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ABSTRACT: A rich and diversified assemblage of well preserved calcareous algae from the Upper Viséan limestones of the Lublin Coal Basin, eastern Poland, contains 29 taxa, among which the green algae are the most frequent. The six species (*Calcifolium okense, Kamaena delicata, Exvotarisella maponi, Nanopora anglica, Kulikia sphaerica,* and *Stacheoides polytrematoides*) have a significant share in this assemblage. The chemically prepared specimens allowed to elucidate morphological details of some groups (*e. g.* tribe Palaeobereselleae and genus *Saccaminopsis*). The algal microfacies, typical of shallow and quiet epiplatform sedimentation, is comparable to the Recent accumulation of *Halimeda*-bearing sediments.

INTRODUCTION

This paper presents the results of investigations of calcareous algae occurring in the Upper Viséan limestones, which have been pierced by boreholes situated between Włodawa and Parczew in the north-eastern part of the Lublin Coal Basin, eastern Poland (*see* Text-fig. 1).

The Viséan sediments have been reported from numerous areas of southern Poland, both from the outcrops (Bardo Mts in the Sudetes, Cracow Upland, Holy Cross Mts), and from the boreholes (Miechów Trough, Fore-Carpathian Depression, and Lublin Coal Basin). Among the bathymetrically differentiated Viséan facies, the shallow water facies containing calcareous algae are relatively frequent, but this group of fossils has not hitherto subjected to detailed investigations. The primary informations on these algae were offered by MAMET & ROUX (1974, 1975a, b, 1977) in their monographic study of the Devonian and Carboniferous algae from the western Tethys: from the Bardo Mts and the Cracow Upland they described such genera as *Girvanella, Vermiporella, Palaeoberesella, Epistacheoides, Parachaetetes, Shartymophycus, Kamaena, Exvotarisella,* and *Koninckopora.* Recently, CHOROWSKA & RAD-

LICZ (1984) reported the stratigraphically important species *Calcifolium punctatum* in the Kłodzko area (Bardo structure in the Sudetes). From the Cracow Upland the genera *Stacheia, Stacheoides, Ortonella, Garwoodia,* and *Archaeolithophyllum* were identified by several authors (ALEXANDROWICZ & MAMET 1973, ALEXANDROWICZ & SIEDLECKA 1964, BEŁKA 1981, PASZKOWSKI 1983). The richly fossiliferous *Koninckopora*-calcarenites from boreholes situated between Olkusz and Sosnowiec (north-eastern margin of Silesian Coal Basin) are reported by BEŁKA (1985). In the Fore-Carpathian Depression, the calcareous algae have been noted in many boreholes (*see* JURKIEWICZ & ŻAKOWA 1978; ZAJĄC 1984), with the most characteristic genera *Koninckopora, Solenopora,* and *Parachaetetes.*

The calcareous algae were also mentioned from the very diversified fossil assemblages of the Viséan limestone lenses in the Holy Cross Mts (GROMCZAKIEWICZ 1967, 1969, 1973; GROMCZAKIEWICZ & ŻAKOWA 1968). Detailed research of algae (JURKIEWICZ & ŻAKOWA 1978) showed that the specimens are very rare and they represent the genera: *Girvanella, Koninckopora, Nanopora, Solenopora,* and *Asphaltina.*

As compared to the mentioned areas, the Viséan deposits of the Lublin Coal Basin bear more diversified and numerous algal assemblage.

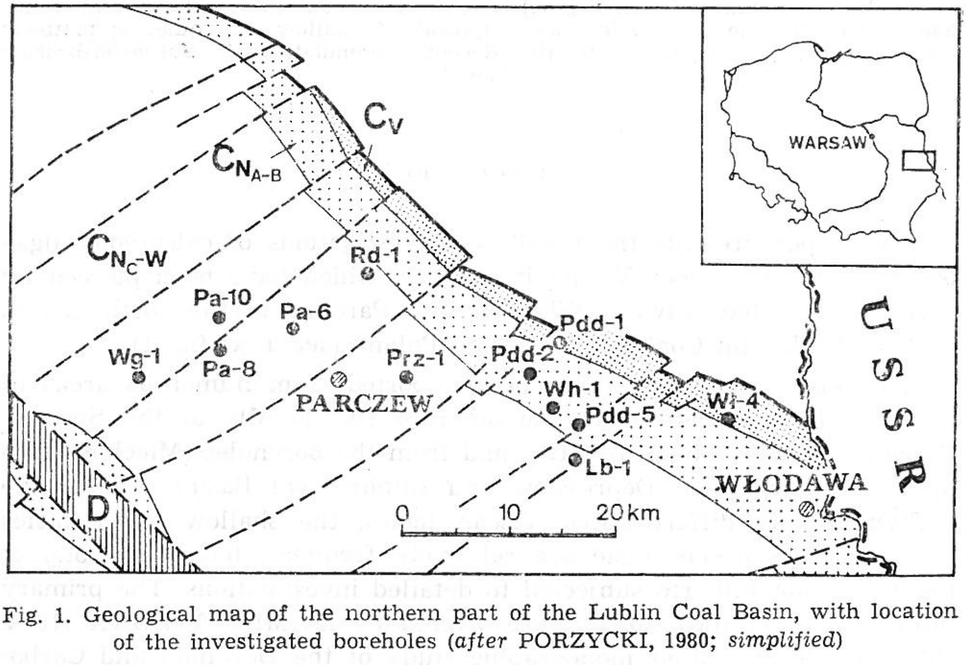


Fig. 1. Geological map of the northern part of the Lublin Coal Basin, with location of the investigated boreholes (*after* PORZYCKI, 1980; *simplified*)

D — Devonian; **C** — Carboniferous: **V** — Upper Viséan, $\mathbf{N_{A-B}}$ — Namurian *A—B*; $\mathbf{N_C}$—**W** — Namurian C through Westphalian

Abbreviations of boreholes: Lb-1 — Lubień *IG-1*; Pa-6, 8, 10 — Parczew *IG-6, IG-8, IG-10*; Pdd-1, 2, 5 — Podedwórze *IG-1, IG-2, IG-5*; Prz-1 — Przewłoka, *IG-1*; Rd-1 — Rudno *IG-1*; Wł-4 — Włodawa *IG-4* and Wg-1 — Wygnanów *IG-1*

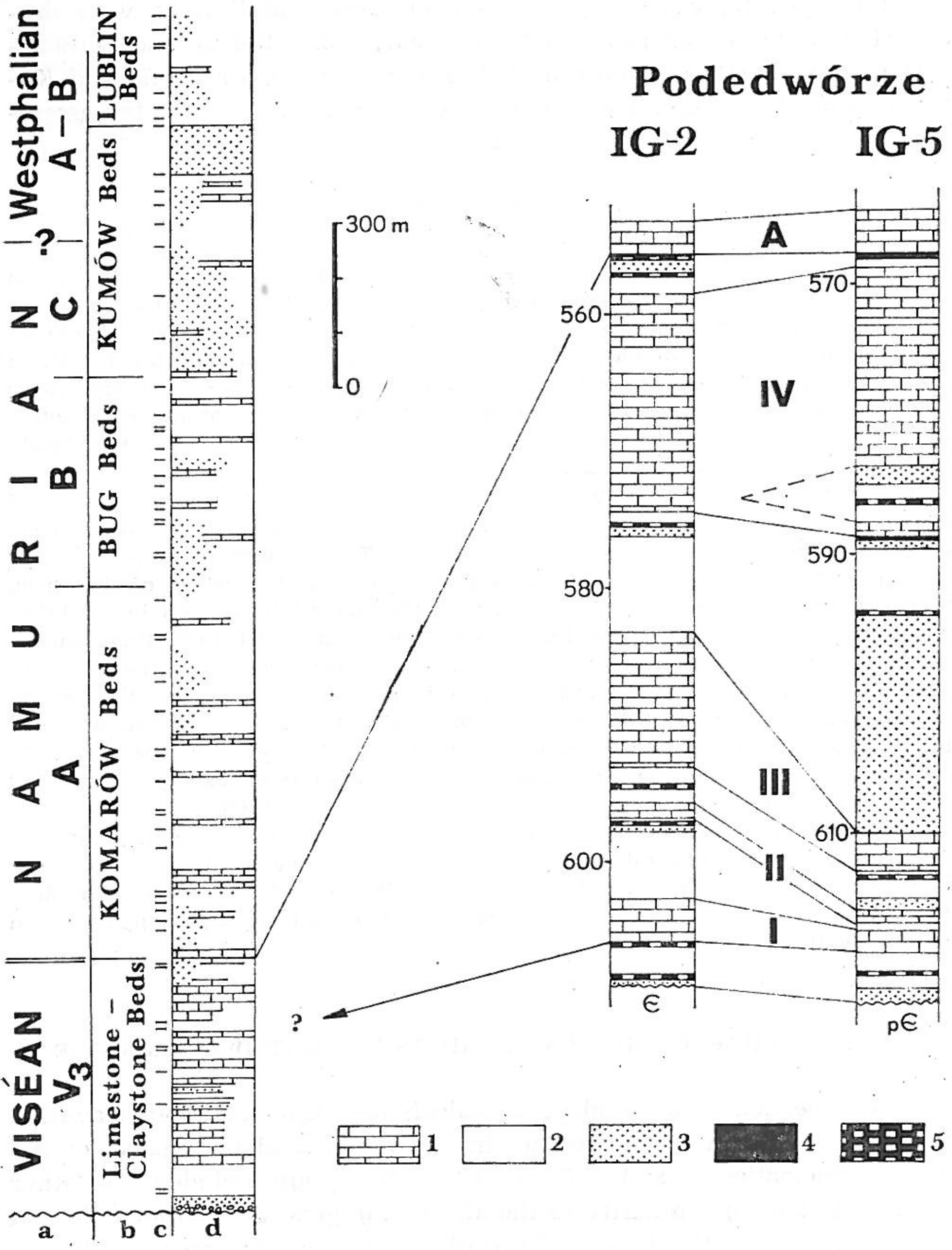


Fig. 2. Stratigraphic position of the investigated limestone beds, exemplified by boreholes Podedwórze *IG-2* and Podedwórze *IG-5*

a chronostratigraphy, *b* lithostratigraphy, *c* position of coal measures, *d* lithology (a—d *after* PORZYCKI, 1980)

1 limestones, *2* claystones and mudstones, *3* sandstones, *4* coal measures, *5* carbonaceous shales

I, II, III, IV, A — number of limestone beds

The three genera, viz. *Calcifolium, Globochaete,* and *Kulikia,* were described in separate papers (SKOMPSKI 1981, 1982, 1984 a), and SOBOŃ-PODGÓRSKA (1978, 1983) reported also the genera *Girvanella* and *Koninckopora* (the latter taxon is not represented in the investigated assemblage).

GEOLOGICAL SETTING

The Lublin Coal Basin represents a typical parallic basin, situated in the south-western margin of the East European Platform. The Lower Carboniferous sequence begins with the Limestone — Claystone Series (CEBULAK & PORZYCKI 1966) which is similar to the Yoredale Series of England and Scotland both in age and facies development. In the Lublin area this Series, covered by the Upper Carboniferous, Mesozoic and Cainozoic sediments, is composed of cyclically interbedded continental and marine deposits. Bioclastic limestones and sporadically claystones represent marine members of the cycles, whereas sandstones, mudstones, seat-earths and thin layers of coal are characteristic of the continental episodes. In the investigated area, only five cycles have been distinguished, most of them with a limestone bed (*see* Text-fig. 2). The number of cycles and the thickness of the Series are considerably greater towards the center of the basin. The topmost limestone bed is correlated with the "Limestone *A*" bed in the lithostratigraphic subdivision of the Lublin sequence (PORZYCKI 1970, 1980). In the chronostratigraphic sense, the "Limestone *A*" bed is connected with the boundary between the Viséan and Namurian, which is sometimes located at the bottom of this limestone bed (PORZYCKI 1984), but more often it is identified with the top of this bed (MUSIAŁ & *al.* 1983). The underlying limestone beds are informally denoted *I, II, III* and *IV* only for the use in this paper (*see* Text-fig. 2). Detailed correlation of these beds is analysed elsewhere (SKOMPSKI 1985).

The investigated limestones are macroscopically differentiated with great subtlety, but fragments of corals and crinoids are distinguishable in this monotonous biomicritic sequence. The microfacies analysis (SKOMPSKI 1985) allows to identify several microfacies, out of which the most important are algal, spicultic, and foraminiferal ones.

GENERAL CHARACTERISTICS OF THE INVESTIGATED ASSEMBLAGE

The investigated assemblage of calcareous algae has been classified into 29 taxa which belong to the three divisions and to a group of the microproblematics (Text-fig. 3). To the latter group included are either the forms showing similarity to the algae (*e. g.* genera *Hypocaustella* and *Saccaminopsis)* or the taxa traditionally settled among the algae (genus *Rectangulina).*

In the investigated assemblage the green algae distinctly dominate both numerically and in the respect of their diversity. This is caused mainly by the abundance of the phylloid alga *Calcifolium okense* (SHVETZOV & BIRINA), especially in the limenstone bed *III* which is a good correlation horizon in all the boreholes *(C. okense* acme zone of SKOM-

DIVISION: NOPHYTA
Girvanella problematica

DIVISION: CHLOROPHYTA
Order: Siphonales
Family: Codiaceae
Calcifolium okense
Calcifolium punctatum
Order: Dasycladales
Tribe: Aciculelleae
Atractyliopsis cumberlandensis
Coelosporella jonesii
Tribe: Diploporeae
Albertaporellinae
Albertaporella radiata
Albertaporella aff. occitanica
(?) Albertaporellinae
Kulikia sphaerica
Kulikia rozovskaiae
Diploporeae gen. indet.
Form A
Form B
Tribe: Bereselleae
Beresella sp.
Exvotarisella maponi
Tribe: Palaeobereselleae
Kamaena delicata
Kamaena awirsi
Kamaenella aff. denbighi
Tribe: Salpingoporelleae
Nanopora anglica

DIVISION: (?) RHODOPHYTA
Family: Ungdarellaceae
Tribe: Stacheiinae
Aoujgalia aff. richi
Eflugelia johnsoni
Fourstonella fusiformis
Pseudostacheoides loomisi
Stacheia marginulinoides
Stacheoides polytrematoides

ALGAL MICROPROBLEMATICS
Globochaete alpina
Hypocaustella cartimandue
Principia donbassica
Rectangulina tortuosa
Saccaminopsis sp.

Fig. 3. Classification scheme of the investigated algae

Species \ Limestone Beds	I	II	III	IV	A
Girvanella problematica	○		⊙	⊕	⊙
Calcifolium okense		○	● *1	●	⊕
Calcifolium punctatum			⊕	⊕	○
Atractyliopsis cumberlandensis	○		○		
Coelosporella jonesii				⊙	
Albertaporella radiata			○		
Albertaporella aff. occitanica			○	○	
Kulikia sphaerica	○		⊙	⊕	⊕
Kulikia rozovskaiae				⊙	
Dipl. gen. indet. Form A			⊙	⊙	
Dipl. gen. indet. Form B	○		○		
Beresella sp.				○	
Exvotarisella maponi	⊕	⊙	○	○	
Kamaena delicata	⊕	⊕	⊙	⊙	⊙
Kamaena awirsi	⊙				
Kamaenella aff. denbighi					
Nanopora anglica				● *2	
Aoujgalia aff. richi					○
Eflugelia johnsoni		○			
Fourstonella fusiformis			⊙		
Pseudostacheoides loomisi			⊙		
Stacheia marginulinoides				○	
Stacheoides polytrematoides	⊕	●	⊙	⊙	
Globochaete alpina	○		○	○	○
Hypocaustella cartimandue	○	○	○	○	
Principia donbassica			○	○	
Rectangulina tortuosa			○	○	○
Saccaminopsis sp.				⊙	⊙

○ single ⊙ rare ⊕ numerous ● abundant

Fig. 4. Distribution and frequency of algae in the investigated limestone beds (*cf.* Text-fig. 2)

Frequency: *single* (1—3 specimens), *rare* (3—10 specimens), *numerous* (10—20 specimens), and *abundant* (over 20 specimens)

*1 — acme zone of *Calcifolium*, *2 — abundant specimens in a single sample

PSKI 1980). Out of the recorded 29 algal taxa, only a few have a significant share in the assemblage: besides *Calcifolium okense,* also *Kamaena delicata, Exvotarisella maponi, Nanopora anglica,* and *Stacheoides polytrematoides.* Among the remaining taxa only the genera *Kulikia* and *Girvanella* are rather numerous, while the others are sometimes represented even by single specimens *(see* Text-fig. 4).

TAXONOMY OF THE INVESTIGATED ALGAE

In the majority of cases, thin sections were the basis for classification of the investigated algae, but sometimes chemically prepared specimens were also available. The latter allowed to recognize *(see* SKOMPSKI 1981, 1984a) morphological details of such species as *Calcifolium okense* (SHVETZOV & BIRINA), *Kulikia sphaerica* (GOLUBTSOV), *Saccaminopsis* sp., and *Kamaena delicata* ANTROPOV.

The classification scheme adopted in this paper (Text-fig. 3) corresponds to the scheme applied by MAMET & ROUX (1974, 1975a, b, 1977). With regard to the order Dasycladales, the present author took into consideration the newer classification of BASSOULLET & *al.* (1979), but included to this order also the tribes Bereselleae and Palaeobereselleae, accordding to the former opinion of MAMET & ROUX.

The species *Calcifolium okense* and *Globochaete alpina,* as well as the genus *Kulikia,* which were the subjects of previous papers (SKOMPSKI 1981, 1982, 1984a) are shortly reported in the present work to illustrate the diversity of the investigated algal assemblage.

SYSTEMATIC ACCOUNT

Division **Cyanophyta**

Genus *Girvanella* NICHOLSON & ETHERIDGE, 1878

In the Upper Paleozoic, MAMET & ROUX (1975b) distinguished only four species with unequivocally defined dimensions of the tube. The classification strongly diminished the number of species described during the last 100 years *(see* DANIELLI 1981, Fig. 2).

Girvanella problematica
(NICHOLSON & ETHERIDGE, 1878) emend. WOOD, 1957
(Pl. 1, Figs 1—6)

1878. *Girvanella problematica* sp. n.; NICHOLSON & ETHERIDGE, pp. 23—24, Pl. 9, Fig. 24.
1957. *Girvanella problematica* NICHOLSON & ETHERIDGE; WOOD, p. 26, Pl. 5, Figs 2—5 and Pl. 6, Figs 1—4.
1983. *Girvanella problematica* (NICHOLSON & ETHERIDGE); MAMET & ROUX, p. 67, Pl. 1, Figs 7—9 and Pl. 2, Fig. 3 [*cum syn.*].

MATERIAL: 30 specimens in thin sections.

DESCRIPTION: In the investigated material, *G. problematica* occurs sometimes in the envelopes of onkoids, but more often in the form of clusters, which are not attached to the bedrock. Among the latter form two morphological groups are distinguishable: the clusters of irregularly interwoven filaments (Pl. 1, Fig. 1), and the sets of semiparallel tubes lying side by side (Pl. 1, Fig. 5) which in the perpendicular sections resemble some sphaerocodium-like forms (Pl. 1, Figs 2—3).

Division **Chlorophyta**
Order **Siphonales**
Family **Codiaceae** ZANARDINI, 1843
Genus *Calcifolium* SHVETZOV & BIRINA, 1935
Calcifolium okense (SHVETZOV & BIRINA, 1935), emend. SKOMPSKI, 1981

1935\. *Calcifolium okense* sp. n.; SHVETZOV & BIRINA, pp. 20—21, Pl. 4, Figs 11—12, 14—15, *non* 10.
1981\. *Calcifolium okense* (SHVETZOV & BIRINA); SKOMPSKI, pp. 168—169, Figs 3a, b, 4a—d and 6a—f [*cum syn.*].

