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Izvorni znanstveni članak

Cylindroporella bradarici n. sp. (Calcareous Algae; Dasycladales) from the Albian of the Dinaric Karst area

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The new dasyclad species *Cylindroporella bradarici* n. sp. has two types of ramifications in alternating arrangement, thus clearly indicating its assignment to the genus *Cylindroporella*. It is characterized by the absence of a well-developed calcareous skeleton, its thallus being made of a thin calcified sheath enveloping the main stem and the clearly individualized fertile and sterile ramifications. By its general appearance it is most similar to *C. taurica* Conrad & Varol from which it can be distinguished, however, by a number of characteristic details.

Ključne riječi: Nova vapnenačka alga, donja kreda, stratigrafija, Hrvatska

Opisana je nova vrsta vapnenačke alge koja osnovnim karakteristikama s dva tipa ogranka, njihovim međusobnim rasporedom nesumnjivo pripada rodu *Cylindroporella*. Nova vrsta *Cilindroporella bradarici* n. sp. odlikuje se nedostatkom izrazitog vapnenačkog skeleta pa joj talus čini kalcificirana ovojnica što ima za posljedicu potpunu individualnost sterilnih i fertilnih ogranaka. Općim izgledom gotovo je identična vrsti *Cylindroporella taurica* Conrad & Varol od koje se diferencira nizom karakterističnih detalja.

Biostratigraphic research of Jurassic and Cretaceous carbonate deposits in the Dinarides, carried out during the recent years, resulted in several published papers. Thus, Velić & Sokač (1978) presented a number of characteristic taxa for different levels, and, among them, a dasyclad alga labelled *Cylindroporella barnesii* Johnson (Pl. II, figs. 4–7). However, the lack of a well visible calcified skeleton, the peculiar shape of the sporangia and their alternating arrangement in the consecutive whorls, and the lack of clearly visible sterile ramifications led Conrad (1982) to reassing these sections (Velić & Sokač, 1978, Pl. II, figs. 4–7) to *Sarfatiella?* n.sp. ind. In the recently established correspondence with Dr. Conrad concerning the taxonomic position or the above mentioned sections, the present author was at first inclined to accept their assignment to *Sarfatiella,* but nevertheless the necessity of more detailed research on this alga was clearly voiced. Therefore additional thin-sections from the alga-bering samples have been prepared yielding several dozens of variously oriented sections which eventually enabled a more complete understanding of the structure of that alga. The newly gained insights into its structure have convinced me, that, first, it should undoubtedly be assigned to the genus *Cylindroporella* and, second, it is sufficiently distinct from recently described *Cylindroporella taurica* Conrad & Varol (1990), a point which will be explained in more detail below.

Order Dasycladales (Pascher, 1931)
Familiy Daycladàceae Kützing, 1843
Tribus Cylindroporelleae Pal. 1976
Genus *Cylindroporella* Johnson, 1954
Cylindroporella bradarici n.sp.

Pls. I–II

1978. *Cylindroporella barnesii* Johnson. – Velić & Sokač, pl. II, figs. 4–7.

1982. *Sarfatiella?* n. sp. ind. – Conrad, p. 1 (refers to the above reference).

1990. (partim). *Cylindroporella taurica* n.sp. – Conrad & Varol, Fig. 7.

Origin of the name: the species is dedicated to P. Bradarić, mining engineer and a friend of geology in Croatia.

Type locality: along the village road 400 m south of the elevation point Škorašnik (347 m), in the field east of Ogulin (central Croatia), coordinates: y=5 519 112,00; x=5 013 657,00.

Type stratum: Albian, predominantly platy micrites and biomicrites.

Holotype: Oblique section figured in Pl. I, fig. 6; thin-section OG-20358-13. Both the holotype and the other topotype material are stored at the Institute of Geology, Zagreb.

Diagnosis: A more or less cylindrical thallus is characterized by peculiar structure, lacking a consistent calcareous skeleton. It is composed of a sligthly calcified thin sheath, enveloping the central cavity (stipe, »main stem«), from which (the central cavity) well individualized ramifications grow out. They, too, are also enveloped by a thin, slightly calcified sheat. Two types or ramifications can be distinguished: (1) the fertile ones, which are spherical to subspherical, and (2) the sterile ones, club-shaped

and bearing secondaries at their distal ends. The alternating arrangement of the fertile and sterile ramifications in the consecutive whorls is a feature typical of the genus *Cylindroporella*.

Description: In the available material, the new species is represented by numerous, variously oriented sections. Besides, the sections are subject to different degree of preservation, due to the micritization of spaces left between the ramifications and the calcitization of their original cavities. In the available sections, the thallus can be seen to be more or less cylindrical, but, characteristically, lacking the unified calcareous skeleton. The thallus, as a whole, consists of a very thin, calcified envelope (sheath) that envelopes the »main stem«(which is probably open at the upper end). Verticills (whorls) grow out from that envelope; they consist of alternating fertile and sterile ramifications (Pl. I, Fig. 2). The ramifications, being fully individualized, are also completely enveloped, each by its own, slightly calcified, sheath. The space between the sporangia, and the much larger space between the secondaries (which grow out from the distal end of the sterile primaries), is filled by micritic mud. This mud, which possibly originally corresponds to some kind of an organic mucus, is brought out in the sections as a thicker or thinner dark ring (Pl. I, Figs. 1–2, 4–6). This structure, as described, lacking the original calcareous skeleton and accumulating micritic mud, seems to indicate that the alge was already during life, or in early post mortem stage (= immediatelly after death), preserved by mud. Because of this, primary cavities in this or similar forms appear visually as white patches, formed by secondary crystallization of calcite from the pore water which filled the cavities. The main stem is very narrow – it occupies only 16–20% of the outer thallus diameter, including the dark outer ring – its outer rim making the extension of the secondary ramifications, which grow out of the distal ends of the sterile primaries.

