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Reinterpretation of "*Palaeodasycladus*" (Chlorophyta, Dasycladales) from the Lower Jurassic of the Tatra Mountains, Poland

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Abstract: The green alga *Palaeodasycladus* (PIA, 1920) was recognized in shallow marine, high-energy calcarenites from the Lower Jurassic Choč Nappe (Hronicum domain) in the Tatra Mountains of Poland. The algal structure is described here. The calcareous skeleton has a regular internal cavity, probably close to the central axis, but very irregular outwardly, enveloping the primary laterals at different lengths. The general shape of the thallus is spherical, with only long, acrophorous primary laterals, probably forming a distal cortex. The external gametophores are attached laterally to the primary laterals. The characteristics allow the alga to be assigned not to *Palaeodasycladus* (PIA, 1920) but to *Goniolina* ORBIGNY, 1850.
The new species *Goniolina tatrarum* n.sp. is here established. A critical review of the genus *Goniolina* ORBIGNY, 1850, and its type species is also provided. The genus *Goniolina* ORBIGNY appears to have been represented so far solely by *G. hexagona* ORBIGNY, 1850. *G. geometrica* BUVIGNIER, 1852, and *G. micraster* BUVIGNIER, 1852, are considered valid and separate species to be assigned to *Coniporella* FISHER & THIERRY, 1971.
Sphaerites regularis QUENSTEDT, 1852, a supposed junior synonym of *Goniolina geometrica* (ROEMER, 1839), is provisionally assigned to the genus *Tersella* J. MORELLET *in* J. MORELLET & TERS, 1952, and indicated as *Tersella* (?) *regularis* (QUENSTEDT, 1852).

Keywords:

- Dasycladales;
- *Goniolina*;
- new taxon;
- Early Jurassic;
- Tatra Mountains

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Résumé : *Réinterprétation de* "Palaeodasycladus" *(Chlorophyta, Dasycladales) du Jurassique inférieur de Tatra Mountains (Pologne)*.- L'algue verte *Palaeodasycladus* (PIA, 1920) a été reconnue dans des calcarénites de milieu marin peu profond et agité du Jurassique inférieur de la Nappe de Choč (domaine Hronicum) dans les montagnes des Tatras en Pologne. La structure de l'algue est décrite. Son squelette calcaire présente une cavité interne régulière probablement proche de l'axe central, mais très irrégulière vers l'extérieur enveloppant les latérales primaires sur différentes longueurs. La forme générale de son thalle est sphérique avec seulement des latérales primaires, longues et acrophores, formant probablement un cortex distal. Ses gamétophores externes sont attachés sur le côté des latérales primaires. Ces caractères permettent d'attribuer l'algue non pas à *Palaeodasycladus* (PIA, 1920) mais à *Goniolina* ORBIGNY, 1850.

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La nouvelle espèce *Goniolina tatrarum* n.sp est ici créée. Une revue critique du genre *Goniolina* ORBIGNY, 1850, et de son espèce type est également fournie. Le genre *Goniolina* ORBIGNY semble être représenté uniquement par *G. hexagona* ORBIGNY, 1850. *G. geometrica* BUVIGNIER, 1852, et *G. micraster* BUVIGNIER, 1852, sont considérées comme deux espèces valides et distinctes à attribuer à *Coniporella* FISHER & THIERRY, 1971.
Sphaerites regularis QUENSTEDT, 1852, synonyme junior supposé de *Goniolina geometrica* (ROEMER, 1839), est provisoirement attribué au genre *Tersella* J. MORELLET *in* J. MORELLET & TERS, 1952, et indiqué comme *Tersella* (?) *regularis* (QUENSTEDT, 1852).

Mots-clefs :

- Dasycladales ;
- *Goniolina* ;
- taxon nouveau ;
- Jurassique inférieur ;
- Tatras

1. Introduction

Calcareous algae represent an informal group of simple plants whose thallus is jacketed with calcium carbonate, which has favoured their preservation as fossils (PIA, 1920; WRAY, 1977). Within this group, the green algae Dasycladales stand out by being good indicators of paleoenvironment (like their Holocene representatives that lived at low latitudes, in warm, shallow, well-lighted waters (*e.g.*, PIA, 1920; VALET, 1969; CONRAD, 1977; BARATTOLO, 1991; FLÜGEL, 1991; BERGER & KAEVER, 1992; BUCUR & SĂSĂRAN, 2005; GRANIER, 2012). Some Dasycladales genera and species are also good age indicators. They have a relatively short duration on a geological scale, being good index fossils at the stage or substage level (*e.g.*, PIA, 1920; BARATTOLO, 1991, 2002; DELOFFRE & GRANIER, 1993; GRANIER & DELOFFRE, 1994, 1995; BUCUR, 1999; BARATTOLO & ROMANO, 2005; BUCUR & REOLID, 2024).

Based on these characteristics, fossil dasycladalean algae have also been used for paleogeographic reconstructions (*e.g.*, MU, 1993; YILMAZ, 1999; TAHERPOUR *et al.*, 2013; BUCUR *et al.*, 2020). To be confident, palaeoecological, stratigraphic or paleogeographic remarks on these fossils must be always based on a good and correct determination. To have merit, such reconstructions must be based on accurate taxonomic assignments. This is the case of the article published by RYCHLINSKI *et al.* (2018) in which, as will be shown below, remains of some dasycladalean algae were erroneously interpreted as belonging to the genus *Palaeodasycladus* (*P.* cf. *mediterraneus* PIA). On this basis, the authors developed a new paleogeographic distribution of this alga, indicating what they considered to be its northernmost occurrence.

