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NON-MARINE LOWER CRETACEOUS ALGAE AND CYANOBACTERIA FROM THE CZORSZTYN UNIT, WESTERN CARPATHIANS

OVIDIU DRAGASTAN[1] and MILAN MIŠÍK[2]

[1]Department of Geology and Paleontology, Faculty of Geology and Geophysics, University of Bucharest, Bd. N. Balcescu no.1, 70111 Bucharest, Romania
Department of Geology and Paleontology, Faculty of Science, Comenius University, Mlynská dolina, 842 l5 Bratislava, Slovak Republic

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Abstract: Rare non-marine, Lower Cretaceous algae belonging to genera *Broutinella* Freytet, *Plaziatella* Freytet, *Toutinella* Freytet, *Koeniguerella* Freytet and *Wallnerella* Freytet were described. New taxa are introduced: *Toutinella lednicae* n.sp., *T. freyteti* n.sp., *Wallnerella reticulata* n.sp., *Koeniguerella cretacea* n.sp., and *Dubrovnikiella slovakiensis* n.sp.

Key words: Lower Cretaceous, Western Carpathians, non-marine algae.

Introduction

The Czorsztyn Unit in the Pieniny Klippen Belt contains shallow-water limestone deposits comprising the span Middle Jurassic–Neocomian. They were deposited on a pelagic swell (Mišík 1994). Rare small hiatuses were considered as the submarine erosional breaks (Birkenmajer 1958). The total lack of the Barremian-Aptian sediments and the stratigraphic contact of Albian marly limestones with Upper Tithonian, Berriasian and also Middle Jurassic limestones indicates a large pre-Albian erosion during the emersion. The continental sediments with manganese residual ores and interesting association of non-marine algae with thalli and tubes-filaments partly filled by Mn-oxides, discovered recently will be described. From the point of paleo-algology, it is interesting that in spite of shallow-water facies of Jurassic-Lower Cretaceous sediments of the Czorsztyn Zone more than 400 km long, no marine algae occur in them (with the one exception of *Rivularia* sp. from neptunian dykes — Mišík & Sýkora 1993, Pl. I: Figs. 4, 5).

Geological setting

The described non-marine algae and cyanobacteria proceed from two localities with manganese ores Mikušovce and Lednica (Fig. 1).

Occurrences of manganese deposits in Mikušovce were known long ago (Andrusov et al. 1955, with older references). The manganese ores occur in two types: crusts of marine hardground nature in red pseudonodular limestones of Callovian–Oxfordian age and redeposited continental manganese accumulations in clefts and pockets of crinoidal limestones of Bajocian–Bathonian age.

Another small locality was recently discovered near the entrance to the ruin of Lednica Castle (6 km from Mikušovce) (Fig. 2).

The isolated rock 3 m high consists of pink Kimmeridgian-Lower Tithonian limestones with Saccocoma microfacies, contains three pockets 20–40 cm in diameter filled with Mn-oxides accumulations. In contrast to the rich microfauna of the surrounding Jurassic limestones, they include no marine organisms, only non-marine algae, some lithoclasts from the surrounding limestone and also a lithoclast of Lower Berriasian *Calpionella*-bearing limestone. A transgression of Albian on the Lower Berriasian limestome accompanied by pelecypod borings can be seen nearby.

At the locality of Mikušovce the filling consisting of manganese residual sediments contains insoluble residues like quartz grains, fragments of dedolomites, silcretes etc. As the whole succession is in an inverted position, the accumulation of residual ores had to take place before the tectonic paroxysm. Then the emersion with sporadic continental sediments deposited in small pools took place during the Barremian–Aptian, which is the most probable age for the described algae.

Paleoalgological description

Non-marine algae

Genus *Broutinella* Freytet l998
Broutinella ramulosa **Freytet l998**
(Fig. 3.l–3)

l998 *Broutinella ramulosa* n.sp. Freytet, p. l5, Plate IX l-j, Fig. 11.

Paratypes: Fig. 3.1–3, Lower Cretaceous. Thin section No. 24705, 1 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava.

Description: Thalli composed by groups of "shrubs" with very fine, internal laminations growing vertically and laterally. Some coarse laminations crossed by filaments of 4–10 μm,

