *Clypeina* (MICHELIN, 1845) BASSOULLET et al., 1978

***Clypeina*? *solkani* CONRAD & RADOIČIĆ, 1972**

Pl. XIX, Figs. 1-6, 8-10

Selected synonymy:

1972 *Clypeina*? *solkani* n.sp. - CONRAD & RADOIČIĆ, p. 87-95, Figs. 1-3; Pl. 1, Fig. 4; Pl. 2, Figs. 1-4

?1978 *Clypeina solkani* CONRAD & RADOIČIĆ - DRAGASTAN, p. 109-110, 113, Fig. 1a-b

1978 *Clypeina*? *solkani* CONRAD & RADOIČIĆ - VELIĆ & SOKAČ, p. 317, Pl. 1, Figs. 2-7

1982 *Clypeina solkani* CONRAD & RADOIČIĆ - LUPERTO-SINNI & MASSE, p. 864, Tabl. 2

1984 *Clypeina*? *solkani* CONRAD & RADOIČIĆ - LUPERTO-SINNI & MASSE, p. 339, Pl. 33, Figs. 3, ?4

1986 *Clypeina*? *solkani* CONRAD & RADOIČIĆ - SOKAČ, p. 46-53, Pl. 3, Figs. 1-5

1987 *Clypeina*? *solkani* CONRAD & RADOIČIĆ - RADOIČIĆ, p. 75, Pl. 1, Figs. 1 pars, 2-3

1992 *Clypeina*? *solkani* CONRAD & RADOIČIĆ - MANCINELLI, p. 9, 13, Pl. 2, Figs. 1-3; Pl. 3, Figs. 13-14; Pl. 5, Fig. 10; Pl. 7, Figs. 7-9

1993 *Clypeina*? *solkani* CONRAD & RADOIČIĆ, 1972 - BODROGI, CONRAD & LOBITZER, p. 64, Pl. 1, Figs. 3, 6; Pl. 2, Figs. 3, 6

1994 *Clypeina*? *solkani* CONRAD & RADOIČIĆ - BODROGI, BÓNA & LOBITZER, p. 233-245, Pl. 3, Fig. 6; Pl. 6, non Fig. 3, ?7, Pl. 10, Figs. 4-7

This alga, thoroughly described by its authors (CONRAD & RADOIČIĆ, 1972), is characterized by widely spaced whorls of fertile ramifications, open toward the exterior. Each whorl has the shape of a rather thick calcareous disc and bears 8-16 (most frequently 10-14) ramifications. Ramifications of the same whorl stay in mutual contact for 1/2 to 2/3 of their length. A significant remark made by the authors (CONRAD & RADOIČIĆ, 1972) refers to the shape of the ramifications, which depends on their number within a whorl. When that number is smaller, the branches are shorter and more strongly widened toward the exterior, having a stocky appearance. When there are more branches in a whorl, they are longer and more slender, compressed in their proximal half. Observations in this study suggest that Barremian specimens observed thus far generally have a smaller number (8-12) of branches per whorl, which results, as mentioned above, in their stocky, pear-shaped appearance.

Clypeina? *solkani* is one of the most common species in the Dinaridic Karst region of Croatia. Its presence has been established in western Istria, along the coastal region, and on the islands, at almost every

Dimensions in mm	CONRAD & RADOIČIĆ 1972	Barremian specimens
Outer diameter (D)	0.52 - 1.20	0.48 - 0.67
Inner diameter (d)	0.15 - 0.31	0.19 - 0.28
The d/D relationship		34 -47 %
Distance between whorls (h)		0.14 - 0.25
Distal diameter of branches (p dist)		0.10 - 0.20
Proximal diameter of branches (p prox)		0.02 - 0.05
Number of branches per whorl (w)	8-16	8-12

Table 7 Dimensions of *Clypeina*? *solkani* CONRAD & RADOIČIĆ.

locality where Lower Cretaceous deposits are exposed. Its stratigraphic range can be defined as ranging from the Hauterivian to the Mid-Upper Barremian. In Hauterivian deposits, it is associated with *Salpingoporella annulata*, *Praturlonella pejovicae*, *P. danilovae*, *Humiella teutae*, and numerous unidentified dasyclad remains. Among the foraminifera, the majority belong to the long-ranging forms, but *Campanellula capuensis* (DE CASTRO) is stratigraphically important. In Barremian deposits, *C.*? solkani is accompanied by a rich algal association composed of *Salpingoporella muehlbergii*, *S. melitae*, *S. biokoviensis*, *S. dinarica*, *Salpingoporella* sp., *Praturlonella danilovae*, *P. pejovicae*, *Actinoporella podolica*, and a *Clypeina* sp. In the original description of this species, the possibility of its Aptian age has been assumed. However, this supposition has not been proven so far, just as the associated fossil assemblage at the type-locality does not prove this age.

There are some indications that *C.*? *solkani* possibly occurs as early as Upper Valanginian, but so far no unequivocally identifiable sections have been found. Transverse sections which are often determined as *C.*? *solkani* may be identical with the sections of a so far unidentified *Salpingoporella*.

Clypeina gigantea n.sp.

Pl. XVII, Figs. 1-7

Origin of the name: This species is the biggest species of *Clypeina* described so far.

Type locality: Road Babino Polje - Sobra, on the Island of Mljet; road cut about 2.15 km before Sobra, i.e. 150 m before the point marked by coordinates mentioned in the description of *S. verrucosa* (Fig. 1).

Type stratum: Well-bedded, light grey, bioturbated algal wackestones with skletal-moldic cavities of green algae and gastropods (Fig. 2). Bioturbations are filled with peloidal grainstone and small benthic foraminifera. Depositional environment may be defined as shallow subtidal.

Holotype: Oblique section figured in Pl. XVII, Fig. 2; thin section Mlj-63/21. Thin sections made from the topotype material are stored at the Institute of Geology, Zagreb. In total, eight sections of this species were used for the description.

Diagnosis: Large *Clypeina* with distinctly spaced, saucer-shaped whorls of numerous club-shaped ramifications and with deeply indented rims.

Further research may show larger variation ranges, as dimensions refer to only 8 specimens (Table 8).

Description: A very large *Clypeina*, whose skeleton is preserved as translucent, coarse-grained sparite. Central cavity appears regularly cylindrical between the whorls and with relatively thick calcareous wall. Sections across that tubular part of the skeleton suggest the existence of tiny longitudinal tubules within the wall. These cannot be connected with the primary ramifications nor can they be identified with the pores on the corresponding parts of the skeleton in *C. jurassica*. In transverse sections cutting the cylindrical skeleton, these tubules appear as tiny, irregular and sometimes indistinct pores (Pl. XVII, Fig. 3) that are partly visible also in the holotype (Pl. XVII, Fig. 2).

The ramifications are phloiophorous and, starting from a comparatively wide pore (Pl. XVII, Figs. 4, 7), they gradually and regularly broaden toward their distal end (Pl. XVII, Figs. 2-4), sometimes somewhat more abruptly within the first half of their length. Each branch has its own calcareous envelope. In their proximal part, the envelopes, in general but not always, are in mutual contact. Along their distal half, or more, the envelopes of the neighbouring branches are separated from each other by narrow and regular, non-calcified, deep indentations (Pl. XVII, Figs. 3-4). Rarely, the calcareous envelope bends toward the interior at the tip of the branch, which suggests their being primarily closed. The available sections indicate the oblique position of the ramification, directed slightly upward. Terminal swelling of ramifications results in their being shifted somewhat below or above the fictitious wavy saucer shaped surface. Such ramifications would then appear as more pronounced ribs on that wavy surface (Pl. XVII, Fig. 6).

Similarities and differences: *Clypeina gigantea* n.sp. belongs to the group of large and quite typical species of the genus. With some of its dimensions (maximum D values), *Clypeina jurassica* may come rather close to *C. gigantea*, but *C. jurassica* shows a much larger variation range, perpendicular to subperpendicular position of branches to the main stem, yellowish calcite in the skeletal structure, thin dark micritic lining around the axial cavity, and clearly visible tiny pores within the walls of the cylindrical stalk between the whorls, which is not present in the new species. By its outer diameter, *C. gigantea* falls within the variation range of the poorly known *C. hanabatensis* YABE & TOYAMA, but *C. gigantea* has a much narrower central cavity and larger distal ramification diameter, is so much more strongly calcified, and the ramifications are closer to a horizontal position. *C. gigantea* is clearly larger than most Mesozoic *Clypeina* species (*C. catinula* CAROZZI, *C. inopinata* FAVRE - possibly synonymous with *C. jurassica*, see BASSOULLET et al., 1978; *C. marteli* EMBERGER, *C. parvula* CAROZZI, *C.? solkani* CONRAD & RADOIČIĆ, *C. zumetae* JAFFREZO & FOURCADE); moreover, it differs from each of the above mentioned species, taken individually, by the degree of calcification, inclination of branches, number of branches in a whorl, shape of the branches, or some other feature, which makes it easily distinguishable. By its much larger size, *C. gigantea* clearly differs also from the stratigraphically close *C. nigra* CONRAD & PEYBERNES (= *Actinoporella nigra* (CONRAD & PEYBERNES) GRANIER, 1994) as well as from the poorly known, and probably questionable, *C. onogosti* RADOIČIĆ (see also the discussion concerning *Praturlonella pejovicae*), which was derived from the identical Barremian algal association. *C. gigantea* is twice the size of *C. neretvae* RADOIČIĆ (according to the recommendation of the ICBN, the specific name should be "*neretvana*"), which is, more over, more weakly calcified, particularly the cylindrical parts of the stalk between the whorls, and has more irregularly shaped ramifications which, in contrast to *C. gigantea*, become slightly thinner toward their distal end. *C. gigantea* is also clearly distinguishable from *C.? alrawii* RADOIČIĆ, which has a much broader axial cavity, larger number of ramifications in whorl, shorter ramifications, and more closely spaced whorls than *C. gigantea*. *C. pastriki* RADOIČIĆ is much smaller, its branches are shorter than the diameter of the central cavity and their number per whorl is about 1/3 of that in *C. gigantea*. *C. estavezii* GRANIER (1986) was inadequately described and poorly illustrated (GRANIER, 1986), so that we could only generally say that it is smaller and with more widely spaced whorls proportionally to its size. *C. gigantea* also clearly differs from Palaeogene species of *Clypeina*, by its larger size, a rather constant d/D relationship (18-20%), shape and length of ramifications, and sometimes also by the number of ramifications per whorl.

Stratigraphic position: *Clypeina gigantea* n.sp. has been found in a sample with a rich algal association, composed of numerous *Salpingoporella melitae*, *S. muehlbergii*, transitional forms between *S. melitae* and *S. hasi*, and less numerous *S. hispanica*, *Clypeina? solkani*, *Praturlonella danilovae*, *P. pejovicae*, and numerous unidentified dasyclad fragments. Among the foraminifera, there are *Campanellula capuensis* (DE CASTRO), *Mayncina bulgarica* LAUG et al., and *Vercorsella scarsellai* (DE CASTRO). About 20 m above, in the continuous sequence, *S. biokoviensis* and *S. urladanasi* have been found. The whole microfossil association, as well as the position of the algal-bearing sample in the continuous sequence at the type locality, suggest that the stratigraphic position should be defined as Lower Barremian. The above mentioned foraminiferal species do not contradict that age, though they are more common, in this area, in the Upper Hauterivian.

Genus *Actinoporella* (GÜMBEL in ALTH, 1881) CONRAD, PRATURLON & RADOIČIĆ, 1974

Actinoporella podolica (ALTH, 1878) CONRAD, PRATURLON & RADOIČIĆ, 1974

Pl. XX, Figs. 1-3, 5-13

Selected synonymy:

1878 *Gyroporella podolica* n.sp. - ALTH, Pl. 6, Figs. 1-8, non Fig. 5

1881 *Actinoporella podolica* (ALTH) n.gen., n.comb. - GÜMBEL in ALTH, p. 322 (140)

1974 *Actinoporella podolica* (ALTH) emend. - CONRAD, PRATURLON & RADOIČIĆ, p. 1-15, Figs. 1-12

1975 *Actinoporella podolica* (ALTH) - DRAGASTAN, p. 66, Pl. 33, Fig. 3; Pl. 36, Fig. 4; Pl. 37, Figs. 1, ?4; Pl. 38, Fig. 1; Pl. 51, ?Fig. 2 pars; Pl. 52, Figs. 2, 4; Pl. 71, non Fig. 2

Dimensions in mm:	
Outer diameter of whorls (D)	3.12 - 4.35
Outer diameter of stalk between whorls (D')	0.94 - 1.20
Inner diameter of thallus (d)	0.54 - 0.82
The d/D relationship	8 - 20 %
Distance between consecutive whorls (h)	0.60 - 0.72
Length of ramifications (l)	1.00 - 1.70
Diameter of ramifications at distal end (pd)	0.28 - 0.44
Diameter of ramifications at the base (db)	0.08 - 0.14
Number of ramifications per whorl (w)	25 - 28

Table 8 Dimensions of *Clypeina gigantea* n.sp.

1978 *Actinoporella podolica* (ALTH) - DRAGASTAN, BUCUR & DEMETER, p. 22-23, Pl. 4, ?Fig. 4; Pl. 11, Figs. ?3, 4 pars.

1978 *Actinoporella podolica* (ALTH) - DRAGASTAN, p. 110-115, Figs. 1 c-e, Pl. 3, Fig. 1; Pl. 5, Fig. 3.

1984 *Actinoporella podolica* (ALTH) 1878 emend. CONRAD et al., 1974 - LUPERTO-SINNI & MASSE, p. 339, Pl. 33, Fig. 9.

1986 *Actinoporella podolica* (ALTH) emend. CONRAD et al., 1974 - GRANIER, p. 47-48, Pl. 9, Figs. e-h.

1989 *Actinoporella podolica* (ALTH) - DRAGASTAN, p. 28, Pl. 14, ?Fig. 4, non Fig. 5

1994 *Actinoporella podolica* (ALTH) - GRANIER, p. 113-117, Pl. 1. Figs. 1, 4, 8-10; Pl. 3, Figs. 5-8

1994 *Actinoporella podolica* (ALTH) CONRAD, PRATURLON & RADOIČIĆ - SCHINDLER & CONRAD, p. 73-74, Pl. 3, Figs. 1, 3, 7-8.

Actinoporella podolica (ALTH) is a well-known species which has been thoroughly redescribed and illustrated by CONRAD et al. (1974). Unfortunately, the authors chose as neotype a washed-out specimen which does not allow insight into the structure and shape of the ramifications, and which are indispensable for the proper generic and species definition. Phloiophorous branches are arranged into distinctly separated whorls. The essential generic characteristic is the so-called corona, which is the swelling of branches at their base and which is in *A. podolica* equally well expressed on both the lower and upper sides of a branch. However, the sections illustrated by SCHINDLER & CONRAD (1994, Pl. 3, Figs. 7-8), as well as those in the present paper (Pl. XX, Figs. 1, 5, 10), suggest the possibility that the corona appears to differ from how it was depicted in the reconstruction of CONRAD et al. (1974, Fig. 5) taken over also by GRANIER (1994, Fig. 1), and, instead, seem to give the impression of stunted or incompletely developed secondary ramifications which also show a phloiophorous shape. This proves the importance of good longitudinal sections for good species determination. Isolated rows of mutually connected rings, which may partially correspond to whorls cut through the distal part of the branches, have frequently been ascribed to this species. However, some similarly constructed species (e.g., certain Clypeinae) may show almost identical sections (also cutting through the outer parts of isolated whorls), which makes the identification of such doubtful sections rather risky. This, in turn, has further implications regarding the stratigraphic position, geographic distribution, and ecological requirements of this species. While single occurrences of *A. podolica* in the Dinaridic Karst area of Croatia, have been recorded in the Upper Malm, its common occurrence marks the Lower Cretaceous, up to, and including, the Aptian.

Genus *Piriferella* n.gen.

Type of the genus: *Piriferella spinosa* n.gen., n.sp.

Origin of the name: The generic name derives from the typically piriferous shape of the ramifications.

