

The genus *Actinoporella* (GÜMBEL in ALTH, 1881) and its representatives. A review

Die Gattung *Actinoporella* (GÜMBEL in ALTH, 1881) und ihre Vertreter: Eine Übersicht

by

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Abstract

The two genera, *Hamulusella* ELLIOTT in DELOFFRE & GRANIER, 1993, and *Pseudoactinoporella* CONRAD, 1970, are considered as junior synonyms for *Actinoporella* GÜMBEL in ALTH, 1881, emend. Their type-species and the species *Clypeina nigra* CONRAD & PEYBERNES, 1978, emend., are transferred to this genus. A new species, *Actinoporella jaffrezoi* n. sp., is described. As a consequence, the genus *Actinoporella* (GÜMBEL in ALTH, 1881) includes at least 7 species ranging from the Late Jurassic to the Paleocene. Phylogenetical relationships between *Actinoporella* ancestors and *Acetabularia* – *Polyphysa* descendants are discussed.

Zusammenfassung

Die zwei Gattungen, *Hamulusella* ELLIOTT in DELOFFRE & GRANIER, 1993, und *Pseudoactinoporella* CONRAD, 1970, werden als Juniorsynonyme der Gattung *Actinoporella* GÜMBEL in ALTH, 1881, emend., erachtet. Ferner sind die Vertreter und die Art *Clypeina nigra* CONRAD & PEYBERNES, 1978, emend., derselben Gattung zugeordnet. Eine neue Art, *Actinoporella jaffrezoi* n. sp., wird beschrieben. Infolgedessen beinhaltet die Gattung *Actinoporella* (GÜMBEL in ALTH, 1881) derzeit 7 Arten, die vom späten Jura bis in das

Paleozän reichen. Die phylogenetischen Beziehungen zwischen den Vorfahren von *Actinoporella* und ihren Nachkommen (*Acetabularia* – *Polyphysa*) werden diskutiert.

1. Introduction

Apart from its type-species, *Actinoporella podolica* (ALTH, 1878) CONRAD et al., 1974 (Pl. 1, Figs. 1, 4 & 8–10; Pl. 3, Figs. 5–8), the genus *Actinoporella* (GÜMBEL in ALTH, 1881) was supposed to include 3 other representatives (DELOFFRE & GRANIER, 1993; GRANIER & DELOFFRE, 1994): *Actinoporella durandelgai* JAFFREZO & FOURCADE ex JAFFREZO in BASSOULLET et al., 1978, *Actinoporella kukoci* RADOICIC, 1975 (not 1974), and *Actinoporella lucasi* (EMBERGER, 1956) GRANIER, 1992. *Actinoporella guembeli* ALTH, 1881, is a junior synonym for *Actinoporella podolica* (ALTH, 1878). “*Actinoporella krymensis*” MASLOV, 1958, is a nomen nudum as several specimens are designated as “holotype” (MASLOV, 1958, Text-Figs. 1.a–e & 2.d). “*Actinoporella israelensis*” RAVIV & LORCH, 1992, is a nomen nudum too as no holotype is quoted (RAVIV & LORCH, 1992, Pl. 3, Figs. a–p; Pl. 4, Figs. a–d); in addition, according to CONRAD (letter of 23–II–1994), the illustrated specimens refer to *Salpingoporella grudii* RADOICIC, 1975. *Actinoporella maslovi* PRATURLON, 1964, and *Actinoporella sulcata* ALTH, 1881 (Pl. 1, Figs. 2–3 & 5–7), have been transferred to the genus *Clypeina* (MICHELIN, 1845) (CONRAD et al., 1974; GRANIER & BRUN, 1991). Finally, *Actinoporella cretacica* RAINERI, 1922, is not an alga but an echinoid spine (PIA, 1936).

2. Amended generic diagnosis

Most of the representatives of the genus *Actinoporella* have the following diagnostic characteristics: Cylindrical main axis bearing close regularly spaced single whorls of branches. Branch consisting of a very short primary

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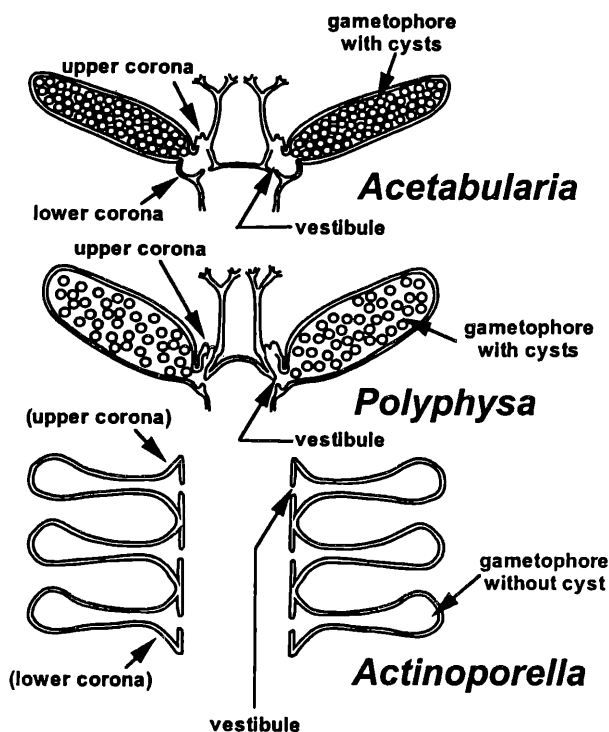


Figure 1: Diagrammatic longitudinal sections through the caps of an *Acetabularia* (with upper and lower coronae, BERGER & KAEVER, 1992) and a *Polyphysa* (with only one upper corona, BERGER & KAEVER, 1992), and diagrammatic axial section of an *Actinoporella* (either with both lower and upper “excrescences”).

branch, i.e. a vestibule, followed by a large phloiophorous secondary branch, i.e. a gametophore, and by (one or two) lateral shorter secondary branch(es). Lateral branches developing corona structure(s) on the upper side of the whorl, on its lower side or on both sides (Fig. 1).

Shape of the larger secondary branch (“main branch” sensu CONRAD et al., 1974), number of shorter secondary branches (“outgrowths” or “excrescences” sensu CONRAD et al., 1974; “branchlets” sensu CONRAD & PEYBERNES, 1976), and measurements (whorl spacing, etc.) constitute criteria for determination at the species level. No cyst has been identified up to now.

Actinoporella durandelgai JAFFREZO & FOURCADE ex JAFFREZO in BASSOULLET et al., 1978, is the sole “representative” with distant whorls. Thus, this species first described as a *Clypeina* should be ascribed to the genus *Actinoporella* with some restrictions.

3. Additional species included, species excluded, and taxonomy.

Dasycladacea PRATURLON & RADOICIC in RADOICIC, 1969, nom. nud., and *Verticilloporella* RAVIV & LORCH, 1970, nom. nud.

According to the International Code of Botanical Nomenclature (1988), the generic name “*Dasycladacea*” PRATURLON & RADOICIC in RADOICIC, 1969, is

rejected. “*Dasycladacea dalmatica*” RADOICIC, 1969, is therefore not validly published; however, it is a genuine *Actinoporella* which should be reexamined. RAVIV & LORCH (1970) have tried to validate RADOICIC’s species by ascribing it to a new genus “*Verticilloporella*” (with “*Verticilloporella dalmatica*” as type-species); (un-)fortunately, they failed: This generic name is a nomen nudum as its type-species is not correctly typified (RAVIV & LORCH, 1970, “syntypes”).