MATERIAL: In several hundreds of thin sections the fragments of plates in the rock-forming amount; several dozens of silicified, recrystallized and pyritized specimens extracted from limestones (four completely preserved specimens, composed of more than one cup).

REMARKS: The description and discussion of this species are given in a previous paper (SKOMPSKI 1981).

Calcifolium punctatum MASLOV, 1956

1935\. *Calcifolium okense* sp. n.; SHVETZOV & BIRINA, pp. 20—21, Pl. 4, Fig. 10.
1956b. *Calcifolium punctatum* sp. n.; MASLOV, pp. 49—51, Text-fig. 8 and Pl. 8, Fig. 2; Pl. 9, Fig. 1; Pl. 10, Fig. 1.
1981\. *Calcifolium punctatum* MASLOV; SKOMPSKI, pp. 171—172, Figs 4e-j [*cum syn.*].

MATERIAL: The fragments of plates in several dozens of thin sections, sometimes in the envelopes of the onkoids; several specimens chemically prepared.

REMARKS: The description and discussion of this species are given in the previous papers (SKOMPSKI 1980, 1981). In the latter, it is suggested that the Upper Carboniferous and Permian genera of the so-called phylloid algae (PRAY & WRAY 1963) evolved from *C. punctatum* which was their ancestor (SKOMPSKI 1981, pp. 172—173; *see also* KONISHI & WRAY 1961). Such supposition was, to some extent, confirmed by specimens of undetermined phylloid algae recently found in the Permian Laborcita Formation of the United States (*letter information* of T. A. CROSS; *cf.* CROSS & KLOSTERMAN 1981). These specimens are probably transitional from C. *punctatum* to the other phylloid algae (*see* Text-fig. 5).

Order **Dasycladales** PASCHER, 1931

The structure of the fossil dasyclads is reconstructed mostly on the basis of thin sections, but sometimes also pyritized moulds were observed and their shape identified with the form of the soft thallus of algae. According to the form of fossilization, the relevant terminology has been adapted, *i. e.* thallus, axial cell and ramification with regard to the soft parts, as well as calcareous sleeve, axial cavity and pores with regard to the calcareous fragments (*see also* BASSOULLET & *al.* 1977).

The investigated material contains the five following tribes of the dasycladacean algae: the Aciculelleae, the Beresselleae, the Diploporeae, the Palaeoberesselleae, and the Salpingoporelleae. This classification is partly incomptible with the new division of Dasycladales by BASSOULLET & *al.* (1979), and it excludes from this order the tribes Beresselleae and Palaeoberesselleae. In the present author's opinion, doubtless dasycladacean features (axial structure, porosity of calcareous sleeve, branching of the pores) of all the genera of the tribe Beresselleae allow to classify it within the order Dasycladales. Anyway, such a classification is concordant with the older opinion of some authors (*e. g.* MASLOV & KULIK 1956; MAMET & ROUX 1974; HERAK, KOCHANSKY-DEVIDÉ & GUŠIĆ 1977).

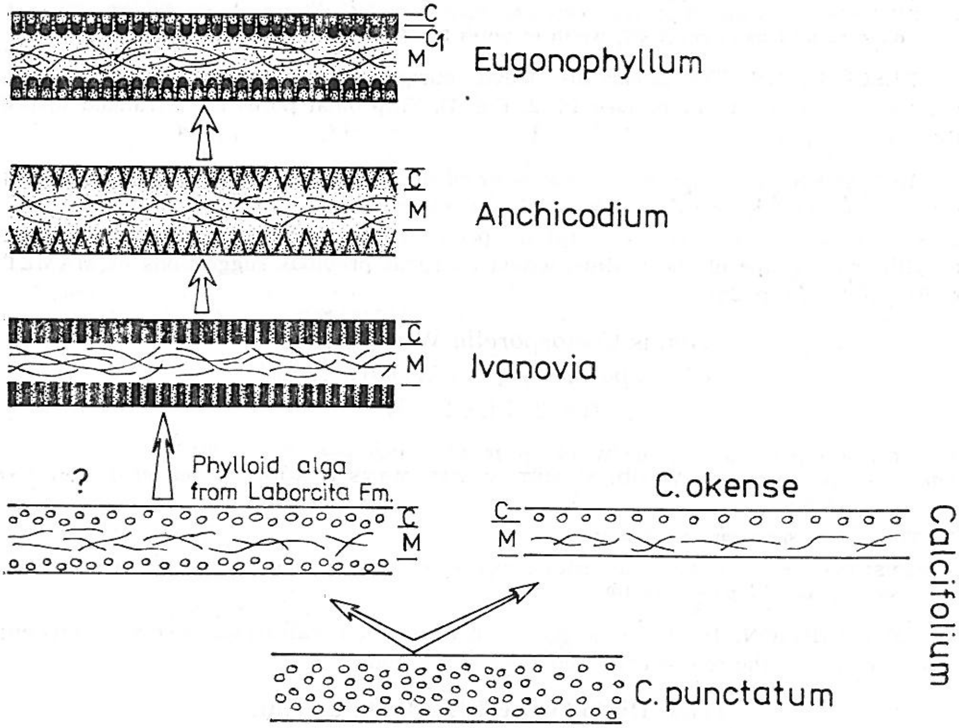


Fig. 5. Position of the *Calcifolium* species in the phylogenetic lineage of phylloid algae (partly *after* KONISHI & WRAY 1961, Fig. 1)

The tribe Palaeoberesselleae was closely connected by its creators (MAMET & ROUX 1974) with the tribe Beresselleae. In the light of the present author's investigations such connection is doubtful; nevertheless, an assignation of this tribe to the order Dasycladales seems probable.

The remaining three tribes are presented in the same scheme as by BASSOULLET & *al.* (1979). The tribe Aciculelleae, regarded as an unformal "morpho-tribe", was introduced to classify some forms with unknown or irregular shape of the thallus, and therefore this group escapes from typical classification. The tribe Diploporeae includes the forms of metaspondyl-type of ramification. This very numerous and stratigraphically important tribe was the subject of many redefinitions; in this paper it is treated in the sense of GÜVENÇ (1979).

Tribe **Aciculelleae** BASSOULLET & al., 1979

Genus *Atractyliopsis* ACCORDI, 1956

Atractyliopsis cumberlandensis RICH, 1974

(Pl. 2, Figs 1 and 6)

1974. *Atractyliopsis cumberlandensis* sp. n.; RICH, p. 367, Pl. 1, Figs 16—18 and Pl. 2, Figs 1—9.
1978. *Atractyliopsis cumberlandensis* RICH; MAMET & ROUX, p. 74, Pl. 3, Figs 7—9 [*cum syn*].

MATERIAL: Three specimens in thin sections.

DIMENSIONS (*in* μm): Maximum external dimension of calcareous sleeve 600, internal dimension of axial canal 400, width of pores 20—80.

DESCRIPTION: The calcareous sleeve sourrounding thallus is cylindrical, but not too regular in its shape (*see* Pl. 2, Fig. 1). Ellipsoidal pores are arranged inside the sleeve.

REMARKS: The species *A. cumberlandensis* has hitherto been known from sections perpendicular to the main axis, in which calcareous sleeve is circular, and pores are unilayered. The illustrated specimen (Pl. 2, Fig. 1) allows to define a cyllindrical shape of the thallus, which confirms previous suggestions of MAMET & ROUX (1975a, p. 257).

Genus *Coelosporella* WOOD, 1940

Coelosporella jonesii WOOD, 1940

(Pl. 2, Figs 2—5)

1940. *Coelosporella jonesii* sp. n.; WOOD, p. 16, Pl. 2, Figs 3—4.
1978. *Coelosporella jonesii* WOOD; MAMET, MORTELMANS & ROUX, p. 363, Pl. 5, Figs 1—8 [*cum syn.*].

MATERIAL: 10 specimens in thin sections.

DIMENSIONS (*in* μm): Width of calcareous sleeve 200—250, longer axis of pores 180—250, shorter axis of pores 130—180.

DESCRIPTION: In the majority of specimens the calcareous sleeve is arched; the pores inside the sleeve are circular or ellipsoidal.

Tribe **Diploporeae** PIA, 1920; emend. GÜVENÇ, 1979; *non* emend. BASSOULLET & *al.*, 1979

Subtribe **Albertaporellinae** GÜVENÇ, 1979

Genus *Albertaporella* (JOHNSON, 1966), emend. GÜVENÇ, 1979

Albertaporella radiata (MAMET & RUDLOFF, 1972)

(Pl. 3, Fig. 1)

1972. *Windsoporella radiata* sp. n.; MAMET & RUDLOFF, pp. 83—84, Pl. 3, Figs 18—25.
1979. *Albertaporella radiata* (MAMET & RUDLOFF); GÜVENC, pp. 632—633.
1980. *Windsoporella radiata* MAMET & RUDLOFF; VACHARD, p. 282, Pl. 11, Figs 3, 5—6.

MATERIAL: One, very well preserved specimen in thin section.

DIMENSIONS (*in* μm): External dimension of sleeve 360, internal dimension of sleeve 180—220, diameter of pores 30—60.

REMARKS: The investigated specimen is somewhat greater than those described by MAMET & RUDLOFF (1972). The type of ramification and the shape of pores unequivocally allow to attribute the species *radiata* to the genus *Albertaporella*.

Albertaporella aff. *occitanica* (VACHARD, 1974)

(Pl. 3, Figs 2, 4)

MATERIAL. Three specimens in thin sections.

DIMENSIONS (*in* μm): Maximum dimension of sleeve 1300, interverticil distance 500, maximum diameter of pores 80.

DESCRIPTION: The investigated specimens show slightly oblique, longitudinal sections, omitting the axial part of the alga. The calcareous sleeve is externally articulated, and the pores are regularly arranged on the surface of the sleeve.

REMARKS: The articulated shape of the sleeve, the type of ramification, and the measurements (*see also* VACHARD 1977, Tab. 2) point to the affinity of the investigated specimens to *A. occitanica.* In the absence of longitudinal axial section it is impossible to recognize the shape of pores and of the axial canal, which precludes a more detailed classification.

?Subtribe **Albertaporellinae** GÜVENÇ, 1979

Genus *Kulikia* (GOLUBTSOV, 1961), emend. SKOMPSKI, 1984

Kulikia sphaerica (GOLUBTSOV, 1961), emend. SKOMPSKI, 1984

1961. *Kulikia sphaerica* sp. n.; GOLUBTSOV, pp. 348—351, Pl. 1, Figs 1—18.
1966. *Coelosporella wetheredii* WOOD; CONIL & LYS, p. 207, Pl. 1, Fig. 2.
non 1979. *Kulikia sphaerica* GOLUBTSOV; MASSA & VACHARD, Pl. 3, Fig. 1.
non 1980. *Kulikia sphaerica* GOLUBTSOV; MAMET, DEJONGHE & ROUX, pp. 291—295, Pl. 1, Figs 1—2
1980. *Kulikia sphaerica* GOLUBTSOV; MUROMTSEVA, pp. 22—24, Pl. 1, Figs a—z, *non* Pl. 1, Fig. e [= *K. rozovskaiae*].
1984a. *Kulikia sphaerica* (GOLUBTSOV); SKOMPSKI, pp. 429—430, Figs 1, 2a—f, 3c—f, 4a.

MATERIAL: 10 specimens with 3—12 verticils, several dozens of fragmentary specimens (1—2 verticils or transversal sections); six pyritized moulds and three calcoreous sleeves chemically prepared.

REMARKS: The description of the species and a discussion of the functional morphology of ramification, are given in a previous paper (SKOMPSKI 1984a).

Kulikia rozovskaiae (MAMET & ROUX, 1975), emend. SKOMPSKI, 1984

1975a. *Sphinctoporella* (?) *rozovskaiae* sp. n.; MAMET & ROUX, p. 260, Pl. 11, Figs 7—13.
1975a. *Sphinctoporella* (?) aff. *rozovskaiae* sp. n.; MAMET & ROUX, p. 260, Pl. 11, Figs 14—16.
1980. *Kulikia sphaerica* GOLUBTSOV; MUROMTSEVA, pp. 22—24, Pl. 1, Fig. e.
1984a. *Kulikia rozovskaiae* (MAMET & ROUX); SKOMPSKI, pp. 430—433, Figs 2e—f, 3a—b, 4b.

MATERIAL: 8 specimens in thin sections; three pyritized moulds and one calcareous sleeve.

REMARKS: The description of the species is given in a previous paper (SKOMPSKI 1984a).

Diploporeae gen. indet.

Several dozens of specimens, which exact classification is impossible, have been found among the investigated dasyclad algae. The state of preservation and a small number of specimens usually allow to define only the internal or external structure of the alga, but never these two features together. All these forms are very close to the specimens of the genus *Kulikia* (in the metaspondyl-type of ramification), but they differ from this genus in the kind of symmetry and in the shape of pores

Form *A*

MATERIAL: Over a dozen specimens in thin sections, 8 prepared fragments of the calcareous sleeve.

DESCRIPTION: Chemically prepared specimens are fragments of articulated algae, characterized by pentagonal (Pl. 18, Figs 5—7) or hexagonal (Pl. 18, Figs. 8—10) axial symmetry. Maximum diameter of sleeve is about 750 μm and the diameter of axial canal about 250 µm. The specimens in the thin sections (*see* Pl. 4, Figs. 1—5) are externally articulated and their verticil segments do not touch each other (Pl. 4, Fig. 5). Maximum diameter of the sleeve is about 1000 µm and diameter of the axial canal about 300—500 µm. In both cases the external surface of the sleeve is covered with cup-like hollows.

REMARKS: The specimens in thin sections can be interpreted as oblique sections of the prepared forms. The structural resistance of this alga is reduced by long joints, and this can explain a finding of prepared forms only as isolated segments.

The discussed specimens are similar to those of the genus *Kulikia* in the dimension of sleeve, in the segmentation of thallus, in the presence of cup-like hollows on the sleeve surface, and probably in the metaspondyl-type of ramification (resulted from the axial symmetry). They differ from this genus in the kind of symmetry, because *Kulikia* is characterized by tetragonal symmetry, while the recognized specimens are pentagonal or hexagonal. This feature (observable only in the perpendicular to the main axis sections) seems to be diagnostic for different genera of Paleozoic Diploporeae.

Form *B*

MATERIAL: Three specimens in thin sections.

DIMENSIONS (*in* µm): Maximum dimension of of sleeve 700, maximum dimension of the axial canal 240, longer axis of the branch 80, interverticil distance 750.

DESCRIPTION: The investigated specimens represent (*see* Pl. 10. Figs. 3—5) oblique sections of the articulated dasyclad algae with two-stage ramification. The ellipsoidal first- and second-order branches are arranged in the verticils. The first-order branches are coupled and everyone of the branch is divided into several secondary branches. The latter are ended with deep cortex-cells (*sensu* ZORN 1972).

REMARKS: The discussed specimens are close to those of the genus *Kulikia* in the two-stage type of ramification and in the articulated shape of its sleeve, they differ in the shape of branches and cortex-cells.

Tribe **Bereselleae** MASLOV & KULIK, 1956

Genus *Beresella* MACHAEV, 1937

Beresella sp.

(Pl. 8, Figs 3, 5)

MATERIAL: Two specimens in thin sections.

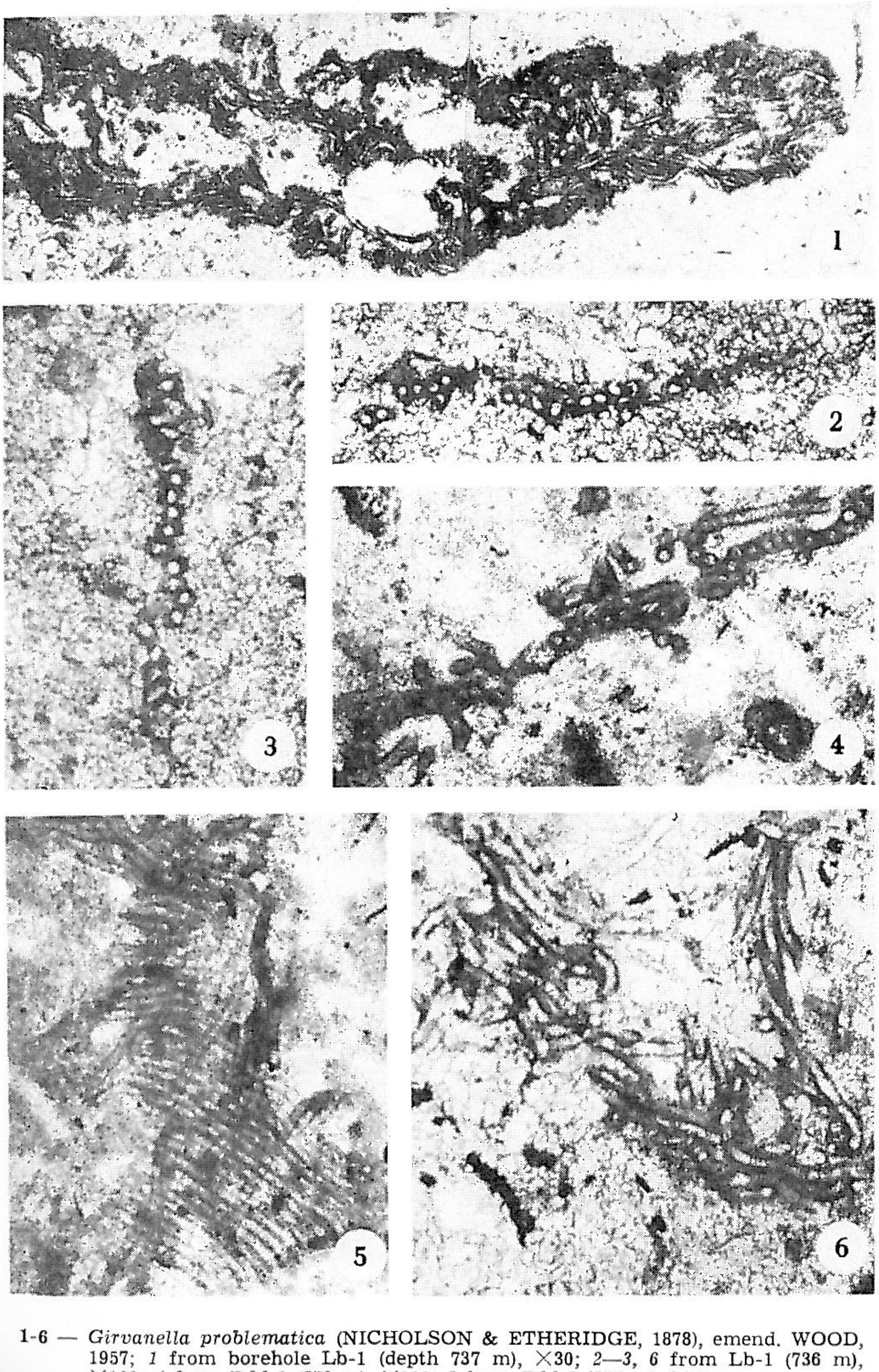
REMARKS: External, thin calcareous envelope makes the investigated specimens resemble to the species *B. translucea* KULIK which, however, is characterized by considerably wider porous units of the cortex. The investigated specimens are very close to the specimens described as *Beresella* sp. by MAMET & RUDLOFF (1972, p. 85, Pl. 5, Figs 5—7).

