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Rivularia barmsteinensis n. sp. and *Rivularia* ? *loseri* n. sp. – Two New Cyanophycean Algae from the Upper Jurassic–Lower Cretaceous of the Northern Calcareous Alps (Germany/Austria)

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2 Text-Figures, 2 Tables and 2 Plates

Oberösterreich
Salzburg
Nördliche Kalkalpen
Oberjura
Unterkreide
Blaugrünalgen
Barmsteinkalk
Tressenstein-Kalk

Österreichische Karte 1 : 50.000
Blätter 94, 95

Inhalt

Rivularia barmsteinensis n. sp. und *Rivularia* ? *loseri* n. sp. – zwei neue Blaugrünalgen aus dem Oberjura und der Unterkreide der Nördlichen Kalkalpen (Deutschland, Österreich)

Zusammenfassung

Zwei neue filamentöse Kalkalgen (Phylum Cyanophyta) werden als *Rivularia barmsteinensis* n. sp. aus dem Obertithonium/Unterberriasium der Barmsteinkalke des Typusprofils nordwestlich von Hallein (Salzburg, Nördliche Kalkalpen) und *Rivularia* ? *loseri* n. sp. vom Loser (Salzkammergut) beschrieben. Die Unsicherheiten beim zweiten Taxon beruhen auf Verästelungen des aufrecht stehenden Thallus, eine beim Genus *Rivularia* unbekannte Struktur. Unterschiede zu anderen Repräsentanten von *Rivularia* (ROTH, 1802) AGARDH 1824 mit grob rekristallisierten Thalli mit dünnen Filamenten werden diskutiert. Außer an der Typlolalität wurde *Rivularia barmsteinensis* n. sp. bisher nur an den Lokalitäten Höherstein (Barmsteinkalk) und Plassen (Plassen-Formation) beobachtet. *Rivularia* ? *loseri* n. sp. ist auch an der Typlokalität des Barmsteinkalks verbreitet.

Abstract

Two new filamentous calcareous algae (Phylum Cyanophyta) are described as *Rivularia barmsteinensis* n. sp. from the Upper Tithonian/Lower Berriasian of the Barmstein limestones of the type-section northwest of Hallein/Salzburg Calcareous Alps and *Rivularia* ? *loseri* n. sp. from slope deposits of the Loser/Salzkammergut. The uncertainties concerning the latter taxon result from the columnar-erect thalli showing branching, a feature unknown from the genus *Rivularia*. Differences to other representatives of *Rivularia* (ROTH, 1802) AGARDH 1824 showing coarsely crystallized thalli with small-sized filaments are discussed. Besides the type-locality, *Rivularia barmsteinensis* n. sp. has so far only been observed from the localities Höherstein (Barmstein limestones) and Plassen (Plassen Formation). *Rivularia* ? *loseri* n. sp. is also common in the Barmsteine type-location.

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1. Introduction

The reinvestigation of the type-locality of the Plassen Formation in the Austrian Salzkammergut (SCHLAGINTWEIT et al., 2003) has evidenced the abundant occurrence of filamentous calcareous algae (former "porostromata") within open and closed lagoonal facies. All together 18 species have been recorded from the Tithonian of Mt. Plassen.

Recently, a new taxon of the Protohalimedaceae sensu DRAGASTAN et al. (2002) has been introduced as *Pinnatiporidium untersbergensis* n. sp. by SCHLAGINTWEIT & DRAGASTAN (in press) from the Plassen Formation of Mt. Untersberg, SW of Salzburg. This species has also been found within the resedimented Barmstein limestones. From the type-region of the latter, the occurrence of "filamentous blue-algae" has already been reported by STEIGER (1981: Pl. 15, Fig. 4; Pl. 17, Fig. 6). Other reports of cyanophycean algae from the Barmstein limestones come from the Trattberg area (FENNINGER [1972]: *Cayeuxia moldavica* FROLLO, *Cayeuxia* sp.) and the Höherstein plateau (GAWLICK et al., 2003).

In the following, two new species are described: *Rivularia barmsteinensis* n. sp. from the "Grosse Barmstein" and "Kleine Barmstein" near Hallein, the type-locality of the Barmstein limestones, and *Rivularia*? *loseri* n. sp. from "Tressenstein Limestones" of the Loser mountain, Austrian Salzkammergut.

2. Geological Setting

2.1. Barmsteine

The type-locality of the Barmstein layers (Upper Tithonian–Lower Berriasian), which are intercalated in the Oberalm beds, is located northwest of Hallein in the Salzburg Calcareous Alps. The type-locality are the "Kleine Barmstein" and the "Grosse Barmstein" around the German-Austrian boundary defined by GÜMBEL (1861) as Barmstein limestone or Barmstein coral limestone (Text-Figs. 1–2). The type section was described in detail by STEIGER (1981, 1992). STEIGER (1981) investigated the components of the resedimented mass-flow deposits and reconstructed the source area of the Barmstein layers as part of the Plassen Formation. The latest Jurassic/earliest Cretaceous mass-flow deposits of the Barmstein layers are separated from the Hallein – Bad Dürrnberg Hallstatt zone by a SSE–NNW striking ?Miocene fault and are not the sedimentary cover of the Hallstatt limestones (see PICHLER, 1963; PLÖCHINGER, 1983, 1995). They belong to the post-tectonic cover of the late Middle to Late Jurassic tectonic event described by GAWLICK et al. (1999). Tectonically they belong to the Lower Tirolic nappe in the sense of FRISCH & GAWLICK (2003) and are not part of the Hallstatt Mélange as the Hallstatt zone of Hallein – Bad Dürrnberg, which belongs to the upper Tirolic nappe. This separation can be confirmed by the evidence of a young fault in the west of the latest Jurassic sedimentary sequence (see GAWLICK et al. [in press] for details).