Actinoporella jaffrezoi n. sp.

JAFFREZO (1973, 1981) has illustrated a new alga from the Lower Valanginian “Calcaires roux I” Formation of the Maitérie-Haute, Corbières, France. This species – first called *Verticilloporella* sp., then *Actinoporella* sp. – is described hereafter as *Actinoporella jaffrezoi* n. sp. (Pl. 2, Figs. 1–8). The holotype has been selected among JAFFREZO’s specimens: It consists of an oblique section (Pl. 2, Fig. 1, thin section 35L, FSL 411.600, Office National de Gestion des Collections Paléontologiques, Villeurbanne, France) which shows two successive whorls of typical branches. Its diagnosis is as follows: Small *Actinoporella* species with a rather large main axis ($d = 150\text{--}450\ \mu\text{m}$ / $D = 300\text{--}700\ \mu\text{m}$) bearing close together whorls of 22–24 branches. Branch consisting of a vestibule followed by a phloiophorous gametophore, ending by an open pore (distal part of the branches not calcified), and by a very short lateral closed in its distal part. Slight calcareous sheath of sparite (recrystallization sensu lato).

1973 nom. nud. “*Verticilloporella*” sp. – JAFFREZO, 86–88, Pl. 3, Figs. 17–19

1981 *Actinoporella* sp. – JAFFREZO, Pl. XV, Figs. 5 & 6 (from JAFFREZO, 1973, Pl. 3, Fig. 18).

Actinoporella nigra CONRAD & PEYBERNES, 1978, emend., n. comb.

In the course of investigations on Urgonian limestones, I have found one uncommon section of *Clypeina nigra* CONRAD & PEYBERNES, 1978, which throws light upon its branch pattern: A genuine *Actinoporella* branching (Pl. 3, Fig. 1). In this subaxial section through three successive whorls, “excrescences” can be seen on one side of the whorls. They were observed in deep tangential sections by CONRAD & PEYBERNES (1976, Pl. II, Figs. 2–3) but they were misinterpreted as “cloisons radiales microgranulaires” or “indentations de l’enveloppe calcaire entre les verticilles”

These data are more than enough to allow the transfer of this species from the genus *Clypeina* (MICHELIN, 1845) to the genus *Actinoporella* GÜMBEL in ALTH, 1881, emend.: *Actinoporella nigra* CONRAD & PEYBERNES, 1978, n. comb., emend. (= *Clypeina nigra* CONRAD & PEYBERNES, 1978, C. R. des Séances, SPHN Genève, (NS), 12/2–3 (1977): 80–81, Geneva).

This species is characterized by a calcareous sheath

consisting of microgranular calcite (micrite) with common occurrence of translucent fibrous calcite layer inward (in relation to epitaxial overgrowth). Calcification does not affect interval between successive whorls; the micritic sheath is interrupted at this level: The thallus is articulated.

- 1976 *Clypeina* sp. 1. – CONRAD & PEYBERNES, 180, Text-Fig. 6
- 1978 *Clypeina nigra* n. sp. – CONRAD & PEYBERNES, 80–82, Pl. II, Figs. 1, 2 (from CONRAD & PEYBERNES, 1976, Text-Fig. 6) & 3–5 (holotype: Pl. 2, Fig. 3, thin section Stratech 4–11, Université Paul Sabatier, Toulouse, France)
- 1979 *Clypeina nigra* CONRAD & PEYBERNES. – PEYBERNES et al., Pl. 3, Fig. 4
- 1980 *Clypeina nigra* CONRAD & PEYBERNES. – ARNAUD-VANNEAU, Pl. 112, Figs. 1–3 (MASSE).

Its amended diagnosis is as follows: Small articulated *Actinoporella* species with a cylindrical main axis bearing close-set whorls of branches. Branch consisting of a vestibule followed by a vesicular to short club-shaped gametophore, by an open pore on one side of the whorl, and by an “excrescence” on the opposite side. Gametophore perpendicular to the main axis and closed at its distal part. Calcareous sheath consisting of microgranular calcite wall.

***Actinoporella sedalanensis* ELLIOTT in DELOFFRE & GRANIER, 1993, n. comb.**

In 1978, ELLIOTT introduced a new genus, “*Hamulusella*”, based on a new species, “*Hamulusella sedalanensis*”, from the Paleocene of Kurdistan. Both taxa have been validated lately by ELLIOTT (in DELOFFRE & GRANIER, 1993) as the type-species was not correctly typified at first. Though poorly documented, *Hamulusella sedalanensis* ELLIOTT in DELOFFRE & GRANIER, 1993 (not 1978), presents patterns similar to the ones observed in *Actinoporella*. Comparison of one of the ELLIOTT’s figures (ELLIOTT, 1978, Pl. 73, Fig. 4) and of the holotype section of *Actinoporella jaffrezoii* n. sp. (Pl. 2, Fig. 1) should convince us of the synonymy of the two allied genera. *Hamulusella* ELLIOTT in DELOFFRE & GRANIER, 1993 (not 1978), is considered as a junior synonym for *Actinoporella* GÜMBEL in ALTH, 1881, emend.; therefore, *Hamulusella sedalanensis* should be transferred to the latter genus:

Actinoporella sedalanensis ELLIOTT in DELOFFRE & GRANIER, 1993, n. comb. (= *Hamulusella sedalanensis* ELLIOTT, 1978, nom. nud., *Palaeontology*, **21**/3: 687–690, London; = *Hamulusella sedalanensis* ELLIOTT in DELOFFRE & GRANIER, 1993, *Revue Paléobiol.*, **11**/2 (1992): 336, Geneva).

- 1978 nom. nud. *Hamulusella sedalanensis* n. sp. – ELLIOTT, 687–690, Pl. 73, Figs. 1–4 (“Syntypes”: Pl. 73, Fig. 1, thin section V. 41606; Pl. 73, Fig. 2, thin section V. 32492, Department of Palaeontology, British Museum (Natural History), London, United-Kingdom)
- 1982 nom. nud. *Hamulusella sedalanensis* ELLIOTT. –

DELOFFRE & GÉNOT, 97–98, Pl. 8, Figs. 6 (from ELLIOTT, 1978, Pl. 73, Fig. 1), 7 (from ELLIOTT, 1978, Pl. 73, Fig. 3) & 8 (from ELLIOTT, 1978, Pl. 73, Fig. 2)

- 1988 nom. nud. *Hamulusella sedalanensis* ELLIOTT. – DELOFFRE, Pl. 13, Fig. 16 (from ELLIOTT, 1978, Pl. 73, Fig. 1)
- 1993 *Hamulusella sedalanensis*. – ELLIOTT in DELOFFRE & GRANIER, 336, not illustrated (Lectotype: ELLIOTT, 1978, Pl. 73, Fig. 1, thin section V. 41606).