Thus the two kinds of ramifications, in addition to their characteristic arrangement and clearly verticillate position, all of which makes the essential features of the genus, are clearly present in the new species. The comparatively large, spherical to (more rarely) subspherical sporangal (= fertile) ramifications, each enveloped by its own thin calcareous sheath, grow out separately from the main stem and are connected with it by a thin, very short and rearely visible stalk (Pl. I, Fig. 3; Pl. II, Fig. 3). These calcite-filled spherical ramifications are sometimes somewhat deformed in their distal part. Being strongly inflated, they are densely packed, leaving little free space between them and being often in mutual contact (both within a whorl and between the two consecutive whorls). Detailed observation showed that the sporangial cavities are enveloped with a thin and hardly visible dark line of constant thickness, composed of microcrystalline calcite corresponding to the calcitization of the primary envelope. Within the sporangial cavities two generations of calcite cements are discernible: the fine-grained, fibrous, often serrated, rim cement represents the first phase of the cavity infilling, and the more coarse, blocky calcite grains, most often one to four of them, in the middle of the cavities, represent the second phase (Pl. I, Figs. 3–4, 9). In contrast to the sporangial ramifications, which are always completly calcitized, the sterile ramifications, alternating with the fertile ones, seem to be calcitized to various degree, usually only after the first third of their length (Pl. I, Figs. 1–3, 5–6, 10, 13). This is the reason why the sterile ramifications, visible in few specimens only, and even then with difficulty, went at first unnoticed and their presence was only faintly suggested by irregularly appearing smaller pores, squeezed between the sporangia. The sterile ramifications branch off in their distal part and, consequently, primary and secondary sterile ramifications are clearly distinguished (Pl. I, Figs. 1–2, 5–6). The primaries are club-shaped (Pl. I, Figs. 1, 6), and, probably because of only partial calcitization of the proximal part, their communication with the main stem through a tiny pore could not be unequivocally ascertained. Partial and unequal calcitization of the envelopes of the sterile ramifications logically explains the fact that the tiny pores between the proximal parts of the inflated globular sporangia are poorly visible or entirely missing (they should be visible in deeper tangential sections, e.g. Pl. III, Figs. 1–2). The sterile primaries are widened at their distal end; they are longer than the sporangia; in shallow tangential or cortical sections they appear as smaller pores squeezed between larger sporangia. Each primary sterile ramification bears at its widened distal end 4–5(?) secondaries, which are distally tapered (Pl. I, Figs. 1–2, 5–6). Most frequently, the secondaries are only fragmentarily preserved in which case they appear as unclear contours of yellowish irregular calcite aggregations in the outer dark micritic ring (Pl. I, Fig. 11; Pl. II, Fig. 1). Both sterile and fertile ramifications are situated perpendicularly (or almost so) to the longitudinal axis, and their arragement is alternating both within a whorl and in successive whorls, which is a typical *Cylindroporella*-feature. Because of their being strongly inflated, the sporangia sometimes touch each other and became sligthly deformed, which produces a slight distortion of their circular shape in sections (Pl. I, Fig. 4; Pl. II, Figs. 1–2). Also, because of that, sterile ramifications do not always appear precisely in the middle between the four sporangia but instead insert themselves where they have enough place, which may distort the geometrically regular arrangement and produce a slightly offset picture. In a few cases, tiny spores have been noticed within the sporangial cavities.

Similarities and differences: *Cylindroporella bradarici* n. sp. has all the essential characters of the genus: fertile and sretile ramifications, with their characteristic shape and arrangement. There are also differences which distinguis the new species from other species of that genus. With regard to the type-species, *C. barnesii* Johnson (1954), to which it was originally assigned (Velić & Sokač, 1978), *C. bradarici* has a larger outer diameter and variable number of fertile ramifications per whorl (varying

Dimensions in mm:

	C. bradarici	C. taurica
Maximum length L	3.30	4.8
Outer diameter D	0.53–0.785	0.60–1.032
Inner diameter d	0.084–0.14	0.10–0.258
Distance between the consecutive whorls h	0.12–0.17	0.14–0.193
Length of sporangia 1	0.12–0.19 R1B	0.240–0.419
Length of sterile primaries 1'	0.19–0.24 R1A	0.240–0.419
Length of sterile secondaries 1''	0.08–0.098	
Diameter of sporangia p	0.15–0.198 R1B	0.125–0.290
Maximum diameter of sterile ramifications p'	0.05–0.09 R1A	0.096–0.18
Total number of ramifications in a whorl w	18–12 (most freq. 10)	14–18 (R1A+R1B)
Number of secondaries per primary sterile branch w'	4–5?	

