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NEW INFORMATION ON THE CALCAREOUS ALGAE IN THE BIOHERM LIMESTONES OF THE PALEOCENE-LOWER EOCENE IN WESTERN AND CENTRAL SLOVAKIA

(Pls. VII—XIV)

Abstract. Some results of lithological, biofacial and phytopaleontological investigations of bioherm limestones in Brezovské pohorie and Považie (western and north-western Slovakia). In the paleontological part of the paper are described and figured calcareous Algae of the family Corallinaceae.

Bioherm limestones in the Upper Cretaceous and Paleogene are very frequent at many localities in Slovakia. In few last years they were studied mainly from a view of their stratigraphical position. Their age was proved mainly on the basis of larger foraminifers.

In the past the authors did not pay an attention to the phytopaleontological study. Detaily was studied only a flora of the calcareous Algae from the bioherm reefs of Hričovské Podhradie (P. Lemoine, 1934; J. Pia, 1934). Some new occurrences of the calcareous Algae are described in one of my recent papers (A. Schaleková, 1963).

In this paper I wish to summarize some results of lithological facial and phytopaleontological study of the bioherm limestones in Brezovské pohorie and Považie.

Part of the studied material afforded me some of my colleagues. At this place I wish to express my gratitude for many samples and slides of Algal flora to my teacher Prof. Dr. D. Andrusov, Doc. Dr. M. Mišík, prom. geol. E. Scheibner and prom. geol. J. Zelman.

I. LITOLOGICAL AND FACIAL PART

Lithologically and facially, as well as phytopaleontologically were studied the bioherm limestones from several localities in Brezovské pohorie and Považie.

1. Bioherm limestones of Brezovské pohorie

In Brezovské pohorie were known a long time ago bioherm limestones. D. Andrusov (1934, 1945, 1959) and O. Kühn, D. Andrusov (1937, 1942) regarded these bioherm limestones from Brezovské pohorie and vicinity of Stará Turá as Senonian on the basis of analogy with the Senonian of the klippen belt in Slovakia and Gosau beds in Alps and on the other hand on the basis of study of Corals, Hippurits and Orbitoids, and occurrence of marls with intercalations of lime-

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stones with *Siderolites vidali* Douvillé. Recent papers of M. Mišík and J. Zelman (1959), J. Salaj (1960) and E. Köhler (1961) show, that the majority of the limestones is of Paleogene age. Upper Paleocene age of the bioherm limestones in the vicinity of Široké bradlo and settlement U Kravárikov was determined on the basis of occurrence of *Discocyclina seunesi* Douvillé and *Discocyclina douvillei* Schlumberger and the age of the limestones to some degree northward in the vicinity of Stará Turá, and Ľubina on the basis of *Discocyclina douvillei* Schlumberger and *Nummulite* cf. *solitarius* Douvillé (Upper Paleocene — Lower Ypresian, see E. Köhler, 1961).

The bioherm limestones of the mentioned region are in comparison with the majority of bioherm limestones in Považie of a quite different character. In majority (besides an occurrence near Hrušové) they occur in the form of smaller and imperfectly reworked block reefs in conglomerates or sandy — conglomerate marls, while occurrences in Považie are of greater dimensions and at some places we may see, that they make greather lenses in sandy-marly, conglomerate-like or flysch beds of the Paleogene. However, more detailed lithological and facial studies showed very identical character of flora and fauna.

The block reefs in the mentioned region we may find at many localities in the vicinity of Stará Turá, Bzince and Myjava. As microcsopic studies showed, the lithological character of the reefs from all localities is the same and the percentual representation of organic remains changes also in the same reef, I give here only their general characteristics.

In general, the bioherm limestones represent quite pure limestones with organogenous, organodetrital, or organodetrital-muddy structure. The clastic admixture is very rare, it is represented mainly by clastic grains of quartz. Some limestones, as for instance near Stará Turá or some occurrences near settlement U Rubaniských, exclusively have rather biostrome character and contain more clastic admixture. We may find also the quartz grains with diameter of about 1 mm and fragments of rocks (spongolith limestones, fragments of quartz and quartzites, calcareous sandstones, radiolarites, fragments of marls with primitive globigerine-like forms and others). In these rocks we may frequently find silicified organic remains (mainly those of coralline Algae and Assilinas), the tests of which are secondary composed of quartzine. We may find also glauconite or chlorite, exclusively biotite and frequently selective Fe-hydrate pigment. The coralline Algae and other organic remains are frequently in the form of fragments. These limestones originated by decomposition of reefs with clastic admixture of surrounding rocks. Pure bioherm limestones are overfilled by reef-building organisms. The majority of the last is represented by calcareous Algae, mainly red Algae. I have determined here these species: *Archaeolithothamnium lugeoni* Pfender, *Archaeolithothamnium ? gunteri* Johnson and Ferris, *Archaeolithothamnium ? proprium* (Lemoine) Schaleková, *Lithothamnium contraversum* Lemoine, *Mesophyllum tropicale* Lemoine, *Lithophyllum quadrangulum* Lemoine, *Lithophyllum* cf. *mengaudi* Lemoine var. *carpathica* Lemoine, *Corallina abundans* Lemoine, *Jania nummulitica* Lemoine, *Elianella elegans* Pfender and Basse, *Pseudolithothamnium album* Pfender, and others. Less frequent are green Algae, firstly found by D. Andrusov (1938, 1950). He found tissues belonging to the genus *Neomeris* Lamouroux and the species *Trinocladus tripolitanus* Raineri. In my material, I also found many sections of Dasycladaceae. Less frequent are also Acicullariae. M. Mišík (1959) and M. Mišík

and J. Zelman (1959) paid attention to the fact of an occurrence of Globochaete in Brezovské pohorie. Besides these representatives of Algae we have to note frequent species *Distichoplax biserialis* (Dietrich) Pia. In some portions of these bioherm limestones prevailing constituent represent Corals. Comparatively frequent are Bryozoa. Very frequent are Rotalidea, Miliolidea, Textularia, less frequent are Discocyclinas, Assilinas, Operculinas and Nummulites. Frequent are also sessil Foraminifera (Planorbulinidae). From other organisms we may find scarce Ostracoda, fragments of Echinodermata, spines of Echini, fragments of Mollusca, exclusively fragments of Vermes (Serpula) and sections of Gastropod shells.

2. *Occurrences of bioherm limestones in Považie*

In Považie I have studied composition of the bioherm limestones at the localities:

a) Makovec, b) Svätá Helena, c) Hričovské Podhradie, d) locality west of Žilina (Závodie).

The bioherm limestones from Makovec and Svätá Helena were regarded by D. Andrusov (1945) as belonging to the Upper Cretaceous. Limestones from Hričovské Podhradie and west of Žilina (D. Andrusov and M. Kuthan, 1944) were regarded as Upper Eocene. O. Samuel and J. Salaj (1963) on the basis of *Discocyclina seunesi* Douvillé and *Discocyclina douvillei* Schlumberger determined their age as Paleocene — Lower Eocene.

a) *Makovec*

At the locality Makovec near Považská Bystrica occurs pure bioherm limestone in the form of larger elongated lens within conglomerate sequence. The lens is represented by light to white limestone with macroscopically visible Corals, remains of Algae and other reef-building organisms. Structure of these limestones is organodetritally-muddy. Sometimes we may see pelet structure. The pelets are small, without structure or oval, originated from originally muddy matrix. During recrystallization the structure was made conspicuous by recrystallization of original matrix in finegrained calcite around pelets. The majority of these limestones is pure, without clastic admixture. Only very rarely was found sandy admixture of silt measurements, isolated pyrite pigment and very rarely authigenic chlorite. Part of the limestones is only Coral, coral—Bryozoan, Bryozoan—Algal and the majority is Algal. From the calcareous Algae the most frequent are red Algae. I have determined these species: *Archaeolithothamnium* ? *proprium* (Lemoine) Schaleková, *Lithophyllum quadrangulum* Lemoine, *Lithothamnium contraversum* Lemoine, *Jania* cf. *mengaudi* Lemoine, *Elianella elegans* Pfender and Basse, less frequent *Pseudolithothamnium album* Pfender. Besides calcareous Algae there are very frequent Corals and Bryozoa here. An amount of other organic remains is much lesser. There are Foraminifera (Miliolidea, Rotalidea, agglutinated Foraminifera and rarely Globigerinas) in these limestones. Less frequent are also sections of Crinoidal internodes, spines of Echini and Ostracoda. Sometimes here occur calcified spiculae of Sponges, sections of Lamellibranchiata and Gastropoda, tubules of Vermes and sections of Discocyclinas.

