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RED ALGAE FROM THE PIŃCZÓW LIMESTONES (MIDDLE MIOCENE, ŚWIĘTOKRZYSKIE MOUNTAINS, POLAND)

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The paper deals with the red algae (mainly Corallinaceae) which are the main component of the Middle Miocene (Badenian) Pińczów Limestones, Świętokrzyskie Mts. (Holy Cross Mts.), Central Poland. Algal growth forms characterize the facies of the Pińczów Limestones. Distribution of several red-algal species shows a correlation with two environmental parameters, viz. water agitation and the substrate. A comparison to Tertiary red-algal floras shows that the specific composition of the Pińczów Limestones flora resembles other assemblages from the Middle Miocene of Poland and those of Ukraine, as well as the assemblage from the Oligocene of Northern Italy. In the systematic part of the paper 73 species of 12 genera (*Archaeolithothamnium*, *Palaeothamnium*, "*Lithothamnium*", *Mesophyllum*, *Lithophyllum*, *Leptolithophyllum*, *Titanoderma*, *Melobesia*, *Lithoporella*, *Jania*, *Corallina*, and *Karpathia*) are described, one of which is new: *Leptolithophyllum maslovi* sp. n.

K e y - w o r d s: Rhodophyceae, Corallinaceae, palaeoecology, systematics, Badenian, Poland.

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INTRODUCTION

The red algae occur very commonly in the Middle Miocene (Badenian) marine deposits of the Fore-Carpathian Depression, where they are frequently a main rock-forming element of diverse calcareous and/or marly and sandy deposits. The red-algal limestones have been reported both from the southern slopes of the Świętokrzyskie Mts. and Lublin Upland (Radwański 1968, 1969, 1973; Piserá 1985), and from the northern Carpathian border (Pisera 1974, Golonka 1981). However, the taxonomy of the red algae have focused surprisingly little attention until now. Two recent systematic studies concern the algal flora of the so-called "Rzeszów Embayment" at the Carpathian border (Golonka 1981; herein fig. 1:Rz) and the algal-dominated (precisely, algal-vermetid) reefs of the Roztocze Hills, Lublin Upland (Pisera 1985; herein fig. 1: RH).

The present paper deals with the red-algal, mainly coralline flora from the Middle Miocene (Badenian) Pińczów Limestones which are exposed along the Wójcza-Pińczów Range on the southernmost slopes of the Świętokrzyskie Mts. (see fig. 1). The coralline algae constitute crusts, branches, and rhodoliths which, together with bryozoans and large foraminifers, make up the principal components of the Pińczów Limestones (Studencki 1988). Skeletal remains of corals, polychaetes, brachiopods, gastropods, bivalves, crustaceans, cirripedes, crinoids, echinoids, asteroids, and vertebrates, although much diversified, are of secondary importance (Kowalewski 1930, Studencki 1987). The thickness of the Pińczów Limestones reaches 25 m.

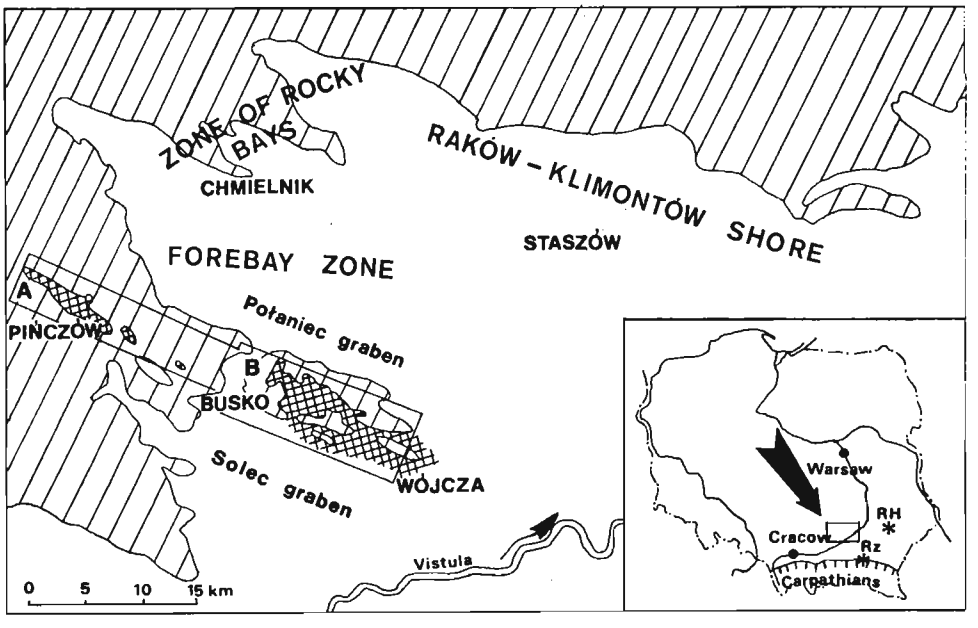

Fig. 1. Location of the Wójcza-Pińczów Range (rectangled), and its relation to the Middle Miocene (Badenian) paleogeographic and tectonic units (adopted from Radwański 1969). Indicated are: present-day exposure areas of the Pińczów Limestones (checkered), Middle Miocene deposits (blank), and pre-Miocene substrate (hachured). A and B denote parts of the Wójcza-Pińczów Range figured on fig. 2A—2B. Asterisks mark regions from where other red algal floras have been reported: Roztocze Hills (RH), and environs of Rzeszów (Rz) at the northern Carpathian border.

The samples for the present study have been collected from 55 outcrops of the Pińczów Limestones. The density of sampling was higher where limestones with in-plance algal accumulations occur (i.e in the region of Zerniki, Szczaworyż and Sułkowice, see fig. 2) but lower in purely organodetrital limestones. Because of the poor exposure the samples were frequently taken from the weathering zone. 150 thin sections that have been prepared, are housed in the Museum of the Earth, Warsaw (MZ).

To explain some ambiguities concerning the species erected by V. P. Maslov, additional, comparative investigations of his collection (housed in the Geological Institute of the Soviet Academy of Sciences, Moscow) have been made.

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DEPOSITIONAL ENVIRONMENT OF THE PIŃCZÓW LIMESTONES

Four facies have been distinguished by the present author (Studencki 1988) in the Pińczów Limestones, viz. (i) the rhodolith pavement facies, (ii) branching algae facies, (iii) algal-bryozoan facies, and (iv) organodetrital facies.

(i) Rhodolith pavement is invariably composed of large, mainly sphaeroidal rhodoliths, the internal structure of which shows typically three growth stages: branching nucleus, laminar stage, and columnar stage. The rhodoliths are complex, multispecific structures, built of thalli representing strongly diversified algal assemblage, in which several species frequently occur: *Archaeolithothamnium keenani* Howe, "*Lithothamnium*" cf. *nitidum* Foslie, "*L.*" *praefruticulosum* Maslov, *Mesophyllum* cf. *roveretoi* Conti, *Lithophyllum albanense* Lemoine, *L. kamptneri* Mastrorilli, *Titanoderma nataliae* (Maslov), *Lithoporella* sp., *Melobesia* sp. The fauna in the rhodolith pavement facies is poor. Rhodolith pavement has many Recent counterparts, e.g. in the Mediterranean "prâlines" deposits.

(ii) Free-living, branching thalli dominate in the branching algae facies, the fragments of crustose thalli being a subordinate element. Diversity of algae is poor: "*Lithothamnium*" *ramosissimum* (Gümbel) and *Archaeolithothamnium* sp. (probably *A. keenani* Howe) dominate the algal assemblage. In contrast, molluscs are frequent and relatively diversified; bryozoans and large foraminifers are also important element. This facies is comparable to the Recent Mediterranean and Atlantic "maërl" deposits.

(iii) Rhodoliths, branching and crustose thalli, celleporiform bryozoans and large foraminifers prevail in the algal-bryozoan facies. In rhodoliths, "*Lithothamnium*" *praefruticulosum* Maslov and *Lithophyllum albanense* Lemoine dominate, branching thalli are built of "*Lithothamnium*" *ramosissimum* (Gümbel) and *Archaeolithothamnium keeneni* Howe, while *Mesophyllum ingestum* Conti, *M. laffittei* Lemoine, *M. rigidum* Mastrorilli, and *Lithophyllum prelichenoides* Lemoine are most frequent among crusts. The diversity of all remaining fossil groups reaches its maximum in this facies.

(iv) Organodetrital facies comprises fine- to coarse-grained limestones composed of reworked bioclastic material.

The horizontal distribution of facies is mosaic, but the facies characterized by the in-place accumulations of fossils prevail over the eastern part of the Wójcza-Pińczów Range, while the organodetrital facies dominates in its western part (fig. 2). The vertical distribution of facies in the western part of the Range is devoid of any order (fig. 3, profiles of Pińczów and Skowronno). In turn, many profiles in the eastern part show particular facies set in definite order (fig. 3, profile of Łysa Góra), beginning from the organodetrital facies with scarce remains of reworked algae, through the branching algae facies (containing thalli increasing upward in both number and dimensions), then algal-bryozoan facies, to rhodo-

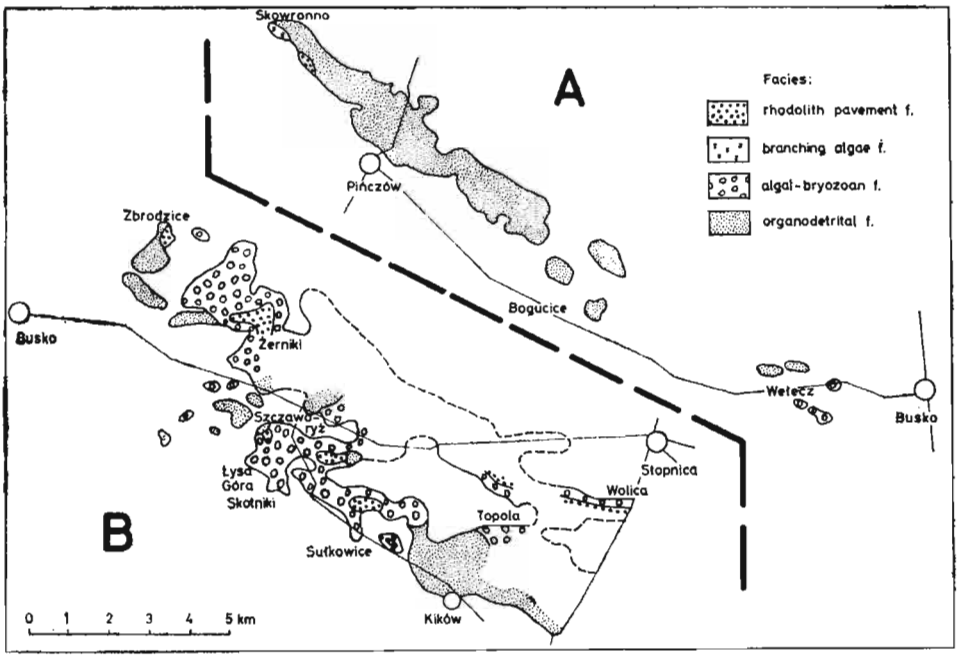


Fig. 2. Distribution of facies of the Pińczów Limestones in the western (A) and eastern (B) parts of the Wójcza-Pińczów Range.

lith pavement facies. This sequence is supposed to reflect increasing hydrodynamics due to gradual shallowing of the sea.

As inferred from the actualistic facies comparisons, bryozoan growth-form study, and distribution of brachiopods (Studencki 1988), the Pińczów Limestones were deposited in a shalow-marine environment, under strong to moderate water agitation, within an elongated submarine platform deepening to the east. The remains of Elasmobranchii indicate subtropical conditions (Radwański 1965).

PALAEOECOLOGY OF THE RED ALGAE

The distribution of several algal species from the Pińczów Limestones shows correlation with such environmental features as water agitation (indicated by the sediment characteristics and algal growth forms) and the nature of the substrate.

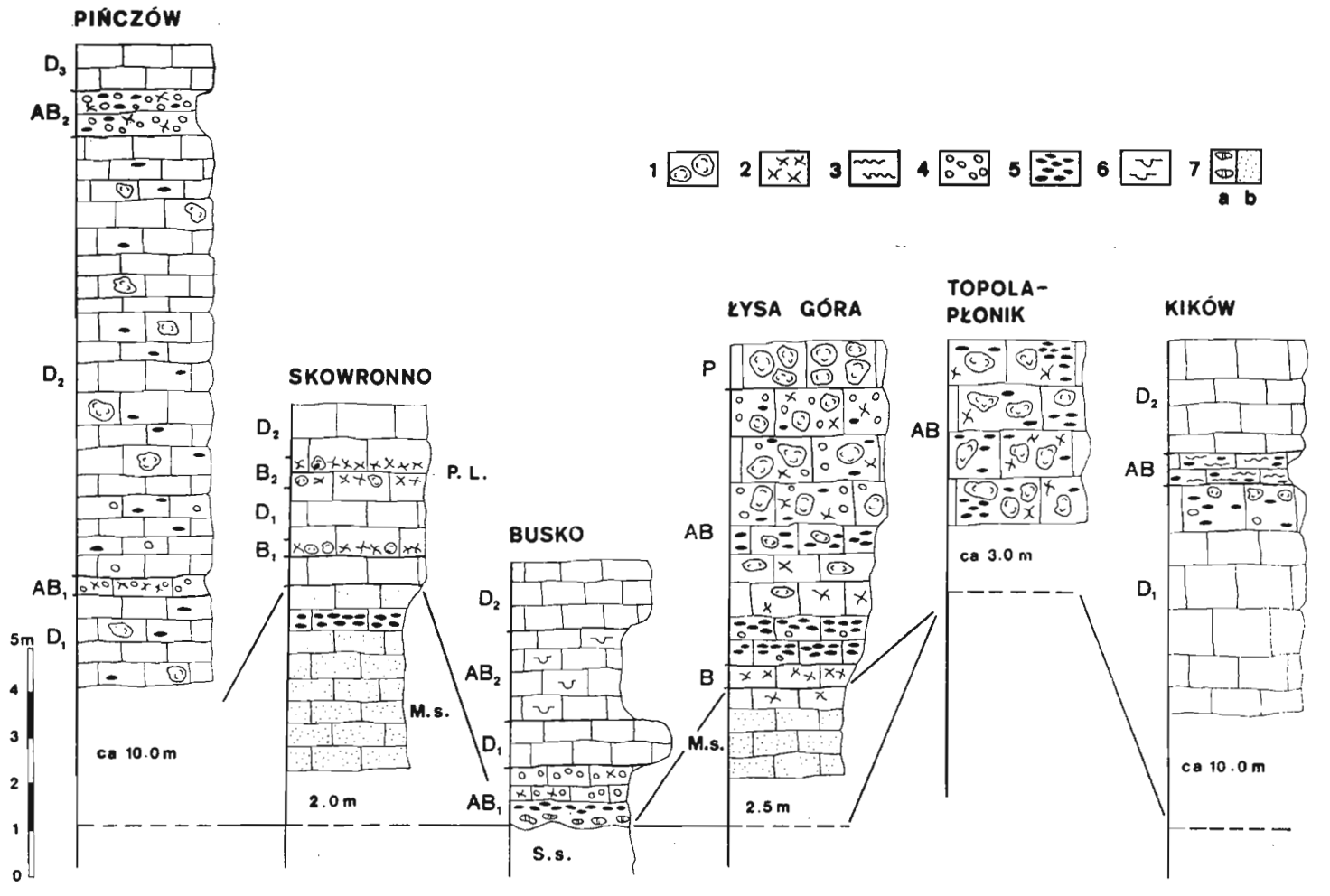
Water agitation

Two species of *Mesophyllum*, viz. *M. vaughani* (Howe) and *M. laffittei* Lemoine occur within the algal-bryozoan facies, always in form of thin, multilayered, mamillate crusts, preserved *in situ*, and alternating with fine-grained, well sorted wackestones (pl. 1: 2). An interpretation that they characterize the lowest energy conditions seems justifiable.

The free-living, branching thalli of *"Lithothamnium" ramosissimum* (Gümbel) are typical of fine- to medium-grained packstones of both the branching algae and the algal-bryozoan facies. Branching growth form and the sediment features indicate that this species apparently avoided the highest energy bottoms as well as extremely sheltered conditions. Very rarely, the crustose thalli of *"L." ramosissimum* (Gümbel) participate in rhodoliths.

Three crustose species similar in their structure, *Mesophyllum ingestum* Conti, *M. rigidum* Mastrorilli, and *Lithophyllum prelichenoides* Lemoine occur within the algal-bryozoan facies, but they have never been found therein as a components of rhodoliths. However, their co-occurrence with rhodoliths supports the inference about relatively high hydrodynamic conditions required by these species.

Many crustose species participated in the laminar stage of the rhodoliths. They evidently sustained periodic to continuous overturning and/or rolling of rhodoliths in high energy conditions. Two of them, *"Lithothamnium"* cf. *nitidum* Foslie and *Mesophyllum* cf. *roveretoi* Conti (pl. 2: 1) occur exclusively within the rhodolith pavement facies. Three other species, *Palaeothamnium archaeotypum* Conti, *"Lithothamnium" praefruticulosum* Maslov (pl. 2: 2), and *Lithophyllum albanense* Lemoine (pl. 2: 1), are common in laminar stage of rhodoliths, but they were also found as


PIŃCZÓW
D3
AB2
D2
AB1
D1
5m
4
3
2
1
0
ca 10.0 m
SKOWRONNO
D2
B2
D1
B1
P. L.
M.s.
2.0 m
BUSKO
D2
AB2
D1
AB1
S.s.
ŁYSA GÓRA
P
AB
B
M.s.
2.5 m
TOPOLA-
PŁONIK
AB
ca 3.0 m
KIKÓW
D2
AB
D1
ca 10.0 m
1
2
3
4
5
6
7
a b

crusts not confined to rhodoliths. This suggests their preference to agitated waters, which agrees well with the similar statement of Bosence and Pedley (1982) and Pisera (1985) on the environmental requirements of "*Lithothamnium*" *praefruticulosum* Maslov and *Lithophyllum albanense* Lemoine.

Substrate

An association of three crustose species, alternating each other and encrusting other algal thalli is commonly observed in the Pińczów Limestones. These species, *Lithophyllum lithothamnioides* Maslov, *Titanoderma nataliae* (Maslov), and *Melobesia* sp., form very thin crusts, consisting of a few series of the filaments of cells. None of the considered species has been found to encrust directly the surface of the bottom or any unpreservable organism (except of some fragments of *Lithophyllum lithothamnioides* Maslov). Hence, it is here suggested that the substrate was a factor controlling the distribution of these species; the nature of this control remains, however, unknown. Perhaps, it was analogous to the present-day epiphytic growths of crustose corallines (cf. Johansen 1981). The discussed species are absent from the branching algae facies which indicates that the hydrodynamics played certain role in their environmental requirements.

A considerable specific diversity of the red algae from the Pińczów Limestones, greater than observed in the present-day environments, may result in part from the typological approach to the fossil red-agal species (see below), but on the other hand it may reflect favourable environmental conditions, i.e. accessibility of various substrates, light conditions, and of water energies. The occurrence of the red algal species within particular facies of the Pińczów Limestones in given in the Table 1 and in the systematic part of this paper to indicate potential palaeoecological relationships.

COMPARATIVE REMARKS

The only way to compare fossil algal floras is to indicate the species in common, as the relative abundances of species are omitted by authors as a rule.

Fig. 3. Geological columns of the Pińczów Limestones showing vertical distribution of facies. Facies: P — rhodolith pavement, B — branching algae, AB — algal-bryozoan, D — organodetrital (AB_{1-2}, B_{1-2}, D_{1-3} — successive horizons of facies in the same profile). Main rock-forming components: 1 — rhodoliths, 2 — branching algal thalli, 3 — crustose algal thalli, 4 — celleporiform bryozoans, 5 — large foraminifers, 6 — oysters, 7 — allochthonous material: 7a — Senonian pebbles, 7b — quartz grains. S.s. — Senonian substrate; M.s. — Miocene substrate; P.L. — Pińczów Limestones.

Table 1

Distribution of the examined red-algal species in

Species \ Distribution	Miocene								Oligocene
	Poland								
	Pinczow Limestone facies								
	rhodolith pavement	branching algae	algal-bryozoan	organodetrital	Roztocze Hills	Northern Carpathian border	Ukraine	Corsica	Liguria and Piemont
1	2	3	4	5	6	7	8	9	10
Archaeolithothamnium keenani Howe	•	•	•	•	•	•	•		•
Palaeothamnium archaeotypum Conti	•		•	•	•	•		•	
P. kossovense Maslov	•		•	•			•		
"Lithothamnium" aggregatum Lemoine	•		•						
"L" alasanii Maslov	•						•		
"L." aff. aucklandicum Foslie	•								
"L." cf. bourcarti Lemoine	•		•			•	•		
"L." disarmonicum Conti	•		•						•
"L." cf. fruticulosum (Kützing) Foslie	•		•	•					
"L." gaschei Johnson	•	•	•	•					•
"L." lacroixi Lemoine			•	•		•	•		•
"L." ladronicum Johnson				•					•
"L." macrosporangicum Mastrorilli			•						•
"L." microcellulosum Maslov			•				•		•
"L." microphyllum Maslov			•		•		•		•
"L." montainvillense Lemoine			•						
"L." moreti Lemoine			•						•
"L." cf. nitidum Foslie	•								
"L." operculatum (Conti) Conti	•		•						•
"L." cf. parvulum Conti				•					•
"L." praefruticulosum Maslov	•		•	•	•	•	•		•
"L." prascoi Mastrorilli				•					•
"L." ramosissimum (Gümbel) Conti	•	•	•	•				•	•
"L." saipanense Johnson			•						
"L." saxorum Capeder			•	•	•	•	•		•

Miocene and Oligocene sites

1	2	3	4	5	6	7	8	9	10
"L." subtile Conti			•	•					•
"L." trinidadensum Johnson			•						•
"L." cf. *viallii* Mastrorilli		•							•
Mesophyllum galettoi Mastrorilli	•		•	•				•	•
M. ingestum Conti		•	•	•					•
M. koritzae (Lemoine) Lemoine			•	•		•	•	•	
M. laffittei Lemoine	•	•	•						
M. marosticae Mastrorilli	•								•
M. obsitum Airoldi			•						•
M. rigidum Mastrorilli		•	•	•					•
M. cf. *roveretoi* Conti	•				•	•		•	•
M. vaughani (Howe) Lemoine			•						•
Lithophyllum albanense Lemoine	•	•	•	•	•	•	•	•	•
L. anguineum Conti	•		•	•					•
L. besalotos Johnson		•	•						
L. bonyense Johnson			•						
L. capederi Lemoine			•			•	•	•	•
L. corculumis Maslov			•		•		•		
L. duplex Maslov	•		•		•	•	•	•	
L. intumescens Mastrorilli				•					•
L. kamptneri Mastrorilli	•		•	•					•
L. cf. *lateporatum* Mastrorilli			•						•
L. lithothamnioides Maslov	•		•	•			•		
L. maemongense Johnson				•				•	
L. mgarrense Bosence	•		•	•					
L. microsporum Maslov	•						•	•	
L. minimum Mastrorilli	•	•	•						•
L. prelichenoides Lemoine			•	•	•	•	•		
L. simplex Lemoine			•					•	•
L. vicetinum Mastrorilli	•								•
Leptolithophyllum maslovi sp.n.	•								
L. platticarpum (Maslov) Poignant	•					•	•	•	
Titanoderma nataliae (Maslov)	•		•		•	•	•		
Lithoporella melobesioides (Foslie) Foslie	•	•						•	•
Jania dniestrovica Maslov	•	•			•	•	•		
J. ucrainica Maslov	•		•	•		•	•		
Karpathia sphaerocellulosa Maslov			•	•					

When compared to the other Tertiary marine red-algal floras, the Middle Miocene asemblage from the Pińczów Limestones shows the greatest resemblance to the assemblages from two different bioprovinces and stages: to those from the Middle Miocene of Poland and Ukraine (central part of Paratethys bioprovince), and to the others, from the Oligocene of northern Italy (Mediterranean bioprovince).

