CZECH MYCOLOGY

VOLUME 57
AUGUST 2005

1–2

CZECH SCIENTIFIC SOCIETY FOR MYCOLOGY PRAHA

ISSN 1211-0981

Vol. 57, No. 1–2, August 2005

CZECH MYCOLOGY

formerly Česká mykologie
published quarterly by the Czech Scientific Society for Mycology
http://www.natur.cuni.cz/cvsm/

Czech Mycology is an international scientific journal publishing papers in all aspects of mycology. Publication in the journal is open to members of the Czech Scientific Society for Mycology and non-members.

Contributions to: Czech Mycology, National Museum, Mycological Department, Václavské nám. 68, 115 79 Praha 1, Czech Republic.

SUBSCRIPTION. Annual subscription is Kč 650,– (including postage). The annual subscription for abroad is US $ 86,– or EUR 83,– (including postage). The annual membership fee of the Czech Scientific Society for Mycology (Kč 500,– or US $ 60,– for foreigners) includes the journal without any other additional payment. For subscriptions, address changes, payment and further information please contact **The Czech Scientific Society for Mycology, P.O. Box 106, 111 21 Praha 1, Czech Republic. http://www.natur.cuni.cz/cvsm/**

This journal is indexed or abstracted in:

Biological Abstracts, Abstracts af Mycology, Chemical Abstracts, Excerpta Medica, Bibliography of Systematic Mycology, Index of Fungi, Review of Plant Pathology, Veterinary Bulletin, CAB Abstracts, Rewiew of Medical and Veterinary Mycology.

Czech Mycology Vol. 56, No. 3–4 appeared on December 22, 2004

CZECH MYCOLOGY
Publication of the Czech Scientific Society for Mycology

Volume 57 August 2005 Number 1–2

Central European genera of the *Boletaceae* and *Suillaceae*, with notes on their anatomical characters

JOSEF ŠUTARA

Prosetická 239, 415 01 Teplice, Czech Republic

Šutara J. (2005): Central European genera of the *Boletaceae* and *Suillaceae*, with notes on their anatomical characters. – Czech Mycol. 57: 1–50.

A taxonomic survey of Central European genera of the families *Boletaceae* and *Suillaceae* with tubular hymenophores, including the lamellate *Phylloporus*, is presented. Questions concerning the delimitation of the bolete genera are discussed. Descriptions and keys to the families and genera are based predominantly on anatomical characters of the carpophores. Attention is also paid to peripheral layers of stipe tissue, whose anatomical structure has not been sufficiently studied. The study of these layers, above all of the caulohymenium and the lateral stipe stratum, can provide information important for a better understanding of relationships between taxonomic groups in these families. The presence (or absence) of the caulohymenium with spore-bearing caulobasidia on the stipe surface is here considered as a significant generic character of boletes. A new combination, *Pseudoboletus astraeicola* (Imazeki) Šutara, is proposed.

Key words: *Boletaceae*, *Suillaceae*, generic taxonomy, anatomical characters.

Šutara J. (2005): Středoevropské rody čeledí *Boletaceae* a *Suillaceae*, s poznámkami k jejich anatomickým znakům. – Czech Mycol. 57: 1–50.

Je předložen taxonomický přehled středoevropských rodů čeledí *Boletaceae* a *Suillaceae* s rourkovitým hymenoforem, včetně rodu *Phylloporus* s lupeny. Jsou diskutovány otázky týkající se vymezení hřibovitých rodů. Popisy a klíče k čeledím a rodům jsou založeny převážně na anatomických znacích plodnic. Pozornost je také věnována periferním vrstvám tkáně na třeni, jejichž anatomická stavba není dostatečně prostudována. Studium těchto vrstev, především kaulohymenia a laterálního strata třeně, může poskytnout informace důležité pro lepší poznání příbuzenských vztahů mezi taxonomickými skupinami v těchto čeledích. Přítomnost (či nepřítomnost) kaulohymenia s výtrusorodými kaulobazidiemi na povrchu třeně je zde považována za významný rodový znak hřibů. Je navržena nová kombinace: *Pseudoboletus astraeicola* (Imazeki) Šutara.

INTRODUCTION

The boletes form a conspicuous group of macrofungi which has been the centre of interest of many mycologists for more than two centuries. Currently the most widely accepted classification of this group is that by Singer (e.g. 1951, 1962, 1965, 1967, 1975, 1986, etc.). Nevertheless, major differences in opinion on the generic and familial limits still exist. Further relevant works dealing with boletes have been those by the following authors: Karsten (1881), Quélet (1886, 1888), Bataille (1908), Gilbert (1931) as forerunners, Snell (1941), Watling (1970), Smith and Thiers (1971), Corner (1972), Arpin and Kühner (1977), Pegler and Young (1981), Alessio (1985), Engel et al. (1983, 1996), Lannoy and Estades (2001) and many others. Anatomical characters of boletes and related groups have been examined by Fayod (1889), Josserand (1932), Lohwag and Peringer (1937), Elrod and Blanchard (1939), Lohwag (1941), Disbrey and Watling (1967), Watling and Largent (1976), Reijnders and Stalpers (1992), Clémençon (1997) etc. Authors who have studied the spore morphology in these groups are Perreau-Bertrand (1961, 1965), Pegler and Young (1971, 1981), Heinemann, Rammeloo and Rullier (1988), Oolbekkink (1991), Holec (1994), etc. Chemotaxonomic analyses by many authors, e.g. Bresinsky and Orendi (1970), Besl and Bresinsky (1977, 1997), Gill and Steglich (1987) etc., have contributed valuable data significant for bolete taxonomy. Molecular studies concerning the boletes and allied groups have been published by Bruns and Szaro (1992), Gardes and Bruns (1996), Bruns et al. (1998), Kretzer and Bruns (1999), Binder and Besl (2000), Hibbett and Thorn (2001), Binder and Bresinsky (2002), etc.

As regards the taxonomic position of the groups in question, the families *Boletaceae* and *Suillaceae* belong to the order *Boletales* Gilbert. The other families of this order [e.g. *Gyrodontaceae* (Singer) Heinem., *Gyroporaceae* (Singer) Binder et Bresinsky, *Paxillaceae* Lotsy, *Gomphidiaceae* Maire ex Jülich] and gasteroid forms recently classified as the *Boletales* (*Gastrosuillus* Thiers, *Chamonixia* Rolland, etc.) are not discussed here.

FAMILIES AND GENERA INCLUDED IN THIS PAPER

family: *Suillaceae* (Singer) Besl et Bresinsky
    genera: *Boletinus* Kalchbr., *Suillus* Adans., *Mariaella* Šutara

family: *Boletaceae* Chevallier
  subfamily: *Boletoideae*
    genera: *Boletus* L. [including subgenus *Xerocomus* (Quél.) Maubl.], *Tylopilus* P. Karst., *Porphyrellus* Gilbert, *Chalciporus* Bataille, *Buchwaldoboletus* Pilát, *Rubinoboletus* Pilát et Dermek, *Pseudoboletus* Šutara, *Phylloporus* Quél., *Leccinum* S. F. Gray
  subfamily: *Strobilomycetoideae* (Gilbert) Watling
    genus: *Strobilomyces* Berk.

Materials and methods

This paper summarizes the results of the author's study of the anatomy of boletes in the last twenty years and supplements some of his earlier published contributions (Šutara 1987a, 1987b, 1989, 1991). A list of studied Central European species is appended to each section dealing with individual genera. The author's collections are deposited in his private herbarium (abbreviation: JŠ). Many specimens examined were loaned from National Museum, Prague (PRM), Moravian Museum, Brno (BRNM), South Bohemian Museum, České Budějovice (CB), Slovak National Museum, Bratislava (BRA), Regional Museum of Litoměřice (LIT) and Regional Museum of Hradec Králové (HK).

Anatomical and histological characters of boletes were studied predominantly on dried material. Microscopic sections were made by hand with a razor blade. Sections from dried material were revived in a 3–10 % solution of ammonium hydroxide (NH_4OH) with (or without) Congo Red or in Melzer's reagent. Microscopic structures of the studied species were mostly examined on a sufficiently large number of both young and middle-aged or mature carpophores. Material of poor quality, with various defects and abnormalities, was excluded from the examination. In several cases the carpophores were also studied in a fresh state. Microscopic examination confirmed the presumption that the results obtained from both revived dried material and fresh carpophores are very similar in every detail. Sections from fresh material were mounted in Melzer's reagent or in an aqueous solution of Congo Red.

Results and discussion

Arrangement of the hymenophoral trama

The main types (or subtypes) of arrangement of the bilateral hymenophoral trama occurring in the families *Boletaceae* and *Suillaceae* are: phylloporoid, boletoid and mariaelloid.

The boletoid and phylloporoid type. Probably the first authors who pointed out differences in arrangement of the hymenophoral trama of some poroid boletes were Lohwag and Peringer (1937). The boletoid and phylloporoid tramal structures were studied and discussed by many authors, e.g. by Singer (1951, 1962, 1975, 1986), Snell and Dick (1958), Disbrey and Watling (1967), Corner (1972), Reijnders and Stalpers (1992), etc.

In the boletoid and phylloporoid trama there is a distinctly developed mediostratum which is very similar in both types. The mediostratum is composed of a dense layer of non-gelatinous, densely septate hyphae. In a longitudinal section the mediostratum looks like a darker, narrow stripe of tissue in the central part of the trama (see Figs. 1c, 2c, 3b).

The difference between the phylloporoid and boletoid type of the trama is based on different arrangements of lateral strata. In the phylloporoid trama the lateral strata are composed of non-gelatinous, slightly divergent, densely arranged hyphae touching each other (Figs. 2c, 2d and Šutara 1987a: Fig. 1). In the typical boletoid trama the lateral strata are more or less gelatinized, distinctly divergent, loosely arranged, with hyphae not touching each other (Figs. 1c, 1d, 3b, 3d, 4a). These differences are the main reason why the lateral strata in the phylloporoid trama are almost concolorous with the mediostratum whereas the lateral strata in the boletoid type are distinctly lighter. In microscopic preparations the contrast between the layers of the hymenophoral trama can be improved by suitable stains, e.g. Congo Red.

The phylloporoid type of the trama occurs in its typical form in the genus *Phylloporus* and a few species of the *Boletus subtomentosus* group. The true boletoid type is frequent, occurring in many boletes of *Boletus* s. str., *Leccinum*, *Buchwaldoboletus*, *Suillus*, *Boletinus*, etc. It is, however, important to note that in some boletes the hymenophoral trama is of a structure intermediate between the boletoid and phylloporoid type. This problem will be discussed in detail under *Boletus*, subgenus *Xerocomus*.

The mariaelloid type. In contrast to the boletoid and phylloporoid type, the mariaelloid hymenophoral trama is gelatinized evenly all over its width so that it is not differentiated into a mediostratum and lateral strata. The hyphae of the trama are loosely arranged (not touching each other), slightly divergent or almost parallel (Figs. 3a, 3c, 4d).

The mariaelloid trama has hitherto been found by the present author in *Mariaella bovina* (L.: Fr.) Šutara [≡ *Suillus bovinus* (L.: Fr.) Roussel] and in some carpophores of *Suillus flavidus* (Fr.) J. Presl and the North American *Suillus pictus* (Peck) Smith et Thiers.

Changes of the hymenophoral trama in the course of development

In his Agaricales in Modern Taxonomy, Singer (1986: 55) stated, 'It is essential to keep in mind that the tramal configuration may change during the individual development of a hymenophore'. This important principle should be respected during microscopic examination.

Development of the boletoid and phylloporoid hymenophoral trama. At the very beginning (i.e. at the primordial or postprimordial stage) the bilateral tramas of both the phylloporoid and boletoid type are rather densely arranged, non-gelatinous and therefore very similar to each other. During further growth, however, these two types of trama develop in a different way.

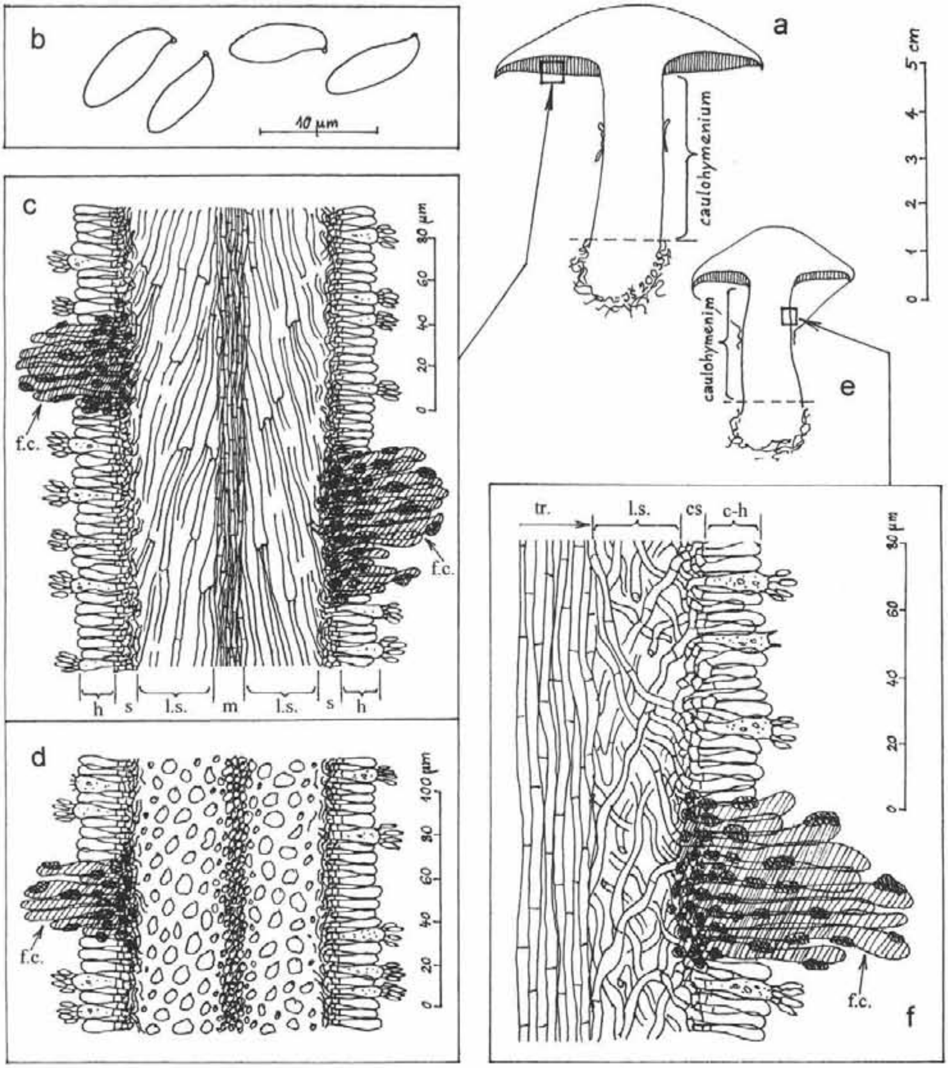


Fig. 1. *Suillus luteus* (type species of *Suillus*) – **a:** A middle-aged carpophore in a section (JŠ 4050). – **b:** Spores. – **c:** The boletoid hymenophoral trama in a longitudinal section. Both dense mediostratum and loosely arranged, gelatinous lateral strata are well distinct. Fasciculate oleocystidia of the *Suillus* type with an incrustation and dark content are present; h = hymenium, s = subhymenium, l.s. = lateral stratum, m = mediostratum, f.c. = fascicles of oleocystidia. – **d:** The boletoid trama in a transverse section. – **e:** A young carpophore in a section (JŠ 4051). – **f:** Peripheral layers of tissue in the upper half of the stipe. Beneath the caulohymenium with fertile caulobasidia there is a loosely arranged, gelatinous lateral stratum of the stipe; tr. = stipe trama proper, l.s. = lateral stipe stratum, cs = caulosubhymenium, c–h: caulohymenium, f.c. = fascicle of incrusted oleocystidia of the *Suillus* type.

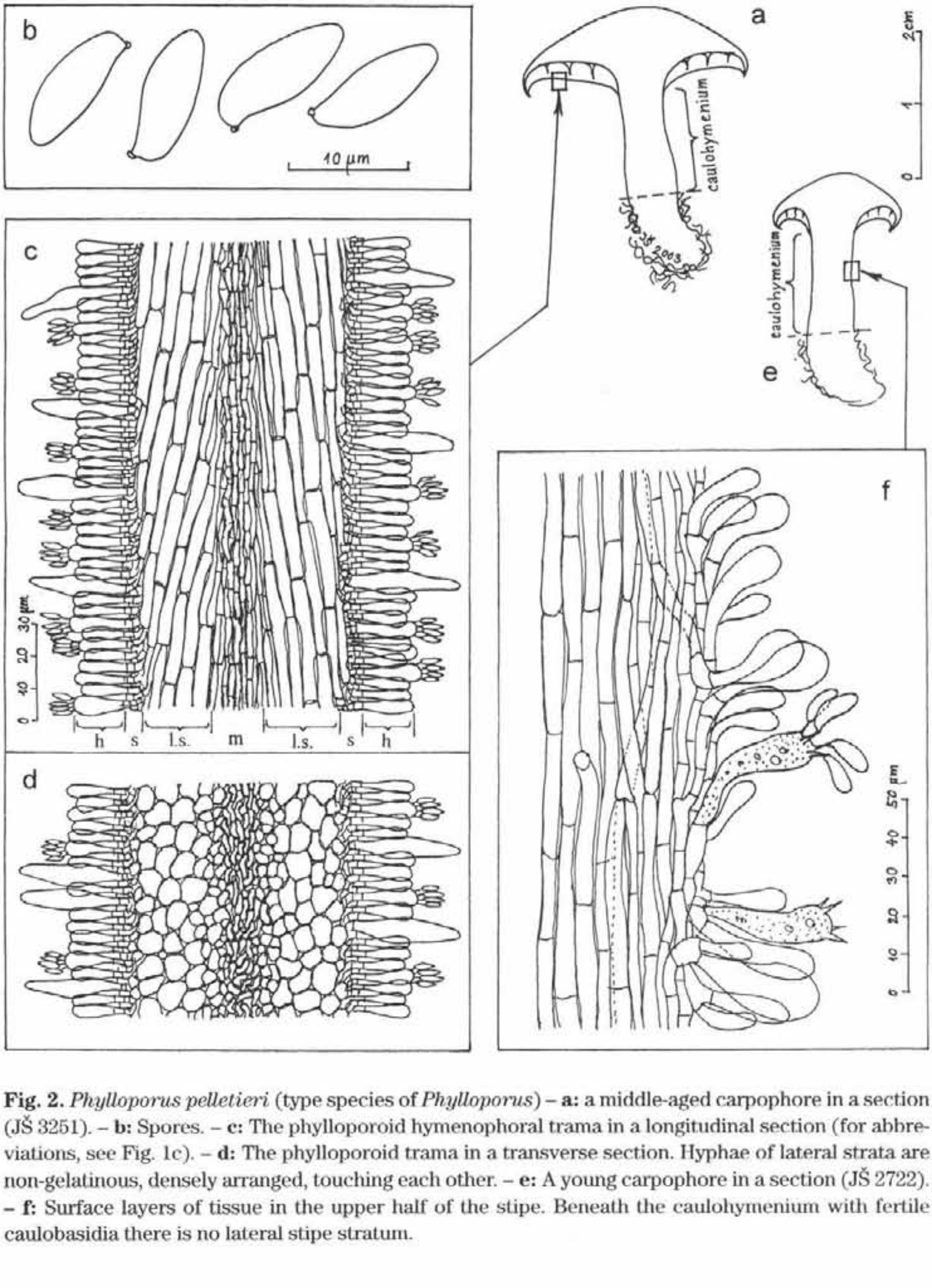


Fig. 2. *Phylloporus pelletieri* (type species of *Phylloporus*) – **a:** a middle-aged carpophore in a section (JŠ 3251). – **b:** Spores. – **c:** The phylloporoid hymenophoral trama in a longitudinal section (for abbreviations, see Fig. 1c). – **d:** The phylloporoid trama in a transverse section. Hyphae of lateral strata are non-gelatinous, densely arranged, touching each other. – **e:** A young carpophore in a section (JŠ 2722). – **f:** Surface layers of tissue in the upper half of the stipe. Beneath the caulohymenium with fertile caulobasidia there is no lateral stipe stratum.

In the phylloporoid trama both mediostratum and lateral strata remain non-gelatinous all through the development of the carpophore.

In the boletoid trama the mediostratum also remains permanently non-gelatinous but lateral strata soon gelatinize. This process of gelification, which is moreover connected with changes in density and divergence of hyphae of the lateral strata, begins already at a young age and reaches its maximum at a medium stage of development of the tubes, i.e. in younger or middle-aged carpophores. At this stage the contrast between the loosely arranged, gelatinous lateral strata and the dense, non-gelatinous mediostratum is the most conspicuous and the boletoid trama has a typical appearance, very different from the phylloporoid arrangement (Figs. 1c, 3b). During further development the gelification of the lateral strata gradually disappears. Moreover, the hymenophoral trama gradually lengthens with age so that in mature tubes the initially true boletoid arrangement changes into a structure similar to the phylloporoid or into a subregular trama.

The hymenopohoral trama should thus be studied at the stage when the lateral strata are best developed and gelatinized. Examination of the trama in the other developmental stages can give skewed results because at a very young age the typical features of the boletoid structure are not yet sufficiently formed and at a more advanced age (i.e. in carpophores approaching maturity) these features gradually fade away. It is obvious that information about the age of the carpophores examined is very important. In the generic diagnoses given in this contribution the hymenophoral trama is, in all cases, described as it was ascertained by the author just in the best developed stage, i.e. in younger or middle-aged carpophores.

The arrangement of the trama may be negatively influenced by some environmental factors, particularly by dry weather. The true boletoid trama can develop well only under sufficiently favourable circumstances. Results of the microscopic study can also be dependent on the quality of the herbarium material. Specimens which were not dried carefully and whose tissues therefore revive insufficiently in microscopic preparations should be excluded from any anatomical study. The understanding of the arrangement in the hymenophoral trama of a particular species and also the understanding of all developmental changes in this structure sometimes requires repeated re-examinations of a sufficiently large number of specimens. It seems that the methodology of the study of this structure adopted by various mycologists is rather different. This is probably one of the reasons why results of some authors have been contradictory.

Development of the mariaelloid hymenophoral trama. At the very beginning (i.e. at the primordial or postprimordial stage) this hymenophoral trama is distinctly bilateral, non-gelatinous and similar to the trama in very young tubes of the other boletes. At this very early stage there exists a suggestion of a mediostratum and divergent lateral strata. However, this stage lasts only for a short time. During further development the trama quickly changes because both mediostratum and lateral strata very soon become gelatinous. In middle-aged carpophores (which are the most suitable for the study of this type of the tramal structure) the mariaelloid trama is already fully and typically developed, viz. strongly gelatinized and loosely arranged both in the lateral layers and in the middle part (Figs. 3a, 3c, 4d). In fully mature carpophores the hyphal structure finally looses the divergent arrangement and gradually changes into a gelified, subparallel trama.

Surface of the stipe

Except for three species whose stipe surface is infertile (see the note on the stipe surfaces of *Boletinus*, *Mariaella* and *Pseudoboletus*), all the other Central European boletes of the families *Boletaceae* and *Suillaceae* have reproductive organs developed not only in the tubes but also on the stipe. These boletes have a substantial part of the stipe covered by a caulohymenium with spore-bearing caulobasidia. The caulohymenium is absent only in the lowest part of the stipe, which is hidden in the substrate and often covered with a basal tomentum. The presence of basidia on the stipe in some boletes has already been described or mentioned by many authors, e.g. Melzer (1919), Lohwag (1922), Kühner (1926), Němec (1926), Lohwag and Peringer (1937), Elrod and Snell (1940), Singer (1951, 1962, 1975, 1986), Pantidou (1961, 1962), Smith and Thiers (1964, 1968), Disbrey and Watling (1967), Watling and Largent (1976), Watling (1985), Hlaváček (1997 etc.) and others.

Anatomical study of primordial and postprimordial stages of boletes showed that the caulohymenium is in essence a continuation of the fertile hymenium from the tubes on the stipe (cf. Kühner 1926, Němec 1926, Elrod and Snell 1940, Pantidou 1961, Watling 1985, etc.). The hymenial layer on the stipe was described as e.g. 'veritable hyménium' by Kühner (1926), 'hymenial layer of the stem' by Němec (1926), 'true hymenium' by Elrod and Snell (1940), 'fertile palisade' by Pantidou (1961), 'hyménium stipitaire' by Reijnders (1963), 'caulohymenium' by Smith and Thiers (1964, 1968, 1971), Grund and Harrison (1976) and Watling (1985), 'cauline hymenium' or 'stem-hymenium' by Corner (1972), 'hyménium fertile' by Arpin and Kühner (1977), 'kaulohymenium' by Hlaváček (1997), etc. Among the terms used for the hymenial layer on the stipe, the term 'caulohymenium' has been considered the most appropriate by the present author (Šutara 1987a, 1987b, 1989). [Note: In this contribution the caulohymenium is never called 'stipe cuticle' or 'stipe cortex'. The term 'stipe cuticle' is here used only for sterile surface layers of the stipe, e.g. a trichoderm, trichodermal palisade etc.].

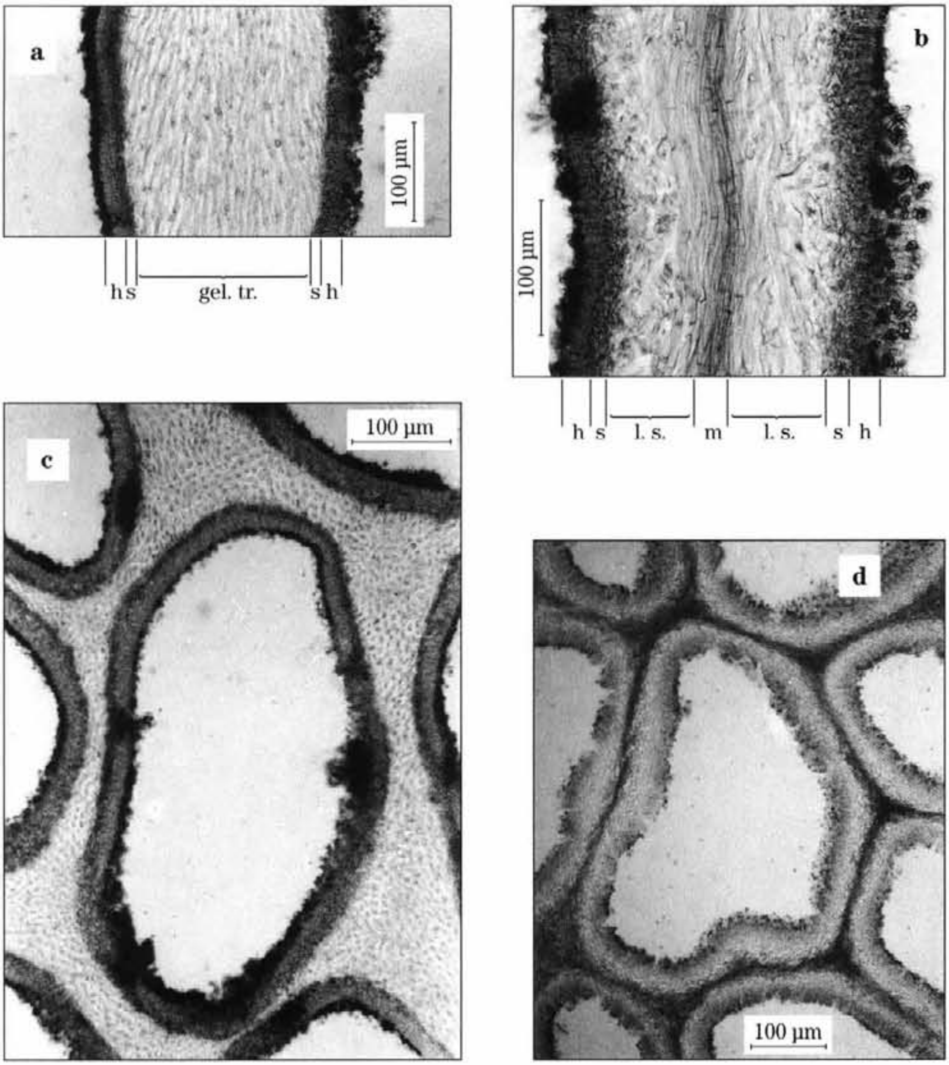


Fig. 3. – **a:** *Mariaella bovina* (type species of *Mariaella*) (JŠ 542), the mariaelloid hymenophoral trama in a longitudinal section; gel.tr. = gelatinous trama without a distinct mediostratum (for the other abbreviations, see Fig. 1c). – **b:** *Suillus variegatus* (JŠ 1566), the boletoid hymenophoral trama in a longitudinal section (for abbreviations, see Fig. 1c). – **c:** *Mariaella bovina* (JŠ 1742), the mariaelloid hymenophoral trama in a transverse section. The trama is not differentiated into a mediostratum and lateral strata. – **d:** *Gyrodon lividus*, *Gyrodontaceae* (BRNM 235941), the boletoid hymenophoral trama in a transverse section. Both dark-coloured mediostratum and light-coloured lateral strata are well distinct. (Sections 3a – 3d were stained with Congo-Red).

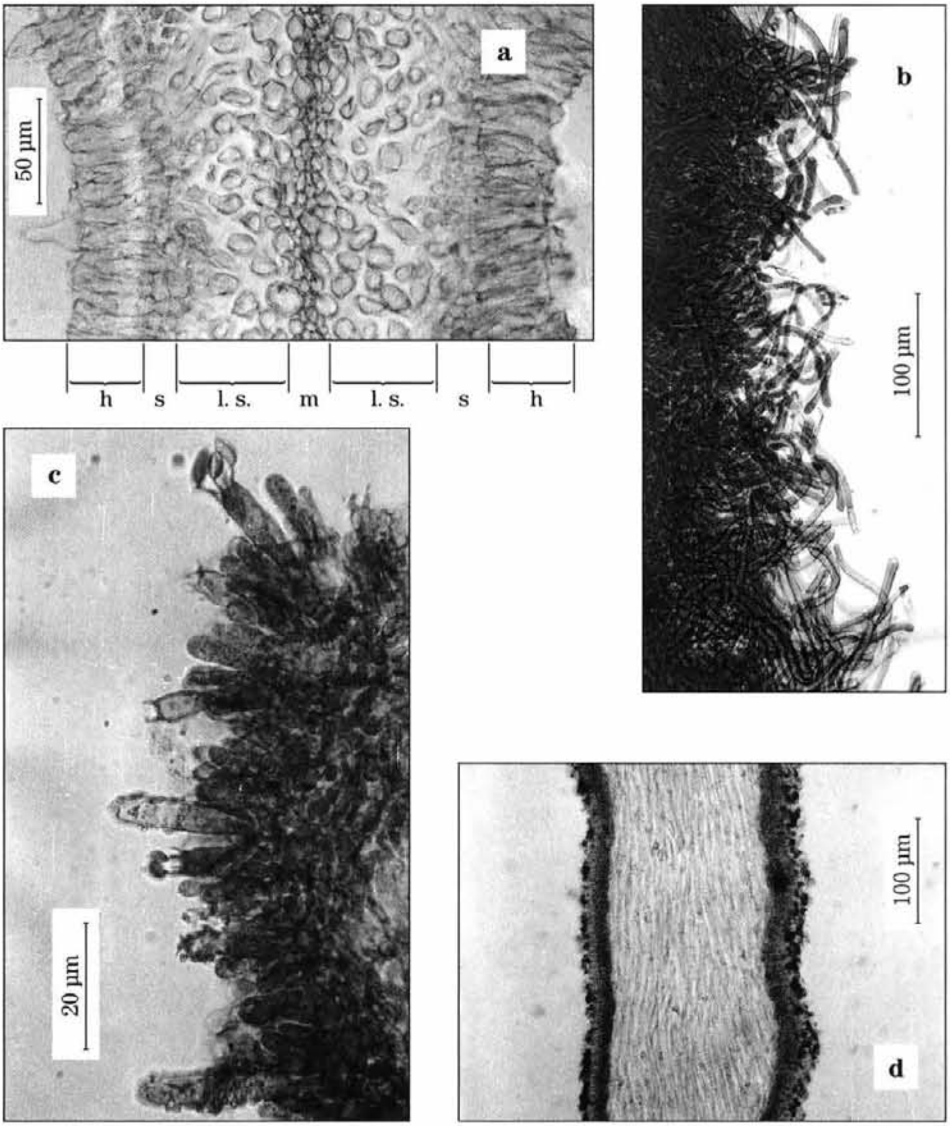


Fig. 4. – a: *Leccinum luteoporum* (LIT 3776/565), the boletoid hymenophoral trama in a transverse section (for abbreviations, see Fig. 1c). – **b:** *Pseudoboletus parasiticus* (type species of *Pseudoboletus*) (JŠ 2109), the infertile stipe cuticle consisting of a filamentous trichoderm (section from the upper part of the stipe). – **c:** *Suillus tridentinus* (JŠ 3073), a fragment of the caulohymenium with spore-bearing caulobasidia from the middle part of the stipe. – **d:** *Mariaella bovina* (JŠ 542), the mariaelloid hymenophoral trama in a longitudinal section. Divergence of tramal hyphae is almost indistinct. (Sections 4a – 4d were stained with Congo-Red).

Some characters of the caulohymenium

The caulohymenium is comparable with the hymenium of the hymenophore in many respects. This layer is composed of caulobasidioles, caulocystidia and sporulating caulobasidia. The term 'caulobasidia' was already used by some authors, e.g. Smith and Thiers (1968). Spores produced by the caulobasidia on the stipe are not different from those originating from the basidia in the tubes. For example, mature spores from the stipe of *Boletus porosporus* (Imler) Moreno et Bon (specimen examined: JŠ 1631) are truncate and spores from the stipe of *Strobilomyces strobilaceus* (Scop.: Fr.) Berk. (JŠ 3420) are shaped, ornamented and dark pigmented in the same way as those from the tubes. Also measurements of spores both from the hymenophore and from the stipe are in essence the same. This was tested by the present author for *Suillus luteus* (L.: Fr.) Roussel (JŠ 2285), *Suillus pictus* (PRM 715519) and some other species (see Šutara 1987b: Figs. 6b, 7c). The spore print obtained from the caulohymenium is the same colour as that from the hymenophore (material examined: *Suillus luteus*, JŠ 2285; *Strobilomyces strobilaceus*, JŠ 3420, etc.). Caulobasidia produce spores even on the places where the stipe surface with the caulohymenium is covered with a veil (or remnants of the veil). This was observed by the present author on such species as *Strobilomyces strobilaceus*, *Suillus luteus*, *Suillus pictus*, *Suillus lakei* (Murrill) Smith et Thiers, *Suillus grevillei* (Klotzsch: Fr.) Singer, *Suillus laricinus* (Berk.) O. Kuntze and *Suillus tridentinus* (Bres.) Singer.

The caulohymenium, naturally, is not as fertile as the hymenium in the tubes. Moreover, the quantity of spores produced by the stipe surface is rather different in various species. In some boletes the caulobasidia are relatively abundant, but in some others they are present only in a small number. Abundant caulobasidia occur in members of *Boletus* s. str., *Suillus*, *Leccinum*, in *Tylopilus felleus* (Bull.: Fr.) P. Karst., *Buchwaldoboletus lignicola* (Kalchbr.) Pilát, etc. A smaller number of caulobasidia is a characteristic feature of such species as *Boletus gentilis* (Quél.) Big. et Guill., *Rubinoboletus rubinus* (W. G. Smith) Pilát et Dermek, *Porphyrellus porphyrosporus* (Fr.) Gilbert, *Phylloporus pelletieri* (Lév.) Quél. and some xerocomoid boletes. The search for caulobasidia on the stipe surface can be very difficult in some cases. For example, in *Boletus pulverulentus* Opat. the caulobasidia are constantly present but are not easy to find because in this species all elements of the caulohymenium, including the caulobasidia, are covered with an amorphous incrustation.

It is also important to note that the number of caulobasidia in various parts of the stipe is very different. In the upper part of the stipe the fertile basidia are much more abundant than in the lower half where they are usually scarce or completely absent. In case of a small number of caulobasidia, the caulohymenial elements should be examined not only in longitudinal and transverse sections but also by means of scalps, in which the caulobasidia are usually best seen.

Changes of the caulohymenium in the course of development

The caulohymenium differentiates together with the hymenium of the hymenophore at a primordial stage (cf. Watling 1985: Fig. 1) and remains on the stipe surface all through the development of the carpophore. Nevertheless, it is necessary to mention that the caulohymenium (like the other surface layers of the carpophore) undergoes certain changes during development. In the primordium the caulohymenium forms a continuous layer. In further stages, however, this layer gradually breaks up into small fragments (small islands of caulohymenial elements) as the stipe grows and expands. Some of sterile caulohymenial cells, especially in the lower half of the stipe, have sometimes also a tendency to proliferate with age (Šutara 1987b: Fig. 5). Moreover, in the lower third of the stipe the caulohymenial cells are sometimes mixed with filamentous elements ascending from the tomentum on the stipe base.

Despite all the above-mentioned changes, however, the caulohymenium never loses its characteristic appearance (particularly in the upper half of the stipe) and the fertile caulobasidia are present on the stipe in all developmental stages. As showed some studies of boletes in culture, the caulobasidia are present on the stipe surface even in the cases when the stipe of a primordium never develop a pileus (cf. Pantidou 1962). Between the fertile caulohymenium and the infertile cuticle of the stipe there is always a visible difference. In boletes the presence of the caulohymenium with fertile caulobasidia on the stipe is not only an incidental deviation but a constant, genetically determined character which is the result of a long evolutionary process. Characters concerning the reproductive organs have been usually considered very important from the taxonomic point of view. Accordingly, the fertility or infertility of the stipe surface, i.e. the presence or absence of a caulohymenium with sporulating caulobasidia, is here treated as a significant generic feature of boletes (see also Šutara 1987a, 1987b, 1991, 1992a).

Lateral stipe stratum

The context of the stipe of almost all boletes is composed of a comparatively dense trama with hyphae arranged in a longitudinal way, more or less parallel to the longitudinal stipe axis. This part of the context is called 'the stipe trama proper' in this contribution.

In many boletes the hyphae beneath the caulohymenium diverge from the longitudinal trama proper and form a more or less distinct lateral layer, which is here termed the 'lateral stratum of the stipe trama' or more simply 'lateral stipe stratum' – a slightly modified English version of the original German term 'Stiellateralstratum' of

Lohwag and Peringer (1937). [Note: In an earlier paper the author (Šutara 1989) used the term 'the stipe lateral stratum'].

The lateral stipe stratum is distinguished from the longitudinal stipe trama proper mainly by its divergence, often also by its looser arrangement of the hyphae and sometimes by its gelification.

The lateral stipe stratum, if present, is best developed in the upper half, sometimes also in the middle part of the stipe. In the lower half of the stipe it is usually either very thin or absent. The lateral stipe stratum begins to differentiate beneath the caulohymenium at an early stage and its full development is reached by young or middle age. During further stages this layer usually gradually disappears so that in old age it is often not present at all. Unless otherwise stated the lateral stipe stratum is, in this paper, described as it is usually developed under sufficiently favourable conditions in the upper half (sometimes also in the middle part) of the stipe of young or middle-aged carpophores, in which this layer has usually the most characteristic appearance.

During microscopic study it is necessary to take into consideration that the development of peripheral layers of the stipe (including the lateral stipe stratum) is, to a certain extent, dependent on environmental conditions. In carpophores which grew under unfavourable circumstances (e.g. in extremely dry weather) the lateral stipe stratum is sometimes poorly developed or completely absent.

Some results of the study of the lateral stipe stratum may also be negatively influenced by poor quality of the material examined. In some herbarium specimens the surface layers on the stipe (both caulohymenium and lateral stipe stratum) may be partly or completely damaged by careless handling.

Relation between the lateral stipe stratum and the fertile caulohymenium

Almost all boletes with a fertile caulohymenium have a tendency to form a more or less distinct lateral stratum of the stipe trama under sufficiently favourable conditions. The only exception among Central European boletes is probably *Phylloporus pelletieri* (Lév.) Quél., in which no distinct lateral stipe stratum was found by the present author although the caulohymenium with fertile caulobasidia is present in this species.

On the other hand, boletes with an infertile stipe cuticle (e.g. genera *Gyrodon* Opat., *Gyroporus* Quél., *Boletinus* and *Pseudoboletus*) have no lateral stratum of the stipe trama. An exception in this regard is *Mariaella*, having sometimes a distinctly developed lateral stipe stratum despite the fact that its stipe surface is infertile.

Types of the lateral stipe stratum

Certain taxonomic groups of boletes possess their own characteristic type of the lateral stipe stratum. A very typical lateral stipe stratum (termed 'leccinoid' by the author of this contribution) is present in the genus *Leccinum*, especially in sections *Leccinum* and *Scabra* Smith, Thiers et Watling. The lateral stipe stratum in these two sections is at first a continuous, relatively thick, rather dense, non-gelatinous, almost anticlinally arranged layer of tissue, which soon disrupts into characteristic fascicles of hyphae during the growth of the stipe. This disrupted layer significantly participates in a typical scabrous stipe ornamentation of this genus (see Šutara 1989). In sect. *Luteoscabra* Singer of *Leccinum* the lateral stipe stratum is very similar but somewhat thinner and, at the initial unbroken stage, less densely arranged. A similar lateral stratum of the stipe trama is also developed in *Boletus depilatus* Redeuilh and *Boletus impolitus* Fr. The presence of this type of lateral stipe stratum, which does not occur in the other *Boletus* species, indicates that *B. impolitus* and *B. depilatus* have an isolated position in *Boletus*.

In many boletes some characters of the peripheral layers of the stipe resemble some features of the hymenophore. One of such characters is gelification of the lateral stipe stratum which rather frequently correlates with gelification of the lateral stratum in the tube trama. For example, in *Boletus* s. str. and *Suillus*, in which the hymenophoral trama has gelatinous lateral strata, the lateral stipe stratum is often also gelatinized (see Fig. 1f and Šutara 1989: Figs. 3, 4). This type of the lateral stipe stratum (termed 'boletoid' by the present author) is loosely arranged, divergent, usually well differentiated in both upper and middle part of the stipe where it is usually present from youth to maturity.

In the *Boletus chrysenteron/pruinatus* group, with a weak or almost no gelification of the hymenophoral trama, the lateral stipe stratum is usually non-gelatinous and less distinct because it is thinner and less loosely arranged than in typical representatives of *Boletus* s. str. In most species of the *Boletus chrysenteron/pruinatus* group the lateral stipe stratum is developed only under sufficiently favourable conditions and merely at a young or middle developmental stage. During later stages this layer completely disappears.

A very poorly developed lateral stratum of the stipe trama occurs in such species as *Chalciporus piperatus* (Bull.: Fr.) Singer, *Porphyrellus porphyrosporus* and *Rubinoboletus rubinus*. In these species the lateral stipe stratum is developed very rarely (only under extraordinarily optimal conditions) and, if present, forms merely a very thin, almost indistinct layer, which is discernible only in the upper part of the stipe of young carpophores. This considerably reduced layer is so thin that it resembles a caulosubhymenium rather than a lateral stratum.

As was already mentioned, *Phylloporus pelletieri*, whose phylloporoid hymenophoral trama is non-gelatinous, has no distinct lateral stipe stratum (Fig. 2f).

It is, however, interesting that the *Boletus subtomentosus* group, in which the hymenophore also possesses the non-gelatinous phylloporoid trama, the lateral stipe stratum is usually well developed. The lateral stipe stratum in this group is distinctly divergent, loosely arranged, but never gelatinous (see Šutara 1991: Fig. 3).

Between the individual types of lateral stipe stratum there may, naturally, occur intermediate forms which are, to a certain extent, analogous with the intermediate forms of the structure of the hymenophoral trama. To define the distinctions between the above-mentioned types of lateral stipe stratum in a more precise way is therefore very difficult. On the other hand, however, it is obvious that more or less distinct differences in arrangement of the peripheral stipe layers (at least between certain groups of boletes) really exist. Further study of these anatomical differences could contribute to our better understanding of relationships between taxonomic groups in the *Boletaceae* and *Suillaceae*. Unfortunately, the anatomy of the stipe of boletes has been hitherto insufficiently studied. Some aspects of this matter was already discussed in the author's earlier papers (see Šutara 1987a, 1987b, 1989, 1991).

Infertile stipe surfaces of the genera *Boletinus*, *Mariaella* and *Pseudoboletus*

As suggested above, in Central Europe the *Gyrodontaceae* and *Gyroporaceae* have an infertile stipe surface whereas the *Boletaceae* and *Suillaceae* have the stipe covered by a fertile caulohymenium. Among the Central European *Boletaceae* and *Suillaceae* there are only three exceptions having the stipe surface infertile: *Boletinus cavipes* (Klotzsch) Kalchbr., *Mariaella bovina* and *Pseudoboletus parasiticus* (Bull.: Fr.) Šutara.

The genus *Boletinus* (with *B. cavipes* as the type species) has, in the author's opinion, a rather isolated position in the family *Suillaceae*. Its infertile stipe cuticle composed of a trichoderm and above all its abundant clamp connections suggest certain relations to the *Gyrodontaceae*.

It is generally accepted that *Pseudoboletus parasiticus* (≡ *Xerocomus parasiticus*) is very close to some xerocomoid boletes. However, if *P. parasiticus* (the type species of the genus *Pseudoboletus*) and the xerocomoid boletes are closely related, they must have originated from a common ancestor. In view of the fact that the xerocomoid boletes and even all the other European *Boletaceae* have a fertile caulohymenium, it is very probable that the stipe surface of an ancestor of *Pseudoboletus* was also at first fertile. In the course of evolution it must have changed into an infertile cuticle when *Pseudoboletus* separated as an independent evolutionary branch from the group of the xerocomoid boletes. In the case of *Pseudoboletus* the loss of fertility of the stipe has been possibly a result of adaptation to the conditions of a parasitic life-strategy.

In the genus *Mariaella* (represented by the species *M. bovina*) there is a situation analogous to that in *Pseudoboletus*. *Mariaella*, with an infertile stipe cuticle, has most likely derived from the closely related genus *Suillus*, with a fertile caulohymenium. Also in this case it is very probable that the stipe of an ancestor of *Mariaella* was at first fertile and only subsequently became infertile. One of the anatomical features supporting this hypothesis is that *Mariaella* has sometimes a tendency to form a loosely arranged, gelatinous lateral stipe stratum. Such a lateral stipe stratum occurs very often in species with a fertile caulohymenium, but in boletes with infertile stipe surface (except *Mariaella*) it never appears. We can thus suppose that the lateral stipe stratum of *Mariaella* is probably a relic of the primary evolutionary stage when the stipe of the ancestor of *Mariaella* was fertile.

Pileus cuticle

The terms trichoderm, ixotrichoderm, epithelium, trichodermal palisade and undifferentiated suprapellis are here used essentially in the same sense as in the work of Largent, Johnson and Watling (1977).

The pileus cuticle (like most cortical layers) often changes its appearance in the course of development. The trichodermal elements sometimes become aggregated into tufts (macroscopically looking like a granulose-tomentose or squamulose surface) or, as the pileus grows and expands, the cuticular layer may disrupt and expose the subcuticular layer of the context in the cracks between fragments of the cuticle (an areolate-rimose surface). Very often the trichodermal hyphae on the pileus collapse with age under the influence of weather conditions so that the initially erect or suberect, anticlinal trichoderm (a tomentose or subtomentose surface) finally changes into a cuticle similar to a cutis with depressed, periclinal hyphae (a glabrous surface). It is obvious that the correct interpretation of dermal layers in older carpophores can sometimes be very difficult. Therefore the cuticle should be studied above all in younger stages whenever possible.

Key to families of Central European boletes with a tubular hymenophore (including the lamellate genus *Phylloporus*)

1a Clamp connections constantly present, abundant in the carpophore 2

1b Clamp connections absent or very rare 4

2a Spores of gyrodontoid shape, broadly ellipsoid or subovoid. Spore surface smooth or with a finely denticulate exosporium distinct under an electron microscope (see Perreau 1981). Partial veil absent 3

2b Spores of boletoid shape, narrowly subfusoid or fusoid-ellipsoid, usually with a suprahilar depression, smooth. Partial veil (annulus) present .... genus *Boletinus*, family *Suillaceae*

3a Peripheral zone of the stipe trama (immediately beneath the outer trichoderm) arranged in a direction more or less parallel to the longitudinal stipe axis. Spore print medium brown with an olivaceous tint. Tubes short, decurrent. Pores at first arranged somewhat irregularly (almost labyrinthiform), finally rather large, more or less radially elongated .... genus *Gyrodon*, family *Gyrodontaceae*

3b Peripheral zone of the stipe trama (beneath the outer trichoderm) of a very unusual structure, forming a hard, very compact cortex with a rather large number of hyphae arranged horizontally, around and across the longitudinal stipe axis (see Reijnders 1963, Corner 1972). Spore print light-coloured: pale yellowish or pale ochraceous. Tubes much longer than in the previous case, depressed around the stipe apex when mature. Pores small, roundish .... genus *Gyroporus*, family *Gyroporaceae*

4a Characteristic fascicles of oleocystidia with a conspicuous, dark incrustation present in the hymenophore. For a detailed description of these fasciculate oleocystidia which are here labelled as 'of the *Suillus* type', see the diagnosis of the genus *Suillus* .... family *Suillaceae*

4b Fascicles of conspicuously incrusted oleocystidia of the *Suillus* type absent .... family *Boletaceae*

Suillaceae (Singer) Besl et Bresinsky
Pl. Syst. Evol. 206: 239, 1997.

Type genus: *Suillus* Adans.

Characters of European genera (North American gasteroid forms, e.g. *Gastrosuillus* Thiers, are not included in this diagnosis): Carpophores pileate-stipitate, fleshy. Pileus covered by a gelatinous ixotrichoderm, filamentous trichoderm or a two-layer cuticle consisting of the upper trichodermal and lower gelatinous layer. Pileus trama composed of loosely interwoven, filamentous or somewhat broadened hyphae. Hymenophore tubular, adnate or decurrent. Pores small, medium-sized or radially elongated (boletinoid). Hymenophoral trama bilateral, mostly boletoid, rarely mariaelloid. Characteristic fascicles of oleocystidia with a dark incrustation often present in the hymenophore and sometimes also on the stipe. Basidia usually smaller than in the *Boletaceae*. Spores relatively small, smooth, of boletoid shape, i.e. elongate subfusoid or fusoid-ellipsoid. Spore print ochraceous, cinnamon-brown, medium brown, brown-olivaceous, grey-brown, ferrugineous brown, chocolate-brown or purplish brown. Partial veil (annulus) either present or absent. Stipe more or less central, mostly solid, less frequently hollow, often covered by a fertile, gradually fragmenting caulohymenium, less frequently by an infertile cuticle consisting of a trichoderm or trichodermal palisade. Basal part of the stipe infertile, usually covered with a tomentum. Lateral stipe stratum mostly present, but sometimes absent. Context of the pileus and stipe composed of a monomitic hyphal system with generative, thin-walled hyphae. Clamp connections either absent or present.

Forms mycorrhizal associations with conifers.

Delimitation: According to Besl and Bresinsky (1997: 239), the family *Suillaceae* is chemotaxonomically characterized by the presence of 'compounds of type cavipetin, suillin and/or boviquinone'. The chemotaxonomic classification has been strongly supported by modern molecular analyses (e.g. Bruns and Szaro 1992, Bruns et al. 1998, Kretzer and Bruns 1999, Binder and Bresinsky 2002, etc.). Anatomical features characterizing the Central European members of this family are obvious from the above description and key.

European genera: *Boletinus, Mariaella* and *Suillus*.

Key to European genera of the family *Suillaceae*

1a Clamp connections none or very scarce in the carpophore. Characteristic fascicles of incrusted oleocystidia of the *Suillus* type constantly present in the hymenophore, sometimes also on the stipe. Stipe solid. Under favourable conditions the carpophores have a tendency to form a lateral stipe stratum, especially in the upper half of the stipe 2

1b Clamp connections constantly present, abundant. Fascicles of incrusted caulocystidia of the *Suillus* type absent both in the hymenophore and in the stipe. Stipe hollow. Lateral stipe stratum never present .... *Boletinus*

2a Stipe surface infertile, composed of a trichodermal palisade of strongly incrusted filamentous elements (see Šutara 1987a, Fig. 6). Caulobasidia absent. Hymenophoral trama of the mariaelloid type, gelatinized over the whole width, not differentiated into a mediostratum and lateral strata (Figs. 3a, 3c, 4d). Atrotomentin, methyl bovinate and simple boviquinone derivates present, but grevillins absent (cf. Høiland 1987, Gill and Steglich 1987, Besl and Bresinsky 1997). Carpophores turning vinaceous red to purple when boiled in water (F. Smotlacha 1947). Development of the carpophores gymnocarpous (Reijnders 1963) .... *Mariaella*

2b Stipe surface fertile, composed of a gradually fragmenting caulohymenium. Spore-bearing caulobasidia present (Figs. 1f, 4c). Hymenophoral trama usually boletoid, with a distinctly differentiated mediostratum and lateral strata (Figs. 1c, 1d, 3b), rarely mariaelloid. Atrotomentin and methyl bovinate absent. Simple boviquinone derivates found very sporadically and, if present, occur together with grevillins (Høiland 1987, Gill and Steglich 1987, Besl and Bresinsky 1997, etc.). Carpophores not changing colour to vinaceous red or purple when boiled in water. Carpophore development (at least in all species whose ontogeny is known) pilangiocarpous or mixangiocarpous (cf. Reijnders 1963) .... *Suillus*

Boletinus Kalchbr.
Mohls Bot. Zeitung 25: 182, 1867.

Syn.: *Euryporus* Quél., Enchir. Fung.: 163, 1886.

Typus: *Boletus cavipes* Klotzsch [≡ *Boletinus cavipes* (Klotzsch) Kalchbr.]

Characters: Pileus cuticle a thick trichoderm. Tubes short, decurrent. Pores large, angular, radially elongated (boletinoid). Hymenophoral trama boletoid. Cystidia scattered, not forming such conspicuous, dark incrusted fascicles as occur in *Suillus*. Spores smooth, relatively small, of boletoid shape, elongate subfusoid or fusoid-ellipsoid, with slight suprahilar depression. Spore print ochraceous olive to brown. Partial veil present, remaining as an annulus on the stipe. Stipe central, hollow. Stipe surface infertile, composed of a trichoderm (see Kühner 1927: Fig. VI and Šutara 1987b: Fig. 1). Peripheral zone of the stipe trama (immediately under the trichoderm) forming a dense, compact tissue with hyphae arranged in a longitudinal way. Lateral stipe stratum absent. Clamp connections abundant, constantly present.

Forms mycorrhizal associations with *Larix*.

Delimitation: The opinions on the taxonomic position and delimitation of this genus have been very controversial. Some authors, e.g. Smith and Thiers (1964) and Arpin and Kühner (1977), have treated *Boletinus* merely as an infrageneric taxon (as a section or subgenus) of the genus *Suillus*. On the other hand, Pegler and Young (1981) and Jülich (1982) have accepted *Boletinus* as a separate genus and have placed it even in another family, viz. in the *Gyrodontaceae*. Similarly, Høiland (1987) has placed the genera *Boletinus* and *Suillus* in two different families, the former in the *Boletaceae* and the latter in the *Gomphidiaceae*. Currently most authors, e.g. Singer (1975, 1986), Moser (1983), Engel et al. (1996), Besl and Bresinsky (1997), Lannoy and Estades (2001) and others, have accepted *Boletinus* (usually in a restricted sense) as an independent genus situated near *Suillus*.

Boletinus in the narrow concept is well distinguished from *Suillus* mainly by the following anatomical characters: (1) abundant clamp connections, (2) infertile stipe cuticle constisting of a trichoderm, and (3) absence of the fasciculate oleocystidia with dark incrustation (see Šutara 1987b). Moreover, the *Suillus* species have a more or less distinct tendency to form a divergent, loosely arranged lateral stratum of the stipe trama under favourable conditions, but in the genus *Boletinus* this layer is never developed.

Material examined: *Boletinus cavipes* (Klotzsch) Kalchbr. (JŠ 413, 661, 2578, 2580, 3061, 3102, 3105 etc.) and *Boletinus asiaticus* Singer (PRM 829078, collection from Finland).

Suillus **Adans.**

Fam. Pl. 2: 10, 1763.

Syn.: *Rostkovites* P. Karst., Rev. Mycol. 3: 16, 1881. – *Cricunopus* P. Karst., Rev. Mycol. 3: 16, 1881. – *Viscipelis* Quél., Enchir. Fung.: 155, 1886. – *Ixocomus* Quél., Fl. Mycol. Fr.: 411, 1888.

Typus: *Boletus luteus* L.: Fr. [≡ *Suillus luteus* (L.: Fr.) Roussel]

Characters: Pileus mostly covered by a strongly gelatinized ixotrichoderm, less frequently by a two-layer cuticle consisting of the upper trichoderm and the lower gelatinous layer (see Bresinsky and Schwarzer 1969: Fig. 15). Tubes short or moderately long, adnate or decurrent. Pores mostly small, roundish, less frequently enlarged or radially elongated. Hymenophoral trama usually boletoid (Figs. 1c, 1d, 3b), rarely mariaelloid. Characteristic fascicles of oleocystidia of the *Suillus* type constantly present in the hymenophore (Figs. 1c, 1d). The fasciculate oleocystidia subcylindric or narrowly clavate, conspicously incrusted with a dark brown matter particularly in their basal part. Content of the fasciculate oleocystidia at first yellowish brown, but finally becoming dark brown or brown violet, especially in dried carpophores or by action of an alkali, e.g. ammonium hydroxide or KOH (for a more detailed description of the cystidia in *Suillus*, see Smith and Thiers 1964). Spores smooth, relatively small, elongate subfusoid or fusoid-ellipsoid, with small suprahilar depression. Spore print of various ochraceous or brownish shades, e.g. ochraceous, cinnamon-brown, olivaceous brown, medium brown, grey-brown, ferrugineous brown, chocolate-brown or reddish brown etc. Partial veil (annulus) either absent or present, in a few species glutinous. Stipe central, solid, covered by a gradually fragmenting caulohymenium with fertile caulobasidia (Figs. 1f, 4c and Šutara 1987a: Fig. 7, Šutara 1987b: Figs. 2–9). So-called 'glandular dots' on the stipe (consisting of such conspicuous fascicles of dark incrusted oleocystidia as occur in the hymenophore) mostly present, but absent in several species. Under sufficiently favourable conditions young and middle-aged carpophores have a tendency to form a lateral stratum of the stipe trama, particularly in the upper half, sometimes also in the middle part of the stipe (Fig. 1f). The lateral stipe stratum rather different in various members of this genus, in some species well developed, loosely arranged, more or less gelatinous, 40–120(–180) µm thick, but in some others inconspicuous, non-gelatinous, thinner than 40 µm. Stipe trama proper composed of densely and longitudinally arranged hyphae. Clamp connections none or very rare in the carpophore.

Mycorrhizal associations with *Pinus*, *Larix*, *Pseudotsuga* and possibly with some other conifers.

Delimitation: Some authors (e.g. Smith and Thiers 1964, 1971; Grund and Harrison 1976) have accepted a wider circumscription of the genus *Suillus*, with *Boletinus* and *Paragyrodon* as infrageneric taxa (but without several species with vinaceous or purplish brown spores which these authors transferred to a separate genus, *Fuscoboletinus* Pomerleau et A. H. Smith). A broad concept of *Suillus* has been also adopted by Kretzer et al. (1996). Currently the most widely accepted opinion on the circumscription of the genus *Suillus* is that of Singer (1967, 1975, 1986), see e.g. Moser (1983), Alessio (1985), Engel et al. (1996), Besl and Bresinsky (1997) and Lannoy and Estades (2001).

The opinion of the present author on the limits between *Suillus* and *Boletinus* was already formulated above. For the differences between *Suillus* and *Mariaella*, see the notes on the delimitation of the latter.

Material examined: *Suillus collinitus* (Fr.) O. Kuntze (PRM 654265; BRNM 346045; JŠ 2608, 3114, 4052 etc.), *Suillus flavidus* (Fr.: Fr.) J. Presl (PRM 619765; JŠ 1887, 2646, 2650, 2653), *Suillus granulatus* (L.: Fr.) Roussel (JŠ 2259, 2398, 3057, 3094 etc.), *Suillus grevillei* (Klotzsch: Fr.) Singer (JŠ 2215, 2225, 3039–40, 3101 etc.), *Suillus lakei* (Murrill) Smith et Thiers var. *landkammeri* (Pilát et Svrček) Engel et Klofac (PRM 628919, 648075; BRNM 235894), *Suillus laricinus* (Berk.) O. Kuntze [= *Suillus aeruginascens* (Opat.) Snell] (JŠ 2434, 2437, 2440, 2498 etc.), *Suillus luteus* (L.: Fr.) Roussel (JŠ 1674, 3045, 4050–51 etc.), *Suillus placidus* (Bonord.) Singer (BRNM 346081; CB 1871; JŠ 2368–69 etc.), *Suillus sibiricus* Singer (CB 143, 147), *Suillus tridentinus* (Bres.) Singer (PRM 709684; JŠ 3073, 3075–76 etc.) and *Suillus variegatus* (Swartz: Fr.) O. Kuntze (JŠ 2643–44, 3056 etc.).

Mariaella Šutara

Čes. Mykol. 41: 73, 1987.

Typus: *Boletus bovinus* L.: Fr. [≡ *Mariaella bovina* (L.: Fr.) Šutara]

Characters: Pileus cuticle a gelatinous ixotrichoderm. Tubes short, adnate or subdecurrent. Pores rather large, angular, somewhat radially elongated, almost boletinoid when mature. Hymenophoral trama of the mariaelloid type, strongly gelatinized, slightly divergent, not differentiated into a mediostratum and lateral strata (Figs. 3a, 3c, 4d). Fascicles of conspicuously incrusted oleocystidia of the *Suillus* type abundant in the hymenophore (see Šutara 1987a: Figs. 3, 5). Spores relatively small, smooth, elongate subfusoid or fusoid-ellipsoid, with small suprahilar depression. Spore print light olive-brown. Partial veil (annulus) absent.

Stipe central, solid. Stipe cuticle infertile, consisting of a trichodermal palisade of filamentous elements strongly incrusted with crystals and amorphous material. The initially continuous layer of the trichodermal palisade gradually fragments into small, often more or less collapsed tufts of cuticular elements as the stipe grows and expands (see Šutara 1987a: Figs. 6b, 6d). Caulobasidia not found. Lateral stipe stratum sometimes developed and, if present, forming a divergent, loosely arranged and gelatinous layer occurring especially in the upper half of the stipe of young carpophores (see Šutara 1987a: Fig. 6d). Stipe trama proper densely arranged in a longitudinal direction. Carpophores turning vinaceous red to purple when boiled in water. Flesh of carpophores more elastic than in *Suillus* species. Clamp connections in the carpophore none or very rare.

Mycorrhizal associations with *Pinus*.

Delimitation: The genus *Mariaella*, represented by the species *Mariaella bovina*, is closely related to *Suillus*, from which it differs particularly in the infertile stipe cuticle lacking caulobasidia. A further distinctive feature of *Mariaella* is the fact that the infertile stipe cuticle occurs simultaneously with the gelatinous lateral stipe stratum. Such a type of arrangement of peripheral stipe layers is exceptional, unknown in the other boletes.

A very typical anatomical character of *Mariaella* is also the mariaelloid hymenophoral trama. In the genus *Suillus* this type of the trama has been found very rarely, only in some carpophores of *Suillus flavidus* and *Suillus pictus*. The fact that the arrangement of the hymenophoral trama in *Suillus bovinus* ≡ *Mariaella bovina* is not identical with the boletoid tramal structure in *Suillus luteus* and *Suillus granulatus* was already mentioned by Disbrey and Watling (1967).

Data published by some authors (Høiland 1987, Gill and Steglich 1987, Besl and Bresinsky 1997, etc.) show that *Mariaella bovina* (cited as *Suillus bovinus* by these authors) is also distinguished from species of *Suillus* chemotaxonomically, e.g. by the presence of atrotomentin and methyl bovinate. In the other *Suillaceae* (including the *Suillus* species) these compounds have not been found. Furthermore, *Mariaella bovina* is the only species of the *Suillaceae* which contains simple boviquinone derivates [boviquinone-4 (bovinone), diboviquinone-4,4, methylenediboviquinone-4,4 (amitenone)], but lacks grevillins. In the 36 *Suillus* species investigated, simple boviquinone derivates have been detected very sporadically, only in two cases: boviquinone-4 in *Suillus pictus* and diboviquinone-4,4 in *Suillus americanus* (Peck) Snell. In contrast to *Mariaella*, however, these two species, like most of the other members of *Suillus*, contain grevillins.

It is interesting that the very rare combination of the presence of boviquinones with the absence of grevillins (which is typical of *Mariaella*) occurs as well as in some *Chroogomphus* species, e.g. *Chroogomphus rutilus* (Schaeff.: Fr.) O. K. Miller, *Chroogomphus helveticus* (Singer) Moser and *Chroogomphus tomentosus*

(Murrill) O. K. Miller. The carpophores of *Chroogomphus rutilus* and *Mariaella bovina* have also some similar colour reactions, e.g. with ethanol and alkali (see Gill and Steglich 1987 and others). These facts suggest an affinity between *Mariaella* and the genus *Chroogomphus* (Singer) O. K. Miller (*Gomphidiaceae*).

Some of the characteristic macrochemical reactions of *Mariaella bovina* have been long known to mushroom pickers because the carpophores change colour to vinaceous red or purple when boiled in water and to vinaceous pink after drying (see F. Smotlacha 1947, Kluzák et al. 1985, M. Smotlacha and Malý 1986 and others). This colour change has not been observed in any species of *Suillus*.

In all the *Suillus* species whose ontogeny is known the development of carpophores is different from that in *Mariaella*. According to Reijnders (1963) the development in *Boletus bovinus* (≡ *Mariaella bovina*) is gymnocarpous while in the species of *Suillus* pilangiocarpous (*S. americanus*, *S. granulatus*, *S. placidus*, *S. spectabilis*, *S. variegatus* and probably *S. pictus*) or mixangiocarpous (*S. luteus*, *S. aeruginascens* and probably *S. grevillei*). Also the development of *Boletinus* species, e.g. *Boletinus cavipes* and *Boletinus paluster* (Peck) Peck, is pilangiocarpous or mixangiocarpous (Reijnders 1963), i.e. pseudoangicarpous in the terminology of some other authors (e.g. Kühner 1926, Gentile and Snell 1953). The gymnocarpous development (unknown in the other genera of this family) complements the exceptional anatomical and chemical characters of *M. bovina*, which indicate the isolated position of *Mariaella* in the *Suillaceae*.

Material examined: *Mariaella bovina* (L.: Fr.) Šutara, according to the present knowledge, the only species belonging to this genus (JŠ 277, 542, 1742, 2077, 2101, 2281–83, 2311, 3034, 3038, 3065, 3069, 4048, 4049 etc.).

Boletaceae Chevallier
Flore Env., Paris 1: 248, 1826.

Syn.: *Strobilomycetaceae* Gilbert, Les Bolets: 105, 1931 (ut *Strobilomyceteae*). – *Xerocomaceae* (Singer) Pegler et Young, Trans. Brit. Myc. Soc. 76: 112, 1981.

Type genus: *Boletus* L.

