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CLYPEINA BESICI PANTIĆ (CHLOROPHYTA, DASYCLADALES) FROM THE "RAIBL BEDS" OF THE WESTERN KARAVANKE MOUNTAINS (SLOVENIA)

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Abstract: The find of *Clypeina besici* from the "Raibl beds" of the Western Karavanke Mts, Slovenia, provides supplementary information to the morphology of this Carnian dasyclad species. Segments of thalli (consisting of some tens of whorls), and numerous isolated whorls are preserved as singles, couples and triplets. Besides, two more dasyclad species that differ from *C. besici* are provisionally described with open nomenclature.

Key words: Upper Triassic, Slovenia, Karavanke Mts, "Raibl beds", morphology, Dasycladales, *Clypeina besici*.

Introduction

Thalli of algal order Dasycladales are often encrusted with biogeneously secreted calcium carbonate. They were important rock builders and are notable for reconstructions of past depositional environments. Living representatives mainly inhabit littoral (infralittoral) zones of tropical and subtropical seas, and, according to Meyen (1987), they do not grow at depths below 60 m, but occasionally they can reach 70 to 90 m (de Castro 1997). The size of the dasyclads depends on environmental conditions, and in fossil forms it mostly ranges from a few to 100 mm, yet some representatives are known to attain greater tallus length (Berger & Kaever 1992). Due to articulation in many species, the dasyclad skeleton is subject to postmortem disintegration into segments or isolated whorls. Dasycladales are mostly observed and studied in petrographic thin sections. Finds of isolated Triassic dasyclad taxa, either segments of thalli or whorls, are relatively rare. Kristan-Tollmann (1988) reported only some finds of isolated whorls or fragments of whorls of *Clypeina besici* Pantić collected from different Alpine localities and from Burma; she also noted that her material included an iron oxide cast of a dissolved whorl from Turkey. This algal species has been first described by Pantić (1965) from the Carnian of Montenegro, Yugoslavia. *C. besici* is a well known species due to its wide distribution across the Tethys. According to Ott (1974) and Kristan-Tollmann (1988), it is the zone fossil of the Cordevolian and Julian, but it continues up into the Tuvalian. It is an index species of the taxon-range zone with a confirmed Carnian range (Grgasović 1997).

The material from the Karavanke Mts, Slovenia (Fig. 1), provides supplementary information about the morphological features, both the external and internal structure, of the species *C. besici*. It contains several segments of thalli embeded in slabs of marly limestone. Among them there is also a segment of thallus, over 7 cm long, of exceptional preservation illustrated here for the first time (Fig. 2). There are also many other preserved parts of thalli or their casts. Furthermore, insoluble microfossil residues yield more than a hundred isolated whorls of the genus *Clypeina,* preserved as singles, couples and also some triplets.

Stratigraphy of the "Raibl beds" with *Clypeina* in the Košuta Nappe, Western Karavanke Mts

The Carnian "Raibl beds" of the Košuta Nappe north of Mojstrana attain thickness of some hundred meters (Jurkovšek 1987a,b). It is mainly made up of dark-grey limestone and marly limestone with intercalations of marls. The limestone is platy to thin-bedded, and according to its texture, biomicrite prevails. An internal lamination can be observed in some limestone beds, but rarely calcarenitic or brecciated beds also occur. In the upper part of the Carnian succession,

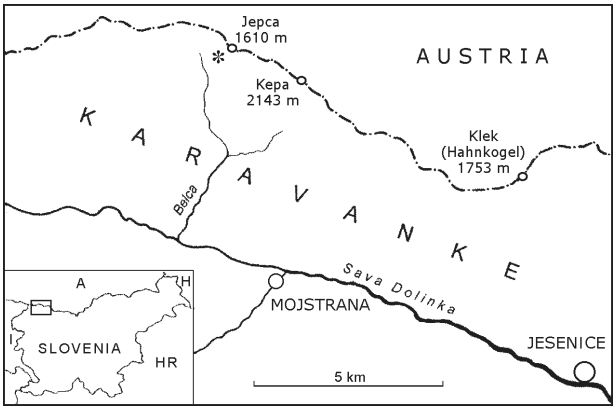

Fig. 1. Geographical sketch map showing position of the studied locality.