Diagnosis: Cylindrical thallus, with thin calcareous envelope, bears apparently densely arranged whorls of large, piriferous, alternately arranged ramifications, each ramification growing out independently and being completely enveloped by its own thin calcareous envelope up to its distant tip.

Piriferella spinosa n.gen., n.sp.

Pl. XXI, Figs. 1-15

Origin of the name: The name derives from the outer spinose appearance of the thallus, caused by outwardly thinning ramifications.

Type locality: Road Babino Polje - Sobra on the island of Mljet; road cut about 2 km before Sobra (17°36'00" E and 42°44'02" N, Fig. 1).

Type stratum: Well-bedded, lightly coloured, algal-pelletal wackestones/packstones with fenestral fabric and vadose crystal silt. Upper Barremian (for details see stratigraphic position of *Salpingoporella verrucosa* and Fig. 2). Depositional environment: peritidal shallowing upward cycles with black pebble breccia. The algal-bearing samples mostly derive from the first, subtidal, member: algal and/or algal-pelletal wackestones, and rarely from the second, intertidal, member with fenestral fabric: fenestral algal-pelletal wackestones with vadose fabric.

Holotype: Oblique section figured in Pl. XXI, Fig. 6, thin-section Mlj-81/28. Paratypes (Pl. XXI, Figs. 1-5, 7-15) derive from the same sample. All material is deposited at the Institute of Geology, Zagreb. The description is based on 20 variously oriented sections from the same sample.

Diagnosis: Alga with a cylindrical thallus, thin calcareous envelope, bearing apparently densely arranged whorls of large, typically piriferous, alternately arranged, obliquely situated, upward directed ramifications. Ramifications grow out independently, each within its own thin calcareous envelope, and are closed at their distal ends. Ramifications of the same whorl or of two consecutive whorls may be separated from each other or they may touch mutually at their maximum swellings. Secondary calcite deposits in the proximal region (between the ramification basses) give an impression of a thicker wall and apparently closer contact between the ramifications.

In total, 15 sections have been measured. Because of destruction, the outer diameter (D) may be somewhat larger.

Description: A comparatively small dasyclad alga, having a weakly calcified thallus that consists of a cylindrical axial cavity with a thin calcareous envelope

Dimensions in mm	
Outer diameter (D)	0.48 - 0.87
Inner diameter (d)	0.20 - 0.34
The d/D relationship	34 - 50%
Distance between consecutive whorls (h)	0.10 - 0.14
length of ramifications (l)	0.22 - 0.34
Maximum diameter of ramifications (p max)	0.10 - 0.19
Diameter of the entrance pore (p prox)	0.04 - 0.05
Number of ramifications per whorl (w)	7 - 8

Table 9 Dimensions of *Piriferella spinosa* n.gen., n.sp.

(Pl. XXI, Fig. 2) and bears apparently densely spaced whorls of undivided, typically piriferous ramifications. The inner surface of the calcareous cylinder is smooth, sharply delimited, and perforated by alternately arranged ramification entrance pores. Axial cavity is comparatively broad. The independently growing, typically piriferous, ramifications (i.e. proximally swollen and tapering distally) give a spinose outer appearance to the thallus.

Undivided, typically piriferous branches, arranged into alternating whorls, grow out independly from each other, each ramification being completely coated by its own thin calcareous envelope (Pl. XXI, Fig. 10). The communication between the axial cavity and the branch is performed through a short pore, situated in the middle of the ramification's base or, sometimes, below it, as the branch's swelling is more pronounced upward (Pl. XXI, Fig. 1). After the entrance pore, each ramification abruptly and regularly swells and then gradually tapers toward its distal end. While the branches of the same whorl, or of two consecutive whorls, are regularly separated from each other, they often touch at their thickest part (Pl. XXI, Fig. 6). Narrow spaces between the branches at their base are completely (Pl. XXI, Fig. 12) or partially (Pl. XXI, Figs. 9-10) filled by secondary calcite, which makes the calcareous envelope secondarily thicker. The alternating arrangement of branches in the consecutive whorls (Pl. XXI, Figs. 7, 12) may not always be wholly regular, depending on the intensity of swelling of the proximal part of a particular branch. The branches are directed slightly upwards, with their distal ends more strongly bent toward the main stem. Though the cysts have not been observed, the strongly swollen branches suggest the cladospore type of reproduction.

Similarities and differences: *Piriferella spinosa* n.gen., n.sp. is distinguished by its peculiarly shaped, spinose thallus, which is the consequence of the shape, arrangement, and mode of growth of the branches, and the degree of calcification. At the generic level, *Piriferella* n.gen. clearly differs from *Clypeina*, the latter being characterized by distinctly spaced whorls, with indented rims, this being a consequence of branches merging together in their proximal parts and being divided only in their exterior (distal) parts. In contrast, *Piriferella* n.gen. has more closely spaced whorls, in which the branches are alternately arranged (which has not been observed in *Clypeina*) and which may come into mutual contact, both within a whorl and between the consecutive whorls. The same features make *Piriferella* different to *Actinoporella*, the latter being additionally characterized by the existence of "coronas" (i.e. vestibule-like basal widening), after which the ramification shrinks and then again widens distally (*A. podolica*). By the arrangement and density of branches, and their independent mode of growth, all of which results in a similar general appearance of the thallus, *Piriferella* n.gen. comes more closely to *Similiclypeina*, which is, however, characterized by *Actinoporella*-type ramifications (i.e., gradually widening toward exterior) and by vertically flattened coronas. In spite of the similarity regarding the arrangement and density of ramifications and their thin calcitic envelopes in *Holosporella* (which makes this genus similar to *Piriferella*), there is a clear difference regarding the shape of the branches: in *Holosporella*, the branches are spherical to hemispherical, in contrast to clearly piriferous to phloiophorous shape in *Piriferella*. PIA (1930) has already emphasized that different genera may have the same arrangement of sporangia. This, of course, may result in the very similar or even identical visual appearance of different genera in certain sections. *Piriferella spinosa* seems to be most similar to *Clypeina somalica* CONRAD et al. (1983), which was subsequently assigned by BUCUR (1993) to his new genus *Similiclypeina*. In fact, the two species are so similar as to belong to the same genus, which led to the proposal of *Piriferella somalica* n.comb. (see below). The similarities between the two species concern the similar dimensions within the same variation range. A more pronounced difference, according to the original description (CONRAD et al., 1983), is visible only in the "h" value, which seems to be twice as large in *P. somalica* as in *P. spinosa*. As a consequence of this, according to CONRAD et al. (1983), the consecutive whorls in *P. somalica* never touch (though it seems that they do, but not as closely as in *P. spinosa*). While in *P. spinosa* the branches grow independently from their base, their envelopes almost always touch at the places of maximum swelling. Furthermore, *P. somalica* is said to have egg-shaped ramifications, as distinct from *P. spinosa* where the branches are typically piriferous and directed more steeply upward. Though *P. somalica* still seems to be inadequately known, the above mentioned differences seem sufficient to justify the separation of the two species.

Stratigraphic position: *Piriferella spinosa* n.gen., n.sp. is associated with *Salpingoporella verrucosa* n.sp., where the discussion of its stratigraphic position is given.

Piriferella somalica (CONRAD, PEYBERNES & MASSE, 1983) n.comb.

Pl. XXII, Figs. 1 - 20

Selected synonymy:

1983 *Clypeina somalica* n.sp. - CONRAD, PEYBERNES & MASSE, p. 93-95, Pl. 6, Fig. 1-12

1992 *Clypeina ? somalica* CONRAD, PEYBERNES & MASSE - MANCINELLI, p. 9-13, Pl. 2, Figs. 4-7, 11

1993 *Similiclypeina* aff. *somalica* (CONRAD, PEYBERNES & MASSE) n.comb. - BUCUR, p. 106-107, Pl. 3, Figs. 7, 9b, 10, 12-25; Pl. 4, Figs. 4-11.

?1993 *Clypeina ? somalica* (CONRAD, PEYBERNES & MASSE) - LUPERTO-SINNI & MASSE, p. 300, Pl. 5, Figs. 1-2

This species was described on comparatively scarce and recrystallized material and figured with a few complete but damaged sections that do not show all the relevant features. This is probably the reason that since then the species has seldom been mentioned and even more rarely illustrated. The sections figured by CONRAD et al. (1983, Pl. 6, Figs. 1-12) seem to belong to heterogeneous material, that has been united into a species. One group of related sections includes the holotype and the paratypes (CONRAD et al., 1983, Pl. 6, Figs. 5, 8, 12) and also some less instructive sections. Another group includes sections from Prestat's material (op. cit., Figs. 4, 10). Heavily recrystallized sections, partly belonging to the type material (op. cit., Figs. 6, 7, 9), seem to include heterogeneous material, and the section figured in Fig. 11 (op. cit.) is also problematical. Thus, sections in Figs. 6 and 11 hint at the possibility of vertically flattened ramifications. Such unclear relations prevent the full insight into the actual characteristics of the species, which, in turn, makes its determination exceedingly difficult (and even problematic). The lack of sterile ramifications (which could not be identified, in contrast to *C. jurassica*), as well as tightly spaced whorls (at least in their proximal parts), led CONRAD et al. (1983) to express some doubts as to the attribution of this species to *Clypeina*. The latter characteristic, the closeness of consecutive whorls, i.e. ramifications, in the proximal region, where the space was infilled by calcite mass, was deemed decisive for the attribution of this species to *Similiclypeina* (BUCUR, 1993).

The genus *Similiclypeina* was established with *S. conradi* BUCUR as type species. It has peculiar, horizontally elongated, (i.e., vertically flattened) swellings in the proximal part of the branches (BUCUR, 1993, Fig. 3), very similar to the coronas in *Actinoporella podolica*, the only difference being that in *S. conradi* these swellings are horizontally elongated, in contrast to *A. podolica* where they are vertically elongated (CONRAD et al., 1974, Fig. 5). This feature, the corona or vestibule-like swellings, which seem to actually represent incompletely developed secondaries (see Pl. XX, Figs. 1, 5, 10), and which is the main diagnostic feature for distinguishing *Actinoporella* from *Clypeina* (e.g., *Actinoporella maslovi* PRATURLON is assigned to *Clypeina* due to the lack of coronas), was neglected by BUCUR (1993). He based his establishment of a new genus on only one characteristic: the dense, more closely spaced whorls of individualized ramifications that often mutually touch, and hence introduced a number of the new combinations: *Similiclypeina alrawii* (RADOIČIĆ), *S. somalica* (CONRAD et al.), *S. pupnatensis* (SOKAČ). Therefore, *Similiclypeina* would include forms with different characteristics: forms with horizontally elongated, corona- or vestibule-like swellings in the proximal part of the ramifications (*S. conradi* and *S.? iustiniani*), forms with no such swellings at all (*S. alrawii* and *S. somalica*), and forms with two types of secondary ramifications, one growing out from the

Dimensions in mm:	***Clypeina somalica* CONRAD et al., 1983**	***Similiclypeina* aff. *somalica* BUCUR, 1993**	***Piriferella somalica* this paper**
Outer diameter (D)	0.47 - 0. 80	0.33 - 0-54	0.34 - 0.68
Inner diameter (d)	0.30 - 0.42	0.16 - 0.23	0.15 - 0.38
d/D relationship	36 - 59%	30 - 46 %	38 - 55 %
Distance between consecutive whorls (h)	0.23	0.07 - 0.09	0.10 - 0.14
Length of branches (l)	0.16 - 0.23	0.19 - 0.23	0.15 - 0.18
Diameter of branches (p)	$p_{prox.}$ 0.04	$p_{dist.}$ 0.08-0.11	$p_{dist.}$ 0.08 - 0.13
Number of branches per whorl (w)	6 - 7	5 - 6 (11)	6 - 7

Table 10 Comparison of the dimensions of *Clypeina somalica* CONRAD et al., *Similiclypeina* aff. *somalica* BUCUR and *Piriferella somalica*.

cylindrical stalk of the thalus, another on the primary branches (*S. pupnatensis*). As the basal swelling of the ramifications is generally agreed to be crucial for distinguishing *Actinoporella* from *Clypeina*, and thus became, by general consensus, a criterion of generic rank, it would be illogical to erect a genus that would unite forms with and without such an important feature. Alternatively, if we agreed that a feature serves as a generic trait for distinguishing *Clypeina* from *Actinoporella*, the same feature should have the same value in assigning similar forms to *Similiclypeina*. This is the main reason for removing *S. somalica* from the genus *Similiclypeina* and its attribution to the new genus *Piriferella*.

In this paper, *Piriferella somalica* (CONRAD et al.) n.comb. is presented with several sections, all of which, except one (Pl. XXII, Fig. 11), were derived from the same sample of Barremian limestone from western Istria. This enable get better insight into the morphology of this form and provided some minor amendments to its description. This is a comparatively small dasyclad alga, whose thallus bears densely spaced whorls of ramifications. The shape of the ramifications was described as being egg-shaped. Almost completely individualized branches are thoroughly coated, each with its own thin calcareous envelope (Pl. XXII, Figs. 4, 6, 9). More secondary calcite deposits infill spaces only in the most proximal region and thus connect the individual branches at their very base. In tangential sections, the ramifications appear more clearly separated than in *P. spinosa*, and the pores have a more or less oval to irregularly elliptical shape (Pl. XXII, Figs. 2, 4, 8, 18), indicating that the ramifications are slightly horizontally flattened. This is different in *P. spinosa*, where, in corresponding sections (deeper tangential sections), pores cut at approximately the same level, appear more or less regularly circular. The arrangement of branches in consecutive whorls is clearly alternating. The branches are perpendicular to subperpendicular to the main stem (Pl. XXII, Figs. 6, 9).

The comparison of the dimensions shows general agreement between *P. spinosa* and *P. somalica*. In *P. somalica*, the distance between consecutive whorls appears to be somewhat larger in the original description than in later quotations. The identical p values in *P. spinosa* and *P. somalica* may be superficially misleading: while in *P. spinosa* the maximum swelling of branches occurs in their proximal part, in *P. somalica* the same value is attained in the distal part. This highlights the main difference between the two species as being the shape of ramifications and their more pronounced regularity in *P. spinosa*. In the Dinaric Karst area, *P. somalica* has so far been found at two, rather distant, localities: western Istria and the west side of the Neretva River, upstream from Mostar. Its stratigraphic position at both localities is Barremian; it is associated with *Salpingoporella muehlbergii*, a *Salpingoporella* sp., *Praturlonella nerae*, *Cylindroporella ivanovici*, and a *Cylindroporella* sp.

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PLATE I

1-13 *Salpingoporella muehlbergii* (LORENZ) PIA in TRAUTH

1, 4, 6, 10-11	Tangential - oblique sections; Figs. 1, 4, 6, x25; Figs. 10-11, x31.
2-3, 5	Longitudinal - oblique sections, x31.
7-9	Oblique sections, x31.
12-13	Transverse sections, x31.

Age and general location:

1, 3, 9	Lower-Middle Barremian; field section on the road cut near Sobra, Mljet island (Figs. 1-2).
4	Lower Barremian; field section Bravči dolac - Debelo brdo, Mt. Dinara.
2, 5-8, 13	Upper Barremian; Veliko jezero, Mljet island.
10-11	Upper Barremian; Mljet island (Fig. 1).
12	Lower Barremian; Mljet island (Fig. 1).

