Bucurella, a new genus of the Tribe Thyrsoporelleae (fossil Dasycladalean algae)

Bruno Granier [1]

Abstract: A new genus, *Bucurella*, is described and figured; it is based on *Macroporella espichelensis* DELOFFRE et RAMALHO, 1971, a taxon known only from the Late Jurassic. It is characterized by the presence of distinctive whorls, each with three thick and broad (fertile) ramifications. The lateral division formula is 1 F: 3 F: (3x2) F: (3x2x2) F = (1: 3: 6: 12); that is the primary ramification divides into three secondaries which in turn branch dichotomously into tertiaries and again into quaternaries. It and its descendant, *Zergabriella*, are assigned to the Tribe Thyrsoporelleae.

Key Words: Algae; Dasycladales; Thyrsoporelleae; systematics; new genus.

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Résumé : Bucurella, *un nouveau genre de Thyrsoporelleae (algues dasycladales fossiles).-* *Macroporella espichelensis* DELOFFRE et RAMALHO, 1971, une espèce connue exclusivement au Jurassique terminal, est choisie comme espèce-type de *Bucurella* nov. gen. Ce dernier est caractérisé par l'existence de verticilles portant trois rameaux larges et épais (fertiles) chacun. Ces rameaux sont divisés selon la formule 1 F : 3 F : (3x2) F : (3x2x2) F = (1 : 3 : 6 : 12) ; c'est-à-dire que la ramification d'ordre I donne naissance à trois ramifications d'ordre II qui vont elles-mêmes se diviser dichotomiquement en ramifications d'ordre III et elles-mêmes en ramifications d'ordre IV. Le nouveau genre, tout comme *Zergabriella* qui en est issu, est rattaché à la tribu des Thyrsoporelleae.

Mots-Clefs : Algues ; Dasycladales ; Thyrsoporelleae ; systématique ; nouveau genre.

Introduction

Restudy of numerous specimens of *Macroporella embergeri* BOUROULLEC et DELOFFRE, 1968, led to a reinterpretation of the body plan of this alga and the establishment of the genus *Zergabriella* GRANIER, 1989. A discrete species, *Macroporella espichelensis* DELOFFRE et RAMALHO, 1971, has often been confused with *Zergabriella embergeri* for among other similar characteristics both have the same type of calcification. Nevertheless, these species are generically distinct as this paper demonstrates.

1. Review of the main features characterizing *Zergabriella*

The classification of the Dasycladales is based on the fundamental criteria listed below. Here we examine these diagnostic criteria with respect to the generic characteristics of both *Macroporella* (PIA, 1912) and *Zergabriella*.

1.1 - The first criterion is the arrangement of the laterals: In *Macroporella* the distribution of the laterals along the main axis (at the level of their insertion points) has no express arrangement; this type of ordering (actually a lack of ordering) is termed "aspondyle". But in *Zergabriella embergeri* the laterals are distributed symmetrically around the main axis (Figs. 2 & 9A; Videos 5-6); this regular arrangement of the whorls is termed "euspondyle". Therefore the euspondyle *Zergabriella* cannot be assigned to the Family Seletonellaceae to which the aspondyle *Macroporella* is referred.

1.2 - A second parameter is the position occupied by the cysts developed when the alga reaches maturity. In *Macroporella* cysts remained in the main axis; this is a characteristic of the most primitive Dasycladales and these forms are "endospore". But the narrow main axis of *Zergabriella embergeri* had little room to host the gametangia, so they migrated into the more spacious laterals; this location indicates a more advanced stage of evolution and these forms are "cladospore". They are assigned the Family Triploporellaceae.

1.3 - The third parameter is the presence or absence of branching in the laterals. In *Macroporella* the coarse calcareous sleeve is perforated by narrow pores that are the trace of the passage of the laterals through the sleeve; these pores never branch. In *Zergabriella embergeri* the laterals are broad and may divide up to the third order (Fig. 9A; Video 4). This addi-

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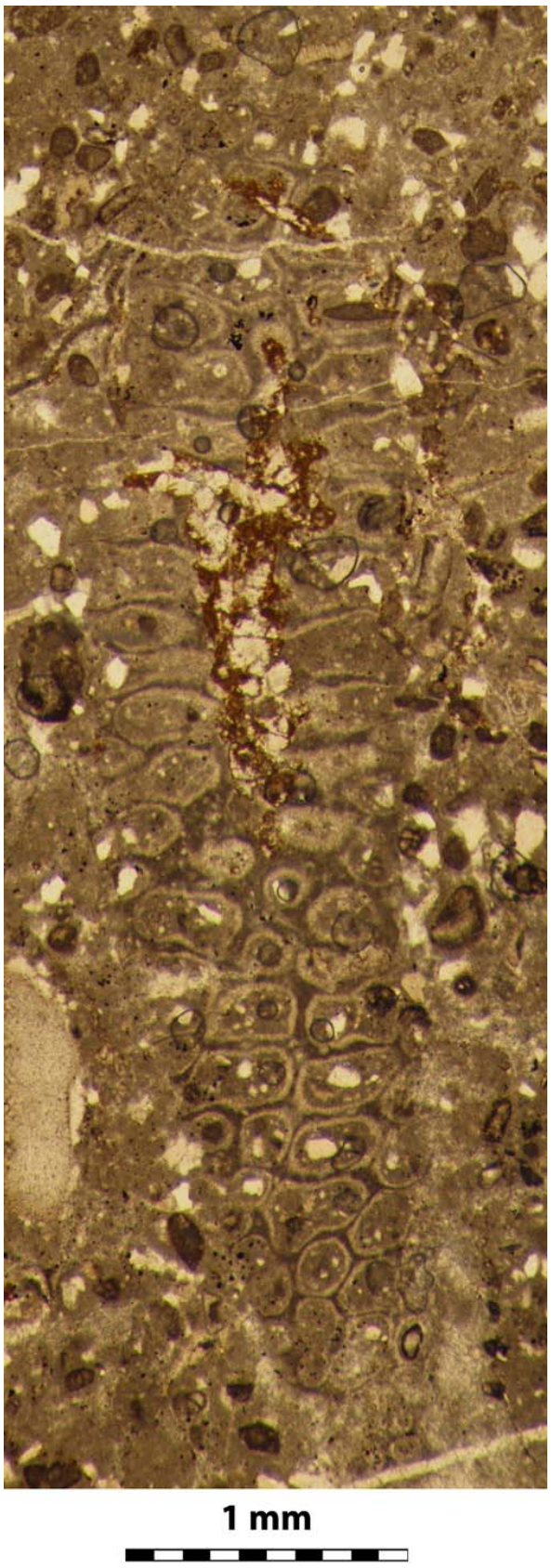


Figure 1: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: longitudinal oblique (subaxial) section.- n° 15-3 DAS A 37, thin section Z-226.

tional criterion, that is the number of orders of ramifications occurring in the laterals (*), here more than 2, allocates this species to the Tribe Thyrsoporelleae.

(*): Ramifications are the discrete segments of laterals resulting from their branching. The "first order" or "primary" ramification is the proximal portion of the lateral, between the insertion point on the main axis and the first branching.

Figure 2: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: longitudinal oblique (subaxial) section with the so-called "cavités sporangiques" which are the proximal end of laterals.- DELOFFRE Collection, thin section PZ 982.

In *Zergabriella embergeri* the degree of calcification of the thallus is variable: Some specimens have structures in the axial cavity of the thallus that BOUROULLEC and DELOFFRE (1968) interpreted as being "cavités sporangiques" (sporangial cavities); in fact they are the proximal end of laterals, bent and narrowed to some fifty µm (BOUROULLEC & DELOFFRE, 1968: Pl. 4, figs. 1-4; GRANIER, 1989: Pl. 1, figs. 1-3 & 5). It is very common that this element, originally aragonitic or uncalcified, is not preserved (Fig. 1 vs. Fig. 2). But in the specimens figured here the cylindrical main axis is narrower than the dimensions ordinarily reported for the axial cavity: it is 0.10-0.16 mm in diameter rather than 0.35-0.375 mm. In addition, these unusually complete specimens demonstrate that this alga is clearly "verticillated", that is, it is a euspondyle. A verticil (a whorl made up of laterals) ranges in height between 0.17 and 0.35 mm.

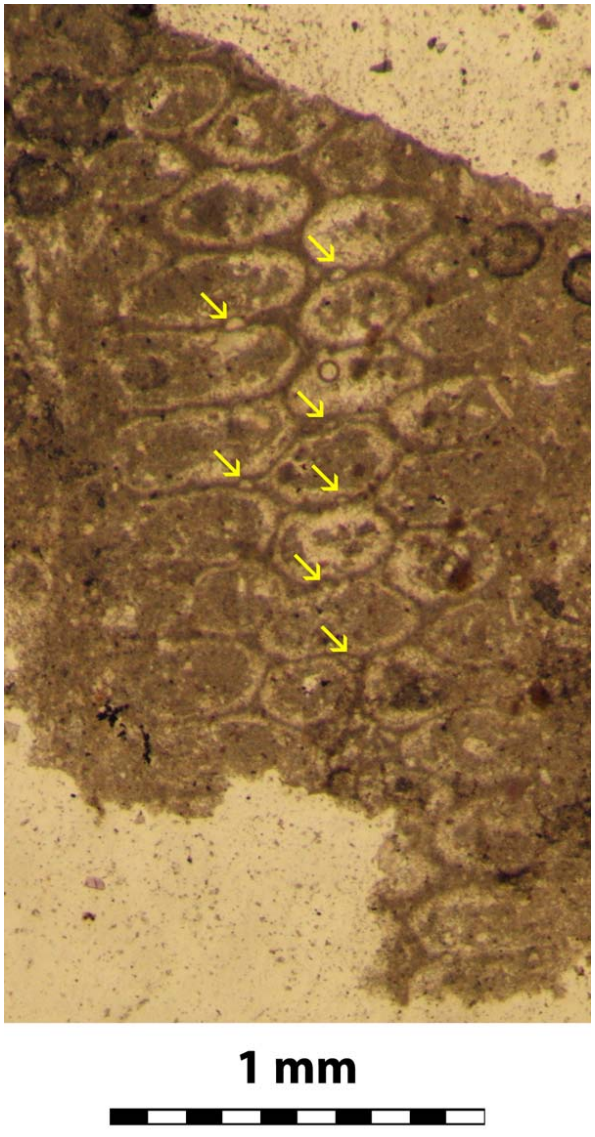


Figure 3: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: tangential section; note the occurrence of the thin secondary sterile ramifications (arrows).- n° 2, thin section Ba 1 ~2402m.

