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Neogyroporella? *gawlicki* n.sp., a New Dasycladale from the Upper Jurassic–Lower Cretaceous "Lärchberg Formation" of the Northern Calcareous Alps, Austria

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Key words: Calcareous algae (Dasycladales), Taxonomy, Upper Jurassic, Lower Cretaceous, "Lärchberg Formation", Northern Calcareous Alps, Austria.

Abstract

A new Dasycladale (calcareous green alga) is described as *Neogyroporella*? *gawlicki* n.sp. from the Upper Jurassic–Lower Cretaceous "Lärchberg Formation" of the Northern Calcareous Alps, Austria. It is distinguished from the type-species *Neogyroporella elegans* YABE & TOYAMA (Upper Jurassic of Japan; currently the only representative of the genus), by its distinctly smaller dimensions and a higher number of laterals. The generic attribution of the new taxon is discussed, including similarities/differences to allied genera, especially *Humiella* SOKAČ & VELIĆ. *Neogyroporella*? *gawlicki* n.sp. is so far only known from the Northern Calcareous Alps. In addition, some other Dasycladales accompanying *Neogyroporella*? *gawlicki* n.sp. are also illustrated.

1. INTRODUCTION

The Upper Jurassic to Lower Cretaceous shallow water platform carbonates of the Northern Calcareous Alps (Plassen Formation, "Lärchberg Formation") and the resedimented deposits of the latter within basinal series (Barmstein Limestone, Tressenstein Limestone) are currently under re-investigation (SCHLAGINTWEIT et al., 2003; GAWLICK et al., 2005). This shallow water development is directly linked to tectonic activity in the Western Tethyan domain causing early nappe formations (GAWLICK et al., 1999; FRISCH & GAWLICK, 2003). Already in the Middle Jurassic, the geodynamic and sedimentological framework was mainly governed by the closure of parts of the Tethyan ocean leading to the first thrust nappes and the formation of a rise-and-basin pattern (e.g. GAWLICK et al., 1999). Starting in the southern parts of the Northern Calcareous Alps, the compressional tectonic regime governed uplift processes producing shallowing-upwards successions from basinal to external and finally internal carbonate platform deposits. In the same way as there were different basins with cherty sediments ("radiolarite basins"), the new results show that there was not only one, but several independent areas with shallow water carbonates within the former deeper-marine area (e.g. KÜGLER et al., 2003 – fig. 3; FRISCH & GAWLICK, 2003; GAWLICK & FRISCH, 2003 – for further details, and unpubl. data).

Current research should help to increase the precision of existing palaeogeographic and geodynamic interpretations and models. However, there is still a lack of knowledge of the micropalaeontological composition of these platform carbonates, in contrast to the comparably good data base of the Alpine Triassic. In the course of recent biostratigraphic and microfacies analyses of the Alpine "Upper Jurassic" platform carbonates, a Dasycladacean alga, that has already been figured several times from the Northern Calcareous Alps since the early 1990's as *Macroporella praturloni* DRAGASTAN, has been recognized as a new species and is established as *Neogyroporella*? *gawlicki* n.sp.

2. GEOLOGICAL SETTING

In the Salzburg Calcareous Alps, near the German–Austrian border, there are several isolated occurrences of shallow water limestones known as the "Lärchberg Formation" (FERNECK, 1962), currently a non-formalized unit. For a long time, these carbonates have been assigned to the Triassic, e.g. Dachstein Limestone, and it was FERNECK (1962) who first recognized their Upper Jurassic–Lower Cretaceous age. He proposed the subdivision of the "Lärchberg Formation" into two parts: a clastic basal complex (Lofer beds or L. member) and the Lerchkogel Limestone. These lithologies have been referred to in the works of FERNECK (1962), DARGA & SCHLAGINTWEIT (1991) and DYA (1992). Another Upper Jurassic carbonate platform evolutionary series in the Northern Calcareous Alps is known as the Plassen Formation, with the type-locality Mount Plassen near Hallstatt in the Austrian Salzkammergut (e.g. TOLLMANN, 1976). In contrast to the latter, the "Lärchberg Formation" partly shows a terrigenous influx unknown from the former. However, detailed discussions on their possible correlation are

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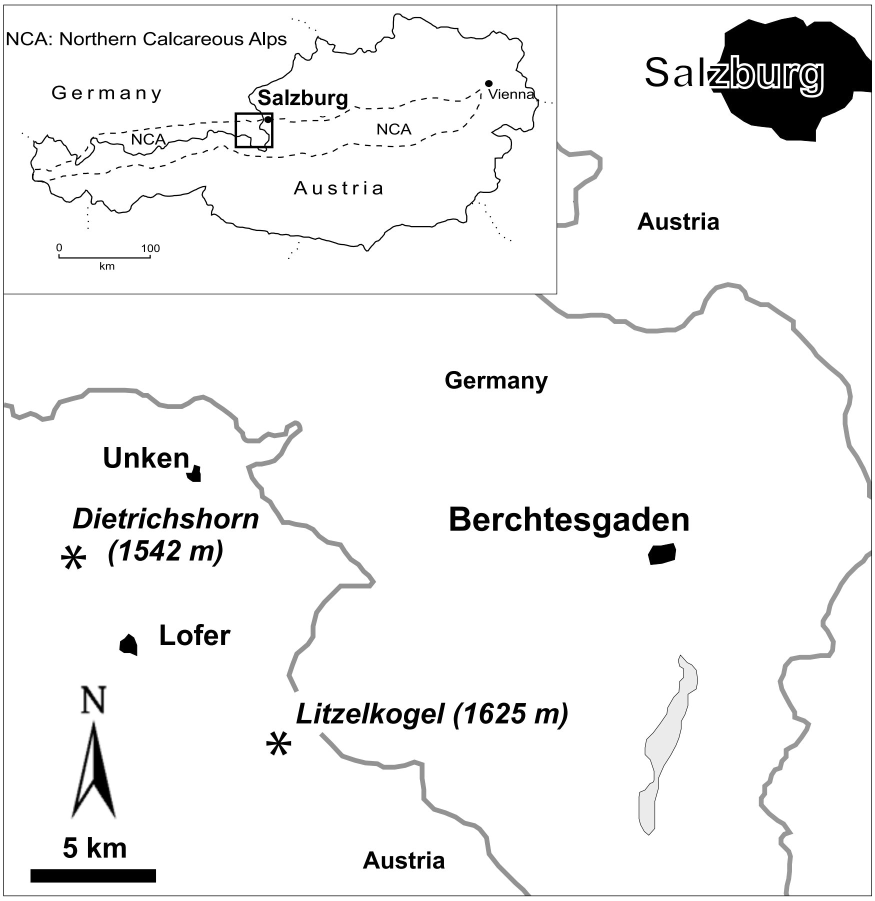

Fig. 1 Generalized geographic sketch map of the localities where the new Dasycladale *Neogyroporella*? *gawlicki* n.sp. has been detected.

beyond the scope of this paper. The marly limestones of the "Lärchberg Formation" are characterized by a rich assemblage of Dasycladales together with "stromatoporoids", benthic foraminifera and cyanophycean algae. In some parts, representatives of the protohalimedacean alga *Pinnatiporidium* (sensu DRAGASTAN et al., 2002) are dominant and can be termed *Pinnatiporidium* wackestones to floatstones. These lithologies yielded the new Dasycladale *Neogyroporella*? *gawlicki* n.sp. detected at the Dietrichshorn and Litzelkogel (Fig. 1).