Characters of European genera (gasteroid forms, e.g. *Chamonixia* Roll., are not included in this diagnosis): Carpophores pileate–stipitate, fleshy. Universal veil mostly absent, but present in one European genus (*Strobilomyces*). Pileus soft; its context composed of loosely interwoven, filamentous or somewhat swollen hyphae. Hymenophore usually tubular, exceptionally lamellate (in *Phylloporus*). Structure of the hymenophoral trama bilateral, mostly boletoid, less frequently phylloporoid or intermediate between the boletoid and phylloporoid type. Pleurocystidia scattered; cheilocystidia sometimes grouped in clusters, but never forming such conspicuous fascicles of oleocystidia with dark incrustation as occur in *Suillus*. Spores smooth or ornamented, mostly elongate subfusoid or fusoid-ellipsoid, less frequently elongate fusoid-cylindric, rarely fusoid-truncate or shortly ellipsoid to subglobose. Stipe solid, mostly central, rarely somewhat eccentric. Except for one species with an infertile stipe cuticle (*Pseudoboletus parasiticus*), all the other European *Boletaceae* have a substantial part of the stipe covered by a fertile caulohymenium with sporulating caulobasidia. The caulohymenium gradually fragments into small islands of caulohymenial elements as the stipe expands. Basal part of the stipe infertile, often covered with a tomentum. Lateral stratum of the stipe trama mostly more or less developed, but sometimes absent. Stipe trama proper densely arranged, more or less parallel with the longitudinal stipe axis. Hyphal system both in pileus and stipe monomitic, with thin-walled generative hyphae. Thick-walled microscopic elements occur very rarely (e.g. thick-walled cystidia in the extra-European genera *Boletochaete* Singer and *Tubosaeta* Horak). Clamp connections none or extremely rare in the carpophore.

A substantial majority of members of this family are mycorrhizal, only a few species saprotrophic [e.g. *Buchwaldoboletus lignicola* (Kallenb.) Pilát]. Only one European species, *Pseudoboletus parasiticus*, is parasitic (see Kavina 1935).

European subfamilies: *Boletoideae* and *Strobilomycetoideae*.

Key to European subfamilies of the family *Boletaceae*

1a Carpophores covered with a true universal veil which disrupts into fragments remaining as floccose-woolly scales on pileus and stipe. The only European species of this group (*Strobilomyces strobilaceus*) has almost globose spores, with a conspicuous reticulate ornamentation distinct even under a low microscopic magnification. Spore print very dark, almost black .... subfamily *Strobilomycetoideae*, genus *Strobilomyces*

1b Universal veil absent. Spores usually elongated, subfusoid, fusoid-ellipsoid or fusoid-truncate, exceptionally shortly ellipsoid (in *Rubinoboletus*). Spores of European species of this subfamily have either a smooth surface or a very fine surface ornamentation discernible only under oil immersion or with an electron microscope. Spore print olivaceous, olivaceous brown, yellow-brown, pinkish brown, ferrugineous, medium brown, reddish brown etc., but never almost black .... subfamily *Boletoideae*

Subfamily ***Boletoideae***

Type genus: *Boletus* L.

Characters of European genera: Both universal and partial veil (annulus) absent. Pileus cuticle a trichoderm, trichodermal palisade or epithelium. Hymenophore usually tubular, exceptionally lamellar. Spores smooth or very finely ornamented. Spore print of various brown, olivaceous or reddish brown shades, e.g. olivaceous, olive-brown, cinnamon, ferrugineous brown, pale brown, medium brown, pinkish brown, reddish brown etc. The other characters are obvious from the above diagnosis of the family *Boletaceae*.

Delimitation: The differences between the subfamilies *Boletoideae* and *Strobilomycetoideae* are apparent from the above key.

European genera: *Boletus*, *Buchwaldoboletus*, *Chalciporus*, *Leccinum*, *Phylloporus*, *Porphyrellus*, *Pseudoboletus*, *Rubinoboletus*, *Tylopilus*.

Key to European genera of the subfamily *Boletoideae*

1a Stipe surface infertile, composed of a filamentous trichoderm (Fig. 4b and Šutara 1991: Figs. 1, 2). Caulobasidia absent. Species growing on carpophores of gasteromycetes (*Scleroderma* or *Astraeus*). Carpophore development of the only Europen species of this genus (*Pseudoboletus parasiticus*) hypovelangiocarpous (paravelangiocarpous), see Reijnders (1963). Spores of *P. parasiticus* distinctly pitted under an electron microscope (see Oolbekkink 1991, Holec 1994) .... *Pseudoboletus*

1b Stipe surface more or less fertile, composed of a caulohymenium which gradually fragments into small islands of caulohymenial elements as the stipe grows and expands. Spore-bearing caulobasidia present. Species not growing on carpophores of gasteromycetes. All the European species of this group whose ontogeny is known have the carpophore development different from that in *P. parasiticus*, viz. gymnocarpous, pilangiocarpous etc. (cf. Reijnders 1963, Pantidou 1964, Watling 1985, Singer 1986 and others). Spores smooth or slightly ornamented under an electron microscope, but never pitted 2

2a Species saprotrophic, growing on wood .... *Buchwaldoboletus*

2b Species not lignicolous 3

3a Spores of boletoid shape, elongate subfusoid, fusoid-ellipsoid or fusoid-truncate, usually with small suprahilar depression 4

3b Spores shortly ellipsoid, some with adaxial applanation .... *Rubinoboletus*

4a Stipe surface covered by a typical scabrous ornamentation, with scabrosities dark-coloured from youth or darkening with age in a large majority of cases. The stipe scabrosities consist of characteristic fascicles of hyphae (i.e. fragments of a characteristic, disrupted, almost anticlinally arranged, non-gelatinous lateral stratum of the stipe trama) ending in elements of the caulohymenium .... *Leccinum*

4b Stipe ornamentation not as above 5

5a Spore print with a more or less distinct olivaceous tint, e.g. olivaceous or olive-brown 6

5b Spore print without olivaceous tint, e.g. pinkish brown, light brown, cinnamon-brown, ferrugineous brown, chocolate- to reddish brown etc. 7

6a Hymenophore tubular. Carpophores having a tendency to form a lateral stipe stratum under sufficiently favourable conditions, particularly in the upper half of the stipe of young or middle-aged carpophores (see Lohwag and Peringer 1937: Figs. 6, 7; Šutara 1989: Figs. 3, 4; Šutara 1991: Fig. 3) .... *Boletus*

6b Hymenophore lamellate, with numerous anastomoses. Carpophores of the only European species of this genus (*Phylloporus pelletieri*) without a distinctly developed lateral stipe stratum (Fig. 2f) .... *Phylloporus*

7a Carpophores slender and relatively small [pileus (10–)20–60(–90) mm and stipe 20–70 x 3–10 mm in a full-grown stage]. Spore print in European species of this genus cinnamon- or ferrugineous brown. Tubes adnate or subdecurrent. Pores (and often also tube-sides) ferrugineous, cinnamon-brown, raspberry- to vinaceous red or vivid yellow. Flesh yellow in the stipe; basal mycelium also yellow .... *Chalciporus*

7b Carpophores usually larger [pileus (40–)50–150(–200) mm and stipe 40–160 x 10–40 mm]. Spore print pinkish brown, pale brown or chocolate- to reddish brown. Tubes long, depressed around the stipe apex when mature. Both pores and tube-sides whitish, pale pinkish or grey-cream when young, pinkish brown, grey-brown or medium brown when mature, never so vividly coloured as above. Flesh at first whitish, sometimes pale greyish, slightly brownish or dirty cream-coloured when old, but never yellow in the stipe. Basal mycelium white or dirty whitish 8

8a Spore print of the only European species of this genus (*Tylopilus felleus*) light-coloured: pinkish brown or pale brown. Lateral stipe stratum usually well developed under normal conditions, loosely arranged, present in both upper and middle part of the stipe .... *Tylopilus*

8b Spore print of the only European species of this genus (*Porphyrellus porphyrosporus*) chocolate-brown or reddish brown, darker than in the previous case. Lateral stipe stratum occurs very rarely and, if present, forms a considerably reduced, very thin, almost indistinct layer present only in the upper part of the stipe .... *Porphyrellus*

Boletus L.
Sp. Pl.: 1176, 1753 (nom. cons.)

Syn.: *Tubiporus* Paulet ex P. Karst., Rev. Mycol. 3: 16, 1881. – *Versipellis* Quél., Enchir. Fung.: 157, 1886. – *Dictyopus* Quél., Enchir. Fung.: 159, 1886. – *Xerocomus* Quél. in Mougeot et Ferry, Fl. Vosges, Champ.: 477, 1887. – *Oedipus* Bataille, Les Bolets: 13, 1908. – *Suillellus* Murrill, Mycologia 1: 16, 1909. – *Ceriomyces* Murrill, Mycologia 1: 140, 1909. – *Xerocomopsis* Reichert, Palest. Journ. Bot. Rehov. Ser. 3: 229, 1940. – *Aureoboletus* Pouzar, Čes. Mykol. 11: 48, 1957.

Typus: *Boletus edulis* Bull.: Fr. (typ. cons.)

Characters: Pileus surface mostly a trichoderm, less frequently a trichodermal palisade, rarely an epithelium consisting of hyphal chains of broad, short cells. Tubes depressed around the stipe apex, adnate or subdecurrent. Pores small or somewhat enlarged. Structure of the hymenophoral trama boletoid, phylloporoid or intermediate between the boletoid and phylloporoid type. Spores of boletoid shape, elongate subfusoid, rarely fusoid-truncate, with more or less distinct suprahilar depression. Spore surface mostly smooth, sometimes very finely ornamented, e.g. venose, rugulose or 'bacillate'. [Note: The adjective 'bacillate' was used by some authors (e.g. Heinemann, Rammeloo and Rullier 1988) for an unusual ornamentation looking as if the surface of spores was covered with rod-like bacteria (bacilli). This ornamentation is distinct only at the level of an electron microscope]. Spore print olivaceous or olive-brown when fresh. Stipe central, solid, with a reticulate or granulate ornamentation. Stipe surface composed of a gradually fragmenting caulohymenium with fertile caulobasidia. Lateral stipe stratum usually more or less developed at least in young or middle-aged carpophores. Stipe trama proper consisting of hyphae more or less parallel with the longitudinal axis of the stipe. Clamp connections none or extremely rare in the carpophore.

Mycorrhizal with both deciduous and coniferous trees.

Delimitation: *Boletus* is distinguished from related genera mainly by the following characters: (a) from *Pseudoboletus* by the fertile caulohymenium on the stipe surface and by the mycorrhizal strategy, (b) from *Rubinoboletus* by the elongate subfusoid shape of the spores, (c) from *Buchwaldoboletus* by the non-lignicolous growth and (d) from *Tylopilus*, *Porphyrellus* and European species of *Chalciporus* by the olivaceous tint of the spore print.

European subgenera: In the European flora the genus *Boletus* is represented by the subgenera *Boletus* and *Xerocomus*.

Key to Central European subgenera of the genus *Boletus*

1a Structure of the hymenophoral trama more or less boletoid. Spores smooth .... subgenus *Boletus*

1b Structure of the hymenophoral trama phylloporoid or intermediate between the phylloporoid and boletoid type. However, the limits between the boletoid, phylloporoid and intermediate forms of the trama are not sharp (see the notes under the subgenus *Xerocomus*). Spores smooth or finely ornamented, e.g. venose, rugulose, bacillate etc. .... subgenus *Xerocomus*

Boletus subg. ***Boletus***

Typus: *Boletus edulis* Bull.: Fr.

Characters: Pileus surface mostly a trichoderm, rarely a trichodermal palisade or epithelium. The pileus cuticle changes its appearance according to weather conditions and age of carpophores. The initially erect trichoderm often gradually collapses. In many species the surface of trichodermal hyphae may sometimes be partly covered with a thin layer of gelatinous matter. Tubes mostly long, depressed around the stipe apex when mature, rarely adnate or subdecurrent. Colour of tubes white or yellow when young, olive-yellow, yellow-brown, yellow-green or olive-brown when mature. Pores usually small, rarely medium large, mostly concolorous with tube-sides, but sometimes coloured differently, e.g. red-orange, deep red or vinaceous purple in section *Luridi*. Hymenophoral trama more or less boletoid (see e.g. Lohwag and Peringer 1937: Figs. 3, 5, 9), with a more or less distinct gelification of lateral strata. Spores smooth, of the boletoid form, elongate subfusoid or fusoid-ellipsoid, with suprahilar depression. Spore print olivaceous or olive-brown when fresh. Stipe mostly rather massive, ornamented with a reticulation or small floccose granules. Although the reticulate and non-reticulate stipe surfaces in the subgenus *Boletus* have a somewhat different macroscopic appearance, from an anatomical viewpoint they are nothing more than modified forms of one type of arrangement of peripheral stipe layers. Stipe surface fertile, composed of a gradually fragmenting caulohymenium with spore-bearing caulobasidia. Lateral stipe stratum usually well developed under normal conditions. Almost all European species of this subgenus have the lateral stipe stratum boletoid, 20–100(–150) µm thick, not disrupting, loosely arranged, rather often gelatinized, consisting of hyphae running divergently or somewhat irregularly from the longitudinal stipe trama proper towards the stipe surface (see Lohwag and Peringer 1937: Figs. 6, 7; Šutara 1989: Figs. 3, 4). Only *B. impolitus* and *B. depilatus* have the lateral stipe stratum 150–400(–640) µm thick, non-gelatinous, arranged almost anticlinally, disrupting into characteristic fascicles of hyphae, very similar to that in *Leccinum*. Flesh white, dirty yellowish or yellow.

Mycorrhizal both with deciduous trees (*Fagales*, *Betulales*, *Salicales*) and with conifers (*Pinaceae*).

Delimitation: The limits between the subgenera *Boletus* and *Xerocomus* are discussed under the latter.

Material examined: *Boletus aereus* Bull.: Fr. (BRNM 236110, 236125, 265773; CB 1348 etc.), *Boletus appendiculatus* Schaeff. (PRM 775391; JŠ 2136), *Boletus badius* (Fr.): Fr. (JŠ 373, 395, 2102, 3089, 3223–25 etc.), *Boletus calopus* Pers.: Fr. (BRA 13.9.1988; LIT 3719/171; JŠ 285, 2139 etc.), *Boletus depilatus* Redeuilh (PRM 647825, 717049; BRNM 265679, 265823, 265858, 265867; JŠ 3155 etc.), *Boletus edulis* Bull.: Fr. (JŠ 3146, 3149–51, 4032 etc.), *Boletus erythropus* Pers.: Fr. (LIT 3719/173; JŠ 058, 282, 316 etc.), *Boletus fragrans* Vitt. (herb. Drescher), *Boletus gentilis* (Quél.) Big. et Guill. (BRNM 265460; CB 1515; JŠ 2127, 4043 etc.), *Boletus impolitus* Fr. (PRM 682521; BRNM 265816; JŠ 1704, 2079–80, 2535–36 etc.), *Boletus junquilleus* (Quél.) Boud. (BRNM 236073, 265822; JŠ 3128, 4044 etc.), *Boletus legaliae* Pilát et Dermek (JŠ 3546), *Boletus luridus* Schaeff.: Fr. (JŠ 059, 317, 2769, 4041 etc.), *Boletus moravicus* Vacek (BRNM 265530–31, 265534; CB 3435–38 etc.), *Boletus pinophilus* Pilát et Dermek (JŠ 2387, 2800, 3139–40 etc.), *Boletus pulverulentus* Opat. (BRNM 265815; CB 922, 1127; JŠ 041–42, 3463 etc.), *Boletus queletii* Schulzer (PRM 836121; BRNM 236086, 265835, 266120 etc.), *Boletus radicans* Pers.: Fr. (JŠ 2785, 3144, 4035, 4037 etc.), *Boletus regius* Krombh. (JŠ 044, 3525), *Boletus reticulatus* Schaeff. (JŠ 2395, 3129–30, 4034 etc.), *Boletus rhodoxanthus* (Krombh.) Kallenb. (BRNM 265697; BRA 17.9.1988; CB 1143–44, 1781 etc.), *Boletus rhodopurpureus* Smotlacha (BRNM 265731, 265746; CB 1145, 1779 etc.), *Boletus satanas* Lenz (JŠ 3091, 3142, 4039 etc.), *Boletus subappendiculatus* Dermek, Lazebníček et Veselský (JŠ 318), *Boletus torosus* Fr. (JŠ 3552).

Notes on *Boletus gentilis* and the genus *Pulveroboletus*

Boletus gentilis was transferred by Singer (1947) to the genus *Pulveroboletus* Murrill. It is, however, necessary to point out that *Boletus gentilis* and *Pulveroboletus ravenelii* (Berk. et Curtis) Murrill (the type species on which *Pulveroboletus* is based) have very different anatomical characters. *B. gentilis* has (1) a fertile caulohymenium on the stipe, (2) a typically boletoid, gelatinous lateral stratum of the stipe trama and (3) no veil. These and all the other anatomical features of *B. gentilis* are very similar to those in *Boletus* s. str. and therefore this species is here treated as a member of *Boletus*.

In contrast to *Boletus gentilis*, *Pulveroboletus ravenelii* has (1) a universal veil, (2) an infertile stipe surface consisting of an undifferentiated suprapellis, densely arranged strictly parallel with the stipe axis and (3) no lateral stratum of the stipe trama. In other words, on the stipe of *P. ravenelii* there is neither a caulohymenium nor a trichoderm nor a palisadoderm nor any other kind of an anticlinally arranged cuticle. Such a type of the outer stipe layer is quite extraordinary from the European view, because it is not present in any European bolete. (Material examined: PRM 487647, specimen of *P. ravenelii* from North Carolina, U.S.A.).

Pulveroboletus in a narrow sense is undoubtedly a good, well separated genus with conspicuous distinctive features. However, *Pulveroboletus* in the widely extended concept adopted by Singer (1947, 1975, 1986 etc.) represents an unnatural, very heterogeneous group of considerably different species, as was already pointed out by some authors (e.g. Smith and Thiers 1971, Corner 1972, Pilát and Dermek 1974, etc.).

Note on *Boletus fragrans* and *Boletus impolitus*

On the basis of study of incorrectly identified herbarium specimens, the present author mistakenly synonymised *Boletus impolitus* with *Boletus fragrans* in one of his earlier papers (see Šutara 1989). In that paper, figure 2 with a drawing of the microstructure of the stipe surface of *Boletus impolitus* was erroneously designated as *Leccinum fragrans*. Later, after examination of a correctly identified material, the present author revised his opinion and came to the conclusion that these boletes are two distinctly separate species, differing in several characters, above all in the anatomy of peripheral stipe layers. *Boletus fragrans* has a typically boletoid lateral stratum of the stipe trama. On the other hand, in *B. impolitus* the lateral stratum of the stipe trama is much thicker and very similar to that in *Leccinum*.

Boletus subg. ***Xerocomus*** (Quél.) Maubl.
Champ. Comest. et Vén. 2: [CXLV], 1927.

Typus: *Boletus subtomentosus* L.: Fr.

Characters: Pileus cuticle usually non-gelatinous, consisting of a trichoderm or trichodermal palisade. Cuticular hyphae smooth or covered with an incrustation (e.g. in the *B. chrysenteron/pruinatus* group). Tubes mostly adnate, sometimes subdecurrent or slightly depressed around the stipe apex, yellow or pale yellowish, rarely whitish when young, olive-yellow, yellow-green, yellow-brown or olive-brown when mature. Pores usually medium large, concolorous with tube-sides. Structure of the hymenophoral trama phylloporoid (see Šutara 1987a: Fig. 1) or intermediate between the phylloporoid and boletoid type; gelification of lateral strata none or not very distinct. Spores of boletoid shape, elongate subfusoid, fusoid-ellipsoid or fusoid-truncate, with suprahilar depression. Spore surface smooth or very finely ornamented, e.g. venose, rugulose or bacillate (see Heinemann, Rammeloo and Rullier 1988, Oolbekkink 1991, Klofac and Krisai-Greilhuber 1992, Holec 1994, Engel et al. 1996, etc.). Spore print olive-brown or olivaceous. Stipe mostly slender, covered with minute granules or dots, less frequently also with a more or less distinct reticulation. Stipe surface composed of a gradually fragmenting caulohymenium with sparsely scattered fertile caulobasidia. Lateral stipe stratum usually non-gelatinous and rather different in various species, sometimes well developed and loosely arranged, e.g. in the *Boletus subtomentosus* group (see Šutara 1991: Fig. 3), but sometimes developed only inconspicuously, e.g. in the *Boletus chrysenteron/pruinatus* group. Flesh yellow or whitish. Basal mycelium whitish, dirty yellowish or yellow.

Mycorrhizal with conifers (*Pinaceae*) and deciduous trees (*Fagales*, *Salicales* etc.).

Delimitation: The subgenus *Xerocomus* is distinguished from the genus *Rubinoboletus* by the elongate spores and olivaceous spore print. Defining limits between the subgenus *Xerocomus* and the genus *Chalciporus* is very difficult and is discussed under the latter.

The limit between the subgenera *Xerocomus* and *Boletus* is unclear. The taxonomic position of some species (e.g. *B. badius*, *B. moravicus* etc.) whose characters are in many regards transitional between these subgenera is still problematic and uncertain. For a detailed discussion on this problem, see below.

Material examined: *Boletus armeniacus* Quél. (JŠ 052, 2043, 2047, 2049 etc.), *Boletus chrysenteron* Bull. (JŠ 2315, 2319–20, 2401, 2674 etc.), *Boletus leguei* Boud. (= *Boletus spadiceus* ss. auct. plur., non orig. Fr.) (JŠ 1632, 1647–48, 1651, 1653 etc.), *Boletus porosporus* (Imler) Moreno et Bon (JŠ 016, 1631, 2802, 3253, 3255 etc.), *Boletus pruinatus* Fr. (JŠ 336, 1836, 1986, 4053 etc.), *Boletus rubellus* Krombh. (JŠ 2321–24, 2371, 2373, 2376–77 etc.) *Boletus subtomentosus* L.: Fr. (JŠ 039, 1548, 2042, 2144–45, 2402 etc.).

The limit between the subgenera *Xerocomus* and *Boletus*

Singer (1945, 1951, 1962, 1975, 1986) and some other authors (e.g. Snell and Dick 1958) treated the arrangement of the hymenophoral trama as the main criterion for separating the genus *Xerocomus* from *Boletus* and defining the subfamily *Xerocomoideae* Singer from *Boletoideae*. Singer (1986: 757) described the trama of the *Xerocomoideae* as 'of the *Phylloporus* type, rarely of a structure somewhat intermediate between the *Boletus*-type and *Phylloporus*-type (*Xerocomus*, sect. *Pseudoboleti*, less so in sect. *Moravici*)'. On the other hand, (according to Singer 1986: 765) the *Boletoideae* have the 'hymenophoral trama always of the *Boletus*-subtype excepting a few species of *Pulveroboletus*'. This opinion, however, was not accepted by some authors (e.g. Watling 1968, Smith and Thiers 1971, Corner 1972, Oolbekkink 1991, etc.) who pointed out that the structure of the trama in some boletes does not conform to the classification outlined by Singer. Also some results of the present author, especially those concerning the species whose structure of the hymenophoral trama is intermediate between the boletoid and phylloporoid type, are in disagreement with some data published by Singer. This matter is very problematic and deserves a detailed analysis.

As mentioned above, the difference between the phylloporoid and boletoid type of the tube trama is based on the different nature of their lateral strata. The lateral strata of these two types are different mainly in (1) gelification, (2) density of the hyphal structure and partly, perhaps, in (3) divergence of the hyphae. The gelification and the divergence of lateral strata are characters more or less distinct in some staining solutions (containing e.g. Congo-Red), but during microscopic observations they can be, unfortunately, assessed only approximately. As regards the density of the hyphal structure, this character can be ascertained somewhat more precisely. The distance between the hyphae of the lateral stratum is best seen in a transverse section of the hymenophore, in which this distance can even be measured. Before the measuring, however, the microscopic preparations should be prepared with particular care because a little excessive pressure on the cover slip could cause deformation of the examined microstructures. Results of the author's own study of this matter, based on examination of the tube trama in younger and middle-aged carpophores in which the hymenophoral trama is best developed, are as follows.

The boletes of the subgenera *Xerocomus* and *Boletus* including some related species can be classified according to the arrangement of the hymenophoral trama roughly into three groups.

The first group is formed by the species whose arrangement of the hymenophoral trama can be designated as phylloporoid (or of the phylloporoid type). This type of the trama occurs in *Phylloporus pelletieri* and in the *Boletus subtomentosus* group, e.g. in *Boletus subtomentosus* and *Boletus leguei* (= *Boletus spadiceus*). Lateral strata in the hymenophore of these species are non-gelatinous, with hyphae touching or almost touching each other. The distance between the hyphae, measured in transverse sections, is only 0–2(–4) µm (see Fig. 2d).

In the second group there are boletes whose structure of the tube trama is intermediate between the phylloporoid and boletoid type. This group includes e.g. species of the *Boletus chrysenteron/pruinatus* group (*Boletus armeniacus*, *Boletus chrysenteron*, *Boletus porosporus*, *Boletus pruinatus* etc.). In these species the gelification of lateral strata is relatively weak or scarcely discernible. Hyphae of the lateral strata are slightly but distinctly distant from each other. At the best developed stage the distance between the hyphae is (1–)2–4(–6) µm.

Also in *Boletus rubellus* and *Chalciporus piperatus* the structure of the trama is intermediate between the phylloporoid and boletoid type, but in exceptional cases it may be somewhat closer to the boletoid one. In this connection it is necessary to add that the difference between hymenophoral tramas of *Boletus rubellus* on the one hand and the *Boletus chrysenteron/pruinatus* group on the other hand (sometimes considered significant) is in reality very small, almost indistinct, obviously irrelevant from the viewpoint of generic taxonomy. In *Pseudoboletus parasiticus* the tube trama in the full developed stage is almost boletoid, with hyphae of the lateral strata distant 2–6(–8) µm from one another.

The arrangement of the hymenophoral trama in the third group can be designated as boletoid (or of the true boletoid type). Lateral strata in this type of the trama are more or less gelatinized, with hyphae yet more distant from each other than in the previous group. The distance between the hyphae is (2–)4–6(–10) µm (Figs. 1d, 4a). The true boletoid trama is a characteristic feature of such boletes as *Buchwaldoboletus lignicola*, *Tylopilus felleus*, most members of the subgenus *Boletus* (including *Boletus badius*, *Boletus moravicus*, *Boletus gentilis*, *Boletus pulverulentus* etc.) and many others. Paradoxically, however, it is not quite certain whether all species of the subgenus *Boletus* have really the true boletoid trama because the anatomy of tubes of some typical representatives of *Boletus* s. str. is not yet known in detail.

It is obvious that in the group of boletes from the subgenera *Xerocomus* and *Boletus* a distinct hiatus between the phylloporoid and boletoid type of the hymenophoral trama does not exist. In this group the above types of the trama and their intermediate forms overlap one another. There is no doubt that in some other cases the arrangement of the trama can significantly help to distinguish certain taxonomic groups, but in this case the difference in the tramal configuration is very unclear and therefore hardly usable for a precise definition of the generic limits. Unfortunately, neither the other characters separate *Xerocomus* from *Boletus* sufficiently clearly. In view of these facts, the author of this contribution is, after long hesitation, inclined to agree with the opinion of the mycologists who have not accepted *Xerocomus* at the generic level (e.g. Pouzar 1966, 1975, Watling 1968, 1970, 2002, Smith and Thiers 1971, Corner 1972, Grund and Harrison 1976, Arpin and Kühner 1977, Oolbekkink 1991, Hlaváček 2000, Kirk et al. 2001, etc.). Nevertheless, it seems that the taxonomic status of *Xerocomus* is a problem which is not yet fully solved. It is to be hoped that further research into the discussed taxonomic groups will bring new results which will shed new light on the matter.

Note on *Boletus badius* and *Boletus moravicus*

Boletus badius (≡ *Xerocomus badius*) and *Boletus moravicus* (≡ *Xerocomus moravicus*) have (1) the true boletoid hymenophoral trama and, according to some authors, (2) their spores are smooth under an electron microscope, see e.g. Pegler and Young (1981: Fig. 59) and Oolbekkink (1991: Figs. 1, 2, 32). For a photograph of the microstructure of the hymenophoral trama of *B. badius*, see Ladurner and Simonini (2003: Fig. 95). The boletoid hymenophoral trama, the smooth spores and some further characters of these species (e.g. the gelatinous pileus cuticle of *B. badius* in wet weather) correspond to *Boletus* s. str. rather than to the *Xerocomus* group. Accordingly, the species *B. badius* and *B. moravicus* are placed into the subgenus *Boletus* in this contribution.

Notes on the subgenus *Xerocomus* and the genus *Boletellus*

Under a light microscope the longitudinally striate surface of spores in several species of the subgenus *Xerocomus* is sometimes seemingly similar to the spore ornamentation in the genus *Boletellus*. On the basis of this seeming similarity, some typical representatives of the *Xerocomus* group (*Boletus pruinatus*, *Boletus zelleri* Murrill and some others) were transferred to the genus *Boletellus*. This brought certain obscurities to the delimitation of these taxonomic groups. However, investigations of some authors, e.g. Pegler and Young (1981) and Heinemann, Rammeloo and Rullier (1988), showed that under an electron microscope the ultrastructure of the spore surface in these two boletaceous groups is qualitatively different.

According to Pegler and Young (1981: 112) the spores of the genus *Boletellus* are 'characterized by a prominent, longitudinally costate ornamentation… The [costate] eusporium is overlain by a persistent membranous or mucilaginous myxosporium which fragments between the costae as the spore expands'.

On the other hand, the striate spores of the *Xerocomus* group are ornamented with a very fine, venose ornamentation which is eusporial, without a myxosporium.

Tylopilus P. Karst.
Rev. Mycol. 3: 16, 1881.

Syn.: *Rhodoporus* Quél. ex Bataille, Les Bolets: 11, 1908.

Typus: *Boletus felleus* Bull.: Fr. [≡ *Tylopilus felleus* (Bull.: Fr.) P. Karst.]

Characters: Pileus cuticle a trichoderm which often more or less collapses with age. Tubes depressed around the stipe apex when mature, at first white, then pale pinkish, finally pinkish brown or light brown. Pores small, concolorous with tube-sides. Hymenophoral trama boletoid (see Lohwag and Peringer 1937: Fig. 8). Spores smooth, of boletoid shape, elongate fusoid or fusoid-ellipsoid, with suprahilar depression. Spore print pinkish brown or light brown. Stipe of the only European species of this genus (*T. felleus*) ornamented with a distinct reticulation. Stipe surface composed of a gradually fragmenting caulohymenium with fertile caulobasidia. Lateral stipe stratum loosely arranged, well developed under normal conditions. Flesh white or whitish. Basal tomentum white or dirty whitish. Clamp connections absent in the carpophore.

Forms mycorrhizal associations with both conifers and deciduous trees.

Delimitation: The anatomical structure of carpophores of *Tylopilus felleus* (the type species of *Tylopilus*) is in essence the same as in true *Boletus* species. As regards European species, the only distinction between *Tylopilus* and *Boletus* is the different colour of their spores. The spore print is pinkish brown or light brown in the former genus and olivaceaous brown in the latter. However, according to some authors, this difference is not sufficiently distinct in extra-European boletes. For example, Corner (1972: 13) pointed out that Malaysian species placed by this author in the subgenus *Tylopilus* have a wide spectrum of spore-colour from pink or vinaceous brown, through cinnamon-ochraceous to olivaceous cinnamon. Corner further stated, 'In view of this spectrum, I can see no reason to single out the olive brown of *Boletus* as a generic character and I treat *Tylopilus* as a subgenus of *Boletus*, possibly a mixture of several specific alliances which cut across the formal classification. *Tylopilus* cannot be defined on spore-colour'.

The position of *Tylopilus* as an independent genus is questionable also in view of the fact that some genera, e.g. *Suillus* and *Leccinum*, comprise species both with and without olivaceous tints of spores. This can be probably stated also about *Chalciporus*. According to Baroni and Both (1991), *Boletus piperatoides* Smith et Thiers, a North American bolete with a dark smoky olive spore print, belongs to the genus *Chalciporus*, whose species (including *Chalciporus piperatus*) have their spores cinnamon-brown or ferrugineous brown, without a discernible olivaceous tint. These authors have expressed the following opinion on the olivaceous and non-olivaceous colour of spores, '… we have found an interesting phenomenon concerning this feature for the species pair of *C. piperatoides* and *C. piperatus* which suggests that spore deposit color should be afforded less emphasis taxonomically at the generic level'.

In the light of the above-mentioned arguments, the position of *Tylopilus* as an independent genus seems to be very uncertain. The limits between the genera *Tylopilus* and *Porphyrellus* are discussed below, see the notes on the latter.

Material examined: *Tylopilus felleus* (Bull.: Fr.) P. Karst. and its varieties (JŠ 1809, 2423, 2569, 4030, 4046 etc.).

Porphyrellus Gilbert
Les Bolets: 99, 1931.

Syn.: *Phaeoporus* Bataille, Les Bolets: 11, 1908, non J. Schröt. 1888.

Typus: *Boletus porphyrosporus* Fr. [≡ *Porphyrellus porphyrosporus* (Fr.) Gilbert]

Characters: Pileus cuticle dry, non-gelatinous, composed of a trichoderm which sometimes partly collapses. Tubes grey or greyish cream when young, grey-brown or brown, depressed around the stipe apex when mature. Pores medium-sized, almost concolorous with tube-sides. Structure of the hymenophoral trama mostly intermediate between the phylloporoid and boletoid type, very rarely somewhat nearer to the boletoid one, but always less gelatinized than the true boletoid trama. Spores smooth, of boletoid shape, elongate subfusoid or fusoid-ellipsoid, with suprahilar depression. Spore print reddish brown or chocolate-brown. Stipe covered by very fine granules consisting of small fragments of a caulohymenium with very sparsely scattered spore-bearing caulobasidia. In the only European species of this genus (*P. porphyrosporus*) a lateral stipe stratum occurs very rarely and, if present, forms merely a considerably reduced, very thin layer distinguishable from the stipe trama proper with difficulty. Flesh at first white or whitish, finally pale greyish, slightly brownish or dirty cream-coloured in some parts. Basal tomentum white or dirty whitish. No clamp connections found in the carpophore.

Mycorrhizal with conifers and *Fagales* (see Singer 1981).

Delimitation: The delimitation of *Porphyrellus* from *Tylopilus* (which is closely related) is very difficult. From the European view it seems that there is a certain hiatus between these two genera. *Porphyrellus porphyrosporus* is different from *Tylopilus felleus* in the darker, reddish or chocolate-brown spore print. But from a world-wide view the position of *Porphyrellus* as a separated genus is controversial. When North American, New Zealand or Malaysian species are examined, the genera *Porphyrellus* and *Tylopilus* merge into one another, as was pointed out by some authors, e.g. McNabb (1967), Smith and Thiers (1968) and Corner (1972). For this reason, *Porphyrellus* has been reduced to the level of subgenus within *Tylopilus*, e.g. by Smith and Thiers (1968, 1971) and Grund and Harrison (1976). Sometimes also both these genera have been included as infrageneric taxa in *Boletus* s. lato (see Corner 1972, Arpin and Kühner 1977, etc.).

However, in the discussion about *Tylopilus* and *Porphyrellus* it should not be overlooked that the type species of these genera are distinguished not only by the colour of their spores but also by some other characters. As regards the anatomical structure, *Tylopilus felleus* is much more different from *Porphyrellus porphyrosporus* than from most representatives of *Boletus* s. str. (including *Boletus edulis*, the type species of *Boletus*). In *Porphyrellus porphyrosporus* the lateral stipe stratum is very poorly developed and occurs very rarely, only under extraordinarily optimal conditions, whereas in *Tylopilus felleus* this layer is usually well developed under normal circumstances. The type species of *Porphyrellus* and *Tylopilus* have also somewhat different arrangements of the hymenophoral trama. In *Porphyrellus porphyrosporus* the lateral strata of the tube trama are less gelatinized than in *Tylopilus felleus*. Unfortunately, it is not known whether these differences are also distinctly developed in the other, extra-European species of *Porphyrellus* and *Tylopilus*. Moreover, it is not quite certain whether these differences (which are not very sharp) could play a sufficiently significant role in the delimitation of these genera. This matter necessitates further study.

Material examined: *Porphyrellus porphyrosporus* (Fr.) Gilb. (= *Porphyrellus pseudoscaber* Singer nom. inval.) (JŠ 268, 3252, 3424, 4028 etc.).

Buchwaldoboletus Pilát

Friesia 9: 217, 1969.

Typus: *Boletus lignicola* Kallenb. [≡ *Buchwaldoboletus lignicola* (Kallenb.) Pilát]

Characters: Pileus cuticle a trichoderm which gradually more or less collapses. Tubes relatively short, yellow or yellow-cinnamon, decurrent in young and maturing carpophores and subdecurrent or adnate at maturity. Pores concolorous with tube-sides, often unequal in size, both small and large on one carpophore. Hymenophoral trama boletoid, with distinctly gelatinized lateral strata. Spores smooth, elongate subfusoid or fusoid-ellipsoid, some with suprahilar depression. Spore print olivaceous or olive-brown when fresh, sometimes medium brown and without an olivaceous tint after long preservation. Stipe central or somewhat eccentric, covered by a gradually fragmenting caulohymenium with fertile caulobasidia. Lateral stipe stratum boletoid, loosely arranged, rather often gelatinized, well developed under normal conditions. Flesh more or less yellow, sometimes partly whitish. Clamp connections absent in the carpophore.

Species lignicolous, growing on decayed coniferous wood.

Delimitation: *Buchwaldoboletus* is very closely related to *Boletus*, from which it differs in the lignicolous growth. Macromorphologically, *Buchwaldoboletus* is also distinguished from *Boletus* s. str. by shorter tubes decurrent on the stipe for a relatively long time, sometimes until maturity. But the anatomical structure of *Buchwaldoboletus lignicola* (the type species of *Buchwaldoboletus*) is essentially the same as in true *Boletus* species.

Buchwaldoboletus lignicola is one of the species which have been sometimes placed in the genus *Pulveroboletus* s. lato. In the author's opinion, however, this bolete can hardly be considered congeneric with *Pulveroboletus ravenelii* (the type species of *Pulveroboletus*), which has very different anatomical features (compare the characters of *P. ravenelii* mentioned above in the note on *Boletus gentilis* and *Pulveroboletus*). In the genus *Pulveroboletus*, the species *Buchwaldoboletus lignicola* would be a heterogeneous element.

Material examined: *Buchwaldoboletus lignicola* (Kallenb.) Pilát (BRNM 235934; CB 3375–77; JŠ 3141 etc.).

Chalciporus Bataille
Les Bolets: 19, 1908.

Typus: *Boletus piperatus* Bull.: Fr. [≡ *Chalciporus piperatus* (Bull.: Fr.) Singer]

Characters: Carpophores small and slender. Pileus cuticle a trichoderm which rather often somewhat gelatinizes and more or less collapses with age. Tubes adnate, cinnamon, ferrugineous, reddish brown or vivid yellow. Pores medium to large, cinnamon, ferrugineous, raspberry-red, vinaceous red or vivid yellow. Structure of the hymenophoral trama usually intermediate between the boletoid and phylloporoid type, exceptionally somewhat nearer to the boletoid one, but always less gelatinized than the true boletoid trama. Spores smooth, of boletoid shape, elongate subfusoid or fusoid-ellipsoid, with suprahilar depression. Spore print of European species of this genus cinnamon-brown or ferrugineous brown. Stipe slender, covered by very fine granules consisting of small fragments of a caulohymenium with sparsely scattered fertile caulobasidia. Lateral stipe stratum occurs very rarely and, if present, forms a very thin, almost indistinct, non-gelatinous layer. Flesh pale cream-coloured, sometimes with a slight ferrugineous shade in the pileus, vivid yellow in the stipe. Basal mycelium yellow. Clamp connections none or extremely rare in the carpophore.

Mycorrhizal with conifers (*Pinaceae*) and deciduous trees (*Fagales*, *Betulales*).

Delimitation: As regards the anatomical structure of the carpophores (including the arrangement of the hymenophoral trama and peripheral stipe layers), *Chalciporus* is very similar to *Rubinoboletus* and some xerocomoid boletes. Nevertheless, *Rubinoboletus* is easily recognized by its short spores and the xerocomoid boletes are distinguished from European species of *Chalciporus* by their olivaceous spore print. However, a problem emerged when Baroni and Both (1991) proposed the transferrence of *Boletus piperatoides* to the genus *Chalciporus*, although the spore print of this species is olivaceous. As mentioned in the notes under *Tylopilus*, it seems that the taxonomic value of the olivaceous or non-olivaceous spore tint as a generic diagnostic character in *Boletaceae* is rather doubtful.

A character which was, until recently, considered rather important for defining the limits between *Chalciporus* and *Boletus* (incl. *Xerocomus*) was the never yellow coloration of the hymenophore in *Chalciporus* (cf. Singer 1986). This character, however, lost its diagnostic meaning for the delimitation of this taxonomic group when *Chalciporus hypochryseus* was found, because this true *Chalciporus* species (closely related to *Chalciporus piperatus*) has a yellow hymenophore similar in colour to the tubes of many members of *Boletus* (incl. *Xerocomus*); see Šutara (1992b).

In view of the difficulties with generic delimitation, the position of *Chalciporus* at the generic level appears to be questionable.

Material examined: *Chalciporus hypochryseus* (Šutara) Courtecuisse (JŠ 2016, 3451), *Chalciporus piperatus* (Bull.: Fr.) Singer (JŠ 325, 3043, 4027, 4045 etc.) and *Chalciporus pseudorubinus* (Thirring) Pilát et Dermek (PRM 672811).

Rubinoboletus Pilát et Dermek
Čes. Mykol. 23: 81, 1969.

Typus: *Boletus rubinus* W. G. Smith [≡ *Rubinoboletus rubinus* (W. G. Smith) Pilát et Dermek]

Characters: Pileus cuticle a trichoderm which often more or less collapses. Tubes adnate or subdecurrent. Pores medium large. Structure of the hymenophoral trama probably intermediate between the boletoid and phylloporoid type. However, the arrangement of the trama needs further examination on more numerous material. Spores smooth, shortly ellipsoid, some with an adaxial applanation. Spore print light brown or (according to Skála 2003) pinkish brown. Stipe central, solid, composed of a longitudinally arranged trama. The only European species of this genus (*R. rubinus*) has a large part of the stipe covered by a fragmenting caulohymenium with very sparsely scattered fertile caulobasidia. Lateral stipe stratum occurs very rarely and, if present, forms merely a very thin layer distinguishable from the stipe trama proper with difficulty. Basal mycelium yellow. Clamp connections absent in the carpophore.

Mycorrhizal assotiations with *Quercus* and possibly with some other trees.

Delimitation: *Rubinoboletus rubinus* (the type species and the only European representative of *Rubinoboletus*) has essentially the same anatomical structure of the carpophores as *Chalciporus* and some xerocomoid boletes, from which it differs in the shortly ellipsoid spores. The xerocomoid boletes, moreover, differ in the olive-brown or olivaceous spore print.

Boletus rubinus was placed in *Suillus* (see e.g. Singer 1951, 1965), *Xerocomus* (Pilát 1952) and *Chalciporus* (Singer 1973, 1975, 1986, Pegler and Young 1981, Moser 1983, Alessio 1985, Lannoy and Estades 2001, etc.), but in these genera (whose common feature is the fact that all their species have a uniform, elongate boletoid shape of spores) it was in an isolated position. Therefore the separation of this species to an independent genus, *Rubinoboletus*, seems to be a fairly acceptable solution (Pilát and Dermek 1969). Nevertheless, the independent generic status of *Rubinoboletus* is still controversial. Many authors (e.g. Corner 1972, Singer 1986) have not considered the shorter spore shape as a character important at the generic level. This matter will undoubtedly require further study above all from the world-wide view.

R. rubinus (or *Rubinoboletus*) has not been generally considered closely related to *Gyrodon* or *Gyroporus*. Despite this fact, several African boletes (some of them originally described as *Gyroporus* species) have been placed by

Heinemann and Rammeloo (1983) in the genus *Rubinoboletus* and simultaneously in the family *Gyrodontaceae*. Recently Kirk et al. (2001) have included *Rubinoboletus* in the *Gyroporaceae*. It is, of course, questionable whether the placement of this genus in the *Gyroporaceae* (or *Gyrodontaceae*) is sufficiently justified. The author of this contribution had not yet an opportunity to examine the African boletes placed in *Rubinoboletus* and therefore he cannot express an opinion on the generic position of these species. It is, however, necessary to point out that *R. rubinus* (the type species on which the genus *Rubinoboletus* is based) has the only character reminiscent of the *Gyroporaceae* (or *Gyrodontaceae*), viz. the shortly ellipsoid shape of the spores. Almost all the other features of this species, e.g. the nearly xerocomoid appearance of the carpophores, the clampless hyphae, the fertile caulohymenium, the anatomical arrangement of peripheral stipe layers, the less gelatinized hymenophoral trama, the colour of spores etc., are very different from the characters of the *Gyroporaceae* (or *Gyrodontaceae*).

Material examined: *Rubinoboletus rubinus* (W. G. Smith) Pilát et Dermek (PRM 532362, 603926; LIT 15.8.2002; JŠ 4048).

Pseudoboletus Šutara

Čes. Mykol. 45: 2, 1991.

Typus: *Boletus parasiticus* Bull.: Fr. [≡ *Pseudoboletus parasiticus* (Bull.: Fr.) Šutara]

Characters: Pileus cuticle a trichoderm which partly collapses with age. Gelification of the trichodermal hyphae not found. Tubes adnate or subdecurrent. Pores medium large. Hymenophoral trama in a well developed stage almost boletoid. Spores of boletoid shape, elongate fusoid-cylindric, with a shallow suprahilar depression. In the only European species of this genus (*P. parasiticus*) the spore surface has an unusual pitted ornamentation under an electron microscope (see Oolbekkink 1991, Holec 1994). Spore print olive-brown. Stipe solid, attached with its basal part to the carpophore of the host. Stipe surface infertile, composed of a filamentous trichoderm (see Fig. 4b and Šutara 1991: Figs. 1, 2). Caulobasidia absent. Stipe trama consisting of longitudinally arranged hyphae. Lateral stipe stratum never present. No clamp connections found in the carpophore.

Growing on carpophores of gasteromycetes (*Scleroderma* or *Astraeus*). The parasitism of *Pseudoboletus parasiticus* was thoroughly studied and described by Kavina (1935: Figs. 4, 6 and Plate 1).

Delimitation: *Pseudoboletus* (which is macroscopically most similar to xerocomoid boletes, particularly the *Boletus subtomentosus* group) is well distinguished from all European *Boletaceae* by (1) the infertile stipe surface without caulobasidia and (2) the growth on gasteromycetes.

A further character distinguishing *Pseudoboletus* from almost all the other European *Boletaceae* (including the xerocomoid boletes) is the absence of a lateral stipe stratum.

Between *Pseudoboletus parasiticus* (the type species of *Pseudoboletus*) and the *Boletus subtomentosus* group, there is also a visible difference in the arrangement of the hymenophoral trama. In *Pseudoboletus parasiticus* the trama is almost boletoid, with distinctly gelatinized lateral strata, whereas in the *Boletus subtomentosus* group the trama is phylloporoid, with lateral strata non-gelatinous. The tramal structure in *Pseudoboletus parasiticus* is even more similar to the true boletoid type than the tube trama in the *Boletus chrysenteron/pruinatus* group.

Results of ontogenetic investigations indicate that between *Pseudoboletus parasiticus* and the xerocomoid boletes there is, moreover, a significant difference in the development of the carpophores. According to Reijnders (1963), the development in *Boletus parasiticus* (≡ *Pseudoboletus parasiticus*) is hypovelangiocarpous (paravelangiocarpous) while in *Boletus subtomentosus* (≡ *Xerocomus subtomentosus*) and *Boletus zelleri* (≡ *Xerocomus zelleri*) is gymnocarpous. The gymnocarpous development was observed also in other boletes which have been often treated as *Xerocomus* species, e.g. *Boletus badius*, *Boletus illudens* Peck (see Pantidou 1964), *Boletus armeniacus*, *Boletus porosporus* and other members of the *Boletus chrysenteron* group (Watling 1985). According to Singer (1981: 270), in *Xerocomus*, excepting the members of the section *Parasitici* (i.e. *Xerocomus parasiticus* and, perhaps, *Xerocomus astraeicola* Imazeki), most or all of the other species are gymnocarpous.

According to the present knowledge, we can suppose that the hypo-(para)-velangiocarpous and pileostipitocarpous development of *P. parasiticus* is a very rare phenomenon in the *Boletoideae*. In *Boletus* s. str. (see Reijnders in Singer 1986: 29) and its satellites, i.e. the genera *Tylopilus* (Singer 1986), *Buchwaldoboletus* (Pantidou 1961, 1962), *Chalciporus* (McLaughlin 1964, 1970), probably also *Porphyrellus* (Singer 1986) and *Rubinoboletus*, there occurs the same (i.e. gymnocarpous and probably stipitocarpous) type of development as in the xerocomoid boletes. In other genera of the *Boletoideae* the following types of development have been ascertained: pilangiocarpous and stipitocarpous in *Leccinum* (Watling 1985), angiocarpous in *Boletellus* (Singer 1986) and metavelangiocarpous in some species of *Pulveroboletus* (Singer 1986).

The above data suggest that certain taxonomic groups of boletes possess a certain, genetically determined type of development. In the *Boletoideae* the carpophore development, as a rule, reflects relationships between genera (or groups of genera) and more or less corresponds with the anatomical structure of the carpophores. For example, the genera *Boletus* (including *Xerocomus*), *Tylopilus*, *Chalciporus*, *Buchwaldoboletus* and probably *Porphyrellus*, which have a more or less similar anatomical structure, have also a similar (i.e. gymnocarpous) type of development. On the other hand, in the genera which are well distinguished from the other taxonomic groups by their anatomical characters (e.g. *Pseudoboletus, Boletellus* and *Pulveroboletus*) the development is different from that in the other boletaceous genera.

In the case of *Pseudoboletus parasiticus* and the xerocomoid species, the different carpophore development has obviously a connection with the different anatomy and the fertility (or infertility) of the stipe surface. In the primordium of *P. parasiticus* the infertile stipe cuticle, i.e. the trichoderm on the stipe, differentiates simultaneously with the trichoderm on the pileus (JŠ 2307, 2342) whereas in the primordium of the xerocomoid species the fertile stipe surface, i.e. the caulohymenium, is formed together with the hymenium of the hymenophore (Watling 1985: Fig. 1).

Note: Singer (1986) mentioned that the hypo-(para)-velangiocarpous carpophore development occurs probably also in *Xerocomus radicicola* Singer et Araujo, a tropical species placed by Singer in section *Brasilienses* of *Xerocomus*. It seems, however, that some characters of *X. radicicola* which could be important from a taxonomic viewpoint (e.g. the anatomical structure of the stipe surface) are still unknown or known only insufficiently. For this reason, the generic position of this species appears rather unclear.

Pseudoboletus parasiticus is, moreover, distinguished from the other European boletes (including species of *Boletus*, subg. *Xerocomus*) by the pitted ornamentation of the spores (see Oolbekkink 1991, Holec 1994). It is not known whether this spore ornamentation occurs also in the extra-European *Pseudoboletus astraeicola* (≡ *Xerocomus astraeicola*).

European material examined: *Pseudoboletus parasiticus* (Bull.: Fr.) Šutara, (CB 2310; JŠ 2088–92, 2106, 2108–09, 2342, 3115, 3243–44 etc.).

New combination

A Japanese species of the genus *Pseudoboletus*, which has also an infertile stipe cuticle consisting of a trichoderm and grows on carpophores of *Astraeus hygrometricus* (Pers.) Morgan, is:

Pseudoboletus astraeicola (Imazeki) Šutara **comb. nov.**

- Basionym: *Xerocomus astereicola* Imazeki, Mycol. J. Nagaoa Inst. 2: 35, 1952.
- Material examined: TFM-M-D 972, Tokyo Univ. Forest, Chiba, Japan, 20. Aug. 1992, H. Neda.

Phylloporus Quél.
Fl. Mycol. Fr.: 409, 1888.

Typus: *Agaricus pelletieri* Lév. [≡ *Phylloporus pelletieri* (Lév.) Quélet]

Characters: Pileus cuticle dry, subtomentose, consisting of a trichoderm. Hymenophore lamellate, with numerous anastomoses. Lamellae decurrent. Hymenophoral trama phylloporoid (Figs. 2c, 2d). Spores elongate subfusoid or fusoid-ellipsoid, with suprahilar depression. Spore surface bacillate (e.g. in *P. pelletieri*) or, in some extra-European species, slightly rugulose or smooth (see Heinemann, Rammeloo and Rullier 1988). Spore print brown-olivaceous. Stipe solid, composed of longitudinally arranged trama. The only European species of this genus (*P. pelletieri*) has a large part of the stipe covered by a fragmenting caulohymenium with very sparsely scattered fertile caulobasidia. Lateral stipe stratum not found. Clamp connections absent in the carpophore.

Mycorrhizal with various trees (Singer 1981).

Delimitation: Among the *Boletaceae*, the genus *Phylloporus* is easily recognized by its lamellate hymenophore. *Phylloporus* is moreover distinguished from almost all the other *Boletaceae* by the phylloporoid hymenophoral trama. The species which have also the phylloporoid hymenophoral trama, viz. the closely related boletes from the *B. subtomentosus* group, differ from *Phylloporus* in the tendency to form a well developed, loosely arranged lateral stratum of the stipe trama (see Šutara 1991: Fig. 3). In the type species of *Phylloporus* no distinctly developed lateral stratum of the stipe trama was ascertained by the present author (Fig. 2f). Nevertheless, this question will require further examination. It is not known whether the lateral stipe stratum is absent also in the other, extra-European species of *Phylloporus*.

Material examined: *Phylloporus pelletieri* (Lév.) Quélet [= *Phylloporus rhodoxanthus* (Schw.) Bres. subsp. *europaeus* Singer], (CB 448; HK 292/81; JŠ 281, 2722, 3251 etc.).

Leccinum S. F. Gray
Nat. Arrang. Br. Pl. 1: 646, 1821.

Syn.: *Krombholzia* P. Karst., Rev. Mycol. 3: 17, 1881 (non Rupr. ex Fourn. 1876). – *Trachypus* Bataille, Les Bolets: 12, 1908 (non Reinw. et Hornsch. 1829). – *Krombholziella* R. Maire, Publ. Inst. Bot. Barcelona 3: 41, 1937.

Typus: *Boletus aurantiacus* Bull. [≡ *Leccinum aurantiacum* (Bull.) S. F. Gray]

Characters: Pileus cuticle mostly a trichoderm with more or less filamentous hyphae, less frequently an epithelium consisting of hyphal chains of broad and short cells. In wet weather the surface of trichodermal hyphae may be slightly gelatinized. In section *Leccinum* the cuticle of the pileus margin overlaps beyond the tubes as an sterile, appendiculate membrane. Tubes long, depressed around the stipe apex when mature. Pores small, roundish. Hymenophoral trama boletoid (Fig. 4a). Spores smooth, of boletoid shape, elongate subfusoid or subcylindric, with suprahilar depression. Spore print of various brown shades, mostly medium brown or umber brown, less frequently olivaceous brown. Stipe central, solid, slender and more elongated than in the other European boletes. Caulohymenium with fertile caulobasidia present on a substantial part of the stipe. Lateral stipe stratum conspicuously developed, at first forming a continuous layer (Šutara 1989: Fig. 1), but soon disrupting with growth of the stipe into characteristic, almost anticlinally arranged fascicles of non-gelatinous hyphae ending in fragments of the caulohymenium. These hyphal fascicles form a typical scabrous ornamentation of the stipe. Species of sections *Leccinum* and *Scabra* have the lateral stipe stratum (200–)300–1000(–2000) µm thick, with a relatively dense and rather regular arrangement of hyphae within the fascicles. Species of section *Luteoscabra* have this layer thinner (150–320 µm) and the arrangement of hyphae within the fascicles somewhat looser and less regular. The stipe trama proper composed of hyphae densely arranged in a longitudinal way, parallel with the stipe axis. Clamp connections none or extremely rare in the carpophore.

Forming mycorrhizal associations with both deciduous and coniferous trees.

Delimitation: Singer (1975, 1986) accepted a wider concept of the genus *Leccinum*, in which he placed such species as *Leccinum chromapes* (Frost) Singer (≡ *Boletus chromapes* Frost), *Leccinum eximium* (Peck) Singer (≡ *Boletus eximius* Peck), *Leccinum subglabripes* (Peck) Singer (≡ *Boletus subglabripes* Peck) and *Leccinum rubropunctum* (Peck) Singer (≡ *Boletus rubropunctus* Peck). In the notes on the delimitation of this genus, Singer (1986: 787) stated, '…the scabrosities of the stipe, the anatomy of these scabrosities and the general habit of *Leccinum* have served as a unifying character'.

Smith and Thiers (1968, 1971) had a somewhat different opinion on the circumscription of *Leccinum*. In the taxonomic arrangement of these authors *Boletus chromapes* and *Boletus eximius* are placed in *Tylopilus* whereas *Boletus subglabripes* and *Boletus rubropunctus* are left in *Boletus*. According to Smith and Thiers (1968: 946), '…the most important character of *Leccinum* is the darkening in color of the stipe ornamentation or its being dark from the beginning'. This diagnostic character was previously mentioned by Smith, Thiers and Watling in their contributions to *Leccinum* (1966, 1967). The dark or darkening stipe ornamentation is a character which possibly helped to solve the problem with the controversial generic position of the above-mentioned species but its application in practice is not always clear. The process of darkening of the stipe scabrosities depends on many factors (not only on the mode of creation of colour pigments, but also on changes caused by oxidation, on moisture, light conditions and some other circumstances). Therefore some carpophores of *Leccinum* species which are found in the field do not conform to the schematic classification based on the darkening or not darkening stipe ornamentation. For example, in some forms of such typical species of this genus as *Leccinum niveum* (Fr.) Rauschert [= *Leccinum holopus* (Rostk.) Watling] and *Leccinum rotundifoliae* (Singer) Smith, Thiers et Watling the stipe scabrosities are whitish when young and persistently pale coloured until maturity. On the other hand, the stipe scabrosities of some species which are mostly considered as members of *Boletus*, e.g. *Boletus impolitus*, may distinctly darken under certain conditions.

In one of his contributions, the author (Šutara 1989) attempted to analyse the differences in anatomical arrangement of the stipe surface between *Leccinum* and the other boletes in detail. A by-product of this effort was the finding that *Boletus depilatus* and *Boletus impolitus* (erroneously merged with *Boletus fragrans* by the author) have peripheral stipe layers very similar to those in *Leccinum*. On the basis of the similarity of anatomical characters, these two species were treated by the author as members of the genus *Leccinum*.

Many new important data have been published by Binder and Besl (2000) in their molecular analysis concerning *Leccinum* and allied boletes. According to the conclusions presented in this work, the recent concepts of the genus *Leccinum* are too wide and the species *Boletus chromapes*, *B. eximius*, *B. subglabripes*, *B. rubropunctus*, *B. impolitus*, *B. depilatus* and some others should be excluded from *Leccinum*.

Material examined: *Leccinum aurantiacum* (Bull.) S. F. Gray [= *Leccinum quercinum* (Pilát) Green et Watling] (CB 1616; JŠ 056, 1585, 1842–45 etc.), *Leccinum duriusculum* (Schulzer) Singer (PRM 566842, 663764; JŠ 169, 2614, 2794 etc.), *Leccinum griseum* (Quél.) Singer sensu orig. Quélet (= *Leccinum variicolor* Watling) (JŠ 460, 1851–55, 2657, 3011 etc.), *Leccinum luteoporum* (Bouchinot ap. Barbier) Šutara (PRM 648066–67; LIT 3776/565; JŠ 152 etc.), *Leccinum niveum* (Fr.) Rauschert [= *Leccinum holopus* (Rostk.) Watling] (JŠ 2317, 2564, 2661, 3007 etc.), *Leccinum piceinum* Pilát et Dermek (CB 1061, 2509; JŠ 525, 2137 etc.), *Leccinum pseudoscabrum* (Kallenb.) Šutara [= *Leccinum carpini* (R. Schulz) Moser] (PRM 520436, 520745; BRA–Fábry 95/965; JŠ 360 etc.), *Leccinum roseotinctum* Watling (JŠ 055, 171), *Leccinum rotundifoliae* (Singer) Smith, Thiers et Watling (PRM 518250, collection from Finland), *Leccinum rufum* (Schaeff.) Kreisel (= *Leccinum aurantiacum* sensu auct. plur., non orig. Bulliard) (JŠ 235, 431, 1863, 2025, 3014 etc.), *Leccinum versipelle* (Fr. sensu Smotlacha) Snell (= *Leccinum testaceoscabrum* Singer nom. inval.) (JŠ 532, 1679, 1905–07, 2160 etc.), *Leccinum scabrum* (Bull.: Fr.) S. F. Gray (JŠ 1579, 2029, 2544, 3023 etc.).

Subfamily ***Strobilomycetoideae*** (Gilbert) Watling

Brit. Fung. Fl. Agar. and Bol. 1: 101, 1970.

Type genus: *Strobilomyces* Berk.

Characters: Universal veil present. Hymenophore tubular. Spores subglobose, subovoid or shortly ellipsoid, conspicuously ornamented. Spore print very dark, almost black, brown-black or purplish black. Clamp connections none or very rare.

Delimitation: The differences between the *Strobilomycetoideae* and the *Boletoideae* are obvious from the delimitation of the genus *Strobilomyces*.

European genus: *Strobilomyces*.

Strobilomyces Berk.
Hookers Journ. Bot. Kew Gard. Misc. 3: 78, 1851.

Syn.: *Eriocorys* Quél., Enchir. Fung.: 163, 1886.

Typus: *Boletus strobilaceus* Scop.: Fr. [≡ *Strobilomyces strobilaceus* (Scop.: Fr.) Berk.]

Characters: Carpophores covered with a true universal veil which disrupts into fragments remaining as floccose-woolly scales on pileus and stipe. Tubes adnate. Pores enlarged, angular. Structure of the hymenophoral trama usually intermediate between the boletoid and phylloporoid type, with a weak or scarcely distinct gelification of lateral strata. Basidia (at least in *S. strobilaceus*) relatively large and somewhat inflated. Spores subglobose, subovoid or shortly ellipsoid, conspicuously reticulate, with smooth suprahilar plage or, in some extra-European species, verrucose or echinate (see Perreau-Bertrand 1961, Corner 1972, Pegler and Young 1981, etc.). Spore print almost black when fresh, brown-black or purplish black when dried. Stipe central, solid. The only European species of this genus (*S. strobilaceus*) has a fertile caulohymenium on a large part of the stipe. Caulobasidia produce the same spores as the basidia in the hymenophore. Lateral stipe stratum occurs rather rarely, only under sufficiently favourable conditions. Stipe trama proper dense, longitudinally arranged. Clamp connections none or extremely rare in the carpophore.

Probably mycorrhizal, growing under various trees.

Delimitation: *Strobilomyces* is one of the best characterized boletaceous genera. Typical characters of this genus are above all (1) the universal veil, (2) the conspicuous shape and ornamentation of the spores and (3) the very dark, almost black spore print.

Material examined: *Strobilomyces strobilaceus* (Scop.: Fr.) Berk. [= *Strobilomyces floccopus* (Vahl.: Fr.) P. Karst.] (JŠ 035–36, 3420 etc.).

ACKNOWLEDGEMENTS

The author wishes to express his thanks to Prom. Biol. Zdeněk Pouzar, CSc. and Dr. Jan Holec, National Museum, Prague, for many useful comments on the manuscript and for lending mycological literature and herbarium material. Special thanks are due to Edvard Skála, Vladimír Zíta and Pavel Špinar for kindly providing their collections of some rare boletes. Thanks are also given to Dr. Vladimír

Antonín, Moravian Museum, Brno, and to the curators of the following herbaria for sending herbarium specimens: South Bohemian Museum, České Budějovice, Slovak National Museum, Bratislava, Regional Museum of Litoměřice and Regional Museum of Hradec Králové.

REFERENCES

ALESSIO C. L. (1985): *Boletus* Dill. ex L. (sensu lato). – In: Fungi Europaei 2, p. 1–712, 84 pl., Saronno.

ARPIN N. and KÜHNER R. (1977): Les grandes lignes de la classification des Boletales. – Bull. Soc. Linn. Lyon 46: 81–108, 181–208.

BARONI T. J. and BOTH E. E. (1991): *Chalciporus piperatoides* in North America. – Mycologia 83(5): 559–564.

BATAILLE F. (1908): Les Bolets. – 30 p. Bésançon.

BESL H. and BRESINSKY A. (1977): Notizen über Vorkommen und systematische Bewertung von Pigmenten in Höheren Pilzen (2). – Z. Pilzk. 43: 311–322.

BESL H. and BRESINSKY A. (1997): Chemosystematics of *Suillaceae* and *Gomphidiaceae* (suborder *Suillineae*). – Pl. Syst. Evol. 206: 223–242.

BINDER M. and BESL H. (2000): 28S rDNA sequence data and chemotaxonomical analyses on the generic concept of *Leccinum* (*Boletales*). – In: Micologia 2000, p. 75–86, Trento.

BINDER M. and BRESINSKY A. (2002): Derivation of a polymorphic lineage of Gasteromycetes from boletoid ancestors. – Mycologia 94(1): 85–98.

BRESINSKY A. and ORENDI P. (1970): Chromatographische Analyse von Farbmerkmalen der *Boletales* und anderer Makromyzeten auf Dünnschichten. – Z. Pilzk. 36: 135–170.

BRESINSKY A. and SCHWARZER G. (1969): Mikroskopische Analyse der Hutdeckschichten einiger *Agaricales*, *Boletales* und *Russulales*. – Z. Pilzk. 35: 263–293.

BRUNS T. D. and SZARO T. M. (1992): Rate and mode differences between nuclear and mitochondrial small-subunit rRNA genes in mushrooms. – Mol. Biol. Evol. 9(5): 836–855.

BRUNS T. D., SZARO T. M., GARDES M., CULLINGS K. W., PAN J. J., TAYLOR D. L., HORTON T. R., KRETZER A., GARBELOTTO M. and LI Y. (1998): A sequence database for the identification of ectomycorrhizal basidiomycetes by phylogenetic analysis. – Mol. Ecol. 7: 257–272.

CLÉMENÇON H. (1997): Anatomie der Hymenomyceten. – 996 p. Wabern-Bern.

CORNER E. J. H. (1970): *Phylloporus* Quél. and *Paxillus* Fr. in Malaya and Borneo. – Nova Hedwigia 20: 793–822.

CORNER E. J. H. (1972): *Boletus* in Malaysia. – 263 p. Singapore.

DISBREY B. and WATLING R. (1967): Histological and histochemical techniques applied to the *Agaricales*. – Mycopath. Mycol. Appl. 81(3–4): 81–114.

ELROD R. P. and BLANCHARD D. L. (1939): Histological studies of the *Boletaceae* and related genera. – Mycologia 31: 693–708.

ELROD R. P. and SNELL W. H. (1940): Development of the carpophores of certain *Boletaceae*. – Mycologia 32: 493–504.

ENGEL H., KRIEGLSTEINER J., DERMEK A. and WATLING R. (1983): Dickröhrlinge. Die Gattung *Boletus* in Europa. – 157 p. Weidhausen.