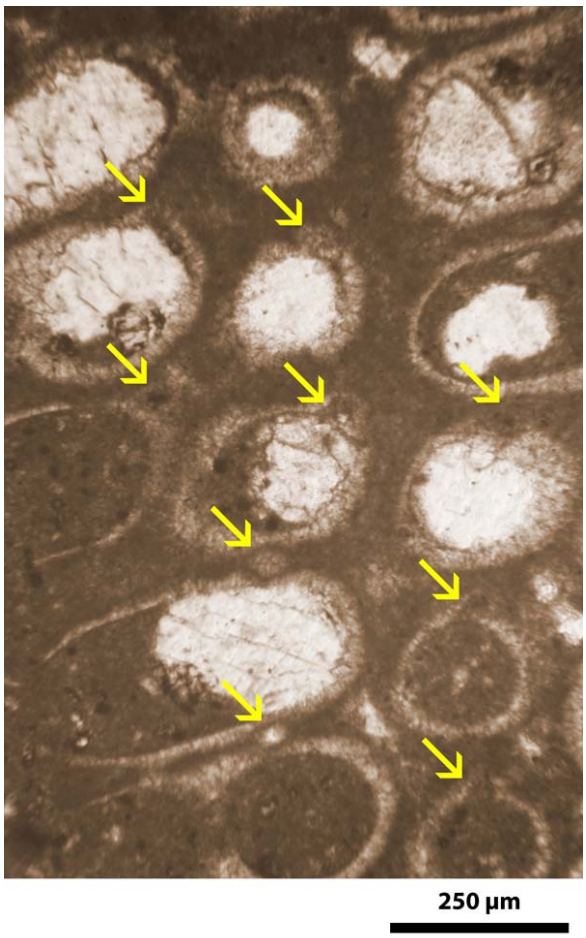


Figure 4: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: detail of the (longitudinal) oblique section illustrated in Pl. 3, fig. 1; note the occurrence of the thin secondary sterile ramifications (arrows) and their branching stage from the primary fertile ramification.- DELOFFRE Collection, "Mont Rose", Marseilles (France).

As mentioned, in most specimens, these remnants of the proximal end of laterals are absent. Both their locations and the site of the main axis is replaced by an "axial cavity". The calcification of the remainder of the laterals consists of a micritic fringe with a thin layer of drusy calcite crystals on the inner side.

Most transverse or oblique sections commonly show a second (GRANIER, 1989: Pl. 1, figs. 4 & 7; Pl. 2, figs. 3 & 6-7), if not a third order of calcified ramifications (BOUROULLEC & DELOFFRE, 1968: Pl. 4, fig. 4; GRANIER, 1989: Pl. 2, figs. 1-2 & 5). These ramifications may attain or even exceed a width of 0.3 mm. The ramifications of the last order form a cortex and the more or less regular arrangement of their distal ends within this cortex is consequent on the constraints that the growing laterals imposed on each other.

In an ideal transverse section, there are 6 to 8 laterals per verticil, each made up of one primary, two secondary and four tertiary calcified ramifications. It appears at first glance that the formula for the division of the laterals is 1: 2: (2x2=4).

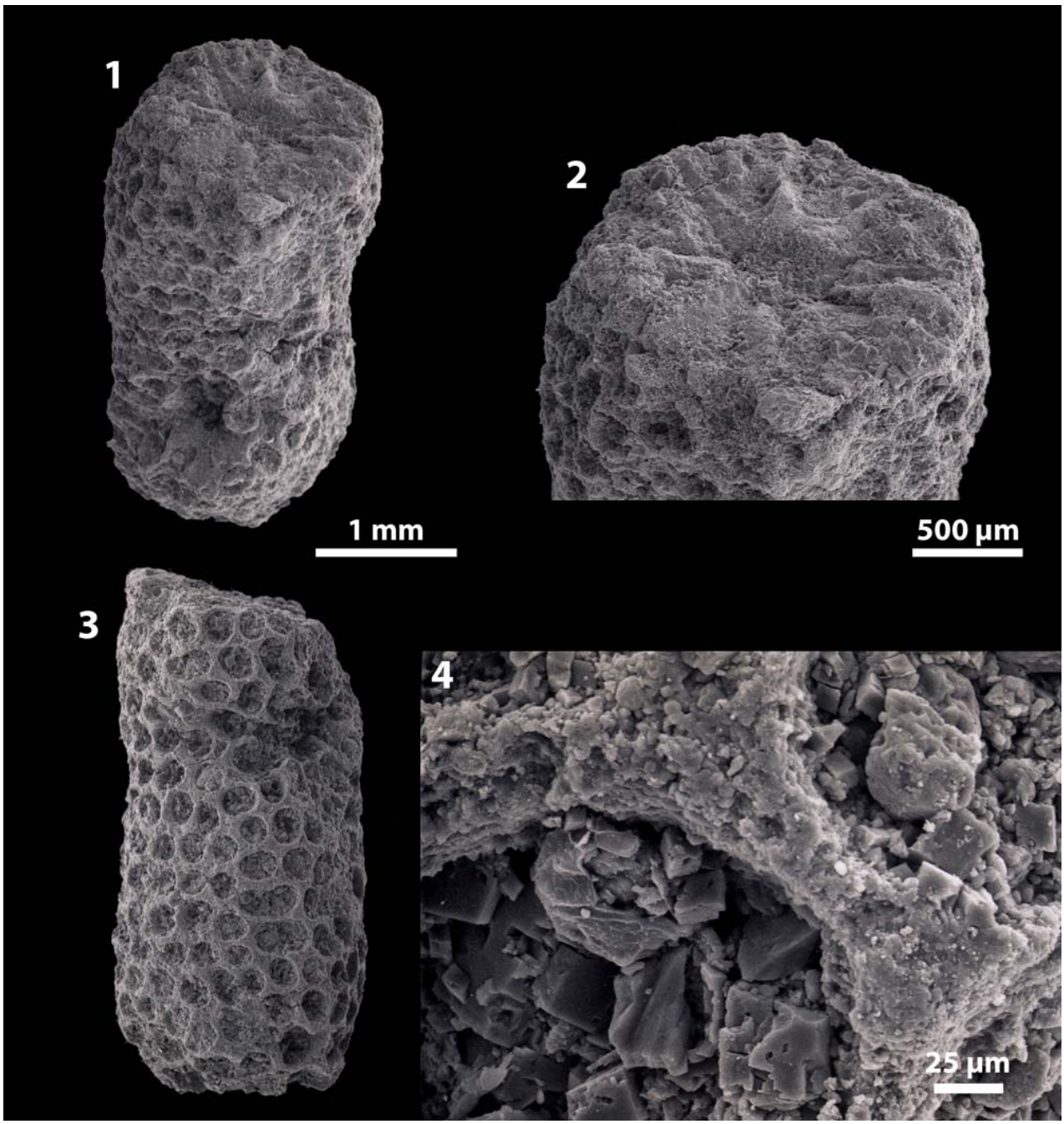


Figure 5: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: SEM views. 1. fragment of the calcified stem.- MOJON Collection, Sample C6 107-8, Saint-Claude, Jura central (France), Vions Formation (M5 Zone), Upper Berriasian; 2. detail of the upper end of the specimen showing the pattern of the laterals; 3. fragment of the calcified stem.- MOJON Collection, Sample F4, Mont Faron, Toulon (France), "Faciès purbeckiens provençaux" (M5 Zone), Upper Berriasian; 4. detail of the specimen showing the calcification around the laterals (pores partly infilled with larger calcitic crystals); boundaries between the discrete coatings of adjacent laterals or ramifications (in the same lateral) are scarcely visible.

However certain sections (GRANIER, 1989: Pl. 1, fig. 6; Pl. 2, figs. 4 & 6) reveal the existence of very fine ramifications (30 to 50 µm), their narrowness supposedly indicating that they were sterile (Figs. 3-4). These ramifications are not always clearly visible, either because they were not developed or because they were not fossilized. The division formula turns to be 1 F: (2F + 1 St): (2x2=4) F.

Some tiny spheres interpreted as cysts were seen in the axial cavities of poorly fossilized specimens, thus suggesting that they were introduced late in the fossilization process (GRANIER, 1989: Pl. 2, figs. 7-8). In most of these occurrences cysts or pluricystic aggregates were also seen in the laterals (GRANIER, 1989: Pl. 2, fig. 9). The diameter of these cysts is about 30 µm.

Taken together, the characters listed above were sufficient to warrant the creation of a new genus. The generic diagnosis: "Algue Dasycladale euspondyle (Dasycladacée), cladospore,

avec de larges ramifications (fertiles), calcifiées jusqu'au deuxième ou au troisième ordre, et présentant parfois de fines ramifications (stériles)" (GRANIER, 1989), translated from the French, follows: Euspondylous, cladospore Dasycladalean alga (Dasycladaceae), with broad (fertile) ramifications, calcified up to the second or third order, and sometimes with thin (sterile) ramifications.

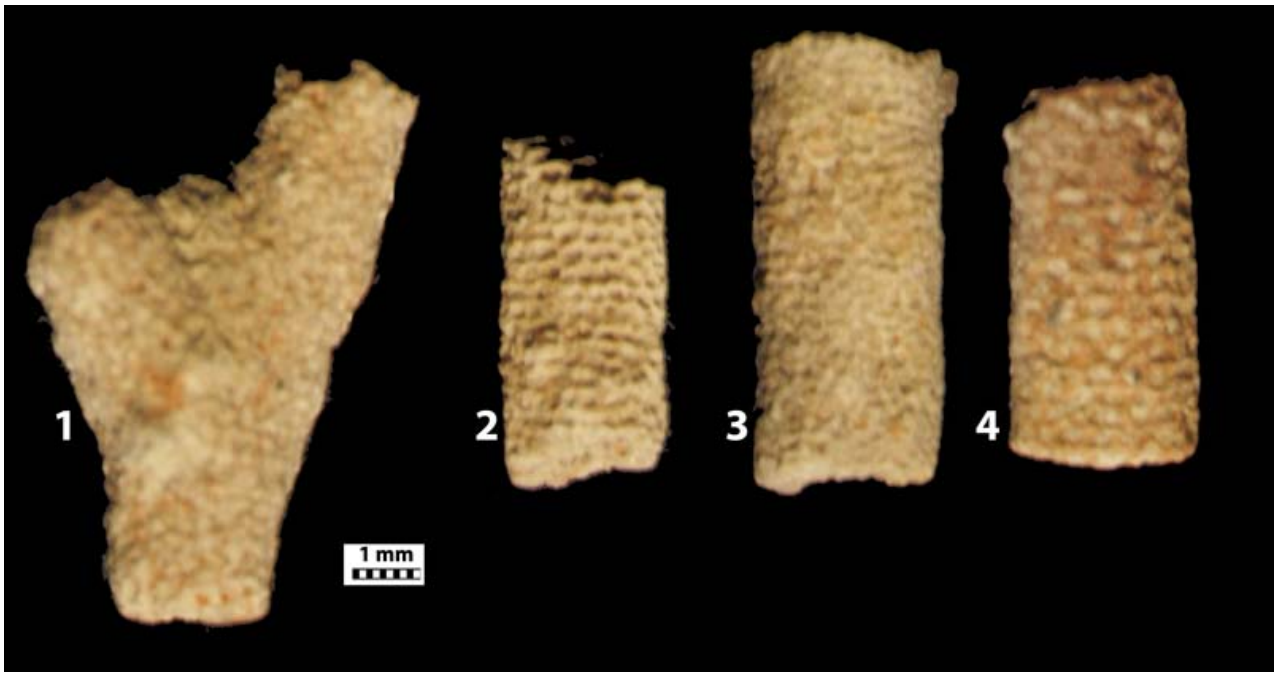


Figure 6: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., n. comb.: paratypes; isolated specimens (= Pl. 1, figs. 1-4 in DELOFFRE & RAMALHO, 1971).- DELOFFRE Collection, H 135, "Portlandien sup.", "Valanginien de Cascais" (Portugal).