The similarity of the Pińczów flora to the Middle Miocene Polish and Ukrainian floras, representing the same Paratethys bioprovince, is rather obvious and follows the expectations in this regard. The three previously reported assemblages — from Ukraine (Maslov 1962), Roztocze Hills (Pisera 1985), and the northern Carpathian border (Golonka 1981) — show moderate diversities (39, 19, and 26 species, respectively), and the majority of species in each case is in common with the Pińczów assemblage (21, 13, and 16 species, respectively, see Table 1). The resemblance, however, does not concern the genus *Mesophyllum*, which shows distinct specific composition in the Pińczów and remaining compared floras, except two species in common.

In spite of its spatial and temporal proximity, the red algal Middle Miocene flora of the Vienna basin includes less species in common (6 of 16 recorded; see Conti 1945) with the Pińczów flora, than do the assemblages from the eastern part of Central Paratethys. Red algae from the Middle Miocene of Slovakia (Schalekova 1969, 1973) and Bulgaria (Bakalova 1980) show comparable degree of dissimilarity.

On the other hand, the diversity of the Oligocene red-algal flora from the Liguria and Piemont (Northern Italy) is even greater than in the Pińczów Limestones (near 90 species — Mastrorilli 1967*a*, 1973). The number of species in common is then high enough (35, see Table 1), and the resemblance is emphasized by the fact, that 7 species of *Mesophyllum* (of 9 recorded in the Pińczów Limestones) have been reported from both the compared assemblages, while only two species of that genus are present in both the Pińczów Limestones and the other areas of the eastern part of Central Paratethys.

Red algae are common in the Tertiary deposits of the Mediterranean bioprovince, particularly in the Eocene to Miocene strata. They are, however, much less diversified and rather distinct from the Pińczów flora, the only exception being for the Corsican Miocene, where a great proportion of species in common occurs (13 of 23 recorded — Orszag-Sperber and Poignant 1972, Orszag-Sperber *et al.* 1977; see Table 1).

Only few species known from the Pińczów Limestones occur apart from the Paratethys and Mediterranean bioprovinces, in this number four in the Atlantic-Boreal bioprovince (*Palaeothamnium archaeotypum* Conti, *Mesophyllum koritzae* (Lemoine), *Lithophyllum albanense* Lemoine, and *Lithophyllum microsporum* Maslov), and 14 in the other regions of the world, i.e. in the Indo-Pacific region, and the Caribbean ("*Lithotham-*

nium" aggregatum Lemoine, "*L.*" aff. *aucklandicum* Foslie, "*L.*" *gaschei* Johnson, "*L.*" *ladronicum* Johnson, "*L.*" cf. *nitidum* Foslie, "*L.*" *saipanense* Johnson, "*L.*" *trinidadensum* Johnson, *Mesophyllum vaughani* (Howe), *Lithophyllum besalotos* Johnson, *L. bonyense* Johnson, *L. capederi* Lemoine, *L. maemongense* Johnson, *L. prelichenoides* Lemoine, and *Lithoporella melobesioides* (Foslie)).

The distributional pattern of several species described in the present paper seems instructive. Of 7 species that are most common in the Pińczów Limestones (Table 3), one is cosmopolitan (*Lithophyllum prelichenoides* Lemoine), three are widespread ("*Lithothamnium*" *praefruticulosum* Maslov, "*L.*" *ramosissimum* (Gümbel), and *Lithophyllum albanense* Lemoine), and the other three show either limited distribution (*Mesophyllum ingestum* Conti, *Lithophyllum anguineum* Conti — Italy, Austria, Poland) or distinct endemism (*Lithophyllum lithothamnioides* Maslov — Ukraine and Poland). However, while three widely distributed species have been reported from the Middle Miocene of Poland and Ukraine ("*Lithothamnium*" *praefruticulosum* Maslov, *Lithophyllum albanense* Lemoine, and *L. prelichenoides* Lemoine), the fourth one ("*Lithothamnium*" *ramosissimum* (Gümbel)) and the remaining three have never been found in these areas apart from Pińczów Limestones. These differences might have been caused by the environmental factors (reefal vs non-reefal conditions) and/or they may result from subtle age differences (Early vs Late Badenian, i.e. before and after the salinity crisis).

Of 73 species recorded in the Pińczów Limestones, only 5 are endemic for the eastern part of Central Paratethys. Two of them, *Lithophyllum lithothamnioides* Maslov, and *Titanoderma nataliae* (Maslov) are common in the Pińczów flora but the others (*Lithophyllum corculumis* Maslov, *Jania dniestrovica* Maslov, and *J. ucrainica* Maslov) are rare. Low level of endemism and the presence of species from distant bioprovinces should reflect good communication between the Paratethys and the Earth's ocean, which confirms the inference from the parallel study of bivalve fauna of Wójcza-Pińczów Range (Studencka and Studencki 1988).

TAXONOMY OF THE FOSSIL RED ALGAE

The systematics of the living Corallinaceae is based largely on these features of the thallus which are unpreservable and cannot be observed in the fossil state. The efforts of palaeoalgologists are thus focused on which features of the mineralized thallus could serve for the determination of fossil genera and for the definition of the most precise and reliable relations between fossil and Recent genera. Following features important for the generic taxonomy are observable in the fossil material (see e.g. Lemoine 1977, Poignant 1979, 1980):

1. hypothallus character (unistratose vs multistratose, cells being arranged in filaments or in rows);
2. perithallus character (cells being arranged in filaments, rows, grid or disorganized);
3. shape of reproductive organs — tetrasporangia but exceptionally also carposporangia;
4. roof of tetrasporangia (mono- vs multipored);
5. shape of hypothallic and perithallic cells;
6. arrangement of heterocysts.

In contrast, many features important for the generic taxonomy, such as epithallic cells, meristem position, primary and secondary pits, cell fusions or sporangial plugs, are lost during the fossilization processes (see e.g. Adey and Johansen 1972, Adey and MacIntyre 1973, Johansen 1976, 1981; Woelkerling 1982, 1983*a*, *b*; Woelkerling *et al.* 1985).

In general, fossil red algal thalli can be easily assigned to a genus by a combination of several features. For this purpose generic keys have been constructed (cf. Johnson 1961, 1964*a*; Poignant 1979, 1985; see also Table 2 in this paper).

The taxonomy of the red algae at the generic level is here applied according to Index Nominum Genericorum (Plantarum) (Farr *et al.* 1979). However, several changes compared to the Index became necessary as a result of reassessment of the genera *Lithothamnium*, *Lithophyllum* and *Dermatolithon*, based on the recent examination of original collections (Woelkerling 1983*a*, *b*; Woelkerling *et al.* 1985). The papers deal with the Recent material but the taxonomic inferences hold true for fossil genera, too.

Woelkerling (1983*a*) found that the name *Lithothamnium* Philippi, 1837 is in fact *nomen nudum* and should be rejected from the nomenclature. From among five species upon which Philippi based the genus *Lithothamnium*, two species are referrable to *Amphiroa*, and the remaining three, showing unipored tetrasporangial conceptacles, are referrable to the genera *Lithophyllum*, *Pseudolithophyllum* and *Goniolithon*. Meanwhile, during the past 90 years the genus *Lithothamnium* has been characterized as possessing multipored conceptacles. Moreover, this name has been referred to more species of crustose Corallinaceae than any other generic name. In such a situation Woelkerling (1983*a*) proposed to replace the name *Lithothamnium* Philippi, 1837 by the name *Lithothamnion* Heydrich, 1897, the latter being a homonym (orthographic variant) of the former, used in literature widely and, as it was supposed, erroneously (Adey and MacIntyre 1973). Heydrich was first to restrict the range of the genus *Lithothamnium* to the species with multipored tetrasporangial conceptacles and it was his concept of the genus (but partially also the name) that spread among the algologists and palaeoalgologists while typically morphologic criterion of Philippi has been given up.

Table 2

Key for the determination of red-algal genera recorded in the Pińczów Limestones

Genus	Thallus flexible	Thallus rigid								Reproductive organs		
		Thallus unilayered	Thallus multilayered									
			Hypothallus			Perithallus						
			monostromatic	multistromatic								
				cells in filaments	cells in rows	cells in filaments	cells in rows	cells in grid	cells disorganised	isolated sporangia	conceptacles multipored	conceptacles unipored
Archaeolithothamnium				+		+	+	+		+		
Palaeothamnium				+		+	+				+[1]	
"Lithothamnium"				+		+					+	
Mesophyllum				+	+			+			+	
Lithophyllum				+	+		+	+	+			+
Leptolithophyllum				+					+			+[2]
Titanoderma			+[3]			+						+
Melobesia			+				+					+
Lithoporella		+				+						+
Jania	+			+		+						+
Corallina	+				+	+						+
Karpathia				+[4]		+				not observed in fossils		

[1] traces of sori (joined sporangia)
[2] conceptacles strongly flattened
[3] oblique arrangement of cells
[4] cells ellipsoidal to polygonal

The change proposed by Woelkerling (1983*a*) is formalized (lectotype species is selected) and addressed to the International Botanical Congress. Until it will be accepted, the name *Lithothamnium* should be written with quotation marks (Woelkerling 1983*a*); this form is admitted in the present paper.

Another important change in generic taxonomy postulated by Woelkerling *et al.* (1985) concerns the genus *Dermatolithon* Foslie, 1898 which proved to be a junior objective synonym of *Titanoderma* Nägeli, 1858. The latter name holds thus priority. Because both the genera are homotypic (based on species formerly known as *Melobesia pustulata*) the diagnosis of *Titanoderma* is concordant with the diagnosis of *Dermatolithon*.

The name *Titanoderma* Nägeli accepted in the present paper instaed of *Dermatolithon* Foslie follows the statement of Woelkerling *et al.* (1985). As the genus *Titanoderma* is largely characterized by the features of calcified parts of the thallus (except secondary pits), its identification in the fossil state appears easy.

The study of the genus *Lithophyllum* based on Philippi's original collection (Woelkerling 1983*b*) did not resolve its status ultimately. Several premises indicate, however, that the name *Lithophyllum* Philippi, 1827 should refer to thalli with unistratose hypothallus only, while those thalli which possess multistratose hypothallus should be described under another generic name.

As far as the identification of fossil genera appears easy, the determination of algal species is rather difficult, which results from several reasons:

1. There is lack of generally accepted species concept in palaeoalgology. The absence of uncalcified details involves typologic approach to the species but it was not clearly expressed until eighties (Poignant 1980, Poignant and Bouillé 1985). Typological species cannot be referred to the recently known biological taxa and this leads inevitably to the increase in fossil species number. However, such classification is of certain interest for palaeoecology and stratigraphy (Beckmann and Beckmann 1966, Buchbinder 1977, Bakalova 1983, Bosence 1983).

2. Comparative investigations are frequently difficult because of diagenetic changes.

3. Species erected long time ago lack adequate photographic documentation. Drawings, fragmentary, inaccurate and subjectively interpreted by the author, are the only illustrations. Later authors interpreted such figures in many different ways and assigned structurally distinct thalli to the same species.

With all these limitations kept in mind one should regard any subspecific classification as being of no value. The varietates distinguished by some authors are then included into respective species in the present paper.

DESCRIPTIONS

Note on the material: the occurrence of particular species in thin sections is indicated (Table 3), instead of number of specimens, as it is impossible to show otherwise the frequency and relative abundances of red-algal species.

Class **Rhodophyceae** Ruprecht, 1851
Order **Cryptonemiales** Schmitz in Engler, 1892
Family **Corallinaceae** (Lamouroux) Harvey, 1849
Subfamily **Melobesioideae** Foslie, 1898
Genus *Archaeolithothamnium* Foslie, 1898
Archaeolithothamnium keenani Howe, 1934

(pl. 2: 2; pl. 3: 1; pl. 9: 5)

1934. *Archaeolithothamnium Keenani* Howe: 513, pl. 54: A—B.
1956. *Archaeolithothamnium Keenanii* var. *lvovicum* Maslov: 151—152, fig. 75, pl. 53: 2; pl. 55: 1—2.
1962. *Archaeolithothamnium keenanii* var. *lvovicum* Maslov; Maslov: 46—47, fig. 21.
1973. *Archaeolithothamnium pseudokeenanii* n. nom.; Mastrorilli: 250—251, pl. 3: 3.
1985. *Archaeolithothamnium lvovicum* Maslov; Pisera: 100, pl. 17: 1—4.

Description. — Numerous thalli forming crusts or branches. Hypothallus of crusts reduced or lacking at all. Hypothallic cells 15 μm in length and 10 μm in width, arranged in ascending filaments. Perithallus and medullary hypothallus of branches distinctly zoned, the zones being more regularly developed in branches than in crusts. Perithallic cells 12—24 μm in length and 10—15 μm in width, arranged either in filaments or in rows. Ellipsoidal sporangia 100—120 μm in height and 50—70 μm in width, arranged in rows, up to over twenty per row, separated by thin wall of 1—5 filaments of thin, elongated cells.

Remarks. — Mastrorilli (1973) erected a new species, *Archaeolithothamnium pseudokeenani*, to include *A. keenani* var. *lvovicum* Maslov from the Badenian of Ukraine and *A. keenani* var. *veronensis* Mastrorilli from the Lutetian of Northern Italy, and justified this decision by considerable morphometric differences between *A. keenani* Howe and the new species. However, the dimensions of particular structural elements of the specimens from California, Ukraine, Italy and Poland considerably overlap and hence, taxonomic validity of *A. pseudokeenani* Mastrorilli must be rejected.

Pisera (1985) raised varietas *lvovicum* Maslov to the specific level but he did not specify its relation to the species *keenani* Howe, and its diagnostic features, neither.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, branching algae, algal-bryozoan, and organodetrital facies; Roztocze Hills; northern Carpathian border). Eocene of California. Oligocene of Italy. Middle Miocene of Ukraine.

Archaeolithothamnium sp.

(pl. 3: 3—4)

Description. — Numerous crusts up to 1500 μm thick. Hypothallus strongly reduced, with cells 15—18 μm in length and 10—12 μm in width. Short filaments of the hypothallic tissue quickly pass into compact perithallic tissue. Perithallic cells 10—15 μm long and 8—12 μm wide, arranged in distinct, straight filaments but sometimes as a grid. Horizontal walls faint as a rule, although fused into long, horizontal bands in places. Reproductive organs could not be observed.

Remarks. — Closer identification of the discussed specimens is impossible because of lack of sporangia.

The thalli of *Archaeolithothamnium* sp. are variably preserved in Pińczów Limestones. Their majority resembles *A. lauense* Johnson et Ferris, 1950, as figured

Table 3

Relative frequency of species in the examined samples (thin sections)

Species	Number of thin sections	Species	Number of thin sections
Archaeolithothamnium keenani	8	*Mesophyllum galettoi*	10
Archaeolithothamnium sp.	16	*M. ingestum*	20
Palaeothamnium archaeotypum	15	*M. koritzae*	13
P. kossovense	6	*M. laffittei*	9
Palaeothamnium sp. 1	3	*M. marosticae*	2
Palaeothamnium sp. 2	1	*M. obsitum*	1
"Lithothamnium" aggregatum	5	*M. rigidum*	19
"L." alasanii	1	*M.* cf. *roveretoi*	6
"L." aff. *aucklandicum*	1	*M. vaughani*	3
"L." cf. bourcarti	4	*Lithophyllum albanense*	26
"L." disarmonicum	7	*L. anguineum*	23
"L." cf. *fruticulosum*	9	*L. besalotos*	4
"L." gaschei	8	*L. bonyense*	1
"L." lacroixi	2	*L. capederi*	4
"L." ladronicum	2	*L. corculumis*	2
"L." macrosporangicum	2	*L. duplex*	5
"L." microcellulosum	6	*L. intumescens*	2
"L." microphyllum	2	*L. kamptneri*	6
"L." montainvillense	3	*L.* cf. *lateporatum*	1
"L." moreti	10	*L. lithothamnioides*	39
"L." cf. *nitidum*	6	*L. maemongense*	1
"L." operculatum	7	*L. mgarrense*	8
"L." cf. *parvulum*	2	*L. microsporum*	1
"L." praefruticulosum	31	*L. minimum*	5
"L." prascoi	2	*L. prelichenoides*	44
"L." ramosissimum	42	*L. simplex*	2
"L." saipanense	1	*L. vicetinum*	1
"L." saxorum	10	*Lithophyllum* sp.	1
"L." subtile	3	*Leptolithophyllum maslovi*	1
"L." trinidadensum	1	*L. platticarpum*	2
"L." cf. *viallii*	1	*Titanoderma nataliae*	17
"Lithothamnium" sp. 1	1	*Melobesia sp.*	43
"Lithothamnium" sp. 2	1	*Lithoporella melobesioides*	2
"Lithothamnium" sp. 3	2	*Lithoporella* sp.	2
"Lithothamnium" sp. 4	1	*Corallina* sp.	2
		Jania dniestrovica	2
		J. ucrainica	6
		Karpathia sphaerocellulosa	7

by Johnson (1961, 1964*a*), but others are indistinguishable from *A. lauense* Johnson et Ferris shown by Johnson (1965), and Edgell and Basson (1975). The latter mode of preservation increases their resemblance to *"Lithothamnium" alifanense* Johnson which is characterized by reduced hypothallus, thick perithallus with a grid pattern and irregular growth zones.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, algal-bryozoan, and organodetrital facies).

Genus *Palaeothamnium* Conti, 1945
Palaeothamnium archaeotypum Conti, 1945
(pl. 3: 6—7)

1945. *Palaeothamnium archaeotypum* Conti: 42—46, fig. 1, pl. 3: 3a—c; pl. 8: 1a—c.
1972. *Palaeothamnium archaeotypum* Conti; Orszag-Sperber and Poignant: 117, pl. 2: 1—3.
1975. *Palaeothamnium archaeotypum* Conti; Boulanger and Poignant: 686—687, pl. 2: 3.
1977. *Palaeothamnium archaeotypum* Conti; Orszag-Sperber *et al.*: 286 and 290, pl. 3: 3.
1985. *Palaeothamnium archaeotypum* Conti; Pisera: 101, pl. 18: 1—2.

Description. — Thalli crustose, with short mamillae. Hypothallic cells: 12—18 μm long, 6—12 μm wide. Perithallic cells: 10—15 μm long, 8—12 μm wide. Conceptacles: 340—600 μm in diameter, 90—120 μm in height. In one specimen (pl. 3: 7) sporangia inside conceptacles are shorter but twice thicker than usually.

Remarks. — The species under discussion is easily recognizable by its arcuate sporangia that make the difference from the allied species *Palaeothamnium kossovense* Maslov. The specimen with thick sporangia resembles the thallus of *P. oligocenicum* figured by Mastrorilli (1967*a*); the latter species, however, shows less regular setting of sporangia and another contact of the conceptacles with the perithallic tissue (irregular basal cells).

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, algal-bryozoan, and organodetrital facies; Roztocze Hills; northern Carpathian border). Miocene of Austria, Slovakia, and France.

Palaeothamnium kossovense Maslov, 1962
(pl. 3: 2, and 5)

1962. *Palaeothamnium kossovense* Maslov: 54—56, figs 29—32, pl. 18: 1 and 4; pl. 19: 1—4.
1979. *Palaeothamnium kossovense* Maslov, 1962; Dieni *et al.*: 500—501, pl. 49: 4.

Description. — Several crustose and branching thalli. No hypothallic tissue in crusts. Both perithallus and medullary hypothallus heavily zoned, more regularly in branches than in crusts. Perithallic cells 10—15 μm in length and 8—10 μm in width, arranged in rows, occasionally in filaments. Medullary hypothallus of branches with cells arranged in rows, 12—15 μm in length and 10—12 μm in width each cell. Reproductive organs numerous, preserved at all developmental stages. Mature chambers oval to rectangular in section measure 200—450 μm in diameter and 120 μm in height.

Remarks. — *Palaeothamnium kossovense* Maslov is close to *P. archaeotypum* Conti but it differs from the latter species in its sporangia being straight at the early developmental stage, then oval to subrectangular in shape compared to the arcuate and pear-shaped sporangia at the respective stages in *P. archaeotypum* Conti.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, algal-bryozoan, and organodetrital facies). Paleocene of Ukraine (Carpathians), and Italy. Eocene of Ukraine (Crimea).

Palaeothamnium sp. 1
(pl. 16: 1)

Description. — Several branches 2.0—2.5 mm in diameter, showing distinct zonation. Zones irregular in outline but sometimes lenticular. Medullary hypothallic cells 12—15 μm in length and 7—9 μm in width, arranged in filaments. Perithallic cells isometric, 10×10 μm. Numerous immature reproductive organs filled with spores or preserved as elongated cells. Mature, rectangular to trapezoidal chambers measure 220—275 μm in diameter and 110—120 μm in height.

Remarks. — The specimens under consideration resemble the thalli of *Mesophyllum suganum* (Rothpletz) (see Małecki 1956) in the irregularly zoned thallus with numerous conceptacles. However, the cell arrangement and development of the conceptacles are typical of the genus *Palaeothamnium.*

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies).

Palaeothamnium sp. 2

1962. *Palaeothamnium* sp.; Maslov: 56—57, fig. 33.

Description. — A single branch with distinct but irregualar zonation. Cells arranged in rows, 5—15 μm in length and 8—10 μm in width each cell. Lenticular knots of particular zones comprise rows of elongated cells resembling the initial stages of sporangia, as typical of the genus *Palaeothamnium.* These structures measure 200—300 μm in diameter and 90—100 μm in height.

Remarks. — The specimen under consideration fits the figure of *Palaeothamnium* sp. given by Maslov (1962). Its specific identification cannot be achieved without any information on mature reproductive organs.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies). Miocene of Ukraine.

Genus "*Lithothamnium*" Philippi, 1837
"*Lithothamnium*" *aggregatum* Lemoine, 1939
(pl. 4: 2)

1939. *Lithothamnium aggregatum* Lemoine: 66—67, fig. 27, pl. 1: 12; pl. 3: 3—4.
1955. *Lithothamnium* cf. *aggregatum* Lemoine; Johnson: 71, pl. 7: 1.
1966. *Lithothamnium* cf. *aggregatum* Lemoine; Beckmann and Beckmann: 16, pl. 2: 26—27.

Description. — Thalli crustose, 250—400 μm thick in the sterile parts.
Hypothallic cells: 15—20 μm long, 8—15 μm wide.
Perithallic cells: 8—15 μm long, 5—10 μm wide.
Conceptacles: 300—540 μm in diameter, 120—180 μm in height.

Remarks. — The discussed specimens are consistent with the descriptions and figurations referred to in the synonymy.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement and algal-bryozoan facies). Eocene of Bulgaria. Eocene/Oligocene of Trinidad. Oligocene of Algeria. Miocene of Borneo and Guam.

"Lithothamnium" alasanii Maslov, 1956
(pl. 4: 1)

1956. *Lithothamnium alasanii* Maslov: 114—115, fig. 43, pl. 33: 5.
1962. *Lithothamnium alasanii* Maslov; Maslov: 58, fig. 34.

Description. — A single fragment of crust compo. ed exclusively of distinctly zoned perithallus. Cells 10—15 μm in length and 6—1 : μm in width, arranged in filaments; long, straight series of filaments clearly visible above the conceptacles. Conceptacles semilunar to triangular in section, 600—750 μm in diameter and 200—300 μm in height.

Remarks. — The discussed specimen is consistent with the thallus of *"Lithothamnium" alasanii* Maslov in its particularly large conceptacles but it differs from the holotype in much thicker roof above its conceptacles. This may be an artefact, however, resulting from a slight obliqueness of the section through the thallus.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement facies). Paleocene of Georgia.

"Lithothamnium" aff. *aucklandicum* Foslie, 1907
(fig. 4)

1961. *Lithothamnium* aff. *L. aucklandicum* Foslie; Johnson: 923—924, pl. 270: 6.

Description. — A single fragment of crust 300 μm thick, composed of hypothallus and lenticularly zoned perithallus. Hypothallic cells 10—15 μm in length and 10—12 μm in width, arranged in ascending filaments. Perithallic cells 10—12 μm long and 6—8 μm wide. Multipored conceptacles more or less regularly oval in section, 240—270 μm in diameter and 120—150 μm in height.