Genus *Exvotarisella* ELLIOTT, 1970

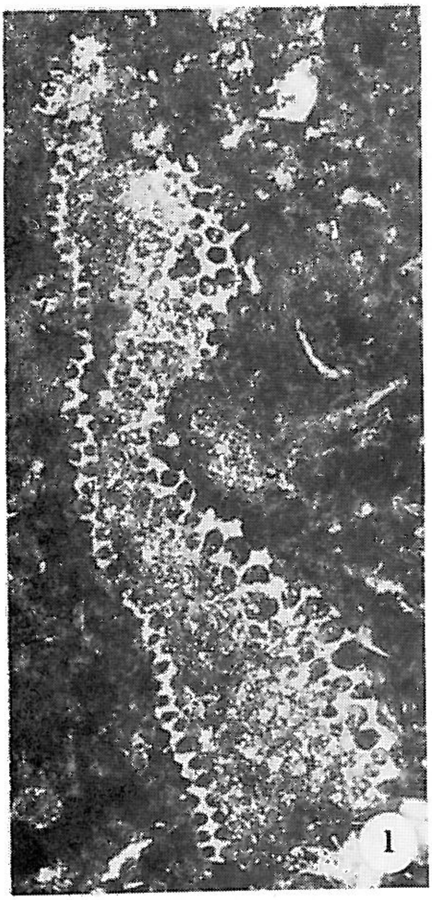
Exvotarisella maponi ELLIOTT, 1970

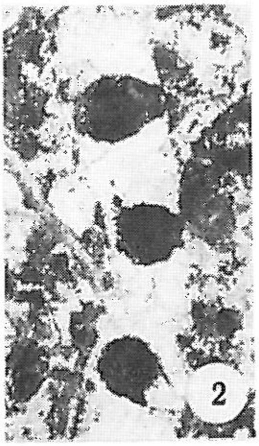
(Pl. 7, Figs 4—8; Pl. 8, Figs 1, 6—8 and Pl. 9, Figs 5—6)

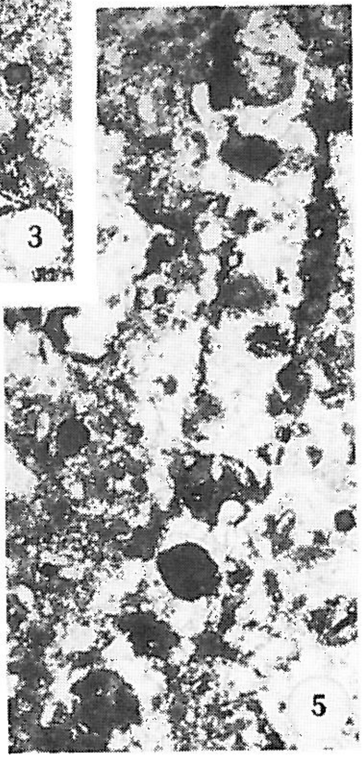
1969. *Anthracoporellopsis machaevi* MASLOV; PELHATE, pp. 67—68, Pl. 6, Fig. 76.
1969. *Anthracoporella* sp.; PELHATE, p. 63, Pl. 6, Fig. 73.
1970. *Exvotarisella maponi* sp. n.; ELLIOTT, p. 446—449, Pl. 82, Figs 1—5 and Pl. 83, Figs 1—5.

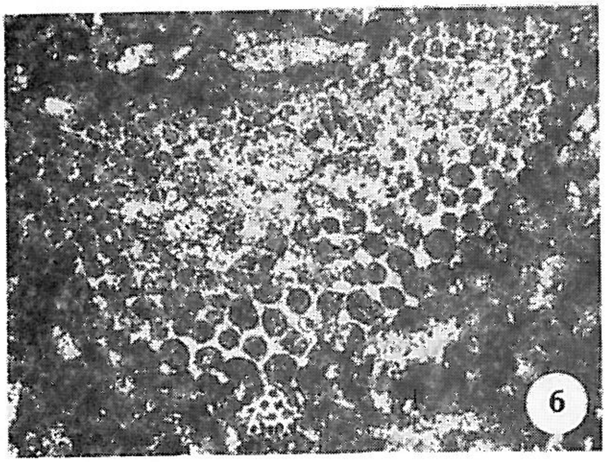


1-6 — *Girvanella problematica* (NICHOLSON & ETHERIDGE, 1878), emend. WOOD, 1957; *1* from borehole Lb-1 (depth 737 m), ×30; *2—3*, *6* from Lb-1 (736 m), ×100; *4* from Pdd-2 (573 m), ×100; *5* from Pdd-5 (577 m), ×90



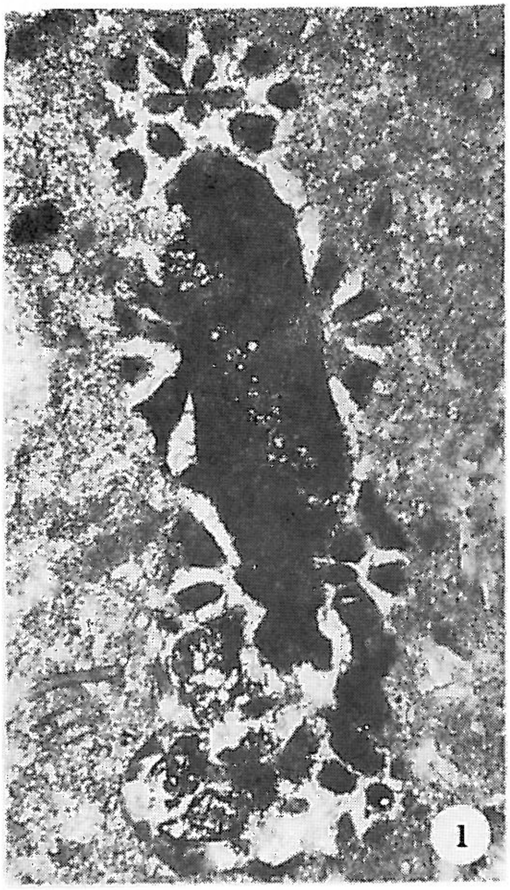


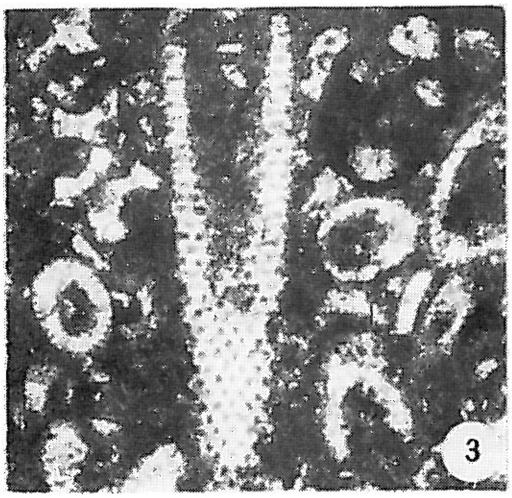




1, 6 — *Atractyliopsis cumberlandensis* RICH, 1974; *1* longitudinal axial section, borehole Pdd-2 (depth 603 m), ×55; *6* section tangential to the surface of calcareous sleeve, Pdd-2 (595 m), ×100

2-5 — *Coelosporella jonesii* WOOD, 1940; all from Wł-4 (384 m), ×45

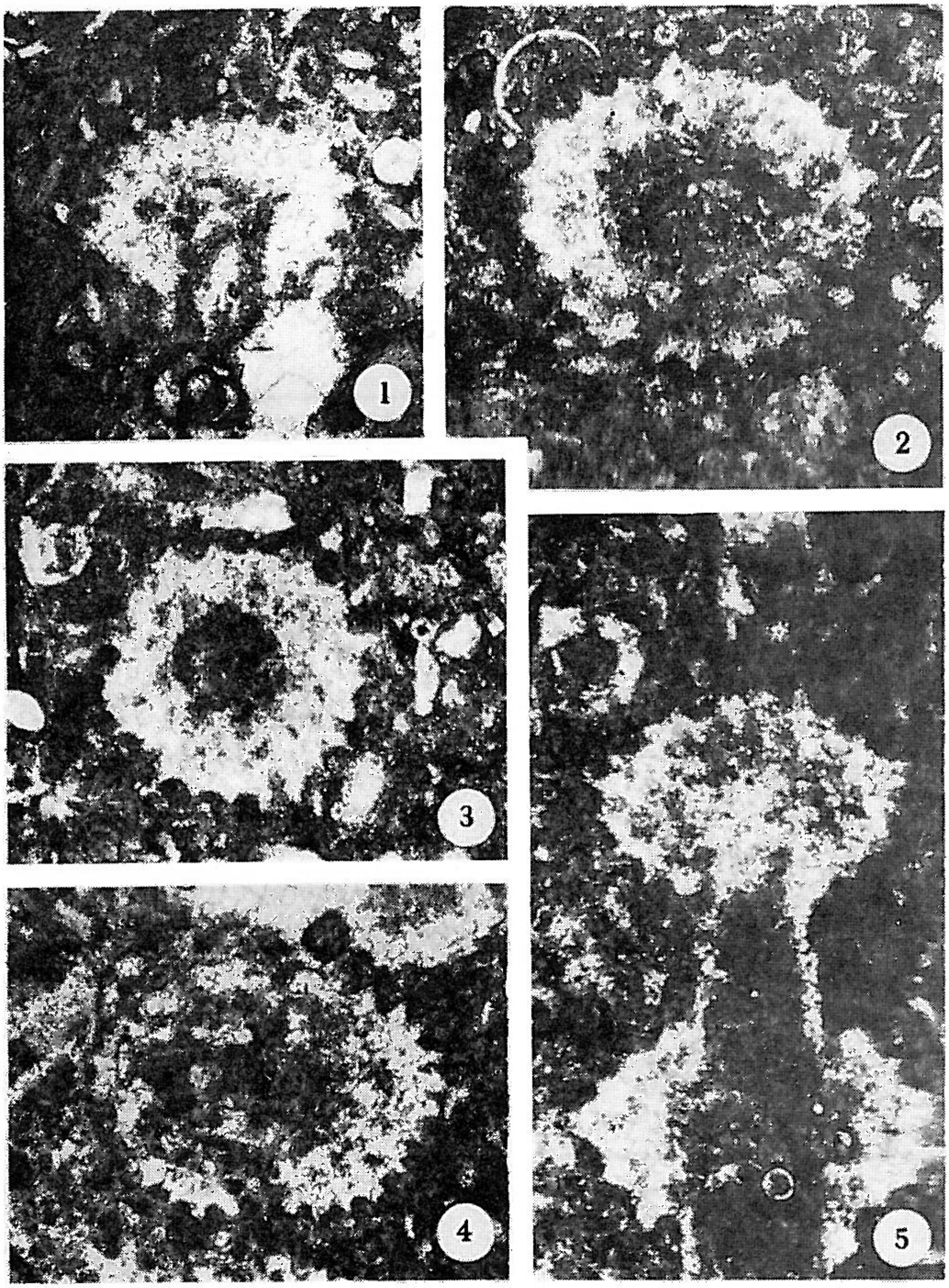




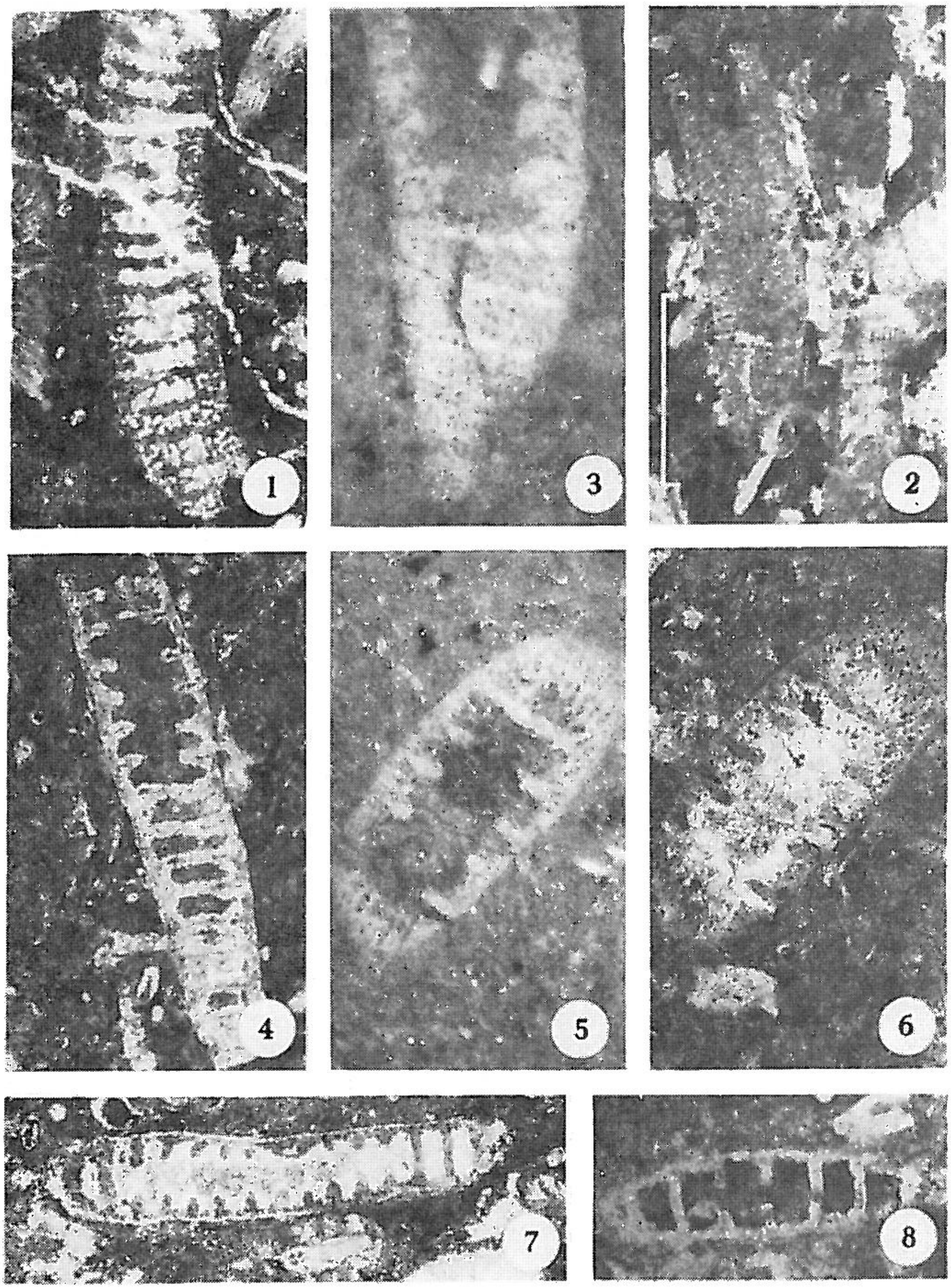
1 — *Albertaporella radiata* (MAMET & RUDLOFF, 1972); longitudinal axial section, borehole Lb-1 (depth 736 m), ×100

2, 4 — *Albertaporella* aff. *occitanica* (VACHARD, 1974); sections oblique to the algal axis; *2* from Wł-4 (376 m), ×30; *4* from Pdd-2 (593 m), ×35

3 — *Nanopora anglica* (WOOD, 1964), emend. PERRET & VACHARD, 1977; longitudinal, slightly oblique section from Pa-8 (1071 m), ×65

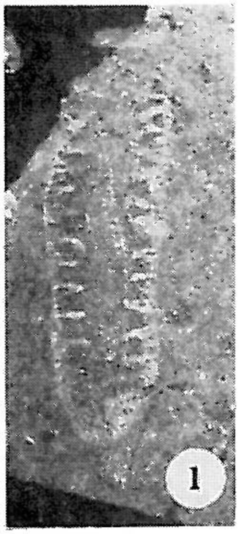


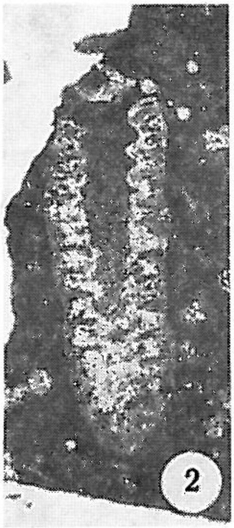
1-5 — Diploporeae gen. indet., Form *A*; *1, 3—4* from borehole W1-4 (depth 377 m), ×55; *2, 5* from Pdd-2 (570 m), ×55

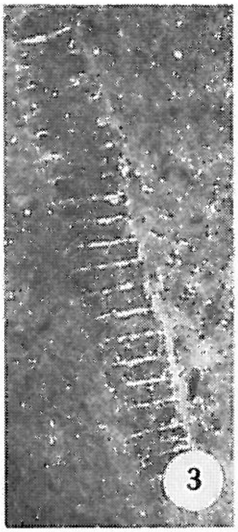


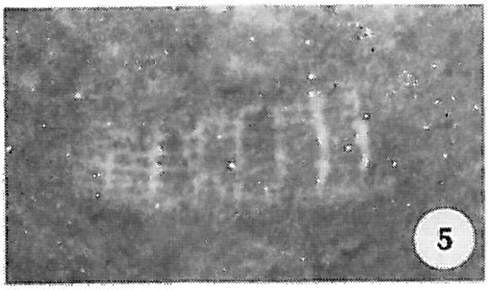
Kamaena delicata ANTROPOV, 1967

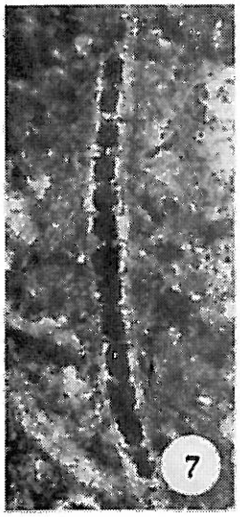
1 — longitudinal, slightly oblique section (in lower part, a net-like structure of calcarcous wall is visible), specimen from borehole Pdd-2 (depth 584 m), × 40; **2, 4** — longitudinal, slightly oblique sections from Pdd-2 (605 m), × 30; **3** — enlarged part of Fig. 2, × 60 (reflected light); **5—6** — sections through the curled part of specimen from Pdd-2 (605 m), × 30; **7** — specimen with external neomorphic layer, from Pdd-2 (605 m), × 30; **8** — longitudinal section, from Prz-1 (833 m), × 40