The aim of the present work is to provide a revised interpretation of the alga illustrated by RYCHLINSKI *et al.* (2018). According to their morphological characteristics, these remains are attributed to a new species of the genus *Goniolina* ORBIGNY, 1850. In view of this change, the paleogeographic interpretation advanced by RYCHLINSKI *et al.* (2018) is no longer valid.

2. Geological setting

From a geological point of view the outcrop with *Goniolina tatrarum* n.sp., belongs to the Mesozoic succession of the Choč Nappe (Upper Sub-Tatric) referred to the Hronicum domain of the Central Western Carpathians Basin. For more details we refer to RYCHLINSKI *et al.* (2018).

3. Materials and methods

The study is based on the figures provided by RYCHLINSKI *et al.* (2018). The material is licensed by Swiss Journal of Geosciences (Springer Nature), License Number 6114910131117 on Sep 23, 2025.

Repositories and institutional abbreviations

IGS, Institute of Geological Sciences, Jagiellonian University in Krakow, Poland.

Nomenclatural acts

This published work and the nomenclatural acts it contains have been registered in Plant Fossil Names Registry (PFNR): *urn:lsid:plantfossilnames.org:ref:974*

4. Systematic palaeontology

Order Dasycladales PASCHER, 1931
Family Bornetellaceae GRANIER & BUCUR *in* GRANIER *et al.*, 2013
Tribe Bornetelleae
L. MORELLET & J. MORELLET, 1913
Genus *Goniolina* ORBIGNY, 1850

Type species. *Goniolina hexagona* ORBIGNY; "Corallien", Pointe-du-Ché (Chay?), near La Rochelle (Charente-Maritime), SW France.

Emended diagnosis. Spherical thallus, euspondyl. Phloiophorous primary laterals only. Reproductive organs set laterally on primary laterals (goniosporate type) (Fig. 1).

Description. The original diagnosis by ORBIGNY (1850) is: "It is a *Conodictyum* without pores, with the surface divided into regular hexagons" (translation from BASSOULLET *et al.*, 1978). According to PIA (1920) the thallus is composed of a terminal ovoid part and a basal cylindrical peduncle without traces of branches. Ovoid terminal part presents on its outer surface hexagonal or pentagonal cortical plates, at the end of terminal branches. Two probable orders of branches. Euspondyl type (see BASSOULLET *et al.*, 1978). CHERCHI and SCHROEDER (1993) re-described the ORBIGNY's material, but they do not supply a generic diagnosis. According to their description, the thallus is spherical with euspondyl, phloiophorous primary laterals only, and with reproductive organs set laterally on the laterals (goniosporate type) (Fig. 1).

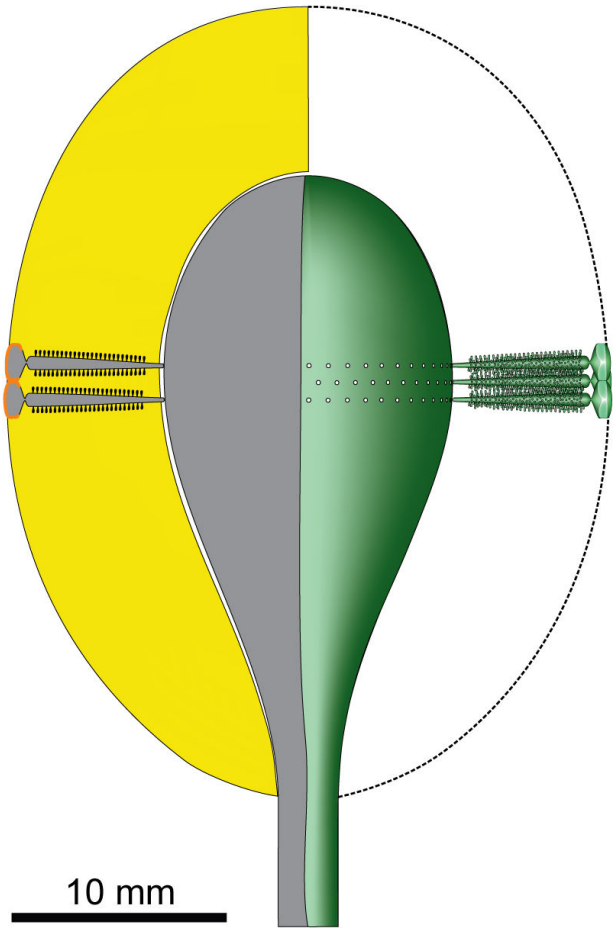


Figure 1: Reconstruction of the dasycladalean alga *Goniolina hexagona* ORBIGNY (1850), Kimmeridgian of La Rochelle (Charente-Maritime), SW France. *Left*: extracellular calcified skeleton (yellow), intracellular cortical calcification (orange), soft parts (grey) and gametophores (black) in axial section, only two central laterals are depicted; *right*: axial view of the soft parts (green), only laterals of tree central whorl are depicted.

