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Remarks on *Neomeris circularis* BADVE & NAYAK, 1983 (Calcareous Alga, Dasycladacea)

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7 Text-Figures, 2 Tables, 1 Plate

Nördliche Kalkalpen
Gosau-Schichtgruppe
Oberkreide
Kalkalgen
Systematik
Stratigraphie
Fazies

Österreichische Karte 1 : 50.000
Blatt 37

Contents

Bemerkungen über *Neomeris circularis* BADVE & NAYAK, 1983 (Kalkalge, Dasycladaceae)

Zusammenfassung

Die Kalkalge (Dasycladaceae) *Neomeris circularis* BADVE & NAYAK aus dem Cenoman (?) von Indien, wurde anhand eines einzigen Bruchstückes aufgestellt. Reichhaltiges und relativ gut erhaltenes Material aus dem Turon–Coniac der Gosau-Schichtgruppe des Sonnwendgebirges/Österreich erlaubt eine detaillierte biomorphologische Studie, welche die Eigenständigkeit der Art belegt. Neben einer emendierten Artdiagnose werden Anmerkungen zur stratigraphischen, palökologischen und paläobiogeographischen Bedeutung gemacht.

Abstract

The dasycladacean alga *Neomeris circularis* BADVE & NAYAK from the Cenomanian ? of India has been established on the basis of one single fragment. Abundant and fairly well-preserved specimens from the Turonian-Coniacian Gosau Formation of the Sonnwend Mountains/Austria allow us to carry out a detailed biomorphological study revealing species individuality. An emended species diagnosis is supplied and remarks on stratigraphical, paleoecological and paleobiogeographical significance are presented.

1. Introduction

In 1983, BADVE & NAYAK described several species of calcareous algae from the Cenomanian (?) Nimar Sandstone of Madhya Pradesh/India introducing besides others *Neomeris circularis* n.sp. The original description, based on one single fragment, was given as follows:

> *"There is a small fragment of ring containing sporangia which are situated at equal distance and distinctly circular in outline".*

The latter feature has been considered to represent the specific criterion since other Cretaceous representatives

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of *Neomeris* display bottle-shaped to ovoid sporangia (or fertile ampullae). Accordingly, biometrical parameters essential for specific characterization such as diameter of calcareous skeleton and axial cavity, number of fertile ampullae per segment (and others) as well as their ranges of variability are not available for comparison purposes. Moreover, the position of the secondary branches with regard to the fertile ampullae, as discernible in tangential sections, needs to be deciphered for subgeneric ranking of *Neomeris* (DELOFFRE, 1970; GENOT, 1980; RADOICIC, 1984). Representing a poorly defined taxon, *N. circularis* has been included in the general table of species in the recent critical revision of Jurassic-Cretaceous dasycladacean algae by GRANIER & DELOFFRE (1993).

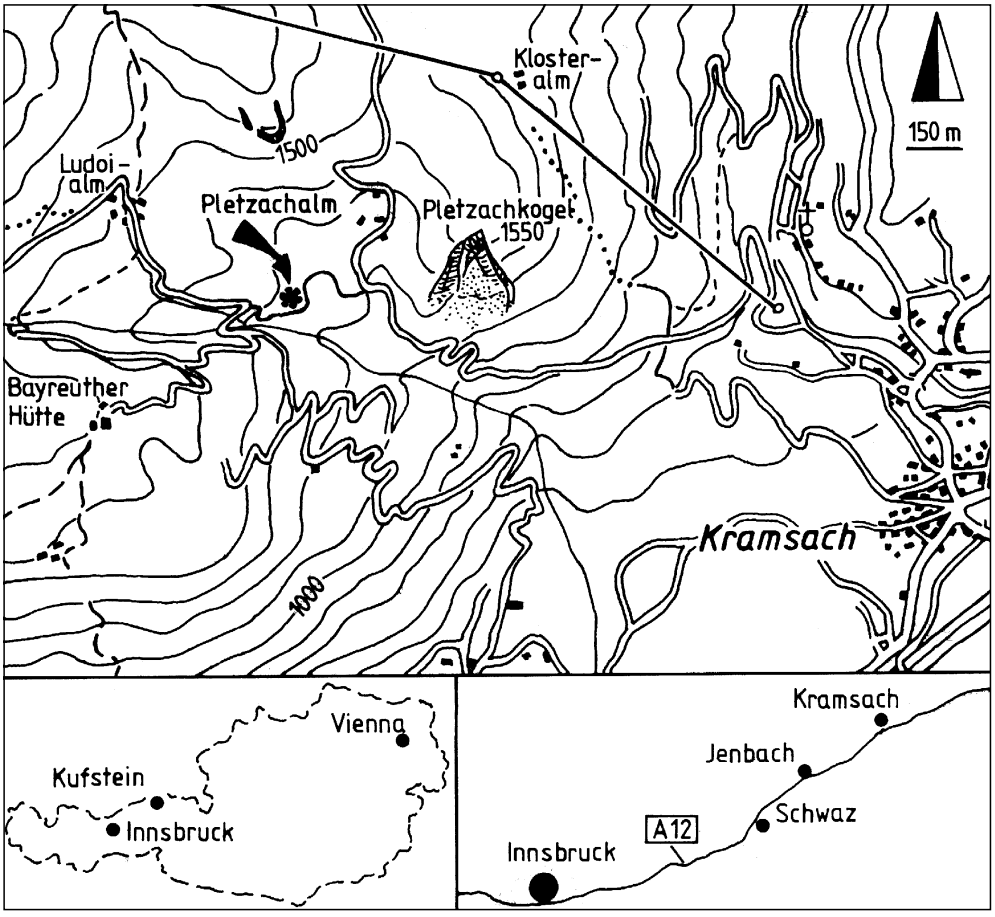
In the Northern Calcareous Alps Upper Cretaceous dasycladacean algae are reported from carbonate to mixed siliciclastic horizons within the transgressive sedimentary cycles of the Branderfleck Formation (Cenomanian–Coniacian) and Gosau Formation (Turonian–Santonian) (SCHLAGINTWEIT, 1993). An interesting sequence of the Gosau Formation is exposed in the Sonnwend Mountains/ Austria in the vicinity of the Pletzachalm. Since the biostratigraphic data of the section in question are up to now insufficient for the establishment of a detailed stratigraphic succession, it has thoroughly been reinvestigated (SCHLAGINTWEIT & EBLI in prep.). In the framework of this study abundant and well-preserved specimens of *Neomeris* assigned to *Neomeris circularis* BADVE & NAYAK have been yielded, enabling a detailed biomorphological study.