The marly limestones containing the new alga outcrop near the summit of the Litzelkogel (1625 m a.s.l.), which forms a plateau-like mountain, together with the Gerhardstein (1541 m a.s.l. – Fig. 2). Due to sporadic outcrops and vegetation as well as steep flanks bordering the plateau, a lithological profile cannot be provided. According to DYA (1992), the "Lärchberg Formation" of the Litzelkogel-Gerhardstein has a thickness of about 250 m. *Neogyroporella*? *gawlicki* n.sp. was figured by DYA (1992 – Profile 11) as *Macroporella*? *praturloni* DRAGASTAN (see synonymy below) from the northern part of the Gerhardstein–Litzelkogel plateau. Detailed sampling carried out in recent times, has shown that *Neogyroporella*? *gawlicki* n.sp. is missing at the Gerhardstein. Here, the youngest sediments exposed can be attributed to the uppermost Kimmeridgian or lowermost Tithonian due to subaerial exposure (unpublished data).

At the Dietrichshorn (1542 m a.s.l.), located about 11 km northwest of the Litzelkogel, *Neogyroporella*? *gawlicki* n.sp. was also figured by DARGA & SCHLAGINTWEIT (1991) as *Macroporella*? *praturloni* DRAGASTAN (see synonymy below) from marly limestones that have been attributed to the Lofer Member, the clastic influenced part of the "Lärchberg Formation". For further details see DARGA & SCHLAGINTWEIT (1991).

3. SYSTEMATICS

Order Dasycladales
Tribe Salpingoporelleae
Genus *Neogyroporella* YABE & TOYAMA, 1949

Remarks: As will be discussed below, we tentatively assign our specimens to the genus *Neogyroporella* YABE & TOYAMA. The genus *Neogyroporella* with the type-species *Neogyroporella elegans* has been established by YABE & TOYAMA (1949), from the Upper Jurassic Torinosu Limestone of the Sakawa Basin, Japan. The age of the Torinosu Limestone, previously referred to the Oxfordian–Tithonian interval, has more recently been precisely dated as Tithonian–Berriasian (e.g. OHGA & IRYU, 2003; SHIRAISHI & KANO, 2004). Therefore the exact stratigraphic position of *Neogyroporella elegans* is not known in detail. *Neo-*

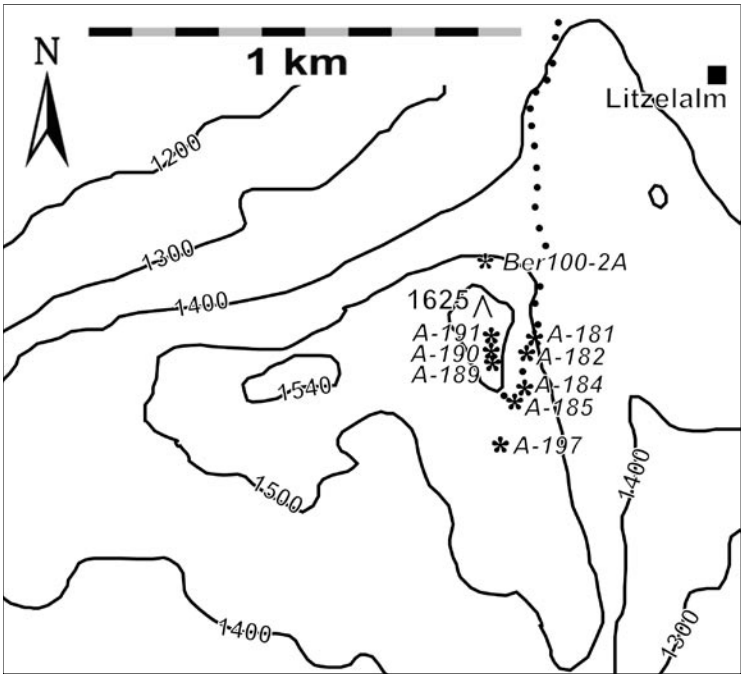

Fig. 2 General position of the sample localities with *Neogyroporella*? *gawlicki* n.sp. at the Litzelkogel type locality. The sample A-190 contains the holotype.

gyroporella elegans has not been recorded again since 1949 from its type-locality nor from any other occurrence. The original figures, however, have been re-illustrated by JOHNSON (1964), BASSOULLET et al. (1978) and DELOFFRE (1988). BASSOULLET et al. (1978) regard the "weakly known alga" as well characterized by the shape and arrangement of the primaries. The latter are of the cladosporous type (BARATTOLO, 1991 – p. 523). In his classification of the Dasycladales the genus *Neogyroporella* has been included in the subtribus Salpingoporellinae BASSOULLET et al. 1978 by DELOFFRE (1988), characterized by phloiophorous first order laterals. The primaries can also be compared with elongated vesiculiferous laterals comparable for example with the Triassic *Gyroporella ampleforata* PIA (see Pl. II, Fig. 5). OTT & FLAVIANI (1983 – p. 25) state that on two original figures of *Neogyroporella elegans,* the existence of a corona at the proximal part of the laterals could be assumed. YABE & TOYAMA (1949 – p. 162) just indicate that the calcareous crust "more or less thickens at the very basal part" of the laterals. Anyway, the existence of a corona structure in *Neogyroporella* has not so far been observed. It should be noted that the presence/absence of such proximal modifications of the laterals are regarded as generic characteristics. For example *Clypeina*-type dasycladales with a short basal portion below the junction point were removed from *Clypeina* and refered to the genus *Hamulusella* ELLIOTT by BARATTOLO (1998). Similar structures were also illustrated by DE CASTRO (1997 – pl. 20, fig. 1) from *Clypeina sulcata* (ALTH) and called "small lower protuberance (lp)".

A second species of *Neogyroporella* has been described as *Neogyroporella servaisi* by MICHAUD (1988) from the Maastrichtian of Mexico. Due to the existence of pedunculated primaries it has been transferred to the genus *Morelletpora* by GRANIER et al. (1991). BARATTOLO (2002 – p. 25), however, prefers to keep the species in the genus *Neogyroporella* although with some doubts. In revision of the Jurassic–Cretaceous Dasycladales by GRANIER & DELOFFRE (1993), *Neogyroporella elegans* has been treated as a valid taxon and the only species of the genus *Neogyroporella.*

Although never discussed previously, another genus very similar to *Neogyroporella* is *Humiella* SOKAČ & VELIĆ (1981), with the type-species *Humiella catenaeformis* (RADOIČIĆ) from the Neocomian of Southern Herzegovina. In fact, representatives of *Humiella* are characterized by alternating fertile laterals (ampullae), closed at the tips which are of variable shape (mostly bulbous). In both the original description, and others, "a thin corticular envelope enwrapping the soft parts of the plant" has been proposed by SOKAČ & VELIĆ (1981 – p. 104) as the main generic characteristic. This feature has also been remarked for *Neogyroporella* by YABE & TOYAMA (1949 – "surface is covered by a thin calcareous crust"). Later, the main characteristic of *Humiella* was said to be represented by tiny pores or indentations in the calcareous wall of the laterals with the main axis corresponding to sterile laterals (MASSE et al., 1984; SOKAČ, 1987). In fact, these "pores" or indentations (= "kleine Zähnchen" – OTT & FLAVIANI, 1983) obviously only seldom cut through the whole wall and can therefore be termed "blind pores" as described from the genus *Drobnella* BARATTOLO, 1998 (Chlorophyta or Charophyta). The existence of such blind pores or real pores, however, is not clearly observed in the specimens from the Northern Calcareous Alps. Due to strong recrystallization the boundary between adja-