Remarks. *Goniolina* is one of the dasycladalean algae whose phylogenetic affinity has been much discussed and disputed. The genus *Goniolina* was established by ORBIGNY (1850, p. 41) who considered it close to *Conodictyum* but without pores, with a surface divided into regular hexagons. The genus was monospecific, therefore, even if not formally designated by ORBIGNY, type species is *Goniolina hexagona* ["a very remarkable species, representing an oval of 33 mm in diameter, decorated all over with concentric and quincunx lines of very regular hexagons"]. It should be noted that at that time the dasycladalean alga *Conodictyum* was considered a foraminifer.

However, a possible *Goniolina* species was established by F.A. ROEMER (1839, p. 36, Pl. XVIII, fig. 39) under the name *Chama*? *geometrica*, considered to represent a lamellibranchiate valve, this correspond to the first mention of the *geometrica* epithet. Without considering ROEMER's work, BUVIGNIER (1852, p. 47) described two species of the genus *Goniolina* ORBIGNY: *Goniolina geometrica* BUV., Pl. XXXII, figs. 56-57, and *Goniolina micraster* BUV., Pl. XXXII, figs. 58-59, the latter was considered as a senior synonym of the species *Goniolina hexagona* by CHERCHI and SCHROEDER (1992). BUVIGNIER (1852) considered the two species as belonging to polypiers. Other authors have attributed the fossils of *Goniolina* with reservation to echinoderms, bryozoans, terebratulid brachiopods, tunicates or sponges (see CHERCHI & SCHROEDER, 1993, p. 239).

SAPORTA (1891) attributed *Goniolina* to plants, specifically to monocotyledons. A first suggestion of these fossils as algae was advanced by STEINMANN (1880, p. 138), but the author doubted this affiliation because the branches of this genus do not open freely at the surface of the calcareous skeleton but are closed on the outside by polygonal calcareous plates. The one who assigned *Goniolina* to algae was SCHENK (1890, p. 192).

Remarks on the species assigned to the genus and type species.

The history of the species attributed to *Goniolina* is quite complicated as well as the assignment of type species. Fundamentally, this depends on the peculiar shape of the fossil instituted by ORBIGNY (1850), *i.e.*, an ovoid body covered by juxtaposed hexagonal calcareous tiles. The author gave a description of the species *Goniolina hexagona* (ORBIGNY, 1850, p. 41) but did not illustrate it. Two years later BUVIGNIER (1852, Atlas, p. 47) described and figured two new species, *Goniolina geometrica* BUVIGNIER, 1852, whose hexagonal facets display six, slightly projecting rays [Fig. 2 (1a-1b)] and *Goniolina micraster* BUVIGNIER, 1852, slightly smaller than the previous species and whose hexagonal facets form a hollow ring surrounding a convex disc with a punctiform embedded center [Fig. 2 (1c)], seemingly corresponding to the scar left by a deciduous assimilator.

In the same year QUENSTEDT (1852, p. 630, Pl. 61, fig. 25) described a new species, *Sphaerites regularis*, from the Portlandkalke of Kammin, Pomerania region.

A few years later *Chama* (?) *geometrica* ROEMER, 1839, a bivalve with the impression of hexagonal plates on a valve, was transferred in the genus *Goniolina* ORBIGNY. Furthermore, *Goniolina geometrica* BUVIGNER, 1852, was considered a junior synonym (and homonym) of this former species (SEEBACH, 1864, p. 87). The following authors accepted the synonymy, and the species was cited as *Goniolina geometrica* (ROEMER, 1839).

Finally, SAPORTA (1891, p. 219) considered *Goniolina hexagona* ORBIGNY, the type species of the genus, junior synonym of *Goniolina geometrica* (ROEMER, 1839). Therefore, for principle of priority, this latter species became the type species and the only species of the genus *Goniolina* ORBIGNY. Also, *Sphaerites regularis* QUENSTEDT (1852) was considered a junior synonym of *Goniolina geometrica* (ROEMER, 1839).