ENGEL H., DERMEK A., KLOFAC W. and LUDWIG E. (1996): Schmier- und Filzröhrlinge s. l. in Europa. – 268 p., 56 pl., Weidhausen.

FAYOD V. (1889): Prodrome d'une histoire naturelle des Agaricinés. – Ann. Sci. Nat. Bot. ser. 7, 9: 181–411.

GARDES M. and BRUNS T. D. (1996): Community structure of ectomycorrhizal fungi in a *Pinus muricata* forest: above- and below-ground views. – Can. J. Bot. 74: 1572–1583.

GENTILE A. C. and SNELL W. H. (1953): Development of the carpophore of *Boletinus paluster*. – Mycologia 45: 720–722.

GILBERT E. J. (1931): Les Bolets. – In: Les livres du mycologie, Tome 3, p. 1–254, Paris.

GILL M. and STEGLICH W. (1987): Pigments of fungi (macromycetes). – Prog. Chem. Nat. Prod. 51: 1–317.

GRUND D. V. and HARRISON A. K. (1976): Nova Scotia boletes. – 283 p. Vaduz.

HEINEMANN P. and RAMMELOO J. (1983): Combinaisons et taxons nouveaux de *Gyrodontaceae* (*Boletineae*). – Bull. Jard. Bot. Nat. Belg. 53: 294–297.

HEINEMANN P., RAMMELOO J. and RULLIER E. (1988): L'ornamentation sporale des *Xerocomaceae* à spores dites lisses. – Bull. Jard. Bot. Nat. Belg. 58: 513–534.

HIBBET D. S. and THORN R. G. (2001): Basidiomycota: Homobasidiomycetes. – In: The Mycota, vol. 7, part B, Systematics and Evolution, D. J. G. McLaughlin, E. G. McLaughlin and P. A. Lemke (Eds.), p. 121–168, Berlin.

HLAVÁČEK J. (1997): Přehled našich hub hřibotvarých (Boletales) 35. – Mykologický Sborník 74: 54–57.

HLAVÁČEK J. (2000): Přehled našich hub hřibotvarých (Boletales) 46. – Mykologický Sborník 77: 49–56.

HØILAND K. (1987): A new approach to the phylogeny of the order *Boletales* (Basidiomycotina). – Nord. J. Bot. 7: 705–718.

HOLEC J. (1994): The ultrastructure of the spore wall and ornamentation in the *Xerocomus* group of *Boletus*. – Czech Mycol. 47: 173–184.

JOSSERAND M. (1932): Sur la nature de la trame dans les genres *Paxillus* et *Phylloporus*. – Bull. Soc. Mycol. France 48: 112–117.

JÜLICH W. (1982): Higher taxa of Basidiomycetes. – Bibl. Mycol. 85: p. 1–485, Vaduz ('1981').

KAVINA K. (1935): Příspěvek k histologii a biologii *Boletus parasiticus* Bull. (Contribution à l'histologie et biologie de *Boletus parasiticus* Bull.) – Rozpravy II. Tř. Čes. Akademie 45(23): 1–16, 1 pl.

KARSTEN P. A. (1881): Enumeratio Boletinearum et Polyporearum Fennicarum, systemate novo dispositarum. – Rev. Myc. 3(9): 16–19.

KIRK P. M., CANNON P. F., DAVID J. C. and STALPERS J. A. (2001): Ainsworth & Bisby's Dictionary of the fungi. 9th Ed. – 655 p. Wallingford.

KLOFAC W. and KRISAI-GREILHUBER I. (1992): *Xerocomus chrysenteron* und ähnlich aussehende Röhrlinge. – Öst. Z. Pilzk. 1: 19–59.

KLUZÁK Z., SMOTLACHA M., ERHART J. and ERHARTOVÁ M. (1985): Poznáváme houby. – 374 p. Praha.

KRETZER A. and BRUNS T. D. (1997): Molecular revisitation of the genus *Gastrosuillus*. – Mycologia 89(4): 586–589.

KRETZER A. and BRUNS T. D. (1999): Use of atp6 in fungal phylogenetics: An example from the *Boletales*. – Mol. Phyl. Evol. 13(3): 483–492.

KRETZER A., LI Y., SZARO T. and BRUNS T. D. (1996): Internal transcribed spacer sequences from 38 recognized species of *Suillus* sensu lato: phylogenetic and taxonomic implications. – Mycologia 88(5): 776–785.

KÜHNER R. (1926): Contribution à l'étude des Hyménomycètes et spécialement des Agaricacés. – Le Botaniste 17: 5–225.

KÜHNER R. (1927): Le développement du *Boletinus cavipes* (Opat.) Kalch. – Le Botaniste 18: 177–181.

LADURNER H. and SIMONINI G. (2003): *Xerocomus* s. l. – In: Fungi Europaei 8, p. 1–526, 21 pl., Alassio.

LANNOY G. and ESTADES A. (2001): Les bolets. – In: Flore Mycologiques d'Europe 6, p. 1–161, 6 pl., Lille.

LARGENT D., JOHNSON D. and WATLING R. (1977): How to identify mushrooms to genus III: Microscopic features. – 148 p. Eureka.

LOHWAG H. (1922): Neues über den Satanpilz und seine Verwandten. – Öst. Bot. Zeitschr. 71: 129–134.

LOHWAG H. (1941): Anatomie der Asco– und Basidiomyceten. – In: Handbuch der Pflanzenanatomie, vol. 6, part 2/3c, p. 1–572, Berlin.

LOHWAG H. and PERINGER M. (1937): Zur Anatomie der *Boletaceae*. – Ann. Mycol. 35: 295–331.

MCLAUGHLIN D. J. (1964): Production of fruitbodies of *Suillus rubinellus* in pure culture. – Mycologia 56: 136–138.

MCLAUGHLIN D. J. (1970): Environmental control of fruitbody development in *Boletus rubinellus* in axenic culture. – Mycologia 62: 307–331.

MCNABB R. F. R. (1967): The *Strobilomycetaceae* of New Zealand. – New Zealand J. Bot. 5: 532–547.

MELZER V. (1919): O původu síťky na třeni některých hřibů. – Čas. Čes. Houbařů 1: 9–10.

Moser M. (1983): Die Röhrlinge und Blätterpilze. Ed. 5. – In: H. Gams, Kleine Kryptogamenflora, vol. IIb/2, p. 1–533, Jena.

Němec B. (1926): Basidie na třeni hřibovitých hub. – Preslia 4: 30–36.

Oolbekkink G. T. (1991): The taxonomic value of the ornamentation of spores in 'the *Xerocomus* group' of *Boletus*. – Persoonia 14(3): 245–273.

Pantidou M. (1961): Carpophores of *Phlebopus sulphureus* in culture. – Can. J. Bot. 39: 1163–1167.

Pantidou M. (1962): Cultural studies of *Boletaceae*. Carpophores of *Phlebopus lignicola* in culture. – Can. J. Bot. 40: 1313–1319.

Pantidou M. (1964): Cultural studies of *Boletaceae*. Carpophores of *Xerocomus badius* and *Xerocomus illudens* in culture. – Can. J. Bot. 42: 1147–1149.

Pantidou M. and Watling R. (1973): Fruit–bodies of *Boletus amarellus* in pure–culture. – Notes Roy. Bot. Gard. Edinburgh 32: 439–443.

Pegler D. N. and Young T. W. K. (1971): Basidiospore morphology in the *Agaricales*. – Beih. Nova Hedwigia 35: 1–210.

Pegler D. N. and Young T. W. K. (1981): A natural arrangement of the *Boletales*, with reference to spore morphology. – Trans. Brit. Mycol. Soc. 76: 103–146.

Perreau J. (1981): A propos de la structure pariétale basidiosporique chez les *Gyrodontaceae*. – Bull. Soc. Mycol. France 97(3) 135–142.

Perreau–Bertrand J. (1961): Recherches sur les ornamentations sporales et la sporogenèse chez quelques espèces des genres *Boletellus* et *Strobilomyces* (Basidiomycétes). – Ann. Sci. Nat. (Bot.) 2: 399–489.

Perreau–Bertrand J. (1965): Structure membranaire et différenciations apicales chez les spores des genres *Xerocomus*, *Boletellus*, *Heimiella* et *Strobilomyces*. – C. R. Hedb. Séanc. Acad. Sci. 260: 4245–4248.

Pilát A. (1952): Klíč k určování našich hub hřibovitých a bedlovitých. – 722 p. Praha ('1951').

Pilát A. and Dermek A. (1969): *Rubinoboletus*, genus novum Boletacearum. – Čes. Mykol. 23: 81–82.

Pilát A. and Dermek A. (1974): Hríbovité huby. – 206 p., 103 pl., Bratislava.

Pouzar Z. (1966): Dvě zajímavé hřibovité houby: *Boletus truncatus* a *Boletus subtomentosus* var. *leguei*. – Čes. Mykol. 20: 1–7.

Pouzar Z. (1975): Systém rodů hřibovitých hub (*Boletaceae*). – Mykol. Zpravodaj 19(2): 43–49.

Quélet L. (1886): Enchiridion fungorum in Europa et praesertim in Gallia vigentium. – 352 p. Paris.

Quélet L. (1888): Flore Mycologique de France. – 492 p. Paris.

Reijnders A. F. M. (1963): Les problèmes du développement des carpophores des Agaricales et de quelques groupes voisins. – 412 p., 55 pl., Den Haag.

Reijnders A. F. M. and Stalpers J. A. (1992): The development of the hymenophoral trama in the *Aphyllophorales* and the *Agaricales*. – Stud. Mycol. 34: 1–109.

Singer R. (1945): The *Boletineae* of Florida with notes on extralimital species. II. The *Boletaceae* (*Gyroporoideae*). – Farlowia 2: 223–303.

Singer R. (1947): The *Boletineae* of Florida with notes on extralimital species. III. The *Boletoideae* of Florida. – Amer. Midl. Nat. 37: 1–135.

Singer R. (1951): The *Agaricales* (mushrooms) in modern taxonomy. – Lilloa 22: 1–832, ('1949').

Singer R. (1962): The *Agaricales* in modern taxonomy. Ed. 2. – 915 p. Weinheim.

Singer R. (1965): Die Röhrlinge. Teil I. Die *Boletaceae* (ohne *Boletoideae*). – In: Pilze Mitteleuropas 5: 1–131.

Singer R. (1967): Die Röhrlinge. Teil II. Die *Boletoideae* und *Strobilomycetaceae*. – In: Pilze Mitteleuropas 6: 1–151.

Singer R. (1973): Notes on bolete taxonomy. – Persoonia 7: 313–320.

Singer R. (1975): The *Agaricales* in modern taxonomy. Ed. 3. – 912 p. Vaduz.

Singer R. (1981): Notes on bolete taxonomy – III. – Persoonia 11(3): 269–302.

Singer R. (1986): The *Agaricales* in modern taxonomy. Ed. 4. – 981 p. Koenigstein.

Skála E. (2003): Hřib rubínový (*Rubinoboletus rubinus*) nalezen na Teplicku. – Mykol. Listy no. 84–85: 25–28.

SMITH A. H. and THIERS H. D. (1964): A contribution towards a monograph of North American species of *Suillus*. –116 p., 46 pl., Ann Arbor.

SMITH A. H. and THIERS H. D. (1968): Notes on Boletes I. The generic position of *Boletus subglabripes* and *Boletus chromapes*. A comparison of four species of *Tylopilus*. – Mycologia 60: 943–954.

SMITH A. H. and THIERS H. D. (1971): The boletes of Michigan. – 428 p. Ann Arbor.

SMITH A. H., THIERS H. D. and WATLING R. (1966): A preliminary account of the North American species of *Leccinum*, sections *Luteoscabra* and *Scabra*. – The Michigan Botanist 5: 131–179.

SMITH A. H., THIERS H. D. and WATLING R. (1967): A preliminary account of the North American species of *Leccinum*, section *Leccinum*. – The Michigan Botanist 6: 107–154.

SMOTLACHA F. (1947): Atlas hub jedlých a nejedlých. – 297 p. Praha.

SMOTLACHA M. and MALÝ J. (1986): Atlas tržních a jedovatých hub. Ed. 2. – 272 p. Praha.

SNELL W. H. (1941): The genera of the *Boletaceae*. – Mycologia 33: 415–423.

SNELL W. H. and DICK E. A. (1958): Notes on Boletes X. A few miscellaneous discussions and a new subspecies. – Mycologia 50: 57–65.

ŠUTARA J. (1987a): *Mariaella*, a new boletaceous genus. – Čes. Mykol. 41: 73–84.

ŠUTARA J. (1987b): The limit between the genera *Boletinus* and *Suillus*. – Čes. Mykol. 41: 139–152.

ŠUTARA J. (1989): The delimitation of the genus *Leccinum*. – Čes. Mykol. 43: 1–12.

ŠUTARA J. (1991): *Pseudoboletus*, a new genus of *Boletales*. – Čes. Mykol. 45: 1–9.

ŠUTARA J. (1992a): The genera *Paxillus* and *Tapinella* in Central Europe. – Čes. Mykol. 46: 50–56.

ŠUTARA J. (1992b): *Boletus hypochryseus*, nový hřib ze skupiny druhu *Boletus piperatus*. – Čes. Mykol. 46: 203–208.

WATLING R. (1968): Records of Boleti and notes on their taxonomic position. – Notes Roy. Bot. Gard. Edinburgh 28(3): 301–315.

WATLING R. (1970): *Boletaceae, Gomphidiaceae, Paxillaceae*. – In: D. M. Henderson, P. D. Orton and R. Watling: British Fungus Flora, Agarics and Boleti, vol. 1, p. 1–125, Edinburgh.

WATLING R. (1985): Hymenial surfaces in developing agaric primordia. – Bot. Journ. Linn. Soc. 91: 273–293.

WATLING R. (2002): One bolete genus or …? – Mycol. Res. 105: 1440–1448.

WATLING R. and Largent D. (1976): Macro– and microscopic analysis of the cortical zones of basidiocarps of selected agaric families. – Nova Hedwigia 28: 569–636.

CZECH MYCOL. 57(1–2): 51–55, 2005

Clavulinopsis umbrinella (Basidiomycetes, *Clavariaceae*), the first record in the Czech Republic

OLDŘICH JINDŘICH[1] and VLADIMÍR ANTONÍN[2]

[1]Osek 136, CZ-267 62 Komárov, Czech Republic
jindrich@nemhoro.cz
[2]Moravian Museum, Department of Botany, Zelný trh 6, CZ-659 37 Brno, Czech Republic
vantonin@mzm.cz

Jindřich O. and Antonín V. (2005): *Clavulinopsis umbrinella* (Basidiomycetes, *Clavariaceae*), the first record in the Czech Republic. – Czech Mycol. 57: 51–55.

A find of *Clavulinopsis umbrinella* (Sacc.) Corner (= *C. cinereoides* (G.F. Atk.) Corner; Basidiomycetes, *Clavariaceae*) from the Bílé Karpaty Protected Landscape Area near the Czech-Slovakian border is published. It represents the first record in the Czech Republic. A detailed description is given and differences from similar species are discussed.

Key words: Basidiomycetes, *Clavulinopsis*, Czech Republic, Moravia, White Carpathian Mts.

Jindřich O. a Antonín V. (2005): *Clavulinopsis umbrinella* (Basidiomycetes, *Clavariaceae*), první nález v České republice. – Czech Mycol. 57: 51–55.

Druh *Clavulinopsis umbrinella* (Sacc.) Corner (= *C. cinereoides* (G.F. Atk.) Corner; Basidiomycetes, *Clavariaceae*) byl nalezen v CHKO Bílé Karpaty poblíž Česko-Slovenské hranice. Jedná se o první nález v České republice. Jsou diskutovány rozdíly oproti podobným a příbuzným druhům.

INTRODUCTION

During a mycological collecting trip to the Bílé Karpaty (White Carpathians) Protected Landscape Area late autumn 2000, the second author found an unusual and rather small *Clavaria*-like fungus distinguished by branched, white or whitish coloured carpophores. Some features agreed with *Clavaria aestivalis* Romagn., however, having well-developed hyphal clamp connections, it belongs to the genus *Clavulinopsis* Overeem and represents the very rare species *Clavulinopsis umbrinella* (Sacc.) Corner.

Microscopic features are described from material mounted in Melzer's reagent, Aniline Blue, Congo Red and about 5 % KOH. For the basidiospores the following factors are used: E (quotient of length and width in any one spore) and Q (mean of E-values). Authors of fungal names are cited according to Kirk and Ansell (1992).

RESULTS AND DISCUSSION

Clavulinopsis umbrinella (Sacc.) Corner
= *Clavulinopsis cinereoides* (G.F. Atk.) Corner

Carpophores up to 25 mm high, with cylindrical to slightly laterally compressed, smooth or slightly rugulose branches, mostly branched almost from the base, apices sometimes 3–4 times branched (bifurcate), conical, acute; white or whitish at base, apex with ochraceous tinge to pale ochraceous coloured, becoming darker when dry.

Basidiospores 4.5–6.7(–7.5) x 4.5–6.7 µm, E = 0.9–1.2, Q = 1.0, globose or rarely subglobose, with an up to 1 µm long apiculus, smooth, with one large guttula or several smaller ones, thin-walled, hyaline, non-dextrinoid, congophobe, acyanophilous. Basidia 45–72 x 5.5–9.0 µm, 4-, rarely 2- or 3-spored, narrowly clavate, with 6.7–8.1 µm long sterigmata, sometimes with granular contents. Subhymenial hyphae cylindrical, ± thin-walled, 1.8–5.4 µm wide, non-dextrinoid, congophilous, acyanophilous, with 0.5–0.8 µm thick walls, irregularly septate, some septa very close, other rather distant from each other. Clamp connections present in all tissues.

Ecology: Growing on soil among grasses at a wet place in an open stand.

Locality: Czech Republic, Moravia, Bílé Karpaty Protected Landscape Area, Slavkov near Uherský Brod, National Nature Reserve Porážky, buffer zone Přední louky, 26 Oct. 2000 leg. V. Antonín 00.175 (BRNM 652914).

This record of *Clavulinopsis umbrinella* is the first one in the Czech Republic. So far it has been collected in France, Great Britain, Northern Ireland (Jülich 1984), Germany (Krieglsteiner and Schößler 2002, Oertel and Fuchs 2001), Denmark, Sweden (Knudsen 1997) and Norway (Anonymus 2005); it has also been collected in the USA (Leacock 2004). In Sachsen, it is included in the Red List of fungi in the category "extremely rare" (R) (Hardtke and Otto 1999) and in Denmark in the Red List (Anonymus 1997). McHugh et al. (2001) included this species among valuable species for grassland conservation. Jülich (1984) distinguished two species (*C. umbrinella* and *C. cinereoides*), however, already Petersen (1968) reduced *C. cinereoides* to the synonymy of *C. umbrinella*.

Among other white coloured *Clavulinopsis* species, *C. subtilis* (Fr.) Corner has smaller (3.5–4.5 x 3–3.5 µm), ± subglobose basidiospores with one guttula, and the tops of its branches are simple, not cristate. *Clavulinopsis dichotoma* (Godey) Corner has only slightly smaller (4–6 x 3.5–5 µm), subglobose basidiospores with one guttula and the tops of its branches are darker (like in *C. umbrinella*), but obtuse, never cristate (Corner 1950, 1970).

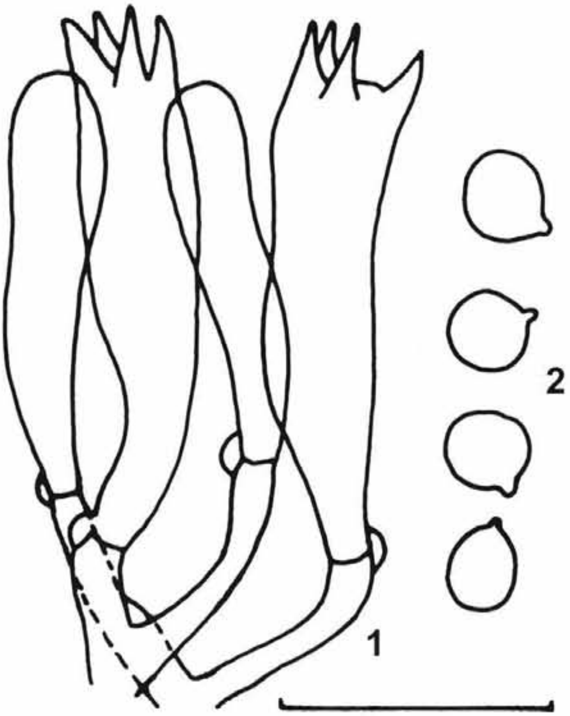


Fig. 1. *Clavulinopsis umbrinella* (Bílé Karpaty, 26 Oct. 2000): 1. Basidia and basidioles, 2. basidiospores. Scale bar = 20 µm.

Clavulinopsis umbrinella is macroscopically very similar to *Clavulina cristata* (Holmsk.) J. Schröt. var. *cristata*. However, the latter species differs by 2-spored basidia and larger basidiospores (Pilát 1958). *Clavaria aestivalis* Romagn. is also rather similar, both macro- and microscopically. However, it is characterised by the absence of clamp connections (Romagnesi 1969). White coloured species of the genus *Ramariopsis* (Donk) Corner have rough to verruculose basidiospores and the tops of their branches are simple, not cristate (Domański 1984).

Fig. 2. *Clavulinopsis umbrinella* (Bílé Karpaty, 26 Oct. 2000), photo V. Antonín.

ACKNOWLEDGEMENTS

The authors wish to thank to Zdeněk Pouzar (Prague, Czech Republic) and Ronald H. Petersen (Knoxville, Tennessee, U.S.A.) for valuable notes. The research was financially supported by the Ministry of Culture of the Czech Republic (MK0CEZ00F2402).

REFERENCES

ANONYMUS (1997): Rødliste 1997 over planter og dyr i Danmark. – an internet page (http://www.sns.dk/netpub/rodliste/71.htm).

ANONYMUS (2005): Norwegian Mycology Database. – an internet page http://www.toyen.uio.no/botanisk/nxd/sopp/db/st_art.htm

CORNER E.J.H. (1950): A monograph of *Clavaria* and allied genera. – Ann. Bot. Mem. 1: 1–740.

CORNER E.J.H. (1970): Supplement to "A monograph of *Clavaria* and allied genera". – Nova Hedwigia, Beih. 33: 1–299.

DOMAŃSKI S. (1984): Mała flora grzybów. Tom 1. Część 4. – Warszawa, Kraków.

HARDTKE H.-J. and OTTO P. (1999): Rote Liste. Pilze. – Materialien zu Naturschutz und Landschaftspflege, Freistaat Sachsen, Dresden.

JÜLICH W. (1984): Die Nichtblätterpilze, Gallertpilze und Bauchpilze. – Kl. Kryptogamenfl., Bd. 2b/1, Jena.

KIRK P.M. and ANSELL A.E. (1992): Authors of fungal names. – International Mycological Institute, Kew.

KNUDSEN H. (1997): *Clavariaceae* Chevall. – In: Hansen L. and Knudsen H. (eds.), Nordic macromycetes, vol. 3, p. 247–253.

KRIEGLSTEINER L. and SCHÖßLER W. (2002): Pilze im westfälisch-hessischen Grenzgebiet I: Die clavarioiden Pilze *Clavulinopsis cinereoides* sowie *Clavaria atrofusca*. – Boletus 24(2): 79–87.

LEACOCK P. (2004): Fungi of Cook County, Illinois. – an internet page (http://www.lactarius.com/fungi/Cook2004-09a.htm).

MCHUGH R., MITCHEL D., WRIGHT M. and ANDERSON R. (2001): The fungi of Irish grasslands and their value for nature conservation. – Biol. Envir. 101B(3): 225–242.

OERTEL B. and FUCHS H.G. (2001): Pilzfloristische Beobachtungen auf Magerwiesen und Halbtrockenrasen im linksrheinischen Mittelgebirge: Clavariaceen sowie weitere bemerkenswerte Asco– und Basidiomyceten. – Z. Mykol. 67(2): 179–212.

PETERSEN R. H. (1968): The genus *Clavulinopsis* in North America. – New York Bot. Garden Mycol. Memoir 2.

PILÁT A. (1958): Übersicht der europäischen *Clavariaceen* unter besonderer Berücksichtigung der tschechoslovakischen Arten. – Acta Mus. Nat. Pragae, 14B(3–4): 229–241.

ROMAGNESI H. (1969): Quelques espèces rares ou nouvelles de clavaires et d´agarics. – Bull. Soc. Mycol. Fr. 85(4): 451–458.

CZECH MYCOL. 57(1–2): 57–78, 2005

Bankeraceae in Central Europe. 1.

PETR HROUDA

Department of Botany, Faculty of Science, Masaryk University
Kotlářská 2, CZ-61137 Brno, Czech Republic
svata@sci.muni.cz

Hrouda P. (2005): *Bankeraceae* in Central Europe. 1. – Czech Mycol. 57: 57–78.

The paper presents a survey of the results of a study of the genera *Bankera*, *Phellodon*, *Hydnellum*, *Sarcodon* and *Boletopsis* in selected herbaria of Central Europe (Czech Republic, Slovakia, Hungary, Austria and southern Germany in this first part). The general and current occurrence is described for each species and some possible problems are discussed under particular species.

Key words: *Bankeraceae*, distribution, Central Europe.

Hrouda P. (2005): *Bankeraceae* ve střední Evropě. 1. – Czech Mycol. 57: 57–78.

Práce představuje přehled výsledků studia rodů *Bankera*, *Phellodon*, *Hydnellum*, *Sarcodon* a *Boletopsis* ve vybraných herbářích střední Evropy (první část je zaměřena na Českou republiku, Slovensko, Maďarsko, Rakousko a jižní Německo). U jednotlivých druhů je popsán celkový a současný výskyt a diskutována případná problematika.

INTRODUCTION

The presented study follows the survey of knowledge of the hydnaceous genera *Bankera*, *Phellodon*, *Hydnellum* and *Sarcodon* in the Czech Republic and Slovakia (Hrouda 1999) and deals with the ecology and distribution of the studied species in surrounding countries. This article represents first part of the study, which describes the distribution of *Bankeraceae* in Czechia, Slovakia, Hungary, Austria and southern Germany; in the second part the distribution in northern Germany and Poland will be commented and the study should be completed with a summary of the recent state of occurrence of this group in Central Europe.

General information about the ecology and phenology of the studied genera was given in the above cited study, so it is not repeated here. According to the current edition of the Dictionary of Fungi (Kirk et al. 2001), the family *Bankeraceae* contains the genera *Bankera*, *Boletopsis*, *Hydnellum*, *Phellodon* and *Sarcodon*; this is why the species of the genus *Boletopsis* are also incorporated in this study. The ecology and phenology of *Boletopsis* species was described by Kotlaba (1984) and Niemelä and Saarenoksa (1989).

MATERIAL AND METHODS

The core of the work represents revision of herbarium material; except Czech collections, material deposited in selected Slovak, Hungarian, Austrian and German herbaria (BRA, BP, WU, W, GZU, GJO, LI, IB, M, STU, KR and HBG) was revised. Specimens of critical species (not safely distinguished by macroscopical characters) were studied microscopically, as well as unidentified or uncertainly identified specimens of other species; studied specimens were provided with revision cards.

Where useful, some data from literature were taken either for completing information or for a comparison with facts based on herbarium material. The following journals have been excerpted: Czech Mycology (formerly Česká mykologie), Mykologický sborník – Časopis čs. houbařů, Mykologické listy, Spravodajca slovenských mykológov, Mikológiai Közlemények Clusiana, Österreichische Zeitschrift für Pilzkunde, Zeitschrift für Mykologie (formerly Zeitschrift für Pilzkunde), Regensburger Mykologische Schriften, Hoppea and Südwestdeutsche Pilzrundschau; besides many individual records, principal sources of literature data were Velký fotoatlas hub z jižních Čech (Papoušek 2004), Mycoflora Slovaca (Škubla 2003), Die Pilzflora des Ulmer Raumes (Enderle 2004), Die Großpilze Baden-Württembergs (Krieglsteiner 2000) and articles by Buchmann (1998) and Krieglsteiner (1999, 2004).

General information about the occurrence and distribution in particular countries and partial regions is presented for each species. In the case of very rare species, data of individual finds and collections and/or literature records are presented. In most species, "recent occurrence" involves records of the past 30 years. (This is not strictly used in the text and it may somewhat differ in particular species, but in general "recent" means approximately "since the 1970s".) The 30-year period might seems long, but the reason is that many regions are not systematically explored and some localities would be omitted if a shorter period was used (although occurrence of the species is still probable there).

Of course, the article does not present a complete survey of the occurrence of *Bankeraceae* in the region. As it is based on the study of material from selected herbaria, some further material certainly remains omitted, but the selection contains the largest herbarium collections and this should provide a general view of the situation in the whole region.

Short notes on the occurrence in surrounding countries (sometimes completed with information from other countries in southern Europe) are only informative, based on literature (Arnolds 2003, Breitenbach and Kränzlin 1991, Krieglsteiner 2000, Maas Geesteranus 1975, Otto 1992; the individual sources are not cited under every species) and records from the Central European herbaria (see abbreviations); herbarium collections from the surrounding countries have not been revised.

RESULTS

Bankera fuligineo-alba (J. C. Schmidt: Fr.) Coker et Beers ex Pouzar

Relatively rare species associated with *Pinus* (if specified, always with *Pinus sylvestris*), which seems to be the reason of its absence in higher altitudes. It rarely occurs in southern Bohemia (Cep, 1978, PRM) and the neighbouring part of Niederösterreich (Streitbach, 2001, WU), central Bavaria (scattered occurrence, few localities in Mittelfranken and the vicinity of Regensburg) and southern Baden-Württemberg, and has isolated localities in western Bohemia (Plzeň, 2002, coll. L. Zelený) and southern Moravia (Ratíškovice, 1999, BRNM). *Bankera fuligineo-alba* is a very rare species in Slovakia (Kráľova Lehota, 1982; Bílkove Humence, 1970, both BRA, cit. in Škubla 2003) and Austria (Rinner, 1979, GZU; Ötztal, 1972, M).

In surrounding countries the species is documented from northern Italy (M, LI, W, old collections) and reported from France, Switzerland and Slovenia.

Bankera violascens (Alb. et Schw.: Fr.) Pouzar

Syn.: *Bankera cinerea* (Bull.: Fr.) Rauschert sensu auct. non orig.

Compared to the previous species, *Bankera violascens* is a relatively common species especially in sub-mountainous and mountainous areas. It seems that the species is not only associated with *Picea*, but it probably mainly occurs in habitats with natural occurrence of this tree. The name *Bankera violascens* for this species is preferred to *Bankera cinerea* (see Hrouda 1996).

Bankera violascens is a rather common species in Austria. In the Czech Republic its historical occurrence has been recently confirmed in the southern half of the country (from western Bohemia to the Bohemian-Moravian Highland), in southern Germany it occurs in isolated areas: northern Bavaria, vicinity of Augsburg, Schwarzwald and Schönbuch hills. In Slovakia there are only few recent localities in the Vysoké Tatry and Beskydy Mts.; the only find in Hungary is from the westernmost part of the country (Brennbergbánya near Sopron, 1937, BP).

In surrounding countries the species has been recently documented from eastern France (LI), Switzerland (STU), northern Italy (M, W) and Slovenia (STU), and is reported also from Romania.

Phellodon niger (Fr.: Fr.) P. Karst.

Comparatively common species in Central Europe. Its recent distribution range can be divided into several areas of common occurrence: southern and central parts of Bohemia and Moravia and the neighbouring part of Niederösterreich, the central part of the Western Carpathians in Slovakia, Steiermark and southern parts of Ober- and Niederösterreich and in Germany Baden-Württemberg and western and northern Bavaria (the Austrian and German areas are connected through southern Bavaria and Tirol, where the occurrence is recently more rare). Surprisingly, the species is almost absent from the Danube river basin – there is about a 100 km wide "zone of absence" (from Schwaben to Slovakia), which separates the Czech and the German-Austrian parts of the distribution range. In Hungary the species has been collected only in the vicinity of Budapest (Budakeszi, Mts. Budai, 1967-8, BP).

Phellodon niger is similarly common also in surrounding countries and is documented from France (M, BP), Switzerland (STU), Italy (M, WU, BP) and Slovenia (W); in southern Europe it is reported from Croatia, Spain and Portugal.

Phellodon confluens (Pers.) Pouzar

A rare species with some recent collections. In the Czech Republic there are currently two localities in southern Bohemia (Klec, 2001, CB, cit. in Papoušek 2004, and Stará Hlína, 2004, BRNU) and two new localities in eastern Bohemia (Týniště nad Orlicí and Trusnov, both 2001, HR). In Slovakia the species occurs in the Malé Karpaty Mts. and newly it was found in the Bukovské vrchy Mts. (Stakčín, 1990, BRA). In Hungary, the situation is different. Here, *Phellodon confluens* is the most frequent species of the genus (latest find: Nagymaros, 1991, BP), which corresponds with the composition of the forests in this country, where deciduous ones predominate (similarly, *Castanea* is a frequent accompanying tree just as *Quercus* in the area of its natural occurrence). In Austria there are some older records from Niederösterreich and probably the latest finds of this species in southern Germany are from Schramberg (Baden-Württemberg), "Seedorfer Wald", 1997 (KR) and Urspringen (Bavaria), "Hoher Rodkopf", 2002 (Krieglsteiner 2004), and a few more records (mainly from Oberpfalz).

In the surrounding countries, *Phellodon confluens* is documented from France, Italy (M, IB, W, WU) and Slovenia (LI), in southern Europe it is reported from Croatia, Switzerland, Spain and Portugal.

Phellodon connatus (Schultz: Fr.) P. Karst.

Syn.: *Phellodon melaleucus* (Sw.: Fr.) P. Karst.

Phellodon connatus is the correct name for the species commonly named (and documented in almost all herbaria) as *Phellodon melaleucus*. The priority of the name *Phellodon connatus* must be accepted since the shift of the "starting point" for fungi from Fries 1821 to Linnaeus 1753. The name *P. connatus* is currently used by Otto (1992, 1997), Krieglsteiner (2000, 2004) and Niemelä et al. (2003).

Northern Bavaria and southern and central parts of Bohemia and Moravia appear to be the only areas, where this species commonly occurs. In the whole surrounding area there are scattered localities (in *Fagus* and *Quercus* forests in Hungary, mostly in coniferous forests in other countries). As there is not any large area completely without this species, it is probable that this subtle fungus is rather overlooked than rare. Also wrong identifications of *Phellodon connatus* (confusion with any other species of the genus *Phellodon*) can be recorded in the herbaria.

In southern Europe the species is recently documented from the French Alps (M), Portugal (WU) and it is also known from northern Italy (M, W, BP), Slovenia (W), and reported from Switzerland.

Phellodon tomentosus (L.: Fr.) Banker

Relatively common species, especially in the southern half of Bohemia, but also in the Carpathians (especially in central Slovakia) and in central and south-eastern Austria. The species has not been often collected in Moravia and nor in southern Germany, where there are only scattered localities. Similarly as *Phellodon niger*, *P. tomentosus* is rare in the Danube river basin. Specimens of this species are sometimes erroneously identified as *Hydnellum concrescens* (and conversely, too).

In the surrounding countries, *Phellodon tomentosus* has recently been documented from France (IB) and Switzerland (HBG, M, IB, GZU, W, WU, BP), also from Italy (M, W, WU) and Slovenia; in southern Europe it is reported from Romania, Bulgaria and Spain.

Hydnellum suaveolens (Scop.: Fr.) P. Karst.

Not a very frequent species, associated mostly with *Picea*, having its principal distribution centres in the mountain areas – central part of the Western Carpathians (recent finds: Malužiná in the Nízke Tatry Mts., 1999, BRA; Lutiš in the Kysucké vrchy Mts., 1998, and Mútne in the Slovenské Beskydy Mts., 2001; the last two ones cited in Škubla 2003) and the area of Tirol (still rather often collected, 3 finds in the 2000s, WU and IB) and Oberbayern (Oberstdorf, 1991, MSTR). It appears to have a scattered occurrence in Austria (the rest of the mountain part of the country, except Tirol) and Baden-Württemberg (mainly in Schwarzwald). The species is very rare in central and northern Bavaria; in the Czech Republic there is only one recent find (Hlinice, 1997, CB, cit. in Papoušek 2004), although formerly it was collected in various places of this country. It appears that the relatively great decline in occurrence of this species outside the mountain areas (the Alps, Carpathians) is continuing.

In the surrounding countries, *Hydnellum suaveolens* has recently been documented from eastern France (M), Switzerland (STU), northern Italy (W, M, HBG) and Romania (Carpathians, Transylvania, BP).

Hydnellum caeruleum (Hornem.) P. Karst.

Species similarly endangered as *Hydnellum suaveolens*. Recently it has been mainly collected in the central part of the Western Carpathians (Vysoké Tatry Mts. and surrounding mountains) in Slovakia, in the alpine part of Austria (Niederösterreich, Steiermark, Kärnten) and in the southeastern part of Baden (area east of Schwarzwald). There are scattered localities in the rest of southern Germany (Kochenthal, 1987, in Buchmann 1988), Austria (Reichenstein in Oberösterreich, 2004, LI) and southern Bohemia (Malonty, 2001, CB, cit. in Papoušek 2004); its former occurrence has not been recently confirmed in the rest of the Czech Republic (especially southern Moravia, where the species was relatively common until the 1960s) and also in Tirol. The species has always been rare in Bavaria (except Oberbayern) and western Bohemia, and surprisingly also in western and central Slovakia (west and south of the Váh river), which contrasts with the number of records from the Tatra region. In Hungary, there is only one specimen collected near the Steiermark border (Szakonyfalu, 1958, BP).

In the surrounding countries, old collections are documented from northern Italy (Südtirol, now Trentino-Alto Adige, W, HBG); the species also occurs in Romania, Switzerland, France, Spain and Portugal.

Hydnellum ferrugipes Coker

There is only one collection of this American species (similar to *Hydnellum caeruleum*) from Austria, Steiermark, Ragnitztal east of Graz, against Schweinberg, 24. IX. 1975, leg. et det. Riedl as *H. suaveolens*, rev. Maas Geesteranus 1977, GZU. Maas Geesteranus added to the exsiccate a note that it is the second find of this species in Europe. According to Jülich (1984), the species occurs in Austria, France, Norway and Sweden.

Hydnellum floriforme (Schaeff.) Banker

Syn.: *Hydnellum aurantiacum* (Batsch: Fr.) P. Karst. sensu Maas Geesteranus (1975)

Otto (1997) presents the opinion that Batsch's illustration of *Hydnum aurantiacum* (on which the basionym of this epithet is based) represents a species with a dark orange context and sometimes concentrically zoned pileus, well-known under the name *Hydnellum auratile* (Britzelm.) Maas Geest., and therefore the correct name for the species with a light context is *Hydnellum* *floriforme*. As I consider his opinion correct, the name *Hydnellum floriforme* is used in this study as well. Nevertheless, this species is found under the name *Hydnellum aurantiacum* in all herbaria in Central Europe.

There are great differences in the occurrence of this species in particular countries. *Hydnellum floriforme* is recently rather common in Austria, especially in eastern Kärnten and southern Steiermark, and the zone of localities continues through southern Oberösterreich and Salzburg to Berchtesgaden in Germany; recent localities have also been discovered in Tirol and Osttirol. Besides, there are two more distribution centres of this rather rare species – southern Bohemia together with the neighbouring part of Niederösterreich and the Carpathian mountains in Slovakia (mainly in the northern part of central Slovakia). In southern Germany, the species is not common, occurring above all in the Schwarzwald region and northern Bavaria.

In the surrounding countries, *Hydnellum floriforme* is documented from eastern France (M), Switzerland (STU) and northern Italy (Südtirol, M, IB, W); in southern Europe it is reported from Romania, Spain and Portugal.

Hydnellum aurantiacum (Batsch: Fr.) P. Karst. em. Otto 1997

Syn.: *Hydnellum auratile* (Britzelm.) Maas Geest.

The species is well-known under the name *Hydnellum auratile*, as explained above, and under this name it is also deposited in the Central European herbaria (if the identification is correct; this species is often not distinguished).

It is very rare in the whole area. There are only isolated localities in Germany (Baden-Württemberg: Tuttlingen, 1969; Oberkochen, 1975; Waldenbuch, 1980, all STU; Bayern: Mühlbach, 1994, STU, cit. in Krieglsteiner 1999, and Kochenthal, 1987, in Buchmann 1988), Austria (Tirol: Brandenberg, 1998, in Peintner et al. 1999; Kärnten: Bodental, 1977, GZU; St. Margareten, 1998, in Hausknecht et al. 2000; Niederösterreich: Bad Fischau, 1984, WU; Oberösterreich: Gosau, 1989, LI), the Czech Republic (recently Vlastiboř, 1991, PRM) and Slovakia (upper Váh basin: Vavrišovo, 1974, BRA; Važec, 1988, PRM).

In the surrounding countries, the species is documented from northern Italy (M) and also reported from France and Switzerland.

Hydnellum peckii Banker in Peck

Syn.: *Hydnellum diabolus* Banker

If all basidiomes with an acrid taste of the context are identified as *Hydnellum peckii* (according to Maas Geesteranus 1975), then it seems to be a very variable species. On the other hand, some authors are of the opinion that it contains two confused species. According to Harrison et Grund (1987a, 1987b), mature basidiomes of *Hydnellum peckii* s. str. have a darker, sometimes ridged or scrobiculate pileus with a smooth surface (somewhat similar to *H. scrobiculatum*), whereas the separate species *Hydnellum diabolus* is characterised by a velutinous pileus (possibly it represents the type which looks like *Hydnellum ferrugineum*). Pouzar (in verb.) also mentioned a difference between velutinous basidiomes from *Pinus* forests and scrobiculate ones, typically growing in *Picea* forests. Stalpers (1993) presents a difference of these species in the presence of clamps in stipe and pileus trama – present on all primary septa in *H. peckii* versus scattered in *H. diabolus*. Nevertheless, the last mentioned character is discutable, because only scattered clamps can be seen in the trama of the scrobiculate basidiome; further study, including molecular methods, might solve this problem.

In this study, *Hydnellum peckii* is still considered in a wide sense. Recently it occurs in southern Bohemia and the Šumava Mts. (Holec 2004), there are a few isolated localities in eastern Bohemia and central Moravia, and it still rather commonly occurs in the Slovak Carpathians – mainly collected in northern Slovakia, from the Beskydy to the Tatry Mts., newly also in the Bukovské vrchy Mts. (Stakčín, 1991, cit. in Škubla 2003). *Hydnellum peckii* is rather common also in almost the whole of Austria, except the northern part of the country. Here the "zone of absence" along the Danube river (described for some *Phellodon* species) is extremely prominent and begins east of Regensburg; this zone separates the Austrian and Oberbayern part of the distribution range from the localities ranging from Schwarzwald through Mittelfranken to Bohemia. In Hungary, there is only one locality near the Steiermark border (Szakonyfalu, 1958, 1963, BP).

In the surrounding countries, the occurrence of *Hydnellum peckii* is documented from Switzerland (W), northern Italy (M, W, WU) and Slovenia, and it is reported also from France (Krieglsteiner 2000) and Bosnia and Hercegovina (Otto 1992).

Hydnellum mirabile (Fr.) P. Karst.

Hydnellum mirabile is a very rare species with only three localities in the studied area: Gressenberg (Koralpe Mts., Steiermark, 1978, GZU) and Ödenhaus near Innsbruck (Tirol, 1935, W) in Austria and Partutovice (= Bartelsdorf in German, central Moravia, 1934, M and W) in the Czech Republic. In all three cases, coniferous woodland (*Picea* or *Picea* + *Pinus*) was present at the locality.

In the surrounding countries, the species is documented from northern Italy (old collections in W, recent find near Bolzano, 1991, IB) and reported from Switzerland (canton Uri, Maas Geesteranus 1975).

Hydnellum compactum (Pers.: Fr.) P. Karst.

Hydnellum compactum is similarly rare as the preceding species. Recently it is known from Neupurkersdorf in Wiener Wald (Niederösterreich, 1998 and 2002, WU; older collections from nearby Purkersdorf are deposited in W), Engel and Friederichsen (1974) report it near Lermoos (Tirol, 1961–2; the occurrence at this locality is doubtful, *H. caeruleum* has been often named *H. compactum*, but the authors distinguish these two species in the article and mixed coniferous-deciduous forest is mentioned for *Calodon compactum*) and Krieglsteiner (2000) reports four localities from Baden-Württemberg: Obersasbach (1931), Gündelwangen (1971), Breitenbach (1980–1995) and "under Büchereck" (close to Breitenbach, 1994); Krieglsteiner (1991, 1999) reports also a few localities from northern Bavaria. If the accompanying trees are mentioned, *Quercus* or *Fagus* are present (under Büchereck *Fagus* combined with *Abies*). In several herbaria, some specimens of *Hydnellum caeruleum* are documented under the name *Hydnellum compactum*.

In the surrounding countries, there are old collections from France, Switzerland (HBG) and Italy (M, W); besides, the species is also reported from Spain and Slovenia.

Hydnellum spongiosipes (Peck) Pouzar

A very rare species, associated with deciduous trees, occuring at isolated localities in all countries. In the Czech Republic the species is known from Obrubce (1970) and Pořičany (last find in 1980, both PRM), in Slovakia it has been found at five localities: Žemberovce (1987), Mačov (1980), and Gbely, Kuchyňa and Zlatníky (western Slovakia, in the 1970s, all BRA). In southern Germany *Hydnellum spongiosipes* recently occurs in Schwarzwald (near Hausach, 1987, STU), formerly it also occurred in Oberpfalz (Altenschwand, 1963, M). Other localities are situated in Austria (Klöch near Bad Radkersburg, Steiermark, 1995, WU) and in Hungary (Kőszeg near Austrian border, 1979, and Parád in Mátra Mts., 1965, both BP). *Quercus* or *Quercus* + *Pinus* occur at the localities, and *Castanea* near Kőszeg.

In surrounding countries, *Hydnellum spongiosipes* was found near Gorizia ("nördlich Triest, Gorice", IB, 1977) and reported from France, Switzerland and Slovenia.

Hydnellum ferrugineum (Fr.: Fr.) P. Karst.

Hydnellum ferrugineum shows an apparently non-uniform distribution in the area. The clear centre of its occurrence is located in the sandy pine forests of southern Bohemia and neighbouring part of Niederösterreich, where the species also does not show any distinct decline. Smaller areas of occurrence can be found in central Moravia in the Czech Republic and in the Váh river basin in Slovakia. *Hydnellum ferrugineum* rarely occurs in higher altitudes, which is confirmed in Austria – the only part with a rather frequent occurrence of this species is central Steiermark and the adjacent areas of Burgenland and Niederösterreich. Other isolated localities are located in Oberösterreich, Kärnten, and Tirol. In southern Germany, there are scattered groups of localities in several areas of the country.

In the surrounding countries, the species is known from France (BP), Switzerland, and Italy (M); Krieglsteiner (2000) also mentions its occurrence in Spain and Montenegro, Otto (1992) in Portugal.

Hydnellum tardum Maas Geest.

A very rare species, which is characterised by pink colouring of the young basidiomes, character is repeatedly presented in the determination keys. Of course, this character is not usable in the case of old basidiomes or herbarium specimens, where the pink hues disappear. As I had the possibility to see some collections from Baden-Württemberg (identified or revised by Maas Geesteranus), I discovered that *Hydnellum tardum* differs from similar species (*H. concrescens* group) by a slightly velutinous surface of the pileus and stipe (not so prominently velutinous as e. g. at *H. spongiosipes*, but not smooth as is typical for *H. concrescens*).

According to my revision, the occurrence of *Hydnellum tardum* is not limited only to a few localities in Baden-Württemberg; nevertheless, this part of Germany remains the distribution centre of this species (seven localities known to date). Outside Germany, there are single localities in Austria (Oberösterreich, Gosau, Leitgeb-kogel, foot of hill, 1985, LI) and in the Czech Republic (Bohemian-Moravian Highland, Těšenov near Horní Cerekev, Skála hill, 2001; now in my hands, will be deposited in CB). At all localities, *Picea* is mentioned as the accompanying tree or coniferous woodland is present there. In the surrounding countries, the species was also found in France (Bozel Sons Glaigetan in the Savoy Alps, 1971, M).

After discovering this species in the Czech Republic, I looked at the specimens of *Hydnellum concrescens* and *H. scrobiculatum* in the Prague herbarium (PRM), but not any specimen resembles *H. tardum*. In my opinion, it is really a rare species, not only little known.

Hydnellum scrobiculatum (Fr.) P. Karst.

A relatively rare species, especially in comparison with the very similar *Hydnellum concrescens*, from which it differs by spores with rounded warts (compared to truncate warts in *H. concrescens* and *H. tardum*). *Hydnellum scrobiculatum* remains rather common in southern Bohemia (but it is recently almost unknown from other parts of the Czech Republic). Further areas of recent occurrence are Baden-Württemberg and southern Austria. There are also scattered localities in Bavaria. Formerly the species was found in western and northern Austria, too. Only few collections are known from Slovakia (recently near Raková, 1991, and near Važec, 1988, both PRM) and only once the species was collected in Hungary (Imókö hill in the Bükk Mts., 1954, BP).

In the surrounding countries, *Hydnellum scrobiculatum* is documented from Switzerland (STU) and northern Italy (M, W), and it is also known from Portugal (W).

Hydnellum concrescens (Pers.) Banker

As said above, *Hydnellum concrescens* is a more common species than *H. scrobiculatum* and *H. tardum*. Its distribution range covers almost the whole area of the Czech Republic, and further western and northern Slovakia (with a lot of recent finds at the foot of the Tatra Mts.) and a zone in Austria through Waldviertel, the surroundings of Vienna, Burgenland and Steiermark to eastern Kärnten (a few localities in western Hungary also belong to this "branch"). Another area of recent occurrence is Baden-Württemberg and northern Bayern; almost only older collections are known from southern Bavaria and Tirol, and the species is almost absent from a wide zone covering Osttirol, Salzburg, western Steiermark and Oberösterreich (with one recent exception near Offensee, 1994, LI). Small isolated areas where it occurs are known from the Visegrád Mts. and Mátra Mts. in northern Hungary. Compared to other hydnaceous species, *Hydnellum concrescens* is found in warmer areas, but its ecological amplitude is rather wide in this regard (see finds from Tatra region or recently from Šumava Mts. in Bohemia).

In the surrounding countries, this species is documented with old collections from France (M, W, BP) and with recent ones from Italy (M, IB, W, WU; many localities not only in the northern part), Slovenia (STU, W) and Romania (M), there are also recent collections from Portugal (WU); the species is also reported from Switzerland, Croatia, Macedonia, Spain and Portugal.

Hydnellum cumulatum K. Harrison

The only record in Central Europe remains the find from Šalmanovice (southern Bohemia), 1960, preserved in herbarium L (Maas Geesteranus 1975, Kubička 1981).

Hydnellum geogenium (Fr.) Banker

Hydnellum geogenium is a species very distinctly associated with *Picea* in mountain areas. This corresponds with its distribution – the species is absent from Hungary and almost absent from Germany and the Czech Republic (very old collections from Bavaria and Bohemia, more recent ones (1950s–1970s) from Baden-Württemberg and Moravia). It seems that the great decline in occurrence still continues – its distribution range is now limited to the central part of the Slovak Carpathians (Važec, 1980, LIT; Čingov, 1985; Štrbské Pleso, 1989, both BRA) and scattered localities in Steiermark (Walstern near Mariazell, 1994, WU; Weissenbach in the Totes Gebirge Mts., 1998; Stainzer Warte, 2002, both GJO), Kärnten (St. Margareten in Rosental, 2002, WU) and Tirol (Innsbruck, Stangensteig 1995, IB; Hochpillberg, 1998, in Peintner et al. 1999) in Austria.

In the surrounding countries, *Hydnellum geogenium* has been collected in Romania (M) and is reported from Switzerland.

Sarcodon imbricatus (L.: Fr.) P. Karst.

Sarcodon imbricatus has for a long time been confused with *Sarcodon squamosus*. For details see Johannesson et al. (1999) and Schmidt-Stohn (2001). The latter publication is complemented with photographs, but in my opinion the basidiome of *S. squamosus* is extremely dark (the entire photo seems to be shifted in colour); more recommendable are the photos in Arnolds (2003) and illustrations in Maas Geesteranus (1975, tab. 26: fig. a shows typical *S. imbricatus*, whereas fig. b illustrates the pileus of *S. squamosus*). Because of the mentioned confusion, almost all specimens collected in the 20th century have been identified as *Sarcodon imbricatus*, and an exact revision is difficult in some cases. Identification according to the accompanying trees is also discutable, because in some cases of reliable identification the data on the herbarium labels do not confirm the supposed association of *S. imbricatus* with *Picea* and *S. squamosus* with *Pinus*.

Similarly as in the case of *Phellodon niger*, there appears to be a "zone of absence" along the Danube river basin. South of this zone, there is a zone of rich occurrence running from westernmost Hungary (Vas region) through Steiermark, Oberösterreich, and Salzburg to Oberbayern, Tirol and Baden-Württemberg. North of the Danube river basin, there is another zone of occurrence approximately between the 49th and 50th parallel of latitude: southern Bohemia – Moravia – northern Slovakia. *Sarcodon imbricatus* mostly accompanies *Picea* as its symbiont, but compared to some other species, it is probably not strictly associated with natural *Picea* forests. Several isolated localities occur in northern Hungary (Budapest vicinity, Mátra Mts.).

In the surrounding countries, *Sarcodon imbricatus* is documented from France (BP), Switzerland, Italy (HBG, STU, M, W, WU, BP), Slovenia and Romania (Transylvania, M, BP). Moreover, specimens from Spain, Turkey and also Georgia (W) are kept in the Central European herbaria.

Sarcodon squamosus (Schaeff.) Quél.

Species distinguished with certainty only in the past few years; this fact has some influence on its knowledge. Probably it occurs more commonly than is shown in the distribution map, which is based only on critically identified specimens. Kotlaba and Pouzar (2000) present the hypothesis that *Sarcodon squamosus* occurs more often than the real *Sarcodon imbricatus* – they described its occurrence in Bohemia (especially southern Bohemia), which can be expected according to the quantity of *Pinus* forests. The southern half of Bohemia can be considered as one of the distribution centres of *S. squamosus*; another one is found in Niederösterreich and Burgenland (recently Lockenhaus, 2001, in Hausknecht and Klofac 2004). Only isolated localities are known from southern Germany and Tirol, as well as the Carpathian region.

In the surrounding countries, *Sarcodon squamosus* is documented by old collections from northern Italy (W); recently it was collected in Portugal (WU).

Sarcodon leucopus (Pers.) Maas Geest. et Nannf.

A rare species, which has been supposed to be a species of higher altitudes, but it occurs in the lowlands as well. Its occurrence has been documented from the Outer Western Carpathians (Beskydy and surrounding mountains, Malé Karpaty Mts. and surroundings, last records in 1980), continuing in southern Niederösterreich (Mollram, 1990, WU), northern Steiermark (Vorberg above Kulm, 2002, WU), southern Oberösterreich (Grünburg, 1993, LI), Tirol, Oberbayern and Baden-Württemberg. In the past there were only a few isolated localities in western Moravia, Bohemia and the rest of Bavaria and the occurrence of *Sarcodon leucopus* has probably not been recently confirmed there.

Specimens of *Hydnum ebneri* Wettst. from the locus classicus (Tirol, Trins in Gschnitztal valley, typus deposited in GZU) are considered to be basidiomes of *Sarcodon leucopus*; as such they were revised by Maas Geesteranus in W and by Michelitsch in GJO.

In the surrounding countries, *Sarcodon leucopus* is documented from Italy (Südtirol, M, W) and Switzerland (M), reported from France, Romania and also from Portugal.

Sarcodon versipellis (Fr.) Quél.

Sarcodon versipellis is a species of mountainous habitats, occurring mainly in mountain *Picea* (maybe also *Abies*) forests. It is correspondingly rare species with two distinct distribution centres – the first of them covers the Carpathians in central Slovakia (latest record: near Liptovský Ján in the upper Váh river basin, 1985, BRA). Possibly more important is the second centre in Tirol and Oberbayern, where the species has been regularly found to date (5 collections in the late 1980s and 1990s). Beside these ones, there are isolated localities in Bodental (Kärnten, 1994, WU), near Annarotte (Niederösterreich, 1993, WU) and a few older ones in Baden-Württemberg.

In the surrounding countries, *Sarcodon versipellis* is recently documented from Italy (M), and reported from France, Switzerland and Romania.

Sarcodon scabrosus (Fr.) P. Karst.

A rather rare species with a distribution similar to *Hydnellum ferrugineum* – recently a common occurrence in southern Bohemia extending to Niederösterreich, scattered localities in other parts of the Czech Republic, Slovak Carpathians (Beskydy Mts., surroundings of the Váh river, Bukovské vrchy Mts.), eastern and central Austria, southern Baden and northern Bavaria (recently Weisbach, 2002, cit. in Krieglsteiner 2004). In southern Bohemia, the dominant accompanying tree is *Pinus*, whereas other coniferous and deciduous trees (*Pinaceae*, *Fagaceae*) occur also in other areas. In Hungary the species is reported from the Vasa region (Otto 1992).

In the surrounding countries, *Sarcodon scabrosus* is documented from Switzerland, Italy (Südtirol, W), and Romania (Carpathian region), reported also from France and Croatia.

Sarcodon glaucopus Maas Geest. et Nannf.

Rare species with scattered localities. Recently it is known from southern Bohemia (Lužnice in the Novohradské hory Mts., 2002, CB, and Hlinice, 2000, CB, cit. in Papoušek 2004) and adjacent Niederösterreich (Streitbach near Zwettl, 2001, WU), northern Slovakia (Vyšné Hágy in the Vysoké Tatry Mts., 2002, BRNU), Steiermark (Feldbach, 1982, GZU) and westernmost Hungary (Szakonyfalu, 1958, BP), Vorarlberg (Damüls, 1995, WU, cit. in Krisai-Greilhuber et al. 1997), southern Baden (Wolterdingen, 1990, STU, cit. in Gminder 1991) and northern Bayern (Sperbeslohe in Mittelfranken, 1993, WU).

In the surrounding countries, *Sarcodon glaucopus* is reported from Switzerland, documented from Italy (Trentino, M) and also from Portugal (WU).

Sarcodon fennicus (P. Karst.) P. Karst.

Formerly rare, currently almost extinct species in the region. Recently it has been documented from Baden-Württemberg (Wolterdingen in southern Baden, 1990; Zwiefalten in Schwäbische Alb, 1970, both STU), central Tirol (Hungerburg near Innsbruck, 2002; St. Martin in Gnadenwald, 1975, both IB; Tschirgant hill near Strad 1968, HBG), and southern Bohemia (Buzice, 1974; Spolí near Třeboň, 1972; Týn nad Vltavou, 1965, all PRM). A few old records from Moravia and eastern Austria have not been confirmed during the last 70 years.

In the surrounding countries, *Sarcodon fennicus* is documented from Italy (M).

Sarcodon regalis Maas Geest.

Baden-Württemberg: Tuttlingen, Russberg and Witthoh Wald, 1971, preserved in herbarium L (Maas Geesteranus 1975) remain the only known localities in the region. Besides Germany, the species is known from France and Great Britain (Krieglsteiner 2000).

Sarcodon lundellii Maas Geest. et Nannf.

There is only one find of this species in the region: Austria, Niederösterreich, Streitbach near Zwettl, 2001, WU. Formerly this species was known in northern Europe: Sweden and Norway (Maas Geesteranus 1975).

Sarcodon martioflavus (Snell) Maas Geest.

Probably only four localities of *Sarcodon martioflavus* (well distinguishable by its stipe covered with orange felt, which may be darker on dry carpophores) are known from Germany: Weidhausen near Coburg in northern Bayern (1970, M, cit. in Engel 1973; 1977, STU) and Hagelloch in Schönbuch hills, Schwenningen and Schramberg-Sulgen in Ostschwarzwald (1993, the latest record) in Baden-Württemberg (Krieglsteiner 2000). The specimen of *S. martioflavus* cited by Škubla (2003) from Slovakia does not represent this species (an old polypore with a broken hymenophore, probably *Phaeolus schweinitzii*).

In Europe the species is also known from Switzerland (canton Uri, 1970) and Norway (Maas Geesteranus 1975).

Sarcodon joeides (Pass.) Bataille

Very rare species with three known localities: western Slovakia, Kuchyňa in the Malé Karpaty Mts., 1972 (Dermek 1973), Niederösterreich, Neupurkersdorf in

Wienerwald, 1989, WU, and Baden, Hausach in Schwarzwald, 1982, STU. *Fagus* occurs at all three localities, although mixed with other deciduous trees.

In the surrounding countries, *Sarcodon joeides* is documented from Italy (Leuchtenburg near Bolzano, 1966, M), and reported from France and Switzerland.

Sarcodon fuligineo-violaceus (Kalchbr.) Pat.

Besides the type locality in eastern Slovakia (Spišské Vlachy, in German Wallendorf, in Hungarian Szepesolaszi, 1870, UPS), from which the species has not been confirmed later, there are two localities in Austria: Bodental in southern Kärnten (1971, HBG) and Seefeld in central Tirol (1975, IB), and four in Germany: Upflamör in Mittlere Donaualb (latest 1974, STU), Lauf in Oberrheingebiet, vicinity of Tuttlingen (1979) and vicinity of Wüstenstein (Oberfranken, 1979; the three latter localities according to Krieglsteiner 1991, 2000).

In southern Europe, *Sarcodon fuligineo-violaceus* has been also reported from Italy, Spain and Greece.

Boletopsis leucomelaena (Pers.) Fayod

Although the two species of the genus *Boletopsis* are well recognisable when fresh (the differences were well described by Niemelä and Saarenoksa 1989), in Germany and Austria almost all finds of *Boletopsis* have so far been named as *B. leucomelaena*. Whereas the recent herbarium specimens can usually be easily identified, some of the older ones (especially the type of "thin dark brown slices on a paper sheet") are not always certainly identifiable; these specimens were taken into consideration only if it was highly probable to be *B. leucomelaena* (e.g. growth in *Picea* forest). Omitting of some specimens may (to a certain degree) therefore have an influence on the image we have of the occurrence of this species.

In the Czech Republic, the species occurs rarely on scattered localities (recently Rychtářov, 2001, BRNM, and Hartmanice near Sušice, 2002, PRM), whereas in Slovakia there is a distinct centre in the Carpathians (from Beskydy through Malá Fatra and Veľká Fatra to the Tatra Mts.). In the Alpine region, *Boletopsis leucomelaena* has many (also recent) localities from Baden-Württemberg (mainly east of Schwarzwald) through Vorarlberg, Tirol, Oberbayern (especially vicinity of Berchtesgaden) to southern parts of Ober- and Niederösterreich and northern Steiermark, with a "southern branch" in the Koralpe Mts. and Kärnten. Summarised, the species (mostly associated with *Picea*) is rather common in mountain regions.

In the surrounding countries, *Boletopsis leucomelaena* is documented from southeastern France (BP), northern Italy (W), recently also from Spain (M), and reported from Switzerland.

Boletopsis grisea (Peck) Bondartsev et Singer

As mentioned above, *Boletopsis grisea* has not been often distinguished from the previous species – the image of its occurrence may therefore be rather incomplete, if only the finds certainly identified or revised as *B. grisea* are considered.

Compared to *B. leucomelaena*, its occurrence is not concentrated in mountain areas, but corresponds with areas with sandy *Pinus* forests as its typical habitat (but this connection is not absolute, other conifers are also acceptable as accompanying trees). The species is not very rare in the Czech Republic – mainly in southern Bohemia, recently in the Šumava Mts. (Srní, 2001, in Holec 2004), but has also scattered localities in other parts of the country. A great contrast is noticeable in Slovakia, where may be the only locality is located in Záhorská nížina (near Veľké Leváre, western Slovakia, 1975, BRA). From here, the distribution range continues to Niederösterreich and then there are scattered localities in Steiermark, Salzburg (highest locality: Lungau, Gstoder, 1600 m a. s.l., connected with *Pinus mugo*, GJO), and Tirol. In southern Germany, there are some localities in Bayern (recently Unterleinach, 1994, in Krieglsteiner 1999) and only one in Baden-Württemberg (Wolterdingen, 1990, in Gminder 1992).

In the surrounding countries, *Boletopsis grisea* is documented from Spain (IB, M; also Canary Islands), France (IB), Italy (BP, IB, M, HBG), Slovenia (STU) and Romania (M), reported also from Switzerland, and Portugal (Kotlaba 1984).

Occurrence of *Bankeraceae* – historical overview

The family *Bankeraceae* contains species of various ecological affinity. Several species are associated with deciduous trees (*Phellodon confluens*, *Hydnellum compactum*, *H. spongiosipes*, *Sarcodon joeides*) and the centres of their distribution are therefore in the lowlands or in low hills with dominance of deciduous forests. Also species connected (mainly or exclusively) with *Pinus sylvestris*, such as *Boletopsis grisea*, *Bankera fuligineo-alba*, *Sarcodon squamosus*, *Hydnellum ferrugineum*, and *Phellodon niger*, have their distribution centres in areas of lower altitude (in Central Europe, southern Bohemia connected with northern Austria represents such centre). On the other hand, species of mountain regions (connected with *Picea*, may be also with *Abies*) are above all *Sarcodon versipellis*, *Hydnellum geogenium*, *H. suaveolens*, and *Boletopsis leucomelaena*, which have their distribution centres in the Alps and Carpathians.

Tab. 1. Numbers of recorded finds in particular countries.

Country	–1915	1916–45	1946–60	1961–75	1976–90	1991–05
Czech Republic	79	259	407	168	84	148
Slovakia	42	5	20	154	137	71
Hungary	1	2	6	31	1	4
Austria	123	180	8	141	124	160
Southern Germany	76	22	33	131	101	44

The degree of mycological investigation is very different in particular countries and regions. The situation in Czechia and Slovakia was described in a previous study (Hrouda 1999) as rather permanent since World War I (in Czechia), and since 1960s (in Slovakia), respectively. In Austria, the level of mycological investigation can also be described as almost permanent (in general, of course with some local fluctuations) with exception of the 1940s and 1950s (only few records from this time). A similar situation is found in southern Germany (Bavaria, Baden-Württemberg), especially since the 1960s.

In the second half of the 20th century a decline in occurrence of the hydnaceous fungi appeared in Czechia especially in the 1970s–1980s. A rather similar situation occurred in areas with conditions similar to Czechia (e.g. northern Bavaria and northern Austria), but the decline was not so distinct there. In general, in the 1990s and the beginning of the 21st century the number of records again increases in Czechia and Austria and it is very probable that this is connected with better environmental conditions after 1990. The low total number of German records in this time can be caused by deficient data, but in northern Bavaria the decline in the 1980s and increase in the 1990s is also visible (in the 1980s, most finds in Bavaria came from the alpine region).

In mountain areas, especially in the alpine regions of Austria and Germany and in the central Western Carpathians in Slovakia, the situation is much better. A decline in occurrence is almost unknown there and also species which became extremely rare in non-mountain areas (e.g. *Hydnellum suaveolens* or *H. caeruleum*) are less rare in the mountains. The decreasing number of finds in Slovakia is probably caused by higher mycological activity in the 1970s and 1980s than now.

Tab. 2. Numbers of recorded finds of *Bankeraceae* species in particular countries.

Particular columns at each country show numbers of finds in historical periods: 1st column up to 1915, 2nd column 1916–1945, 3rd column 1946–1960, 4th column 1961–1975, 5th column 1976–1990, 6th column 1991–2005.