b) *Svätá Helena near Považská Bystrica*

The bioherm limestones from the locality Svätá Helena near Považská Bystrica occur only in smaller blocks and conglomeratelike, respectively sandy sequence. The organodetrital to organodetritally-muddy limestones contain sometimes certain amount of quartz of the silt measurements. The most frequent organic remains are calcareous red Algae, locally are quite frequent Corals and Bryozoa. From the Algae was determined by P. Lemoine (1934) the species *Mesophyllum ramosum* Lemoine. The author found here *Jania* cf. *nummulitica* Lemoine and *Lithothamnium contraversum* Lemoine, and many undetermined Lithothamnium and Lithophyllum. Rarely occurs the species *Pseudolithothamnium album* Pfender. The green Algae are represented by lees frequent Acicullariae. There were found single section of *Distichoplax biserialis* (Dietrich) Pia. Besides these most extended organisms we may find sometimes Foraminifera [Miliolidea, Globigerinas, Textularias, Rotalidea and sessil Foraminifera (Planorbulinidae)]. Less frequent are also fragments of Mollusca, Ostracoda and sections of spines of Echini and Crinoidal internodes.

c) *Hričovské Podhradie*

The bioherm limestones from Hričovské Podhradie were well known and studied already many years ago lithologically as well as stratigraphically and phytopaleontologically. Summarized data on these bioherm limestones were given by D. Andrusov and M. Kuthan (1944). Phytopaleontologically they were studied by P. Lemoine (1934), J. Pia (1934) and D. Andrusov (1938).

The bioherms from Hričovské Podhradie differ from the majority of bioherms from Brezovské Pohorie by their greater size. They make lenses and klippens of the thickness from some m to 10 m. However, there are also 30—40 m thick and 200 m long blocks, which occur in Paleogene sandy, marly, respectively conglomeratelike sequences. Locally we may see a sharp boundary with surrounding beds, but frequently this boundary is gradual and organic remains of bioherm character are in surrounding detrital sediments.

The lithological character of these limestones is clearly bioherm. In majority these limestones are pure, with organogenous structure, respectively organogenous — detrital with muddy matrix. Sometimes, mainly in the portions with frequent Foraminifera, we see admixture of silt quartz. In some slides I have seen silicification of organic fragments (mainly fragments of Mollusca).

From the organic remains most frequently we may find calcareous Algae. At some places predominate Corals. In the rocks with considerable percentage of clastic detrital material are very abundant Foraminifera. Other organic remains occur in second-rate amount and their content changes from place to place. Quite rare are remains of Bryozoa, larger Foraminifera *(Discocyclina, Assilina, Alveolina* and *Nummulites),* locally are frequent *Miliolidea (Triloculina, Quinqueloculina)* and *Rotalidea.* Less frequent are agglutinated Textularias, sessil *Planorbulinidae* and small Globigerinas. From other organic remains we have to quote fragments of Mollusca, rare sections of Echinodermata and spines of Echini. Sometimes we meet with sections of Ostracoda and Serpula.

Red Algae were studied by P. Lemoine (1934). She found the following species, from which the majority is represented by new species: *Archaeolithotham-*

nium nummuliticum (Gümbel) Rothpletz, *Lithothamnium andrusovi* Lemoine, *Lithothamnium contraversum* Lemoine, *Lithophyllum quadrangulum* Lemoine, *Lithophyllum carpathicum* Lemoine, *Lithophyllum mengaudi* (Lemoine var.) *carpathica* Lemoine, *Lithophyllum dubium* Lemoine, *Lithophyllum densum* Lemoine, *Lithophyllum continuum* Lemoine, *Mesophyllum varians* Lemoine, *Mesophyllum tropicale* Lemoine, *Mesophyllum heteroclithum* Lemoine, *Amphiroa propria* Lemoine, *Corallina abundans* Lemoine, *Jania nummulitica* Lemoine. D. Andrusov (1934) has determined these species: *Archaeolithothamnium* cf. *oulianovi* Pfender, *Pseudolithothamnium album* Pfender. J. Pia (1934) determined at this locality sections of Acicularias, *Distichoplax biserialis* (Dietrich) Pia and remains of Characeae, which he included into the „genus" *Gyrogonites*. Besides of the mentioned forms I found non frequent specimens of the species *Elianella elegans* (Pfender) Basse. M. Mišík and J. Zelman (1959) described from this locality also the sections of zoospores of *Globochaete alpina* Lombard.

d) *Bioherm limestones west of Žilina (Závodie)*

Smaller reefs of the similar character as the mentioned ones were described from the locality west of Žilina. I have studied mainly composition of smaller reefs near Bradová potok and reef near Rubanice near Ovčarisko. These reefs are pure bioherm limestones most frequently with organodetrital muddy structure. Locally the original muddy matrix is recrystallized and exclusively developed pelet structure. Rarely occurs in the limestone quartz of silt measurements and locally the authigenic chalcedony displaces calcitic shells of some organisms. In some slides we may see the presence of glauconite in shells of larger Foraminifera.

From the organic remains predominate mainly red Algae. Only locally predominate Corals. Quite frequent are *Bryozoa,* locally Foraminifera *(Rotalidea,* and *Miliolidea),* less frequent are Globigerinas. In portions with larger Foraminifera (Discocyclinas, and Operculinas) distinctly decreases an amount of Algae and Corals. In some slides I have found problematic organisms (*Carpenteria* ?). From other organisms I have found single fragments of Echinodermata, exclusively sections of spines of Echini, crinoidal internodes, Ostracoda, sections of Serpula and shells of Mollusca and Gastropoda.

As in the mentioned bioherms also at this locality predominate red Algae. Dasycladaceae are represented only very rarely. I have found the species as follows: *Archaeolithothamnium* ? *proprium* (Lemoine) Schaleková, *Lithothamnium contraversum* Lemoine, *Corallina abundans* Lemoine, *Jania nummulitica* Lemoine, *Elianella elegans* Pfender and Basse, *Pseudolithothamnium album* Pfender, undetermined sections of *Dasycladaceae, Acicularia* sp., and *Distichoplax biserialis* (Dietrich) Pia.

II. PALEONTOLOGICAL PART

For the study of flora of the calcareous Algae I had in my disposal original slides of P. Lemoine, from which described this authors new species (1934). Unfortunately considerable part of these slides was damaged in the last war, or they are quite badly preserved. Due to these reasons comparative study of this material sometimes was impossible. Some figures of new species described by

P. Lemoine are very schematic, and therefore, if the material was well preserved, I give the pictures of the original material of P. Lemoine in this paper.

Some of the species described by P. Lemoine (1934) from the mentioned original slides I dit not find in my own material, and I quote them in the paleontological part without further description.

Family *Corallinaceae*
Subfamily *Melobesioideae*
Genus *Archaeolithothamnium* Rothpletz, 1891

The representatives of this genus develope into crustose, nodular and also branching forms. The tissue consists of the hypothallium and perithallium. In crustose forms the hypothallium is frequently weakly developed and it is composed of irregularly arranged layers (similarly as in the genus *Lithathamnium*). Erected hypothallium layers pass to the perithallium. The layers of the last are closely spaced themselves, generally with regularly arranged cells. In the branching forms there is developed the central hypothallium with arch-like arranged transversal walls of cells and thin marginal perithallium. By the anatomic construction this type is closely allied to the genus Lithophyllum. The most characteristic mark of this genus is a presence of isolated sporangia. In the section of the tissue we may see egg-shaped, oval or rounded cavities after sporangia, arranged most frequently in concentric rows in the tissue.