2. Geological Setting

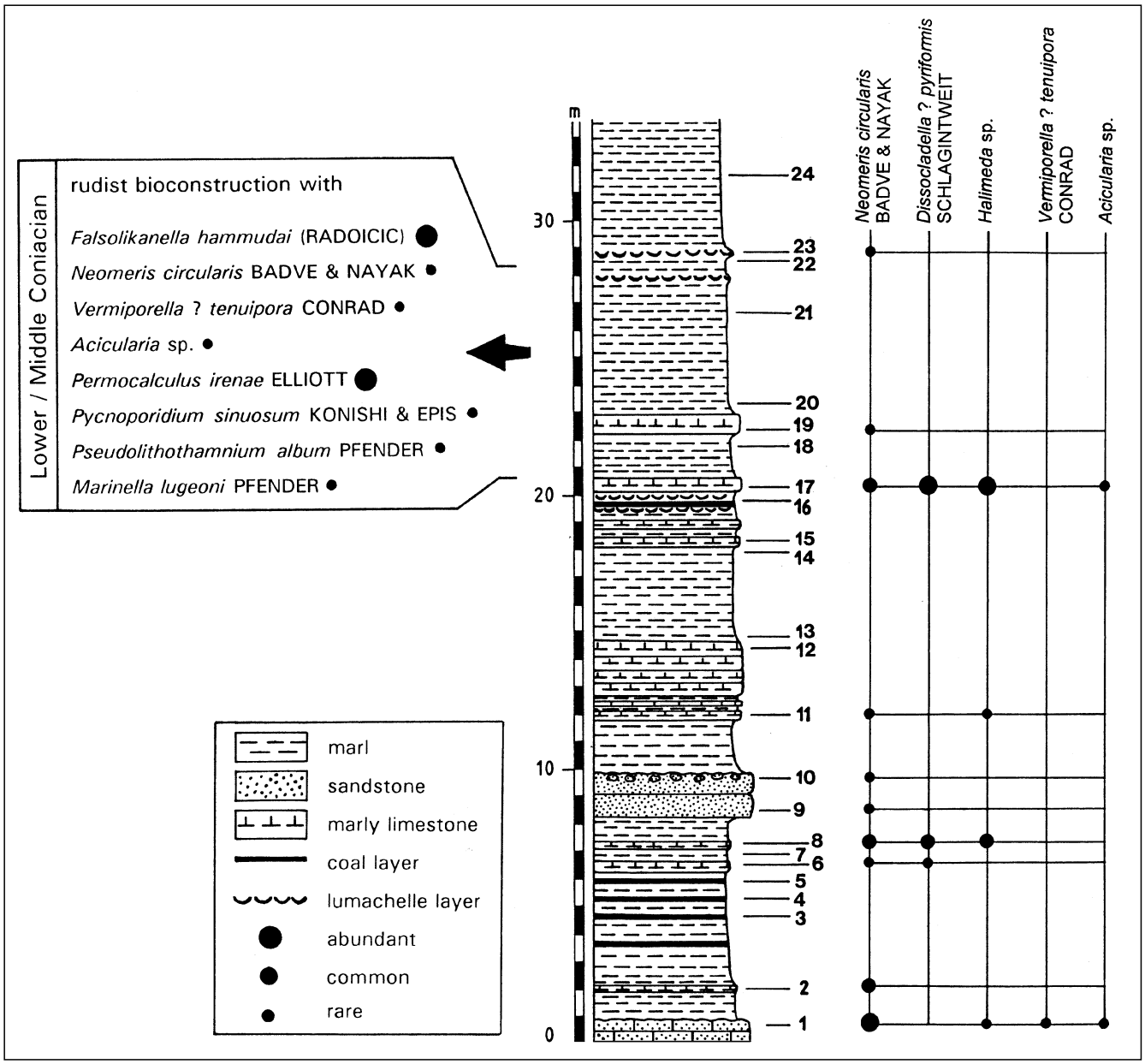
In the Sonnwend Mountains of Tyrol, there are some smaller outcrops of Upper Cretaceous Gosau Formation resting unconformably upon carstified Upper Triassic rocks. The section studied (total thickness about 35 m) is situated along the road from the Ludoialm to the Pletzachalm at about 1280 m above sea-level (Text-Fig. 1). Owing to the rich macrofauna this locality has been mentioned in literature already since the end of the last century (KLIPPSTEIN, 1885). An accurate geological description of the sequence has been provided for the first time by LEISS (1988), already noting the occurrence of chlorophycean algae (without specific determinations) in his samples. Later the calcareous algae, predominantly linked to the rudistid limestones have been treated by SCHLAGINTWEIT (1990, 91a, 93).

The base of the outcrop section (Sample no. 1, Text-Fig. 2) consists of a mixed siliciclastic-carbonate bank (thickness about 70 cm), the uppermost part of which contains abundant thalli of *Neomeris circularis* BADVE & NAYAK already discernible in the field (Pl. 1, Fig. 3). Apart from remains of gastropods and ostracods, *N. circularis* is associated with remains of the udoteacean alga *Halimeda* sp., *Vermiporella* ? *tenuipora* CONRAD, *Acicularia* sp. and the benthic foraminifera *Cuneolina* sp., textulariids, miliolids and *Rheopax* sp. To note is, that some of the fertile ampullae of *Neomeris circularis* are partly filled with pyrite (Pl. 1, Fig. 9). Depending on the amount of larger bioclasts a wackestone to floatstone texture is prevailing (Pl. 1, Fig. 1).

The bank is followed by dark argillaceous marls with gastropods and coal layers. Important to mention is the occurrence of one sandstone bed (thickness about 180 cm) which is quite resistant against erosion in comparison to the enclosing marls („Sandsteinleitbank" of LEISS, 1988). Reworking structures in the uppermost part of the bank (intraformational clasts) and the presence of planctonic foraminifera (e.g. *Marginotruncana pseudolinneiana* PESSAGNO) indicate a storm-generated origin (tempestite). The middle part of the profile comprises fossiliferous marls with gastropods and bivalves and intercalated banks of marly limestones. These contain a dasycladacean-udoteacean assemblage with *Dissocladella* ? *pyriformis* SCHLAGINTWEIT, *Neomeris circularis* BADVE & NAYAK and *Halimeda* species. The microfauna is dominated by miliolids, the most typical being *Vidalina hispanica* SCHLUMBERGER. Washing samples of the marls contain miliolids, arenaceous foraminifera, ostracods along with juvenile inoceramids and



Text-Fig. 1.
Location map of the studied section in the Northern Calcareous Alps (arrow).
Redrawn from Kompass-Wanderkarte 1 : 50.000, Nr. 27 Achensee-Rofangebirge.



