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Polyphysaceae fertile caps in Hungarian Sarmatian sediments

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ABSTRACT

Three fragments of reproductive caps have been discovered in the Sarmatian limestones of Tinnye (Hungary). They are assigned to the genus Acetabularia *(Polyphysaceae, formerly Acetabulariaceae). Two of these fragments are quite well preserved with nine rays each. One specimen bears distinct spines at the outer ends of long rays, whereas another one has short rays with rounded outer ends and, possibly, a partially preserved corona. The third fragment is characterized by very elongated rays containing numerous gametangia.*

Keywords: calcareous algae, Dasycladales, Polyphysaceae, *Acetabularia*, Sarmatian, Hungary

1. INTRODUCTION

The Polyphysaceae (Dasycladales) studied in this paper were discovered in the Upper Sarmatian Tinnye Formation, defined at Tinnye, a village located in the Zsámbék Basin, about 30 km west of Budapest (Fig. 1). Specimens have been found in limestones with oolitic grapestones, microbial features encrustations and crustose foraminifera, within oolitic sandstones series (Fig. 2). Due to rarity of these fossils, their occurrence merits description and illustration.

There is a pattern of large oolitic and bioclastic shoals in the Zsámbék Basin, on top of which bio-constructed facies and encrustations developed.

Calcareous algae are associated with bivalves (*Obsoletiforma, Paphia, Tapes*), gastropods (*Granulolabium, Pirenella, Clithon*), foraminifera (*Elphidium*, miliolids, nubecularids) and serpulids. The facies indicates a shallow water environment but the discussion is open with regard to salinity (HARZHAUSER & PILLER, 2004). Isotopic analysis undertaken on molluscs shells seems to reveal brackish influences, or even fresh water ones (Moissette, pers. comm., 2008).

2. PALAEONTOLOGICAL DESCRIPTION

Specimens from Tynnie consist of three fragments of fertile caps lying on a limestone surface. Two of them are quite well preserved with nine cap rays firmly held together by strong calcification.

Specimen 1 (Fig. 3)

Nine cap rays can be observed on this specimen. The entire cap of the living alga was probably composed of 14 rays. The most remarkable feature of this species is the distinct spines at the outer ends of the rays. The gametangia are not visible.

Diameter of the cap: 4.45 mm.

Length of the rays: 1.75–2 mm (approximate data because of the poor preservation of the cap central zone).

Maximum width of the rays: 0.75–0.90 mm.

Specimen 2 (Fig.4)

The fragment of this small cap is composed of nine rays. The estimated initial number of rays is 14 or 15. Cap rays are short. Their outer ends seem more or less rounded but it is not pos-

Figure 1: Location of the Zsámbék Basin.

sible to confirm this because of the poor preservation of the peripheral outline of the cap. For the same reason, it is difficult to know if the circular swelling, located at the proximal ends of the rays, in the central area of the cap, is a partially preserved corona. Longitudinal sections of three rays show 5

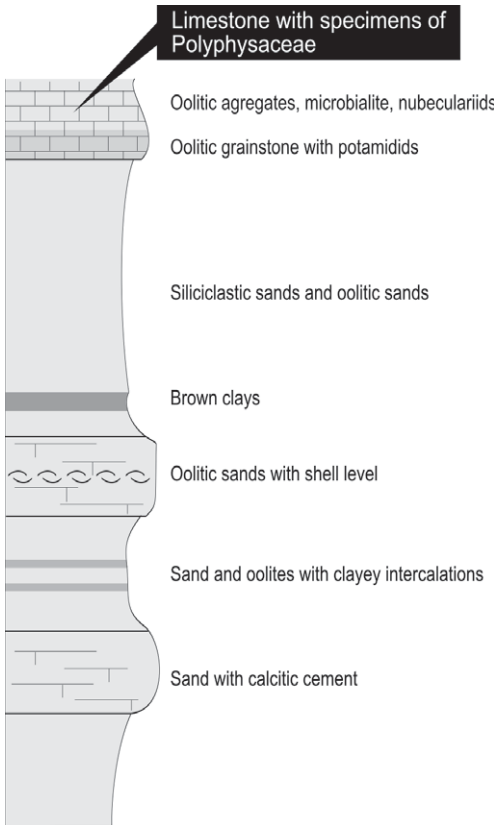

Figure 2: Oolitic sandstones series of Tinnye.

