

Clypeina radici n. sp. (Calcareous algae; Dasycladaceae) from the Neocomian of the Coastal Part of the Outer Dinarides

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A new species of tiny calcareous algae is described and attributed to the genus *Clypeina* (*C. radici* n. sp.) on the basis of the shape of its undivided ramifications, their position in widely spaced whorls, and the characteristics of the calcareous skeleton. The new species has been found at several localities in the Neocomian carbonate deposits in the central and southern parts of the coastal part of the Outer Dinarides.

Opisana je nova vrsta izrazito sitne vapnenačke alge, koja je na osnovi slika nepodijeljenih ogranaka, njihovog položaja u razmaknutim pršljenima i karakteristikama vapnenačkog skeleta uvrštena u rod *Clypeina* (*Clypeina radici* n. sp.). Vrsta je nađena na više lokaliteta u karbonatnom neokomu središnjeg i južnog dijela Dinarida.

INTRODUCTION

Extensive investigations aiming at a more detailed lithostratigraphic and biostratigraphic analysis of the Jurassic and Lower Cretaceous carbonate deposits in the southern coastal and island parts of the Dinarides, carried out through several years, have locally yielded, among other things, rich fossil finds. This fossil material contains both calcareous algae and foraminifers, among which it is possible to distinguish (1) remains of already known species which are, moreover, frequently found in that region; (2) remains of already known species but which have not, so far, been found in that region; and (3) remains which cannot be ascribed to any taxon described so far. Moreover, detailed observations in normal successions of beds with good outcropping conditions enabled the tracing of the first occurrences and of the extinctions of individual species at separate localities, the insight into the entire fossil association in which individual species were thriving and into the sedimentary environment in which these species have been found. From the very beginning, particular attention has been devoted to that part of the uninterrupted sedimentary succession, which was situated between the well-documented underlying Upper Malm and the equally well-established overlying Lower Cretaceous. However, differing opinions as to stratigraphic ranges of individual taxa resulted in different interpretations of the Jurassic/Cretaceous boundary in the uninterrupted sedimentary column. This part of the column was most thoroughly sampled in order to obtain an insight into the changing

composition of the entire microfossil association as an indication of occurrences of the new forms, which will dominate and give the characteristic appearance to the oncoming microfossil association. Such a change is marked by the disappearance of the typical Jurassic species and by the appearance of tiny calcareous algae, often with abundant specimens, sometimes accompanied also by fragments of larger forms, to be overlain by deposits with first occurrences of the genus *Cuneolina* and other typically Cretaceous foraminiferal genera. The bed-by-bed sampling within that interval revealed a conspicuous absence of foraminifers and yielded several samples with abundant algal remains (fragments and sections in various state of preservation). Thus the new species, *C. radici*, has first been found as early as 1977 on Mt. Biokovo, but the material collected was too scarce and too badly preserved to enable a description. Afterwards this alga has been found, in fully identical stratigraphical position, not far from the village Zavala in Hercegovina, in the neighbourhood of Osojnik, in the Konavoska Brda Mts., and on the island of Mljet and these finds have made its description possible. Its biostratigraphic value, based on its identical stratigraphical position at the different localities, as well as on its often abundant occurrence, is even more emphasized by the similarity of some of its section with the corresponding sections of *Clypeina? solkani* Conrad & Radoičić, which at the same time casts doubt on the true stratigraphic range of the latter.

Systematic description

Family Dasycladaceae Kützing, 1843

Tribe Clypeineae Bassoullet et al., 1979

Genus *Clypeina* Michelin, 1845

Clypeina radici n. sp.

Origin of the name: the species is named in honour of the Franciscan, Dr. Jure Radić, devoted and meritorious explorer of the recent flora of Mt. Biokovo.

Type locality: outcrops along the road Slano-Zavala, about 2 km before the Zavala village in Hercegovina.

Type stratum: partly recrystallized biointrasparites with abundant algal remains, pelecypod fragments and rare foraminifers, in the level between certainly documented Upper Tithonian and Lower Cretaceous levels.

Holotype: longitudinal-tangential section depicted in Pl. 1, Fig. 1 (slide SZ—179/4, deposited at Institute of Geology Zagreb, collection B. Sokač).

Diagnosis: Calcareous alga with a cylindrical skeleton bearing widely spaced, more or less pronounced, calcified disks, or rings, tapering off at their rims, which — the rings — may be reduced to slight swellings at the position of whorls. Simple, undivided ramifications are arranged in single-rowed whorls, spaced widely apart (in relation to the overall

dimensions), this being one of the main characteristics of the new species. The main stem shows more or less pronounced widenings at the inner side of the whorls.

Description: a large number of variously oriented, though not always well-preserved, sections shows this alga to be unbranched, with a simple, cylindrical calcereous skeleton bearing on its outer surface more or less pronounced, distally thinned, calcitic rings or else only slight calcitic swellings of the skeleton, corresponding to the whorls of ramifications. If these calcitic rings are well-developed, with tapering rims and enveloping ramifications staying more or less perpendicularly to the plant's long axis, they assume a disk-like shape, producing a truncated spine in longitudinal sections (Pl. I, figs. 2, 6, 8 upper part of the figure). If the ramifications are situated somewhat oblique, this disk assumes a saucer — or bowl-like shape, respectively, depending on the inclination angle of the ramifications (Pl. II, figs. 2, 5). In specimens with only slightly developed calcite thickenings, instead of well-developed disks, the outer surface of the skeleton appears as a wavy line in longitudinal sections (Pl. II, figs. 1, 4). Some specimens show a more or less bent thallus (Pl. I, figs. 1, 4; Pl. II, figs. 1, 4). Similarly to the variable outer surface, the inner surface of the calcareous skeleton, lining the main stem, also shows a variable outline. While being in all available sections clear and sharp, the inner margin varies, in longitudinal sections from being straight-lined to wavy, this being caused by more or less pronounced swellings of the main stem at the inner side of the whorls, or by its narrowing halfway between two consecutive whorls. The shape of the central cavity (main stem) varies visually in a comparatively broad range from almost undiscernible widenings, resulting in straightlined inner surface (Pl. I, figs. 1, 3—4), to visible but not very pronounced swellings and narrowings (Pl. I, figs. 1, 7—8) to pronouncedly wavy inner surface due to regular alternation of swellings and narrowings along the main stem axis in some specimens (Pl. II, figs. 1—2, 4). The inner diameter varies depending on the position of the section, amounting to about 1/3 of the maximal outer diameter.