Text-Fig. 2.
Lithologic column of the Pletzachalm section, number of samples and distribution of calcareous algae.

pyrite framboids, so-called "Rogenpyrit" in German literature.

In the upper part of the sequence corals and rudistids occur, laterally passing into a lenticular to dome-shaped build-up structure of about 30 meters in lateral extension and max. 6 meters in height. Here, *N. circularis* is represented only rarely by its isolated ampullae due to post-mortem mechanical fracture and transportation.

The microflora shows an dasycladacean-gymnocodiacean association with *Falsolikanella* ? *hammudai* (RADOICIC), *Permocalculus gosaviense* SCHLAGINTWEIT and *P. irenae* ELLIOTT. The absence of corallinacean algae is striking. Benthic foraminifera are the most characteristic *Pseudocyclammina* ? *sphaeroidea* GENDROT, *Dictyopsella kiliani* SCHLUMBERGER, *Montcharmontia apenninica* (DE CASTRO) and rarely *Murgeina apula* (LUPERTO SINNI).

Based on nannoplancton determinations from the under- and overlying marls, the rudist bioconstruction can be assigned to the lower/middle Coniacian (Dr. M. WAGREICH, Vienna, in SCHLAGINTWEIT, 1991 a). The top part of the section consists of marls with some lumachelle layers. These contain foraminifera of the families Nodosariidae and Vaginulinidae indicating a more open marine environment of outer shelf setting.

A detailed biostratigraphy of the section based on multiple microfossil groups is in preparation (SCHLAGINTWEIT & EBLI in prep.).

The following systematic description of *Neomeris circularis* BADVE & NAYAK is based almost exclusively on thin-sections from the mixed siliciclastic carbonate bank at the base of the section and some specimens protruding from the rock.

3. Palaeontological Part

The genus *Neomeris* LAMOUROUX, 1816 is characterized by two types of ramifications: primary branches (R1) each bearing two sterile secondary branches (R2) set on both sides of the fertile ampulla. On the basis of the arrangement of the branched laterals different subgenera can be

distinguished (DELOFFRE, 1970; GENOT, 1980; RADOICIC, 1984):

- *Neomeris* (s.str.): secondary branches situated on both sides of the fertile ampulla (Cretaceous – Recent)
- *Neomeris* (*Larvaria*): secondary branches below the plane of the fertile ampulla (Tertiary – Recent)
- *Neomeris* (*Drimella*): secondary branches laterally set on one side of the ampulla (Upper Cretaceous).

The earliest recordings of genus *Neomeris* in the literature are from the Hauterivian–Barremian of the Bolshoi Balkhan, Soviet Union (SRIVASTAVA, 1973), the Hauterivian of Southern France (CONRAD & MASSE, 1989) and the Hauterivian of the south-eastern Iberides/Spain (CANEROT & CUGNY, 1982). In Portugal, representatives of *Neomeris* even occur in Valanginian strata (pers. comm. B. GRANIER).

Disadvantageous for specific identifications is the different degree of calcification of the calcareous skeleton (GENOT, 1985) accounting for the easy fragmentation of the thallus. Moreover, most often morphological details are masked by recrystallization phenomena. Hence, the excellent state of preservation of Neomereae in the Tertiary of the Paris basin (GENOT, 1980) cannot be regarded as the normal case in the fossil record, especially as regards Cretaceous representatives.

The confusion concerning species identifications in thin-sections is also reflected by the fact, that in the literature some Tertiary representatives have been reported from the Cretaceous and vice versa. For example, fragmentary transverse sections of *N. plagnensis* DELOFFRE, 1970 from the Palaeocene of France (e.g. Pl. 5, Fig. 3 in DELOFFRE et al., 1977) can be misidentified as *N. pfenderae* KONISHI & EPIS, 1962 from the Albian of Arizona (e.g. Pl. 20, Fig. 11 in BASSOULLET et al., 1978). This accounts also for different stratigraphic distributions given in the literature (e.g. for *Neomeris cretacea*: Hauterivian–Danian according to BASSOULLET et al., 1978; Albian–Cenomanian according to GRANIER & DELOFFRE, 1993). As a whole, the distinction of Cretaceous representatives is „délicate, et basée sur des critères sans doute peu significatifs“ (CONRAD & MASSE, 1989: p. 283).

Current developments of paleoalgalogical taxonomy also resulted in critical revisions of specimens originally assigned to genus *Neomeris*.

- *Neomeris budaense* JOHNSON 1968 from the Albian–Cenomanian of Texas is regarded synonymous to *Heteroporella lepina* PRATURLON (e.g. GRANIER & DELOFFRE, 1993).
- *Neomeris pfenderae* KONISHI & EPIS, 1962 from the Albian/Cenomanian of Arizona has been transfered to new genus *Genotella* by GRANIER, BERTHOU & FOURCADE (1991) based on well-preserved specimens from the Lower Cretaceous of Portugal showing „that the calcification of the fertile ampullae follows the exact shape of its cyst contents“ (3–4? cysts for the type-species). In *Neomeris* each sporangium bears only one gametangium or cyst (BERGER & KAEVER, 1992: p. 105).
- *Neomeris occidentalis* (JOHNSON & KAKSA, 1965) DELOFFRE 1970 from the Cretaceous of Guatemala: treated as nomen nudum in the revisional work of GRANIER & DELOFFRE, 1993. Moreover, *Neomeris*-type arrangement of fertile ampullae and sterile branches is not detectable in the original illustrations.

As a consequence, there are left only two valid Cretaceous representatives of *Neomeris* s.str.: *N. cretacea* STEINMANN and *N. circularis* BADVE & NAYAK.

Class: Chlorophyceae
Order: Dasycladales
Family: Dasycladaceae KÜTZING, 1843
Tribe: Neomereae (PIA, 1920) BASSOULLET et al., 1979
Subtribe: Neomerinae (PIA, 1927) BASSOULLET et al., 1979
Genus: *Neomeris* LAMOUROUX, 1816

Neomeris circularis BADVE & NAYAK, 1983

(Text-Fig. 3, Pl. 1, Figs. 1–10)

1971 *Neomeris* sp. – MASSE & POIGNANT: p. 261, Pl. 1, Fig. 6 (Lower Aptian of S-France).

1976 *Neomeris* ? cf. *N. cretacea* STEINMANN-CONRAD & PEYBERNES: p. 187, Figs. 11b, 14e (Albian of spanish Prenees).