The genus *Archaeolithothamnium* is extended from the Lower Cretaceous to recent with maximum development in the Upper Cretaceous.

Archaeolithothamnium lugeoni Pfender 1926

Pl. VII, figs. 1, 2

1926 *Archaeolithothamnium Lugeoni*, Pfender, p. 324, pls. 9, 13.
1939 *Archaeolithothamnium Lugeoni*, Lemoine, p. 52, figs. 14, 15.
1962 *Archaeolithothamnium lugeoni*, Maslov, p. 48, fig. 23, pl. 13, fig. 3.

Descriptions: the tissue makes thin crusts, respectively crusts with mammillae, frequently superimposed. Hypothallium is ussually narrow, composed of some layers, which are almost horizontal, but later become erected and pass into the perithallium. The height of the hypothallium cells is 13—14 μ, breadth 8—13 μ. The perithallium constructs the main part of the tissue. It is composed of rows of cells. Both horizontal and vertical walls of cells are well developed. Sporangia, sometimes closely spaced, have oval to egg-shaped form and they are arranged into rows. Their height is between 64—83 μ; breadth 30—41 μ.

Remark: as example of certain variability I give two instances of tissues. In the first instance we see, that the tissue has more closely spaced sporangia, developped in one niveau. Zones with sporangia are developed in the tissue in short intervals. In the second instance we see the mammillate tissue. Despite the first instance the sporangia here are less closely spaced, more irregularly arranged and single zones with sporangia show smaller or larger distances. Also an arrangement of cells in the perithallium is to some degree different. More evident are horizontal walls, the height of which sometimes varies. In both the instances there are almost identical dimensions of cells and

Table 1

	Hypothallium		Perithallium		Sporangia	
	hight	breadth	hight	breadth	hight	breadth
Brezovské pohorie	15–34 13–30	8–12 8–13	10–19 10–23	7,5–13 7–12	68–38 64–79	30–41 30–42
Pfender (1926) Spain	30	6	10–20	7,5–13,5	90–95	
Lemoine (1949) Alger	26–37	8–12	13–20	8–15	70–80	35–40
Maslov (1962) USSR	16–30	6– 8	16–20	4– 8	60–100	20–30

sporangia and therefore I regard them as belonging to one species. I give dimensions of the mentioned two exemplares and comparison with other species described in literature (all dimensions in μ) (Tab. 1).

Occurrences: Brezovské pohorie (Široké bradlo, south-eastern slope of Krásny vrch).

Archaeolithothamnium gunteri ? Johnson and Ferris, 1948

Pl. VIII, fig. 3.

1948 *Archaeolithothamnium gunteri*, Johnson and Ferris, p. 764, pl. 116, fig. 3.

Description: to this species might belong forms, which on a whole resemble the mentioned species. They differ mainly in developing thicker crusts, frequently mammillate. They have to some degree smaller and narrower sporangia. Smaller fragments, which I have found in my material have narrow hypothallium (30 × 6 μ, perithallium (9—20 μ × 7,5—11 μ) and sporangia (57—72 μ × × 27—34 μ).

Remark: by dimensions of cells and sporangia this species corresponds to originality described species from the Eocene of Florida (Johnson and Ferris, 1948). I suggest that establishment of this species as new does not seem sufficient as *Archaeolithothamnium gunteri* and *Archaeolithothamnium lugeoni* have only very slightly different diagnostic features. For sufficient determination it would be necessary to have in disposal material of the mentioned authors. It seems possible that the species *Archaeolithothamnium lugeoni* Pfender is very variable and therefore also the tissues in my material might be regarded as belonging to the mentioned species.

Occurrences: Brezovské pohorie (south-eastern slope of Čirkov vrch).

Archaeolithothamnium ? *proprium* (Lemoine, 1934) nov. comb.

Pl. VIII, fig. 4; pl. IX, fig. 5.

1934 *Amphiroa propria*, Lemoine, p. 283, fig. 15.

Description: the species is branching with well developed medullar hypothallium with narrow marginal perithallium. Frequently we may see in slides the cross-sections also in the places of branching (dichotomic or trichotomic). The tissue is light, as the cell walls are thin.

The hypothallium is composed of arched rows of cells. Transversal partitions are arranged in continuous lines. Under greater enlargement we may see, that they have zig-zag course. Longitudinal walls of cells are continuous. Very characteristic for this species is alternation of height of narrow cells in the single rows in the hypothallium in irregular intervals. Alternated are rows withe height of cells of 10—50 μ, most frequently occur cells with height of 28—38 μ. Transversal walls at the margins are suddenly curved and gradually pass into the perithallium. The breadth of cells is mostly 7—9 μ, only exclusively 5 μ and in some specimens it reaches the maximum — 10 μ. The hypothallium mostly gradually passes into the perithallium with cells arranged in some rows. They have hight of 10—22 μ, breadth of 7—9 μ. The rounded cavities after sporangia(?) are characteristically shallowly immersed into the perithallium, frequently irregulary closely spaced. Diameter of the cavities is 56—76 μ.

Remark: In 1934 P. Lemoine described from Hričovské Podhradie new species *Amphiroa propria.* Dimensions of cells of this species correspond with those of my specimens. The mentioned author included the described species to the articulate Coralline Algae, and to the genus *Amphiroa.* The species was included to the mentioned genus mainly on the basis of hypothallium, with alternating cells of various height. Sporangia not visible. I had in my disposal the original slide of P. Lemoine. Dimensions and description are identical with those of my specimens.

Presence of rows of cells of various dimensions and their regular alternation is characteristic for the genus Amphiroa Alternation of cells of various height was observed also in some species of the subfamily Melobesioideae. For instance *Lithophyllum moluccense* Foslie, *Lithophyllum bamleri* Heyd. J. Pfender (1926) described the branching types of Archaeolithothamnium with alternating rows of cells with various height in the medular hypothallium. These phenomena we may see also in the species *Archaeolithothamnium turonicum* Rothpletz and *Archaeolithothamnium hypuritorum* (Munier — Chalm.) Pfender. However, in these species an alternation of the height of rows of cells is more regular as in our case.

In many slides with the mentioned species I have seen that in the majority these forms have shallowly placed rounded cavities with sharp margins, which may be regarded as cavities after sporangia (?). In every case we may see, that the course of walls of cells of the perithallium in neighbourhood of these cavities is interrupted not as in the case of the genus Archaeolithothamnium. After reading this paper Prof. Maslov expressed an opinion that in the case of these cavities we might take into consideration certain sphaeric parasites. However, it is not probable, that such parasites occur only in this species at all the studied localities. On second thoughts I have placed this species to the genus *Archaeolithothamnium.*

Occurrences: this species is one of the most extended Coralline Algae in the studied bioherm limestones in Slovakia. In some cases, as for instance from the locality Ľubina in Brezovské pohorie, almost all the slide is composed of specimes of this species. Besides Brezovské pohorie, where the species occurs at several localities (Ľubina, south-eastern slope of Čirkov vrch, settlement Tomišovia, east of Kostolančíkovia, Široké bradlo near Košarisk á. o.), it occurs also in the bioherm limestones at the locality Makovec, Závodie near Žilina and in Hričovské Podhradie.

Archaeolithothamnium nummuliticum (Gümbel) Rothpletz, 1891)

1934 *Archaeolithothamnium nummuliticum*, Lemoine, p. 273.

Occurrence: Hričovské Podhradie.