Genus	*Neogyroporella*	*Humiella*	*Clypeina*	*Similclypeina*	*Actinoporella*
Laterals	in mutual contact	in mutual contact or spaced-out	spaced-out	in mutual contact	spaced-out
Corona structure	? (1)	missing	missing (1)	missing	present
Blind pores (sterile branches)	?	present	maybe present (2)	missing	missing

Table 1 Main characteristics of *Neogyroporella* and allied Dasycladale genera. Legend: (1): see remarks in the text, (2): as shown in some Clypeina species (e.g. RADOIČIĆ, 1969).

cent calcite crystals may suggest a finely perforated wall (diagenetic origin!). This uncertainty has been the reason to only tentatively refer these specimens to the genus *Neogyroporella*. However, if a re-investigation of the type-material of *Neogyroporella elegans* YABE & TOYAMA shows both types of pores in the calcareous walls, as could perhaps be assumed in, for example, fig. 5 from YABE & TOYAMA (1949) and any kind of corona structure is absent, the genus *Humiella* would become very close to *Neogyroporella* or perhaps even a synonym of the former.

Finally, it should be mentioned that the genus *Humiella* has been included in the tribe Clypeineae with "verticilles espacés" by DELOFFRE (1988). The genus *Humiella*, however, includes both species with well spaced-out verticals, such as *Humiella sardiniensis* (OTT & FLAVIANI), or forms with closely packed touching laterals, such as *Humiella japodica* recently described by SOKAČ (2001) from the Lower Jurassic of Croatia. For the *Clypeina* species with slightly touching whorls ("overlapping whorls"), the genus *Similiclypeina* has been established by BUCUR (1993).

Last but not least, the systematic framework becomes more complex as the genus *Humiella* SOKAČ & VELIĆ has been regarded as a synonym of *Sarfatiella* CONRAD & PEYBERNES by CONRAD (1982). *Sarfatiella*, however, is treated as a synonym of *Holosporella* PIA by BASSOULLET (1987) and by GRANIER & DELOFFRE (1993). The whole brief discussion of current taxonomic incongruencies is not pursued further here; it is just mentioned for completeness, but it also expresses the uncertainties we have in the systematic attribution of these specimens (see also Table 1).

Neogyroporella? *gawlicki* n.sp.

Pl. I, Figs. 1–9; Pl. II, Figs. 1–2, 4; Pl. III, Figs. 2–5

1991 "*Macroporella*" *praturloni* DRAGASTAN – DARGA & SCHLAGINTWEIT: p. 209; pl. 3, figs. 2–3

1991 "*Macroporella*" *praturloni* DRAGASTAN – SCHLAGINTWEIT: pl. 1, fig. 7

1992 "*Macroporella*" *praturloni* DRAGASTAN – DYA: p. 83; pl. 7, fig. 15; pl. 8, figs. 4–5, 8

Origin of the name: Dedicated to Prof. H.-J. Gawlick, University of Leoben, in recognition of his stimulating new concepts and ideas concerning the geodynamic evolution of the Alpine Jurassic.

Type-locality: Litzelkogel, Topographic Map of Austria ÖK 92 sheet Lofer, marly limestones cropping out in the area of the summit (Fig. 2). The location of the summit of the Litzelkogel is 12º46' geographic longitude and 47º38' geographic latitude.

Type strata: Light brownish, marly limestones of the "Lärchberg Formation", partly displaying a siliciclastic influx. The Dasycladales include *Salpingoporella* gr. *pygmaea* (GÜMBEL) (common), *Salpingoporella* cf. *istriana* (GUŠIĆ) (rare; Pl. III, Fig. 1), *Chinianella*? sp. (rare; Pl. III, Fig. 10), *Montenegrella florifera* BERNIER (Pl. III, Fig. 6), *Neogyroporella*? *gawlicki* n.sp., with protohalimedacean algae (genus *Pinnatiporidium*) and benthic foraminifera with *Comaliamma*? cf. *gediki* (TASLI), *Rheopax* sp. and *Protopeneroplis ultragranulata* (GORBATCHIK) (Pl. III, Fig. 7). In addition, remains of gastropods, stromatoporoids, oncoids and nodules formed by *Lithocodium aggregatum* ELLIOTT are present.

At the Dietrichshorn locality, *Neogyroporella*? *gawlicki* n.sp. is associated with *Clypeina* aff. *parasolkani* FARINACCI & RADOIČIĆ (Pl. II, Fig. 6), *Clypeina catinula* CAROZZI (Pl. II, Fig. 13), *Clypeina* aff. *isabellae* MASSE, BUCUR, VIRGONE & DALMASSO (Pl. II, Fig. 11), *Cylindroporella*? sp. (Pl. II, Fig. 9), *Zergabriella embergeri* (BOUROULLEC & DELOFFRE) (Pl. II, Fig. 7), *Salpingoporella annulata* CAROZZI, *Rajkaella bartheli* (BERNIER) and *Deloffrella querciifoliipora* GRANIER & MICHAUD (Pl. II, Figs. 8, 10, 12) and the benthic foraminifera *Anchispirocyclina lusitanica* (EGGER) and *Kastamonina abanica* SIREL (Pl. III, Figs. 8–9). At both the Dietrichshorn and Litzelkogel localities, the Dasycladalean remains typically show micritic envelopes of presumably cyanophycean origin.

Material: One thin-section containing about 30 specimens from Mount Dietrichshorn and several thin-sections each with 2–5 specimens from Mt. Litzelkogel.

No.	D	d	d/D	p_{max}	l	h	w	L
1	0.4	0.1	0.26					
2	0.52			0.09	0.28		22	
3	0.56	0.18	0.31					
4	0.56	0.16	0.28					
5	0.59	0.2	0.34	0.09	0.22		24	
6	0.62	0.17	0.27	0.055				
7	0.64	0.19	0.3				23	
8	0.64	0.29	0.185					
9	0.67	0.19	0.29					
10	0.68	0.2	0.29				21	
11	0.68	0.19	0.28				22	
12	0.7	0.14	0.2		0.22			
13	0.74	0.24	0.32		0.25			
14	0.8	0.22	0.28					2.65
15	0.8	0.22	0.28				24	
16	0.8	0.2	0.25				24	
17	0.8	0.22	0.28	0.08	0.28	0.07–0.08		2.75
18	0.98	0.37	0.38	0.1		0.08–0.09		5.68
19				0.08				
20	1.2	0.2	0.17					

Table 2 The main biometric parameters of *Neogyroporella*? *gawlicki* n.sp. (in mm). Legend: D – outer thallus diameter; d – inner diameter; p_{max} – maximum diameter of laterals; l – length of laterals; h – distance between whorls; w – number of laterals per whorl; L – maximum observed length. No. 20 – data given by DYA (1992).

Holotype: Oblique-tangential section figured on Pl. I, Fig. 5, thin section labelled A–190 (exact location see Fig. 2). The material from the Litzelkogel is stored at the "Institut für Geowissenschaften, Universität Leoben". Isotypes are represented by different sections shown in Pls. I–III.