*1983 *Neomeris circularis* n.sp. – BADVE & NAYAK: p. 189, Pl. 1, Fig. 5 (Cenomanian? of India).

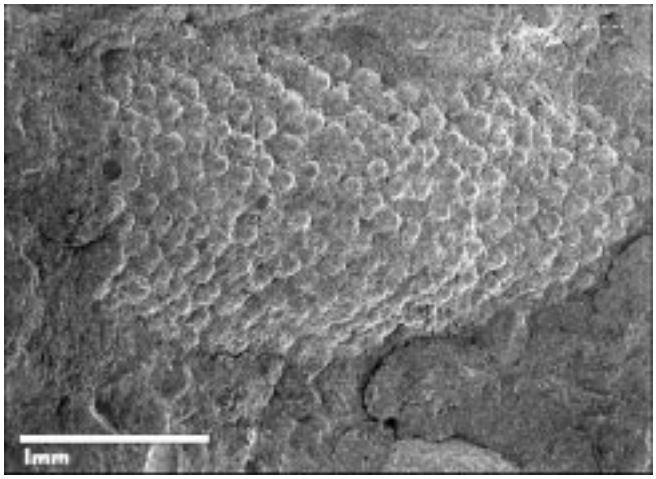
1987 *Neomeris cretacea* STEINMANN – REITNER: Pl. 44, Fig. 6 (Cenomanian of Spain).

1991 *Neomeris* cf. *pfenderae* KONISHI & EPIS – SCHLAGINTWEIT: p. 49, pl. 18, Fig. 8 (Albian of Northern Calcareous Alps).

1993 *Neomeris* sp. – SCHLAGINTWEIT:Pl. 2, Fig. 2 (Coniacian of Northern Calcareous Alps).

Depository of thin sections: The thin-sections are stored at the Institute of Paleontology, University of Munich, under the code-numbers BSPG 5212–5215 a 93.

Description: Calcareous skeleton cylindrical in shape with wide axial spacing that amounts about two third of total thickness. The external view displays a fine perforation corresponding to the last order pores (Pl. 1, Fig. 3). In some partly free specimens, the cortex formed by the enlarged and rounded distal ends of the secondary branches is preserved (Text-Fig. 3).
In thin-sections the wall appears light, brownish untypical for fossilized dasycladales that are usually recrystallized due to transformation of original aragonite to calcite. The calcification is distinctly pronounced around the fertile ampullae. Ampullae are spherical and set in a median position within the thin calcareous wall



Text-Fig. 3.
SEM-Photograph of external surface of calcareous skeleton of *Neomeris circularis* BADVE & NAYAK showing outer aspect of cortex with rounded distal endings of secondary branches.
Sample StE 1995-2.

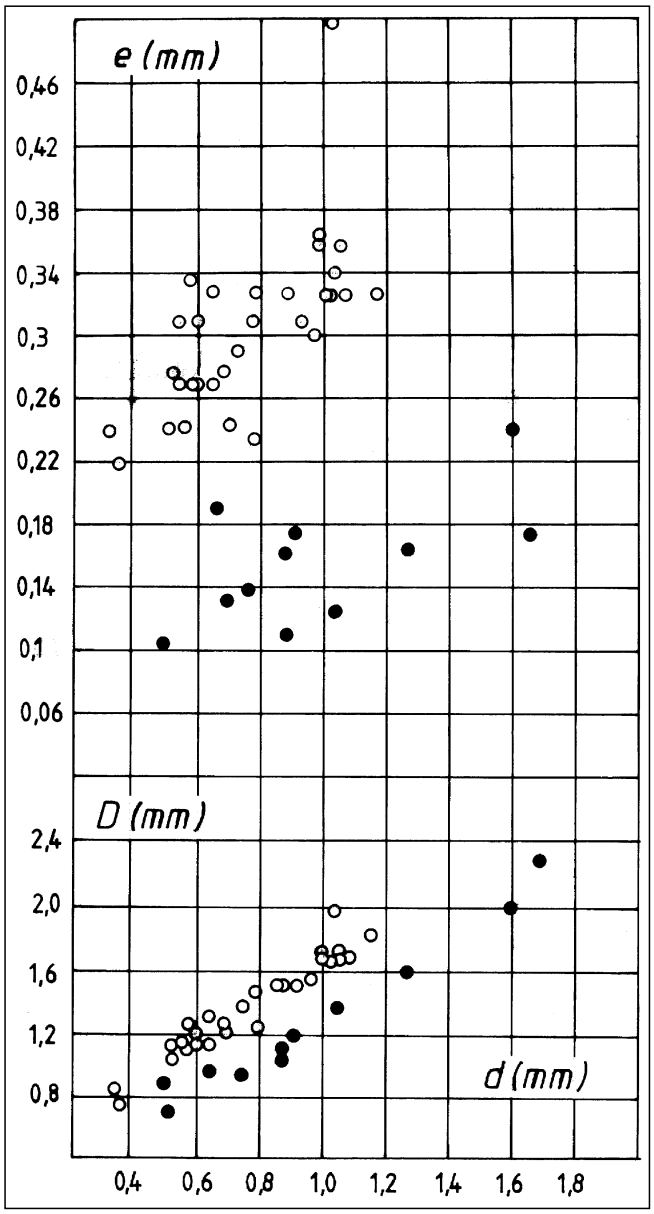
Table 1.
Values of the main biometrical parameters (in mm) of *Neomeris circularis* BADVE & NAYAK.
D = outer diameter of calcareous skeleton; d = inner diameter of calcareous skeleton; e = thickness of calcareous wall; ds = width of the ampulla; p' = diameter of sterile branches; la = length of the ampulla (incl. pedunculus); h = distance between two succeeding whorls; w = number of ampullae in transverse section.

Parameter	range	mean	standard deviation	n
D	0,72 - 2,32	1,29	0,49	11
d	0,58 - 1,68	0,99	0,37	11
d/D	0,60 - 0,88	0,76	0,076	11
D/d	1,12 - 1,80	1,33	0,17	11
e	0,104 - 0,240	0,157	0,04	11
ds	0,04 - 0,128	0,097	0,033	19
p´	0,016 - 0,040	0,034	0,0089	7
la	0,08 - 0,18	0,13	0,03	12
h	0,027 - 0,16	0,08	0,06	13
w	26 - 34	30	3,8	5

(Text-Fig. 6, e.g. Pl. 1, Fig. 4). As discernible in tangential sections, they alternate in position between successive rows (Pl. 1, Figs. 9–10). The pedunculi of the ampullae are short, thin (0.016–0.024 mm) and clearly differentiated but seldom visible. This phenomenon might be caused due to weak primary calcification and/or rarely cuttings in the plane of the section. Two secondary branches are belonging to one ampulla. These lie in one plane with the ampullae with opposite dip in adjoining whorls (angle of 75° to 85°). The secondary branches are set at right angle to the axis and widen distally accounting for the slight rugose outer aspect of the skeleton. Primary branches are not calcified and have thus not been observed.