between 4–6, most frequently 5, in *C. bradarici,* while it is 6 in *C. barnesii*). The same feature distinguishes *C. bradarici* from *C. arabica* Elliott (1957), *C. sugdeni* Elliot (1957), *C. parva* Radoičić (1983), *C. benizarensis* Fourcade et al. (1972), *C. elassonos* Johnson (1965); all these species differ from each other in the different values of dimensions, which often makes the possibility of their differentiation rather doubtful (if the two last mentioned species are considered valid?). With its varying number of fertile and sterile ramifications within a whorl, *C. bradarici* n. sp. agress with *C. kochanskyae* Radoičić (1970). Also, the variation ranges of the measured elements are similar in the two species, although the variation range is somewhat larger in *C. kochanskyae.* The main visible difference between the two spacies consists in the shape of the sterile primaries, which *C. kochanskyae* are comparatively large and roughly cylindrical (though slightly windened at the distal end), while in *C. bradarici* they are clearly club-shaped, and, as a rule, longer than the sporangia. The rare and inadequately known species *C. arsici* Radoičić (1971) is clearly distinguished from *C. bradarici,* being three to four times larger (comparing the outer thallus diameter) and having in total more than twice as much ramifications per whorl. Besides, the shape of the sterile primaries is clearly different in the two species. *C. bradarici* is distinguished from the recently described *C. lyrata* Masse & Luperto Sinni (1989) by its smaller size, differently shaped fertile and sterile ramifications and their number per whorl and by the lack of a clearly developed calcareous skeleton (which is present in *C. lyrata*). A thorough comparison with *C. elliptica* Bakalova (1971) is not possible, because *C. elliptica* was inadequately described and figured, but, anyway, *C. elliptica* has a well developed calcerous skeleton, which is missing in *C. bradarici.* Independently from the above mentioned similarities and differences, which in many *Cylindroporella* species can be reduced to different dimensions and size, and which, morever, frequently overlap, *C. bradarici* is clearly distinguished from other species by lacking a consistent calcareous skeleton, i.e. by having only a thin calcitized sheat, enveloping soft parts of the alga. However, this feature makes *C. bradarici* very similar to the form assigned by Bassoullet & al. (1978, Pl. 31, Figs. 7–8) to *Sarfatiella dubari* Conrad & Peybernès (according to Conrad & Varol, 1990, *S. dubari* is posibily a younger synonym od *Holosporella siamensis* Pia), with which, however, the form figured by Bassoullet et al. (1978) is not comparable. In the absence of an adequate description, the differences between *C. bradarici* and the above mentioned from can be given only ont the basis of visual comparison. The above mentioned from lacks a consistent calcareous skeleton, the thallus being represented by a calcified envelope, which is also the case in *C. bradarici.* However, that from seems to possess only on type of globular, undivided ramifications, arranged alternately in the consecutive whorls. The lock of sterile ramifications and a larger number of fertile sporangia per whorl make a clear distinction in relation to *C. bradarici.* Another from which should be considered here has been figured by Luperto Sinni & Masse (1984, Pl. 36, Fig. 1) and labelled *Montiella? elitzae* (Bakalova). (It has been put into the synonymy of *C. taurica* by Conrad & Varol, 1990). Because there is only one section published (largely tangential and only in the lower part somewhat oblique), without description and measurement data, it is difficult to compare it, both with *C. bradarici* and *C. taurica.* General impression, gained from one tangential section only, confirms the roughly identical structure of the thallus as in *C. bradarici* and *C. taurica.*

When the present report was already fully prepared, Dr. Conrad was so kind to send me the typescript of his and Dr. Varol's paper (Conrad & Varol, 1990), which contained the description of *C. taurica* and went at that time to the printers. As regards the general appearence of the thallus, the mode of calcification, the presence of two types of ramifications and their arrangement, *C. taurica* indeed appears to be almost identical to *C. bradarici.* This fact probably led Conrad & Varol (1990, Fig. 7) to include some sections of what is in the present paper assigned to *C. bradarici,* to *C. taurica.* However, a number of details, as well as different dimensions – both of which are to-day regarded and accepted, by general consensus, as valid criteria for distinguishing species within the genus *Cylindroporella* – can be used to distinguish the two species. From the dimension table it is visible that the values for *C. taurica* are generally langer than those for *C. baradarici* (e.g., outer and inner thallus diameter, diameter of sporangia, etc.), though they partly overlap (= maximum values for *C. bradarici* equal smaller values of *C. taurica*). Another difference, which seems to be more important and independent of dimensions (size), is that the total number or ramifications per whorl (= including fertile branches, or sporangia, plus sterile primaries) amount to 8–12 (most frequently 10) in *C. bradarici,* in contrast to 14–18 in *C. taurica.* Moreover, sporangial ramifications in *C. bradarici* are more regularly spherical and less deformed (distorted) than the pear-shaped sporangia in *C. taurica.* Another well-visible difference consists in the shape of the sterile primaries,

which in *C. taurica* – according both to the desciption and to what can be seen on the holotype (Conrad & Varol, 1990, Fig. 4) – are clearly funnel-shaped, gradually widening toward their outer end, and reaching, in some cases, a maximum diameter which comes close to the diameter of sporangia, or, in some cases, even surpasses the smallest sporangial diameter. This is never the case in *C. bradarici*. In contrast, the sterile primaries in *C. bradarici* are finer (thinner) and they swell more abruptly at their distal end – such a shape resulting in a picture where a stalk and a distal swelling can be more clearly differentiated (Pl. I, Figs. 1–2). Also, the sterile primaries in *C. taurica* are about of the same length as is the length of sporangia, while in *C. bradarici* they are clearly (for 1/5 to 1/4) longer than sporangia (Pl. I, Figs. 1–2, 4–5). In *C. bradarici*, the fertile primaries clearly bear the four (or five) secondaries, which seem to grow out from a common base, are widened at the beginning and tapering distally. In *C. taurica*, the presence of the sterile secondaries could not have been unequivocally established, though possibly their traces can be recognized as calcite grains or irregular calcite aggregates within the dark micritic envelope of the thallus. Consequently, their presence can be inferred as being highly probable. More precise data on their shape, mode of growth etc., are lacking, though some poorly visible details of the holotype (Conrad & Varol, 1990, Fig. 4) suggests the nipple-like excrescences rather than the secondaries growing out from a common starting point (in a bush-like manner) as in *C. bradarici*. Summing up, in spite of the obvious and great similarity, the enumerated differences seem to support the separating of *C. bradarici* and *C. taurica*, at least if the generally accepted criteria are still considered valid.

For some species that are not mentained above – *C. texana* Johnson, *C. adducta* (Maslov), *C. maslovi* Srivastava, to which *C. elassonos* should also be added – we fully agree with the opinion of Conrad & Varol (1990), taht their available illustrations and/or descriptions are unfortunately insufficient for comparison, or that they (*C. maslovi*) represent synonyms of the earlier valid species.

Stratigraphic position: At its topotype locality, *C. bradarici* has been found in thin-bedded mudstones which, according to the microfossil association they contain, have been ascribed to transitional Lower Albian–Upper Albian levels. The exhaustive list of determined fossils can be found in Velić & Sokač (1978) and again in Conrad & Varol (1990).