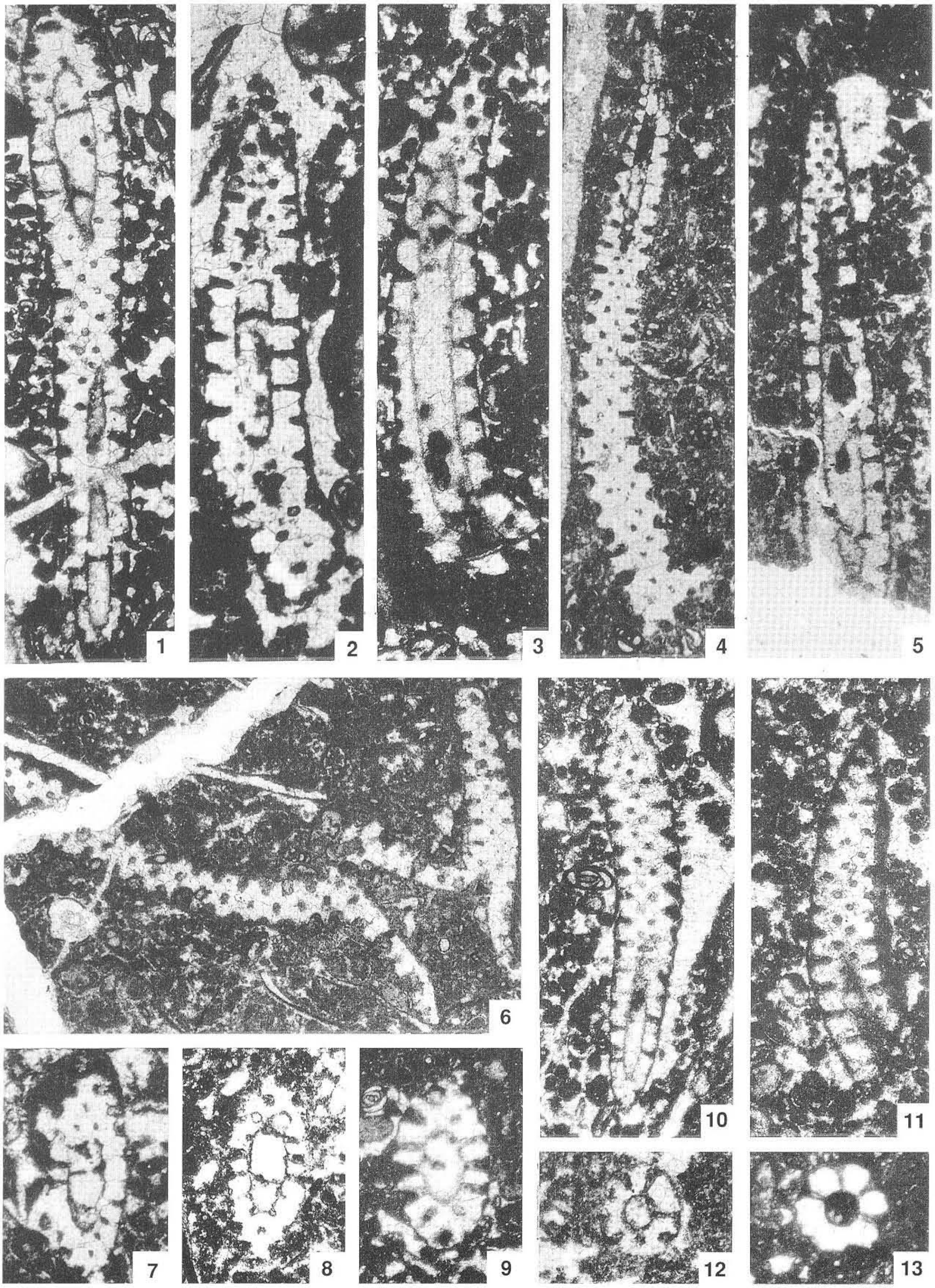
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PLATE II

1-5 *Salpingoporella hasi* CONRAD, RADOIČIĆ & REY

1, 3-4	Transverse sections, x57.
2	Transverse slightly oblique section, x57.
5	Recristalized tangential - longitudinal section, x47.

5-13 *Salpingoporella melitae* RADOIČIĆ

6	Longitudinal - tangential section, x23.
7	Tangential section, x25.
8-9	Tangential - oblique sections; Fig. 8, x25; Fig. 9, x23.
10-12	Oblique sections, x23.
13	Transverse section, x18.

Age and general location:

1-5	Barremian; Cres island.
6, 9, 11-12	Lower Barremian; field section on the road cut near Sobra, Mljet island (Figs. 1-2).
7-8, 10, 13	Upper Barremian; Veliko jezero, Mljet island.

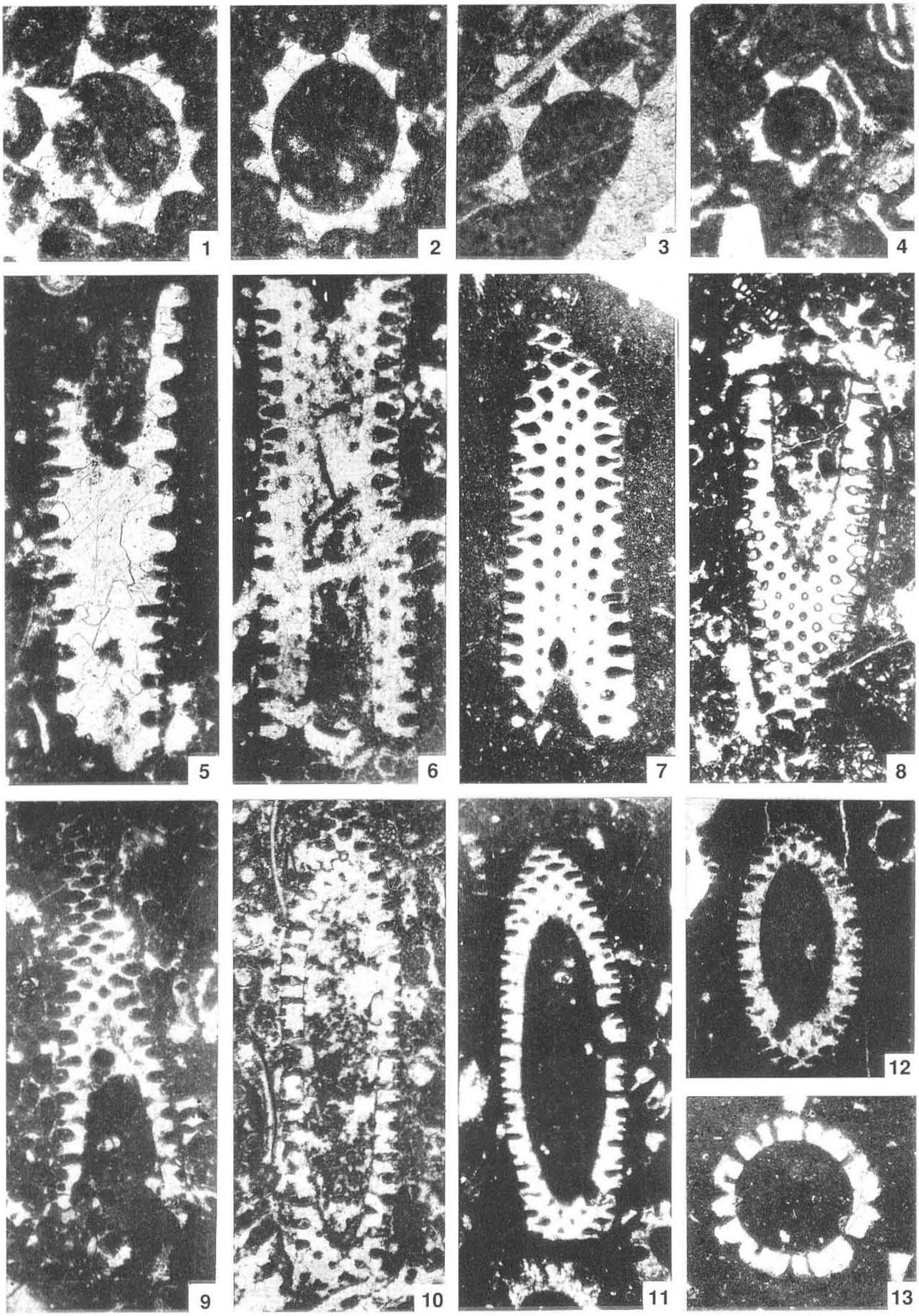
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PLATE III

1-2 *Salpingoporella melitae* RADOIČIĆ

1	Longitudinal - tangential section, x23.
2	A - Oblique section, B - Longitudinal section, x18.

3-10 *Salpingoporella polygonalis* n.sp., x23

3, 5, 8-9	Oblique sections; Fig. 3 - Holotype.
4	Tangential section.
6	Longitudinal - oblique section.
7, 10	Oblique - tangential sections.

Age and general location:

1	Upper Barremian; Veliko jezero, Mljet island.
2	Barremian; Gornje Igrane, Mt. Biokovo.
3-10	Lower Barremian; field section on the road cut near Sobra, Mljet island (Fig. 1-2).

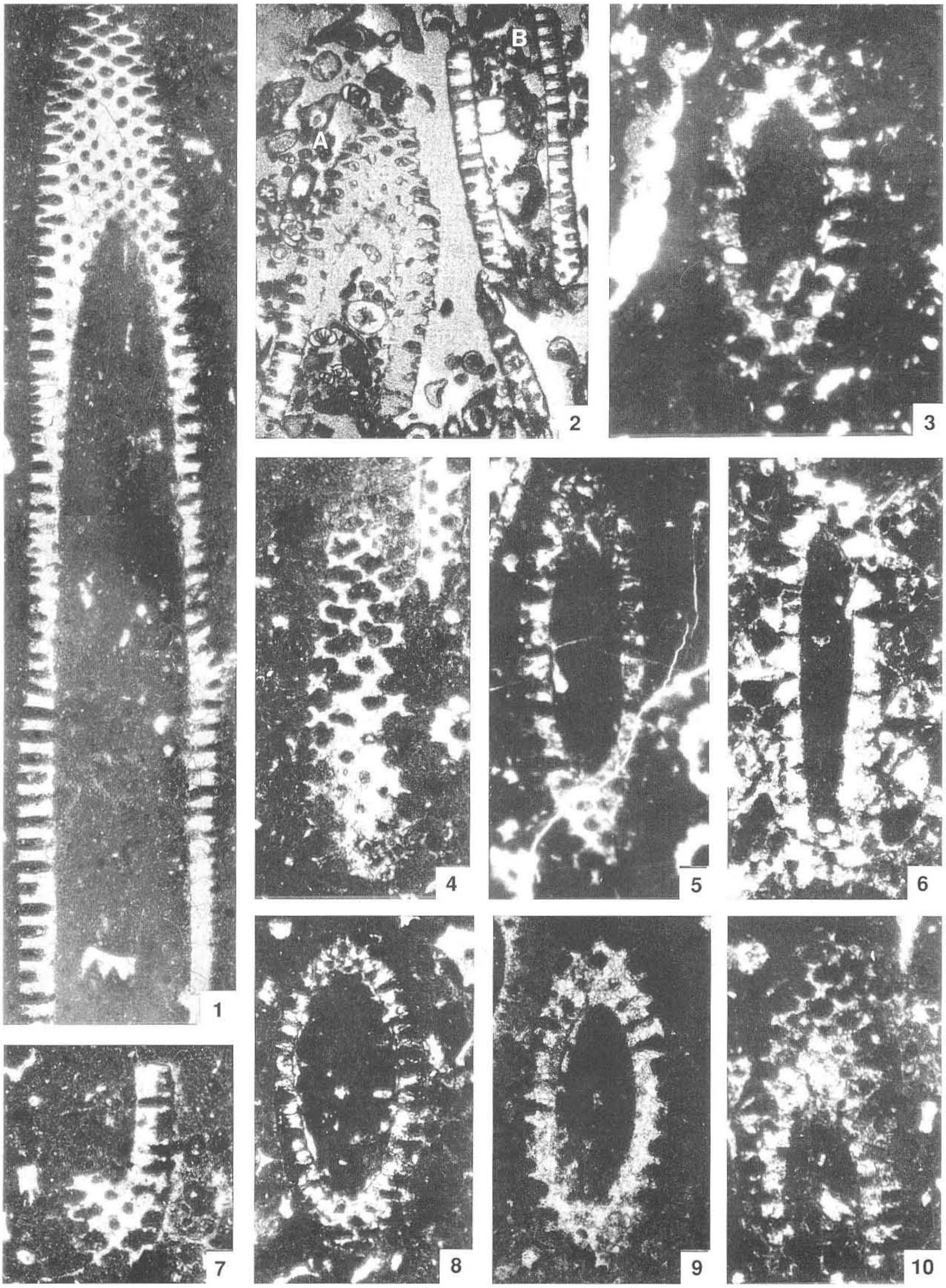
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PLATE IV

1-17 *Salpingoporella polygonalis* n.sp., x23

1-5, 7-8B, 10-11, 13	Oblique sections.
6	Tangential - oblique section.
8A-9, 12, 14, 16	Transverse sections.
15, 17	Transverse slightly oblique sections.

Age and general location:

1-17	Lower Barremian; field section on the road cut near Sobra, Mljet island (Figs. 1-2).

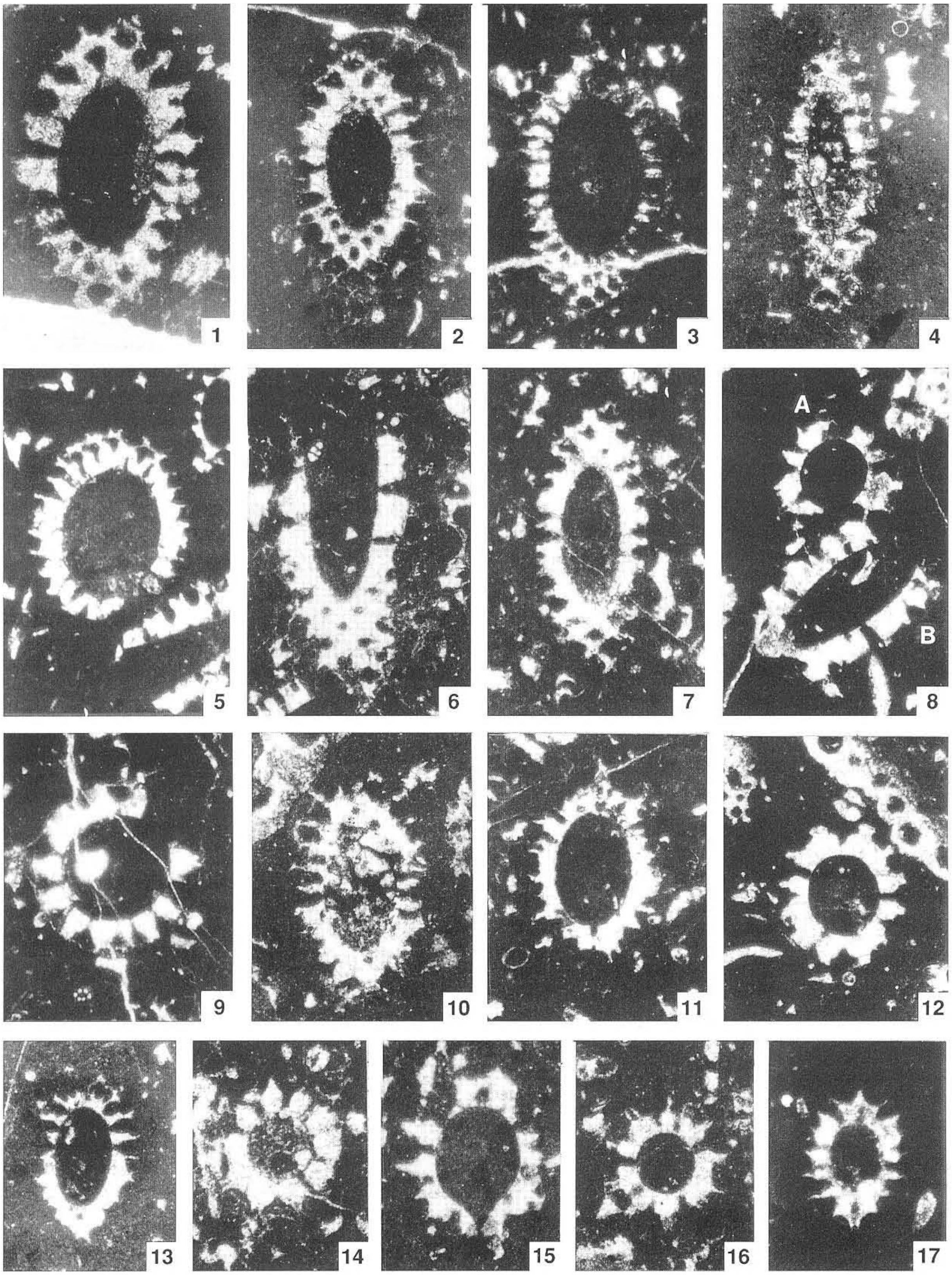
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PLATE V

1-8, 9A-11A *Salpingoporella hispanica* CONRAD & GRABNER

1-2	Tangential - longitudinal sections; Fig. 1, x54; Fig. 2, x57.
3-4	Longitudinal sections, x57.
5-8	Oblique sections, x57.
9A	Tangential - longitudinal section, x36.
10A-11A	Oblique sections, x57.