***Actinoporella fragilis* CONRAD, 1970, n. comb., and *Actinoporella ?silvaeregis* BUCUR, 1981, n. comb.**

Finally, the herein amended generic diagnosis for *Actinoporella* (GÜMBEL in ALTH, 1881) though quite limitative is broad enough to include the genus *Pseudoactinoporella* (CONRAD, 1970) CONRAD & PEYBERNES, 1976. The amended diagnosis by CONRAD & PEYBERNES (from BASSOULLET et al., 1978) mentions that “Near their basis, branches bear, or are likely to bear, secondary branchlets”. Several sections show this character: Its branches consist of a very short primary branch, i.e. a vestibule, followed by a large phloioforous secondary branch, i.e. a gametophore, and by one lateral shorter secondary branch. One section of an unique specimen, first illustrated by FOURCADE et al. (1972, Pl. 3, Fig. 9), then by BASSOULLET et al. (1978, Pl. 24, Fig. 8), and later by JAFFREZO (1981, Pl. XII, Figs. 1–2), shows a rounded form following one short lateral. This rounded form has been interpreted as a fertile organ; however, in my opinion, this unique feature is merely a clionid boring. Therefore, the genus *Pseudoactinoporella* (CONRAD, 1970) is considered as a synonym for *Actinoporella* (GÜMBEL in ALTH, 1881). Accordingly, its type-species is transferred to the latter genus:

Actinoporella fragilis CONRAD, 1970, n. comb. (= *Pseudoactinoporella fragilis* CONRAD, 1970, *Geol. Rom.*, **IX**: 66–67, Rome).

- 1968 *Actinoporella podolica* ALTH. – BOUROULLEC & DELOFFRE, 229, Pl. 5, Figs. 1–3, 5–6 & 9–10;
- 1970 *Pseudoactinoporella fragilis* n. gen. n. sp. – CONRAD, 66–67, Text-Fig. 4; Pl. I, Figs. 1–3; Pl. II; Pl. VIII, Fig. 4 (holotype: Text-Fig. 4, thin section 2 (sample CONRAD 766), Museum of Natural History, Geneva, Switzerland)
- 1970 (non) *Pseudoactinoporella fragilis* n. gen. n. sp. – CONRAD, Pl. I, Fig. 4
- 1970 *Actinoporella podolica* ALTH. – BOUROULLEC & DELOFFRE, Pl. 2.c, Fig. 18
- 1972 *Pseudoactinoporella fragilis* CONRAD. – FOURCADE et al., 240, Pl. 3, Figs. 7–9
- 1973 *Triploporella* sp. – SRIVASTAVA, 702, Text-Fig. 21
- 1974 *Pseudoactinoporella fragilis* CONRAD. – CANEROT, Pl. XVII, Fig. 2
- 1974 ? *Actinoporella* sp. – CANEROT, Pl. XXIV, Figs. 12–13

1976 *Pseudoactinoporella fragilis* CONRAD. – KAME-NICKY et al., Pl. 22, Figs. 3–4
 1976 *Pseudoactinoporella fragilis* CONRAD. – MASSE, 189, Pl. 6, Fig. 6
 1976 *Pseudoactinoporella fragilis* CONRAD. – PEYBERNES, Pl. XXIV, Figs. 2–3
 1976 *Pseudoactinoporella fragilis* CONRAD, emend. – CONRAD & PEYBERNES, 188, Text-Figs. 12. a–b, 12.d (from CONRAD, 1970, Text-Fig. 4) & 12, e–f
 1976 (non) *Pseudoactinoporella* ? sp. aff. *fragilis* CONRAD, emend. – CONRAD & PEYBERNES, 188, Text-Fig. 12.c
 1978 *Pseudoactinoporella fragilis* CONRAD. – GARCIA HERNANDEZ, 218, Pl. XXVIII, Figs. 1 & 6;
 1978 “Forma proxima a *Pseudoactinoporella*” – GARCIA HERNANDEZ, Pl. XXVIII, Fig. 13
 1978 *Pseudoactinoporella fragilis* CONRAD. – BAS-SOULLET et al., 212–213, Pl. 25, Figs. 6 (from CONRAD, 1970, Text-Fig. 4), 7 (from CONRAD, 1970, Pl. I, Fig. 1) & 8 (from FOURCADE et al., 1972, Pl. 3, Fig. 9)
 1979 *Pseudoactinoporella fragilis* CONRAD. – AZEMA et al., Pl. XXXI, Fig. 5 (from GARCIA HERNANDEZ, 1978, Pl. XXVIII, Fig. 6)
 1979 *Pseudoactinoporella fragilis* CONRAD. – PEYBERNES et al., Pl. 3, Fig. 7
 1980 *Pseudoactinoporella fragilis* CONRAD. – ARNAUD-VANNEAU, Pl. 111, Figs. 1–2
 1981 *Pseudoactinoporella fragilis* CONRAD. – JAFFREZO, 331–332, Pl. XII, Figs. 1 (from FOURCADE et al., 1972, Pl. 3, Fig. 9) & 2
 1982 *Pseudoactinoporella fragilis* CONRAD. – JAFFREZO et al., 769, Pl. 1, Figs. 8 & 11
 1988 *Pseudoactinoporella fragilis* CONRAD. – DELOFFRE, Pl. 8, Figs. 20 (from FOURCADE et al., 1972, Pl. 3, Fig. 9) & 21 (from CONRAD, 1970, Text-Fig. 4)
 1989 *Pseudoactinoporella fragilis* CONRAD. – CONRAD & MASSE, 283, Pl. II, Fig. 8
 1993 *Pseudoactinoporella fragilis* CONRAD. – MASSE, Pl. 2, Fig. 15
 1993 *Pseudoactinoporella fragilis* CONRAD. – SOTAK & MISIK, Pl. 3, Fig. 1–11.

Falsolikanella GRANIER, 1987; further investigations are required:

Actinoporella ?silvaeregis BUCUR, 1981, n. comb. (= *Pseudoactinoporella silvaeregis* BUCUR, 1981, Revue Roum. Géol., Géophys. Géogr., 25:151–153, Bucharest).
 1981 *Pseudoactinoporella silvaeregis* n. sp. – BUCUR, 151–153, Pl. I, Figs. 1, 3 & 6; Pl. II, Figs. 1–4 (holotype: Pl. I, Fig. 1, thin section N.I. 1051 (sample 48E), University of Cluj-Napoca, Romania; paratypes: Pl. I, Figs. 3 & 6; Pl. II, Figs. 1–4)
 1981 (non) *Pseudoactinoporella silvaeregis* n. sp. – BUCUR, 151–153, Pl. I, Figs. 2 & 4–5; Pl. II, Fig. 5 (paratypes: Pl. I, Figs. 2 & 4–5; Pl. II, Fig. 5)
 1985 *Pseudoactinoporella silvaeregis* BUCUR. – BUCUR, Pl. IV, Fig. 1
 1993 *Pseudoactinoporella silvaeregis* BUCUR. – BUCUR, 450–451, Pl. III, Figs. 1–11.

4. A word on phylogeny

As already pointed out by VALET (1969), then by CONRAD et al. (1974), representatives of the genus *Actinoporella* (GÜMBEL in ALTH, 1881) present some affinities with the modern Acetabulariaceae, and more precisely with *Acetabularia* (LAMOUROUX, 1812) (Pl. 4, Figs. 1–2 & 4–10) and *Polyphysa* (LAMOUROUX, 1816). These two modern genera are characterized by bearing at the stipe extremity one or a few whorls of fertile branches (with cysts) with respectively upper and lower corona or upper corona only; the other verticillated branches are regularly arranged along the stipe being sterile and deciduous hairs (Fig. 1). According to GÉNOT (1987), the *Acetabularia*–*Polyphysa* group includes very few genuine fossil representatives: *Acetabularia chianovica* SQUINABOL, 1902, from Oligocene strata, and possibly *Acicularia andrussowi* SOLMS-LAUBACH, 1895, and *Acicularia transylvana* BANYAI & L. & J. MORELLET, 1936, from Miocene localities; these fossil specimens are found in the form of isolated discs or groups of rays, but no calcified main stem has been found up to now.