Archaeolithothamnium cf. *oulianovi* Pfender, 1926

1926 *Archaeolithothamnium Oulianovi*, Pfender, p. 325, pl. 10.
1938 *Archaeolithothamnium* cf. *oulianovi* Andrusov, p. 19, pl. 4, fig. 2.
1957 *Archaeolithothamnium oulianovi*, Johnson, p. 218, pl. 38, fig. 5, pl. 39, figs. 4, 5.
1961 *Archaeolithothamnium oulianovi*, Johnson, p. 918.

Description: crustose tissue is composed only of perithallium, cells of which are irregulary arranged and by its shape it resembles rather the tissue of Lithothamnium. The height of cells is 15—19 μ and breadth 7—9 μ. Sporangia are mostly rounded or oval, and not arranged in regular rows. Their dimensions are 55—58 × 23—38 μ.

Remark: this species was firstly described by D. Andrusov (1938) from the locality Hričovské Podhradie in Slovakia. The height of sporangia as well as that of the perithallium cells (regarded by him probably as hypothallium) he does not quote. Our form is identical with that described by Mme Pfender (1926). The Spain specimens have only smaller dimensions of sporangia. In my specimen I had not basal hypothallium.

Comparison of some specimens (in μ) in Table 2.

Occurrence: Hričovské Podhradie.

Genus Lithothamnium Philippi, 1837

Tissues develope in various forms. They are crustose, foliage, mammillate to nodular, but also branching. They are composed of hypothallium and perithallium. They are of 11—48 μ, mostly 27—38 μ in height and of 7,6 (sometimes only 5 μ) to 11 μ in breadth. The cells in the perithallium are arranged into concentrical rows with continued verticval walls. Their height is 7,6—23 μ and breadth 7,6—11 μ. The hypothallium cells pass at margins into the perithallium almost in 90° angle.

The oldest representatives of the genus we may find in the Lower Cretaceous. The maximum extension is in the Miocene and Pliocene. They are restricted also in the recent seas, mainly in colder waters.

Table 2

	Hypothallium		Perithallium		Sporangia	
	hight	breadth	hight	breadth	hight	diameter
Hričovské podhradie			15–19	7–9	55–58	23–38
Pfender (1926)	24	8	9–21	5–10,5	75	45
Andrusov (1938)				?5–10		28–33
Johnson (1957)	10–16	6–10	9–14	7–10	46–90	32–63

Lithothamnium contraversum Lemoine, 1934

Pl. IX, fig. 6; pl. X, fig 7

1934 *Lithothamnium contraversum*, Lemoine, p. 275.

Description: the species represents a branching form with characteristic well developed medullar hypothallium, with narrow marginal perithallium, restricted into few rows of cells. The medullar hopothallium is composed of narrow cells. They are of 11—48 μ, mostly 27—38 μ in height and of 7,6 (sometimes only 5 μ) to 11 μ in breadth. The cells in the perithallium are arranged into concentrical rows with continued vertical walls. Their height is 7,6—23 μ and breadth 7,6—11 μ. The hypothallium cells pass at margins into the perithallium almost in 90° angle.

Remark: the species was described by P. Lemoine (1934) from Slovakia (locality Hričovské Podhradie). Specimens in my slides are identical with an original description, however, they have mostly narrower cells. P. Lemoine (1934) gave the breadth of 9—13 μ.

Occurrence: Brezovské pohorie (south-eastern slope of Čirkov vrch, south-east of elevation point 297 and east of the settlement Kostolančíkovia), the bioherm limestones at Makovec, Svätá Helena near Považská Bystrica, Závodie near Žilina, and Hričovské Podhradie.

Lithothamnium andrusovi (Lemoine, 1934)

1934 *Lithothamnium Andrusovi*, Lemoine, p. 274, fig. 2.
1939 *Lithothamnium andrusovi*, Lemoine, p. 67.
1962 *Lithothamnium Andrusovi*, Maslov, p. 58, fig. 6.

Description: the species makes most frequently crusts of 100—300 μ in breadth, composed of the hypothallium and thin perithallium. Very characteristic is considerable variability of the length of cells in the hypothallium (9—30 μ). The breadth of hypothallium cells is 7—12 μ. In the central part of the hypothallium there are longer and wider cells. The hypothallium cells are erected and compose the perithallium, which is only weakly developed. It is composed of almost quadrate cells, or they are rather long than thick. Dimensions of the perithallium: length 7—13 μ, breadth 6—8—10 μ.

Remark: my specimens are identical with Lemoine's exemplares from Hričovské Podhradie. V. P. Maslov (1962) described specimens with better developed perithallium.

Occurrences: Hričovské Podhradie, Závodie near Žilina.

Genus *Mesophyllum* Lemoine, 1928

The features of the tissue are characteristic for the genus Lithophyllum, as the hypothallium and perithallium cells are arranged in regular rows, frequently with zonal construction. Tetrasporangial conceptacles resemble those of the genus Lithothamnium, but they have more cavities in their top. They occur from the Upper Cretaceous to recent with maximum development in the Eocene—Oligocene.

Mesophyllum tropicale Lemoine, 1934

Pl. X, fig. 8

1934 *Mesophyllum tropicale*, Lemoine, p. 277, fig. 7.

Description: the tissue developes into slender branches 500—800 μ in breadth. It is composed of arched rows of cells, mostly with hight of 23—38 μ and breadth of 7—15 μ. These higher cells are interrupted in certain intervals by a row of shorter cells with hight of 10—15 μ. Rows of cells under these shorter cells are usually darker and this darker zone extends little beyond the upper horizontal wall of shorter cells. In some specimens there were developed also marginal narrow perithallium with cells of 7—15 μ hight and 7—11 μ breadth.

Remark: the studied specimens are identical with an original description of P. Lemoine (1934) from Hričovské Podhradie. The specimen described by the mentioned author had not the marginal perithallium.

Occurrence: Brezovské pohorie (east of the settlement Kostolančíkovia), Hričovské Podhradie.

Mesophyllum varians Lemoine, 1934

1934 *Mesophyllum varians*, Lemoine, p. 276, fig. 6.

Occurrence: Hričovské Podhradie.

Mesophyllum heteroclitum Lemoine, 1934

1934 *Mesophyllum heteroclitum*, Lemoine, p. 277, figs. 3, 9.

Occurrence: Hričovské Podhradie.

Mesophyllum ramosum Lemoine, 1934

Pl. X, fig. 9

1934 *Mesophyllum ramosum*, Lemoine, p. 276, fig. 5.

Remark: the species was described by P. Lemoine (1934) from the locality near Považská Bystrica. The perfect locality is unknown, but it is possible, that it is in reality Svätá Helena. In such case it is necessary to change the stratigraphical restriction of this species into the Paleocene—Lower Eocene instead of the Santonian-Campanian. On the plate I figure the tissue from the original slide, from which the species was established.

Genus *Lithophyllum* Philippi, 1837

The tissue makes crustose, nodular and also branching forms.

Both hypothallium and perithallium have regular constructions. The hypothallium has rows of cells arranged mostly in arched layers, respectively they are only slightly curved. The perithallium is composed of cells arranged in rows with

transversal walls mostly in equal height, so that there is the „net" structure. Conceptacles are opened into one opening in the top.

Representatives of the genus are restricted from the Senonian with maximum in the Miocene. They live in warm recent seas.

Lithophyllum quadrangulum Lemoine, 1934

Pl. XI, fig. 10

1934a *Lithophyllum quadrangulum*, Lemoine, p. 178, fig. 4.
1934b *Lithophyllum quadrangulum*, Lemoine, p. 279, fig. 10.

Description: the species has the tissue with diameter of 325—640 μ. Characteristic for this species are very big cells, with height of 30—50 μ and breadth of 11—34 μ. Longitudinal walls of cells cross all the tissue and transversal walls of cells make arched lines. Under greater magnification we may see, that the transversal walls of cells, which are concetrically arranged, are not in the same level.

Remark: the species is very frequent in the bioherm limestones at the studied localities. For somparison I give a review of dimensions of some specimens from the studied localities and those of the specimens described in the literature (in μ) (Table 3).