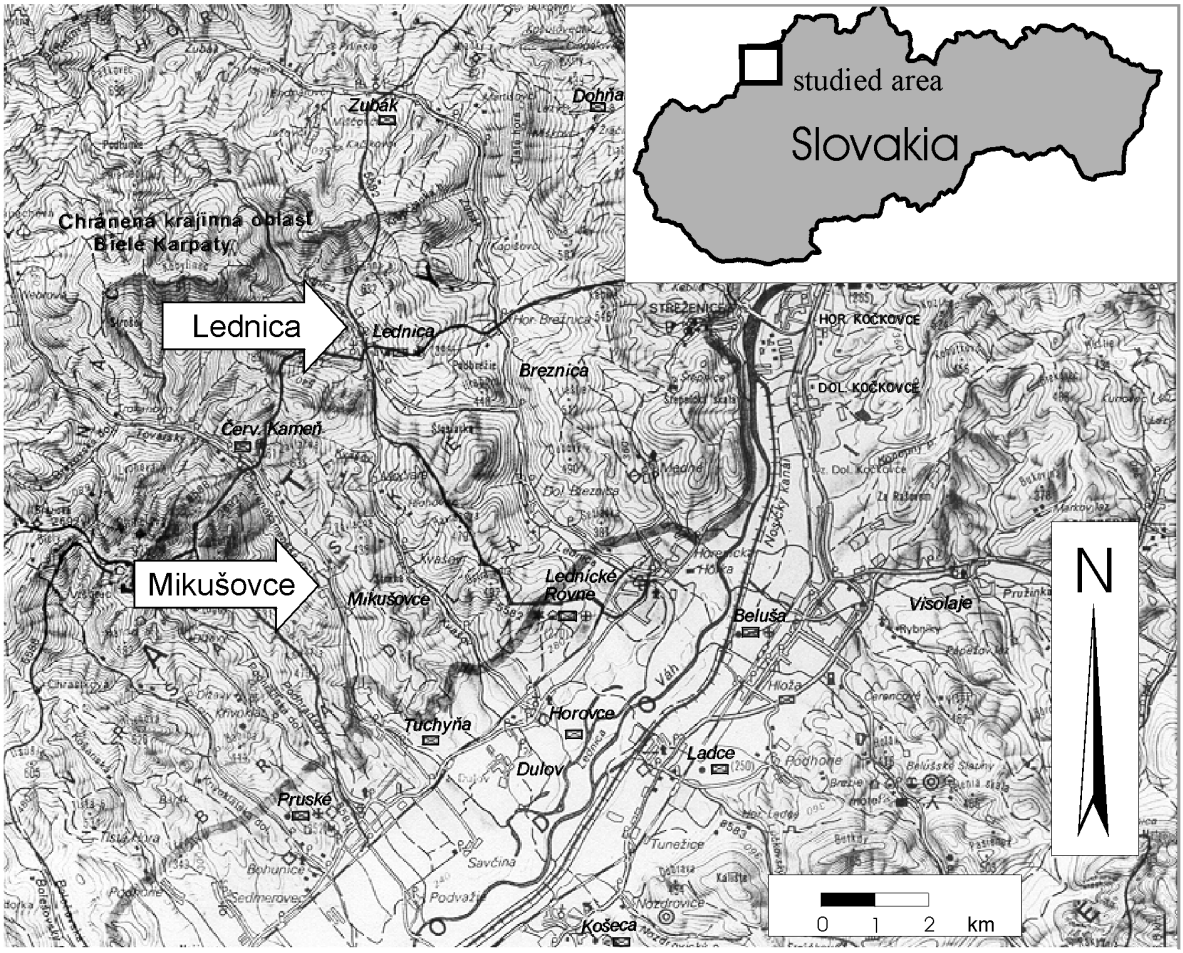


Fig. 1. Situation of localities with non-marine algae.

which have a radial fabric preserved in micrite (Fig. 3.3). The groups (=shrubs) reach 3–4 mm high and have branches 150–400 μm in diameter.

Discussion: Freytet (1998) observed that this species is rare, but proceeds from an encrustation of 1–2 cm on a branch mostly associated with very diverse forms of *Broutinella arvernensis*. The shrubs (branches) begin at the same level, have small or narrow bases growing up and overlapping each-other, composed to the top of the thallus of fan-shaped lobes. This kind of growth stimulates coarse sparitic laminations, more or less equal in rate of accumulation. The laminations follow a regular succession (Fig. 3.3). The micritic filaments have a radial fabric and crossed the central part of the shrubs. The spar-calcite is distributed in the periphery of the fan-shaped lobes.

The stratigraphical span of *Broutinella ramulosa* was from Lower Cretaceous to Oligocene (Freytet 1998).

Broutinella arvernensis f. *copiaesparitica* Freytet 1998
(Fig. 3.4)

1998 *Broutinella arvernensis* f. *copiaesparitica* n.sp. and n. forma Freytet, p.13, Pl.XII c–d–e.

Paratype: Fig. 3.4, Lower Cretaceous. Thin section No. 25657, 2 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Description: Thallus columnar, 4–8 mm high and 2–4 mm wide disposed at the base on *Plaziatella colleniaeformis* Freytet. The columnar edifice is crossed by fine filaments with 5–8 μm in diameter, more or less preserved only to the base or to the top of algal construction (Fig. 3.4). Due to the strong recrystallization the buildup is almost entirely sparitic in the case of forma *copiaesparitica* sensu Freytet 1998.

The lamination is not so clear, sometimes micrite-spots like small inclusions are preserved. The layers making continous, planar mini-folded "beds".

The species has a large variability of "forms", and some difficult to designate or to interpret irregularities of growth.

Discussion: *Broutinella arvernensis* Freytet is the main organism of the ministromatolitic buildups, together with other alga, *Plaziatella colleniaeformis* Freytet forming different "stages" of accumulation at the surface of lamination sets.

This species-form could be an indicator of the environment controlled at the proximity of the water surface, in a flat lacustrine area.

The species was described by Freytet from the Limagne d'Allier, Central France, Oligocene. Recently, it was also identified in the Serpulit Formation (Berriasian) of Weserbergland, NW Germany by Dragastan & Richter (2001).