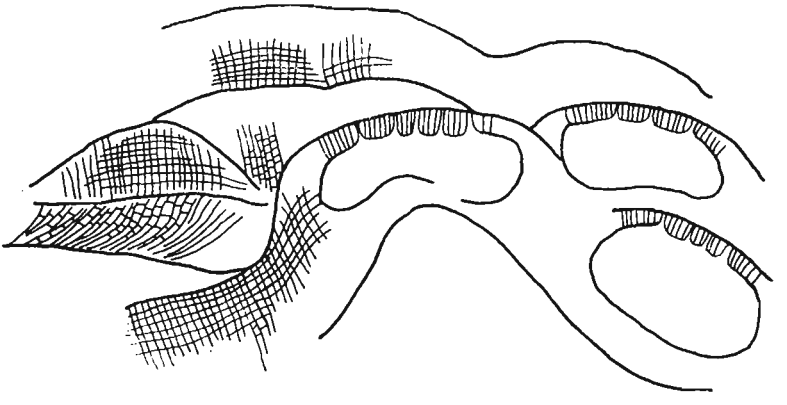


Fig. 4. *"Lithothamnium"* aff. *aucklandicum* Foslie; slice no. 40—3, ×120. Szczaworyż.

Remarks. — All the structural elements of the discussed specimen are consistent with those mentioned by Johnson (1961).

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement facies). Miocene of the Eniwetok Atoll.

"*Lithothamnium*" cf. *bourcarti* Lemoine, 1923
(pl. 4: 5—6)

1962. *Lithothamnium cf. bourcarti* Lemoine; Maslov: 59, pl. 15: 2.

Description. — A few branching and crustose thalli. Hypothallus 150 μm thick, with cells 18—24 μm long and 8—10 μm wide, arranged in ascending filaments. Perithallus zoned, consisting of minute cells 8—10 μm long and 6—8 μm wide. Conceptacles more or less rectangular, 240—280 μm in diameter and 120—180 μm in height.

Remarks. — The specimens under consideration are consistent with the figure of "*Lithothamnium*" cf. *bourcarti* Lemoine from the Miocene of Ukraine (see Maslov 1962). The original diagnosis of "*L.*" *bourcarti* given by Lemoine (1923a) includes no characteristics of the conceptacle shape and height. Therefore, the taxonomic position of the specimens from the Pińczów Limestones and those from Ukraine remains unclear. Possibly, the same concerns the specimens from Guam (Johnson 1964*a*).

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement and algal-bryozoan facies; northern Carpathian border). Middle Miocene of Ukraine.

"*Lithothamnium*" *disarmonicum* Conti, 1943
(pl. 5: 1; pl. 6: 1)

1967*a*. *Lithothamnium disarmonicum* Conti; Mastrorilli: 249—251, pl. 6: 1.
?1975. *Lithothamnium disarmonicum* Conti; Edgell and Basson: 174, pl. 4: 1—2.

Description. — Thick, mamillate crusts, composed exclusively of perithallus, sometimes with irregular zonation. Cells small-sized, 9—14 μm in length and 7—9 μm in width, arranged in filaments. Two kinds of conceptacles present: multipored conceptacles, 240—360 μm in diameter and 90—120 μm in height, more or less regularly oval or semilunar in section, and cystocarps (?) 300—480 μm in diameter and 120 μm in height, with one short, wide pore channel, concave or flat bottom, and regularly arched roof.

Remarks. — Two kinds of perithallic tissue typical of "*Lithothamnium*" *disarmonicum* Conti were not observed in the material from the Pińczów Limestones. The remaining diagnostic feature, however, viz. the conceptacle morphology, is clearly visible, and makes the thalli indistinguishable from those figured by Mastrorilli (1967*a*).

Edgell and Basson (1975) described some poorly preserved fragments of thalli with problematic conceptacles as "*L.*" *disarmonicum* Conti but this appears to be an overinterpretation, for no diagnostic features are discernible at the figures.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement and algal-bryozoan facies). Oligocene of Italy. Miocene of Bulgaria.

"*Lithothamnium*" cf. *fruticulosum* (Kützing) Foslie
(pl. 5: 3)

Description. — Several thalli forming crusts with mamillae and short branches. Hypothallic cells 18—30 μm in length and 8—12 μm in width. Perithallus distinctly zoned in branches, the zones being lenticular in shape or with an undulate contour. Perithallic cells 12—20 μm in length and 8—10 μm in width, arranged in filaments.

Conceptacles abundant, 180—300 μm in diameter, but exceptionally as much as 800 μm, and 80—150 μm in height, variable in section: suborbicular through oval to elongated, with the bottom and the roof parallel to each other. Sterile threads separating spores frequently preserved inside the conceptacle chambers.

Remarks. — The specimens under consideration resemble the thalli of "*L.*" *fruticulosum* (Kützing) reported by Lemoine (1919) from the Quaternary deposits of Sicily but differ from the latter in their conceptacles being smaller in diameter on the average.

The species "*L.*" *praefruticulosum* Maslov resembles "*L.*" *fruticulosum* (Kützing) in its numerous conceptacles, which are, however, much larger in size and more regular in shape in the former species.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, algal-bryozoan and organodetrital facies).

"*Lithothamnium*" *gaschei* Johnson, 1955

(pl. 5: 4—5)

1955. *Lithothamnium gaschei* Johnson: 73, pl. 8: 2 and 5.
1967*a*. *Lithothamnium gaschei* Johnson; Mastrorilli: 259—261, pl. 7: 3—4.

Description. — Mamillae or short branches, 1000—1500 μm in diameter. Hypothallus has not been observed.
Perithallic cells: 12—18 μm long, 10—12 μm wide.
Conceptacles: 260—300 μm in diameter, 100—120 μm in height.

Remarks. — The characteristic shape and dimensions of mature conceptacles, and the general appearance of the thalli closely correspond to the descriptions and figures referred to in the synonymy.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, branching algae, algal-bryozoan and organodetrital facies). Eocene of Bulgaria. Eocene/Oligocene of Trinidad. Oligocene of Italy.

"*Lithothamnium*" *lacroixi* Lemoine, 1917

(pl. 6: 5)

1917. *Lithothamnium lacroixi* Lemoine: 269—271, figs. 17—18.
1962. *Lithothamnium* aff. *lacroixi* Lemoine; Maslov: 63—64, fig. 38.
non 1985. *Lithothamnium lacroixi* Lemoine; Pisera: 101—102, pl. 19: 1—2.

Description. — Two fragments of crusts, 600 μm and 1000 μm thick, respectively, composed of reduced hypothallus and thick perithallus. Hypothallic cells 18×12 μm in size. Perithallic cells 12—15 μm in length and 8—10 μm in width, arranged in filaments but occasionally in rows. Conceptacles 330—400 μm in diameter and 120—150 μm in height, with concave to flat bottom. Traces of falciform spores preserved in conceptacle chambers.

Remarks. — The considered specimens are consistent with the descriptions and figures given by Lemoine (1917) and Maslov (1962). Whereas, thalli figured by Pisera (1985), showing distinct zonation, fan-like arrangement of hypothallic filaments, serial arrangement of perithallus and numerous conceptacles filled with 2—3 rows of spores, should be attributed rather to *Mesophyllum* than to "*Lithothamnium*".

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan and organodetrital facies; northern Carpathian border). Oligocene of Italy. Miocene of Ukraine and Martinique.

"Lithothamnium" ladronicum Johnson, 1957

(pl. 6: 6)

1967*a*. *Lithothamnium ladronicum* Johnson; Mastrorilli: 268—269, pl. 8: 4.

Description. — Two fragments of thalli of unknown growth form, composed exclusively of perithallus. Cells 12—15 μm in length and 9—10 μm in width, arranged as a grid. The greater falciform conceptacle chamber has 600 μm in diameter and 120 μm in height.

Remarks. — The characteristic shape of reproductive organs in conjunction with the grid arrangement of cells which is exceptional in the genus *"Lithothamnium"* sharply differs *"L." ladronicum* from its congeners. More conspicuous conceptacle curvature was figured by Mastrorilli (1967*a*) but this certainly falls within the range of intraspecific variability.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — organodetrital facies). Oligocene of Italy. Miocene of Saipan.

"Lithothamnium" macrosporangicum Mastrorilli, 1950

(pl. 5: 2)

1967*a*. *Lithothamnium macrosporangicum* Mastrorilli; Mastrorilli: 257—259, pl. 7: 2.

Description. — Two fragments of encrustations composed of hypothallus and perithallus, up to 250 μm thick in sterile parts. Hypothallus 80—100 μm thick, with fan-like arrangement of cells; cell dimensions unknown, for all the available sections are perpendicular to the propagation of the filaments. Perithallic cells 10—12 μm in length and 8—9 μm in width, arranged in filaments. The only conceptacle with axial section is trapezoid-ovoidal in shape, relatively high (400 μm in diameter and 240 μm in height), with indistinct pores in its roof.

Remarks. — The considered specimens have the conceptacles relatively wider at the base than in the holotype but its dimension and proportions as well as the general appearance of the thallus conform well to *"Lithothamnium" macrosporangicum* Mastrorilli.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies). Oligocene and Miocene of Italy. Miocene of Turkey.

"Lithothamnium" microcellulosum Maslov, 1956

(pl. 6: 2a—2b)

1956. *Lithothamnium microcellulosum* Maslov: 136, pl. 37: 2; pl. 40: 1; var. *junior* Maslov: 150, figs. 72—73.

1962. *Lithothamnium microcellulosum* Maslov; Maslov: 65—66, fig. 40; var. *junior* Maslov: 66, figs. 41—42.

Description. — A few crustose thalli about 500 μm thick, composed exclusively of perithallus. Thick-walled cells 8—15 μm in length and 7—10 μm in width, arranged either in filaments or in rows. Conceptacles 360—600 μm in diameter and 90—180 μm in height, elongated, with bottom flat or curved, conforming to the thallus curvature, with roof parallel to the bottom or slightly undulated. Conceptacles are partially filled with spores.

Remarks. — The average cell dimensions in the specimens under consideration are greater than those reported by Maslov (1956, 1962) but both the shape and the diameter of the reproductive organs are typical of *"Lithothamnium" microcellulosum* Maslov. These specimens correspond particularly well to those described by Maslov (1956, 1962) as the variety *junior*. The red-algal varieties are, however, not accepted by the present author (see p. 16), being included into respective species.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies). Late Eocene of Italy. Middle Miocene of Ukraine.

"Lithothamnium" microphyllum Maslov, 1956
(pl. 6: 3)

1985. *Lithothamnium microphyllum* Maslov; Pisera: 102, pl. 19: 3—4 (cum syn.).

Description. — Two fragments of perithallic tissue 300—600 μm thick. Cells 6—8 μm in length and 5—6 μm in width but up to 10—12 μm in length in distinctly zoned thalli, arranged in filaments and indistinct rows. Conceptacles with concave bottom and irregular, multipored roof, ranging from 170 to 200 μm in diameter and from 120 to 130 μm in height.

Remarks. — The original diagnosis and drawing of *"Lithothamnium" microphyllum* Maslov are inconsistent with the accompanying photograph (Maslov 1956). The drawing shows thallus with thin perithallic tissue and reniform conceptacles (which corresponds to the description), while the photograph presents conceptacles oval in section, with strongly concave bottom and irregular roof. Any variability in conceptacle shape is not mentioned in the text. The study of Maslov's collection made by the present author has shown the identity of the photograph with the holotype. The thalli from the Pińczów Limestones along with the specimens described by Mastrorilli (1967*a*) and Pisera (1985) are indistinguishable from the holotype of *"L." microphyllum* Maslov.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies; Roztocze Hills). Oligocene of Bulgaria and Italy. Middle Miocene of Ukraine.

"Lithothamnium" montainvillense Lemoine, 1923
(pl. 5: 6)

1923*a*. *Lithothamnium montainvillense* Lemoine: 67, fig. 6.

Description. — A few fragments of zoned thalli, probably crustose in form, very peculiar in structure. Hypothallus gradually passing into the perithallic tissue. Hypothallic cells elongated (12—18 μm in length and 8 μm in width) but progressively shorter near the transitional zone. Perithallic cells rectangular and vertically elongated, then subquadrate, and again rectangular but horizontally elongated; they are 5—12 μm in length and 8—10 μm in width. Conceptacles not observed.

Remarks. — The original description of *"Lithothamnium" montainvillense* (see Lemoine 1923*a*) is vague, exacerbated by very schematic drawing. The specimens under consideration are assigned to *"L." montainvillense* Lemoine because of peculiar sequence of cells along the filaments which seems to be the diagnostic feature of the species.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies). Paleocene of France.

"*Lithothamnium*" *moreti* Lemoine, 1927
(pl. 6: 4)

1939. *Lithothamnium moreti* Lemoine; Lemoine: 71—73; figs. 32—33.
1967*a*. *Lithothamnium moreti* Lemoine; Mastrorilli: 239—240, pl. 4: 1—2.

Description. — Numerous thalli forming branches or mamillate crusts, without hypothallic tissue. Perithallus zoned, with cells 10—18 μm in length and 9—12 μm in width, arranged in filaments. Conceptacles 180—800 μm in diameter and 80—110 μm in height, with bottom and roof parallel to each other. The longest conceptacles bent, conforming to the curvature of the thallus.

Remarks. — The considered specimens differ in their longer perithallic cells from those figured by Mastrorilli (1967*a*), and additionally, in their longer conceptacles from those reported by Lemoine (1939).

"*Lithothamnium*" *moreti* Lemoine resembles "*L.*" *pianfolchi* Mastrorilli from the Italian Oligocene (Mastrorilli 1967*a*) but the conceptacles of the latter are less than 400 μm in diameter.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan and organodetrital facies). Oligocene of Italy and Algeria.

"*Lithothamnium*" cf. *nitidum* Foslie, 1901
(pl. 7: 2)

1961. *Lithothamnium* cf. *L. nitidum* Foslie; Johnson: 924, pl. 270: 3—4.

Description. — A small number of thick (up to 1000 μm), crustose thalli. Hypothallus thin and poorly preserved, with cells 24—34 μm in length and 8—10 μm in width. Perithallus distinctly zoned, with cells arranged in filaments or as a grid but locally also in rows. Perithallic cells subquadrate in shape, 8—12 μm in length and 8—12 μm in width. Large, multipored conceptacles irregularly bean-shaped to oval in section, 480—750 μm in diameter and 180—300 μm in height.

Remarks. — The specimens under consideration are consistent with the description and figuration of "*Lithothamnium*" cf. *nitidium* Foslie, given by Johnson (1961), the only difference being in longer hypothallic cells in the Pińczów material.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement facies). Miocene of the Eniwetok Atoll.

"*Lithothamnium*" *operculatum* (Conti) Conti, 1950
(pl. 7: 1 and 3)

1945. *Pomatophyllum operculatum* Conti; Conti: 52—54, pl. 4: 3a—3b.
1966. *Lithothamnium operculatum* Conti; Mastrorilli: 230—233, pl. 2: 2.
1967*a*. *Lithothamnium operculatum* (Conti) Conti; Mastrorilli: 255—257, pl. 6: 3—5.

Description. — Thalli crustose with mamillae. Hypothallus poorly preseved.
Perithallic cells: 9—12 μm long, 6—8 μm wide.
Conceptacles: 240—300 μm in diameter, 100—120 μm in height.

Remarks. — The considered specimens are consistent with the descriptions and figures referred to in the synonymy.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement and algal-bryozoan facies). Oligocene of Italy. Miocene of Austria and Slovakia.

"*Lithothamnium*" cf. *parvulum* Conti, 1943
(pl. 8: 1)

Description. — Two fragments of thalli composed exclusively of perithallus. Cells subquadrate to rectangular in section, 8—18 μm in length and 6—10 μm in width, arranged in distinct, regular filaments. Some conceptacles with flat bottom and regularly arched roof, 200 μm in diameter and 100 μm in height; others in form of triangular chambers surrounded with a dark areola, 100—250 μm in diameter and 100—120 μm in height.

Remarks. — The specimens under consideration differ from those described by Mastrorilli (1967*a*) as "*Lithothamnium*" *parvulum* Conti in their larger perithallic cells; the conceptacles are consistent with two of the three kinds of reproductive organs of "*L.*" *parvulum* Conti but the third one has not been identified in the investigated material.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — organodetrital facies).

"*Lithothamnium*" *praefruticulosum* Maslov, 1956
(pl. 2: 2; pl. 7: 5)

1985. *Lithothamnium praefruticulosum* Maslov; Pisera: 101, pl. 20: 1—3 (cum. syn.).

Description. — Numerous crustose thalli, sometimes growing superimposed on one another and forming thick crusts, occasionally with mamillae. Hypothallus 60—100 μm thick, with cells in ascending filaments which commonly show a fan-like arrangement. Hypothallic cells 18—30 μm long and 10—12 μm wide. Perithallus with rectangular (10—18 μm×9—12 μm) or quadrate (12×12 μm) cells arranged either in filaments or in rows. Abundant conceptacles 300—780 μm in diameter and 120—150 μm in height, with the bottom and the roof parallel to each other.

Remarks. — Very numerous reproductive organs well distinguish "*Lithothamnium*" *praefruticulosum* Maslov among its congeners. Neither the hypothallus nor the perithallus is diagnostic because of their variable structure.

The specimens from Ukraine (Maslov 1956, 1962), including the holotype, lack the hypothallus. Mastrorilli (1967*a*) described the hypothallic cells having 9×10 μm in size, while Bosence (1983) gave the following size range: 18—22 μm in length and 8—10 μm in width.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, albal-bryozoan and organodetrital facies; Roztocze Hills; northern Carpathian border). Oligocene of Italy. Miocene of Ukraine and Malta.

"*Lithothamnium*" *prascoi* Mastrorilli, 1967
(fig. 5)

1967*a*. *Lithothamnium prascoi* Mastrorilli: 277—278, pl. 10: 2.

Description. — Two fragments of crustose thalli composed of thin (60 μm), reduced hypothallus and thick (400—600 μm) perithallus. Hypothallic cells 10—16 μm in length and 8 μm in width, arranged in filaments that diverge in a fan-like man-

ner. Perithallus with quadrate (8×8 μm) to rectangular (8—12×6—8 μm) cells, arranged in filaments. Scarce reniform conceptacles 180 μm in diameter and 90 μm in height, with flat to concave bottom.

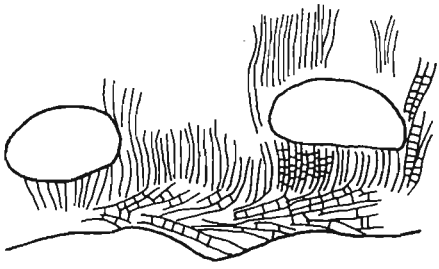


Fig. 5. *"Lithothamnium" prascoi* Mastrorilli; slice no. 6/II, ×120. Pińczów.

Remarks. — The considered specimens are consistent with the holotype of *"Lithothamnium" prascoi* Mastrorilli, the only difference being in their slightly shorter perithallic cells.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — organodetrital facies). Oligocene of Italy.

"Lithothamnium" ramosissimum (Gümbel) Conti, 1945

(pl. 8: 2 and 4)

1945. *Lithothamnium ramosissimum* Guembel (*non* Reuss); Conti: 18—22, pl. 1: 1a—1f; pl. 7: 1—3.

?1964*b*. *Lithothamnium ramosissimum* (Reuss) Schimper; Johnson: 478.

1966. *Lithothamnium ramosissimum* Gümbel, 1871, *sensu novo* Conti, 1945; Mastrorilli: 223—225, pl. 1: 2.

Description. — Branching, but exceptionally crustose thalli. Hypothallus 150—260 μm thick in crusts, composed of ascending filaments of cells that have 15—20 μm in length and 8—15 μm in width. Perithallic cells of crusts equidimensional with those of the medullary hypothallus of branches (10—15 μm in length and 8—10 μm in width). Perithallic cells of branches 10—12 μm long and 8—10 μm wide. Medullary hypothallus distinctly, very regularly zoned, with cells arranged in filaments or in rows within the zones. Only two conceptacles have been found in the very abundant material; they have 250 and 330 μm in diameter and 100 and 120 μm in height, respectively.

Remarks. — This is one of the most common species in the Pińczów Limestones. The conceptacles are smaller than those recorded in *"Lithothamnium" ramosissimum* (Gümbel) from the Leitha Limestones (Conti 1945) but comparable to those found in the specimens from the Miocene of Iraq (Johnson 1964*b*).

Johnson (1964*b*) *considered "L." ramosissimum* to have been erected by Reuss, although Conti (1945) had demonstrated Gümbel to be the author of *"L." ramosissimum*, for *Nullipora ramosissima* Reuss represents in fact the genus *Lithophyllum*.

The crustose species *"L." pseudoramosissimum* Poignant (see Boulanger and Poignant 1975, Orszag-Sperber *et al.* 1977) resembles *"L." ramosissimum* (Gümbel) in its general structure but differs from the latter in its numerous, large conceptacles (700 μm in diameter).

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, branching algae, algal-bryozoan and organodetrital facies). Oligocene of Italy. Miocene of Austria, Slovakia, France, and Iraq.

"Lithothamnium" saipanense Johnson, 1957
(pl. 8: 3)

1964b. *Lithothamnium saipanense* Johnson; Johnson: 478, pl. 2: 1.
non 1975. *Lithothamnium saipanense* Johnson; Edgell and Basson: 176, pl. 4: 6.

Description. — A single encrustation composed of thin (100 μm) hypothallus and very thin (80 μm in sterile parts) perithallus. Hypothallic cells 15—18 μm in length and 12—14 μm in width, arranged in indistinct vertical filaments. Perithallic cells 9×9 μm in size, without any recognizable arrangement. Two conceptacles present, the larger one (300 μm in diameter and 180 μm in height) with concave bottom and flat roof.

Remarks. — The discussed specimen is consistent with *"Lithothamnium" saipanense* Johnson in its peculiar structure and dimensions of the elements but it differs from Johnson's specimen in its conceptacle shape and thicker perithallus.

The specimen referred by Edgell and Basson (1975) to *"L." saipanense* Johnson has no conceptacles; moreover, its perithallic tissue is several times thicker than the hypothallus. In fact, that specimen shows no features typical of *"L." saipanense* Johnson.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies). Miocene of Iraq, Guam, and Saipan.

"Lithothamnium" saxorum Capeder, 1900
(pl. 8: 5—6; pl. 13: 7)

1956. *Lithothamnium saxorum* Capeder; Maslov: 143—144, fig. 64, pl. 45: 2; pl. 46: 1—3; *non* var. *Korolukae* Maslov: 144, fig. 65, pl. 47: 1—2.
1962. *Lithothamnium saxorum* Capeder; Maslov: 68—69, fig. 45; *non* var. *korolukae* Maslov; Maslov: 69, fig. 46.
1963. *Lithothamnium saxorum* Capeder; Souaya: 1209, pl. 161: 1.
1977. *Lithothamnium sp.* cf. *L. saxorum* Capeder; Buchbinder: 420, pl. 1: 6.
1985. *Lithothamnium saxorum* Capeder; Pisera: 102, pl. 18: 3—4.

Description. — Thallus crustose.
Hypothallic cells: 15—27 μm long, 8—12 μm wide.
Perithallic cells: 15—20 μm long, 8—12 μm wide.
Conceptacles: 300—350 μm in diameter, 140 μm in height.

Remarks. — The considered specimens closely correspond to the thalli of *"Lithothamnium" saxorum* Capeder as described in papers referred to in the synonymy, but not to the variety *korolukae* erected by Maslov (1956). Comparative investigations made by the present author on Maslov's original material have shown, that thallus described as *"L." saxorum* var. *korolukae* represents in fact *Lithophyllum albanense* Lemoine.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies, organodetrital facies; Roztocze Hills; northern Carpathian border). Oligocene of Italy. Miocene of Ukraine, Israel, and Egypt.