Actinoporella is known from the Late Jurassic up to the Paleocene (Table 1) while the *Acetabularia*–*Polyphysa* group starts (at least) in Oligocene times. At first sight,

Provisionally, the species *Pseudoactinoporella silvaeregis* BUCUR, 1981, is attributed to the genus *Actinoporella* (GÜMBEL in ALTH, 1881) too. However, in my opinion, it should possibly be ascribed to the genus

SYSTEM	JURASSIC										CRETACEOUS					PALEOGENE													
	LIAS				DOGGER			MALM	NEOC.		SENONIAN			PAL.	EOCENE		OLI.												
	H	SI	PL	TO	A	BAJ	BA	CA	OX	KI	PO	BE	VA	HA	B	APT	ALBI	CE	T	S	CAMP	MA	DA	TH	YP	LU	B	P	R

Actinoporella

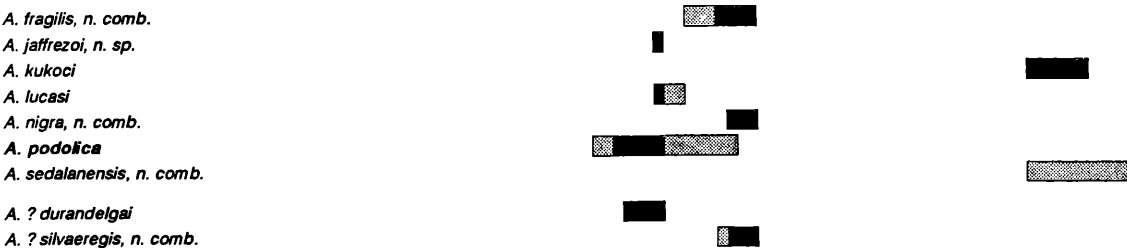


Table 1: Stratigraphic distribution of the *Actinoporella* species quoted in this article.

their stratigraphic ranges do not overlap but it must be borne in mind that the form-genus *Acicularia* ARCHIAC, 1843 (Pl. 4, Fig. 3), should correspond to fossil remains of the *Acetabularia-Polyphysa* group (GÉNOT, 1987); the genuine *Acicularia* forms are known at least from the Late Cretaceous (Many of the older so-called *Acicularia* sp. should be ascribed to the form-genus *Terquemella* MURNIER-CHALMAS ex L. & J. MORELLET, 1913, i. e. to dasycladacean and not to acetabulariacean remains). As a consequence, a phylogenetical relationship can be considered between *Actinoporella* ancestors and *Acetabularia-Polyphysa* descendants.

5. Conclusion

In conclusion, the genus *Actinoporella* (GÜMBEL in ALTH, 1881) as amended herein includes at least 7 representatives which range from the Late Jurassic to the Paleocene with a significative gap corresponding to the Late Cretaceous.

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6. References

- ALTH, A. von, 1878. O Galicyjskich gatunkach skamieniałych otwornic rodzaju *Gyroporella* GÜMBEL. — Rozprawy i sprawozdania z posiedzen wydziału matematyczno-przyrodniczego, **V**:71–112, Krakow.
- ALTH, A. von, 1881. Die Versteinerungen des Nizniower Kalksteines. — Beitr. Paläontol. Österreich-Ungarns, **I**:183–332, Vienna.
- ARNAUD-VANNEAU, A., 1980. Micropaléontologie, paléocologie et sédimentologie d'une plate-forme carbonatée de la marge passive de la Téthys: l'Urgonien du Vercors septentrional et de la Chartreuse (Alpes occidentales). — Thèse Doct. Sci. nat., Géol. alpine, Mém., **11/1-3**:1–874, Grenoble.
- AZEMA, J., FOUCALT, A. FOURCADE, E., GARCIA HERNANDEZ, M., GONZALEA DONOSO, J.M., LINARES, A., LINARES, D., LOPEZ GARRIDO, A.C., RIVAS, P. & VERA, J.A., 1979. Las microfácies del Jurásico y Cretácico de las zonas externas de las Cordilleras Béticas. — 1–83, Granada (Universidad de Granada).
- BANYAI, J. & MORELLET, J. & L., 1936. Deux Acétabulariacées nouvelles du Sarmatien de Transylvanie. — Bull. Sect. sci. Acad. Roum., **16**:168–172, Bucharest.
- BASSOULLET, J.-P., BERNIER, P., CONRAD, M.A., DELOFFRE, R. & JAFFREZO, M., 1978. Les algues Dasycladales du Jurassique et du Crétacé. — Géobios, Mém. spéc., **2**:1–330, Lyon.
- BERGER, S. & KAEVER, M.J., 1992. Dasycladales. An illustrated monograph of a fascinating algal order. — 247 pp., Stuttgart (Georg Thieme Verlag).
- BOUROULLEC, J. & DELOFFRE, R., 1968. Les algues du Néocomien d'Aquitaine. — Bull. Centre Rech. Pau-SNPA, **2/2**:213–261, Pau.
- BOUROULLEC, J. & DELOFFRE, R., 1970. Interprétation sédimentologique et paléogéographique, par microfaciès, du Crétacé inférieur basal d'Aquitaine Sud-Ouest. — Bull. Centre Rech. Pau-SNPA, **4/2**:381–429, Pau.
- BUCUR, I.I., 1981. *Pseudoactinoporella silvaeregis* n. sp. in the Lower Cretaceous limestones from Padurea Craiului (Apuseni Mountains). Revue Roum. — Géol., Géophys. Géogr., **25**:151–153, Bucharest.
- BUCUR, I.I., 1985. A new dasycladacean alga in the Urgonian limestones from Padurea Craiului (Apuseni Mountains): *Salpingopoporella patrulei* n. sp. in the Lower Cretaceous limestones. Revue Roum. Géol., Géophys. Géogr., **29**:81–84, Bucharest.
- BUCUR, I.I., 1993. Revised description of some dasyclad species from the Romanian Lower Cretaceous. — Rev. Paléobiol., **11/2**(1992):447–461, Geneva.
- CANEROT, J., 1974. Recherches géologiques aux confins des chaînes ibériques et catalanes. — Thèse Doct. Sci. nat., Univ. P. Sabatier, Toulouse, (5), **4**:1–517, Madrid (Enadimsa).
- CONRAD, M.A., 1970. Barremian and Lower Aptian Dasycladaceae in the area surrounding Geneva (Switzerland). — Geol. Rom., **IX**:63–99, Rome.
- CONRAD, M.A. & MASSE, J.-P., 1989. Les algues calcaires des formations carbonatées de l'Hauterivien-Barrémien *pro parte* du Jura vaudois et neuchâtelois (Suisse). — Mém. Soc. neuchâteloise Sci. nat., **XI**:277–290, Neuchâtel.
- CONRAD, M.A. & PEYBERNES, B., 1976. Hauterivian-Albian Dasycladaceae from the Urgonian limestones in the French and Spanish eastern Pyrenees. — Geol. Rom., **XV**:175–197, Rome.
- CONRAD, M.A. & PEYBERNES, B., 1978. Sur quelques Dasycladales de l'Urgo-Aptien du Prébalkan bulgare. — C.R. des Séances, SPHN Genève, (NS), **12/2-3**(1977):69–83, Geneva.
- DELOFFRE, R., 1988. Nouvelle taxonomie des algues Dasycladales. — Bull. Centres Rech. Explor. – Prod. Elf-Aquitaine, **12/1**:165–217, Pau.
- DELOFFRE, R. & GENOT, P., 1982. Les algues Dasycladales du Cénozoïque. — Bull. Centres Rech. Explor. – Prod. Elf-Aquitaine, Mém., **4**:1–247, Pau.
- DELOFFRE, R. & GRANIER, B., 1993. Inventaire critique des algues Dasycladales fossiles. I^o partie – Les algues Dasycladales du Tertiaire. — Rev. Paléobiol., **11/2**(1992):331–356, Geneva.