Simple, undivided, phloiophorous ramifications are arranged in single-rowed whorls, these being evenly distributed and spaced widely apart along the calcereous skeleton. To each whorl corresponds a calcite ring, starting proximally with a wide basis and gradually tapering outwards, this resulting — with simultaneous slight broadening of ramifications — in the calcareous envelope of individual ramifications becoming distally thinner. Ramifications communicate with the main stem through a tiny pore. In relation to the overall dimensions, visually the most obvious feature is the large distance between the consecutive whorls, giving a high λ/μ value. The position of ramifications in relation to the main stem varies from more or less perpendicular to slightly oblique upwards. The number of ramifications in a whorl varies from 7 to 14. Though the spores have not been detected they are supposed to develop in the main stem, with a possibility of being situated in the distally widened portions of the ramifications.

	Dimensions in mm:	<i>Clypeina ? solkani</i> according to Conrad & Radoičić, 1972
	<i>Clypeina radici</i>	
Maximally observed length (L)	4,05	
Outer diameter (D)	0,47—0,98	0,52—1,20
Inner diameter (d)	0,14—0,30	0,15—0,31
Distance between two consecutive whorls (h)	0,35—0,72	0,32—0,40 sometimes 0,56
Number of ramification in a whorl (w)	7—14	8—16 mostly 10—14

Similarities and differences: The new species is attributed to the genus *Clypeina* on the basis of several characteristic features of that genus: undivided phloiphorous branches, grouped into single-rowed whorls, and the manner of their arrangement along the thallus; calcite saucer — or bowl-shaped rings (= disks) corresponding to the whorls or else calcite swellings on the outer surface of the skeleton. In spite of the variability, which is, in that species, manifested, first of all, by the variable shape of the calcareous skeleton, this species shows nevertheless some specific features that differentiate it clearly from other species of that genus, having the same or similar stratigraphic position. The differences with regard to *C. jurassica* Favre, *C. caliciformis* Nikler & Sokač, *C. catinula* Carozzi, *C. hanabatensis* Yabe & Toyama, *C. inopinata* Favre (probably synonymous with *C. jurassica*; Remane, 1969), *C. marteli* Emberger, and *C. zumetae* Jaffrezo & Fourcade are sufficiently obvious and need not be described in detail. A greater amount of similarity — along with some differences, however — exists with regard to *C. ? solkani* Conrad & Radoičić, which calls for a more detailed analysis, the more so as there is some doubt that *C. radici* has been, in some cases, identified with *C. ? solkani*. Both species have in common the general appearance and are of approximately the same size, which results in approximately identical appearance of certain sections. Therefore the differences between them, enabling their distinction, will be described in more detail.

The most obvious difference is that, in *C. radici*, the distance between the consecutive whorls is, on the average, for 1/3 greater than in *C. ? solkani*, when specimens of about the same size are compared. The next difference consists in the different calcification pattern of the whorls of ramification, which in both species, produces a ring-shaped structure. However, in *C. radici*, that ring starts proximally with a broadened base and tapers off distally, along the rim, giving, in vertical sections — in extreme cases — the appearance of a truncate spine. In *C. ? solkani*, on the contrary, the calcareous envelopes of the individual ramifications do not thicken at their base but, rather, follow the shape of the ramifications, these being in *C. ? solkani* generally pyriform (Conrad & Radoičić, 1972, Pl. II, figs. 2—3) while club-shaped in *C. radici*. This produces a di-

stally widened, funnel-shaped, calcareous envelope of individual ramifications in *C. ? solkani*, resulting, in extreme cases, and coupled with a smaller »h« value in their merging together in the vertical direction, i. e. in connecting the superimposed consecutive whorls distally (at their rims) (Conrad & Radoičić 1972, p. 91—92, Pl. II, fig. 3). Further on, the ring-shaped envelope, distally more or less widened, of *C. ? solkani*, is homogeneous along the contact of the neighbouring ramifications within a whorl (up to one half or two thirds of the overall length of the ramifications), becoming, more distally, individualized for each ramification separately, a feature that has never been observed in *C. radici*. The differences concerning the calcareous rings (= envelopes of the whorls) are particularly well pronounced with regard to those specimens of *C. radici* in which the ring-shaped envelopes of the whorls are reduced to mere thickenings of the calcareous skeleton at the issuing places of the whorls. As a consequence of the above mentioned differences in the calcification pattern of the outer envelope, along with somewhat more intense calcification of the entire skeleton, the isolated whorls (= calcified disks, or rings) are never met in *C. radici*, while that is a rather frequent case in *C. ? solkani*, particularly with high »h« values (compare section in Pl. II, fig. 2A, lower part, with sections in Pl. III, figs. 2 and 3 lower part). Finally, the difference in the shape of the main stem between *C. radici* and *C. ? solkani* is worth mentioning: more or less pronounced swellings and constrictions in *C. radici*, which has not been observed in *C. ? solkani*. In spite of the differences mentioned, the similarity and the close relationship of the two species are beyond doubt. Thus their common occurrence (though rare) in the Upper Neocomian suggests the possibility that *C. radici* represents the older (ancestral?) and probably the more primitive form than *C. ? solkani*. A phylogenetic connection between the two species seems likely. Another form, which should be briefly mentioned here, is *C. somalica* Conrad et al. This species is similar to *C. radici* as regards some dimensions, but otherwise shows clear differences which make the confusion of the two species impossible.