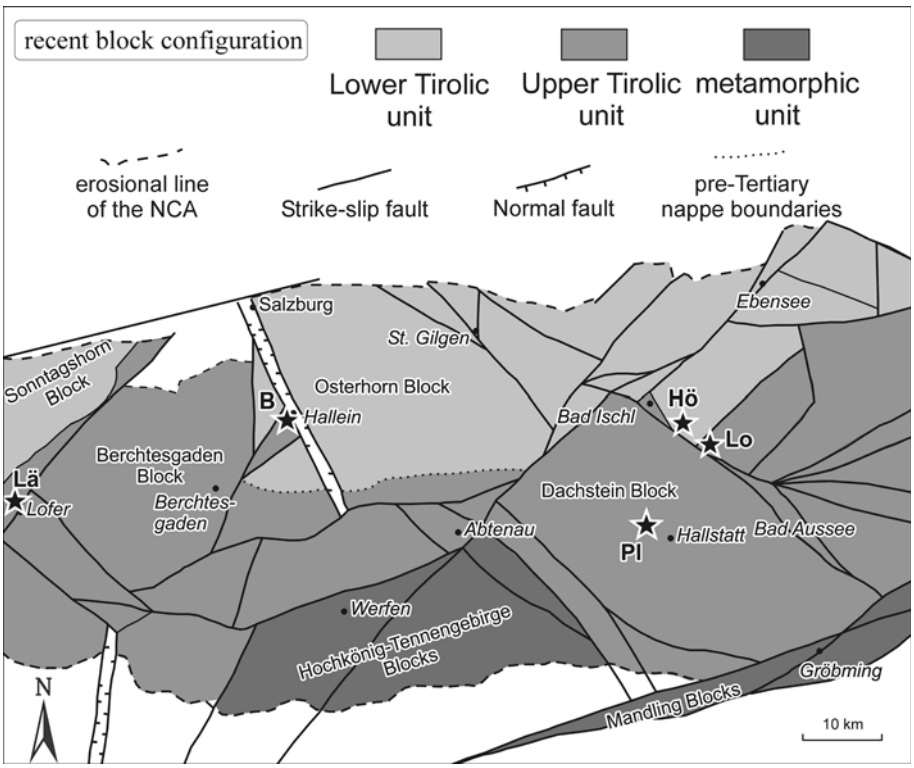
Both new species, *Rivularia barmsteinensis* n. sp. and *Rivularia*? *loseri* n. sp. have been detected at Kleine and Grosse Barmstein (see Text-Fig. 2). Occassionally both occur together, but generally the former is more frequent.

2.2. Loser

The mount Loser is located in the Salzkammergut area northeast of the small village Altaussee and belongs to the Upper Tirolic nappe in the sense of FRISCH & GAWLICK (2003). According to LUKENEDER et al (2003) the limestones in question were referred to the Tressenstein Formation following FENNINGER & HOLZER (1972). By means of an ammonoid bearing loose boulder in the middle part of the section of Lower Kimmeridgian age the base of the "Loser section" about 150 m below was also still transferred to the same stratigraphic age. Within these Upper Jurassic limestones we found *Clypeina* cf. *parasolkani* FARINACCI & RADOICIC, a species we never observed within the Kimmeridgian. The same accounts also for the benthic foraminifera *Pseudocyclammina lituus* (YOKOMAMA). Noteworthy, that Kimmeridgian slope sediments should – according to own observations – most typically contain in various abundances resedimented *Labyrinthina mirabilis* WEYNSCHENK. Sedimentological analyses show intercalated mass-flow deposits in this sedimentary succession with resedimented older clast. Further investigations of the still poorly known "Tressenstein Formation" of the Loser are in progress.

3. Systematic Micropaleontology

The former Porostromata sensu PIA (1927) comprise an artificial and heterogeneous group of filamentous calcareous algae belonging to both, Cyanophyta (blue-green algae) and Chlorophyta (green algae). Regarding the most



Text-Fig. 1.
Recent tectonic block configuration of central Northern Calcareous Alps after FRISCH & GAWLICK (2003) with occurrences of *Rivularia barmsteinensis* n. sp. (B, Pl, Hö) and *Rivularia*? *loseri* n. sp. (B, Lo, Lä).
B = Barmsteine, Hö = Höherstein plateau, Lo = Loser, Pl = Plassen, Lä = Lärchberghörndl.

widespread genera (*Garwoodia, Hedstroemia, Rivularia*) occurring in the alpine Upper Jurassic shallow water limestones, their suprageneric classification based on DRAGASTAN et al. (1996, 1997) is presented in Table 1.

Table 1.
Systematic overview of the most important genera of filamentous calcareous algae of Upper Jurassic shallow water limestones of the Northern Calcareous Alps (compiled after DRAGASTAN [1988] and DRAGASTAN et al. [1996, 1997]).

Phylum Cyanophyta **Class Cyanophyceae** **Order Nostocales**	**Phylum Siphonophyta** **Class Bryopsidophyceae** **Order Bryopsidales**
Family Rivulariaceae RABENHORST, 1865	Family Pseudoudoteaceae DRAGASTAN et al., 1997
Genus ***Rivularia*** (ROTH, 1802) AGARDH, 1824	Genus *Garwoodia* (NICHOLSON, 1888) Genus *Hedstroemia* ROTHPLETZ, 1913
"Porostromata" sensu PIA, 1927	

Phylum: Cyanophyta
Class: Cyanophyceae
Order: Nostocales
Phylum: Siphonophyta
Class: Bryopsidophyceae
Order: Bryopsidales
Family: Rivulariaceae RABENHORST 1865
Genus: *Rivularia* (ROTH 1802) AGARDH 1824

Rivularia barmsteinensis n. sp.

(Pl. 1, Figs. 1–6)

Derivation of the name: The species name refers to the occurrence in the Barmstein limestones where the new species has been detected.

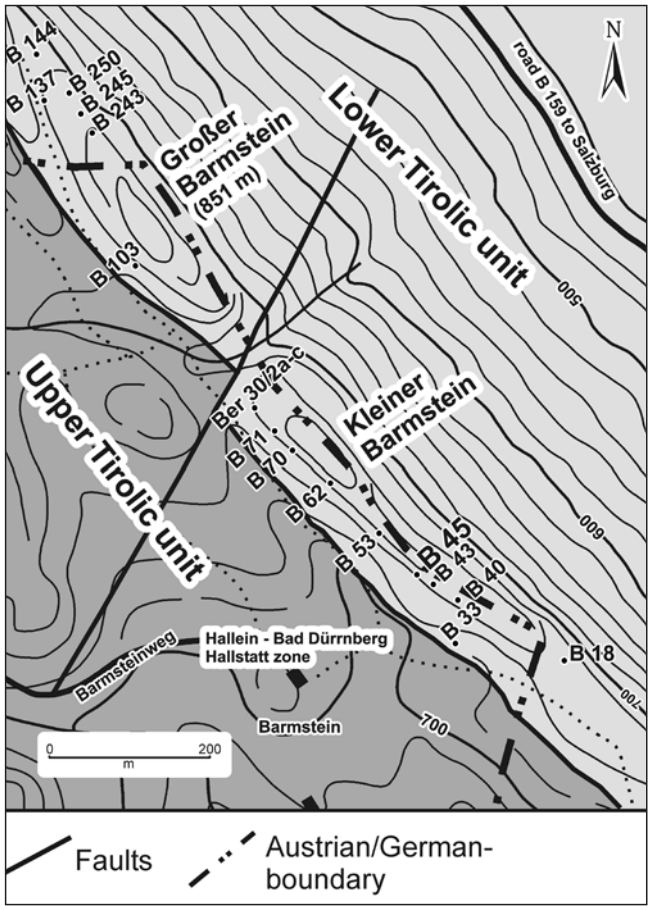
Material: About 20 specimens in different thin-sections from the Barmsteine: samples B 18, B 33, B 40, B 43, B 45, B 53, B 62, B 70, B 71, B 103, B 111, B 125 ?, B 137, B 144, B 145, Ber 30-2-C, Ber 30-2-A (see Text-Fig. 2).