- DETRAZ, H. & MOJON, P.-O., 1989. Evolution paléogéographique de la marge jurassienne de la Téthys du Tithonique-portlandien au Valanginien: corrélations biostratigraphique et séquentielle des faciès marins à continentaux. — *Eclogae Geol. Helv.*, **82/1**:37–112, Basel.
- ELLIOTT, G.F., 1978. A new dasycladacean alga from the Palaeocene of Kurdistan. — *Palaeontology*, **21/3**: 687–691, London.
- EMBERGER, J., 1956. Les Clypéines (algues siphonnées verticillées) des Monts des Oulad-Naâl, Atlas saharien, Algérie. — *Bull. Soc. géol. Fr.*, (6), **V/7–9** (1955):543–552, Paris.
- FOURCADE, E., JEREZ, L., RODRIGUEZ, T. & JAFFREZO, M., 1972. El Jurasico terminal y el Cretacico inferior de la Sierra de la Muela (provincia de Murcia). Consideraciones sobre las biozonas con foraminiferos del Albense-Aptense del Sureste de España. — *Rev. Españ. Micropaleontol.*, Num. Extr.: 215–248, Madrid.
- GARCIA HERNANDEZ, M., 1978. El Jurasico terminal y el Cretacico inferior en las sierras de Cazorla y del Segura (Zona prebetica). — Tesis doct. Univ. Granada, **190**:1–344, Granada.
- GÉNOT, P., 1987. Les Chlorophycées calcaires du Paléogène d'Europe nord-occidentale (Bassin de Paris, Bretagne, Cotentin, Bassin de Mons). — Thèse Doct. Etat, Univ. Nantes, **I**:1–500, **II**:1–48, Nantes.
- GRANIER, B., 1987. Révision de *Likanella campanensis* Azéma et Jaffrezo, 1972, Algues Dasycladacée du Crétacé inférieur du Sud-Est de l'Espagne. — *Rev. Paléobiol.*, **6/2**:207–212, Genève.
- GRANIER, B., 1992. Les algues et foraminifères benthiques du Jurassique supérieur et du Crétacé inférieur du Sénégal. — *J. Afr. Earth Sci.*, **14/2**:239–253, Oxford.
- GRANIER, B. & BRUN, R., 1991. *Cylindroporella cruciformis* et *Holosporella arabica*, deux dasycladacées nouvelles du Groupe Thamama, (? Portlandien-) Berriasien-Aptien d'Abu Dhabi, Emirats Arabes Unis. — *Cretaceous Research*, **12**:403–410, London.
- GRANIER, B. & DELOFFRE, R., 1994. Inventaire critique des algues Dasycladales fossiles. II^e partie – Les algues Dasycladales du Jurassique et du Crétacé. — *Rev. Paléobiol.*, **12/1**(1993):19–65, Geneva.
- JAFFREZO, M., 1973. Les algues calcaires du Jurassique supérieur et du Crétacé inférieur des Corbières. Première partie. — *Rev. Micropaléontol.*, **16/2**:75–88, Paris.
- JAFFREZO, M., 1981. Les formations carbonatées des Corbières (France) du Dogger à l'Aptien: micropaléontologie stratigraphique, biozonation, paléoécologie, extension des résultats à la Mésogée. — Thèse Doct. Sci. nat., Univ. P. & M. Curie, 1–614, Paris.
- JAFFREZO, M., KOTETICHVILI, E. & TSIREKIDZE, L., 1982. Algues Dasycladales des faciès urgoniens de la R.S.S. de Géorgie (Caucase). — *Géobios*, **15/5**:765–773, Lyon.
- KAMENICKY, L., MARSCHALCO, R. & MISIK, M., 1976. Petrographie der Flysch-Konglomerate und Rekonstruktion ihrer Ursprungszonen (Paläozen der Klippenzone und der angrenzenden tektonischen Einheiten der Ostslowakien). — *Zapadn. Karpaty, Geol.*, **1**:7–124, Bratislava.
- LAMOUREUX, J.V., 1812. — *Nouv. Bull. Sci. Soc. Philom.* **3**:1–185, Paris.
- LAMOUREUX, J.V. 1816. Histoire des Polypiers coralligènes flexibles, vulgairement nommés Zoophytes. Poisson, 1–559, Caen.
- MASLOV, V.P., 1958. New discoveries of algae in the Jurassic of Crimea. — *Doklady Akademii Nauk SSSR*, **121/2**:354–357, Moscow.
- MASSE, J.-P., 1976. Les calcaires urgoniens de Provence. Valanginien – Aptien. Stratigraphie, paléontologie, les paléoenvironnements et leur évolution. — Thèse Doct. Sci., Univ. Aix-Marseille II, 1–445, Marseille.
- MASSE, J.-P., 1993. Early Cretaceous Dasycladales biostratigraphy from Provence and adjacent regions (South of France, Switzerland, Spain). A reference for Mesogean correlations. [in:] BARATTOLO, F., DE CASTRO, P. & PARENTE, M. (eds): *Studies on Fossil Benthic Algae*. — *Boll. Soc. Paleont. Ital., Spec. Vol.*, **1**:311–324, Modena.
- PIA, J. von, 1936. Calcareous green algae from the Cretaceous of Tripoli (North Africa). — *J. Paleontol.*, **10**/1:3–13, Menasha.
- PEYBERNES, B., 1976. Le Jurassique et le Crétacé inférieur des Pyrénées franco-espagnoles entre la Garonne et la Méditerranée. Thèse Doct. Sci. nat., Univ. P. Sabatier, 1–459, (C.R.D.P.), Toulouse.
- PEYBERNES, B., CONRAD, M.A. & CUGNY, P., 1979. Contribution à l'étude biostratigraphique, micropaléontologique et paléoécologique des calcaires urgoniens du Barrémo-Bédoulien bulgare (Prébalkan et plate-forme moésienne). — *Rev. Micropaléontol.*, **21/4**:181–199, Paris.
- PRATURLON, A., 1964. Calcareous algae from Jurassic-Cretaceous limestone of Central Apennines (Southern Latium – Abruzzi). — *Geol. Rom.*, **III**:171–202, Rome.
- RADOICIC, R., 1969. Jurske i kredne dazikladacee istocne Srbije (Dasycladacées jurassiques et crétacées de la Serbie orientale. Jurassic and Cretaceous dasycladaceans of eastern Serbia). — *Zavod Geol. Geofiz. Istraz.*, *Vesnik*, (A), **XXVII**:177–190 & 193–220, Belgrade.
- RADOICIC, R., 1974. A new Palaeocene *Actinoporella* (Dasycladaceae) (A preliminary report). — *Bull. sci., Conseil Acad. RSF Yougoslavie*, (A), **19/9–10**:1, Zagreb.
- RADOICIC, R., 1975. *Linoporella buseri* sp. n. from the Liassic of the Julian Alps (A preliminary report). — *Bull. sci., Conseil Acad. RSF Yougoslavie*, (A), **20**(9–10):277–278, Zagreb.
- RAINERI, R., 1922. Alghe sifonee fossili della Libia. — *Atti Soc. Ital. Sci. nat. Mus. civ. Stor. nat. Milano*, **LXI**:72–86, Milano.
- RAVIV, V. & LORCH, J., 1970. *Verticilloporella*, a new Mesozoic genus of Dasycladaceae, with discussion on *Munieria* and *Actinoporella*. — *Israel J. Bot.*, **19**:225–235, Jerusalem.