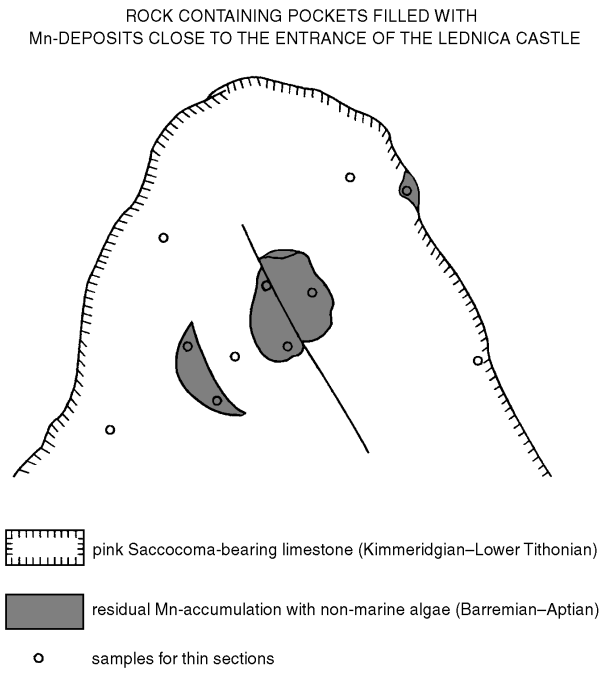


Fig. 2. Rock containing pockets filled with Mn-deposits close to the entrance of Lednica Castle.

Genus *Plaziatella* Freytet 1998
Plaziatella colleniaeformis **Freytet 1998**
(Fig. 3.5)

1998 *Plaziatella colleniaeformis* n.sp. Freytet, p. 9, Pl. IX g–h–i and Pl. X a–c, Fig. 10 a–e.

Paratype: Fig. 3.5, Lower Cretaceous. Thin section No. 25657, 2 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Description: Thallus calcareous resembling the form of stromatolite *Collenia*. It is disposed on the base of *Broutinella arvernensis* buildups (Fig. 3.5). Each micritic layer corresponds to one lamina and the superimposition of several laminae take the aspect of *Collenia*.

The filaments 5–10–15 μm in diameter preserved like micrite-inclusions and small fenestrae (Fig. 3.4f). The last ones interpretable as the beginning of differenciation of fascicles.

Discussion: *Plaziatella colleniaeformis* Freytet is responsable for lamination of *Collenia* type in hypo- or hypersaline waters (Freytet 1998). In living laminated tufas *Plaziatella* presents various assemblages of *Schizothrix* (*pulvinata*, *fasciculata*), *Pleurocapsa* or other Cyanophytes, Chlorophytes, desmids and diatoms.

This species is frequently associated with *Broutinella arvernensis* on the base of buildup (Fig. 3.4).

The stratigraphic range of *Plaziatella colleniaeformis* is from Permian to Recent. In the molassic series of Upper Cretaceous–Eocene from Languedoc and Provence this species occurs in association with *Broutinella,* being found also in fluvial oncolites (Freytet 1998).

Genus *Toutinella* Freytet 1997
Toutinella lednicae n.sp.
(Fig. 3.6 and Fig. 5.7–9)

Derivatio nominis: from type locality Lednica, Slovakia.

Holotype: Fig. 5.7, Lower Cretaceous. Thin section No. 25454, 3 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Isotypes: Fig. 3.6; Fig. 5.8–9, Lower Cretaceous. Thin section No. 25454, 3 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Diagnosis: Thallus composed of small, digitiform branched bushes, parallel to each other crossed by dichotomic branched filaments, sometimes like *Ortonella*, closely packed with microcrystalline calcite filling and thin, white sparite coating. Filaments disposed in small fascicles. The transverse section never circular, but petaloid or oval-ellipsoidal.

Description: Thallus: branched, formed by finger like small columns like growing bushes. Filaments mostly dichotomic branched like *Ortonella* with larger diameter in the distal parts. In the transverse section the filaments show a petaloid shape (Fig. 5.9). Two or four filaments grouped in fascicles.

Dimensions in mm:

Height of thallus (H) — 2.0–3.0; width of thallus (W) — 3.0–4.0; height of finger-branch (h) — 2.0–2.2; width of finger branch (w) — 0.60–0.80; diameter of filaments: proximal (dp) — 0.010; distal (dd) — 0.015–0.020; diameter of fascicles (df) — 0.050–0.15.

Discussion: *Toutinella lednicae* n.sp. can be compared with *T. hispanica* Freytet 1997 from the Miocene of Spain. Differs from this species by the reduced number of filaments (2–4) grouped in fascicles, by sparitic coating and a petaloid shape in transversal section. The initial needles of calcite coatings recrystallized to blocky sparite crystals as in thermal springs, hypersaline waters or in fluviatile deposits.

The taxonomical status of *Toutinella* remain open, Cyanophyceae (*Schizothrix*) or Rhodophyceae/Phaeophyceae.