Stratigraphic position: As has already been mentioned in the introduction, *C. radici* has most frequently been found in a horizon which is supposed to belong to, or could be with certainty established as, the lowest part of the Lower Cretaceous — Beriasian. The topotype locality also belongs to this stratigraphic level. The position of the samples containing *C. radici* is about 70 m above the last occurrence of *Campbelliella striata* (Radoičić) and about 15 m below the first occurrence of *Pseudotextulariella salevensis* Charollais et al. and *Cuneolina* sp. Immediately below the sample with figured specimens, debris of *C. radici* has been found accompanied with *Salpingoporella annulata* Carozzi, rare sections of *Salpingoporella katzeri* Conrad & Radoičić, and fragments of *Lagenoporella sardiniensis* Ott & Flaviani, the latter being certainly established, in that region, in the deposits of the Lower Neocomian. It can be concluded, both from such a position and the presence of the above mentioned fossils in the under- and overlying deposits, that *S. radici* on its type locality is of the lowest Cretaceous — Beriasian — age. On Mt. Biokovo, *S. radici* has been found in the identical stratigraphical position: about 70 m above the last occurrence of *Clypeina ju-*

rassica Favre and accompanied with *Salpingoporella katzeri* and *Lagenoporella? dalmatarum* (Sokač & Velić). In the neighbourhood of the village Gubci (environs of Dubrovnik), small fragments have been found, which could, with due caution, be attributed to *C. radici*, in the levels with *S. katzeri*, their position being here, also, about 70 m above the last occurrence of *Campbelliella striata*. Again in the same stratigraphical position, *C. radici* has been found in the Konavoska Brda Mts. (SE of Dubrovnik) and on the island of Mljet, along the road Sobra — Babino Polje, about 2 km off Sobra. The only one locality which differs from the above mentioned ones is in the village Orah (hinterland of Dubrovnik), where *C. radici* has been found together with typical specimens of *C. ? solkani* (Pl. III, figs. 3, 5) and immediately above *Orbitolinopsis capuensis* (De Castro). From all that, it can be concluded that *C. radici* occurs by far most frequently in the lowest levels of the Lower Cretaceous and consequently can, in association with *S. katzeri*, *S. annulata*, *L. sardiniensis*, *L. ? dalmatarum*, and rare remains of *Pseudoclypeina crnogorica* Radoičić, be considered as an important index fossils for the earliest Lower Cretaceous. However, its presence on the last of the above mentioned localities, together with *C. ? solkani* and immediately above *O. capuensis*, but below the first occurrence of *Salpingoporella melitae* Radoičić, extends its stratigraphical range somewhat more upwards, comprising the entire Neocomian. The specimens from the Upper Neocomian are, in general, smaller and less well developed, which agrees with its possible phylogenetic connection with *C. ? solkani*. Their partly overlapping ranges, along with their similarity, suggest (and even emphasize) the possibility of their confusion (misidentification). Because of that, but also because of the existence of other, as yet undescribed, algae whose transverse and tangential sections are similar to both *C. radici* and *C. ? solkani*, the occurrence of *C. ? solkani* in the Beriasian and the Valanginian, at least in the Dinarides, seems unlikely, the more so since the figured by Conrad & Radoičić (1972, text-fig. 3) under the name of *C. ? solkani* cannot be identified with the forms figured in their Plate 2, figs. 1—4. Moreover, determinations based only on transverse sections or isolated whorls cannot be taken as valid. However the large variation range of *C. ? solkani* in our material should also be emphasized, concerning, first of all, the overall dimensions, but always being characterized by constantly pyriform ramifications, i. e. by distally widened, funnel-shaped, calcareous envelope of the whorls. All that discloses the necessity of further detailed elucidating of stratigraphical ranges of individual taxa, coupled with precise and reliable identifications.

Remark: Forms originally described as *Clypeina delmatarum* Sokač & Velić and *Coniporella piriformis* Sokač & Velić are considered by Ott & Flaviani (1983) to represent different parts of the same species, in that the form described as *C. piriformis* represents piriform, bulbous ramifications torn off of the main stem, described itself as *C. delmatarum*. Following that line of reasoning, *Lagenoporella delmatarum* (Sokač & Velić) Ott & Flaviani n. comb. has been established. A bit later, Masse et al. (1984) have recognized — quite correctly, to be sure — that *C. piriformis* represents the same organism that has been described by Radoičić (1967) as *Lacrymorphus cate-*

naeformis (considered by that author to be a microproblematicum). At the same time, Masse et al. (1984) proposed an emendation of the generic diagnosis of the genus *Humiella*, which should now be characterized by having perforated bulbous ramifications. So far, so good. However, Masse et al. (1984) pushed their point still further — too far, in my opinion — concluding that *Lacrymorphus catenaeformis* Radoičić, *L. barremianus* Dragastan (1971), *Coniporella piriformis*, and *Humiella teutae* all represent one and the same organism, which, according to the authors, should be named *Humiella catenaeformis* (Radoičić) Masse, Acquaviva & Luperto-Sinni n. comb. Our recent investigations, carried out subsequently in accordance with the aforementioned considerations by Ott & Flaviani (1983) and Masse et al. (1984) and taking in account the emended generic diagnosis of *Humiella*, make the existence of the genus *Lagenoporella* Ott & Flaviani (1983) questionable. However, the newly gathered material containing the form originally described as *L. catenaeformis* — which will be described on another occasion — suggests that the synonymizing of *L. catenaeformis* with *H. teutae* is not justified. Moreover, the present author thinks that *L. barremianus* Dragastan cannot be identified with *L. catenaeformis* and, still worse, *H. teutae*. Since the emendation of *Humiella* by Masse et al. (1984) is based on observations carried out on the material that corresponds to *L. catenaeformis*, and taking in account that I do not accept the synonymizing (on the species level) of *H. teutae* with *L. catenaeformis* — the latter being evidently characterized by perforated main stem and ramifications and belonging, equally evidently, to the dasycladaceans — the question is whether *H. teutae*, too, has perforated ramifications remains, for the time being, unanswered (though the repeated investigation of our material does not exclude such a possibility). Therefore, the species originally described as *Clypeina delmatarum* is here tentatively ascribed to the genus *Lagenoporella* (thus *Lagenoporella? delmatarum*) and following the same criteria — I am inclined to include *Lacrymorphus catenaeformis*, too, in that genus (= *Lagenoporella*). Contrary to that, *Lacrymorphus globosus* Radoičić (1967) and *L. barremianus* Dragastan (1971) still considered problematical, because perforated ramifications and main stem — that being one of the main characters of the genus *Lagenoporella* — are clearly visible in Ott's & Flaviani's (1983) material, while being unclear in *Humiella*. The latter genus, however, is distinct from *Sarfatiella* Conrad & Peybernès (1973). Further detailed investigations are admittedly needed which would — it is hoped — help in resolving some questions still left open and/or bring the necessary corrections into where the relationships are not — for the time being — clearly and unequivocally defined.