Some rare specimens are comparable small with high number of small ampullae (Pl. 1, Fig. 5).

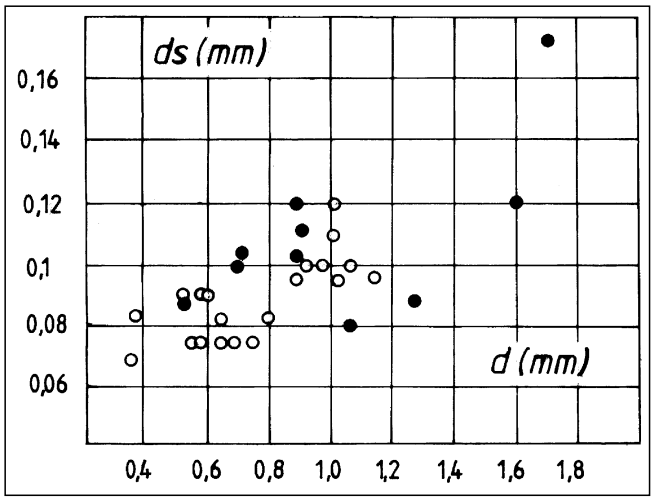
Summarizingly, we provide an emended species diagnosis as follows: Calcareous skeleton cylindrical with wide axial cavity and thin walls. Transverse sections display a high number of spherical- to subspherical-



Text-Fig. 4.
Outer diameter of thallus (D) against inner diameter (d) (lower portion of the figure) and width of calcareous wall (e) (upper portion).
Neomeris circularis BADVE & NAYAK (black dots) and *Neomeris cretacea* STEINMANN (white dots; data from BARATTOLO, 1990).

Table 2.
Dimensions of *Neomeris circularis* BADVE & NAYAK (data from references in synonymy) in comparisons to *Neomeris cretacea* STEINMANN (data from BARATTOLO, 1990). Values in parenthesis indicate average values (* = measured from original references).

Species	*Neomeris circularis*			*N. cretacea*
Dimensions (mm)	Turonian/Coniacian NCA	Cenomanian (?) India	L. Aptian France	Albian Mexico
L	4			up to 15
D	0,96 - 2,3 (1,3)			0,2 - 2 (1,4)
d	0,53 - 1,68 (1)			0,36 - 1,15 (0,77)
D/d	1,2 - 1,5 (1,3)			1,65 - 2 *
d/D (%)	67 - 83 (77)			42 - 59 *
e	0,06 - 0,24 (0,2)	0,09 - 0,1 *	0,22	0,2 - 0,48 (0,3)
ds	0,04 - 0,17 (0,11)	0,043 - 0,048	0,12 - 0,13	0,07 - 0,12 (0,09)
p	0,03 - 0,04		0,03 - 0,04	0,028 - 0,051 (0,04)
w	27 - 34 (30)			16 - 34 (26)
h	0,08 - 0,2 (0,14)			0,1 - 0,2

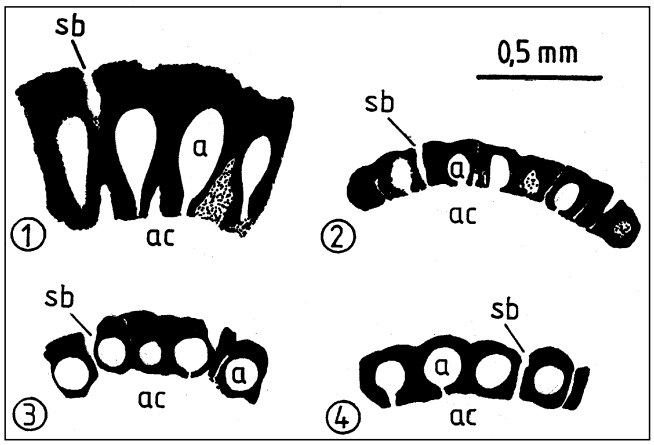


Text-Fig. 5.
Inner diameter (d) against width of the fertile ampullae (ds).
Neomeris circularis BADVE & NAYAK (black dots): Turonian of the Northern Calcareous Alps.
Data from different thin-sections of sample no. 1 (Text-Fig. 2).
Neomeris cretacea STEINMANN (white dots; data from BARATTOLO, 1990): Albian of Mexico.

shaped fertile ampullae (up to 34). Pedunculus of ampullae thin, short and weakly calcified. R1 not calcified, two sterile secondary branches (R2) are set on both sides of the ampullae. These lie on planes with opposite dip in successive rows. Calcification pronounced around the organs.

Biostatistical approach: As can be expected from cylindrical-shaped dasycladales, the inner diameter of the skeleton correlates well with the outer one as has been evidenced for example in *N. cretacea* STEINMANN by the thorough analysis of BARATTOLO (1990). In contrast hereto, *N. circularis* shows a wider axial cavity owing to reduced wall thickness. The coefficient of relation shows high values in the d–D ratio (r = 0.99) and a distinctly lower value for the couple of parameters d/e (r = 0.289). Thus, on the basis of the d–D and d–e diagram, both species are clearly separated from each other (Text-Fig. 4). The diagram also displays, that the maximum values for d are larger in *Neomeris circularis*.

There is also a interrelationship between d–ds (r = 0.659) but much less pronounced than in d–D (Text-Fig. 5). A correlation of the number of fertile ampullae (ns) and the inner diameter (d) as demonstrated in *N. cretacea* (BARATTOLO, 1990) is unclear, since our data base of transverse sections is too small to be statistically significant.



Text-Fig. 6.
Arrangement and shape of fertile ampullae (a) and sterile branches (sb) of different *Neomeris* species in transverse sections (ac = axial cavity).
1) *Neomeris cretacea* STEINMANN, Albian of Mexico (redrawn from BARATTOLO, 1990: Pl. 3, Fig. 5).
2) *Neomeris pfenderae* KONISHI & EPIS, Albian of Texas (redrawn from BASSOULLET et al., 1978: Pl. 20, Fig. 11).
3) *Neomeris fragilis* (DEFRANCE) MORELLET, Lutetian of France (redrawn from GENOT, 1980: Pl. 20, Fig. 11).
4) *Neomeris circularis* BADVE & NAYAK, Turonian of Northern Calcareous Alps (this work).

