

Myxomycetes in Bohemian Karst and Hřebeny Mts.

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Data on species composition and ecology of Myxomycetes are presented for three National Reserves in the Bohemian Karst and the northern part of Hřebeny Mountains.

During a period of three years, all localities were investigated intensively. In addition to field collections, bark of living trees, twigs and dead leaves were cultivated in moist chambers. Specimens from the National Museum in Prague were revised. Ninety-five species of Myxomycetes belonging to 29 genera were registered with certainty, 17 of these new to the Czech Republic. Species descriptions are provided for newly recorded species including microhabitat preferences. Differences between species diversity in the Bohemian Karst and Hřebeny Mts. are discussed as well as the seasonal dynamics of Myxomycetes in Central European conditions.

Key words: Myxomycetes, Bohemian Karst, Hřebeny Mts., Species diversity, Moist chamber culture

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V letech 1996–1999 probíhal průzkum myxomycetů (hlenek) v NPR Karlštejn, Koda a Radotínské údolí a v severní části Hřebenů. Vedle sběru v terénu a revize herbářových položek v Národním muzeu v Praze byla využita metoda kultivace hlenek ve vlhkých komůrkách. Je uveden přehled 95 zastoupených druhů hlenek patřících do 29 rodů spolu s popisem a podrobnějšími údaji k 17 druhům novým pro ČR. Dále jsou diskutovány rozdíly v zastoupení druhů v Českém krasu a na Hřebenech a sezónní dynamika hlenek ve středoevropských podmínkách.

INTRODUCTION

In the last 110 years little attention has been paid to Myxomycetes in the Czech Republic. Čelakovský's study on Czech Myxomycetes (Čelakovský 1890), focusing mainly on Western Bohemia, left a relatively large collection of Myxomycetes in the National Museum in Prague (PRM). This collection was further enlarged with material from Svrček (1959–1972) and Wichanský (1962–1968). Cejp (1962) reported 150 species of Myxomycetes from Western and Central Bohemia, leaving part of his material in the Herbarium of Charles University in Prague (PRC). Svrček (1972) also cultivated 12 species of Myxomycetes on bark of living trees in moist chambers. Vondrová (1991) reported 6 species from moist chamber cultures. Thus, until 1996, a total of 188 species of Myxomycetes were reported from the Czech Republic.

During the years 1996–1999 the author studied Myxomycetes in two relatively different localities near Prague (Hřebený Mts. and Bohemian Karst Protected Landscape Area). An intensive survey of all suitable microhabitats was carried out. The main tasks of the work were:

revealing the species diversity

contributing to the knowledge of Myxomycetes ecology in Central European conditions.

comparing the spectrum of Myxomycetes in two areas with different geological structures (especially whether the limestone base in the Bohemian Karst influences the presence of the order *Physarales*)

STUDY AREA

Bohemian Karst Protected Landscape Area is a hilly area situated in central Bohemia to the south-west of Prague, touching the valley of the Berounka River between the capital and the town of Beroun. Elevation above sea level: 208–499 m. It is characterised by a moderately warm and dry climate with a low level of precipitation (500–550 mm). The mean annual temperature varies between 8 and 9 °C.

A limestone base, forming a considerable part of the geological structure, is broken by karst canyons and drilled through by caves. Due to extreme geomorphological conditions and the limestone base a wide variety of ecosystems occur (forest steppes with *Quercus pubescens*, calciphilous beechwoods, thermophilous mixed oak woods, slope forests etc.)

For this study, the three largest Nature Reserves were chosen – Karlštejn (49°57'N., 14°9'E.), Koda (49°56'N., 14°6'E.) and Radotínské valley (49°59'N., 14°18'E.) with a total area of c.21 km² (see Fig. 1).

Hřebený Mts. are the N-E part of the Brdy Mts., representing the largest complex of woodland in the neighbourhood of Prague. The maximum height above sea level reaches 600 m. It is also characterised by a moderately warm, quite dry climate with a low level of precipitation (550–610 mm). The mean annual temperature is 7–8 °C.

The northern part consists mainly of Ordovician quartzite. On the top parts and slopes the remnants of the original forest cover can still be found (woodrush and herb-rich beech forests, oak-hornbeam woods). Spruce forests or pinewood monocultures cover most of the area today, but large old oak or beech stumps are also present.

For the purpose of this study the northern part of Hřebený Mts. of a size comparable to the study area in the Bohemian Karst was chosen (49°54'N., 14°16'E.). The survey was concentrated especially on deep valleys and gorges of streams with plenty of decaying wood and high humidity. Material for moist chamber cultures was collected from the whole area studied (see Fig. 1).



Fig. 1. Map of the area studied. Forested areas are marked with grey, localities of interest are striped and numbered: 1 = Karlštejn Nature Reserve, 2 = Koda Nature Reserve, 3 = Radotínské valley Nature Reserve, 4 = Northern part of Hřebeny Mts.

MATERIAL AND METHODS

The fieldwork was carried out for 3 years, from July 1996 till May 1999, and included moist chamber experiments. All localities were visited regularly during the year, approximately once a month or more often in the season. Common and easily recognised myxomycete species were collected only occasionally, but rare species and species not easy to recognise in the field were always collected. Specimens collected by M. Svrček, E. Wichanský, J. Baier, V. Eckert, R. Fellner, B. Ježek, J. Nitka, A. Pilát, R. Škvrně, V. Vacek and S. Vondrová on the localities studied, deposited in the Mycological Herbarium of the National Museum in Prague (PRM), were also included in the study.

Samples for the moist chamber cultures were taken from bark of living and dead trees (up to 1.5 m high) and from litter (leaves, needles and twigs) of each tree species present. A total of 250 moist chamber cultures were cultivated. Cultures were prepared as described by Härkönen (1977, 1983), kept in a klimabox at a temperature of 19–22 °C and c.75 % humidity, illuminated artificially in a 12:12 light:dark cycle. The cultures were moistened with distilled water adjusted with KOH to pH 7. Moist chambers were first examined after 24 hours and then every second or third day under a dissecting microscope for about 5 weeks. Chambers with no or very few Myxomycetes developed were let to dry and after 6–8 weeks rewetted and cultivated once again.

From most of the collections, sporocarps were preserved as permanent slides in lactophenol or Hoyer medium (Nannenga-Bremekamp 1991). Specimens of Myxomycetes collected in the field or obtained from the moist chamber cultures were deposited in the herbarium at the Department of Botany, Faculty of Nature Science of Charles University in Prague (PRC), and in the personal collection of the author.

The abundance was estimated with a simple scale proposed by Stephenson et al. (1993), based on the proportion of records for one species on all fructifications recorded in the survey: R (rare <0.5%), O (occasional 0.5–1.5%), C (common 1.5–3%), A (abundant >3%). The geographical distribution of species is provided according to Nannenga-Bremekamp (1991) and Neubert et al. (1993, 1995).

RESULTS

In total 813 specimens were studied. Out of these, 340 were collected in the field, 362 were harvested from moist chamber cultures and 99 were found in the Mycological Herbarium of the National Museum in Prague (PRM). Twelve specimens were kindly lent by M. Svrček from his personal herbarium. Thirty-two specimens from the moist chamber cultures were not mature or developed enough to be identified with certainty and were not included in further results.

The collections comprised 95 species, including 17 new to the Czech Republic¹⁾ and one seemingly undescribed (*Didymium* cf. *squamulosum*). The species were identified according to Martin and Alexopoulos (1969), Lado and Pando (1997), Nannenga-Bremekamp (1991), Neubert et al. (1993, 1995) and Ing (1999).

Table 1. shows all recorded species in alphabetical order, their occurrence on localities studied and estimated abundance.

Table 1. Occurrence and abundance estimations of all species and varieties of Myxomycetes recorded on localities studied. Those new to the Czech Republic are marked *. (R = rare, O = occasional, C = common, A = abundant).

species	Hřebený Mts.	Bohemian Karst	abundance
<i>Arcyria affinis</i> Rostaf.	+	+	R
<i>Arcyria cinerea</i> (Bull.) Pers.	+	+	A
<i>Arcyria denudata</i> (L.) Wettst.	+	+	C
<i>Arcyria ferruginea</i> Sauter	+	+	R
<i>Arcyria incarnata</i> (Pers.) Pers.	+	+	C
<i>Arcyria insignis</i> Kalchbr. et Cooke	+	-	R
<i>Arcyria major</i> (G. Lister) Ing *	-	+	R
<i>Arcyria minuta</i> Buchet	+	+	R
<i>Arcyria obvelata</i> (Oeder) Onsberg	+	+	C
<i>Arcyria oerstedtii</i> Rostaf.	-	+	R
<i>Arcyria pomiformis</i> (Leers) Rostaf.	+	+	A
<i>Arcyria stipata</i> (Schw.) Lister	+	+	O
<i>Calomyxa metallica</i> (Berk.) Nieuwl. *	-	+	R
<i>Badhamia dubia</i> Nann.-Bremek. *	-	+	R
<i>Ceratiomyxa fruticulosa</i> (Müller) T. Macbr.	+	+	A
<i>Ceratiomyxa fruticulosa</i> var. <i>porioides</i> (Alb. et Schw.) A. Lister	+	+	C
<i>Comatricha elegans</i> (Racib.) G. Lister	-	+	R
<i>Comatricha nigra</i> (Pers.) Schroet.	+	+	C
<i>Comatricha pulchella</i> (C. Bab.) Rostaf.	+	+	R
<i>Craterium leucocephalum</i> (Pers.) Ditmar	+	+	C
<i>Craterium minutum</i> (Leers) Fr.	+	+	C
<i>Cribraria argillacea</i> (Pers.) Pers.	+	+	O
<i>Cribraria aurantiaca</i> Schrad.	+	+	R
<i>Cribraria cancellata</i> (Batsch) Nann.-Bremek.	+	+	A
<i>Cribraria macrocarpa</i> Schrad.	+	-	R
<i>Cribraria microcarpa</i> (Schrad.) Pers.	+	+	R

¹⁾ Nine species were previously published in Dvořáková (1999a): Myxomycetes developed in moist-chamber cultures. *Licea parasitica* was lately published by Kocourková (2000).