Holotype and depository: The holotyp is the vertical section of the specimen figured in Plate 1, Fig. 5, sample B 45. The whole material figured is stored at the University Leoben, Institute of Geoscience, Leoben.

Type-locality: Kleiner Barmstein northwest of Hallein, Topographic Map of Austria 1 : 50.000 ÖK 94 Hallein (see Text-Fig. 2).

Type-stratum: Mass flow deposits of the Barmstein limestones refered to the Upper Tithonian–Lower Berriasian stratigraphic interval (STEIGER 1981). *R. barmsteinensis* n. sp. occurs as a single component not within clasts, hence, nothing can be said about its original paleoenvironment. The components deriving from the shallow water carbonates of the Plassen Formation are mainly wackestones of the closed lagoon but there are also clasts that can be refered to platform margin to upper slope deposits. The former contain oncoids, dasycladales with *Clypeina*? *solkani* CONRAD & RADOIČIĆ, *Salpingoporella annulata* CAROZZI and *Clypeina sulcata* (ALTH). The most frequent benthic foraminifera are *Pseudocyclammina lituus* (YOKOYAMA), *Trocholina elongata* (LEUPOLD) and *Mohlerina basiliensis* (MOHLER). Common bioclasts are stromatoporoids (see Pl. 1, Fig. 7).
Indications for Berriasian parts of the Barmstein limestones are indicated by the dasycladales *Actinoporella*? *geredeensis* FARINACCI & RADOIČIĆ, *Macroporella praturloni* DRAGASTAN or *Selliporella neocomiensis* (RADOIČIĆ) BUCUR & SASARAN (see Pl. 1, Fig. 8).

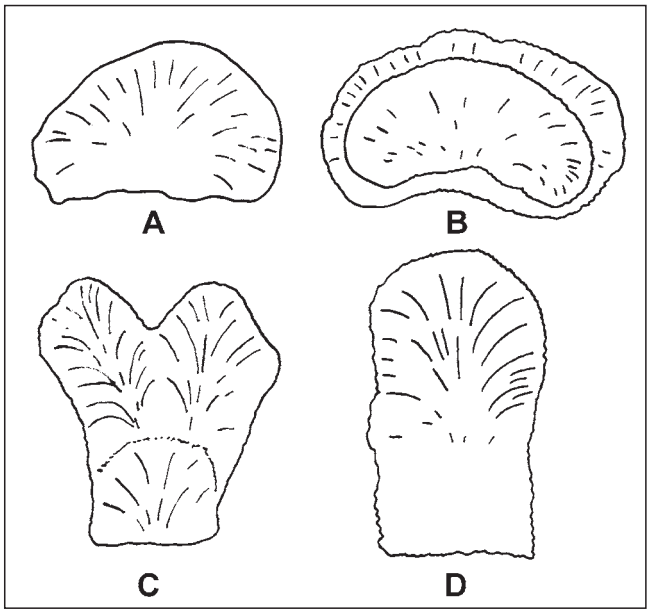
Diagnosis: Representative of *Rivularia* showing coarsely crystallized thalli, elliptical to hemispherical in shape with concave or irregular flat base and fine dichotomic branching filaments. The thalli may show two growth zones.



Text-Fig. 2.
Topographic map of the Barmsteine west of Hallein and sample localities of *Rivularia barmsteinensis* n. sp.
The sample containing the holotype is B-45. In sample Ber 30-2-a *R. barmsteinensis* n. sp. occurs together with *Rivularia*? *loseri* n. sp. In the samples B 243, B 245 and B 250 the latter species occurs alone.

Description: The thalli are composed of light-yellowish calcite. Their shape is often hemispherical rounded (Pl. 1, Fig. 1) with flat or slightly concave base (e.g. Pl. 1, Fig. 5). In most cases the thalli are not exactly hemispherical but are somehow flattened (semi-elliptic) with respect to the base resulting in a height/width ratio of 0.5 to 0.65. In general, it seems that the thallus shape is in a certain manner also controlled by its size, respectively young and adult thalli. The thalli may display two growth zones (bistratose thallus) (Pl. 1, Fig. 2, 5). With respect to the radial diameter, the inner of these two zones is distinctly larger making up about 60–70 % of the total thallus in hemispherical thalli. The fine filaments, diverging from the middle portion of the thallus base, are dichotomically branched and filled with micrite; walls coarsely crystallized. This central part, where the filaments are the closest to each other has a dark appearance (e.g. Pl. 1, Fig. 3). In the adult part of the thallus, the filaments are bending outwards.

Remarks and comparisons: First of all it should be mentioned that *Rivularia barmsteinensis* n. sp. has possibly already been remarked by FENNINGER & HOLZER (1972: p. 111). In their faunal and floral list from the Barmsteine they also included *Stenoporidium chaetetiformis* YABE & TOYAMA, 1928, a form that from the original figurations shows some similarities with *R. barmsteinensis* n. sp. The filament diameter of the former, however, is distinctly larger with



Text-Fig. 3.
Thallus morphology of *Rivularia barmsteinensis* n. sp. (A and B: Hemispherical to semielliptical) and *Rivularia*? *loseri* n. sp. (C and D: columnar-erect with branching) (without scale).