9B - 11B *Salpingoporella hasi* CONRAD, RADOIČIĆ & REY

9B	Longitudinal slightly oblique section, x36.
10B-11B	Oblique sections, x57.

Age and general location:

1-11	Barremian; Cres island.

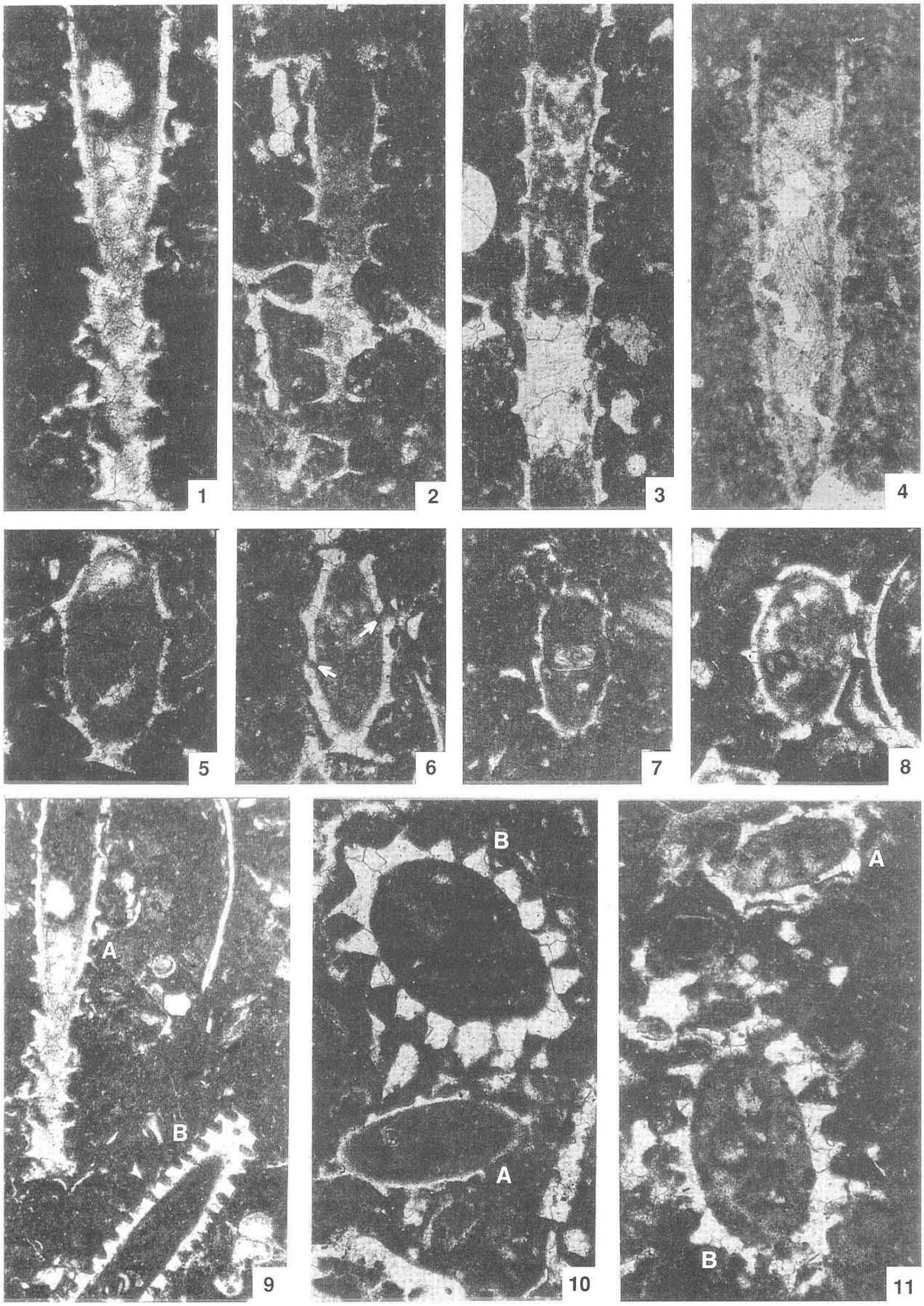
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PLATE VI

1- 15 *Salpingoporella verrucosa* n.sp.

1, 5-8, 10	Oblique sections; Fig. 1, x38; Figs. 5, 7-8, x57; Fig. 6, x38; Fig. 10, x47.
2, 9	Longitudinal sections, x47.
3	Tangential section, x57.
4	Longitudinal slightly oblique section - Holotype, x57.
11	Transverse slightly oblique section, x47.
12-15	Transverse sections; Figs. 12-13, x57; Figs. 14-15, x47.

Age and general location:

1-15	Upper Barremian; field section on the road cut near Sobra, Mljet island (Figs. 1-2).

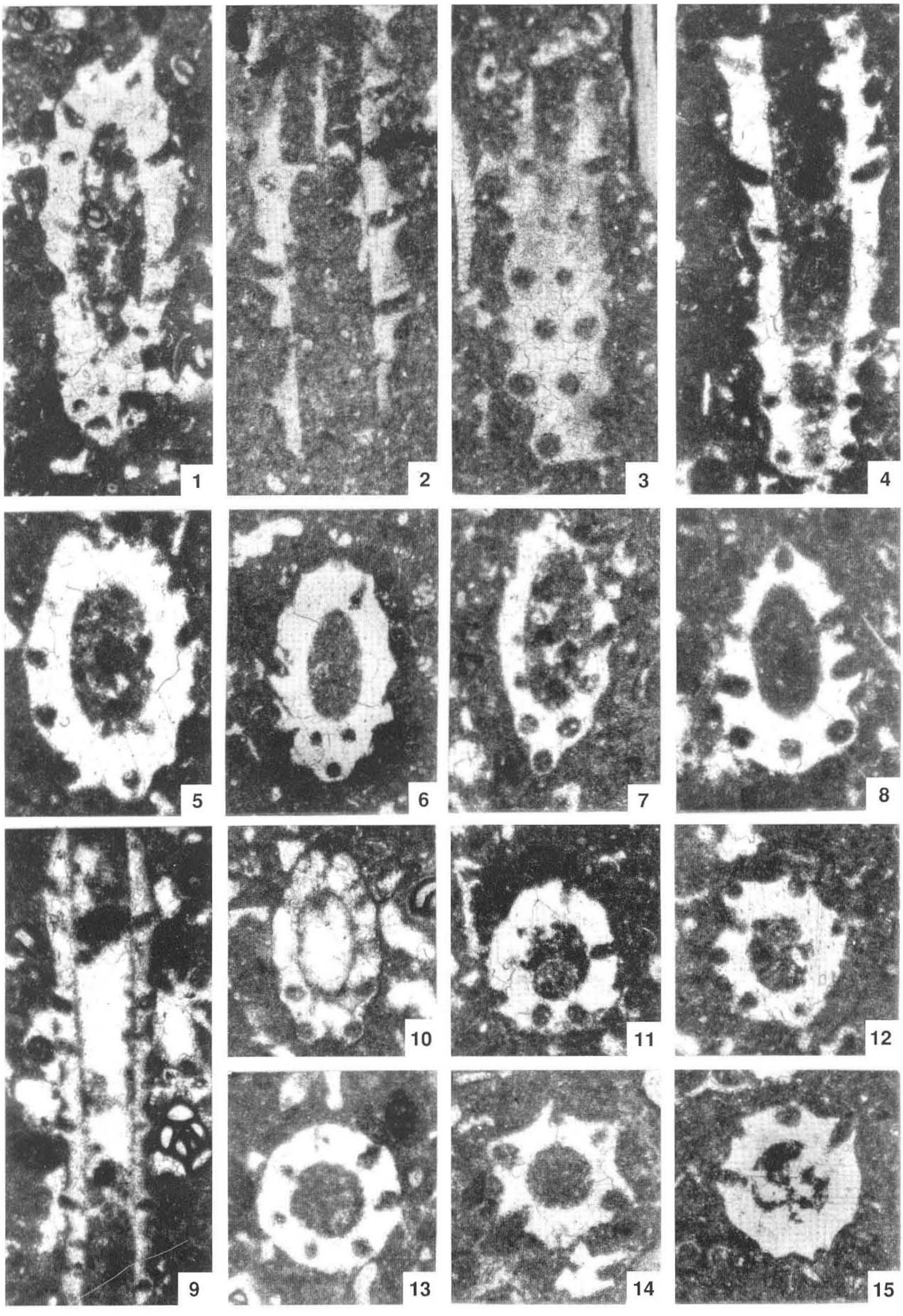
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PLATE VII

1-18 *Salpingoporella heraldica* n.sp., x31

1-2, 4, 7, 9, 11-14	Oblique sections.
3	Tangential - oblique section.
5-6, 8A, 10	Tangential sections, Fig. 5 - Holotype.
15	Transverse slightly oblique section.
8B, 16-18	Transverse sections.

Age and general location:

1-18	Top Barremian or Lower Aptian; Brna village, Korčula island (Fig. 3).

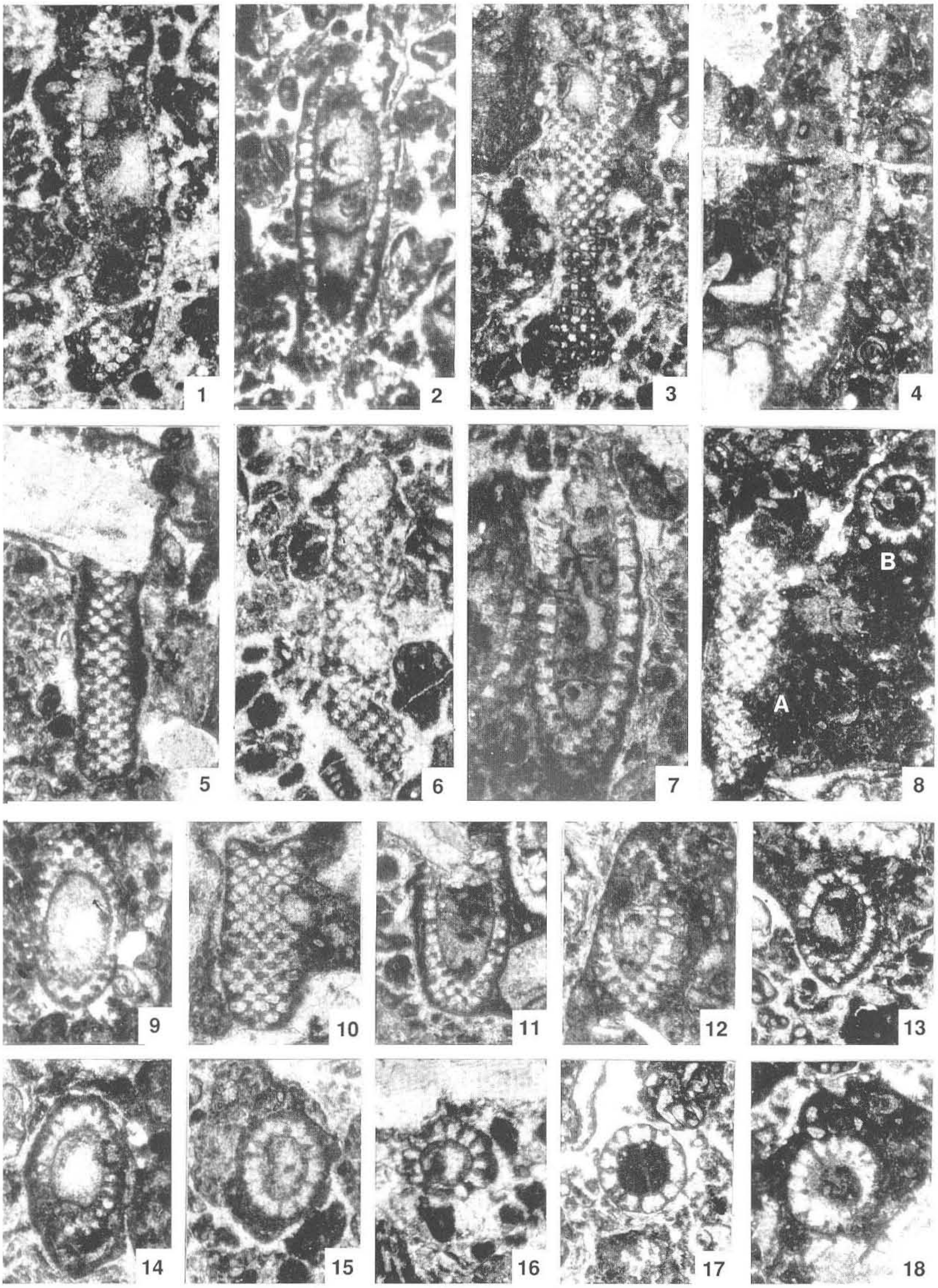
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PLATE VIII

1-10 *Salpingoporella hasi* CONRAD, RADOIČIĆ & REY

1	Longitudinal section, x47.
2	Tangential - longitudinal section, x47.
3, 6A	Tangential sections, x57.
4-5, 6B, 7	Oblique sections; Figs. 4-5, x47; Figs. 6A-7, x57.
8, 10	Transverse sections, x57.
9	Transverse slightly oblique section, x57.

Age and general location:

1-10	Barremian; Cres island.