"Lithothamnium" subtile Conti, 1943
(pl. 9: 4)

1962. *Lithothamnium subtile* Conti; Johnson: 78, pl. 13: 3.
1966. *Lithothamnium subtile* Conti; Beckmann and Beckmann: 16, pl. 2: 28.
1966. *Lithothamnium subtile* Conti, 1943; Mastrorilli: 228—229, pl. 2: 1.

Description. Three fragments of crusts composed of thin hypothallus (40—60 μm) and comparably thin perithallus (40—50 μm in sterile parts). Because of the poor preservation, only the perithallic cells could be measured. They are 12—15 μm long and 6—8 μm wide. Conceptacles numerous, 240 μm in diameter and 100—120 μm in height, commonly bean-shaped.

Remarks. — The considered specimens closely correspond to the one figured by Mastrorilli (1966). They are less consistent with the figures presented by Johnson (1962) and Beckmann and Beckmann (1966) which show thalli with immature reproductive organs.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan and organodetrital facies). Oligocene of Italy.

"Lithothamnium" trinidadensum Johnson, 1955
(pl. 9: 2)

1955. *Lithothamnium trinidadensum* Johnson: 72, pl. 7: 5.

Description. — A single thallus, probably fragment of a mamillate crust, composed of perithallus only. Cells 7—15 μm in length and 10—12 μm in width, arranged in filaments or indistinct rows. Conceptacles numerous, subrectangular, 300—360 μm in diameter and 120 μm in height.

Remarks. — The specimen closely corresponds to the holotype of *"Lithothamnium" trinidadensum* Johnson, the only difference being its slightly lower conceptacles.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies). Eocene/Oligocene of Trinidad. Oligocene of Italy.

"Lithothamnium" cf. *viallii* Mastrorilli, 1973
(pl. 9: 6)

Description. — A single fragment composed exclusively of perithallus. Cells subquadrate, 8—10 μm in length, and 8—10 μm in width, arranged in filaments. The only conceptacle chamber with its bottom elevated and the roof lowered in the middle, and with a wide, narrowing pore channel bifurcated at the end. The conceptacle has 300 μm in diameter and 70 μm in height.

Remarks. — More accurate identification is impossible because of the lack of hypothallus and slightly different shape of the conceptacle. The conceptacle bottom in the holotype specimen of *"Lithothamnium" viallii* (see Mastrorilli 1973) is provided with a roof-like structure, which is lacking in the discussed specimen. Possibly, this is due to the non-axial section of the conceptacle chamber.

Similar conceptacle shape is known also in the species *Lithophyllum exiguum* Conti; it differs from *"Lithothamnium" viallii* Mastrorilli, however, in the structure of the perithallic tissue and in twice as large diameter of the reproductive organs.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — branching algae facies).

"Lithothamnium" sp. 1

(pl. 9: 3)

1966. *Lithophyllum simplex* Lemoine; Beckmann and Beckmann: 20, pl. 4: 48—50.

Description. — A single fragment of crustose thallus 300 μm thick. Hypothallic cells 15—27 μm in length and 10—12 μm in width, arranged in filaments that at first run horizontally over a considerable distance, then ascend to gradually pass into the perithallic tissue. Hypothallic filaments may also show an indistinct fan-like arrangement. Perithallic cells 8—12 μm in length and 6—8 μm in width, arranged in filaments. Oval-shaped conceptacles 100—120 μm in diameter and 80—90 μm in height, with indistinct remnants of the sterile threads inside.

Remarks. — The considered specimen is indistinguishable from those reported by Beckmann and Beckmann (1966) from the Oligocene of Cuba under the name *Lithophyllum simplex* Lemoine. The Cuban and Polish specimens resemble each other in the general aspect of the thallus as well as in the arrangement and dimensions of particular structural elements. The only difference is in the smaller diameter of conceptacles in the specimen from the Pińczów Limestones. No doubt, these specimens are representatives of the genus *"Lithothamnium"* and not *Lithophyllum* (with respect of cell arrangement and conceptacles' character). Perhaps, they should be separated as a new species but the Pińczów material is insufficient to this purpose and requires comparative investigations.

The species *Lithophyllum simplex* Lemoine is described further in this paper.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies). Oligocene of Cuba.

"Lithothamnium" sp. 2

(pl. 9: 1)

Description. — A single fragment of branch or mamilla, composed exclusively of perithallus. Cells 15—21 μm in length and 12—15 μm in width, arranged in rectilinear filaments. Thallus strongly but irregularly zoned. Growth disturbances apparent within individual zones. Reproductive organs absent.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies).

"Lithothamnium" sp. 3

(pl. 4: 3—4)

Description. — Two encrustations 200—250 μm thick, composed of thin hypothallus and thick perithallus. Hypothallus consisting of one to several filaments that run horizontally, then ascend and gradually pass into the perithallus. Hypothallic cells 12—24 μm long and 9—12 μm wide. Perithallic cells 15—24 μm in length and 12—18 μm in width, arranged in filaments. Reproductive organs absent.

Remarks. — The considered specimens resemble the thallus of *"Lithothamnium" andrusovi* Lemoine, schematically drawn by Maslov (1956, 1962). However, the original presentation of *"L." andrusovi* by Lemoine (1933) shows cell arrangement different from the one drawn by Maslov (1956, 1962).

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement and algal-bryozoan facies).

"Lithothamnium" sp. 4
(pl. 7: 4)

1977*b*. *Lithothamnium* sp. B; Buchbinder: 420, pl. 2: 2.

Description. — A single crustose thallus, composed of thick (ca 200 μm) hypothallus and also thick (ca 1000 μm) perithallus. Hypothallic cells large (20—30 μm long and 10—15 μm wide), arranged in a fan-like manner. Perithallic cells quadrate in general (15—17 μm long and 12—15 μm wide), arranged in filaments but sometimes as irregular grid. Any zonation is absent. Reproductive organs were not observed.

Remarks. — This specimen resembles closely the one described by Buchbinder (1977*b*), particularly in its large hypothallic cells and proportion to the perithallic cells, as well as in its thick, devoid of zonation, perithallus.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement facies). Miocene of Israel.

Genus *Mesophyllum* Lemoine, 1928

Mesophyllum galettoi Mastrorilli, 1967
(pl. 10: 1 and 3)

1967*a*. *Mesophyllum galettoi* Mastrorilli: 303—305, pl. 17: 1—3.
1972. *Mesophyllum galettoi* Mastrorilli; Orszag-Sperber and Poignant: 120, pl. 3: 6.

Description. — Numerous crustose thalli, occasionally superimposed on one another to form multilamellar crusts. Hypothallus approximately 150 μm thick, with sections typical of the genus *Mesophyllum* alternating with those typical of *"Lithothamnium"*. Hypothallic cells arranged in rows in average longer than those arranged in filaments (16—21×6—8 μm and 14—20×6—12 μm respectively). Perithallic cells of the sterile parts subquadrate, 8—10 μm long and 6—9 μm wide. Conceptacles numerous, 210—300 μm in diameter and 100—150 μm in height, oval to bean-shaped in section, with two or three series of spores inside.

Remarks. — The specimens under discussion closely correspond to the descriptions and figures referred to in the synonymy, except for their hypothallic cells being almost twice longer than reported by Mastrorilli (1967*a*).

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, algal-bryozoan and organodetrital facies). Oligocene of Italy. Miocene of France.

Mesophyllum ingestum Conti, 1945
(pl. 11: 6)

1945. *Mesophyllum ingestum* Conti: 49—52, pl. 4: 2a—2c.
1967*a*. *Mesophyllum ingestum* Conti; Mastrorilli: 296—299, pl. 15: 1—4.

Description. — Numerous crustose thalli up to 700 μm thick, composed of very regular hypothallus and perithallus. Coaxial hypothallus 240—360 μm thick, with cells usually 20—30 μm in length and 10—12 μm in width. Perithallic cells rectangular as a rule, 10—15 μm in length and 8—10 μm in width, arranged in rows or as a grid. Conceptacles irregularly oval, poorly defined, 250—360 μm in diameter and 90—180 μm in height, filled with spores.

Remarks. — The original drawings of *Mesophyllum ingestum* (see Conti 1945) are too schematic to give and idea about the general structure of the thallus. The specimens from Pińczów Limestones have longer hypothallic cells and smaller reproductive organs than those described by Conti (1945). On the other hand, they are consistent with the specimens of *M. ingestum* Conti described by Mastrorilli (1967*a*), except for their thicker perithallus.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — branching algae, algal-bryozoan and organodetrital facies). Oligocene of Italy. Miocene of Austria.

Mesophyllum koritzae (Lemoine) Lemoine, 1939
(pl. 10: 2)

1923*b*. *Lithophyllum Koritzae* Lemoine: 279—280, figs. 4—5.
1939. *Mesophyllum Koritzae* Lemoine; Lemoine: 84—85, figs. 49—51.
1962. *Mesophyllum koritze* Lemoine; Maslov: 74—75, fig. 52.
1972. *Mesophyllum koritzae* Lemoine; Orszag-Sperber and Poignant: 120, pl. 2: 5.
1983. *Mesophyllum koritzae* Lemoine; Bosence: 158—159, pl. 16: 8—10.

Description. — Thalli crustose.
Hypothallic cells: 28—30 μm long, 10—15 μm wide.
Perithallic cells: 8—18 μm long, 6—8 μm wide.
Conceptacles: 180—480 μm in diameter, 90—180 μm in height.

Remarks. — The original diagnosis of *Mesophyllum koritzae* (see Lemoine 1923*b*) gives no information on the conceptacles, except for their diameter. The consistence of the considered specimens with the holotype remains thus unclear. They correspond, however, to the descriptions and figures referred to in the synonymy.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan and organodetrital facies; northern Carpathian border). Miocene of Ukraine, France, Malta, Albania, and Algeria.

Mesophyllum laffittei Lemoine, 1939
(pl. 1: 2 pl. 10: 5—6)

1939. *Mesophyllum Laffittei* Lemoine: 88—89, figs. 59—60, pl. 3: 1 and 7.
1964*b*. *Mesophyllum laffittei* Lemoine; Johnson: 480, pl. 2: 4—6.
non 1967*a*. *Mesophyllum laffittei* Lemoine; Mastrorilli: 292—294, pl. 13: 4.
1977. *Mesophyllum laffittei* Lemoine; Buchbinder: 420, pl. 2: 3—4.

Description. — A few thalli forming mamillate crusts with short, stubby branches. Non-coaxial hypothallus approximately 250 μm thick, with rectangular cells 18—30 μm long and 10—12 μm wide, arranged in filaments, occasionally diverging in a fan-like manner. Hypothallus locally shows a zonation caused by development of successive "probing fingers". Perithallic cells 12—15 μm in length and 8—10 μm in width, arranged in regular rows or as a grid. Perithallus distinctly zoned. Conceptacles large, multipored, commonly oval in section, 400—1200 μm in diameter and 180—300 μm in height.

Remarks. — The species *Mesophyllum laffittei* Lemoine is characterized by its large reproductive organs distributed in a thick, regularly zoned perithallus. The specimens preserved in the Pińczów Limestones are consistent in this respect with those described by Buchbinder (1977) and Johnson (1964*b*). They are, however, entirely different from the one reported by Mastrorilli (1967*a*) who figured a thallus with small, trapezoidal conceptacles.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, branching algae and algal-bryozoan facies). Miocene of Slovakia, Bulgaria, Algeria, Israel and Iraq.

Mesophyllum marosticae Mastrorilli, 1973
(pl. 10: 4)

1973. *Mesophyllum marosticae* Mastrorilli: 265—266, pl. 5: 3—5.

Description. — The fragments of crustose thalli, 400 μm thick. Hypothallus is either reduced or, possibly, partially preserved, less than 100 μm thick. Hypothallic cells 25—30 μm in length and 12 μm in width, arranged in semi-arcuate rows. Perithallus strongly zoned, with rectangular to subquadrate cells 8—12 μm long and 6—12 μm wide. Conceptacles 300—360 μm in diameter and 150 μm in height, suboval in section, contacting directly the hypothallus, with the bottom parallel to the roof.

Remarks. — The general character of the thallus and the dimensions of particular structural elements conform well to the original description and figures of *Mesophyllum marosticae* Mastrorilli. The hypothallic and perithallic cells, however, are a little wider than in the holotype. Furthermore, the conceptacles are placed inside the perithallic tissue, slightly above the hypothallus, in the Italian specimens.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement facies). Oligocene of Italy.

Mesophyllum obsitum Airoldi, 1932
(pl. 11: 5)

1967*a*. *Mesophyllum obsitum* Airoldi; Mastrorilli: 290—292, pl. 13: 3.

Description. — Two fragments of crustose thalli, composed of thin (40—60 μm), possibly reduced hypothallus and thin perithallus (less than 100 μm in the sterile parts). Hypothallic cells 18—20 μm long and 8—10 μm wide, arranged in filaments or irregular rows. Perithallus zoned, with cells 8—10 μm long and 10 μm wide, arranged in rows. Conceptacles 270—330 μm in diameter and 130—150 μm in height, suboval in section, with the bottom and roof parallel to each other, and two series of spores preserved inside.

Remarks. — The specimens under consideration are indistinguishable from the thalli of *Mesophyllum obsitum* Airoldi reported by Mastrorilli (1967a) except for the hypothallus being 200 μm thick in the latter case.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies). Oligocene of Italy.

Mesophyllum rigidum Mastrorilli, 1967
(pl. 11: 1 and 3)

1967*a*. *Mesophyllum rigidum* Mastrorilli: 309—311, pl. 18: 3—4.

Description. — Thalli crustose.
Hypothallic cells: 25—36 μm long, 8—12 μm wide.
Perithallic cells: 10—18 μm long, 10—15 μm wide.
Conceptacles: 400—420 μm in diameter, 90—130 μm in height; one very long concept-

acle (600 μm in diameter and 120 μm in height (pl. 11: 1), may reflect fusion of two neighbouring chambers.

Remarks. — The considered specimens are entirely consistent with the description and figures of *Mesophyllum rigidum* Mastrorilli, given by Mastrorilli (1967*a*).

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — branching algae, algal-bryozoan and organodetrital facies). Eocene of Bulgaria. Oligocene of Italy.

Mesophyllum cf. *roveretoi* Conti, 1943

(pl. 2: 1; pl. 12: 1)

Description. — Several mamillate crusts composed of partly damaged hypothallus and strongly zoned perithallus. Hypothallic cells 24 μm long and 8—10 μm wide. Perithallic cells 15—18 μm long and 8—10 μm wide. Conceptacles 220—360 μm in diameter and 150—180 μm in height, with strongly concave bottom and flat roof perforated by 4—6 pores.

Remarks. — The considered specimens are consistent in their growth form, strong zonation of the perithallus, and dimensions of the particular structural elements with the description and figures of *Mesophyllum roveretoi* given by Conti (1945), Mastrorilli (1967*a*), and Orszag-Sperber and Poignant (1972). However, they are distinctive in the shape of the reproductive organs (which may be due to the non-axial section) and also in the lack of characteristic cystocarps. Consequently, they are assigned to *Mesophyllum roveretoi* Conti with reservations.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement facies).

Mesophyllum vaughani (Howe) Lemoine, 1928

(pl. 11: 2; pl. 16: 4)

1939. *Mesophyllum Vaughani* (Howe) Lem.; Lemoine: 89—92, pl. 1: 2, 8, 11 and 15.
?1965. *Mesophyllum vaughani* (Howe) Lemoine; Johnson: 268, pl. 4: 3; pl. 5: 5.
?1966. *Lithothamnium vaughani* Howe; Beckmann and Beckmann: 17—18, pl. 3: 35—36.
1967*a*. *Mesophyllum vaughani* (Howe) Lemoine; Mastrorilli: 284—286, pl. 12: 1—4.

Description. — Several encrustations up to 1000 μm thick, composed of hypothallus and perithallus. Both the tissues zoned, with successive hypothallic zones passing into perithallic zones. Non-coaxial hypothallus thick (up to 400 μm), with cells 15—24 μm long and 10—14 μm wide, arranged either in irregular rows or in filaments that diverge in a fan-like manner. Perithallic cells subquadrate, 8—10 μm in length and 6—10 μm in width, arranged in rows. The only conceptacle 600 μm in diameter and 180 μm in height with slightly concave bottom and with roof perforated by at least three pores (the roof is partially damaged by irregularly growing perithallic cells).

Remarks. — The specimens under consideration correspond to the thalli of *Mesophyllum vaughani* (Howe) described by Lemoine (1939) and by Mastrorilli (1967*a*) but they have hypothallic cells smaller than in the specimens from Algeria while larger than in those from Italy.

The species *vaughani* has originally been attributed to the genus "*Lithothamnium*" but subsequently (Lemoine 1928 *fide* Mastrorilli 1967*a*) transferred to the genus *Mesophyllum*. Beckmann and Beckmann (1966) retained its previous taxonomic position, unfortunately with no comment. This is invalid, according to the present

author, as the regular arrangement of perithallic cells is diagnostic rather for *Mesophyllum* than for "*Lithothamnium*". The non-coaxial character of hypothallus is typical of the genus "*Lithothamnium*" but it commonly occurs also in many species of both *Mesophyllum* and *Lithophyllum*.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — agal-bryozoan facies). Eocene of Bulgaria. Oligocene of Italy, Algeria, and Cuba. Miocene of Borneo.

Genus *Lithophyllum* Philippi, 1837
Lithophyllum albanense Lemoine, 1923
(pl. 2: 1; pl. 12: 2)

1962. *Lithophyllum albanense* Lemoine; Maslov: 77—78, fig. 55, pl. 17: 3; pl. 22: 1—3 (cum syn.).
1962. *Lithothamnium saxorum* var. *korolukae* Maslov; Maslov: 69, fig. 46.
1964*b*. *Lithophyllum albanense* Lemoine; Johnson: 482, pl. 3: 2.
1967*a*. *Lithophyllum albanense* Lemoine; Mastrorilli: 315—317, pl. 21: 1—2.
1972. *Lithophyllum albanense* Lemoine; Orszag-Sperber and Poignant: 118, pl. 3: 1.
1975. *Lithophyllum albanense* Lemoine; Boulanger and Poignant: 686, pl. 2: 2.
1977. *Lithophyllum albanense* Lemoine; Buchbinder: 422—423, pl. 4: 2—3.
1977. *Lithophyllum albanense* Lemoine; Orszag-Sperber *et al.*: 288, pl. 4: 1.
1983. *Lithophyllum albanense* Lemoine; Bosence: 160, pl. 17: 1—4.
1985. *Lithophyllum albanense* Lemoine; Pisera: 103—104, pl. 23: 1—4.

Description. — Thalli crustose, with mamillae.
Hypothallic cells: 18—24 μm long, 8—18 μm wide.
Perithallic cells: 12—15 μm long, 10—15 μm wide.
Conceptacles: 300—520 μm in diameter, 150—200 μm in height; one very large conceptacle (1200 μm in diameter, 850 μm in height).

Remarks. — The peculiar character of both the perithallus and conceptacles makes *Lithophyllum albanense* Lemoine very distinctive among the red algae. The specimens from the Pińczów Limestones are entirely consistent with the descriptions and figures referred to in the synonymy.

The examination of Maslov's original collection by the present author enabled to state that the thalli distinguished as *Lithothamnium saxorum* var. *korolukae* Maslov represent actually *Lithophyllum albanense* Lemoine. This is seen in the chaotic arrangement of the perithallus, coaxial to chaotic hypothallus typical of *L. albanense* Lemoine. The conceptacles are without any pore but this is due to non-axial section.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, branching algae, algal-bryozoan and organodetrital facies; Roztocze Hills; northern Carpathian border). Oligocene of Italy. Miocene of Ukraine, France, Malta, Algeria, Albania, Bulgaria, Israel, and Iraq.

Lithophyllum anguineum Conti, 1945
(pl. 16: 5)

1945. *Lithophyllum anguineum* Conti: 64—67, pl. 6: 2a—2c; pl. 9: 5—6.
1966. *Lithophyllum anguineum* Conti; Mastrorilli: 240—243, pl. 4: 2.
1967*a*. *Lithophyllum anguineum* Conti; Mastrorilli: 330—332, pl. 24: 4—6.

Description. — Numerous fragments of crusts represented exclusively by perithallus. Perithallic cells highly variable in shape, dimensions and arrangement. Most commonly the cells have 15—22 μm in length and 12—15 μm in width. They are distributed either chaotically or in irregular filaments. Reproductive organs infrequent, 250 μm in diameter and 70—80 μm in height, with the bottom parallel to the roof, the latter with short, wide pore.

Remarks. — The conceptacles are smaller than those described by Conti (1945) and Mastrorilli (1967*a*) and the thalli lack hypothallus but the conceptacle shape and the peculiar disorder among the perithallic cells in conjuction with their shape and dimensions are typical of the species *Lithophyllum anguineum* Conti.

The sterile parts of *L. anguineum* Conti considerably resemble some fragments of *L. albanense* Lemoine and *Titanoderma nataliae* (Maslov).

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, algal-bryozoan and organodetrital facies). Oligocene of Italy. Miocene of Austria.

Lithophyllum? besalotos Johnson, 1962
(fig. 6)

Description. — Two fragments of presumably crustose thalli, composed exclusively of perithallus. Cells rectangular, 15—30 μm in width and 6—12 μm in length, arranged in rows of variable height, distributed like bricks in a wall. Conceptacles lacking.

Remarks. — The identification of the considered specimens is uncertain, as it refers only to the description of *Lithophyllum besalotos* given by Johnson (1965) who reported brick-like arrangement of cells which is unusual and seems diagnostic.

A similar specimen has been illustrated by Mastrorilli (1967*a*) under the name *Lithothamnium perplexum* Johnson. It shows rows of quadrate cells alternating with rows of horizontally rectangular cells, while the former do not appear in the Pińczów material.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — branching algae and algal-bryozoan facies).

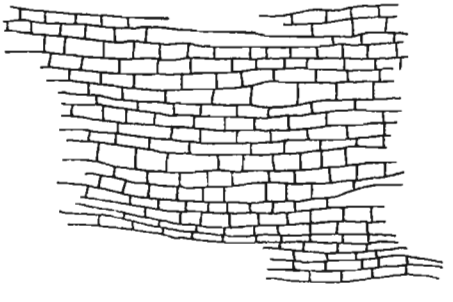


Fig. 6. *Lithophyllum? besalotos* Johnson; slice no. 34—2, ×250. Grobie near Żerniki.

Lithophyllum bonyense Johnson, 1964
(pl. 11: 4 and 7)

1964*a*. *Lithophyllum bonyense* Johnson; Johnson: G19—G20, pl. 4: 8; pl. 5: 1—2.
1975. *Lithophyllum bonyense* Johnson; Edgell and Basson: 172, pl. 1: 6—7.
1977. *Lithophyllum bonyense* Johnson; Buchbinder: 423, pl. 4: 4—5.

Additional description. — Thallus crustose.

Hypothallic cells 28—35 μm long and 8—12 μm wide, arranged in coaxial rows but not very regularly. Perithallic cells 7—14 μm in length and 6—9 μm in width, arranged in rows that may change their thickness, disappear or diverge in places. Conceptacles unusually small (60—85 μm in diameter and 15—20 μm in height), hardly recognizable, with bottom and roof flat and parallel to each other (pl. 11: 7); pore channel short, trapezoidal in section. Cells surrounding the conceptacles undisturbed.

Remarks. — The described specimen closely corresponds to the thalli of *Lithophyllum bonyense* described from Guam by Johnson (1964*a*). The only difference is in the absence of reproductive organs from the type material from Guam. Conceptacles are lacking also in the specimens reported by Buchbinder (1977) and Edgell and Basson (1975). Therefore, they are described for the first time in the present paper.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies). Miocene of Israel, Lebanon, and Guam.

Lithophyllum capederi Lemoine, 1925

(pl. 12: 3)

1939. *Lithophyllum Capederi* Lem.; Lemoine: 100—101, fig. 68.
?1956. *Lithophyllum Capederi* Lem.; Maslov: 154, pl. 57: 1—2.
1963. *Lithophyllum capederi* Lemoine; Souaya: 1211, pl. 163: 2—3.
1965. *Lithophyllum capederi* Lemoine; Johnson: 269, pl. 5: 6.
1967*a*. *Lithophyllum capederi* Lemoine; Mastrorilli: 319—322, pl. 20: 1—2.
1972. *Lithophyllum capederi* Lemoine; Orszag-Sperber and Poignant: 118, pl. 3: 3 and 5.