which is characterized by frequent *Clypeina* occurrences (segments of thalli and isolated whorls), individual breccia layers occur, 30 to 40 cm thick. Abundant thin-shelled posidonias occur in certain beds (also in beds with *Clypeina*), whereas plant fossils of the genus *Voltzia* (Dobruskina et al. 2001), and well preserved fish with the prevailing genus *Peltopleurus* are frequent in more marly beds. In the lower part of the sequence, ammonoids *Trachyceras aonoides* or *Austrotrachyceras austriacum* were found (Ramovš 1993). Conodont apparatus *Nicoraella*? *budaensis* Kozur & Mostler was also recovered from the succession, 15 m below the beds with algae (Kolar-Jurkovšek & Jurkovšek 1999).

A detailed lithostratigraphic comparison of the Carnian beds with *Clypeina* in the Košuta Nappe of Karavanke Mts with the developments of the Raibl Group (Gruppo di Raibl) in the typical locality of Western Julian Alps (Assereto et al. 1968; Lieberman 1978, 1980; De Zanche et al. 2000) has not been done yet and will be the aim of further studies.

Systematic paleontology

Clypeina besici Pantić in Granier & Deloffre 1995, non 1965
(Fig. 2, Fig. 3.1–9)

For synonymy see Granier & Grgasović (2000, p. 29–30).

Material and repository: Segments of thalli (BJ 1288A, BJ 1288B, BJ 1411B) and casts of thalli (BJ 1412) embedded in the limestone slabs. Isolated whorls, over 60, have been recovered from the microfossil residues collected in the samples GeoZS 3023, GeoZS 3055, GeoZS 3088.

The illustrated and examined specimens marked with BJ have been catalogued and deposited in the Jurkovšek Paleontological collection at Dol pri Ljubljani (Slovenia), registered at the Ministry of Culture of the Republic of Slovenia and the Natural History Museum of Slovenia. Microfossil material marked with GeoZS has been stored at the Geološki zavod Slovenije (Geological Survey of Slovenia).

Description: The species displays a cylindrical thallus with wide central cavity. Whorls, bowl shaped, are arranged at distinct intervals. Simple, undivided branches are arranged in a single row. Branches are evenly distributed along the calcareous skeleton. In the proximal part, branches are closely set parallel to the main axis. Distal part of the branches has radial arrangement and they become gradually thinner towards the distal end. Central cavity is wide; its diameter is constant along the main axis.

Remarks: Segment of thallus, over 7 cm long (BJ 1288A — Fig. 2), of exceptional preservation is preserved on the limestone slab. It has 66 almost completely preserved whorls and at least 3 more partly preserved whorls, the whole set of whorls being interrupted at three places. They are embedded in a sediment to a different degree and are lying in different positions; some are still set in a life position, showing lateral surface of the whorls touching each other, either in part or hardly so; in places, the whorls are turned and shown in transversal view; in between there are whorls in oblique position and they partly cover each other. The number of branches is difficult to count precisely; however, in the whorls with the orientation that allows counting, and depending on the preservation, there are 20 branches per whorl. The longest measured free part of the branch is 0.64 mm long.

Fig. 2. *Clypeina besici* Pantić, external aspect of the thallus (without uppermost portion) in exceptional preservation from Carnian of the Karavanke Mts, Slovenia, sample BJ 1288A. Scale bar = 1cm.