species	Hřebený Mts.	Bohemian Karst	abundance
<i>Cribraria persoonii</i> Nann.-Bremek. *	+	-	R
<i>Cribraria rufa</i> (Roth) Rostaf.	+	+	O
<i>Cribraria violacea</i> Rex	-	+	O
<i>Cribraria vulgaris</i> Schrad.	+	+	C
<i>Diachea leucopodia</i> (Bull.) Rostaf.	+	+	C
<i>Dictydiaethalium plumbeum</i> var. <i>ferrugineum</i> (Nann.-Bremek.) L. Krieglsteiner	+	-	R
<i>Diderma cingulatum</i> Nann.-Bremek. *	-	+	R
<i>Diderma crustaceum</i> Peck	-	+	R
<i>Diderma spumarioides</i> (Fr.) Fr.	-	+	O
<i>Diderma testaceum</i> (Schrad.) Pers.	+	+	A
<i>Didymium difforme</i> (Pers.) S. F. Gray	+	+	O
<i>Didymium melanospermum</i> (Pers.) T. Macbr.	+	+	O
<i>Didymium minus</i> (Lister) Morgan	+	+	C
<i>Didymium nigripes</i> (Link) Fr.	+	-	O
<i>Didymium serpula</i> Fr.	+	-	R
<i>Didymium squamulosum</i> (Alb. et Schw.) Fr.	-	+	C
<i>Didymium</i> sp. cf. <i>squamulosum</i> (Alb. et Schw.) Fr.	+	-	R
<i>Echinostelium minutum</i> de Bary	+	+	A
<i>Echinostelium apitectum</i> Whitney *	-	+	R
<i>Enerthenema papillatum</i> (Pers.) Rostaf.	+	+	A
<i>Enteridium lycoperdon</i> (Bull.) Farr	+	+	C
<i>Fuligo cinerea</i> (Schw.) Morgan	-	+	R
<i>Fuligo leviderma</i> Neubert, Nowotny et K. Baumann *	+	+	O
<i>Fuligo rufa</i> Pers.	-	+	R
<i>Fuligo septica</i> (L.) F. H. Wigg.	+	+	C
<i>Fuligo septica</i> var. <i>candida</i> (Pers.) Fr.	+	+	O
<i>Fuligo septica</i> var. <i>flava</i> (Pers.) Fr.	+	-	R
<i>Hemitrichia calyculata</i> (Speg.) Farr *	+	+	A
<i>Hemitrichia clavata</i> (Pers.) Pers.	+	+	C
<i>Hemitrichia serpula</i> (Scop.) Rostaf.	-	+	R
<i>Lamproderma arcyrioides</i> (Sommert.) Rost	-	+	R
<i>Lamproderma arcyronema</i> Rostaf.	+	+	O
<i>Lamproderma scintillans</i> (Berk. et Br.) Morgan *	+	+	O
<i>Leocarpus fragilis</i> (Dicks.) Rostaf.	+	+	O
<i>Licea biforis</i> Morgan *	+	+	O
<i>Licea kleistobolus</i> G. W. Martin *	+	+	A
<i>Licea minima</i> Fr. *	+	+	A

DVOŘÁKOVÁ R.: MYXOMYCETES IN BOHEMIAN KARST AND HŘEBENY MTS.

species	Hřebený Mts.	Bohemian Karst	abundance
<i>Licea operculata</i> (Wingate) G. W. Martin *	-	+	R
<i>Licea parasitica</i> (Zukal) G. W. Martin *	+	+	O
<i>Licea variabilis</i> Schrad.	-	+	O
<i>Lycogala epidendrum</i> (L.) Fr.	+	+	A
<i>Lycogala flavo-fuscum</i> (Ehrenb.) Rostaf.	-	+	R
<i>Metatrichia floriformis</i> (Schw.) Nann.-Bremek.	+	-	O
<i>Metatrichia vesparium</i> (Batsch) Nann.-Bremek.	+	+	C
<i>Mucilago crustacea</i> F. H. Wigg.	-	+	C
<i>Paradiacheopsis fimbriata</i> (G. Lister et Cran) Hertel	+	+	A
<i>Paradiacheopsis solitaria</i> (Nann.-Bremek.) Nann.-Bremek. *	-	+	O
<i>Perichaena corticalis</i> (Batsch) Rostaf.	+	+	A
<i>Perichaena depressa</i> Libert	-	+	C
<i>Perichaena chrysosperma</i> (Currey) Lister	-	+	R
<i>Physarum bivalve</i> Pers.	+	-	O
<i>Physarum cinereum</i> (Batsch) Pers.	+	-	O
<i>Physarum decipiens</i> M. A. Curtis *	-	+	R
<i>Physarum leucophaeum</i> Fr.	-	+	O
<i>Physarum leucopus</i> Link	-	+	O
<i>Physarum nutans</i> Pers.	+	+	A
<i>Physarum rubiginosum</i> Fr.	-	+	R
<i>Physarum virescens</i> Ditmar	+	-	O
<i>Physarum viride</i> (Bull.) Pers.	+	+	R
<i>Physarum viride</i> (Bull.) Pers. var. <i>aurantiacum</i> (Pers.) Lister	+	+	O
<i>Stemonitis axifera</i> (Bull.) T. Macbr.	+	+	C
<i>Stemonitis fusca</i> Roth	+	+	O
<i>Stemonitopsis subcaespitosa</i> (Peck) Nann.-Bremek. *	-	+	R
<i>Stemonitopsis typhina</i> (F. H. Wigg.) Nann.-Bremek.	+	+	C
<i>Trichia botrytis</i> (J. F. Gmel.) Pers.	+	+	R
<i>Trichia contorta</i> (Ditmar) Rostaf.	+	+	R
<i>Trichia decipiens</i> (Pers.) T. Macbr.	+	+	A
<i>Trichia favoginea</i> (Batsch) Pers.	+	+	A
<i>Trichia munda</i> (Lister) Meylan *	+	+	O
<i>Trichia persimilis</i> Karst.	+	+	O
<i>Trichia scabra</i> Rostaf.	+	+	A
<i>Trichia varia</i> (Pers.) Pers.	+	+	A
<i>Tubifera ferruginosa</i> (Batsch) J. F. Gmel.	+	+	A

Brief descriptions of 17 species new to the Czech Republic are given, based on the Czech material. Notes on species ecology and geographical distribution are also added. (MCC = cultivated in moist chamber culture, RD = R. Dvořáková, PRC = Department of Botany Herbarium, Faculty of Nature Science, Charles University, Prague)

Arcyria major (G. Lister) Ing, Trans. Br. Myc. Soc. 50: 556. 1967.
Fig. 2, A-C

Specimens examined: Bohemian Karst: Srbsko, Karlštejn Nature Reserve, Bubovický potok valley; decaying log of *Carpinus betulus*, 5. XI. 1998, leg. RD, det. L. Kriegelsteiner (PRC).

Sporangia in small groups, shortly stalked, cylindrical, 2–3 mm tall, bright red-pink when fresh, later changing to orange-brown. Stalk short, yellow-brown, hypothallus extending under the whole group. Peridium fugacious except for the cup, which is shallow, pleated, translucent and iridescent; inner side of the cup covered with reticulum with fine ridges. Bottom of the cup and the stalk are filled with round cysts of the same size as spores or larger (up to 20 μm toward the base of the stalk). Capillitium forming an elastic, expanding, large meshed net, easily blown out of the cup as a long plume, leaving remnants of the tubes attached to the cup; tubes yellow in transmitted light, 3–4.8 μm in diam., branching and decorated with half-rings. Spores very pale yellow in transmitted light, almost smooth, with groups of small wartlets; 7.2–8.5 μm in diameter.

Found only once on dead wood of *Carpinus*, specimen with c. 15 sporangia.

Badhamia dubia Nann.-Brem., Proc. K. Ned. Akad. Wet. Ser. C. 71: 49. 1968.
Fig. 3, A-C

Specimens examined: Bohemian Karst: Radotínské údolí Nature Reserve, east edge of the forest above Maškův mlýn; piece of bark of *Quercus sp.*, lying on a big pile of decaying herbaceous material, 11. VII. 1998, leg. et det. RD (PRC).

Sporangia crowded in small groups, sessile, almost spherical, about 1 mm in diam., blue-grey with metallic shine. Peridium thin, one-layered, translucent and shining, slightly covered with lime crystals, dehiscing irregularly. Capillitium consisting of a regular, wide net; tubes quite slender, filled with lime material. Spores black in mass, purple-brown in transmitted light, in clusters of 8–12 spores; individual spores spherical to ovoid, 9.6–12 μm in diam., covered with large spines (forming a cup) on the outside of the cluster and scattered small warts on the other side.

Species described from the Netherlands in 1968, first record from the Czech Republic. This is the only *Badhamia* species found in the study area at all. Nine other *Badhamia* species have been reported from the Czech Republic, last record in Sept. 1961.