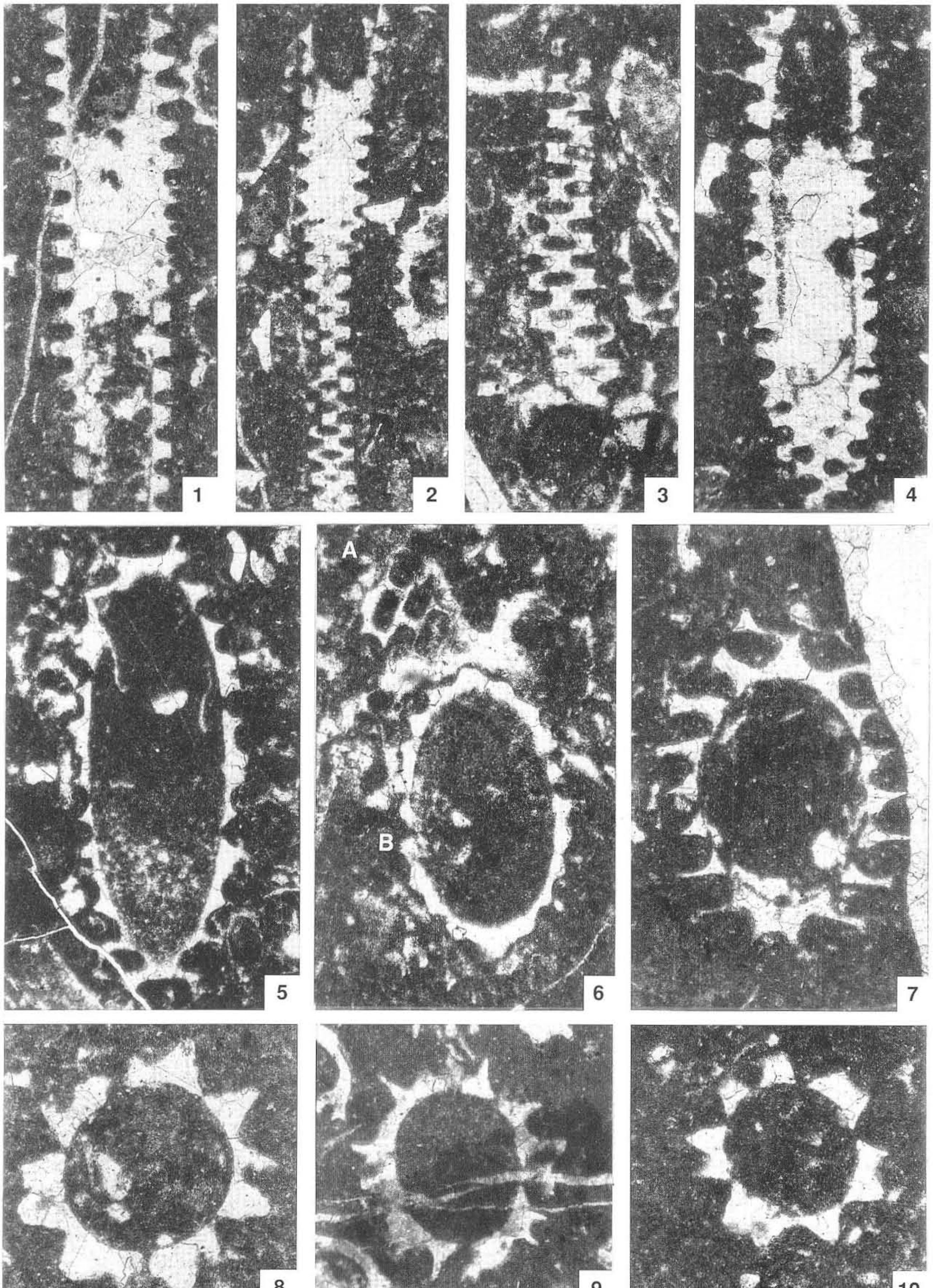
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PLATE IX

1-13 *Salpingoporella urladanasi* CONRAD, PEYBERNÉS & RADOIČIĆ

1, 9	Longitudinal sections, x54.
2, 4	Tangential sections; Fig. 2, x44; Fig. 4, x60.
3, 5-8, 10-11A	Oblique - tangential sections; Figs. 3, 7, 10, x54; Figs. 5-6, x44; Figs. 8, 11A, x57.
11B, 12A - 13	Transverse sections; Figs. 11B, 13, x54; Fig. 12A, x57.

12B *Salpingoporella dinarica* RADOIČIĆ- transverse section, x57

Age and general location:

1-13	Top Aptian; field section Bravči dolac - Debelo brdo, Mt. Dinara.

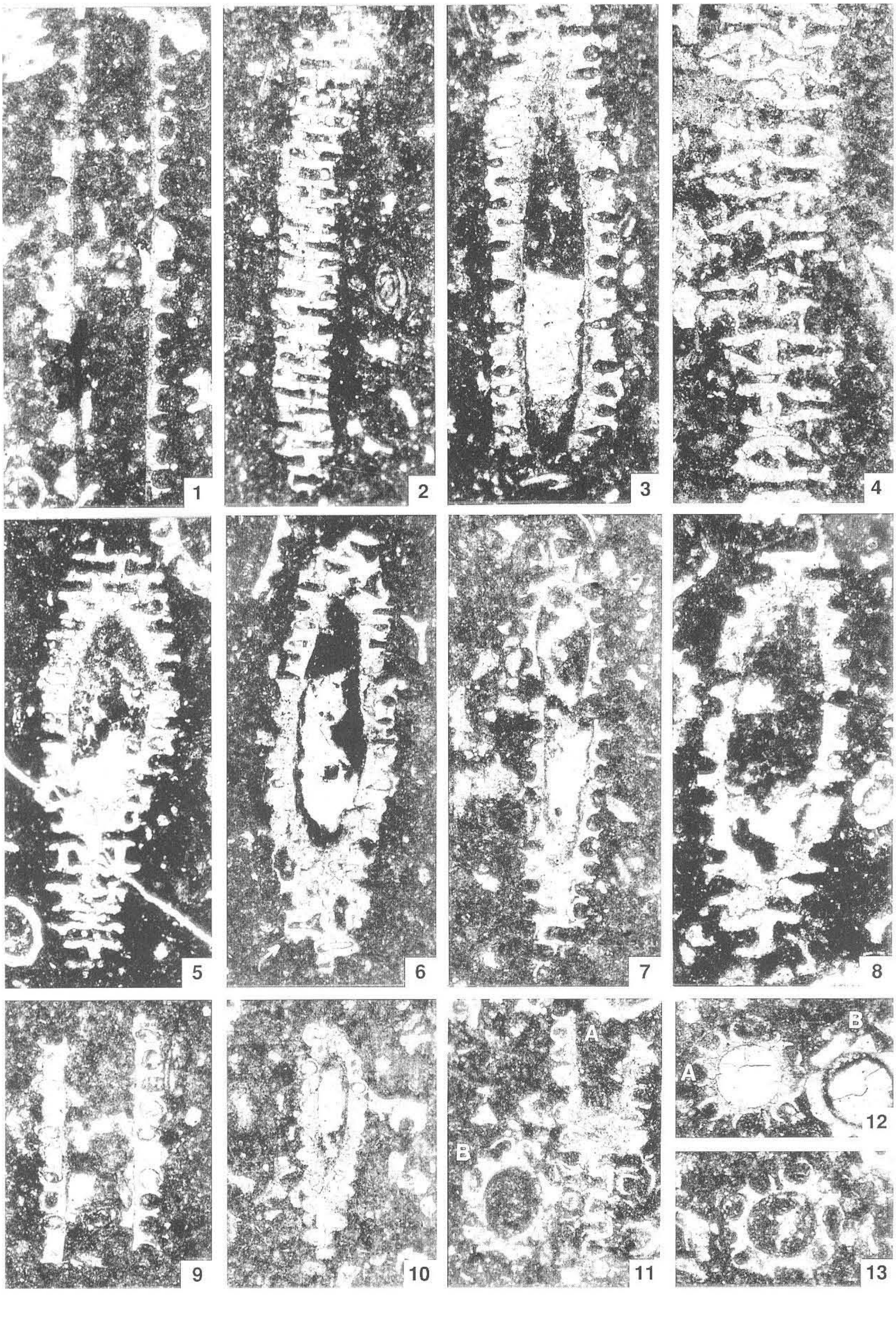
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PLATE X

1A	*Salpingoporella urladanasi* CONRAD, PEYBERNÈS & RADOIČIĆ - transverse slightly oblique section.
1B	*Salpingoporella dinarica* RADOIČIĆ - longitudinal section, B_1 - oblique section, x54.
2, 6-7	*S. urladanasi* - oblique sections; Figs. 2, 7, x54; Fig. 6, x45.
3 part.	*S. urladanasi* - oblique sections, x45.
4	A - *S. urladanasi* - tangential section; B - *S. dinarica* - tangential section, x45.
5	A - *S. urladanasi* - oblique section; B - *S. dinarica* - tangential section, x57.
8 part.	*S. urladanasi* - transverse slightly oblique section, x54.
9 part.	*S. urladanasi* - transverse section, x57.

10-12 *Salpingoporella katzeri* CONRAD & RADOIČIĆ, x22.5

10	Longitudinal section.
11-12	Oblique sections.

Age and general location:

1-9	Top Aptian; field section Bravči dolac - Debelo brdo, Mt. Dinara.
10-12	Berriasian; field section south of the peak Stratinovac, Mt Biokovo.

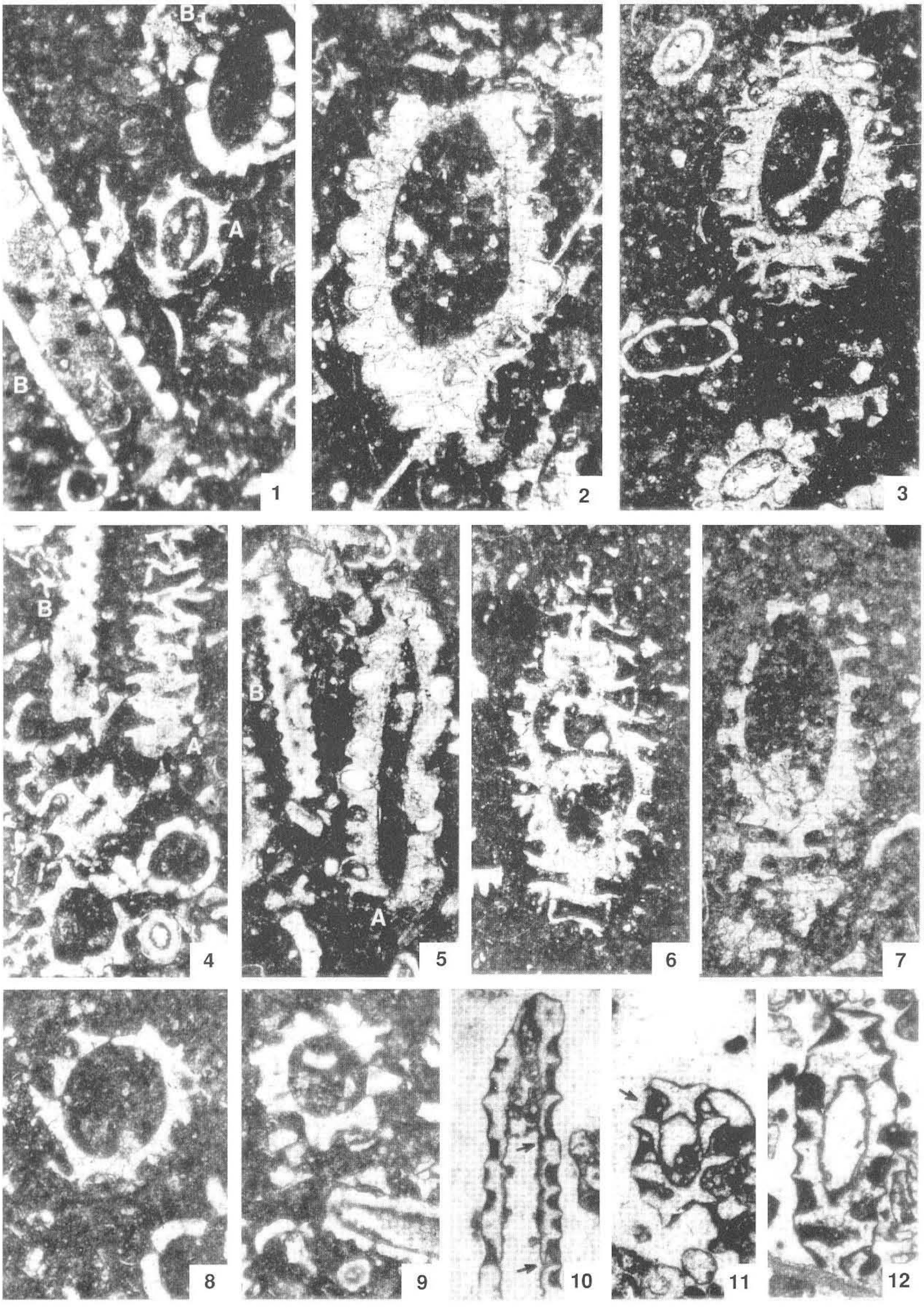
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PLATE XI

1-10 *Salpingoporella dinarica* RADOIČIĆ

1-2	Oblique sections; 1A - Charophyta; Fig. 1, x60; Fig. 2, x50.
3	Longitudinal sections, x60.
4	Tangential section, x60.
5	Longitudinal - tangential section, x60.
6-8, 10	Oblique sections, x60.
9	A - Tangential section, B - oblique section, C - transverse section, x28.

Age and general location:

1	Upper Valanginian; Šošići village, W Istria.
2, 7	Aptian; Božavčica bay near Božava, Dugi otok island.
3	Aptian; Jesenje hill, SE Ogulin.
4	Aptian; Poljana cove, Mali Lošinj island.
5-6, 8, 10	Upper Aptian; Velo Grablje near Stari Grad, Hvar island.
9	Middle Aptian; field section near Saranač, Mt. Biokovo.

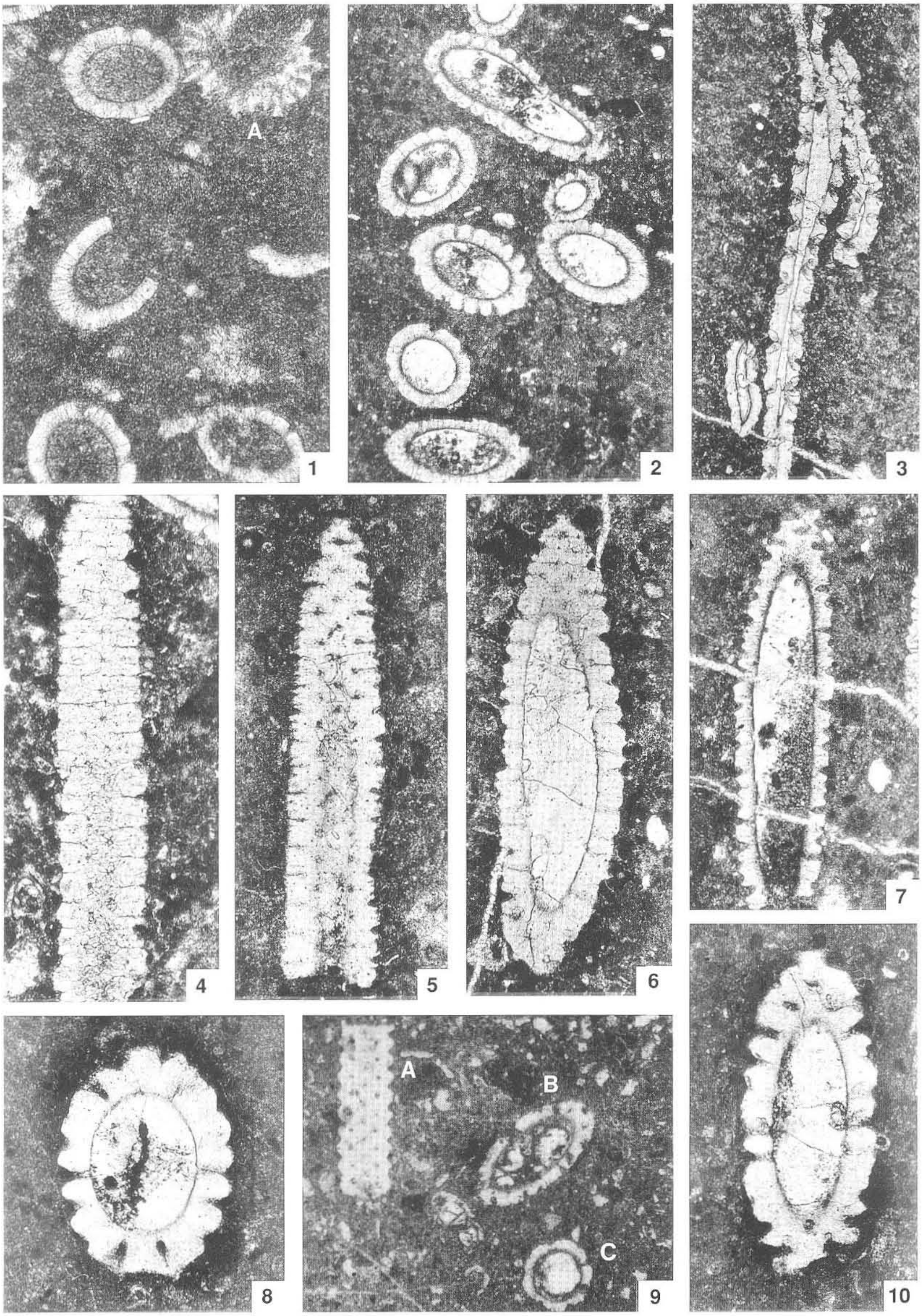
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PLATE XII

1-13 *Salpingoporella dinarica* RADOIČIĆ

1, 5, 9	Oblique sections, x150.
2, 4	Tangential - oblique sections; Fig. 2, x57; Fig. 4, x36.
3	Longitudinal section, x36.
6	A - oblique section, B - transverse section, x44.
7	Oblique section, x44.
8	Transverse sections, x57.
10	Transverse slightly oblique section, x150.
11-13	Oblique sections, x57.