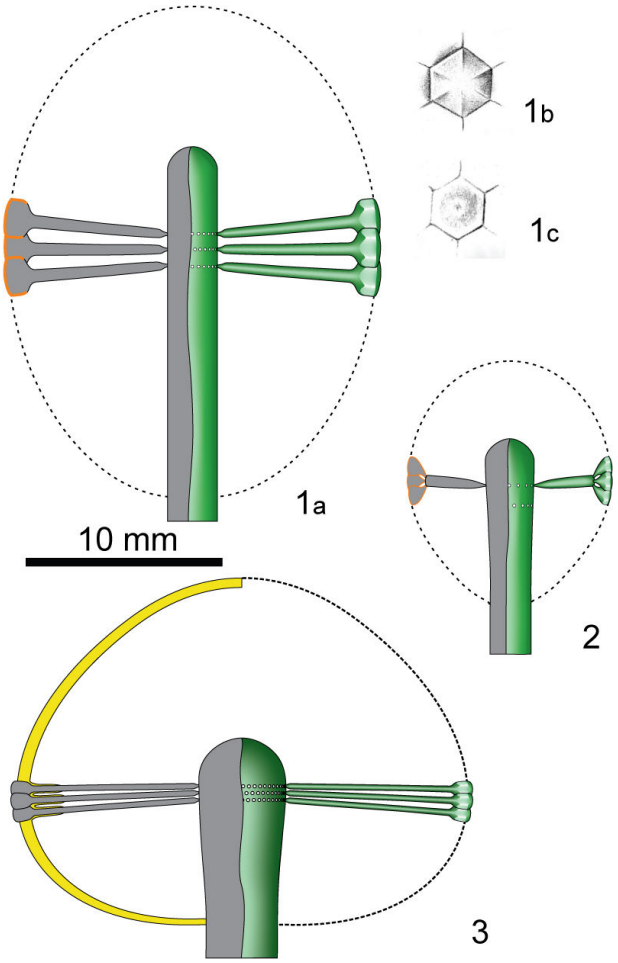


Figure 2: Schemes of some dasycladalean algae with spherical thalli like *Goniolina* ORBIGNY (1850): **1a)** *Goniolina geometrica* BUVIGNIER (1852), Calcaire à Astartes (upper Oxfordian) of Senoncourt-les-Maujouy, département de la Meuse, NE France; **1b)** cortical mesh of *Goniolina geometrica* BUVIGNIER (1852, Pl. 32, fig. 36); **1c)** cortical mesh of *Goniolina micraster* BUVIGNIER (1852, Pl. 32, fig. 38); **2)** *Sphaerites regularis* QUENSTEDT (1852), Kimmeridgian of Tribsow, Pomerania, Poland [interpretation based on CHERCHI & SCHROEDER, 1992, Pl. 1, fig. 1, *sub Goniolina hexagona* ORBIGNY (1850)]; **3)** *Landereria decastroi* CHERCHI & SCHROEDER (2006), environs of Morella, Aptian, Castellon province, E Spain. For all figures *left*: extracellular calcified skeleton (yellow), intracellular cortical calcification (orange), soft parts (grey) in axial section, only central laterals are depicted; *right*: axial view of the soft parts (green), only laterals of central whorls are depicted.

All taxa established in the middle of the 19th century are often depicted in a schematic way and always in external view. It should not be forgotten that these algae were not recognized as such. It is not surprising that in the revision phase SAPORTA (1891) considered all these species as belonging to one. Studies of the last century, however, allow us to reconsider the taxonomic status of these forgotten species. Therefore, the taxonomical steps shown above should be re-examined.

As to the taxa described by BUVIGNIER (1852), it is noteworthy that the presence or absence of the scar on the facets is a character at species level. For example, it is used, among other characters, to distinguish the species of the genus *Bornetella* (*e.g.*, see BERGER & KAEVER, 1992, p. 95 and Fig. 3.25c, and p. 99 and Fig. 2.29d for *Bornetella nitida* (HARVEY, 1857) and *Bornetella sphaerica* (ZANARDINI, 1878) respectively). Such a character usually cannot be applied to fossil dasycladales because the cortical meshes are not calcified, but it is possible when the facets are well calcified as in the genera *Goniolina* ORBIGNY, 1850, *Stichoporella* PIA, 1922, and *Coniporella* FISHER & THIERRY, 1971. Accordingly, the two BUVIGNIER's (1852) species should be treated as separated taxa.

Chama (?) *geometrica* ROEMER, 1839, has been discussed by CHERCHI and SCHROEDER (1992). Ultimately the taxon is a finely ribbed oyster and on its upper valve a hexagonal pattern is found as a xenomorph sculpture of a fossil that the two authors refer to *Goniolina hexagona* ORBIGNY, 1850. Anyway, the attribution of *Chama* (?) *geometrica* ROEMER, 1839, to the genus *Goniolina* ORBIGNY should be discarded as well as the synonymy with *Goniolina geometrica* BUVIGNIER, 1852. There is no way of associating the regular smooth hexagonal meshes observed on the valve to the genus *Goniolina* ORBIGNY, much less to *Goniolina geometrica* BUVIGNER, 1852.

Even the solution proposed by SAPORTA (1891) to include all known goniolinids in a single species does not seem acceptable. *Goniolina geometrica* (ROEMER, 1839) *sensu* SAPORTA, 1891, looks heterogeneous, gathering different taxa. Indeed, according to SAPORTA and MARION (1881, p. 1270) and SAPORTA (1891, p. 213-214), the genus must be interpreted as an external mold, therefore the internal structures were destroyed (*i.e.*, only the distal cortical part is calcified and preserved) except for the specimens of the ORBIGNY's collection where an internal structure can be observed in a broken specimen (SAPORTA, 1891, Pl. CCLVIII, fig. 3). DEECKE (1901, p. 472-473) studied some *Goniolina* specimens from the Pomerania region. He observed the similar thin cortical calcification and judged that such a character was sufficient to put them in two separate genera. PIA (1920, p. 113) disagreed with DEECKE's opinion.