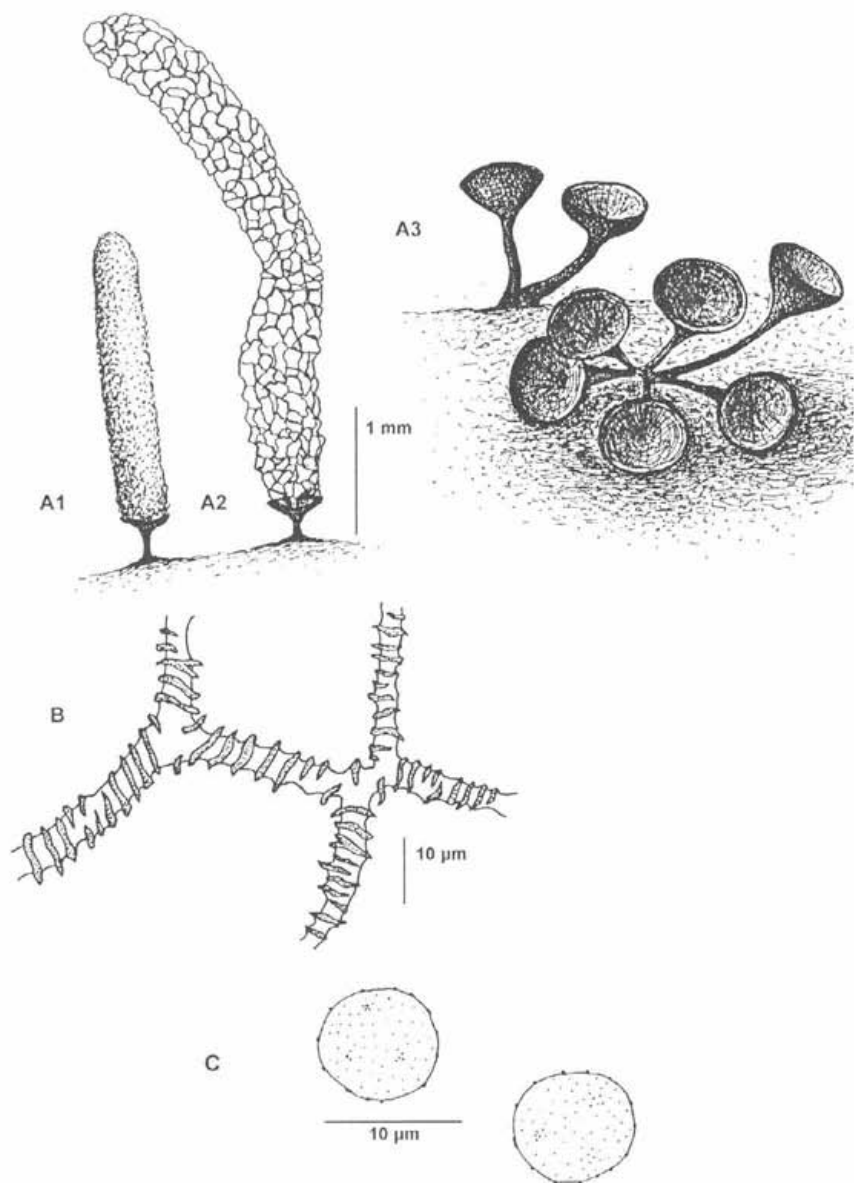


Fig. 2. *Arcyria major* (G. Lister) Ing. A1 - sporangium, A2 - sporangium with expanded capillitium, A3 - stalked cups, B - capillitium, C - spores

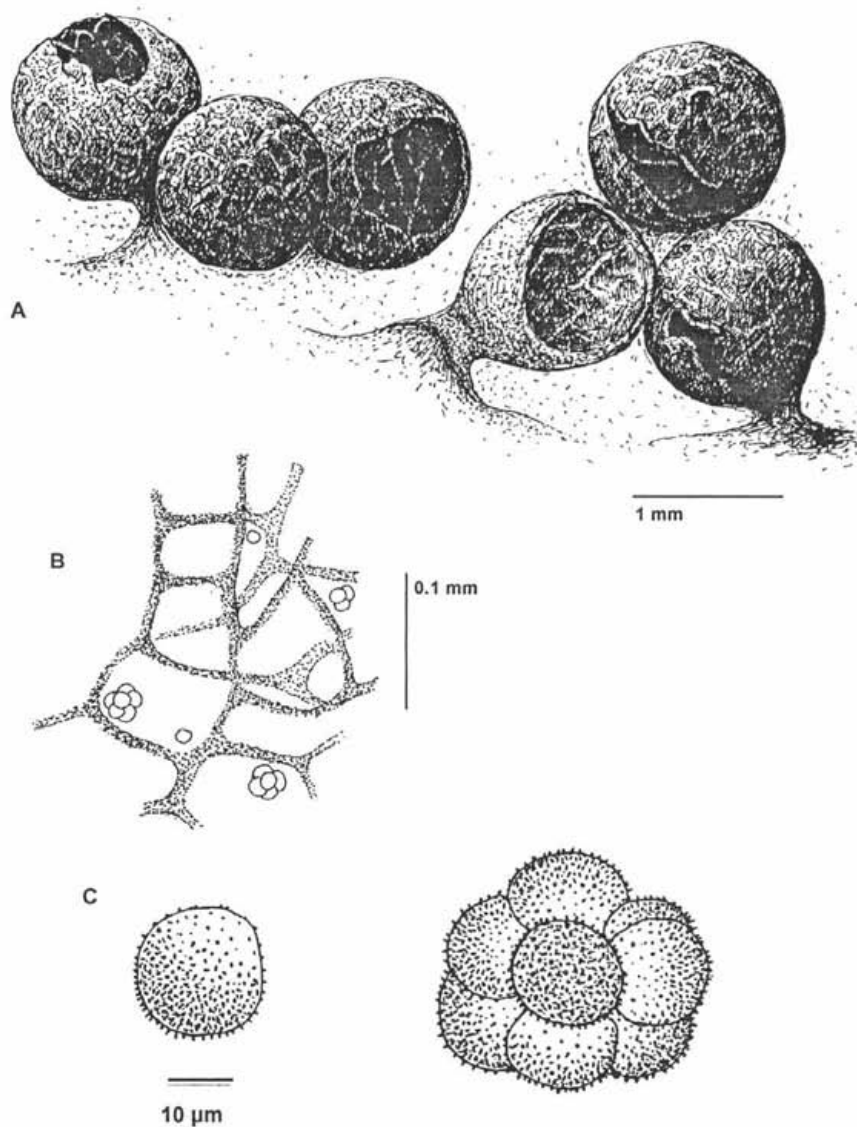


Fig. 3. *Badhamia dubia* Nann.-Bremek. A – sporangia, B – part of capillitium, C – spores

This material was found on a large pile of decaying herbaceous material together with extensive aethalia of *Fuligo cinerea*.

Calomyxa metallica (Berk.) Nieuwl., Am. Mid. Nat. 4: 335. 1916.

Specimens examined: Bohemian Karst: Karlštejn Nature Reserve, east slope of Mt. Doutnáč; on the inner side of bark of *Quercus* sp., 5. XI.1998, leg. et det. RD (PRC). – Radotínské údolí Nature Reserve; on bark of living tree of *Tilia cordata* (MCC), 20. III.1998, leg. et det. RD (PRC).

Sporangia and/or short plasmodiocarps, sessile, spherical or pulvinate, 0.3–0.5 mm in diameter and up to 2 mm long, rosy when fresh, changing to golden iridescent. Peridium of one layer, thin and translucent, pale ochraceous in transmitted light. Threads of the capillitium very long, pale yellow, 0.5–1 μm in diam., expanding elastically from the sporangia, tangled with many loops, covered with spirally arranged bands of spinules. Spores beige in mass, yellow in transmitted light, 9.7–10.7 μm in diam., covered with distinct warts.

In moist chamber cultures developing together with *Trichia munda*.

Widely distributed (Europe, American continent, India, Japan, Jamaica) but not very common.

Cribraria persoonii Nann.-Brem., Proc. K. Ned. Akad. Wet. Ser. C 74: 353. 1971. Fig. 4 A-C

Specimens examined: Hřebeny Mts.: Řevnice, valley of Moklický stream; dead coniferous wood, 14. VII.1998, leg. et det. RD (PRC).

Sporangia ochraceous-brown, stalked, subglobose, 1.5–2 mm in diameter. Stalk length 2 times the sporangium diameter, dark brown, plicate. Peridium persisting in the basal third as a cup, which is hazelnut brown and radially plicate, with thickened rim; there are short ribs or teeth regularly placed on the rim and connected by threads to the reticulum. Net nodes small and round, thickened with dark lime granules, almost without any free-ending threads. Spores almost colourless in transmitted light, with no oil inclusion, c. 7 μm in diam. (6.5–7.5 μm according to Nannenga-Bremekamp), covered with small warts.

Described by Nannenga-Bremekamp in 1971 from decayed pinewood only.

Diderma cingulatum Nann.-Brem., Proc. K. Ned. Akad. Wet. C. 71: 91. 1968.

Specimens examined: Bohemian Karst: Radotínské údolí Nature Reserve; decayed leaves and branches of *Quercus* and *Carpinus* sp., several large colonies, 19. IX.1998, leg. et det. RD (PRC).

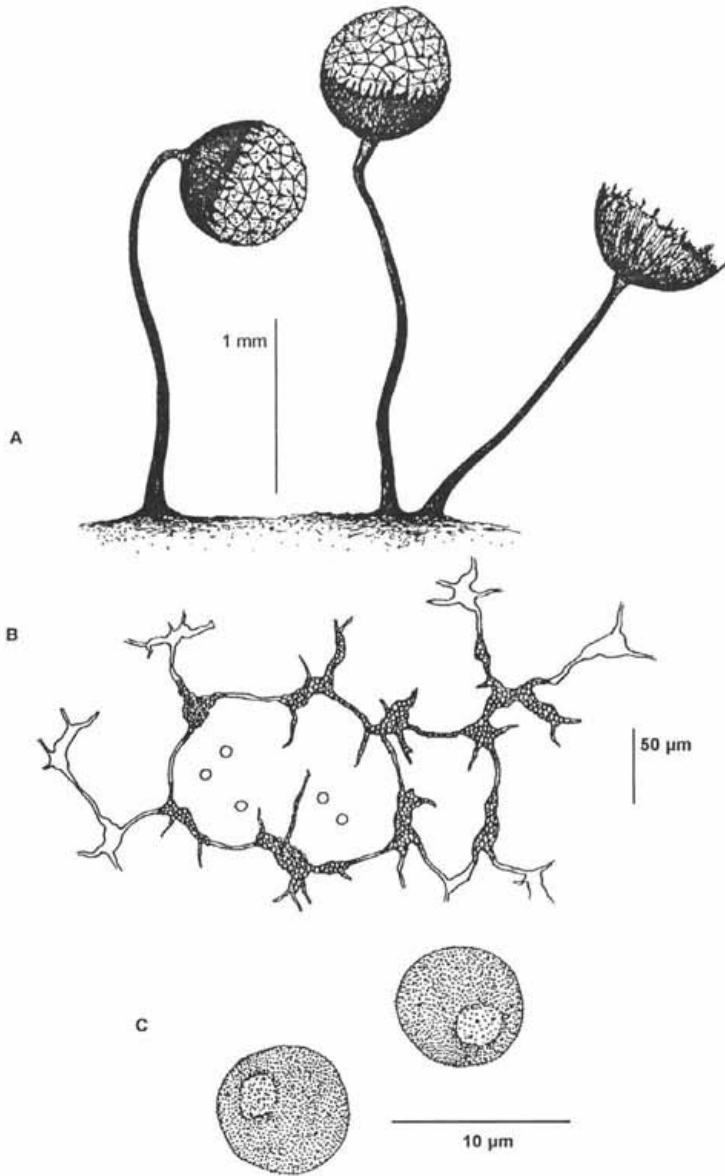


Fig. 4. *Cribraria persoonii* Nann.-Bremek. A – sporangia, B – peridial net, C – spores

Sporangia crowded in grape-like clusters, almost subglobose with a wide base, white, sessile. Limy hypothallus shared by the whole group. Peridium of two layers; the outer a thick white lime crust is brittle and crumbles easily, the inner one is membranous and colourless. White cylindrical columella slightly flattened and almost reaching the top of the sporangium. Capillitium consisting of dark thin tubules, pale on the top ends, sometimes dichotomously branched and only sparingly anastomosing, with few perforated swellings. Spores dark brown in mass, purple-brown in transmitted light, 9.6–12.5 μm in diam., covered with fine warts and few fine ridges forming a lax reticulum; a pale narrow germination line is distinct.