Description. — Numerous thin crusts composed of regularly coaxial hypothallus 180—200 μm thick and regular perithallus 150 μm thick (in the sterile parts). Hypothallic cells 15—18 μm in length and 6—8 μm in width; perithallic cells 9—15 μm in length and 7—9 μm in width, arranged in rows. Conceptacles absent except for what may be a part of collapsed conceptacle; its original dimensions can be estimated as 400 μm in diameter and 120 μm in height.

Remarks. — The species *Lithophyllum capederi* Lemoine is easily recognizable due to its large conceptacles with long pore, surrounded with thick perithallic tissue. The fragment of conceptacle preserved in the considered material shows much similarity to the figure of *L. capederi* Lemoine given by Mastrorilli (1967*a*, pl. 20: 2).

Maslov (1956) figured poorly preserved thalli devoid of perithallus and reproductive organs under the name *L. capederi* Lemoine, which appears to be an overinterpretation.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies; northern Carpathian border). Oligocene of Italy. Miocene of Ukraine, Slovakia, France, Turkey, Algeria, and Borneo.

Lithophyllum corculumis Maslov, 1962

(pl. 12: 4)

1962. *Lithophyllum corculumis* Maslov: 80, fig. 57, pl. 20: 1—3; pl. 21: 2; pl. 27: 2.
1985. *Lithophyllum corculumis* Maslov; Pisera: 104, pl. 24: 1—4.

Description. — Two crustose thalli 250 μm thick, composed exclusively of perithallus. Tissue very regularly developed, with cells large (12—15 μm long and 8—10 μm wide), commonly subquadrate in shape but rectangular above the conceptacles.

Reproductive organs 180—240 μm in diameter and 70—110 μm in height, oval in section, with a short pore channel triangular in section.

Remarks. — The considered specimens closely resemble the original drawing by Maslov (1962: fig. 57) but differ from the photographs (Maslov 1962, pl. 20: 1—3), as the latter specimens have abundant conceptacles that make the tissue less compact than in the specimens from the Pińczów Limestones. The conceptacles are a little larger-sized in the holotype than illustrated in the present paper.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies; Roztocze Hills). Miocene of Ukraine.

Lithophyllum duplex Maslov, 1962

(pl. 13: 1—2)

1962. *Lithophyllum duplex* Maslov: 82—83, fig. 60, pl. 21: 1 and 3.
1971. *Lithophyllum duplex* Maslov; Poignant: 1172—1174, pl. 1.
1972. *Lithophyllum duplex* Maslov; Orszag-Sperber and Poignant: 118.
1977. *Lithophyllum duplex* Maslov; Orszag-Sperber *et al.*: 290, pl. 4: 4.
1985. *Lithophyllum* cf. *duplex* Maslov; Pisera: 105, pl. 20: 4.

Description. — Thalli crustose; hypothallus is lacking.
Perithallic cells: 15—24 μm long, 12—15 μm wide.
Conceptacles: 180—230 μm in diameter, 90—120 μm in height.

Remarks. — In spite of the lack of hypothallus and the relatively small perithallic cells, the specific identification is doubtless, for thick cell walls and the peculiar, trifoliate shape of the conceptacles well distinguish *Lithophyllum duplex* Maslov among its congeners.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement and algal-bryozoan facies; Roztocze Hills; northern Carpathian border). Miocene of Ukraine and France.

Lithophyllum intumescens Mastrorilli, 1967

(pl. 12: 6)

1967*a*. *Lithophyllum intumescens* Mastrorilli: 353—354, pl. 31: 1—4.

Description. — A single fragment of thin (200—300 μm), crustose thallus composed exclusively of perithallus. Cells small (7—9 μm long and 7—9 μm wide), arranged in filaments. The only conceptacle has 300 μm in diameter and 120 μm in height, flat bottom and subspherical roof. The roof descends near the pore and forms characteristic stripes at its sides. The pore shape could not be determined.

Remarks. — The species *Lithophyllum intumescens* Mastrorilli is easily recognizable by its peculiar reproductive organs. Similar conceptacles occur only in *L. contii* Mastrorilli. The latter species, however, has very regular hypothallus and bilateral perithallus (Mastrorilli 1967*b*), while the crusts of *L. intumescens* Mastrorilli are often without hypothallus (Mastrorilli 1967a, pl. 31: 2). The discussed specimen from the Pińczów Limestones differs from the holotype in its smaller conceptacle.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — organodetrital facies). Oligocene of Italy and Bulgaria.

Lithophyllum kamptneri Mastrorilli, 1967
(pl. 1: 1; pl. 13: 3, 4 and 6)

1967*a*. *Lithophyllum kamptneri* Mastrorilli: 344—345, pl. 27: 1—4.

Additional description. — Thalli crustose.
Hypothallic cells: 12—25 μm long, 10—15 μm (rarely 6—8 μm) wide.
Perithallic cells: subquadrate — 5—7 μm long, 6—7 μm wide; rectangular — 10—15 μm long, 6—12 μm wide.
Conceptacles with long (up to 200 μm), wide pore channel, variable in shape and dimensions, e.g.: 270×50 μm, 330×90 μm, 420×180 μm, 630×200 μm.

Remarks. — The considered specimens closely correspond to the descriptions and illustrations of the holotype. All fragments figured (pl. 13: 3, 4 and 6) are parts of one thallus and show the variability of hypothallus, perithallus and conceptacles.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, algal-bryozoan and organodetrital facies). Oligocene of Italy.

Lithophyllum cf. *lateporatum* Mastrorilli, 1973
(pl. 14: 3)

Description. — A single fragment of thin crust composed of reduced hypothallus and fully developed perithallus, the latter having 600 μm in thickness in the reproductive part. Hypothallic cells 15—30 μm in length and 6—8 μm in width. Perithallic cells 8—15 μm in length and 6—8 μm in width, arranged in filaments or indistinct rows. Conceptacle 350 μm in diameter and 120 μm in height, provided with long and wide pore (150×80 μm). Conceptacle bottom flat, lateral walls vertical, roof slightly arcuate.

Remarks. — This specimen resembles the thallus of *Lithophyllum lateporatum* Mastrorilli in conceptacle shape and dimension but the perithallic cells are subquadrate and arranged in rows in *L. lateporatum* (see Mastrorilli 1973), whereas they are rectangular and in filaments in the discussed specimen. Moreover, the hypothallic cells are longer and narrower than in *L. lateporatum* Mastrorilli.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies).

Lithophyllum lithothamnioides Maslov, 1962
(pl. 7: 3; pl. 14: 1—2)

1962. *Lithophyllum (Tenarea?) lithothamnioides* Maslov: 96—97, fig. 75, pl. 27: 3.
1967*b*. *Lithophyllum contii* Mastrorilli: pl. 2: 6, *non* pl. 2: 1—5 and 7—8.

Description. — Thin, long crusts, 60—70 μm in thickness. Hypothallic cells 10—20 μm in length and 8—12 μm in width, arranged indistinctly in a fan-like manner. Perithallus always uniserial, with cells 8—12 μm long and 8—10 μm wide. Most commonly, the preservation is very poor: the thallus being in the form of a uniform, grey band with distinct, thin, light layer at its upper surface. In spite of the abundance of the material, only one conceptacle has been found. Its relation to the thallus is dim but it might be produced by the hypothallus. Were it so, it would be exceptional among the red algae. The conceptacle is relatively large (480 μm in diameter and 200 μm in height), with flat bottom and arcuate roof perforated by a long and

wide, triangular pore channel. The pore channel is 120 μm long and 60 μm wide at its base.

Remarks. — Maslov (1962) described only sterile specimens of *Lithophyllum lithothamnioides* from the Miocene of Crimea and included them tentatively to the subgenus *Tenarea* of the genus *Lithophyllum*. However, *Tenarea* Bory, 1832, is at present considered as a distinct genus characterized, according to Wray (1977) and Poignant (1979), by reduced perithallus and uniserial, vertical hypothallic cells arranged in a palisade. Following Maslov (1962), the present author attributes the species *lithothamnioides* to the genus *Lithophyllum* which is supported by the presence of the unipored conceptacle, presumably the first one found in this species.

Thin, uniserial layer of cells at the surface of the hypothallus has been interpreted by Maslov (1962) as an epiphytal crust of *Melobesia parasitica* Maslov. In fact, however, it certainly constitutes a part of the thallus; this is clearly seen in the holotype specimen, as stated by the present author, as well as in well preserved specimens from the Pińczów Limestones (pl. 14: 1). This is indirectly confirmed by its invariable presence in all the crusts. It is noteworthy, however, that some parts of the uniserial thalli of *M. parasitica* Maslov are indistinguishable from the perithallus of *L. lithothamnioides* Maslov.

The thallus ilustrated by Mastrorilli (1967*b*, pl. 2: 6) under the name *Lithophyllum contii* Mastrorilli shows no difference from *L. lithothamnioides*. Its perithallus has been apparently misinterpreted as a rare case of fossilized epithallus.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, algal-bryozoan and organodetrital facies). Miocene of Ukraine.

Lithophyllum maemongense Johnson, 1964
(fig. 7)

1964*a*. *Lithophyllum maemongense* Johnson: G17, pl. 4: 1—3.

Description. — A single fragment of crust, composed exclusively of perithallus 200—250 μm thick. Cells 8—12 μm long and 6—10 μm wide, arranged either in filaments or as a grid. Conceptacle 300 μm in diameter and 90 μm in height, 8 — shaped in cross-section with a triangular pore at its narrowest part.

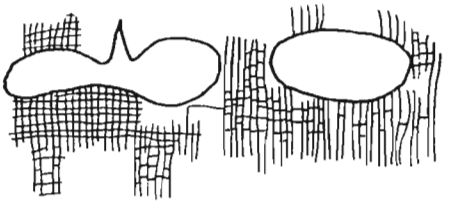


Fig. 7. *Lithophyllum maemongense* Johnson; slice no. 47—2, ×120. Kamieniec near Żerniki.

Remarks. — The features of the perithallus and conceptacle are consistent with the description and illustrations of *Lithophyllum maemongense* Johnson, except the size of the conceptacle that is only 300 μm in diameter in the discussed specimen compared to 460—480 μm in the holotype from Guam.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — organodetrital facies). Miocene of France and Guam.

Lithophyllum mgarrense Bosence, 1983
(pl. 12: 5)

1983. *Lithophyllum mgarrense* Bosence: 164—165, pl. 17: 5—6.

Description. — Several thick crusts, composed exclusively of perithallus up to 600 μm thick. Cells 10—18 μm in length and 8—15 μm in width, arranged as a grid, irregular in places. Unipore conceptacles often distributed in rows, with bottom flat or slightly convex and roof walls oblique relative to the bottom. Conceptacle diameter 180—240 μm, height 90—120 μm.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, algal-bryozoan and organodetrital facies). Miocene of Malta.

Lithophyllum microsporum Maslov, 1962
(fig. 8)

1962. *Lithophyllum microsporum* Maslov: 85—86, fig. 63, pl. 18: 3.
1972. *Lithophyllum microsporum* Maslov; Orszag-Sperber and Poignant: 118—120, pl. 3: 4.
1975. *Lithophyllum microsporum* Maslov; Boulanger and Poignant: 686, pl. 2: 1.
1977. *Lithophyllum microsporum* Maslov; Orszag-Sperber *et al.*: 288—289, pl. 3: 2; pl. 4: 3.

Description. — A single fragment of crust composed exclusively of perithallus. Cells rectangular, 10—12 μm long and 7—10 μm wide, arranged in filaments. Conceptacles small (90×30 μm), bean shaped, with relatively wide, short pore channel surrounded with a dark cloud.

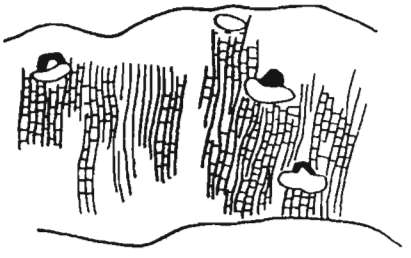


Fig. 8. *Lithophyllum microsporum* Maslov; slice no. 49—2, ×120. Wolica.

Remarks. — Small, conical conceptacles are diagnostic for the species *Lithophyllum microsporum* Maslov. The specimen under consideration differs in this respect from the holotype but flattened reproductive organs have already been recorded in this species (Orszag-Sperber *et al.* 1977, pl. 3: 2).

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement facies). Miocene of Ukraine, France and Turkey.

Lithophyllum minimum Mastrorilli, 1967
(pl. 14: 8)

1967*a*. *Lithophyllum minimum* Mastrorilli: 363—365, pl. 36: 3—4.

Description. — Several crusts composed exclusively of perithallus up to 160 μm thick. Cells subquadrate, 8—10 μm in length and 6—9 μm in width, to horizontal rectangular (8×12 μm), arranged in filaments or as an indistinct grid. The only

conceptacle irregularly ovoid in section, 80 μm in diameter and 50 μm in height, with partially damaged pore.

Remarks. — The considered specimens resemble the thalli of *Lithophyllum minimum* Mastrorilli in the general appearance of the thallus and the conceptacle shape but their cells and the conceptacle are smaller than in the holotype.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, branching algae and algal-bryozoan facies). Oligocene of Italy.

Lithophyllum prelichenoides Lemoine, 1917
(pl. 14: 5—7)

1917. *Lithophyllum prelichenoides* Lemoine: 262—264 and 267, figs. 8—9, and 19.
1939. *Lithophyllum prelichenoides* Lem.; Lemoine: 99, figs. 65—66.
1949. *Lithophyllum* aff. *prelichenoides* Lem.; Johnson and Ferris: 195, pl. 38: 3.
1956. *Lithophyllum prelichenoides* Lem.; Maslov: 155, pl. 58: 1—3.
1962. *Lithophyllum prelichenoides* Lemoine; Maslov: 89, fig. 67, pl. 29: 2 and 4.
1966. *Lithophyllum prelichenoides* Lemoine; Beckmann and Beckmann: 21, pl. 4: 57—58.
1975. *Lithophyllum prelichenoides* Lemoine; Edgell and Basson: 172, pl. 2: 1—5.
1977. *Lithophyllum prelichenoides* Lemoine; Buchbinder: 424 and 426, pl. 5: 4—6.
1983. cf. *Lithophyllum prelichenoides* Lemoine; Bosence: 165, pl. 18: 2.
1985. *Lithophyllum prelichenoides* Lemoine; Pisera: 104—105, pl. 25: 1—2.

Description. — Numerous crusts composed of structurally uniform hypothallus and variably thick perithallus. Hypothallus coaxial, with cells 25—40 μm long and 8—12 μm wide in the axial part, arranged in regular, arched rows. Perithallus multiserial in most cases (pl. 14: 7) but sometimes uniserial (pl. 14: 6). Exceptionally, the perithallic tissue developed at the both sides of the hypothallus (pl. 14: 5). Perithallic cells in multiserial tissue arranged as regular grid. They are subquadrate to rectangular in shape, 6—15 μm in length and 6—10 μm in width. The only two conceptacles are oval in section (270 and 300 μm in diameter while 90 and 130 μm in height, respectively).

Remarks. — There is much uniformity in structure within the thalli of *Lithophyllum prelichenoides* Lemoine, particularly in hypothallus thickness and cell arrangement. However, there is much variability among thalli (for extreme examples see Beckmann and Beckmann 1966, pl. 4: 58; Buchbinder 1977, pl. 5: 6). The specimens from the Pińczów Limestones fall within the range of intraspecific variability of *L. prelichenoides* Lemoine.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan and organodetrital facies; Roztocze Hills; northern Carpathian border). Miocene of Ukraine, Slovakia, Malta, Algeria, Albania, Israel, Lebanon, Martinique, and Guam.

Lithophyllum simplex Lemoine, 1927
(pl. 13: 5)

1939. *Lithophyllum simplex.*; Lemoine: 95—96, fig. 62.
non 1966. *Lithophyllum simplex* Lemoine; Beckmann and Beckmann: 20, pl. 4: 48—50.
1967*a*. *Lithophyllum simplex* Lemoine; Mastrorilli: 322—324, pl. 21: 3.
1972. *Lithophyllum simplex* Lemoine; Orszag-Sperber and Poignant: 120.

Description. — A single fragment of thallus composed exclusively of hypothallus 200 μm thick. Cells thick-walled, 21—24 μm in length and 10—15 μm in width, arranged in regular rows but also in filaments that are disposed in a fan-like manner.

An external layer of small cells may be interpreted as initial perithallus. Reproductive organs absent.

Remarks. — The considered specimen differs from the one reported by Lemoine (1939) in its perithallus not fully developed. However, in the specimen from Algeria (Lemoine 1939) the perithallus is no more than 30—40 μm thick.

Beckmann and Beckmann (1966) described under the name *Lithophyllum simplex* Lemoine a specimen, that is entirely different from all another reported specimens of the species. It was tentatively included by Mastrorilli (1967*a*) into the synonymy of *L. simplex* Lemoine. In the present paper, however, it is considered jointly with an indistinguishable specimen from the Pińczów Limestones and described as "*Lithothamnium*" sp. 1.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — algal-bryozoan facies). Eocene and Oligocene of Italy. Oligocene of Algeria. Miocene of France.

Lithophyllum vicetinum Mastrorilli, 1973
(fig. 9)

1973. *Lithophyllum vicetinum* Mastrorilli: 271—274, pl. 6: 3.

Description. — A single fragment of crust, ranging in thickness from 200 μm in its sterile parts up to 500 μm in the fertile part. Hypothallus 100 μm thick, with cells 18—27 μm in length and 9—12 μm in width, arranged in filaments. Perithallic cells 10—12 μm long and 6—10 μm wide, arranged either in filaments or in rows but disorganized above the conceptacle. Conceptacle with flat bottom, subsphaerical roof, and eccentrically placed pore. Its dimensions are: diameter 450 μm, height 100 μm, pore diameter 50 μm, pore length 50 μm.

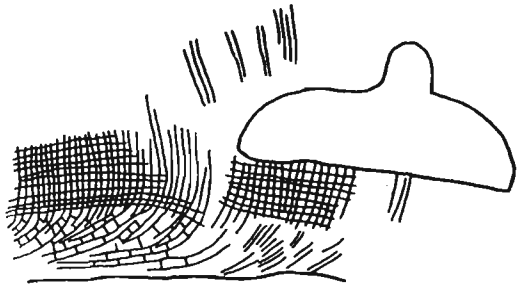


Fig. 9. *Lithophyllum vicetinum* Mastrorilli; slice no. 40—3, ×120. Szczaworyż.

Remarks. — The considered specimen is consistent with the one named as *Lithophyllum vicetinum* Mastrorilli in the general structure of thallus and in conceptacle shape and dimensions. However, it has larger-sized cells. Closer comparisons are hardly possible because of the poor illustration of the holotype.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement facies). Oligocene of Italy.

Lithophyllum sp.
(pl. 14: 4)

Description. — A single fragment of very thick (more than 1200 μm), crustose thallus. Hypothallus thick (300—330 μm), with cells thick-walled, 25—35 μm long and 10—15 μm wide, arranged in arched, but not very regular rows. Perithallic cells

thick-walled, 10—15 μm in length and 8—10 μm in width, arranged in rows or as a grid. Perithallus contains light rows of cells within the dark part of tissue; light and dark rows of cells alternate regularly in places. Conceptacles absent.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement facies).

Genus *Leptolithophyllum* Airoldi, 1932

Leptolithophyllum maslovi sp. n.

(pl. 15: 1—2)

Holotype: MZ VII/77/35 Żerniki; pl. 15: 1—2.

Type horizon: Middle Miocene (Badenian).

Type locality: Żerniki near Busko, 50 km SSE of Kielce, southern slopes of the Świętokrzyskie Mts, Central Poland.

Derivation of the name: In honour of V. P. Maslov, the author of many papers on the red algae.

Diagnosis. — Hypothallus and perithallus zoned; long, strongly flattened conceptacles with triangular pore.

Material. — A long crust, contributing to the construction of a rhodolith.

Description. — Crustose thallus, forming long encrustations up to 1000 μm thick. Hypothallus irregularly zoned, with cells 15—24 μm long and 10—15 μm wide, arranged in filaments. Hypothallic zones pass into the zones of perithallus. Perithallic cells 10—15 μm in length and 10—12 μm in width, often subquadrate (10×10 μm), apparently regularly arranged in rows but actually, the horizontal cell walls do not join to form continuous line; perithallic tissue entirely disordered in places. Conceptacles strongly flattened, up to 540 μm in diameter, but no more than 50—60 μm in height, with flat bottom and triangular pore.

Remarks. — The species *Leptolithophyllum maslovi* sp. n. shows some resemblance to *L. intermedium* Mastrorilli from the Oligocene of Italy (see Mastrorilli 1967*a*), but it has a different structure and larger-sized hypothallic cells. Its conceptacles are extremely flattened and provided with a triangular pore compared to relatively higher conceptacles with a long, rectangular pore channel in *L. intermedium* Mastrorilli.

L. maslovi sp. n. differs from the species *L. contii* Beckmann et Beckmann 1966, the latter species having perithallic cells in filaments, and small conceptacles with long, rectangular pore.

The species *Leptolithophyllum platticarpum* (Maslov) from the Miocene of Ukraine (see Maslov 1962), in turn, is distinctive in its low-triangular conceptacles, thin hypothallus, and disordered perithallus.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement facies).

Leptolithophyllum platticarpum (Maslov) Poignant

(pl. 15: 3)

1962. *Lithophyllum platticarpum* Maslov: 88—89, fig. 66, pl. 26: 1—3.

1977. *Leptolithophyllum platticarpum* (Maslov) Poignant; Orszag-Sperber *et al.*: 200, pl. 3: 4.

Description. — Several fragments of crusts composed of perithallus 500 μm thick. Cells 10—15 μm in length and 9—12 μm in width, arranged in filaments or chaotically. Conceptacles 120—150 μm in diameter and 30—40 μm in height, with triangular pore

and flat or slightly concave bottom. A dark cloud appears above the conceptacle roof.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement facies; northern Carpathian border). Miocene of Ukraine and France.

Genus *Titanoderma* Nägeli, 1858
Titanoderma nataliae (Maslov, 1956) nov. comb.
(fig. 10)

1956. *Lithophyllum* (*Dermatolithon*) *nataliae* Maslov: 160—161, fig. 81, pl. 63: 1—2.
1962. *Lithophyllum* (*Dermatolithon*) *nataliae* Maslov; Maslov: 94, fig. 73, pl. 23: 1 and 3; pl. 27: 1.
?1985. *Dermatolithon natalice* Maslov; Pisera: 106, pl. 21: 4.

Description. — Numerous thin crusts (up to 300 μm), with rarely preserved hypothallus. Hypothallic cells 20 μm in length and 12 μm in width, oblique to the substrate. Perithallic cells 15—25 μm long and 12—18 μm wide, arranged in filaments, frequently in a fan-like manner. Conceptacles infrequent, 270 μm in diameter and 120 μm in height, with concave bottom, irregularly convex and very long (140 μm), wide pore channel.

Remarks. — The discussed specimens closely correspond to the diagnosis of *Lithophyllum* (*Dermatolithon*) *nataliae* given by Maslov (1956). Uniserial hypothallus with oblique cells is diagnostic for the genus *Dermatolithon* (see e.g. Poignant 1979). According to the recent investigations, however (Woelkerling *et al.* 1985), the name *Dermatolithon* is the junior objective synonym of *Titanoderma*. Therefore, the species *nataliae* is here assigned to the genus *Titanoderma* Nägeli.