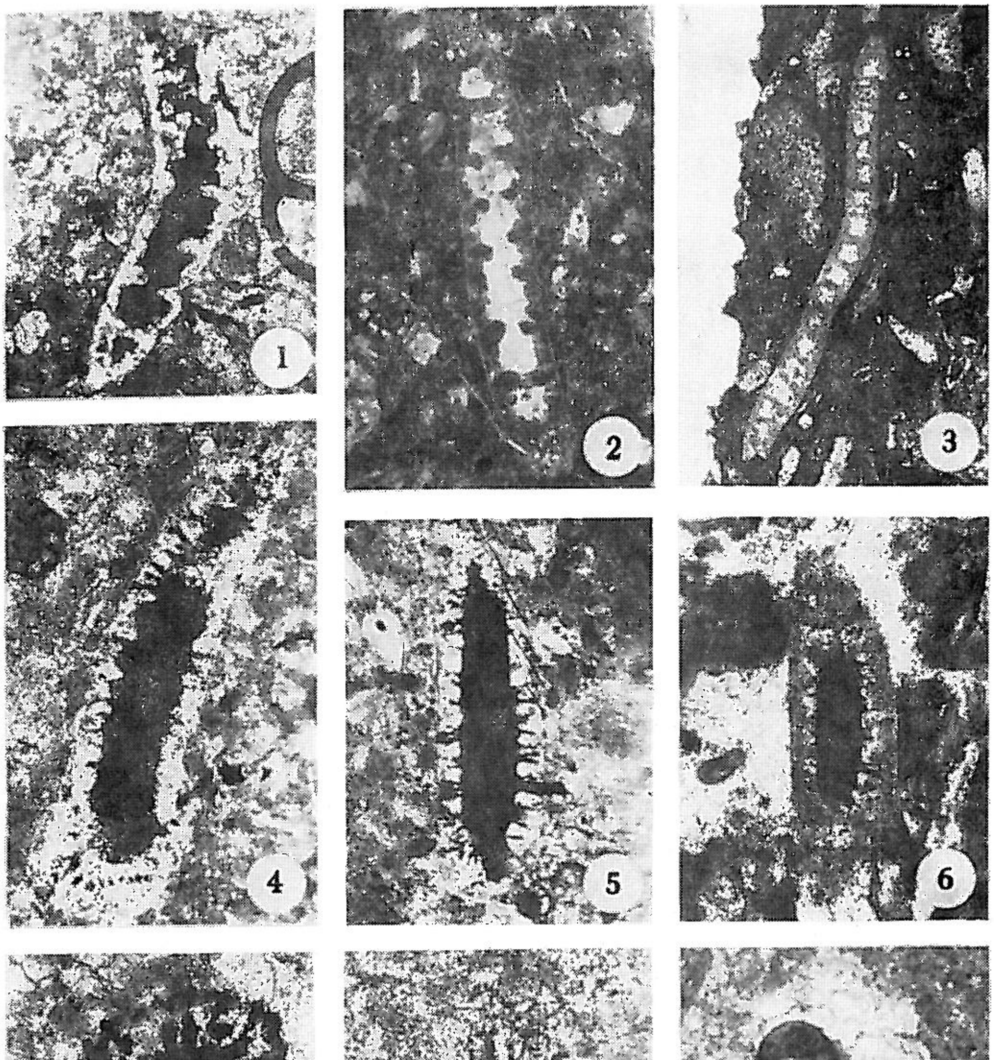






1-6 — *Kamaena delicata* ANTROPOV, 1967 — different stages of neomorphism; all specimens from borehole Pdd-2 (depth 604-605 m), ×30 (Figs. 1, 3, 5 in reflected light)

7-10 — *Kamaena awirsi* MAMET & ROUX, 1974 — longitudinal axial sections; 7 from Pdd-2 (605 m), ×120; *8* from Pdd-2 (604 m), × 150; *9—10* from Pdd-2 (603 m), ×150



1-3 — *Kamaena delicata* ANTROPOV, 1967 — longitudinal sections; *1* from borehole Pdd-2 (depth 594 m), ×40; *2* from Pdd-2 (605 m), ×30; *3* from Pdd-2 (596 m), ×25

4-9 — *Exvotarisella maponi* ELLIOTT, 1970; *4—6* longitudinal axial sections; *4*, *6* from Pdd-2 (592 m), ×60; *5* from Wh-1 (653 m), ×50; *7—9* transverse sections, all from Pdd-2 (591 m), ×130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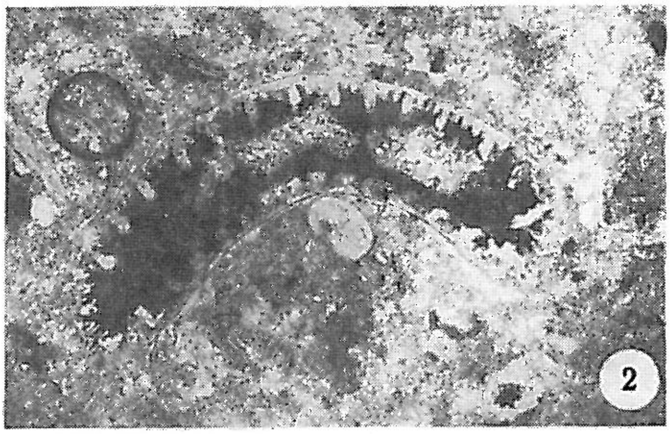
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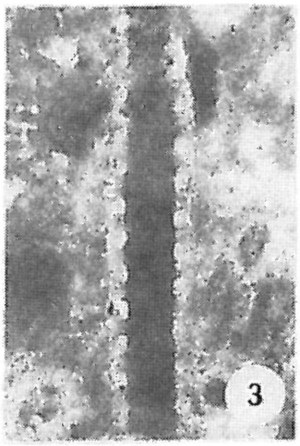
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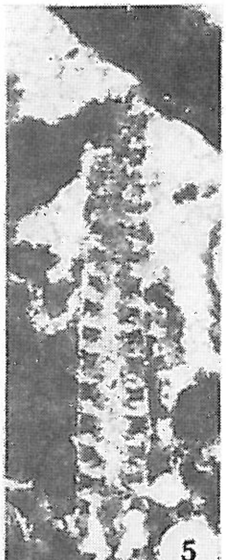
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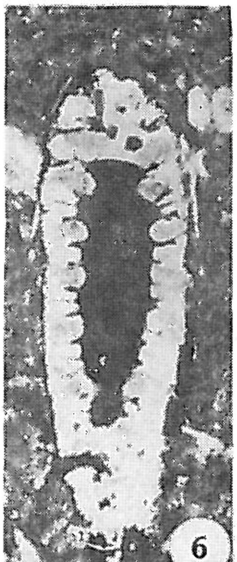
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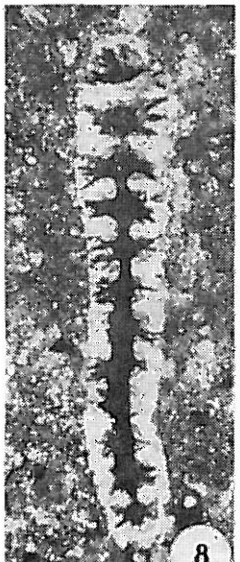
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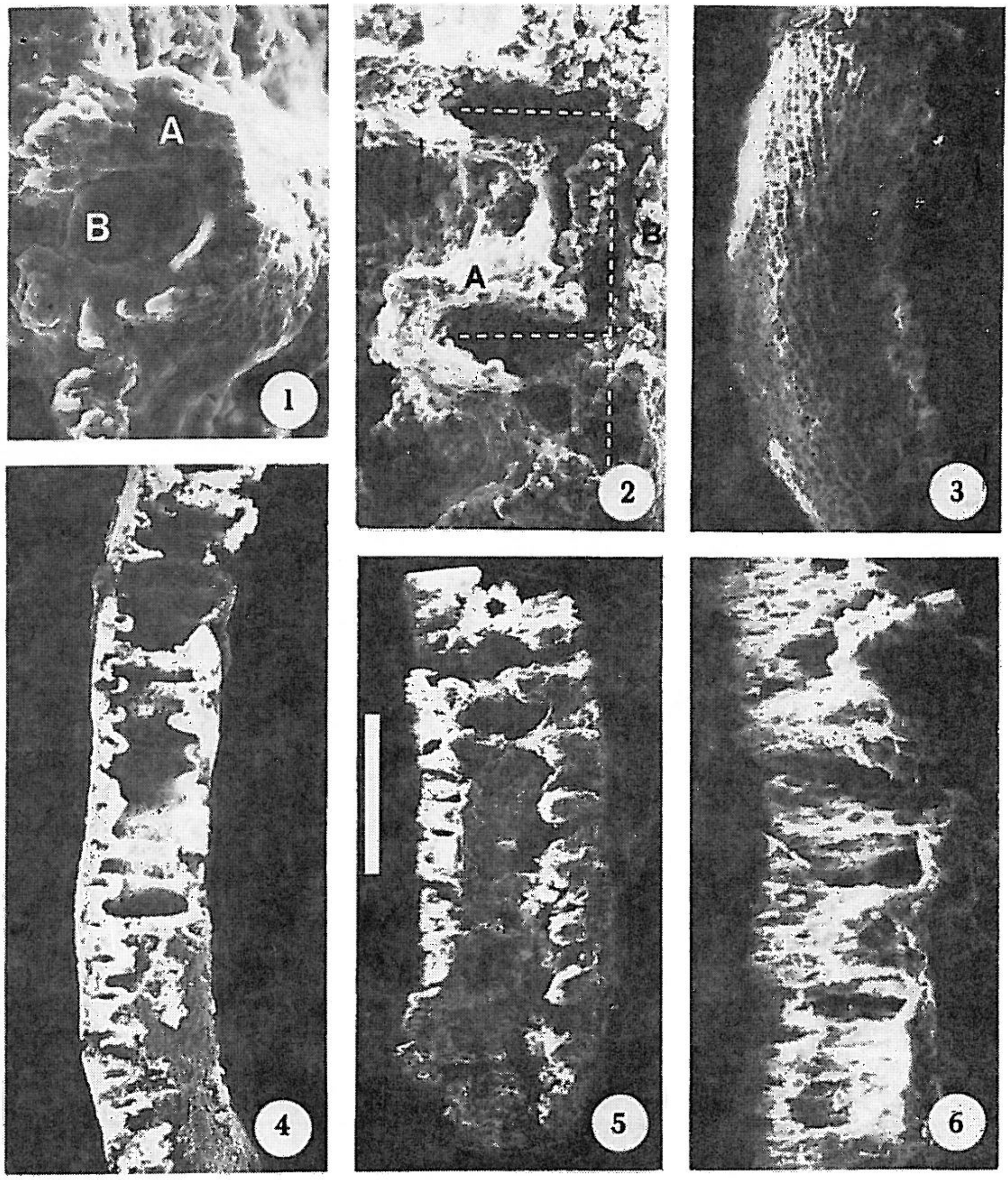
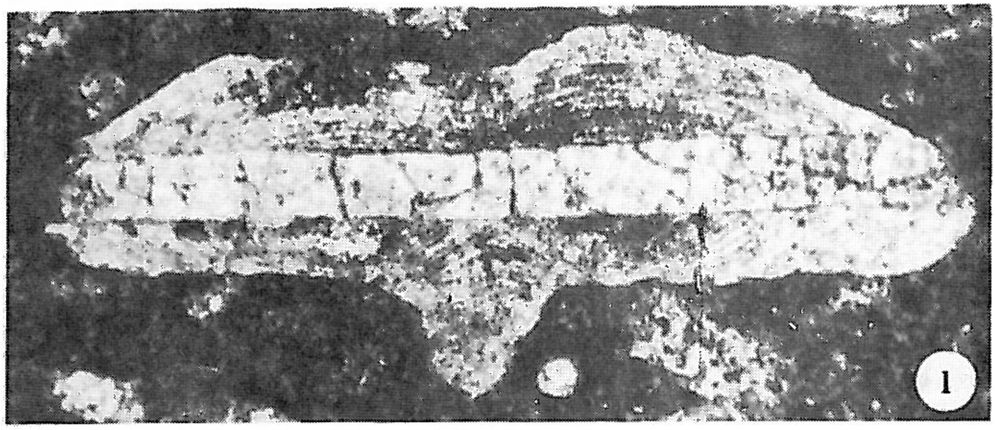
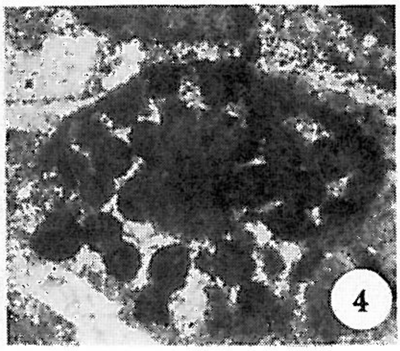


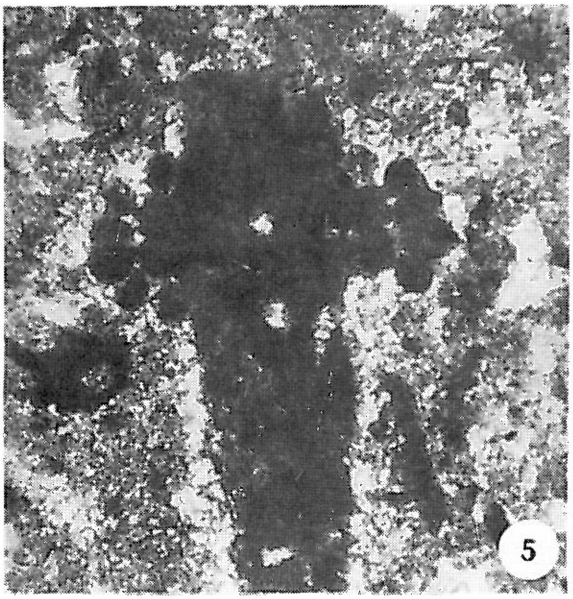
1-4 — *Kamaena delicata* ANTROPOV, 1967 — chemically prepared specimens; *1* transverse section through the partition: *A* neomorphic layer, *B* primary layer, ×700; *2* external (*B*) and internal (*A*) neomorphic layers, ×650; *3* net-like surface of calcareous sleeve, ×50; *4* longitudinal axial section, ×40

5-6 — *Exvotarisella maponi* ELLIOTT, 1970 — chemically prepared specimen; longitudinal axial section, white bar in Fig. 5 shows fragment enlarged in Fig. 6 (*5* is ×30, *6* is ×60)

All specimens from borehole Pdd-2 (depth 605 m)

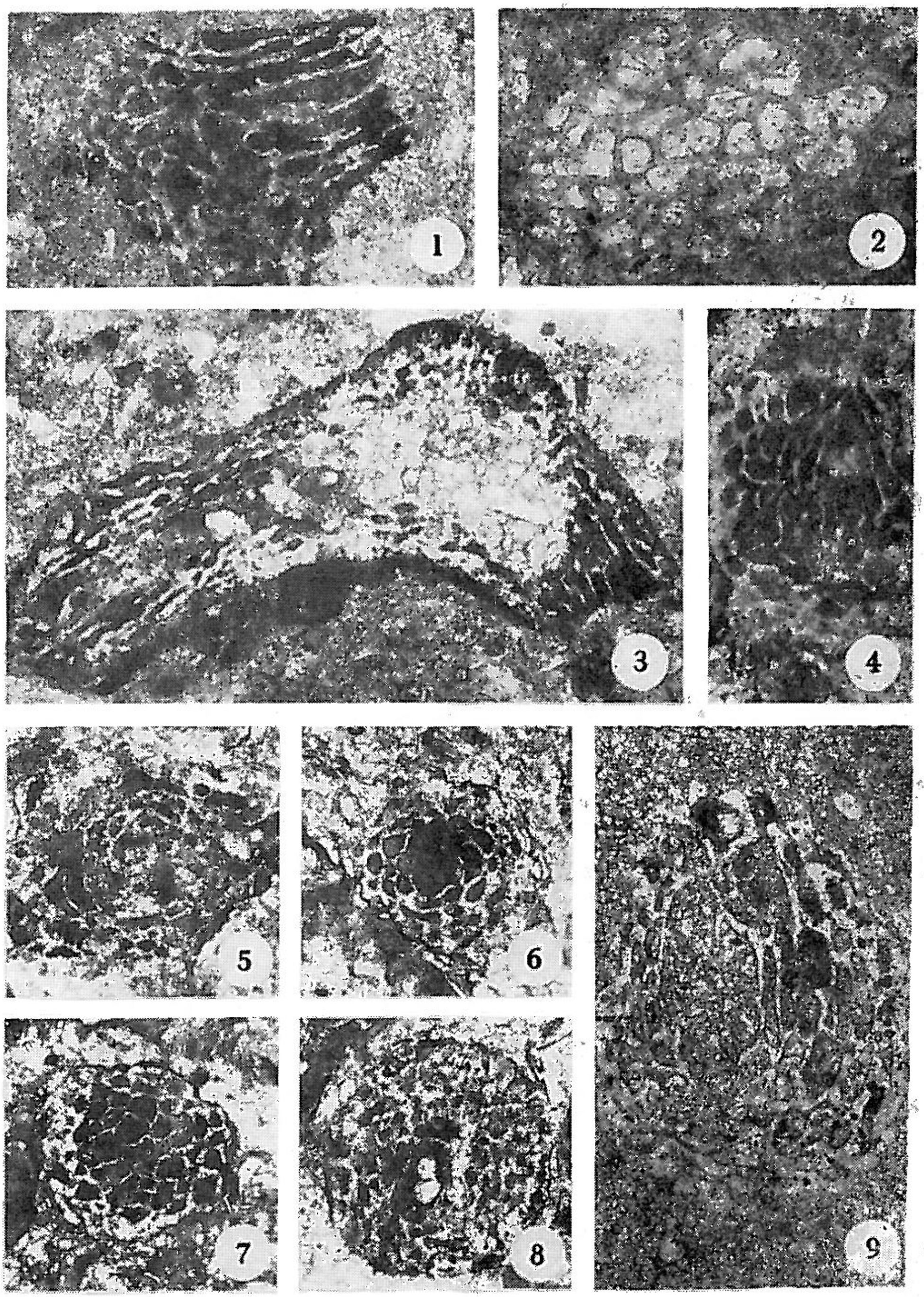




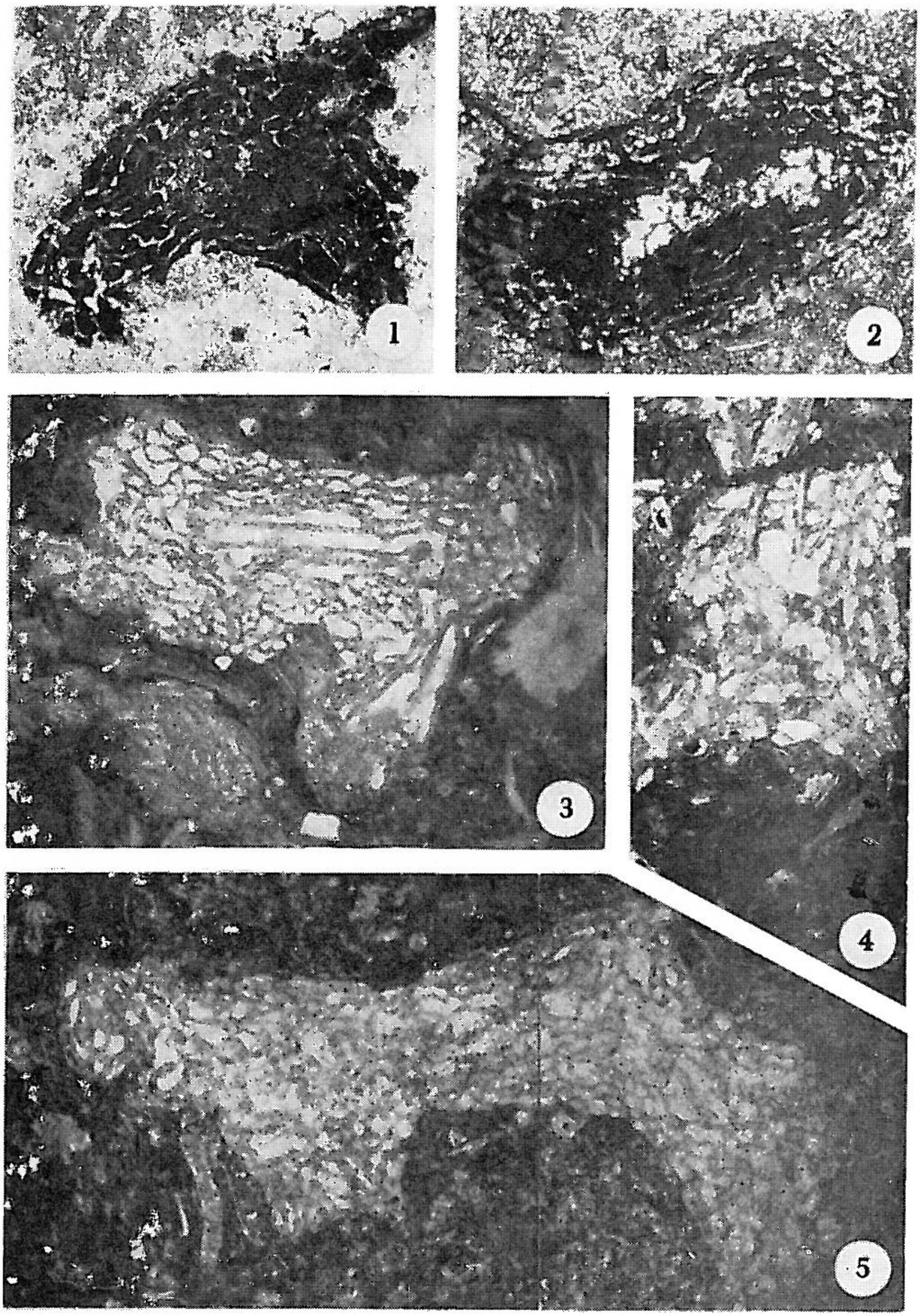


1—2 — *Eflugelia johnsoni* VACHARD, 1977; *1* from borehole Prz-1 (depth 828 m), × 55; *2* enlarged part of Fig. 1, × 110