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Cylindroporella bradarici n. sp. (vapnenačka alga; Dasycladales) iz alba dinarskog krša

B. Sokač

U okviru biostratigrafskih istraživanja sprovedenih u prethodnom razdoblju objavljeno je više radova, među kojima i rad Velić & Sokač (1978). Prikazom većeg broja karakterističnih taksona za pojedine nivoe obuhvaćena je u spomenutom radu (Pl. II, fig. 4–7) i vapnenačka alga označena tom prilikom kao *Cylindroporella barnesii* Johnson. No nedostatak izrazito vidljivog vapnenačkog skeleta, sferičnost sporangija i njihov naizmjenični raspored unutar susjednih prišljena kao i nedostatak jasne prisutnosti sterilnih ogranaka naveli su Conrada (1982) da u svojoj sinonimiji vrste *Cylindroporella barnesii* Johnson, 1954 ilustrirane primjerke (Velić & Sokač, 1978, tab. II, sl. 4–7) označi kao *Sarfatiella?* n.sp. ind. U razmjeni mišljenja oko ovih primjeraka koje sam u posljednje vrijeme vodio s Dr. Conradom bio sam ispočetka sklon prihvatiti njihovu pripadnost rodu *Sarfatiella*, ali s nesumnjivo potrebom daljnjeg izučavanja ove vapnenačke alge. Ovime je bila i potaknuta daljnja izrada nekoliko desetaka novih presjeka koji su konačno omogućili da se argumentirano i faktografski sagleda i razjasni građa ove alge, koju danas

neosporno treba uvrstiti u rod *Cylindroporella* i ujedno je razlikovati od gotovo istovremeno opisane vrste *Cylindroporella taurica* Conrad & Varol (1990).

Genus *Cylindroporella* Johnson 1954

Cylindroporella bradarici n.sp.

Tab. I – II

Podrijetlo imena: vrsta je posvećena rudarskom inženjeru Pavlu Bradariću, prijatelju geologije u Hrvatskoj.

Tipičan lokalitet: uz seoski put 400 m južno od trigonometra Škorašnik (347) u polju istočno od Ogulina, koordinate: y=5519112,00; x=5013657,00.

Tipični slojevi: dominantno pločasti mikriti i biomikriti alba.

Holotip: kosi presjek prikazan na tab. I sl. 6, utvrđen u preparatu pod oznakom OG–20358–13. Materijal je pohranjen u Institutu za geološka istraživanja, Zagreb.

Dijagnoza: Talus ove vrste uz generalno cilindričnu formu odlikuje se specifičnom građom s izrazitim nedostatkom cjelovitog vapnenačkog skeleta. Sastoji se od slabo kalcificirane tanke ovojnice oko matične stanice iz koje izrastaju individualizirani ogranci također obavijeni tankom slabo kalcificiranom ovojnicom. Prisutne su dvije vrste ogranaka, fertilni sferičnog ili subsferičnog oblika i sterilni, kijačaste forme koji na distalnom kraju nose sekundarne ogranke proširene u bazi. Karakterističan je alternirajući raspored fertilnih i sterilnih organaka susjednih pršljena koji je tipično cilindroporelski.

Opis: Ova nova vrsta predstavljena je u analiziranom materijalu velikim brojem različito orjentiranih presjeka a i različitog stupnja očuvanosti što je uvjetovano mikritizacijom međuprostora ogranaka i kalcitizacijom njezinih primarnih šupljina. Talus alge s obzirom na prezentirane presjeke upućuje na generalno cilindričnu formu s karakterističnom odsutnošću cjelovitog vapnenačkog skeleta. Cjelokupni talus sastoji se od vrlo tanke kalcificirane ovojnice (opne) koja obavija matičnu stanicu vjerojatno zatvorenu na vršnom kraju. Iz ove ovojnice izrastaju pršljeni koji se sastoje od izmjene fertilnih i sterilnih ogranaka (Tab. I sl. 2). Svaki od ovih ogranaka, koji su u potpunosti samostalni, obavija vlastita također slabo kalcificirana ovojnica. Međuprostore ogranaka koji su manji između sporangija, a brojniji i veći između sekundarnih ogranaka koji izrastaju na distalnom kraju primarnih sterilnih ispunjava mikritni mulj. Ovaj mulj koji moguće prvobitno odgovara nekoj vrsti organske sluzi manifestira se u ilustriranim presjecima kao uži ili širi tamni prsten (Tab. I, sl. 1–2, 4–6). Iz ovakve građe, nedostataka primarnog vapnenačkog skeleta i nakupljanja mikritnog mulja čini se da je alga već za života ili neposredno nakon uginuća konzervirana muljem. Iz ovog razloga, primarne se šupljine kod ove vrste, ili slično građenih forma, vizuelno manifestiraju kao bijela polja nastala sekundarnom kristalizacijom kalcita iz pornih voda koje su doticale u spomenute šupljine. Matična stanica vrlo je uska i zaprema 16–20% od ukupnog promjera u koji se uključuje i tamni prsten čiji vanjski rub označava i granicu sezanja sekundarnih organaka izraslih iz distalnog kraja primarnih sterilnih ogranaka.