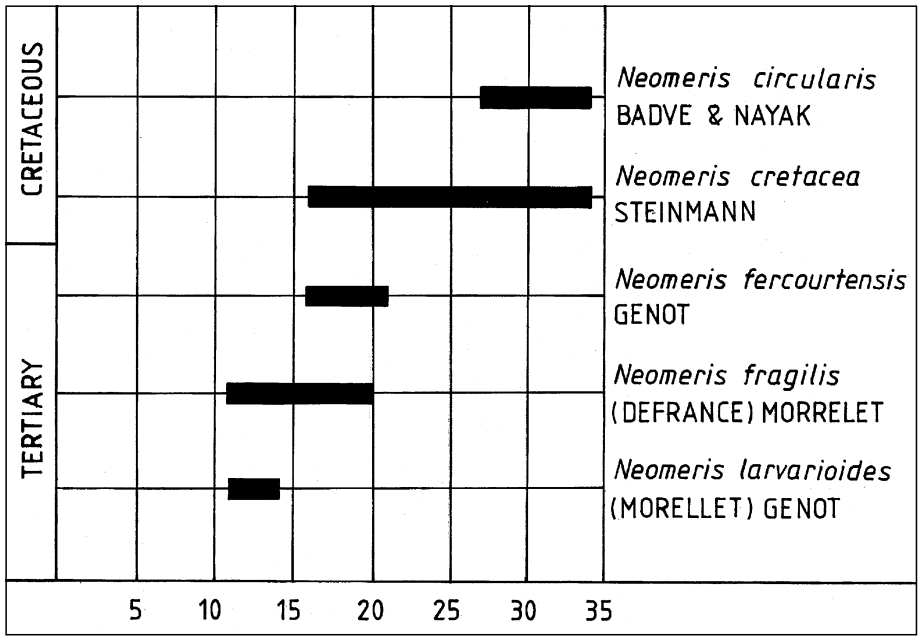
Comparisons: Considering species from thin-sections, besides others, the shape and the position of fertile ampullae can be of specific importance (GENOT, 1980, 1994) (Text-Fig. 6). Due to the spherical shape of ampullae, *N. circularis* is clearly differentiated from all other Cretaceous as well as most of Tertiary species (*N. cretacea*: ovoid to ellipsoidal, „*N. pfenderae*": ovoid; GENOT, 1994: p. 105; see Text-Fig. 6). On the basis of this main characteristic, *N. circularis* is recognizable even in fragmentary transverse sections (Pl. 1, Fig. 7). It is worth mentioning, that the general shape of the ampullae allows a comparison to *Neomeris fragilis* MORELLET from the Lutetian of the Paris basin (GENOT, 1980: Pl. 11, Fig. 9, Pl. 10, Figs. 7–8). Apart from other dimensional data, *N. circularis* differs from the latter by the high number of ampullae arranged in the middle part of the thin calcareous wall. (*N. fragilis*: 11–20, acc. to GENOT, 1980) (Text-Fig. 6, 7). Moreover, in *N. fragilis* they occupy an intern marginal position, whereas in *N. circularis* they are set in a medium position. For comparisons some Cretaceous and Tertiary representatives are considered, showing that also the number of ampullae can be of specific significance (Text-Fig. 7). Mention should be made that from seven today living species of *Neomeris* four display spherical ampullae (BERGER & KAEVER, 1992: Table 3.1).

As clearly evidenced, the sterile secondary branches of our specimens are set on both sides of the fertile ampullae (= diagnostic character of *Neomeris* s.str.) so that differences to the subgenus *Drimella* RADOICIC, 1984 (Upper Cretaceous of Serbia) have not to be considered.

The particular arrangement of sterile branches with respect to fertile ampullae in *N. circularis* ("opposite dip between two whorls") is reported from many other Cretaceous and Tertiary representatives (DELOFFRE, 1970; GENOT, 1980; DIENI et al., 1985; BARATTOLO, 1990).

One could consider, that the few indian data are part of a biometric range that is on the whole different from that of the alpine specimens and partly overlapping only with its lower end. In this case the two taxa could be different. Taking into account the dimensional data given by BADVE & NAYAK (1983) and the ranges of variability in our specimens (Table 1), however, we hypothetisize that the original description was based on a fragment exhibiting comparable tiny ampullae most probably belonging to a less developed specimen (?disfavourable ecologic conditions). Concerning differentiating of modern representatives, BERGER & KAEVER (1992: 116) conclude „that one cannot strictly rely on statements of size. They might be rather variable due to environmental conditions". Therefore, we consider the Indian and Alpine specimens belonging to the same species. Nonetheless, more data from Indian material would be helpful for a thorough comparative study.

Stratigraphy and occurrences: MASSE & POIGNANT (1971) described and figured fragments of *Neomeris* sp. from the Lower Aptian of the Provence area (S-France)



Text-Fig. 7.
Numerical importance of fertile ampullae of selected Cretaceous and Tertiary representatives of genus *Neomeris*.
Data concerning different taxa are expressed only by the ranges; average values and standard deviations not given.Choice of species is arbitrary to demonstrate the overall variability of this parameter. Apart from *Neomeris circularis* BADVE & NAYAK, all data from BARATTOLO (1990) and GENOT (1980).

with fertile ampullae „parfaitement sphériques". They stated that this characteristic „does not correspond with any other species known so far, but the lack of other parameters hinders a specific determination" (translated from MASSE & POIGNANT, 1971: page 261). Apart from the spherical shape of the ampullae, the dimensions given agree perfectly with *Neomeris circularis* BADVE & NAYAK (Table 1). According to our knowledge this is the oldest stratigraphic record in the literature so far.

From the Cenomanian of the Bascocantabric Mountains (Spain), *N. circularis* has been figured by REITNER (1987) as *N. cretacea* STEINMANN (see synonymy).

The type-locality of *N. circularis* has been given as not older than Cenomanian since the lack of other biostratigraphic markers. In the Northern Calcareous Alps, a fragment of *N. circularis* recovered from a pebble of an allochthonous Urgonian limestone has been indicated as *N.* cf. *pfenderae* KONISHI & EPIS (see synonymy). The age of the pebble is (early ?) Albian. The species has been identified also in one pebble of Upper Cretaceous age in the basal conglomerates of the Eocene Oberaudorf Formation, located about 35 km northeast to the Pletzachalm in the Lower Inn Valley.

In the Pletzachalm section the species is a omnipresent floral element and reaches up to the top of the rudistid limestones, that are dated as lower/middle Coniacian, whereas the base of the section might be assigned to the (Upper ?) Turonian.