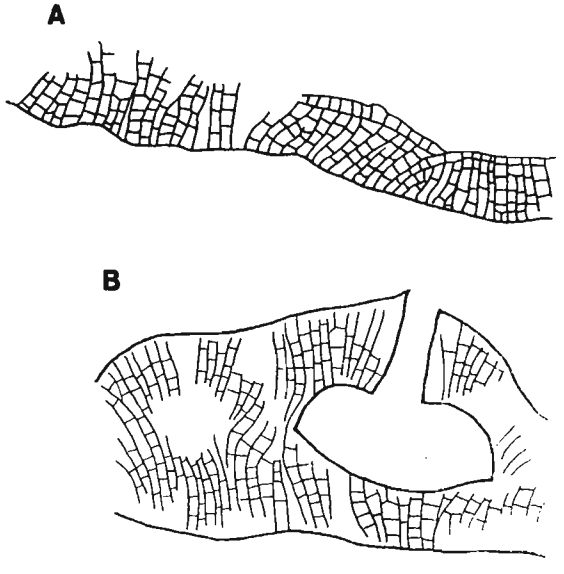


Fig. 10. *Titanoderma nataliae* (Maslov): A sterile crust; B reproductive part of crust; slice no. 40—3, ×120. Szczaworyż.

The species *T. nataliae* (Maslov) resembles "*Lithothamnium*" *praetanapagense* Mastrorilli from the Oligocene of Italy (see Mastrorilli 1967*a*) in its fan-like arrangement of perithallic filaments as well as in cell dimensions. "*L.*" *praetanapagense*

Mastrorilli shows, however, bean-shaped conceptacles and subquadrate hypothallic cells.

The specimen figured by Pisera (1985) under the name *Dermatolithon nataliae* Maslov lacks both hypothallus and conceptacles, so its attribution seems doubtful.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement and algal-bryozoan facies; Roztocze Hills?; northern Carpathian border). Miocene of Ukraine.

Genus *Melobesia* Lamouroux, 1812

Melobesia sp.

(pl. 15: 4)

Description. — Thallus uniserial to biserial but exceptionally in form of multilamellar crusts. Cells horizontal, 24—28 μm long and 10—15 μm wide, rectangular, thick-walled. No conceptacles have been observed.

Remarks. — The lack of reproductive organs makes the specific identification impossible.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, branching algae and algal-bryozoan facies).

Genus *Lithoporella* Foslie, 1909

Lithoporella melobesioides (Foslie) Foslie, 1909

(pl. 16: 2)

1939. *Melobesia* (*Lithoporella*) *melobesioides* Fosl.; Lemoine: 108—110, fig. 79.
1964*b*. *Lithoporella melobesioides* (Foslie) Foslie; Johnson: 482 and 484, pl. 3: 3.
1972. *Lithoporella melobesioides* (Foslie); Orszag-Sperber and Poignant: 122, pl. 1: 4.
1977. *Lithoporella melobesioides* (Foslie) Foslie; Buchbinder: 428 and 430, pl. 6: 2, 3 and 5.
1983. *Lithoporela melobesioides* (Foslie); Foslie; Bosence: 165—166, pl. 18: 1.

Description. — Two fragments of uniserial crusts. Cells rectangular, vertically elongated, 48—54 μm in height and 16—20 μm in width. Two or three points appear in some cells, one of them at the middle of the cell, two others at the upper and lower walls. The points are frequently connected with a thin line. Reproductive organs are absent.

Remarks. — The species under consideration not only is highly variable in morphology but it also shows cosmopolitan distribution and long duration (Eocene — Miocene). Its multiserial, thick crusts (see e.g. Johnson 1964*b*, Orszag-Sperber and Poignant 1972) are composed of rectangular but occasionally also subquadrate cells varying in both shape and dimensions, oriented perpendicularly but exceptionally obliquely to the substrate.

The specimens from the Pińczów Limestones fall within this wide range of intraspecific variability.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement and branching algae facies). Eocene to Miocene of Europe, Asia, and Pacific islands.

Lithoporella sp.
(pl. 16: 3)

Description. — Several uniserial thalli forming loose, multiserial encrustations. Cells 18—24 μm high and 12—18 μm wide, narrow rectangular to subquadrate. Conceptacles absent.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement and algal-bryozoan facies).

Subfamily **Corallinoideae** Foslie, 1898
Genus *Corallina* Linnaeus, 1759
Corallina sp.
(pl. 15: 7)

Description. — Several fragments of internodes 500 μm thick, composed exclusively of hypothallic cells. Cells 40—60 μm in height and 8—10 μm in width, thin-walled, with their shorter walls perpendicular, but occasionally oblique to the longer walls, arranged in regular series. Marginal cells shorter than axial ones, with no traces of perithallic tissue, however. Reproductive organs were not observed.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement and algal-bryozoan facies).

Genus *Jania* Lamouroux, 1812
Jania dniestrovica Maslov, 1961
(pl. 15: 6)

1985. *Jania dniestrovica* Maslov; Pisera: 106, pl. 29: 1—2; pl. 30: 1 (cum syn.).
1985. *Jania ucrainica* Maslov; Pisera: pl. 29: 4a—b.

Description. — Internodes of flexible thalli.
Hypothallic cells: 42—60 μm high, 6—10 μm wide, in 8 filaments.
Perithallic cells: 12—15 μm long, 15 μm wide, in one layer.
Conceptacles not observed.

Remarks. — The specimens from the Pińczów Limestones are entirely consistent with the description and illustrations given by Maslov (1961, 1962).

The internode illustrated by Pisera (1985: pl. 29: 4a—b) under the name *Jania ucrainica* Maslov is indistinguishable from *J. dniestrovica* Maslov from the Pińczów Limestones, as shown by the comparative investigations. It shows hypothallus with few filaments, distinctly unilayered perithallus, i.e. features typical of *J. dniestrovica* Maslov.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement and branching algae facies; Roztocze Hills; northern Carpathian border). Miocene of Ukraine.

Jania ucrainica Maslov, 1962
(pl. 15: 5)

1962. *Jania ucrainica* Maslov: 108—110, fig. 87, pl. 29: 3; pl. 30: 3, 4, and 6.
non 1985. *Jania ucrainica* Maslov; Pisera: pl. 29: 4a—b.

Description. — Internodes of flexible thalli.
Hypothallic cells: 40—60 μm high, 8—10 μm wide, in 20—30 filaments.
Perithallic cells: 12—16 μm long, 12 μm wide.
Conceptacles not observed.

Remarks. — The considered specimens are entirely constistent with the original diagnosis of *Jania ucrainica* given by Maslov (1962). Specimen figured by Pisera (1985) under the name *J. ucrainica* Maslov is indistinguishable from *J. dniestrovica* Maslov from the Pińczów Limestones (see above).

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — rhodolith pavement, algal-bryozoan and organodetrital facies; northern Carpathian border). Miocene of Ukraine.

Family **Squamariaceae** Agardh, 1851
Genus *Karpathia* Maslov, 1962
Karpathia sphaerocellulosa Maslov, 1962
(pl. 16: 6—7)

1962. *Karpathia sphaerocellulosa* Maslov: 123—124, fig. 95, pl. 23: 2.

Description. — Several long, complete crust, up to 300 μm thick. Hypo-, meso- and perithallus very rarely developed all together; rather, only two tissue types coexist. Hypothallic cells thin-walled, polygonal in shape, 30—40 μm in maximum length and 15—20 μm in width, arranged in filaments. Thick-walled, subsphaeric cells of the hypothallus are 35—40 μm in diameter. Mesothallic cells 15—20 μm in maximum length and 20 μm in width, thick-walled, polygonal. Perithallic cells subquadrate (10×10 μm), arranged in filaments.

Remarks. — The considered specimens are consistent with the original diagnosis of *Karpathia sphaerocellulosa* given by Maslov (1962). The species was previously described from the Paleogene of Carpathians and has not been mentioned from any younger strata.

Occurrence. — Middle Miocene of Poland (Pińczów Limestones — agal-bryozoan and organodetrital facies). Paleogene of Ukraine (Carpathians).

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WIESŁAW STUDENCKI

KRASNOROSTY Z WAPIENI PIŃCZOWSKICH (ŚRODKOWY MIOCEN, GÓRY ŚWIĘTOKRZYSKIE)

Streszczenie

Krasnorosty z rodziny Corallinaceae są głównym elementem skałotwórczym środkowomioceńskich wapieni pińczowskich, odsłaniających się w południowym obrzeżeniu Gór Świętokrzyskich. Obecność różnych form wzrostowych krasnorostów pozwala na wyróżnienie odmian facjalnych wapieni pińczowskich.

Cechy osadu i kształt plechy sugerują związek niektórych gatunków krasnorostów z ruchliwością wody i rodzajem podłoża. Płożące się po powierzchni dna skorupowe plechy *Mesophyllum vaughani* (Howe) i *M. laffittei* Lemoine preferowały warunki najsłabszej hydrodynamiki. Gatunek *"Lithothamnium" ramosissimum* (Gümbel) o plechach gałązkowych, związany był z wodami o umiarkowanej ruchliwości. Trzy gatunki skorupowe, współwystępujące z rodolitami, *Mesophyllum ingestum* Conti, *M. rigidum* Mastrorilli i *Lithophyllum prelichenoides* Lemoine wymagały wód o stosunkowo dużej ruchliwości. *"Lithothamnium"* cf. *nitidum* Foslie i *Mesophyllum* cf. *roveretoi* Conti są charakterystyczne wyłącznie dla rodolitów, a *Palaeothamnium archaeotypum* Conti, *"Lithothamnium" praefruticulosum* Maslov i *Lithophyllum albanense* Lemoine są najczęściej, choć nie zawsze, składnikami rodolitów. Sugeruje to, że preferowały one środowisko o wysokiej energii, zapewniającej stały lub częsty ruch rodolitów. Plechy trzech gatunków skorupowych: *Lithophyllum lithothamnioides* Maslov, *Titanoderma nataliae* (Maslov) i *Melobesia* sp., często przewarstwiające się wzajemnie, inkrustują zawsze inne krasnorosty, a nigdy podłoże innego typu (powierzchnię dna, zoaria, muszle itp.). Prawdopodobnie właśnie podłoże kontrolowało ich rozmieszczenie.

Zespół krasnorostów z wapieni pińczowskich wykazuje największe podobieństwo do flor krasnorostowych znanych ze środkowego miocenu Roztocza, północnego brzegu Karpat i Ukrainy (wschodnia część Paratetydy Centralnej) oraz z oligocenu Północnych Włoch (prowincja śródziemnomorska), wykazuje natomiast niewielką zbieżność z mioceńską florą basenu wiedeńskiego (zachodnia część Paratetydy Centralnej).

W systematycznej części pracy opisano 73 gatunki krasnorostów, należące do 12 rodzajów, w tym jeden nowy gatunek: *Leptolithophyllum maslovi* sp. n.

EXPLANATION OF PLATES 1—16

In the parentheses are indicated MZ VII/77 collection numbers of thin sections

Plate 1

1. Crustose thalli of *Lithophyllum kamptneri* Mastrorilli forming the boxwork-like rhodolith. Spaces between crusts are filled with well sorted wackestone. (49—1), ×5. Wolica.
2. Multilayered, mamillate crusts of *Mesophyllum laffittei* Lemoine alternating with well sorted wackestone. (31—3), ×5. Szczaworyż.

Plate 2

1. Crustose thalli of *Mesophyllum* aff. *roveretoi* Conti (marked Mr) and *Lithophyllum albanense* Lemoine (marked La) forming a laminar growth stage of a rhodolith. (35), ×5. Żerniki.

2. Crustose thalli of *Archaeolithothamnium keenani* Howe (marked Ak) and "*Lithothamnium*" *praefruticulosum* Maslov (marked Lp), forming a laminar growth stage of a rhodolith. (35—1), ×5. Żerniki.

Plate 3

1. *Archaeolithothamnium keenani* Howe. (41/III), ×100. Łysa Góra.
2, 5. *Palaeothamnium kossovense* Maslov: *2* fragment of a branch (52/III—1), ×60. Sułkowice; *5* fragment of a crust (49—2), ×60. Wolica.
3—4. *Archaeolithothamnium* sp.: two types of preservation (35—1, 52/II—2), ×120. Żerniki, Sułkowice.
6—7. *Palaeothamnium archaeotypum* Conti: *6* typical crustose thallus with arched sporangia (48/I), ×120. Wolica; *7* thallus with unusually thick sporangia (38—1), ×160. Szczaworyż.

Plate 4

1. "*Lithothamnium*" *alasanii* Maslov. (40—3), ×60. Szczaworyż.
2. "*Lithothamnium*" *aggregatum* Lemoine. (41/III), ×120. Łysa Góra.
3—4. "*Lithothamnium*" sp. 3: *3* crust with several hypothallic filaments (57/II), ×160. Topola; *4* crust with a single hypothallic filament (41/III), ×200. Łysa Góra.
5—6. "*Lithothamnium*" cf. *bourcarti* Lemoine: *5* fragment of a branch (35—2), ×120. Żerniki; *6* fragment of a crust (2), ×60. Pińczów.

Plate 5

1. "*Lithothamnium*" *disarmonicum* Conti: crust with a multipored conceptacle and a cystocarp (?) (46/III—2), ×120. Szczaworyż.
2. "*Lithothamnium*" *macrosporangicum* Mastrorilli. (52/II—1), ×90. Sułkowice.
3. "*Lithothamnium*" cf. *fruticulosum* (Kützing). (6/II), ×60. Pińczów. .
4—5. "*Lithothamnium*" *gaschei* Johnson: *4* fragment of a branch (57/II—1), ×60. Topola; *5* fragment of a crust (41/III), ×200. Łysa Góra.
6. "*Lithothamnium*" *montainvillense* Lemoine. (31), ×60. Szczaworyż.

Plate 6

1. "*Lithothamnium*" *disarmonicum* Conti: crust with a cystocarp (?) (31A—2), ×60. Szczaworyż.
2a—2b. "*Lithothamnium*" *microcellulosum* Maslov: conceptacles with traces of spores (46/II—3), ×100. Szczaworyż.
3. "*Lithothamnium*" *microphyllum* Maslov. (49—2), ×120. Wolica.
4. "*Lithothamnium*" *moreti* Lemoine. (6/IV), ×60. Pińczów.
5. "*Lithothamnium*" *lacroixi* Lemoine. (39/IIIa—1), ×120. Zbrodzice near Busko.
6. "*Lithothamnium*" *ladronicum* Johnson. (46/II—3), ×120. Szczaworyż.

Plate 7

1, 3. "*Lithothamnium*" *operculatum* (Conti): *1* fragment of mamilla with numerous conceptacles (58/II), ×90. Sułkowice; *3* crustose thallus on *Lithophyllum lithothamnioides* Maslov (58/II), ×200. Sułkowice.

2. "*Lithothamnium*" cf. *nitidum* Foslie. (35—4), ×60. Żerniki.
4. "*Lithothamnium*" sp. 4. (52/III—1), ×120. Sułkowice.
5. "*Lithothamnium*" *praefruticulosum* Maslov. (39/II—2), ×60. Zbrodzice near Busko.

Plate 8

1. "*Lithothamnium*" cf. *parvulum* Conti: two types of conceptacles (39/II—2), ×120. Zbrodzice near Busko.

2, 4. "*Lithothamnium*" *ramosissimum* (Gümbel): *2* fragment of a crust (40S/III), ×120. Skotniki; *4* fragment of regularly zoned branch (40S/III), ×120. Skotniki.

3. "*Lithothamnium*" *saipanense* Johnson. (36—1), ×60. Żerniki.

5, 6. "*Lithothamnium*" *saxorum* Capeder: *5* sterile crust with irregularly disposed perithallic cells (22—2), ×120. Wełecz; *6* crust with reduced hypothallus and conceptacle with undulating roof (42), ×120. Łysa Góra.

Plate 9

1. "*Lithothamnium*" sp. 2 (58/II), ×80. Sułkowice.
2. "*Lithothamnium*" *trinidadensum* Johnson. (57/II—1), ×90. Topola.
3. "*Lithothamnium*" sp. 1. (46/III—1), ×120. Szczaworyż.
4. "*Lithothamnium*" *subtile* Conti. (42/I), ×60. Łysa Góra.
5. *Archaeolithothamnium keenani* Howe: sporangia arranged in rows (35—3), ×60. Żerniki.
6. "*Lithothamnium*" cf. *viallii* Mastrorilli: conceptacle with bifurcated pore channel (52/II—1), ×120. Sułkowice.

Plate 10

1, 3. *Mesophyllum galettoi* Mastrorilli: *1* two types of hypothallus (40—3), ×120. Szczaworyż. *3* superimposed crusts (57/II—2), ×60. Topola.

2. *Mesophyllum koritzae* (Lemoine). (50N), ×120. Topola.

4. *Mesophyllum marosticae* Mastrorilli: conceptacles contacting the hypothallus (35—2), ×60. Żerniki.

5, 6. *Mesophyllum laffittei* Lemoine: *5* "probing fingers" of the hypothallus and regular structure of the perithallus (31—3), ×60. Szczaworyż; *6* regularly oval, multipored conceptacle (31—3), ×60. Szczaworyż.

Plate 11

1, 3. *Mesophyllum rigidum* Mastrorilli: *1* large, mature conceptacle, resulting probably from a fusion of two chambers (40S/II), ×120. Skotniki; *3* immature conceptacles filled with spores (42), ×90. Łysa Góra.

2. *Mesophyllum vaughani* (Howe). (40SB), ×60. Skotniki.

4, 7. *Lithophyllum bonyense* Johnson: *4* thick hypothallus and irregular perithallus (50N), ×120. Topola; *7* small conceptacle chamber (50N), ×250. Topola.

5. *Mesophyllum obsitum* Airoldi. (40S/III), ×60. Skotniki.

6. *Mesophyllum ingestum* Conti. (40SB), ×60. Skotniki.

Plate 12

1. *Mesophyllum* cf. *roveretoi* Conti. (35), ×60. Żerniki.
2. *Lithophyllum albanense* Lemoine: conceptacles with secondary hypothallus above (57/II—2), ×60. Topola.
3. *Lithophyllum capederi* Lemoine: crust with presumably collapsed conceptacle (46/II—2), ×60. Szczaworyż.
4. *Lithophyllum corculumis* Maslov: perithallus encrusting the hypothallus of *Lithophyllum prelichenoides* Lemoine (50N), ×120. Topola.
5. *Lithophyllum mgarrense* Bosence. (57/I), ×60. Topola.
6. *Lithophyllum intumescens* Mastrorilli. (57/II), ×120. Topola.

Plate 13

1, 2. *Lithophyllum duplex* Maslov: fragments of the thallus showing different sections through the perithallus and conceptacles (31B), ×100, ×120. Szczaworyż.

3, 4, 6. *Lithophyllum kamptneri* Mastrorilli: fragments of the thallus showing structure of hypothallus and perithallus, and variable shapes of conceptacles (49—1), ×60. Wolica.

5. *Lithophyllum simplex* Lemoine. (50N), ×200. Topola.
7. *"Lithothamnium" saxorum* Capeder: (42), ×60. Łysa Góra.

Plate 14

1, 2. *Lithophyllum lithothamnioides* Maslov: *1* structure of the hypothallus and its relation to the uniserial perithallus (34S), ×250. Grobie near Żerniki; *2* large, unipore conceptacle (42/I), ×60. Łysa Góra.

3. *Lithophyllum* cf. *lateporatum* Mastrorilli. (42), ×120. Łysa Góra.
4. *Lithophyllum* sp.: crustose thallus with light rows of perithallic cells (57/II—2), ×60. Topola.

5, 6, 7. *Lithophyllum prelichenoides* Lemoine: *5* crust with bilateral hypothallus (57/II), ×60. Topola; *6* crust with uniserial perithallus (40S/III), ×120. Skotniki; *7* crust with multiserial perithallus (56/IIIb), ×60. Skotniki.

8. *Lithophyllum minimum* Mastrorilli. (52/II—1), ×120. Sułkowice.

Plate 15

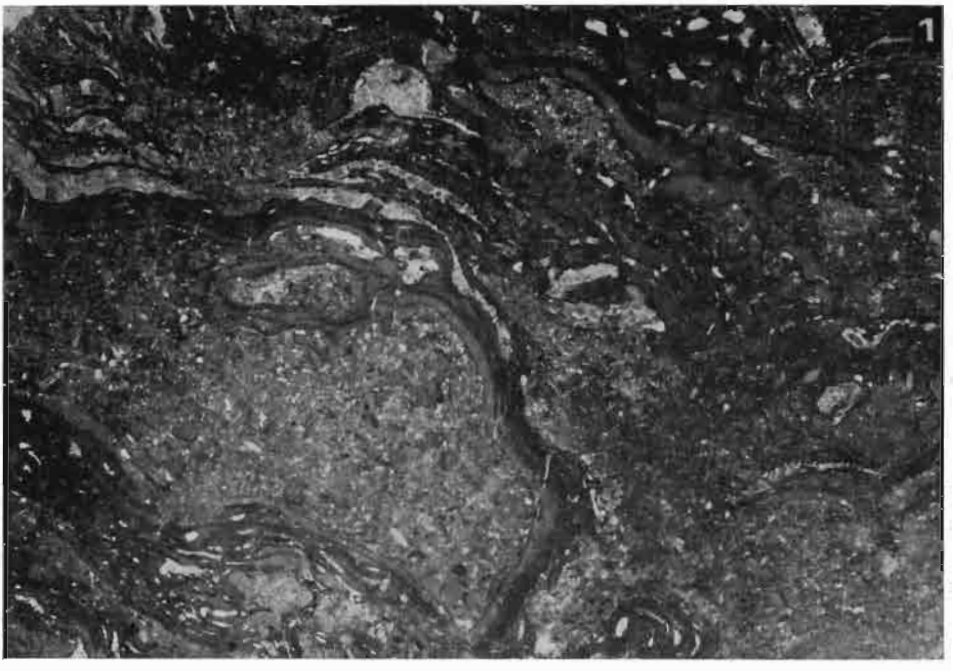
1, 2. *Leptolithophyllum maslovi* sp. n.: fragments of a thallus; *1* zoned hypothallus and perithallus; *2* irregular hypothallus and zoned perithallus with two conceptacles (35), ×60. Żerniki.

3. *Leptolithophyllum platticarpum* (Maslov). (49—2), ×120. Wolica.
4. *Melobesia* sp.: epiphytic, biserial crust (52/II—1), ×120. Sułkowice.
5. *Jania ucrainica* Maslov. (31B), ×120. Szczaworyż.
6. *Jania dniestrovica* Maslov. (40S/II), ×250. Skotniki.
7. *Corallina* sp. (49—2), ×120. Wolica.

Plate 16

1. *Palaeothamnium* sp. 1: conceptacles in different developmental stages (40S/II), ×60. Skotniki.
2. *Lithoporella melobesioides* (Foslie). (35—3), ×120. Żerniki.
3. *Lithoporella* sp. (35), ×120. Żerniki.
4. *Mesophyllum vaughani* (Howe). (57/II—2), ×60. Topola.
5. *Lithophyllum anguineum* Conti. (58/II), ×120. Sułkowice.