Age and general location:

1-2, 5, 8-9, 12	Aptian; Mt. Velika Kapela.
3-4, 6-7, 10-11, 13	Upper Aptian; field section on the road cut near Sobra, Mljet island (Fig. 1).

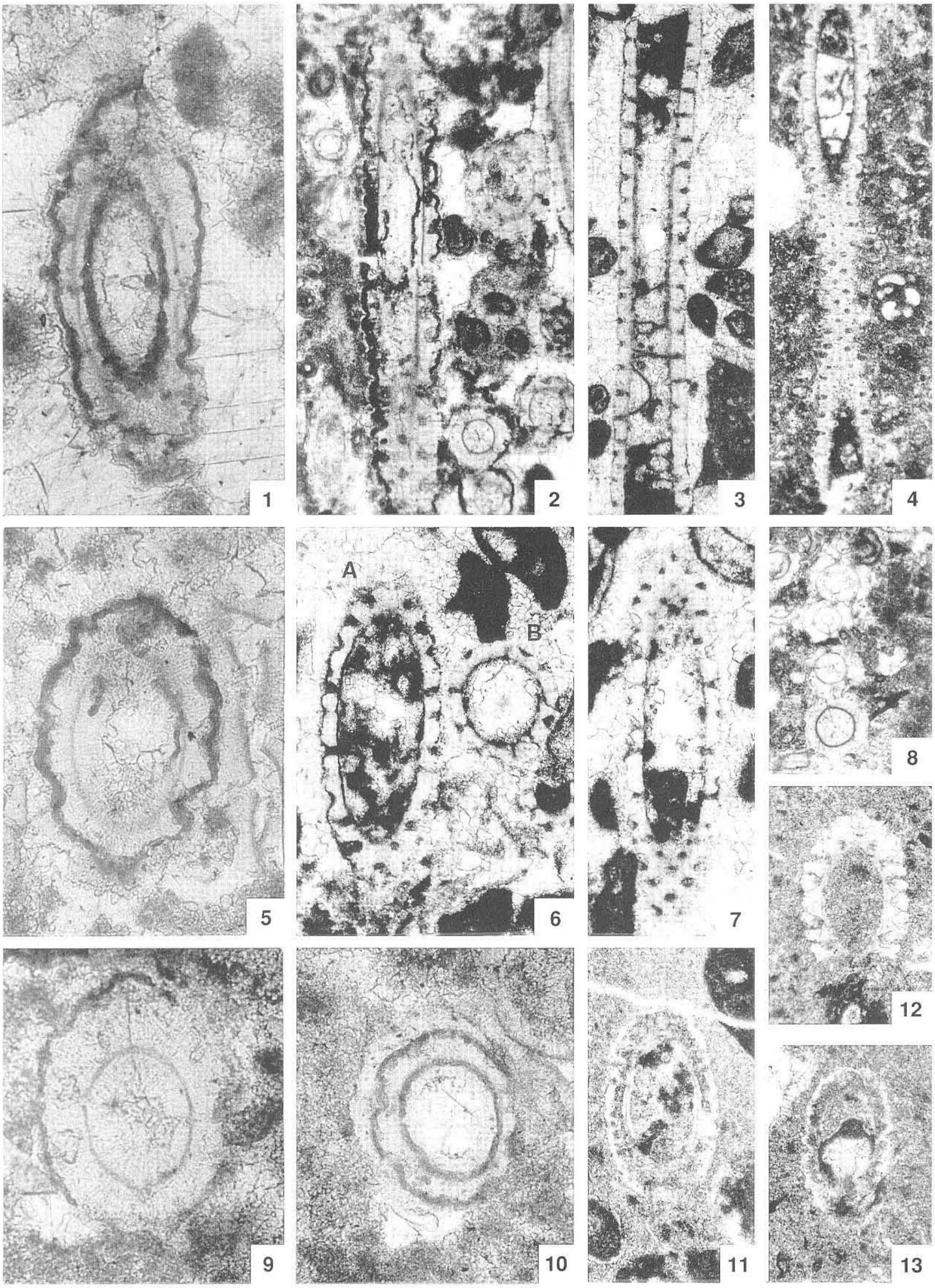
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PLATE XIII

1-8 *Salpingoporella dinarica* RADOIČIĆ

1	Tangential - oblique section, x42.
2, 4	Oblique sections, x42.
3	Tangential - oblique section, x38.
5	Longitudinal section, x34.
6-8	Different oblique sections; Figs. 6-7, x4; Fig. 8, x34.

Age and general location:

1-4	Aptian; Poljana cove, Mali Lošinj island.
5-8	Aptian; Božavčica cove near Božava, Dugi otok island.

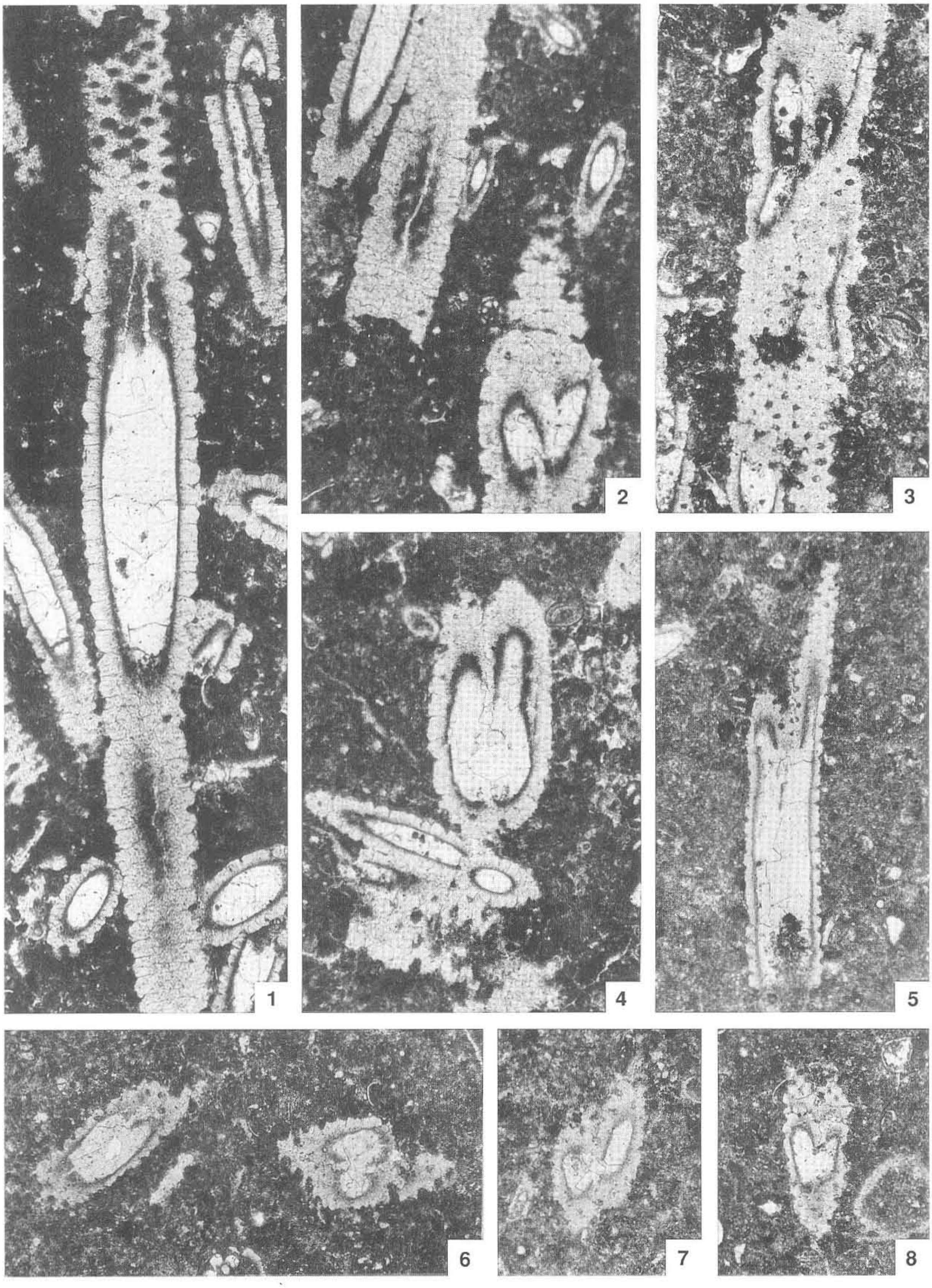
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PLATE XIV

1-9 *Salpingoporella dinarica* RADOIČIĆ

1	Oblique sections, x31.
2	Longitudinal - tangential section, x31.
3-9	Different oblique sections; Fig. 3, x34; Fig. 4, x42; Figs. 5-9, x31.
10-13	Charophytes; Fig. 10, x50; Fig. 11, x60; Fig. 12, x57; Fig. 13, x44.

Age and general location:

1-4, 7-9	Aptian; Poljana cove, Mali Lošinj island.
5-6	Aptian; Božavčica cove near Božava, Dugi otok island.
10-13	Upper Valanginian; Gustinja cove, SE Rovinj, Istria.

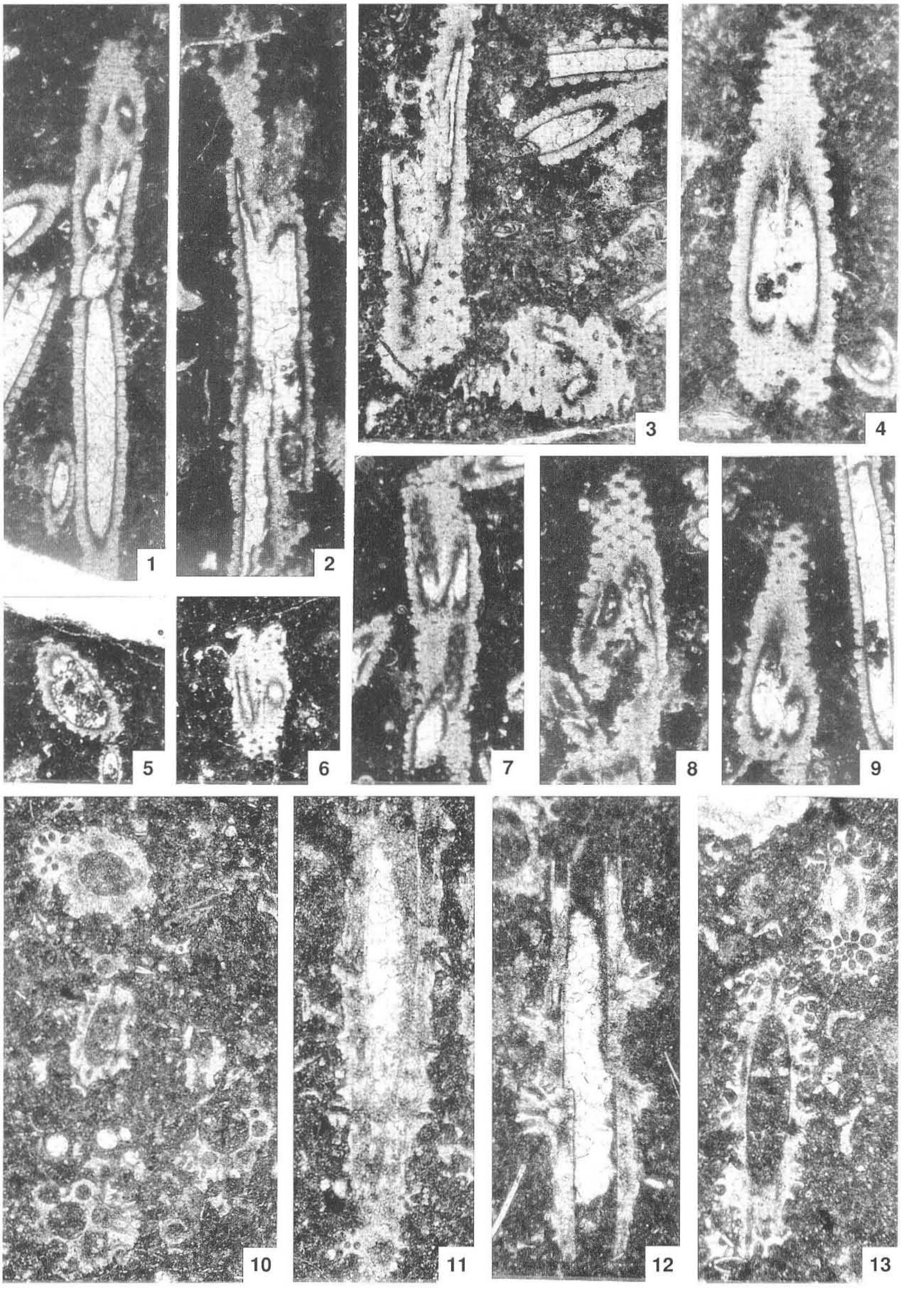
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PLATE XV

1-19 *Praturlonella nerae* (DRAGASTAN, BUCUR & DEMETER) BUCUR, x32

1B, 2B, 6, 9-10, 16	Longitudinal sections; Fig. 2B Holotype.
1A, 2A, 3-4, 7-8, 12-14	Oblique sections.
5, 11	Tangential sections.
15, 17, 19	Transverse sections.
18	Transverse slightly oblique section.

Age and general location:

1-19	Top Barremian or Lower Aptian; Brna village, Korčula island (Fig. 3).

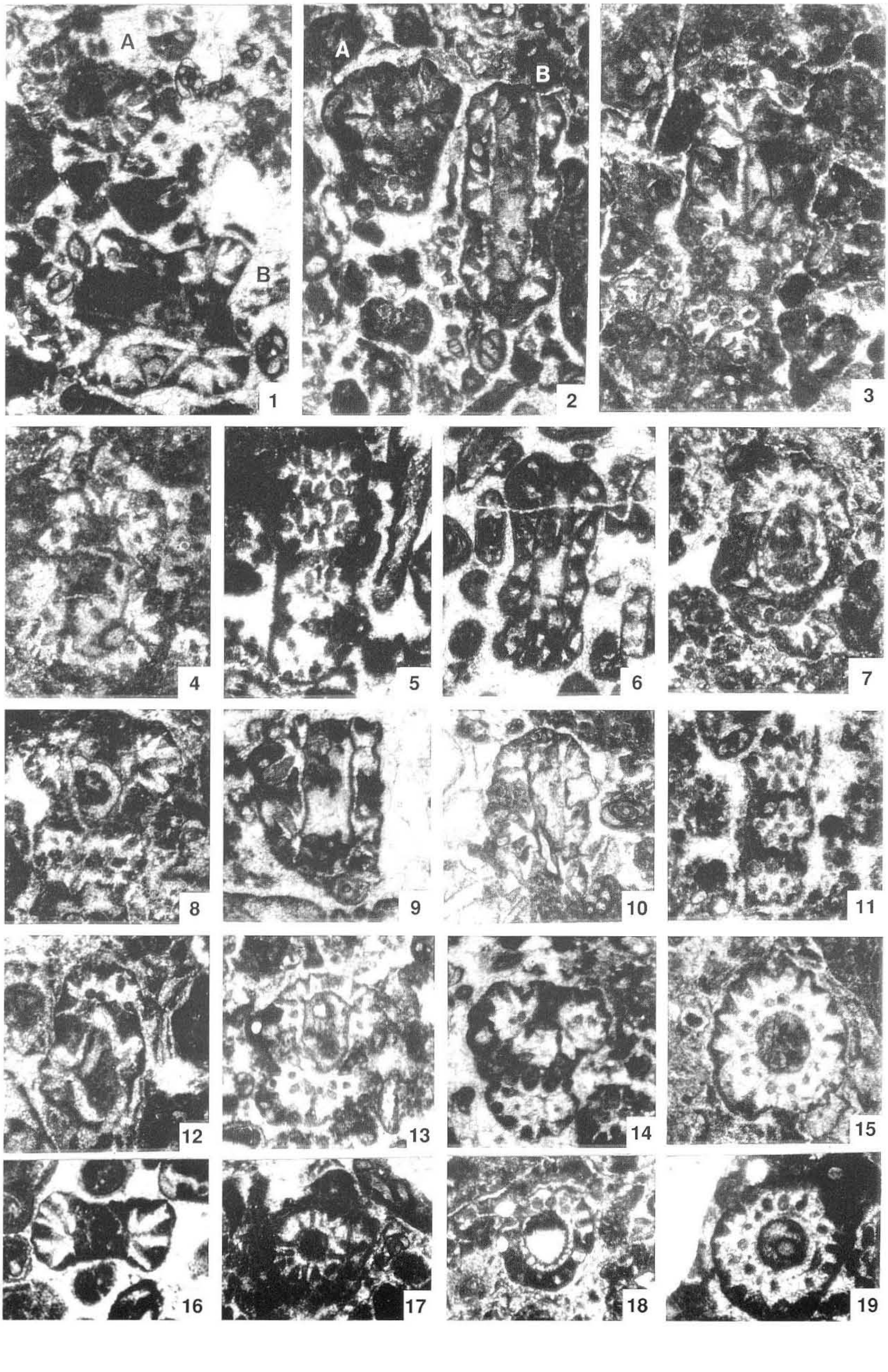
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PLATE XVI

1-15 *Praturlonella danilovae* (RADOIČIĆ) BARATTOLO

1	A - *Praturlonella danilovae* - oblique sections, x16. B - *Salpingoporella melitae* - tangential section, x16. C - *Praturlonella pejovicae* - oblique section, x16. D - *Salpingoporella* sp., x16.
2	*P. danilovae* - different sections, x16.
3	Longitudinal and transverse sections, x22.
4-6, 8, 12-15	Different oblique sections, x22.
7, 9-11	Transverse slightly oblique sections, x22.