2. Morphological classification induced by the location of the reproductive structures

The Family Triploporellaceae which includes all euspondylous, cladospore Dasycladales was set up by BERGER and KAEVER in 1992, that is 3 years after the new genus was introduced. Consequently, the genus *Zergabriella* was ascribed by default to the Family Dasycladaceae.

However it would be misleading to exclude this genus from the Dasycladaceae and to transfer it to the Triploporellaceae solely on the fact that it has been determined to be a cladospore.

As reported above:

Endospore dasycladales (all extant) have narrow laterals and the cysts form only in the main axis;

Cladospore dasycladales (all extant) have laterals with inflated first-order ramifications and, if present, narrow higher-order ramifications. The cysts form in the primary ramifications.

Another type known as choristospore (and umbrellospore) develops specialized cyst-bearing appendages, the gametophores (= fertile ampullae), which are located either at the distal end of the ramifications or ... along them. Although both were previously assigned the choristospore group, we now suggest that those of these forms in which the ampullae are disposed laterally along first order ramifications (example: *Bornetella* MUNIER-CHALMAS, 1877) be designated by the term 'goniophore'. The term choristospore is then restricted to those forms in which the ampullae are in a terminal position on the ramifications (of any order). The umbrellospores are distinguished from the choristospores because their cysts are markedly elongated and they commonly coalesce along in one whorl to form a distinctive disc (example: *Acetabularia acetabulum* (LINNAEUS) SILVA, 1952).

None of the reproduction-related morphological categories discussed here match the features displayed in *Zergabriella*. In that genus both first and higher order ramifications were inflated and did not develop true gametophores. The term "syringospore", derived from the ancient Greek word "syrinx" (a one-reed pipe or panpipe), is proposed here to designate forms with laterals consisting of more than one order of inflated ramifications, in which the cysts, visible or not, were located.

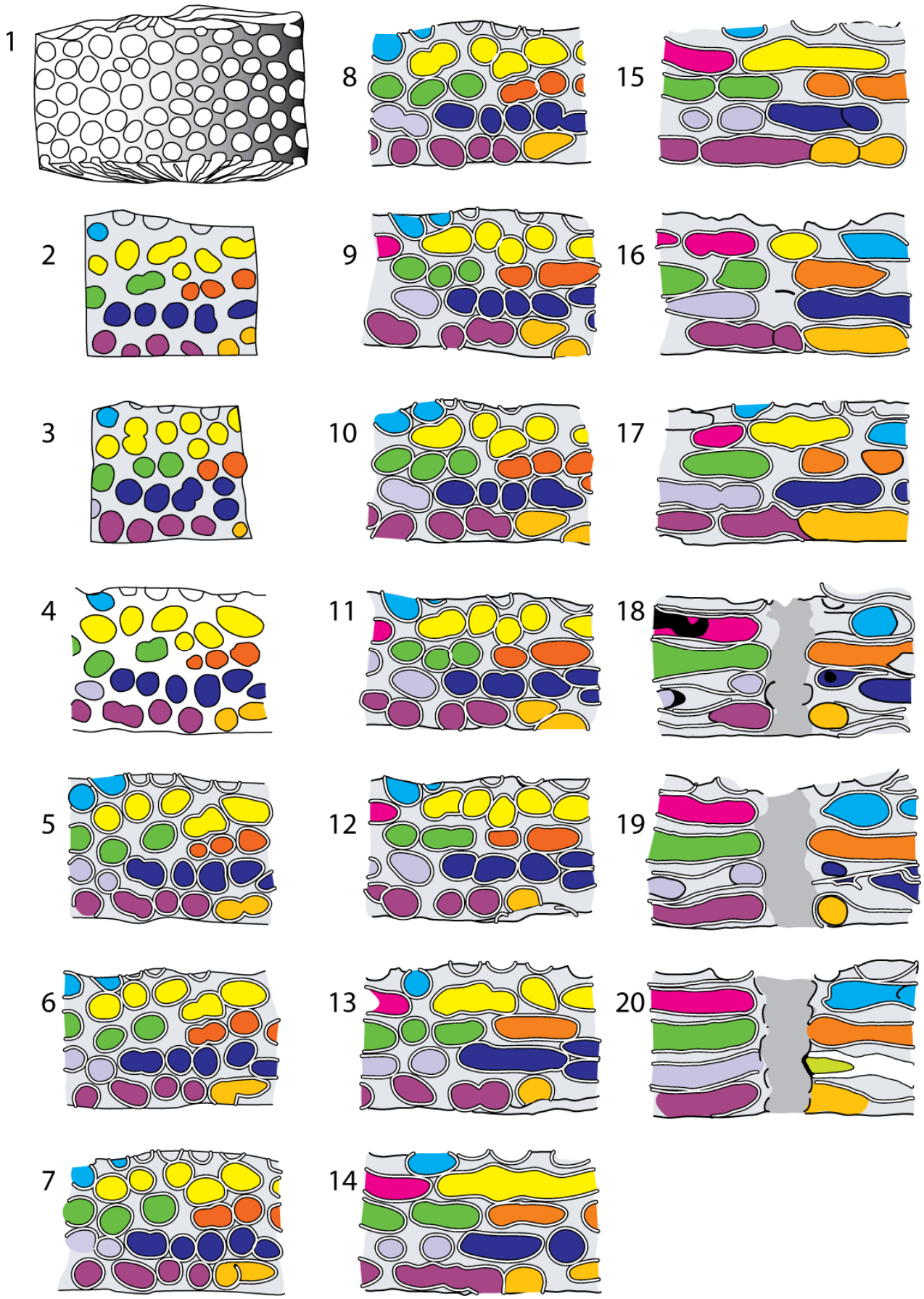


Figure 7: Drawings of serial sections of *Bucurella espichelensis*, n. gen., n. comb., illustrating the branching pattern in the laterals (*i.e.*, in the pores).

3. Avatars of *Zergabriella*

Soon after the publication of *Macroporella embergeri* BOUROULLEC et DELOFFRE, 1968, RADOIČIĆ (1970a, 1970b) introduced a new species, named "*Dasycladacea*" *nisi* (nomen nudum). This form, which until 1975 was not published validly, was renamed under the new combination *Triploporella* ? *nisi* RADOIČIĆ, 1975, non 1970. It is a junior synonym of *Macroporella embergeri*.

More recently, using well-preserved specimens but making erroneous tri-dimensional reconstructions, DRAGASTAN (1999) emended the diagnosis of the genus *Zergabriella* GRANIER, 1989. He went even farther, for he introduced a new species that he ascribed to that genus: *Zergabriella neaguii* n. sp., and also described two new taxa, a genus and its type species: *Pseudosalpingoporella cernavodensis* n. gen. n. sp. As a matter of fact all the specimens he illustrated are ascribable to one unique species *Zergabriella embergeri* (and one genus *Zergabriella*). This error necessitates these taxa being regarded as junior synonyms of the previous designation, and both the generic and specific emendations are null and void.

4. Revision of the *Macroporella espichelensis* material

The type material of *Macroporella espichelensis* DELOFFRE et RAMALHO, 1971, is stored in the Geology Laboratory of the TOTAL Scientific and Technical Centre (formerly S.N.E.A.(P.) C.S.T.J.F.) in Pau. Some features characterizing this form are similar to those of *Zergabriella embergeri* so it was transferred to the then newly erected genus. However, the pattern of branching differs significantly, for in this species each verticil consists of only three laterals which divide according to the following formula 1: 3: (3x2=6): (3x2x2=12) (see DELOFFRE & RAMALHO, 1971: Pl. 1, fig. 5; Pl. 2, figs. 2 & 4) - and lack sterile ramifications (see DELOFFRE & RAMALHO, 1971: Pl. 1, fig. 6; Pl. 2, figs. 1 & 6). Hypothetically, the absence of fertility in one of the three second-order ramifications would as a consequence increase the number of laterals per verticil (Fig. 7; Video 7) and bring its formula close to that of *Zergabriella embergeri* : 1F: (2F + 1St): 4F. Figures 8 (old) and 9 (new) and Video 1 and 4 suggest a reconstitution of the form of the laterals of the two species.

The pattern of the laterals (and more specifically the division of the ramifications in the laterals) is a fundamental criterion of Dasycladalean classification at the generic level. Using this criterion, a new genus is introduced here to accommodate this discrete species.

5. Systematics

Order Dasycladales

Family Triploporellaceae

Tribe Thyrsoporelleae

Genus *Zergabriella* emend.

Emended generic diagnosis: Euspondylous Dasycladalean alga, syringospore (Triploporellaceae), with laterals consisting of both broad inflated (fertile) ramifications, calcified up to the second or third order, and thin (sterile) ramifications. Branching formula for the laterals: 1F : (2F + 1St) : 4F, that is 1F : (1St + 2F : (2x2=4F)).

Type species: *Macroporella embergeri* BOUROULLEC et DELOFFRE, 1968.

Zergabriella embergeri (BOUROULLEC et DELOFFRE, 1968) GRANIER, 1989

(Figs. 1-5; Pls. 1-4)

Synonymy:

	1968	*Macroporella embergeri*, n. sp.- BOUROULLEC & DELOFFRE, Pl. 4, figs. 1-10 (1: holotype; 5 & 6: "paratypes")
(nom. nud.)	1969-1970a	"Dasycladacea" nisi, n. sp.- RADOIČIĆ, Pl. VIII, figs. 1-3; Pl. IX, figs. 1-4
	1987	*Macroporella embergeri*.- GRANIER, Pl. 30, figs. c-e
	1988	*Macroporella embergeri*.- GRANIER, Pl. 1, figs. c-e (1987 *Macroporella embergeri*.- GRANIER, Pl. 30, figs. c-e)
	1988	*Macroporella* ? *embergeri.*- CONRAD & BEIGHTOL, Fig. 2
	1988	*Macroporella embergeri*.- ADATTE, Pl. XIII, figs. 1-3
	1989	*Zergabriella embergeri* , n. gen., n. comb.- GRANIER, synonymy to date, Pl. 1, figs. 1-7; Pl. 2, figs. 1-9
	1991	? Triploporella *embergeri* , n. comb.- FARINACCI & RADOIČIĆ, Pl. 8, figs. 3-4
	1991	*Zergabriella embergeri.*- DARGA & SCHLAGINTWEIT, Pl. 3, fig. 7 & 12
	1992	*Macroporella embergeri*.- GRANIER, Pl. 2, figs. 3-4
	1993	*Zergabriella embergeri.*- SCHLAGINTWEIT, Pl. I, fig. 3
	1993	*Zergabriella embergeri.*- MASSE, Pl. 1, fig. 4 (=1976 *Macroporella embergeri*.- MASSE, Pl. 2, fig. 5)
	1993	*Macroporella embergeri*.- AVRAM et alii, Fig. 7.e
	1994	*Zergabriella embergeri.*- BUCUR, Pl. II, figs. 3-6
	1997	*Zergabriella embergeri.*- VIRGONE, Pl. I, fig. 10

	1998	*Zergabriella embergeri.*- BERNAUS, Pl. XVII, figs. 6-8
	1999	*Zergabriella embergeri.*- DRAGASTAN, Pl. 3, figs. 5-7 & 8(Z); Pl. 4, figs. 1-2 & 4
	1999	*Zergabriella* neaguii n. sp.- DRAGASTAN, Pl. 3, fig. 8(D); Pl. 4, figs. 3 & 5-7 (6: holotype)
	1999	Pseudosalpingoporella cernavodensis n. sp.- DRAGASTAN, Pl. 3, fig. 8(S); Pl. 4, figs. 8-9 (9: holotype)
	2002	*Zergabriella embergeri.*- BERNAUS et alii, Fig. 6.F (=1998 *Zergabriella embergeri.*- BERNAUS, Pl. XVII, fig. 8) & 6.G (=1998 *Zergabriella embergeri.*- BERNAUS, Pl. XVII, fig. 6)
	2003	*Zergabriella* sp.- DRAGASTAN & RICHTER, Pl. 11, fig. 10
	2005	*Zergabriella embergeri.*- SCHLAGINTWEIT, Pl. II, fig. 7
	2006	*Zergabriella embergeri.*- ALBRICH et alii, Pl. 7, fig. 4
NON	2008	*Zergabriella embergeri.*- HOSSEINI & CONRAD, Pl. 1, fig. A (possibly Otternstella lemmensis (BERNIER, 1971) GRANIER et alii, 1995)
NON	2008	*Zergabriella* ? cf. *embergeri.*- HOSSEINI & CONRAD, Pl. 4, figs. A-B

Genus *Bucurella* n. gen.