*) The distribution of *Boletopsis* species until 1984 was taken from Kotlaba (1984); this is why other numbers of finds from the Czech Republic are not presented here.

Species	Czech Republic						Slovakia						Hungary						Austria						Southern Germany					
Bankera fuligineo–alba	3	7	12	6	1	2				1	1								2	9		1	2	1	4	2	1	6	2	3
Bankera violascens	2	14	12	5	5	6				1	5	1		1					2	9		13	10	16		1	4	7	4	4
Phellodon niger	7	12	47	17	15	18	2			5	9	3				2			11	20		19	15	15	9		4	17	8	3
Phellodon confluens		4	4	8	2	4	2			5	1					7		1	2	2										1
Phellodon connatus	8	30	42	19	4	13	1		1	4	5	3			1	3			7	7		3	3	7	2	1		4	6	2
Phellodon tomentosus	13	28	31	23	10	14	4	2	1	18	10	11			1	1			10	19	3	17	8	17	10	1	5	11	4	1
Hydnellum suaveolens	7	16	21	6		1	12	2	5	14	4	2							17	11		8	5	7	9	3	5	8	6	1
Hydnellum caeruleum	8	29	46	11	2	1	2		2	7	11	7	1		1				17	17		14	3	5	7	1	1	8	8	2
Hydnellum ferrugipes																						1								
Hydnellum floriforme	5	14	13	2	1	4	2		2	9	12	5							10	15	2	14	14	15	7		1	6	2	
Hydnellum aurantiacum		2				1				1	1								2	1		1	4		1			3	1	1
Hydnellum peckii		8	16	2	9	4	2			13	6	4			1	1			6	12		8	5	15	2	1	3	9	13	6
Hydnellum mirabile		1																		1			1							
Hydnellum compactum																			1	1				2		1		1	1	1
Hydnellum spongiosipes		1	2	4	1					5	2					1	1		1				1	1			1	1	1	
Hydnellum ferrugineum	5	14	37	13	10	22	1			4	7	1							1	7	1	6	15	4	3		2	1	2	2
Hydnellum tardum						1																	1			1		6	3	
Hydnellum scrobiculatum	2	11	15	6	2	6	1			2	2	1			1				1	7		3	3	2	3	1	1	1	4	1
Hydnellum concrescens	6	20	41	21	5	9	4		3	17	11								11	9	1	5	7	7	4	1	3	8	4	5
Hydnellum cumulatum			1																											
Hydnellum geogenium		3	7	1			1		2	7	7									2		6		5	1			2		
Sarcodon imbricatus	10	28	19	7	4	18	5		2	9	23	26		1		6		3	11	5		7	6	13	4	3	1	7	15	5
Sarcodon squamosus	1	3	6	3	5	12			1	1	5	4							2	1				3						1
Sarcodon leucopus		2	5		1		1		1	5	1								3	7	1	1	1	2	3	2		1		
Sarcodon versipellis	1	2					1			12	3								1	7		1	1	5	3			4	1	1
Sarcodon scabrosus		8	20	10	7	7				5	6									3		1		3	1			4	1	
Sarcodon glaucopus	1		6	1		2				3	2	1			1								3	2					3	1
Sarcodon fennicus		2	4	3															2	3		2	1	1				2	1	
Sarcodon regalis																												2		
Sarcodon lundellii																								1						
Sarcodon martioflavus																												1	1	
Sarcodon joeides										1													1						1	
Sarcodon fuligineo–violaceus							1															2						4		
*Boletopsis leucomelaena *)*						2		1		4	3	1								1		7	9	9	2	1		6	9	1
*Boletopsis grisea *)*						1				1		1							3	4		1	5	2	1	2	1	1		2
Total	79	259	407	168	84	148	42	5	21	154	137	71	1	2	6	31	1	4	123	180	8	141	124	160	76	22	33	131	101	44

A somewhat different situation is found in Hungary, where the number of records shows a prominent peak in the 1960s, followed by a rapid decline. It is probably connected with the small area of woodland in this country (also with another composition of forests in which deciduous trees predominate), where any change is rapidly expressed in the number of fungal collections.

Finally, the situation of some endangered species should be commented. Among the species of deciduous forests, *Hydnellum spongiosipes* and *Phellodon confluens* have become very rare (with the exception of three new localities of *P. confluens* in Czechia during the last decade). The occurrence of *Bankera fuligineo-alba* has rapidly decreased since 1980s. Several more species of coniferous forests show decline – besides the above-mentioned *Hydnellum suaveolens* and *H. caeruleum* also *H. floriforme* and *Sarcodon leucopus* have become rare outside mountain areas. The mountain species *Sarcodon versipellis* and *Hydnellum geogenium* are still rare in general, but their occurrence is rather constant. (Extremely rare species with up to 10 localities are not commented in this paragraph.)

ACKNOWLEDGEMENTS

I wish to thank the curators and employees of all visited herbaria for their service and help (and enabling me to work at night in some cases), and Czech colleagues for sending material or providing information about the current occurrence of hydnaceous fungi. Last, but not least my thanks go out to Mgr. Zdeněk Pouzar, CSc. who advised me in case of arising problems.

The work was supported by the Grant Agency of the Czech Republic (project no. 206/02/D052).

REFERENCES

ARNOLDS E. (2003): De Stekelzwammen en Pruikzwammen van Nederland en België. – Coolia 46(3), 2003 supplement: 1–96.

BREITENBACH J. and KRÄNZLIN F. (eds.) (1986): Pilze der Schweiz, vol. 2. – 412 p. Luzern.

BUCHMANN D. (1998): Regensburger Pilzflora 9: Gestielte Stachelpilze. – Regensb. Mykol. Schriften 8: 169–195.

DERMEK A. (1973): Tri zriedkavé druhy húb z čeľade plesňovkovitých – *Thelephoraceae*. – Čas. Čs. Houb.-Mykol. Sborn. 50: 33–34.

ENDERLE M. (2004): Die Pilzflora des Ulmer Raumes. – 521 p. Ulm.

ENGEL H. (1973): *Sarcodon martioflavus* in Bayern gefunden. – Z. Pilzk. 39(3–4): 257.

ENGEL H. and FRIEDERICHSEN I. (1974): Der Aspekt der Großpilze um Mitte September im Nadelwaldgürtel der nördlichen Kalkalpen in Tirol II. Die Artenliste. – Z. Pilzk. 40: 25–68.

GMINDER A. (1991): Interessante Pilzfunde 1990 (1). – Südwestdeutsche Pilzrundschau 27(1): 6–10.

GMINDER A. (1992): Interessante Pilzfunde (Teil 2) 1990/91. – Südwestdeutsche Pilzrundschau 28(1): 14–19.

HARRISON K.A. and GRUND D.W. (1987a): Preliminary keys to the terrestrial stipitate hydnums of North America. – Mycotaxon 28(2): 419–426.

HARRISON K.A. and GRUND D.W. (1987b): Differences in European and North American stipitate hydnums. – Mycotaxon 28(2): 427–435.

HAUSKNECHT A., JAKLITSCH W. and KRISAI-GREILHUBER I. (2000): Ergebnisse des Mykologisches Arbeitstreffens in Jerischach (Südkärnten) im August/September 1998. – Österr. Z. Mykol. 9: 163–190.

HAUSKNECHT A. and KLOFAC W. (2004): Ergebnisse des Mykologisches Arbeitstreffens in Horitschon (Burgenland) im September/Oktober 2001. – Österr. Z. Mykol. 13: 237–265.

HOLEC J. (2004): Rare and interesting fungi from the Vydra-Otava River valley in the Šumava National Park (Bohemian Forest, Czech Republic). – Silva Gabreta 10: 79–86.

HROUDA P. (1996): Notes on two hydnums – *Bankera violascens* and *Sarcodon versipellis*. – Czech Mycol. 49(1): 35–39.

HROUDA P. (1999): Hydnaceous fungi of the Czech Republic and Slovakia. – Czech Mycol. 51(2–3): 99–155.

JOHANNESSON H., RYMAN S., LUNDMARK H. and DANELL E. (1999): *Sarcodon imbricatus* and *S. squamosus* – two confused species. – Mycol. Res. 103(11): 1447–1452.

JÜLICH W. (1984): Die Nichtblätterpilze, Gallertpilze und Bauchpilze. – In: Gams H. (ed.), Kleine Kryptogamenflora 2b(1): Basidiomyceten 1, 626 p., Stuttgart and New York.

KIRK P.M., CANNON P.F., DAVID J.C. and STALPERS J.A. (eds.) (2001): Dictionary of the Fungi, 9th edition. – 655 p. Egham.

KOTLABA F. (1984): Zeměpisné rozšíření a ekologie chorošů (*Polyporales* s. l.) v Československu. – 194 p. + 123 maps. Praha.

KOTLABA F. and POUZAR Z. (2000): Přehlížený druh našich lošáků – *Sarcodon squamosus*. – Mykol. Listy 74: 5–7.

KRIEGLSTEINER G. J. (1991): Verbreitungsatlas der Großpilze Deutschlands (West), Band 1 Ständerpilze, Teil A Nichtblätterpilze. – 1600 maps. Stuttgart.

KRIEGLSTEINER G. J. (2000): Die Großpilze Baden-Württembergs, vol. 1. – 629 p. Stuttgart.

KRIEGLSTEINER L. (1999): Pilze im Naturraum Mainfränkische Platten und ihre Einbindung in die Vegetation. – Regensb. Mykol. Schriften 9, vol 1: 1–464.

KRIEGLSTEINER L. (2004): Pilze im Biosphären-Reservat Rhön und ihre Einbindung in die Vegetation. – Regensb. Mykol. Schriften 12: 1–770.

KRISAI-GREILHUBER I., HAUSKNECHT A. and SCHEUER C. (1997): Ergebnisse des Mykologisches Arbeitstreffens in Sibratsgfäll (Vorarlberg) vom 30. 8.–6. 9. 1995. – Österr. Z. Mykol. 6: 155–180.

KUBIČKA J. (1981): Nový lošák pro naše území. – Mykol. Listy no. 3: 14.

MAAS GEESTERANUS R.A. (1975): Die Terrestrischen Stachelpilze Europas. – 127 p. + 40 tab. Amsterdam and London.

NIEMELÄ T., KINNUNEN J., RENVALL P. and SCHIGEL D. (2003): *Phellodon secretus* (Basidiomycota), a new hydnaceous fungus from northern pine woodlands. – Karstenia 43: 37–44.

NIEMELÄ T. and SAARENOKSA R. (1989): On Fennoscandian polypores 10. *Boletopsis leucomelaena* and *B. grisea* described and illustrated. – Karstenia 29: 12–28.

OTTO P. (1992): Verbreitung und Rückgang der terrestrischen Stachelpilze Ostdeutschlands. – Gleditschia 20(1): 153–202.

OTTO P. (1997): Kommentierter Bestimmungsschlüssel der terrestrischer Stachelpilze Deutschlands mit taxonomischen und nomenklatorischen Anmerkungen. – Boletus 21(1): 1–21.

PAPOUŠEK T. (ed.) (2004): Velký fotoatlas hub z jižních Čech. – 819 p. České Budějovice.

PEINTNER U., KIRCHMAIR M., MOSER M., PÖDER R. and LADURNER H. (1999): Ergebnisse der 26. Mykologischen Dreiländertagung in Rotholz-Jenbach (Tirol) vom 29. August bis 5. September 1998. – Österr. Z. Mykol. 8: 83–123.

SCHMIDT-STOHN G. (2001): *Sarcodon imbricatus* und *S. squamosus* – zwei vermischte Arten. – Boletus 24(1): 48–53.

STALPERS J. A. (1993): The Aphyllophoraceous fungi I. Keys to the species of the *Thelephorales*. – Stud. Mycol. no. 35: 1–168.

ŠKUBLA P. (2003): Mycoflora Slovaca. – 1103 p. Šaľa.

CZECH MYCOL. 57(1–2): 79–89, 2005

Saprobic microfungi in tea based on *Camellia sinensis* and on other dried herbs

VERONIKA ŘEZÁČOVÁ[1,2*] and ALENA KUBÁTOVÁ[1]

[1] Department of Botany, Faculty of Science, Charles University, Benátská 2, CZ-128 01 Prague 2, Czech Republic
strver@seznam.cz, * corresponding author
[2] Laboratory of Fungal Biology, Institute of Microbiology, Academy of Sciences of the Czech Republic, Vídeňská 1083, CZ-142 20, Prague 4, Czech Republic

Řezáčová V. and Kubátová A. (2005): Saprobic microfungi in tea (*Camellia sinensis*) and dried herbs. – Czech Mycol. 57: 79–89.

The quality of various types of tea from shops in Prague (Czech Republic) in respect to microfungal contamination was investigated. Altogether, 40 samples of tea were tested including black, green and herbal teas. Eighty-one species of microfungi were detected. *Aspergillus niger* agg. was found to be the most frequent. Great differences were recorded in microfungal species composition between various kinds of tea. However, when using the Monte Carlo Permutation test in CCA, we did not find any correlation between microfungi and type of tea. Aflatoxin production was not proven in any of the tested strains. Colony forming units (CFU) did not exceed the limits valid in the Czech Republic.

Key words: tea, *Camellia sinensis*, contamination, ascomycete anamorphs, toxigenic fungi

Řezáčová V. a Kubátová A. (2005): Saprobní mikroskopické houby v čajích *Camellia sinensis* a dalších sušených rostlinách. – Czech Mycol. 57: 79–89.

Byla studována kvalita různých typů čajů pocházejících z pražských obchodů (Česká republika) z hlediska jejich kontaminace mikroskopickými houbami. Celkem bylo testováno 40 vzorků černých, zelených a bylinných čajů. Bylo v nich zjištěno 81 druhů mikroskopických hub. Nejčastějším druhem byl *Aspergillus niger* agg. Mezi různými typy čajů byly zaznamenány velké rozdíly v druhovém složení společenstev mikroskopických hub. Pokud byl ale použit Monte Carlo permutační test v CCA, nezaznamenaly jsme žádnou asociaci mezi mikromycety a druhem čaje. Produkce aflatoxinů nebyla prokázána u žádného z testovaných kmenů hub. Počet zárodků houbových organizmů (CFU) nepřekročil limity platné v České republice.

INTRODUCTION

Teas are one of the basic commonly used drinks. Their contamination with microfungi, which can be a possible source of mycotoxins, is therefore undesirable. Teas, as a dry herbal product, present a substrate, which contains a low amount of water as well as soluble sugars. This means that teas are a product which may be colonised first of all by xerotolerant and osmotolerant fungi comprising many potentially toxigenic species.

Data on fungal contamination of teas are sporadic. Only a few authors have dealt with the occurrence of microfungi in teas. For example, Jesenská (1987) investigated mycobiota of dried food including black teas in Slovakia. Abdel-Hafez and El-Maghraby (1992) examined microfungi in tea in Egypt. In the Sultanate of Oman, Elshafie et al. (1999) studied tea quality and fungi associated with black tea. In the Czech Republic, several authors (e.g. Kubátová et al. 2000, Ostrý et al. 2002) were interested in microbial, in particular microfungal, contamination of teas. Also in other works (e.g. Aziz et al. 1998, Halt 1998) microfungi contaminating herbal teas have been investigated.

The main aim of our study was therefore to discover the spectrum of microfungi in teas in the sale conditions of the Czech Republic and evaluate the quality of teas according to the Czech hygienic standard (ČSN ISO 7954). Further we aimed to compare the quality of different types of teas, i.e. black (fermented) versus green (non-fermented) teas and packaged (tea bags) versus unpackaged teas to know the effect of processing, and to carry out a simple test of aflatoxin production among the strains of the genus *Aspergillus* section *Flavi*.

MATERIALS AND METHODS

Forty tea samples used for mycological examination were obtained from local markets in Prague between 1999 and 2001. They came from different producers and belonged to the most widespread types of tea in the Czech Republic. They were in good condition and without visible growth of moulds. To make a comparison, ten black, fermented tea samples (*Camellia sinensis*), ten green, non-fermented ones, ten samples of herbal teas of plants from the temperate zone (*Matricaria chamomilla*, *Melissa officinalis*, *Mentha piperita*, *Sambucus nigra*, *Tilia cordata*, and *Urtica dioica*) and ten samples of herbal teas of subtropical or tropical plants (*Aspalathus linearis*, *Cassia senna*, *Foeniculum vulgare*, *Hibiscus sabdariffa*, *Ilex paraguariensis*) were processed. Each sample was represented by only one plant. Moreover the difference between packaged and unpackaged teas was investigated (Tab. 1).

For the qualitative study the direct inoculation method was used. A small amount, c. 0.2 g of each sample was equally distributed on a medium. The following three isolation media were used: dichloran 18 % glycerol agar (DG18) according to Pitt and Hocking (1997), soil extract agar with glucose and Rose Bengal (SEGA) and wort agar (WBA) according to Fassatiová (1986). Streptomycin was added to suppress bacterial growth (100 mg/l). Petri dishes were incubated at c. 25 °C for seven days. The method of heating samples at 75 °C for 30 min. according to Samson et al. (1996) was used to isolate heat resistant fungi. Growth of microfungi was examined during a period of two weeks.

Tab. 1. Types and numbers of tested teas.

		unpackaged teas	packaged teas
Camellia sinensis	Fermented (black) teas	5	5
	Non-fermented (green) teas	5	5
other herbal teas	Teas of temperate origin	5	5
	Teas of (sub)tropical origin	5	5

The quantitative study followed the ČSN ISO 7954 standard. The dilution plate technique was used for the isolation of microfungi. A portion of each sample (1 g) was shaken for 10 min. in 10 ml of sterile deionised water. One ml of each diluted suspension (1:10 and 1:100) was pipetted into a 90-mm Petri dish and mixed with the medium (yeast extract 5 g, glucose 20 g, chloramphenicol 0.1 g, agar 15 g and distilled water 1000 ml). Two Petri dishes were prepared per sample. Colony forming units (CFU) were counted after 5 days of incubation at ca 25 °C.

Microfungi were identified according to micro– and macro-morphological characteristics. For *Aspergillus*, *Penicillium*, *Paecilomyces*, and *Verticillium* strains, Czapek yeast extract agar (CYA) and malt extract agar (MEA) (Pitt 1979) were used. To identify *Eurotium* strains, dichloran 18 % glycerol agar (DG18) and Czapek yeast extract agar with 20 % sucrose (CY20S) according to Pitt and Hocking (1997) were used. Species of the order *Mucorales* were identified on malt extract agar (MEA) according to Pitt and Hocking (1997) and the other fungi on potato dextrose agar (PDA).

Microfungi were identified according to Domsch et al. (1980) and monographic works and reports (Arx 1981, 1982, Ellis 1971, 1976, Horn 1997, Kozakiewicz 1989, Pitt 1979, Pitt and Hocking 1997, Tzean et al. 1990, Váňová 1989).

Some physiological methods were used for the identification of *Penicillium* species (Frisvad 1981, 1983, 1985): the production of acids on creatine sucrose agar (CREA), growth on nitrite sucrose agar (NSA), production of a brown pigment on the reverse side of the colony on yeast extract sucrose agar (YES) and the ability to cause apple rot (according to Raper and Thom 1949). The following methods were used to differentiate species of the genus *Aspergillus* section *Flavi*: production of an orange or brown pigment on the reverse side of colonies on *Aspergillus flavus/parasiticus* agar (AFPA) at 30 °C according to Pitt et al. (1983) and the growth on Czapek agar (CZA) at 42 °C according to Kurtzman et al. (1987). Moreover, a rapid method for the detection of aflatoxin-producing strains was used by means of a 25 % solution of ammonia (Saito and Machida 1999).

Data analysis: effects of the type of tea on fungal species richness were assessed using the Sørensen index. It is described as: $SI = 2j/(a + b)$, where j = number of species in common at site A and B, a = number of species at site A, b = number of species at site B.

Effects of tea variables (fermented, non-fermented, unpackaged, packaged, origin in the temperate or (sub)tropical zone) on species composition were tested by means of the canonical correspondence analysis (CCA), using Canoco version 4.5. The significance of the relationship between fungal species and type of tea was assessed using the implemented Monte Carlo permutation test (499 permutations). Significance of the analyses was accepted at $p \leq 0.05$.

RESULTS

All the 40 samples of tested teas were contaminated with microfungi. A total of 81, mainly saprotrophic microfungal species from 31 genera, were identified in the tea samples in the period 1999–2001 (Tab. 3). A majority of the isolated microfungi were ascomycete anamorphs. Most of them are fungi typical of food or feed, many of them are xerotolerant or osmotolerant. Although a great number of species was recorded, many isolates are sporadic or accidental occurrences and seem to have very little significance from the viewpoint of quality. *Aspergillus niger* agg. (82.5 % of samples), *Rhizopus stolonifer* (40 %), *Eurotium repens* (32.5 %), *Penicillium chrysogenum* (32.5 %), *Eurotium amstelodami* (27.5 %), *E. chevalieri* (27.5 %) and *Penicillium aurantiogriseum* (25 %) were identified as the most frequent species.

Sørensen similarity index (Tab. 2) revealed great differences in species composition between all types of tea studied. Many more species (62) were found in packaged tea samples compared to the unpackaged tea samples (49 species; Tab. 2). Higher counts of species (37) were also recorded from fermented than from non-fermented tea samples (25 species). In herbal tea samples of local origin 48 species were detected compared to teas of other origin (25 species). There were no great differences between herbal teas and tea from *Camellia sinensis* in numbers of fungal species.

When the data were processed using the Monte Carlo permutation test in CCA, no correlation between microfungal species and type of tea was found. The only significant graphic evaluation is given in Fig. 1.

A large number of toxigenic fungi were found. The most important are the potentially aflatoxigenic *Aspergillus flavus*, ochratoxigenic *A. ochraceus* and *A. niger*, and *A. versicolor*, which can produce sterigmatocystin (see e.g. Frisvad and Samson 1991, Samson et al. 2004). But using the rapid screening method for the detection of aflatoxins according to Saito and Machida (1999), the production of aflatoxins was not demonstrated in any of the isolated *Aspergillus* section *Flavi* strains.

Using the method for isolation of heat resistant fungi some thermophilic or thermotolerant (e.g. *Rhizomucor pusillus*, *Aspergillus fumigatus*) and thermoresistant fungi (*Eurotium* species) were recorded; the ascospores of the latter can survive higher temperatures (Pitt and Hocking 1997).

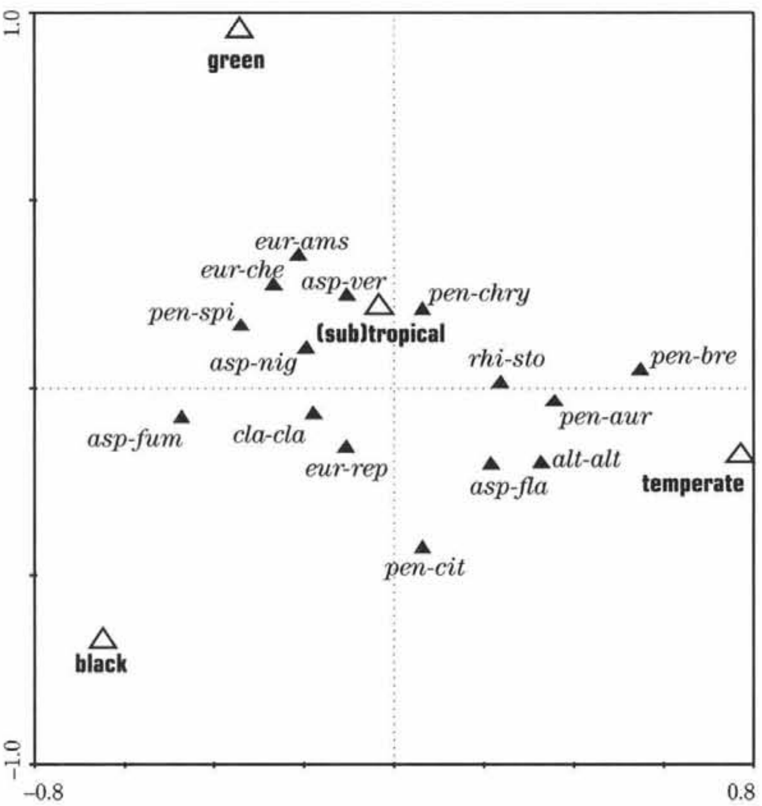


Fig. 1. Graphic evaluation (ordination biplot) resulting from canonical correspondence analysis CCA of fungal species data with kind of tea as an explanatory variable. All species data were included in the analysis, but only the most frequent ones (isolated at least from 5 samples) are shown here. The first axis explained 4.3 % (P-value = 0.002) and all axes together 15.9 % (P-value = 0.002) variability of the data package.

Abbreviations: fermented, black, teas (black), non-fermented, green, teas (green), teas from plants originated in temperate zone (temperate), teas from plants originated in subtropical or tropical areas (sub/tropical), *Alternaria alternata* (alt-alt), *Aspergillus flavus* (asp-fla), *A. fumigatus* (asp-fum), *A. niger* (asp-nig), *A. versicolor* (asp-ver), *Cladosporium cladosporioides* (cla-cla), *Eurotium amstelodami* (eur-ams), *E. chevalieri* (eur-che), *E. repens* (eur-rep), *Penicillium aurantiogriseum* (pen-aur), *P. brevicompactum* (pen-bre), *P. chrysogenum* (pen-chry), *P. citrinum* (pen-cit), *P. spinulosum* (pen-spi), *Rhizopus stolonifer* (rhi-sto).

Tab. 2. Species richness, mean values of colony forming units per gram and Sørensen similarity index (SI) calculated for microfungi obtained from different types of tea.

kind of tea	**species numbers**	**SI**	**CFU/g**
packaged	62	0.56	0.20×10^3
unpackaged	49		0.09×10^3
herbal tea	50	0.52	0.13×10^3
Camellia sinensis	57		0.15×10^3
fermented (black)	37	0.43	0.08×10^3
non-fermented (green)	25		0.22×10^3
local origin	48	0.46	0.09×10^3
other origin	25		0.06×10^3

Tab. 3. List of micromycetes isolated from two types of teas.
Abbreviations: black: fermented, black, teas, green: non-fermented, green, teas, temperate: herbs of temperate origin, (sub)tropical: herbs of subtropical or tropical origin, L: unpackaged, P: packaged

Fungal species	**Numbers of contaminated samples**								
	Camellia sinensis				**other herbs**				**total**
	black		**green**		**temperate**		**sub/tropical**		
	L	**P**	**L**	**P**	**L**	**P**	**L**	**P**	
Acremonium sp. 1		1							1
Acremonium sp. 2						1			1
Acremonium sp. 3					1				1
Acremonium strictum W. Gams						1			1
Alternaria alternata (Fr.) Keissl.						3		1	5
Aspergillus aculeatus Iizuka							1		1
Aspergillus cf. *caelatus* B. W. Horn		1							1
Aspergillus flavus Link	1	1			2	3			7
Aspergillus fumigatus Fresen.	1	3		2			1		7
Aspergillus niger agg. Tiegh.	5	5	5	5	2	3	3	4	32
Aspergillus ochraceus K. Wilh.			1			1			2
Aspergillus parasiticus Speare						1			1
Aspergillus penicillioides Speg.					1				1
Aspergillus sydowii (Bainier et Sartory) Thom et Church				1			1		2
Aspergillus tamarii Kita	2	1							3
Aspergillus versicolor (Vuill.) Tirab.	1		1	1		1	1	1	6
Basipetospora sp.		1							1
Byssochlamys nivea Westling					1	1	1	1	4
Chaetomium cf. *fusiforme* Chivers				1					1
Chaetomium globosum Kunze: Fr.		1							1
Chaetomium sp.		1							1

Tab. 3. Continuation.

Cladosporium cladosporioides (Fresen.) G. A. de Vries	1	1		1		1		1	5
Clonostachys rosea (Link : Fr.) Schroers, Samuels, Seifert et W. Gams				1					1
Emericella nidulans (Eidam) Vuill.					1	1		1	3
Epicoccum nigrum Link						1			1
Eupenicillium sp.		1							1
Eurotium amstelodami L. Mangin	1	2		4		1	1	2	11
Eurotium chevalieri L. Mangin	2	3		3		1		2	11
Eurotium cristatum (Raper et Fennell) Malloch et Cain						1			1
Eurotium repens de Bary	3	2		1	2	1	3	1	13
Eurotium rubrum Jos. König et al.		1				1			2
Eurotium sp.					1				1
Fusarium sp.				1					1
Gelasinospora cf. *retispora* Cain		1		1	1				3
Microascus brevicaulis S. P. Abbott					1	1		1	3
Microascus manginii (Loubiére) Curzi					1				1
Mucor dimorphosporus f. *sphaerosporus* (Hagem) Váňová				1	1	2			4
Mucor petrinsularis Naumov					1				1
Mucor plumbeus Bonord.					1				1
Mycocladus corymbifer (Cohn) Váňová	1				1			1	3
Paecilomyces variotii Bainier		1							1
Penicillium aurantiogriseum Dierckx		1			3	3		2	10
Penicillium bilaiae Chalab.								1	1
Penicillium brevicompactum Dierckx				1	2	2			5
Penicillium chrysogenum Thom		2	2	3	2	3		1	13
Penicillium citrinum Thom	2	1			2	1			6
Penicillium commune Thom			1	1		1			3
Penicillium cf. *coprophilum* (Berk. et M. A. Curtis) Seifert et Samson						1			1
Penicillium corylophilum Dierckx		1						1	3
Penicillium crustosum Thom				1	1		1	1	4
Penicillium expansum Link					1				1
Penicillium fellutanum Biourge		1							1
Penicillium glabrum (Wehmer) Westling					1			1	2
Penicillium miczynskii K. M. Zalessky		2							2
Penicillium minioluteum Dierckx						1			1
Penicillium solitum Westling	1			2					3
Penicillium spinulosum Thom		2		1			1	1	5
Penicillium cf. *verrucosum* Dierckx		1			1				2

Tab. 3. Continuation.

Penicillium waksmanii K. M. Zalessky			2						2
Penicillium sp.1	1								1
Penicillium sp.2	1								1
Penicillium sp.3	1								1
Penicillium sp.4			1						1
Periconia byssoides Pers.						1			1
Phoma sp. 1						1			1
Phoma sp. 2		1							1
Rhizopus arrhizus A. Fisch.					1				1
Rhizomucor pusillus (Lindt) Schipper		2							2
Rhizopus microsporus var. *rhizopodiformis* (Cohn) Schipper et Stalpers	1				1				2
Rhizopus stolonifer var. *stolonifer* (Ehrenb.) Vuill.	2		1	1	4	4	1	3	16
Sordaria fimicola (Roberge) Ces. et de Not.				1	1	1			3
Stachybotrys sp.							1		1
Syncephalastrum racemosum Cohn ex J. Schröt.							1	1	2
Talaromyces flavus (Klöcker) Stolk et Samson						1			1
Talaromyces wortmanii (Klöcker) C. R. Benj.		2							2
Talaromyces sp.		1							1
Trichoderma longibrachiatum Rifai				2					2
Trichothecium roseum (Pers.: Fr.) Link					1				1
Ulocladium botrytis Preuss					2	1			3
mycelia sterilia 1					1				1
mycelia sterilia 2								1	1
Total no. of fungal species	**17**	**29**	**8**	**22**	**30**	**25**	**13**	**21**	**81**

The quantitative study according to ČSN ISO 7954 confirmed that all tested tea samples met the hygienic conditions relating to them by Act no. 294/1997 coll. The most contaminated sample of packaged non-fermented tea contained only 1.2×10^3 CFU/g, whereas according to the above cited notice teas can not contain more than 10^5 CFU/g. Mean values of colony forming units per gram (CFU/g) are in Tab. 2.

DISCUSSION

In the majority of the tested samples and in all tea samples (*Camellia sinensis*), *Aspergillus niger* agg. was found. Its occurrence was also reported by all the other authors who carried out mycological examination of teas (Dvořáková 1982, Jesenská 1987, Abdel-Hafez and El-Maghraby 1992, Březina et al. 1997, Čutková 1997, Elshafie et al. 1999, Kubátová et al. 2000, Ostrý et al. 2000, Ostrý et al. 2002). This result could indicate that there is a relationship between the *Camellia sinensis* and *Aspergillus niger* agg. But when using the Monte Carlo Permutation test in CCA, we did not found out any correlation between particular microfungal species and a type of tea studied. In respect of the collateral high occurrence of this species in other herbal tea samples, it could be rather the substrate containing a low amount of water which *A. niger* agg. prefers.

Aspergillus niger and three other species of the section *Nigri* now belong to ochratoxigenic fungi (Abarca 1994, Samson et al. 2004). Therefore, the occurrence of *A. niger* in teas should not be underestimated. The very important aflatoxigenic fungus *A. flavus* was found in only 13 % of samples. We did not prove production of aflatoxin in any isolate. However, we used only a simple screening method. For achieving more exact results, other methods could be used.

There were quite some differences in species richness between all kinds of tea, which was reflected in a low value of the Sørensen similarity index. This result is interesting mainly in the case of fermented compared to non-fermented tea and in the case of local teas compared to teas of other origin. But we did not find any effect of fermentation or origin of plant on the species composition. Likely, most microfungi coloniaze the tea product later during processing. This hypothesis supports not only the fungal spectrum recorded (generally saprobic fungi preferring dried food) but also the great difference in species composition between our results and microfungal species isolated from soils under tea shrubs (*Camellia sinensis*) and directly from living tea plants (Agnihothrudu 1962, Farr et al. 1994). Unfortunately, data about the country of plant origin and packing hall could not be obtained. The amounts of colony forming units (CFU/g) and so the differences among various types of tea were too low to assess a significant effect of any type of tea.

The quantitative study according to ČSN ISO 7954 confirmed that the tested groups of green teas met all the hygienic conditions concerning them according to Act no. 294/1997 coll. But the quantitative study was also applied to the black teas even though they are considered as food without risk to human health and there are not any hygienic standards in the act. This result is very favourable, because the number of colony forming units (CFU/g) was much lower than 10^5 CFU/g which is the admissible maximum of CFU/g according to the above mentioned act.

ACKNOWLEDGEMENTS

We thank Marie Váňová for her valuable help with identification of microfungi of the order *Mucorales* and Karel Prášil for revision of the species of family *Dematiaceae*. The study was partly supported by the Ministry of Education of the Czech Republic (MSM 0021620828).

References

Abarca M. L., Bragulat M. R., Castella G. and Cabañes F. J. (1994): Ochratoxin A production by strains of *Aspergillus niger* var. *niger*. – Appl. Environ. Microbiol. 60: 2650–2652.

Abdel-Hafez A. I. I. and El-Maghraby O. M. O. (1992): Fungal flora and aflatoxin associated with cocoa, roasted coffee and tea powders in Egypt. – Crypt. Mycol. 13: 31–45.

Agnihothrudu V. (1962): A comparison of some techniques for the isolation of fungi from tea soils. – Mycopathol. Mycol. Appl. 16: 235–242.

Arx J. A. von (1981): The genera of fungi sporulating in pure culture. – 422 p. Vaduz.

Arx J. A. von (1982): A key to the species of *Gelasinospora*. – Persoonia 11: 443–449.

Aziz N. H., Youssef Y. A., El-Fouly M. Z. and Moussa L. A. (1998): Contamination of some common medicinal plant samples and species by fungi and their mycotoxins. – Bot. Bull. Acad. Sin. 39: 279–285.

Březina P., Šimůnek J., Petláková J. and Božek F. (1997): Mikroflóra čajů ve vztahu k možné tvorbě mykotoxinů [Microflora of teas in relation to potential production of mycotoxins]. – In: Muzikář V., Bartl V. (eds.), Sborník přednášek mikrobiologie potravin, p. 87–90, Třešť. [in Czech]

Čutková P. (1997): Mikroskopické houby na sušených potravinách, speciálně na koření [Microscopic fungi on dried foods, especially in spices]. – Dipl. Thesis, 100 p. [in Czech; depon. in: Dep. Bot., Charles University, Prague]

Domsch K. H., Gams W. and Anderson T.-H. (1980): Compendium of soil fungi. Vol. 1. – 859 p. London etc.

Dvořáková A. (1982): Mikroskopické houby na potravinách rostlinného původu [Microscopic fungi on foods of plant origin]. – Dipl. Thesis, 81 p. [in Czech; depon. in: Dep. Bot., Charles University, Prague]

Ellis M. B. (1971): Dematiaceous hyphomycetes. – 608 p. Kew.

Ellis M. B. (1976): More dematiaceous hyphomycetes. – 507 p. Kew.

Elshafie A. E., Al-Lawatia T. and Al-Bahry S. (1999): Fungi associated with black tea and tea quality in the Sultanate of Oman. – Mycopathologia 145: 89–93.

Farr D. F., Bills G. F., Chamuris G. P. and Rossman A. Y. (1994): Fungi on plants and plant products in the United States. – 1252 p. St. Paul.

Fassatiová O. (1986): Moulds and filamentous fungi in technical microbiology. – 233 p. Amsterdam etc.

Frisvad J. C. (1981): Physiological criteria and mycotoxin production as aids on identification of common asymmetric penicillia. – Appl. Environ. Microbiol. 41: 568–579.

Frisvad J. C. (1983): A selective and indicative medium for groups of *Penicillium viridicatum* producing different mycotoxins in cereals. – J. Appl. Bacteriol. 54: 409–416.

Frisvad J. C. (1985): Creatine sucrose agar, a differential medium for mycotoxin producing terverticillate *Penicillium* species. – Lett. Appl. Microbiol. 1: 109–113.

Frisvad J. C., Samson R. A. (1991): Mycotoxins produced by species of *Penicillium* and *Aspergillus* occurring in cereals. – In: Chelkowski J. (ed.), Cereal grain. Mycotoxins, fungi and quality in drying and storage, p. 441–476, Amsterdam etc.

Halt M. (1998): Moulds and mycotoxins on herb tea and medicinal plants. – Eur. J. Epidemiol. 14: 269–274.

Horn B. W. (1997): *Aspergillus caelatus*, a new species in section *Flavi*. – Mycotaxon 61: 185–191.

Jesenská Z. (1987): Mikroskopické huby v požívatinách a krmivách [Microscopic fungi in foods and feeds]. – 319 p. Bratislava. [in Slovak]

Kozakiewicz Z. (1989): *Aspergillus* species on stored products. – Mycol. Pap. 161: 1–188.

Kubátová A., Váňová M., Prášil K. and Fassatiová O. (2000): Microfungi contaminating foods with low water content. – Novit. Bot. Univ. Carol. 13: 13–25.

Kurtzman C. P., Horn B. W. and Hesseltine C. W. (1987): *Aspergillus nomius*, a new aflatoxin-producing species related to *Aspergillus flavus* and *Aspergillus tamarii*. – Ant. Leeuwenhoek 53: 147–158.

Ostrý V., Ruprich J., Procházková I., Škarková J. and Kubátová A. (2000): MYKOMON – project for the determination and the identification of toxigenic fungi in food in the Czech Republic. – In:

Grajewski, J. (ed.), 5^{th} International Conference Mycotoxins and Dioxins and the Environment, p. 191–196, Bydgoszcz.

OSTRÝ V., RUPRICH J., ŠKARKOVÁ J., PROCHÁZKOVÁ I. and KUBÁTOVÁ A. (2002): MYCOMON – monitoring project of toxigenic fungi in food in years 1999–2001. – Mycotoxin Res. 18A(2): 193–197.

PITT J. I. (1979): The genus *Penicillium* and its teleomorphic states *Eupenicillium* and *Talaromyces*. – 634 p. London.

PITT J. I. and HOCKING A. D. (1997): Fungi and food spoilage. – 593 p. London etc.

PITT J. I., HOCKING A. D. and GLENN D. R. (1983): An improved medium for the detection of *Aspergillus flavus* and *A. parasiticus*. – J. Appl. Bacteriol. 54: 109–114.

RAPER K. B. and THOM C. (1949): A manual of the *Penicillia*. – 875 p. Baltimore.

SAITO M. and MACHIDA S. (1999): A rapid identification method for aflatoxin-producing strains of *Aspergillus flavus* and *A. parasiticus* by ammonia vapor. – Mycoscience 40: 205–208.

SAMSON R. A., HOEKSTRA E. S., FRISVALD J. C. and FILTENBORG O. (1996): Introduction to foodborne fungi. – 322 p. Baarn and Delft.

SAMSON R. A., HOUBRAKEN J. A. M. P., KUIJPERS A. F. A., FRANK J. M. and FRISVAD J. C. (2004): New ochratoxin A or sclerotium producing species in *Aspergillus* section *Nigri*. – Stud. Mycol. 50: 45–61.

TZEAN S. S., CHEN J. L., LIOU G. Y., CHEN C. C. and HSU W. H. (1990): *Aspergillus* and related teleomorphs from Taiwan. –113 p. Hsinchu.

VÁŇOVÁ M. (1989): Revize československých zástupců vybraných čeledí řádu Mucorales (*Absidiaceae, Cunninghamellaceae, Mucoraceae, Mycotyphaceae, Syncephalastraceae* a *Thamnidiaceae*) [Revision of Czechoslovak members of selected families of the order Mucorales (*Absidiaceae, Cunninghamellaceae, Mucoraceae, Mycotyphaceae, Syncephalastraceae* a *Thamnidiaceae*)]. – PhD thesis, 255 p. [in Czech; depon. in: Dep. Bot., Charles University, Prague]

CZECH MYCOL. 57(1–2): 91–96, 2005

Notes on mycobiota associated with *Ips typographus* from the Šumava Mts. (Czech Republic)

DAVID NOVOTNÝ[1] and LIBOR JANKOVSKÝ[2]

[1]Research Institute of Crop Production, Division of Plant Medicine, Drnovská 507,
161 06 Praha 6 – Ruzyně, Czech Republic
e-mail: novotny@vurv.cz
[2]Department of Forest Protection and Hunting, Faculty of Forestry and Wood Technology,
Mendel University of Agriculture and Forestry Brno, Zemědělská 3, 613 00 Brno, Czech Republic

Novotný D. and Jankovský L. (2005): Notes on mycobiota associated with *Ips typographus* from the Šumava Mts. (Czech Republic). – Czech Mycol. 57: 91–96.

In 1999 and 2000, stem samples of Norway spruce (*Picea abies*) infested by bark beetle (*Ips typographus*) from one spruce stand locality affected by massive infestation by *Ips typographus* in the central part of the Šumava mountains were taken. The mycobiota of 20 adults was studied. Eighteen species of microscopic fungi were recorded. Yeasts and ophiostomatoid fungi were detected most frequently.

Key words: *Picea abies*, ophiostomatoid fungi, bark beetles

Novotný D. a Jankovský L. (2005): Příspěvek k mykobiotě lýkožrouta smrkového (*Ips typographus*) ze Šumavy (Česká republika). – Czech Mycol. 57: 91–96.

V letech 1999 a 2000 byly vždy na jedné vybrané lokalitě postižené kůrovcovou kalamitou ve střední části Šumavy odebrány vzorky kmenů smrku (*Picea abies*) napadených lýkožroutem smrkovým (*Ips typographus*). Z odebraných vzorků smrku bylo odchyceno celkem 20 dospělých brouků a zjišťovány mikroskopické houby, které přenášejí. Celkem bylo nalezeno 18 druhů mikroskopických hub, mezi nimiž dominovaly kvasinky a ophiostomatální houby.

INTRODUCTION

Fungi and insects are important factors in trees pests in different parts of the world. Mycological and phytopathological research in the last 20 years has been focused on understanding the importance and role of fungi – bark beetle associations in trees dieback. The role of fungi associated with bark beetles as potential pathogens of vascular tissues is investigated (Krokene and Solheim 1996, Yamaoka et al. 1997, Kirschner 2001).

In this field, spruce bark beetle (*Ips typographus)* is frequently studied. The mycobiota associated with this beetle species was investigated in Europe (e.g. Solheim 1986, 1993; Krokene and Solheim 1996; Kirisits 1998) and Japan (Yamaoka et al. 1997). Fungi, especially ophiostomatoid, associated with spruce bark beetles are known to be pathogenic to various species of trees (e.g. Krokene and Solheim 1996, Kirisits 1998).

So far, the mycobiota of eight species of bark beetles (*Hylurgops palliates*, *Ips typographus*, *Myelophilus piniperda*, *Pityogenes chalcographus*, *Scolytus intricatus*, *Tomicus minor*, *T. piniperda*, *Xyloterus lineatus*), including *Ips typographus*, has been investigated in the Czech Republic (Novotný and Šrůtka 2004). Fungi associated with bark beetles, including *I. typographus*, from Central Bohemia were investigated by Kotýnková-Sychrová (1966). She studied a very limited number of adult bark beetles and did not pay attention to the frequency of occurrence of these fungi. Phytopathological aspects of fungi associated with *Ips typographus*, especially *Ceratocystis polonicum* and *Ophiostoma bicolor*, were investigated by Jankovský and Mrkva (1997) and Jankovský et al. (1998, 2003).

The aim of the present study is to contribute to the knowledge of mycobiota of *Ips typographus* which causes mass dieback of Norway spruce in the Šumava Mts. (southwest part of the Czech Republic).

MATERIALS AND METHODS

Samples of spruce stems (*Picea abies*) including galleries and adults of *Ips typographus* were taken from spruce stands from two localities in the central part of the Šumava Mts., South Bohemia, Czech Republic. One was near the village of Modrava (48°58'44"N 13°28'42"E) and the second one was on the slope of Mt. Luzný (48°58'47"N, 13°28'54"E). The samples from the first study site were taken in August 1999 and samples from the second study site were taken in June 2000. The spruce stands were affected by mass infestation by *Ips typographus*. Both localities belong to the study sites of the Institute of Landscape Ecology, Academy of Sciences of the Czech Republic.

Tab. 1. Overview of studied samples.

Sample No.	Date	Locality	Samples
1	2 Aug 1999	Modrava	10 adults beetles from 1 stem
2	21 June 2000	Mt. Luzný	10 adults beetles from 1 stem

Mature beetles were excised from the bark and separately washed in 5 ml of sterile water with Tween 80 for 3 minutes in an ultrasonic cleaner. Washed beetles, 1 ml of the suspension and detritus from galleries were separately inoculated on Petri dishes with 2 % malt extract agar. After 10–14 days of incubation at room temperature the fungi were isolated and identified.

Ophiostomatoid fungi were identified using following literature: Upadhyay (1981), Solheim (1986), Grylls and Seifert (1993) and Yamaoka et al. (1997).

RESULTS

In the present study, 18 fungal species were detected in Norway spruce samples infested with *Ips typographus*. Yeasts and ophiostomatoid fungi dominated the fungal community, but other filamentous fungi were recorded, too. Five fungal species (yeast sp. 1, *Graphium* cf. *fimbriisporum*, *Ophiostoma piceaperdum*, a sterile dark mycelium and *Ophiostoma bicolor*) were recorded in association with at least 40 % of beetles. Small differences were observed in the occurrence of fungi on bodies of beetles, in the suspension and in galleries. More fungal species were found in galleries than in the suspension or beetle bodies. All dominant species, excluding *Ophiostoma bicolor*, were found in the suspension, beetle bodies and galleries (Table 2).

In 1999, 13 species were isolated from beetles from Modrava. Five dominant species (yeast sp. 1, *Graphium* cf. *fimbriisporum*, *Ophiostoma bicolor*, *Ophiostoma minutum* and *Ophiostoma piceaperdum*) were observed in association with at least 40 % of beetles.

In 2000, 11 fungal species were detected in association with beetles from the locality Mt. Luzný. The fungal community was dominated by three species (yeast sp. 1, *Ophiostoma piceaperdum* and a sterile dark mycelium) which occurred in association with at least 40 % of beetles.

DISCUSSION

Many of the fungal species, especially ophiostomatoid fungi, isolated in the present study, are well known for *Ips typographus*, i.e. *Ceratocystis polonica*, *Ophiostoma bicolor*, *O. piceaperdum* (formerly *O. europhioides*), *O. minutum* (formerly *Ceratocystiopsis minuta*), *O. piceae*, *Graphium* spp. and *Leptographium* spp. (e.g. Solheim 1986; Kirschner 1994, 2001; Krokene and Solheim 1996; Yamaoka et al. 1997).

Kotýnková-Sychrová (1966) investigated fungi associated with *Ips typographus* in the Czech Republic. She isolated seven species of ophiostomatoid fungi (*Ophiostoma bicolor*, *O. minutum*, *O. penicillatum*, *O. piceae*, *O. piceaperdum*, *O. serpens* and *Graphium pycnocephalum*), but she did not pay attention to the frequency of occurrence of these fungi. In the present study we recorded 10 species of ophiostomatoid fungi and their frequency of occurrence. *Ophiostoma bicolor*, *O. minutum*, *O. piceae* and *O. piceaperdum* were found in the present study and by Kotýnková-Sychrová (1966).

Tab. 2. Fungi recovered in the mycobiota study of *Ips typographus* from the Šumava Mts. (T – total occurrence, B – body of adult, G – gallery, S – suspension, % – percentage of beetles colonised by fungi).

Species of fungi	Modrava 1999 (10 beetles)			Luzný 2000 (10 beetles)			Both localities		
	B%	S%	G%	T%	B%	S%	G%	T%	T%
basidiomycete sp. 1					10	20		20	10
Ceratocystis polonica (Siemaszko) C. Moreau			10	10	10	10	10	20	15
Cladosporium herbarum (Pers.: Fr.) Link			10	10					5
Graphium cf. *fimbriisporum* (Morelet) K. Jacobs, T. Kirisits et M. J. Wingf.	40	30	60	90	30	10	20	30	60
Graphium sp. 2							10	10	5
Leptographium sp. 1	10		30	30					15
Leptographium sp. 2					20	10	20	20	10
Mucor racemosus Fresen.			20	20					10
Ophiostoma bicolor Davidson et Wells	60	70	20	80					40
Ophiostoma piceaperdum (Rumbold) Arx	30	30	30	40	40	30	60	70	55
Ophiostoma minutum Siemaszko	20	40	40	60					30
Ophiostoma piceae (Münch) H. et P. Sydow						10		10	5
Ophiostoma sp. 1			10	10					5
Phoma sp.	10			10					5
sterile dark mycelium	10		30	30	20	60	20	60	45
sterile light mycelium	10		30	30		10	0	10	20
yeast sp. 1	90	100	50	100	90	90	80	90	95
yeast sp. 2							10	10	5
Number of species	9	5	12	13	7	9	8	11	18

At the two study sites, significant differences in the composition of the mycobiota, specifically in the occurrence of dominant species, were find, but some frequently occurring fungi (*Ophiostoma piceaperdum* and *Graphium* cf. *fimbriisporum*) were recorded at both localities. The differences in mycobiota composition are probably caused by origin or by time of sampling of beetles. The investigated beetles were sampled on one spruce stem each year. The investigated beetles were born in one maternal gallery or the fungi grew through the plant tissue (wood and bark) and colonised more beetle galleries.

The differences in mycobiota composition were compared with results by Solheim (1992) and studies by Kirschner (2001), too. In the present study, yeast sp. 1, *Graphium* cf. *fimbriisporum*, *Ophiostoma piceaperdum*, a sterile dark mycelium and *Ophiostoma bicolor* were isolated most frequently. *Ceratocystis polonica*, *Graphium* sp., *Ophiostoma penicilliatum* and *O. bicolor* were dominant species in the study by Solheim (1992); and Kirschner (2001) recorded most frequently *Ophiostoma minutum* (as *Ceratocystiopsis minutum*), *O. piceae* and *O. piceaperdum* (as *O. europhioides*), *O. japonicum* and *O. bicolor*. The mentioned fungal species are associated with *Ips typographus* and frequencies of their occurrence differ from case to case.

According to Solheim´s (1992) classification of fungal succession in spruce infested by *Ips typographus*, most recorded fungi (almost all species of ophiostomatoid fungi) in the present study belong to secondary or tertiary invaders. Only *Ceratocystis polonica* belongs to primary invaders. Quaternary invaders were recorded in very low frequency (e.g. *Mucor racemosus*, *Cladosporium herbarum*, *Phoma* sp.), but some of these fungi (*Cladosporium herbarum*, *Phoma* sp.) are known as saprophytes or endophytes of conifers, including spruce (Petrini and Fisher 1988, Butin and Kowalski 1990).

The method of direct isolation (beetles are taken from their galleries and directly placed on agar medium) is most frequently used to study the mycobiota of bark beetles (Kirschner 1994, 2001; Krokene and Solheim 1996; Solheim 1986; Yamaoka et al. 1997). In the present study, the mycobiota of *Ips typographus* was investigated by using an ultrasonic cleaner. Kubátová et al. (2002) employed the same method during a study of fungi associated with *Scolytus intricatus* as in the present study. We did not know if the method of using an ultrasonic cleaner was appropriate to study fungi associated with bark beetles, because Kubátová et al. (2002) recorded ophiostomatoid fungi in low frequencies. Our results are similar to observations by Kirschner (1994, 2001), Solheim (1992) and Yamaoka et al. (1997), who used the method of direct isolation and therefore the method based on using an ultrasonic cleaner is applicable for the study of the mycobiota of bark beetles.

An attention was paid to the occurrence of *Ceratocystis polonica*, because this species is known to be potentially pathogenic or pathogenic to spruce (Kirisitis 1998). In the present study, this species was detected in low frequency each year.

In 2000, a so far unidentified basidiomycete (sp. 1) (Table 2) was isolated. It was morphologically similar to *Dacryobolus ipidophyllus*, which is known from beetle galleries (Fassatiová 1954), but the full description of this species was not available to the authors of the present paper. Some other basidiomycete species (e.g. *Amylostereum* spp.) are known for their symbiosis with insects (Slippers et al. 2002) and the observed unidentified basidiomycete could be symbiotic with *Ips typographus*.

Yeast sp. 1 occurred more frequently in the suspension and on insect bodies than in galleries. Intestines of beetles could be probably its ecological niche and therefore this species occurs less frequently in galleries.

ACKNOWLEDGEMENTS

The work was supported by the Grant Agency of the Ministry of Education, Youth and Sports of the Czech Republic (project no. 434100005).

References

Butin H. and Kowalski T. (1990): Die natürliche Astreinigung und ihre biologischen Voraussetzungen 5. Die Pilzflora von Fichte, Kiefer und Lärche. – Eur. J. For. Path. 20: 44–54.

Fassatiová O. (1954): Houby v chodbách kůrovců [Fungi in bark beetle galleries]. – Čes. Mykol. 8: 138–143 (in Czech, with English abstract).

Grylls B. T. and Seifert K. A. (1993): A synoptic key to species of *Ophiostoma*, *Ceratocystis* and *Ceratocystiopsis*. – In: Wingfield M. J., Seifert K. A. and Webber J. F. (eds.), *Ceratocystis* and *Ophiostoma* – taxonomy, ecology and pathogenicity., p. 261–268, St. Paul.

Jankovský L. and Mrkva R. (1997): Přenos patogenů vaskulárních pletiv na smrku lýkožroutem smrkovým *Ips typographus* L. [Transmission of vascular tissue pathogens in spruce by *Ips typographus* L.]. – In: Križová E. and Kodrík J. (eds.), Les, drevo, životné prostredie. Zborník referátov. [Forest, wood and environment. Proceedings], TU Zvolen, p. 209–218 (in Czech).

Jankovský L., Mrkva R. and Ambrožová L. (1998): Ranové reakce na infekci imágy *Ips typographus* [Induced wound response to infection by imagoes of *Ips typographus*]. – In: Pavlík M. (ed.), Mykoflóra pod vplyvom zmien životného prostredia. Zborník referátov. [Mycoflora under the influence of a changing environment. Proceedings.] TU Zvolen, p. 48–57.

Jankovský L., Novotný D. and Mrkva R. (2003): Induced response of Norway spruce *Picea abies* P. Karst. After artificial inoculation by imagoes of *Ips typographus* L.. – J. For. Sci. 49: 403–411.

Kirisits T. (1998): Pathogenicity of three blue-stain fungi associated with the bark beetle *Ips typographus* to Norway spruce in Austria. – Österr. Z. Pilzk. 7: 191–201.

Kirschner R. (1994): Mit Borkenkäfern assoziierte Pilze. – 148 p., ms. [depon. in Bibliothek des Universität Tübingen, Tübingen].

Kirschner R. (2001): Diversity of filamentous fungi in bark beetle galleries in Central Europe. – In: Misra J. K. and Horn B. W. (eds.), Trichomycetes and other fungal groups, p. 175–196, Enfield (USA) and Plymouth (UK).

Kotýnková-Sychrová E. (1966): Mykoflóra chodeb kůrovců v Československu [The mycoflora of bark-beetle galleries in Czechoslovakia]. – Čes. Mykol. 20: 45–53 (in Czech, with English abstract).

Krokene P. and Solheim H. (1996): Fungal associates of five bark beetle species colonizing Norway spruce. – Can. J. For. Res. 26: 2115–2122.

Kubátová A., Novotný D. and Prášil K. (2002): Microscopic fungi associated with oak bark beetle (*Scolytus intricatus*) in the Czech Republic. – Book of abstracts of the seventh international mycological congress (IMC7), Oslo, Norway, August 11–17, 2002, p. 300.

Novotný D. and Šrůtka P. (2004): *Ophiostoma stenoceras* and *O. grandicarpum* (*Ophiostomatales*), first records in the Czech Republic. – Czech Mycol. 56: 19–32.

Petrini O. and Fisher P. J. (1988): A comparative study of fungal endophytes in xylem and whole stem of *Pinus sylvestris* and *Fagus sylvatica*. – Trans. Brit. Mycol. Soc. 91: 233–238.

Slippers B., Coutinho T. A., Wingfield B. D. and Wingfield M. J. (2002): Relationship amongst the fungal symbionts of siricid woodwasps and their spread in the Southern Hemisphere. – Book of abstracts of the seventh international mycological congress (IMC7), Oslo, Norway, August 11–17, 2002, p. 133.

Solheim H. (1986): Species of *Ophiostomataceae* isolated from *Picea abies* infested by the bark beetle *Ips typographus*. – Nord. J. Bot. 6: 199–207.

Solheim H. (1992): Fungal succession in sapwood of Norway spruce infested by the bark beetle *Ips typographus*. – Eur. J. For. Path. 22: 136–148.

Solheim H. (1993): Fungi associated with the spruce bark beetle *Ips typographus* in an endemic area in Norway. – Scand. For. Res. 8: 118–122.

Yamaoka Y., Wingfield M. J., Takahashi I. and Solheim H. (1997): Ophiostomatoid fungi associated with the spruce bark beetle *Ips typographus* f. *japonicus* in Japan. – Mycol. Res. 101: 1215–1227.

Upadhyay H. P. (1981): A monograph of *Ceratocystis* and *Ceratocystiopsis*. – 176 p. Athens (USA).

CZECH MYCOL. 57(1–2): 97–115, 2005

Distribution and ecology of *Camarops tubulina* (Ascomycetes, *Boliniaceae*) in the Czech Republic and remarks on its European distribution

JAN HOLEC

National Museum, Mycological Department, Václavské nám. 68, 115 79 Praha 1, Czech Republic
jan.holec@nm.cz

Holec J. (2005): Distribution and ecology of *Camarops tubulina* (Ascomycetes, *Boliniaceae*) in the Czech Republic and remarks on its European distribution. – Czech Mycol. 57(1-2): 97–115.

Camarops tubulina is a remarkable pyrenomycete included in the Red Book and protected by law in the Czech Republic. Until 1995, 8 localities were known. Due to intensive searching in the period 1996 – spring 2005, the species is currently known from 66 localities (94 finds). Its stromata mostly occur on old, fallen, decaying trunks of *Picea* and *Abies*, rarely of *Fagus*, especially in virgin forests or minimally influenced natural forests, but rarely also on old, decaying trunks lying in man-made forests. Most frequent habitats are submontane herb-rich beech forests with admixture of *Abies* and *Picea*, mixed mountainous forests composed of *Fagus*, *Picea* and *Abies*, natural spruce forests of the supramontane belt and bog spruce forests surrounding mountain peat bogs. The species also occurs in lowlands, but at sites with climatic inversion such as stream valleys, small canyons and gorges. An analysis of its habitats showed that the most important conditions necessary for its occurrence are the existence of more or less natural forest stands with presence of fallen, decaying trunks of *Picea*, *Abies* or *Fagus* (or, rarely, presence of such trunks in man-made forests) and a stable, humid and cool microclimate, best ensured by a closed forest stand. From the point of view of nature conservation, *Camarops tubulina* is an important bioindicator of natural forest ecosystems. The Czech Republic represents the richest area of its occurrence in Europe, where the species is currently known from northern and central part. Distribution maps for the Czech Republic and Europe are provided.

Key words: fungi, pyrenomycetes, *Camarops tubulina*, natural forests, virgin forests, bioindicator

Holec J. (2005): Rozšíření a ekologie druhu *Camarops tubulina* (Ascomycetes, *Boliniaceae*) v České republice a poznámky k jeho rozšíření v Evropě. – Czech Mycol. 57(1-2): 97–115.

Camarops tubulina je pozoruhodný pyrenomycet, zahrnutý do Červené knihy SR a ČR a zároveň v ČR zákonem chráněný. Do roku 1995 byl v ČR znám z 8 lokalit. Díky intenzivnímu sledování v letech 1996 – jaro 2005 je nyní znám už ze 66 lokalit. Stromata se většinou vyskytují na starých padlých a tlejících kmenech smrků a jedlí, vzácně i buků, zejména v pralesovitých a přirozených lesních porostech, ale vzácně i na starých padlých kmenech ležících v kulturních lesích. Nejčastějšími biotopy jsou podhorské květnaté bučiny s příměsí jedle a smrku, horské smíšené lesy tvořené bukem, smrkem a jedlí, klimaxové horské smrčiny a podmáčené smrčiny lemující horská rašeliniště. Druh se vyskytuje i v nížinách, tam ovšem na místech s inverzním klimatem jako jsou údolí a kaňony potoků a rokle. Analýza stanovištních nároků ukázala, že nejdůležitějšími předpoklady výskytu *Camarops tubulina* jsou existence více či méně přirozených lesů se starými padlými kmeny smrků, jedlí a buků (nebo ve vzácných případech alespoň přítomnost takových kmenů v kulturních lesích) a zároveň stabilní, vlhké a chladnější mikroklima, které nejlépe zajistí uzavřený lesní porost. *Camarops tubulina* lze pokládat za významného bioindikátora přirozených až pralesovitých porostů. Česká republika nyní představuje nejbohatší arelu jeho výskytu v Evropě, kde se tento druh vyskytuje v její severní a střední části. To vše dokumentují mapy rozšíření v ČR a v Evropě.

INTRODUCTION

Camarops tubulina (Alb. et Schwein.: Fr.) Shear [≡ *Bolinia tubulina* (Alb. et Schwein.: Fr.) Sacc.] is a remarkable species in the Czech Republic. It is a saprotrophic fungus producing stromata on old, decaying trunks of conifers (*Picea*, *Abies*), less frequently of broadleaved trees. The first finds were published by Svrček (1969), who reported collections made by Z. Pouzar in virgin forests of Southern Bohemia (Boubínský prales, Žofínský prales) in 1967. Another 4 localities were published by Pouzar (1986), all of them natural or seminatural forests protected as nature reserves. These finds led to the inclusion of *Camarops tubulina* into the Red Book of the Slovak and Czech Republics (Kotlaba et al. 1995). In this book 2 more localities were reported and the species was characterised as a typical fungus of natural beech-fir and spruce forests of the submontane (500-800) and montane (800-1100) belt, producing stromata on old, fallen trunks of *Abies*, *Picea* and rarely *Fagus* in later stages of decay. At the same time the species was included into the list of fungi protected by law in the Czech Republic (Antonín and Bieberová 1995) as a critically endangered species. Some recent records were published by Holec (1998, 1999) and Réblová and Prášil (1999) from the Šumava Mts., and by Tomšovský (2000) from the Slezské Beskydy Mts. Beran and Tondl (1997) presented a distribution map for Southern Bohemia and a photograph by Holec.

During field work in natural forests of the Czech Republic the present author recorded *Camarops tubulina* at many new localities and several new regions. The aim of this paper is to evaluate the distribution and ecology of this remarkable species in the light of the newly obtained field data.

MATERIAL AND METHODS

Field work

Camarops tubulina was intensively searched for at all localities in the Czech Republic I visited in the period 1996 – spring 2005, especially in nature reserves and forests with a high amount of dead wood. Of course I was not able to visit all regions of the Czech Republic, but the areas with a richer occurrence of natural to virgin forests (Šumava Mts., Krkonoše Mts., Brdy hills, Moravskoslezské Beskydy Mts., Javorníky Mts.) were included. Voucher specimens of these finds are kept at the Mycological Department of the National Museum, Prague (herbarium PRM). The data obtained from the field were supplemented by data from the herbaria PRM, CB and BRNM and data kindly provided by some Czech mycologists.

Terminology

Locality: for the purpose of this article, one locality is characterised as a place of occurrence of *Camarops tubulina* having the same type of vegetation, altitude and inclination and situated at a distance of about 0.5-1 km from neighbouring locality. At one locality, several trunks with stromata of *C. tubulina* can be present.

Find: record of *C. tubulina* on one trunk. The finds were documented by herbarium specimens, photograps or (exceptionally – at localities with several finds of *C. tubulina*) by records in a notepad.

Altitudinal distribution: for definitions of categories see Kotlaba (1984: 187).

Habitats: Chytrý et al. (2001). Names of geographic units are taken from the phytogeographical division of the Czech Republic (Skalický 1988).

Abbreviations

CR – Czech Republic, dia – photographed using colour slides (kept in PRM), digifoto – photographed with a digital camera (file kept in PRM), not. – a field record which is only noticed or photographed but not documented by a herbarium specimen, NP – National Park, PLA – Protected Landscape Area.

RESULTS

All findings presented in this chapter are based exclusively on data from the Czech Republic. Both published, herbarium, and personal data were evaluated. Their comparison with data from other European countries is presented in paragraphs „Discussion".

Camarops tubulina (Alb. et Schwein.: Fr.) Shear Figs. 4-8
= *Bolinia tubulina* (Alb. et Schwein.: Fr.) Sacc.
Basionym: *Sphaeria tubulina* Alb. et Schwein., Consp. fung. Lusat., p. 6, tab. 4, fig. 4, 1805.

For complete synonymy and taxonomy see Svrček (1969), Nannfeldt (1972), Hilber and Hilber (1980), Pouzar (1986).

Coloured illustrations published in Czech literature: Kotlaba et al. (1995: 33, picture), Beran and Tondl (1997: 21, photograph by J. Holec), Holec (2000: 166, photograph).

DISTRIBUTION

Number of known localities: 66
Number of finds: 94

In the following survey, the records published by Svrček (1969), Pouzar (1986) and Réblová and Prášil (1999) are cited in a shortened way. The codes of geographical units agree with the numbers in distribution map (Fig. 1).