Summarizingly, the stratigraphic distribution of *Neomeris circularis* BADVE & NAYAK ranges at least from the Lower Aptian to the Coniacian. Thus, representing a fairly long-living species (time-span of more than 30 million of years), *N. circularis* is of little stratigraphic significance.

Remarks on Paleoecology: Fossil representatives of *Neomeris* have been described almost exclusively from back-reef settings (facies zones 7–10, WILSON, 1975). Some rare records also are from open marine outer platform environment (e.g. type-locality of *N. cretacea* in Mexico, BARATTOLO, 1990).

As a whole, both, lithological and (micro)paleontological characteristics of the sequence studied refer to a confined lagoonal environment of low energy level favouring the sedimentation of fine muddy material. In the sandy basal bed the algal remains and other bioclasts have been transported storm-generated in direction towards the shoreline (tempestite). The marly limestones with the characteristic association of *N. circularis* BADVE & NAYAK, *D.* ? *pyriformis* SCHLAGINTWEIT and *Halimeda* species in the lower (sample no. 8) and middle part (sample no. 17, Text-Fig. 2) of the sequence were most likely set in a backward position to the rudist bioconstruction. The latter only contains some rare allochthonous fragments (isolated ampullae).

BOUROULLEC & DELOFFRE (1976) reported *Neomeris* in argillaceous biomicrites with small gastropods and *Munieria baconica* DEEKE (?charophyte alga) from the Vraconian of France. Thus, one can assume that some representatives of genus *Neomeris* had a certain tolerance towards fluctuating salinities. Today-living species of *Neomeris* even occur in the intertidal zone, with a preferation of 0 to 10 meters of water depth (VALET, 1979). For example, *Neomeris annulata* DICKIE mostly grows gregariously in colonies and is common in tide pools close to the lower water mark (BERGER & KAEVER, 1992: p. 107).

Remarks on Palaeobiogeography: Under the specific name, *N. circularis* has hitherto been reported only from its type-locality in India. The references in the synonymy show that it had a fairly wide distribution especially in the domain of the western Tethys (Spain, France, Eastern Alps). Due to the specific confusions discussed before, it can be speculated that some more reports of *Neomeris* sp., "*Neomeris*" *pfenderae* or *Neomeris cretacea* in the literature (without figurations), might belong to *Neomeris circularis*.

Plotted on a paleogeographical map, European occurrences are situated approximately between 20° and 35° N within the low-latitude equatorial belt of the Tethys. The Indian locality was set at about 45° S (VAN DER VOO, 1993). Today-living representatives of *Neomeris* are known from the tropical to subtropical zones of the Atlantic, Indian and Pacific Oceans between 35° N to 30° S (BERGER & KAEVER, 1992: Fig. 3.32). In comparison hereto, the Indian occurrence does not appear to lie within a palaeoposition suitable for dasycladacean algae. Following MU (1993), the northern border of the Tethyan realm during the Upper Cretaceous has been recorded from Western Carpathians, Czechoslowakia at 49° N. The southern border is tentatively assumed to be delineated along a line running from southern S-America through S-Africa to the southern end of India, since no late Cretaceous calcareous algae have been reported south of this line.

4. Conclusions

The detailed biomorphical analysis of *Neomeris circularis* BADVE & NAYAK from the alpine Upper Cretaceous clearly displays species validity.

The arrangement of branches on both sides of the fertile ampullae accounts for *Neomeris* s.str. Above all, *N. circularis* is characterized by its spherical ampullae and thin walls of thallus.

Based on the D-d- and e-d-diagrams, *N. circularis* is clearly distinguished from *N. cretacea* STEINMANN.

Taking into account the data from the proposed synonymy references, *N. circularis* has a long stratigraphic distribution, ranging at least from the Lower Aptian to Coniacian.

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Plate 1

Neomeris circularis BADVE & NAYAK
from the Gosau Formation (Turonian) of the Pletzachalm (Austria).

Fig. 1: Photomicrograph of facies showing a sandy biomicrite with gastropods and debris of *Neomeris circularis* BADVE & NAYAK. Sample BSPG 5212 a 93 (× 29).

Fig. 2: Tangential section cutting two whorls. Sample BSPG 5212 a 93 (× 63).

Fig. 3: Outer aspect of thallus protruding from the rock. Sample S + E 1995–1 (× 9).

Fig. 4: Slightly oblique transverse section displaying spherical appearance of fertile ampullae. Sample BSPG 5213 a 93 (× 29).

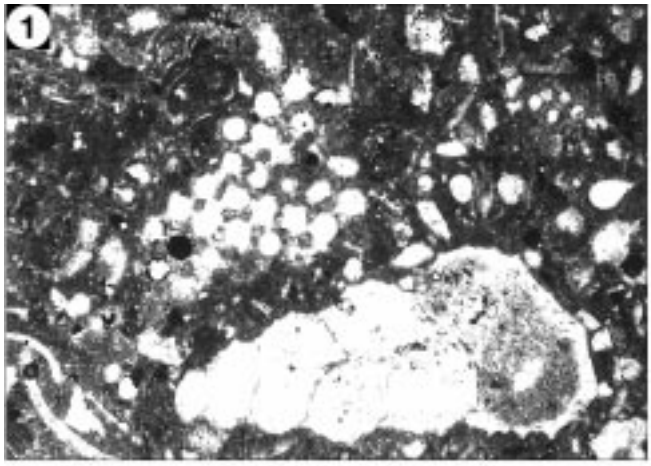
Fig. 5: Transverse section of small specimen (A) (? narrow lower part of thallus) and fragment with large ampullae (B). Sample BSPG 5214 a 93 (× 30).

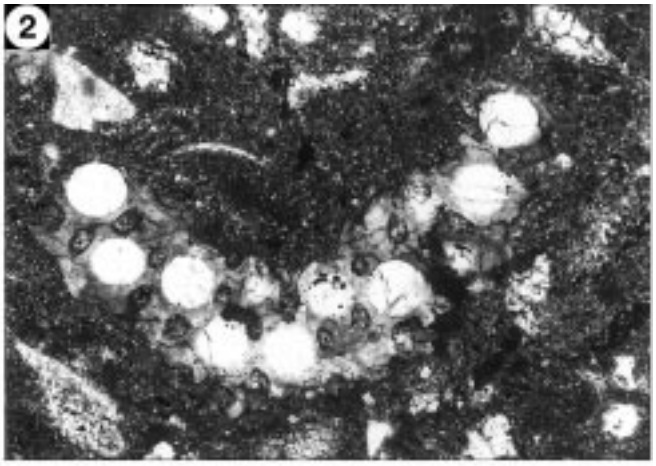
Fig. 6: Longitudinal section showing large axial spacing due to thin walls of calcareous skeleton. Sample BSPG 5214 a 93 (× 24).