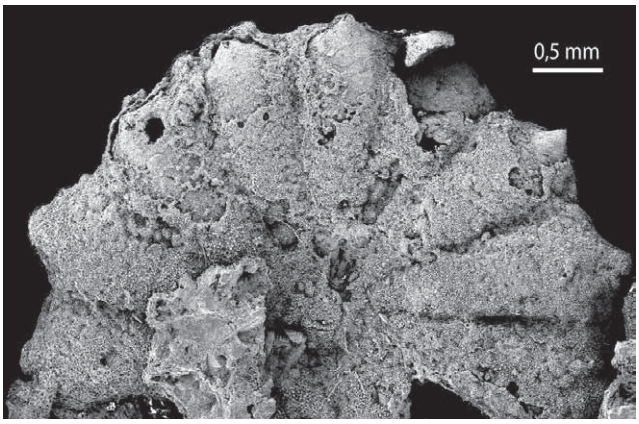

Figure 3: Specimen 1 – external view of a partially preserved cap.

to 8 hemispherical cavities corresponding to the location of the gametangia. There are only 2 to 3 laterally juxtaposed gametangia in the widest part of the ray. The estimated number of gametangia inside each fertile organ is 8 to10 (but may be 16–20 if gametangia were arranged in 2 superimposed planes, that are difficult to determine on the specimen).

Diameter of the cap: 2.8 mm.
Length of the rays: 1.07–1.14 mm.
Maximum width of the rays: 0.51–0.56 mm.
Diameter of the central zone: 0.6 mm.
Diameter of gametangia: 0.16–0.18 mm.

Specimen 3 (Fig.5)

The third specimen is composed of five very partially preserved cap rays. It looks different from the previous one: rays are elongated and contain numerous rounded gametangia, probably more than 40 in each organ. There are 4 to 5 laterally juxtaposed gametangia in the widest part of the ray.

Approximative length of the rays: at least 2.6 mm.

Maximum width of the rays: at least 1.1 mm (only 2 rays can be measured).

Diameter of gametangia: 0.20–0.23 mm.

3. GENERIC ATTRIBUTION

We adopt here the generic concepts recently defined by BERGER et al. (2003), after a detailed study of the phylogeny and evolution of cap development in living Polyphysaceae (formerly Acetabulariaceae). Using a combination of morphological, developmental and molecular characteristics, the authors consider *Acicularia* as "…completely identical in its morphology with *Acetabularia"* and show that earlier stages of cap development are very similar in both genera. The only difference concerns the calcification: gametangia are embedded into a lime matrix in *Acicularia*, whereas gametangia are uncalcified and free in *Acetabularia*, but the authors demonstrate that lime-embedding of gametangia is in fact, a late developmental event of maturing caps. Therefore, they assign the living *Acicularia* species (*A. schenckii*) to the genus *Acetabularia.* They also propose two subgenera within *Acetabularia*: *Acicularia*, containing all species of *Acetabularia,* except *A. acetabulum,* with the following definition: "unfused cap primordia", and

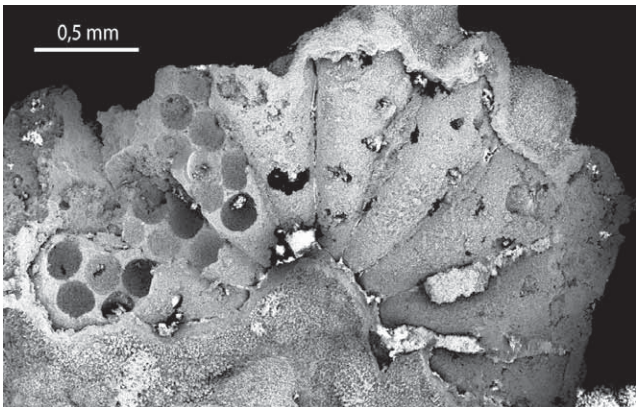

Figure 4: Specimen 2 – external and internal views of a partially preserved cap.