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Clypeina radici n. sp. (Dasycladaceae) iz neokoma priobalnog dijela Vanjskih Dinarida

B. Sokač

UVOD

Višegodišnja istraživanja s ciljem detaljnijeg litostratigrafske i biostratigrafske analize karbonatnih naslaga jure i donje krede južnog priobalnog i otočnog dijela Dinarida rezultirala su, među ostalim, i mjestimičnim nalazom obilnog fosilnog materijala. U ovom materijalu, koji objedinjuje vapnenačke alge i foraminifere moguće je razlikovati: ostatke poznatih vrsta relativno učestalih u ovom području, ostatke poznatih vrsta, ali dosada neutvrđenih u ovom području i najzad ostatke koji se ne mogu pribrojiti dosada opisanim taksonima. Osim ovoga, detaljna promatranja u dobro otkrivenim profilima s evidentnim normalnim slijedom naslaga omogućila su praćenje prvih pojava i nastajanja pojedinih vrsta na pojedinim lokalitetima, uvid u izgled cjelokupne zajednice unutar kojih pojedine vrste egzistiraju, te okoliš sedimentacije u kojem su utvrđene vrste nađene. U sklopu ovih radova već od samog početka istraživanja posebnu pažnju privlačio je dio naslaga smješten između pouzdano dokazanog gornjeg malma u podini i sigurno utvrđene donje krede u krovini. Međutim, različita mišljenja o stratigrafskom rasponu pojedinih taksona uvjetovala su i različito shvaćanje položaja granice jura-kreda u stupu kontinuiranog slijeda naslaga. Iz ovog razloga velikim brojem analiza praćen je sastav i izgled cjelokupne fosilne zajednice s ciljem da se uoče bitnije promjene kao iradikacija pojave novih forma, koje će dati i novo obilježje nastupajućoj fosilnoj zajednici. Takva promjena markirana je nestankom tipičnih jurskih vrsta te nastupom algalne zajednice pretežno sitnih vapnenačkih alga često brojnih individua, ali mjestimično i obilnim kršjem krupnih, iznad kojih slijede i prve pojave predstavnik roda *Cuneolina* kao i drugih za kredu značajnih foraminifera. Promatranja unutar tako označenog intervala s evidentnim pomanjkanjem foraminifera, vršena od sloja do sloja i u različitim dijelovima pojedinih slojeva, omogućila su nalaz i takvih uzo-

raka koji su sadržavali obilje ostataka različitih vapnenačkih alga prezentiranih kršjem i presjecima različitog stupnja očuvanosti. Često loše očuvan i rekristaliziran fosilni materijal, kao što je to bio slučaj s prvim nalazima *Clypeina radici* n. sp. u Biokovu još 1977. g., odgađao je njezin prikaz do neke druge prilike. Ponovni nalaz ove iste alge u stratigrafski potpuno identičnoj poziciji nedaleko zaseoka Zavala u Hercegovini, pa zatim široj okolini Osojnika, Konavoskim brdima i najzad na otoku Mljetu omogućio je da se pristupi njezinom opisu. Biostratigrafska vrijednost ove alge, koja proizlazi iz spomenute identične stratigrafske pozicije na navedenim lokalitetima kao i česte brojnosti njezinih individua, naglašena je i sličnošću nekih njezinih presjeka s istovrsnim presjecima vrste *Clypeina ? solkani* Conrad & Radoičić, što dovodi u pitanje utvrđivanje stvarnog stratigrafskog raspona ove posljednje.

Familija: Dasycladaceae Kützing, 1843.

Tribus: Clypeineae Bassoullet et al, 1979.

Rod: *Clypeina* Michelin, 1845.

Clypeina radici n. sp.

Podrijetlo imena: vrsta je posvećena predanom i zaslužnom istraživaču recentne flore Biokova dr. Fra. Juri Radiću.

Tipični lokalitet: izdanci uz cestu Slano—Zavala oko 2 km prije zaseoka Zavala u Hercegovini.

Tipični slojevi: dijelom rekristalizirani biointraspariti s brojnim ostacima alga, kršjem školjkaša i rijetkim foraminiferama u nivou između sigurno utvrđenog gornjeg tibona i pouzdano dokazane donje krede.

Holotip: uzdužno tangencijalni presjek prikazan na Tab. I. sl. 2 sadržan u preparatu SZ-179/4.

Dijagnoza: Vapnenačka alga cilindričnog skeleta s više ili manje razvijenim, prema obodu istanjenim ovapnjenim prstenima ili tek neznatno naglašenim odebljanjima u nivou pršljena. Jednostavni nepodijeljeni ogranaci smješteni su u jednoređne, i s obzirom na ukupne dimenzije, izrazito razmaknute pršljene, što je i jedna od osnovnih odlika nove vrste. Matična stanica pokazuje jače ili slabije izraženo proširivanje u nivou pršljena.