Derivatio nominis: The new taxon is dedicated to Professor Ioan I. BUCUR, "Babes-Bolyai" University (Romania).

Generic diagnosis: Euspondylous Dasycladalean alga, syringospore (Triploporellaceae), with but few laterals that, depending on the degree of calcification, branch according to the formula 1: 3: (3x2=6) - and possibly one more set : (3x(2x2) = 12), that is 1 : (3 : ((3x2=6) : ((3x2)x2=12))) in non abraded or better calcified specimens - into broad inflated (fertile) calcified ramifications.

Type species: *Macroporella espichelensis* DELOFFRE et RAMALHO, 1971.

Bucurella espichelensis DELOFFRE et RAMALHO, 1971, emend., n. comb.

(Fig. 6; Pl. 5)

Synonymy:

	1971	*Macroporella espichelensis*, n. sp.- DELOFFRE & RAMALHO, Figs. 1-1 & 1-2; Pl. 1, figs. 1-5 (1-4: paratypes); Pl. 2, figs. 1-6 (1: holotype; 4 & 6: paratypes)
	1971	Zergatella sp. 1.- RAMALHO, Pl. XXXI, figs. 1-2 & 4 (non 3 & 5)
NON	1977	*Macroporella espichelensis*.- FARÈS, Pl. 4, figs. 1-4
NON	1978	*Macroporella* cf. *espichelensis*.- GARCIA HERNANDEZ, Pl. X, figs. 7-9
	1978	*Macroporella espichelensis*.- BASSOULLET et alii, Pl. 18, fig. 6 (= Pl. 2, fig. 4 in DELOFFRE & RAMALHO, 1971) & 7 (= Pl. 2, fig. 1 in DELOFFRE & RAMALHO, 1971)
NON	1984	*Macroporella espichelensis*.- BERNIER, Pl. 1, figs. 5-6
NON	1987	*Macroporella espichelensis*.- MICHAUD, Pl. 21, figs. 1-3
	1989	*Zergabriella espichelensis*, n. comb.- GRANIER, not illustrated

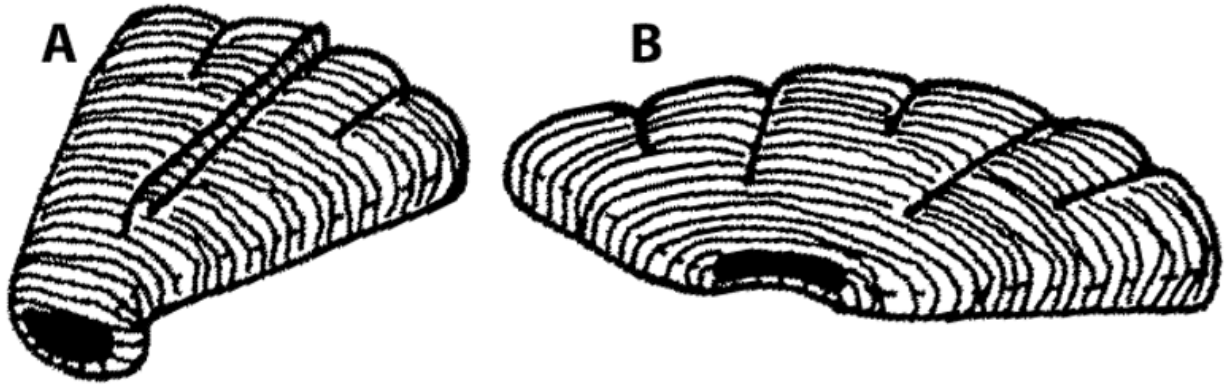


Figure 8: Reconstruction of the pattern of a lateral in A) *Zergabriella embergeri* (left) and in B) *Bucurella espichelensis* (right, with 3 orders of ramifications only) after GRANIER, 1989.

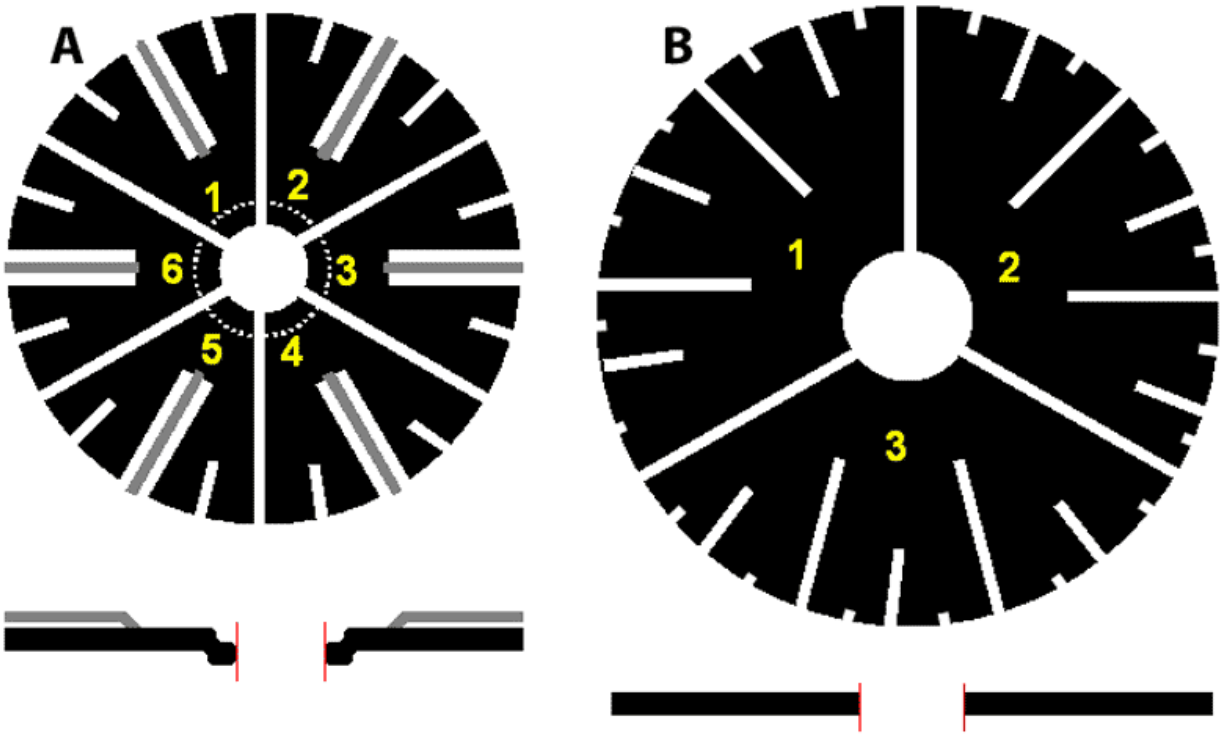


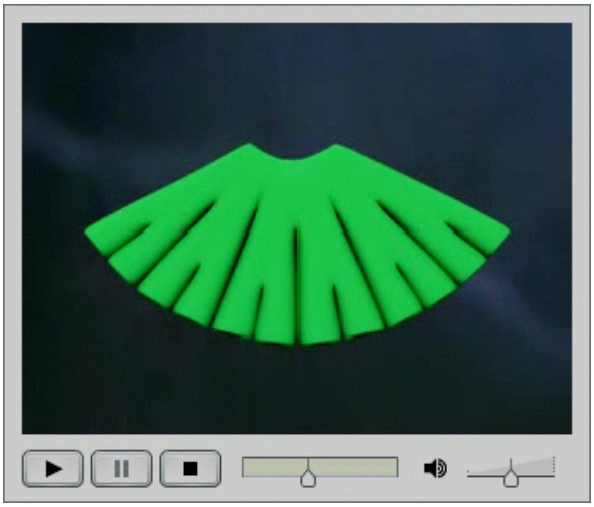
Figure 9: Schematic reconstruction of the pattern of the laterals and their arrangement within a whorl for A) *Zergabriella embergeri* (left) and for B) *Bucurella espichelensis* (right).

Conclusions

The Tribe Thyrsoporelleae consists of the following genera, in order of appearance:

- *Placklesia* BILGÜTAY, 1968 (Norian - Rhetian),
- *Pentaporella* SENOWBARI-DARYAN, 1978 (Rhetian), both were possibly endospore,
- *Dobuniella* ELLIOTT *in* GRANIER et DELOFFRE, 1993, non 1975 (Bathonian),
- *Deloffrella* GRANIER et MICHAUD, 1987 (Kimmeridgian - Aptian and ? Cenomanian),
- *Thyrsoporella* GÜMBEL, 1872 (Oxfordian - Tithonian and Danian – Lutetian),
- *Bucurella*, n. gen. (Tithonian),
- *Zergabriella* GRANIER, 1989 (Tithonian - Valanginian),
- ? *Fourcadella* GRANIER, 2002 (Valanginian and Cenomanian),
- ? *Heteroporella* (PRATURLON, 1967) GRANIER *et alii*, 1995 (Albian – Turonian),
- *Belzungia* L. MORELLET, 1908 (Danian - Lutetian).

Whether or not the genera *Trinocladus* RAINERI, 1922, and *Sarosiella* SEGONZAC, 1972, should be assigned this tribe is not yet resolved.

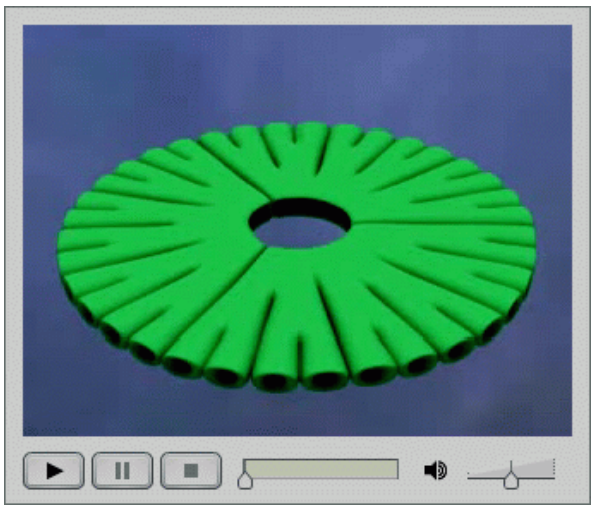


Video 1: Reconstruction of the pattern of a lateral (calcified coating) of *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., n. comb.