Age and general location:

1-15	Lower Barremian; field section on the road cut near Sobra, Mljet island (Figs. 1-2).

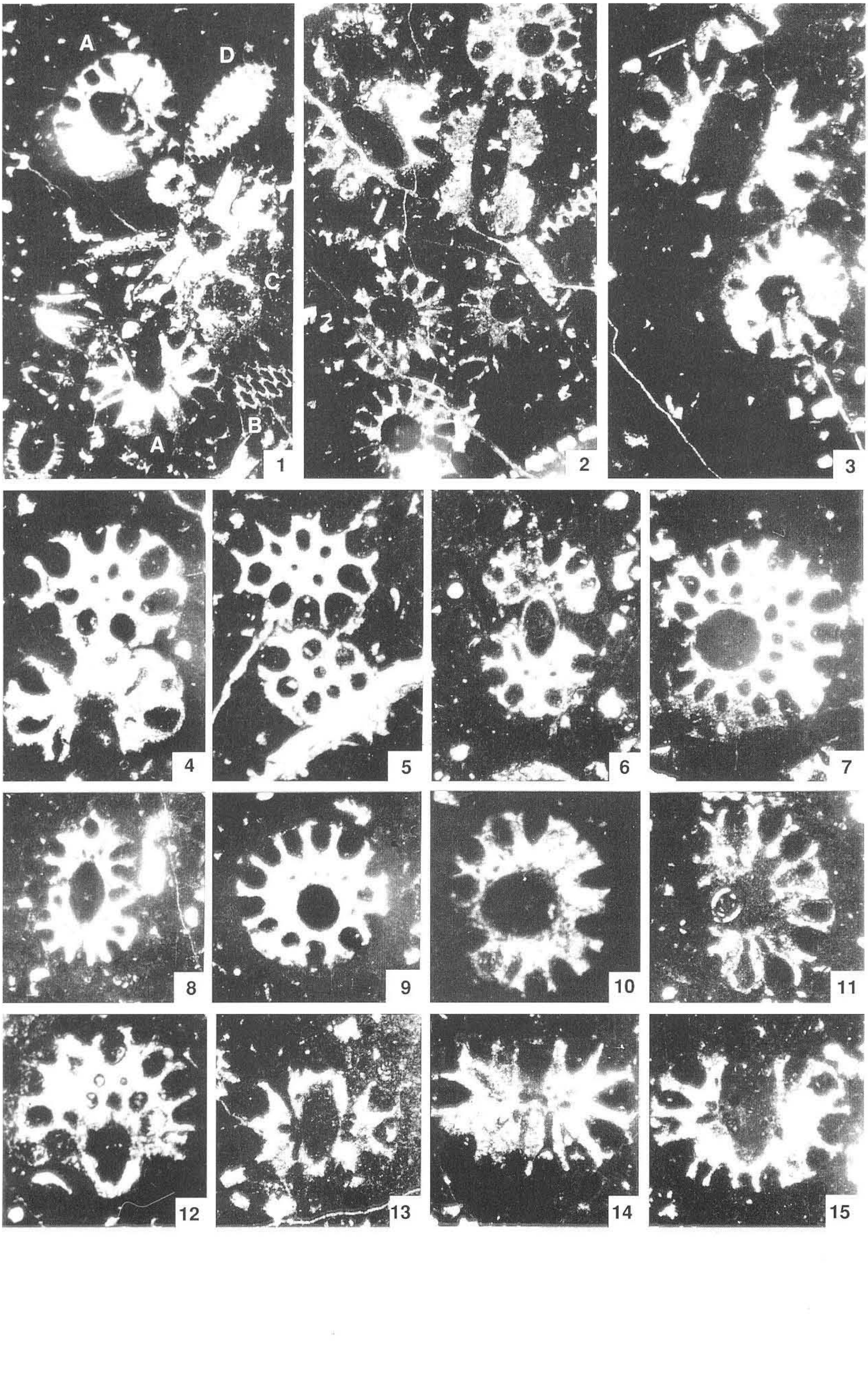
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PLATE XVII

1-7 *Clypeina gigantea* n.sp., x18

1	Transverse section.
2	Oblique section, Holotype.
3-4	Transverse slightly oblique sections.
5-6	Tangential sections.
7	Transverse section.

8-14 *Praturlonella pejovicae* (RADOIČIĆ) n.comb., x22

8	Tangential - longitudinal section.
9-10, 13	Oblique sections.
12	Tangential and transverse - oblique sections.
11	Tangential section.
14	Transverse slightly oblique section.

Age and general location:

1-14	Lower Barremian; field section on the road cut near Sobra, Mljet island (Figs. 1-2)

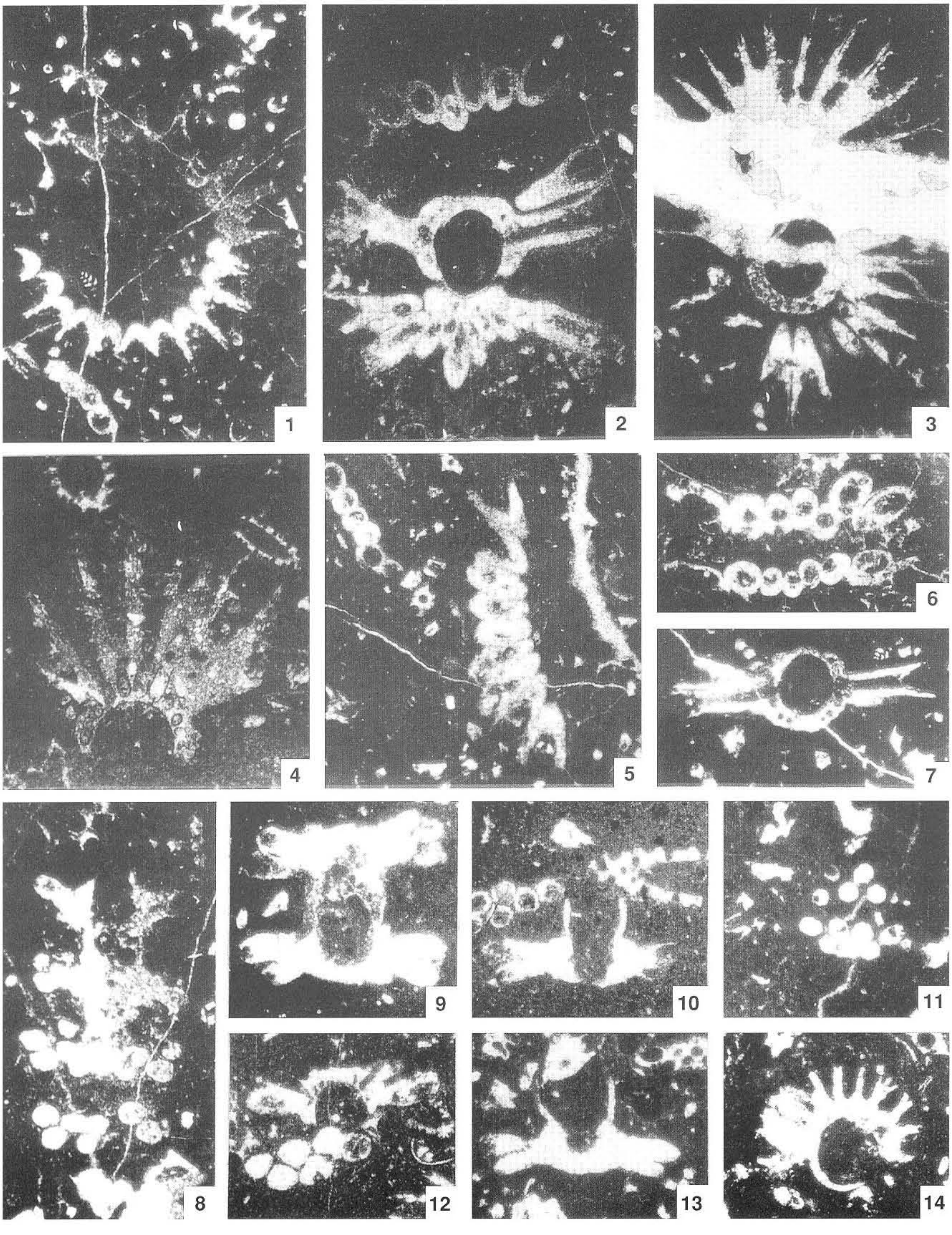

PLATE XVIII

1-20 *Acroporella radoicicae* (PRATURLON) PRATURLON & RADOIČIĆ

1, 4-6, 9-10	Oblique - tangential sections, x23.
2	Tangential section, x18.
3, 7-8, 11-14, 16-17	Oblique sections; Fig. 3, x18; Figs. 7-8, 11-14, 16-17, x23.
15	Transverse - oblique section, x23.
18-20	Transverse sections, x23.

Age and general location:

1-7, 9, 12-20	Lower Aptian; NW from the bridge on the Mrežnica River, between Primišlje and Juzbašići.
8, 10-11	Upper Aptian; field section Bravči dolac - Debelo brdo, Mt. Dinara.

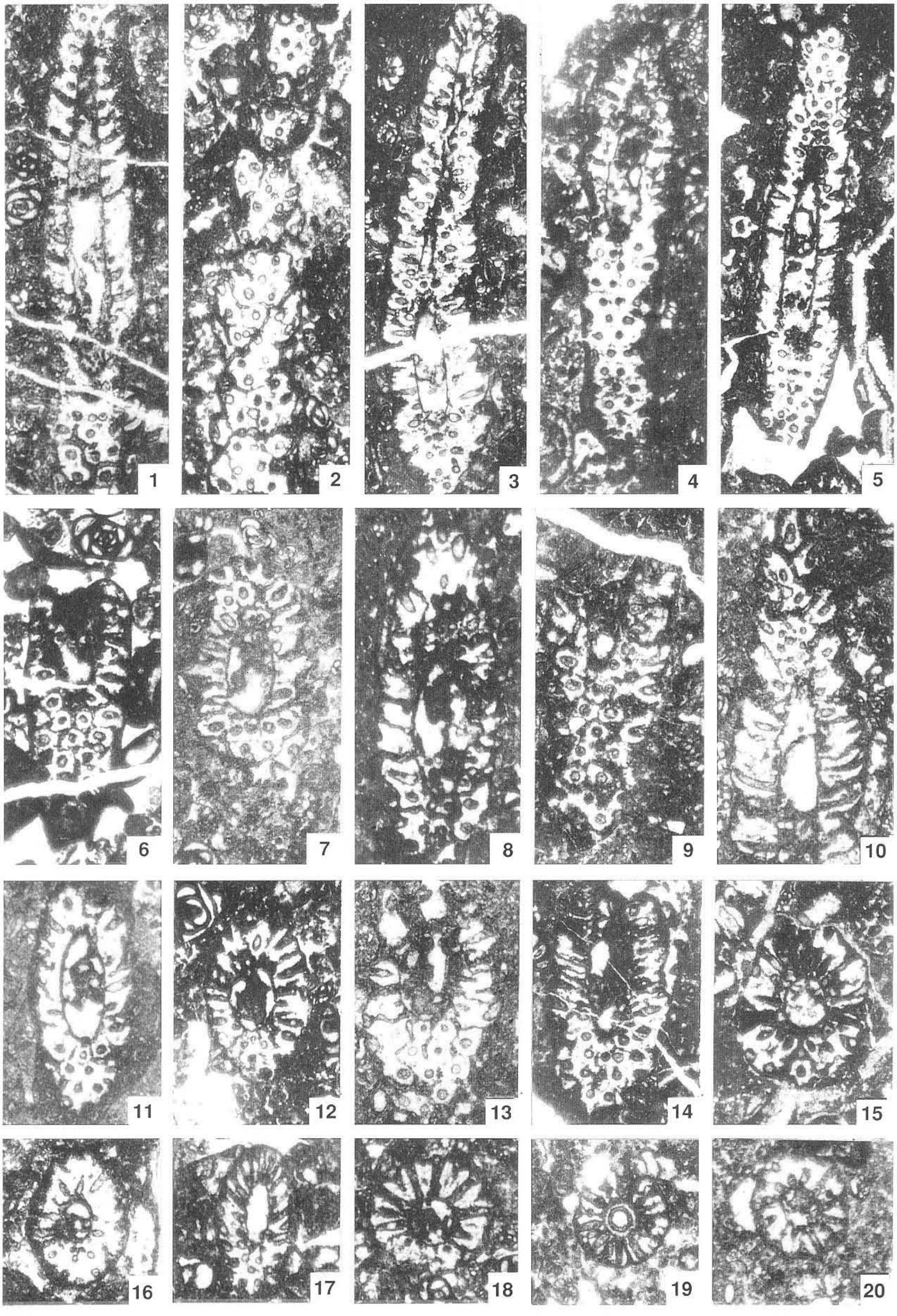
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PLATE XIX

1-6, 8-10 *Clypeina*? *solkani* CONRAD & RADOIČIĆ

1-2, 4, 6	Tangential - longitudinal sections; Fig. 1, x18; Figs. 2, 4, 6, x23.
3,5	Longitudinal sections, x29.
8	Oblique sections, x23.
9A, 10	Transverse sections, x23.
7	*Salpingoporella melitae* - longitudinal section, x23.
9B	*Salpingoporella biokoviensis* - oblique section, x23.

Age and general location:

1-5, 7-10	Barremian; Gornje Igrane, Mt. Biokovo.
6	Upper Barremian; Veliko jezero, Mljet island.