Occurrences: Hričovské Podhradie, Makovec near Považská Bystrica, Brezovské pohorie.

Lithophyllum mengaudi Lemoine var. *carpathica* Lemoine, 1934

Pl. XII, fig. 11

1934 *Lithophyllum mengaudi* var. *carpathica*, Lemoine, p. 281.
1939 *Lithophyllum mengaudi* var. *carpathica*, Lemoine, p. 102.

Description: found cross-sections of the branching form have a diameter of 480 μ. The main part of the tissue is composed of the medullar hypothallium with arched rows of cells, with height of 24—34 μ and breadth of 10—15 μ. The

Table 3

	Diameter of tissue	Hypothallium	
		hight	breadth
	600—640	38—40	19—20
Brezovské pohorie		38—40	17—22
		38—45	11—23
Makovec	325—415	30—48 (53)	15—34
Hričovské Podhradie Lemoine (1934)	350—500	35—50	17—25 (35)
Spain Lemoine (1934)	325—600	30—45	10—21

Table 4

	Hypothallium		Perithallium		Diameter of tissue
	higth	breadth	higth	breadth	
Brezovské pohorie	28–30	11–15	7–13	7–10	
	24–34	10–15	8–14	7–11	480
Hričovské Podhradie, Lemoine (1934)	22–35	10–17	10–17	10–14	
Alger, Lemoine (1939)	20–30	(20)			200–700

perithallium is weakly developed with cells arranged in parallel rows. Dimensions of cells are: height 7—14 μ, breadth 7—11 μ.

Remark: found species are identical with the mentioned form described by P. Lemoine (1934) from the locality Hričovské Podhradie. However, they have to some degree smaller cells in the perithallium (Tab. 4).

Occurrences: Hričovské Podhradie, Brezovské pohorie, Závodie near Žilina.

Lithophyllum densum Lemoine, 1934

Pl. XII, fig. 12

1934 *Lithophyllum densum*, Lemoine, p. 282, fig. 14.

Occurrence: Hričovské Podhradie.

Lithothamnium carpathicum Lemoine, 1934

Pl. XIII, fig. 13

1934 *Lithophyllum carpathicum*, Lemoine, p. 279, fig. 11.

Remark: this form was described by P. Lemoine (1934) from the locality Hričovské Podhradie. For illustration I give an original picture of the slide of P. Lemoine (No. 46) which I have in my disposal. V. P. Maslov (1956, 1962) described and figured this species, but his forms differs in some features .

Lithophyllum dubium Lemoine, 1934

1934 *Lithophyllum dubium*, Lemoine, p. 283, fig. 13.
Occurrence: Hričovské Podhradie.

Lithophyllum continuum Lemoine, 1934

1934 *Lithophyllum continuum*, Lemoine, p. 280, fig. 12.
Occurrence: Hričovské Podhradie.

Subfamily *Corallinoideae*
Genus *Corallina* Lamouroux, 1816

The genus developes into segmented branches, which are dichotomically, trichotomically or feathered branching. The internodes are composed mostly of the

hypothallium with transversal partitions of cells arranged in convex lines. The perithallium is weakly developed and indistinct. The conceptacles are placed usually at endings of internodes and in the fossil material they do not preserve. The fossil species appear from the Aptian, mostly from the beginning of the Tertiary. Now they live in tropical and subtropical seas.

Corallina abundans Lemoine, 1934

Pl. XIII, fig. 14

1934 *Corallina abundans*, Lemoine, p. 284, fig. 16.
1962 *Corallina* cf. *abundans*, Maslov, p. 105.

Description: the cross-sections of the internodes have a diameter of 400—500 μ, less frequently of about 380 μ. The axial cells are 55—90 μ high and 10—20 μ wide. The transversal walls of cells are distinct and make arched rows with zig-zag coarse (height of cells are not uniform). The running lines make also the longitudinal walls of cells. The marginal cells, developed mostly in the single row, have dimensions of 15—35 μ.

Occurrences: Brezovské pohorie, Hričovské Podhradie, Závodie near Žilina.

Genus *Jania* Lamouroux, 1816

The tissue is dichotomically branching. Thin internodes are mainly composed of the hypothallium. The transversal partitions are mostly in various level, so that they make irregular line. The perithallium is narrow and frequently composed of the single layer of long cells perpendicularly placed against the margin of the tissue, or it originates by division of long cells from the hypothallium and by their bending toward the margin of the tissue.

The oldest fossil representatives we know from the Upper Cretaceous with maximum extension in the Eocene. In the recent time numerous species live in warm and tropical waters of the Atlantic ocean.

Jania nummulitica Lemoine, 1927

Pl. XIV, fig. 15

1927 *Jania nummulitica*, Lemoine, p. 550, fig. 6.
1928 *Jania nummulitica*, Lemoine, p. 104, figs. 19, 20.
1932 *Jania nummulitica*, Airoldi, p. 82, pl. 12, figs. 6, 7.
1934 *Jania nummulitica*, Lemoine, p. 285.

Description: diameter of internodes is 150—272 μ. The hypothallium is composed of cells with non equal height (63—114 μ) frequently in slightly curved rows. The breadth of the cells is 5 (9)—14 μ. Marginal perithallium cells originate by division of long cells and by their bending almost perpendicularly to the margin of the tissue. The perithallium is composed of cells of 15—26 μ in size.

Remark: dimensions of cells in slides show considerable variability. For instance there are dimensions of three specimens from Brezovské pohorie and those of cells figured in two papers of P. Lemoine (in μ) (Tab. 5).

Table 5

	Diameter of internode	Hypothallium	
		hight	breadth
Brezovské pohorie	228	94–113	9–14
	150	108–114	5–7,5
	166–272	63– 80	7,6–11
Lemoine (1934)	175–225	85– 87	9–12
Lemoine (1928)	150–210	60–110	

Table 6

	Diameter of internode	Hypothallium		Perithallium	
		hight	breadth	hight	breadth
Lemoine (1934) Spain	220–275	50–70	5–10	10–14	5–7
Makovec	182	46–69	7– 8	11–19	6–7/11

Occurrences: Brezovské pohorie, Závodie near Žilina, Hričovské Podhradie, Svätá Helena near Považská Bystrica.

Jania cf. mengaudi Lemoine, 1934

1934 *Jania mengaudi*, Lemoine, p. 178—179, figs. 5—6.

Description: internodes of this species are 182 μ in diameter. The hypothallium is composed of rows of cells, which are only slightly arched or almost straight and curved only near their margins. Horizontal partitions are not in the same level. Height of cells in the central portion is 46—69 μ, breadth 7—8 μ. The marginal perithallium is made of cells 11—19 × 6—7 (11) μ in size. Their course and arrangement are indistinct.

Remark: P. Lemoine (1934) figured specimens with distinct arrangement of cells into rows in the perithallium. On a whole she quoted larger diameter of internodes than it is in our case. For comparison I give dimensions of cells (in μ) (Tab. 6).

Occurrences: Makovec near Považská Bystrica.

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After a consultation with V. P. Maslov (Moscow) recommended for publication by D. Andrusov.

Explanations of the Plates VII—XIV

Pl. VII

Fig. 1. *Archaeolithothamnium lugeoni* Pfender, Brezovské pohorie, Široké bradlo, KPUK (a) 0001 (slide Ab/232), x55. Fig. 2. *Archaeolithothamnium lugeoni* Pfender, Brezovské pohorie, south-eastern slope of Krásny vrch, KPUK (a) 0002 (slide Ab/209), x43. Photo L. Osvald.

Pl. VIII

Fig. 1. *Archaeolithothamnium gunteri* ? Johnson and Ferris, Brezovské pohorie, south-eastern slope of Čirkov vrch, KPUK (a) 0003 (slide Ab/172), x136. Fig. 2. *Archaeolithothamnium* ? *proprium* (Lemoine) nov. comb., Brezovské pohorie, Ľubina, KPUK (a) 0004 (slide Ab/145), x43. Photo L. Osvald.