0.041–0.081 mm. The genus *Stenoporidium* YABE & TOYAMA 1928 has been regarded a synonym of *Rivularia* by DRAGASTAN (1985: p. 105) with the species *S. chaetetiformis* being synonymous to *Rivularia lissaviensis* (BORNEMANN 1887).

Amongst the different fossil *Rivularia* species described, comparisons include those exhibiting the same general thallus appearance being light, coarsely crystallized. Within this "group" that differs from the dark, micritic thallus appearance of the other representatives such as for example *Rivularia lissaviensis* (BORNEMANN) or *Rivularia carpathica* DRAGASTAN (e.g. DRAGASTAN, 1985), there are 4 species curiously all of them established from the Tithonian of Romania (see Table 1). In their discussion of thallus architecture of fossil *Rivularia* species, DRAGASTAN et al. (1996: p. 51) assume that in the group of species *Rivularia moesica, R. dianae, R. carpathica, R. subrotundata* and *R. globosa*, the outer diameter of the filaments including the wall (in the case of a concentric ring structure) "is a criterion with taxonomical value".

With constantly not more than two growth zones, the comparable small thallus width and the reduced filament diameter, *R. barmsteinensis* n. sp. can not be mistaken for *R. subrotundata* DRAGASTAN, *R. moesicus* (DRAGASTAN & BUCUR) and *R. dianae* (DRAGASTAN & BUCUR). Worth mentioning, that with respect to other cyanobacteria, namely *Apophoretella dobunnorum* ELLIOTT and *A. bancilai* DRAGASTAN et al., DRAGASTAN et al. (1998: p. 65) note a constant number of growth zones showing "temperature and light variation in the Upper Jurassic sea basin, because of currents and influx of mud-sedimentation".

The species which *R. barmsteinensis* n. sp. resembles the most is *Rivularia globosa* DRAGASTAN. The latter, however, exhibits a sphaeroidal thallus with a central tubular hollow of 0.22 mm.

Occurrences: The new species *Rivularia barmsteinensis* n. sp. has been found in the Barmstein limestones (Kleiner and Grosser Barmstein, Höherstein plateau) and the Plassen Formation (Plassen).

Große und Kleine Barmsteine: Type-locality of *Rivularia barmsteinensis* n. sp.

Höherstein plateau: Topographic map of Austria 1 : 50.000 ÖK 96 Bad Ischl, Austrian Salzkammergut

Literature: GAWLICK et al. (2003).

In contrast to the Barmstein limestones of the Barmsteine, *Rivularia barmsteinensis* n. sp. is extremely rare at the Höherstein plateau (1 specimen in about 100 thin-sections). The sample (D 57) with *R. barmsteinensis* n. sp. is a comparably well washed-out packstone with *Pseudocyclammina lituus* (YOKOMAMA), *Mohlerina basiliensis* (MOHLER), ?*Protopeneroplis striata* WEYNSCHANK, *Coscinophragma* aff. *cribrosa* (REUSS), *Clypeina sulcata* (ALTH), *Carpathiella triangulata* MISIK, SOTAK & ZIEGLER and abundant echinoid fragments.

Stratigraphy: Most probably Upper Tithonian.

Plassen near Hallstatt: The Plassen represents the type locality of the Plassen Formation ranging from the Kimmeridgian to Berriasian (SCHLAGINTWEIT et al. 2003). Here, *Rivularia barmsteinensis* n. sp. has been found extremely rarely, with one specimen in one sample respectively. The sample (Pl 86) represents a poorly washed out packstone with remains of corals, stromatoporoids and pharetronid sponges. Microfossils occurring are the benthic foraminifera *Mohlerina basiliensis* (MOHLER) and *Trocholina* sp., dasycladales are present with debris of *Anisoporella*? *jurassica* (ENDO). In addition we find serpulid tubes of *Carpathiella triangulata* MISÍK, SOTÁK & ZIEGLER. From the

Table 2.
Comparison table between *Rivularia barmsteinensis* n. sp., *Rivularia*? *loseri* n. sp. and other representatives of *Rivularia*.

Species	Type-locality Stratigraphy	Thallus shape, (diameter)	Growth zones, (thickness)	Filament diameter
R. barmsteinensis n. sp.	Upper Tithonian to Lower Berriasian of Northern Calcareous Alps	semielliptical-nodular (0.92 – 2.4 mm)	2	6 – 12 µm
R.? loseri n. sp.	? Tithonian to Lower Berriasian of Northern Calcareous Alps	Columnar-erect, branching Diameter: 0.4 – 1.12 mm Length: 1.04 – 1.95 mm	–	7 – 10 µm
R. subrotundata DRAGASTAN, 1990	Tithonian of Apuseni Mts., Romania	Nodular sphaeroidal (3.9 – 4 mm)	3 to 4 (0.45 – 0.75 mm)	30 – 40 µm
R. globosa DRAGASTAN, 1990	Tithonian of Eastern Carpathians, Romania	Sphaeroidal with central tubular hollow (1.6 mm)	2 (varying)	5 – 8 µm
R. moesicus (DRAGASTAN & BUCUR, 1978)	Upper Tithonian of Eastern Carpathians, Romania	Semielliptic to subspheric (1.5 – 3 mm)	2 to 5 (max. 0.15 mm)	15 – 200 µm
R. dianae (DRAGASTAN & BUCUR, 1978)	Tithonian of Eastern Carpathians	Semielliptic or fan-shaped (4 – 4.5 mm)	3 to 4 (0.45 – 0.6 mm)	30 µm

general facies reconstruction, these peri-reefal, platform margin deposits have been referred to the Uppermost Tithonian (see SCHLAGINTWEIT et al. [2003] for details).
Stratigraphy: Taking into account the data compiled from the mentioned localities, *Rivularia barmsteinensis* n. sp. has been found in samples referred to the Upper Tithonian–Lower Berriasian.

Rivularia ? *loseri* n. sp.