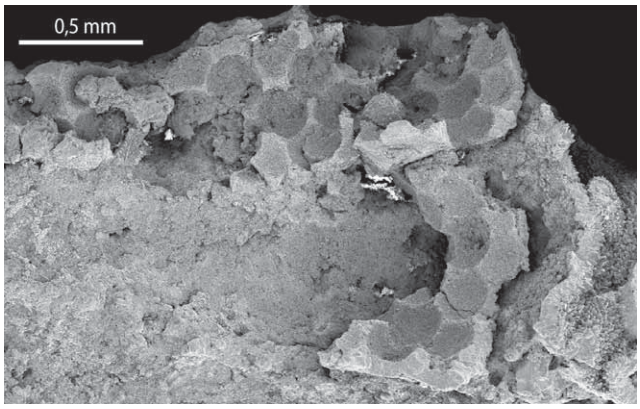

Figure 5: Specimen 3 – location of gametangia inside two cap rays.

Acetabularia, containing *A. acetabulum,* characterized by "congenitally fused cap primordia". There is no mention of the calcification in these definitions.

So, *Acetabularia* is now the only genus of the Recent Polyphysaceae (formerly Acetabulariaceae) including species bearing fertile caps with gametangia embedded into a lime matrix (Fig. 6). If palaeontologists adopt these new generic concepts, it would be coherent to assign all fossil species of *Acicularia* to the genus *Acetabularia*. This is why the three fertile caps studied in this paper are considered as *Acetabularia.*

Associated rays forming caps are also known in the following genera:

– *Orioporella* MORELLET & MORELLET, characterized by its hollow caps with perforated walls and partially calcified gametangia;
– *Chalmasia* SOLMS-LAUBACH, with strongly calcified gametangia but which are free inside the rays;
– *Parvocaulis* BERGER *et al.,* with uncalcified gametangia.

Another feature may be observed in these genera (Fig. 6): the presence of lower and upper coronae in *Acetabularia*, a corona only on the upper side of the cap in *Parvocaulis* and *Chalmasia*. But this morphological characteristic is almost never observed on fossils, even when the specimens