- RAVIV, V. & LORCH, J., 1992. Mesozoic Dasycladaceae (*Chlorophyceae*) from Israel. — Israel J. Bot., **41/1**:1–54, Jerusalem.
- SOLMS-LAUBACH, H., 1895. Monograph of the Acetabularieae. — Trans. Linnean Soc. London, (2), **V/I**:1–39, London.
- SOTAK, J. & MISIK, M., 1993. Jurassic and Lower Cretaceous dasycladalean Algae from the Western Carpathians. [in:] BARATTOLO, F., DE CASTRO, P. & PARENTE, M. (eds). Studies on Fossil Benthic Algae. — Boll. Soc. Paleont. Ital., Spec. Vol., **1**:383–404, Modena.
- SQUINABOL, S., 1902. Di una specie fossile di *Acetabularia*. — Atti Mem. R. Acad. Sci. Lett. Art. Padova, **18/3**:151–155, Padova.
- SRIVASTAVA, N.K., 1973. Neocomian calcareous algae from Bolshoi Balkhan, U.R.S.S. — N. Jb. Geol. Pal., Mh., **11**:690–708, Stuttgart.
- VALET, G., 1969. Contribution à l'étude des Dasycladales. 2—Cytologie et reproduction. 3—Révision systématique. — Nova Hedwigia, **XVII**:551–644, Lehre.

PLATE 1

- Figs. 1, 4 & 8–10. Isolated whorls of *Actinoporella podolica* (ALTH, 1878). – Lavans-lès-Saint-Claude section (DETRAZ & MOJON, 1989), Purbeckian (Lower Berriasian), Sample LV 9. Figs. 1 & 9: x116; Figs. 4, 8 & 10: x 58.
- Figs. 2–3, 5 & 7. *Clypeina sulcata* (ALTH, 1881). – Lavans-lès-Saint-Claude section (DETRAZ & MOJON, 1989), Purbeckian (Lower Berriasian), Sample LV 9. Figs. 2–3 & 7. Isolated whorls: x 58. Fig. 5. Two successive whorls: x 58.
- Fig. 6. Isolated whorl of *Clypeina sulcata* (ALTH, 1881). – Vuache Mt. section (DETRAZ & MOJON, 1989), Purbeckian (Lower Berriasian), Sample V 260: x 39.

PLATE 1

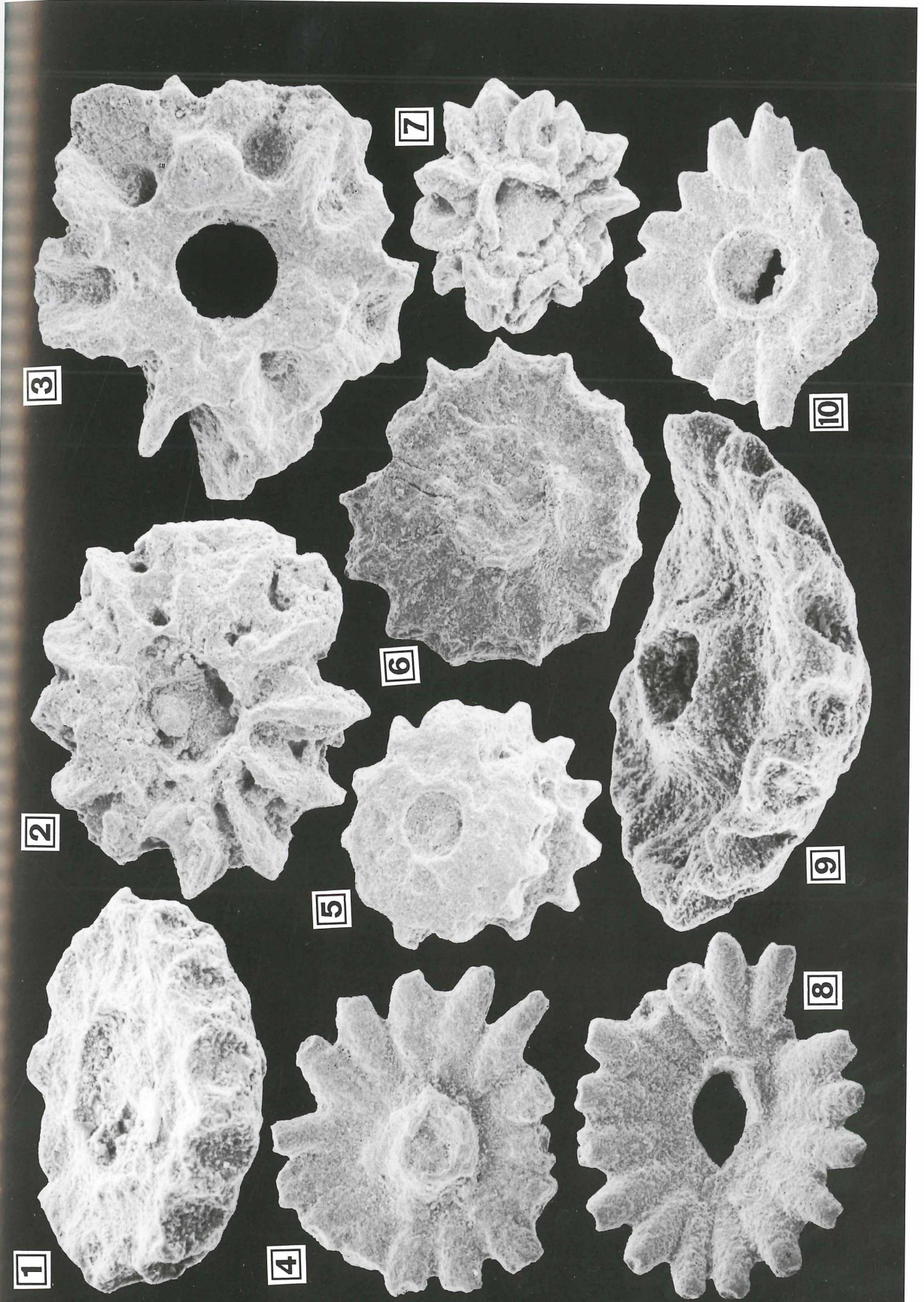


PLATE 2

Figs. 1–8. *Actinoporella jaffrezoi* n. sp. Maitérie-Haute section (JAFFREZO, 1981), “Calcaires rouxI” Formation (Lower Valanginian), Sample 35L, thin section FSL 411.600 (registered at the Office National de Gestion des Collections Paléontologiques, Villeurbanne, France).