Dvije vrste ogranaka, koji su uz karakterističan raspored i pršljenasti položaj bitna odlika roda, prisutni su i u ove vrste. Relativno krupni sporangijski ogranci sferičnog rjeđe subsferičnog oblika obavijeni tankom ovojnicom izrastaju samostalno a povezani su s matičnom stanicom tankom i vrlo kratkom rijetko uočljivom drškom (Tab. I, sl. 3, tab. II, sl. 3). Ovi ogranci ponekad su nešto deformirani u svom vanjskom dijelu. Zbog izrazitog napuknuća djeluju gusto pakirani s malo slobodnog međuprostora i često s međusobnim dodirom ogranaka istog i susjednih pršljena. Detaljna promatranja pokazuju da su sporangijske šupljine obavijene tankom, teško uočljivom tamnom linijom podjednake debljine, koju izgrađuje mikrokristaliničan kalcit što odgovara kalcitizaciji primarne ovojnice. U šupljinama sporangijskih ogranaka zapažaju se dvije zone kalcitizacije (dvije generacije kalcita). Prva uz unutrašnji vrh izgrađena od sitnozrnatijeg kalcita, često zupčasta, predstavlja prvu fazu ispunjavanja i sporangijske šupljine, i druga koja zaprema središnji dio šupljine u kojoj se nalaze krupna zrna kalcita od jednog do četiri, rjeđe više (Tab. I, sl. 3–4, 9). Za razliku od sporangijskih ogranaka koji su redovito u cjelini zahvaćeni kalcitizacijom, sterilne ogranke, koji su razvijeni naizmjenično s fertilnim čini se da kalcitizacija zahvaća nejednako i redovito tek nakon prve trećine njihove ukupne dužine (Tab. I, sl. 1–3, 5–6, 10, 13). Iz ovog razloga, općenito teško, i na malom broju primjeraka, uočljivi sterilni ogranci u samom početku promatranja ove forme nisu jasno zapaženi i na njihovo postojanje sugerirale su tek neredovito prisutne pore manjih dimenzija locirane između sporangija. Sterilni ogranci su razgranjeni i jasno se razlikuju primarni od sekundarnih (Tab. I, sl. 1–2, 5–6). Primarni su kijačastog oblika (Tab. I, sl. 1, 6), a najčešće zbog vjerojatno nepotpune kalcifikacije u proksimalnom dijelu njihove komunikacije s matičnom stanicom posredstvom male pore samo je objektivna pretpostavka. Necjelovita i nejednaka kalcitizacija ovojnice sterilnih ogranaka logično objašnjava slabu uočljivost ili izostanak sitnih pora između sporangija u njihovom proksimalnom dijelu odnosno dubljem tangencijalnom presjeku (Tab. II, sl. 1–2). Primarni sterilni ogranci prošireni prema vanjskom kraju dužinom nadrastaju sporangije i u tangencijalnim presjecima blizu vanjske površine manifestiraju se porama manjeg dijametra u odnosu na dijametar sporangija. Na svakom primarnom sterilnom ogranku s distalnog kraja izrastaju 4–5 sekundarna ogranka koji se prema vanjskoj površini sužuju (Tab. I, sl. 1–2, 5–6). Sekundarni ogranci najčešće su samo fragmentarno očuvani i vidljivi kao nejasni obrisi žućkastih nepravilnih kalcitnih nakupina u vanjskom tamnom mikritnom prstenu (Tab. I, sl. 11, Tab. II, sl. 1). I fertilni i sterilni ogranci su u odnosu na uzdužnu os okomiti ili što je rjeđe slučaj skoro okomiti. Naizmjeničan raspored fertilnih i sterilnih ogranaka unutar istog pršljena (Tab. I, sl. 2,5) evidentiran je i u odnosu ogranaka susjednih pršljena pa je tipično cilindroporelski. Zbog proširivanja sporangija dolazi ponekad do njihovog međusobnog stiskanja pa i do manjih deformacija čime se, ali ne bitno, narušava njihov u presjeku dosta pravilan kružni izgled (Tab. I, sl. 4, Tab. II, sl. 1–2). Iz istog razloga položaj primarnih sterilnih ogranaka nije uvijek u zamišljenom središtu između četiri sporangija, već se umeće u najširi prostor, što može narušiti geometrijski pravilan raspored i dati dojam ekscentričnosti. Sitne spore pojedinačno su primjerene u sporangijskim šupljinama.

Dimenzije su navedene u engleskom tekstu.

Sličnost i razlike: Opisana vrsta *Cylindroporella bradarici* n.sp., posjedovanjem fertilnih i sterilnih ogranaka, njihovim oblikom i međusobnim rasporedom uključuje osnovne i najbitnije odlike roda *Cylindroporella* uz razlike koje ju diferenciraju od ostalih do sada opisanih vrsta ovoga roda. Prema tipskoj vrsti *C. barnesii* Johnson (1954), kojoj je prvobitno i bila pripisana (Velić & Sokač, 1978) *C. bradarici* pokazuje razlike u većoj vrijednosti vanjskog dijametra, broju fertilnih ogranaka jednog pršljena koji kod *C. barnesii* iznosi 6 dok kod ove vrste varira od 4 do 6, a najčešće iznosi 5. Ova odlika izražena je kao razlika i prema vrstama *C. arabica* Elliott, (1957), *C. sugdeni* Elliott, (1957), *C. parva* Radoičić, (1983), *C. beniezarensis* Fourcade et al. (1972), *C. elassonos* Johnson (1965), koje se međusobno razlikuju u vrijednosti pojedinih dimenzija, što često dovodi u sumnju mogućnosti i opravdanost njihovog diferenciranja (ukoliko dvije posljednje navedene i smatramo validnim?). *C. bradarici* n.sp. varijabilnim brojem fertilnih i sterilnih ogranaka u pršljenu podudarna je vrsti *C. kochanskyae* Radoičić, (1970) s kojom pokazuje i slične varijabilnosti mjerenih elemenata premda su u ove vrste variranja u širem rasponu nego što je to kod *C. bradarici*. Vidljiva razlika između ovih dviju vrsta izražena je u usporedbi primarnih sterilnih ogranaka koji su kod *C. kochanskyae* relativno krupni i valjkastog oblika prema nešto proširenu na distalnom kraju, za razliku od *C. bradarici* kod koje su izrazito kijačasti i u pravilu duži od sporangija. Do sada rijetka i općenito slabo poznata vrsta *C. arsici* Radoičić (1971) oštro se diferencira od *C. bradarici* s tri do četiri puta većim vanjskim i unutrašnjim dijametrom talusa te dvostruko većim brojem ogranaka u pršljenu kao i izgledom primarnih sterilnih ogranaka. Od nedavno opisane vrste *Cylindroporella lyrata* Masse & Luperto Sinni (1989), *C. bradarici* razlikuje se ukupno znatno manjim dimenzijama, različitim oblikom fertilnih i sterilnih ogranaka i njihovim brojem u jednom pršljenu i nedostatkom izrazitog vapnenačkog skeleta prisutnim u *C. lyrata*. Usporedba *C. bradarici* s vrstom *C. elliptica* Bakalova (1971) ne može biti u potpunosti sprovedena zbog manjkavog opisa i neadekvatne ilustracije *C. elliptica*. Za razliku od *C. bradarici*, kod *C. elliptica* prisutnost vapnenastog skeleta je evidentna. Neovisno od prethodno navedenih sličnosti i razlika koje se kod većeg broja do sada poznatih *Cylindroporella* svode na razliku pojedinih dimenzija usporedba kojih pokazuje u graničnim intervalima a često i šire međusobnu podudarnost, *C. bradarici* jasno se diferencira od ostalih odsutnošću vapnenačkog skeleta, odnosno postojanjem samo kalcitizirane ovojnice oko mekih dijelova biljke. Upravo ta odlika *C. bradarici* n.sp. čini ju vrlo sličnom formi koju su Bassoullet et al. (1978, Tab. 31, sl. 7–8) pripisali vrsti *Safartiella dubari* Conrad & Peybernès (*S. dubari* moguće je mladi sinonim vrste *Holosporella*