6, 7. *Karpathia sphaerocellulosa* Maslov: fragments of a crust; 6 polygonal hypothallic cells and subquadrate perithallic cells; 7 tangential section through the perithallus (46/II—2), ×120. Szczaworyż.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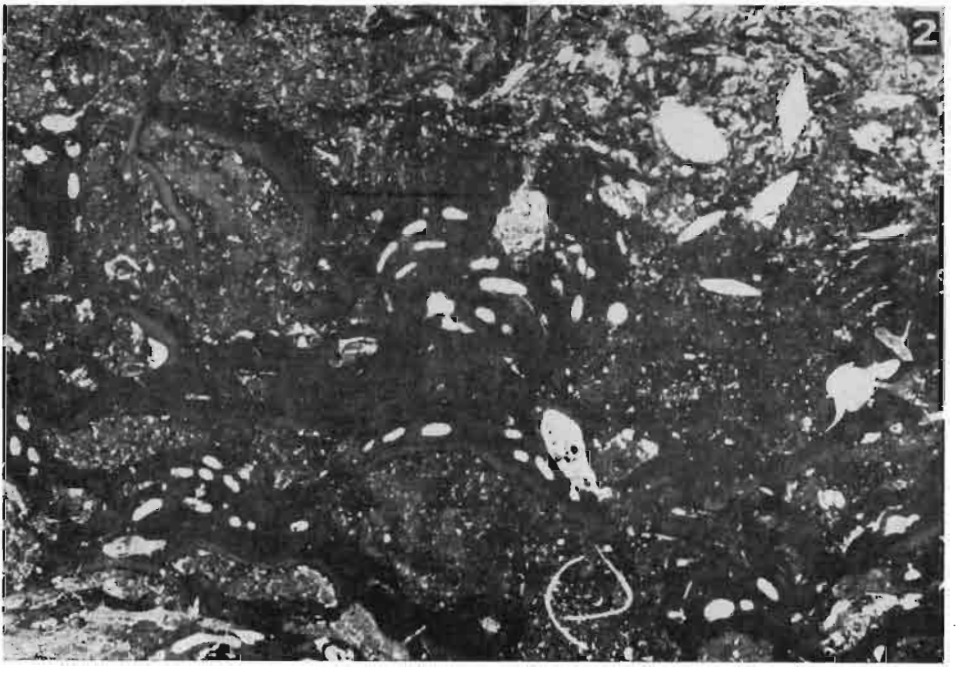
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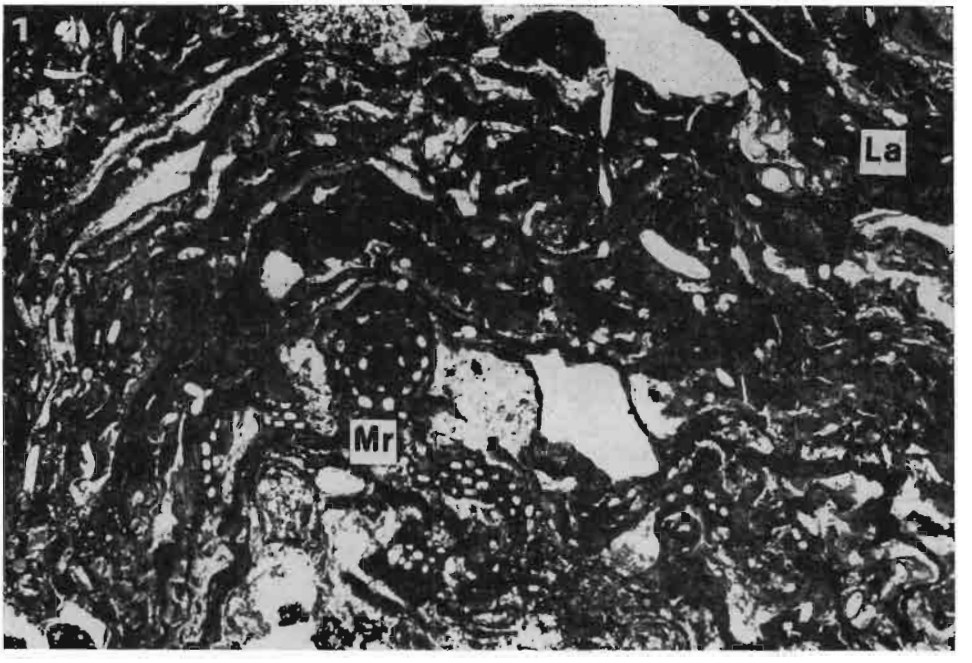
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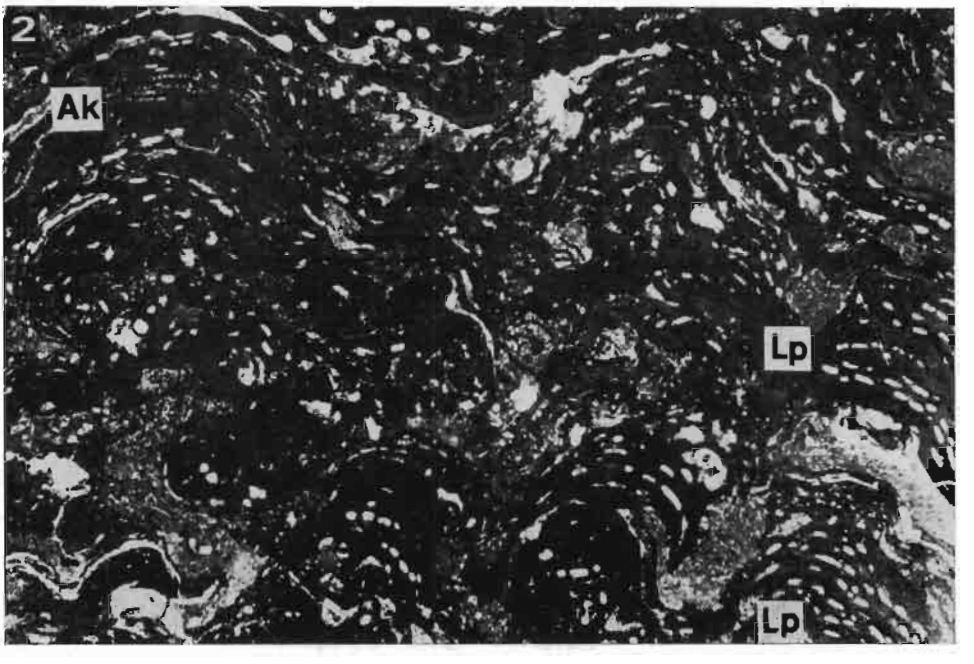
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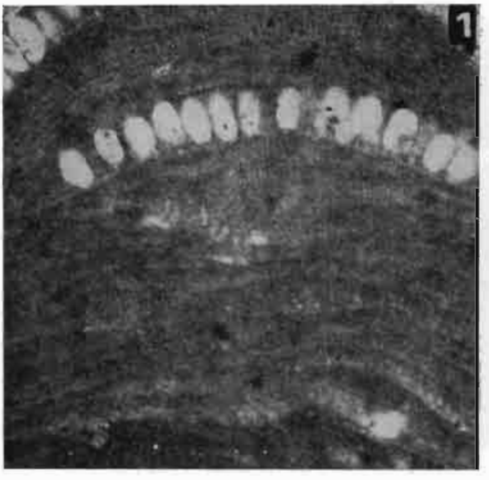
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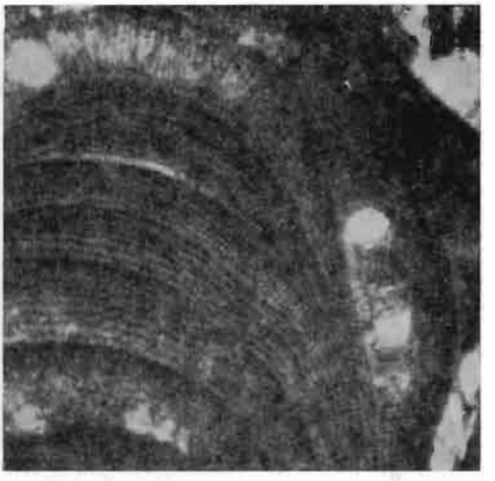