Diagnosis: Thallus euspondyl, cylindrical with a comparable small main axis and numerous elongated, gently broadening laterals with swollen endings. The laterals, closed at tips, are arranged more or less perpendicular or slightly inclined to the axis. The microstructure of the individual calcified sheaths enclosing the laterals has a fibrous appearance. The whorls are close-set with alternating laterals touching those from adjacent whorls. Reproductive organs presumably cladosporous.

Description: Thallus simple and cylindrical. The axial cavity is comparatively small, most frequently comprising 27–30% of the total diameter. The simple, undivided and elongated laterals communicate with the axial cavity by means of narrow connecting pores that broaden gently, then swell into sphere-like distally closed ends. The arrangement of laterals in consecutive whorls is alternating. The main axis and the laterals are each covered with their own thin calcareous envelope. Due to secondary calcification, the laterals are in contact at their proximal parts. At the most distal parts, adjacent laterals are not in contact with each other. The outer part of the thallus is composed of the distal ends of individual laterals of alternating arrangement; the inner surface of the thallus is straight. The laterals are slightly inclined to the axis at an angle between 5 to 15º. In tangential sections, the laterals appear as a rounded pore meaning that they are neither longitudinally nor transversally compressed. Although cysts have not been observed in our specimens, the swollen laterals suggest a cladosporous type of reproduction.

Dimensions: see Table 2 and Fig. 3.

Remarks: The species in question has repeatedly been confused with *Macroporella praturloni* DRAGASTAN (see synonymy). In fact, the laterals with individual calcareous sheets are very similar in tangential sections and also the d/D ratio is the same. *M. praturloni*, however, is on the whole different from *Neogyroporella*? *gawlicki* n.sp. by possessing phloiophorous laterals, open at the tips and distinctly inclined to the axis. Additionally, *M. praturloni* is much larger than *N.*? *gawlicki* n.sp. with a thallus diameter reaching up to several millimetres (see also BUCUR, 1985 – table 1).

The only species to which *Neogyroporella*? *gawlicki* n.sp. can be compared to is the type-species *N. elegans* YABE & TOYAMA. Generally, this new species can be regarded as a "mini version" of the latter. *N. elegans* is distinctly larger than *N.*? *gawlicki* n.sp. (see Table 3). The d and D values do not show any overlapping areas but are distinctly separated from each other. Thus, both species are clearly individual due to their dimensions. In addition, the type-species possess a lower number of laterals (w, see Table 3) which more or less thicken at their proximal parts. In addition, a second taxon has been briefly recorded by YABE & TOYAMA (1949)

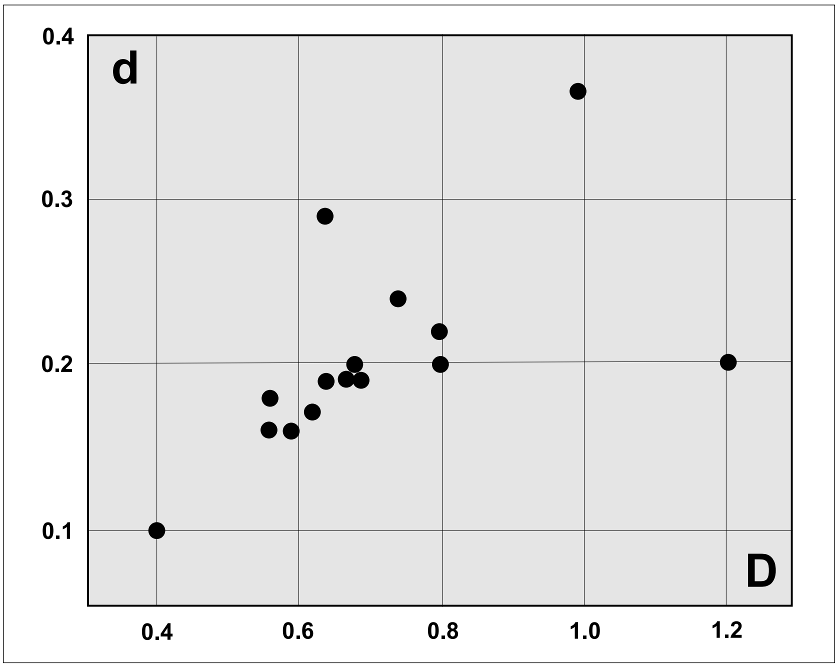

Fig. 3 *Neogyroporella*? *gawlicki* n.sp.: outer diameter of the thallus against the inner diameter of the thallus (d). The parameters d and D are well correlated except the value indicated by DYA (1992 – D = 1.2 mm).

as *Neogyroporella* sp. from the same locality as *N. elegans.* While being distinctly larger than *N.*? *gawlicki* n.sp., the number of laterals per whorl (~34) approach the maximum value measured for *N.*? *gawlicki* (~26) (see Table 3).

Stratigraphy: Based on the aforementioned microfossil assemblages and results of previous and recent investigations, the samples containing *Neogyroporella*? *gawlicki* n.sp. can be assigned to the Late Tithonian or Early Berriasian. The evaluation of the total stratigraphic range, however, cannot be established reliably and surely needs further data. In this connection it should be mentioned that *Neogyroporella*? *gawlicki* n.sp. has not been detected in the samples of the Gerhardstein where the youngest sediments match the Kimmeridgian–Tithonian boundary or the earliest Tithonian. However, the marly limestones containing *Neogyroporella*? *gawlicki* n.sp. which crop out at the Litzelkogel summit represent the final part of the exposed succession.

Facies and palaeoenvironmental interpretation: The marly limestones that crop out around the summit of the Litzelkogel (see Fig. 2) follow micrite dominated low energy platform margin deposits that are represented by *Bacinella–Lithocodium* bindstones associated with "stromatoporoid" wackestones (genus *Milleporidium*). As no high energy outer central reef deposits characterized by Actinostromariids were found, it is assumed that the barrier reef model of TURNŠEK et al. (1981) cannot be applied. It should be noted that the protohalimedacean alga *Pinnatiporidium* frequently associated with *Neogyroporella*? *gawlicki* n.sp., is according to our own observations, also a typical back-reef inhabitant. In a Late Jurassic–Early Cretaceous platform model from the East Carpathians of Romania, DRAGASTAN (1999 – fig. 6) also reported on a bindstone facies with *Lithocodium* and *Pinnatiporidium* assigned to a reef-flat facies that passes to a back-reef lagoon facies. Therefore, the wackestones, which are partly oncoidal, containing *Neogyroporella*? *gawlicki*

Species / Dimensions	*Neogyroporella elegans* YABE & TOYAMA	*Neogyroporella* sp. YABE & TOYAMA	*Neogyroporella*? *gawlicki* n.sp.
D	3.5–5.5	3.5	0.4–1.2
d	1.1–1.5	2.1	0.1–0.37
d/D	–	–	0.185–0.38
p	–	–	0.055–0.1
l	1.5–2.0	–	0.22–0.28
h	–	–	0.07–0.09
w	about 13	~34	21–26
L	–	–	5.68

Table 3 Dimensions of *Neogyroporella elegans* YABE & TOYAMA, *Neogyroporella* sp. and *Neogyroporella*? *gawlicki* n.sp. (in mm).

n.sp. may be assigned to a sheltered “back-reef” environment with terrigenous influence (siliciclastic detritus, terrestrial? plant remains).