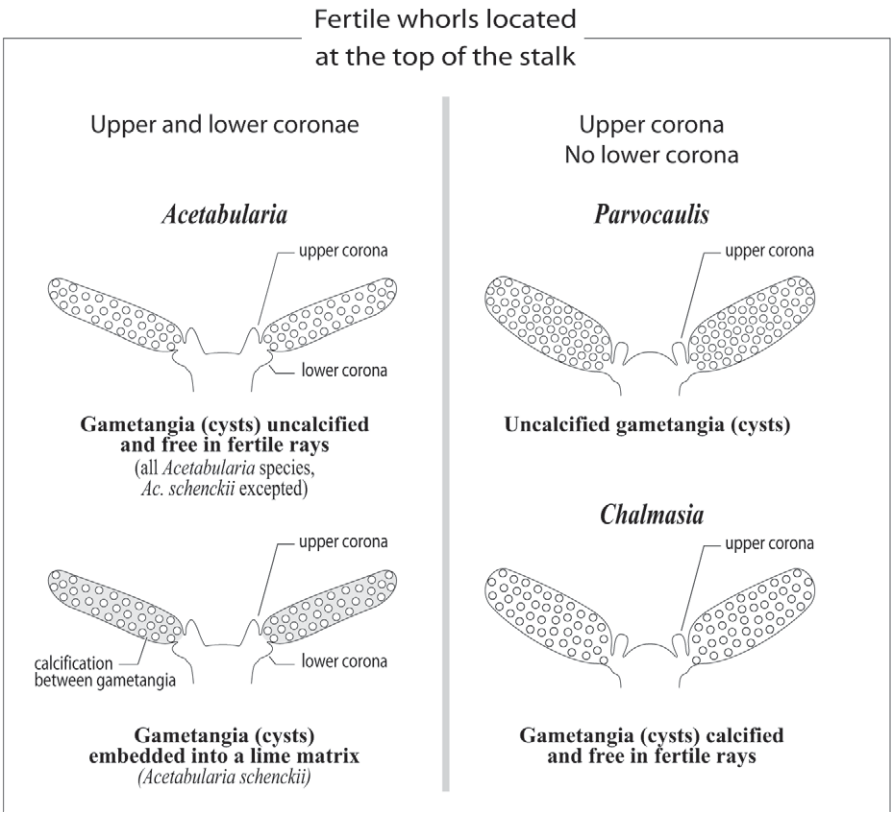

Figure 6: Some features of caps in present-day Polyphysaceae (data from VALET, 1969; BERGER & KAEVER, 1992; BERGER et al., 2003; BERGER, 2006).

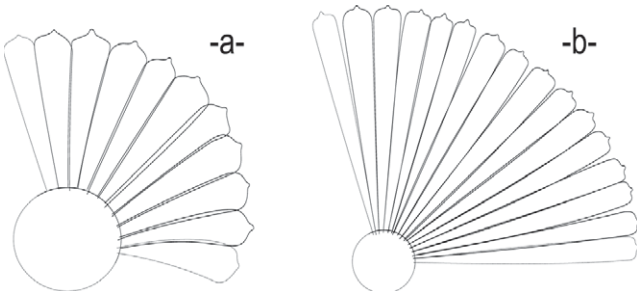

Figure 7: Reproductive caps of living *Acetabularia dentata* (a) and *A. kilneri* (b) (BERGER & KAEVER, 1992, modified; BERGER, 2006)

may be entirely isolated from the sediment (GENOT, 1987). The corona zone is often badly preserved and when the specimens are lying on a limestone surface, only one side of the cap can be studied (MORELLET, 1939). This is the case for specimen 2.

4. COMPARISONS

Polyphysaceae fertile caps have already been discovered in Sarmatian limestones from Hungary, near Ecseg (BODA, 1959). The author assigned to a new species, *Acicularia conica*, different specimens which, in fact, belong to distinct species (see the discussion in BUCUR et al*.,* 1993). Among these specimens, two of them are reproductive caps lying on a limestone surface (*ibid*., pl. 44, fig. 1–2). The most complete specimen is an entire cap composed of 25 rays. The rays look much more elongated, compared with our specimens 1 and 2. Unfortunately, the comparison cannot go further because the outline of the caps is badly preserved and the internal aspect of the rays remains unknown.

The presence of spines at the distal ends of the rays, observed on specimen 1, is known in present-day species, such as *Acetabularia crenulata* LAMOUROUX, *A. dentata* SOLMS-LAUBACH (Fig. 7a) and *A. kilneri* AGARDH (Fig. 7b). But this is the only common feature with the Sarmatian caps: the rays are much more elongated in *A. crenulata* and *A. kilneri* (VALET, 1969; BERGER & KAEVER, 1992; BERGER, 2006).

Specimen 2 bears, at the centre of the cap, a fragment of a circular swelling which might be a corona. Despite the exceptional occurrence of this feature on fossils, it has already been possible to describe a rather well preserved corona on Sarmatian Acetabulariaceae from Romania (GÉNOT et al., 2002) with the characteristic protuberances (*ibid*., pl. III, fig.2) on which branched sterile hairs develop in living representatives. These protuberances are unknown on the Hungarian specimen. Concerning the cap rays, only one Romanian specimen (*ibid*., pl.III, fig.1) has similarities with specimen 2: short rays containing a small number of gametangia.

5. CONCLUSION

Hungarian specimens from Tinnye probably belong to *Acetabularia*, because of the strong calcification filling the spaces between the gametangia. This type of calcification is unknown inside the fertile caps of the other genera of Polyphysaceae.

Concerning the specific attribution of these three specimens, we consider that is not possible, with a so small number of partially preserved fossil caps, to determine if they may be assigned to previously described species or if they correspond to new ones. Thus, more samples would be necessary to precisely establish the morphological features of these species, so as to avoid future confusion in the literature.

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