Opis: Veći broj različitih orijentiranih presjeka, ali nažalost i ne uvijek u stanju dobre očuvanosti, prezentira nam ovu algu kao nerazgranjenu, s jednostavnim cilindričnim skeletom kojega na vanjskoj površini odlikuju više ili manje razvijeni distalno istanjeni kalcitni prsteni, ili njihna odgovarajuća vapnenačka odebljanja skeleta u nivou pršljena. U slučaju intenzivno razvijenih kalcitnih prstena i njihovog uočljivog distalnog stanjivanja, uz približno okomiti položaj ogranaka na uzdužnu os biljke, ovi prsteni imaju izgled diska, a u uzdužnom presjeku tupog trna (Tab. I., fig. 2, 6, 8 u gornjem dijelu slike), odnosno kod kosog položaja ogranaka taj prsten poprma izgled tanjura ili plitke zdjelice, ovisno o kutu nagiba ogranaka (Tab. II., sl. 2, 5). Kod primjeraka gdje vapnenačke prstene zamjenjuju više ili manje naglašena odebljanja, vanjska površina skeleta u uzdužnom presjeku oortava se valovitim izgledom (Tab. II., sl. 1, 4). Na stanovitom broju primjeraka zapaža se jače ili slabije povijanje talusa (Tab. I., sl. 1, 4, Tab. II. sl. 1, 4). Slično kao što je varijabilna vanjska površina skeleta, varijabilnim izgledom odlikuje se i unutrašnja površina uz matičnu stanicu. Redovito jasno i oštro ocrtani rub unutrašnje površine varira od približno ravnog do valovitog. Ovo je uzrokovano više ili manje izraženim proširivanjem matične stanice u nivou ogranaka, odnosno njezinim sužavanjem na približno polovini udaljenosti dva susjedna pršljena. Variranje oblika šupljine matične stanice kreće se vizuelno u relativno širokom rasponu od gotovo neuočljivog proširivanja, pa time i ravnog unutrašnjeg ruba (Tab. I., sl. 1, 3—4), preko vidljivog, ali nenaglašenog proširivanja i sužavanja (Tab. II., sl. 1, 7, 8) do jasno valovitog unutrašnjeg ruba kao posljedica pravilnog sužavanja i širenja matične stanice kod pojedinih primjeraka (Tab. II., sl. 1—2, 4). Promjer unutrašnje šupljine ovisno o mjestu presjeka varira i u najširem dijelu zaprema približno 1/3 ukupnog dijametra.

Jednostavni nepodijeljeni ogranaci floiofornog tipa raspoređeni su u jednoređne pršljene, koji su jednolično, pravilno i široko razmaknuti duž vapnenačkog skeleta.

Svakom pršljenu odgovara kalcitni prsten koji se od šire baze postupno stanjuje prema obodu što uz istovremeno distalno lagano proširenje ogranaka uvjetuje tanju kalcitnu ovojnici u vrhu ogranaka. Komunikacijska ogranaka s matičnom stanicom ostvarena je porama vrlo malih dimenzija. U odnosu na cjelokupne dimenzije alge vizuelno je naglašena međusobna udaljenost susjednih pršljenja, odnosno velika vrijednost h . Položaj ogranaka u odnosu na uzdužnu os stabiljike kreće se od subvertikalnog do lagano ustrmljenog prema gore. Broj ogranaka u pršljenu varira od 7 do 14. Premda spore nisu primjećene, pretpostavlja se njihov razvoj u matičnoj stanici kao i mogući smještaj u distalnom proširenju ogranaka.

Dimenzije su prikazane u engleskom tekstu.

Sličnosti i razlike: Opisana vrsta pribrojena je rodu *Clypeina* na osnovi više odlika značajnih za ovaj rod: nepodijeljenih ogranaka floioformnog tipa, grupiranih u jednoređne pršljene i načina njihovog rasporeda duž talusa, vapnenačkih prstena koji odgovaraju pršljenima, a diskoidalnog su ili plitko zdjelicačastog oblika, ili pak njima odgovara odebljanje na vanjskoj strani skeleta. Unatoč varijabilnosti, koja se unutar vrste manifestira prvenstveno promjenjivim izgledom skeleta, ova vrsta pokazuje niz specifičnosti kojima se jasno razlikuje od ostalih vrsta roda *Clypeina* bliskog ili identičnog stratigrafskog položaja. Zbog očitih razlika između *C. radici n. sp.* i *C. jurassica* Favre, *C. caliciformis* Nikler & Sokač, *C. ca tinula* Carozzi, *C. hanabataensis* Jabe & Toyama, *C. inopinata* Favre (vjerojatno sinonim *C. jurassica*, Remane 1969), *C. marteli* Emberger i *C. zumetae* Jaffrezo & Foureade, njihova daljnja detaljnija usporedba nije potrebna. Međutim, *C. radici n. sp.* pokazuje dosta sličnosti, ali i razlika, s vrstom *Clypeina* ? *solkani* Conrad & Radoičić što zahtijeva njihovu iscrpniju međusobnu usporedbu, tim više, jer postoji opravdana sumnja da je u pojedinim slučajevima ovdje opisana vrsta poistovjećena s vrstom *C. ? solkani*. Sličnost ovih dviju vrsta postoji u njihovom općem izgledu, pa i približno identičnim dimenzijama, što ima za posljedicu i približno isti izgled nekih njihovih presjeka. Zbog toga iscrpnije će se prikazati razlike koje omogućuju njihovo razlikovanje. Vrsta *C. radici* razlikuje se od *C. ? solkani* evidentno (približno jednu trećinu) većom udaljenošću susjednih pršljenja, promatrano na primjercima podjednakih dimenzija. Razlika ovih vrsta uočljiva je i u intenzitetu ovaprijenja ovojnice ogranaka stoljenih u vanjski prsten. Dok se taj prsten kod *C. radici* od odebljanog proksimalnog dijela distalno istanjuje, pa ekstremno poprima izgled tupog trna u vertikalnom presjeku, kod *C. ? solkani* vapnenačka ovojnica ogranaka nema tog zadebljanja u proksimalnom dijelu i prema vani slijedi oblik ogranaka koji je kod *C. ? solkani* pretežno kruškastog oblika (Conrad & Radoičić 1972. Tab. II. sl. 2—3), dok je kod ove vrste u pravilu kijačast. Ovo rezultira distalnim proširenjem ovojnice kod *C. ? solkani* da bi se u ekstremnim slučajevima ostvarila mogućnost dodira ovojnice u superpoziciji susjednih pršljenja (Conrad & Radoičić 1972, p. 91—92, Tab. II., sl. 3). Nadalje prstenasta ovojnica više ili manje proširena prema vani kod *C. ? solkani* jedinstvena je na dužini dodira susjednih ogranaka istog pršljenja (do polovine ili dvije trećine ukupne dužine ogranaka) dok se prema vani individualizira za svaki ogranak posebno, što nikada nije slučaj u *C. radici*. Razlika ovih dviju vrsta u pogledu vanjskih prstena naročito je izražena u odnosu na one individue *C. radici*, kod kojih je prstenasta ovojnica zamijenjena odebljavanjem vapnenačkog skeleta u nivou pršljenja. Posljedica navedenih razlika u oblikovanju vanjske ovojnice i nešto jače ovaprijenje cjelokupnog skeleta, očituje se gotovo potpunim izostankom izoliranih pršljenja kod *C. radici*, što inače nije rijedak slučaj za *C. ? solkani* posebno kada je u pitanju visoka vrijednost h (usporedi presjeke Tab. II, sl. 2A niži dio presjeka s presjecima Tab. III, sl. 2 i 3 donji dio presjeka). Na kraju usporedbe ovih dviju vrsta vrijedno je spomenuti i razliku u obliku matične stanice, s više ili manje vidljivim proširivanjem i sužavanjem kod *C. radici* što nije uočeno i kod *C. ? solkani*. Unatoč navedenih razlika nesumnjiva je sličnost i srodnost ovih vrsta, pa njihov, premda rijedak, zajednički nalaz u istom uzorku (iz gornjeg neokoma), sugerira mogućnost da *C. radici* predstavlja stariju i vjerojatno ishodišnu formu za *C. ? solkani*. Manja sličnost, ali samo u pogledu nekih dimenzija postoji između *C. radici* i *C. somalica* Conrad et al., uz inače evidentne razlike koje isključuju potrebu njihove detaljnije usporedbe.