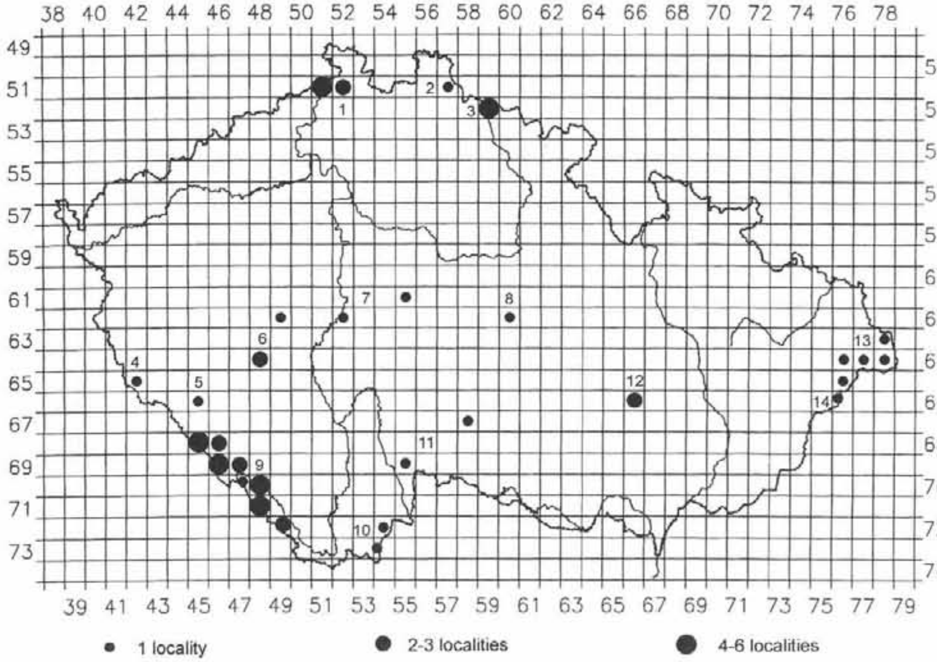


Fig. 1. Distribution of *Camarops tubulina* in the Czech Republic (MTB mapping grid). The numbers indicate geographical units (see Results, chapter Distribution). The find from Český Ráj, locality Prachovské skály by A. Lepšová (pers. comm.) is not included as not all data on it were available.

1. České Švýcarsko (Czech Switzerland) NP in Labské pískovce region

0.6 km SW of Vysoká Lípa (Lípa hotel) near Jetřichovice, Kostelní stezka path: bottom of the gorge, mixed forest on sandstone bedrock: mainly *Picea*, admixture of *Fagus*, *Pinus*, alt. 230 m, *Picea abies*: fallen, decaying trunk covered with mosses (diam. 0.5 m), 21 Sep 2002 leg. J. Holec JH 200/2002 (PRM 902210). – Ditto, *Picea abies*: decaying trunk covered with mosses, 21 Sep 2002 not. J. Holec. – Ditto, *Picea abies*: decaying trunk covered with mosses, 21 Sep 2002 not. J. Holec. – 0.7 km WSW of Vysoká Lípa (Lípa hotel) near Jetřichovice, Kamenice river valley between Kostelní stezka and Šindelový důl, mixed forest on sandstone bedrock: *Picea* + *Fagus*, *Carpinus*, *Fraxinus*, *Corylus*, alt. 190 m, *Picea abies*: fallen, decaying trunk, 21 Sep 2002 leg. J. Holec JH 212/2002 (PRM 902199). – 0.8 km ESE of Vysoká Lípa (Lípa hotel) near Jetřichovice, gorge between Jetřichovická Bělá stream and Intercamp, spruce forest on sandstone bedrock + *Fagus*, *Quercus*, alt. 220 m, *Picea abies*: fallen, decaying trunk, 23 Sep 2002 leg. J. Holec JH 241/2002 (PRM 902217). – 2.2 km WNW of Vysoká Lípa near Jetřichovice, deep gorge between Soorgrund („Kout") gorge and Kamenice river (upper part), yellow-marked tourist path, *Picea* forest + *Fagus*, alt. 190 m, *Picea abies*: fallen, decaying trunk covered with mosses (diam. 30 cm), 23 Sep 2002 leg. J. Holec JH 243/2002 (PRM 902236). – 1.1 km S of Mezní Louka between Hřensko and Jetřichovice, soutěska Kamenice river canyon between Soorgrund gorge and Divoká soutěska, natural forest on sandstone bedrock (*Fagus*, *Carpinus*, *Acer pseudoplatanus*, *Picea*), alt. 165 m, *Picea abies*: fallen, decaying trunk (diam. 30 cm), 24 Sep 2002 leg. J. Holec JH 252/2002 (PRM 902229). – 0.2 km S of Mezná between Hřensko and Jetřichovice, gorge between Mezní můstek and Mezná, S slope, mixed forest on sandstone bedrock (old *Picea*, *Fagus*), alt. 210 m, *Picea abies*: fallen, decaying trunk (diam. 50 cm), 24 Sep 2002 leg. J. Holec JH 262/2002 (PRM 902222). – 1.9-2.4 km NNE of Klepáč hotel in Hřensko, Suchá Bělá stream valley, steep slope with sandstone rocks, mixed forest (*Fagus*, *Picea*), alt. 320 m, *Picea abies*: decaying trunk, 18 Sep 2003 leg. J. Holec JH 92/2003 (PRM). – ca. 1 km N of Mezní Louka near Hřensko, gorge between Gabrielina stezka path and stream from Ponova louka reserve, man-made spruce forest + *Fagus* on sandstone bedrock, alt. 320 m, *Picea abies*: fallen trunk without bark, 19 Sep 2003 leg. et det. W. Jaklitsch (herb. Jaklitsch?). – 2.1-2.3 km N of the church in Růžová near Hřensko, Kamenice river canyon, gorge between sandstone rocks: valley of a small stream flowing into the Kamenice river S of Mezní můstek, grown by *Acer pseudoplatanus*, *Picea*, *Fagus*, alt. 190 m, *Picea abies*: decaying trunk covered with mosses, 21 Sep 2003 leg. J. Holec JH 142/2003 (PRM).

2. Jizerské hory Mts.

Near Hejnice, Holubník mountain, *Picea abies*, 8 Oct 1970; for details see Pouzar (1986: 218).

3. Krkonoše Mts.

ca. 6 km NW of Špindlerův Mlýn, Labská rokle gorge below the Labská bouda cottage, old climax spruce forest with *Sorbus aucuparia*, alt. 1200 m, *Picea abies*: old, fallen, decaying trunk, 30 May 2002 leg. J. Holec JH 23/2002 (PRM 896415). – Ditto, *Picea abies*: old, fallen, decaying trunk, 30 May 2002 not. J. Holec. – Near Dolní Mísečky in Kotelský potok stream valley, nature reserve V bažinkách, natural mixed forest (*Picea*, *Fagus*), alt. 900 m, *Picea abies*: on fallen, decaying trunk covered with mosses, 29 May 2002 leg. J. Holec JH 19/2002 (PRM 896412). – Ditto, 29 May 2002 leg. J. Holec JH 22/2002 (PRM 896414). – 1.1 km W of Dolní Mísečky, nature reserve V bažinkách, upper part, E slope, natural mixed forest (*Picea*, *Fagus*), alt. 1020 m, *Picea abies*: on decaying trunk covered with mosses, 26 Sep 2001 leg. J. Holec JH 439/2001 (PRM). – 1.4 km NW of Dolní Mísečky, Kotelský potok stream valley below Mt. Kotel, E slope, natural mixed forest (*Fagus*, *Picea*), alt. 1050 m, *Picea abies*: on decaying trunk, 26 Sep 2001 leg. J. Holec JH 430/2001 (PRM). – Ditto, *Picea abies*: on decaying trunk, 26 Sep 2001 leg. J. Holec JH 428/2001 (PRM).

4. Český les Mts.

Near Díly in the Domažlice region, between Škarmanka and Tyrolka, alt. 700 m, *Abies alba*: on fallen trunk, 25 Sep 1989 leg. Z. Pouzar (PRM 871543).

5. Plánický hřeben ridge (Plzeň region)

10 km E of Klatovy, 1.5 km ESE of Habartice near Plánice, nature reserve Jelení vrch, natural forest (*Fagus*, *Picea*, *Abies*), alt. 620 m, *Picea abies*: on fallen, decaying trunk, 19 May 2004 leg. J. Holec JH 42/2004 (PRM 902168). – Ditto, *Picea abies*: on fallen, decorticated trunk, 2 Jul 2004 not. J. Holec.

6. Brdy hills

9 km W of Rožmitál pod Třemšínem, 3 km NE of Chynín, nature reserve Chynínské buky, old natural *Fagus* forest, alt. 745 m, *Picea abies*: on fallen trunks, 19 May 2004 leg. J. Holec JH 32/2004 (PRM 902160). – Ditto, *Abies alba*: on fallen, decaying trunk, 19 May 2004 not. J. Holec. – Ditto, *Picea abies*: on decaying trunk, 15 Sep 2004 not. J. Holec. – Near Nové Mitrovice, nature reserve Fajmanovy skály, *Picea abies*: on fallen trunk, 10 Sep 1989 leg. J. Vlasák (PRM 870725). – Near Míšov in Rožmitál pod Třemšínem region, nature reserve Míšovské buky, natural *Fagus* forest, alt. 740 m, *Fagus sylvatica*: on dead standing trunk, 26 Nov 1997 leg. J. Holec (PRM 891608). – Ditto, *Fagus sylvatica*: on dead standing trunk, 13 Nov 1997 leg. Š. Bayerová et D. Stříteská (PRM 891606). – Ditto, *Fagus sylvatica*: on dead standing trunk, 26 Nov 1997 leg. J. Holec (PRM 891609). – Ditto, *Picea abies*: on fallen trunk, 12 Dec 1997 leg. Z. Pouzar (PRM 891604). – Near Pičín, Kuchyňka forest, *Abies alba*, 30 Sep 1980; for details see Pouzar (1986: 218).

7. Střední Povltaví region

7 km NW of Sedlčany, 0.5 km NE of Nalžovské Podhájí, deep valley of a small stream on the left side of Musík stream (right of Vltava river), man-influenced forest (*Picea*, *Pinus*, *Carpinus*) with big *Picea* trees near the stream, alt. 330 m, *Picea abies*: fallen, decaying trunk covered with mosses (diam. 70 cm), 22 Aug 2003 leg. J. Holec JH 34/2003, digifoto (PRM). – Near Stříbrná Skalice, nature reserve Ve Studeném, *Fagus sylvatica*: 17 Oct 1982, *Abies alba*: 13 July 1985; for details see Pouzar (1986: 218).

8. Železné hory hills

Near Bradlo in Chotěboř vicinity, nature reserve Polom, natural forest (*Fagetum*), alt. 575 m, *Abies alba*: on fallen trunk, 17 Oct 1986 leg. Z. Pouzar (PRM 866546).

9. Šumava Mts.

near Železná Ruda, glacier cirque of the Černé jezero lake, *Abies alba*, 27 Aug 1997; for details see Réblová and Prášil (1999), and Holec (1998: 39), finds also in other years (Prášil, pers. comm.). – Near Železná Ruda, glacier cirque of the Čertovo jezero lake, *Picea abies*, 28 Aug 1997; for details see Réblová and Prášil (1999), and Holec (1998: 39), finds also in other years (Prášil, pers. comm.). – 1.7 km S of the church in Železná Ruda, site called Debrník (part of Medvědí jámy zone 1 of Šumava NP), old natural forest (*Fagus*, *Abies*, *Picea*), SW slope, alt. 800 m, *Picea abies*: on decaying fallen trunk, 6 June 2001 not. J. Holec, dia. – Ditto, *Abies alba*: on decaying fallen trunk, 19 June 1997 leg. J. Holec JH 56/1997 (PRM). – Ditto, *Picea abies*: on decaying fallen trunk covered with mosses, 16 Oct 1997 leg. J. Holec et Z. Pouzar JH

826/1997 (PRM 898618). – Ditto, *Picea abies*: on fallen trunk, 16 Oct 1997 leg. J. Holec (PRM 891595). – 2.2 km SSE of the church in Železná Ruda, Grosse Deffernick stream valley, mixed forest (*Fagus*, *Picea*, rarely *Abies*), alt. 780 m, *Abies alba*: on decaying fallen trunk, 6 June 2001 leg. J. Holec JH 46/2001 (PRM). – Ditto, *Abies alba*: on decaying fallen trunk covered with mosses, 16 June 1997 leg. J. Holec JH 19/1997 (PRM). – 3.7 km W of Prášily, near Laka lake, 1 km S of its centre, natural *Picea* forest with mosses and *Calamagrostis villosa*, alt. 1220 m, *Picea abies*: on decaying fallen trunk covered with mosses, 1 Oct 2001 leg. J. Holec JH 555/2001 (PRM). – 2.5-2.8 km W of Prášily, Ždanidla mountain, SW slope, natural mixed forest (*Fagus*, *Picea*, *Acer pseudoplatanus*), alt. 1160 m, *Picea abies*: on decaying fallen trunk covered with mosses, 8 Oct 2000 leg. J. Holec JH 196/2000 (PRM 897864). – 1.5 km SSW of Prášily, Ždanidla mountain, SE slope, valley of a small stream, waterlogged *Picea* forest with *Sphagnum* and *Vaccinium myrtillus*, alt. 950 m, *Picea abies*: on decaying fallen trunk covered with mosses, 16 July 2002 leg. J. Holec JH 56/2002 (PRM 898685). – 1.2 km S of Prášily, Prášilský potok stream valley, man-influenced *Picea* forest, alt. 900 m, *Picea abies*: on decaying fallen trunk covered with mosses, 16 July 2002 leg. J. Holec JH 54/2002 (PRM 898684). – 4.3 km SSE of Prášily, glacier cirque of Prášilské jezero lake, 0.9 km S of its centre, steep ENE slope, natural *Picea* forest, alt. 1200 m, *Picea abies*: on decaying fallen trunk, 2 June 1999 leg. J. Holec JH 13/1999 (PRM 897904). – 4.7 km SSE of Prášily, Stará jímka near Prášilské jezero lake, steep NE slope above the peat bog, waterlogged to climax *Picea* forest, alt. 1120 m, *Picea abies*: on decaying fallen trunk, 10 Oct 2000 leg. J. Holec JH 221/2000 (PRM 897888). – 3.5 km NNE of Srní, protected area Dračí skály, slope S of the rock ridge, WSW slope, seminatural *Abies* forest on stony slope with admixted *Picea* and *Fagus*, alt. 730 m, *Abies alba*: on decaying fallen trunk, 13 May 2004 leg. J. Holec JH 7/2004 (PRM 902095). – Ditto, *Abies alba*: on decaying fallen trunk, 10 Oct 2002 leg. J. Holec JH 460/2002 (PRM 900667). – 0.9 km NE of Srní, protected area Povydří, between Hrádecký potok stream and Čeňkova Pila, NE slope, old, man-made *Picea* forest, alt. 740 m, *Picea abies*: on decaying fallen trunk covered with mosses, 24 Sep 1998 leg. Z. Pouzar JH 724/1998 (PRM 897432). – 0.8 km SE of Srní, Hrádecký potok stream valley (protected area Povydří), SE slope, man-made *Picea* forest with *Betula*, *Pinus*, alt. 820 m, *Picea abies*: on decaying fallen trunk covered with mosses, 25 Sep 1998 leg. J. Holec JH 745 (PRM 897451). – Near Srní, Vydry river valley (protected area Povydří) between Čeňkova Pila and Turnerova chata, S slope, old mixed forest (*Picea abies*, *Abies alba*, *Ulmus glabra*, *Pinus sylvestris*), alt. 780 m, *Picea abies*: on decaying fallen trunk, 28 Oct 2002 leg. J. Holec JH 532/2002 (PRM 900965). – Valy hill near the village of Popelná, NW slope below Obří hrad, alt. 850 m, *Fagus* forest with admixed *Abies*, *Abies alba*: on thick fallen trunk without bark, 30 Apr 2005 leg. M. Tůmová (PRC). – 3.7 km S of Šumavské Hoštice, protected area Čertova stráň, stream valley in NW part, seminatural *Fagus* forest with *Picea* and *Abies*, SE slope, alt. 770 m, *Picea abies*: on decaying fallen trunk, 27 Oct 2003 leg. J. Holec JH 214/2003 (PRM). – 3.4 km NEN of Zátoň, nature reserve Boubínský prales, at S margin of the central part, virgin forest (*Fagus*, *Picea*, *Abies*), alt. 1000 m, *Picea abies*: on decaying fallen trunk covered with mosses, 28 Aug 2003 not. J. Holec, dia. – Ca. 1.8 km WSW of the top of Mt. Boubín, nature reserve Boubínský prales, between Bazumská and Lukenská cesta forest roads, mountain virgin forest (*Fagus*, *Picea*, *Abies*), ENE slope, alt. 1150 m, *Abies alba*: on decaying fallen trunk, 5 Aug 1997 leg. J. Holec JH 169/1997 (PRM 898206). – ca. 3.5-4.5 km NNE of Zátoň, nature reserve Boubínský prales, near Kaplický potok stream, virgin forest (*Fagus*, *Picea*, *Abies*), ENE slope, alt. 1000 m, *Abies alba*: on decaying fallen trunk, 12 July 2001 leg. P. Balda, not. J. Holec, dia. – Near Zátoň, nature reserve Boubínský prales, virgin forest (*Fagus*, *Picea*, *Abies*), alt. 950 m, *Picea abies*: on fallen trunk, 22 Oct 1988 leg. J. Vlasák (PRM 868652). – Ditto, alt. 950 m, *Picea abies*: on fallen trunk, 22 Oct 1988 leg. J. Vlasák (PRM 868652). – 4.7 km WNW of Strážný, protected area Častá, between Častá stream and Žďárecká hora mountain, natural spruce forest around a peat bog, alt. 910 m, *Picea abies*: on decaying fallen trunk covered with mosses, 8 June 2001 leg. J. Holec JH 58/2001 (PRM). – 2 km W of Strážný, protected area Lískový vrch, natural mixed forest (*Picea*, *Fagus*, *Abies*, *Acer pseudoplatanus*), alt. 970 m, *Picea abies*: on decaying fallen trunk covered with mosses, 4 Sep 1999 leg. J. Holec JH 158/1999 (PRM 897988). – 1.7 km NNW of Strážný, protected area below Kunžvart castle on slopes of Strážný mountain, E slope, mixed forest (*Picea*, *Fagus*, *Abies*) on steep, stony slope, alt. 960 m, *Picea abies*: on decaying fallen trunk, 28 Aug 2001 leg. J. Holec JH 188/2001 (PRM). – 2 km SSE of Lenora, protected area Radvanovický hřbet, E slope of the northern top, natural mixed forest (*Fagus, Picea, Abies*), alt. 810 m, *Abies alba*: on decaying fallen trunk, 11 July 2001 leg. J. Holec JH 103/2001 (PRM). – 2.8-3 km NE of České Žleby, protected area Radvanovický hřbet, ENE slope of the southern top, natural forest composed of *Picea* and admixted *Fagus, Abies, Ulmus, Acer pseudoplatanus*, alt. 880 m, *Picea abies*: on fallen trunk, 18 Oct 1997 leg. Z. Pouzar (PRM 891593). – Ditto, alt. 900 m, *Picea abies*: on decaying fallen trunk covered with mosses, 14 July 1998 leg. J. Holec JH 275/1998 (PRM 897041). – 0.5 km SW of České Žleby, Žlebský kopec hill (protected area), E slope, natural ravine forest (*Acer pseudoplatanus, Fagus, Picea, Sorbus, Abies, Fraxinus*), alt. 990 m, *Picea abies*: on decaying fallen trunk, 3 Sep 1999 leg. J. Holec JH 145/1999 (PRM 897973). – 0.6 km SW of České Žleby, Žlebský kopec hill (protected area), E slope, natural mixed forest (*Picea, Fagus, Abies*), alt. 1040 m, *Picea abies*: on decaying fallen trunk, 6 Oct 2004 not. J. Holec, dia. – Ditto, *Picea abies*: on decaying fallen trunk covered with mosses, 13 Sep 1999 leg. J. Holec JH 176/1999, dia (PRM 897996). – 1.3 km E of the centre of České Žleby, Spáleniště hill (protected area), NNE slope, natural mixed forest (*Fagus, Picea, Abies, Ulmus glabra, Acer pseudoplatanus*), alt. 930 m, *Fagus sylvatica*: on decaying fallen trunk covered with mosses, 3 Aug 1998 leg. J. Holec JH 345/1998 (PRM 897097). – Near České Žleby in the vicinity of Volary, Spáleniště hill, old natural forest (*Fagus, Picea, Abies*), alt. 920 m, *Picea abies*: on fallen trunk, 15 Oct 1997 leg. Z. Pouzar (PRM 891597). – 2.6 km SW of Stožec, protected area Spálený luh, at N margin, moist *Picea* forest, alt. 800 m, *Picea abies*: on decaying fallen trunk, 28 Sep 2000 leg. J. Holec JH 154/2000 (PRM 897826). – 2.9 km NNE of Stožec, protected area Medvědice, on slopes of Stožec mountain, NE slope, natural mixed forest (*Fagus, Picea, Abies*), alt. 870 m, *Abies alba*: on decaying fallen trunk, 15 Oct 1996 leg. Z. Pouzar JH 738/1996, dia (PRM). – Near Nová Pec, Plechý mountain (protected area Trojmezná), 1.2 km NEN of the top, ENE slope, natural mixed forest (*Picea, Fagus, Abies*), alt. 1060 m, *Abies alba*: on fallen, decaying trunk, 20 May 2005 leg. J. Holec JH 27/2005 (PRM). – Near Nová Pec, Smrčina mountain (protected area), 1-1.2 km N of the top, N slope, valley of a small stream, climax *Picea* forest, alt. 1230 m, *Picea abies*: on strongly decayed fallen trunk, 4 June 1998 leg. J. Holec JH 42/1998 (PRM 892348).

10. Novohradské hory Mts.

Nature reserve Žofínský prales, virgin forest (*Fagus, Picea, Abies*), *Picea abies*, 18 Oct 1967 leg. Z. Pouzar (PRM 646760). – Ditto, alt. 780 m, *Abies alba*: on fallen trunk, 9 Oct 1968 leg. Z. Pouzar (PRM 661453). – Ditto, alt. 780 m, *Picea abies*: on fallen trunk, 9 Oct 1968 leg. Z. Pouzar et J. Kubička (PRM 661454). – Ditto, spruce stand on waterlogged soil, *Picea abies*: on fallen trunk, 18 Oct 1967 leg. Z. Pouzar (PRM 647008). – Ditto, flat site, alt. 790 m, *Picea abies*: on old, fallen, decaying trunk, 12 June 2004 leg. A. Lepšová (CB). – Ditto, NW slope, alt. 750 m, *Picea abies*: on fallen, decaying trunk, 3 May 2005 leg. M. Beran (CB). – Nature reserve Hojná Voda, between natural mixed forest (*Fagus, Picea, Abies*) and man-made spruce forest, E slope, alt. 840 m, *Picea abies*: on several fallen trunks without bark, 29 May 2004 leg. M. Beran (CB).

11. Českomoravská vrchovina highland

ca. 4 km E of Libořezy near Stráž nad Nežárkou, nature reserve Fabián: old natural *Fagus* forest with many fallen trees, alt. 600 m, *Picea abies*: on fallen, decaying trunk, 18 Oct 2003 leg. J. Holec JH 202/2003 (PRM). – 8 km NWN of Telč, 2 km NWN of the village of Doupě, nature reserve Roštejnská obora, alt. 650 m, on fallen trunk of *Picea abies*, 2 June 2005 leg. P. Vampola (PRM).

12. Moravian Karst

ca. 5.5 km E of Blansko, nature reserve Vývěry Punkvy, Pustý žleb valley, E slope N of Skalní mlýn site, alt. 350 m, beech forest with admixted *Abies* and *Picea*, on fallen, decaying trunk of *Abies alba*, 5 May 2005 leg. D. Dvořák (herb. Dvořák + BRNM). – ditto, above left bank of Punkva stream ca. 100 m below Punkevní jeskyně caves, alt. 370 m, 49.22.12.7 N, 16.43.26.9 E (WGS-84), *Picea* forest on scree slope, on fallen trunk of *Picea abies* covered with mossses, 5 May 2005 leg. D. Dvořák (herb. Dvořák). – ditto, Suchý žleb valley, ca. 0.2 km E of Kateřinská jeskyně cave, at bottom of the valley, alt. 340 m, 49.21.37.8 N 16.42.43.8 E (WGS-84), mixed forest, on fallen, strongly decayed trunk of *Abies alba*, 8 June 2005 leg. D. Dvořák (herb. Dvořák).

13. Moravskoslezské Beskydy Mts.

3 km NE of Nýdek, nature reserve Čantorija, alt. 850 m, *Abies alba*: on fallen trunk, 2 Oct 1999 leg. M. Tomšovský (PRM 893043). – 3.5 km WSW of Dolní Lomná near Jablunkov, nature reserve Mionší, virgin forest (*Fagus, Picea, Abies*), alt. 750 m, *Abies alba*: on decaying trunk, 20 Oct 1998 leg. J. Holec JH 1062/1998 (PRM). – Ca. 8 km ESE of Horní Bečva, nature reserve Salajka, virgin forest (*Fagus, Abies*), alt. 760 m, *Abies alba*: on decaying trunk, 4 Oct 1999 leg. J. Holec JH 379/1999 (PRM). – Ca. 3 km SE of Ostravice near Frýdlant n. Ostravicí, nature reserve Mazácký Grůnik, natural forest (*Fagus, Picea, Abies*), alt. 700 m, *Abies alba*: on decaying trunk, 6 Oct 1999 leg. J. Holec JH 426/1999 (PRM). – Near Morávka in Frýdek region, Mt. Travný, virgin forest, *Abies alba*: on fallen trunk, 17 Sep 1987 leg. Z. Pouzar (PRM 866551).

14. Javorníky Mts.

7 km of centre of Velké Karlovice, nature reserve Razula, virgin forest (*Fagus, Abies*), alt. 750 m, *Abies alba*: on decaying trunk, 12 Sep 2001 leg. F. Jaskula JH 326/2001 (PRM).

Two distribution patterns of *Camarops tubulina* in the Czech Republic can be recognised: 1. relatively frequent occurrence in several geographical areas (which also represent distinct geomorphological and phytogeographical units). 2. isolated records from several other regions of the CR. These two patterns are described below (see also Fig. 1).

1. The areas with richer occurrence of *Camarops tubulina* are (in descending order according to the number of localities): 30: Šumava Mts. (National Park: NP), 9: České Švýcarsko National Park, 5: Moravskoslezské Beskydy Mts. (Protected Landscape Area: PLA), 4: Krkonoše Mts. (National Park), 4: Brdy hills. A common feature of these regions is their relatively high percentage of natural forest ecosystems (mostly protected in nature reserves), which is also clear from the fact that most of the regions are protected as a whole (NP or PLA). The regions mentioned above represent the most important refugees of *C. tubulina* not only in the CR, but in the whole of Central Europe. Most of them are mountainous areas, however, České Švýcarsko and Moravian Karst represent areas with a low altitude, where *C. tubulina* grows in stream canyons and gorges (cold sites typical of climatic inversion).

2. The isolated records are from nature reserves protecting small remnants of natural forests with a high amount of fallen, decaying trunks. The distribution of such habitats in the Czech Republic is irregular. In my opinion, based on rich field experience, such finds are to be expected in almost all „better“ forest re-

Fig. 2. Distribution of *Camarops tubulina* in Europe.

serves of the submontane and montane belt. However, the forest must be continuous (without clearings in the stand or around it) and rich in fallen trunks of conifers in appropriate stage of decay.

According to a personal communication by A. Lepšová, *C. tubulina* also occurs in sandstone gorges of the Český ráj Protected Landscape Area (Český ráj –

Prachovské skály, Fortna, on dry fallen trunk of *Picea abies*) where its occurrence has a similar character as in the České Švýcarsko National Park (see above).

In my opinion, other areas where *C. tubulina* could (and should!) be found are some nature reserves in the Českomoravská vrchovina highland and the Hrubý Jeseník Mts.

Discussion: In Europe, some localities were published by e.g. Nannfeldt (1972) and Hilber and Hilber (1980). At present, *Camarops tubulina* is known from the following European countries (Fig. 2):

Denmark, Sweden: up to the boreal zone and as a rare species (Hansen and Knudsen 2000).

Norway: one find from southeastern Norway collected in 1997, on a trunk of *Picea*, det. A. Granmo, material probably in Tromsø herbarium (personal communication by A. Granmo).

Switzerland: Nannfeldt (1972: 370).

Germany: e.g. Albertini et Schweinitz (1805: p. 6, tab. 4, fig. 4, as *Sphaeria tubulina* – original description, from the vicinity of Niesky near Görlitz, Saxony, Upper Lusatia = Oberlausitz), Hilber and Hilber (1980: Bayerischer Wald, near Zwiesel), Krieglsteiner (1991).

Poland: e.g. collections by Schröter (1908: 465, Lower Silesia, for comments on this find see Svrček 1969: 118), Z. Pouzar (Starożyn Reserve, *Picea abies*, leg. Z. Pouzar. – Hruskie near Augustów, in the forest with *Alnus glutinosa* and *Picea abies*, on dead trunk of *Picea abies*, 9 Sep 1974, leg. Z. Pouzar, PRM 815140), and A. Chlebicki (Białowieża National Park, personal communication).

Slovakia: Svrček (1969), Pouzar (1986), Kotlaba et al. (1995), Škubla (2003).

Austria: W. Jaklitsch, personal cummunication: rare in Austria, but at least 3 finds by W. Jaklitsch from Niederösterreich, Ybbstaler Alpen, region Scheibbs, near Gaming, Rotwald: Kleiner Urwald, Großer Urwald, years 1997, 1999, herb Jaklitsch.

Ukraine: Pilát (1940): Eastern Carpathians, for interpretation of his localities see Holec (2002); my collection from the same area: NE of Kvasy near Rachiv, Menchul mountain, natural mixed forest composed of *Fagus* and *Abies*, alt. 650 m, *Abies alba*: on decaying trunk, 15 July 1999 leg. J. Holec JH 96/1999 (PRM 892904).

In all these countries the species is considered to be very rare. I agree that it is not a common species, but the relatively constant presence of this species at appropriate localities in the Czech Republic suggests that it should be more frequent, at least in the neighbouring countries. I think that it is overlooked or not recognised as its stromata resemble small black knobs produced on wood surface by *Fomitopsis pinicola*. This opinion is supported by the fact that the mapping in Sweden (Ek et al. 2003) showed a considerable number of localities in southern part of the country. *Camarops tubulina* occurs there in coniferous forests.

Based on currently available data from Europe, *Camarops tubulina* can be considered a species occurring in Central Europe and the southern part of Northern Europe. It would be interesting to know if it is present in the Mediterranean or Atlantic region. It is also known from e.g. North America (Miller 1961).

SUBSTRATE SPECTRUM

Tab. 1. Substrate spectrum.

	Picea abies	*Abies alba*	*Fagus sylvatica*
finds	65	26	3
%	69	28	3

Picea abies clearly prevails as a substrate. Records from broadleaved trees are rare and restricted to *Fagus*. Almost all records originate from fallen trunks. In one case (Míšovské buky nature reserve), *C. tubulina* was found on a dead, standing stump (about 10 m high fragment of a dead trunk). The fallen trunks are mostly very old and thick ones, having a diameter of about 0.5-1(-1.5) m. Concerning the stage of decay, most records are from moderately to strongly decayed trunks having soft wood and being covered with carpets of mosses. Stromata mostly occur on lateral or undersides of the trunks, however, their occurrence on the upper side was also observed. They are arranged in rows following fissures in wood (which may be caused by pressure of stromata protruding from the wood). In some trunks the rows with stromata are up to 5 m long, however, the stromata occur irregularly and with variously long gaps between them. Stromata were observed both on trunks with bark and on the decorticated ones. The wood decay caused by *C. tubulina* is very intensive. In trunks observed 3-5 years, the wood around and below the stromata changed from relatively hard to very soft and strongly decayed. At the same time the fungus ends its life, the stromata become sterile and decay together with the wood. In such case, the mycelium dislocates its active life to less decayed parts of the same trunk or the fungus spreads via ascospores to surrounding trunks or localities.

Discussion: The same substrate spectrum (*Picea*, *Abies*, *Fagus*) is given from Sweden and Denmark (Hansen et Knudsen 2000).

HABITATS AND ALTITUDINAL DISTRIBUTION

Tab. 2. Altitudinal distribution.

altitude (m a.s.l.)	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800-899	900-999	1000-1099	1100-1199	1200-1299
localities	4	3	7	0	2	3	13	9	10	8	3	4

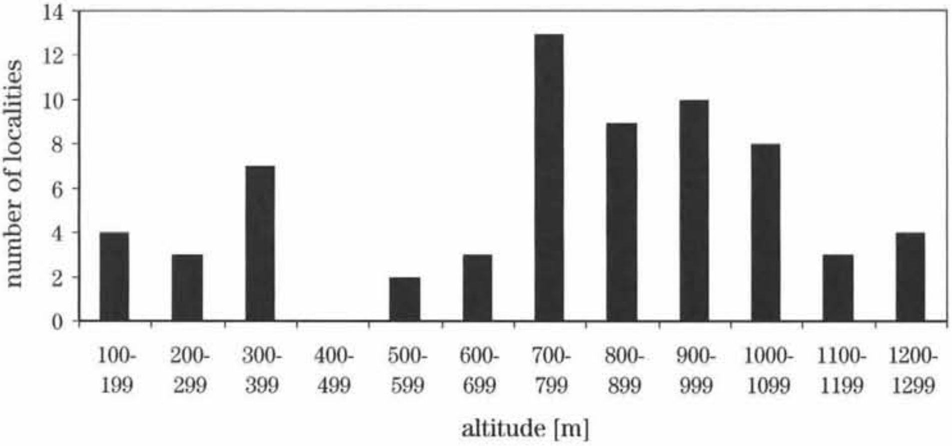


Fig. 3. Altitudinal distribution of *Camarops tubulina* in the Czech Republic.

Lowest find: Kamenice river canyon near Hřensko, alt. 165 m.
Highest find: Smrčina mountain near Nová Pec in the Šumava Mts., alt. 1230 m.

In the Czech Republic, *C. tubulina* is distributed from the lowest parts of the country up to the mountains. Surprisingly, the species has two distribution „centres“ along the altitude gradient (Fig. 3). One of them is represented by records from the planar belt and lower parts of the colline belt (lowlands and hills), ranging from 165 (Kamenice river canyon near Hřensko) to 370 m (in Moravian Karst). All these finds are from deeper stream valleys or gorges where *C. tubulina* occurs on slopes or on the bottom of valleys (České Švýcarsko National Park, Střední Povltaví region, Moravian Karst). A common feature of these habitats is climatic inversion causing cold, humid, and rather stable microclimate. Such habitat conditions enable a more or less natural occurrence of *Picea*, *Abies* or *Fagus* and a continuous decay of fallen trunks.

A second centre in altitudinal distribution is the altitude from 700 to 1230 m a.s.l., which covers upper parts of the submontane belt (up to 800 m a.s.l.), the whole montane belt (800-1100 m a.s.l.) and lower parts of the supramontane belt. *Camarops tubulina* occurs there in herb-rich beech forests with admixture of *Abies* and *Picea* (submontane belt), rarely having a slight ravine character (steep slopes with stones or rocks) and especially in mixed mountainous forests composed of *Fagus*, *Picea* and *Abies*. The species is less frequent in spruce forests of the supramontane belt, but is well documented from several natural *Calamagrostis* or *Athyrium* spruce forests and bog spruce forests surrounding peat bogs.

NATURALNESS OF VEGETATION

Almost all finds of *Camarops tubulina* in the CR are from nature reserves, where the forest vegetation is much more natural than in man-made forest cultures covering most areas of the CR. Three degrees of naturalness can be recognised in these reserves:

1. Virgin forests (in the European sense, as true virgin forest untouched by man are no more present in Europe). Old forests with original tree species composition, heterogeneous age structure of trees, never cut, fallen trunks not removed, almost untouched by man, surrounded by forests with natural tree species composition.
2. Minimally influenced natural forests. Forests with original tree species composition, heterogeneous age structure of trees, influenced by partial cutting in the past or selective cutting at present, most fallen trunks not removed, surrounded by forest cultures with unnatural tree species composition (mostly *Picea* stands).
3. Moderately influenced natural forests. Forests having an original tree species composition but homogeneous age structure. Influenced by cutting and removing of some fallen trunks, surrounded by forest cultures.

Camarops tubulina is most frequently found in virgin forests (examples: Boubínský prales, Žofínský prales), where it regularly occurs on many old, fallen trunks. Such localities are very rare in the CR but represent the most important refugees for *C. tubulina*. Most localities of this species are in minimally influenced natural forests. *C. tubulina* is not frequent at such localities. It usually occurs there on one or two fallen trunks. This is probably caused by the lower amount of dead wood in appropriate stages of decay, smaller pool of spores necessary for successful spreading and smaller continuity of vegetation (interrupted by cutting or other types of forestry management) which is connected with instability of microclimatic conditions.

In about 5 cases (from 94 finds) the species was found on old, thick, fallen trunk of *Picea* (diameter about 0.5 m) lying in man-made forest. At all these localities the fallen trunks clearly represented the last remnants of more natural forests which were present there in the past but were cut and replaced by man-made stands. In addition, such records were always from small stream valleys (both deep and shallow) where the microclimate was more humid and colder than in the vicinity.

This analysis can be concluded with the statement that *Camarops tubulina* is a species clearly preferring natural forests (or their remnants represented by old fallen trunks) with a high amount of dead wood (especially fallen trunks). Therefore, it can be considered a bioindicator of natural or even virgin forest stands.

Discussion: Christensen et al. (2004) consider *Camarops tubulina* an indicator of high habitat quality of European beech forests growing there on „large logs of beech and fir, where the species often occur in abundance, sometimes forcefully protruding through the outermost layers of wood". The species is included in

Fig. 4. Krkonoše Mts., nature reserve V bažinkách, 29 May 2002. A typical habitat of *Camarops tubulina* – natural mixed mountainous forest (*Picea*, *Fagus*). The fungus was found on the second fallen trunk (*Picea abies*: PRM 896414, for details see collections studied).

Fig. 5. České Švýcarsko National Park, Kamenice river canyon between Soorgrund gorge and Divoká soutěska, 24 Sep 2002. An example of occurrence in the lowlands (alt. 165 m), but in a canyon with an inverse climate (on fallen trunk of *Picea abies* in the foreground, PRM 902229, for details see collections studied).

Fig. 6. Šumava Mts., Grosse Deffernick stream valley, 6 June 2001. A typical substrate of *Camarops tubulina* – a thick fallen trunk of conifer (*Abies alba* in this case) in later stage of decay, covered with mosses (the same trunk on which the specimen JH 19/1997 kept in PRM was collected). All photographs by J. Holec.

Fig. 7. *Camarops tubulina*. Moravskoslezské Beskydy Mts., nature reserve Mionší, 13 Sep 2001. A typical feature of younger stromata is a pale reddish-brown colour of their marginal part (a shot from the same trunk on which the specimen JH 1062/1998 kept in PRM was collected).

Fig. 8. *Camarops tubulina*. For explanations see Fig. 6. A detailed view of fully mature stromata which are characteristic for their „dotted" surface (from ostiolae of the perithecia) and thin film of water (a manifestation of the mature state of perithecia). All photographs by J. Holec.

red lists of 6 European countries: Sweden (Larsson 1997), Denmark (Stoltze and Pihl 1998), Germany (Benkert 1992), Poland (Wojewoda and Ławrynowicz 2004), Czech Republic (Kotlaba 1995: Red Book) and Slovakia (Lizoň 2001), mostly as an endangered or vulnerable species. This shows that *C. tubulina* represents a remarkable and rare species of European fungi which is of high value for nature conservation.

CONCLUSIONS

Until the last decade of the 20th century, *Camarops tubulina* was considered a rare and critically endangered species (see Introduction) in the Czech Republic. However, the numerous recent finds from the period 1996-2005 (94 finds from 66 localities) show that the species is well established in virgin, natural and near-natural forest stands, in almost all cases protected as nature reserves. The habitats are herb-rich beech forests with admixture of *Abies* and *Picea* (submontane belt), and especially mixed mountainous forests composed of *Fagus*, *Picea* and *Abies*. The species is less frequent in spruce forests of the supramontane belt, but is well documented from several natural *Calamagrostis* or *Athyrium* spruce forests and bog spruce forests surrounding peat bogs. Furthermore, the species also occurs in stream valleys, small canyons and gorges characteristic of climatic inversion causing humid, cold, and rather stable microclimate. Such habitat conditions enable a more or less natural occurrence of *Picea*, *Abies* or *Fagus* and a continuous decay of fallen trunks. In the stream valleys the species was also rarely found on old thick fallen trunk of *Picea* lying in man-made forests.

The conditions necessary for the occurrence of *Camarops tubulina* are:

1. more or less natural forest stands with presence of fallen, decaying trunks of *Picea*, *Abies* or *Fagus* (especially old, thick trunks) or a presence of such trunks in man-made forests (a rare but possible case),

2. stable, humid and cool microclimate of the locality (either in places with climatic inversion such as stream valleys or at localities at higher altitudes – optimally 700-1100 m a.s.l.). The stable microclimate is best ensured by a closed forest stand (no cutting at the locality, no clearings or deforested areas around it).

The relatively frequent occurrence of *C. tubulina* in the Czech Republic (66 localities) and the concentration of finds in some areas (mostly National Parks or Protected Landscape Areas) means, that the Czech Republic represents (at the present state of knowledge) the richest area of its occurrence in Europe. However, I think that the situation in neighbouring countries could be similar and the species must have been overlooked or not recognised there. From the point of view of nature conservation, *Camarops tubulina* is an important bioindicator of natural forest ecosystems.

ACKNOWLEDGEMENTS

I thank Miroslav Beran (České Budějovice), Milena Tůmová (Prague), Petr Vampola (Jihlava), Anna Lepšová (České Budějovice), Daniel Dvořák (Brno), Walter Jaklitsch (Austria), Andrzej Chlebicki (Poland) and Alfred Granmo (Norway) for providing their data on finds of *Camarops tubulina*. The work was financially supported by the Grant Agency of the CR (project no. GA 206/04/0356) and the Ministry of Culture of the CR (projects no. MK0CEZ99F0201, MK00002327201).

REFERENCES

Antonín V. and Bieberová Z. (1995): Chráněné houby ČR (Fungi protected by law in the Czech Republic). – 88 p. Praha (in Czech).

Benkert D. et al. (1992): Rote Liste der gefährdeten Großpilze in Deutschland. – 132 p. Eching.

Beran M. and Tondl F. (1997): Chráněné houby v jižních Čechách (Fungi protected by law in Southern Bohemia). – 32 p. České Budějovice.

Christensen M., Heilmann-Clausen J., Walleyn R. and Adamčík S. (2004). Wood inhabiting fungi as indicators of natural value in European beech forest. EFI-proceedings. http://www.flec.kvl.dk/indicators/.

Chytrý M., Kučera T. and Kočí M., eds. (2001): Katalog biotopů České republiky (Habitat catalogue of the Czech Republic). – 307 p. Praha (in Czech with English summary).

Ek T., Hagström M. and Wadstein M. (2003): Visst finns det barrskogar med hög biologist mångfald i södra Sverige! (Old-growth coniferous forests with high biodiversity are present also in south Sweden). – Svensk Bot. Tidskr. 97: 135-149 (in Swedish with English summary).

Hansen L. and Knudsen H., eds. (2000): Nordic Macromycetes. Vol. 1. Ascomycetes. – 309 p. Copenhagen.

Hilber R. and Hilber O. (1980): Notizen zur Gattung *Camarops* (*Boliniaceae*). – Čes. Mykol. 34: 123-151.

Holec J. (1998): Houby Šumavy chráněné zákonem nebo zahrnuté v Červené knize: shrnutí literárních údajů a současný stav výskytu (Šumava´s fungi protected by law or included in Red Book: a review of literature and current distribution). – Silva Gabreta 2: 35-52 (in Czech with English summary).

Holec J. (1999): Houby Šumavy chráněné zákonem nebo zahrnuté v Červené knize: nálezy v roce 1998 (Bohemian Forest fungi protected by law or included in Red Book: finds in the year 1998). – Silva Gabreta 3: 17-24 (in Czech with English summary).

Holec J. (2000): Chráněné houby (Protected fungi in the Czech Republic). – Ochrana Přírody 55(6): 163-167 (in Czech with English summary).

Holec J. (2002): Fungi of the Eastern Carpathians (Ukraine) – important works by Albert Pilát, and locations of his collecting sites. – Mycotaxon 83: 1-17.

Kotlaba F. et al. (1995): Červená kniha ohrozených a vzácnych druhov rastlín a živočíchov SR a ČR. Vol. 4. (Red book of threatened and rare species of the Slovak and Czech Republics). – 221 p. Bratislava (in Slovak with English summary).

Krieglsteiner G. J. (1991): Verbreitungsatlas der Großpilze Deutschlands (West). Band 2: Schlauchpilze. – 596 p. Stuttgart.

Larsson K.-H., ed. (1997): Rödlistade svampar i Sverige – artfakta (Swedish Red Data Book of Fungi 1997). – 547 p. Internet version: Official Swedish Red Lists, http://www.artdata.slu.se/redlist.htm

Lizoň P. (2001): Červený zoznam húb Slovenska. 3. verzia (december 2001). [Red list of Slovak fungi. 3rd version (December 2001)] – In: Baláž D., Marhold K. and Urban P. (eds.), Červený zoznam rastlín a živočíchov Slovenska, Ochr. Prír. 20., suppl., p. 6-13.

Miller J. H. (1961): A monograph of the world species of *Hypoxylon*. – Athens.

NANNFELDT J. A. (1972): *Camarops* Karst. (*Sphaeriales-Boliniaceae*). With special regard to its European species. – Svensk Bot. Tidskr. 66: 335-376.

PILÁT A. (1940): Hymenomycetes Carpatorum orientalium. – Sborn. Nár. Mus. v Praze, Řada B, Přír. Vědy (Acta Musei Nationalis Pragae, Ser. B), vol. 2, no. 3: 37-80.

POUZAR Z. (1986): *Camarops* subgen. *Bolinia* in Czechoslovakia. – Čes. Mykol. 40: 218-222.

RÉBLOVÁ M. and PRÁŠIL K. (1999): Příspěvek k poznání askomycetů a deuteromycetů v karech šumavských jezer – vstupní studie pro monitoring (Contribution to the knowledge of Ascomycetes and Deuteromycetes in the glacial cirques of the Šumava Mts. lakes). – Příroda 14: 7-31 (in Czech with English summary).

SCHRÖTER J. (1908): Die Pilze Schlesiens. – In: Cohn J., Kryptogamen-Flora von Schlesien, vol. 3, Heft 5, Breslau.

SCHWEINITZ L. D. and ALBERTINI J. B. (1805): Conspectus fungorum in Lusatiae superioris agro niskiensi crescentium e methodo Persooniana. – 376 p. Leipzig.

SKALICKÝ V. (1988): Regionálně fytogeografické členění (Regional phytogeographical division). – In: Hejný S. and Slavík B. (eds.), Květena České socialistické republiky, vol. 1 (Flora of the Czech Socialist Republic, vol. 1), p. 103-121 + map, Praha (in Czech with English summary).

STOLTZE M. and PIHL S. (1998): Rødliste 1997 over Planter og Dyr i Danmark. Miljø– og Energiministeriet. – 219 p. Copenhagen. http://130.225.211.158/mycosoc/Reddata/search.htm

SVRČEK M. (1969): *Bolinia tubulina* (Alb. et Schw. ex Fr.) Sacc. v Československu [*Bolinia tubulina* (Alb. et Schw. ex Fr.) Sacc. in der Tschechoslowakei]. – Čes. Mykol. 23: 118-122 (in Czech with German abstract).

ŠKUBLA P. (2003): Mycoflora Slovaca. – 1103 p. Šaľa.

TOMŠOVSKÝ M. (2000): Nález dvou vzácných askomycetů ze Slezských Beskyd (Records of two rare ascomycetes from the Slezské Beskydy mountains). – Mykol. Listy no. 74: 15-17.

WOJEWODA W. and Ławrynowicz M. (2004). Red list of threatened macrofungi in Poland (3 ed.) [Czerwona lista grzybów wielkoowocnikowych zagrożonych w Polsce (wyd. 3)]. – In: Zarzycki K. and Mirek Z. (eds), List of slime moulds, algae, macrofungi, mosses, liverworts and plants threatened in Poland, W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

CZECH MYCOL. 57(1–2): 117–138, 2005

Some species of the genus *Diatrype* from the Czech Republic preserved in PRM, BRNM and KRAM

ANDRZEJ CHLEBICKI

Polish Academy of Sciences, W. Szafer Institute of Botany, Lubicz 46, PL-31 512 Kraków, Poland
chlebick@ib-pan.krakow.pl

Chlebicki A. (2005): Some species of the genus *Diatrype* from the Czech Republic preserved in PRM, BRNM and KRAM. – Czech Mycol. 57: 117–138.

This paper is a preliminary note on fungi from the genus *Diatrype* collected in the Czech Republic: *Diatrype bullata*, *D. disciformis*, *D. decorticata*, *D. flavovirens*, *D. stigma*, *D. subaffixa* var. *rappazii* and *D. undulata*. Two species, *D. undulata* and *D. subaffixa*, have so far not been reported from the Czech Republic. The most interesting appeared to be a collection of *Diatrype* from *Loranthus europaeus* temporarily included in *Diatrype disciformis*.

Key words: *Diatrype*, distribution, taxonomy, Bohemia, Moravia.

Chlebicki A. (2005): Houby rodu *Diatrype* v České republice z herbářů PRM, BRNM a KRAM. – Czech Mycol. 57: 117–138.

Příspěvek pojednává o druzích *Diatrype bullata*, *D. decorticata*, *D. disciformis*, *D. flavovirens*, *D. stigma*, *D. subaffixa* var. *rappazii*, *D. undulata* nalezených v České republice. Pro srovnání byl též studován materiál některých druhů z jiných substrátů a z Polska a jiných zemí. Dva druhy, *D. undulata* a *D. subaffixa* nebyly z České republiky dosud udávány. Zajímavý sběr *Diatrype* na větvičkách *Loranthus europaeus* je dočasně zahrnutý pod *Diatrype disciformis*.

INTRODUCTION

Fungi of the genus *Diatrype* inhabit mostly senescent branches and twigs of trees and shrubs. Species such as *Diatrype disciformis*, *Diatrype bullata* and *Diatrype flavovirens* are very common and easy for identification. Fungi earlier referable to *Diatrype stigma* are difficult to separate. Rappaz (1987) split *Diatrype stigma* into several species, such as *Diatrype decorticata*, *Diatrype undulata* and *Diatrype stigma* sensu stricto. Chlebicki (1995) distinguished another taxon from this group, *Diatrype subaffixa* var. *rappazii*, differing from the others species by strongly undulating stromata and distinctly larger ascospores.

Fungi from the genus *Diatrype* were for the first time reported from the Czech Republic by Opiz (1823, 1852, 1855), Peyl (1857a, 1857b, 1858), Veselsky (1856, 1859) and Niessl (1865). Veselsky (1859) and Niessl (1865) noted *Sphaeria undulata* (*Diatrype undulata*) on *Corylus avellana*. However, the specialised fungus *Diatrype undulata* occurs only on *Betula* spp. (Rappaz 1987a). It is not clear which species Veselsky and Niessl collected, possibly it was *D. decorticata*. Veselsky (1859) found fungus *Sphaeria stigma* Hoffm. b. *decorticata* DC., which at present is classified as *Diatrype decorticata*. Further localities of some species of this genus were reported by Petrak (1920, 1923, 1927, 1940), Svrček (1959, 1990, 2001), Svrček and Kubička (1964, 1971), Podlahová (1973), Prášil and Réblová (1998), Réblová and Prášil (1999). The majority of data referred to as *Diatrype stigma* are mostly incorrect. *Diatrype disciformis*, *D. flavovirens* and *D. stigma* have been cultured (Prášil et al. 1973) and then screened for antibiotic activity (Prášil and Šašek 1977), but no activity has been found in these species.

I followed Rappaz (1987b) in the use of terms of stromata morphology. Especially meaning of such terms as ectostroma and entostroma should be explained. Ectostroma is an upper, homogenous part of stroma which can produce conidiomata and conidia. Sometimes such conidial stromata can be visible together with adult teleomorph stromata (see Chlebicki and Krzyżanowska 1995, Fig. 7). Entostroma can produce perithecia and ascospores. It is heterogenous part of stroma, lying below the ectostroma and is composed of two layers (Prášil 1984). The upper layer is homogenous, composed of mycelium, but the lower one is heterogenous, composed of mycelium and host plant tissue (Fig. 1).

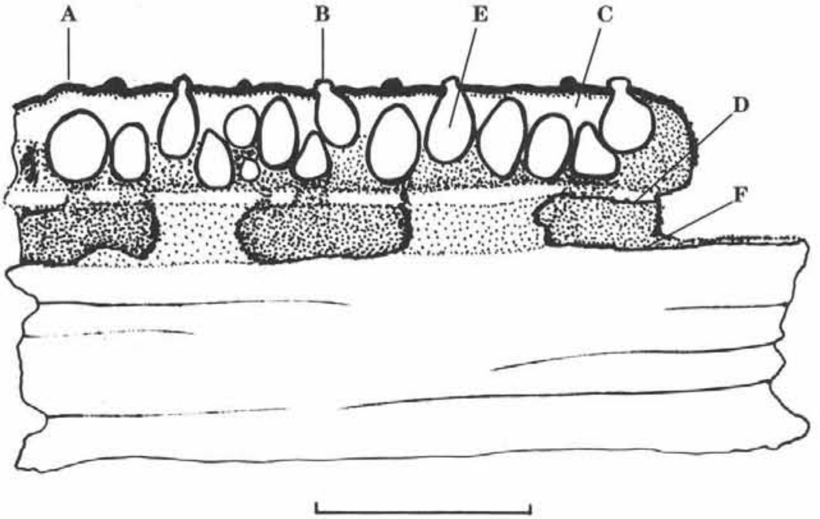


Fig. 1. Morphology of *Diatrype* stroma: A – ectostroma, B – ostioles, C – upper, homogenous entostroma, D – lower, heterogenous entostroma, E – perithecia, F – dorsal zone. Scale bar = 1000 µm.

METHODS

Surface of stromata as well as ostioles were observed under Nikon SMZ 1500 stereomicroscope. Dried material was prepared in water and studied under a Labophot 2 light microscope with an oil immersion lens. Host plants were identified on the basis of Schweingruber's Anatomy of European woods (Schweingruber 1990). Descriptions of fungi are based on material deposited in the herbaria PRM in Prague and BRNM in Brno. Fungi collected by the author are deposited in KRAM F (Kraków, Poland).

RESULTS AND DISCUSSION

Diatrype bullata (Hoffm.: Fr.) Fr., Summa Veg. Scand. 2: 385, 1849.

Syn.: *Sphaeria bullata* Hoffm.: Fr., *Sphaeria placenta* Tode, *Diatrype macounii* Ellis et Everh.

Description. Stromata erumpent through the bark, mostly circular or sligthly elongate, sometimes confluent and then irregular, brownish-grey, surface ± pulvinate, sides surrounded (Fig. 2A), stromata 4–7 mm diam., 0.5–0.7 mm high, perithecia pyriform, in a single layer, ectostroma black, entostroma creamy white, black stromatic zone (dorsal zone) extending down to the wood (Fig. 3A), ostioles slightly erumpent, hemisphaerical, three- to four-sulcate, black, asci spindle shaped 20–34 x 5–6 µm p. sp., pedicel 50–80 µm long, apical apparatus I+, ascospores allantoid, subolivaceous 5–7 x 1.1–1.3 µm.

Comments. Known mostly from various species of the genus *Salix* and rarely on *Populus*. In the Czech Republic it has been collected on such host plants as *Salix aurita*, *Salix caprea*, *Salix cinerea*, *Salix fragilis*, *Salix pentandra*, *Salix viminalis* and *Salix* spp. J. Peyl collected it in 1852 but wrongly identified it as *Sphaeria depressa* Bolton (Opiz 1855), which is a synonym of *Diatrype disciformis*. Petrak (1923) noted it on *Salix caprea* in Šternberk (Moravia). It is a very common species on willows, reported by various authors.

Material studied. **Bohemia**: Western Bohemia: Šumava Mts., forest near Černé jezero (lake), on dead twigs of *Salix caprea*, 29 October 2004, coll.: A. Chlebicki and M. Suková, KRAM F 54767; Western Bohemia: Javornická hornatina, Zuklín near Strašín, 900 m elev., on dead twig of *Salix caprea*, 3 October 1997, coll.: M. Svrček, PRM 891815; Western Bohemia: Javornická hornatina, Nahořánky near Strašín, Hrbeček, on dead twig of *Salix fragilis*, 29 November 1997, coll.: M. Svrček, PRM 891739; Central Bohemia: Hřebeny Mts., Řevnice, in valley of 'Babský potok' (stream), on dead twigs of *Salix caprea*, 12 April 1959, coll.: M. Svrček, PRM 516007; Central Bohemia: Hřebeny Mts., Dobřichovice, on dead twigs of *Salix caprea*, 20 June 1995, coll.: M. Svrček, PRM 887845; Central Bohemia: Prag-Hetzinsel (Praha-Štvanice), in *Salice* (on twig of *Salix* sp.), no date, coll.: A. C. I. Corda, (as *Sphaeria disciformis* Hoffm.) PRM 800164; Central Bohemia: Neratovice, on dead twig of *Salix* sp., 29 September 1953, coll.: Z. Pouzar, PRM 669897; Central Bohemia: circa 1.5 km NNW of Lysá nad Labem, 'Hrabanovská černava' nature reserve, on twigs of *Salix* sp., 10 April 2004, coll.: M. Suková and A. Chlebicki, PRM 901977; Central Bohemia: Kačin (Kačina castle near Kutná Hora), 1853, coll.: J. Peyl, PRM 669893, 823830; Central Bohemia, Kačina (Kačina castle near Kutná Hora), 1852, coll.: J. Peyl, PRM 669905; Central Bohemia: Kačina castle near Kutná Hora, 1854, coll.: J. Peyl, PRM 799763, 799765, 813235, 813307, 823947 (as *Sphaeria ballota* Ehrh.); Central Bohemia: Neuhof (Nové Dvory near Kutná Hora) on dead twig of *Salix* sp., 1853, coll.: Weselský (F. Veselsky), PRM 669908, 799764; Eastern Bohemia: 'Hříva' near Skuhrov, Česká Třebová, on dead twig of *Salix caprea*, 8 August 1983, coll.: F. Kotlaba, ident.: Z. Pouzar, PRM 831637; Southern Bohemia: Vrábsko near Čimelice, 'Mandelíkovská' forest, on dead twigs of *Salix caprea*, 6 August 1964, coll.: M. Svrček, PRM 613311; Southern Bohemia: Čimelice, in 'Chlum' forest (Rakovický vrch), on dead twigs of *Salix caprea*, 6 August 1969, coll.: M. Svrček, PRM 684659; Southern Bohemia: Jetětice near Milevsko, valley of Jetětický potok (stream), on dead twigs of *Salix* cf. *caprea*, 6 April 1969, coll.: M. Svrček, PRM 684259; Southern Bohemia: Putim near Písek, old willow tree, on dead twig of *Salix* cf. *viminalis*, 16 October 1979, coll.: J. Kubička, ident.: Z. Pouzar, PRM 822274; Southern Bohemia: 'Soběslavská blata' peat-bog, named 'U Rozhledny' near Vlastiboř, on dead twigs of *Salix aurita*, 15 July 1954. coll.: Z. Pouzar, PRM 713569; Southern Bohemia: in 'Soběslavská (Borkovická) blata' peat-boog, eastern part of 'Komárovský chobot' near Soběslav, on dead twigs of *Salix cinerea*, 22 June 2001, coll.: F. Kotlaba, ident.: Z. Pouzar, PRM 895051; Southern Bohemia: Smržov near Lomnice nad Lužnicí, 'Dvořiště' pond, on dead twigs of *Salix caprea*, 12 July 1962, coll.: M. Svrček, ident.: M. Svrček, PRM 567908; Southern Bohemia: Třeboň, Prameniště u Jindrů, on *Salix* sp., 7 September 1971, coll. and ident.: J. Kubička, PRM 842443; Southern Bohemia: Třeboň, "Mokré louky", on *Salix pentandra*, 10 July 1979, coll.: J. Kubička, ident.: M. Svrček, PRM 824453; Southern Bohemia: Třeboň, 'Mokré louky', on *Salix cinerea*, 11 August 1979, coll.: J. Kubička, ident.: M. Svrček, PRM 824452; Southern Bohemia: Třeboň, 'Stupský rybník' pond in Prales, on dead twig of *Salix* sp., 7 December 1957, coll.: J. Kubička and M. Svrček, ident.: M. Svrček, PRM 867007; Southern Bohemia: Třeboň, Zámecký revír, wet forest named 'Spálená borkovina', on dead twigs of *Salix aurita*, 7 December 1957, coll.: J. Kubička and M. Svrček, ident.: M. Svrček, PRM 879210.

Moravia: Weisskirchen (Hranice): Hrabůvka, on dead twig of *Salix caprea*, 18 April 1912, coll.: F. Petrak, PRM 669894, BRNM 04258/39; Mycotheca carpatica No. 225; West-Beskiden: Ufer der Unt. Bečwa bei Rož...? (bank of Dolní Bečva near Rožnov pod Radhoštěm), September 1922, coll.: F. Petrak, PRM 481528; Hostýnské kopce Mts., in the forest on southern slope of Mt. Ožinák, elev. c. 600 m, on dead twigs of *Salix caprea*, 13 September 1958, coll.: H. Zavřel, PRM 614302; Vsetínské vrchy Mts., Mt. Cáb, under Cábská road, on dead twigs of *Salix* sp., 20 January 1951, coll.: Z. Pouzar, ident. M. Svrček, PRM 716996; Kamenice near Turovice, on dead twig of *Salix cinerea*, 5 March 1939, coll.: H. Zavřel, BRNM 127766; Arboretum Křtiny near Blansko, on dead twigs of *Salix* sp., 8 November 1983, coll.: A. Vágner, BRNM 0457465, 289316; Jelení skok, c. 1.5 km E of Vranov near Brno, on dead twig of *Salix caprea*, 16 May 1985, coll.: A. Vágner, BRNM 0457464; Moravský kras, Ochoz near Brno, Říčky valley, Lysá hora, on dead twig of *Salix caprea*, 14 April 2001, coll.: A. Vágner, BRNM 665303; Coufavá, 1 km NE of Útěchov near Brno, on dead twig of *Salix caprea*, 12 August 1984, coll.: A. Vágner, BRNM 457463; Útěchov near Brno, on dead twig of *Salix caprea*, 27 April 2001, coll.: A. Vágner, BRNM 667726.

Other collections: Slovakia, Liptovské Tatry Mts., Zverovka near Zuberec, on dead twig of *Salix* sp., 28 June 1949, coll.: A. Příhoda, PRM 607436; Slovakia: Západné Tatry (Western Tatra Mts.), Pribylina, near Hrdovo, on dead twig of *Salix caprea*, 30 August 2003, coll.: A. Vágner, BRNM 686471; Slovakia: Západné Tatry (Western Tatra Mts.), Pribylina, near Tábor, on dead twig of *Salix caprea*, 28 August 2003, coll.: A. Vágner, BRNM 686436; Slovakia: Tatranská Lomnice, on dead twig of *Salix caprea*, 27 February 1923, coll.: E. Baudyš, BRNM 120012, 335732; Slovakia: Velká Fatra Mts., Rojkov, Rojkovské rašeliniště (peat bog), on dead twig of *Salix* sp., 30 August 2002, coll.: A. Vágner, BRNM 670898; Slovakia: Eperjes (Prešov), on dead twig of *Salix* sp., 1855, coll.: F. Veselsky, PRM 669900; Poland: near Przemyśl in Galicia (Poland), on dead twigs of *Salix* sp. May 1912, coll.: A. K. Klain, PRM 669910.

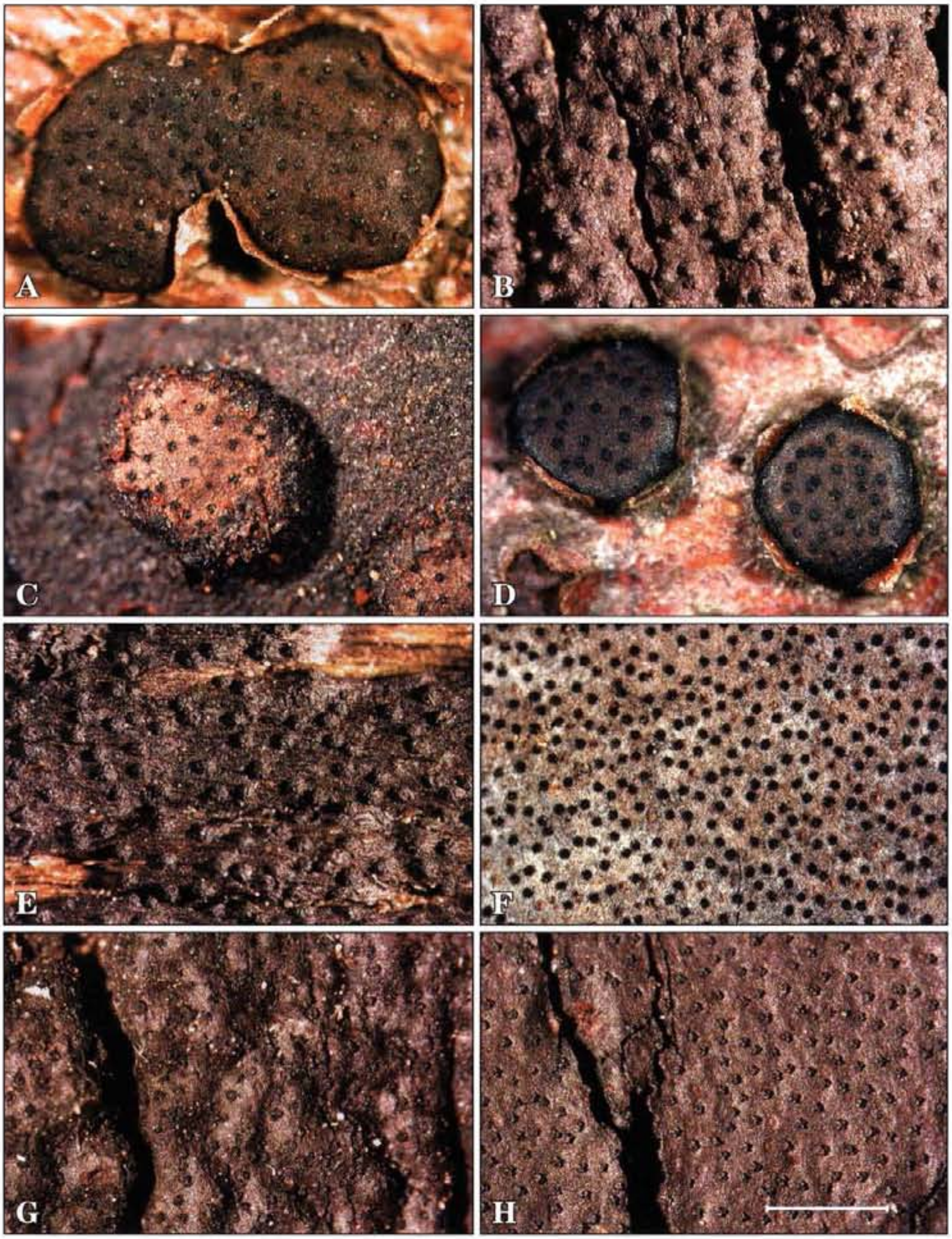


Fig. 2. Surface of stromata. A – *Diatrype bullata* on *Salix caprea* KRAM F 54757; B – *Diatrype decorticata* on *Acer platanoides* PRM 889795; C – *Diatrype disciformis* on *Loranthus europaeus* BRNM 120421; D – *Diatrype disciformis* on *Fagus sylvatica* KRAM F 54765; E – *Diatrype flavovirens* on *Salix* sp. KRAM F 54766; F – *Diatrype stigma* on *Quercus* sp. PRM 642525; G – *Diatrype subaffixa* var. *rappazii* on *Carpinus betulus* PRM 801567; H – *Diatrype undulata* on *Betula* sp. PRM 614421. Scale bar = 1000 µm.