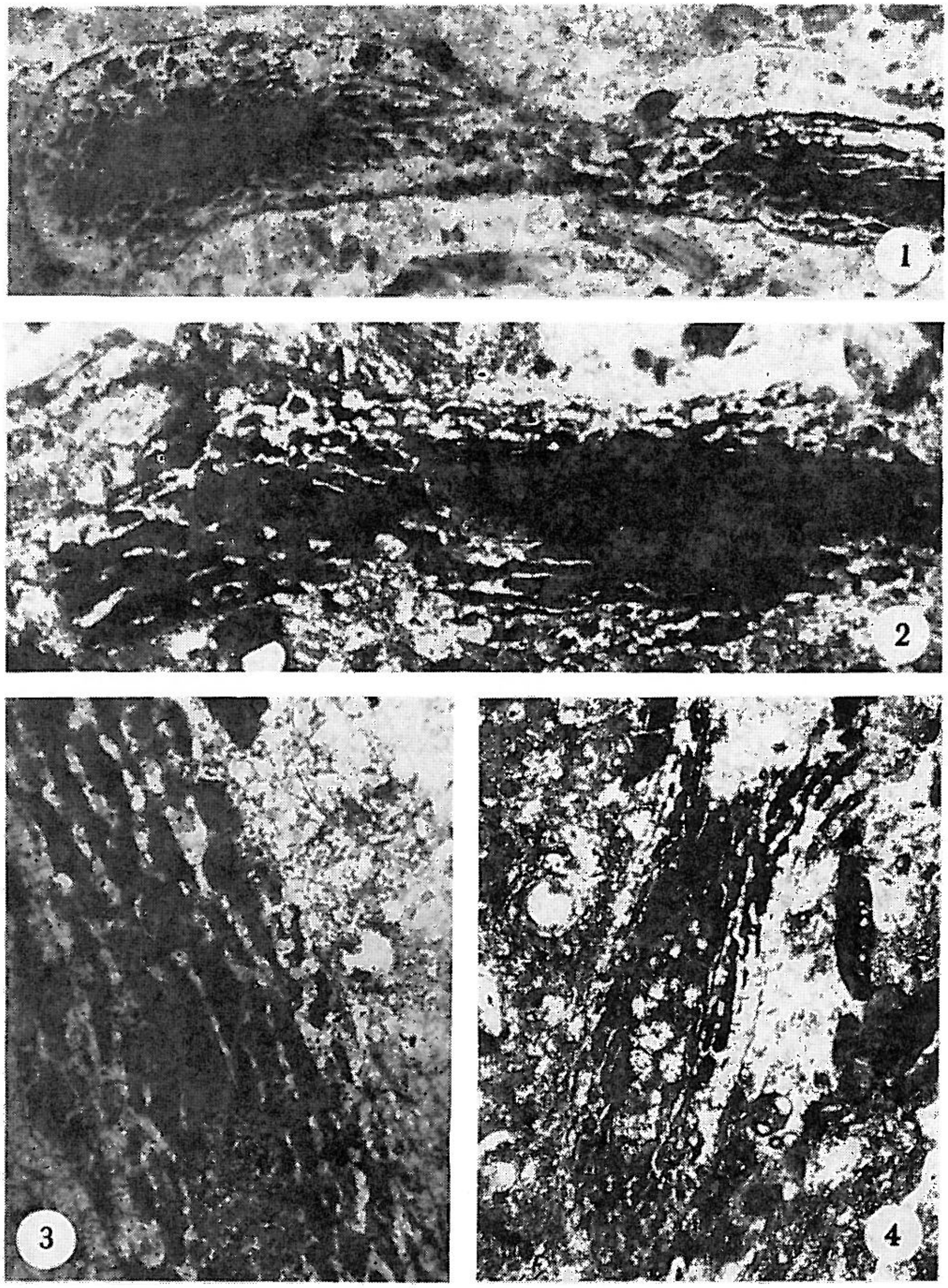
3—5 — Diploporeae gen. indet., Form *B*; *3* from Pdd-2 (591 m), × 80; *4* from Wł-4 (409 m), × 80; *5* from Wh-1 (653 m), × 80



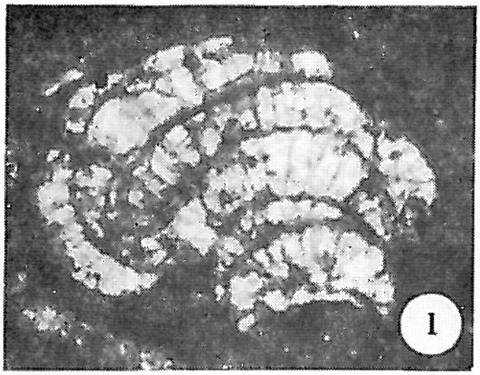
1-9 — *Stacheoides polytrematoides* (BRADY, 1876); *1, 2, 4* from borehole Lb-1 (depth 732 m), ×75; *3* from Rd-1 (754 m), ×60; *5—8* from Pdd-2 (594 m), ×60 and *9* from Prz-1 (821 m), ×90

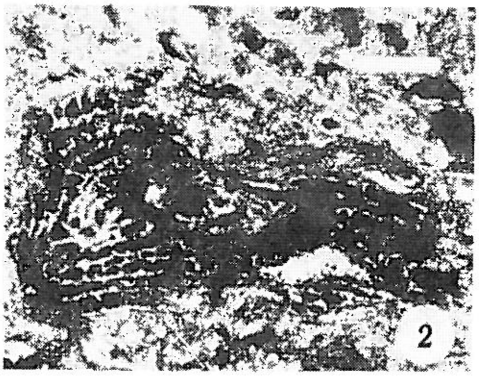


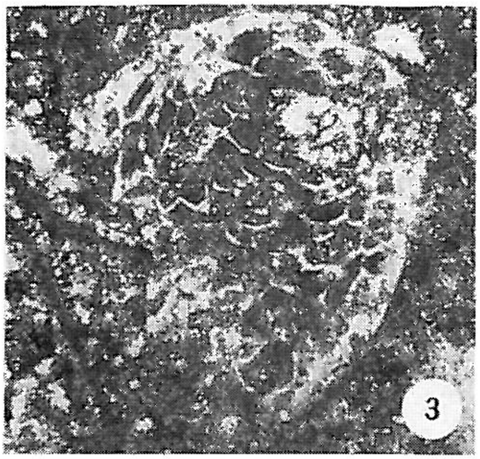
1-5 — *Stacheoides polytrematoides* (BRADY, 1876); *1* from borehole Lb-1 (depth 737 m), ×60; *2* from Pdd-2 (588 m), × 40; *3—5* from Lb-1 (733 m), ×40 Figs. *3* and *5* in reflected light)

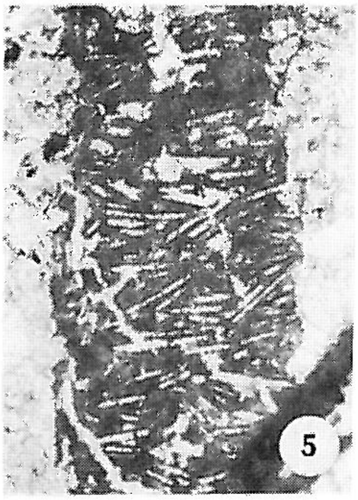


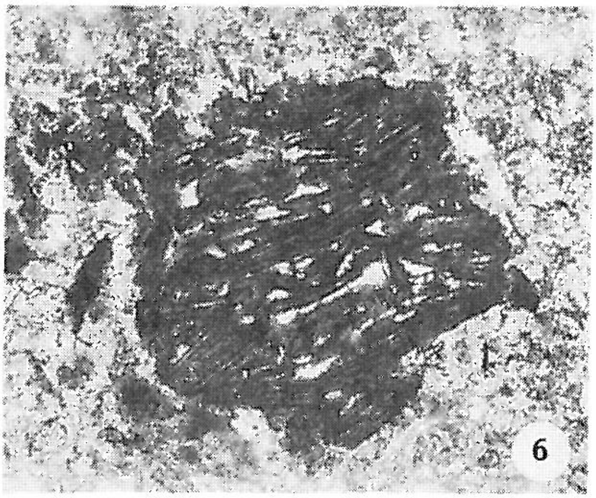
1-4 — *Pseudostacheoides loomisi* PETRYK & MAMET, 1972; *1* from borehole Lb-1 (depth 738 m), × 40; *2* from Pdd-2 (594 m), ×40; *3* from Wł-4 (409 m), ×70; *4* from Pdd-2 (596 m), ×40









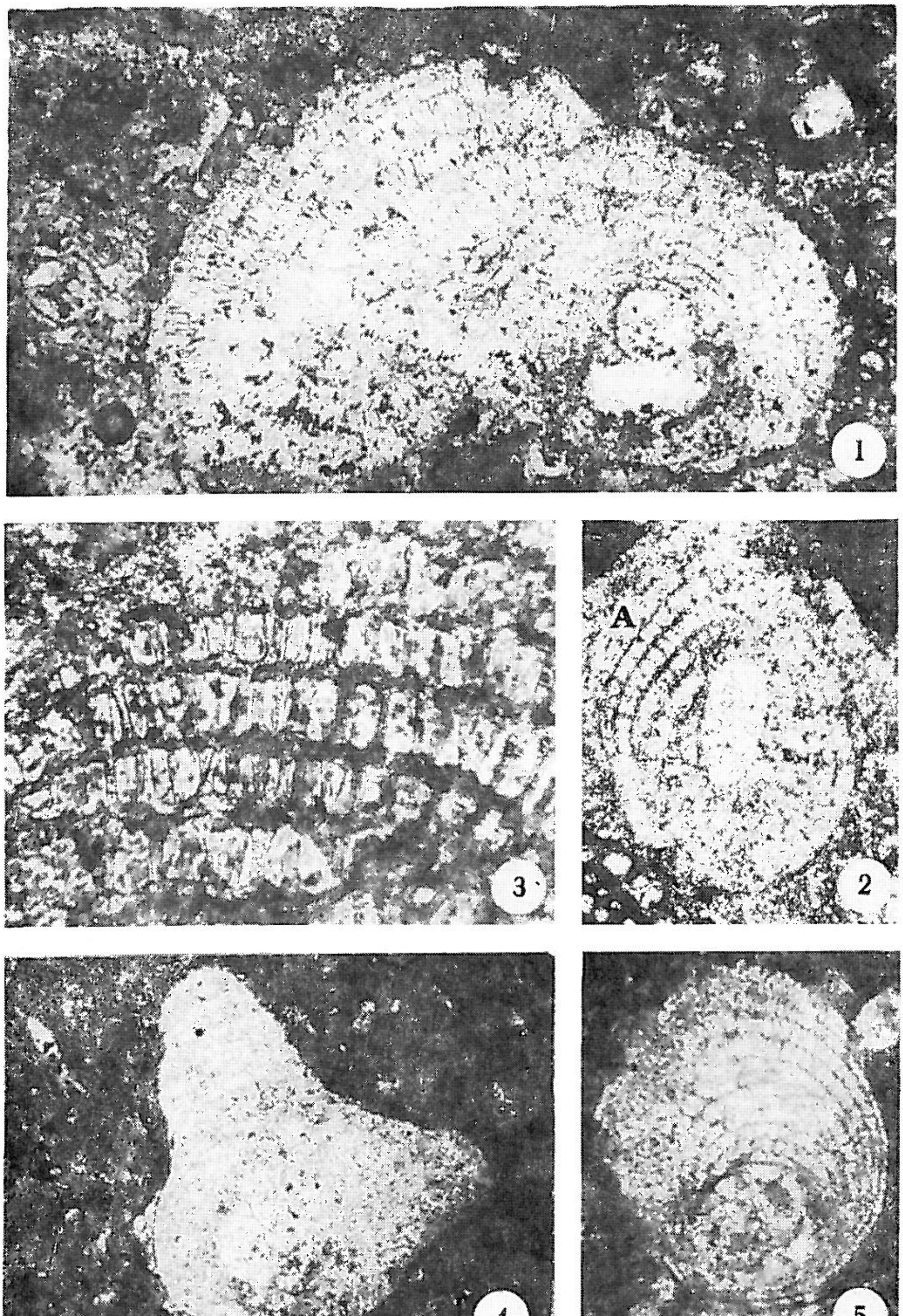


1 — *Stacheia marginulinoides* BRADY, 1876; from borehole Pdd-2 (depth 561 m), ×110

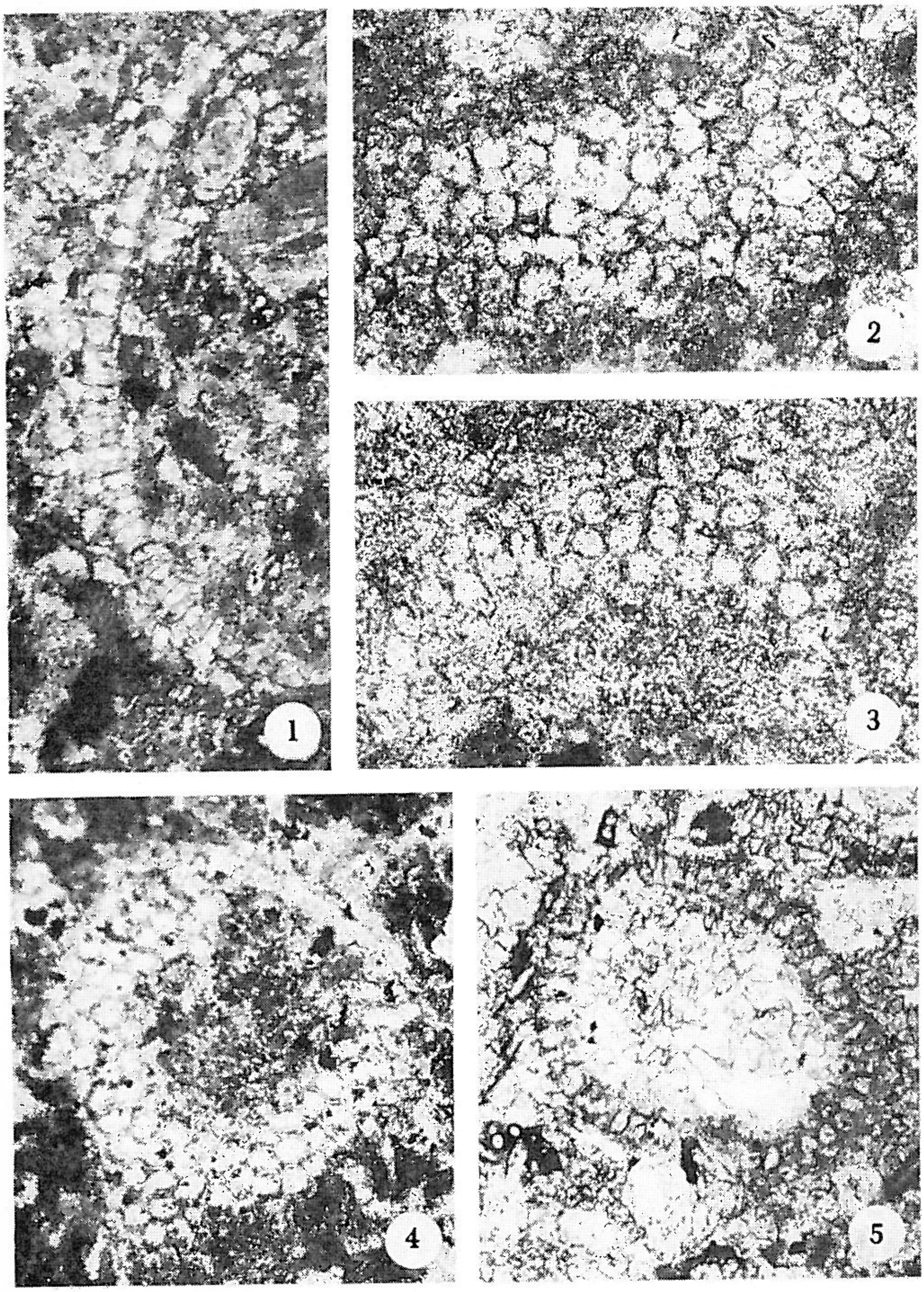
2 — *Aoujgalia* aff. *richi* MAMET & ROUX, 1978; from Pa-10 (984 m), ×70

3-4 — *Stacheoides polytrematoides* BRADY, 1876; *3* from Lb-1 (734 m), ×70; *4* from Pdd-2 (596 m), ×40

5-6 — *Rectangulina tortuosa* (ANTROPOV, 1950); *5* from Pdd-2 (592 m), ×60, *6* from Wł-4 (376 m), ×50



1—5 — *Fourstonella fusiformis* (BRADY, 1876); *1* from borehole Pdd-2 (depth 591 m), × 120; *2* from Lb-1 (733 m), × 120 (*A* shows fragment enlarged in Fig. 3); *4—5* from Pdd-2 (584 m), × 110



1-5 — *Hypocaustella cartimandue* ELLIOTT, 1980; *1* section transverse to the layer of cells, specimen from borehole Wł-4 (depth 410 m), ×80; *2—3* sections tangential to the layer of cells, *2* from Prz-1 (829 m), ×130; *3* from Lb-1 (733 m), ×140; *4* section through the marginal part of spherical form, from Wł-4 (410 m), ×120; *5* section through the central part of spherical form, from Lb-1 (736 m), ×100

1974\. *Exvotarisella index* (von MÖLLER); MAMET & ROUX (*partim*), pp. 148—150, Pl. 5, Figs 20, 22, 24 and Pl. 6, Fig. 8.
1975\. *Anthracoporellopsis index* (von MÖLLER); TERMIER, TERMIER & VACHARD, p. 81, Pl. 5, Fig. 1 and Pl. 10, Fig. 5.
1978\. *Exvotarisella index* (von MÖLLER); MAMET, MORTELMANS & ROUX, pp. 359—360, Pl. 3, Fig. 11.

MATERIAL: About 60 specimens in thin sections, and several specimens chemically prepared.

DESCRIPTION: These tubular algae are externally non-articulated. Internally, the tubes are also not segmented, but sometimes internal appendices of the cortex look like transverse, not too regular partitions (Pl. 8, Fig. 8). The pores in the cortex are sporadically branching dichotomously, and in the transverse sections of tubes a two-stage type of ramification is visible (Pl. 7, Fig. 8). Diameter of the tubes ranges from 160 to 400 μm.