Finally, CHERCHI and SCHROEDER (1993) restudied the ORBIGNY's collection and showed that *Goniolina hexagona* ORBIGNY, 1850, has thin, phloiophorous primary laterals with numerous lateral gametophores around them (Fig. 1). Furthermore, the two authors designated the specimen in SAPORTA (1891, Pl. CCLIX, fig. 2) as lectotype. However, one year before, CHERCHI and SCHROEDER (1992) restudied the algae from the Pomerania region previously described by QUENSTEDT (1852) as *Sphaerites regularis*. They agree with the opinion expressed by PIA (1920, p. 113, see before) and referred the algal specimens to *Goniolina hexagona* ORBIGNY, 1850. In this paper the authors displayed that here and there the cortical laterals have a rosette-shaped arrangement (CHERCHI & SCHROEDER, 1992, Pl. II, figs. 3-5). Such a pattern usually indicates that laterals are at least of second order (also considered by CHER-

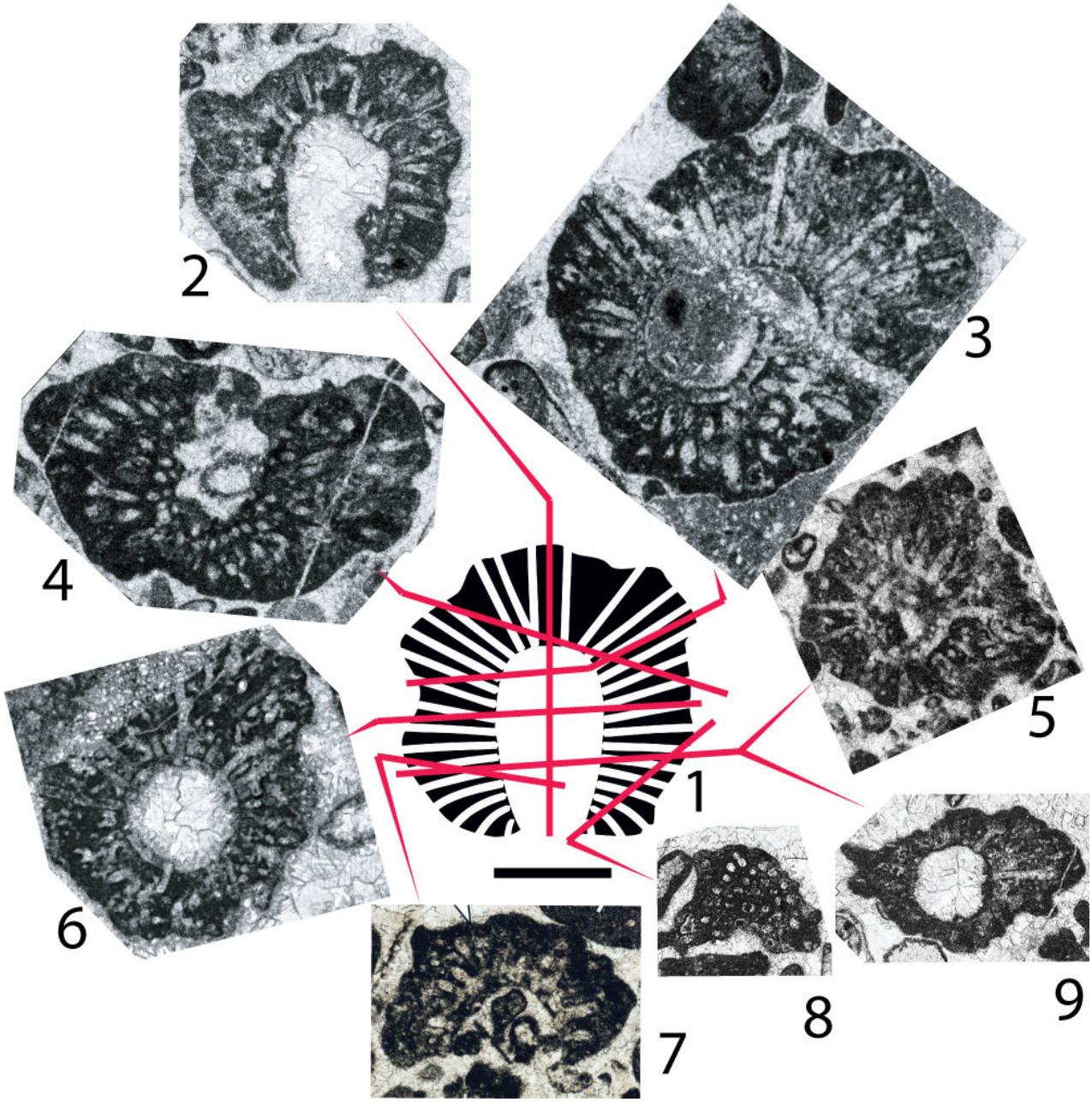


Figure 3: Dasycladalean alga *Goniolina tatrarum* n.sp. from the upper Sinemurian - lower Pliensbachian, western side of the Brama Kantaka, Tatra Mts., Poland: **1)** Scheme of the calcareous skeleton of the alga, calcification in black, pores in white colour with the traces of cuts (red lines) of figures 3 (2-9); **2) holotype**, axial section. **3)** paratype, oblique section; **4)** paratype, oblique section, close to the apex; **5)** paratype, subtransversal section, probably in the lower part of the thallus; **6)** paratype, subtransversal section; **7)** paratype, probably oblique section of a broken specimen; **8)** paratype, tangential section; **9)** paratype, subtransversal section, probably in the lower part of the thallus. Scale bar = 0.50 mm. Samples: IGS-BP1A1 (2-7), IGS-BP1B (8-9).