At the Dietrichshorn locality, the co-occurrence with *Zergabriella embergeri* (BOUROULLEC & DELOFFRE) may point to freshwater influences (CONRAD, 1977). Indications of a very shallow water setting with signs of subaerial exposure are indicated by components showing circumgranular cracking sensu ESTEBAN & KLAPPA (1983).

For *Neogyroporella elegans*, YABE & TOYAMA (1949) did not give comments on the facies or associated microflora and microfauna, but the illustrated figurations show a micritic microfacies (wackestones) indicating a quiet water setting. Thus, the Torinosu Formation does not only comprise reefal facies (SHIRAISHI & KANO, 2004) but also lagoonal facies, as indicated by the occurrence of wackestones with *Cladocoropsis mirabilis* FELIX (YABE & TOYAMA, 1927).

4. CONCLUSIONS

Neogyroporella? *gawlicki* n.sp. represents another species of the so-far poorly known genus *Neogyroporella* YABE & TOYAMA. It occurs in marly limestones of the “Lärchberg Formation” of Late Tithonian or Early Berriasian age. This terrigeneously influenced lithofacies, rich in calcareous algae has up to now not been recorded from the Alpine Plassen Formation. Thus, many Dasycladales that occur together with *Neogyroporella*? *gawlicki* n.sp., such as *Zergabriella embergeri* (BOUROULLEC & DELOFFRE), *Deloffrella quercifoliipora* GRANIER & MICHAUD or *Clypeina catinula* CAROZZI, are therefore also missing in the Plassen Formation. The new species *Neogyroporella*? *gawlicki* n.sp. furthers the knowledge not only of the poorly known genus *Neogyroporella* YABE & TOYAMA but also of Upper Jurassic–Lower Cretaceous Dasycladales of the Northern Calcareous Alps.

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5. REFERENCES

BARATTOLO, F. (1991): Mesozoic and Cenozoic marine benthic calcareous algae.– In: RIDING, R. (ed.): Calcareous Algae and Stromatolites. Springer–Verlag, Berlin, 504–540.

BARATTOLO, F. (1998): Dasycladacean green algae and microproblematica of the uppermost Cretaceous–Paleocene in the Karst Area (NE Italy and Slovenia).– Dela – Opera SAZU 4. razr., 34/2, 65–127.

BARATTOLO, F. (2002): Late Cretaceous–Paleogene Dasycladaleans and the K/T boundary problem. – In: BUCUR, I.I. & FILIPESCU, S. (eds.): Research Advances in Calcareous Algae and Microbial Carbonates. Cluj University press, 17–40.

BASSOULLET, J.-P. (1987): *Sarfatiella dubari* CONRAD et PEYBERNES 1973: A junior synonym of *Holosporella siamensis* PIA 1930.– In: 4th International Symposium on Fossil Algae (Cardiff 6-11, July 1987), Abstracts, Friends of the Algae Newsletter, 8, 20–21.

BASSOULLET, J.-P., BERNIER, P., CONRAD, M.A., DELOFFRE, R. & JAFFREZO, M. (1978): Les Algues Dasycladales du Jurassique et du Crétacé [*Jurassic and Cretaceous Dasycladalean Algae* – in French].– Géobios, Mém. Spéc., 2, 1–330.

BUCUR, I.I. (1985): Sur la présence des cysts reproducteurs dans les ramifications de *Macroporella praturloni* et quelques considérations concernant l’évolution de la cladosporie chez les Dasycladales fossils [*On the occurrence of reproductory cysts within the ramifications of Macroporella praturloni and some considerations about the evolution of fossil cladospore Dasycladales* – in French].– Evol. Adapt., 2, 101–109.

BUCUR, I.I. (1993): Some new or poorly known calcareous algae (Dasycladales, Gymnocodiacea) in the Lower Cretaceous deposits from the Resita–Moldova Noua zone (Southern Carpathians, Romania).– Rev. Esp. de Micropal., 25/1, 93–126.

CONRAD, M.A. (1977): The Lower Cretaceous calcareous algae in the area surrounding Geneva (Switzerland): biostratigraphy and depositional environments.– In: FLÜGEL, E. (ed.): Fossil Algae. Springer-Verlag, Berlin, Heidelberg, New York, 295–300.

CONRAD, M.A. (1982): Comments on *Korkyrella* and other new Dasycladaceae.– Rev. de Paléobiol., 1/1, 1–5.

DARGA, R. & SCHLAGINTWEIT, F. (1991): Mikrofazies, Paläontologie und Stratigraphie der Lerchkogelkalke (Tithon–Berrias) des Dietrichshorns (Salzburger Land, Nördliche Kalkalpen) [*Microfacies, palaeontology and stratigraphy of the Lerchkogel Limestone (Tithonian–Berriasian) of the Dietrichshorn – Salzburg area, Northern Calcareous Alps* – in German].– Jahrb. der Geol. Bundesanst., 134/2, 205–226.

DE CASTRO, P. (1997): Introduzione allo studio in sezione sottile delle dasicladali fossili [*Introduction to thin-section studies of fossil Dasycladales* – in Italian].– Quad. Accad. Pontaniana, 22, 1-137.

DELOFFRE, R. (1988): Nouvelle taxonomie des Algues Dasycladales [*New taxonomy of Dasycladacean Algae* – in

French].– Bull. Centr. Rech. Explor.-Prod. Elf-Aquitaine, 12/1, 165–217.

DRAGASTAN, O. (1999): Jurassic–Cretaceous calcareous algae of the Transylvanides, Inner Dacides and Moesian Platform (Romania).– Rev. Espan. de Micropal., 31/2, 185–218.

DRAGASTAN, O., LITTLER, D.S. & LITTLER, M.M. (2002): Recent vs. fossil *Halimeda* species of Angaur Island, Palau and adjacent western Pacific areas.– Acta Palaeont. Roman., Spec. Publ., 1, 3–20.

DYA, M. (1992): Mikropaläontologische und fazielle Untersuchungen im Oberjura zwischen Salzburg und Lofer [*Micropalaeontological and facies analysis in the Upper Jurassic between Salzburg and Lofer* – in German].– Unpublished PhD Thesis, Technical University of Berlin, 137 p.

ESTEBAN, M. & KLAPPA, C.F. (1983): Subaerial exposure environments.– In: SCHOLLE, P.A., BEBOUT, D.G. & MOORE, C.H. (eds): Carbonate Depositional Environments. Am. Assoc. Petrol. Geol. Memoir, 33, 1–54.

FERNECK, F.A. (1962): Stratigraphie und Fazies im Gebiet der mittleren Saalach und des Reiteralm-Gebirges [*Stratigraphy and facies in the middle part of the Saalach area and the Reiteralm Mountains* – in German].– Unpubl. PhD Thesis, Technical University of Munich, 107 p.

FRISCH, W. & GAWLICK, H.-J. (2003): The nappe structure of the central Northern Calcareous Alps and its disintegration during Miocene tectonic extrusion – a contribution to understanding the orogenic evolution of the Eastern Alps.– Inter. Jour. Earth Sci., 92, 712–727.

GAWLICK, H.-J., FRISCH, W., VECSEI, A., STEIGER, T. & BÖHM, F. (1999): The change from rifting to thrusting in the Northern Calcareous Alps as recorded in Jurassic sediments.– Geol. Rundsch., 87, 644–657.