(Pl. 2, Figs. 1–5)

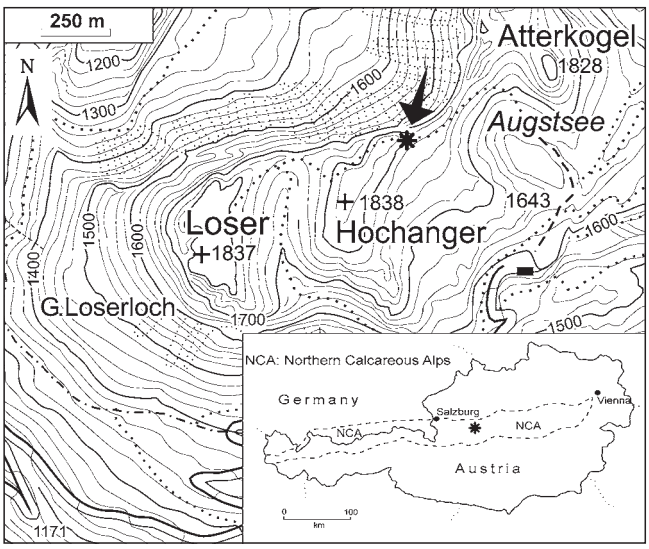
Derivation of the name: The species name refers to the occurrence at the Loser.

Material: Two specimens from Mt. Loser, sample A 3420-3 and further specimens from the Kleine and Große Barmsteine near Hallein and Lärchberghörndl – Kalvarienberg at Lofer.

Holotype and depository: The holotype is the specimen figured in Pl. 2, Fig. 4, showing well the thallus bifurcation, sample A 3420-3. The holotype material figured is stored at the University of Vienna, collection Prof. LEIN. Other sections are kept at Leoben, Institute of Geoscience.

Type-locality: NE of the Hochanger, altitude 1800 m, topographic map of Austria 1 : 50.000 ÖK 96 Bad Ischl, Austrian Salzkammergut. The geographic coordinates are 13°46´ longitude and 47°39´ latitude.

Type-stratum: In accordance with *Rivularia barmsteinensis* n. sp., *Rivularia loseri* n. sp. also occurs in slope resediments in the eastern Loser area composed of closely packed clasts of different microfacies types (such as fine-peloidal packstones or dasycladale wackestones) and single bioclasts. The following microfossils have been found in the sample containing *Rivularia*? *loseri* n. sp. (Sample A 3420/3): *Salpingoporella annulata* CAROZZI, *Pseudocyclammina lituus* (YOKOYAMA), *Thaumatoporella parvovesiculifera* (RAINIERI), *Koskinobullina socialis* CHERCHI & SCHROEDER, *Redmondoides* cf. *lugeoni* (SEPTFONTAINE), *Clypeina sulcata* (ALTH), *Lithocodium aggregatum* ELLIOTT, *"Tubiphytes" morronensis* CRESCENTI, *Trocholina* cf. *alpina* (LEUPOLD). A precise stratigraphic dating is not possible by means of the mentioned taxa. Noteworthy, that we never observed *Pseudocyclammina lituus* (YOKOYAMA) in the Kimmeridgian of the Northern Calcareous Alps so far. Thus, a Tithonian age seems most likely.



Text-Fig. 4.
Topographic map of the Loser area.
The sample containing the holotype of *Rivularia*? *loseri* n. sp. is marked with an asterisk.

Diagnosis: Thallus composed of coarsely crystallized calcite, columnar-erect in shape with branching. Fine dichotomous branching filaments running more or less parallel in the central part then bending towards the outer surface.

Description: The thalli, composed of coarsely crystallized calcite, are finger-shaped (columnar-erect) (e.g. Pl. 2, Fig. 3) and reach a length of up to 1.95 mm and width of up to 0.68 mm. Most conspicuous are branching thalli (e.g. Pl. 2, Figs. 1, 2, 4–5). In this case, another branch splits off in an angle between 16o and 60o whereas the direction (growth axis) of the other remains unchanged (no Y-type branching!). In the branched part the thalli reach a width of up to 1.12 mm.
The internal part is composed of fine dichotomously branching filaments with a diameter of 7 to 10 μm. In the central part these are arranged more or less parallel to the longitudinal axis then bending towards the outer surface (e.g. Pl. 2, Fig. 3).

Remarks and comparisons: At first sight, the elongated, finger-shaped thalli of *Rivularia*? *loseri* n. sp. show some similarities to representatives of the Protohalimedaceae sensu DRAGASTAN et al. (2002). A differentiation of a central medullar zone (e.g. with uni- or multiaxial medullary siphons) where lateral filaments split off becoming successively finer in diameter, forming a cortical zone, however, is not present in *Rivularia*? *loseri* n. sp. Here, the filaments are continuously bending outwards from the central part and there are no differences in filament diameter throughout their length. Noteworthy that branching thalli have not been reported from the genus *Rivularia* (see DRAGASTAN [1985], DRAGASTAN et al. [1996]). According to DRAGASTAN (1985: p. 109) the thallus variability of the genus *Rivularia* includes "subspherical, hemisphaerical, columnarerect or fanlike nodules with more or less flaring borders". Branched growth forms are reported from Udoteaceae and Gymnocodiaceae (e.g. MU, 1991) (example see Pl. 2, Fig. 8) or the ancestral corallinacean alga *Marinella lugeoni* PFENDER (LEINFELDER & WERNER 1993: Pl. 1, Fig. 9). For example, SENOWBARI-DARYAN et al. (1994: p. 233) have provided an emendation of the protohalimedacean alga *Nipponophycus ramosus* YABE & TOYAMA, 1928 concerning the thallus shape as follows: "Udoteacean alga with cylindrical, multiple branched (dendriform) thallus". *Nipponophycus ramosus* is larger than *Rivularia*? *loseri* n. sp. with outer diameters of 0.48–1.74 mm (frequently 0.96–1.44 mm) and often shows an incomplete calcification of the central medullar zone (SENOWBARI-DARYAN et al., 1994). Worth mentioning that *Nipponophycus ramosus* also occurs in the Alpine Plassen Formation (e.g. Krahstein, Plassen, Arzberg/Steiermark). Nice figurations of branched thalli have furthermore been figured by LE MAÎTRE (1937) from specimens of *Boueina hochstetteri* TOULA var. *liassica* LE MAÎTRE. But also dasycladales or solenoporacean red algae may show branchings of the thalli (examples see Pl. 2, Figs. 6–7).
In summary, the observable thallus characteristics fit better the Rivulariaceae rather than the Protohalimedaceae. The mentioned uncertainties, however, account for the question mark with respect to the generic status of the new taxon. The filament diameter resembles the values obtained for *Rivularia barmsteinensis* n. sp. (see Table 2) and in some samples from the Barmsteine both species are co-occurring.

Stratigraphy: Uncertain so far, probably the same as for *Rivularia barmsteinensis* n. sp.