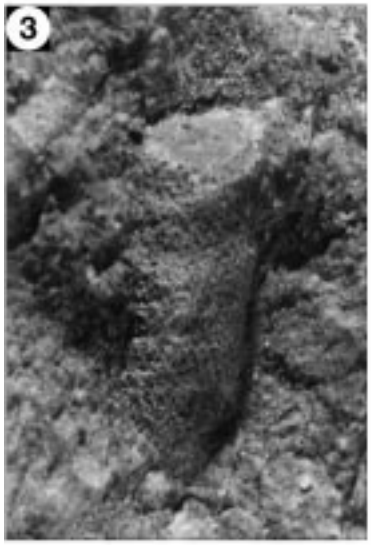
Fig. 7: Fragments with spherical ampullae; rugose external aspect is caused by distal widening of sterile branches. Sample BSPG 5214 a 93 (× 83).

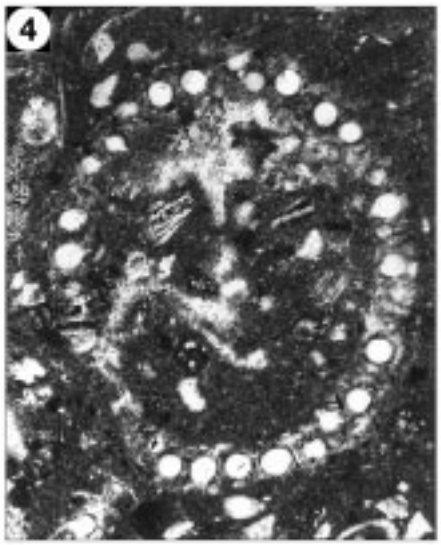
Fig. 8: Fragment with ampullae, left one with pedunculus. Sample BSPG 5213 a 93 (× 117).

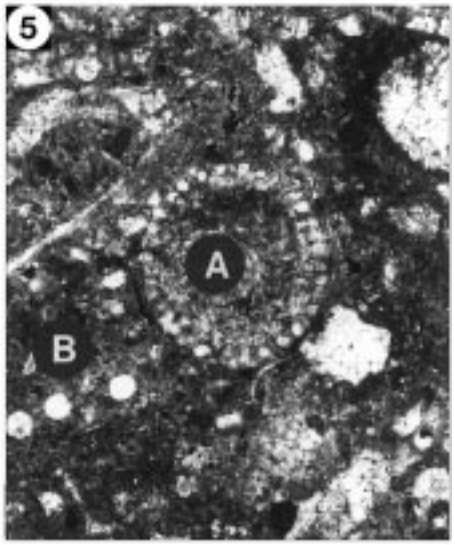
Fig. 9,10: Fragmentary tangential sections exhibiting alternation of fertile ampullae (large pores) between two succeeding rows and sterile branches (small pores) set symmetrically on both sides. The latter lie on planes with opposite dip in successive rows.
Fig. 9: × 83
Fig. 10: × 75
In Fig. 10 the traces of the planes are marked by black lines.
Both Samples BSPG 5215 a 93.

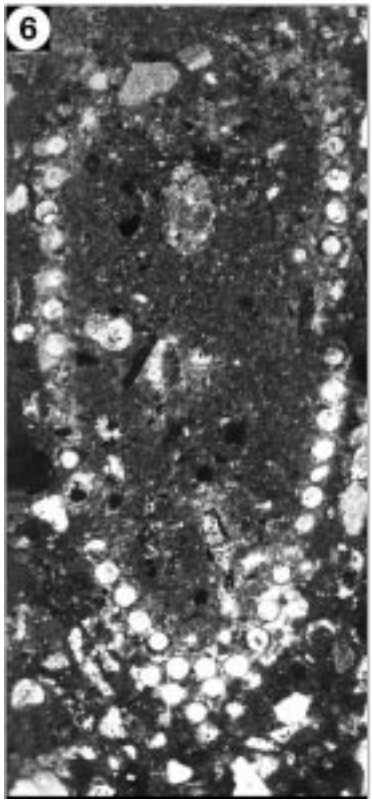


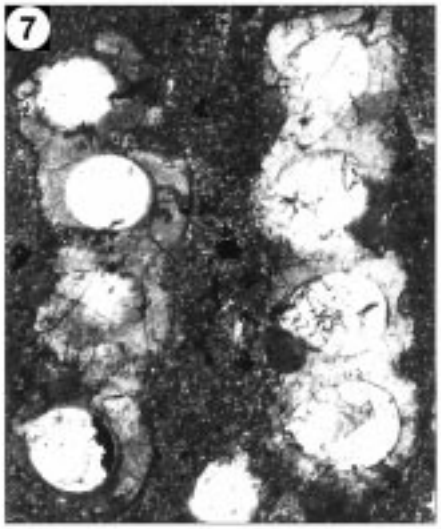


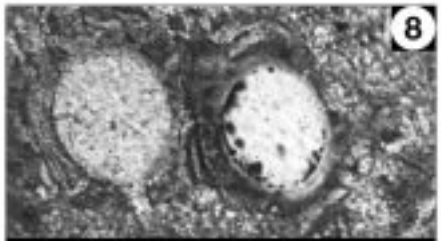


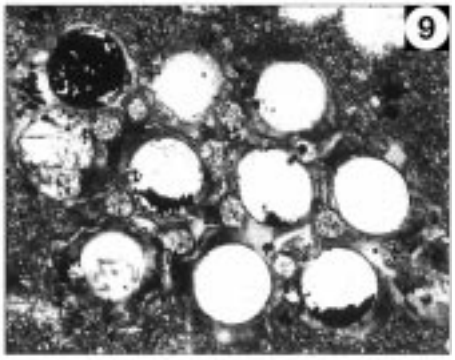


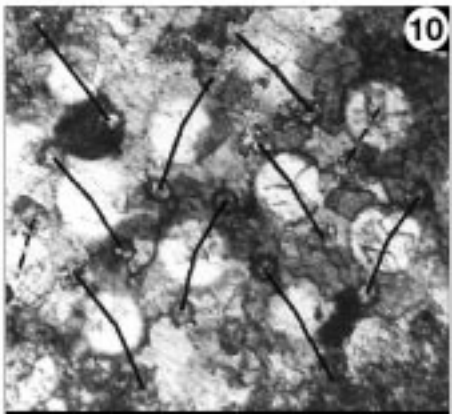












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