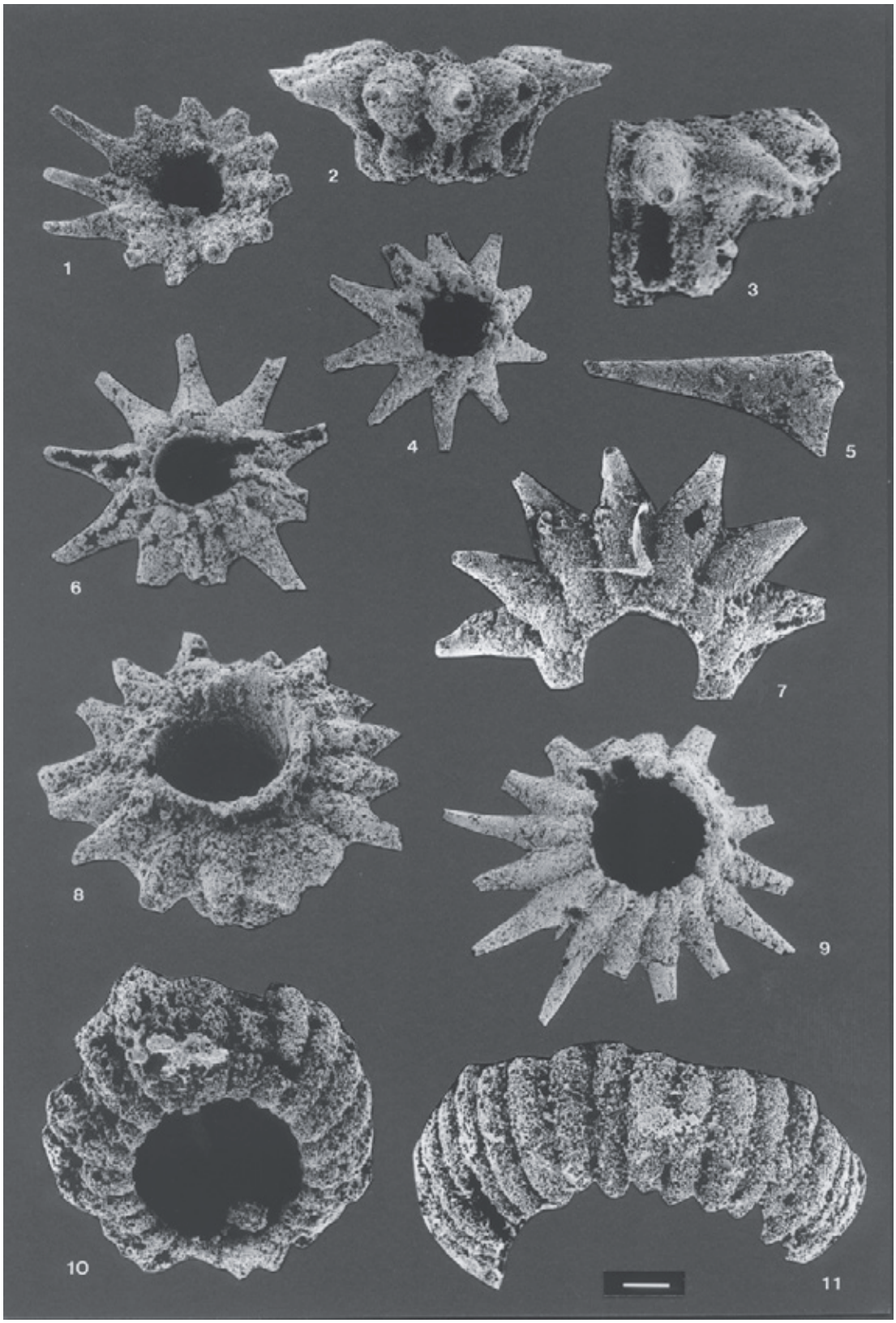

Fig. 3. 1–9: *Clypeina besici* Pantić, Carnian, Karavanke Mts, Slovenia. 1, 2, 4, 6, 8: external aspect of the whorls or their fragments (1,8 — upper views, GeoZS 3023; 2 — lateral view, GeoZS 3023; 3 — lateral view, GeoZS 3055; 4,6,7,9 — lower views, GeoZS 3055). 5: external aspect of the branch, GeoZS 3023. **10, 11:** *Clypeina* sp. B, Carnian, Karavanke Mts, Slovenia — external aspect of the whorls, lower views, GeoZS 3023. Scale bar = 100 μm except in fig. 9 = 200 μm.