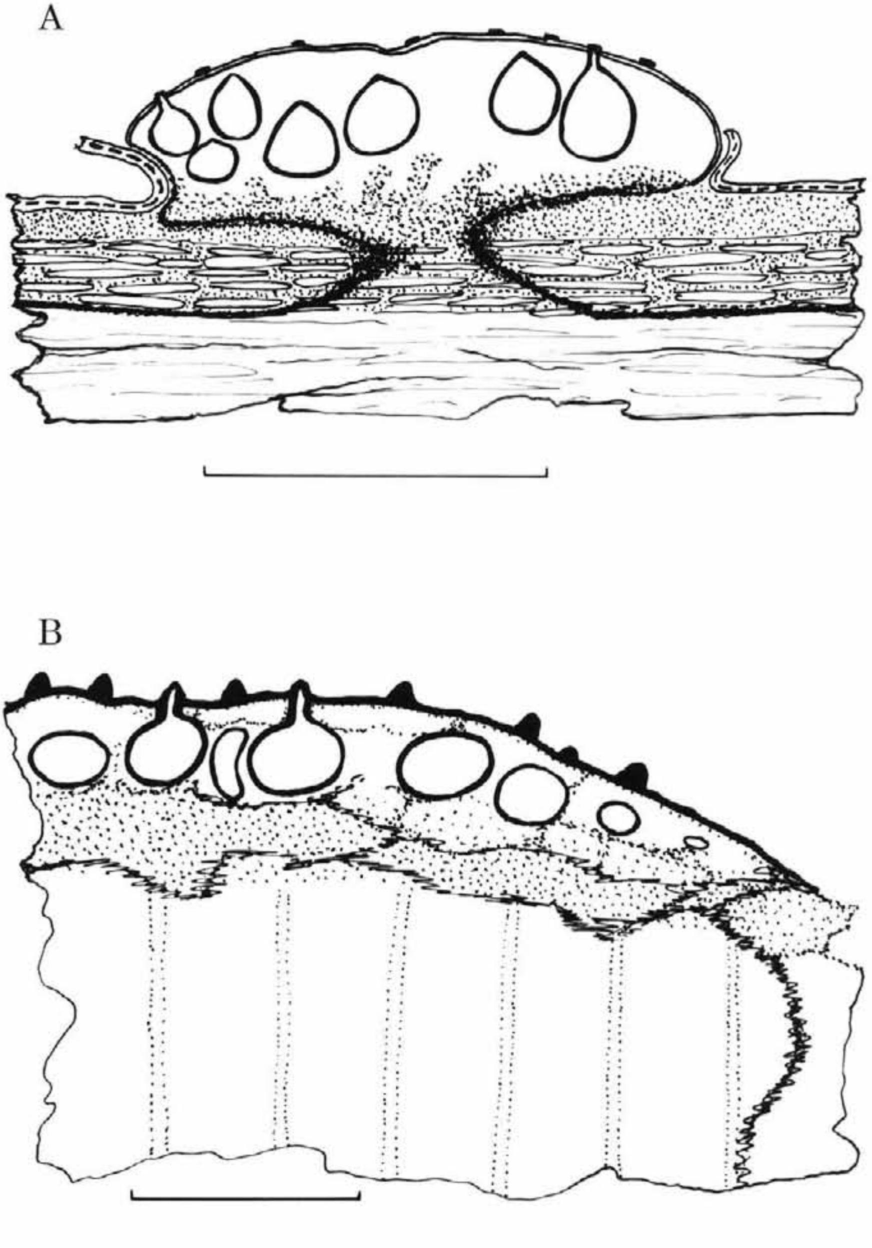


Fig. 3. Section of stroma. A – *Diatrype bullata*, B – *Diatrype decorticata*. Scale bar = 1000 µm.

Diatrype decorticata (Pers.) F. Rappaz, Mycologia Helvetica 2: 398, 1987.

Syn.: *Sphaeria stigma* Hoffm. var. *decorticata* Pers.: Fr. as 'β *Sphaeria decorticata*', *Stromatosphaeria decorticata* (Pers.) Grev.

Description. Stromata reddish-brown to brownish-black, widely effused with deep transverse fissures (Fig. 2B), slightly erumpent, 2–3 mm high, margin mostly low, surfaces of stroma flat, perithecia oval, in one or two layers, ectostroma black, endostroma creamy white, black stromatic zone (dorsal zone) extending down to the wood, ostioles ± prominent, discoid or cruciform (Fig. 3B), asci 20–40 µm with pedicel up to 70 µm long, apical apparatus I+, ascospores allantoid 7–9(10) x 1.2–1.5 µm.

Comments. This species frequently occurs on *Fagus sylvatica*. I saw only one collection of *Diatrype stigma* noted on *Fagus sylvatica* in Poland! (KRAM F 41 732). Prášil et al. (1973) cultured a specimen of *Diatrype stigma* found on *Fagus sylvatica*. In fact it is *D. decorticata*. Also the size of the obtained conidia (15–20 x 1–1.5 µm) is typical of the anamorph of *D. decorticata*. The species was collected also on *Acer pseudoplatanus*, *Acer platanoides*, *Acer* sp., *Corylus avellana*, *Carpinus betulus*, *Cornus sanguinea* and *Prunus spinosa*. Possibly only Veselsky (1859) correctly identified this fungus as *Sphaeria stigma* Hoffm. b. *decorticata* DC. Peyl's collection from Kačina castle, named *Sphaeria stigma decorticata* De Cand. possess only some young ascospores (on *Alnus* sp., PRM 801564). A further collection (PRM 801567), named *Sphaeria stigma* var. b. *decorticata* DC., on *Carpinus betulus* belongs to *D. subaffixa* var. *rappazii* Chleb.

Material studied. **Bohemia**: Northern Bohemia, České středohoří Mts., SE of Milešov, S slope of Ostrý hill, forest (*Fagus*, *Quercus*, *Fraxinus*, less frequent *Betula*), 440–470 m elev., on dead twigs of *Carpinus betulus*, 25 May 2005, coll.: M. Suková, KRAM F 54919; Western Bohemia: Císařský Les, Mt. 'Lazurová hora' near Chodová Planá, on dead twig of *Salix caprea*, 30 July 1949, coll.: M. Svrček (as *D. stigma*), PRM 670064; Western Bohemia: Javornická hornatina, Nahořánky near Strašín, on hill 737 m above sea level, on dead twigs of *Corylus avellana*, 22 October 1997, coll.: M. Svrček (as *D. stigma*), PRM 891804; Central Bohemia: Křivoklát, on dead twig, lying on the forest floor in the forest near Prostřední potok brook near Tejřov (Týřov), on *Corylus avellana*, 18 July 1912, coll.: F. Maloch (as *D. stigma*), PRM 670046; Central Bohemia, Tuchonín (near Chyňava), on dead twig of *Fagus sylvatica*, 21 May 1927, coll.: A. Hilitzer (as *D. stigma*), PRM 670039; Central Bohemia, Český kras, NNE of Srbsko, Doutnáč hill, on dead branch of *Carpinus betulus*, 16 April 2005, coll.: A. Chlebicki, KRAM F 54846; Central Bohemia, Český kras, NNE of Srbsko, Doutnáč hill, on dead twig of *Corylus avellana*, 16 April 2005, coll.: A. Chlebicki, KRAM F 54848; Central Bohemia, Český Kras, NNE of Srbsko, Doutnáč hill, on dead twig of *Fagus sylvatica*, 16 April 2005, coll.: A. Chlebicki, KRAM F 54847; Central Bohemia: Loděnice, on dead twigs of *Acer* sp., 20 April 1927, coll.: A. Hilitzer (as *D. stigma*), (the same collection includes true *D. stigma* on *Cornus sanguinea*!), PRM 670038; Central Bohemia: Praha-Radotín, on dead twig of *Corylus avellana*, 13 April 1927, coll.: A. Hilitzer (as *D. stigma*), it also includes *Eutypa* sp. on a decorticated twig! PRM 670041; Central Bohemia: Závist near Zbraslav, Mt. Hradiště, 369 m elev., on dead twigs of *Acer platanoides*, 3 October 1996, coll.: M. Svrček (as *D. stigma*), PRM 889795; Southern Bohemia: Třeboň, 'Prameniště u Jindrů', on dead twigs *of Prunus spinosa*, 30 March 1959, coll.: J. Kubička, ident.: M. Svrček (as *D. stigma*), PRM 613841.

Moravia: Hrubá Voda near Olomouc, on dead twigs of *Corylus avellana* (as *Tilia* sp.), 13 April 1910, coll.: R. Picbauer (as *D. stigma*), BRNM 120001; Mähr. Weisskirchen (Hranice), Welka (Velká), on dead twig of *Prunus spinosa*, 29 October 1911, coll.: F. Petrak (as *D. stigma*), PRM 670035, 670023, 670019, BRNM 04268/39; Surroundings of Brno, Adamsthal (Adamov), on dead twigs (*Fagus sylvatica*), 25 March, 1862, coll.: J. Kalmus (as *D. stigma*), PRM 670054; Village Ochoz near Brno, on dead twigs of *Corylus avellana*, 6 April 1924, coll.: R. Picbauer (as *D. stigma*), BRNM 134887; Zlobice forest, Kuřim near Brno, on dead twig of *Corylus avellana*, 15 April 1952, coll.: F. Šmarda (as *D. stigma*) BRNM 695288; Bílé Karpaty Mts., Mt. Javorina, primeval forest, on dead twig of *Acer pseudoplatanus*, 23 August 1962, coll.: M. Svrček (as *D. stigma*), PRM 568125.

Diatrype disciformis (Hoffm.: Fr.) Fr., Summa Veg. Scand. 2: 385, 1849.

Syn.: *Sphaeria disciformis* Hoffm.: Fr., *Stromatosphaeria disciformis* (Hoffm.: Fr.) Grev., *Variolaria punctata* Bull., *Sphaeria depressa* Bolton, *Sphaeria grisea* DC, *Diatrype rimosa* Fuckel

Description. Stromata circular, very rarely confluent, flat surface brownish-violet-grey (Fig. 2D), side distinctly darker, 1.2–3 mm diam., 0.5–0.6 mm high, perithecia ovoid, in one or two layers, ectostroma black, endostroma creamy white, black stromatic zone (dorsal zone) extending down to the wood (Fig. 4B), ostioles discoid, only slightly protruding the crust, flat, three– to five-sulcate, asci 22–35 x 5–7 µm p. sp., pedicel up to 80 µm long, apical apparatus I+, ascospores allantoid, 5–8 x 1.2–1.3 µm.

Comments. This species has been noted mostly on *Fagus sylvatica*, rarely on such host plants as *Acer pseudoplatanus*, *Acer platanoides*, *Carpinus betulus*, *Crataegus* sp., *Corylus avellana* and *Ribes grossularia* (Petrak 1940, Prášil et al. 1973). Podlahová (1973) noted this fungus on *Alnus viridis*. Zavřel found it on twigs of *Loranthus europaeus*. This collection differs from typical *Diatrype disciformis* by the mostly elliptical shape of the stromata similar to those of *Diatrype bullata* (Fig. 2C, Fig. 4A), its ligth brown surface, smaller diameter of ostioles and slightly bigger ascospores 7–9(10) x 1.2–1.8 µm. *Loranthus europaeus* grows in the Czech Republic mostly on various species of *Quercus* (*Q. robur*, *Q. petrea*, *Q. pubescens*, *Q. rubra*, *Q. cerris*) in warm forests situated along big rivers. Very rarely this plant was noted on *Carpinus betulus*, *Prunus spinosa*, *Acer campestre*, *Castanea sativa*, *Fagus* sp., *Tilia americana* (*T. alba*) and *Acer campestre*. The accidental occurrence of *Loranthus europaeus* on *Fagus sylvatica* is noteworthy.

The jump of the true *Diatrype disciformis* for which *Fagus sylvatica* is the primary host to *Loranthus* is hardly acceptable. The fungus noted on *Loranthus europaeus* probably belongs to another species or a distinct variety of *Diatrype disciformis*. However this collection is old and cannot be used for cultures on MAA. Fresh and living specimens are necessary to establish the taxonomic status of this fungus.

D. disciformis was collected for the first time in Czechia by W. Siegmund in 1848 and later by Opiz (1852) as *Sphaeria disciformis* Hoffm. Petrak (1923a) noted it on *Fagus sylvatica* in Šternberk (Moravia). It is the most common species of *Diatrype* especially on *Fagus sylvatica*, collected by various authors.

Material studied. **Bohemia**: Northern Bohemia: Zinnwald (Cínovec near Dubí, Krušné hory Mts.), on dead twig of *Fagus sylvatica*, autumn 1872, coll.: Thümen, PRM 669934; Northern Bohemia: Reichenberg (Liberec), 1848, coll.: W. Siegmund, PRM 800163; Northern Bohemia: Jizerské hory Mts., Ferdinandov near Hejnice, valley of 'Velký Štolpich' river, on dead twig of *Acer platanoides*, 3 February 1966, coll.: M. Svrček, PRM 622560; Northern Bohemia: Turnov, 'Farářství' forest, distr. Turnov, on dead branch of *Fagus sylvatica*, 26 March 1940, coll.: H. Schmidt, PRM 521993; Northern Bohemia: Turnov, park, on dead branch of *Fagus sylvatica*, 20 May 1945, coll.: J. Herink, ident. M. Svrček, PRM 669944, 669927, 669928; Northern Bohemia, České středohoří Mts., SE of Milešov, S slope of Ostrý hill, forest (*Fagus*, *Quercus*, *Fraxinus*, less frequently *Betula*), alt. 440–470 m, on dead twig of *Fagus sylvatica*, coll.: M. Suková, KRAM F 54922; Western Bohemia: Herštýn (ruin Nový Herštejn near Kdyně, see Hilitzer 1925: 154, 182), on dead branch of *Fagus sylvatica*, 14 July 1919, coll.: A. Hilitzer, PRM 669957; Central Bohemia, Tuchonín (near Chyňava), on dead twig of *Fagus sylvatica*, 21 May 1927, coll.: A. Hilitzer, PRM 669973; Central Bohemia, Krušná Hora near Beroun, on twigs of *Fagus sylvatica*, 24 April 1927, coll.: A. Hilitzer, PRM 669958; Central Bohemia, Český kras, NNE of Srbsko, Doutnáč hill, on dead twig of *Fagus sylvatica*, 16 April 2005, coll.: A. Chlebicki, KRAM F 54849; Central Bohemia: Dobříšské Hřebeny (Hřebeny Mts.), on dead twig of *Fagus sylvatica*, 20 March 1927, coll.: A. Hilitzer (as *D. stigma*), PRM 670047; Central Bohemia: Dobříšské Hřebeny (Hřebeny Mts.), on dead twig of *Fagus sylvatica*, 20 March 1927, coll.: A. Hilitzer, PRM 669963; Central Bohemia: Brdské Hřebeny Mts., Řevnice, valley of 'Babský potok' stream, on dead twig of *Fagus sylvatica*, 12 April 1959, coll.: M. Svrček, PRM 516012; Central Bohemia: Hřebeny Mts., Dobřichovice, on twigs of *Sorbus aucuparia*!, 20 June 1955, coll.: M. Svrček, PRM 887849; Central Bohemia: Praha – Divoká Šárka, 'Purkrabský les' forest, on dead twigs of *Fagus sylvatica*, 2 and 13 June 1993, coll.: M. Svrček, PRM 879777; Central Bohemia: Praha-Kosoř (gorge), on dead twig of *Crataegus* sp., 19 April 1959, coll.: M. Svrček, PRM 516029; Central Bohemia: Stř. Skalice (Stříbrná Skalice), on dead twig of *Fagus sylvatica*, 3 April 1965, coll.: A. Příhoda, PRM 607021; Central Bohemia: Studený vrch hill near Stříbrná Skalice, on dead twig of *Fagus sylvatica*, 11 November 1952, coll.: Z. Pouzar, PRM 669920; Central Bohemia, Studený vrch hill near Stříbrná Skalice, 'Ve Studeném' nature reserve c. 1.5 km ESE of the village of Samechov, on dead twigs of *Fagus sylvatica*, 1 May 2005, coll.: A. Chlebicki, KRAM F 54859; Central Bohemia, Studený vrch hill near Stříbrná Skalice, 'Ve Studeném' nature reserve c. 1.5 km ESE of the village of Samechov, on dead twig of *Acer* sp., 1 May 2005, coll.: A. Chlebicki, KRAM F 54858; Central Bohemia: Louňovice (Louňovice pod Blaníkem), on dead twig of *Fagus sylvatica*, 13 September 1969, coll.: M. Svrček, PRM 684520; Eastern Bohemia: Krkonoše Mts. between the hotels Patejdlova bouda and Davidovy boudy, on dead twig of *Fagus sylvatica*, 17 June 1955, coll.: V. Skalický, ident.: M. Svrček, PRM 879703; Eastern Bohemia: Broumovské stěny, inter montes Lopota et Bílá skála apud Božanov (sylva no. 334 b–c), on dead twig of *Fagus sylvatica*, 3 October 1972, coll: Z. Pouzar, PRM 814492; Eastern Bohemia: Peklo near Nové Město nad Metují, on dead twig of *Corylus avellana*, 19 July 1956, coll.: B. Hofman (young stromata), PRM 607063, published (Hofman 1959); Eastern Bohemia: Peklo near Nové Město nad Metují, on dead twig of *Carpinus betulus*, 7 July 1956, coll.: B. Hofman, PRM 607111, published (Hofman 1959); Eastern Bohemia, Orlické hory Mts., Deštná, in 'Bukačka' beech forest, on dead twig of *Fagus sylvatica*, 29 October 1969, coll.: M. Svrček, PRM 684519; Southern Bohemia: Šumava Mts., 'Boubínský prales' forest near Horní Vltavice, on twigs of *Fagus sylvatica*, 3 November 1973, coll.: J. Kubička, PRM 877629; Southern Bohemia: Šumava Mts., Huť (Kubova Huť') near Boubín, on twigs of *Fagus sylvatica*, 9 September 1933, coll.: A. Hilitzer, PRM 823769; Southern Bohemia: Šumava Mts. (Gabreta), near Lukenská road (E of Mt. Boubín), on branch of *Fagus sylvatica*, 16 September 1950, coll.: Z. Pouzar, PRM 669917; Southern Bohemia: Šumava Mts., forest near Plešné jezero (lake), on dead twigs of *Fagus sylvatica*, 27 October 2004, coll.: A. Chlebicki & M. Suková, KRAM F 54765; Southern

Bohemia, Čertova Stěna (Čertova stěna near Vyšší Brod), 3 September 1921, coll.: A. Hilitzer, PRM 669971; Southern Bohemia, Mt. Todeňská hora, above Todeň near Trhové Sviny, on dead twig of *Fagus sylvatica*, 28 October 1965, coll.: M. Svrček and J. Kubička, PRM 610222.

Moravia: Rychlebské hory Mts., near waterfall of Stříbrný stream near Nýznerov, beech forest, on dead twig of *Fagus sylvatica*, 16 July 1964, coll.: K. Kříž, PRM 685554; Rychlebské hory Mts., Horní Lipová, valley of Hornolipský stream, on dead twig of *Fagus sylvatica*, 20 July 1962, coll.: K. Kříž, ident. M. Svrček, BRNM 695283; Rychlebské hory Mts., Lázně Jeseník, on dead twig of *Fagus sylvatica*, 9 August 1962, coll.: K. Kříž, BRNM 695282; Velké Vrbno near Staré Město, on dead twigs of *Fagus sylvatica*, 8 August 1919, coll.: E. Baudyš, BRNM 335734; Freiwaldau (= Frývaldov = now Jeseník), Reihwiesen (= Rejvíz, National Nature Reserve), on dead twigs of *Fagus sylvatica*, May 1913, coll.: J. Hruby, BRNM 04264/39; Hrubý Jeseník Mts., Mt. Keprník, on dead twig of *Fagus sylvatica*, 15 July 1911. coll.: R. Picbauer, BRNM 119991; Hochgesenke (Hrubý Jeseník Mts.): Rother Berg (Červená hora), on dead twig of *Fagus sylvatica*, March 1911, coll.: J. Hruby, BRNM 04266/39; Hrubý Jeseník Mts. (valley of Hučivá Desná river) on branch of *Sorbus aucuparia*, 20 October 1948, coll.: A. Příhoda, as '(*Diatrype*)', the host is probably *Fagus sylvatica*, the surface of the stromata was covered by a mycophilous fungus similar to *Immotia*, PRM 670065; Hrubý Jeseník Mts., Winkelsdorf (Kouty nad Desnou), on dead branch of *Fagus sylvatica*, September 1912, coll.: F. Schenk, BRNM 695293; Hrubý Jeseník Mts., Winkelsdorf (Kouty), on dead twig of *Fagus sylvatica*, 1912, coll.: R. Picbauer, BRNM 119992, 119988; Hrubý Jeseník Mts., near Kouty nad Desnou, on dead twig of *Fagus sylvatica*, 20 October 1948, coll.: A. Příhoda, PRM 669967; Hrubý Jeseník Mts., Teplice, on dead twig of *Fagus sylvatica*, no date, coll.: R. Picbauer, BRNM 119993; Schönberg (= Šumperk), Bürgerwald (Mt. Pod skalami), on dead branch of *Fagus sylvatica*, 5 January 1883, coll.: J. Paul, BRNM 05778/33; Olomouc, Hrubá Voda, on dead twig of *Fagus sylvatica*, 13 April 1910, coll.: R. Picbauer, BRNM 119989; Weisskirchen (Hranice): Hrabůvka, on dead twig of *Fagus sylvatica*, 18 April 1912, coll.: F. Petrak, PRM 669955, BRNM 04269/39; Weisskirchen (Hranice): Hrabůvka, on dead twigs of *Fagus sylvatica*, 18 April 1912, coll.: F. Petrak, PRM 669951; Štramberk, Kotouč hill, on dead twigs of *Fagus sylvatica*, 26 July 1952, coll.: F. Šmarda, BRNM 695284; 'Beskiden'mountains, Mt. Javornik, August, coll.: F. Matouschek, PRM 669969; Rožnov pod Radhoštem, Hutisko, on dead twig of *Fagus sylvatica*, 25 June 1926, coll.: R. Picbauer, BRNM 119996; Bystřicko (Bystřice pod Hostýnem), Dřevohostický forest, on dead twigs of *Loranthus europaeus*, 13 March 1948, coll.: H. Zavřel, BRNM 120421; Carpathians, Mt. Hostýn, on dead twig of *Fagus sylvatica*, October 1938, coll.: H. Zavřel, BRNM 125985; Hostýnské kopce Mts., bank of Liškárna stream, on dead twigs of *Fagus sylvatica*, 5 August 1937, coll.: H. Zavřel, BRNM 125986; Hostýnské kopce Mts., in the forest W of slope of Hostýn, c. 500 m elev., on dead branch of *Fagus sylvatica* (as *Betula pendula*), 2 April 1956, coll.: H. Zavřel, ident. M. Svrček, PRM 617035; Rajnochovice near Bystřice pod Hostýnem in Košovy valley, on dead twig of *Fagus sylvatica*, 13 June 1957, coll.: Kříž, BRNM 305654; Vsetínské vrchy Mts., Cáb Mt., below Cábská road, on dead branch of *Fagus* sp., 27 January 1951, coll.: Z. Pouzar, PRM 669915; Třebíč, on dead twig of *Fagus sylvatica*, 18 September 1907, coll.: R. Dvořák, BRNM 119990; Brno (bei Adamsthal – Adamov), on dead twigs of *Fagus sylvatica*, 25 March 1862, coll.: J. Kalmus, PRM 800148; Malá Baba near Brno-Řečkovice, on dead twig of *Fagus sylvatica*, no date, coll.: A. Vágner, BRNM 645286; Kroměříž, on dead twig of *Fagus sylvatica*, no date, coll.: H. Zavřel, BRNM 695285; Chřiby Mts., Buchlov, on dead twig of *Fagus sylvatica*, 23 August 1962, coll.: M. Svrček, PRM 568281; Braitava reserve, Vranov n. Dyjí near Znojmo, on dead twig of *Fagus sylvatica*, 12 October 1994, coll.: A. Vágner, BRNM 590503; Pavlov near Velké Meziříčí – 'Křiky', on dead twig of *Fagus sylvatica*, 29 July 1913, coll.: R. Picbauer, BRNM 119994; Bílé Karpaty Mts., primeval forest 'Javorina', on dead branch of *Acer pseudoplatanus*, 23 August 1962, coll.: M. Svrček, PRM 568140; Bílé Karpaty Mts, Vlára pass near the village of Sidonie, on dead branch of *Fagus sylvatica*, 29 June 1922, coll.: R. Picbauer, BRNM 119995; Vratíkov, on dead twig of *Corylus avellana*, 5 May 1999, coll.: A. Vágner, BRNM 642777.

Other collections: Germany: Malý Falkenstein (Kleiner Falkenstein) near Bayerisch-Eisenstein in the Bayerischer Wald Mts., see Hilitzer (1925): 82–174, on dead twig of *Fagus sylvatica*, 14 September 1926, coll.: A. Hilitzer, PRM 669968; Bohemia: no data, coll.: Greger, PRM 669929; ident.....Lof..., no

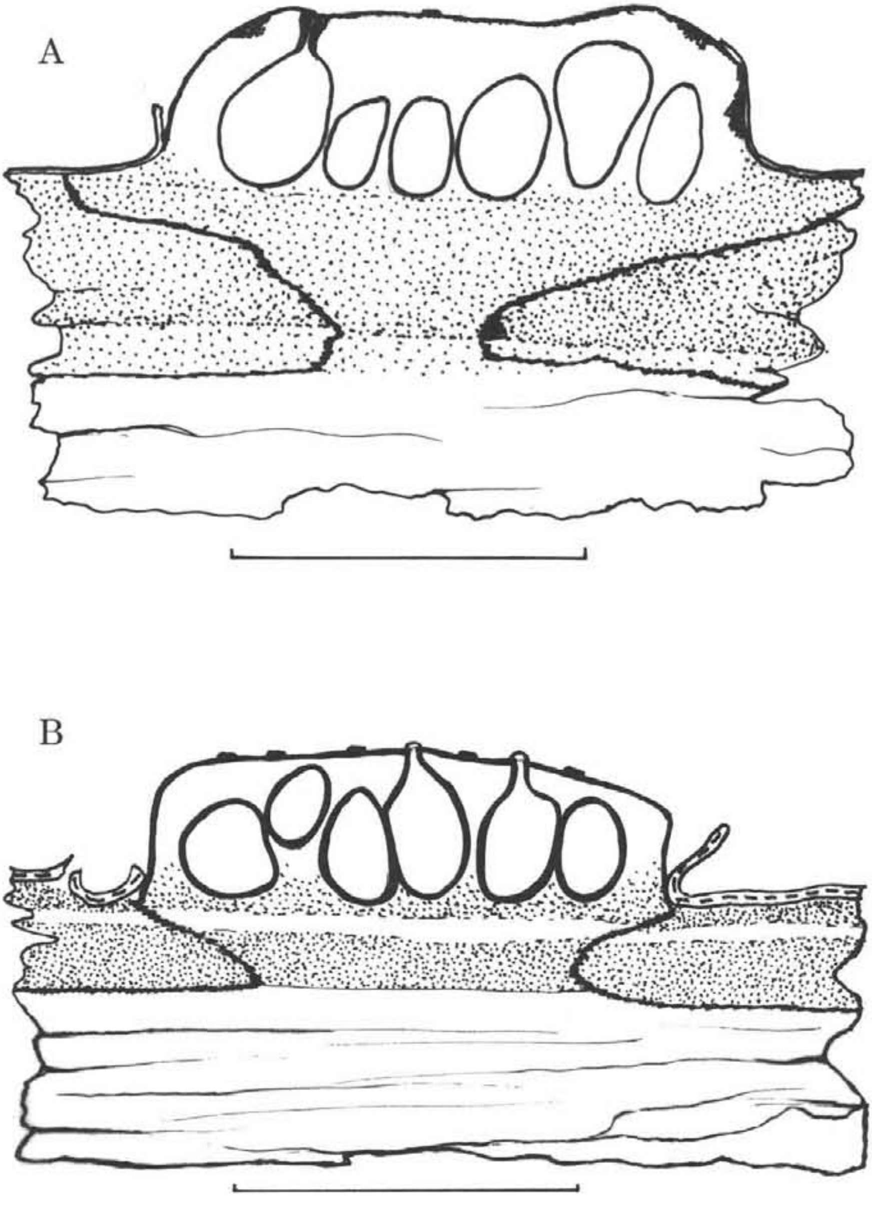


Fig. 4. Section of stroma. A – *Diatrype disciformis* on *Loranthus europaeus*, B – *Diatrype disciformis* on *Fagus sylvatica*. Scale bar = 1000 µm.

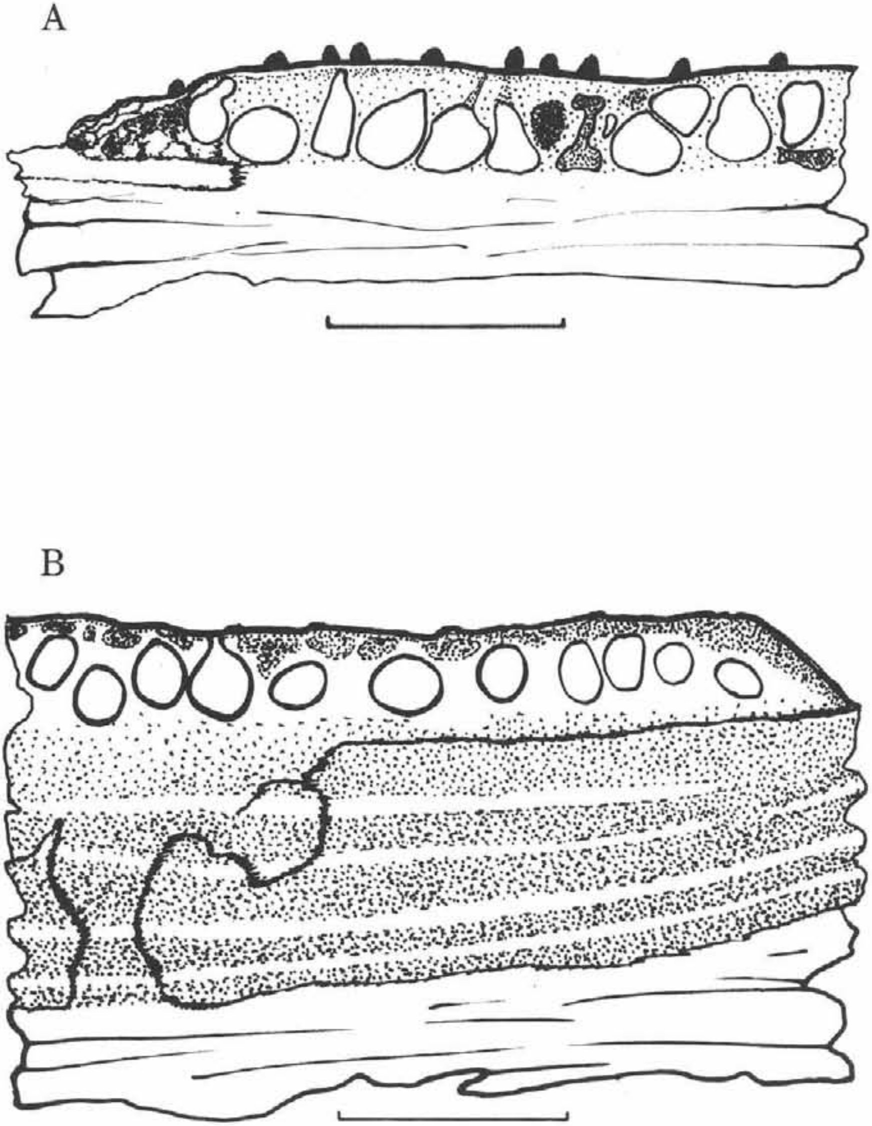


Fig. 5. Section of stroma. A – *Diatrype flavovirens*, B – *Diatrype stigma*. Scale bar = 1000 µm.

date, coll.: Opiz, PRM 669933; Czech Republic: Javorníky, on dead twig of *Fagus sylvatica*, 19 August 1921, coll.: A. Hilitzer, PRM 669962; Czech Republic: Mt. Žákova hora, Hoštánka, deciduous forest, on dead twigs of *Fagus sylvatica*, 26 May 1957, coll.: O. Láznička, ident. F. Kotlaba, PRM 669925; Czech Republic? Poland?: Sudetes (as Sudet.), no data, PRM 669932; Slovakia: Pukanec, under Tatiar hill, on dead twig of *Fagus sylvatica*, 5 August 1897, coll.: S. Kupčok, PRM 669923.

Diatrype flavovirens (Pers.: Fr.) Fr., Summa Veg. Scand. 2: 385, 1849.

Syn.: *Sphaeria flavovirescens* Hoffm., *Sphaeria flavovirens* Pers.: Fr., *Eutypa flavovirens* (Pers.: Fr.) Tul. et C. Tul.

Description. Stromata widely effused on naked wood, eutypoid as well as diatrypoid, often composed of longitudinal lobes parallel to the direction of wood vessels, sometimes irregular, frequently confluent, erumpent, surface covered by thin layer of dead wood, brownish-grey (Fig. 2E, Fig. 5A), 0.6 mm high, perithecia ovoid in a single layer, ectostroma black, endostroma olive-green, delimited by black stromatic zone in the wood, ostioles prominent, conical, three– to four-sulcate or cruciform, asci 34–46 x 6–8 µm p. sp., pedicel up to 90 µm long, ascospores 7–9 x 1.4–2.0 µm.

Comments. It is species intermediate between the genera *Eutypa* and *Diatrype* with very variable stromata, eutypoid as well as diatrypoid (Rappaz 1987b). It is the only *Diatrype* species in which the stroma surface is covered by a thin layer of wood. Known from various species of trees and shrubs. Niessl (1865) noted it on *Quercus* sp. and *Prunus avium*. Bäumler (1897) recorded the fungus on *Quercus cerris* in Bratislava (Slovakia). Podlahová (1972, 1973) reported host plants such as *Alnus viridis*, *Crataegus*, *Malus*, *Pyrus*, *Prunus*, *Sorbus* and *Ribes alpinum* (this last collection from Slovakia). Petrak (1927) reported it from *Alnus glutinosa* in Šternberk (Moravia). Svrček (2001) mentioned as further host plant species *Corylus avellana*, *Fagus sylvatica*, *Fraxinus excelsior* and *Rosa canina*.

Material studied. **Bohemia**: Northern Bohemia: České středohoří Mts., western part of Mt. 'Kletečná' near Velemín, on dead branch of *Aesculus hippocastanum* (in forest), 20 July 1956, coll.: M. Svrček, PRM 617863; Northern Bohemia: České středohoří Mts., on Mt. 'Hora' near Lipá, on dead branch of *Betula* sp., 19 July 1956, coll.: M. Svrček, PRM 617862; Northern Bohemia: České středohoří Mts., in the village of Páleč near Milešov, on dead twig of *Corylus avellana*, 19 July 1956, coll.: M. Svrček, PRM 617861; Western Bohemia: Šipín, valley of Úterský potok (stream), on dead twig of *Quercus* sp., 16 July 1966, coll.: M. Svrček, PRM 624944; Western Bohemia: Šumava Mts., bank of Černé jezero (lake), on dead twigs of *Salix* sp., 29 October 2004, coll.: A. Chlebicki and M. Suková, KRAM F 54766; Western Bohemia: Javornická hornatina, Strašín, Zábrdí valley, on dead twig of *Alnus glutinosa*, 22 October 1997, coll.: M. Svrček, PRM 891807; Central Bohemia: Hostomice pod Brdy, valley of Chumava river, on decorticated twig of *Betula pendula* (as *B. alba*), 23 April 1954, coll.: M. Svrček (including stromata of *Diatrype undulata* on the same twig), PRM 890135; Central Bohemia: Srbsko, Doutnáč hill, on dead twig of *Carpinus betulus*, 6 May 1967, coll.: M. Svrček, PRM 890332; Central Bohemia: Srbsko, 'Velká hora' hill, on decorticated branch of *Acer pseudoplatanus*, 30 March 1958, coll.: M. Svrček, PRM 614441; Central Bohemia: Hodov near Úvaly, valley of Výmola river, 2 November 1969, coll.: M. Svrček, PRM 684522; Central Bohemia: Jevany, on dead branch of *Fagus sylvatica*, 9 November 1947, coll.: M. Svrček, PRM 685557; Central Bohemia: Struhařov near Mnichovice, on dead twig of *Prunus spinosa*, 29 October 1960, coll.: M. Svrček, PRM 879234; Southern Bohemia: Čimelice, forest near the pond Nerestec, on dead twig of *Quercus* sp., 27 July 1964, coll.: M. Svrček, PRM 613330; Southern Bohemia: Laziště near Čimelice, forest near 'Březinka', on dead branch of *Fraxinus excelsior*, 21 August 1966, coll.: M. Svrček, PRM 625903; Southern Bohemia: Laziště near Čimelice, pond 'Tisíčky', on dead twig of *Prunus spinosa*, 8 August 1964, coll.: M. Svrček, PRM 613333; Southern Bohemia: Laziště near Čimelice, bank of pond 'Tisíčky', in the forest, on dead twigs of *Ulmus scabra*, 8 August 1964, coll.: M. Svrček, (with an old stroma of *Diatrype undulata*) PRM 613332; Southern Bohemia: Buda near Čimelice, top of Mt. Velký Kosatín, on decorticated branch of *Carpinus betulus*, 23 August 1964, coll.: M. Svrček, (including *Diatrype undulata* on the same branch), PRM 613331; Southern Bohemia: Hradiště near Kaplice (distr. Č. Krumlov), forest near road, on decorticated branch of *Quercus robur*, 26 June 1971, coll. and ident.: R. Podlahová, PRM 731851; Southern Bohemia: Třeboň, Prameniště 'U Jindrů' (spring), on dead twig of *Salix* sp., 16 May 1962, coll.: M. Svrček, PRM 560467; Southern Bohemia: Velký Chuchelec near Kaplice, 'Kůzlův dvůr', on dead branch of *Alnus viridis*, 4 November 1969, coll.: R. Podlahová, PRM 715890, 715891; Southern Bohemia: Novohradské hory Mts., 'Žofínský prales' primeval forest, on dead twig of *Fagus sylvatica*, 13 May 1966, coll.: M. Svrček and J. Kubička, ident. M. Svrček, PRM 622573; Southern Bohemia: 'Žofínský prales' primeval forest in Novohradské hory Mts., on dead twig of *Fagus sylvatica*, 3 September 1970, coll.: M. Svrček, PRM 716059.

Moravia: Weisskirchen (Hranice): Welka (Velká), on dead twigs of *Prunus spinosa*, 29 October 1911, coll.: F. Petrak, PRM 675913; Weisskirchen (Hranice), on dead branch of a deciduous tree, September 1931, coll.: F. Petrak, PRM 675910; Veveří, on dead twig of *Ulmus* sp., 18 May 1969, coll.: M. Svrček, PRM 684262.

Diatrype stigma (Hoffm.: Fr.) Fr., Summa Veg. Scand. 2: 385, 1849.

Syn.: *Sphaeria stigma* Hoffm.: Fr., *Stromatosphaeria stigma* (Hoffm.: Fr.) Grev.

Description. Stromata widely effused, brownish-grey, covered sometimes by white remains of conidial ectostroma (Fig. 2F), 0.5 mm high, with nearly flat surfaces, perithecia ovoid, in a single layer, ectostroma black, endostroma creamy white, black stromatic zone (dorsal zone) extending down to the wood (Fig. 5B), similar the genus *Diaporthe*, ostioles discoid, flat, four- to five-sulcate, asci 32–50 x 4–6 µm, ascospores allantoid 8–11 x 1.6–2.7 µm.

Comments. Known mostly from various species of the genus *Quercus* as well as various *Rosaceae* and *Betulaceae* (Rappaz 1987b). In the Czech Republic it has been collected on such host plants as *Quercus robur*, *Quercus rubra*, *Quercus* sp., *Acer pseudoplatanus*, *Acer* sp., *Salix fragilis*, *Prunus spinosa*, *Sorbus torminalis*, *Sorbus aucuparia*, *Crataegus oxyacantha*, *Crataegus* sp., *Cornus sanguinea*, *Juglans regia* and a single collection on *Fagus sylvatica*. Probably it was collected for the first time in territory of Czech Republic by Niessl (1865). He mentioned *Fagus*, *Carpinus* and *Prunus* spp. as hosts. Of these *Prunus* can be inhabited by the true *Diatrype stigma*. Petrak (1927) noted it on *Crataegus oxyacantha*. Other plants – *Betula pendula* and *Fagus sylvatica* – are hosts of *Diatrype undulata* and *Diatrype decorticata*. It is a very common species.

Hoffman's description (Hoffman 1787) of *Sphaeria stigma* avoids a host name – *in ramis arborum emortuis*. Also the shape of the ostioles (flat as well as prominent) did not allow a definite decision on the species (*Diatrype stigma* or *Diatrype undulata*). The contour of the stroma in his drawing (Tab. II, fig. 2) indicates rather *Diatrype undulata* than true *D. stigma* (see Fig. 7). Rappaz (1987a) typified *D. stigma* and selected a neotype from Persoon´s collections (L-Pers, 90 OH 910269-940) gathered on *Crataegus* sp. (*Crataegus oxyacantha*).

Material studied. **Bohemia**: Northern Bohemia: České středohoří Mts., village Páleč near Milešov, on dead twig of *Sorbus aucuparia*, 19 July 1956, coll.: M. Svrček (as *D. stigma*), ostioles typical as in *D. stigma*, PRM 617853; Northern Bohemia: České středohoří Mts., Mt. 'Ostrý' near Milešov, on dead twigs of *Quercus* sp., 22 July 1956, coll.: M. Svrček (as *D. stigma*), PRM 617854; Northern Bohemia: České středohoří Mts., Mt. 'Kletečná' near Velemín, on dead twig of *Quercus* sp., 20 July 1956, coll.: M. Svrček (as *D. stigma*), PRM 617855; Northern Bohemia, České středohoří Mts., SE of Milešov, S slope of Ostrý hill, forest (*Fagus*, *Quercus*, *Fraxinus*, less frequently *Betula*), alt. 440–470 m, on dead twigs of *Sorbus torminalis*, coll.: M. Suková KRAM F 54921; Western Bohemia: Javornická hornatina, Nahořánky near Strašín, Hrbeček, on twig of *Salix fragilis*, 29 November 1997, coll.: M. Svrček, ostioles 3–4 sulcate, nearly flat or slightly erumpent, stroma with similar cracks as in *D. decorticata*, PRM 891735; Central Bohemia: Zdice, forest in valley near Mt. 'Vraní skála', on dead twig of *Rosa* sp., coll.: M. Svrček (as *D. stigma*), ostioles typical as in *D. stigma*, PRM 614420; Central Bohemia: Zdice, Mt. 'Vraní skála', on dead twig of *Sorbus aucuparia*, 24 April 1927, coll.: A. Hilitzer (as *D. stigma*), ostioles typical of *D. stigma*, PRM 670043; Central Bohemia: Hostomice pod Brdy, 'Provazec' hill, on dead twig of *Quercus* sp., 22 April 1954, coll.: M. Svrček (as *D. stigma*), PRM 890175; Central Bohemia: Loděnice, on dead twigs of *Cornus sanguinea*, 20 April 1927, coll.: A. Hilitzer (as *D. stigma*), in the same collection also *D. decorticata* on *Acer* sp. was found! PRM 670038; Central Bohemia: Hlásná Třebáň, on dead twigs of *Crataegus oxyacantha*, 16 July 1944, coll.: M. Svrček (as *D. stigma*), ostioles typical of *D. stigma*, PRM 670030; Central Bohemia: Hlásná Třebáň, 'Políčko' forest, on dead twig of *Crataegus* sp., 20 April 1958, coll.: M. Svrček (as *D. stigma*), PRM 614419; Central Bohemia: Hřebeny Mts., Řevnice, valley of 'Babský potok' stream, on dead twig of *Fagus sylvatica*, 12 April 1959, coll.: M. Svrček (as *D. stigma*), ostioles are typical for *D. stigma*, surface flat, margin distinctly visible, PRM 516005; Central Bohemia: (Praha –) Horní Chabry, on dead twig of *Juglans regia*, November 1956, coll.: J. Pachmanová (as *D. stigma*), PRM 522365; Central Bohemia: Praha, Dolní Šárka, protected area 'Duchoňská', on dead branches of *Sorbus torminalis*, 25 May 1993, coll.: M. Svrček (as *D. stigma*), it possesses slightly erumpent ostioles, not typical of *D. stigma*, PRM 879771; Central Bohemia: Praha, Divoká Šárka, in warm oak forest, on twigs of *Quercus robur*, 20 May 1995, coll.: M. Svrček (as *D. stigma*), PRM 887872; Central Bohemia: Praha, Divoká Šárka, on dead twig of *Acer pseudoplatanus*, 2 June 1993, coll.: M. Svrček (as *D. stigma*), PRM 879742; Central Bohemia: Praha, between Velká Chuchle and Radotín, on dead twig of *Prunus spinosa*, 19 January 1958, coll.: M. Svrček (as *D. stigma*), PRM 614418; Central Bohemia: Praha, Radotínské údolí valley, on dead twig of *Quercus robur*, 7 April 1951, coll. and ident.: A. Příhoda (as *D. stigma*), PRM 606277; Central Bohemia: Praha-Kosoř (gorge), on dead twig of *Crataegus* sp., 19 April 1959, coll.: M. Svrček, it is a single twig with stromata of *D. stigma* and *D. disciformis*! PRM 516021; Central Bohemia: Praha, Krčský forest, on dead twig of *Quercus* sp., 25 November 1945, coll. and ident.: M. Svrček, (as *D. stigma*), PRM 670044; Central Bohemia: Černínovsko reserve near Neratovice, on dead branch of *Fraxinus excelsior*, 24 October 2004, coll.: A. Chlebicki, KRAM F 54778; Central Bohemia: Černínovsko reserve near Neratovice, on dead branch of *Quercus rubra*, 24 October 2004, coll.: A. Chlebicki, KRAM F 54779; Central Bohemia: Kersko (SE of Lysá nad Labem), on dead twig of *Quercus* sp., 19 September 1924, coll.: A. Hilitzer (as *D. stigma*), PRM 670042; Central Bohemia: Libický luh reserve near Velký Osek, on dead branch of *Quercus* sp., 23 October 2004, coll.: A. Chlebicki, KRAM F 54777; Central Bohemia: Libický luh near Velký Osek, on dead branch of *Carpinus betulus*, 23 October 2004, coll.: A. Chlebicki, KRAM F 54780;

Central Bohemia: Veltrubský luh reserve near Velký Osek, on dead branch of *Carpinus betulus*, 23 October 2004, coll.: A. Chlebicki, KRAM F 54781; Central Bohemia: Kačina castle near Kutná Hora, on dead twig of *Sorbus aucuparia*, 1856, coll.: J. Peyl, PRM 801563; Central Bohemia, ENE of Benešov, village of Zálesí near Teplýšovice, on dead twig of *Quercus* sp., 1 May 2005, coll.: A. Chlebicki, KRAM F 54862; Central Bohemia: Blaník, on dead twig of *Acer* sp., 7 August 1935, coll.: A. Hilitzer (as *D. stigma*), PRM 820464; Central Bohemia: Milín near Příbram, on dead twigs of *Quercus* sp., coll.: M. Svrček (as *D. stigma*), PRM 672831; Central Bohemia: forest NE of Struhařov, on dead twigs of *Quercus robur*, 5 June 2005, coll.: A. Chlebicki, KRAM F 54965; Southern Bohemia: Čimelice, forest 'Chlum' (Rakovický vrch), on dead twigs of *Quercus* sp., 6 August 1969, coll.: M. Svrček (as *D. stigma*), PRM 684660; Southern Bohemia: Laziště near Čimelice, 'Březinka' forest, on dead twig of *Quercus rubra*, 13 August 1966, coll. and ident.: M. Svrček (as *D. stigma*), PRM 625887; Southern Bohemia: Třeboň, 'Branské doubí' oak forest, on dead twig of *Quercus* sp., 6 December 1957, coll.: J. Kubička and M. Svrček, ident. M. Svrček (as *D. stigma*), PRM 867047; Southern Bohemia: Chlum u Třeboně, Dračice valley, on dead twig of *Quercus* sp., 27 August 1932, coll.: A. Hilitzer (as *D. stigma*), PRM 820849; Southern Bohemia: Třeboň, 'Stará řeka' reserve, in the beech forest, 431 m elev., on dead branch of *Quercus rubra*, 28 November 1959, coll.: J. Kubička, ident. M. Svrček (as *D. stigma*), PRM 518858; Southern Bohemia: Třeboň, pond 'Opatovický rybník', on dead twig of *Quercus* sp., 16 May 1962, coll.: M. Svrček (as *D. stigma*), PRM 560468.

Moravia: Weidenau (Vidnava), on dead twig of *Corylus avellana* [as *Quercus* sp. – auf morschem Eichenästchen im Pfarrwald (Farský les)], June 1911, coll.: J. Hruby, BRNM 042753/39; Weisskirchen (Hranice): Welka (Velká), on dead twigs of *Crataegus oxyacantha*, 5 February 1913, coll.: F. Petrak, BRNM 04271/39; Bystřicko (Bystřice pod Hostýnem), Dřevohostický forest, on dead twigs of *Salix fragilis*, 11 May 1941, coll.: H. Zavřel, BRNM 125988; Sudice near Náměšť nad Oslavou, Českomoravská vrchovina, on dead branch of *Quercus rubra*, 26 August 1998, coll.: A. Vágner, ident. Z. Pouzar, BRNM 642525; Moravský Krumlov, near Rokytná river, on dead twig of *Crataegus oxyacantha*, 15 March 1928, coll.: R. Picbauer (as *D. stigma*), BRNM 120007; Ivaň, Dolní Mušovský luh, on dead twig of *Quercus* sp., 29 June 2001, coll.: A. Vágner, BRNM 666761; Theimwald forest (Boří les near Lednice), on lying twig of *Quercus* sp., June–September 1912, coll.: H. Zimmermann, (as *D. stigma*), PRM 670018; 1.5 km SW of Cahnov Reserve, near Lanžhot (district Břeclav), on dead twig of *Crataegus* sp., 4 August 1994, coll.: A. Vágner, BRNM 590628; Čejkovice near Hodonín, Kapansko forest, on dead twig of *Fraxinus excelsior*, 5 December 1954, coll.: F. Šmarda, ident. M. Svrček, BRNM 695290; Luhačovice, on dead twig of *Quercus* sp., 15 January 1970, coll.: M. Svrček (as *D. stigma*), PRM 711840.

Other collections: Slovakia: Eperjes (Prešov), ex herb. Peyl, on dead twigs of *Quercus* sp. (as *D. stigma*), no collector named (probably F. Veselsky), PRM 670024.

Diatrype subaffixa (Schwein.) Cooke var. ***rappazii*** Chleb., Sydowia 47: 24, 1995.

Description. Stromata widely effused, but narrower than in *D. decorticata* and *D. stigma*, brownish grey, strongly undulate and raised (Fig. 2G), divided into irregular lobes, margin distinct, steep, up to 1 mm high, perithecia ovoid in one or two layers, ectostroma black, endostroma creamy white, black stromatic zone (dorsal zone) extending down to the wood (Fig. 6A), ostioles prominent, conical, three- to four-sulcate, asci 30–40 x 5–6 µm, ascospores allantoid, sometimes with slightly budding apex 8.2–10.6(–11) x 1.5–2.4 µm.

Comments. Known from *Carpinus betulus*, *Acer platanoides* and *Sambucus nigra* in Poland (Chlebicki and Krzyżanowska 1995). Generally, stromata of the Czech collections are not so strongly undulate as those from Poland. The spores of collection PRM 607072 are 8–9 x 2–2.4 µm, the ostioles circular

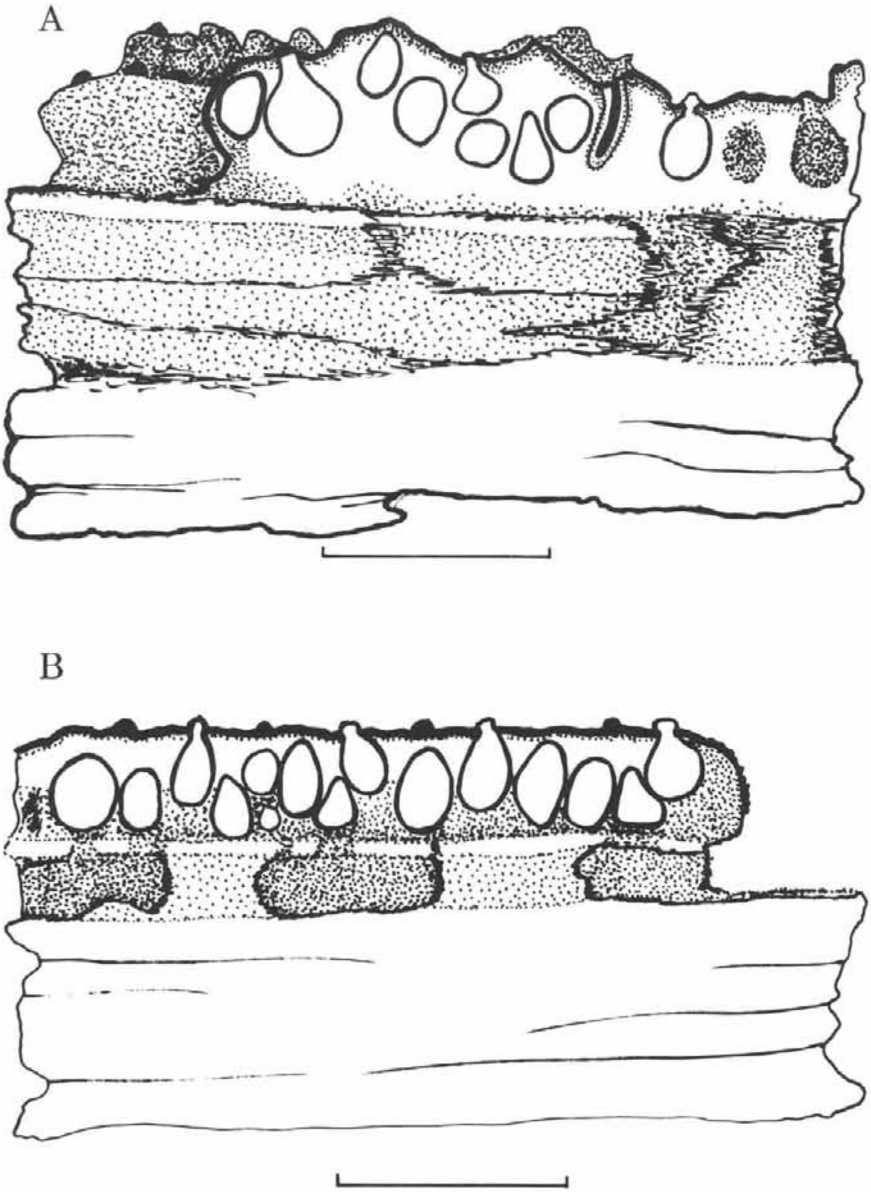


Fig. 6. Section of stroma. A – *Diatrype subaffixa* var. *rappazii*, B – *Diatrype undulata*. Scale bar = 1000 µm.

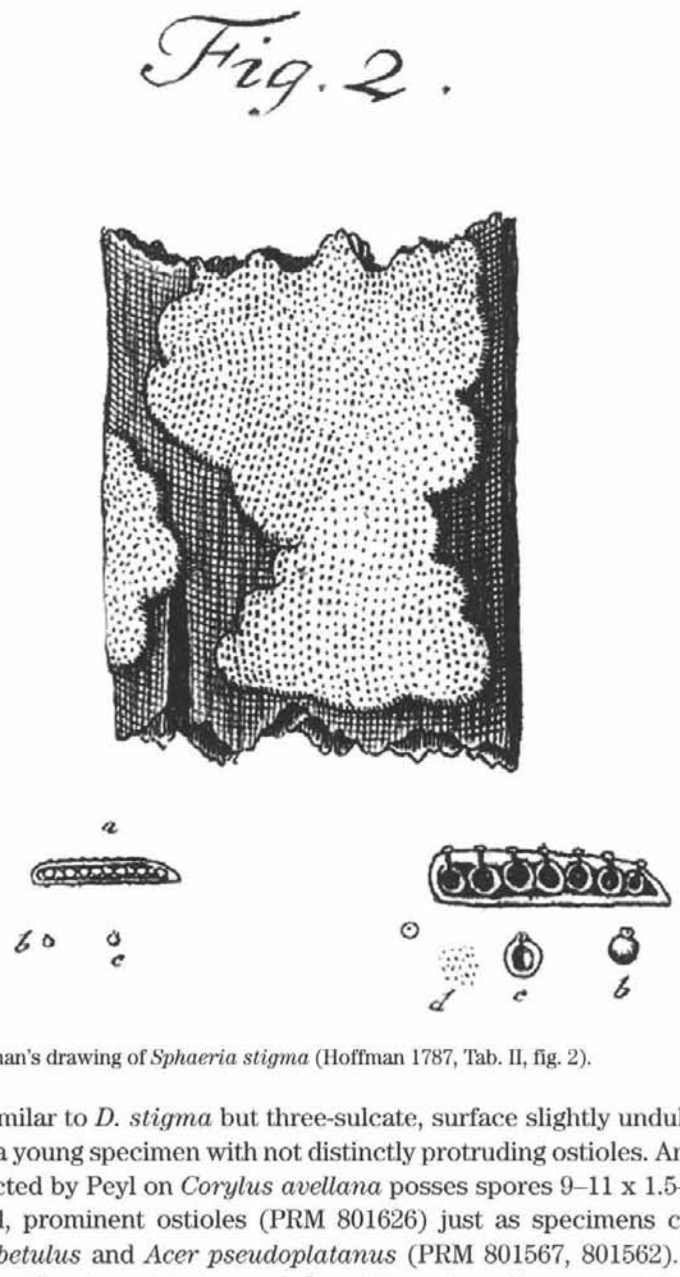


Fig. 7. Hoffman's drawing of *Sphaeria stigma* (Hoffman 1787, Tab. II, fig. 2).

and low, similar to *D. stigma* but three-sulcate, surface slightly undulate, margin steep. It is a young specimen with not distinctly protruding ostioles. Another specimen collected by Peyl on *Corylus avellana* posses spores 9–11 x 1.5–1.8(–2) µm and typical, prominent ostioles (PRM 801626) just as specimens collected on *Carpinus betulus* and *Acer pseudoplatanus* (PRM 801567, 801562). Specimens collected on *Carpinus betulus* and *Carpinus orientalis* are sometimes hard to identify (Rappaz 1987b). Such specimens were noted in Bulgaria (PRM 841829), former Yugoslavia (PRM 814314), Austria (KRAM F 54771) and Poland (KRAM F 40998).

Material studied. **Bohemia**: Central Bohemia: Srbsko, valley near Doutnáč, on dead branch of *Carpinus betulus*, 6 May 1967, coll.: M. Svrček (as *D. stigma*), PRM 890354; Central Bohemia, Český kras, NNE of Srbsko, Doutnáč hill, on dead twig of *Carpinus betulus*, 16 April 2005, coll.: A. Chlebicki, KRAM F 54851; Central Bohemia: Károvské údolí valley near Zbraslav, on dead twig of *Carpinus betulus*, 2 April 1944, coll.: M. Svrček (as *D. stigma*), PRM 670036; Eastern Bohemia: Peklo near Nové Město nad Metují, on dead twig of *Carpinus betulus*, 17 November 1956, coll.: B. Hofman (as *D. stigma*), PRM 607072, published as *D. stigma* (Hofman 1959); **Moravia:** Brno, Bobrava, on dead twig of *Rosa* sp., June 1923, coll.: J. Hruby (as *D. stigma*), BRNM 04272/39.

Other collections: Loc.?, in ligno et subcort. on dead partially decorticated branch of *Corylus avellana*, 27 September 1856, no collector named, PRM 801626; Loc.?, on dead twig of *Carpinus betulus*, 14 May 1859, no collector named, (as *Sphaeria stigma* var. b. *decorticata* DC.) PRM 801567; Loc.?, on dead branch of *Acer pseudoplatanus*, no date and collector (as *Sphaeria stigma* var. *decorticata*), PRM 801562; SE Bulgaria: Eminska planina Mts., valley of Vlas river near Slančev Briag, on dead branch of *Carpinus orientalis*, 20 August 1982, coll.: F. Kotlaba, ident.: Z. Pouzar (as *D. stigma*), PRM 841834; Yugoslavia: Sutomore, 'macchia' community, on dead twig of *Carpinus* sp., 10 June 1977, coll.: S. Šebek, ident.: Z. Pouzar (as *D. stigma*), ostioles flat as in *D. stigma*, margin of stromata distinct, PRM 814314.

Diatrype undulata (Pers:. Fr.) Fr., Summa Veg. Scand. 2: 385, 1849.

Syn.: *Sphaeria undulata* Pers.: Fr., *Stictosphaeria undulata* (Pers.: Fr.) Fuckel

Description. Stromata mostly widely effused, strongly raised and divided into irregular lobes, with steep margin, brownish grey, up to 0.8 mm high, surface flat (Fig. 2H), perithecia ovoid in a single layer, ectostroma black, endostroma creamy white, black stromatic zone (dorsal zone) extending down to the wood (Fig. 6B), ostioles prominent, conical, three– to four-sulcate, asci 23–40 x 4–5 µm p. sp. (pars sporifera), pedicell up to 60 µm, ascospores allantoid 6–8.4 x 1.2–1.5 µm.

Comments. Known from various species of the genus *Betula* (Rappaz 1987b). It was noted in the Czech Republic on *Betula pendula* and *Betula* sp. It was possibly the first time collected by Opiz (1855) in Prague on *Betula* sp. and wrongly identified as *Sphaeria stigma*. Peyl collected a fungus identified by him as *Sphaeria undulata* Pers. (PRM 813309, on decorticated wood of *Acer* sp.), but it is in fact *Eutypa* sp., possibly *Eutypa lejoplaca* (Fr.: Fr.) Fuckel. Also another collection of *Sphaeria undulata* made by Peyl on *Corylus avellana* was composed of two other species: *Diatrype subaffixa* and *Eutypa* sp. (PRM 801626). Petrak (1920) published this species (as *Diatrype stigma*) on *Betula pendula* from Konradsgrün (Kunrátov near Chleb, Western Bohemia).

Material studied. **Bohemia**: Northern Bohemia: Herbarium Marschner (no 110), on dead twig of *Betula pendula* (as "*Betula verruc.*") near Altehrenberg (Staré Křečany near Šluknov), 27 May 1944, coll.: G. Marschner, ident. G. Feunich (as *D. stigma*), PRM 725340; Northern Bohemia: Hely, near Kyjov close to Krásná Lípa, on dead twig of *Betula* sp., 20 August 1960, coll.: M. Svrček (as *D. stigma*), PRM 620115; Northern Bohemia, České středohoří Mts., SE of Milešov, S slope of Ostrý hill, forest (*Fagus*, *Quercus*, *Fraxinus*, less frequent *Betula*), alt. 440–470 m, on dead branches of *Betula* sp., 25 May 2005, coll.: L. Edrová, ident. M. Suková, KRAM F 54920; Northern Bohemia, České středohoří Mts., Oparenské údolí (valley of Milešovský brook) between Velemín and Oparno, on dead branch of *Betula* sp., 3 May 2005, coll.: M. Suková, KRAM F 54923; Western Bohemia: Javornická hornatina, Strašín, Zábrdí valley, on twigs of *Betula pendula*, 2 October 1997, coll.: M. Svrček (as *D. stigma*), PRM 891761; Central Bohemia: Hostomice pod Brdy, valley of the Chumava river, on dead twigs of *Betula pendula* (as *Betula alba*), 23 April 1954, coll.: M. Svrček (as *D. stigma*), PRM 890134; Central Bohemia: Hostomice pod Brdy, 'Provazec' hill, on dead branches of *Betula pendula* (as *B. alba*), 22 April 1954, coll.: M. Svrček (as *D. stigma*), PRM 890180; Central Bohemia, Čelákovice, pine forest, on dead twig of *Betula pendula*, 27 March 2005, coll.: A. Chlebicki, KRAM F 54786; Southern Bohemia: Jiříkovo údolí near Šalmanovice, on dead twigs of *Betula* sp., 18 May 1965, coll. and ident.: M. Svrček (as *D. stigma*), PRM 604074; Southern Bohemia: pond Vydýmač (near Lomnice n. Luž.), on twig of *Betula* sp., 25 August 1942, coll.: K. Kavina (as *D. stigma*), PRM 670021; Southern Bohemia: Nová Ves nad Lužnicí near Třeboň, on dead twig of *Betula* sp., 11 June 1959, coll.: J. Kubička, ident. M. Svrček (as *D. stigma*), on the same twig also *Peniophora incarnata* is present, PRM 617701; Southern Bohemia: Třeboň, 'U Jindrů', on dead twig of *Betula* sp., 31 August 1958, coll.: J. Kubička, ident. M. Svrček (as *D. stigma*), PRM 614421; Southern Bohemia: Třeboň, wet alder forest 'U Jindrů', on dead twigs of *Betula pendula*, 27 October 1958, coll.: M. Svrček (as *D. stigma*), PRM 890227.

Moravia: Weidenau (Vidnava), on dead twig of *Betula* sp., 1911, coll.: J. Hruby, (as *D. stigma*), BRNM 04269/39; Třebíč, near Kotkovice, on dead twigs of *Betula* sp. (as *Fagus sylvatica*), August 1910, coll.: R. Picbauer, BRNM 120000; Čejkovice, on dead twig of *Betula pendula*, 27 May 1985, coll.: M. Svrček, BRNM 695691; Vel. Meziříčí, near Netín, on dead twig of *Betula pendula* (as *Betula verrucosa*), July 1913, coll.: R. Picbauer (as *D. stigma*), BRNM 120008; Vel. Meziříčí near Netín, on dead twig of *Betula pendula*, July 1911, coll.: R. Picbauer (as *D. stigma*), BRNM 119999.