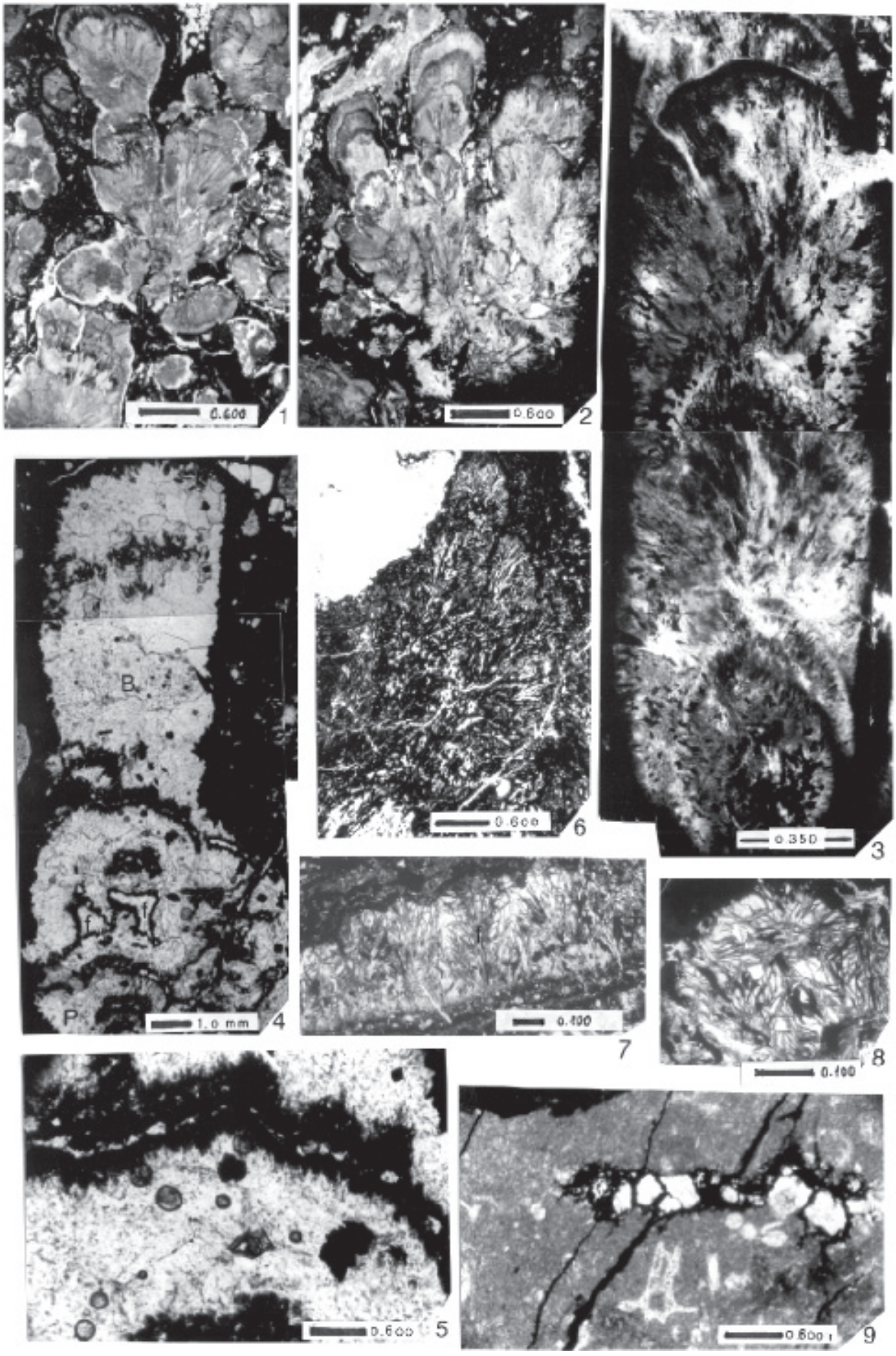
Toutinella freyteti n.sp.
(Fig. 4.1–8)

Derivatio nominis: Species dedicated to Pierre Freytet for his important contributions to the knowledge of non-marine algae from the Phanerozoic.

Holotype: Fig. 4.1 (H on the right side of the photo), Lower Cretaceous. Thin section No. 25454, 3 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Isotypes: Fig. 4.2–8, Lower Cretaceous. Thin sections No. 25454 and No. 24907, 4 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Diagnosis: Thallus formed by large, columnar edifices, mostly branched including fan-shaped bushes. The bushes are crossed by dichotomic branched filaments, large in diameter making fascicles with over 6 filaments. The filaments and fascicles filled with microcrystalline calcite, sometime large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sparitic area marked by subrhombic or rhombic crystals as "coating".

Description: Thallus erected, vertical, composed of columnar, large, fan-shaped bushes (Fig. 4.l,2,6). Each columnar branch is crossed by dichotomic filaments filled with microcrystalline calcite. The filaments are coated with thick layer of sparite included in large, subconical fascicles. Over 6 filaments in each fascicle. The fascicles (Fig. 4.3f) consist of subrhombic or rhombic large crystal of calcite (Fig. 4.5).

In the transverse section the columnar branch has an irregular, triangular shape (Fig. 4.5).

Dimensions in mm:

H — 3.0–4.0; W — 3.0–5.0; h — 2.0–4.0; w — l.0–l.5; dp — 0.005–0.0l0; dd — 0.0l5; df — 0.20–0.35.