Develops on dead wood, dead leaves and living herbs. Described from the Netherlands.

Echinostelium apitectum Whitney, Mycologia 72:954. 1980 Fig. 5

Specimens examined: Bohemian Karst: Karlštejn Nature Reserve, west slope of Boubová Mt.; bark of living tree of *Quercus petraea* (MCC), 6. XI.1998, leg. et det. RD (PRC).- Karlštejn Nature Reserve, valley of Loděnice River under the village of Hostim, bark of living tree of *Quercus petraea* (MCC), 7. XI.1998, leg. et det. RD.

Comparing to *Echinostelium minutum* the sporangia of this species were much smaller (70–150 μm), white, hyaline and very fragile. Stalk about 20 μm in diam. at the base, tapering to the apex (up to 2 μm in diam.), filled with granular material and hyaline in the upper part. Columella cylindrical to hemispherical, very small (c. 3 μm), with a globose or oval spore-like covering 7–12 μm in diam. and a basal collar (remnant of peridium). Capillitium absent or present as one thread, arising from the columella (in one case the thread was dichotomously branched). Spores smooth, hyaline, 7–8 μm in diam. (6–12 μm in diam. according to Lado and Pando 1997).

Large colonies fructificated on bark of old trees of *Quercus petraea* together with *Arcyria cinerea*, *Licea kleistobolus* and *Paradiacheopsis fimbriata*. Incubation time 7 and 18 days respectively.

Reported from the USA (Whitney 1980), France and Spain (Lado and Pando 1997).

Hemitrichia calyculata (Speg.) Farr, Mycologia 66: 887, 1974.

Specimens examined: Bohemian Karst: Karlštejn Nature Reserve, waterfalls on Bubovický stream; decayed mossy log, 18. IX.1997, leg. et det. RD (PRC). – Karlštejn Nature Reserve, Bubovický stream near Srbsko; on decayed deciduous wood, 5. VIII.1998, leg. et det. RD (PRC). – Karlštejn Nature Reserve, Loděnice

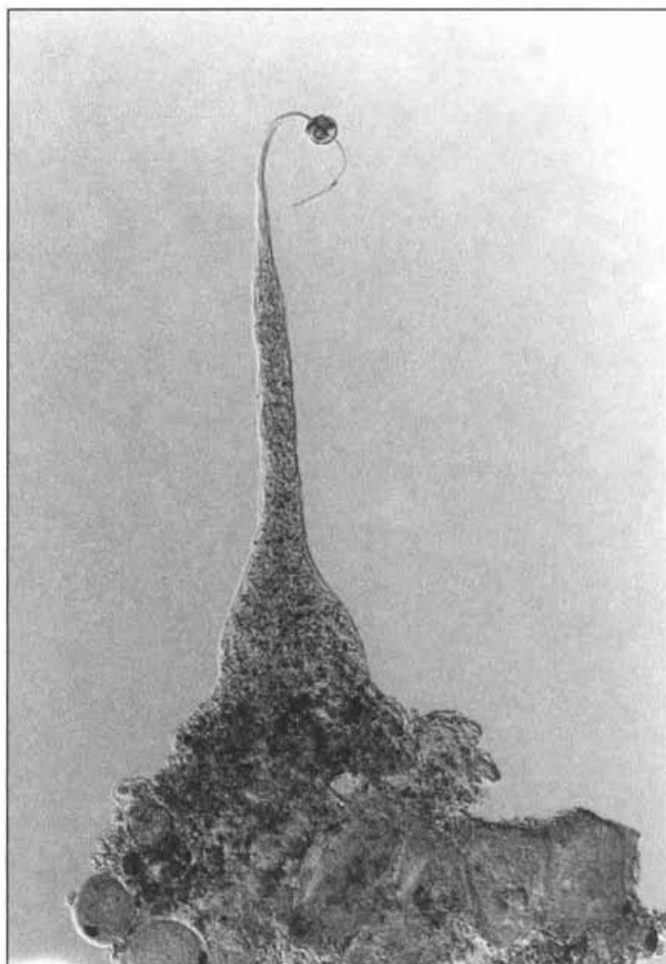


Fig. 5. *Echinostelium apitectum* Whitney (scale bar = 25 μ m)

stream; on decayed deciduous wood, 24. IX.1998, leg. et det. RD (PRC). – Karlštejn Nature Reserve, Bubovický stream under Mt. Doutnáč; on decaying log of *Quercus* sp., 5. XI.1998, leg et det. RD (PRC). – Radotínské údolí Nature Reserve, Kalinův mlýn; on decayed log of *Carpinus betulus*, 8. XI.1998, leg. et det. RD (PRC). – Hřebený Mts.: Moklický stream, on decayed log of *Fagus sylvatica*, 15. VII.1998, leg. et det. RD (PRC). – Kejná stream under Mt. Hvízdinec; on decayed log of *Fagus sylvatica*, 31. X.1998, leg. et det. RD (PRC).

Sporangia in groups, stalked, 2–5 mm high, yellow or ochraceous-yellow, shiny. Stalk dark brown, thin, abruptly tapering into the sporangium, 30–50 % of the

total sporangium high, on a red-brown membranous hypothallus. Peridium thin, yellow, translucent, dehiscing irregularly leaving a deep plicate cup with a revolute margin. Capillitium elastic, expanding and leaving the cup (not connected with the peridium or the wall of the stalk); long branching tubes are decorated with 4-5 spirals which are covered with fine spines (appearing velvety under oil immersion). Spores pale yellow, 7-8 μm in diameter, covered with a delicate reticulum.

Typical of the autumn aspect, on strongly decayed wood of deciduous trees (esp. *Fagus sylvatica*), together with *Trichia favoginea*, *T. scabra*, *Metatrichia vesparium*, *M. floriformis* and *Arcyria denudata*. Large colonies found in autumn 1998. Known from Spain, France, Israel, Germany, Indonesia, etc.

Lamproderma scintillans (Berk. et Br.) Morgan, Jour. Cinc. Soc. Nat. Hist. 16:131. 1894.

Specimens examined: Bohemian Karst: Radotínské údolí Nature Reserve; decayed leaves of *Quercus robur*, 10. VII.1998, leg. et det. RD (PRC). - Hřebený Mts.: Babský stream under Mt. Babka; decayed leaves of *Quercus* sp. and *Pinus sylvatica*, 15. VII.1998, leg. et det. RD (PRC).

Sporangia stalked, spherical, 0.5-1 mm tall; stalk slender, black, length 1.5-2 times the sporangium diameter. Peridium blue-purple iridescent in reflected light, falling off in large flakes and leaving only a red-brown collar around the stalk. Cylindrical columella with a blunt apex, up to about half of the sporangium height. Capillitium dark brown, colourless at the base around the columella, rather straight; threads emerging from the apex of the columella, radiating outwards, branching several times. Spores dark brown in mass, pale lilac-brown in transmitted light, 8-9.6 μm in diam., with dark, dispersed warts.

Found on both localities in July on decayed leaves and needles. Material revised by L. Krieglsteiner.

Licea biforis Morgan, Jour. Cinc. Soc. Nat. Hist. 15: 131; 1893
Fig. 6 A, B

Specimens studied: Bohemian Karst: Radotínské údolí Nature Reserve; inner side of bark of *Fraxinus excelsior*, 8. XI.1998, leg. et det. RD (PRC). - Karlštejn Nature Reserve; bark of living tree of *Sambucus nigra* (MCC), 3. X.1996, leg. et det. RD (PRC). - Hřebený Mts.: Všenory railway station; bark of living tree of *Populus nigra* (MCC), 3. XII.1996, leg. et det. RD (PRC).

Sporangia in groups, sessile, laterally flattened, elongate, c. 240 μm long, brown to yellow-brown. Peridium pale yellow-brown in transmitted light, covered with granulose inclusions which are absent from the pale longitudinal line of dehiscence.

Capillitium absent. Spores yellow in mass, very pale yellow in transmitted light, globose to oval, 8.4–10.8 μm in diameter, minutely punctate.

The only field collection is from the inner side of bark of a decaying log, found together with *Trichia varia* and *Perichaena corticalis*. In moist chamber cultures it fructificated a few times on bark of *Populus nigra* and *Sambucus nigra*, together with *Echinostelium minutum*, *Enerthenema papillatum*, *Perichaena corticalis* and *Physarum nutans*. Development of sporangia in moist chambers completed in 21–30 days.

Note: This corticolous species seems to prefer tree species with higher bark pH (*Fraxinus excelsior*, *Populus nigra*, and *Sambucus nigra*).

Licea kleistobolus G. W. Martin, Mycologia 34: 702. 1942.

Fig. 7, A–C

Specimens examined: Bohemian Karst: Karlštejn Nature Reserve, Loděnice river; bark of living tree of *Quercus petraea* (MCC), 17. XI.1998, leg. et det. RD (PRC). – Karlštejn Nature Reserve, Loděnice river; bark of living tree of *Alnus glutinosa* (MCC), 19. XI.1998, leg. et det. RD (PRC). – Karlštejn Nature Reserve, Boubová Mt., bark of living tree of *Quercus petraea* (MCC), 19. XI.1998, leg. et det. RD (PRC). – Radotínské údolí Nature Reserve; bark of living tree of *Aesculus hippocastanum* (MCC), 16. I.1999, leg. et det. RD (PRC). – Radotínské údolí Nature Reserve; bark of living tree of *Pinus sylvestris* (MCC), 20. I.1999, leg. et det. RD (PRC). – Hřebeňy Mts.: under Mt. Hvízdinec; bark of living tree of *Aesculus hippocastanum* (MCC), 21. XI.1996, leg. et det. RD (PRC). – Kejná stream near the village of Řevnice; bark of living tree of *Quercus petraea* (MCC), 14. V.1998.