REMARKS: The pores with the second-order dichotomy and a lack of distinct segmentation indicate an attribution of the discussed species to the tribe Bereselleae, accordingly to the opinion of ELLIOTT (1970). MAMET & ROUX (1974) considered *E. maponi* ELLIOTT as a synonym of *Exvotarisella index* (von MÖLLER), and they included the genus *Exvotarisella* into the tribe Palaeoberesellеae. According to these authors, the genus *Exvotarisella* is characterized by internally segmented forms, with regular, curved to conical partitions, and with dichotomously branching pores in the cortex. However, the shape of partitions results from neomorphic processes, and it should be noted that out of the specimens, described by MAMET & ROUX (1974) as *E. index*, only several display the porosity. Therefore, the genus *Exvotarisella* is understood in this paper in the sense of ELLIOTT (1970), and the specimens described by MAMET & ROUX (1974) are assigned either to the species *E. maponi* (if they show distinct porosity and a lack of segmentation) or to the species *Kamaena delicata* (if they are internally articulated).

Tribe **Palaeobereselleae** MAMET & ROUX, 1974

To this group belong tubular microorganisms with a diversified structure of the calcareous wall, and segmented with partitions. The group is considered as representing the calcareous algae (ANTROPOV 1959; KULIK 1964; MAMET & ROUX 1974), although some authors classify it among the foraminifers (MENNER & REITLINGER 1971; RIDING & JANSA 1974; TOMAŚ 1974), the calcareous sponges (TERMIER, TERMIER & VACHARD 1975, 1977; VACHARD 1980), or simply among the Devonian — Carboniferous microproblematics (LANGER 1979). The investigated specimens from the Lublin Coal Basin do not solve that problem, but they deliver some data about the outer morphology and the structure of the wall, what in consequence involves a revision of some former determinations.

MAMET & ROUX (1974) presented for the discussed group a classificational scheme which is based mainly on the shape of the cell, determinated by walls of the tube and transverse partitions; as the additional features they regarded

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PLATE 8

1, 6-8 — *Exvotarisella maponi* ELLIOTT, 1970 — longitudinal sections; *1, 6, 8* from borehole Prz-1 (depth 819 m), ×100; *7* from Wł-4 (384 m), ×100
2 — *Kamaena delicata* ANTROPOV, 1967 — longitudinal axial section, to show pseudoporosity of calcareous wall; from Lb-1 (737 m), ×40
3, 5 — *Beresella* sp. — longitudinal axial sections, both from Lb-1 (714 m), ×40
4 — *Kamaenella* aff. *denbighi* MAMET & ROUX, 1974; from Prz-1 (833 m), ×40

porosity of the wall, branching of the tube as well as the width of particular elements (the tube, the wall, partitions, *etc.*). ZADOROZHNYJ & YUFEREV (1980) used also other features, *e. g.* an average height of the cell. The presented material from the Lublin Coal Basin indicates that at least a part of these features was dependent on neomorphic processes in the sediment and, consequently, devoid of any taxonomic importance.

An analysis of the structure of the Palaeoberesellеae was supplemented by observations performed in the reflected light, with a use of the white filter placed below the thin section (method of DELGADO, 1977), as well as by investigations of chemically prepared specimens.

THE INFLUENCE OF NEOMORPHISM

In the original stage, the calcareous wall of the investigated Palaeobereselleae, is composed of micrite or microsparite. It is generally enough sparitic to be brighter than micritic matrix, and enough micritic to be darker than sparitic infilling of the tube (*see e. g.* Pl. 5, Fig. 1). During diagenesis of sediments with the Palaeobereselleae, the mode of recrystallization was two-directional (*cf.* MAKSIMOVA 1977). On one hand, fine-grained calcite, building both the cortex and the partitions, was transformed into sparitic calcite (Pl. 7, Fig. 1), or it was replaced by silica or pyrite. On the other hand, the original surface of the tube could be covered by a sparitic envelope, with only partial preservation of micritic walls. The latter process caused a thickening of the wall and partitions, and a rounding of primarily rectangular junctions of the wall and partitions. In the final stage, sparite could fill the whole space inside the tube. This type of recrystallization, recognizable in this sections, is confirmed by the prepared specimens. During the dissolution of limestones with 10% acetic acid, micritic parts are dissolved considerably quicker than the sparitic ones. In consequence of such selective dissolution, the inner, micritic parts of the wall and partitions are dissolved, whereas the external envelopes (sparitic and neomorphic) are preserved (*see e. g.* Pl. 9, Figs 1—2 and 4). Under the microscope, the neomorphic layers can be distinguished from the original ones in reflected light: fine-grained fragments are white and brighter, while sparitic parts mix with gray matrix (*see e. g.* Pl. 6, Figs 1—4; Pl. 5, Figs 2—3). The observations indicate that such features as the shape of cells (ovate or rectangular) and the thickness of walls and partitions can be treated only as secondary diagenetic features, and thus they should not have any taxonomical importance. This consequently implicates recognition of the genera *Palaeoberesella* and *Exvotarisella* sensu MAMET & ROUX (1974) as diagenetic taxa (*cf.* remarks to the species *Exvotarisella maponi*).

DIMENSIONS AS THE TAXONOMICAL FEATURE

The width of the tube and the height of the cell (*viz.* distance between twc partitions) as well as other indexes connected with these measurements are dependent on orientation of the thin section. Merely the measurements made in the axial section, perpendicular or parallel to the axis of an alga, have taxonomical value. The most important parameter seems to be the ratio of the width of a cell to its height.

It should be noted that a favoring only one individual diameter can give reasonable mistakes. For instance, an analysis of the tube width for the species described by MAMET & ROUX (1974) shows that this differentiation, on this base only, between *Kamaena delicata*, *Kamaena* aff. *delicata* and *Kamaena maclareni* is extremely arbitrary, in the face of continous change of parameter. A similar situation is in the case of the species *Kamaenella tenuis* and *K. denbighi*. However, the presence of a distinct measurement gap between *Kamaena awirsi* and *K. pirleti* justifies a separateness of these two species.

POROSITY IN THE CALCAREOUS WALL

The majority of genera assigned by MAMET & ROUX (1974) to the tribe Palaeoberesselleae is characterized by the straight pores. This is, however, not confirmed in illustrations: out of several hundred of excellent micrographs presented by MAMET & ROUX, only a dozen or so specimens display porosity, what was already noticed by ZADOROZHNYJ & YUFEREV (1980). The investigated specimens rarely present porosity (*see e. g.* Pl. 8, Fig. 2). These data can be explained with the aid of chemically prepared specimens. In the tribe Palaeoberesselleae, the structure of the wall is regular and reticular (Pl. 9, Fig. 3), and it is also visible in the reflected light (Pl. 5, Fig. 2). Probably this structure, dependent on the angle of cross section, can simulate an effect of porosity and even of branching pores.

The observations of porosity in the tribe Palaeoberesselleae have important significance for taxonomy of this tribe. The Palaeoberesselleae together with the tribe Bereselleae are the group of calcareous algae which, owing to their axial structure and porosity of the wall, remind the Dasycladales. The bringing of porosity *s. stricto* to question, removes the tribe Palaoberesselleae from the tribe Bereselleae, and generally, from the order Dasycladales. However, the reticular structure of the wall contradicts a suggestion about an assignation of this group to the foraminifers, and shows its distinct affinity to the red algae of the family Ungdarellaceae (*see* remarks on the tribe Stacheiinae). This opinion, although highly speculative in the present knowledge on calcareous algae, was already announced by VACHARD (1980).

Genus *Kamaena* ANTROPOV, 1967
(= *Palaeoberesella* MAMET & ROUX, 1974; = *Anthracoporellopsis* MASLOV, 1956)

REMARKS: MASLOV (1956b) described as *Anthracoporellopsis machaevi* poorly preserved, fragmentary specimens, which corresponded with the latter description of *Kamaena delicata* ANTROPOV, 1967. The only difference in these two descriptions was the type of pores in the cortex: according to MASLOV (1956b) the pores could branch, whereas ANTROPOV (1967) reported straight pores. However, it should be noted that MASLOV did not illustrate dichotomously branched pores (*cf.* remarks of JOHNSON 1963, p. 11), and also ANTROPOV (1967) did not any presence of pores at all. In the light of the above remarks on pseudo-porosity in the Palaeoberesselleae, this feature ought to be considered as rather accidental and visible only in some cross sections. The next feature which caused creation of the genus *Palaeoberesella* by MAMET & ROUX (1974) was the shape of partitions (rectangular in *Kamaena*, and curved to conical in *Palaeoberesella).* As is proved above, this shape, and consequently the shape of the cell are dependent on the stage of neomorphism (*see* Pl. 6, Fig. 1). Therefore, the present author consideres the genus *Anthracoporellopsis* MASLOV and *Palaeoberesella* MAMET & ROUX as synonyms of the genus *Kamaena*. Acording to the priority rule, the correct name should be *Anthracoporellopsis*, but any acceptation of this name can only enlarge confusion in the taxonomy of that group, because a description of the type species, *A. machaevi* did not specify diagnostic features of the taxon. Furthermore, the description is discordant with illustrations.

The synonimization of *Kamaena* with *Anthracoporellopsis* was already proposed by VACHARD (*in:* TERMIER, TERMIER & VACHARD 1975, pp. 79-80), but it was subsequently objected by MAMET & ROUX (1978).

Kamaena delicata ANTROPOV, 1967

(Pl. 5, Figs 1—8; Pl. 6, Figs 1—6; Pl. 8, Fig. 2 and Pl. 9, Figs 1—4)

1956b. *Anthracoporellopsis machaevi* sp. n.; MASLOV, p. 62, Text-fig. 15 and Pl. 13, Figs 3—4.
1966. *Nodosinella* sp.; AJZENVERG & BRAZHNIKOVA, p. 123, Pl. 22.
1967. *Kamaena delicata* sp. n.; ANTROPOV, pp. 123—124, Pl. 27, Figs 1—2, 4.
1971. *Moravammina tatarstanica* (ANTROPOV); MENNER & REITLINGER, Pl. 7, Fig. 9; Pl. 8, Fig. 13 and Pl. 12, Fig. 10.
1972. *Kamaena maclareni* sp. n.; MAMET & RUDLOFF, p. 87, Pl. 5, Fig. 15.
1974. *Nodosinella tatarstanica* (ANTROPOV); TOMAŠ, pp. 192—193, Pl. 1, Figs 1—4 and Pl. 2, Figs 1—4.
1974. *Kamaena delicata* ANTROPOV; MAMET & ROUX, p. 142, Pl. 1, Figs 11—32.
1974. *Kamaena* aff. *delicata* ANTROPOV; MAMET & ROUX, p. 142, Pl. 2, Figs 1—5.
1974. *Palaeoberesella lahuseni* (von MÖLLER); MAMET & ROUX, pp. 144—145, Pl. 2, Figs 20—27; Pl. 3, Figs 1—29 and Pl. 4, Figs 1—17.
1974. *Exvotarisella index* (von MÖLLER); MAMET & ROUX (*partim*), p. 143, Pl. 5, Figs 1—19 and Pl. 6, Figs 1—2, 4—6.
1975b. *Anthracoporellopsis machaevi* MASLOV; MAMET & ROUX, p. 264, Pl. 13, Figs 9—11.
1976. *Kamaena delicata* ANTROPOV; MAMET, Pl. 5, Fig. 1.
1976. *Palaeoberesella lahuseni* (von MÖLLER); MAMET, Pl. 6, Fig. 2; Pl. 56, Fig. 3 and Pl. 59, Figs 2—3.
1978. *Exvotarisella index* (von MÖLLER); JANSA & *al.*, p. 1434, Pl. 1, Fig. 14.
1978. *Palaeoberesella lahuseni* (von MÖLLER); JANSA & *al.*, p. 1434, Pl. 1, Figs 15 and 18.
1978. *Kamaena delicata* ANTROPOV; JANSA & *al.*, pp. 1432—1433, Pl. 1, Fig. 16.
1978. *Anthracoporellopsis machaevi* MASLOV; MAMET & *al.*, p. 360, Pl. 3, Fig. 16.
1980. *Kamaena delicata* ANTROPOV; ZADOROZHNYJ & YUFEREV, p. 106, Pl. 1, Figs 1—5.

MATERIAL: A large number of specimens in more than 60 thin sections, sometimes in the rock-forming amount; several specimens chemically prepared.

DESCRIPTION: The cells are rectangular, wider than high. Partitions are of the same thickness as the cortex (about 20 µm). Maximum diameter of the tube is about 400 µm . The straight, non-branching pseudo-pores are visible in the larger (wider than 150 µm) specimens (*see* Pl. 5, Figs 1-2 and Pl. 8, Fig. 2).

REMARKS: The investigated specimens are considerably greater than those described by ANTROPOV (1967), but their measurements are consistent with the description of *K.* aff. *delicata* by MAMET & ROUX (1974). Pseudoporosity of *K. delicata*, resulting from a reticular structure of the cortex, is well visible in the larger specimens, because the meshes have not been filled by neomorphic calcite.

Kamaena awirsi MAMET & ROUX, 1974

(Pl. 6, Figs 7—10)

1974. *Kamaena awirsi* sp. n.; MAMET & ROUX, p. 141, Pl. 1, Figs 7—10.
1980. *Kamaena awirsi* MAMET & ROUX; ZADOROZHNYJ & YUFEREV, p. 107, Pl. 2, Figs 1—4.
1983. *Kamaena awirsi* MAMET & ROUX; MAMET & ROUX, p. 72, Pl. 5, Fig. 6.

MATERIAL: Six specimens in thin sections.

DESCRIPTION: The cells are quadratic; diameter of tubes ranges from 60 to 100 µm.

Genus *Kamaenella* MAMET & ROUX, 1974

Kamaenella aff. *denbighi* MAMET & ROUX, 1974

(Pl. 8, Fig. 4)

MATERIAL: One, poorly preserved specimen in thin section.

DESCRIPTION: The cells are rectangular, twice higher than wide, diameter of the tube is about 110 µm. The branching of the tube is well visible.

REMARKS: The lack of axial section does not allow to estimate the real dimension of the tube, and thus the specific assignation is approximate.

Tribe **Salpingoporelleae** BASSOULLET & al., 1979

Genus *Nanopora* WOOD, 1964

Nanopora anglica (WOOD, 1964), emend. PERRET & VACHARD, 1977

(Pl. 3, Fig. 3 and Pl. 18, Figs 3—4)

1964. *Nanopora anglica* sp. n.; WOOD, pp. 181—185, Pl. 31, Figs 1—3 and Pl. 32, Figs 1—4.
1977. *Nanopora anglica* (WOOD); PERRET & VACHARD, pp. 23—25, Pl. 4, Figs 6—7 [*cum syn.*].
1978. *Nanopora* cf. *fragilissima* MASLOV; JANSA & *al.*, p. 1431, Pl. 1, Figs 19—20.
1978. *Nanopora* sp.; JURKIEWICZ & ŻAKOWA, p. 30, Pl. 6, Figs 5—6.
1980. *Nanopora* cf. *anglica* WOOD; MUROMTSEVA, p. 24, Figs 2a—b.

MATERIAL: Several dozens of specimens in one thin section.

DIMENSIONS (*in* µm): External dimension of the sleeve 60—130, width of the wall 10—40, diameter of the pores 2—14.

DESCRIPTION: The calcareous sleeve is straight, without branching. The pores inside the wall of the sleeve are also straight, slightly widened outwards, arranged in regular, side-by-side lying verticils. The number of pores in verticils ranges from 20 to 50.

REMARKS: According to WOOD (1964), the species *Nanopora anglica* is characterized by pores diametered from 10 to 18 µm. This criterion, in spite of apparent precision not unequivocal, because usually the measurements are dependent on the orientation of the particular sections. With regard to the broadened scope of diversity (*see* PERRET & VACHARD 1977; dimension of tubes from 2 to 18 µm), the investigated specimens exactly correspond to the species *N. anglica.*

Division (?) **Rhodophyta**

Family **Ungdarellaceae** MASLOV, 1956

Tribe **Stacheiinae** LOEBLICH & TAPPAN, 1964

The recognized assemblage contains six genera of the family Ungdarellaceae MASLOV. The classification of this family is very unclear (*see* MAMET & RUDLOFF 1972, PETRYK & MAMET 1972, MAMET & ROUX 1977). According to older opinions, these forms have been assigned to the encrusting foraminifers (CUMMINGS 1955, LOEBLICH & TAPPAN 1964, BRAZHNIKOVA & *al.* 1967). However, the Stacheiinae differ from the other, very numerous Carboniferous foraminifers by yellowish and hyaline calcareous wall, typical of some calcareous algae. The shape of cells also makes these forms resembling the Recent red algae of the family Phylloporaceae. Therefore, PETRYK & MAMET (1972), studying a great number of well preserved, sometimes silicified specimens, assigned the Stacheiinae to the red algae.

A quite different opinion was presented by some French scientists, who consequently assigned this group to the calcareous sponges (TERMIER, TERMIER & VACHARD 1975, 1977; PERRET & VACHARD 1977; MASSA & VACHARD 1979; VACHRD 1980). This view has not currently been accepted, similarly as an attribution of the discussed group to the stromatoporoid hydrozoans (WILSON & *al.* 1963).

In the investigated Viséan limestones the Stacheiinae occur sporadically (except of the genus *Stacheoides*), often as single, poorly preserved specimens.

Genus *Aoujgalia* TERMIER & TERMIER, 1950
Aoujgalia aff. *richi* MAMET & ROUX, 1978
(Pl. 14, Fig. 2)

MATERIAL: One, poorly preserved specimen in thin section.

REMARKS: The species *A. richi,* according to its first description (MAMET & ROUX 1978a, p. 81) differs from the most widespread species *A. variabilis* "par la finesse de ses cloison et par ses cellules plus regulier". The subjectivism of these features causes that the sure assignation is possible only with the greater amount of comparative material.

Genus *Eflugelia* VACHARD, 1979
Eflugelia johnsoni (FLÜGEL, 1966)
(Pl. 10, Figs 1—2)

1966. *Cuneiphycus johnsoni* sp. n.; FLÜGEL, pp. 17—19, Pl. 2, Figs 1—5.
1979. *Eflugelia johnsoni* (FLÜGEL); MASSA & VACHARD, p. 34, Pl. 9, Fig. 10.
1980. *Eflugelia johnsoni* (FLÜGEL); VACHARD, pp. 396—397, Pl. 5, Fig. 2; Pl. 23, Fig. 8; Pl. 25, Fig. 1; Pl. 27, Figs 1—5, 7—8 and Pl. 34, Fig. 9 [*cum syn.*].
1983. "*Eflugelia*" sp. A; GROVES, p. 30, Pl. 8, Figs 6—9.

MATERIAL: One, completely preserved specimen in thin section.

DESCRIPTION: The thallus is composed of the layers of subquadratic cells, with a height of cells about 20 μm. The layers are arranged around the central canal and the younger envelopes cover the older ones. The growth of envelopes is different along the both sides of the canal (*see* Text-fig. 6): in the lower part it is "directional", while above it is "enveloped" (determination of the types *after* TERMIER, TERMIER & VACHARD 1977, Fig. 2). The wall of cells is hyaline and yellowish.