Discussion: *Toutinella freyteti* n.sp. is close to *T. lednicae* n.sp., but differs by the large columnar branches, subconical shape of fascicles and many filaments grouped in fascicles.

The new species can also be compared with *T. sardiniana* f. *conica* Freytet from the Permian of Sardinia which show fascicles of fan-like shape.

Toutinella freyteti n.sp. was found together with *Wallnerella reticulata* n.sp., the last one disposed on the base of *Toutinella* thallus (Fig. 4.5W).

Fig. 3. l–3 — *Broutinella ramulosa* Freytet 1998; l–2 — Thalli in vertical sections, composed by groups of "shrubs" with internal laminations crossed by fine filaments with a radial disposition; 3 — enlarged thallus-shrub with coarse lamination crossed by filaments preserved in micrite and some parts in sparite. Thin section No. 24705, Lednica. **4–5** — *Broutinella arvernensis* Freytet l998 (B) and to the base *Plaziatella colleniaeformis* Freytet 1998 (P); 4 — *B. arvernensis* f. *copiaesparitica* Freytet 1998; thallus erect-digitate, columnar with sparitic laminae and some dark micritic area of simple or bifurcate short filaments. This species is the main organism of the stromatolitic buildups from the Lednica area. Thin section No. 25675; 5 — *Plaziatella colleniaeformis* Freytet 1998, thallus disposed to the base of *Broutinella arvernensis* (see Fig. 4). It is possible to see alternative distribution between planar, undulating micritic layer (one lamination) and the superimposition of several sparitic laminations similar in aspect to *Collenia*, Mikušovce. Thin section No. 25675, small "fenestrae" occur interpretable as beginning of fascicles. **6** — *Toutinella lednicae* n.sp. Isotype. Thallus erect-digitiform strongly branched, crossed by fine filaments grouped in fascicles, Lednica. Thin section No. 25454. **7–8** — *Wallnerella reticulata* n.sp.; 7 — Holotype. Thin section No. 25666/ns — thallus crustose composed of branched filaments between trangular, rhombic or subrhombic crystals of sparite in a reticulum of successive generations of fascicles; 8 — Cross-section, thallus with characteristic pattern distribution of sparite fascicles in four rhomboidal network fascicles. Isotype. Thin section No. 25666, non-marine algae in the residual manganolite, filling a pocket in Kimmeridgian-Lower Tithonian limestone, Czorsztyn Succession, Pieniny Klippen Belt, Lednica. **9** — Micritic limestone with articles and plates of *Saccocoma* and brecciated pocket filled with residual manganolite, Kimmeridgian–Lower Tithonian. Thin section No. 25453, Lednica.

All holotypes and isotypes deposited in Coll. Department of Geology & Paleontology, Faculty of Science, J.A.Comenius University, Bratislava, Slovakia.

Genus *Wallnerella* Freytet l997
Wallnerella reticulata n.sp.
(Fig. 3.7–8)

Derivatio nominis: "reticulata" from the disposition like a network of crystals between the filament-fascicles.

Holotype: Fig. 3.7, Lower Cretaceous. Thin section No. 25666, Czorsztyn Succession, Pieniny Klippen Belt, Lednica, Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Isotype: Fig. 3.8, Lower Cretaceous. Thin section No. 25666, Czorsztyn Succession, Pienniny Klippen Belt, Lednica, Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Diagnosis: Thallus, crustose-lamellar, crossed by very fine filaments grouped in fascicles (Fig. 3.7f). The filaments preserved in a mass of coarsely crystalline calcite, variable in shape. In transverse section the shape of thallus-crust is circular and the fascicles are radially disposed (Fig. 3.8).

Description: Thallus lamellar, crustose, the upper part wavy-undulose, formed by very fine filaments grouped in large, vertical fan-shaped fascicles (Fig. 3.7f). The filament-fascicles mostly preserved in blocky calcite crystals (light sparite) and have different shape and sizes (Fig. 3.8). In the transverse section the shape of thallus crust is circular and the filament-fascicles are disposed radially (Fig. 3.8).

Dimensions in mm:

Height of thallus crust (H) — 1.67–2.00; width of thallus crust (W) — 1.08–1.40; diameter of filaments (df) — 0.004; diameter of fascicles (dfa) — 0.27.

Discussion: *Wallnerella reticulata* n.sp. is comparable with *W. fascinans* Freytet l997 from subfossil tufa of Baume-les-Messieurs, Jura. The new species differs by the shape of its filament fascicles, by missing of successive generations of fascicles, the variable sizes and shape of calcite crystals and no states of growth.

In subfossil samples, *Wallnerella* is in an intense, early diagenetic stage which affects the edifices of *Oocardium* (Freytet 1997).