Black shiny sporangia in groups, sessile, very small (c. 0.1 mm in diam.), round, flattened, dehiscing along a sunken preformed lid with a distinct margin. Peridium yellow-brown in transmitted light, thin, the operculum on the inside covered with large hollow papillae, which get smaller towards the margin. Spores very pale in transmitted light, 9.6–12 μm in diameter; the wall almost smooth with groups of tiny spinules, germination pore absent.

Corticolous species occurring on bark of *Quercus*, *Aesculus*, *Alnus*, *Pinus*. In moist chamber cultures developing together with *Paradiacheopsis fimbriata*, *Enerthenema papillatum*, *Arcyria pomiformis*, *Echinostelium minutum* (often) and *Licea parasitica* (occasionally), incubation time 7–28 days. Reported from Europe, Turkey, USA and Japan.

Licea minima Fr., Syst. Myc. 3: 199. 1829.

Fig. 8, A–C

Specimens examined: Bohemian Karst: Radotínské údolí Nature Reserve, Maškův mill; decaying barkless log, 10. VII.1998, leg. et det. RD (PRC). – Hřebeňy

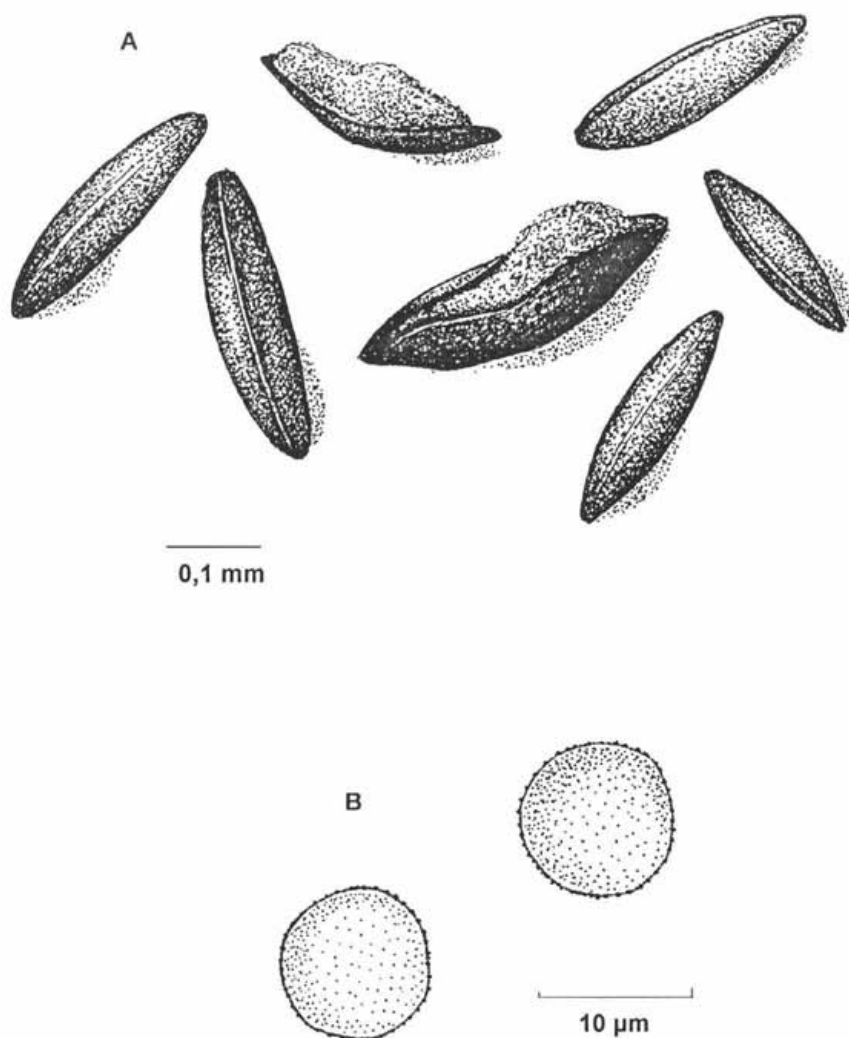


Fig. 6. *Licea biforis* Morgan. A – sporangia, B – spores

Mts.: Dobřichovice; bark of living tree of *Betula pendula* (MCC), 9. IX.1996, leg. et det. RD (PRC). - Dobřichovice; bark of living tree of *Pinus sylvestris* (MCC), 9. IX.1996, leg. et det. RD (PRC). - Mt. Chlum above Dobřichovice; bark of living tree of *Pinus sylvestris* (MCC), 12. II.1997, leg. et det. RD (PRC). - Dobřichovice;

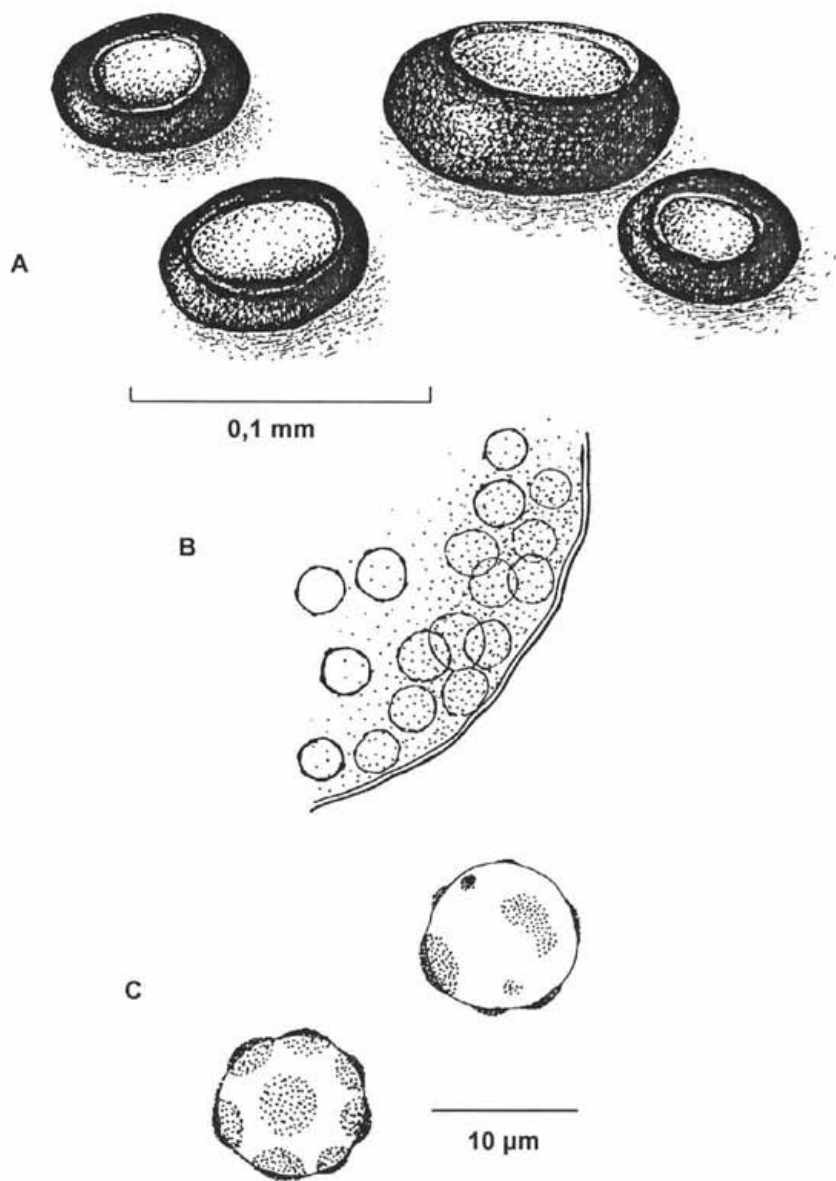


Fig. 7. *Licea kleistobolus* G. W. Martin. A – sporangia, B – part of the peridium, C – spores