siamensis (Pia); Conrad & Varol, 1990), s kojom međutim ta forma nije usporediva. Razlika *C. bradarici* prema ovoj formi, u nedostatku adekvatnog opisa, može se dati samo na osnovi vizuelne usporedbe. Kod spomenute forme nema vapnenačkog skeleta već je talus predstavljen kalcificiranom ovojnicom gotovo identično kao i kod *C. bradarici*. Međutim, ova forma čini se ima samo jedan tip mjehurastih nepodijeljenih ogranaka koji su međusobno alternirajućeg rasporeda. Nedostatak sterilnih ogranaka i veći broj fertilnih u pršljenu omogućuje jasno razlikovanje ove dvije forme. U ovoj prilici potrebno je osvrnuti se i na presjek prezentiran od Luperto Sinni & Masse (1984, Tab. 36, sl. 1) označen kao *Montiella? elitzae* (Bakalova) koji je u radu Conrad & Varol (1990) uvršten u sinonimiju vrste *Cylindroporella taurica*. S obzirom da je ilustrirani presjek generalno tangencijalan a tek najnižim dijelom odgovara kosom, bez navedenog opisa i dimenzija teško može biti objektivno uspoređen bilo s vrstom *C. taurica* bilo s vrstom *C. bradarici*. Generalni izgled u vidljivom dijelu tangencijalnog presjeka upućuje samo na identičnost građe talusa s vrstama *C. taurica* i *C. bradarici*.

U momentu kada je ovaj tekst već bio pripremljen, ljubaznošću dr. Conrada primio sam manuskript rada Conrad & Varol (1990) koji se tada nalazio u tisku, s opisom nove vrste *Cylindroporella taurica* Conrad & Varol. *C. taurica*, barem što se tiče generalnog izgleda talusa, načina njegove kalcifikacije, prisutnosti dvije vrste ogranaka i njihovog rasporeda gotovo da je identična vrsti *C. bradarici*. Ovo je bilo razlogom da se neki primjerci u ovom radu uključeni u *C. bradarici* pripišu vrsti *C. taurica* (Conrad & Varol, 1990, sl. 7). No, niz detalja kao i različitost dimenzija, objektivno i u skladu s već usvojenim kriterijima međusobnog razlikovanja pojedinih vrsta roda *Cylindroporella*, jasno diferenciraju i ove dvije vrste. Iz usporedne tablice dimenzija ovih dviju vrsta vidljivo je da unatoč preklapanja u graničnom intervalu maksimalnih vrijednosti za *C. bradarici* i minimalnih za *C. taurica*, vrsta *C. taurica* dimenzijama nadmašuje *C. bradarici*. Izrazitija razlika između ovih vrsta, a što ne može biti uvjetovano dimenzijama talusa, očituje se u broju ogranaka jednog pršljena koji kod *C. bradarici* iznosi 8 do 12 (najčešće 10), odnosno 14 do 18 kod *C. taurica* (navedene vrijednosti odgovaraju ukupnom broju ogranaka, fertilni plus sterilni prvog reda). Sporangijski ogranci u *C. bradarici* izrazitije su sferični i manje deformirani nego što su to kruškoliki u *C. taurica*. Vidljiva razlika postoji i u obliku sterilnih ogranaka prvog reda koji su prema opisu i onom što se vidi na holotipu (Conrad & Varol, 1990, sl. 4) izrazito lijevkasti s postupnim širenjem prema vanjskom kraju i s maksimalnim dijametrom koji se u pojedinim slučajevima približava dijametru sporangija, ili, štoviše, njihov maksimalni dijametar prelazi vrijednost minimalnog dijametra sporangija, što nikada nije slučaj kod *C. bradarici*. U *C. bradarici* sterilni ogranci prvog reda finije su građe i naglijeg zadebljanja na distalnom kraju, pa se jasnije diferencira držak od većeg ili manjeg napuknuća distalnog kraja (Tab. I, sl. 1–2). U usporedbi sterilnih ogranaka prvog reda postoji također vidljiva razlika u pogledu njihove dužine koja je kod *C. taurica* identična dužini sporangija, dok kod *C. bradarici* sterilni ogranci za četvrtinu do petinu svoje dužine nadrastaju sporangijske ogranke, odnosno oni su u pravilu duži od sporangija (Tab. I, sl. 1–2, 4–5). U *C. bradarici* evidentno su na primarnim sterilnim ograncima prisutni sekundarni ogranci, koji, čini se, iz zajedničkog ishodišta prošireni su u bazi a stanjuju se distalno. Kod *C. taurica* ovi ogranci nisu sigurno zapaženi, premda njihove tragove možemo prepoznati u obliku kalcitnih zrna ili nepravilnih kalcitnih oaza unutar tamne zone koja obavija talus, pa je njihova prisutnost vrlo vjerojatna. O njihovom izgledu i načinu izrastanja s distalnog kraja primarnih ogranaka moglo bi se samo nagađati, a na osnovi nekih detalja na holotipu (Conrad & Varol, 1990, sl. 4) čini se da izrastaju prstoliko odvojeni od same baze, a ne u snopiću kao kod *C. bradarici*. Na osnovi iznijetog, velike sličnosti ali i postojećih razlika, validnost obih vrsta prema postojećim kriterijima ne bi smjela biti dovedena u pitanje.