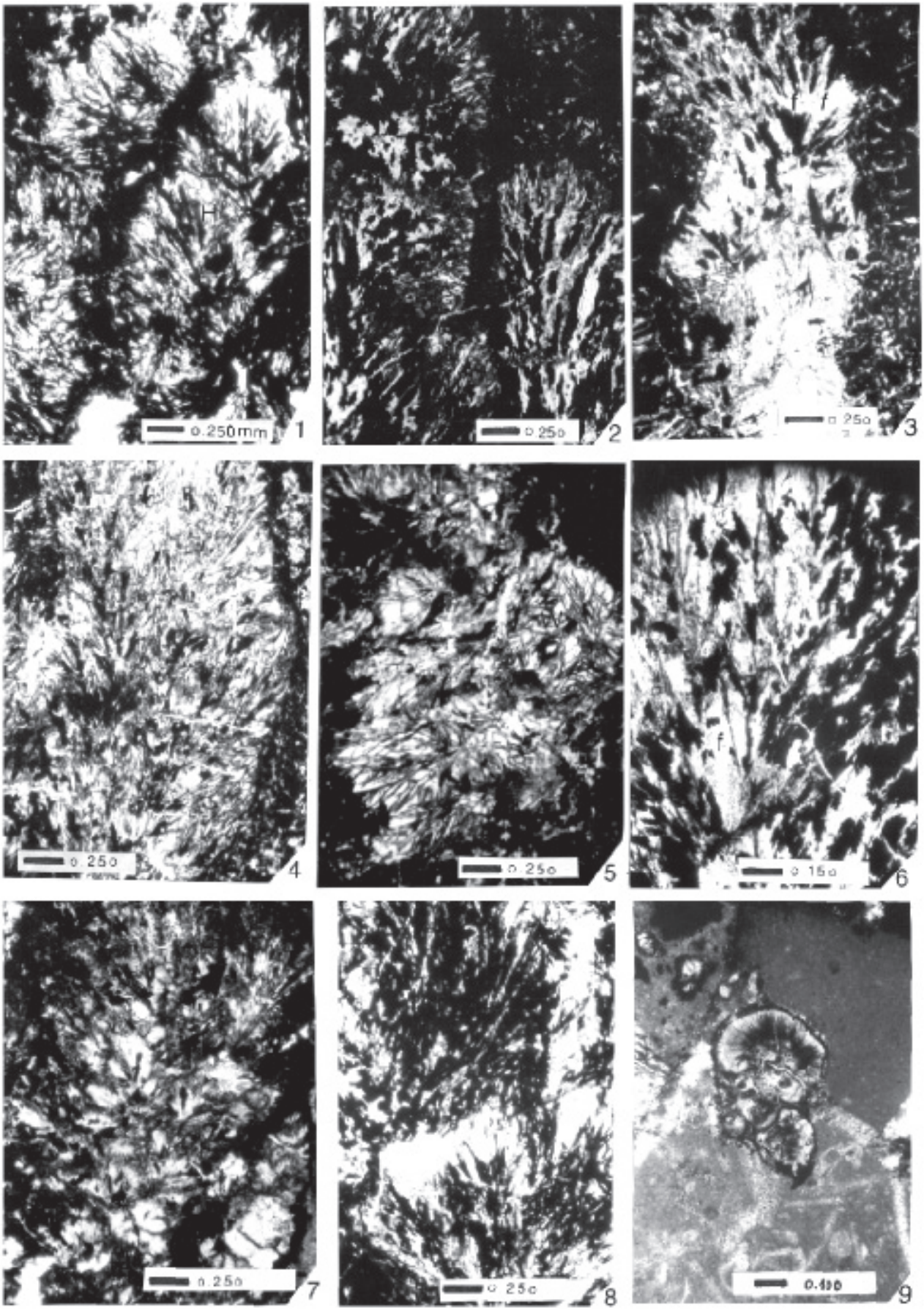
Genus *Koeniguerella* Freytet 1997
Koeniguerella alpina f. *compacta* **Freytet 1997**
(Fig. 4.9)

1997 *Koeniguerella alpina* f. *compacta* n.sp.n. forma — Freytet, p. 317, Pl. Va,b,c (1).

Paratype: Fig. 4.9, Lower Cretaceous, Mikušovce. Thin section No. 25491, 5 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Description: Thallus bulbous, fan shaped, crossed by rectilinear fine filaments, 5–l0 μm in diameter grouped in jet-triangular fascicles, l50–200 μm in diameter to the distal part. The fascicles only of the first order, very compact or packed.

Dimensions in mm: width of the thallus (W) — 0.34; diameter of filaments (df) — 0.0015.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9

Discussion: Freytet (1997) described this species as subfossil and living on moss tufa from Fôret de Saou (Drôme). We found this species in the brown matrix of carbonate breccia (predominantly Oxfordian and Kimmeridgian limestone cherts) in Mikušovce area, near the refuse pile of a gallery prospecting for manganese ore.

Koeniguerella cretacea n.sp.
(Fig. 5.1–3)

Derivatio nominis: from Cretaceous deposits.

Holotype: Fig. 5.3, Lower Cretaceous. Thin section No. 25657, Mikušovce, 2 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Isotypes: Fig. 5.l–2, Lower Cretaceous. Thin section No. 25657, Mikušovce, 2 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Diagnosis: Thallus fasciculate, composed of fan-shaped bushes. Each bush is crossed by a group of dichotomic filaments lined more or less by a sparitic coating. The filaments are disposed in triangular fascicles, in the proximal part they have a punctiform base, becoming larger in the distal part. The filament fascicles disposed bilateral along the axis of the bush.