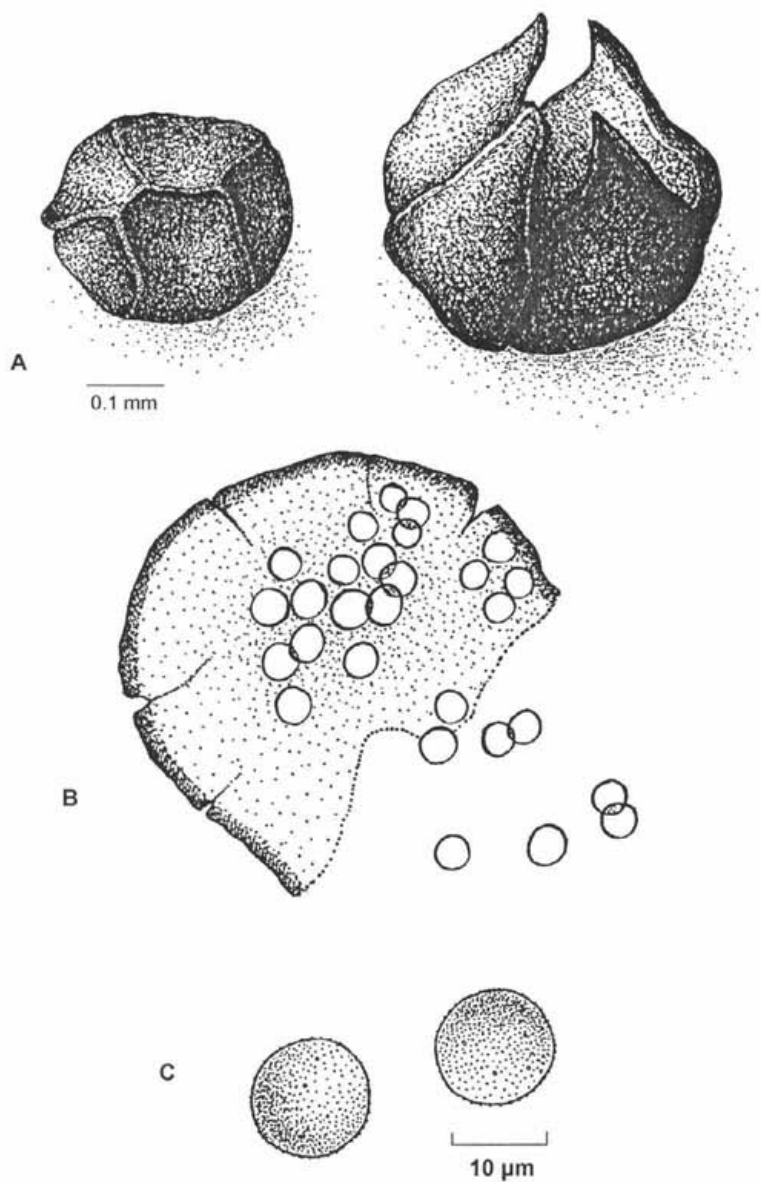


Fig. 8. *Licea minima* Fr. A - sporangia, B - part of peridium, C - spores

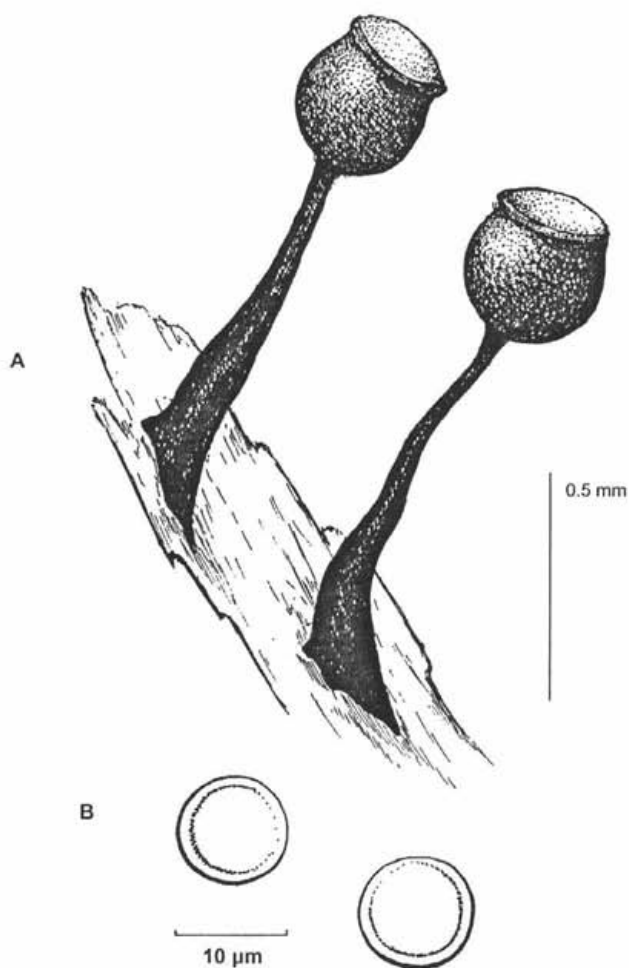


Fig. 9. *Licea operculata* (Wingate) G. W. Martin. A - sporangia, B - spores

bark of living tree of *Picea abies* (MCC), 22. IV.1997, leg. et det. RD (PRC). - Řevnice, valley of Kejná stream; bark of living tree of *Betula pendula* (MCC), leg. et det. RD (PRC). - Řevnice, valley of Kejná stream; bark of living tree of *Picea abies* (MCC), leg. et det. RD (PRC).

Sporangia sessile, small, 0.2-0.6 mm in diam., almost black, somewhat angular or spherical. Peridium thick, double-layered, splits along a network of prominent shining ridges; the outer layer covered with dark inclusions, the inner layer thin,

shiny, brown, translucent in transmitted light. Spores rust-red to brown in mass, pale ferruginous to smoke-brown in transmitted light, 9.6-13.2 μm in diameter, minutely warted, the paler germination area sometimes visible.

Only one specimen collected in the field on decayed log of *Quercus* or *Carpinus*, together with *Arcyria pomiformis*. In moist chamber culture developing on bark of *Betula*, *Picea* and *Pinus* of samples from the Hřebený Mts. only. Occurring often together with *Echinostelium minutum*, *Paradiacheopsis fimbriata* and *Enerthenema papillatum*. Sometimes obtained after drying and rewetting, incubation time varying in 17-60 days.

Widely distributed in temperate and tropical regions throughout the world.

Licea operculata (Wingate) G. W. Martin, *Mycologia* 34: 702. 1942.

Fig. 9, A-B

Specimens examined: Bohemian Karst, Karlštejn Nature Reserve, Mt. Boubová; bark of living tree of *Juniperus communis* (MCC), 18. XI.1998, leg. et det. RD (PRC).

Sporangia stalked, dark brown, urn-shaped with a lid, 0.5-1.2 mm high, 0.3 mm in diam. Lid flat, paler, with a golden shine. Stalk 2-3 times longer than the sporangium, black, cylindrical, wider towards the base and filled with granular inclusions. Spores beige in mass, almost colourless in transmitted light, 9.6-10.8 μm in diam., spore wall smooth, paler on the large germination pore.

According to Nannenga-Bremekamp (1991) the sporangia of this species are 0.4-1.0 mm in diam. and the spore size is 10-13 μm . Martin and Alexopoulos (1969), however, mention *L. operculata* with spore size 8-11 μm , which fits to this material better.

Developed in moist chamber culture on bark of *Juniperus communis*, incubation time 20 days. The samples yielded only 8 fully mature sporangia. Developing together with *Enerthenema papillatum*.

Widely distributed in Europe, North America, West India and Japan, known from bark of various tree species. Not very common.

Licea parasitica (Zukal) G. W. Martin, *Mycologia* 34: 702. 1942.

Fig. 10, A-C

Specimens examined: Bohemian Karst: Radotínské údolí Nature Reserve, Homolka; bark of living tree of *Sambucus nigra* (MCC), 4. III.1998, leg. et det. RD (PRC). - Karlštejn Nature Reserve, alley near Hostim in the direction of Bubovice; bark of living tree of *Acer pseudoplatanus* (MCC), 16. VI.1998, leg. et det. RD (PRC). - Karlštejn Nature Reserve, Mt. Boubová; bark of living tree of *Acer campestre* (MCC), 16. VI.1998, leg. et det. RD (PRC). - Radotínské údolí

Nature Reserve; bark of living tree of *Aesculus hippocastanum* (MCC), 9. I.1999, leg. et det. RD (PRC). – Hřebený Mts.: Řevnice, valley of Kejtná stream; bark of living tree of *Acer pseudoplatanus* (MCC), 30. III.1998, leg. et det. RD (PRC).

Sporangia sessile, black-brown, spherical when immature, later pulvinate, 0.02-0.5 mm in diam. Peridium thick, double-layered; granulose outer layer with dark deposits, the inner layer membranous and translucent. More or less distinct lid paler and sideways when immature. Spores dark brown in mass, pale olive-brown in transmitted light, often showing a few drops of pink inclusion, 12-13 μm in diameter; the wall is smooth with a thinner, paler germination area.

Fructifications developed in moist chamber cultures on bark of *Aesculus*, *Acer* and *Sambucus*, together with *Arcyria cinerea*, *A. incarnata*, *Echinostelium minutum*, *Liccia kleistobolus* and *Physarum nutans*. Incubation time 12-31 days.

In the Czech Republic also collected by Kocourková as a lichenicolous species (Kocourková 2000). Common in moist-chamber cultures, reported from Germany, Austria, Corsica, Luxembourg, USA and Japan.

Paradiacheopsis solitaria (Nann.-Brem.) Nann.-Brem., Proc. K. Ned. Akad. Wet. Ser. C. 70:209. 1967. Fig. 11

Specimens examined: Bohemian Karst: Karlštejn Nature Reserve, Svatý Jan pod Skalou; bark of living tree of *Acer pseudoplatanus* (MCC), 3. III.1998, leg. et det. RD (PRC). – Radotínské údolí Nature Reserve; bark of living tree of *Acer campestre* (MCC), 2. I.1999, leg. et det. RD (PRC). – Hřebený Mts.: Všenory, railway station; bark of living tree of *Populus nigra* (MCC), 15. XI.1996, leg. et det. RD (PRC).

Sporangia stalked, 0.5-0.8 mm high, spherical, dark brown, solitary or in small groups. Stalk 1-2 times longer than the sporangium, black, widened and fibrous at the base. Peridium fugacious. Columella at the centre of the sporangium divided into 2-3 main capillitial branches. Capillitium dark brown, rigid, a few times dichotomously branched; does not form a net. Free ends are not swollen or club-shaped at the tips. Spores smoke brown in transmitted light, 12-14.5 μm in diameter, covered with fine warts which are less dense and more distinct than those of *Paradiacheopsis fimbriata*.

Material from Radotínské valley is somewhat different – the stalk is more reddish-brown, longer (2.5-3 times longer than the sporangium) and less fibrous at the base. The spores are smaller (9.6-12 μm in diameter), but show the same colour and ornamentation. Perhaps this could be the small-spored variety with the relatively longer stalk mentioned by Nannenga-Bremekamp (1991, p. 365).