4. Conclusions

Rivularia barmsteinensis n. sp. and *Rivularia*? *loseri* n. sp. represent new cyanophycean algae from the Alpine Upper Jurassic to Lower Cretaceous shallow water limestones. Being rather common in the type-region of the Barmsteine, *R. barmsteinensis* n. sp. has so far only been found sporadically at Mt. Plassen. Possible explanations for this observation could be the restriction of the new species within a portion of the Plassen Formation that has been nearly totally eroded or that we simply still have not located and studied.

Noteworthy that occurrences of Tithonian shallow water carbonates in the central Northern Calcareous Alps are rare. The best known and most complete section at the moment is from the type-locality mount Plassen (SCHLAGINTWEIT et al., 2003) showing a lagoonal facies in the late Tithonian. At the type-locality the facies changed in latest Tithonian by a breakup and new facies characteristics. Reefal limestones occur with a slope apron to the north in direction to the tectonically influenced Trattberg rise and the Tauglboden Basin. During late Tithonian times, the widespread shallow water carbonate platform in the south of the Trattberg Rise (see GAWLICK et al., 1999, for explanation) was partly eroded shedding bioclasts (including *Rivularia barmsteinensis* n. sp.) and lithoclasts to the north forming the Barmstein limestones intercalated within the Oberalm Formation. At mount Plassen, although intensely studied, *Rivularia barmsteinensis* n. sp. has been observed only with one specimen in one sample. Thus, it can be concluded, that the source area with the new species *Rivularia barmsteinensis* n. sp. was situated between the mount Plassen to the south and the deposition area of the Barmstein layers in the north.

From the general microfacies aspect, the Barmstein limestones of different localities appear rather homogeneous mainly comprising clasts of the closed lagoon (wackestones). Some differences with respect to the occurrence or missing of different facies sensitive dasycladales between various occurrences have already been stressed by GAWLICK et al. (2003) and GAWLICK et al. (in press). In this context it is noteworthy that *Rivularia barmsteinensis* n. sp. is very rare at the Höherstein plateau. These differences in micropaleontological content, however, do not contrast the mentioned general homogeneity but may perhaps offer possibilities to distinguish between different source areas or local facies differences in the source area(s). Moreover these observations may be useful for the reconstruction of the shallow water carbonate platform in the Northern Calcareous Alps.

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Tafel 1

Rivularia barmsteinensis n. sp. from the Barmsteine type-region (Figs. 1–6)

Fig. 1: Vertical section nearly hemispherical thallus.
Sample B 33.

Fig. 2: Oblique vertical section of semi-elliptical thallus with concave base and two growth zones.
Sample Ber 30-2-A.

Fig. 3: Oblique vertical section.
Sample B 18.

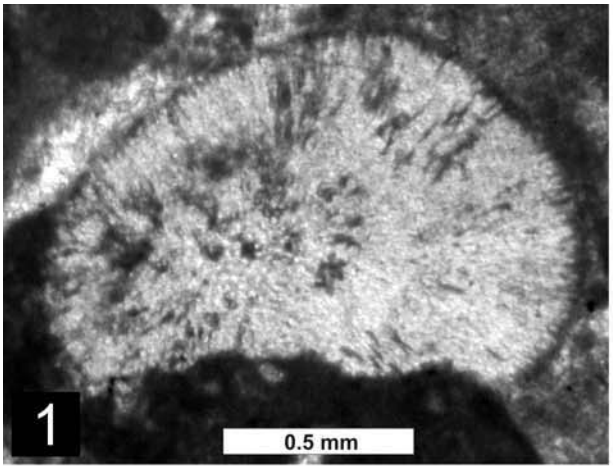
Fig. 4: Oblique section.
Sample B 18

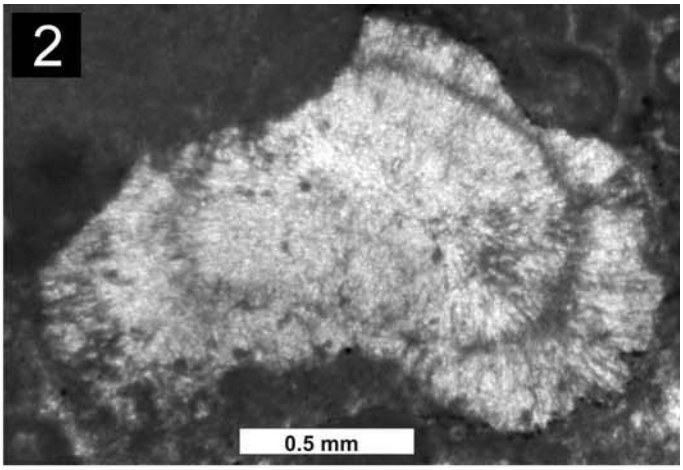
Fig. 5: Holotype, vertical section, semielliptical thallus with two growth zones.
Sample B 45.

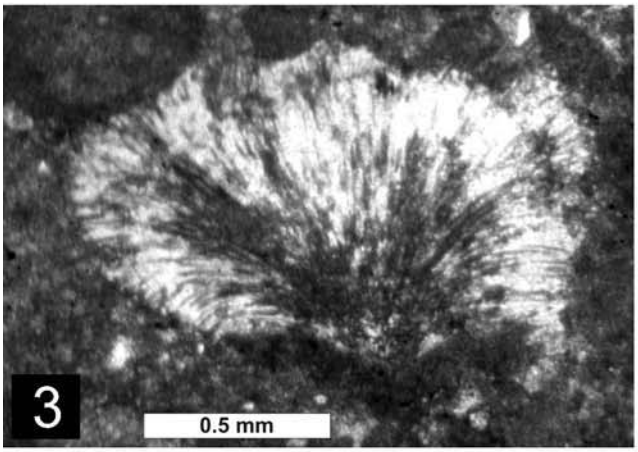
Fig. 6: Oblique section, note the diverging filaments from the central part.
Sample B 43.