Description: Thallus built by fan-shaped bushes flaring to the distal margin. Thallus-fasciculate crossed by fine, dichotomic filaments grouped in fascicles. The fascicles have a narrow base becoming triangular in shape to the distal end (Fig. 5.3f). The filament fascicles disposed symmetrical and bilateral along the main axis of the bush. The filaments, dichotomic branched are small in diameter, fine and parallel to each other. The filaments are filled by microcrystalline calcite and more or less with a sparitic coating (Fig. 5.2).

Dimensions in mm:

Height of fan-shaped bush (Hb) — 0.60–0.80; width of fan-shaped bush (Wb) — to the base — 0.35–0.40; diameter of the fascicles: at the base — 0.030–0.050; at the distal part (dd) — 0.30–0.40; diameter of filaments (df) — 0.005–0.0l0.

Discussion: *Koeniguerella cretacea* n.sp. is comparable with *K. marocana* Freytet and *K. pyrenaica* Freytet, first a subfossil and second a living species.

K. marocana show lanceolate fascicles forming "elementary colonies compact or lobate rounded" sensu Freytet (l997).

The second species *K. pyrenaica* differs also by the filaments fascicles, more or less rounded in shape.

Freytet (1997) argued that "the distinction between the diverse species of *Koeniguerella* (*alpina, fruticosa, robusta, pyrenaica, marocana, sequanensis*) is based on the filament diameter, the size and the shape of elementary fascicles".

The stratigraphical span of the genus *Koeniguerella* is Pliocene to Recent (Freytet 1997).

The taxonomic position of different species of *Koeniguerella* (*alpina, pyrenaica* and *marocana*) are "certainly different forms of growth of *Oocardium stratum*" probably related to a particular environment, chironomid tufa, moss tufa, submerged substrate or seeping (Freytet l997).

The other species, *K. sequanensis* and *K. robusta* could be attributed to Chetophorales, like species of *Gongrosira*, or to other Chlorophyceae and even Cyanophyceae (Freytet l997).

Genus *Dubrovnikiella* Dragastan 1990
Dubrovnikiella slovakiensis n.sp.
(Fig. 5.4–6)

Derivatio nominis: from Slovakia.

Holotype: Fig. 5.4 (specimen with H), Lower Cretaceous. Thin section No. 25657, 2 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Isotypes: Fig. 5.5–6, Lower Cretaceous. Thin section No. 25657, 2 Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovak Republic.

Diagnosis: Thallus formed by small bushes, quadrangular in shape having an "emtpy" hollow filled by sparite (Fig. 5.4). The bushes have a disposition between them at different angles (40–90°). Each bush consists of two kinds of filaments: trichotomic, subrhomboidal (Fig. 5.4bt) and dichotomic (bifurcate), filiform, small in diameter (Fig. 5.4bd), which do not start from the trichotomic filaments.

Description: Thallus irregular in shape, composed of quadrangular bushes crossed in central part by a large cavity (Fig. 5.4–6). The "emtpy" hollow filled with sparite has an irregular tubular shape. The bushes show a basal part, equal with the distal ones. The bushes on the both sides present thin filiform filaments, small in diameter. The filaments consist of two types: trichotomic and dichotomic successive branched filaments, mostly preserved in sparite (Fig. 5.4). The bushes disposed at different angle varying from 40° to 90°.

Dimensions in mm:

Heigth of the bush (H) — 00.50–0.60; width of the bush (W) — 0.30–0.35; diameter of cavity (c) — 0.060–0.080; diameter of filaments: base of trichotomic filaments (dbt) —

Fig. 4. l–8 — *Toutinella freyteti* n.sp.; 1 — Holotype (H in the right side of the photo). Thin section No. 25454, thallus, branched, formed by several bushes crossed by radiating filaments grouped in fascicle, strongly calcified; 2 — Isotype. Axial-vertical section showing the micritic dichotomic branched filaments and the spar coating; 3–4, 6–8 — Isotypes. Thalli in vertical or oblique sections, the filaments grouped in fascicles; 5 — Isotype. Oblique cross-section with distribution of filaments (micritic) and strong spar crystals as coating. In the right corner of the photo *Wallnerella reticulata* (W). **9** — *Koeniguerella alpina* f. *compacta* Freytet 1997; thallus hemispherical built by very packed triangular fascicles in a brown matrix of carbonate breccia (predominantly of Oxfordian and Kimmeridgian limestone cherts). Thin section No. 25491, Mikušovce, close to the refuse pile of a gallery for prospecting manganese ore.

All holotypes and isotypes deposited in Coll. Department of Geology & Paleontology, Faculty of Science, J.A.Comenius University, Bratislava, Slovakia.