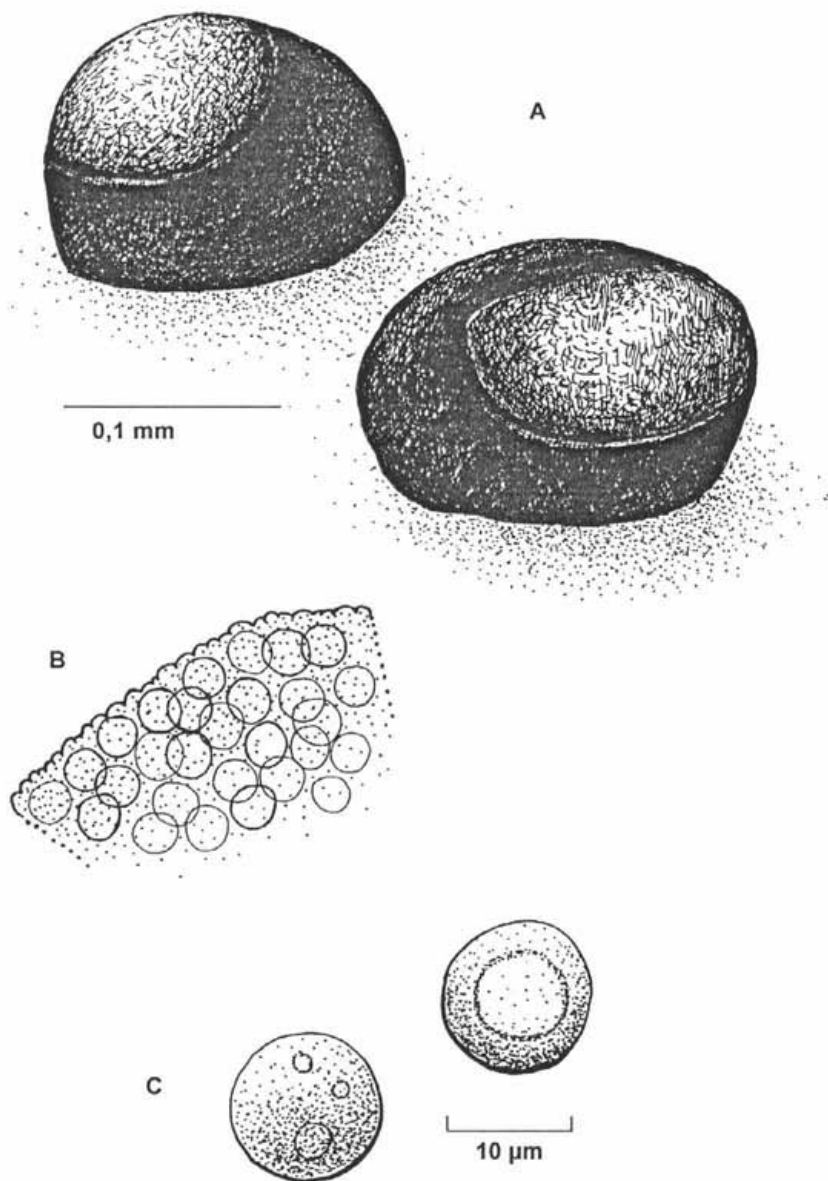


Fig. 10. *Licca parasitica* (Zukal) G. W. Martin

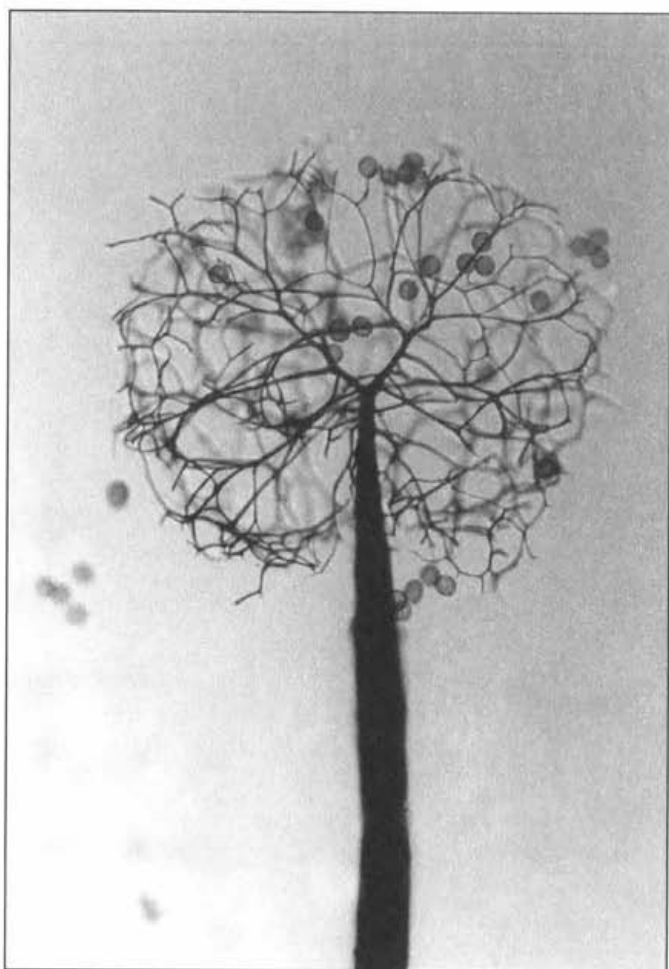


Fig. 11. *Paradiacheopsis solitaria* (Nann.-Bremek.) Nann.-Bremek., as seen under the microscope with Nomarski differential interference contrast. (Scale bar = 100 μ m)

Occurring in moist chamber cultures from Bohemian Karst only, incubation time 3-9 days, together with *Arcyria pomiformis*, *A. incarnata*, *Perichaena corticalis*, *P. chrysosperma* and *P. depressa*. The very small sporangia of *Paradiacheopsis solitaria* have so far been obtained only in moist chambers on bark of living deciduous trees. Described from the Netherlands in 1962.

Physarum decipiens M. A. Curtis, Am. Jour. Sci. II, 6: 352; 1848

Specimens examined: Bohemian Karst, Karlštejn Nature Reserve, Srbsko; bark of old living tree of *Crataegus* sp. (MCC), 16. VI.1998, leg. et det. RD (PRC).

Sessile sporangia and/or short plasmodiocarps, 0.2-0.8 mm in diameter and up to 2 mm long, on a colourless hypothallus. Peridium single-layered, light yellow, encrusted with yellow to orange-yellow lime scales (sometimes forming short veins). Columella absent. Capillitium consisting of a net with large flattened lime nodes, connected by colourless tubules; the lime nodes angular and irregularly shaped, filled with bright yellow lime inclusions. Spores black in mass, dark purple brown in transmitted light, 10-14 (15) μm in diameter, spore wall densely warted with a paler germination pore.

2 plasmodiocarps with one sessile sporangium developed in moist chamber culture together with *Arcyria cinerea* and *Perichaena corticalis*, incubation time 1 month.

Reported from Greece, Germany, the Netherlands and other countries of western Europe, USA, Canada, South America, Asia and Australia; not very common.

Stemonitopsis subcaespitosa (Peck) Nann.-Brem., De Nederlandse Myxomyceten, 1974

Specimens examined: Bohemian Karst, Radotínské údolí Nature Reserve; bark of living tree of *Malus domestica* (MCC), 10. III.1998, leg. et det. RD (PRC).

Sporangia stalked, cylindrical, c.2 mm tall, dark brown. Stalk black, shiny, 1/3-1/4 of the total height, fibrous at the base. Peridium fugacious. Columella reaching almost the apex of the sporangium and there merging into the capillitium. Capillitium lilac-brown, the inner net with large expansions, irregular surface net showing only fragments. Spores dark lilac-brown in transmitted light, covered with fine warts or spinules, 8.4-9.6 μm in diameter. (According to Martin and Alexopoulos (1969) the spore size is (7)8-9(10) μm).

Developed in moist chamber culture on bark of old *Malus domestica* with no other species, incubation time 29 days.

Trichia munda (Lister) Meylan, Bull. Soc. Vaud. Sci. Nat. 56: 327. 1925

Fig. 12, A-C

Specimens examined: Bohemian Karst, Radotínské údolí Nature Reserve; bark of living tree of *Tilia cordata* (MCC), 20. III.1997, leg. et det. RD (PRC). - Koda Nature Reserve, bark of living tree of *Crataegus* sp. (MCC), 21. III.1997, leg. et det. RD (PRC). - Hřebeny Mts.: Dobřichovice under Mt.

Hvízdinec; dead leaves of *Aesculus hippocastanum* (MCC), 21. III.1997, leg. et det. RD (PRC).

Sporangia stalked, small (0.8-1.2 mm high), almost globose, brown with pale yellow bands forming a large-meshed net. Stalk dark brown, thick, 2/3 of the total height, on a small dark brown hypothallus. Peridium consisting of two adherent layers; the outer layer thickened and encrusted with dark granulose material (except for the pale bands with the spore mass visible through), the inner layer thin and translucent; dehiscing along the bands. Elaters not branched, relatively short (140-200 μm), ornamented with three smooth spirals, tapering into 30-40 μm long points with blunt apex. Spores and capillitium olive-yellow in mass, spores minutely warted, 9.6-12 μm in diam.

Cultivated in moist chamber culture on bark of *Tilia* and *Crataegus* and on dead leaves of *Aesculus hippocastanum*, together with *Arcyria cinerea*, *A. pomiformis*, *Calomyxa metallica*, *Enerthenema papillatum* and *Physarum nutans*. Sporangia developing solitary, in small numbers (up to 10 sporangia per one chamber), incubation time 24-31 days. The specimen from dead leaves developed after drying and rewetting of the substrate (total time 4 months).

Usually obtained in moist chamber cultures only, recorded from Germany, the Netherlands, Switzerland, Portugal, Iceland and the USA.

DISCUSSION

Species diversity. – From the whole Czech Republic, 204 Myxomycete species have been reported (Dvořáková 1999b). The 95 species found in the area studied (about 40 sq km) indicate a rich offer of substrates for Myxomycetes present here as well as low research intensity in the rest of the country. Also the average number of species per genus (3.27) shows a relatively high species diversity. The degree of species classified as rare (collected 1-2 times) is relatively high – 40%, which corresponds with similar studies (Schnittler et Novozhilov 1996, Schnittler et Stephenson 2000) and shows the importance of long-term studies in Myxomycetes research.

Comparing the spectrum of Myxomycetes in the localities studied (as shown in Table 1), only 55 species (58 %) were found in both localities. There is a higher number of species recorded in the Bohemian Karst (84 species) than in the Hřebený Mts. (68 species). This is mainly due to a different and richer vegetation composition in Nature Reserves caused by the limestone base in the Bohemian Karst.