Fig. 1. Holotype, oblique section through two whorls, note the vestibule followed by a phloiophorous secondary open pore on one side and a very short lateral closed pore on the opposite side (arrows): x 63.

Fig. 2. Oblique section through two whorls: x 63.

Figs. 3–4. Oblique sections through one whorl: x 63.

Fig. 5. Transverse (slightly oblique) section of one whorl: x 63.

Fig. 6. Oblique section through one whorl: x 63.

Fig. 7. Oblique section through two whorls: x 40.

Fig. 8. Various sections of isolated whorls: x 40.

PLATE 2

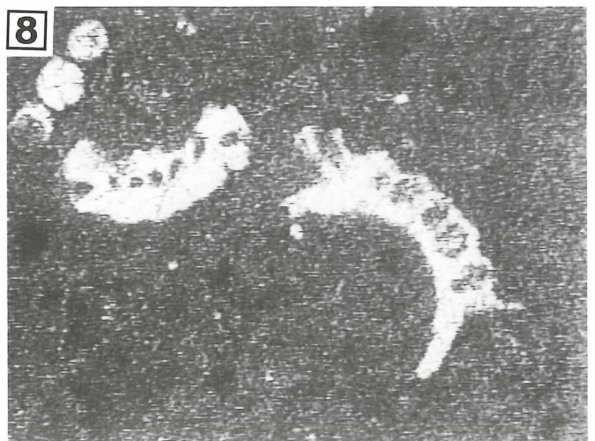
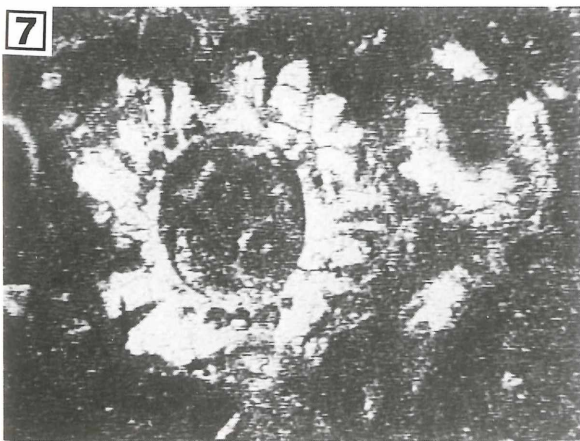
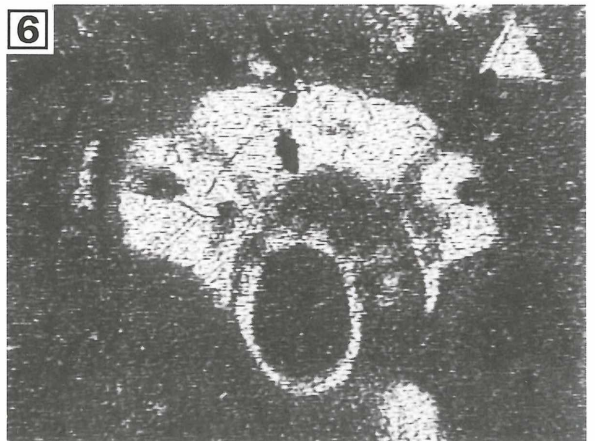
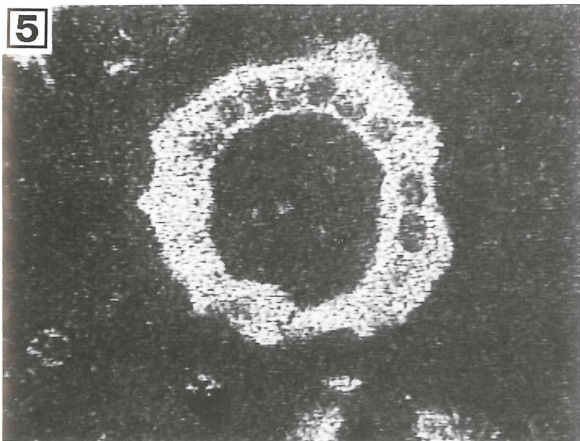
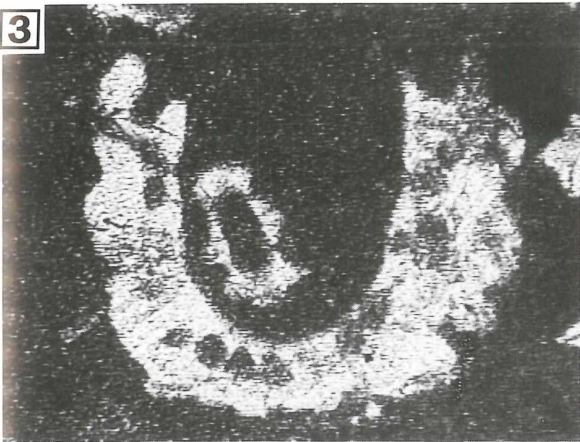
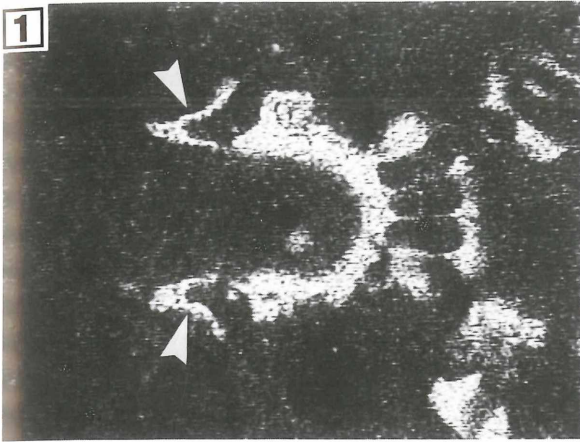


PLATE 3

- Fig. 1. Subaxial section through three successive whorls of *Actinoporella nigra* CONRAD & PEYBERNES, 1978, n. comb., emend.; an “excrescence” can be seen on one side (arrows); on the opposite side, the calcification (micritic) is less extensive and the pore was possibly open at this place. – Province of Valencia, Urgonian (Lower Aptian), Sample FOURCADE G.1280: x 116.
- Figs. 2–4. Transverse sections through a whorl of *Actinoporella nigra* CONRAD & PEYBERNES, 1978, n. comb., emend. – Pré de Gève-Achard section (ARNAUD-VANNEAU, 1980), Urgonian (Lower Aptian), Sample ID 269, ID 270 & ? (Fig. 2: from ARNAUD-VANNEAU, 1980, Pl. 112, Fig. 2; Fig. 3: from ARNAUD-VANNEAU, 1980, Pl. 112, Fig. 3): x 50.
- Figs. 5–8. *Actinoporella podolica* (ALTH, 1878) with its original aragonite sheath. – Sarajevo, Bosnia–Herzegovina, Lowermost Cretaceous, Sample MASSE 12071.
- Fig. 5. Oblique and axial sections: x 25.
- Fig. 6. Deep tangential section illustrating the “excrescences” (corona structure): x 63.
- Fig. 7. Oblique section through three (?) successive whorls: x 25.
- Fig. 8. Close up of Figure 7 (the occurrence of cysts within the branches is questionable): x 100.