REMARKS: The diagnosis of the genus *Eflugelia*, given by VACHARD (*in:* MASSA & VACHARD 1979), is very incomplete. For that reason, the schematic drawings comparable to the other similar forms (MASSA & VACHARD 1979, Fig. 12; VACHARD 1980, Fig. 73) are more significant to define characteristic features of this monospecific genus. Unfortunately, these drawings present the main feature of the genus, namely the growth of envelopes, in different ways: the first shows directional growth only on one side of the central canal (part "*a*" in Text-fig. 6), while the latter present enveloped growth (the upper part of the form

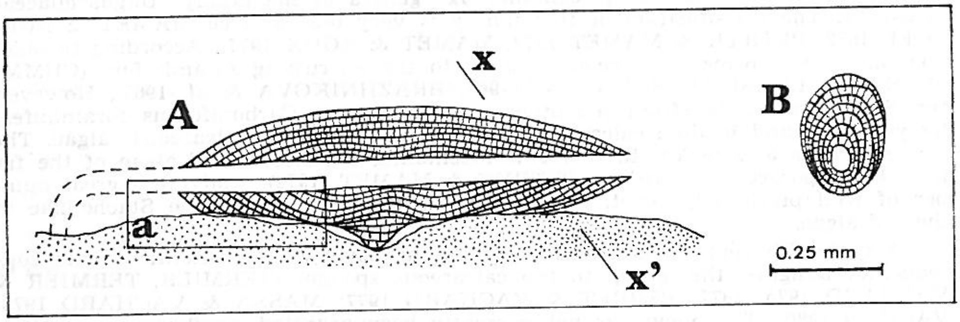


Fig. 6. Schematic sections of *Eflugelia* VACHARD, 1979; **A** — longitudinal axial section, **B** — transverse section along *xx′* line, to show similarity to the genus *Fourstonella* CUMMINGS, 1955
a fragment exemplifying "directional growth"

schematized in Text-fig. 6). The investigated specimen proves that both ways of growth can exist together in one specimen, and probably they are dependent on the growth stage of an alga. In the initial stage, the central canal is probably vertical and the following envelopes are freely composed. In the next stage, position of the canal is horizontal and it causes a directional growth in the lower part of alga (*see* Text-fig. 6).

In consequence of the above argumentation, the genera *Eflugelia* VACHARD, *Fourstonella* CUMMINGS, and *Chuvashovia* VACHARD (*see* comparison by VACHARD 1980, Fig. 73), characterized by the same type of cell, are regarded as the morphotypes of one genus. The diferences are either ecologically controlled (*Eflugelia-Chuvashovia*), or they are effected by different cross sections (*Eflugelia -Fourstonella*, as in Text-fig. 6). However, the present author does not give formal revision because of a too low number of specimens.

Genus *Fourstonella* CUMMINGS, 1955
Fourstonella fusiformis (BRADY, 1876)
(Pl. 15, Figs 1—5)

1876. *Stacheia fusiformis* sp. n.; BRADY, p. 114, Pl. 8, Figs 12—16.
1955. *Fourstonella fusiformis* (BRADY); CUMMINGS, p. 7, Pl. 5, Figs F, G.
1977. *Fourstonella irregularis* sp. n.; MAMET & ROUX, p. 223, Pl. 2, Figs 5—7.
1977. *Fourstonella fusiformis* (BRADY); PERRET & VACHARD, p. 30, Pl. 5, Fig. 3 [*cum syn.*].

MATERIAL: 8 specimens in thin sections.

REMARKS: According to MAMET & ROUX (1977), the species *F. irregularis* differs from *F. fusiformis* only in more irregular structure. In the present author's opinion, these differences can be caused by different orientation of cross sections of the specimens belonging to the same species (*see* remarks on the genus *Eflugelia*).

The illustrated specimen (Pl. 15, Fig. 4), according to the criteria presented by PERRET & VACHARD (1977, Fig. 11) may be assigned to the genus *Cuneiphycus* JOHNSON. However, it would be discordant with the present understanding of this genus, which includes three-dimensional, chainlike algae (*cf.* WRAY 1977b, p. 74, Fig. 74).

Genus *Pseudostacheoides* PETRYK & MAMET, 1972
Pseudostacheoides loomisi PETRYK & MAMET, 1972
(Pl. 13, Figs 1—4)

1972. *Pseudostacheoides loomisi* sp. n.; PETRYK & MAMET, p. 793, Text-fig. 9 (explanation of Text-fig. 7) and Pl. 9, Figs 6—8.
1972. *Pseudostacheoides loomisi* PETRYK & MAMET; MAMET & RUDLOFF, p. 89, Pl. 6, Figs 12—14.
1977. *Pseudostacheoides loomisi* PETRYK & MAMET; MAMET & ROUX, pp. 225—226, Text-fig. 6 and Pl. 4, Figs 1—5.

MATERIAL: Five specimens in thin sections.

REMARKS: The investigated specimens are close to the specimens described by MAMET & RUDLOFF (1972), especially in their measurements (width of wall 70 μm, height of cell 70 μm). The rare pores in the wall are very obscure because of high degree of neomorphism.

Genus *Stacheia* BRADY, 1876

Stacheia marginulinoides BRADY, 1876

(Pl. 14, Fig. 1)

1876. *Stacheia marginulinoides* sp. n.; BRADY, pp. 112—113, Pl. 7, Figs 16—21.

1983. *Stacheia marginulinoides* BRADY; MAMET & ROUX, pp. 81—82, Pl. 8, Fig. 16 [*cum syn.*]

MATERIAL: One specimen in thin section.

Genus *Stacheoides* CUMMINGS, 1955

Stacheoides polytrematoides (BRADY, 1876)

(Pl. 11, Figs 1—9; Pl. 12, Figs 1—5 and Pl. 14, Figs 3—4)

1876. *Stacheia polytrematoides* sp. n.; BRADY, p. 118, Pl. 9, Figs 9—12, *non* 13.

1955. *Stacheoides polytrematoides* (BRADY); CUMMINGS, p. 344, Figs 2—3 and 7—8.

1977. *Stacheoides tenuis* PETRYK & MAMET; BRENCKLE, Pl. 4, Figs 13—15.

1977. *Stacheoides polytrematoides* (BRADY); PERRET & VACHARD, pp. 115—116, Pl. 5, Figs 2, 7 [*cum syn.*].

MATERIAL: Several dozens of specimens in thin sections, sometimes in the rock-forming amount.

DESCRIPTION: In the majority of specimens the cells are pyritized (Pl. 11, Fig. 1), but sometimes, they are sparitized (Pl. 11, Fig. 9). In the latter case the hyaline walls are distinguishable only by yellowish color or they are visible in the reflected light (Pl. 12, Fig. 3-5). Dimensions of the investigated specimens corresponds to those reported by other authors (*see* PERRET & VACHARD 1977, p. 116).

Some of the investigated specimens (Pl. 11, Figs. 5-8) represent sections across protuberances of the extremely large specimens, but concentration of internal canals is not so great as in the species *S. tenuis*, described by BRENCKLE (1977, Pl. 1, Figs. 13-15).

Algal microproblematics

Genus *Globochaete* LOMBARD, 1945

Globochaete alpina LOMBARD, 1945

1945. *Globochaete alpina* sp. n.; LOMBARD, pp. 166—170, Pl. 19.

1960. *Globochaete alpina* LOMBARD; LEFELD & RADWAŃSKI, p. 599, Pl. 38, Figs 4—6; Pl. 39, Fig. 4; Pl. 40, Figs 1, 3—4 and Pl. 41, Figs 3, 5—6.

1968. *Globochaete alpina* LOMBARD; RADWAŃSKI, pp. 52—53, Pl. 6, Figs 3—4 and Pl. 38, Figs 2—3.

1972. *Globochaete alpina* LOMBARD; ZAWIDZKA, pp. 467—472, Pl. 1, Figs 1—2 and Pl. 2, Figs 1—2.

1980. *Globochaete aplina* LOMBARD; MORENO DE CASTRO, Pl. 1, Fig. 1; Pl. 2, Fig. 1 and Pl. 3, Fig. 2.

1982. *Globochaete alpina* LOMBARD; SKOMPSKI, Pl. 1, Figs 1—2; Pl. 2, Figs 1—2 and Pl. 3, Figs 1—7 [*cum syn.*].

1983. *Nostocites* cf. *vesiculosa* MASLOV; GROVES, pp. 31—32, Pl. 7, Figs 7, 10—12.

1983. *Nostocites vesiculosa* MASLOV; MAMET & ROUX, p. 98, Pl. 10, Figs 9—11, *non* Figs 12—13.

MATERIAL: Over a dozen of specimens in thin sections.

REMARKS: The description and discussion of this species are given in a previous paper (SKOMPSKI 1982). The synonimization of the genera *Globochaete* LOMBARD and *Nostocites* MASLOV, as used in that paper, was subsequently questioned by MAMET & ROUX (1983; *cf. also* MAMET & ROUX 1978). It should be noticed, that diagnosis (rather: description) of the genus *Notocites* MASLOV, 1929, given by MAMET & ROUX (1983) is far distant to the original diagnosis given by MASLOV (*cf. also* their different "diagnoses" of the same species, *N. vesiculosa* MASLOV in: MAMET & ROUX 1978 and MAMET & ROUX 1983). Some of the specimens of the latter species, illustrated by MAMET & ROUX (1983), are more similar (in their monostromatic arrangement of cells) to another Carboniferous microproblematicum, *Litostroma* MAMAY, than to linear, chain-like organized *Nostocites* MASLOV (cf. analogous remarks given by GROVES 1983).

Genus *Hypocaustella* ELLIOTT, 1980

Hypocaustella cartimandue ELLIOTT, 1980

(Pl. 16, Figs 1—5)

1980. *Hypocaustella cartimandue* sp. n.; ELLIOTT, pp. 73—77, Figs 1—7.

MATERIAL: A dozen of specimens in thin sections.

DESCRIPTION: The investigated specimens occur either as fragmentary layers of cells or as completely preserved forms with circular outline. In both cases the thallus is monostromatic and it consists of compactly arranged hexagonal cells (Pl. 16, Figs. 2-4). The width of the cells ranges from 20 μm to 50 μm, their depth = thickness of thallus) can imperceptibly exceed the width.

REMARKS: According to the diagnosis given by ELLIOTT (1980), the thallus of *Hypocaustella* is monostromatic, composed of tiny (hexagonal-prismatic) and occasionally larger (rounded-lenticular) cells, originally attached or partly encrusting. The spherical, often crumpled specimens from the investigated material can not certainly be considered as encrusting thalli, and they seem to represent separate organisms (*see* similar specimens presented by ELLIOTT 1980, Fig. 7). The species *Hypocaustella cartimandue* appears to be close to the ancestral corallines (*sensu* WRAY 1977a, b). In the sections tangential to the surface of the thallus, it is very similar to another monostromatic Carboniferous microproblematic, *Litostroma oklahomense* MAMAY, 1959 (*see* illustrations *in*: HOMANN 1972, Fig. 73), which is however unknown as spherical specimens.

Genus *Principia* BRENCKLE, 1982

Principia donbassica (KOSSENKO, 1972)

(Pl. 17, Figs. 1—3)

1972. *Archaeolithophyllum donbassicum* sp. n.; KOSSENKO, pp. 294—295, Pl. 64, Figs 2—3.
1977. *Archaeolithophyllum donbassicum* KOSSENKO; MAMET & ROUX, p. 238, Pl. 6, Fig. 6.
1982. *Principia* cf. *donbassica* KOSSENKO; BRENCKLE, pp. 59—60, Pl. 6, Figs 6—17 and Pl. 7, Figs 1—4.

MATERIAL: 6 specimens in thin sections.

DIMENSIONS (*in* μm): Maximum diameter of thallus 700, maximum diameter of cell 70.

DESCRIPTION: The cyllindrical and branched thallus is composed of polygonal, slightly rounded cells with bright, microsparitic walls.

REMARKS: BRENCKLE (1982) in the description of genus, emphasized the affinity of *Principia* to the genus *Archaeolithophyllum*, and by analogy he used the term hypothallium for the inner part of the thallus. In the investigated specimens it is impossible to distinguish this part; moreover in the specimens illustrated by BRENCKLE it is also very difficult to recognize the hypothallium.

In the original description by BRENCKLE the walls of cells are dark and finegrained, while in the investigated specimens they are bright and microsparitic. This is probably caused by diagenetic processes, extremely intensive in the peripheral part of the thallus (Pl. 17, Fig. 3; and *see also* BRENCKLE 1982, Pl. 7, Fig. 1).

Genus *Rectangulina* (ANTROPOV, 1959)

Rectangulina tortuosa (ANTROPOV, 1950)

(Pl. 14, Figs 5—6)

1950. *Syniella tortuosa* sp. n.; ANTROPOV, pp. 30—31, Pl. 3, Figs 13—14.
1959. *Rectangulina tortuosa* (ANTROPOV); ANTROPOV, pp. 30—31, Pl. 1, Figs 8—10.
1983. *Rectangulina tortuosa* (ANTROPOV); MAMET & ROUX, p. 68, Pl. 1, Fig. 1 [*cum syn.*].

MATERIAL: 3 specimens in thin sections.

REMARKS: The measurements of tubes (dimensions range from 10 to 18 μm) influence the specific assignation of the investigated specimens.

Genus *Saccaminopsis* SOLLAS, 1921

Saccaminopsis sp.

(Pl. 17, Figs 4—6 and Pl. 18, Figs 1—2)

MATERIAL: Several dozens of specimens in thin sections, and 12 specimens chemically prepared.

DESCRIPTION: The genus *Saccaminopsis* in thin sections is represented by circular or ovate forms with a thin, distinct rim, infilled by sparite. Sporadically, these forms are connected one with the other (*see* Text-fig. 7 and Pl. 18, Figs. 1-2). The prepared specimens (sometimes pyritized) represent single segments of longer forms with a rosary-like outline. The segments are ovate, culary ended in one side and elongated in the neck in another one (Pl. 17, Figs. 4-5). A regular network of holes (Pl. 17, Fig. 6) is visible on the surface of some strongly corroded specimens.

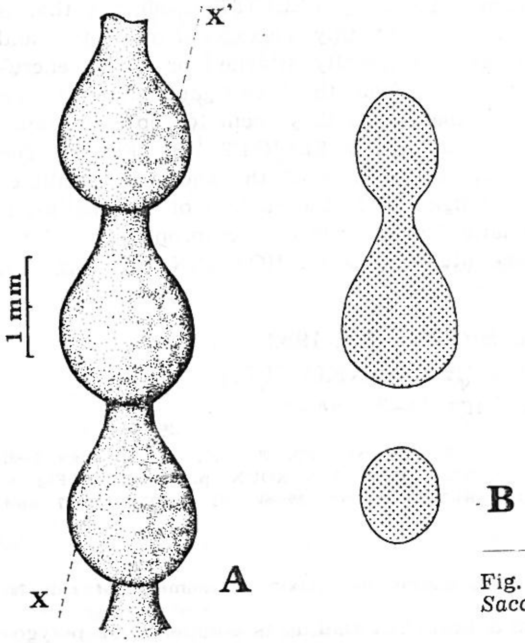
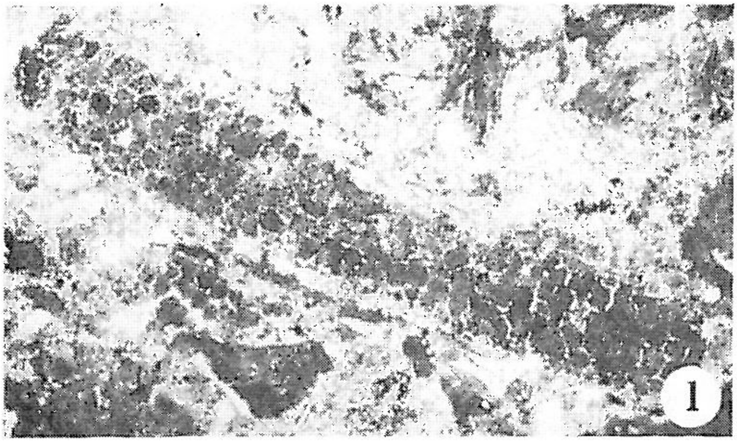
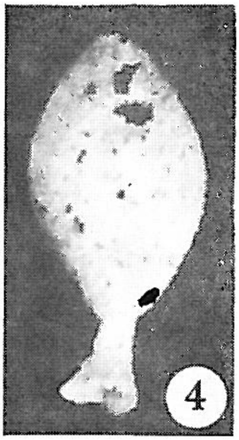
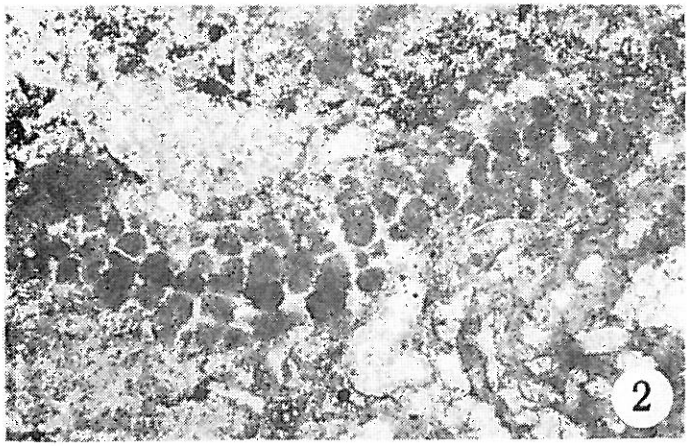


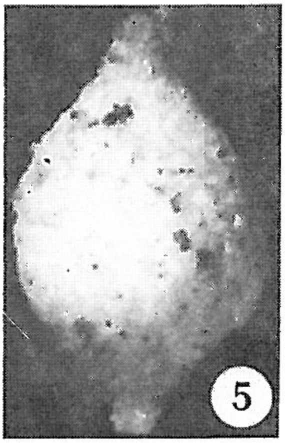
Fig. 7. A part of the thallus in the genus *Saccaminopsis* (**A**) and its section along xx' line (**B**)

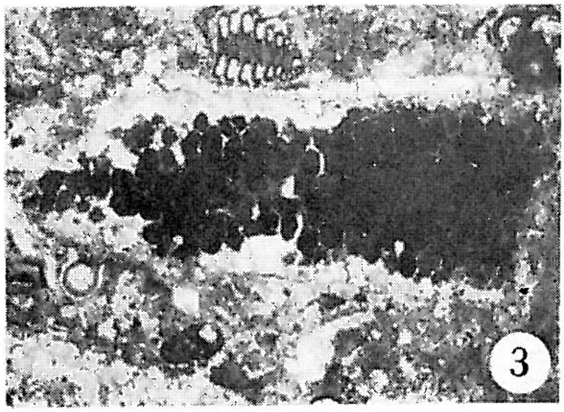
REMARKS: The thin sections and prepared specimens allow to reconstruct the morphology of *Saccaminopsis*. This reconstruction (Text-fig. 7) is very close (except of the holes on the surface) to the original illustration of the genus. Because *Saccaminopsis* is very rarely preserved in such an unbroken form, the single segments are commonly regarded as complete specimens (BRAZHNIKOVA & *al.* 1967, JURKIEWICZ & ŻAKOVA 1978). Also an establishing of any new species only on the basis of measurements and shape of specimens observed in thin sections (*e. g.* BRAZHNIKOVA & *al.* 1967) is often groundless, because of a haphazard orientation of the thin section (*cf.* Text-fig. 7b).