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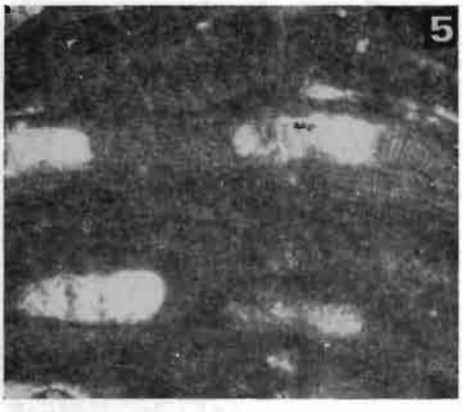
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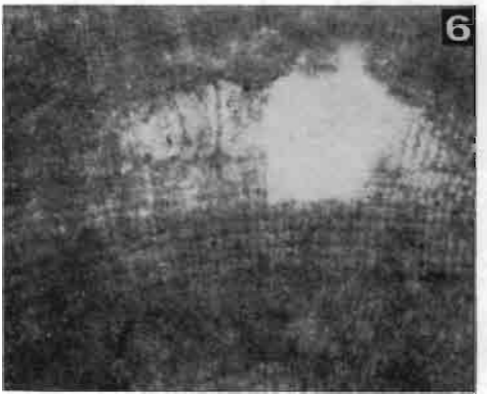
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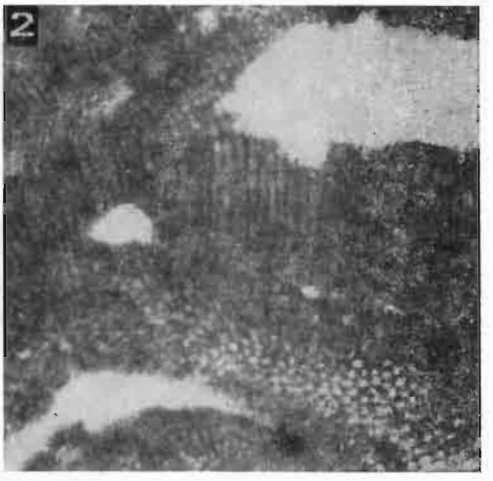
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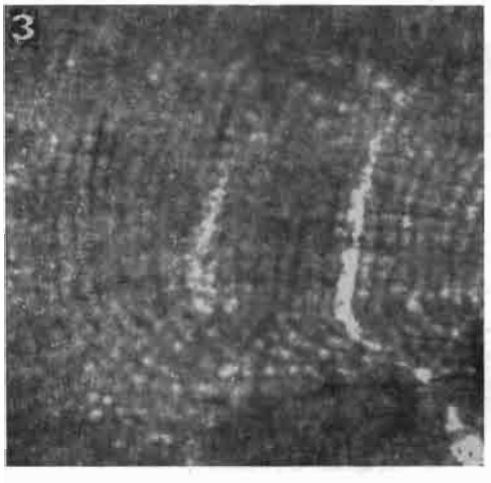
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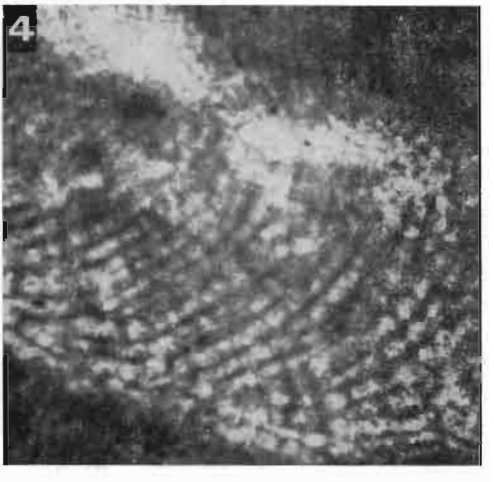
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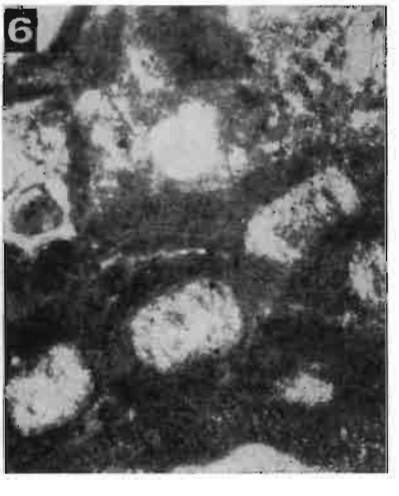
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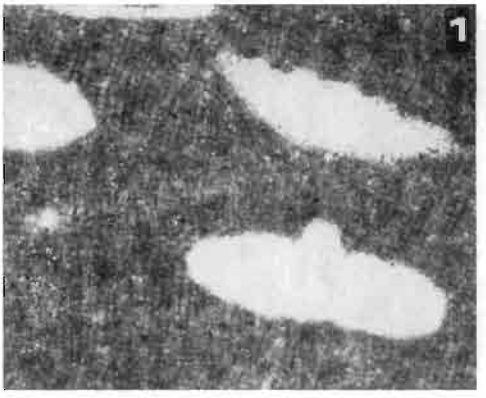
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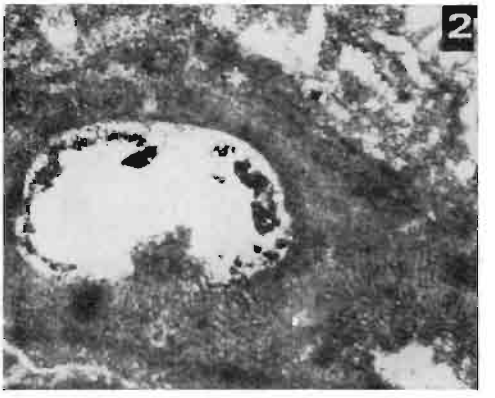
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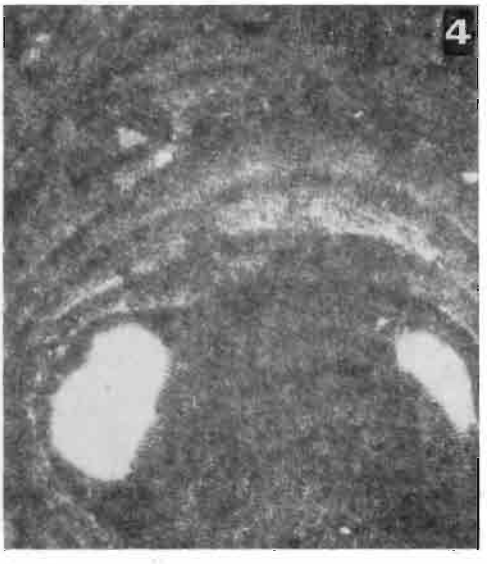
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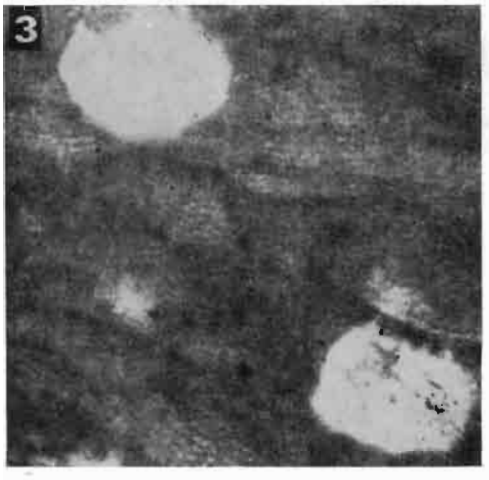
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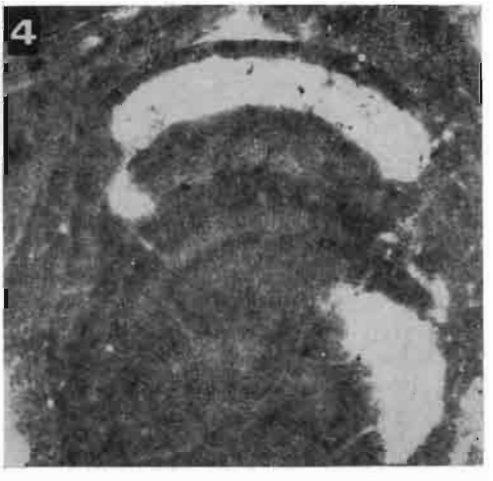
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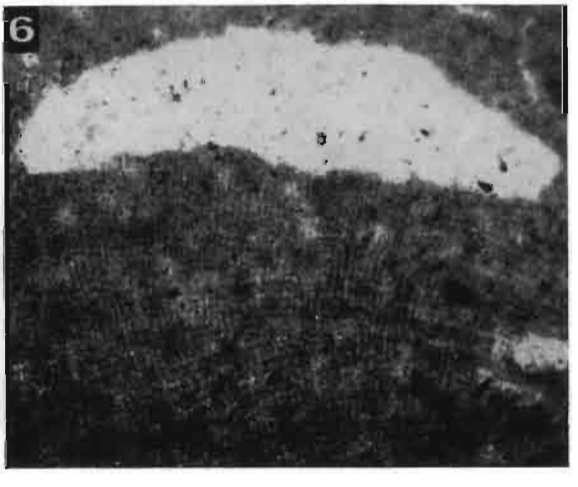
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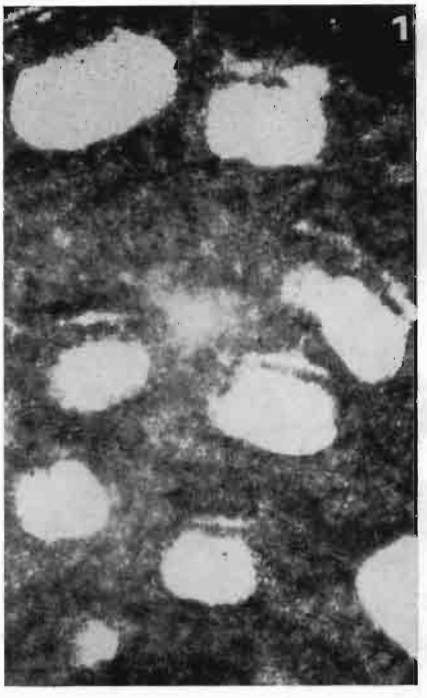
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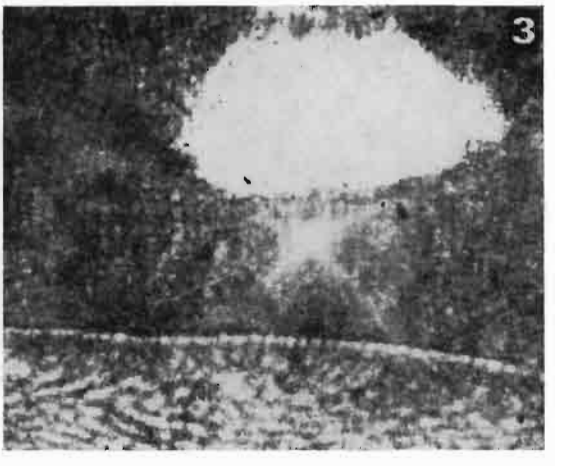
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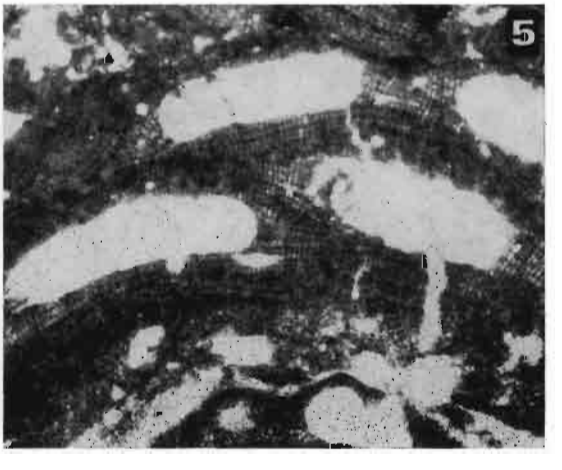
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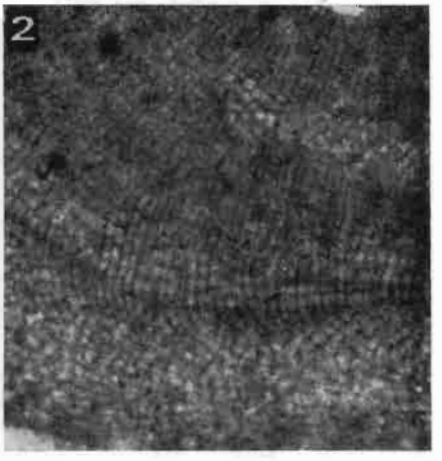
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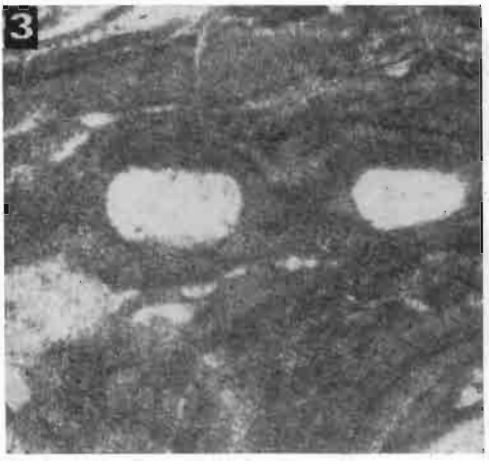
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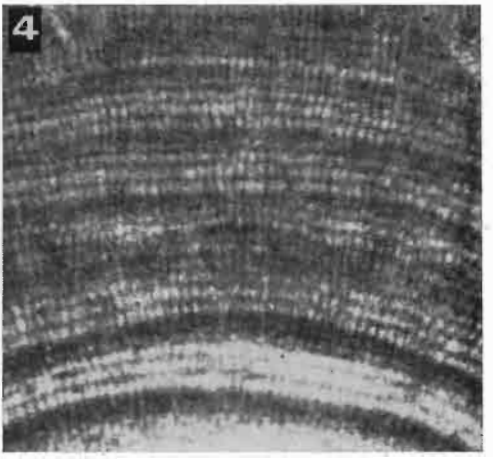
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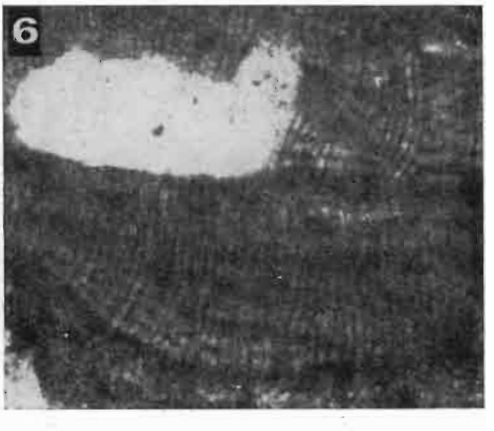
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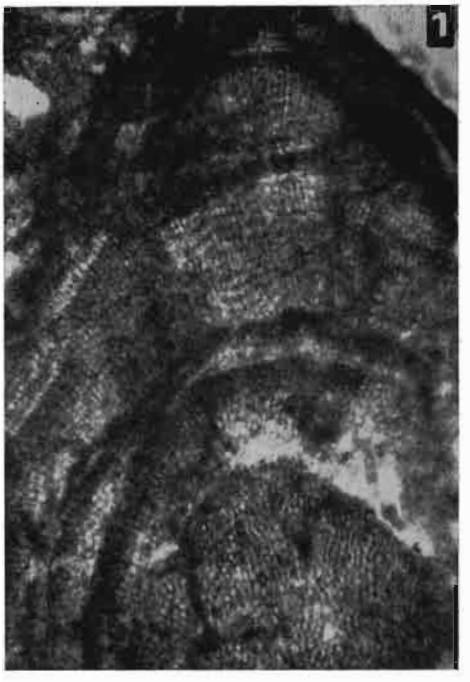
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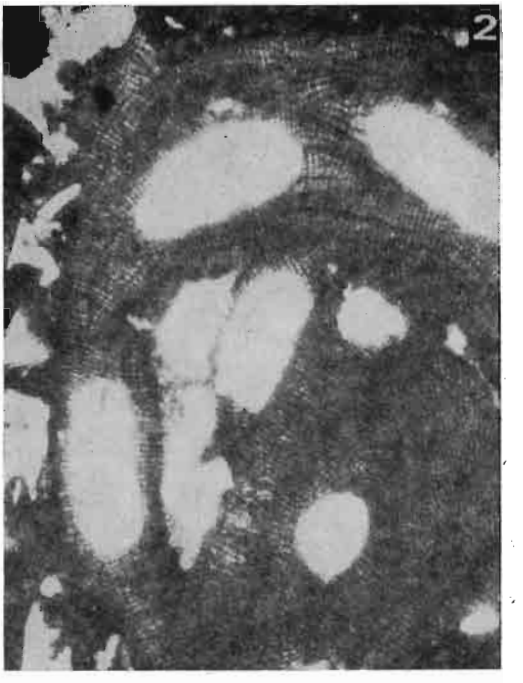
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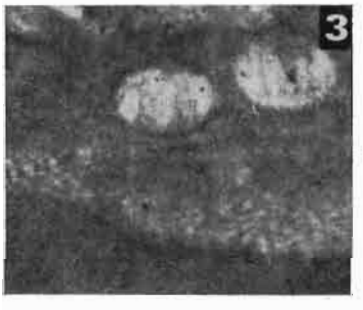
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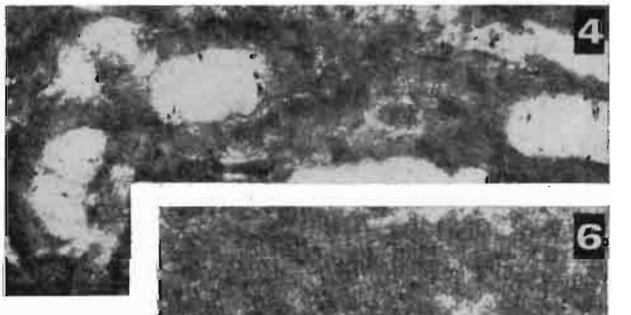
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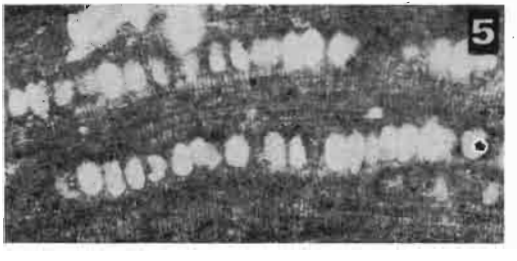
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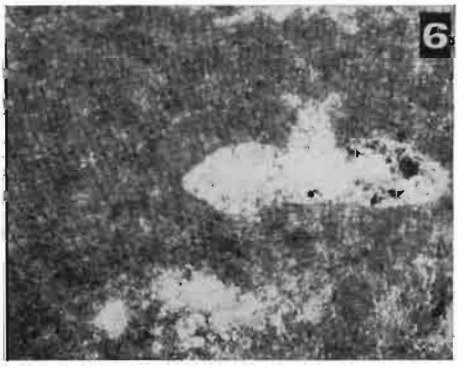
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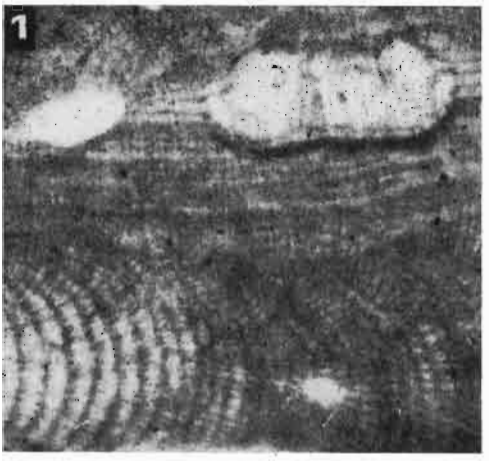
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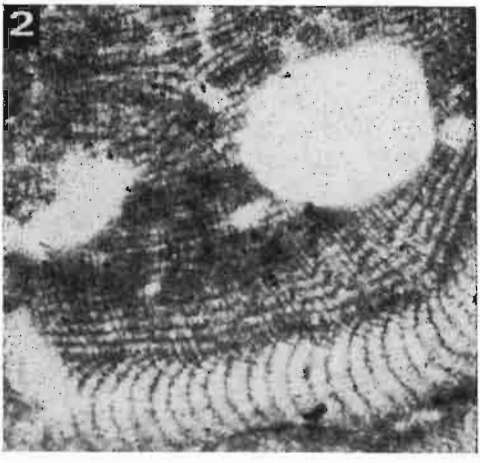
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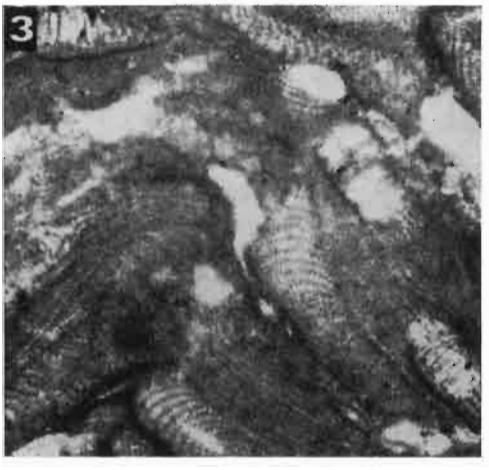
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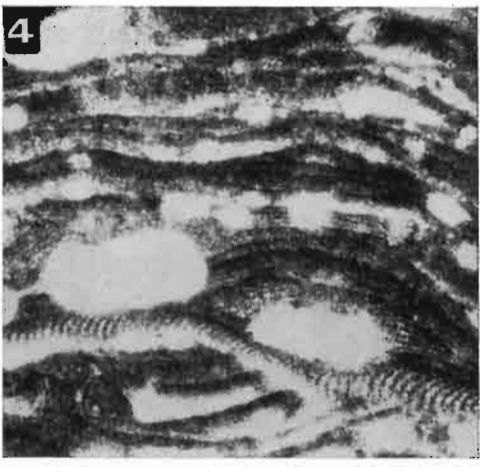
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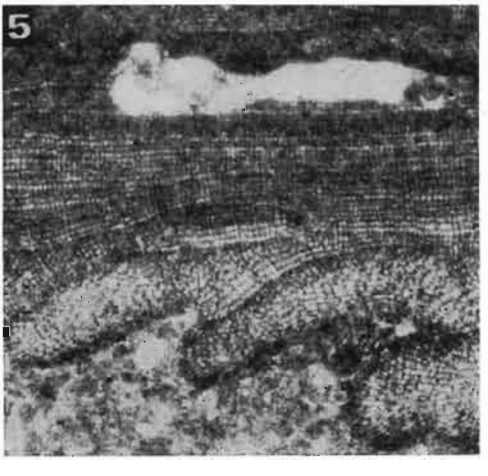
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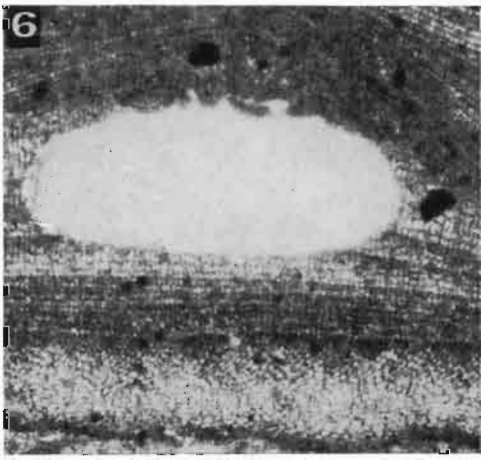
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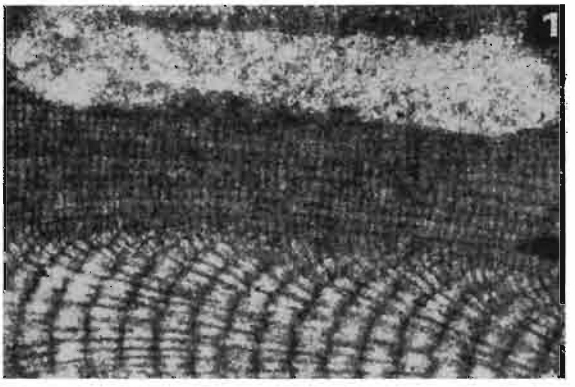
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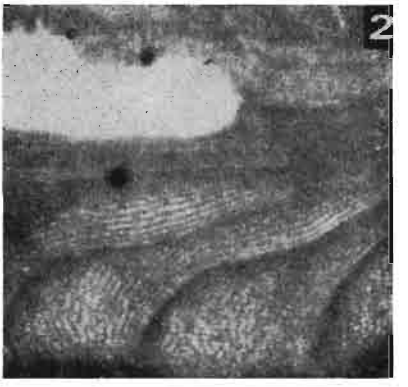
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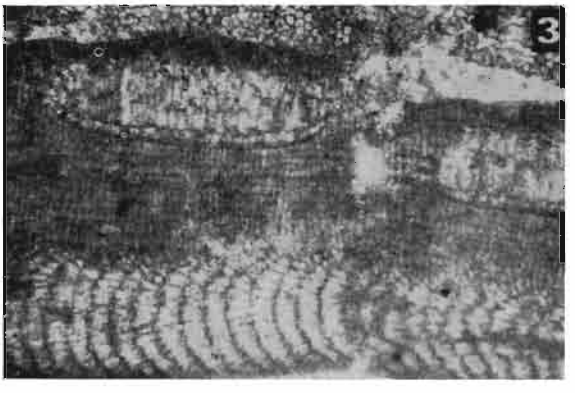
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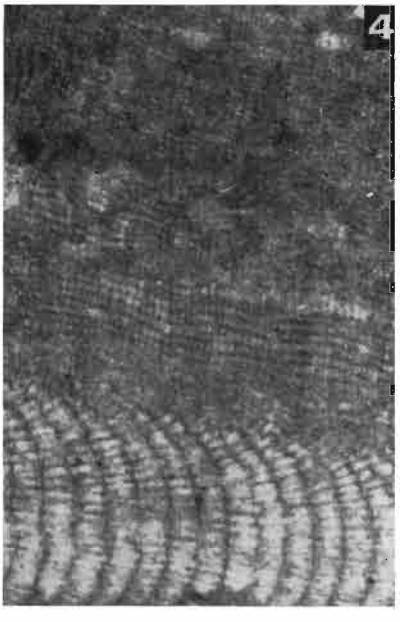
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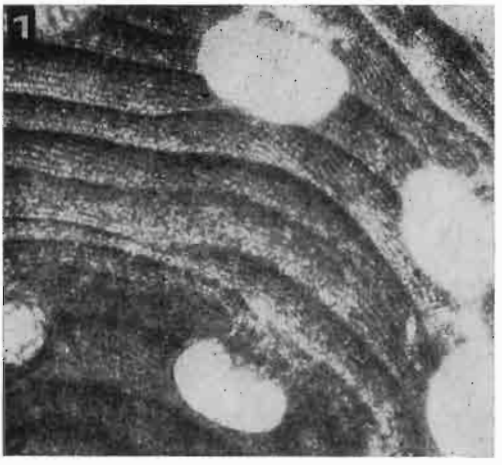
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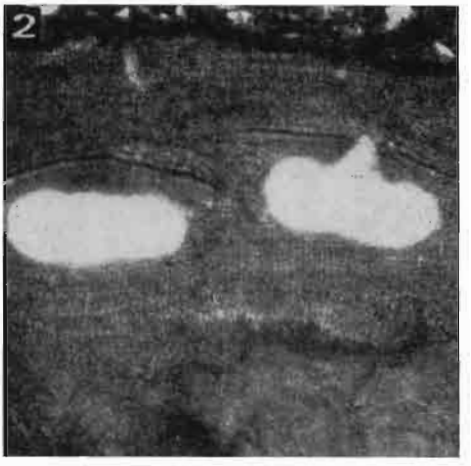
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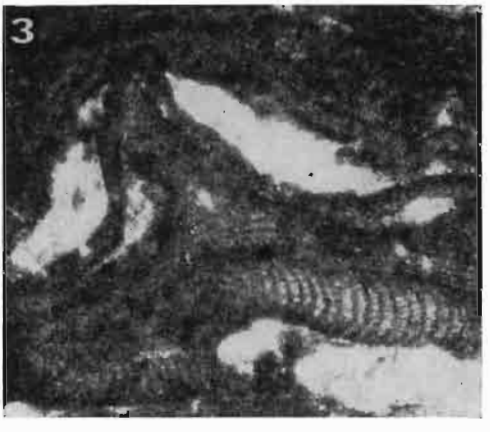
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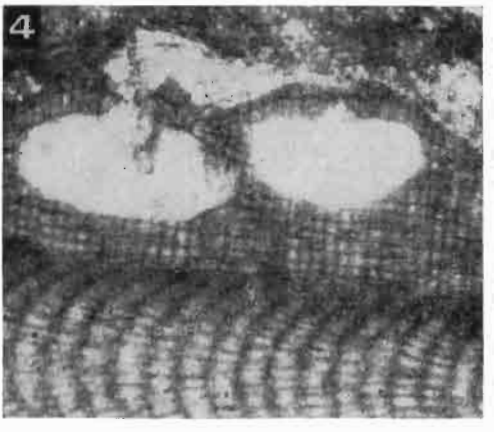
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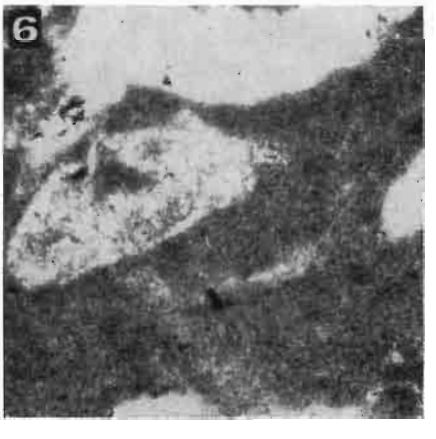
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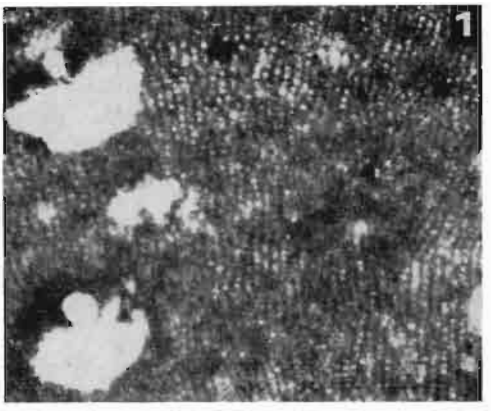
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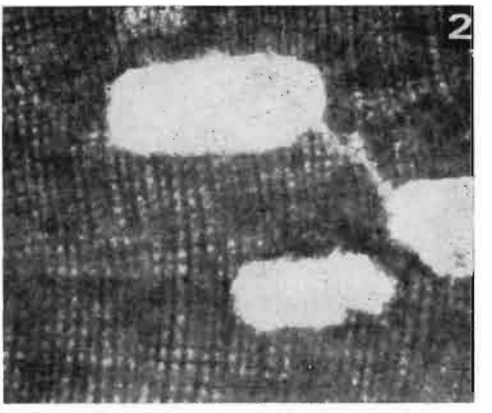
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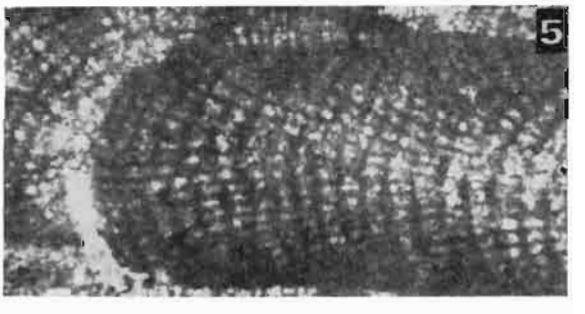
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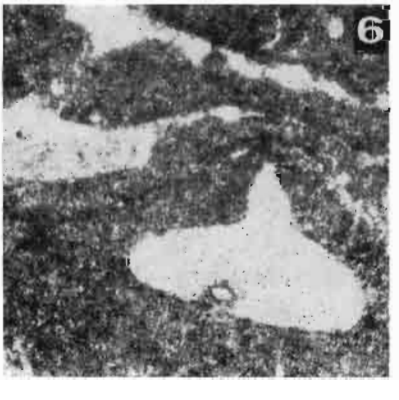
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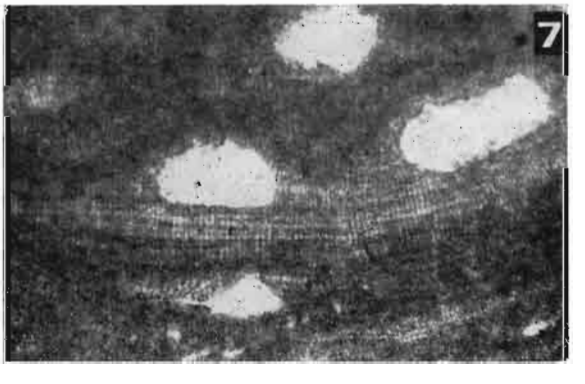
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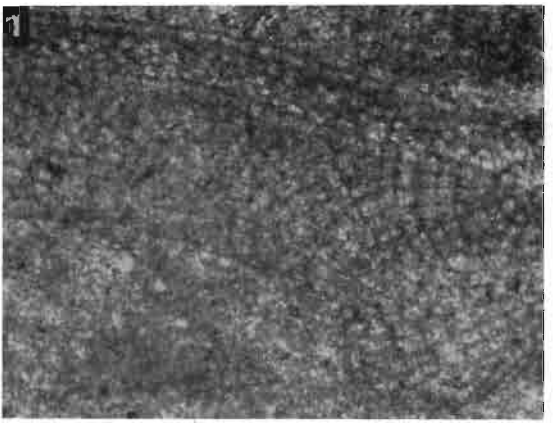
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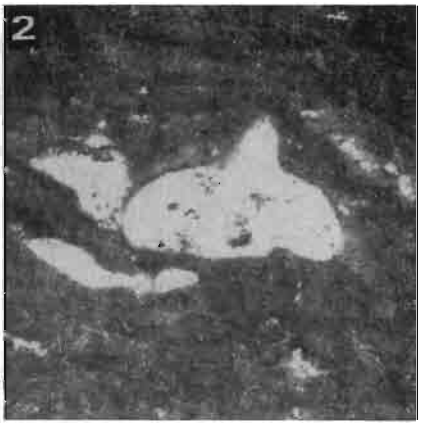
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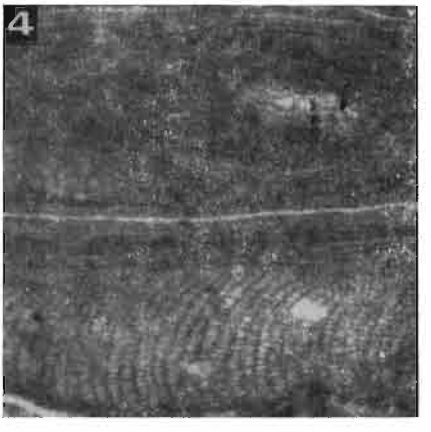
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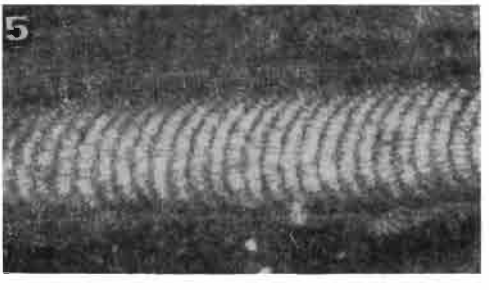
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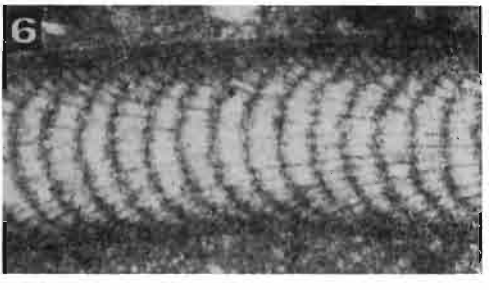
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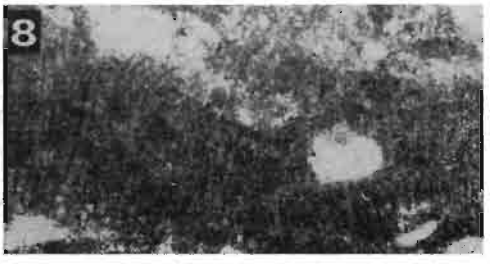
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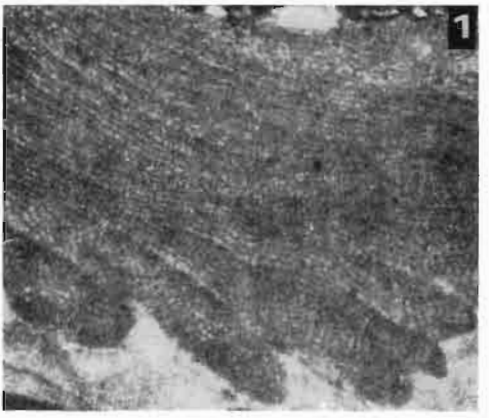
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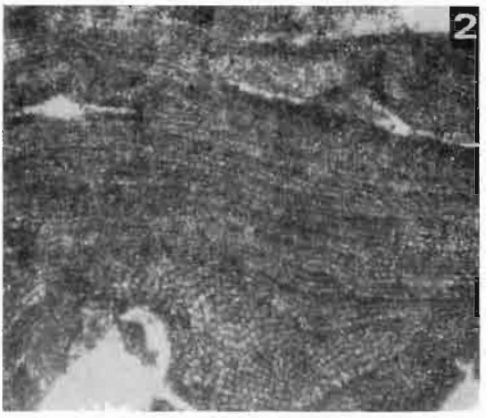
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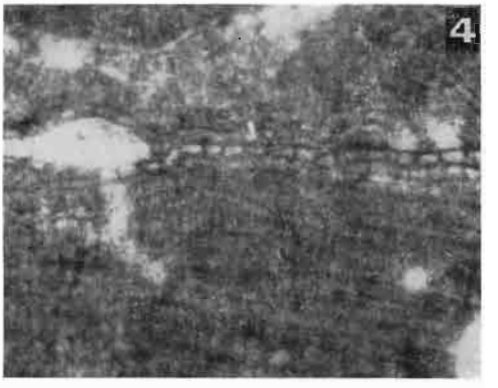
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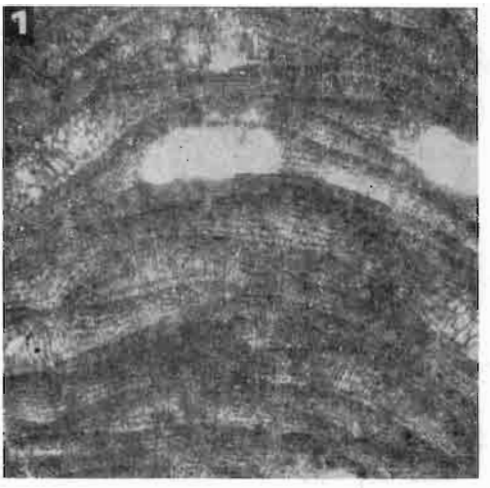
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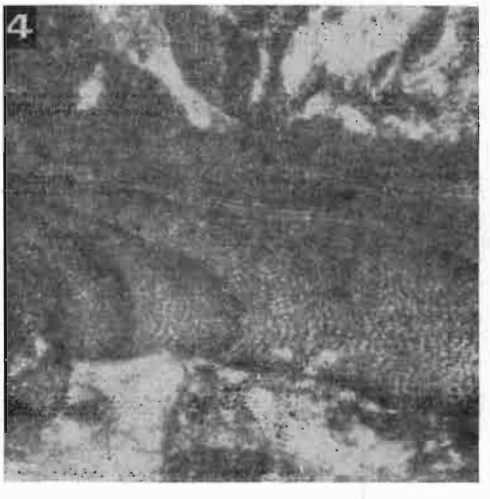
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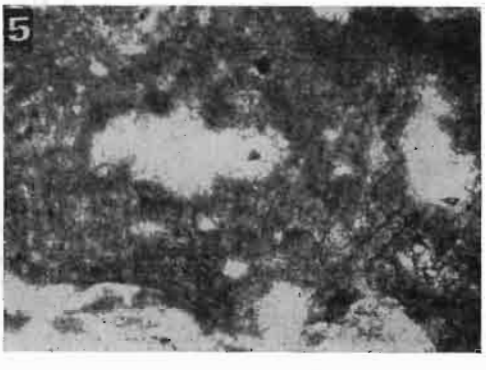
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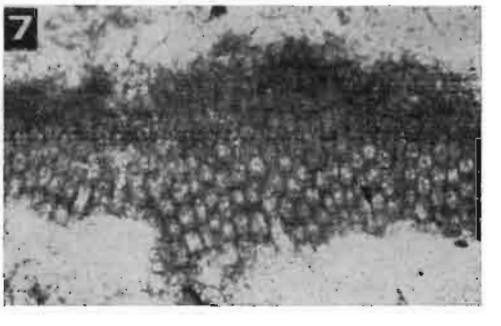
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