PLATE 3

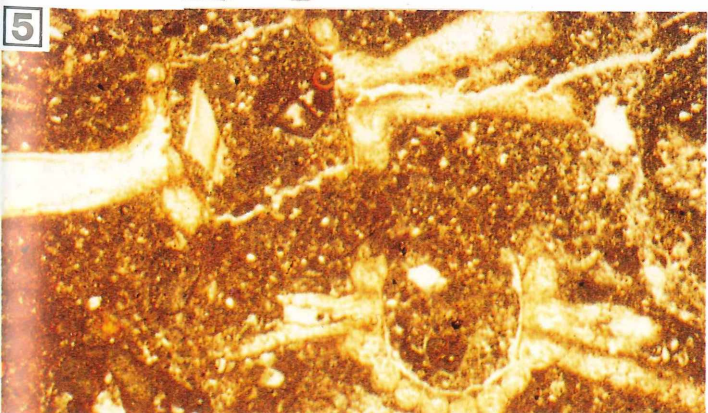
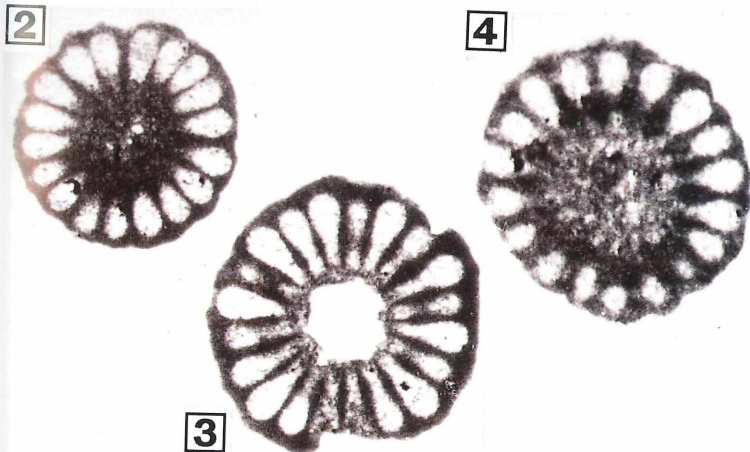
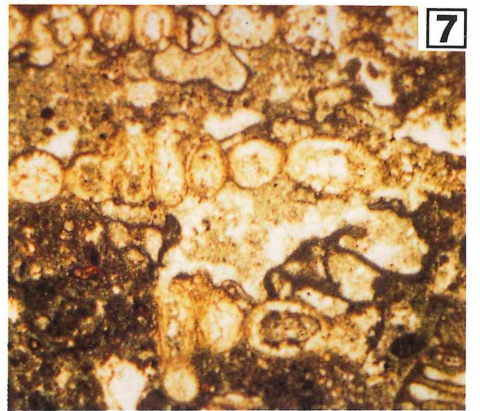


PLATE 4

Figs. 1–2 & 4–10. *Acetabularia* sp. – Abu Dhabi onshore, Holocene, Samples ABA 127.

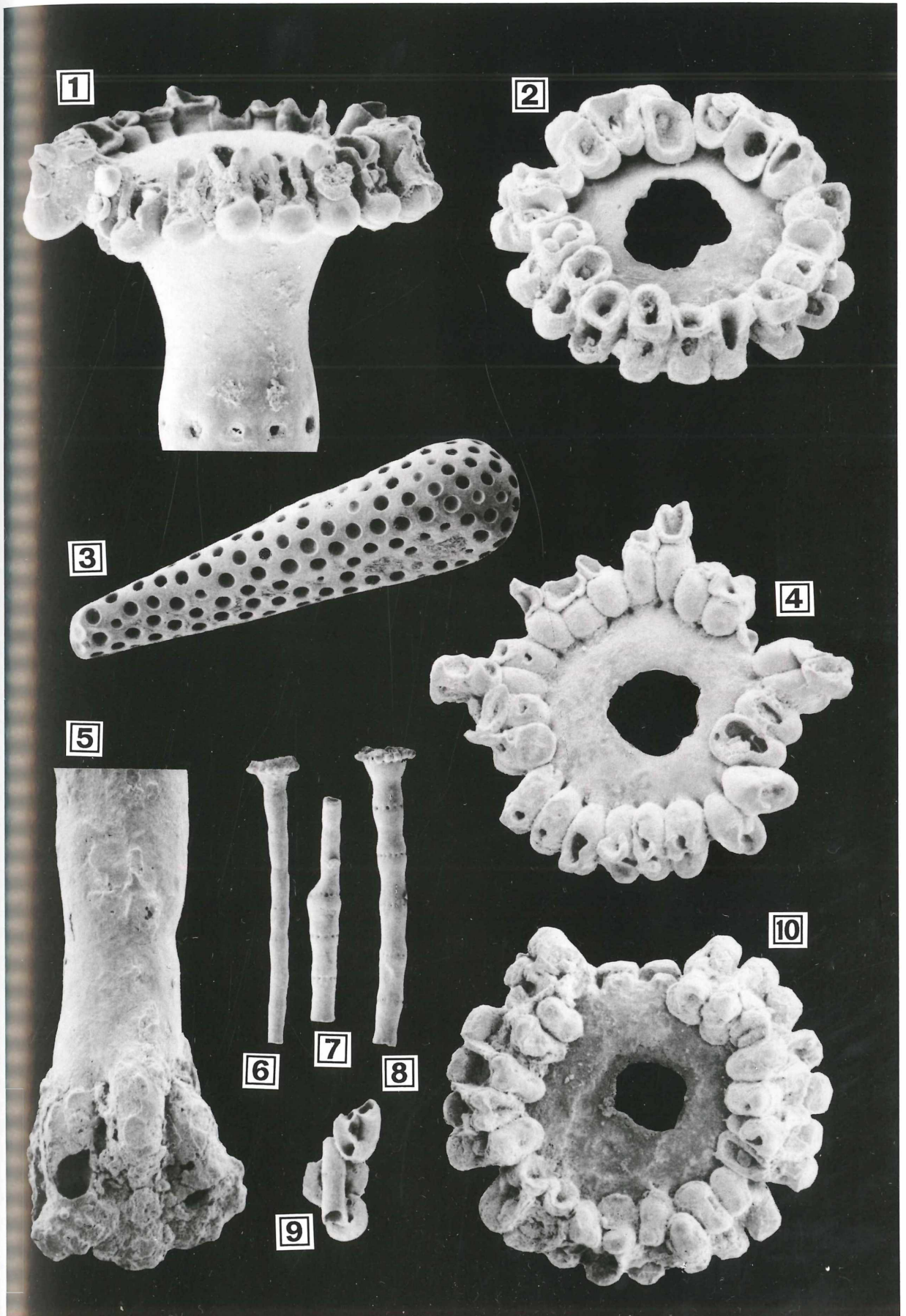
View of the cap with corona structures. Figs. 1–2 & 10: x 80; Fig. 4: x 68;

Fig. 5. Anchor organ, calcified: x 80.

Figs. 6–9. Part of the main axis calcified with scars of sterile whorls; two specimens bear cap rays (Figs. 6 & 8); one specimen is encrusted by a *Spirorbis* sp. (Fig. 9): x 12.

Fig. 3. *Acicularia* sp. (organo-species). – Abu Dhabi offshore, Holocene: x 80.

PLATE 4



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