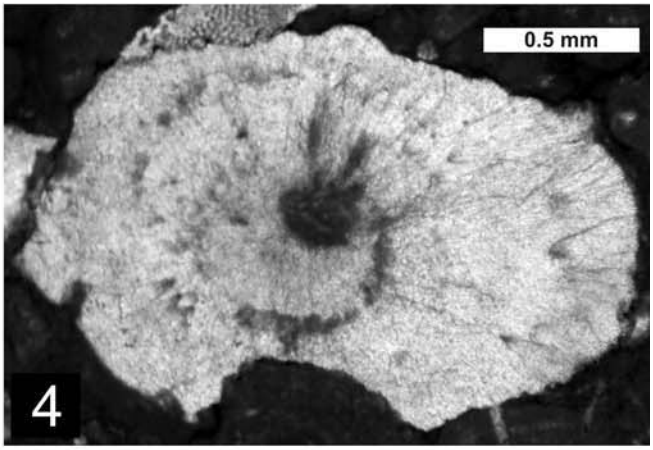
Fig. 7: Typical microfacies of the Barmstein limestones with close packed clasts of different microfacies types and stromatoporoids as single bioclasts, here *Actinostromaria shimizui* YABE & SUGIYAMA. Note bioerosion by lithophag bivalve within stromatoporoid skeleton.
Sample B 8.

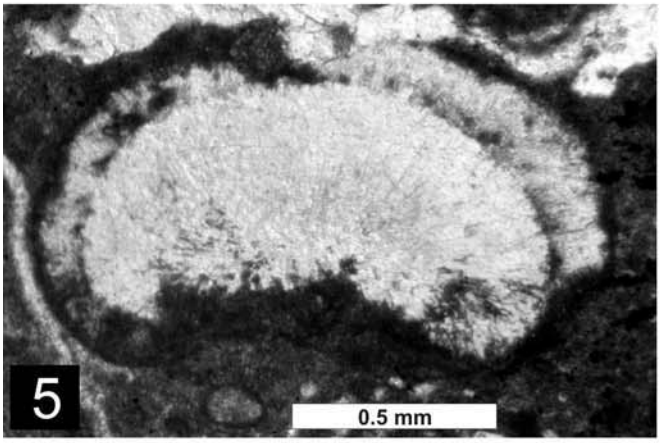
Fig. 8: Dasycladale *Selliporella neocomiensis* (RADOIČIĆ) BUCUR & SASARAN.
Oblique transverse section.
Sample B 125.

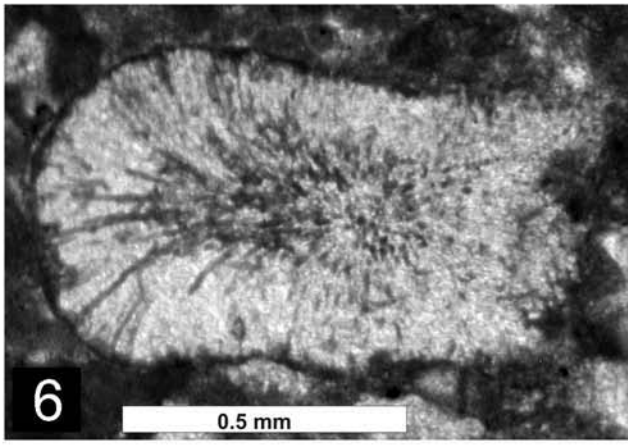


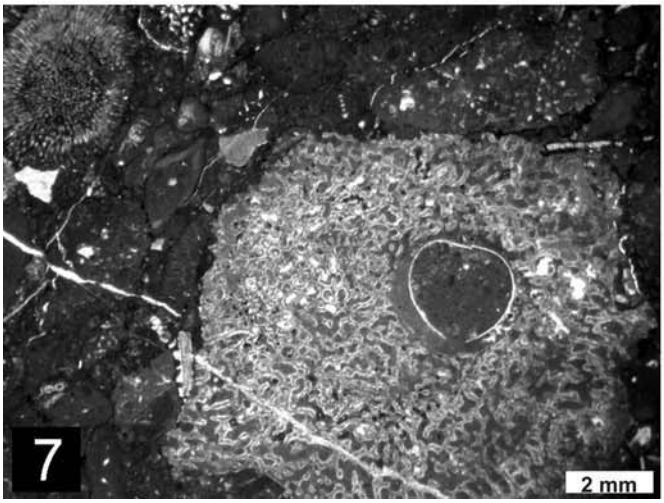


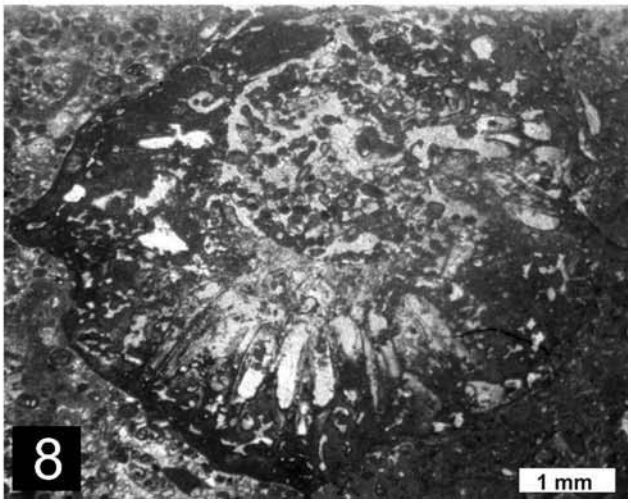












Tafel 2

Rivularia ? *loseri* n. sp. from the Loser (Figs. 3–4)
and the Barmsteine type-region (Figs. 1–2, 5)

Fig. 1: Various sections with the specimen right above showing very well the thallus branching.
Sample B 250.

Fig. 2: Longitudinal section showing thallus branching.
Sample B 243.

Fig. 3: Longitudinal section.
Sample A-3420-3.

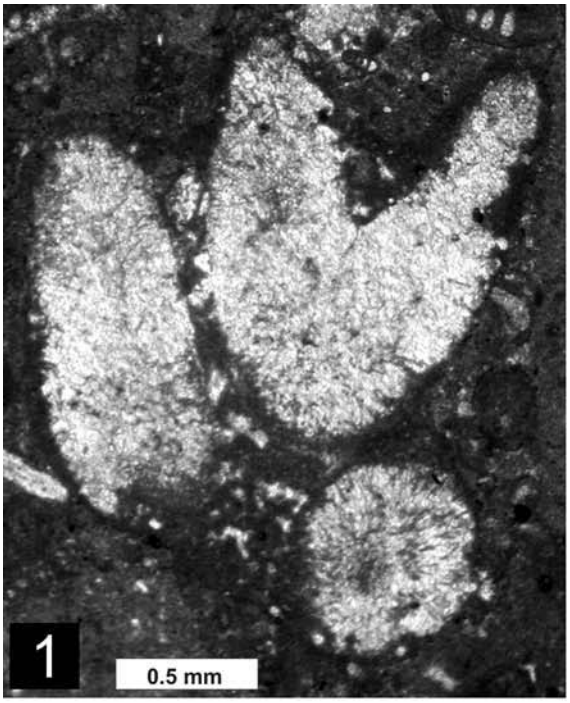
Fig. 4: Oblique section, showing thallus branching, holotype.
Sample A-3420-3.