GAWLICK, H.-J. & FRISCH, W. (2003): The Middle to Late Jurassic carbonate clastic radiolaritic flysch sediments in the Northern Calcareous Alps: sedimentology, basin evolution, and tectonics – an overview.– N. Jb. Geol. Paläont. Abh., 230/2–3, 163–213.

GAWLICK, H.-J., SCHLAGINTWEIT, F. & MISSONI, S. (2005): Die Barmsteinkalke der Typlokalität nordwestlich Hallein (hohes Tithonium bis tieferes Berriasium; Salzburger Kalkalpen) – Sedimentologie, Mikrofazies, Stratigraphie und Mikropaläontologie: neue Aspekte zur Interpretation der Entwicklungsgeschichte der Ober-Jura-Karbonatplattform und der tektonischen Interpretation der Hallstätter Zone von Hallein–Bad Dürrnberg [*The Barmstein Limestones of the type-locality northwest of Hallein – Late Tithonian–Early Berriasian, Salzburg Calcareous Alps – sedimentology, microfacies, stratigraphy and micropalaeontology – new aspects for the interpretation of the evolution of the Hallstatt Zone from Hallein–Bad Dürrnberg* – in German].– N. Jb. Geol. Paläont. Mh.., 236/3, 351–421.

GRANIER, B. & DELOFFRE, R. (1993): Inventaire critique des algues Dasycladales fossils – II° Partie – Les algues Dasycladales du Jurassique et du Crétacé [*Critical inventory of fossil Dasycladalean algae – 2nd part – Jurassic and Cretaceous Dasycladalean algae* – in French].– Rev. de Paléobiol., 12/1, 19–65.

GRANIER, B., BERTHOU, P.-Y. & FOURCADE, E. (1991): The Dasycladalean algae from the Cretaceous of the New World.– Transactions 2nd Geol. Conf. Geol. Soc. Trinidad and Tobago, Port-of-Spain (April 3–8, 1990), 178–183.

JOHNSON, J.H. (1964): The Jurassic Algae.– Quart. Colorado School Min., LIX/2, 1–129.

KÜGLER, U., SCHLAGINTWEIT, F., SUZUKI, H. & GAWLICK, H.-J. (2003): Stratigraphie und Fazies des höheren Mittel- bis Ober-Jura im Bereich des Falkensteinzuges am Wolfgangsee, Salzkammergut (Österreich) mit besonderer Berücksichtigung der Plassen-Formation (Kimmeridgium) [*Stratigraphy and facies of the upper Middle to Upper Jurassic in the Falkenstein area at lake St. Wolfgang, Salzkammergut, Austria, with spezial reference of the Plassen Formation, Kimmeridgian* – in German].– In: WEIDINGER, J.T., LOBITZER, H. & SPITZBART, I. (eds.): Beiträge zur Geologie des Salzkammergutes. Gmundner Geo-Studien, 2, 97–106.

MASSE, J.-P., ACQUAVIVA, M. & LUPERTO-SINNI, E. (1984): *Humiella catenaeformis* (RADOIČIĆ), nov. comb. (Dasycladale) de l'Eocrétacé italo-dinarique.- Revue de Micropal., 27/2, 139-143.

MICHAUD, F. (1988): *Neogyroporella*? *servaisi* n.sp., nouvelle dasycladaceae du Maastrichtian du Chiapas, sud-est du Mexique [*Neogyroporella*? *servaisi* n.sp.*, a new Dasycladale from the Maastrichtian* of Chiapas, SE-Mexico – in French].– Cret. Res., 9, 369–378.

OHGA, H. & IRYU, Y. (2003): Facies analysis of Tithonian–Berriasian limestone in Torinosu area, Kochi Prefecture, Japan.– Berichte Institut Geologie Paläontologie Karl-Franzens-Universität Graz, 7 (9th Int. Symp. Fossil Cnidaria and Porifera), 77.

OTT, E. & FLAVIANI, A. (1983): Eine neue Kalkalgengattung (*Lagenoporella*, Dasycladales) aus dem Oberjura von Sardinien [*A new genus of calcareous algae, Lagenoporella, Dasycladales, from the Upper Jurassic of Sardinia*].– N. Jb. Geol. Paläont. Mh., 1983, 3, 16–26.

PIA, J. (1927): Tallophyta.– In: HIRMER, M. (ed.): Handbuch der Paläobotanik. Oldenbourg, München, 31–136.

RADOIČIĆ, R. (1969): A new Lower Cretaceous Dasycladacea: *Clypeina pejovici*, and note on some Clypeina.– Geol. Romana, 14, 71-84.

SCHLAGINTWEIT, F. (1991): Neritische Oberjura- und Unterkreide-Kalkgerölle aus den Losensteiner Schichten (Alb–Cenomanium) der Typlokalität Stiedelsbachgraben (Oberösterreich; Nördliche Kalkalpen) [*Neritic Upper Jurassic–Lower Cretaceous carbonate pebbles from the Losenstein Formation, Albian–Cenomanian, of the type-locality Stiedelsbachgraben, Upper Austria, Northern Calcareous Alps* – in German].– Mitteil. Ges. Geol. Bergbaustud. Österr., 37, 83–95.

SCHLAGINTWEIT, F., GAWLICK, H.-J. & LEIN, R. (2003): Die Plassen-Formation der Typlokalität (Salzkammergut, Österreich) – neue Daten zur Fazies, Sedimentologie und Stratigraphie [*The Plassen Formation of the type-locality – Salzkammergut, Austria – new data on facies, sedimentology and stratigraphy* – in German].– Mitteil. Ges. Geol. Bergbaustud. Österr., 46, 1–34.

SHIRAISHI, F. & KANO, A. (2004): Composition and spatial distribution of microencrusters and microbial crusts in upper Jurassic–lowermost Cretaceous reef limestone (Torinosu Limestone, southwest Japan).– Facies, 50/2, 217–227.

SOKAČ, B. (1987): On some controversial Dasyclad genera and species and their stratigraphic position in the Lower Cretaceous deposits of the Dinarides.– Geol. vjesnik, 40, 9–38.

SOKAČ, B. (2001): Lower and Middle Liassic calcareous algae (Dasycladales) from Mt. Velebit (Croatia) and Mt. Trnovski Gozd (Slovenia) with particular reference to the genus *Palaeodasycladus* (PIA, 1920) 1927 and its species.– Geol. Croat., 54/2, 133–257.

SOKAČ, B. & VELIĆ, I. (1981): *Humiella teutae* n.sp. (Dasycladaceae) from the Neocomian of Southern Herzegovina.– Geol. vjesnik, 33, 101–105.

TOLLMANN, A. (1976): Analyse des klassischen nordalpinen Mesozoikums [*Analysis of the classical North Alpine Mesozoic* – in German].– Deuticke, Wien, 580 p.

TURNŠEK, D., BUSER, S. & OGORELEC, B. (1981): An Upper Jurassic reef complex from Slovenia, Yugoslavia.– Soc. Econ. Paleont. Mineral., Spec. Pub., 30, 361–369.

YABE, H. & TOYAMA, S. (1927): *Cladocoropsis mirabilis* FELIX from the Torinosu Limestone of Japan.– Japan J. Geol. Geograph., 5/3, 107–110.

YABE, H. & TOYAMA, S. (1949): New Dasycladaceae from the Jurassic Torinosu Limestone of the Sakawa Basin. II.– Proceedings of Japan Academy, 25/7, 160–164.