Stratigrafski položaj: Kao što je već spomenuto u uvodnom dijelu, vrsta *C. radici n. sp.*, nalazom na većem broju lokaliteta, najčešće potječe iz nivoa za kojeg se pretpostavlja ili se argumentirano može označiti najnižim dijelom donje

krede — berias. Iz ovog nivoa prikupljeni su uzorci i na topotipskom lokalitetu kojih je položaj u kontinuiranom slijedu naslaga markiran zadnjim nalazom *Campbelliella striata* (Radoičić) oko 70 m ispod, te prvom pojavom *Pseudotextulariella salevensis* Charollais et al. i prvim predstavnicima roda *Cuneolina* oko 15 m iznad uzorka s *C. radici*. Neposredno ispod uzorka iz kojeg je vrsta opisana, njezini fragmenti nađeni su u zajednici s fragmentima *Salpingoporella annulata* Carozzi, rijetkim presjecima *Salpingoporella katzeri* Conrad & Radoičić te fragmentima *Lagenoporella sardiniensis* Ott & Flaviani, za koju je u ovom području utvrđena nesumnjiva prisutnost u naslagama nižeg neokoma. Iz ovakvog položaja, te prisutnosti spomenutih fosila u podini i krovini, može se zaključiti da *C. radici* na topotipskom lokalitetu potječe iz najniže donje krede-beriasa. Identičnog položaja, u zajednici sa *Salpingoporella katzeri* Conrad & Radoičić, *Lagenoporella ? delmatarum* (Sokač & Velić), a oko 70 m iznad zadnje pojave *Clypeina jurassica* Favre, ova vrsta nađena je i u Biokovu. U okolini zaseoka Grebci (šira okolina Dubrovnika), nalazi sitnih fragmenata koji bi se uz nužnu opreznost mogli pribrojiti ovoj vrsti također potječu iz nivoa sa *Salpingoporella katzeri* Conrad & Radoičić, a koji i ovdje leži oko 70 m iznad zadnjih nalaza *Campbelliella striata*. U istoj stratigrafskoj poziciji vrsta je nađena i u Konavoskim brdima (jugoistočno od Dubrovnika) te na otoku Mljetu uz cestu što od Babinog polja vodi za Sobru (oko 2 km prije Sobare). Od dosada navedenog stratigrafskog položaja ove vrste odstupa lokalitet u zaseoku Orah (zaleđe Dubrovnika) gdje je nađena u zajednici s tipičnim oblicima *C. ? solkani* (primjerci na Tab. III. sl. 3, 5) i neposredno iznad nalaza *Orbitolinopsis capuensis* (De Castro). Iz cjelokupne analize položaja na pojedinim lokalitetima može se zaključiti da se ova vrsta dominantno pojavljuje u najnižim dijelovima donje krede za koju je, u asocijaciji sa *Salpingoporella katzeri*, *Salpingoporella annulata*, *Lagenoporella sardiniensis*, *Lagenoporella ? delmatarum*, i rijetke ostatke *Pseudoclypeina crnogorica* Radoičić, značajan biostratigrafski marker nastupa donje krede. Međutim, prisutnost ove vrste na posljednje spomenutom lokalitetu u zajednici s *C. ? solkani*, a neposredno iznad *O. capuensis*, ali ispod prvih pojava *Salpingoporella melitae* Radoičić, proširuje vertikalni raspon *C. radici* na cijeli neokom, premda su primjerci iz gornjeg neokoma sitniji i općenito kržljiviji što također stoji u prilog već navedenoj mogućnosti njezine filogenetske povezanosti s *C. ? solkani*. Ovakav stratigrafski raspon, uz postojeću sličnost *C. radici* s *C. ? solkani*, sugerira i naglašava mogućnost njihove zamjene. Iz ovog razloga, kao i pojava još nedefiniranih alga kojima su poprečni i tangencijalni presjeci slični opisanoj vrsti, ali i *C. ? solkani*, malo je vjerojatno — barem što se tiče područja Dinarida — da je *C. ? solkani* prisutna u beriasu i valensisu. Ovo tim više što se materijal prikazan od Conrad & Radoičić (1972, text. fig. 3) označen vrstom *C. ? solkani* ne može poistovjetiti s materijalom na njihovoj Tab. 2, sl. 1—4, kao što se ne mogu prihvatiti kao validne ni odredbe osnovane sarno na poprečnim presjecima ili izoliranim pršljenima. Međutim potrebno je ukazati i na široki raspon variranja *C. ? solkani* (u našem materijalu) prvenstveno u pogledu općih dimenzija uz uvijek isto oblikovane ogranke krušastog izgleda, odnosno s distalnim proširenjem vapnenačke ovojnice pršljena. Sve ovo ukazuje na nužnost daljnjeg praćenja stratigrafskog raspona pojedinih taksona, s predviđanjem njihove pouzdane determinacije.