CHI & SCHROEDER, 1992, p. 12). The specimens from the Pomerania region, *i.e.*, *Sphaerites regularis* QUENSTEDT, 1852, must be separated from *Goniolina hexagona* ORBIGNY by exhibiting laterals calcified only peripherally and probably assigned to a different genus because laterals are of second order [Fig. 2 (2)]. The specimen figured by QUENSTEDT (1852) should have been stored in the Eberhard Karls Universität Tübingen, but our research has been unsuccessful. The specimen probably should be considered missing. A **neotype** is here designated. The specimen illustrated by CHERCHI and SCHROEDER (1992, Pl. 1, fig. 1) has been chosen. The specimen is stored in Museum der Fachrichtung Geowissenschaften der Universität Greifswald, collected by A. ROEMER in Tribsow and indicated as *Goniolina geometrica*, sample II.2 (CHERCHI & SCHROEDER, 1992, p. 5).

In conclusion, the genus *Goniolina* ORBIGNY looks to be represented only by *Goniolina hexagona* ORBIGNY, 1850, whose lectotype is SAPORTA (1891, Pl. CCLIX, fig. 2) designated by CHERCHI and SCHROEDER (1993). *Goniolina geometrica* BUVIGNIER, 1852, and *Goniolina micraster* BUVIGNIER, 1852, could be tentatively assigned to the genus *Landereria* CHERCHI & SCHROEDER, 2006 [Fig. 2 (3)], or *Coni-*

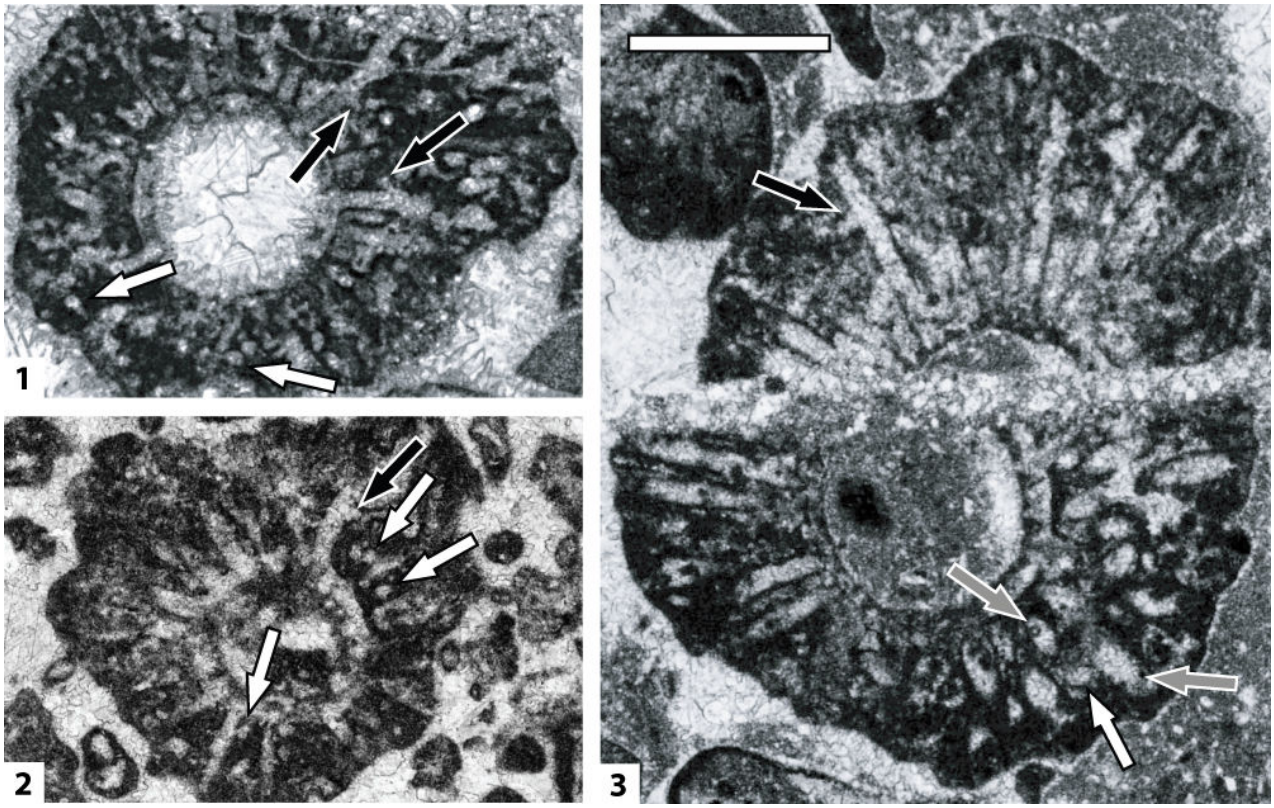


Figure 4: Dasycladalean alga *Goniolina tatrarum* n.sp. from the upper Sinemurian - lower Pliensbachian, western side of the Brama Kantaka, Tatra Mts., Poland: 1) Detail of Fig. 3 (6); 2) detail of Fig. 3 (3); 3) detail of Fig. 3 (5). All figures show lateral appendages (black arrows) and rounded corpuscles aside laterals (white arrows). Scale bar = 0.50 mm. Samples: IGS-BP1A1 (1-3). Scale bar = 0.5 mm.

porella Fisher & Thierry, 1971. The occurrence of calcification limited to a thin cortex composed of facets superficially sealed and arranged in whorls points to the second hypothesis. Therefore, they are indicated as *Coniporella geometrica* (Buvignier, 1852) and *Coniporella micraster* (Buvignier, 1852).