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PLATE I

Neogyroporella? *gawlicki* n.sp. from the Late Tithonian–Early Berriasian of the Northern Calcareous Alps

1 Various oblique sections, Dietrichshorn locality.

2 Oblique section together with the benthic foraminifera *Anchispirocyclina lusitanica* (EGGER), Dietrichshorn locality.

3 Transverse section (left) and various algal fragments, Litzelkogel locality, thin-section A–190.

4 Oblique section, Dietrichshorn locality.

5 Oblique–tangential section, holotype, Litzelkogel locality, thin-section A–190.

6 Detail from Fig. 5 showing the close and alternating laterals, Litzelkogel locality, thin-section A–190.

7 Oblique section, Dietrichshorn locality.

8 Fragmentary transverse section, Dietrichshorn locality.

9 Transverse section, Dietrichshorn locality.

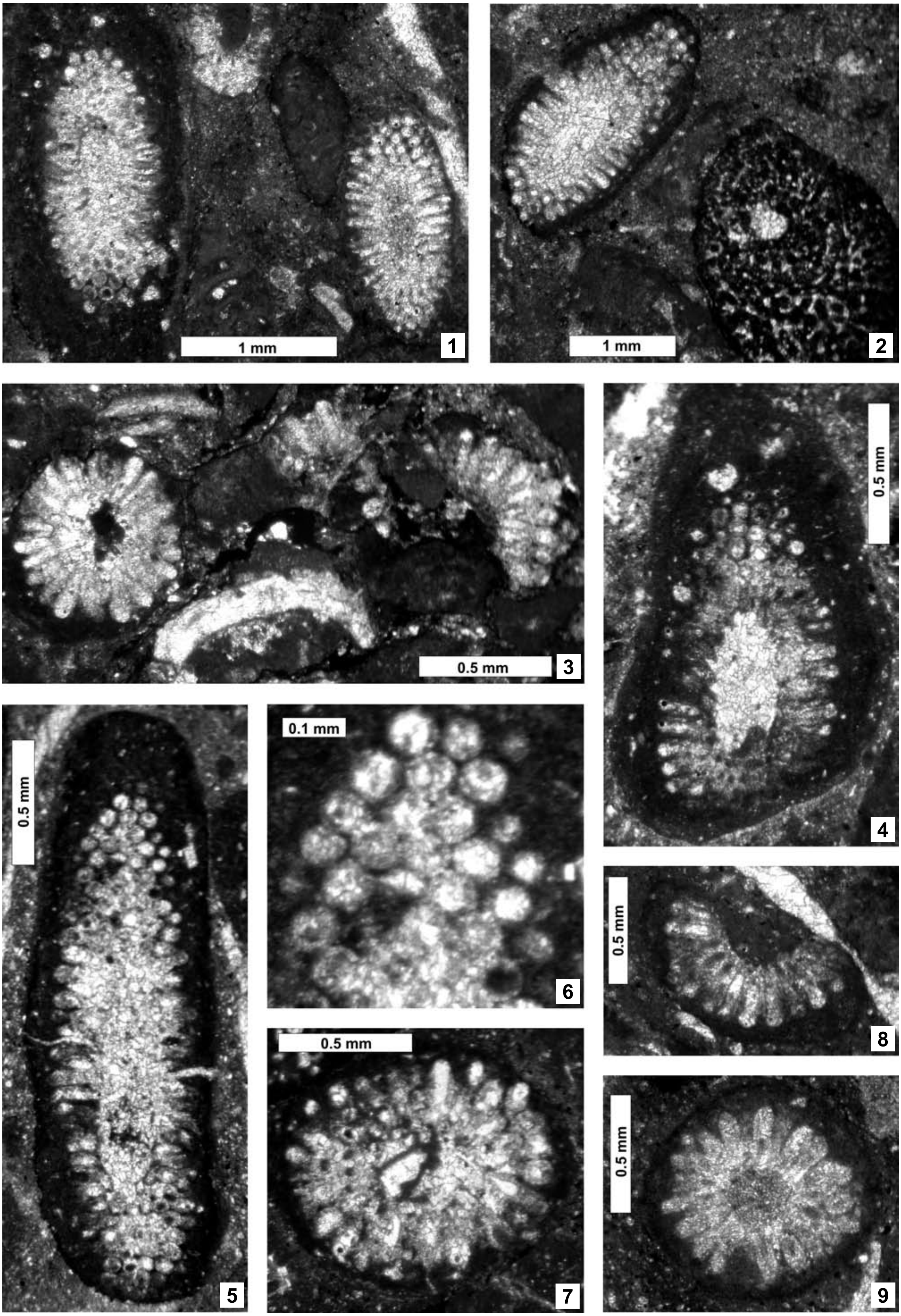
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PLATE II

Neogyroporella? *gawlicki* n.sp. and other Dasycladales from the Late Tithonian–Early Berriasian of the Northern Calcareous Alps

1 *Neogyroporella*? *gawlicki* n.sp., transverse section, Dietrichshorn locality.

2 *Neogyroporella*? *gawlicki* n.sp., tangential section, Litzelkogel locality, thin-section A–190.

3 Unknown dasycladale with a calcareous envelope consisting of radial-fibrous calcite, Dietrichshorn locality.

4 *Neogyroporella*? *gawlicki* n.sp., Detail from Pl. I, Fig. 8, showing elongated vesiculiferous branch morphology, Dietrichshorn locality.

5 Branch morphology of *Gyroporella ampleforata* PIA (from PIA, 1927).

6 *Clypeina* aff. *parasolkani* FARINACCI & RADOIČIĆ, transverse section, Dietrichshorn locality.

7 *Zergabriella embergeri* (BOUROULLEC & DELOFFRE), Dietrichshorn locality.

8, 10, 12 Different sections of *Deloffrella quercifoliipora* GRANIER & MICHAUD, Dietrichshorn locality.

9 *Cylindroporella*? sp., Dietrichshorn locality.

11 *Clypeina* aff. *isabellae* MASSE, BUCUR & VERON, Dietrichshorn locality.

13 *Clypeina catinula* CAROZZI, longitudinal section showing the swelling of the main axis at the vertical plane, Dietrichshorn locality.