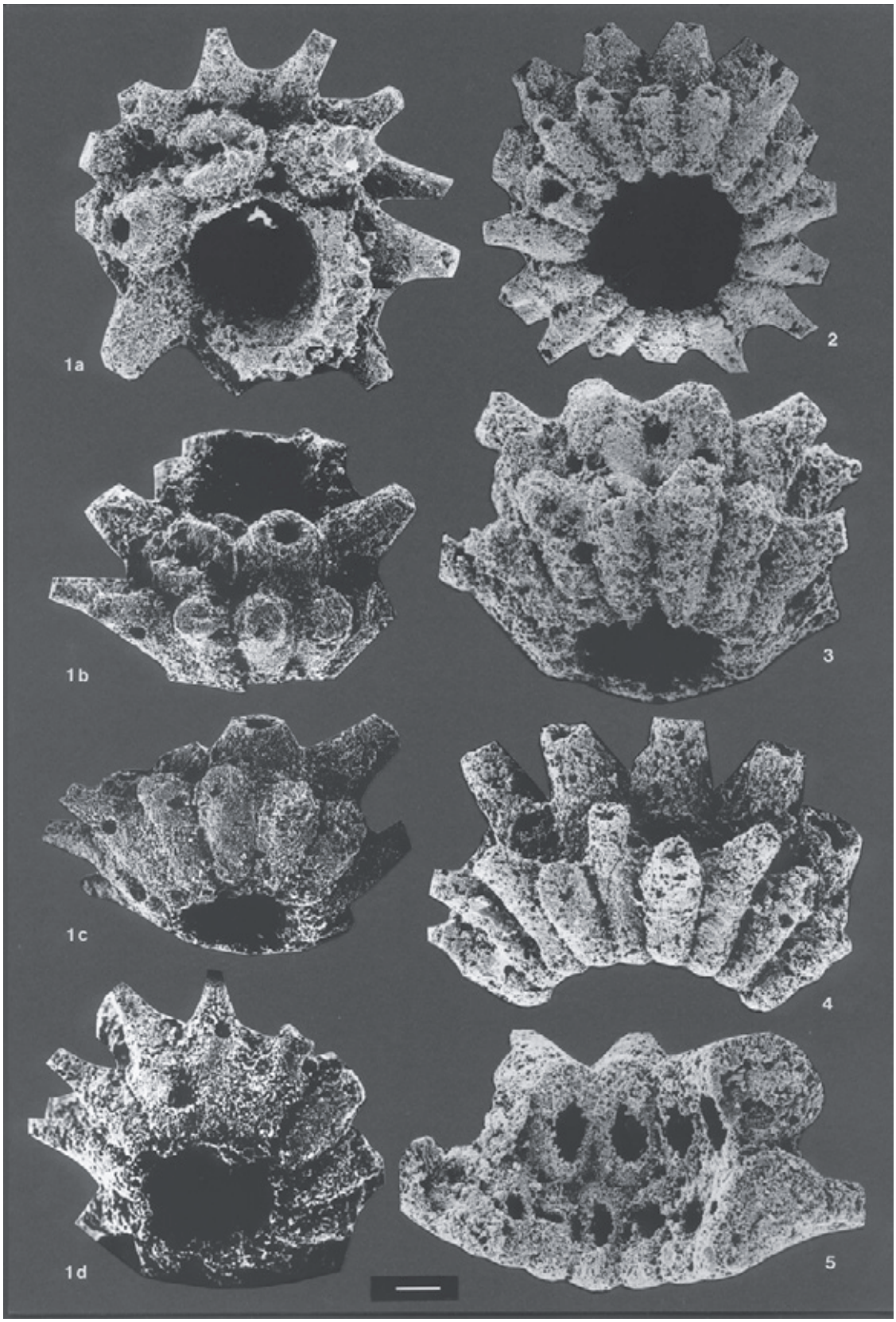

Fig. 4. *Clypeina*? sp. A, Carnian, Karavanke Mts, Slovenia. **1–4:** external aspect of the whorls. 1a–d — specimen shown in *a* — upper, *b* — lateral, *c* — oblique lateral, *d* — lower views, GeoZS 3055; 2 — lower view, GeoZS 3023; 3 — lower view, GeoZS 3055; 4 — oblique lateral view, GeoZS 3055). **5:** internal view, GeoZS 3023. Scale bar = 100 μm.