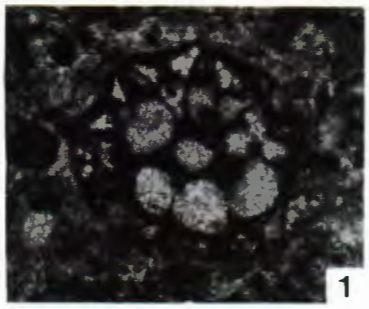
Za neke vrste koje ovdje nisu spomenute, kao što su *C. texana* Johnson, *C. adducta* (Maslov), *C. maslovi* Srivastava, kojima treba pribrojiti i *C. elassonos* Johnson ili neadekvatne presjeke pripisane pojedinim vrstama roda *Cylindroporella*, usvaja se mišljenje Conrada & Varola (1990), prema kojima opisi i ilustracije tih vrsta nisu dovoljni za usporedbu, ili (*C. maslovi*) predstavljaju sinonime postojećih vrsta.

Stratigrafski položaj: Nalaz vrste *Cylindroporella bradarici* n.sp. na topotipskom lokalitetu potječe iz pločastih mikrita koji su na osnovi ukupne zajednice fosilnih mikroorganizama stratigrafski pripisani graničnom intervalu donji-gornji alb. Iscrpna lista fosilne zajednice navedena je u radu Velić & Sokač (1978) i ponovno u okviru opisa *C. taurica* Conrad & Varol (1990).

PLATE – TABLA I

1–15. *Cylindroporella bradarici* n. sp.

1–3, 5, 10, 13.	Cross sections (poprečni presjeci); x 57
4, 9.	Tangential sections (tangencijalni presjeci); x 57
6.	Oblique section – Holotype (kosi presjek – holotip); x 57
7–8, 11–12, 14–15.	Oblique sections (kosi presjeci); x 31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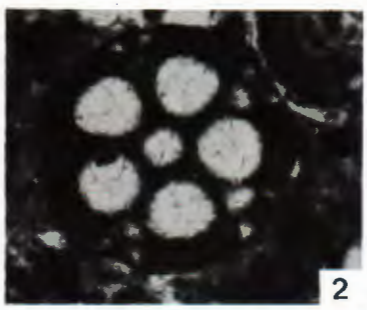
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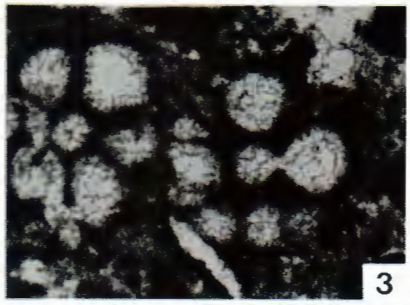
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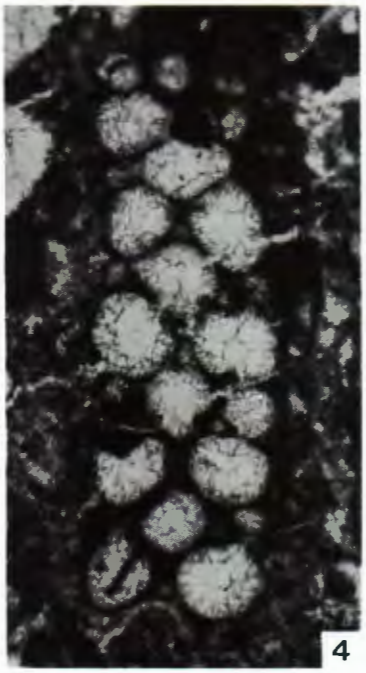
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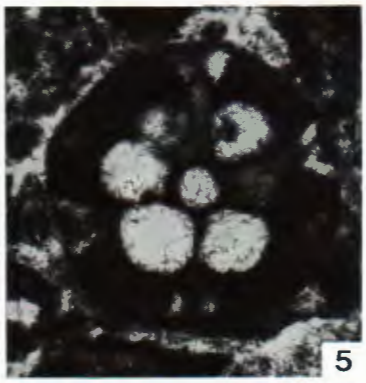
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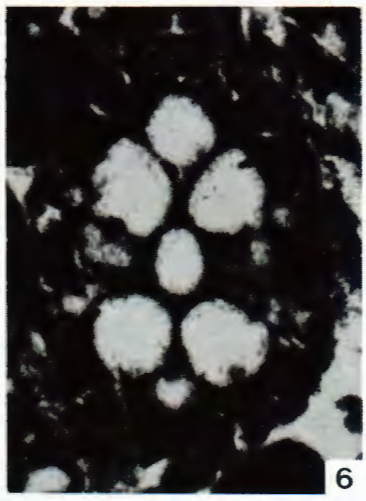
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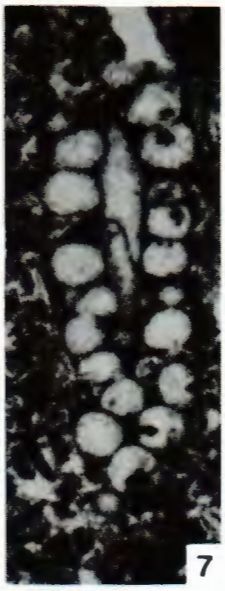
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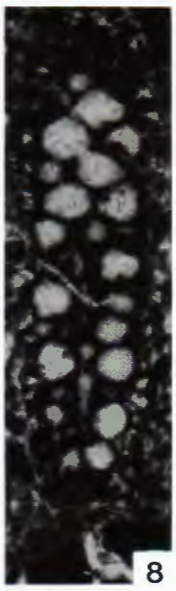
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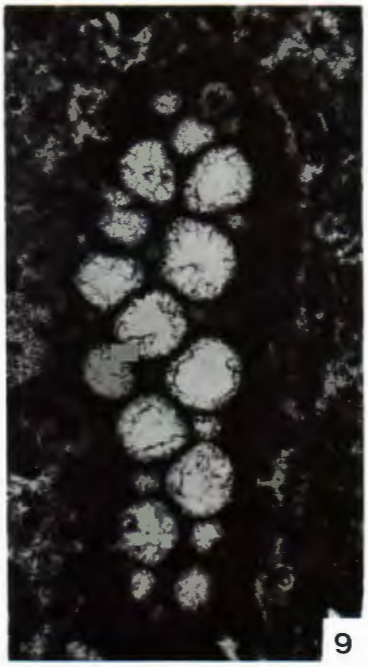
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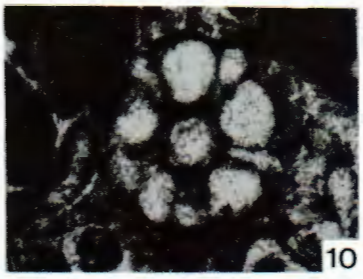
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13