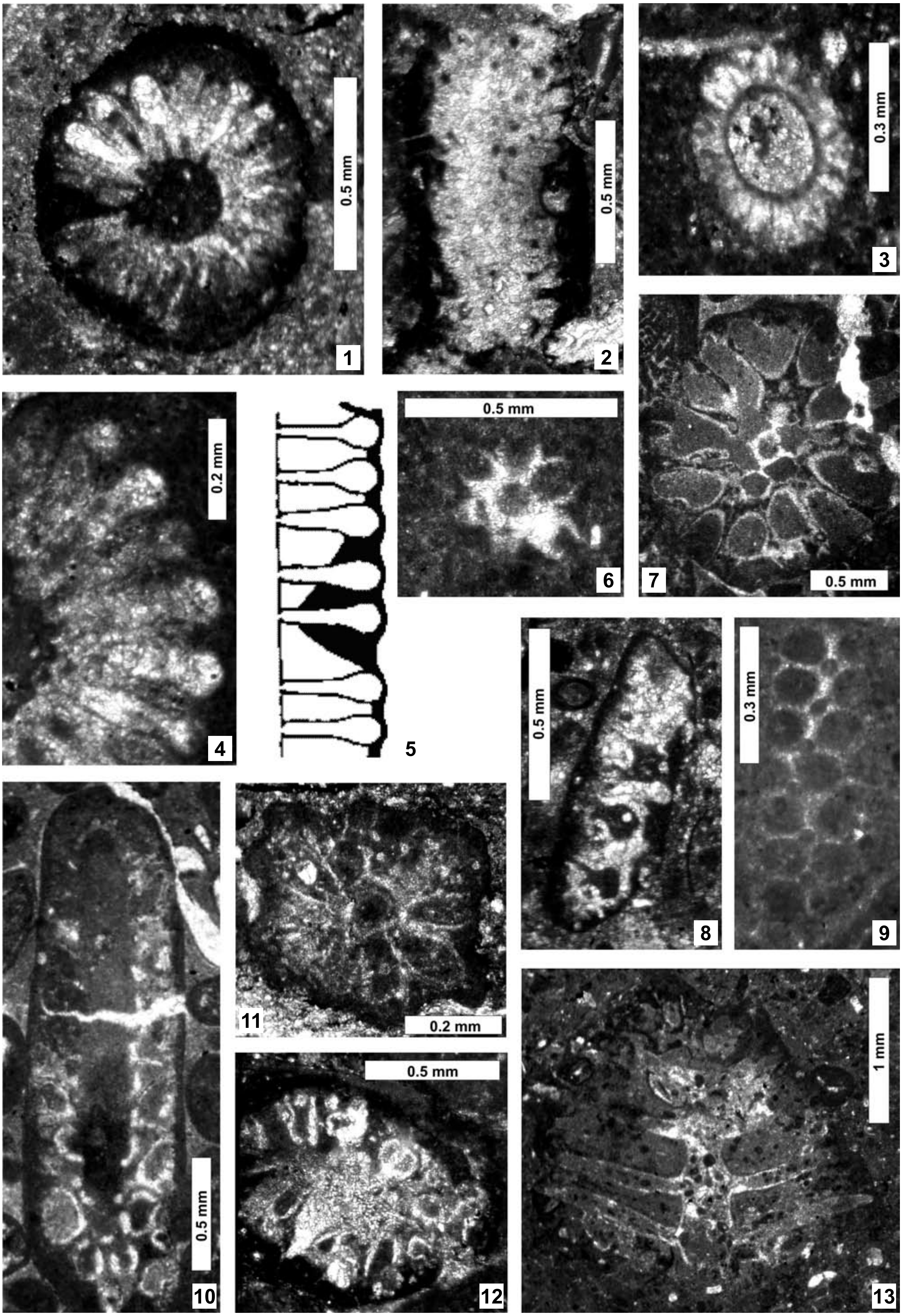
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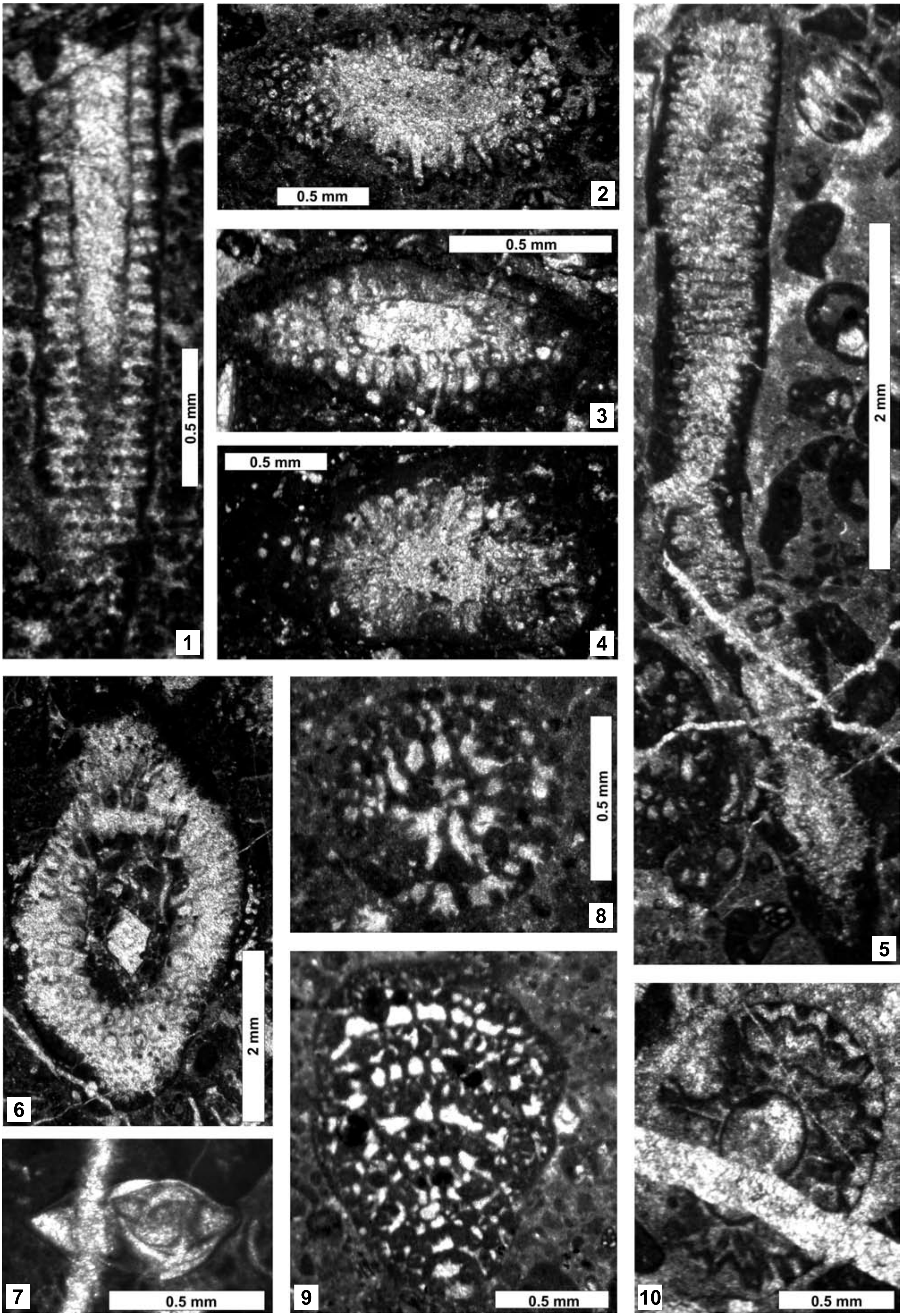
PLATE III

Neogyroporella? *gawlicki* n.sp. and other Dasycladales and benthic foraminifera from the Late Tithonian–Early Berriasian of the Northern Calcareous Alps

1	*Salpingoporella* cf. *istriana* (GUŠIĆ), longitudinal section, Litzelkogel locality, thin-section Ber–17a.
2–5	*Neogyroporella*? *gawlicki* n.sp. 2–4: oblique sections, thin-sections A–149 and A–182, 5: longitudinal–tangential section, thin-section A–191 (all from Litzelkogel locality).
6	*Montenegrella florifera* BERNIER, Litzelkogel locality, thin-section A–189–2.
7	*Protopeneroplis ultragranulata* (GORBATCHIK), axial section, Litzelkogel locality, thin-section Ber–100–2.
8–9	*Kastamonina abanica* SIREL, transverse section (8) and subaxial section (9), Dietrichshorn locality.
10	*Chinianella*? sp., oblique transverse section, Litzelkogel locality, thin-section A–191.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