The video file can be downloaded from:
<http://paleopolis.rediris.es/cg/CG2010_A03/CG2010_A03_Video01.mpg > = 817 KB

Although this group is relatively homogeneous, the absence of phyletic continuity between the several representatives is striking and exists even between species of the same genus. For example, see *Thyrsoporella* with its discontinuous stratigraphic record. Two factors may be involved: on one hand a documentary lacuna (the fossils have not been found), on the other

- and just as probable - the absence of calcification or a weak expression thereof, well known in numerous existing Dasycladales, and consequently having a poor potential for preservation, two factors that are often neglected in synthetic studies of the fossil representatives of this Order.



Video 2: Reconstruction of a whorl (consisting of 3 laterals) of *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., n. comb.

The video file can be downloaded from:
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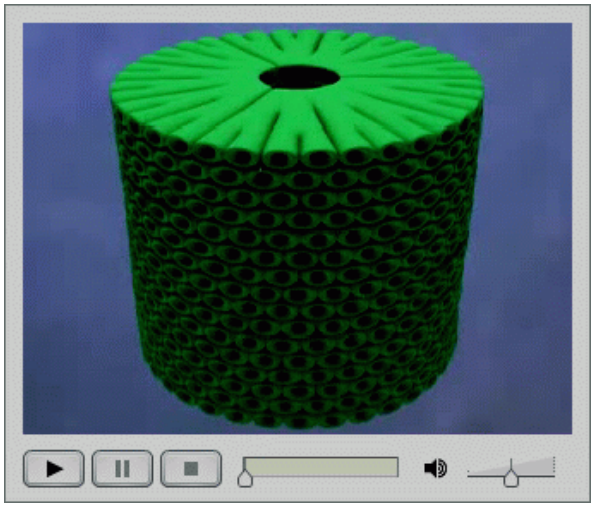

Video 3: Reconstruction of a segment of the thallus (calcified coating) of *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., n. comb.

The video file can be downloaded from:
<http://paleopolis.rediris.es/cg/CG2010_A03/CG2010_A03_Video03.mpg > = 725 KB

Acknowledgments

This publication follows the author's presentation (GRANIER, 2005) at the 5th Regional Symposium of the International Fossil Algae Association at Ferrara, Italy (August 30th-31st, 2005). It was originally planned that the Symposium communications be published in a special issue of *Neues Jahrbuch für Geologie und Paläontologie*, but the author withdrew his submittal for publication therein as it is not technically feasible to reproduce 3-dimensional models of these algae in a paper-printed journal.

The author warmly thanks Pierre MASSE and Jean-Louis VOLAT for giving him access to the micropaleontological collections of the TOTAL Scientific and Technical Centre (CSTJF) in Pau and for facilitating their loan. Thanks are also due Raoul DELOFFRE who gave his invaluable collection to Bruno GRANIER, thus making him his "scientific heir", and to Pierre-Olivier MOJON who found these beautifully preserved specimens of *Zergabriella embergeri* (some of which are illustrated in Fig. 5) while looking for Berriasian charophytes and sent them to the author in 1989. Nestor SANDER contributed to the easy comprehension of this publication by suggesting corrections and emendations to its English.

Video 4: Reconstruction of the pattern of a lateral (calcified coating) of *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989.

The video file can be downloaded from:
<http://paleopolis.rediris.es/cg/CG2010_A03/CG2010_A03_Video04.mpg > = 667 KB

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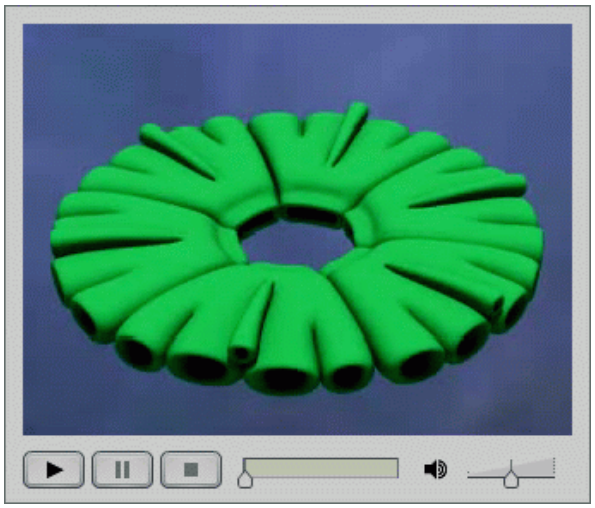

Video 5: Reconstruction of a whorl (consisting of 3 laterals) of *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989.

The video file can be downloaded from:
<http://paleopolis.rediris.es/cg/CG2010_A03/CG2010_A03_Video05.mpg > = 1,415 KB

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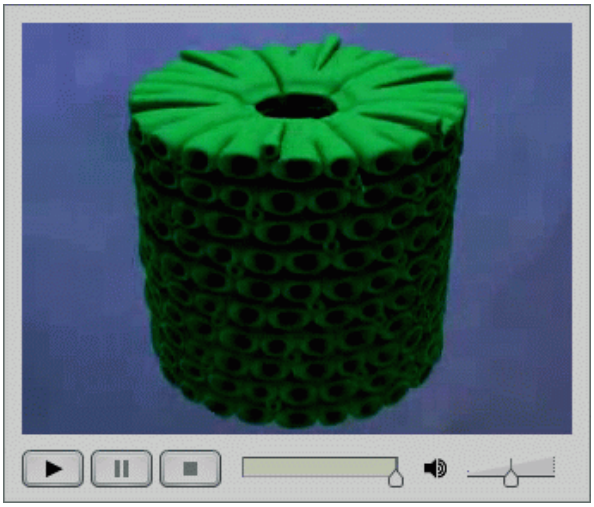

Video 6: Reconstruction of a segment of the thallus (calcified coating) of *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989.

The video file can be downloaded from:
<http://paleopolis.rediris.es/cg/CG2010_A03/CG2010_A03_Video06.mpg > = 2,056 KB

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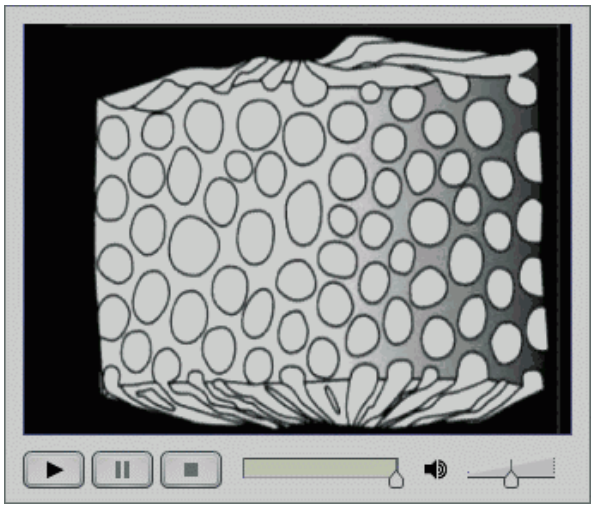

Video 7: Drawings of serial sections of *Bucurella espichelensis*, n. gen., n. comb., illustrating the branching pattern in the laterals (*i.e.*, in the pores).

The video file can be downloaded from:
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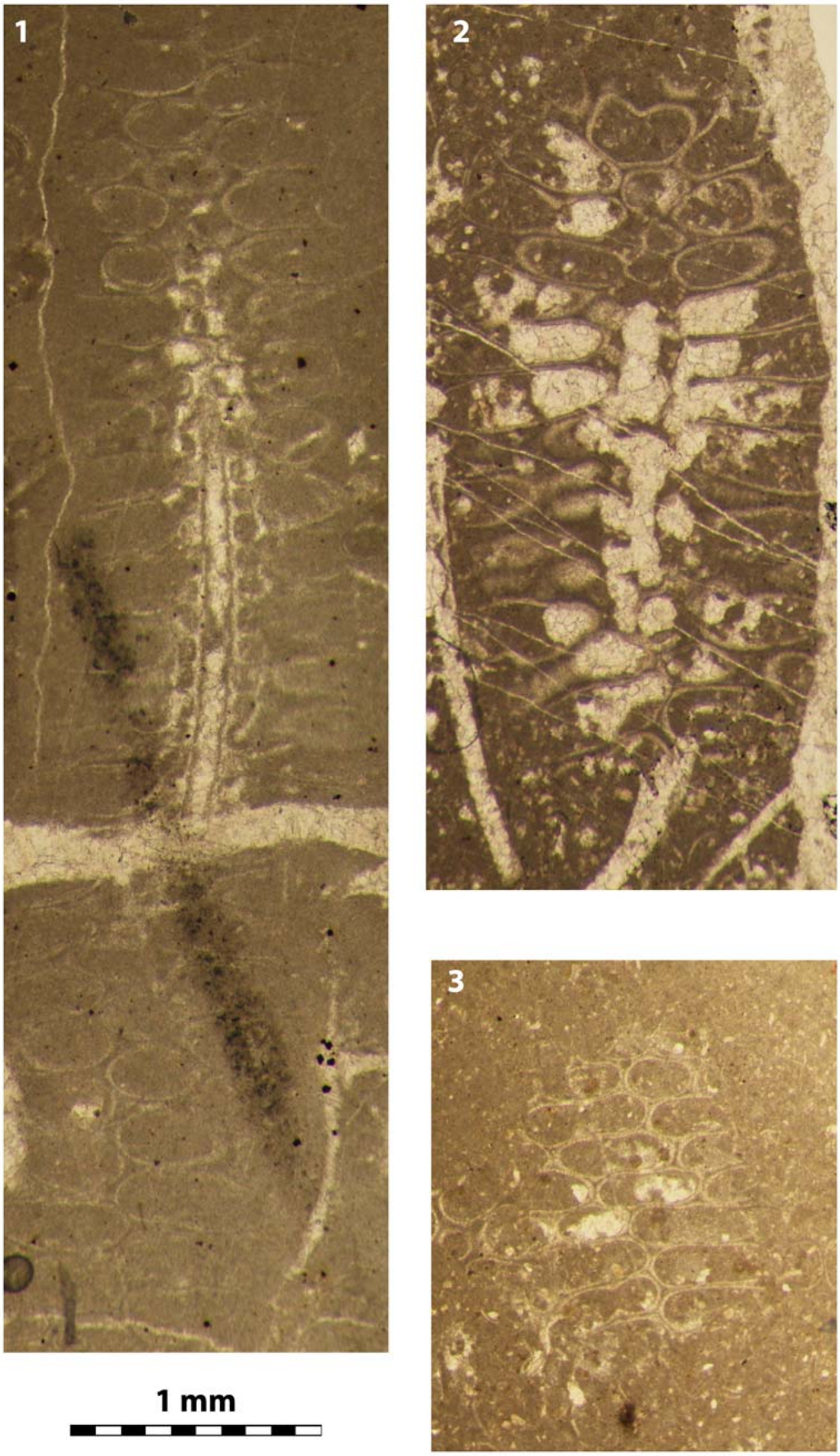
Plates