Pl. IX

Fig. 1. *Archaeolithothamnium* ? *proprium* (Lemoine) nov. comb., Brezovské pohorie, south-eastern slope of Čirkov vrch, KPUK (a) 0005 (slide Ab/145), x43. Fig. 2. *Lithothamnium contraversum* Lemoine, Závodie near Žilina, KPUK (a) 0006 (slide Ac/262), x136. Photo L. Osvald.

Pl. X

Fig. 1. *Lithothamnium contraversum* Lemoine, Hričovské Podhradie, KPUK (a) 0007 (slide Aa/109), x136. Fig. 2. *Mesophyllum tropicale* Lemoine, Hričovské Podhradie, KPUK (a) 0008 (slide 11), x55. Photo L. Osvald.

Pl. XI

Fig. 1. *Mesophyllum ramosum* Lemoine, Považská Bystrica, KPUK (a) 0009 (slide No. 5533), x136. Fig. 2. *Lithophyllum quadrangulum* Lemoine, Hričovské Podhradie, KPUK (a) 0010 (slide Aa/108), x136. Photo L. Osvald.

Pl. XII

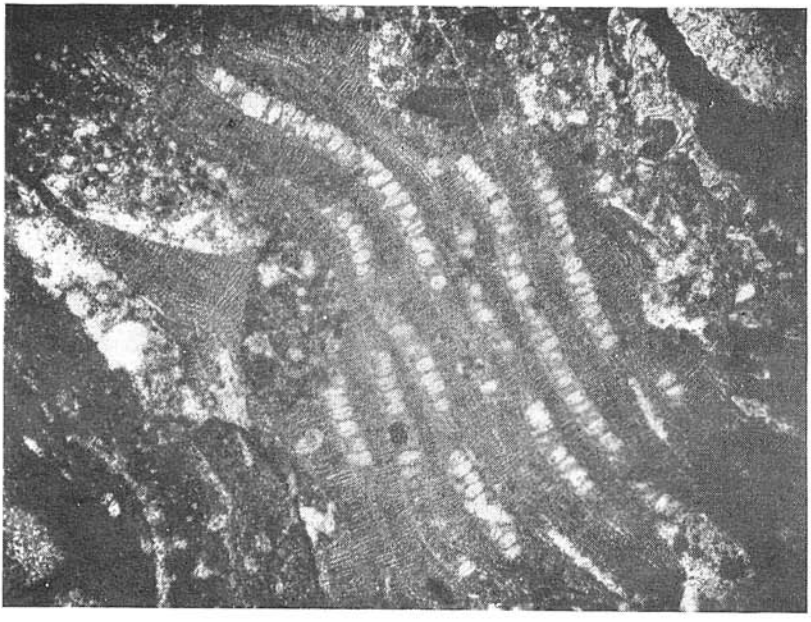
Fig. 1. *Lithophyllum mengaudi* Lemoine var *carpathica* Lemoine. Závodie near Žilina, KPUK (a) 0011 (slide Ac/261), x136. Fig. 2. *Lithophyllum densum* Lemoine, Hričovské Podhradie, KPUK (a) 0012 (slide No. 11), x136. Photo L. Osvald.

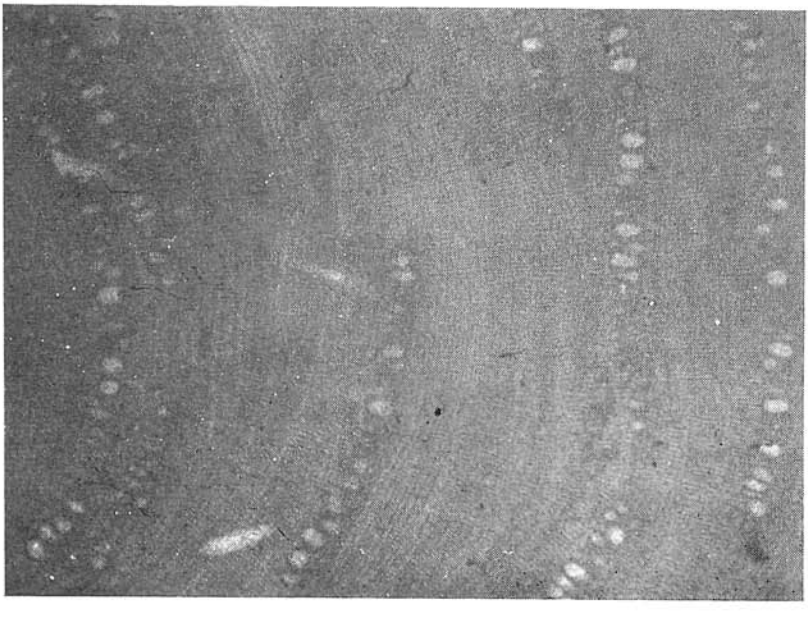
Pl. XIII

Fig. 1. *Lithophyllum carpathicum* Lemoine, Hričovské Podhradie, KPUK (a) 0013 (slide No. 46), x136. Fig. 2. *Corallina abundans* Lemoine, Hričovské Podhradie, KPUK (a) 0014 (slide No. 395), x136. Photo L. Osvald.

Pl. XIV

Fig. 1. *Jania nummulitica* Lemoine, Závodie near Žilina, KPUK (a) 0015 (slide Ac/262), x136. Fig. 2. *Distichoplax biserialis* (Dietrich) Pia, Brezovské pohorie, near the road east-south of elevation point 298,00, KPUK (a) 0016 (slide Ab/210), x136. Photo L. Osvald.





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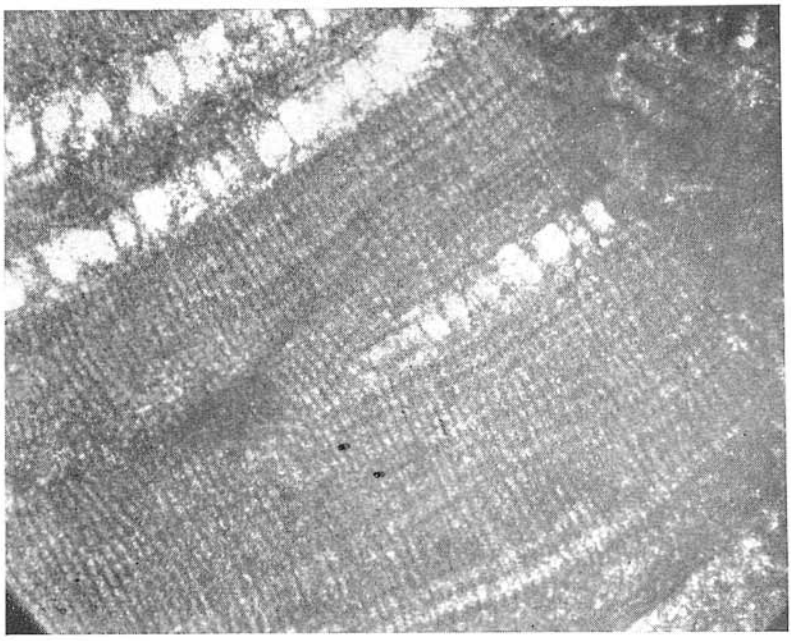