Sphaerites regularis Quenstedt (1852) from the Pomerania region most likely corresponds to a species different from *Goniolina hexagona* Orbigny, 1850, because the calcified cortical is made by secondary laterals. The species is assigned tentatively to the genus *Tersella* J. Morellet *in* J. Morellet & Ters, 1952 (*e.g.*, see Granier *et al.*, 2016), and indicated as *Tersella* (?) *regularis* (Quenstedt, 1852). It may seem like fate's joke that the characters of this species closely match those of the genus *Goniolina* Orbigny assumed by Pia (1920).

Subsequent mentions of *Goniolina* species belong to Pugaczeska (1971), Silva-Pineda (1977, the only mention outside Europe), Dzik (1979), Erbacher (1987), Schormann and Zawicha (1991), Sturm and Brauckmann (1999), Wittler (2000), and Moreau *et al.* (2016, 2023).

Goniolina tatrarum n.sp.

(Figs. 3 - 5)

Origin of the name: Named from the Tatra Mts., in Latin "of Tatra (Mts.)".

Type material: Holotype: axial section (Fig. 3 (2) = Rychliński *et al.*, 2018, Fig. 5b), IGS-BP1A1. Paratypes: specimens contained in the thin sections, IGS-BP1A1 and IGS-BP1B (Fig. 3 (8-9) = Rychliński *et al.*, 2018, Fig. 5a). The outcrop is located on the western side of the Brama Kantaka, Tatra Mts., Poland (Rychliński *et al.*, 2018, Fig. 1b), coordinates approx. 49°16'22.24"N, 19°52'09.73"E.

Type stratum: upper Sinemurian - lower Pliensbachian.

Depository: Institute of Geological Sciences, Jagiellonian University in Krakow, Poland.

Diagnosis: Spherical simple thallus. Only primary laterals, long, acrophorous to slightly flaring outwards. They probably make a cortex distally. Spherical reproductive organs attached laterally on primary laterals (gametophores). Calcareous skeleton with a regular inner cavity (close to the central axis) but very irregular outwards enveloping primary laterals at different lengths.

Description: The calcareous sleeve is simple, not articulated, closed at the top. The shape is roughly spherical, as long as wide [Fig. 3 (2)]. The lower part is tapered [Fig. 3 (2)]. The inner surface is usually regular [Fig. 3 (3, 5-6)], seemingly close to the central stem. The inner cavity is quite small. The outer surface is very irregular in some specimens [Fig. 3 (2 up, 3 down left, 4, 5 up, 9)] and in others more regular, undulose [Fig. 3 (2 right, 3 upper right, 5 down, 6 right)]. Calcification encrusts the inner part of primary laterals, probably up to the middle-outer part [Fig. 3 (5, 9)]. Although the character is not very recognisable, the primary laterals are set in close whorls [Fig. 3 (2, 8)], with 24-36 per whorl. The distance between whorls (h) is relatively low (0.137 mm). The arrangement apparently alter-

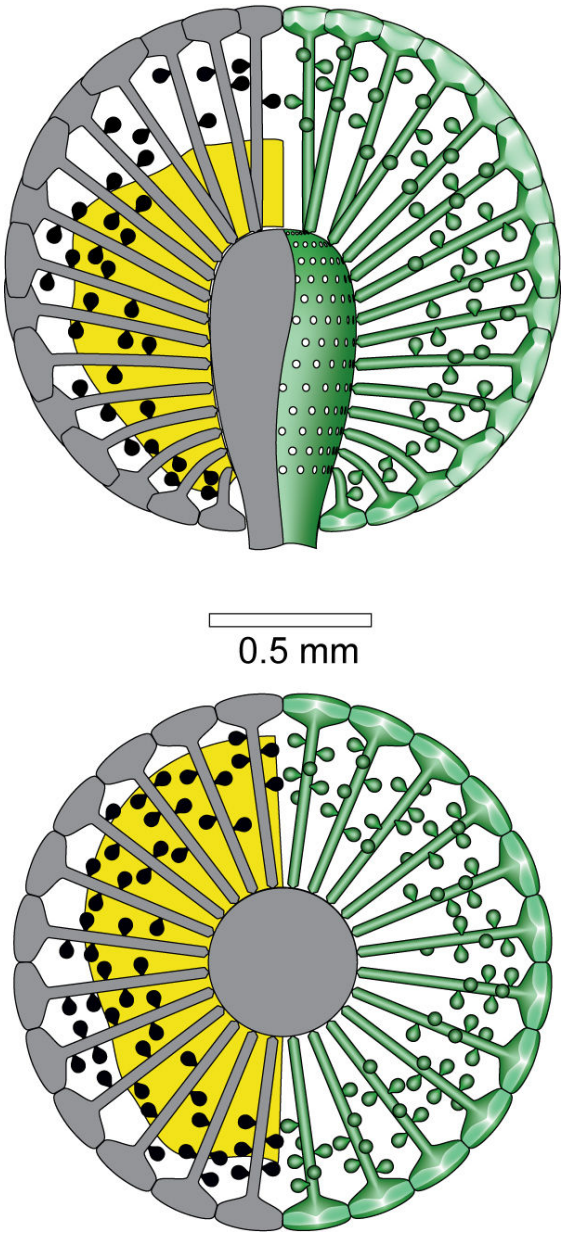
Table 1. Dimensions (mm) of *Goniolina tatrarum* n.sp. d, internal diameter (diameter of the axial cavity); l_{axis}, length of the axis; D, external diameter; l, length of first order laterals; p_i, proximal width of primary laterals; p, width of primary laterals (outer part); h, distance between whorls; w, number of primary laterals per verticil (estimated); da, width of gametophores; la, length of gametophores.