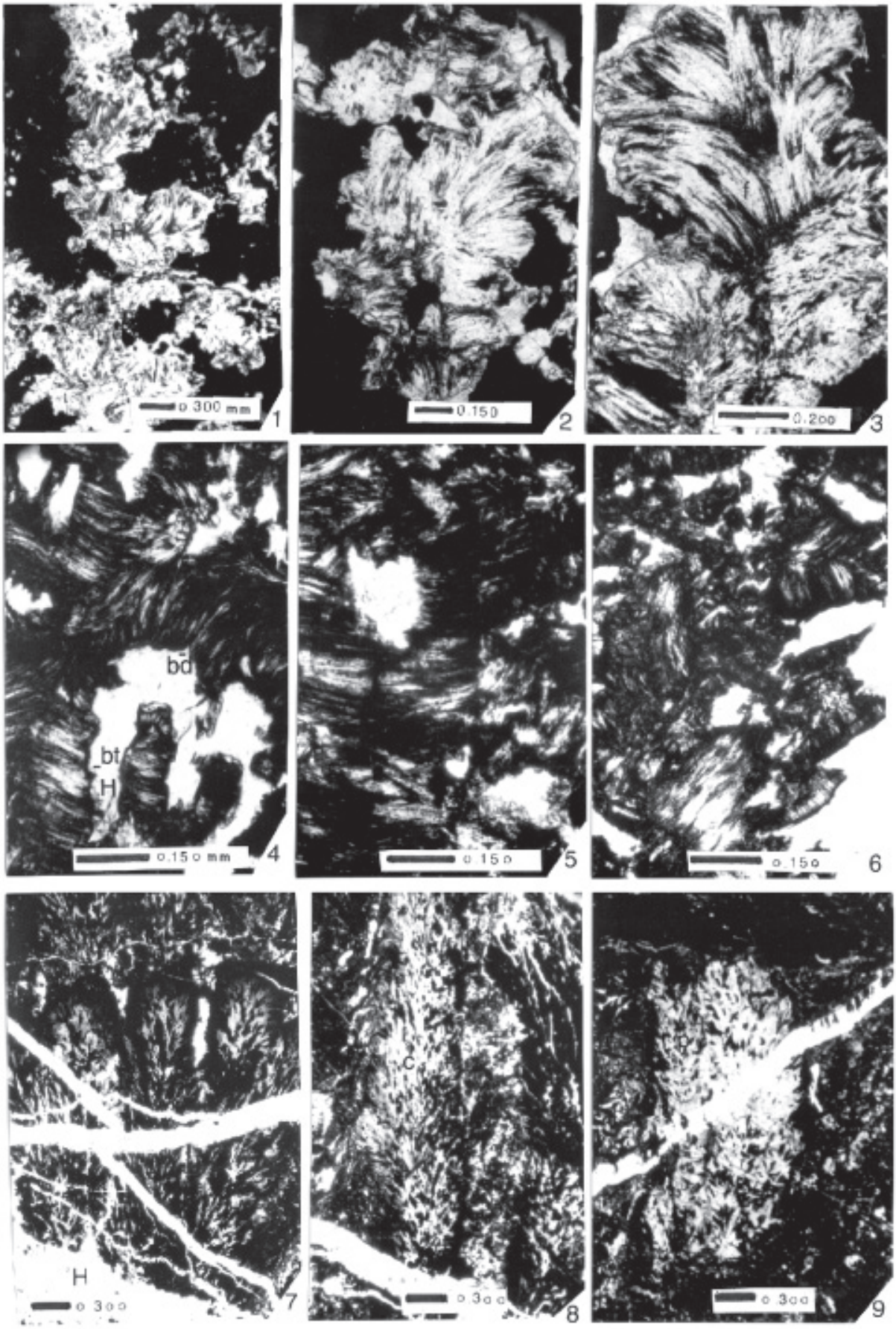
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Fig. 5. 1–3 — *Koeniguerella cretacea* n.sp.; 3 — Holotype. Thin section No. 25657. Thallus composed of the fan-shaped bushes crossed by dichotomic filaments grouped in long fascicles (f) disposed bilaterally along the axis; 1–2 — Isotypes at 1 in the middle of photo the holotype. Thalli and small fan-shaped bushes; 3 — Replaced by gypsum. **4–6** — *Dubrovnikiella slovakiensis* n.sp.; 4 — Holotype. Thin section No. 25657. Thallus built by quadrangular small bushes disposed between them at angles of 40–90°. Bushes crossed by two kind of filaments, trichotomic (bt) and dichotomic (bd); 5–6 — Isotypes. Thin section No. 25657. Thalli bushes with different angles of disposition, central cavity and filaments disposed bilaterally along the axis. **7–9** — *Toutinella lednicae* n.sp.; 7 — Holotype. Thin section No. 25454. Thallus delicate, digitiform, closely branched crossed by filament fascicles in successive manner, axial vertical section; 8 — Isotype. Tangential section in two finger branches showing the micritic filaments and the sparitic coating of fascicles (c); 9 — Isotype. Thin section No. 25454, cross-section in thallus colonies.

All holotypes and isotypes deposited in Coll. Department of Geology and Paleontology, Faculty of Science, J.A. Comenius University, Bratislava, Slovakia.

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0.040; diameter after branching (dbr) — 0.020 and in the distal part (dd) — 0.010; diameter of dichotomic filament (df) — 0.010; angles between bushes 40–90°.

Discussion: *Dubrovnikiella slovakiensis* n.sp. from the Lower Cretaceous non-marine facies is comparable with *D. illyrica* Dragastan 1990 described from the Neocomian marine limestone of Dubrovnik (Croatia). It differs from the marine species by a different shape of the bushes, a different mode of disposition of filaments and lack of continuation between trichotomic and dichotomic filaments like in marine species. The bushes present a central "emtpy" hollow filled with sparite. Could be a Chlorophycean alga.

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