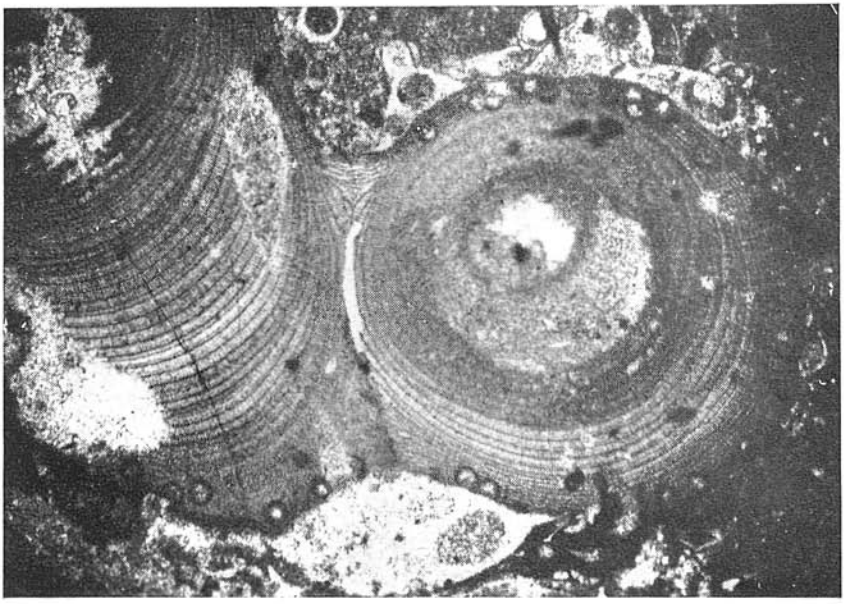

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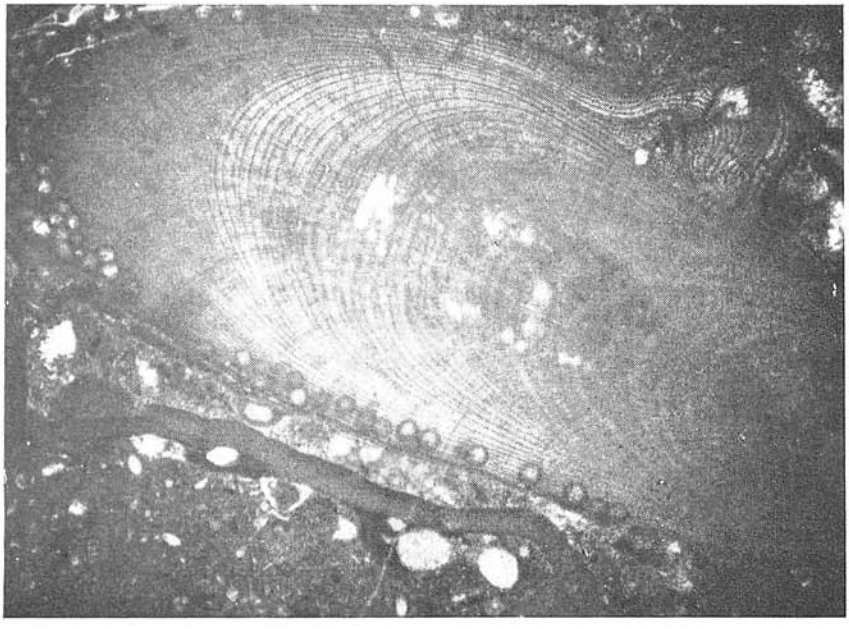

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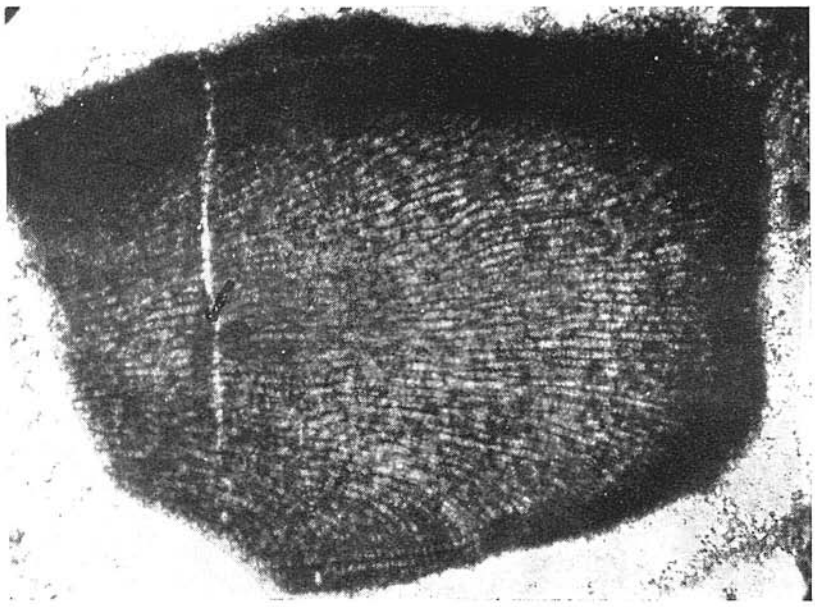

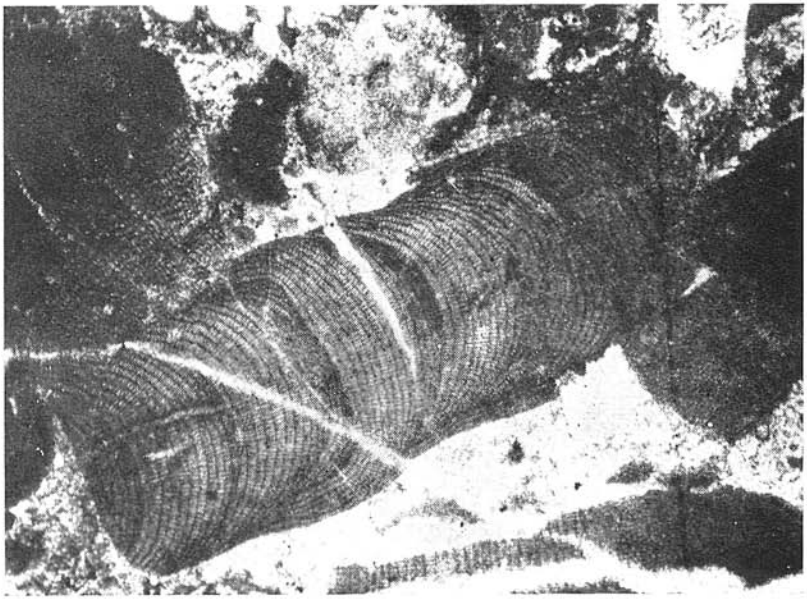

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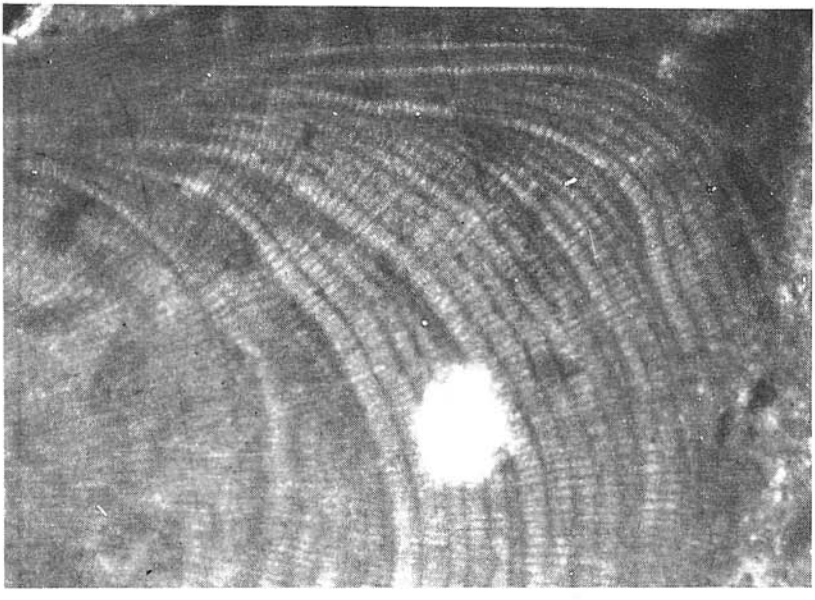