Id. number	Sample	Specimen	d	l axis	D	pi	p	l	h	w	da	la
1	IGS-BP1A1	0	0.518		1.197		0.049			24		
2	IGS-BP1B	a1	0.572		1.842		0.072					
3	IGS-BP1B	a2					0.081		0.137			
4	IGS-BP1A1	b	0.448	0.788	1.181		0.044	0.388				
5	IGS-BP1A1	c	0.304		1.152		0.049			12	0.048	0.048
6	IGS-BP1A1	d	0.508		1.414		0.050			22	0.047	
7	IGS-BP1A1	e			1.811	0.039	0.073					
8	IGS-BP1A1	f	0.549		1.609		0.088	0.638		22	0.097	
Number			6	1	7	1	8	2	1	4	3	1
Min			0.304	0.788	1.152	0.039	0.044	0.388	0.137	12	0.047	0.048
Max			0.572	0.788	1.842	0.039	0.088	0.638	0.137	24	0.097	0.048
Average			0.483	0.788	1.458	0.039	0.063	0.513	0.137	20.000	0.064	0.048
St. Deviation			0.097		0.299		0.017	0.177		5.416	0.029	

nates in two subsequent whorls [Fig. 3 (8)]. In the lower part of the calcareous skeleton, primary laterals are bent downward, with respect to the vertical axis [Fig. 3 (2)]. In the middle part, they are roughly orthogonal, and inclined then decrease towards the top where they are arranged vertically [Fig. 3 (2)]. The primary laterals are long and acrophorous, in some specimens they gently increase in size outwards [compare grey arrows in Fig. 4 (3)]. Corpuscles of 0.047-0.097 mm are found between laterals and attached sideways to primary laterals (Fig. 4, white arrows). In other specimens short appendages branch transversely to the primary laterals (Fig. 4, black arrows). Such structures are related to the occurrence of lateral gametophores (goniosporate reproduction).

Measurements: D: 1.152-1.842 mm; d: 0.304-0.572 mm; p: 0.044-0.088 mm; h: 0.137 mm; w: 24-36.

Remarks: The green alga referred to *Palaeodasycladus* cf. *mediterraneus* (Pia, 1920) by Rychlinski *et al.* (2018) displays a thallus with a spherical shape and a regular inner cavity probably indicating that the calcareous skeleton was close to the central axis. At the same time, the calcareous skeleton is very irregular outwards enveloping only primary laterals at different lengths, no ramification can be observed. Structures possibly interpreted as external gametophores are remarkably attached laterally on primary laterals. Conversely, all species of the genus *Palaeodasycladus* (Pia, 1920) exhibit an elongated club-shaped thallus and three order of laterals. No structures



▶ **Figure 5:** *Goniolina tatrarum* n.sp.: **1)** Reconstruction of the alga in axial view; *left*: calcified skeleton (yellow), soft parts (grey) and gametophores (black) in axial section; *right*: axial view of the soft parts (green); **2)** reconstruction of the alga in transverse section. B1, *left*: calcified skeleton (yellow), soft parts (grey) and gametophores (black) in axial section; *right*: axial view of the soft parts (green). Scale bar= 0.5 mm.

possibly related to external reproductive organs have ever been observed. Therefore, the attribution to *Palaeodasycladus* (PIA, 1920) must be excluded. The alga can be assigned to a new species, *Goniolina tatrarum* n.sp., based on the diagnostic features mentioned above, and attributed to the genus *Goniolina* ORBIGNY, 1850. According to the characters of the genus evidenced by CHERCHI and SCHROEDER (1992), *Goniolina* ORBIGNY, 1850, has been monospecific so far. The new species differs from the type species by many and marked differences. The general size of the thallus (D) is very small (less than 2 mm vs. 28 mm, see CHERCHI & SCHROEDER, 1993). The calcareous skeleton is restricted to the lower middle part of the primary laterals and the cortex is not preserved.

Occurrence: Type locality and horizon only.

5. Discussion

RYCHLIŃSKI *et al.* (2018) referred the taxon to *Palaeodasycladus* cf. *mediterraneus* PIA, according a wider paleogeographic distribution for this alga supposing Tatra Mts to be its northernmost occurrence. The paleogeographic interpretation formulated by RYCHLINSKI *et al.* (2018) is no longer valid due to the erroneous attribution to *Palaeodasycladus* (PIA). Conversely, *Goniolina tatrarum* n.sp. (Fig. 5) is more interesting from the evolutionary point of view. The occurrence of external gametophores is well documented in the Late Triassic and Early Jurassic (BARATTOLO *et al.*, 2021). The existence of gametophores aside on primary laterals of *Goniolina tatrarum* n.sp. suggests that Bornetellaceans were already quite diversified in the Early Jurassic.

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