There were 12 species of *Physarales* collected in Bohemian Karst only (e.g. *Badhamia dubia*, *Diderma cingulatum*, *D. crustaceum*, *D. spumarioides*, *Fuligo cinerea*, *F. rufa*, *Mucilago crustacea*, *Physarum decipiens*, *P. leucophaeum*, *P. leucopus*, see Table 1.). Another 5 species belonging to *Physarales* were collected

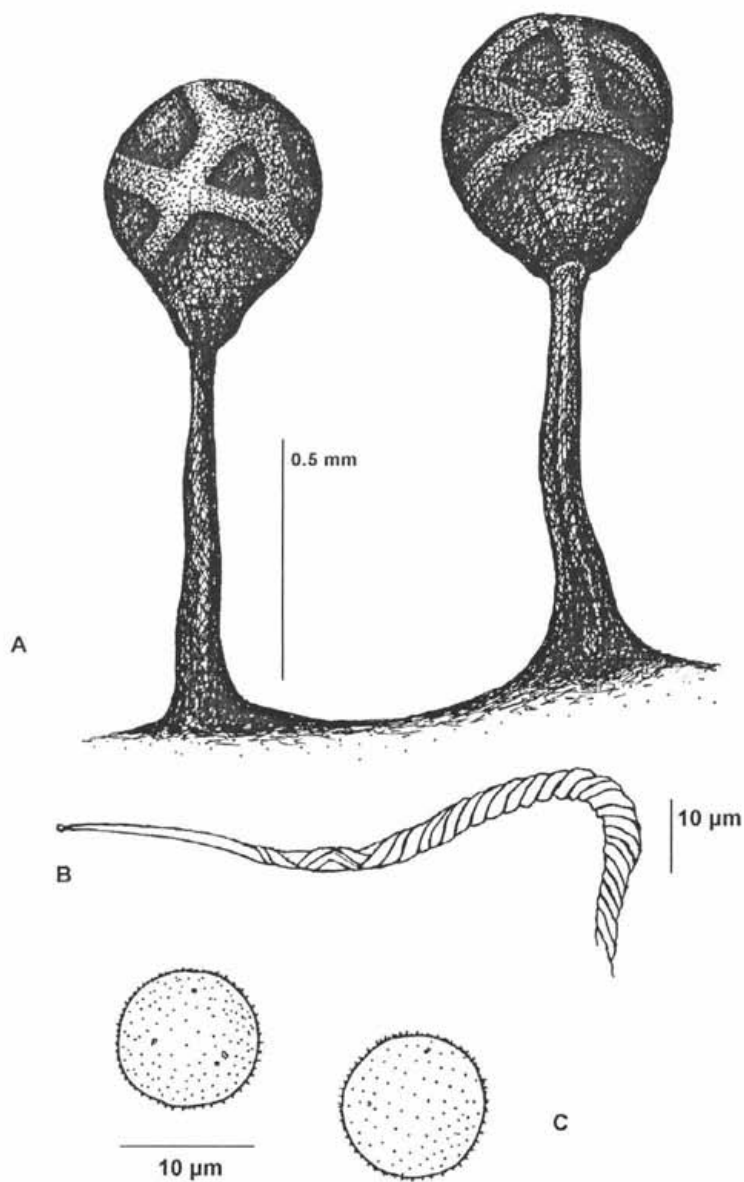


Fig. 12. *Trichia munda* (Lister) Meylan. A - sporangia, B - part of capillitium, C - spores

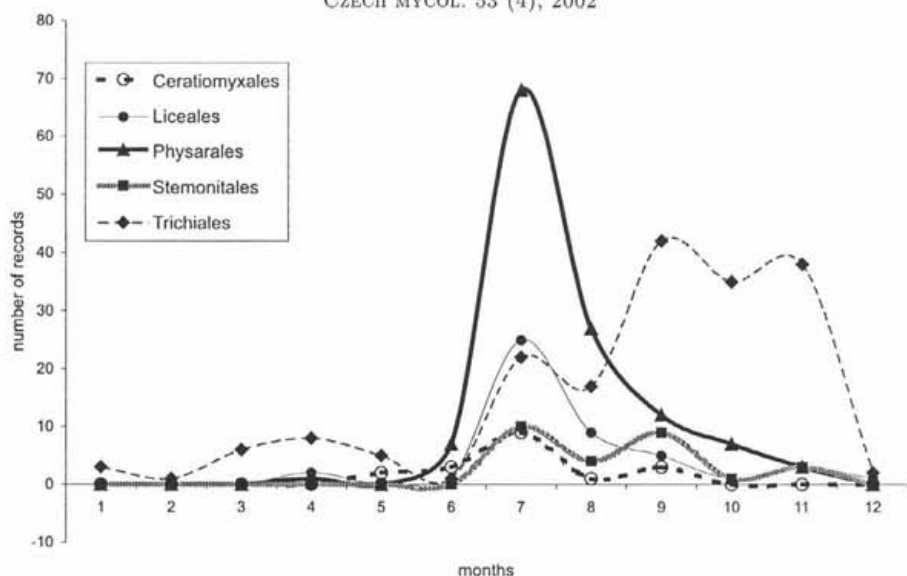


Fig. 13. Seasonal dynamics of orders of Myxomycetes in localities studied (based on data from Bohemian Karst and Hřebený Mts. from 1935–1999)

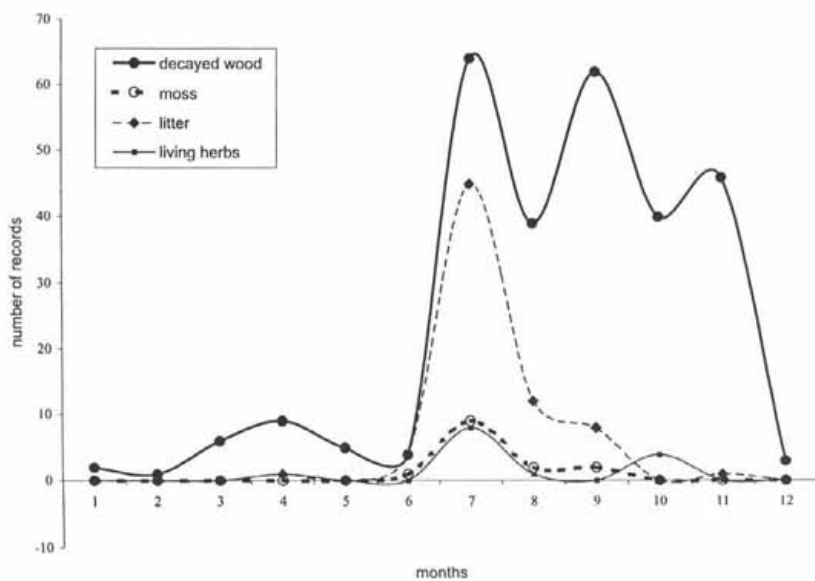


Fig. 14. Seasonal appearance of Myxomycetes on microhabitats (based on data from Bohemian Karst and Hřebený Mts. from 1935–1999)

only in the Hřebeny Mts. (*Didymium nigripes*, *D. serpula*, *Physarum bivalve*, *P. cinereum* and *P. virescens* – mostly small folicolous species), indicating there was a conspicuous difference in both quality and quantity of Physarales present in the localities studied. The question whether this difference is directly due to the lime presented in Bohemian Karst or to other factors will remain an object of further long-term research and discussion.

Seasonal dynamics. – After putting together all data available for seasonal analysis (field collections only), a simple graph on seasonal dynamics came out (Fig. 13). It is only of informative value as the amount of fieldwork differed per every month of the year. It naturally reflects the Central-European climate with usually two main rain seasons suitable for Myxomycetes in July and September–November. As seen from the graph and well-known from field experience, the occurrence of the Myxomycete orders of *Physarales* and *Liceales* is more or less concentrated to one relatively short period of time during the summer season (the highest peak in July). Species of *Trichiales* (mostly xylophilous) are typical of the autumn aspect and otherwise fructified in a small quantity during the whole year. A similar situation is seen in Fig. 14, which reflects the preference of microhabitats in Myxomycete orders. The maximum of litter-inhabiting species in July is determined by the order *Physarales*.

Moist chamber cultures. – 250 chambers, prepared with samples of bark and litter, yielded 33 species representing 19 genera of Myxomycetes. Only 73 % of the moist chambers yielded Myxomycete fructifications. Species of the genus *Diderma* and *Didymium* fructified only after the cultivation was repeated. Among the most favourable substrates were *Acer* spp., *Aesculus hippocastanum*, *Betula pendula*, *Crataegus* sp. and *Quercus* spp. (see Table 2.). A quite specific Myxomycete flora occurred on *Juniperus communis*, *Malus domestica* and *Sambucus nigra*.

Spare material from moist chamber cultures (2–3 fructifications per moist chamber) was successfully multiplied by repeated cultivation several times. For example, a moist chamber with 2 sporangia of *Physarum viride* var. *aurantiacum* left on the substrate was rewetted and cultivated again. Finally 3 large colonies of this species were harvested. The same occurred with the species *Arcyria cinerea* and *Paradiacheopsis fimbriata*. If successful with other species of Myxomycetes as well, this could be a possible way of solving problems with lack of material from moist chambers.

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Table 2. List of substrates cultivated in moist chamber cultures with numbers of Myxomycete species and specimens developed (both on bark and litter).

substrate	moist chambers	species	specimens
<i>Acer campestre</i>	11	10	21
<i>Acer platanoides</i>	18	9	28
<i>Acer pseudoplatanus</i>	13	12	23
<i>Aesculus hippocastanum</i>	11	11	25
<i>Alnus glutinosa</i>	8	8	27
<i>Betula pendula</i>	11	10	26
<i>Crataegus sp.</i>	6	10	17
<i>Fagus sylvatica</i>	22	9	24
<i>Juniperus communis</i>	3	5	6
<i>Larix decidua</i>	13	3	17
<i>Malus domestica</i>	6	6	23
<i>Picea abies</i>	14	5	24
<i>Pinus nigra</i>	5	2	4
<i>Pinus sylvestris</i>	18	6	31
<i>Populus alba</i>	1	5	5
<i>Populus nigra</i>	4	5	7
<i>Pseudotsuga menziesii</i>	2	3	4
<i>Pyrus communis</i>	6	5	15
<i>Quercus petraea</i>	16	8	38
<i>Quercus robur</i>	15	10	39
<i>Robinia pseudacacia</i>	7	6	12
<i>Salix fragilis</i>	5	7	19
<i>Sambucus nigra</i>	13	7	23
<i>Sorbus aucuparia</i>	4	4	8
<i>Sorbus torminalis</i>	3	5	7
<i>Tilia cordata</i>	4	6	10

Museum in Prague for enabling me to study their Myxomycete collection and M. Chumchalová for redrawing the pictures.

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