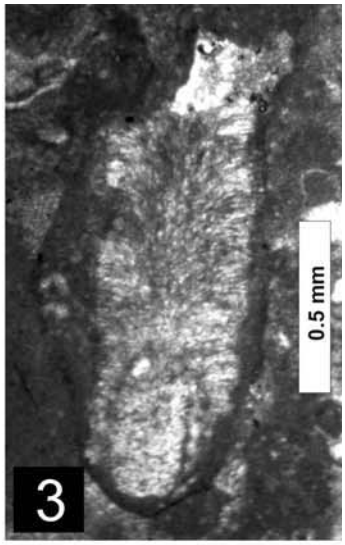
Fig. 5: Two specimens with branching.
Sample Ber 30-2a.

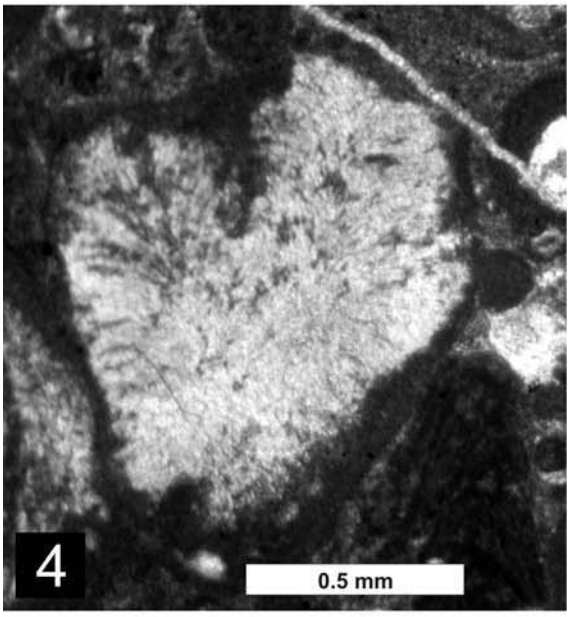
Fig. 6: Branched thallus of the solenoporaceae *Parachaetetes lichenoides* ELLIOTT, 1959.
(?Upper) Santonian of the Lower Gosau Subgroup (Hochmoos Formation) of Gosau.
Sample Go-18.

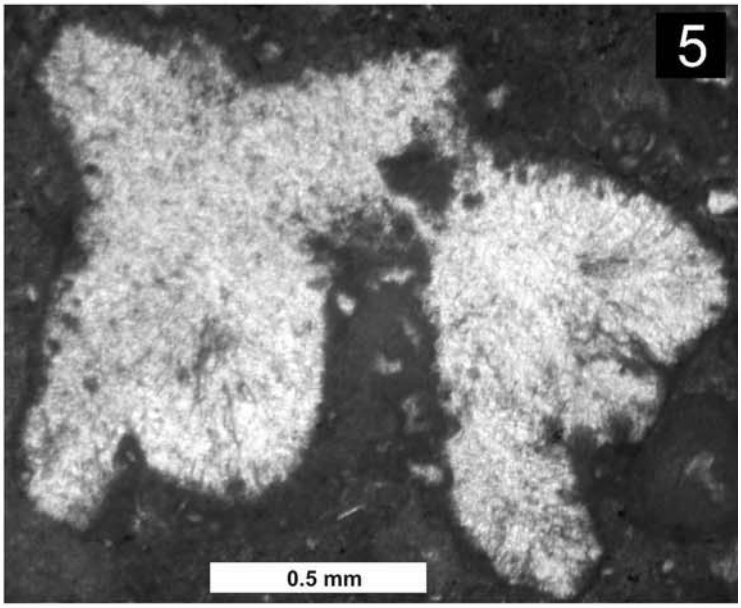
Fig. 7: Branching dasycladale *Thrysoporella eisenbachensis* SCHLAGINTWEIT & LOBITZER, 2003.
Turonian of the Lower Gosau Subgroup of Eisenbach, Lake Traun, Upper Austria.

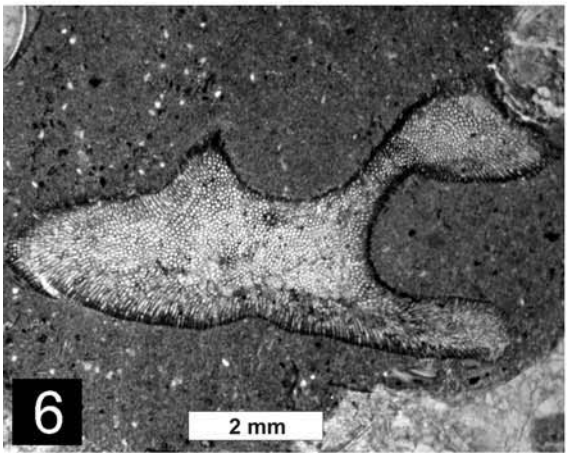
Fig. 8: Branching gymnocodiacean alga *Permocalculus nicolapantici* RADOIČIĆ (2003).
Upper Turonian of the Lower Gosau Subgroup of Brandenberg, Tyrol.
Sample 16795-9a.

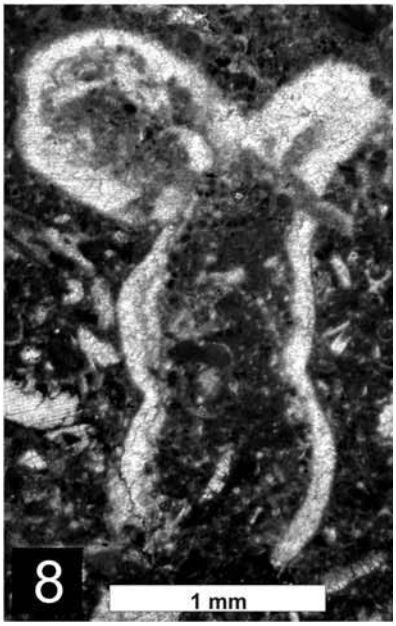












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