▶ **Plate 1:**
fig. 1: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: holotype; longitudinal oblique (partly axial) section (previously illustrated by BOUROULLEC & DELOFFRE, 1968: Pl. 4, fig. 1).- n° 15-3 DAS A 30, thin section PZ 982.
fig. 2: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: longitudinal oblique (subaxial) section.- n° 15-3 DAS A 32, thin section OSN2 C3 3917.25m.
fig. 3: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: tangential section (previously illustrated by BOUROULLEC & DELOFFRE, 1968: Pl. 4, fig. 9).- n° 15-3 DAS A 34, thin section OSN2 C3 3917.10m.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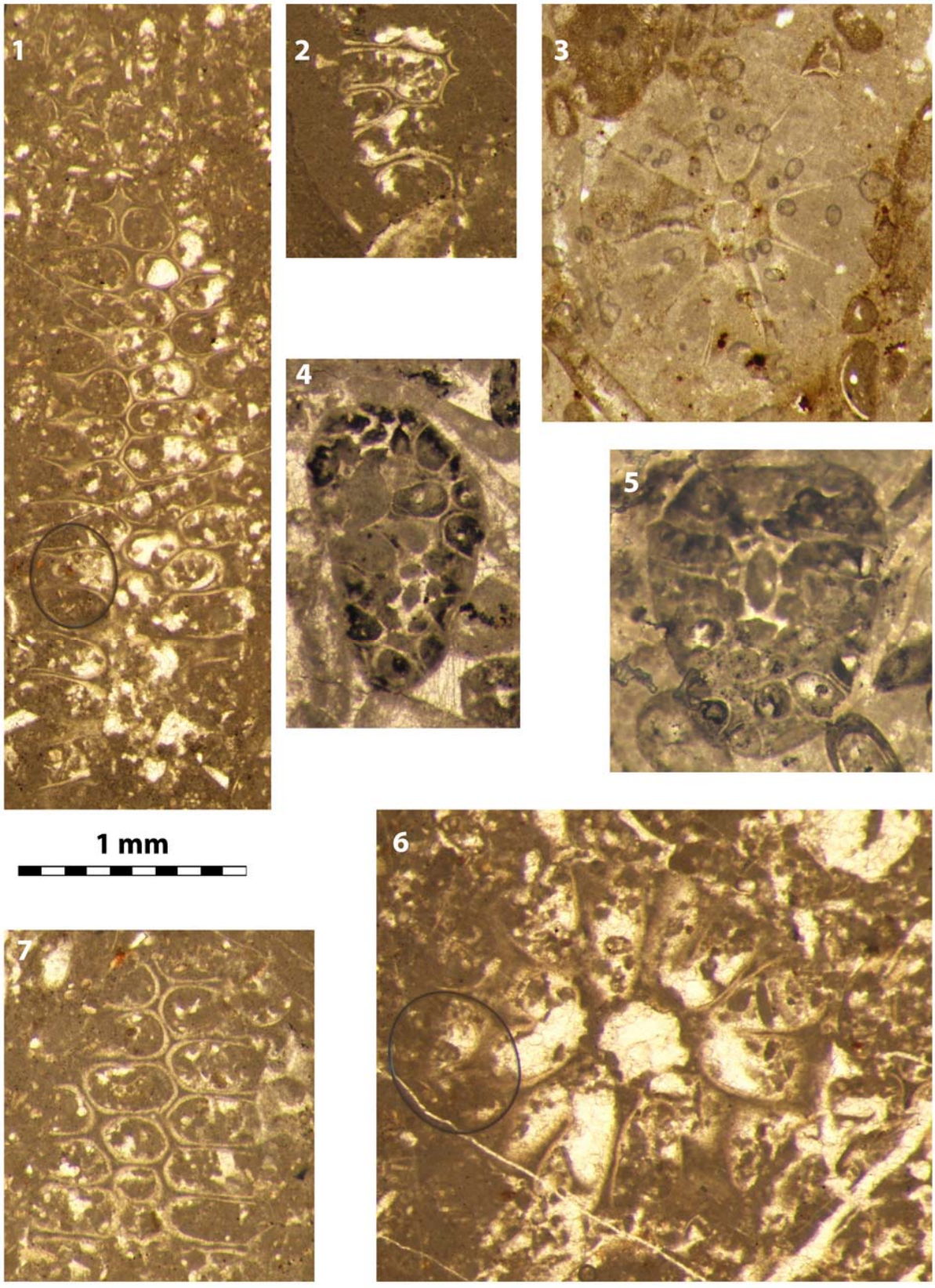
▶ Plate 2:

fig. 1: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: longitudinal oblique section (previously illustrated by BOUROULLEC & DELOFFRE, 1968: Pl. 4, fig. 7).- n° 15-3 DAS A 32, thin section OSN2 C3 3917.25m.
fig. 2: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: tangential section (previously illustrated by BOUROULLEC & DELOFFRE, 1968: Pl. 4, fig. 10).- n° 15-3 DAS A 33, thin section OSN2 C3 3917.15m.
fig. 3: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: transverse section.- n° 15-3 DAS A 36, thin section Z-238.
fig. 4: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: oblique section with the so-called "cavités sporangiques" (in fact the proximal end of laterals).- n° 3, thin section Ba 1 ~2372m.
fig. 5: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: oblique section with the so-called "cavités sporangiques" (previously illustrated by BOUROULLEC & DELOFFRE, 1968: Pl. 4, fig. 3).- n° 15-3 DAS A 35, thin section Ba1 2358m (cuttings).
fig. 6: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: "paratype"; transverse section (previously illustrated by BOUROULLEC & DELOFFRE, 1968: Pl. 4, fig. 6).- n° 15-3 DAS A 32, thin section OSN2 C3 3917.25m.
fig. 7: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: tangential section (previously illustrated by BOUROULLEC & DELOFFRE, 1968: Pl. 4, fig. 8).- n° 15-3 DAS A 33, thin section OSN2 C3 3917.15m.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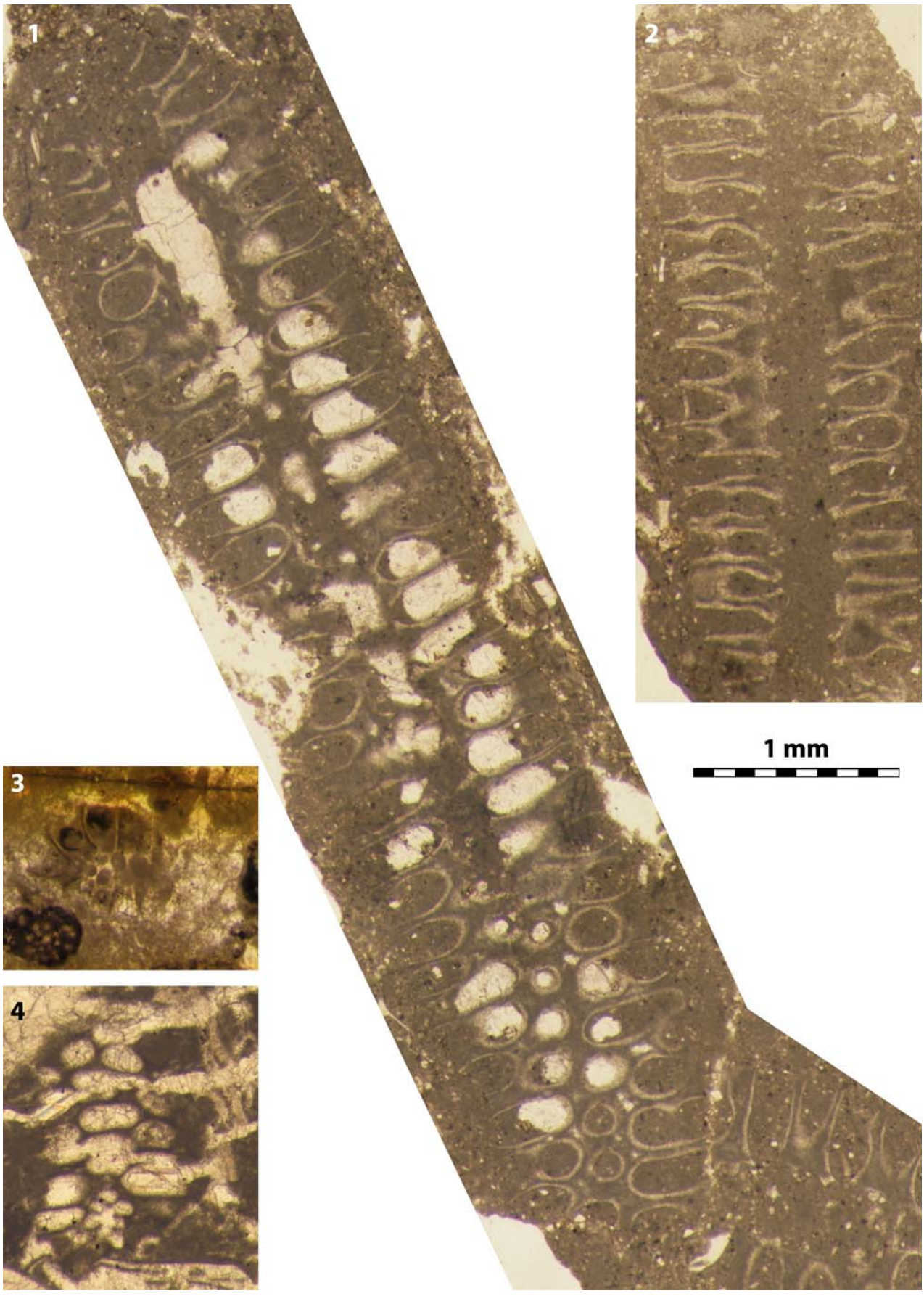
▶ Plate 3:
fig. 1: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: longitudinal oblique (subaxial) and oblique sections.- DELOFFRE Collection, "Mont Rose", Marseilles (France).
fig. 2: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: axial section.- DELOFFRE Collection, "Mont Rose", Marseilles (France).
fig. 3: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: oblique section with the so-called "cavités sporangiques" (previously illustrated by BOUROULLEC & DELOFFRE, 1968: Pl. 4, fig. 4).- n° 4, thin section Ba 1 ~2372m.
fig. 4: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989: oblique section with the so-called "cavités sporangiques".- DELOFFRE Collection, thin section PZ 982.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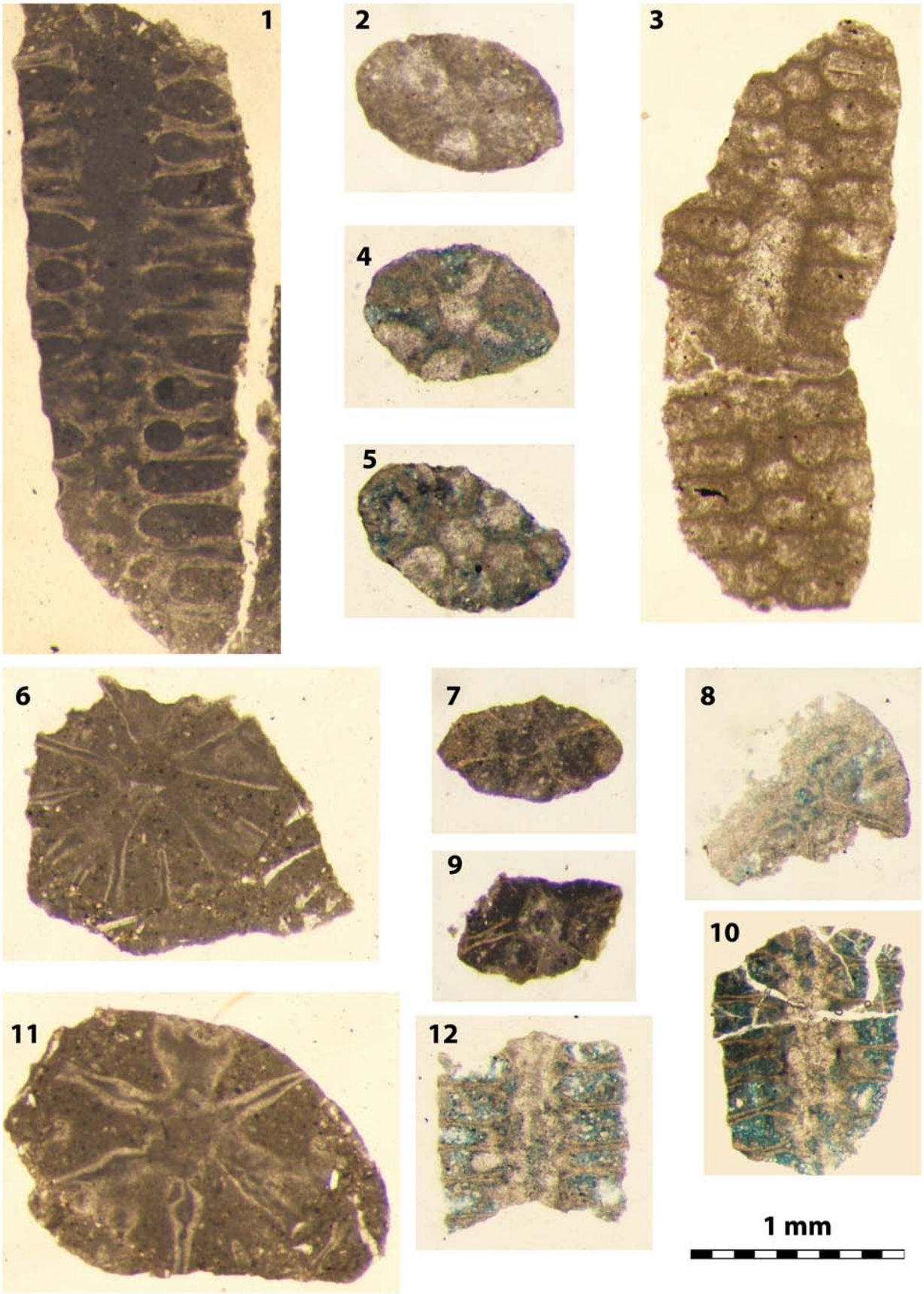
▶ Plate 4:
figs. 1, 6 & 11: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989. 1: subaxial section; 6 & 11: transverse sections.- DELOFFRE Collection, thin sections from E 31 cell samples, "Mont Rose", Marseilles (France).
figs. 2-5, 7-10 & 12: *Zergabriella embergeri* (BOUROULLEC & DELOFFRE, 1968), GRANIER, 1989. 2, 4-5, 7-9: transverse sections; 3: longitudinal oblique section; 10 & 12: axial sections.- DELOFFRE Collection, thin sections from H 135 cell samples, "Valanginien de Cascais" (Portugal).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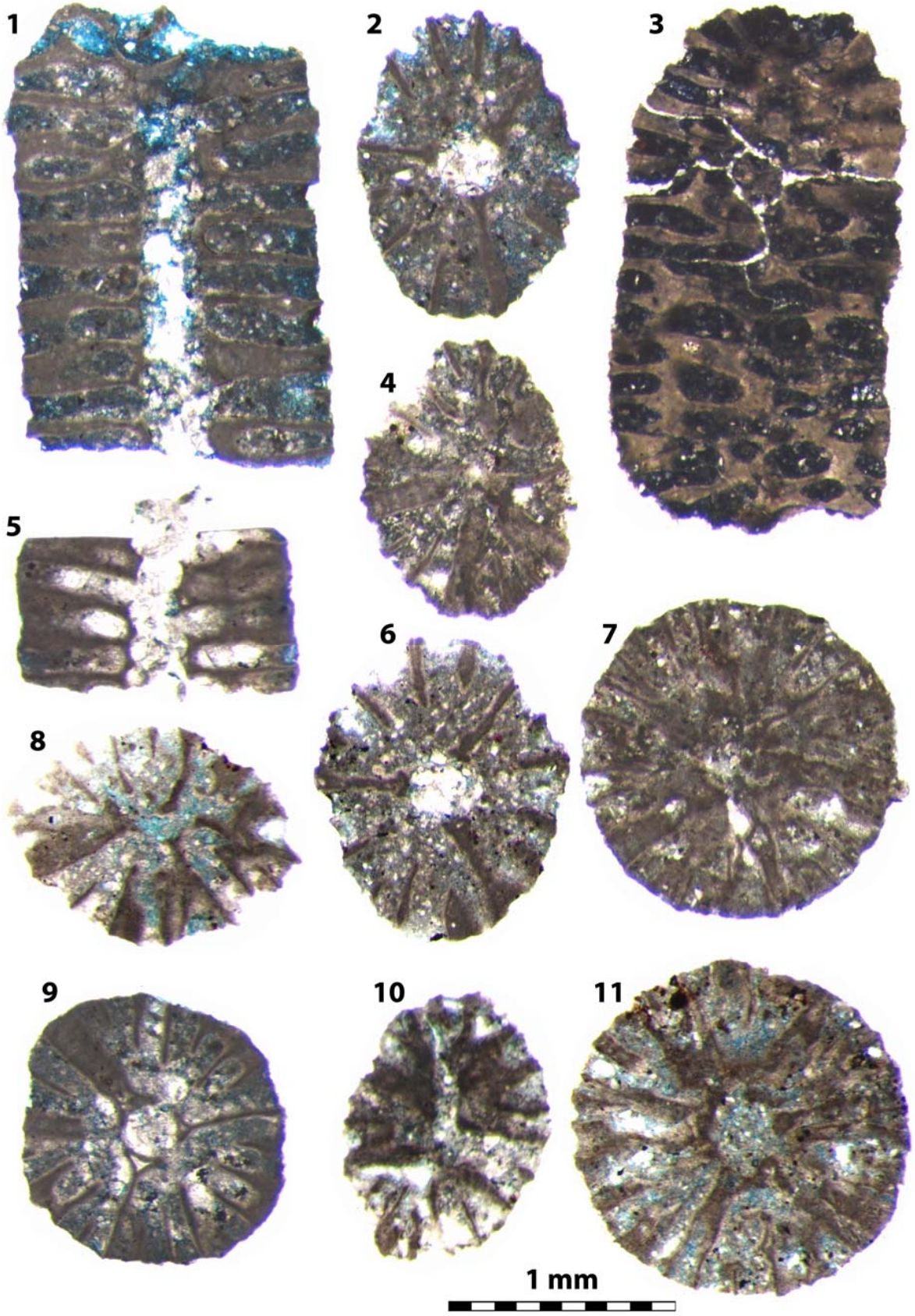
▶ Plate 5:
fig. 1: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., nov. comb.: holotype; axial section (previously illustrated by DELOFFRE & RAMALHO, 1971: Pl. 2, fig. 1).- n° 15-3 DAS A 1, thin section H 135-3.
fig. 2: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., nov. comb.: subtransverse section (previously illustrated by DELOFFRE & RAMALHO, 1971: Pl. 1, fig. 5).- n° 15-3 DAS A 8, thin section H 135-1.
fig. 3: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., nov. comb.: longitudinal tangential section (previously illustrated by DELOFFRE & RAMALHO, 1971: Pl. 1, fig. 6).- n° 15-3 DAS A 7, thin section H 135-7.
fig. 4: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., nov. comb.: subtranverse section.- n° 15-3 DAS A 10, thin section H 135.
fig. 5: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., nov. comb.: paratype; axial section (previously illustrated by DELOFFRE & RAMALHO, 1971: Pl. 2, fig. 6).- n° 15-3 DAS A 2, thin section H 135-6.
fig. 6: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., nov. comb.: subtranverse section (previously illustrated by DELOFFRE & RAMALHO, 1971: Pl. 2, fig. 2).- n° 15-3 DAS A 6, thin section H 135-8.
fig. 7: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., nov. comb.: tranverse section (previously illustrated by DELOFFRE & RAMALHO, 1971: Pl. 2, fig. 5).- n° 15-3 DAS A 5, thin section H 135-4.
fig. 8: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., nov. comb.: subtranverse section.- n° 15-3 DAS A 11, thin section H 135.
fig. 9: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., nov. comb.: paratype; tranverse section (previously illustrated by DELOFFRE & RAMALHO, 1971: Pl. 2, fig. 4).- n° 15-3 DAS A 3, thin section H 135-9.
fig. 10: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., nov. comb.: subtranverse section.- n° 15-3 DAS A 9, thin section H 135
fig. 11: *Bucurella espichelensis* (DELOFFRE & RAMALHO, 1971), n. gen., nov. comb.: tranverse section (previously illustrated by DELOFFRE & RAMALHO, 1971: Pl. 2, fig. 3).- n° 15-3 DAS A 4, thin section H 135-5.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Appendix

List of the original thin sections exhibiting *Bucurella espichelensis*, n. gen., n. comb.:

New /	Old Numbers	Species		Original Illustration	Taxonomic Status	Herein
15-3 DAS A 1	H 135-3	*Macroporella* (*Macroporella*) *espichelensis*	DELOFFRE & RAMALHO, 1971	Pl. 2, fig. 1	holotype	Pl. 5, fig. 1
15-3 DAS A 2	H 135-6	*Macroporella* (*Macroporella*) *espichelensis*	DELOFFRE & RAMALHO, 1971	Pl. 2, fig. 6	paratype	Pl. 5, fig. 5
15-3 DAS A 3	H 135-9	*Macroporella* (*Macroporella*) *espichelensis*	DELOFFRE & RAMALHO, 1971	Pl. 2, fig. 4	paratype	Pl. 5, fig. 9
15-3 DAS A 4	H 135-5	*Macroporella* (*Macroporella*) *espichelensis*	DELOFFRE & RAMALHO, 1971	Pl. 2, fig. 3		Pl. 5, fig. 11
15-3 DAS A 5	H 135-4	*Macroporella* (*Macroporella*) *espichelensis*	DELOFFRE & RAMALHO, 1971	Pl. 2, fig. 5		Pl. 5, fig. 7
15-3 DAS A 6	H 135-8	*Macroporella* (*Macroporella*) *espichelensis*	DELOFFRE & RAMALHO, 1971	Pl. 2, fig. 2		Pl. 5, fig. 6
15-3 DAS A 7	H 135-7	*Macroporella* (*Macroporella*) *espichelensis*	DELOFFRE & RAMALHO, 1971	Pl. 1, fig. 6		Pl. 5, fig. 3
15-3 DAS A 8	H 135-1	*Macroporella* (*Macroporella*) *espichelensis*	DELOFFRE & RAMALHO, 1971	Pl. 1, fig. 5		Pl. 5, fig. 2
15-3 DAS A 9	H 135	*Macroporella* (*Macroporella*) *espichelensis*	DELOFFRE & RAMALHO, 1971	not illustrated		Pl. 5, fig. 10
15-3 DAS A 10	H 135	*Macroporella* (*Macroporella*) *espichelensis*	DELOFFRE & RAMALHO, 1971	not illustrated		Pl. 5, fig. 4
15-3 DAS A 11	H 135	*Macroporella* (*Macroporella*) *espichelensis*	DELOFFRE & RAMALHO, 1971	not illustrated		Pl. 5, fig. 8