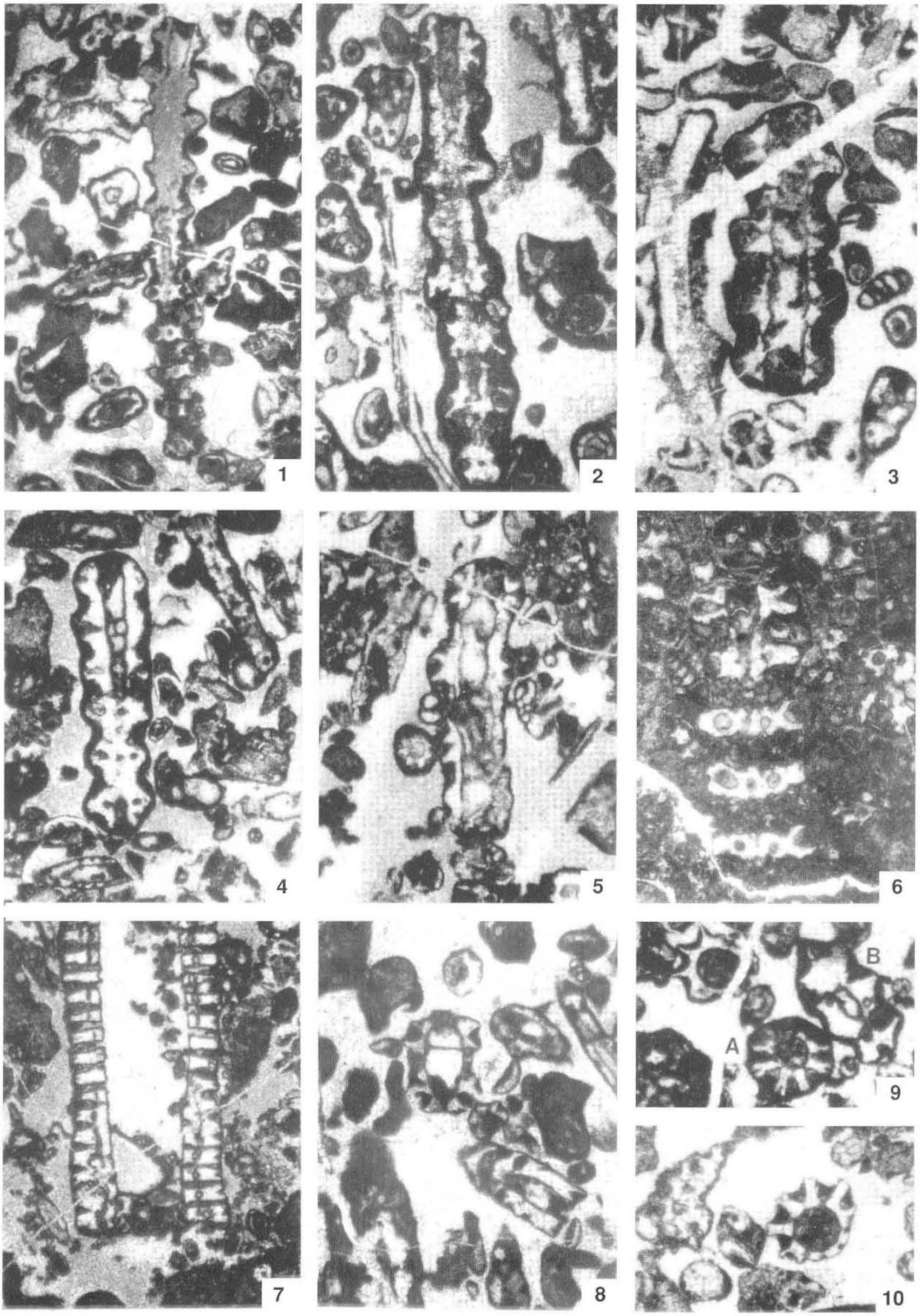
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PLATE XX

1-13 *Actinoporella podolica* (ALTH) CONRAD, PRATURLON & RADOIČIĆ, x23

1, 2A, 5A	Longitudinal sections.
3A, 6, 8-10, 13	Diferent oblique sections.
4A, 7, 11	Tangential sections.
4C	*Clypeina*? *solkani* - longitudinal slightly oblique section.
12	Transverse section.
2B, 3B	*Salpingoporella melitae* - oblique sections.
4B, 5B	*Salpingoporella muehlbergii* - oblique sections.

Age and general location:

1-13	Upper Barremian; Veliko jezero, Mljet island.

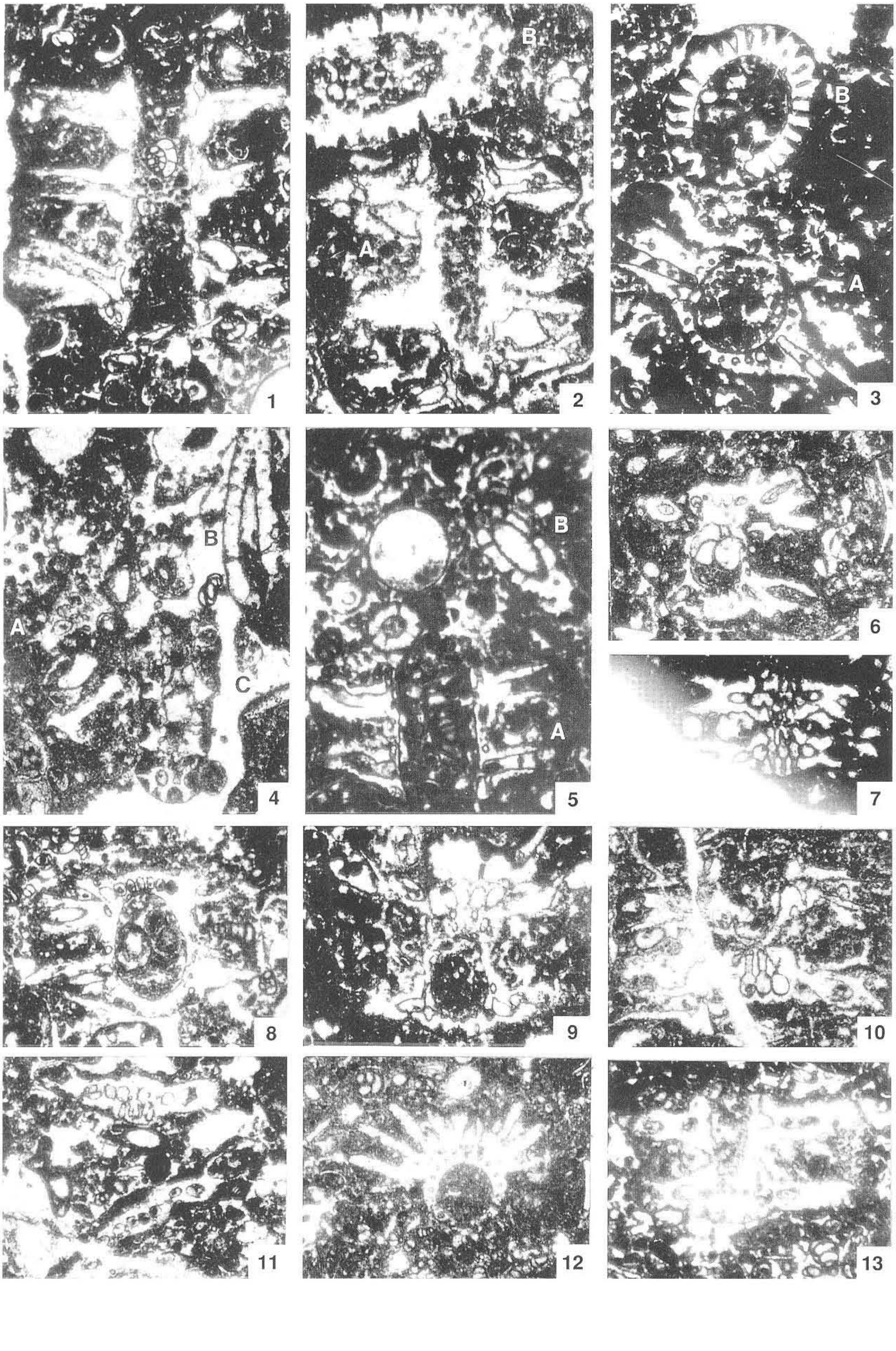
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PLATE XXI

1-15 *Piriferella spinosa* n.gen., n.sp.; Fig. 1, x38; Figs. 2-15, x50

1, 4-8,11, 13-14	Oblique sections; Fig. 6 - Holotype.
2	Longitudinal section.
3, 9, 12	Tangential sections.
10, 15	Transverse slightly oblique sections.

Age and general location:

1-15	Upper Barremian; field section on the road cut near Sobra, Mljet island (Figs. 1-2).

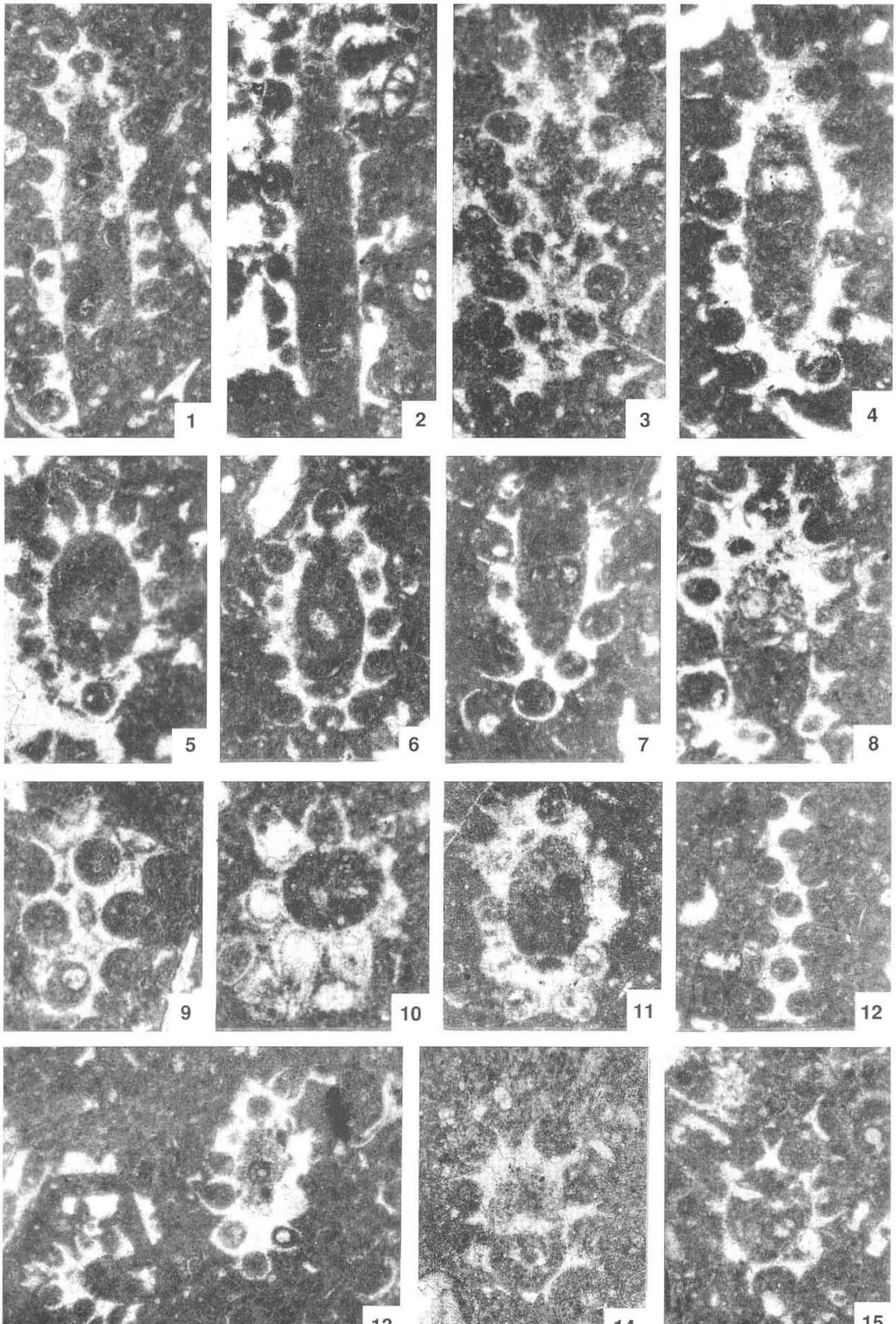
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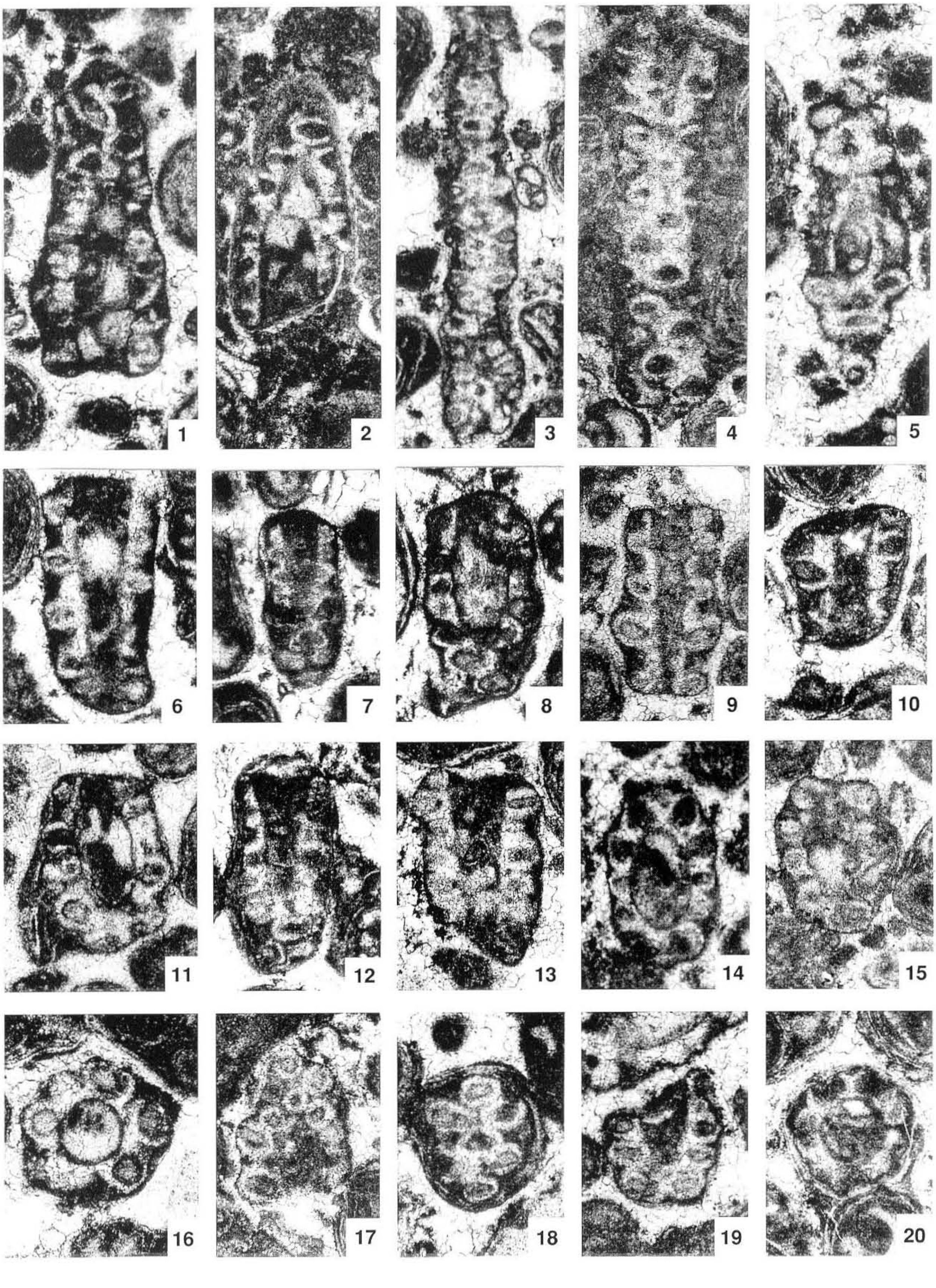
PLATE XXII

1-20 *Piriferella somalica* (CONRAD, PEYBERNES & MASSE) n.comb., x46

1-2, 5, 11, 14-15, 19	Oblique sections.
3-4, 18	Tangential sections.
6, 9-10, 13	Longitudinal sections.
7-8, 12, 17	Tangential - oblique sections.
16, 20	Transverse sections.

Age and general location:

1-10, 12-20	Upper Barremian; sea-side 3 km N from Poreč.
11	Barremian; Raška gora, W side of Neretva river, NE Mostar.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