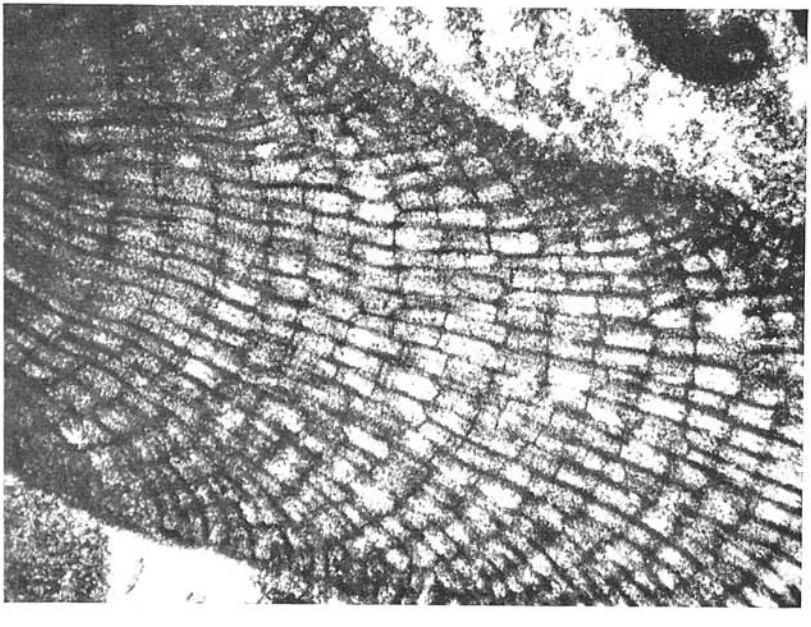

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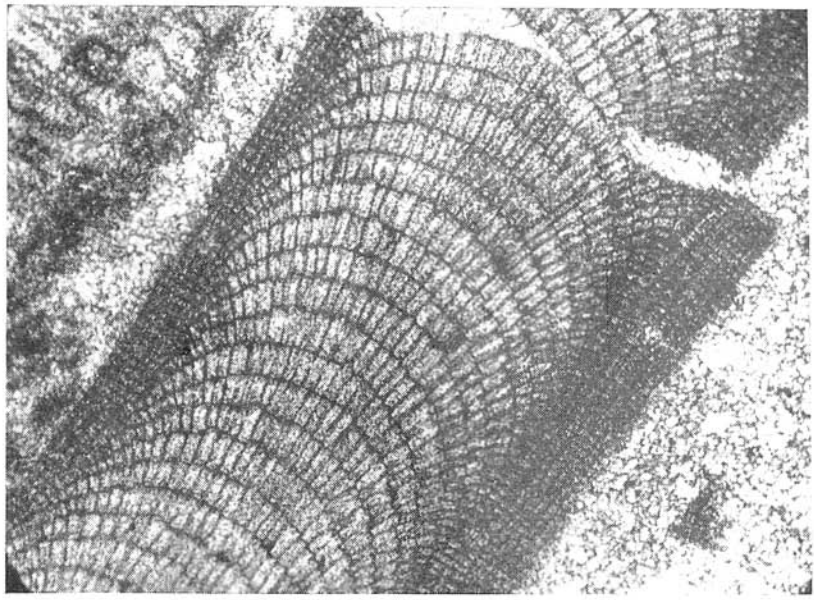

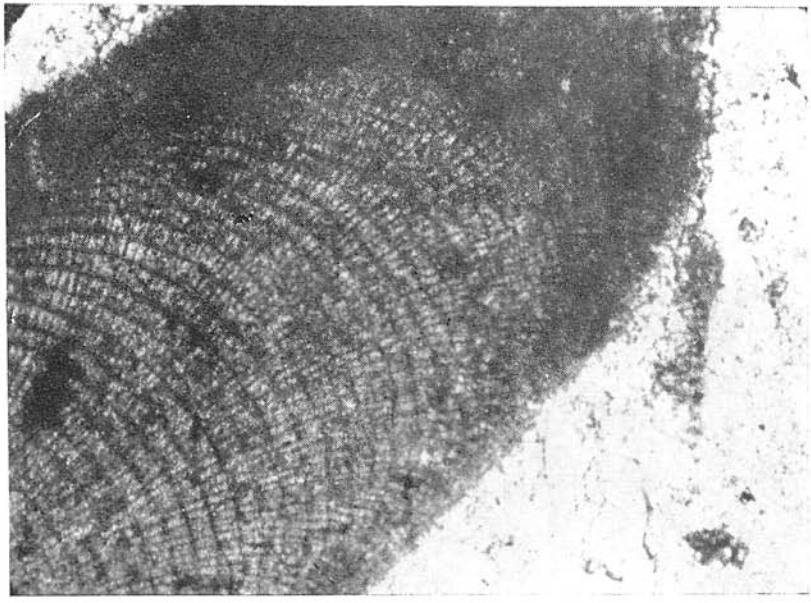

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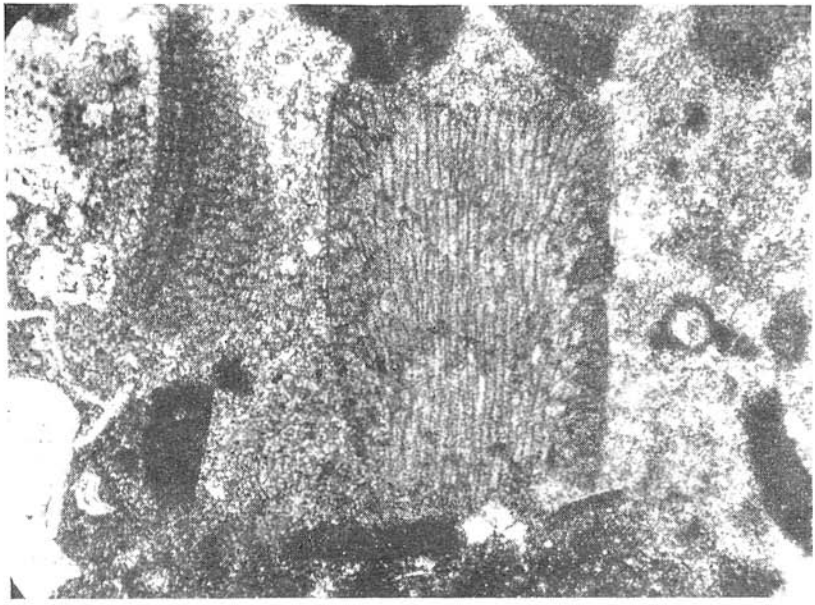

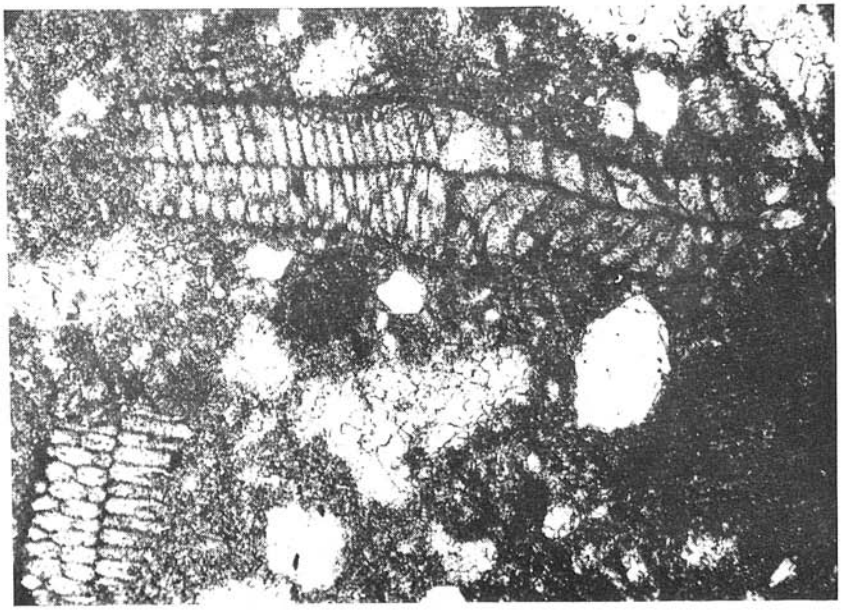

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