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15

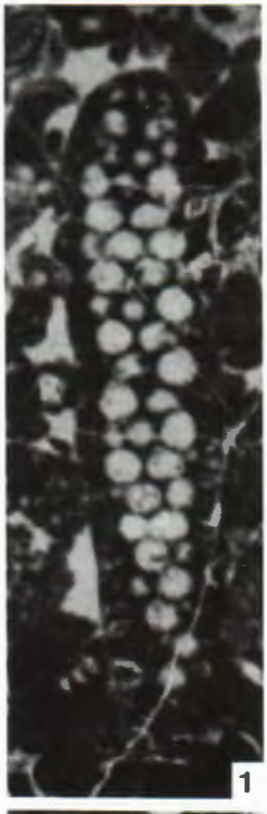
PLATE – TABLA II

1–6. *Cylindroporella bradarici* n. sp.

1–2, 5. Tangential sections (tangencijalni presjeci); x 31

3. Longitudinal section (uzdužni presjek); x 31

4, 6. Oblique sections (kosi presjeci); x 31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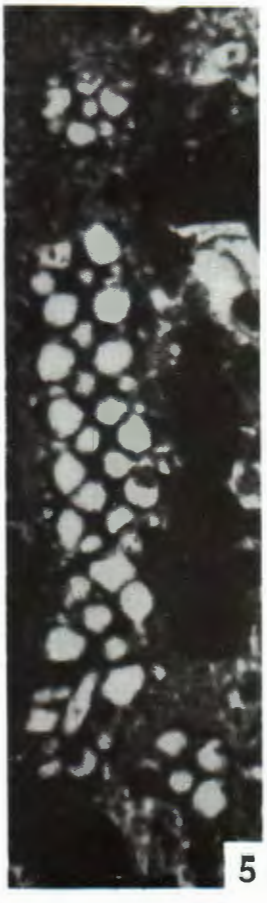
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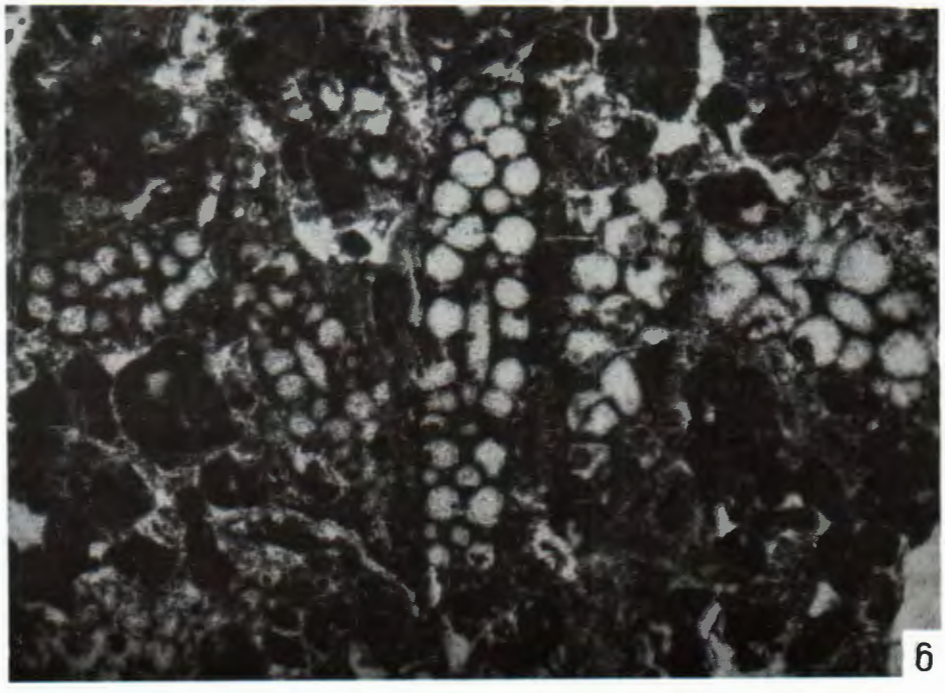
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