Key to the *Diatrype* species from the Czech Republic

1. Stroma circular in outline 2
1. Stroma irregular in outline 3

2. Stroma circular, darker from the side, surface flat, ascospores 5–8 x 1.2–1.3 µm, mostly on *Fagus* .... *D. disciformis*
2. Stromata elliptical in outline, surface pulvinate, ascospores 7–9 x 1.2–1.8 µm .... *'D. disciformis'* on *Loranthus europaeus*
2. Stromata mostly circular or elongate, sometimes confluent, sides rounded, surface pulvinate, ascospores 5–7 x 1.1–1.3 µm, on *Salix* spp. .... *D. bullata*

3. Ascospores 8–11 µm 4
3. Ascospores smaller 5

4. Stromata nearly flat with low margin, surface covered by white remains of conidial ectostroma, ostioles disk-shaped, indistinctly 4–6-sulcate, ascospores 8–11 x 1.6–2.7 µm, on a wide range of hosts .... *D. stigma*
4. Stromata mostly strongly undulated, raised, with distinctly marked margin, ostioles cone shaped, three– to four-sulcate, ascospores 8–11 x 1.5–2.4 µm, on *Carpinus betulus* .... *D. subaffixa* var. *rappazii*
4. Stromata partly eutypoid, entostroma olive green .... *D. flavovirens*

5. Margin of stromata distinct, sinuate in contour, surface flat, ostioles cone-shaped, erumpent, ascospores 6–8 x 1.2–1.5 µm, on *Betula* spp. .... *D. undulata*
5. Margin of stromata low, stromata wide-spreading with deep transverse fissures, ostioles cone-shaped, erumpent or flat, ascospores 7–9 x 1.2–1.5 µm, mostly on *Fagus sylvatica*, but also on *Acer*, *Corylus*, *Carpinus*, *Prunus* ... *D. decorticata*

ACKNOWLEDGEMENTS

Special thanks are due to Markéta Suková for her help with the Czech literature searching, organizing of excursions in the Czech Republic and correction of Czech locality names. Vladimír Antonín helped me explain in Moravian locality names. I am grateful to the curators of the herbaria PRM and BRNM for arranging loans. I thank the reviewers, Dr. Jan Holec, Dr. Zdeněk Pouzar and Dr. Karel Prášil for critically reviewing the paper.

REFERENCES

BÄUMLER J. A. (1897): Beiträge zum Cryptogamen-Flora des Pressburger Comitates. – Verh. Ver. Natur. u. Heilkunde Pressburg, Neue Folge 9: 129–206.

CHLEBICKI A. and KRZYŻANOWSKA J. (1995): Notes on Pyrenomycetes and Coelomycetes from Poland. 3. *Diatrype subaffixa*, a new species for Europe. – Sydowia 47(1): 10–30.

HILITZER A. (1925): Étude sur la végétation épiphyte de la Bohéme. – Publ. Fac. Sci. Univ. Charles 41: 1–200, Prague.

HOFFMAN G. F. (1787): Vegetabilia cryptogama 1: 1–42. Erlangae.

HOFMAN B. (1959): Příspěvek k poznání dřevokazných hub Pekelského údolí. – Česká Mykol. 13: 217–223.

KIRCHNER L. (1856): Beschreibung einiger neuer und im Südlichen Theile des budweiser Kreises seltener vorkommenden Pilze. – Lotos (Praha) 6: 242–247.

NIESSL G. (1865): Vorarbeiten zu einer Kryptogamenflora von Mähren und Oesterr. Schlesien. II. Pilze und Myxomyceten. – Verh. Naturforsch. Ver. Brünn 3 [1864]: 60–193.

OPIZ P. M. (1823): Böheims phänerogamische und cryptogamische Gewächse. – 168 p. Prag.

OPIZ F. M. (1852): Seznam rostlin květeny české. – 216 p. Praha.

OPIZ P. M. (1855): Mykologische Nachträge. – Lotos (Praha) 5: 213–218.

PETRAK F. (1920): Der mykologische Nachlaß Josef Jahn's, ein Beitrag zur Pilzflora des Egerlandes. – Ann. Mycol. (Berlin) 18: 105–135.

PETRAK F. (1923): Beiträge zur Pilzflora von Sternberg in Mähren. I. – Ann. Mycol. (Berlin), 21: 107–132.

PETRAK F. (1927): Beiträge zur Pilzflora von Sternberg in Mähren. II. – Ann. Mycol. (Berlin), 25: 344–388.

PETRAK F. (1940): Schedae ad Cryptogams exsiccatas. – Ann. Naturhist. Mus. Wien 51: 347–373.

PEYL J. (1857a): Beschreibungen einiger neuer Pilze. – Lotos (Praha) 7: 26–29.

PEYL J. (1857b): Beschreibungen einiger neuer Pilze. – Lotos (Praha) 7: 66–68.

PEYL J. (1858): Beschreibungen einiger neuer Pilze. – Lotos (Praha) 8: 30–32.

PODLAHOVÁ R.(1972): A contribution to the knowledge of Pyrenomycetes of the Lubietovský Vepor near the town Banská Bystrica (Central Slovakia). – Česká Mykol. 26(1): 43–57.

PODLAHOVÁ R. (1973): Über einige Pyrenomyceten auf *Alnus viridis* (Chaix) Lam. et DC. aus Südböhmen. – Česká Mykol. 27(2): 84–97.

PRÁŠIL K. (1984): Revize československých druhů rodu *Diatrypella* (Ces. et de Not.) de Not. – Kandidátská disertační práce. Přírodovedecká fakulta Univerzity Karlovy. Katedra botaniky nižších rostlin, 230 pp.

PRÁŠIL K. and RÉBLOVÁ M. (1998): Biodiversity of selected Ascomycetes groups in the Šumava Mountains. – Silva Gabreta 2: 7–22.

PRÁŠIL K. and ŠAŠEK V. (1977): Antibiotic activity of some Pyrenomycetes. – Česká Mykol. 31(1): 1–7.

PRÁŠIL K., ŠAŠEK V. and URBAN Z. (1973): Isolation and cultivation of some stromatic lignicolous Pyrenomycetes. – Česká Mykol. 27(3): 133–150.

RAPPAZ F. (1987a): Taxonomie et nomenclature de *Diatrype stigma*, *D. decorticata* et *D. undulata* (*Diatrypaceae*, Ascomycetes). – Mycotaxon 30: 209–219.

RAPPAZ F. (1987b): Taxonomie et nomenclature des Diatrypacées a asques octosporés. –Mycol. Helvetica 2(3): 285–648.

RÉBLOVÁ M. and PRÁŠIL K. (1999): Contribution to the knowledge of Ascomycetes and Deuteromycetes in the glacial cirques of the Šumava Mts. lakes. – Příroda (Praha) 14: 7–31.

SCHWEINGRUBER F. H. (1990): Anatomy of European woods. – WSL FNP, Bern & Stuttgart, 800 pp.

SVRČEK M. (1959): Resultate der mykologischen Durchforschung Böhmens für das Jahr 1958. 1. Der Winter- und Frühlingsaspekt der mittelböhmischen Mykoflora. – Česká Mykol. 13(3): 153–159.

SVRČEK M. (1990): A report on mycological trips to Krkonoše Mts. (Giant Mts.), Bohemia, in the years 1986–1989 – II. – Czech Mycol. 44(3): 140–146.

SVRČEK M. (2001): The fungi of the Javornická hornatina Mts – Ascomycetes. – Silva Gabreta 7: 199–210.

SVRČEK M. and KUBIČKA J. (1964): Fungi from the Žofínský Virgin Forest in the Novohradské Mountains (Southern Bohemia). – Česká Mykol. 18(3): 157–179.

SVRČEK M. and KUBIČKA J. (1971): Zweiter Beitrag zur Kenntnis der Mykoflora des Urwaldes "Žofínský prales" im Gebirge Novohradské hory (Südböhmen). – Česká Mykol. 25(2): 103–111.

THÜMEN F. (1875): Beiträge zur Pilz–Flora Böhmens. – Verh. Zool.–Bot. Ges. Wien 25: 523–554.

VESELSKY F. (1856): Die Pilze Böhmen's. (Fortsetzung.). – Oesterr. Bot. Wochenbl. 6: 109–110.

VESELSKY F. (1859): Nachtrag zu dem Verzeichnisse der Pilze Böhmens. – Oesterr. Bot. Zeitschr. 9: 387–403.

CZECH MYCOL. 57(1–2): 139–172, 2005

A revision of selected material of lignicolous species of *Brunnipila*, *Capitotricha*, *Dasyscyphella* and *Neodasyscypha* from the Czech Republic

MARKÉTA SUKOVÁ

Mycological Department, National Museum, Václavské nám. 68, 115 79 Praha 1, Czech Republic
e-mail: marketa.sukova@nm.cz

Suková M. (2005): A revision of selected material of lignicolous species of *Brunnipila*, *Capitotricha*, *Dasyscyphella* and *Neodasyscypha* from the Czech Republic. – Czech Mycol. 57: 139–172.

Selected material of lignicolous species of *Brunnipila*, *Capitotricha*, *Dasyscyphella* and *Neodasyscypha* from the Czech Republic was studied. Possible forms of *Brunnipila fuscescens* s.l. and their characters are outlined. The generic name *Dasyscyphus* (Nees) ex Gray typified by Korf using *D. virgineus* belongs to the synonymy of *Lachnum*. For its later homonym, *Dasyscyphus* Fuckel (nom. illeg.), the nomen novum *Neodasyscypha* Suková et Spooner is proposed. The replacing name *Neodasyscypha* was already earlier proposed by Spooner, but was published invalidly by him. The new combinations *Neodasyscypha cerina* (Pers.: Fr.) Spooner and *Neodasyscypha subciboria* (Rodway) Spooner are published.

Key words: Bohemia, Moravia, taxonomy, nomenclature, *Dasyscyphus*, *Lachnella brunneola* var. *fagicola*

Suková M. (2005): Revize vybraného materiálu lignikolních druhů rodů *Brunnipila*, *Capitotricha*, *Dasyscyphella* a *Neodasyscypha* z České republiky. – Czech Mycol. 57: 139–172.

Byly studovány lignikolní druhy rodů *Brunnipila* (hnědochlupka), *Capitotricha* (dlouhochlupka), *Dasyscyphella* (chlupáčkovec) a *Neodasyscypha* (pachlupáček) na vybraném materiálu z území České republiky. Možné formy v rámci širokého pojetí druhu *Brunnipila fuscescens* a jejich nejdůležitější znaky jsou načrtnuty. Rodové jméno *Dasyscyphus* (Nees) ex Gray s typovým druhem *D. virgineus* stanoveným Korfem patří do synonymiky rodu *Lachnum*. Pro jeho pozdější homonymum, *Dasyscyphus* Fuckel (nom. illeg.), je navrženo nahrazující jméno (nomen novum) *Neodasyscypha* Suková et Spooner. Jméno *Neodasyscypha* bylo již dříve navrženo Spoonerem, ale bylo publikováno neplatně. Jsou publikovány nové kombinace *Neodasyscypha cerina* (Pers.: Fr.) Spooner a *Neodasyscypha subciboria* (Rodway) Spooner.

INTRODUCTION

This contribution focuses on lignicolous species of selected genera of *Lachnaceae* (Nannf.) Raitv. (Raitviir 2004) from the Czech Republic.

Dennis (1949) had a wide generic concept of the genus *Lachnum* Retz. (as *Dasyscypha* Fuckel). He divided the genus into 9 sections, some of them belonging at present to *Hyaloscyphaceae* Nannf. emend. Raitviir (Raitviir 2004). Raitviir (1970) separated the following taxa from *Lachnum* s. l. (as *Dasyscyphus* Gray): *Dasyscyphella* Tranzschel, *Dasyscyphus* subgen. *Capitotricha* Raitv. and *Belonidium* Mont. et Durieu. Species of *Belonidium* s. Raitviir (1970) are currently placed in two or three genera named *Trichopeziza* Fuckel and *Lasiobelonium* Ellis et Everh. s. Spooner 1987 (including *Trichopezizella* Raitv.); according to Raitviir (1980) *Trichopezizella* is a separate genus. Baral (in Baral and Krieglsteiner 1985) divided *Dasyscyphus* subgen. *Capitotricha* Raitv. into three taxa and raised the emended subgenus to the generic level. *Capitotricha* (Raitv.) Baral includes only taxa formerly belonging to *Dasyscyphus bicolor* s.l. The newly described genus *Brunnipila* Baral includes brown-haired species and the new genus *Incrucipulum* Baral was described for small species with rather wide and thick-walled hairs bearing apical crystals and with a warted ectal excipulum. The division of *Lachnum* s.l. (s. Raitviir 1970, as *Dasyscyphus*) into *Brunnipila*, *Capitotricha* s. str., *Incrucipulum* and *Lachnum* s. str. was supported by ultrastructural studies of the morphology of hair wall and apical apparatus of the ascus (Leenurm et al. 2000). Also a molecular study (Cantrell and Hanlin 1997: 750) provided support for a separation of *Brunnipila* and *Capitotricha*. Later, Haines (1989) separated *Fuscolachnum* Haines from *Lachnum* s.l., which includes small, non-lignicolous species with brownish-coloured hair walls. Lately, also *Peziza cerina* Pers.: Fr. should be excluded and put into a genus of its own (see Raitviir 1980, Haines and Dumont 1984, Spooner 1987). This problem is discussed below under *Neodasyscypha*.

Studying discomycetes has a long tradition in the Czech Republic. This work is based on collections from the PRM herbarium. The majority of collections deposited there comes from the collectors M. Svrček and J. Velenovský.

MATERIAL AND METHODS

Material from herbarium specimens was prepared using tap water as a mountant. Microcharacters were first observed in water in several specimens of each species and in all *Dasyscyphella* specimens. Measurements and drawings of microcharacters were made in freshly made slides in 5 % KOH. Measurements of living cells (see Baral 1992), especially asci, would yield much larger values, and therefore paraphyses exceed dead asci distinctly more than living asci. Also spore arrangement (biseriate vs. uniseriate) strongly depends on the state: spores inside living asci are always biseriate in the species treated here (Baral 1992). The term "warted" is used as proposed by Leenurm et al. (2003). Before the publication, a less appropriate term was used for warted hair walls: "encrusted" or "incrustated". Amyloidity of the ascoapical apparatus was observed in Melzer's reagent mostly after pretreatment in 5 % KOH (marked KOH/MLZ), its reaction in Lugol's solution (IKI: 1 % iodine and 3 % KI in water) was observed in most cases without the KOH pretreatment. Apothecia in longitudinal section were studied in tap water. Ascus bases, croziers and the thickness of hair walls were studied mostly in KOH at a magnification of 2000x using an oil-immersion lens on an Olympus BX-51 microscope. The croziers are visible also at a magnification 1000x using an oil-immersion lens, at which the other characters were studied. Colours of dried apothecia are in some cases provided with numbers which come from a lexicon of colours (Kornerup and Wanscher 1981), e.g. '4–A5' means tab. 4, colour A5. Abbreviations used in the drawings are: 'h.' = hairs, 'a.' = asci, 'p.' = paraphyses, 's.' = ascospores. Selected material from the herbarium PRM was revised. Localities, substrata and dates from labels of important old collections are cited without square brackets and explanatory or additional information. Published records of studied species from the Czech Republic are listed. In case specimens of those were studied, results of the revision are given. Czech generic and specific names are proposed or follow earlier national literature. Unless stated otherwise, articles from the St. Louis Code (Greuter et al. 2000) are cited.

RESULTS

Key to species examined, based on studied material

In the following key, characters observed on dried material and in slides in KOH from dried material are used.

1a Hairs greyish brown with olive tint, roughly and irregularly warted, warts higher and their size variable (Fig. 11). Ascospores ellipsoidal, with rounded ends (8.5–10.5 × 2.3–3 µm). Asci arising from simple septa. – *Neodasyscypha cerina* (apothecia dark when dry, densely covered with olive brown hairs, paraphyses cylindrical-lanceolate, densely guttulate [in older specimens (c. from 1950) also guttulate, but guttules slightly smaller and less abundant]).
1b Hairs hyaline or brown, finely and regularly warted, warts not so high and their height almost invariable. If hairs brown, then ascospores fusiform to narrowly fusiform and asci arising from croziers [in lignicolous species].
2a Hairs with pigmented, brown wall; crystals or masses of refractive amorphous matter mostly present at (hair) apices – *Brunnipila*.

3a Hairs 137–157(–165) µm, asci 45–56 µm, mostly on *Corylus* – *Brunnipila calyculiformis*.

3b Hairs 70–113(–130) µm, asci 30–44 µm, frequent on *Fagus* cupules – *Brunnipila fuscescens*.

2b Hairs hyaline (sometimes lower part of hair becoming brown [cytoplasmatic pigment] on drying and sometimes remaining brown also after rehydratation on slide); crystals or refractive amorphous matter on hair apices not present or present, if present then hairs (110–)145–300 µm long.

4a Hairs (110–)145–300 µm long, wall (0.6–)0.75–1.6 µm thick, crystals at apices present at least on some hairs. – *Capitotricha* (apothecia densely covered with white hairs, discs orange or dark orange).

5a Ascospores longer, c. (6.4–)8.4–11(–12.3) µm, on *Fagus*. – *Capitotricha fagiseda*.

5b Ascospores shorter, c. (6.4–)7.4–9.2(–9.9) µm, on *Quercus*, *Crataegus*, *Betula*, *Corylus*. – *Capitotricha bicolor*.

4b Hairs up to 120(–160) µm long, wall up to 0.9(–1) µm thick, crystals at hair apices never present (sometimes octahedral crystals present among hairs, but usually not at hair apices).

6a Apical cell of hair or also part of subapical cell smooth. – *Dasyscyphella* (outer surface of dried apothecia often covered with lumps of pale orange to dark orange resinous matter).

7a On cones of conifers. – *Dasyscyphella conicola*.

7b On wood.

8a Paraphyses 3–5 µm wide, protruding for 10–29 µm (exceeding the asci), asci arising from simple septa. – *Dasyscyphella crystallina*.

8b Paraphyses up to 3 µm wide, protruding for up to 10(–12.5) µm, asci arising from croziers. – *Dasyscyphella nivea*.

6b Apical hair cell as well as whole surface of the hairs warted (warts sometimes absent in lower part of hair, especially when marginal hairs are dense, or on apex of hair). – *Lachnum* (a key to *Lachnum* species will be published in another article).

LIST OF SPECIES

Brunnipila Baral – hnědochlupka

Brunnipila Baral in Baral et Krieglst., Beih. Z. Mykol. 6: 49, 1985.
Type species: *Peziza clandestina* Bull.: Fr.

Note: Hair apices observed in studied material were naked (Fig. 3A) or possessed amorphous refractive matter (as illustrated here especially in Fig. 1; previously observed in *Brunnipila calycioides* by Scheuer 1988: 218–219 and Suková 2004: 68) or with crystals of octahedral shape (Fig. 3B). The crystals of octahedral shape were less sharp than crystals known from the genus *Incrucipulum* Baral, where the crystals are more regular and sharper (see e.g. Chlebicki and Suková in print).

Brunnipila calyculiformis (Schumach.: Fr.) Baral Fig. 1.

Peziza calyculiformis Schumach., Enumeratio plantarum 2: 425, 1803. – *Peziza calyculiformis* Schumach.: Fr., Syst. Mycol. 2(1), p. 94, 1822. – *Lachnum calyculiforme* (Schumach.: Fr.) P. Karst., Bidrag Kännedom Finlands Natur Folk 19: 178, 1871. – *Brunnipila calyculiformis* (Schumach.: Fr.) Baral in Baral et Krieglst., Beih. Z. Mykol. 6: 49, 1985.

Description. Dried apothecia stipitate, 0.65–1.1 mm high, 0.55–1.2 mm in diam., outside brown, covered with brown hairs, hairs often with pale (almost white) crystals on their apices, discs pale ochraceous. Hairs brown (dark or with beige or olive tint), warted, 5–9(–13)-septate, 137–157(–165) × 3.5–6 µm, with walls 0.7–1 µm thick, often bearing amorphous, hyaline, refractive matter or crystals of octahedral shape at their tips, young hairs paler in their upper part. Asci arising from croziers, 8-spored, 45–56 × 4–5 µm, KOH/MLZ blue. Ascospores hyaline, one-celled, narrowly fusiform, (6.5–)7–9.6 × 1.5–2 µm. Paraphyses lanceolate with acute tips, 2.8–5(–6) µm wide, exceeding asci for (11–)15–19 µm.

Comments. In the Czech Republic this species is known only from *Corylus avellana*. Dimitrova (2002) reported it from Bulgaria also from *Corylus*. It seems that it is the most common host of this fungus. However, Dennis (1949) reported the species also from *Alnus* and Nannfeldt (1928) from *Sorbus aucuparia*. Baral (in Baral and Krieglsteiner 1985) reported it from *Alnus* sp., *Alnus incana*, *Corylus* and *Acer*.

Published records: Velenovský 1934: 246 (as *Lachnum calyculiforme*, Central Bohemia, Hrusice, on beech cupule – revised, the specimen (PRM 151461) contains one apothecium, it is *B. calyculiformis*, hairs of the material were 135–165 × 4–6 µm and paraphyses 5–6 µm wide; but the substrate is not present in the specimen).

Material revised: Central Bohemia: Mnichovice, on small twig of *Corylus avellana*, April 1934, leg. et det. J. Velenovský, PRM 152047. – [Central Bohemia, Hrusice, brick-field] "Hrusická cihelna", [substrate not present in the specimen, said to be from] *Fagus* cupules, July 1931, leg. et det. J. Velenovský, PRM 151461. – Southern Bohemia: Orlík, valley of Vltava river, gorge, on corticated twigs of *Corylus avellana*, 12 May 1955, leg. et det. M. Svrček, PRM 816242. – Ounuz near Jistebnice, on twigs (wood and bark) of *Corylus avellana*, 28 May 1950, leg. et det. M. Svrček, PRM 816239. – Kaplice, valley of Malše river, Loužek ruin, on cortex of twig of *Corylus avellana*, 29 July 1971, leg. et det. M. Svrček, PRM 802066.

Brunnipila fuscescens (Pers.: Fr.) Baral – hnědochlupka nahnědlá Fig. 2, 3.

Peziza fuscescens Pers., Syn. Meth. Fung., p. 654, 1801. – *Peziza fuscescens* Pers.: Fr., Syst. Mycol. 2(1), p. 95, 1822. – *Dasyscyphus fuscescens* (Pers.: Fr.) Gray, Nat. Arrang. Brit. Pl. 1: 671, 1821. – *Lachnum fuscescens* (Pers.: Fr.) P. Karst., Acta Soc. Fauna Fl. Fenn. 2(4): 134, 1885 (n.v.). – *Brunnipila fuscescens* (Pers.: Fr.) Baral in Baral et Krieglst., Beih. Z. Mykol. 6: 50, 1985.

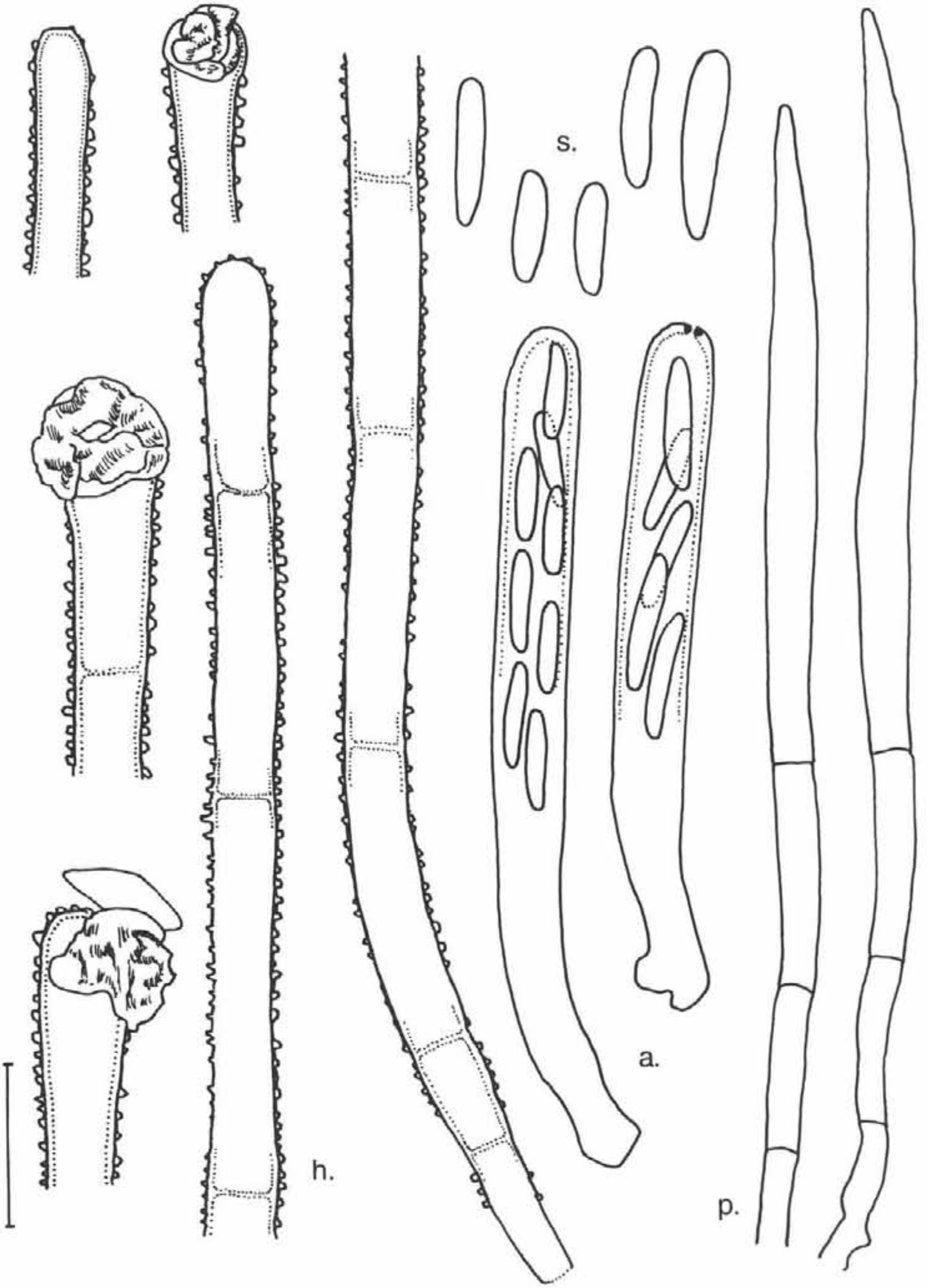


Fig. 1. *Brunnipila calyculiformis* (Schumach.: Fr.) Baral, PRM 802066. Scale bar = 10 µm. For explanations see Material and Methods.

Description (material from *Fagus* cupules). Dried apothecia stipitate, 0.4–0.6 mm high, 0.3–0.6(–0.7) mm in diam., outside pale brown (cf. 5–D6 to 5–D8) to brown (6–E8), covered with concolorous hairs, hairs usually with whitish crystals on their apices, discs orange yellow (4–A6 to A8). Hairs brown, warted, up to 5–septate, 70–113(–130) × 4.8–6.2 µm, with walls 0.5–0.8(–1) µm thick, often bearing amorphous, hyaline, refractive matter or crystals of octahedral shape at their tips, very young hairs almost hyaline. Asci arising from croziers, (6–)8–spored, 30–44 × (3–)3.5–4.5 µm, MLZ very slightly blue, KOH/MLZ blue, IKI blue, KOH/IKI deeply dark blue. Ascospores one-celled, mostly narrowly fusiform, (5.8–)6.5–8.5(–10.5) × 1.3–1.9 µm (average 7.45 × 1.6 µm). Paraphyses lanceolate with acute tips, (3.3–)3.7–5.1(–6) µm wide, exceeding asci for (9–)10–19(–22.5) µm (average 14.6 µm).

Comments. Various taxon epithets have been described in literature, which most probably belong to the synonymy of *Brunnipila fuscescens* (Pers.: Fr.) Baral s.l. (see Tab. 1). Moreover, some varieties or even separate species were distinguished.

I also found some differences in the studied material. The differences in ascospore width, in the literature (Le Gal 1939, Dennis 1949, Baral in Baral and Krieglsteiner 1985) considered to be an important distinguishing character (ascospores 1.5–2 vs. 2–2.5 µm wide) proved to be less conspicuous in the studied dried material, although they were observed (see Tab. 2). Moreover, it seems that the differences in microcharacters do not correlate with the substrate (Tabs. 1, 2).

Short-stalked, often dark coloured apothecia collected on *Quercus* leaves often had slightly darker hairs, flank hairs with capitate apices were more abundant than in other material and the ascospores were relatively wide. It is possible that this form could be a separate species as mentioned by Le Gal (1939) and Baral (in Baral and Krieglsteiner 1985). Persoon's *Peziza dryophila* (Persoon 1822) might correspond with this short-stalked form. *Peziza dryophila* was originally even described as "sessile", but hairy and brown in contrast to the sessile *Mollisia rabenhorstii* (Auersw.) Rehm common on *Quercus* leaves. The name *Lachnella brunneola* (Desm.) W. Phillips in its original sense (Desmazières 1842 as *Peziza brunneola*, *Quercus* leaves) probably relates to this form according to the description provided by Le Gal (1939), who revised a specimen from Desmazières's exsiccate collection.

Not so dark, relatively long-stalked apothecia with cylindrical or only slightly enlarged hairs apices, moderately wide ascospores and not too much protruding paraphyses named *Lachnella brunneola* (Desm.) W. Phillips by Le Gal (1939) and reported from *Fagus* leaves, have been observed by me on *Fagus* cupules and *Quercus* leaves. The name of a species originally described from *Fagus* leaves (Persoon 1801) seems to be appropriate for it: *Brunnipila fuscescens* (Pers.: Fr.) Baral. In the case its neotypification is needed, I would suggest to select material with less protruding paraphyses rather than material of the rare form with more protruding paraphyses described below.

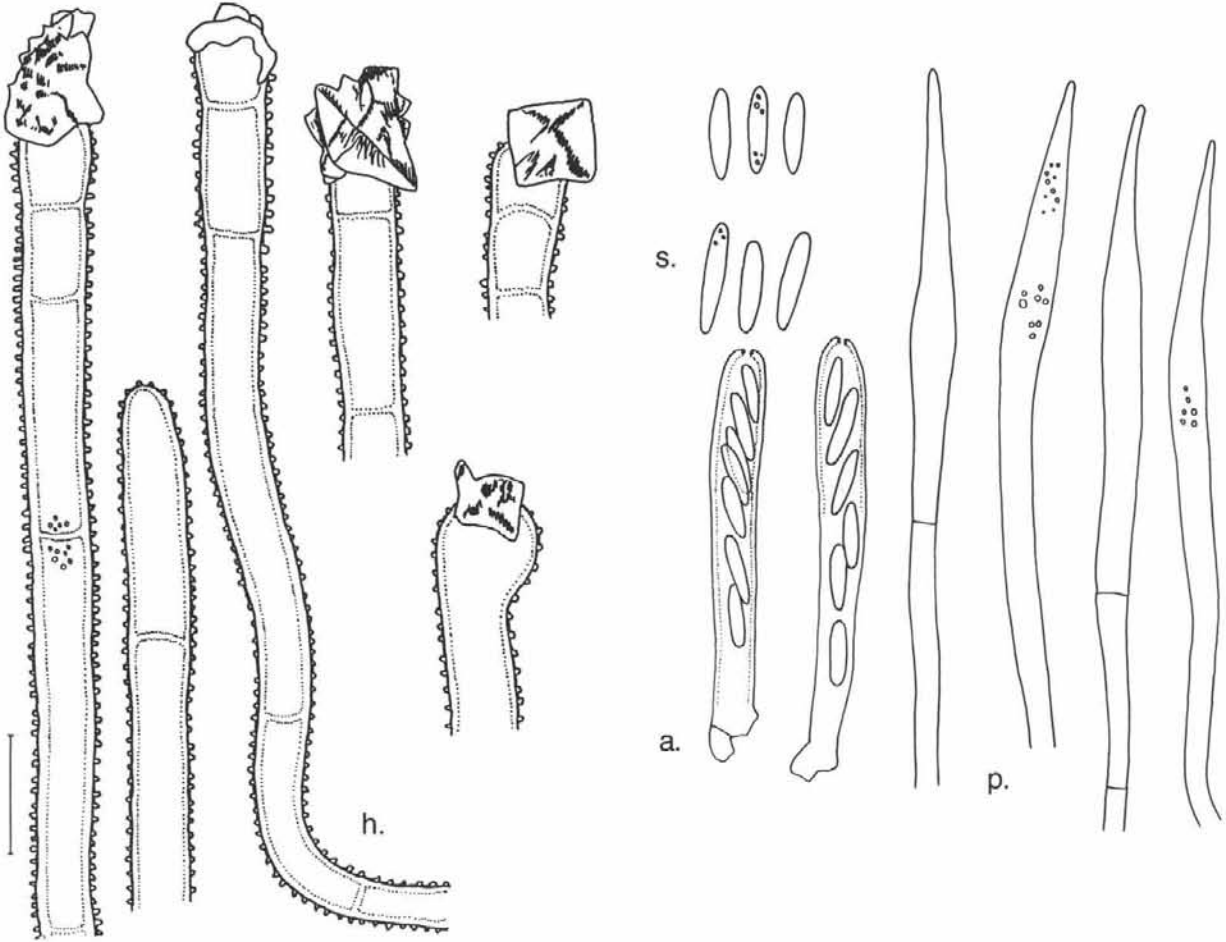


Fig. 2. *Brunnipila fuscescens* (Pers.: Fr.) Baral, PRM 816299. Scale bar = 10 µm. For explanations see Material and Methods.

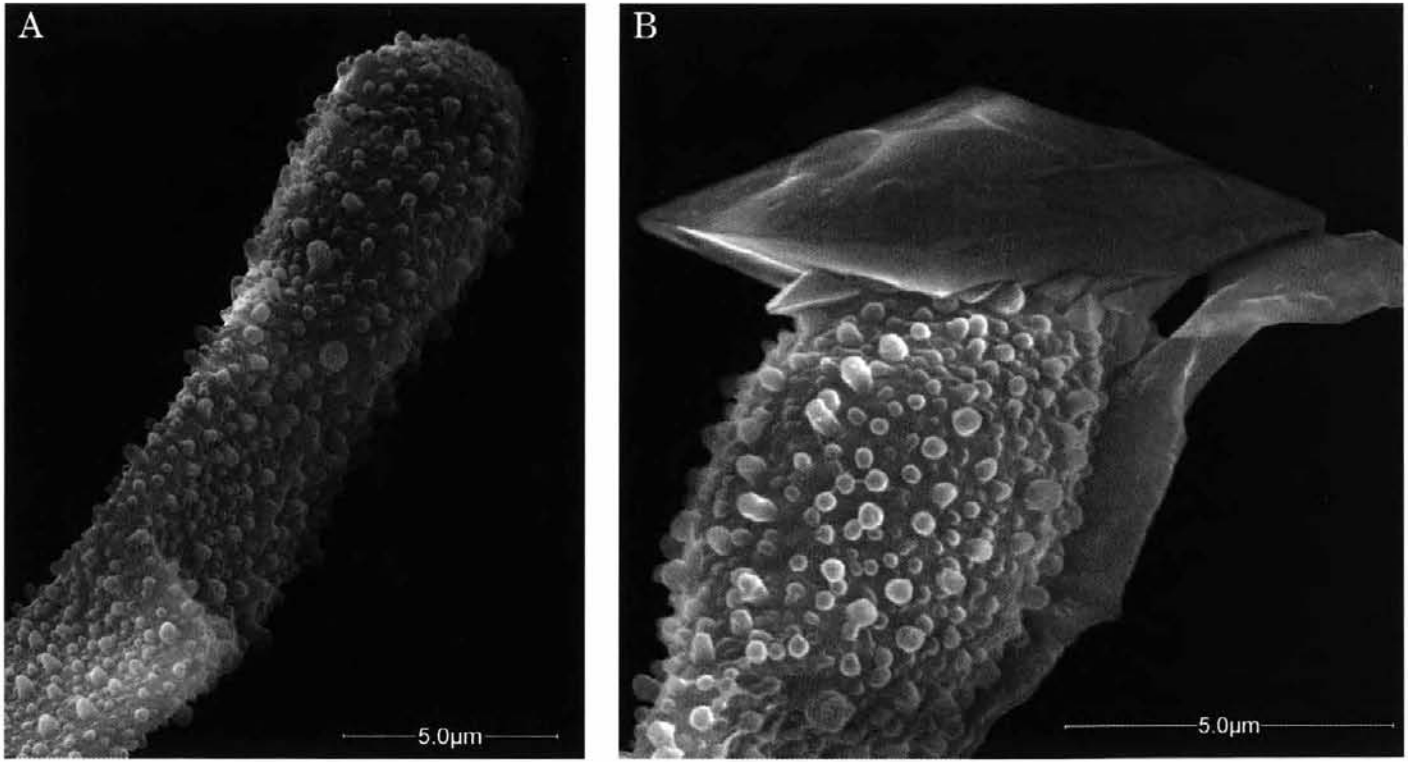


Fig. 3. *Brunnipila fuscescens* (Pers.: Fr.) Baral on *Fagus* cupules (PRM 902331), SEM photographs of hairs: A. hair without apical crystals, B: hair with apical crystals.

Tab. 1. Epithets belonging to the synonymy of *Brunnipila fuscescens* s.l. and substrates from which they were reported. *Dasyscyphus brunneolus* (Desm.) Sacc. was included in the synonymy of *Dasyscyphus fuscescens* by Rehm (1893: 900) and Dennis (1949). *Peziza dryophila* Pers. might belong to the synonymy of *Brunnipila fuscescens* s.l. according to Saccardo (1889: 460) and Rehm (1893: 900), but they considered only *Peziza dryophila* Pers. sensu other authors, not its protologue or type. Indexes B, D, FA and FU are abbreviations for '*brunneola*', '*dryophila*', '*fuscescens* forma *fagicola*' and '*fuscescens* f. *fuscescens*' and indicate my opinion on the material based on descriptions published by the authors. *Peziza brunneola* Desm. was evaluated according to the description provided by Le Gal (1939), who revised a specimen from Desmazières's exsiccate collection.

author	**year**	**according to**	**rank of '*fagicola*'**	**leaves of another tree or other trees**	***Quercus* leaves**	***Fagus* leaves**	***Fagus* cupules**	***Alnus* catkins**
Persoon	1801	Persoon (1801)	–	–	–	***fuscescens***$^{\mathrm{(FU)}}$ **1801**	–	–
Persoon	1822	Persoon (1822)	–	–	***dryophila***$^{\mathrm{(D–B?)}}$ **1822**	*fuscescens*	–	–
Desmazières	1842	Desmazières (1842)	–	–	***brunneola***$^{\mathrm{(B)}}$ **1842**	–	–	–
Phillips	1887	Phillips (1893)	var. under '*brunneola*'	*brunneola*	*brunneola*	–	***fagicola***$^{\mathrm{(FA)}}$ **1887**	–
Boudier	1907, 1911	Boudier (1907, 1911)	var. under '*brunneola*'	–	*brunneola*	*fagicola*	–	–
Boudier	1907, 1911	Korf (1985)	–	–	*?fuscescens*	*fuscescens*	–	–
Le Gal	1939	Le Gal (1939)	species	–	–	*brunneola*$^{\mathrm{(FU)}}$	*fagicola*$^{\mathrm{(FA)}}$	–
Dennis	1949	Dennis (1949)	var. under '*fuscescens*'	–	*fuscescens*	*fuscescens*	*fagicola*	–
Baral	1985	Baral (in Baral and Krieglsteiner 1985)	species	*fagicola*	*fuscescens*$^{\mathrm{(B)}}$	*fagicola*	*fagicola*	*fagicola*
Suková	2005	–	–	–	*brunneola*$^{\mathrm{(B)}}$ *fuscescens*$^{\mathrm{(FU)}}$	*fagicola*$^{\mathrm{(FA)}}$	*fuscescens*$^{\mathrm{(FU)}}$	–

Tab. 2. Small differences in morphological characters demonstrated on selected specimens of *Brunnipila fuscescens* s.l. (herbarium material studied in KOH). Indexes B, FA and FU ('*brunneola*', '*fuscescens* forma *fagicola*' and '*fuscescens* f. *fuscescens*') are used in the same sense as in Tab. 1.

specimen	**substrate**	**dried apothecia**	**stalks**	**colour of hairs**	**ascospores (µm)**	**average (µm)**	**paraphyses exceed asci for (µm)**	**average (µm)**
PRM 900754 (B)	*Quercus* leaves	**hemisphaerical**, dark	**short**, widened towards cup	**darker**	6.8–8.8(–9.7) × 1.5–2.2	7.88 × **1.85**	(13–)14.5–20.5(–23)	17.5
PRM 907154 (B)	*Quercus* leaves	rather dark, basis darkened	**short**, widened towards cup	paler	6.7–7.2 × 1.7–2.0	6.85 × **1.85**	(15–)16.5–22.5	19.6
PRM 907156 (FU)	*Quercus* leaves	**plane, marginate**, dark	short or longer	paler	(6.4–)6.8–8.8(–9.6) × 1.3–1.8	7.81 × 1.53	9.5–14.5(–16)	12.2
PRM 900754 (FU)	*Quercus* leaves	**plane, marginate**, pale	longer	paler	6.8–8.5(–9.3) × 1.4–1.6	7.64 × 1.51	13–18.3(–20)	16.1
PRM 684251 (FU)	*Fagus* cupules	dark	long	paler	6.3–7.9 × 1.4–1.8	7.09 × 1.63	–	–
PRM 816299 (FU)	*Fagus* cupules	paler	long	paler	(5.8–)6.5–8.5(–10.5) × 1.3–1.9	7.42 × 1.60	(12–)14–21.3(–22.5)	17.6
PRM 902331 (FU)	*Fagus* cupules	paler	long	paler	6.7–8.5(–9.2) × 1.4–1.7	7.67 × 1.56	(7.5–)9.5–17.2	11.9
PRM 900742 (FA)	*Fagus* leaves	rather dark, outer flanks and stipe darkened*	long	paler	(6–)6.6–8(–8.4) × 1.4–1.7	7.33 × 1.48	30–37(–42)	**33.7**

* Apothecia with thickened surface cells of excipulum and with rare flank hairs were present in the collection, but in my opinion, it should not be considered a difference with '*Brunnipila fuscescens* f. *fuscescens*'. According to Suková (2004) apothecia of such kind were observed also on some *Juncus* stems in populations of *Brunnipila calycioides* with prevailing 'normal' apothecia (with non-darkened and rich haired outer surface). Possibly the apothecia were older than the 'normal' apothecia or were more insolated.

A form with more protruding paraphyses was described by Phillips as *Lachnella brunneola* var. *fagicola* W. Phillips and accepted by Le Gal as a separate species. I have observed this form only on *Fagus* leaves, but according to Phillips (1887) and Le Gal (1939) it can occur also on cupules of *Fagus*. The only distinct difference is in fact the length of the paraphyses which is in my opinion not sufficient for distinguishing it at species level. I would prefer distinguishing the long-paraphysate material no higher than at form level (*Brunnipila fuscescens* f. *fagicola*).

Published records: Svrček 1953: 207 (as *Lachnum fuscescens* (Pers.) P. Karst. f. *fagicola* (W. Phillips) 'Svrček' [should be considered a provisional combination, without citation of basionym and not indicated as a new combination], Central Bohemia, Protected Landscape Area Křivoklátsko, valley of Klíčava brook, on *Fagus sylvatica* – revised, PRM 816299, on cupules: it has less exceeding paraphyses and ascospores on average 1.6 µm in diam.). – Svrček 1986: 14 (Western Bohemia, Horomyslice, Bečvářka forest, on cupules of *Fagus sylvatica*). – Suková in Prášil 1999: 24 (Hřebeny hills, Řevnice, valley of Moklický potok brook, on cupules of *Fagus*) as *Lachnum fuscescens* var. *fagicola* (W. Phillips) 'Dennis' [erroneous citation of author, as a variety it has never been combined into *Lachnum*]. – Réblová and Prášil 1999: 30 (Šumava Mts., Černé jezero lake and Mt. Ždanidla, on *Fagus sylvatica*). – Papoušek 2004: 44 (Southern Bohemia, Novohradské hory Mts., Žofínský prales virgin forest, on beech cupule – revised) as *Lachnum fuscescens* var. *fagicola* (W. Phillips) 'Dennis' [mistake in citation of author introduced by Suková in Prášil (1999)].

Material revised (from cupules of *Fagus sylvatica*): Central Bohemia, Protected Landscape Area Křivoklátsko, valley of Klíčava brook, on beech cupules, 28 May 1948, leg. et det. M. Svrček (as *Lachnum fuscescens* (Pers.) P. Karst. f. *fagicola* (W. Phillips)), PRM 816299. – Protected Landscape Area Český kras, NW of Dobřichovice, Karlické údolí (valley), alt. 250–280 m, 25 May 2002, leg. et det. M. Suková, PRM 900750. – Southern Bohemia: Šumava Mts., Mt. Ždanidla (alt. 1308 m) near Prášily, 18 June 1997, leg. et det. M. Svrček, PRM 891845, 891839. – Šumava Mts., Boubínský prales virgin forest, on cupules of *Fagus*, 1 June 1974, leg. et det. M. Svrček, PRM 902331. – Novohradské hory Mts., Žofínský prales virgin forest, 17 April 1970, leg. J. Kubička, det. M. Svrček (as *Dasyscyphus fuscescens* var. *fagicola* (W. Phillips) Dennis), PRM 816300 (too young material, asci not developed, paraphyses long, but still immature with non-acute apices, can be identified only as *Brunnipila fuscescens* s.l.). – Moravia: Veveří, "Obora" forest, 18 May 1969, leg. et det. M. Svrček (as *Dasyscyphus fuscescens* var. *fagicola* (W. Phillips) Dennis), PRM 684521.

Comparative material from leaves of *Fagus sylvatica* and *Quercus* studied: Central Bohemia: Protected Landscape Area Český kras [Bohemian Karst], Srbsko, Doutnáč hill, on fallen leaves of *Quercus*, together with *Mollisia rabenhorstii* (Auersw.) Rehm, 16 May 2002, leg. et det. M. Suková, PRM 907154. – Český kras, Srbsko, SE slope of Doutnáč hill, on fallen leaf of *Quercus*, 16 May 2002, leg. et det. M. Suková, PRM 907156. – Český kras, Velká hora hill near Karlštejn, on fallen leaves of *Quercus pubescens*, 22 May 1960, leg. et det. M. Svrček, PRM 620064. – Český kras, Karlické údolí valley, to 400 m N of Karlík, alt. 245 m, on fallen leaves of *Fagus sylvatica*, 25 May 2002, leg. et det. M. Suková, PRM 900742. – NW of Dobřichovice, Karlické údolí valley, alt. 250–280 m, on *Quercus* leaves, 25 May 2002, leg. et det. M. Suková, PRM 900754. – Vrané nad Vltavou, on *Quercus* leaves, 31 May 1953, leg. et det. M. Svrček, PRM 816297. – Zvánovické údolí, on leaves of *Quercus rubra*, 24 May 1944, leg. et det. M. Svrček, PRM 690212.

Capitotricha (Raitv.) Baral – dlouhochlupka

Dasyscyphus subgen. *Capitotricha* Raitv. pro parte, Scripta Mycol. 1: 88, 1970. – *Capitotricha* (Raitv. emend. Baral) Baral in Baral et Krieglst., Beih. Z. Mykol. 6: 60, 1985.

Type species: *Peziza bicolor* Bull.: Fr.

Capitotricha bicolor (Bull.: Fr.) Baral – dlouhochlupka dvoubarvá Fig. 4, 6.

Peziza bicolor Bull., Herb. France, Tom. 9, Fasc. 97–108, Pl. 410, Fig. 3, 1789. – *Peziza bicolor* Bull.: Fr., Syst. Mycol. 2(1), p. 92, 1822. – *Dasyscyphus bicolor* (Bull.: Fr.) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 305, 1870. – *Lachnum bicolor* (Bull.: Fr.) P. Karst., Bidrag Kännedom Finlands Natur Folk 19: 172, 1871. – *Capitotricha bicolor* (Bull.: Fr.) Baral in Baral et Krieglst., Beih. Z. Mykol. 6: 60, 1985.

Description. Dried apothecia (0.3–)0.4–0.65(–0.85) mm high, 0.55–1.0(–1.8) mm wide, short-stalked, stalks mostly almost smooth, beige to brown, 70–260(–450) µm high (average 136.5 µm) and 90–180(–230) µm wide (average 105 µm), height/width ratio (0.57–)0.69–1.38(–1.65), average 1.04, discs orange (5–A6), up to dark orange (6–A8), outer surface of cup densely covered with pure white, long hairs, with more or less frequent small, white crystals at their apices (visible at magnification 32x). Hairs hyaline, warted, cylindrical or with enlarged apices, 180–240(–260) × (2.6–)3–4.2(–4.6) µm (average length 206 µm), with walls 0.75–1.2 µm thick, multiseptate, frequently bearing crystals at their tips. Asci arising from simple septa, 40–60 × 4.5–5.4 µm. Ascospores rather straight, one-celled, hyaline, tapering to both ends, (6.4–)7.4–9.2(–9.9) × (1.5–)1.7–2.1(–2.2) µm, non-guttulate or with several small guttules in plasma. Paraphyses lanceolate with acute to subacute (conical) tips, with more or less numerous small guttules in plasma, (2.4–)3–4.2 µm wide, exceeding asci for 6.5–23 µm.

Habitat. Corticated twigs of *Quercus*, *Crataegus*, *Betula* and *Corylus avellana*, decorticated twigs of *Crataegus* and partially decorticated twigs of *Crataegus* in top of this tree.

Comments. Baral (in Baral and Krieglsteiner 1985) proposed that two taxa could be distinguished in *Capitotricha bicolor* (s.l.) – one growing on twigs and cupules of *Fagus*, and the other one on twigs of other hosts. The former ('*C. fagiseda* Baral, nom. prov.) is characterised by him as having somewhat longer spores in fresh state (9–15(–17) × 2.5 µm) compared to *C. bicolor* s. str. (7–12 × 2–2.5 µm). This difference was confirmed, although in herbarium material ascospores of both taxa are smaller than in living material. Further differences were noted in the thickness of stalks and excipulum. Stalks were on average slightly shorter and broader in material from *Quercus*, *Crataegus* and other deciduous trees (Fig. 6). Apothecia in this material were also usually slightly smaller and often entirely closed (with non-visible discs), however, not absolutely: e.g. overmature apothecia on a *Quercus* twig were 600–850 µm high, 720–900(–1800) µm wide and usually open in specimen PRM 690113. In macroscopical view it seemed to me that hairs of the fagicolous form are longer and not so abundant. In measurements hairs in material from *Fagus* are on average of the same length, but the length is more variable. Crystals at hair apices were more frequent in the non-fagicolous material.

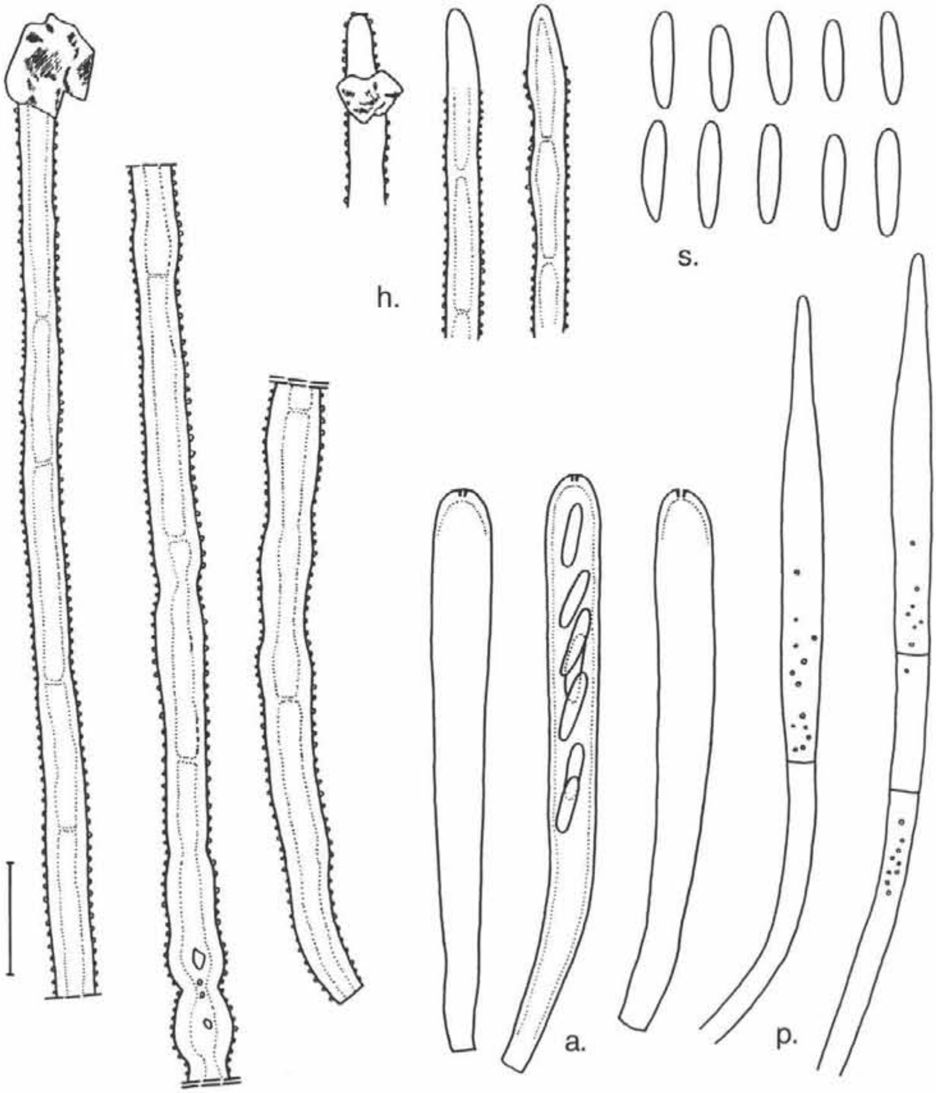


Fig. 4. *Capitotricha bicolor* (Bull.: Fr.) Baral, PRM 690111. Scale bar = 10 µm. For explanations see Material and Methods.

I accept that the fagicolous material (described below) belongs to a separate species which should be distinguished from *Capitotricha bicolor*. The original substrate of *Peziza bicolor* Bull. illustrated by Bulliard (1789) is possibly a twig of *Quercus*, but this is not unambiguous. Some studied specimens from PRM contain *Quercus* twigs with long internodia and thin bark with longitudinal furrows similar to Bulliard's illustration. In Bulliard's later work (1791: 243–244), where descriptions to previously published icones were published, also only deciduous twigs are mentioned as the substrate, but he did not specify the concrete tree. As according to my observation Bulliard (1789) illustrated the short-stalked form of apothecia in original work, the epithet *bicolor* should be used for the non-fagicolous taxon.

Published records: Zimmermann 1909: 75 (Southern Moravia, Lednice, on *Quercus* – revised, PRM 690106). – Velenovský 1934: 248 (as a common species, on twigs, wood and cupules of *Quercus*, twigs of *Betula* – revised, PRM 147387, 147638, 147900, 149636). – Picbauer 1942: 183 (Northern Moravia, Kamenice forest near Turovice, on *Quercus robur*).

Material revised: Central Bohemia: Koněprusy, on *Quercus* twigs, 26 April 1942, leg. et det. V. Vacek, PRM 690112. – Srbsko, Koda, on *Crataegus* twigs, 17 April 1949, leg. et det. V. Vacek, PRM 690111. – Karlštejn, foot of Velká hora and Koníček (hills), on twigs of *Crataegus* in crown of the tree, 11 October 1953, leg. et det. M. Svrček, PRM 816215. – Liteň near Zadní Třebáň, by a pond, on twigs of *Quercus robur*, 2 April 1961, leg. et det. M. Svrček, PRM 615928. – Liteň (near Zadní Třebáň), in Mramor valley, on twigs of *Crataegus* sp., 9 May 1962, leg. et det. M. Svrček, PRM 568482. – Všenory, [on twigs of *Quercus*,] 21 April 1923, leg. et det. J. Velenovský, PRM 149636. – Všenory, on twig of *Quercus*, 4 January 1942, leg. et det. V. Vacek, PRM 690113. – Praha – Zadní Kopanina, on deciduous twigs (*Quercus*), 14 March 1948, leg. et det. V. Vacek, PRM 690123. – Praha – Radotín, on twigs of *Quercus*, 26 February 1950, leg. Z. Pouzar, det. M. Svrček, PRM 623182. – Praha – Hvězda (= Stern), on twig of *Quercus*, date not given, leg. et det. Eck (as *Peziza bicolor* Bull.), PRM 727177, 727178, 727185, 727199, 727204. – Zahořany near Davle, on [dead] twigs of *Quercus* in crown of [living] tree, 6 April 1946, leg. et det. M. Svrček, PRM 816217. – Mnichovice, on twig of *Betula alba* [= *Betula pendula*], August 1926, leg. et det. J. Velenovský, PRM 147900. – Mnichovice, on twigs of *Quercus*, May 1923, leg. et det. J. Velenovský, PRM 147387 (very old, probably overwintered material). – Hrusice, on twigs of *Betula alba* [= *Betula pendula*], 13 June 1923, leg. et det. J. Velenovský, PRM 147638. – Southern Bohemia: Čimelice, *Quercus* forest at Nerestec pond, on twigs in top of tree, *Quercus* sp. (rare), 19 August 1964, leg. et det. M. Svrček, PRM 613283. – Čimelice, Chlum forest, on fallen twigs of *Quercus* sp. (rare), 4 July 1965, leg. et det. M. Svrček, PRM 610639. – Smržov near Lomnice nad Lužnicí, by Dvořiště pond, on twigs of *Quercus* sp., 30 May 1960, leg. et det. M. Svrček, PRM 620059. – Třeboň, under Stupský rybník (pond), on twig of *Quercus* sp., 12 May 1966, leg. et det. M. Svrček, PRM 622523. – Třeboň, Holičky, Vlčí luka, on twigs of *Quercus* sp., 1 March 1959, leg. J. Kubička, det. M. Svrček, PRM 613837. – Třeboň, forest by Fráterský rybník (pond), on twig of *Quercus* sp., 19 May 1964, leg. et det. M. Svrček, PRM 611404. – Třeboň, on dike of Rožmberk pond, on twig of *Quercus* sp., 22 May 1964, leg. et det. M. Svrček, PRM 611405. – Eisgrub [Lednice], Unterwald forest, on twigs of *Quercus robur*, March 1907, leg. et det. H. Zimmermann, PRM 690106, 690117.

Capitotricha fagiseda nom. prov. Fig. 5, 7.

Capitotricha fagiseda nom. prov. proposed by Baral in Baral et Krieglst., Beih. Z. Mykol. 6: 60, 1985.

Description. Fresh apothecia (PRM 907157) 0.6–1.6 mm high, 1.2–2.4 mm in diam., with brightly white hairs and orange-yellow discs, stalks 180–580 µm long. Dried apothecia 0.5–0.8 mm high, 0.5–1.4 mm wide, stalks often covered with some hairs, white or pale beige, (100–)150–400(–600) µm high (average 273 µm) and (90–)100–240(–310) µm wide (average 170 µm), height/width ratio (0.83–)0.95–2.26(–2.92), average 1.61, discs orange (5–A6), outer surface of cup densely covered with pure white, long hairs rather frequently with small, white

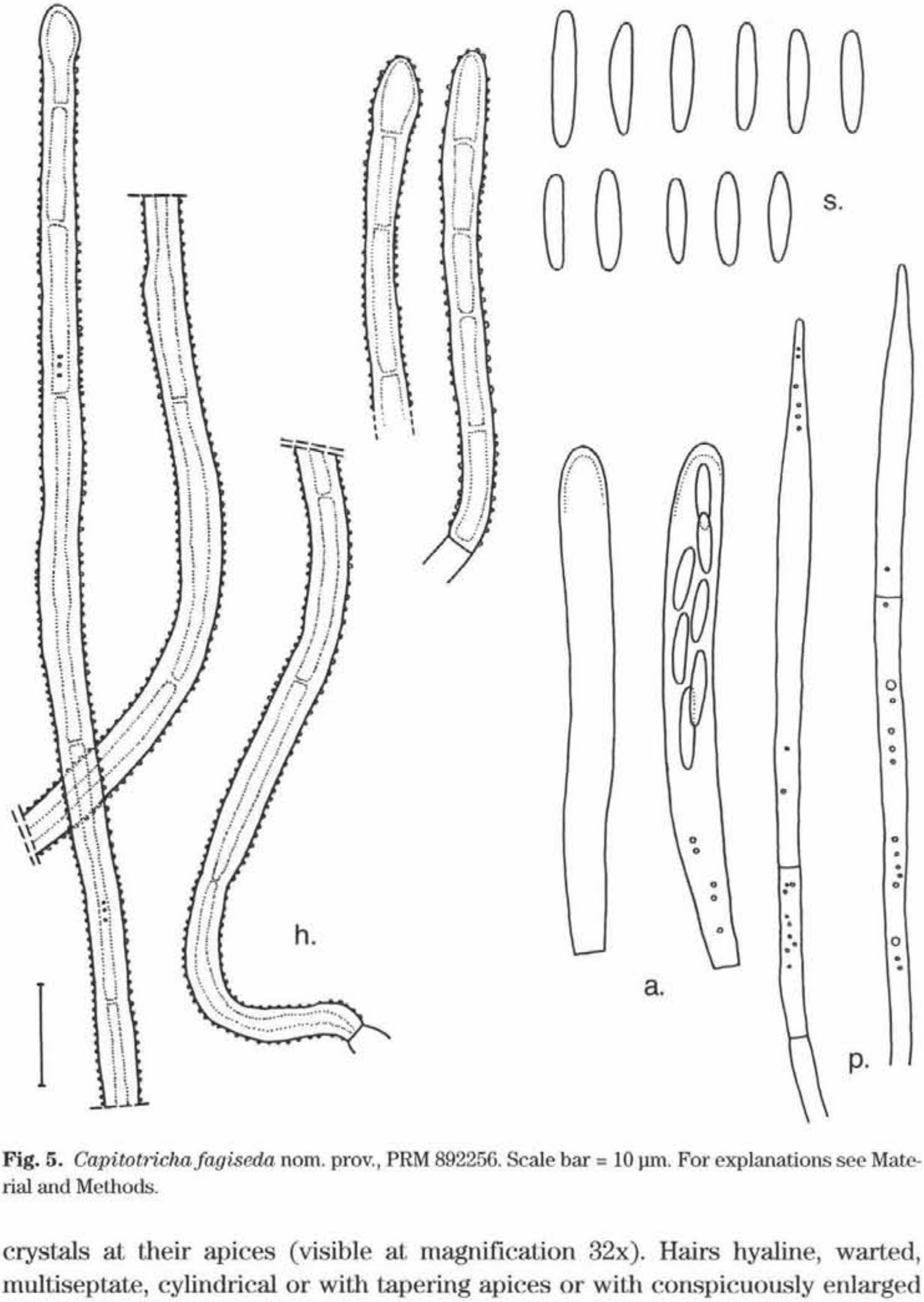


Fig. 5. *Capitotricha fagiseda* nom. prov., PRM 892256. Scale bar = 10 µm. For explanations see Material and Methods.

crystals at their apices (visible at magnification 32x). Hairs hyaline, warted, multiseptate, cylindrical or with tapering apices or with conspicuously enlarged apices, (110–)145–275(–300) × 3–4.5 µm (average length 210 µm), with walls (0.6–)0.8–1.6 µm thick, often bearing crystals (8.5–14 µm diam.) at their tips. Asci arising from simple septa, (38.5–)40–62 × (4.3–)4.6–5.6 µm. Ascospores straight or slightly inequilateral, one-celled, hyaline, tapering to both ends, (6.4–)8.4–11(–12.3) × (1.5–)1.9–2.3(–2.6) µm, non-guttulate or with several small guttules in plasma. Paraphyses lanceolate with acute tips, with more or less numerous small guttules in plasma, (2.4–)3.2–4.5 µm wide, exceeding asci for 6.5–21(–25) µm.

Habitat. Small corticated twigs, bigger decorticated twigs, twigs in the tree top, wood of a lying trunk, wood of a standing trunk, cupules and, moreover, a petiole of a leaf (PRM 690120), all of *Fagus*.

Comments. Differences between *Capitotricha fagiseda* and *C. bicolor* are discussed under *C. bicolor*.

Since an interesting, still unidentified material of *Capitotricha bicolor* s.l. was found on *Alnus viridis*, it is possible, that the provisional epithet '*fagiseda*' is inappropriate for the species. The specimen from *Alnus* contains rather thinner stalked apothecia (briefly described under Unidentified material studied), similar to the fagicolous material, and ascospores slightly longer than in *Capitotricha bicolor* s. str.: (6.2–)7.6–9.4(–11.2) × (1.5–)1.8–2.2(–2.5) µm. Crystals at hair apices were abundant in this collection similarly as in *C. bicolor* s. str.

Published records (as *Lachnum bicolor* (Bull.: Fr.) P. Karst. or *Dasyscypha(-us) bicolor* (Bull.: Fr.) Fuckel): Svrček 1986: 13 (Western Bohemia, Nature Reserve Bělýšov prope Chudenice, on cupules of *Fagus sylvatica*). – Réblová and Prášil 1999: 30 (Western Bohemia, Šumava Mts., Mt. Ždanidla and Černé jezero lake, on *Fagus sylvatica* – revised, PRM 891837–891838, 891852, 892256). – Papoušek 2004: 44–45 (Southern Bohemia, Novohradské hory Mts., Žofínský prales, twig of *Fagus*).

Material revised (in herbarium mostly as *Lachnum bicolor* (Bull.: Fr.) P. Karst. or *Dasyscypha(-us) bicolor* (Bull.) Fuckel): Western Bohemia: Šumava Mts., Černé jezero near Železná Ruda, on *Fagus* cupules, 19 June 1997, leg. M. Svrček, PRM 891852. – Šumava Mts., Mt. Ždanidla, 2.6 km W of Prášily, seminatural mixed forest (*Fagus*, *Picea*, *Acer pseudoplatanus*), on *Fagus* twigs, 18 May 2005, leg. J. Holec, PRM 898748. – Šumava Mts., Mt. Ždanidla (alt. 1308 m) near Prášily, on wood of fallen trunk of *Fagus*, 18 June 1997, leg. M. Svrček, PRM 891837. – l.c., on wood of a standing trunk of *Fagus*, 18 June 1997, leg. M. Svrček, PRM 891838. – l.c., on fallen, decorticated twig of *Fagus*, 18 June 1997, leg. M. Svrček, PRM 892256. – Central Bohemia: Jevany, on twigs and petiole of *Fagus sylvatica*, 28 April 1945, leg. M. Svrček, PRM 690120. – Baba hill near Stříbrná Skalice, on twigs of *Fagus sylvatica*, 25 March 1951, leg. Z. Pouzar, PRM 690107. – Southern Bohemia: Šumava Mts., Boubínský prales virgin forest, on twig and cupules of *Fagus sylvatica*, 11 April 1961, leg. J. Kubička, PRM 615927. – Šumava Mts., Horní Vltavice, Boubínský prales virgin forest, on twig of *Fagus sylvatica*, 19 May 1965, leg. M. Svrček (scanty material, one apothecium only), PRM 604113. – Moravia: Hrubý Jeseník Mts., ENE of Kouty nad Desnou, beech forest on slope between Divoká Desná river and Hřbety, on corticated twigs of *Fagus sylvatica*, 20 May 2002, leg. et det. M. Suková, PRM 907157. – Českomoravská vrchovina, Mt. Javořice near Počátky, on twig of *Fagus sylvatica*, 3 June 1971, leg. F. Kotlaba et Z. Pouzar, det. M. Suková, PRM 902330. – Českomoravská vrchovina, Špičák hill near Třešť, on twigs of *Fagus*, 14 May 1971, leg. M. Svrček, PRM 816214. – Vsetínské vrchy Mts., Mt. Cáb, virgin forest, on twigs of *Fagus sylvatica*, 22 August 1962, leg. M. Svrček, PRM 568313.