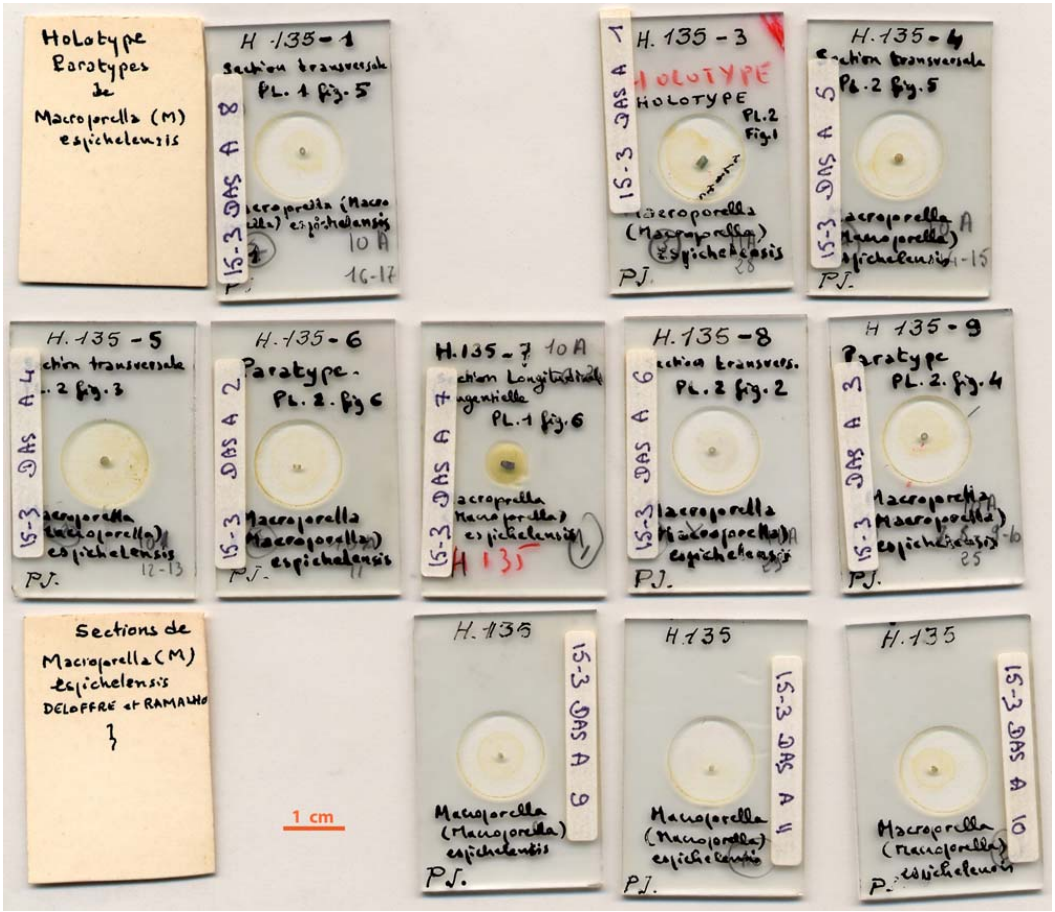

Figure 10: Original thin sections with *Bucurella espichelensis*, n. gen., n. comb.

List of the original thin sections exhibiting *Zergabriella embergeri* :

New /	Old Numbers	Species		Original Illustration	Taxonomic Status	Herein	Assemblage
15-3 DAS A 30	PZ 982	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	Pl. 4, fig. 1	holotype	Pl. 1, fig. 1	*Clypeina*
15-3 DAS A 32	OSN2 C3 3917.25m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	Pl. 4, fig. 6 Pl. 4, fig. 7 not illustrated	"paratype"	Pl. 2, fig. 6 Pl. 2, fig. 1 Pl. 1, fig. 2	*Choffatella*, Charophyte oogonia
15-3 DAS A 33	OSN2 C3 3917.15m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	Pl. 4, fig. 8 Pl. 4, fig. 10		Pl. 2, fig. 7 Pl. 2, fig. 2	*Choffatella*, Charophyte oogonia
15-3 DAS A 34	OSN2 C3 3917.10m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	Pl. 4, fig. 9		Pl. 1, fig. 3	*Choffatella*
15-3 DAS A 35	Ba1 2358m (cuttings)	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	Pl. 4, fig. 3		Pl. 2, fig. 5	
15-3 DAS A 36	Z-238	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	not illustrated		Pl. 2, fig. 3	*Deloffrella*, *Choffatella*
15-3 DAS A 37	Z-226	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	not illustrated		Fig. 1	*Deloffrella*, *Rajkaella*

Original material not found:

Old Numbers	Species		Original Illustration	Taxonomic Status
Polastron 101 (RAP) C5 1110m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	Pl. 4, fig. 2	
OSN2 C3 3917.15m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	Pl. 4, fig. 5	"paratype"

Figure 11: Original thin sections with *Zergabriella embergeri* (15-3 DAS A 31 missing).

List of additional thin sections, made from cuttings:

New	/ Old Numbers	Species		Original Illustration	Herein	Assemblage
1	Bassoués 1 2389	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968			*Choffatella*, *Nautiloculina*
2	Ba 1 ~2402m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	not illustrated	Fig. 3	*Choffatella*
3	Ba 1 ~2372m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	not illustrated	Pl. 2, fig. 4	*Choffatella*, *Clypeina*
4	Ba 1 ~2372m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	Pl. 4, fig. 4	Pl. 3, fig. 3	*Choffatella*
5	Ba 1 ~2368m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968			*Choffatella*
6	Ba 1 2358m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968			
7	Ba 1 2356m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968			*Choffatella*
8	Ba 1 ~2346m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968			Charophyte stems and oogonia
9	Ba 1 2408m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968			
10	SMe I 1710m	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968			

Additional material (DELOFFRE Collection, Brest):

DELOFFRE Collection	Species		Herein	Remarks
5 thin sections, "Mont Rose	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	Fig. 4; Pl. 3, figs. 1-2; Pl. 4, figs. 1, 6, 11	
9 thin sections, "Valanginien de Cascais" (E 31)	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	Pl. 4, figs. 2-5, 7-10, 12	
1 thin section PZ - 982	*Macroporella embergeri*	BOUROULLEC & DELOFFRE, 1968	Fig. 2; Pl. 3, fig. 4	Assemblage: *Falsolikanella*, *Actinoporella*
1 cell (H 135) with 4 isolated specimens	*Macroporella espichelensis*	DELOFFRE & RAMALHO, 1971	Fig. 6	Originally illustrated as Pl. 1, figs. 1-4 (paratypes)

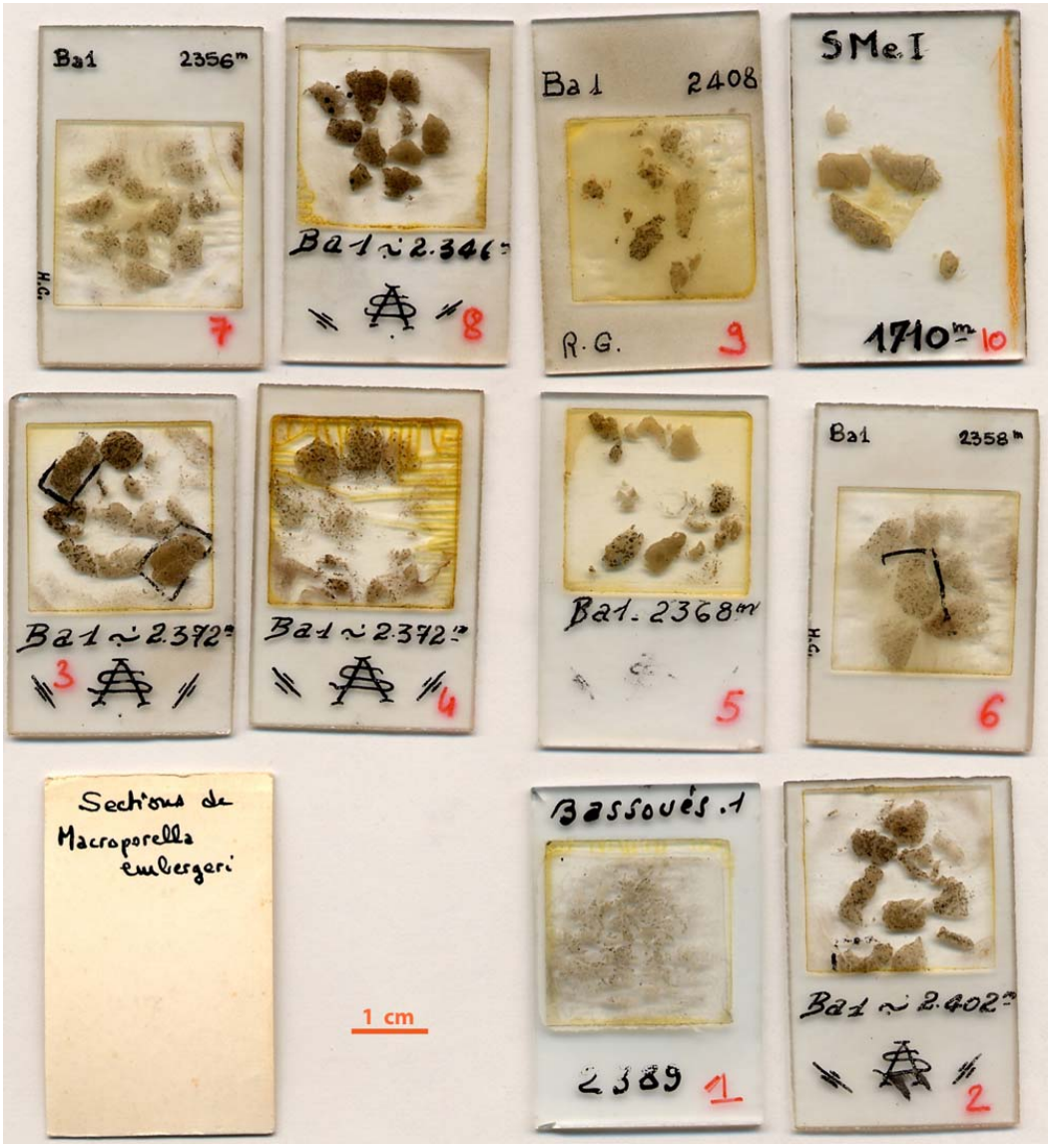

Figure 12: Thin sections from cuttings with *Zergabriella embergeri*.