Opaska: Originalno opisana *Clypeina delmatarum* Sokač & Velić i *Coniporella piriformis* Sokač & Velić 1981. pretpostavljena je od Ott & Flaviani kao jedinstvena vrsta kod koje oblici označeni kao *Coniporella piriformis* predstavljaju samo kruškaste ogranke prvo spomenute vrste, pa je u kontekstu takvog razmatranja načinjena nov. comb. *Lagenoporella delmatarum*. Nešto kasnije Masse et al. (1984), sasvim ispravno, u vrsti od nas opisanoj kao *Coniporella piriformis* prepoznaju od Radoičić (1967) ranije opisanu *Lacrymorphus catenaeformis* Radoičić, navodeći istovremeno dopunu karakteristika roda *Humiella* kojoj se pridaje i perforacija kruškastih ogranaka. Iz ovoga Masse et al. (1984) izvode zaključak da *Lacrymorphus catenaeformis*, *L. barremianus* Dragastan, *Coniporella piriformis* i *Humiella teutae* predstavljaju jedan te isti organizam kojega ovi autori imenuju *Humiella catenaeformis* (Radoičić). Istraživanja provedena naknadno u okviru navedenih razmatranja Ott & Flaviani (1983) i Masse et al. (1984) uz navod dopune karakteristika roda *Humiella* dovode u pitanje i daljnju potrebu egzistencije roda *Lagenoporella* uspostavljenog od Ott & Flaviani (1983). Međutim, nalaz novog materijala koji se odnosi na izvorno opisanu formu *L. catenaeformis*, a koji će biti prikazan u jednoj drugoj prilici, ukazuje na ne-

opravdanost poistovjećivanja *L. catenaeformis* s vrstom *Humiella teutae*. Također sam mišljenja da objektivno nije moguće pistovjetiti oblik opisan od Dragastan (1971) kao *Lacrymorphus barremianus* Dragastan s *L. catenaeformis*, a ni u kojem slučaju s *H. teutae*. Kako je dopuna roda *Humiella* od Masse et al. dana na osnovi promatranja forme *L. catenaeformis*, a s obzirom da ja ne prihvaćam opravdanost kao ni mogućnost poistovjećivanja *Humiella teutae* s *Lacrymorphus catenaeformis* na kojoj je perforacija stabljike i ogranaka evidentna, kao što je evidentna njezina pripadnost dasikladacejama, pitanje perforacije ogranaka kod *Humiella teutae*, za sada smatram nedovoljno jasnim, premda ponovni pregled našeg materijala sugerira tu mogućnost. Za sada primarno opisanu vrstu označenu *Clypeina delmataiarum* uvjetno pribrajam rodu *Lagenoporella* (*Lagenoporella* ? *delmatarum*) kao što sam sklon da na osnovi istih kriterija formu primarno opisanu kao *Lacrymorphus catenaeformis* Radoičić pribrojim rodu *Lagenoporella*, dok forme *Lacrymorphus globosus* Radoičić i *L. barremianus* Dragastan i dalje smatram problematikom. Ovo iz razloga što je perforacija ogranaka i stabljike kao jedne od primarnih odlika roda *Lagenoporella* neosporno vidljiva na materijalu prezentiranom od Ott & Flaviani (1983), a nedovoljno jasno kod roda *Humiella* za kojeg smatram da se ipak diferencira od roda *Sarfatiella* (Conrad & Peybernes, 1973). Daljnja istraživanja koja su očigledno nužna ostavljaju nam mogućnost kasnije korekcije ovisno o rezultatima i novim spoznajama do kojih će se vjerujem doći.

PLATE — TABLA I

1—8. *Clypeina radici* n. sp.

1. Longitudinal — oblique section (uzdužno-kosi presjek); x 29
- 2—3. Longitudinal — tangential sections, fig. 2 Halotype (uzdužno-tangencijalni presjeci, sl. 2 holotip); x 29
- 4—5. Oblique — tangential sections (koso-tangencijalni presjeci); x 29
6. Oblique section (kosi presjek); x 29
7. Longitudinal section (uzdužni presjek); x 28
8. Longitudinal — oblique section (uzdužno-kosi presjek); x 29