Measured dimensions in mm: Outer diameter (D): 0.5–2.0; Inner diameter (d): 0.15–0.7; Distance between two consecutive whorls (h): 0.2–1.0; Number of branches in a whorl (w): 10–20.

Clypeina? sp. A
(Fig. 4.1-5)

Material: Over 100 isolated whorls (GeoZS 3023, GeoZS 3055, GeoZS 3088).

Description: Whorls have double row of densely spaced branches. Both rows of branches clearly differ from each other. The lower row is marked by branches that outnumber the branches from the upper one, minimal difference is 2. Therefore, the diameter of the branches in the upper row is greater. The branches are connected with the central cavity by means of relatively large pores; those of the lower row are smaller and more densely spaced than those arranged in the upper row, which are larger and oval in shape. Both rows of branches stand under the same angle to the main axis.

Remarks: The specimens are characterized by whorls with two rows of branches distinguished by their size and number. The thallus of this species probably had the arrangement of whorls with two alternating rows of branches. Therefore it markedly differs from *Clypeina besici* Pantić, which has branches arranged in a single row. The thallus of the latter species reveals whorls with uniform branches that are in their proximal part parallel to the main axis.

At present, it is not possible to ascertain if the "double-row" whorls are segments containing two successive whorls what could be inferred from longer segments of thalli with more consecutive whorls. Therefore, such forms are tentatively attributed to the genus *Clypeina* and described as *Clypeina*? sp. A.

Measured dimensions in mm: Outer diameter (D): 0.45–1.0; Inner diameter (d): 0.15–0.4; Distance between two consecutive whorls (h): 0.25–0.5; Number of branches in a whorl (w): upper row: 8–18, lower row: 10–20.

Clypeina sp. B
(Fig. 3.10,11)

Material: 14 isolated whorls (GeoZS 3023, GeoZS 3055, GeoZS 3088).

Description: The skeleton, or part of it, bears whorls with a large central cavity. Undivided branches, quite delicate and with constant diameter, are densely set in a single row. In places, branches are so dense that they partly cover adjoining ones. The branches in the form of arches embrace the main stem.

Comparison: Whorls determined as *Clypeina* sp. B differ from other isolated whorls from the same samples both in their shape, orientation, and greater number of the branches per whorl. Whorls of another two recognized species, *Clypeina*? sp. A and *Clypeina besici* Pantić, have radially, or partly radially, oriented branches. The whorls of *Clypeina* sp. B resemble the whorls of the Eocene *Clypeina marginoporella* Michelin; however, the branches of the latter species are standing parallel to the main axis.

Measured dimensions in mm: Outer diameter (D): 0.7–1.0; Inner diameter (d): 0.3–0.8; Distance between two consecutive whorls (h): 0.25–0.45; Number of branches in a whorl (w): 14–22.

Conclusion

Micropaleontological study of the "Raibl beds" revealed the presence of the alga *C. besici* in the upper part of the section below Mt Jepca. The collected material includes several segments of thalli (the longest measuring over 7 cm) in the slabs of marly limestone, and it substantially adds to the better understanding of the morphology of this dasyclad alga. The samples, after acid treatment for conodonts, also produced isolated whorls of this alga. *C. besici* is an index species of the taxon-range zone with confirmed Carnian range (Grgasović 1997). The samples of the examined section with dasyclad alga also yield conodont apparatus *Nicoraella*? *budaensis* Kozur et Mock (Kolar-Jurkovšek & Jurkovšek 1999), and thus indicating a possibility for correlation between the algal and conodont Triassic zonations. In addition, the samples also yielded two more dasyclad species that differ from *C. besici* and are provisionally described with open nomenclature.

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