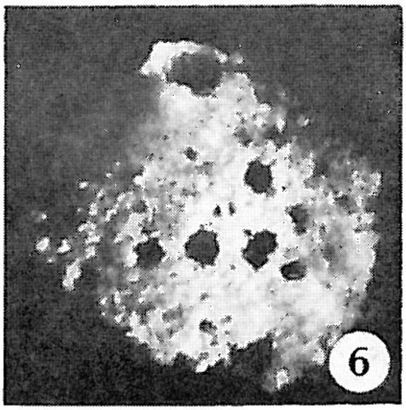






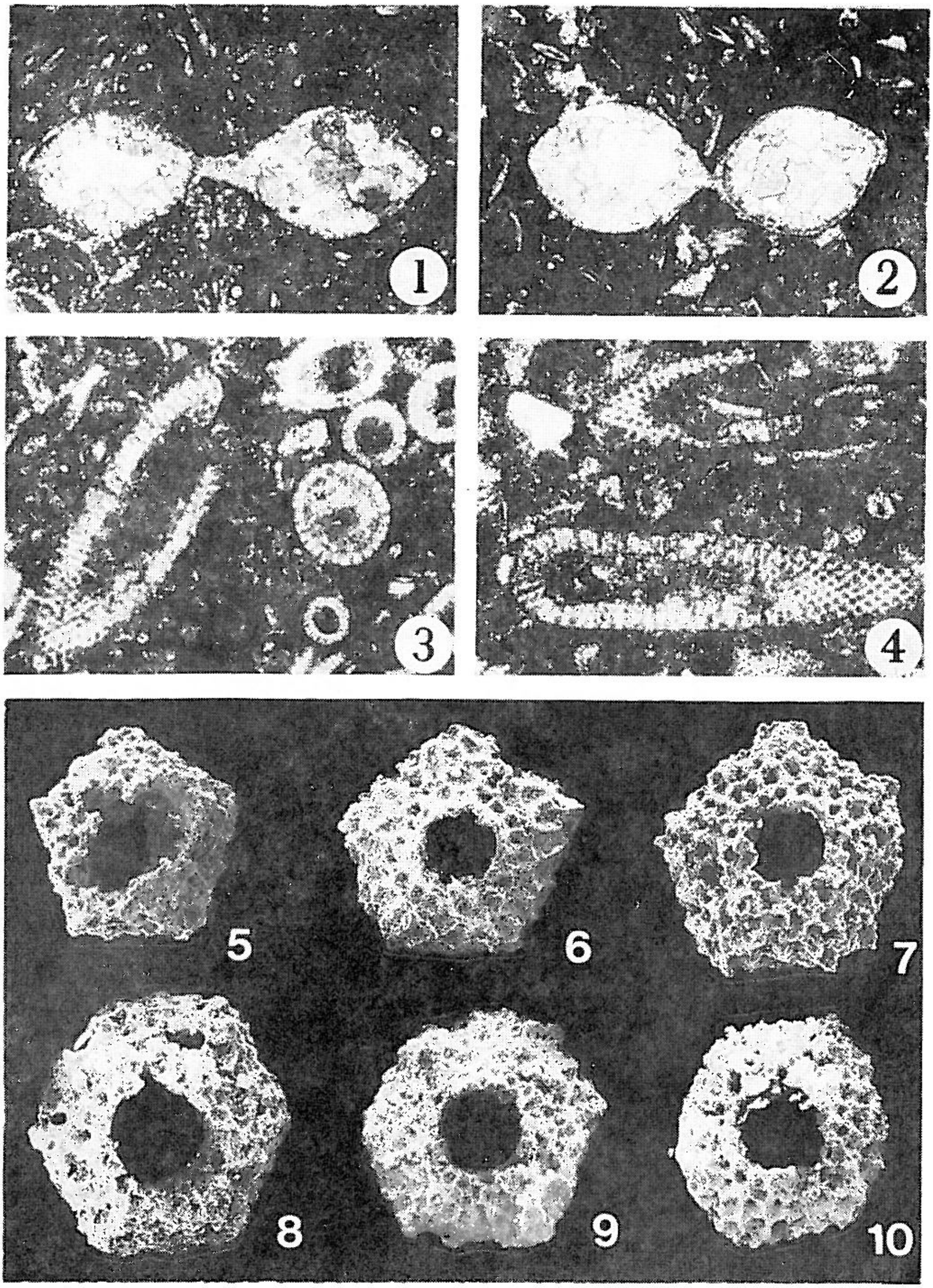






1-3 — *Principia donbassica* (KOSSENKO, 1972); *1-2* from borehole Lb-1 (depth 733 m), ×60 (Fig. 1) and ×100 (Fig. 2); *3* from Prz-1 (792 m), ×60

4-6 — *Saccaminopsis* sp. — specimens chemically prepared; *4—5* single segments with fragments of neck, both from Wh-1 (614 m), ×20; *6* segment with perforated wall, from Wh-1 (614 m), ×20

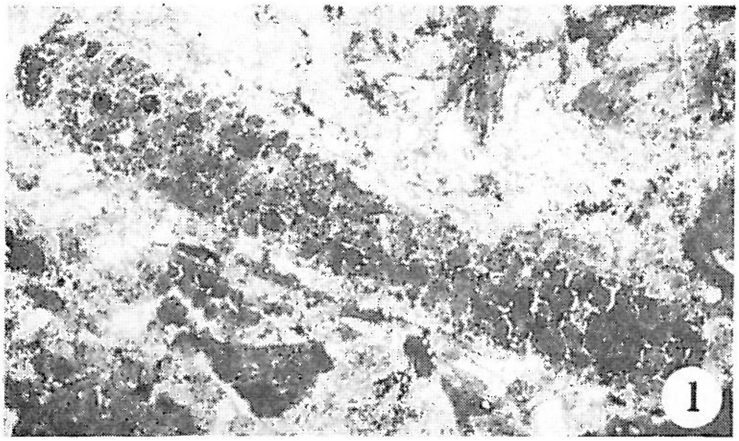


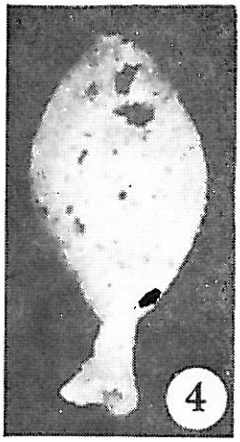
1-2 — *Saccaminopsis* sp.; longitudinal sections, both from borehole Pa-10 (depth 1021 m), ×12

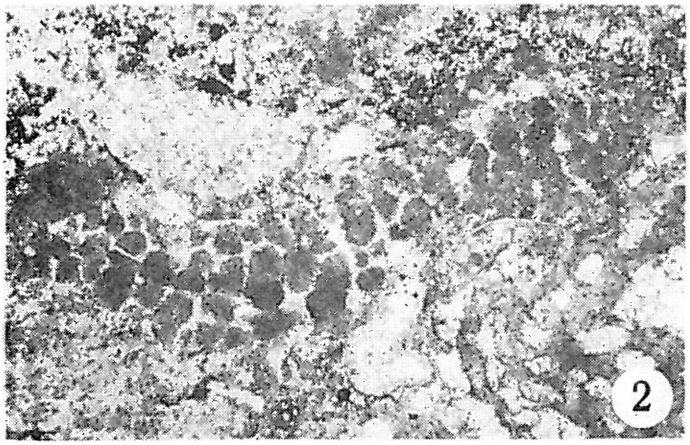
3-4 — *Nanopora anglica* (WOOD, 1964), emend. PERRET & VACHARD, 1977; both from Pa-8 (1071 m), ×65

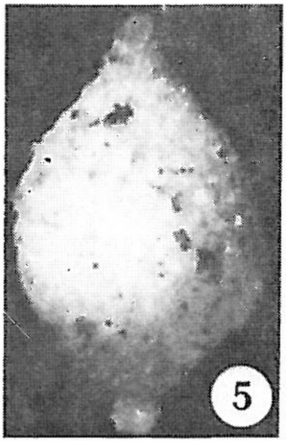
5-10 — Diploporeae gen. indet., Form *A* — chemically prepared specimens with pentagonal (Figs 5—7) and hexagonal symmetry (Figs 8—10)

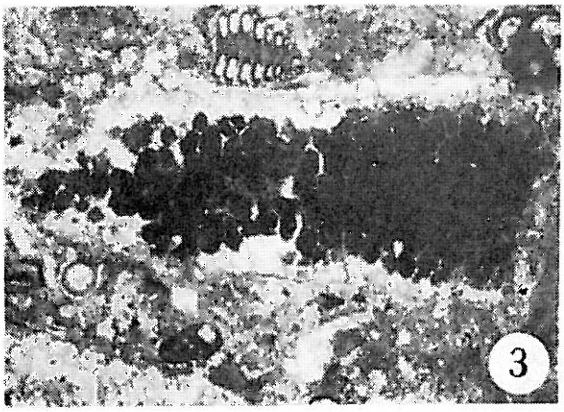
All specimens from Lb-1 (736 m), ×60

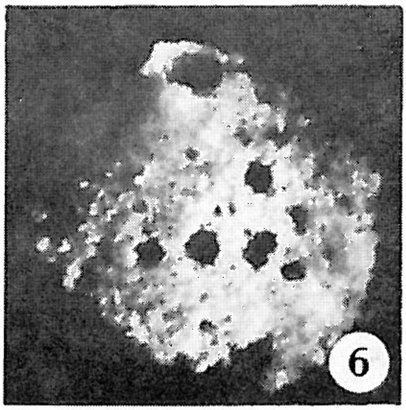






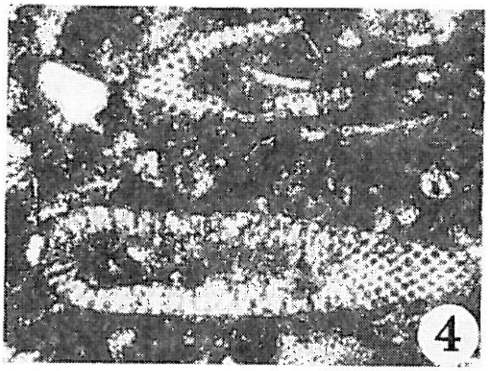


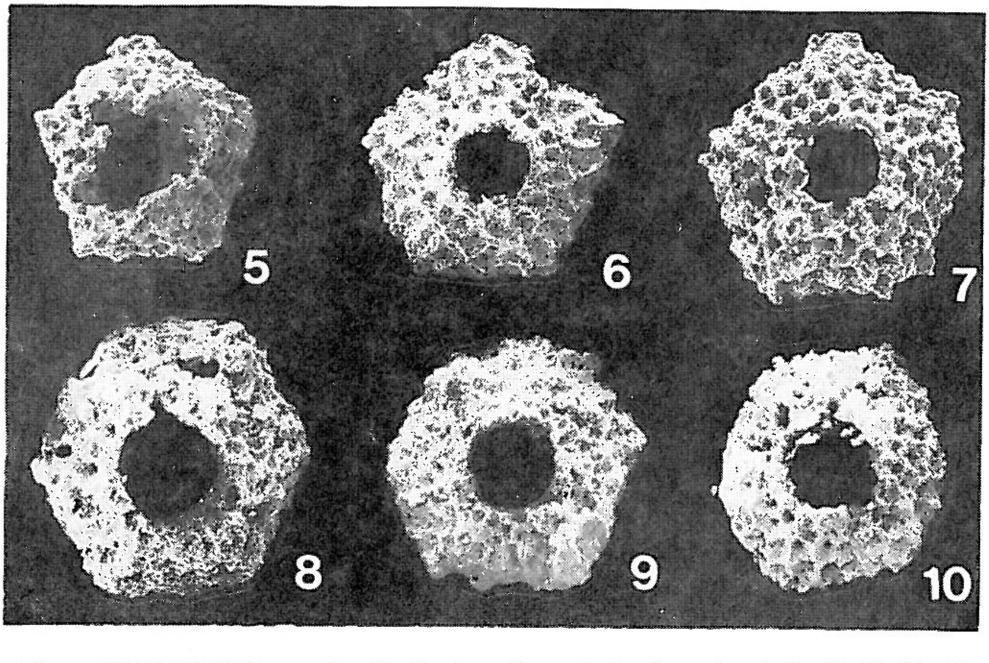




1-3 — *Principia donbassica* (KOSSENKO, 1972); *1-2* from borehole Lb-1 (depth 733 m), ×60 (Fig. 1) and ×100 (Fig. 2); *3* from Prz-1 (792 m), ×60

4-6 — *Saccaminopsis* sp. — specimens chemically prepared; *4—5* single segments with fragments of neck, both from Wh-1 (614 m), ×20; *6* segment with perforated wall, from Wh-1 (614 m), ×20





1-2 — *Saccaminopsis* sp.; longitudinal sections, both from borehole Pa-10 (depth 1021 m), ×12

3-4 — *Nanopora anglica* (WOOD, 1964), emend. PERRET & VACHARD, 1977; both from Pa-8 (1071 m), ×65

5-10 — Diploporeae gen. indet., Form *A* — chemically prepared specimens with pentagonal (Figs 5—7) and hexagonal symmetry (Figs 8—10)

All specimens from Lb-1 (736 m), ×60

Usually, the genus *Saccaminopsis* is included to the foraminifers (LOEBLICH & TAPPAN 1964), although such classification is not unequivocal. The holes on the surface and the articulated structure resemble those of some dasyclad algae (*e. g.* of the genus *Mizzia*).

SEDIMENTARY ENVIRONMENT OF THE ALGAL MICROFACIES

Among the microfacies recognized in the Viséan limestones of the Lublin Coal Basin (SKOMPSKI 1985), the algal microfacies is the most frequent (31% of total thickness of limestones). In this microfacies, the algal remains occupy usually from a dozen or so to 50% of the surface in a thin section. To the concurrent components belong the echinoderms (mainly crinoids) and in minority, the bryozoans. The increase of amount of the algae is correlated with the increasing frequency of the calcispheres, while the total number of foraminifers decreases. Among the sporadic components of the algal microfacies there appear brachiopods, bivalves, vermiform gastropods, sponge spicules, as well as onkoids and intraclasts.

A considerable amount of the algal microfacies indicates a remarkable significance of algae in the sedimentary environment of the Viséan sea. To define their role in sedimentation it is necessary to estimate the real spatial form of beds dominated by algae. Because this is practically difficult due to of a great distance between the boreholes (several kilometers), it is needful to base a reconstruction on sedimentary models.

As mentioned above, the genus *Calcifolium* belongs to the group of phylloid algae, together with the Carboniferous and Permian genera *Anchicodium, Ivanovia, Eugonophyllum,* and doubtfully *Archaeolithophyllum.* The *Calcifolium*-bearing limestones are known from the exposures in Great Britain (*see* JOHNSON 1958, BURGESS 1965) and in the Soviet Union (*see* OSIPOVA & BELSKAYA 1977), but in their descriptions detailed sedimentary data are lacking. In contrast, other phylloid algae, abundant in some carbonate build-ups, have numerous, but sometimes contradictory sedimentological descriptions (comparison *in:* FLÜGEL 1977). In the first group of these interpretations an active role of algae in sedimentation is highly emphasized (*e. g.* HECKEL & COCKE 1969, TILLMAN 1971, WELCH 1977, TOOMEY 1979). The growth of algae is believed to have involved precipitation of a calcareous ooze, while their „root-system" and the development of microbial mats caused stabilization of the sediment composed of the ooze and of the algal debris. On the other hand, BALL & *al.* (1977) denied this model and accepted only a passive role of the phylloid algae in the sedimentation of algal banks. Compromising in a way is an opinion of CROSS & KLOSTERMAN (1981) who distinguished, among phylloid algal mud-mounds, the high (up to 10 m) and rigid (owing to stromatolites binding the growing algae) bioherms, which essentially modified the bottom topography, and the smaller banks, which originated due to accumulation of detrital material, without any influence on a general pattern of sedimentation.

The last model seems to be the most convenient for an interpretation of depositional conditions of the investigated *Calcifolium*-bearing sediments. Contrary to the above menetioned phylloid forms with several centimeters long plates, *Calcifolium* is a very small alga (*see* SKOMPSKI 1981), similar to that of the Recent Codiaceae (*e. g.* as *Halimeda*), in which from the basal segment the next sets of cups and plates grow up. This structure causes, after the decay of the plant, its disintegration into single fragments and a production of the detrital deposit. A poor mechanic resistance of this alga explains an absence of the umbrella structures so characteristic of some phylloid algal mud-mounds.

The morphological analogies are also useful for a reconstruction of forms produced by these algae on the sea bottom. The genus *I alimeda* is reported, similarly as the other Recent Codiaceae, from different depths (ranging from 1 to 300 m; *see* WRAY 1977b), but its great accumulations are present only in very shallow and quiet lagoons. KOBLUK & KAROLYI (1979) gave a detailed description of small (up to 1 m high) *Halimeda*-mounds from the lagoons of Bonaire (Dutch Antilles). These mounds are irregular to circular in outline (with diameter over 5 m) and convex in their profile. The core of the mound consists of closely packed *Halimeda*-segments, which are covered by a layer of living plants, filamentous algae, and of the lime mud. The associated fauna is represented by herbivorous gastropods, soft sponges, cavity-dwelling fish and crabs, branching hydrozoans, worms, ophiuroids, and foraminifers. It is thought that the investigated *Calcifolium* debris was accumulated in a very similar manner. In other occurrences, the *Calcifolium* layers are often replete with the *Girvanella*-incrustations (BURGESS 1965). In the investigated material a correlation between the occurrence of the genera *Girvanella* and *Calcifolium* has not been stated. Such comparable components of the assemblage as the herbivorous gastropods (BEŁKA & SKOMPSKI 1982) and fish remains (teeth and scales) have however been commonly recognized in the samples.

The accumulation of calcareous deposits with *Kamaena and Stacheoides* was probably similar. Distinctly different was the mode of sedimentation of the layers with *Nanopora*. A small amount of components other than *Nanopora* sleeves, and grain supported fragments of this alga indicate an allochthonous deposition. The porous, light fragments could easily be transported and selectively winnowed and concentrated upon low-energy beaches to an extent comparable to that reported by CROSS & KLOSTERMAN (1981) from the shores of the U. S. Virgin Island.

In general, the investigated Upper Viséan algal sediments were accumulated in an extensive, marginal epiplatform sea. In spite of large amount of terrigenic material, sedimentation in the basin was controlled by the hydraulic energy, according to the model proposed by IRWIN (1965). The algal facies dominated in the zone *Z* of this model (low-energy, near--shore zone), and it was less frequent in the zone *X* (low-energy zone, below wave base), characterized largely by the foraminiferal facies. These two zones were separated by a periodically emerged, high-energy area that supplied organodetrital, mainly crinoidal material. Such schematized spatial arrangement of facies is confirmed by their vertical succesion, in which algal sediments usually promote and terminate sedimentation of limestone beds (*cf.* SKOMPSKI 1984b).

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S. SKOMPSKI

GÓRNOWIZEŃSKIE GLONY WAPIENNE Z LUBELSKIEGO ZAGŁĘBIA WĘGLOWEGO

(Streszczenie)

Przedmiotem pracy jest analiza glonów wapiennych i mikroproblematyków glonowych pochodzących z górnowizeńskich wapieni północno-wschodniego obrzeżenia Lubelskiego Zagłębia Węglowego, a napotkanych w kilkunastu wierceniach zlokalizowanych pomiędzy Włodawą a Parczewem (*patrz* fig. 1—2). W badanym zespole glonów wyróżniono 29 taksonów (*patrz* fig. 3—4), wśród których przeważają zielenice. Pod względem ilościowym zespół jest zdominowany przez gatunek *Calcifolium okense* (SHVETZOV & BIRINA). Dobry stan zachowania okazów badanych w szlifach mikroskopowych oraz liczne okazy wypreparowane pozwoliły na pełniejszą lub bardziej poprawną niż dotychczas rekonstrukcję niektórych glonów, m.in. podrodzin Bereselleae i Palaeobereselleae oraz rodzajów *Eflugelia* VACHARD i *Saccaminopsis* SOLLAS (*patrz* fig. 5—7 oraz pl. 1—18).

Wapienie, w których najczęstszym składnikiem są badane glony, obejmują około 30% całkowitej miąższości warstw wapiennych. Formy akumulacyjne, które powstały dzięki obfitości tych glonów, charakterystyczne są dla płytkowodnej lecz spokojnie przebiegającej sedymentacji epiplatformowej i odpowiadają współczesnym ławicom z *Halimeda* z Małych Antyli (*patrz* KOBLUK & KAROLYI 1979).