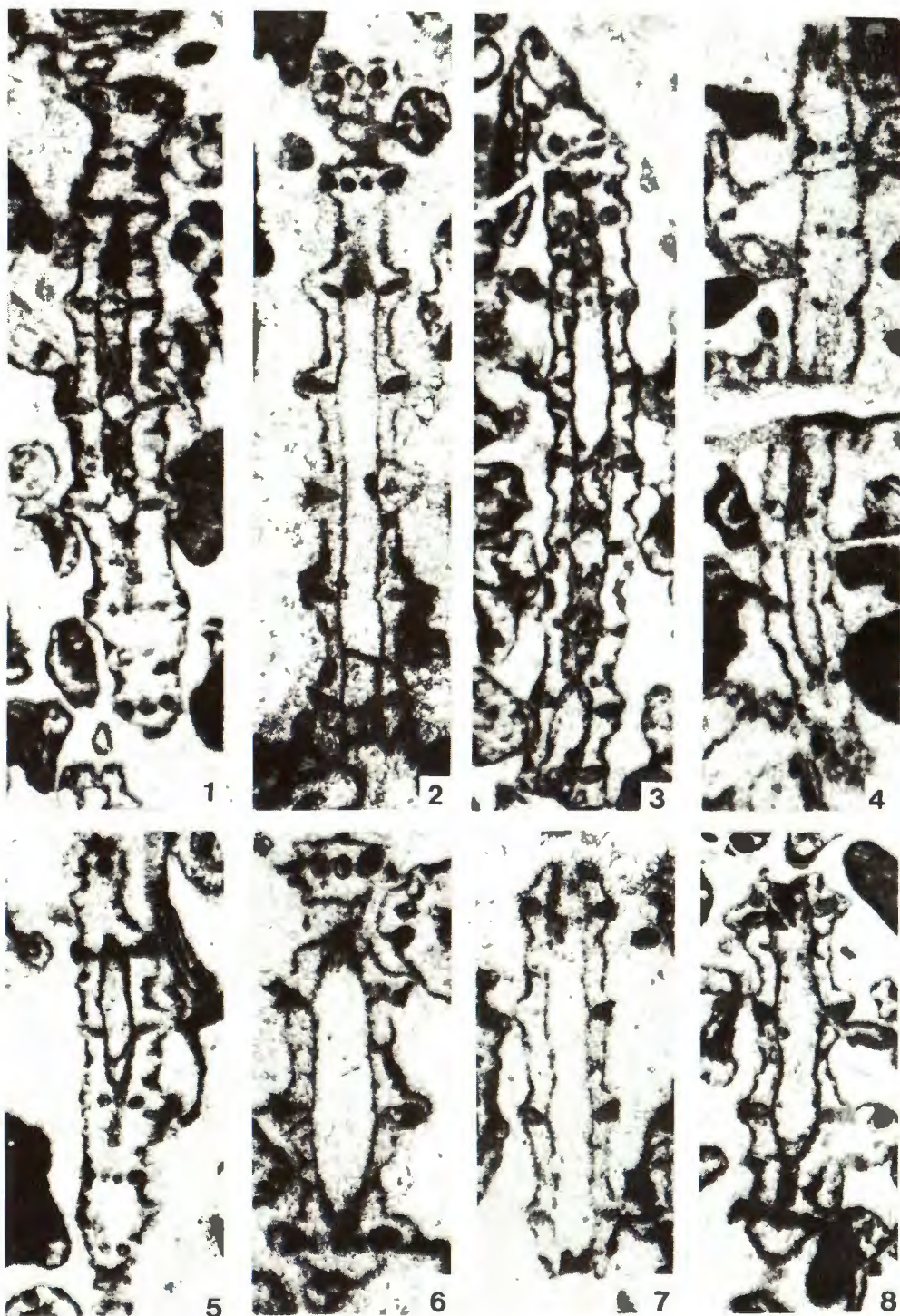


PLATE — TABLA II

1—2, 4—10. *Clypeina radici* n. sp.

1—2, 4. Longitudinal — oblique sections
(uzdužno-kosi presjeci); x 32

3. *Clypeina radici* n. sp. A tangential-oblique section, A' oblique sections,
B *Salpingoporella annulata* Carozzi oblique section
(A tangencijalno-kosi presjek, A' kosi presjeci, B kosi presjek); x 32

5—6. Oblique sections (kosi presjeci); x 32

7—10. Cross sections (poprečni presjeci); x 32

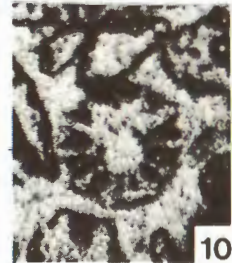
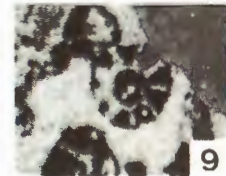
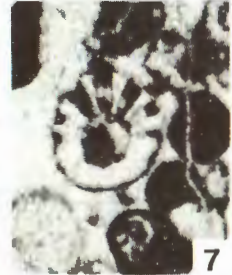
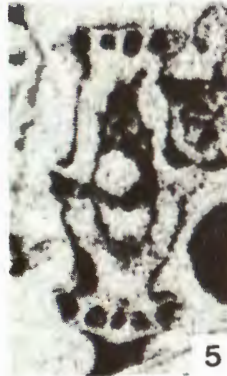
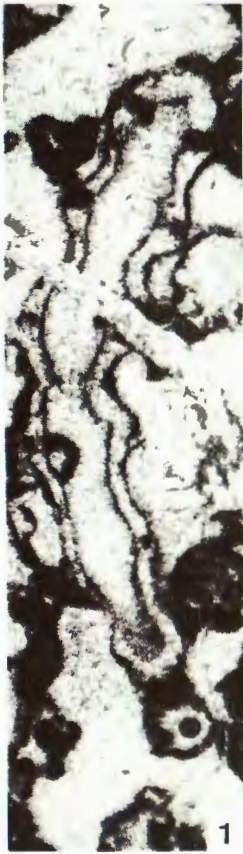


PLATE — TABLA III

- 1—5. *Clypeina? solkani* Conrad & Radoičić
6—7. *A* *Clypeina radici* n. sp., *B* *Salpingoporella katzeri*
Conrad & Radoičić
- 1, 3. Oblique — tangential sections
(koso-tagencijalni presjeci); x 32
2. Tangential section (tangencijalni presjek); x 32
4. Oblique section (kosi presjek); x 32
5. Cross section (poprečni presjek); x 32
6. *A* oblique-tangential section, *B* oblique section
(*A* koso-tagencijalni presjek, *B* kosi presjek); x 32
7. *A* longitudinal section, *B* oblique section
(*A* uzdužni presjek, *B* kosi presjek); x 32