Unidentified material of *Capitotricha bicolor* s.l. studied: Austria, Hohe Tauern Mts., Ankolgelgruppe, NW of Gmünd i. Kärnten, valley of Gößbach brook, NE of Gößkarspeicher, alt. 1920 m, 46° 59' 19" N, 13° 20' 20" E, on twigs (all decorticated, corticated or with only bast) of *Alnus viridis* lying on the ground, 4 July 2005, leg. M. Suková et A. Chlebicki, PRM 907160. – Fresh apothecia

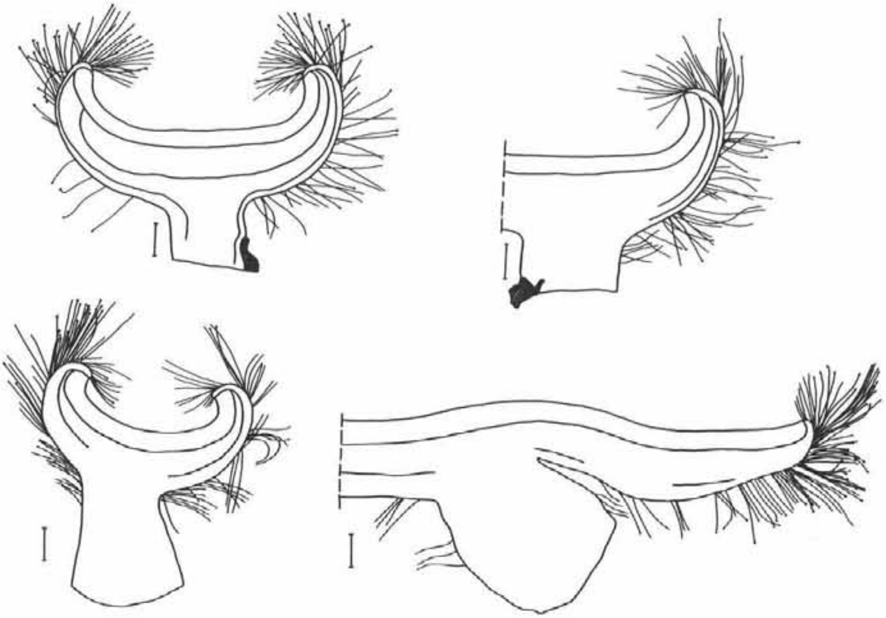


Fig. 6. *Capitotricha bicolor* (Bull.: Fr.) Baral (PRM 690111, on *Crataegus*) – apothecia in longitudinal section studied in water. Scale bars = 100 µm.

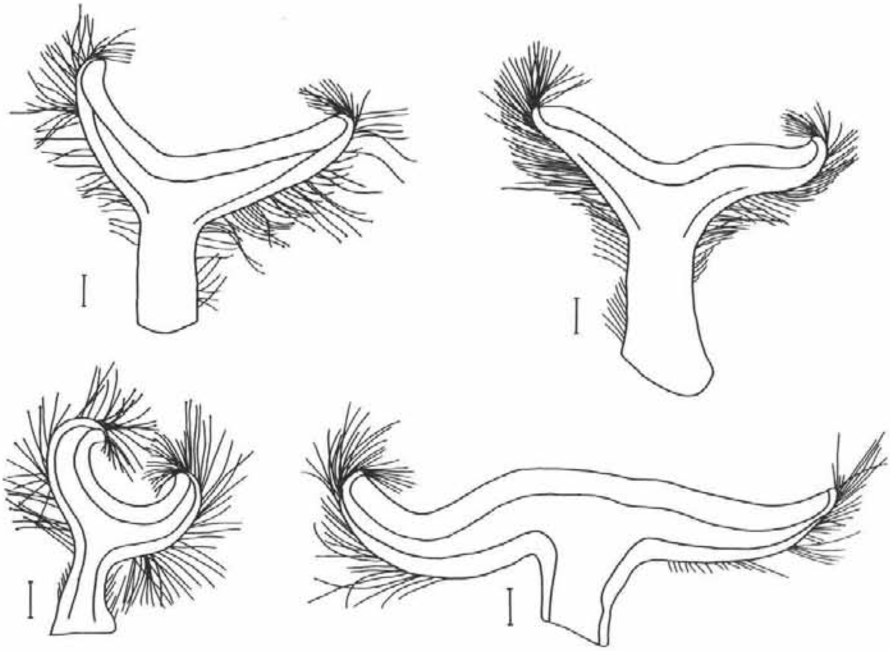


Fig. 7. *Capitotricha fagiseda*, nom. prov. (PRM 892256, on *Fagus*) – apothecia in longitudinal section studied in water. Scale bars = 100 µm.

0.6–1.2(–1.5) mm high, (0.75–)1.0–2.1(–2.4) mm in diam., with brightly white hairs and yellow-orange discs, stalks 180–520 µm long, (120–)160–320(–380) µm wide. Stalks of dried apothecia often covered with hairs, white or pale beige, (140–)210–300 µm high (average 255 µm) and (100–)120–190(–210) µm wide (average 156 µm), height/width ratio (0.95–)1.24–2.13(–2.50), average 1.69.

Dasyscyphella Tranzschel – chlupáčkovec

Dasyscyphella Tranzschel, Trav. Soc. Imp. Naturalistes Saint-Pétersbourg Sect. Bot. 28: 296, 1898.
Type species: *Dasyscyphella cassandrae* Tranzschel

Note: The width of hairs in the descriptions below is given from the central to upper half of the hairs, the width of the apical (often enlarged, subclavate) part of the hairs is given under the measurements of the apical cell.

Dasyscyphella conicola (Rehm) Raitv. et Arendh. Fig. 8.

Dasyscyphus pulverulentus (Lib.) Sacc. var. *conicola* Rehm, Ann. Mycol. 8: 482, 1910. – *Dasyscyphella conicola* (Rehm) Raitv. et Arendh. in Arendh. et Raitv., Mycotaxon 32: 355, 1988.

Description. Dried apothecia stipitate, 0.35–0.65 mm high, (0.2–)0.3–1.0 mm in diam., cup-shaped, outer surface orange-yellow (4–A4), covered by concolorous to whitish hairs and concolorous (4–A8) to orange (5–B8) lumps of resinous matter (dissolving in KOH), discs pale yellow to orange-yellow (4–A6 or 3–A5). Hairs hyaline, 48–60 × 2–3 µm, with lower part cylindrical and warted, in apical part enlarged, with apical cell or very rarely also part of subapical cell smooth, apical cell (7–)9–14(–17.5) × 2.7–4.1 µm. Asci arising from croziers, 40–48 × 4–5 µm, KOH/MLZ blue. Ascospores one-celled, ellipsoidal fusiform, slightly inequilateral or rarely symmetric, 5.4–6.7(–7.4) × 1.4–1.9 µm. Paraphyses narrowly lanceolate, 1.6–1.8 µm in diam., not exceeding asci or exceeding for up to 6.7 µm.

Comments. Raitviir (2002) reported asci arising from simple septa in this species. In Czech collections croziers were constantly present.

Arendholz and Raitviir (1988) reported also another taxon from *Lachnaceae*, *Lachnum pulverulentum* (Lib.) P. Karst. var. *fructicola* (Kauffm.) Arendh. et Raitv. from cones of *Pinus sylvestris*. The variety as described by Arendholz and Raitviir differs from material of *Dasyscyphella conicola* studied by me in exudations insoluble in KOH and hairs without completely smooth tips.

Published records: Velenovský 1934: 233 as *Dasyscypha pulverulenta* (Central Bohemia, Mnichovice, on *Pinus sylvestris* – no specimen from cones seen, probably all the specimens studied by him were from needles).

Material revised (in the herbarium under *Dasyscypha pulverulenta* (Lib.) Sacc.): Central Bohemia: Hřebeny hills, Halouny, on cones of *Pinus sylvestris*, 11 June 1954, leg. et det. M. Svrček, PRM 816365. – Hřebeny hills, Dobřichovice, on cones of *Pinus sylvestris*, 25 August 1957, leg. et det. M. Svrček, PRM 816364. – Mnichovice, on cone of *Pinus sylvestris*, November 1933, leg. et det. J. Velenovský (as *Lachnum papyraceum*), PRM 152023. – Southern Bohemia: Nová Ves near Klikov, Široké blato, Sphagnetum, on cone of *Picea excelsa*, 11 June 1959, leg. J. Kubička, det. M. Svrček, PRM 613863. – Třeboň, forests between Svatý Vít and Nová Hlína, on fallen cones of *Pinus sylvestris*, 11 May 1971, leg. et det. M. Svrček, PRM 816363.

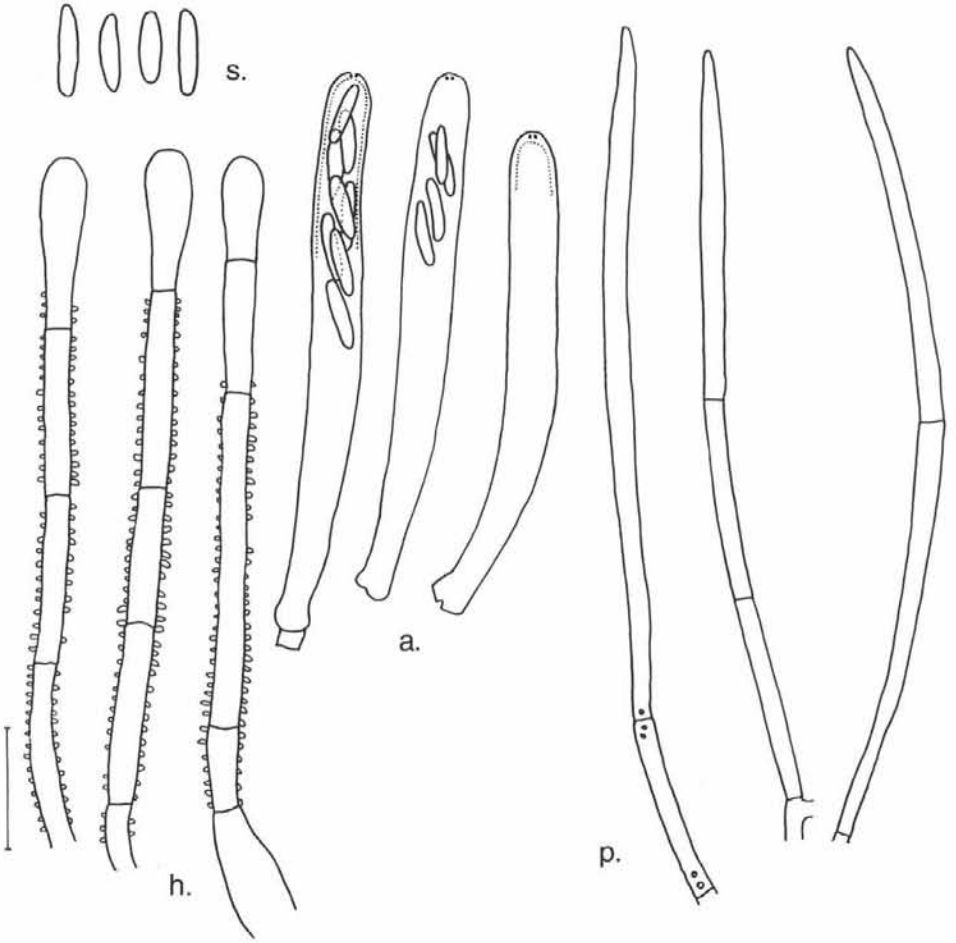


Fig. 8. *Dasyscyphella conicola* (Rehm) Raitv. et Arendh., PRM 816364. Scale bar = 10 µm. For explanations see Material and Methods.

Dasyscyphella crystallina (Fuckel) Raitv. Fig. 9.

Peziza crystallina Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 306, 1870. – *Dasyscyphella crystallina* (Fuckel) Raitv., Scripta Mycol. 1: 72, 1970.

Description (excl. PRM 617298). Dried apothecia stipitate, 0.5–1.2 mm high, 0.45–0.85 mm in diam., cup-shaped, outer surface white to orange-yellow (4–A4, rarely 4–A6), covered with concolorous to white hairs and orange (5–A7 to 6–B8) granules, discs more (5–B7 or 5–B8) or less deeply orange. Hairs 88–106 × 2.3–3.6 µm, hyaline, warted, with apical cell or cells smooth, apical cell

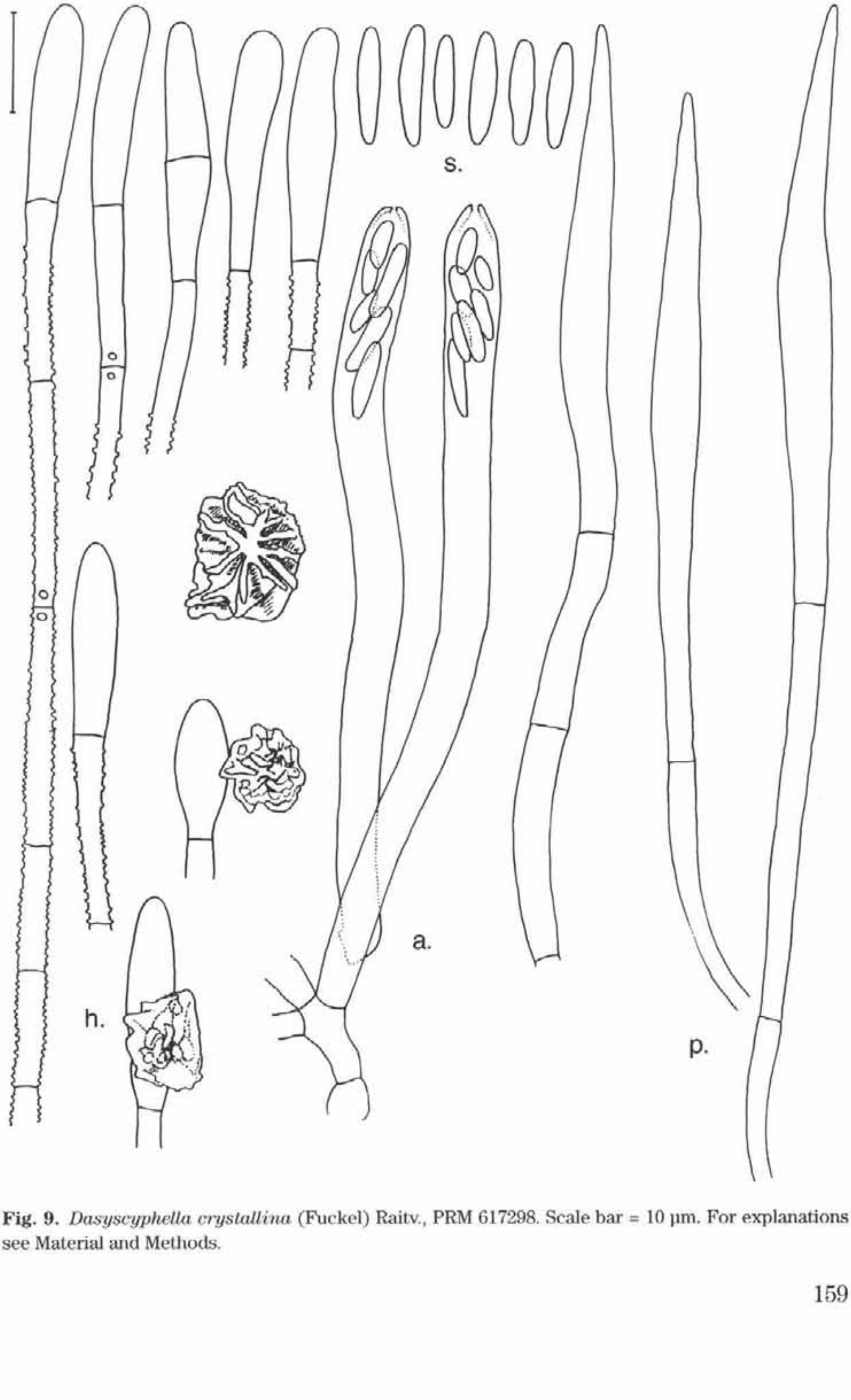


Fig. 9. *Dasyscyphella crystallina* (Fuckel) Raitv., PRM 617298. Scale bar = 10 µm. For explanations see Material and Methods.

14.5–26(–30.5) × 3.4–5.1(–5.6) µm, of the same length as other cells or longer. Asci arising from simple septa, (50–)55–66(–70) × 4.5–6.3 µm, KOH/MLZ blue. Ascospores one-celled, narrowly fusiform, 8.5–12 × 1.4–2.3 µm. Paraphyses lanceolate, 3–5 µm wide, exceeding asci by 10–29 µm.

Comments. In the specimens PRM 907153 and PRM 617298 not very numerous octahedral crystals were observed among the hairs and the asci were longer in the latter specimen than in the other specimens of *D. crystallina* examined, (71–)75–79(–85) µm.

Published records: Velenovský 1934: 410 as *Lachnum crystallinum* (Central Bohemia, Mnichovice, on cone – revised, it is *Lachnum virgineum* on a cone of *Picea excelsa*). – Svrček 1986: 11 (Western Bohemia, Nature Reserve Zlín, on *Carpinus betulus*). – Svrček 1989: 69 (Central Bohemia, Praha, Radotínské údolí valley, on *Quercus robur* and *Q. petraea*).

Material revised: Central Bohemia: Svatý Jan pod Skalou near Beroun, on twig of *Quercus*, 17 May 1942, leg. et det. M. Svrček, PRM 916479. – Karlštejn, on twig of *Quercus*, 30 May 1943, leg. et det. M. Svrček, PRM 816481. – Mořinka, Karlické údolí (valley), on fallen twigs of *Quercus*, 9 May 1958, leg. et det. M. Svrček, PRM 617298. – Hřebeny Mts., Dobřichovice, on twigs of *Quercus*, 21 April 1957, leg. et det. M. Svrček, PRM 816478. – Dobřichovice, on decorticated branch of *Quercus* lying among fallen leaves of trees, 1 June 2005, leg. M. Svrček, PRM 907153. – Jíloviště, on twig of *Quercus*, 11 May 1946, leg. et det. M. Svrček, PRM 816482. – Praha – Suchdol, on wood of fallen trunk of *Quercus*, 25 July 1965, leg. E. Wichanský, det. M. Svrček, PRM 610923.

Dasyscyphella nivea (R. Hedw.: Fr.) Raitv. Fig. 10.

Octospora nivea R. Hedw., ?Observ. Bot., Fasc. 1, p. ?, 1802 (n.v.). – *Peziza nivea* (R. Hedw.) Fr., Syst. Mycol. 2(1), p. 90, 1822. – *Peziza nivea* (R. Hedw.) Fr.: Fr., Syst. Mycol. 2(1), p. 90, 1822. – *Dasyscyphella nivea* (R. Hedw.: Fr.) Raitv., Scripta Mycol. 1: 72, 1970.

Syn.: *Dasyscyphus roburum* Velen., Monogr. Discom. Bohem., p. 237, 1934. – Holotype: [Western Bohemia,] Plzeň-Lohy, on wood of *Quercus*, XII. 1929, leg. A. Pilát, det. J. Velenovský (PRM 812383).

Description (specimens with octahedral crystals, Fig. 10). Dried apothecia stipitate, 0.6–1 mm high, (0.4–)0.65–0.85(–1.15) mm in diameter, disc and outer surface pale yellow (4–A5) to yellow-orange, hairs white. Hairs 45–100 × 2–2.5 µm, warted, one or two apical cells smooth, apical cell 14–22.5 × 3–3.7 µm, subclavate. Typical octahedral crystals of variable size (10–40 µm) among hairs (visible in water and in very fresh slides in KOH). Asci arising from croziers, 44–58 × 3.5–4.5 µm, KOH/MLZ blue. Ascospores one-celled, fusoid, 6–8 × 1.8–2.2 µm. Paraphyses narrowly lanceolate, 1.7–3 µm in diam., exceeding the asci for 2.5–8.5 µm.

Description (specimens without octahedral crystals, incl. PRM 907145). Fresh apothecia (PRM 907126) stipitate, cup-shaped to broadly cup-shaped (almost flattened, with raised margins), 1.2–1.7 mm in diam., outside white, with creamy white discs. Dried apothecia stipitate, cup-shaped, (0.6–)0.85–1.1(–1.8) mm high, (0.4–)0.55–0.85(–1.1) mm in diam., discs yellow-orange (4–A7), outer surface yellow-orange (4–A6 to 4–A7), covered with white to concolorous hairs. Hairs (58.5–)68.5–95 × 1.8–3.5 µm, warted, with apical cells smooth, subclavate, only slightly longer than other cells, 15–25 × 2.8–4.8 µm. Asci arising from croziers,

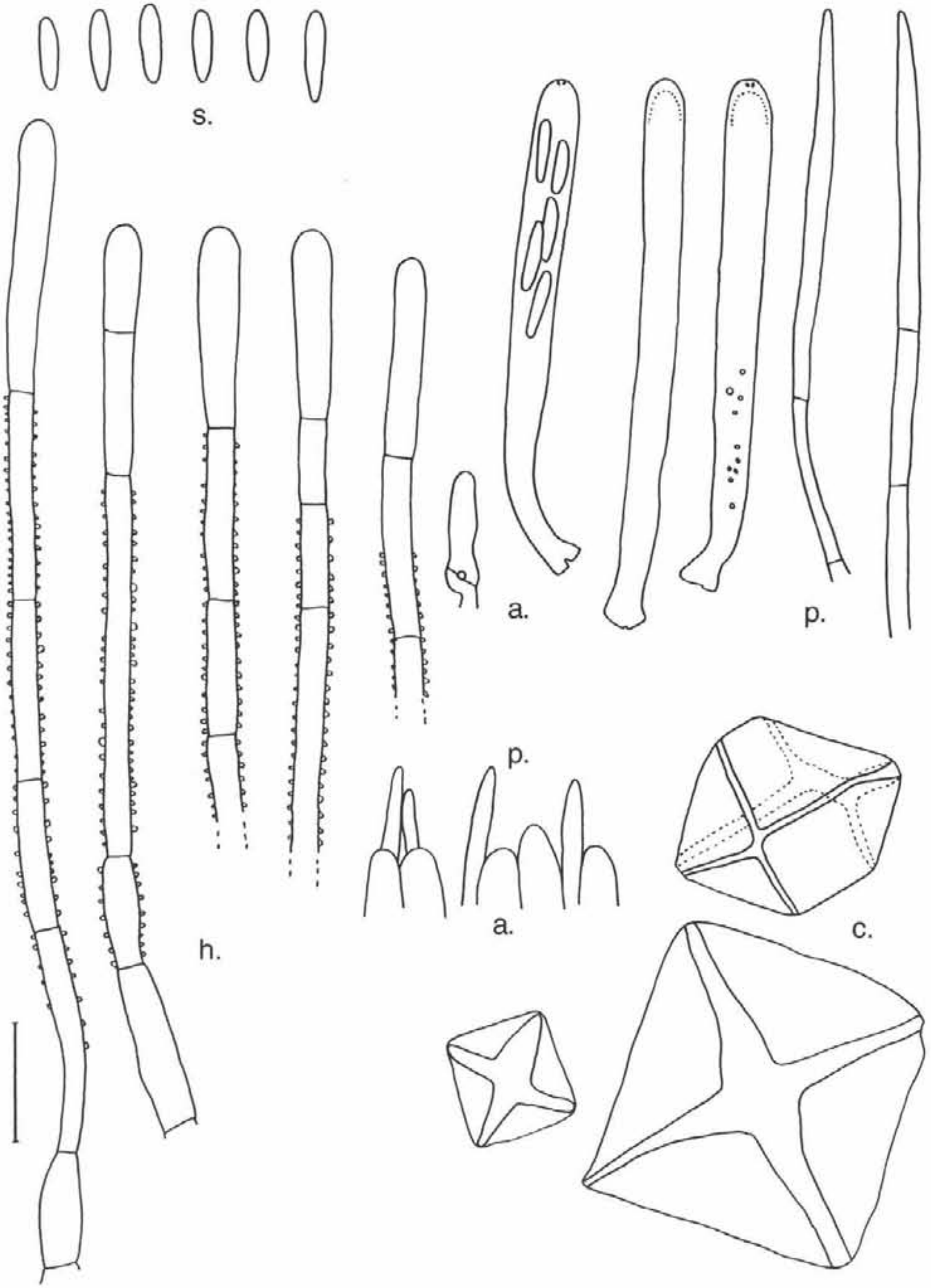


Fig. 10. *Dasyscyphella nivea* (R. Hedw.: Fr.) Raitv., PRM 901179. Scale bar = 10 µm. 'c.' = octahedral crystals present among hairs. For explanation of the other abbreviations see Material and Methods.

41–54.5 × 3.3–4.8 µm, KOH/MLZ blue. Ascospores one-celled, fusiform, (5.8–)6.4–8(–9) × 1.6–2 µm. Paraphyses narrowly lanceolate, 1.6–2.3 µm in diam., exceeding the asci for 3.3–10(–12.5) µm.

Comments. A species similar to *Dasyscyphella nivea* is reported in literature under the name *Dasyscyphella montana* Raitv. It is not included in my key as I did not see any material. But the species should not be overlooked anymore, therefore I discuss here the differences with *D. nivea*. Raitviir (2002) used in his key the presence of crystals as the most important character for distinguishing *Dasyscyphella montana* from *D. nivea*. Otherwise, also some small differences in microcharacters can be found in his descriptions – *D. montana*: apical cells of hairs up to 25 × 4 µm, paraphyses protruding 10–18 µm, ascospores (5.0–)7.1–7.8(–9.0) µm; *D. nivea*: apical cells of hairs up to 20 × 4 µm, paraphyses protruding up to 12 µm, ascospores (5.0–)6.0–7.5(–9.0) µm. According to my observation (also populations of *D. nivea* with lacking crystals seen), the presence of crystals is not the best distinguishing character and the same regards the apical cells of hairs (at *D. nivea* they can be up to 22.5 µm or even 25 µm long according to my descriptions above). According to Baral (in litt.), hairs of *D. montana* are longer [(85–)100–120(–150) µm in living material] than in *D. nivea* and crystals are always absent. On the other side, Raitviir (2002) mentioned a hair length of up to 110 µm for both species (70–110 µm for *D. montana* and 60–110 µm for *D. nivea*). It seems to me that the most useful distinguishing characters can be found in Baral's keys and drawings (Baral 2003, living material) – *D. montana*: hairs (85–)100–150 µm long, paraphyses protruding 0–15 µm; *D. nivea*: hairs (50–)70–110(–120) µm long, paraphyses protruding 0–6(–9) µm; he collected *D. montana* most frequently on *Fagus*, but also on *Fraxinus*, *Populus*, *Salix*, *Robinia*, *Quercus*, *Alnus*, *Ulmus*, and even *Picea*, and *D. nivea* most frequently on *Quercus*, but also quite often on *Fagus*, whereas very rarely on other trees like *Castanea* and *Salix* (Baral, pers. comm.).

Type study: The holotype of *Dasyscyphus roburum* Velen. published as a collection by Pilát from 1931, contains long stalked, old, white apothecia externally covered with brownish to pale orange matter, hymenia are lacking. The hairs with smooth apical cells and typical octahedral crystals among the hairs refer to *Dascyscyphella nivea*. Velenovský (1934) published asci 50–70 × 5 µm, filiform paraphyses and narrowly acicular, straight, 4–5 µm long ascospores.

Published records: Zimmermann 1909: 75 as *Dasyscypha dryina* (P. Karst.) Sacc. [Southern Moravia, Lednice, on decaying log, ?*Quercus* – revised (PRM 668749), it is *Dasyscyphella nivea* (R. Hedw.: Fr.) Raitv.]. – Velenovský 1934: 252 as *Lachnum niveum* Hedw. (as a common species, on dead herbs). – Svrček 1954: 109 as *Lachnum niveum* (Hedw.: Fr.) P. Karst. (Northern Bohemia, České Středohoří Mts., Mt. Milešovka, on *Rubus idaeus*). – Note: The last two records refer to "*Lachnum niveum* (Hedw. ex Fr.) P. Karst." sensu Rehm (1893: 879), a taxon frequent on *Rubus*, which is (according to Rehm's description) *Capitotricha rubi* (Bres.) Baral. Already Rehm (1893) mentioned in his discussion, that the name *Lachnum niveum* was used by various authors in two meanings – for rubicolous and for lignicolous fungi. "*Lachnum niveum* (Hedw. ex Fr.) P. Karst. sensu Rehm" as described by Le Gal (1939) is according to her drawing and description certainly *Capitotricha rubi* (Bres.) Baral.

Material revised (specimens with octahedral crystals): Western Bohemia: Plzeň – Lohy, on wood of *Quercus*, December 1929, leg. A. Pilát, det. J. Velenovský (as *Dasyscypha roburum* Velen.), host rev. A. Chlebicki, PRM 812383 (holotype of *Dasyscyphus roburum* Velen.). – N of Neratovice (between Neratovice and Labe river), nature reserve Černínovsko, E part, floodplain forest, alt. 160 m, on underside of wood piece of *Quercus robur* lying on soil, 23 April 2002, leg. J. Holec, det. M. Suková, PRM 901179. – Kostomlaty nad Labem, nature reserve Mydlovarský luh S of Šnepov, on wood of *Quercus robur*, 23 October 2004, leg. M. Suková et A. Chlebicki, PRM 907159. – Moravia: Eisgrub [Lednice], "Unterwald" forest, on decaying log (?*Quercus*), 2 March 1906, leg. et det. H. Zimmermann (as *Dasyscypha dryina* (P. Karst.) Sacc.), PRM 668749.

Material revised (specimens without octahedral crystals): Černošice, [on wood of *Quercus*,] May 1925, leg. et det. J. Velenovský (as *Lachnum alneum* Velen., non-type material), PRM 148670. – Praha – Klánovice, Klánovický les (forest), on decaying tree stump of *Quercus*, apothecia present in the part close to the soil, 28 April 2002, leg. et det. M. Suková, PRM 907126.

Material revised (specimen without octahedral crystals from other countries): Poland, Biebrza National Park, E of Grajewo, Czerwone Bagno, *Tilio-Carpinetum* forest NW of Grzędy, on wood of decaying basis of *Quercus*, 9 May 2005, leg. et det. M. Suková, PRM 907145.

Neodasyscypha Suková et Spooner, **nom. nov.** – pachlupáček

Syn.: *Dasyscypha* Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 304, 1870. (diagnosis latina).
Dasyscypha Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 304, 1870, nom. illeg. [type species: *D. cerina* (Pers.: Fr.) Fuckel, lectotype designated by Clements and Shear (1931)]

Comments. *Peziza cerina* Pers.: Fr. (see also Raitviir 1980, Haines and Dumont 1984) should be put into a genus of its own. The separate genus should include also one other species, *Phialea subciboria* Rodway, studied by the second author (see Spooner 1987). There is no legitimate generic name available for such a genus at present. *Peziza cerina* was designated as a lectotype of the generic name *Dasyscypha* Fuckel by Clements and Shear (1931). The name *Dasyscypha* Fuckel and an earlier competing name *Dasyscyphus* (Nees) ex Gray have already been discussed many times and the problem has a really interesting history from the nomenclatural point of view.

Dasyscypha Fuckel (1870) had been used for more than 80 years, when suddenly Korf (1954) discovered an earlier name for the genus, *Dasyscyphus* Gray (1821). He lectotypified the earlier name by *D. virgineus* and stated that *Dasyscypha* is only an orthographical variant of it and all species names already combined into *Dasyscyphus* or *Dasyscypha* should be used without the necessity of new combinations.

Holm (1976) indicated for the first time, that *Dasyscypha* Fuckel was already lectotypified by *Dasyscypha cerina* by Clements and Shear (1931) and that *Dasyscypha* Fuckel should be considered a later homonym of *Dasyscyphus* Gray, if the names are orthographical variants of one name.

Korf (1977) proved that the names are orthographical variants and, moreover, showed for the first time that both the generic names are, according to him, based on the same taxon, *Peziza* fam. *Dasyscyphi* Nees (1817), and therefore must have the same type. He connected *Dasyscypha* Fuckel with *Peziza* ser. *Lachnea* trib.

Dasyscyphae (Nees) ex Fr.: Fr. (1822) by an indirect reference. Holm (1978) did not accept the existence of the indirect reference.

Svrček (1962) was probably the first one who excluded *Dasyscyphus cerinus* from the genus *Dasyscyphus* Gray (and put it into the genus *Perrotia*, discussed below under *Neodasyscypha cerina*). Raitviir (1970) transferred *P. cerina* to *Belonidium* subgen. *Phaobelonidium* Raitv., however ten years later (Raitviir 1980: 100, 124) stated that *Dasyscyphus cerinus* is not congeneric with *Dasyscyphus virgineus* nor *Belonidium* subgen. *Phaeobelonidium*. He considered *Dasyscyphus* Gray to be typified by *Peziza cerina* and warned that this earliest typification could cause a lot of transfers from *Dasyscyphus* Gray to *Lachnum* P. Karst. [*Lachnum* Retz. ex P. Karst.] and suggested to conserve *Dasyscyphus* Gray for the type species *Dasyscyphus virgineus* and to treat *P. cerina* in a genus of its own.

After the change in starting point from 1 January 1821 to 1 May 1753 (the Sydney Code from 1983), *Lachnum* Retz. became valid and began to have priority for species congeneric with *Dasyscyphus virgineus*. Many combinations at species level were already done by Karsten (1871). Haines and Dumont (1984: 2) stated briefly that *Dasyscyphus* Gray thanks to the change in starting point must be replaced by *Lachnum* Retz. for all species congeneric with it except for *D. cerinus*. They erroneously presumed, similarly as Raitviir (1980), that the earliest lectotypification of *Dasyscyphus* Gray was the one of *Dasyscypha* Fuckel by *D. cerina*. Baral (in Baral and Krieglsteiner 1985: 65) cited Haines and Dumont, considered the situation again and also accepted *Dasyscyphus* (Nees) ex Gray for the type *D. cerinus*.

Spooner (1987: 590–592) indicated that the key to the solution is in the basionym(-s) of the generic names. But he erroneously presumed that the basionym of *Dasyscyphus* (Nees) ex Gray is in Nees (1817) and cited it as *Dasyscyphus* (Nees) Gray. *Peziza* fam. *Dasyscyphi* Nees is really invalid also after the change in starting point, because it was described as a family subordinated to a genus (currently Art. 33.7. of the Saint Louis Code). However, he proved that the alleged indirect reference connecting *Dasyscypha* Fuckel with Fries's tribe *Dasyscyphae* and promoted by Korf (1977) does not really exist and that *Dasyscyphus* and *Dasyscypha* are homonyms. He correctly considered *Dasyscyphus* (Nees) ex Gray as a generic name typified by *D. virgineus*, belonging to the synonymy of *Lachnum* Retz. For the later homonym, *Dasyscypha* Fuckel, typified by *Dasyscypha cerina*, he proposed a nomen novum, *Neodasyscypha* Spooner, including also one other taxon (*Phialea subciboria* Rodway). The nomen novum was unfortunately invalidly published by him (without sufficient reference to the replaced name).

The most important problems concerning the generic names *Dasyscypha* Fuckel and *Dasyscyphus* (Nees) ex Gray, which were discussed or more or less neglected by previous authors, are discussed here in detail. The problem of orthographical variants is important for the decision whether *Dasyscypha* and *Dasyscyphus* can be homonyms or not (1). Basionyms are important for estimating the homonymy again (basionyms vs. a common basionym) and for protologues for considering lectotypifications under Art. 10.5.a (2). The correct citation of *Dasyscypha* Fuckel and the location of its protologue depends on the problem of Fuckel's indirect reference (3). The lectotypifications are important for anchoring the generic names (4, 5).

1) Orthographical variants. We agree with Korf (1954, 1977) that the generic name *Dasyscypha* is an orthographical variant of *Dasyscyphus*. The words "*Dasyscyphi*" and "*Dasyscyphae*" and, consequently, the words "*Dasyscyphus*" and "*Dasyscypha*" should be considered interchangeable in the sense of Art. 60. and therefore writing e.g. "*Dasyscyphus* Fuckel" is no mistake, although the name was originally published by Fuckel (1870) as "*Dasyscypha*". The fact that the infrageneric name in the femininum is only an orthographical variant of the name in the masculinum was demonstrated by Fries (1822: 77) who cited "*P. Dasyscyphae* Nees Syst. p. 264" converted to the femininum with clear reference to Nees's *Dasyscyphi* (also the number of the taxon, 264, agrees). Fries (1822) changed also other names by Nees to the femininum (e.g. "*Hymenoscyphi*" to "*Hymenoscyphae*"). As we agree that Fuckel was inspired by Friesian names, although he used them for his independent genera, we consider also the generic names as interchangeable.

2) Basionyms and protologues. The name *Dasyscyphi* Nees (1817) was introduced for the first time as a "family" subordinated to the genus *Peziza* Pers., hence this name should be considered as not validly published (Art. 33.7.). As *Peziza* fam. *Dasyscyphi* Nees (1817) is an invalid name, there is no common basis for the following three taxa: *Dasyscyphus* (Nees) ex Gray, *Peziza* ser. *Lachnea* trib. *Dasyscyphi* (Nees) ex Fr.: Fr. (valid according to Art. 33.8. and sanctioned at Fries's tribe level) and *Dasyscyphus* Fuckel. Protologues of these names are found in Gray (1821: 160), Fries (1822: 89) and Fuckel (1870: 304). Also in case Fuckel's *Dasyscyphus* were connected with Fries's *Peziza* ser. *Lachnea* trib. *Dasyscyphi* by an indirect reference as proposed by Korf (1977), there still would be two taxa: *Dasyscyphus* (Nees) ex Gray and *Dasyscyphus* (Nees ex Fr.) Fuckel.

3) Fuckel's indirect reference. Korf (1977) suggested that Fuckel (1870) in the case of his *Dasyscypha* indirectly referred to Fries's *Peziza* ser. *Lachnea* trib. *Dasyscyphae*. Therefore, according to Korf, *Dasyscypha* Fuckel should not be considered an independent generic name. Korf argumented that "when Fuckel erected *Dasyscypha*, he included 7 species. Two of these were Fuckel's own taxa, with no bearing on any previous use of the generic name. But

the first 5 species he lists, inclusive of 2 varieties and 1 subspecies, *all* appear in Fries's *Systema mycologicum* (1822) in that exact tribus *Dasyscyphae*. While it is true that Fuckel ascribed the generic name to himself, one cannot ignore the very clear though indirect, reference to Fries's tribe demonstrated by his citation of those pages of the *Systema* in three separate entries; even the formula 'PEZIZA Lachnea *Dasysc.*' heads each page pair where the 7 specific and infraspecific epithets appear in the *Systema*."

We cannot accept Korf's argument that Fuckel's indirect reference can be demonstrated by citation of concrete pages of the Systema. The concrete pages cited by Fuckel (1870: 305) are really those from a part of the Systema devoted to *Dasyscyphae* (Fries 1822: 89–105), but the "three separate entries" where Fuckel mentioned these citations are located under two varieties of *Dasyscypha bicolor* and under *Dasyscypha virginea*. In our opinion, references mentioned under a single species have no importance at generic level. On the contrary, citations under higher taxa can have influence on subordinated taxa, e.g. reference to "*P. Dasyscyphae* Nees Syst. p. 264" mentioned by Fries (1822: 77) under *Peziza* ser. *Lachnea* could act as an indirect reference for the subordinated taxon *Peziza* ser. *Lachnea* trib. *Dasyscyphae*, which was not provided by any direct reference to Nees's work.

Korf's view was restricted only to *Dasyscypha* and we did not confirm that inside of *Dasyscypha* the indirect reference exists. We considered the problem also in the context of Fuckel's entire work and compared it with Kummer's Führer für die Pilzkunde, which is given in Art. 32.4. Ex. 8. as an example of indirect reference. But the situation proved to be not analogous with Kummer's work, because the general arrangement of Fuckel's work does not faithfully follow that of Fries. This can be demonstrated e.g. on the example of *Humaria* Fuckel. Fuckel (1870) included into his genus *Humaria* species which were placed under *Peziza* ser. *Lachnea* trib. *Sarcoscyphae* in Fries's work, although Fries (1822) used the tribe name *Humariae* for other species (*Peziza* ser. *Aleuria* trib. *Humariae*). It is clear that although Fuckel often used for his genera the same or similar names to those adopted at subgeneric level by earlier authors, he was not raising the latter to generic rank but proposing new and independent genera.

4) Typification of *Dasyscyphus* Fuckel. When Clements and Shear (1931: 326) typified *Dasyscyphus* Fuckel by *D. cerinus* (Pers.: Fr.) Fuckel, they cited the genus as "*Dasyscypha* Fr., Syst. Myc. 2: 89, 1822; Fuckel, Symb. Myc. 304, 1869". The first citation should be considered as erroneous (discussed under Note 1 below) and we do not think that the typification was made for the Friesian name *Peziza* ser. *Lachnea* trib. *Dasyscyphi* (Nees) ex Fr.: Fr. The second citation means that they typified *Dasyscyphus* Fuckel (1870). If the indirect reference connecting *Dasyscyphus* Fuckel (1870) with *Peziza* ser. *Lachnea* trib. *Dasyscyphi* (Nees) ex Fr.: Fr. (1822) would exist, then the name typified would be *Dasyscyphus* (Nees ex Fr.) Fuckel, non *Dasyscyphus* (Nees) ex Gray, because of two independent

basionyms (Fries 1822: 89, Gray 1821: 160). For additional information about the typifications by Clements and Shear see Note 2 below.

Note 1. From the history of application of *Dasyscypha* Fuckel (an example of confusion). *Dasyscypha* was cited as *Dasyscypha* Fuckel (Nannfeldt 1932, Dennis 1949), or erroneously as *Dasyscypha* Fr. emend. Fuckel (Saccardo 1889: 432) or even as *Dasyscypha* Fr. (Boudier 1885, Rehm 1893: 829, Clements and Shear 1931, Le Gal 1939). However, in all the mentioned works Fuckel's new combinations were cited as combinations, e.g. *Dasyscypha bicolor* (Bull.) Fuckel [except for Boudier (1885) who listed in his classification only epithets]. The erroneous ascribing of the generic name to Fries was (in our opinion) only a mistake in citation which should be corrected. It is clear that it was erroneously introduced by Saccardo (1889: 432) who cited it as *Dasyscypha* Fr. emend. Fuckel.

Note 2. Typifications by Clements and Shear. Clements and Shear (1931) listed many genera and provided each of them with a type. They gave no reasons for their choices. Also mistakes can be found there, e.g. they typified *Lachnum* Retz. by *L. bicolor* (Bull.: Fr.) P. Karst. (currently belonging to *Capitotricha*), although *Lachnum* was originally described as a monotypic genus for *Lachnum agaricinum* Retz. (currently belonging to *Lachnum* s.str.). However, as already discussed by Huhtinen and Cannon (1987) in the case of *Hyaloscypha*, they did not choose the types mechanically (in the sense of Art. 10.5.b.) as the first species from a protologue. We checked it e.g. at *Erinella* (Saccardo 1889), *Ciboria*, *Dasyscypha*, *Pezizella* (Fuckel 1870) and *Rutstroemia* (Karsten 1871). A mechanical selection according to other than original works cannot be ruled out, but no such work has been found yet and their lectotypifications (we mean those which may not be superseded according to Art. 10.5.a. or are not superfluous because of earlier lectotypifications) are currently considered as obligatory (see e.g. Huhtinen and Cannon 1987).

5) Typification of *Dasyscyphus* (Nees) ex Gray. *Dasyscyphus* (Nees) ex Gray was for the first time lectotypified by Korf (1954) using *Dasyscyphus virgineus* and therefore the generic name belongs to the synonymy of *Lachnum* Retz. Earlier typifications by *Dasyscyphus cerinus* (Clements and Shear 1931) and by *Dasyscyphus bicolor* (Nannfeldt 1932) were made for *Dasyscyphus* Fuckel. As *Dasyscyphus* Fuckel has not the same basionym as *Dasyscyphus* (Nees) ex Gray, the discussed lectotypifications have no influence on Gray's generic name.

6) Conclusion. As *Dasyscyphus* (Nees) ex Gray belongs to the synonymy of *Lachnum* Retz. and *Dasyscyphus* Fuckel, though validly published and useful for *P. cerina*, is an illegitimate name, a replacing generic name for *Dasyscyphus* Fuckel is proposed. The name *Neodasyscypha* was proposed by the second author (Spooner 1987) with the following etymology: from the Latin *neo*, new, and the generic name *Dasyscypha*, which it is to replace. We validate the name as *Neodasyscypha* in the femininum here, although we are aware that it is interchangeable with its orthographical variant in the masculinum – "*Neodasyscyphus*". Until 1954, *Dasyscyphus* in the masculinum was neglected and was not used for *Peziza cerina* at all. Gray's protologue of *Dasyscyphus* did not contain this species and it was for the first time combined into Fuckel's genus, as *Dasyscypha cerina*. Moreover, *Neodasyscypha* in the femininum indicates didactically that the name replaced is *Dasyscypha* Fuckel; non *Dasyscyphus* (Nees) ex Gray. We selected the femininum variant as more appropriate, preserving historical information, and do not wish it to be converted to the masculinum.

The second author of the generic name would like to validate here his previously invalidly published new combinations:

Neodasyscypha cerina (Pers.: Fr.) Spooner, **comb. nov.**
Bas.: *Peziza cerina* Pers., Observ. Mycol., p. 43, 1796.
Neodasyscypha subciboria (Rodway) Spooner, **comb. nov.**
Bas.: *Phialea subciboria* Rodway, Papers and Proceedings of the Royal Society of Tasmania 1924: 104, 1925.

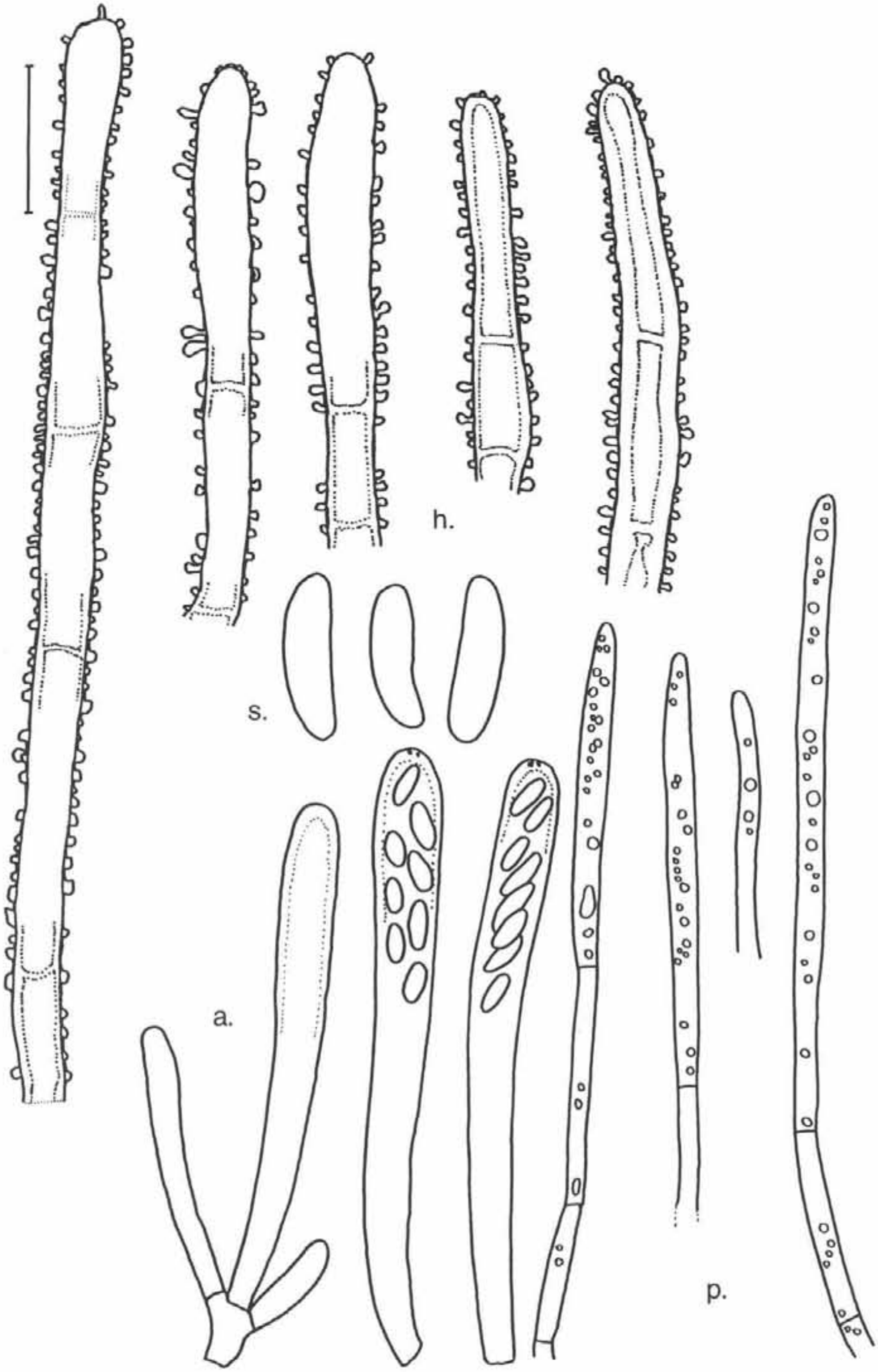
Neodasyscypha cerina (Pers.: Fr.) Spooner – pachlupáček nazelenalý Fig. 11.

Peziza cerina Pers., Observ. Mycol., p. 43, 1796. – *Peziza cerina* Pers.: Fr., Syst. Mycol. 2(1), p. 92, 1822. – *Dasyscypha cerina* (Pers.: Fr.) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 305, 1870. – *Lachnum cerinum* (Pers.: Fr.) Nannf., Nova Acta Regiae Soc. Sci. Upsal., Ser. 4, 8(2): 262, 1932. – *Perrotia cerina* (Pers.: Fr.) Svrček, Česká Mykol. 16: 96, 1962.

Description. Dried apothecia 0.25–0.45(–0.9) mm high, 0.3–1.4 mm in diam., umbilicate sessile or with broad stipe, very dark coloured, blackish brown (olive, 3–F3), covered with yellow to beige hairs with slight olive tint (yellow, 3–A7), discs usually covered by marginal walls of apothecia when dry, with very slight orange or pale beige tint when rehydrated in water (pale yellow, 4–A4). Hairs greyish brown with olive tint, cylindrical, (63–)96–173 × 3–4.3 µm, sometimes arising also from centre of hymenium, roughly and irregularly warted, size of warts variable. Asci arising from simple septa, 42.5–53.5 × 4.5–5.2 µm, MLZ no reaction, KOH/MLZ blue, IKI red. Ascospores one-celled, cylindrical with broad ends, straight or slightly curved, 8.5–10.5 × 2.3–3 µm. Paraphyses cylindrical-lanceolate with subacute tips (cylindrical, attenuated towards apex), with many refractive guttules with fine (yellow-)orange tint in plasma (present also in c. 50 years old collections – guttules are smaller there and almost without the orange tint), 1.8–2.2 µm in diam., exceeding the asci for 6.5–8(–14.5) µm.

Comments. The genus *Neodasyscypha* differs from *Lachnum* Retz. in different hair warts (see also the key) and structure of excipulum (see e.g. drawings by Spooner 1987). Svrček (1962) transferred *Dasyscyphus cerinus* (Pers.: Fr.) Fuckel into the genus *Perrotia* Boud. on the basis of excipulum and hair characters. He considered the difference in amyloidity of the asci (inamyloid in *Perrotia* and amyloid in *D. cerinus*), a character not important at the generic level. I must agree with Svrček (1962) that *Perrotia* (represented in my study by *P. flammea*, type species of *Perrotia*) has a similar shape of apothecia and structure of excipulum as *Neodasyscypha cerina*. However, the asci of *P. flammea* not only show no reactions in MLZ, KOH/MLZ, IKI and KOH/IKI, but also the structure of the ascus apices is different. Only a homogenous wall in the apical part of the

Fig. 11. *Neodasyscypha cerina* (Pers.: Fr.) Spooner, PRM 901970 (ascospores PRM 816265). Scale bar = 10 µm. For explanations see Material and Methods.


h.
s.
a.
p.

ascus is visible in all these media and the same counts for KOH, water and 5 % ammonium. Additionally, the hairs of *Neodasyscypha cerina* have bigger warts, which are not disappearing in MLZ nor in MLZ after pretreatment in KOH. According to Spooner (1987) hairs of various species of *Perrotia* may either appear smooth or finely granulate when observed in Melzer's reagent. In *Perrotia flammea*, I observed that the hairs become almost smooth with scattered fine granules or warts in MLZ and completely smooth in MLZ after the pretreatment in KOH. Agreeing with Spooner's generic concept (and see also Raitviir 1970), I consider *Perrotia flammea* and *Neodasyscypha cerina* to be not congeneric and the characteristic broadly rounded, inamyloid ascus apex, looking like undifferentiated, an important diagnostic character for the delimitation of the genus *Perrotia*.

Published records: Velenovský 1934: 236 as *Dasyscypha cerina* Pers. (as a common species, on wood and bark of deciduous trees).

Material of *Neodasyscypha cerina* revised: Western Bohemia: Šumava Mts., valley of Popelný potok brook (right tributary of Vydra river c. 2.5 km N of Antýgl), alt. 840 m, on lying piece of wood of *Fagus sylvatica*, 15 September 2004, leg. et det. M. Suková, PRM 901970. – Central Bohemia: Koda near Srbsko, on cut log of *Fraxinus excelsior*, 18 May 1950, leg. et det. M. Svrček, PRM 816265. – Srbsko, valley of Bubovický potok (brook), on wood of *Corylus avellana*, 22 March 1974, leg. et det. M. Svrček, PRM 804250. – Poříčko na Sázavě, valley of Křešický potok (brook), on fallen, dry trunk of *Carpinus betulus*, 30 October 1954, leg. et det. M. Svrček, PRM 816268. – Southern Bohemia: Valley of Vltava river between Zvíkov and Červená, Lavička, on branch of *Pyrus communis*, 20 August 1955, leg. et det. M. Svrček, PRM 816263. – Vrábsko near Čimelice, Alnetum by Nerestec pond, on wood of *Salix cinerea*, 16 August 1963, leg. et det. M. Svrček, PRM 805278. – Tábor, on decaying twig of *Betula*, July 1950, leg. et det. M. Svrček, PRM 816271.

Additional material of *Neodasyscypha cerina* from other countries studied: Slovakia, Muránska planina Mts. (alt. 1000–1300 m), Maretkina, on twig of *Fagus sylvatica* in top of the tree, 30 July 1947, leg. et det. M. Svrček, PRM 816262.

Comparative material of *Perrotia flammea* studied: Western Bohemia: Doupovské hory hills, Valeč, on dry decorticated twigs of *Rosa* sp. in arid valley, 28 November 1953, leg. F. Kotlaba, det. M. Svrček, PRM 817784 (as *Lachnum flammeum* (Alb. et Schwein.) Svrček in herb.). – Central Bohemia: Karlštejn, Velká hora hill, on dry twigs of *Ligustrum vulgare*, 14 June 1953, leg. et det. M. Svrček, PRM 817777 (as *Lachnum flammeum* (Alb. et Schwein.) Svrček in herb.). – Hřebeny Mts., Voznice near Dobříš, on decorticated twigs of *Carpinus betulus*, 8 October 1949, leg. et det. M. Svrček, PRM 817776 (as *Lachnella flammea*). – Southern Bohemia, valley of Vltava river between Zvíkov and Červená, on *Pirus communis*, 11 August 1955, leg. et det. M. Svrček, PRM 817779 (as *Lachnum flammeum* (Alb. et Schwein.) Svrček in herb.).

ACKNOWLEDGEMENTS

I would like to thank Drs. Z. Pouzar, J. Holec and H.O. Baral for critically reading the previous version of the manuscript and for valuable comments and suggestions. Dr. Z. Pouzar is acknowledged for consultations devoted to various nomenclatural problems and Dr. W. Gams for consultation concerning Art. 10.1. The mycofloristical and collecting activity of Dr. M. Svrček is greatly appreciated and this article contains many specimens from the PRM collected and identified by him. My thanks are expressed to Dr. A. Chlebicki for identifying wood and providing a final version of the drawings. The work was supported by a grant of the Ministry of Culture of the Czech Republic (project no. RK04P03OMG010).

References

Arendholz W.-R. and Raitviir A. (1988): A new species of *Hyaloscyphaceae* on needles of *Picea* (*Pinaceae*). – Mycotaxon 32: 353–364.

Baral H. O. (1992): Vital versus herbarium taxonomy: morphological differences between living and dead cells of Ascomycetes, and their taxonomic implications. – Mycotaxon 44: 333–390.

Baral H. O. (2003): In vivo veritas, ed. 2. – 2 CD-ROM, unpublished.

Baral H. O. and Krieglsteiner G. J. (1985): Bausteine zu einer Askomyzeten-Flora der BR Deutschland: In Süddeutschland gefundene Inoperculate Discomyzeten mit taxonomischen, ökologischen und chorologischen Hinweisen. – Beih. Z. Mykol. 6: 1–160.

Boudier É. (1885): Nouvelle classification naturelle des Discomycètes charnus, connus généralement sous le nom de Pezizes. – Bull. Soc. Mycol. France 1: 91–120.

Boudier É. (1907): Icones mycologicae. Ser. 3, livr. 13, pl. 212. – Paris.

Boudier É. (1909): Icones mycologicae. Ser. 5, livr. 22, pl. 416. – Paris.

Boudier É. (1911): Icones mycologicae. Tom. 4. – 362 p. Paris.

Bulliard J. B. F. (1789): Herbier de la France. Tom. 9, Fasc. 97–108. – pl. 385–432, Paris.

Bulliard J. B. F. (1791): Histoire des champignons de la France. – 368 p. Paris.

Cantrell S. A. and Hanlin R. T. (1997): Phylogenetic relationships in the family *Hyaloscyphaceae* inferred from sequences of ITS regions, 5.8S ribosomal DNA and morphological characters. – Mycologia 89(5): 745–755.

Chlebicki A. and Suková M. (in print): Helotiales on Dryas. – Mycotaxon.

Clements F. E. and Shear C. L. (1931): The genera of fungi. – 496 p., 58 tab. New York.

Dennis R. W. G. (1949): A revision of British *Hyaloscyphaceae* with notes on related European species. – Mycol. Pap. 32: 1–97.

Desmazières J. B. H. J. (1842): Neuvième notice sur quelques plantes cryptogames, la plupart inédites, récemment découvertes en France, et qui vont paraître en nature dans la collection publiée par l'auteur. – Ann. Sci. Nat., Ser. 2., Bot., 17: 91–118.

Dimitrova E. (2002): Discomycetous fungi of the *Leotiales* found on the *Betulaceae* in Bulgaria. – Turk. J. Bot. 26: 253–258.

Fries E. (1822): Systema mycologicum, vol. 2(1). – 274 p., Lundae.

Fuckel L. (1870): Symbolae mycologicae. – Jahrb. Nassauischen Vereins Naturk. 23–24: 1–459, 6 pl.

Gray S. F. (1821): A natural arrangement of British plants, vol. 1. – 824 p. London.

Greuter W. et al. (2000): International Code of Botanical Nomenclature (Saint Louis Code). – 474 p. Königstein.

Haines J. H. (1989): Studies in the *Hyaloscyphaceae* IV: *Fuscolachnum*, a new genus for *Dasyscyphus pteridis*. – Mem. New York Bot. Gard. 49: 315–325.

Haines J. H. and Dumont K. P. (1984): Studies in the *Hyaloscyphaceae* III: The longspored, lignicolous species of *Lachnum*. – Mycotaxon 19: 1–39.

Holm L. (1976): Some notes on discomycete nomenclature. – Trans. Brit. Mycol. Soc. 76(2): 333–334.

Holm L. (1978): Two controversial discomycete names. – Mycotaxon 7: 139–140.

Huhtinen S. and Cannon P. F. (1987): Proposal to conserve *Hyaloscypha* Boudier with *H. vitreola* (P. Karsten) Boudier as the conserved type (Fungi). – Taxon 36: 649–651.

Karsten P. A. (1871): Mycologia fennica. I. Discomycetes. – Bidrag Kännedom Finlands Natur Folk 19: 1–263.

Korf R. P. (1954): Discomyceteae exsiccatae, Fasc. 1. – Mycologia 46: 837–841.

KORF R. P. (1977): Nomenclatural notes. IX. A misconception in regard to *Dasyscyphus* and *Dasyscypha*. – Mycotaxon 5: 515–516.

KORF R. P. (1985): A compendium of currently valid names for species illustrated in volumes 2 and 3 of Boudier's Icones Mycologicae. – p. 211–252, Lausanne.

KORNERUP A. and WANSCHER J. H. (1981): Taschenlexikon der Farben. Ed. 3. – 242 p. Zürich and Göttingen.

LE GAL M. (1939): Florule mycologique des Bois de la Grange et de l'Etoile. Discomycetes. – Rev. Mycol. (Paris) 4: 25–63.

LEENURM K., RAITVIIR A. and RAID R. (2000): Studies on the ultrastructure of *Lachnum* and related genera (*Hyaloscyphaceae*, *Helotiales*, Ascomycetes). – Sydowia 52(1): 30–45.

NANNFELDT J. A. (1928): Contribution to the mycoflora of Sweden I. Discomycetes from Torne Lappmark. – Svensk. Bot. Tidskr. 22: 115–139.

NANNFELDT J. A. (1932): Studie über der Morphologie und Systematik der nichtlichenisierten und inoperculaten Discomyceten. – Nova Acta Reg. Soc. Sci. Upsal., Uppsala, Ser. 4., 8: 1–368.

NEES von ESENBECK C. G. (1817): Das System der Pilze und Schwämme. Ein Versuch. – 234 p. Würzburg.

PAPOUŠEK T. [ed.] (2004): Velký fotoatlas hub z jižních Čech. – 819 p. České Budějovice.

PERSOON C. H. (1801): Synopsis methodica fungorum. – 706 p. Gottingae.

PERSOON C. H. (1822): Mycologia europaea, vol. 1. – 356 p., 12 tab. Erlangae.

PHILLIPS W. (1893): A manual of the British Discomycetes. Ed. 2. – 462 p., 12 pl. London.

PICBAUER R. (1942): Beitrag zur Pilzflora von Böhmen, Mähren und der Slowakei. – Verh. Naturf. Vereins Brünn, 73 [1941]: 177–203.

PRÁŠIL K. (1999): Exkurze sekce pro studium mikroskopických hub v ČR v roce 1998. – Mykol. Listy 71: 23–27.

RAITVIIR A. (1970): Synopsis of the *Hyaloscyphaceae*. – Scripta Mycol. 1: 1–115, 1 tab.

RAITVIIR A. (1980): The genus *Lasiobelonium*. – Scripta Mycol. 9: 99–132.

RAITVIIR A. (2002): A revision of the genus *Dasyscyphella* (*Hyaloscyphaceae*, *Helotiales*). – Polish Bot. J. 47: 227–241.

RAITVIIR A. (2004): Revised synopsis of the *Hyaloscyphaceae*. – Scripta Mycol., Tartu, 20: 1–133.

RÉBLOVÁ M. and PRÁŠIL K. (1999): Příspěvek k poznání askomycetů a deuteromycetů v karech šumavských jezer – vstupní studie pro monitoring [Contribution to the knowledge of Ascomycetes and Deuteromycetes in glacial cirques of lakes in the Šumava Mts.]. – Příroda (Prague) 14: 7–31.

REHM H. (1893): Ascomyceten: Hysteriaceen und Discomyceten. Lf. 41. – In: Rabenhorst's Krypt.-Fl. Deutschl., Oest. und Schweiz, ed. 2, 1/3: 849–912, Leipzig.

SACCARDO P. A. (1889): Sylloge Fungorum. Vol. 8. – 1143 p. Patavii.

SCHEUER C. (1988): Ascomyceten auf *Cyperaceen* und *Juncaceen* im Ostalpenraum. – In: Bibliotheca Mycologica 123, p. 1–274, Berlin and Stuttgart.

SPOONER B. (1987): *Helotiales* of Australasia: *Geoglossaceae*, *Orbiliaceae*, *Sclerotiniaceae*, *Hyaloscyphaceae*. – Bibliotheca Mycologica 116: 1–711, Berlin and Stuttgart.

SUKOVÁ M. (2004): Fungi on *Juncus trifidus* in the Czech Republic. I. – Czech Mycol. 56: 63–84.

SVRČEK M. (1953): Mykoflora údolí potoka Klíčavy na Křivoklátsku. – Čas. Nár. Mus. 122: 204–215.

SVRČEK M. (1954): První příspěvek k mykoflóře rezervace Milešovka v Českém Středohoří. – Ochr. Přír. 9: 109–112.

SVRČEK M. (1962): Diskomycety z Nízkých Tater, nalezené během posjezdové exkurze II. SEM. 1960 [Discomycetes, qui in montibus Nízké Tatry, Slovakiae, excursione post Congressum Secundum Mycologorum Europaeorum procedente, tempore 5.–10. septembri 1960 collecti sunt.]. – Česká Mykol. 16: 87–114.

SVRČEK M. (1986): Discomycetes from West Bohemia. – Folia Mus. Rer. Natur. Bohem. Occid. Bot. 24: 1–27.

SVRČEK M. (1989): New or less known Discomycetes XIX. – Česká Mykol. 43: 65–76.

VELENOVSKÝ J. (1934): Monographia Discomycetum Bohemiae. Vol. 1, 2. – 436 p., 31 tab. Pragae.

ZIMMERMANN H. (1909): Verzeichnis der Pilze aus der Umgebung von Eisgrub. – Verh. Naturf. Vereins Brünn, 47 [1908]: 60–112, 4 tab.

CZECH MYCOL. 57(1–2): 173–174, 2005

Book Review

PETER ZWETKO und PAUL BLANZ

Die Brandpilze Österreichs. Doassansiales, Entorrhizales, Entylomatales, Georgefischeriales, Microbotryales, Tilletiales, Urocystales, Ustilaginales. – Catalogus Florae Austriae III/3, 241 Seiten, 27 Karten. Biosystematics and Ecology Series No. 21, Verlag der Österreichischen Akademie der Wissenschaften, Wien, 2004. – Ca. 350 Euro. Karten für alle aus Österreich nachgewiesenen Arten, Fotografien sowie Artenlisten der Brandpilze für die Bundesländer und Naturräume Österreichs sind auf der dem Buch beigefügten CD-ROM enthalten.

Der vorliegende Katalog der Brandpilze Österreichs enthält die Fundangaben für 168 Arten aus 25 Gattungen, dazu kurze Anmerkungen zur Taxonomie und Gesamtverbreitung der Taxa in Europa. Die Mehrzahl der Gattungen gehört nach der neuen Klassifikation zur Klasse Ustilaginomycetes und die Gattungen *Microbotryum* und *Sphacelotheca* gehören zur Klasse Urediniomycetes. Es werden auch die Arten, welche bisher in Österreich nicht nachgewiesen worden sind, aber deren Vorkommen möglich ist, kurz besprochen. Die Gattungen sind nummeriert und nach Alphabet angeordnet, ebenso die Arten innerhalb der Gattungen.

Nach dem Vorwort von Friedrich Ehrendorfer, dem Bandherausgeber (Institut für Botanik der Universität Wien), folgen Inhalt und Zusammenfassung in Englisch und Deutsch. In der Einleitung erwähnen die Autoren, dass aus ganz Österreich 2534 Fundmeldungen vorliegen. Im allgemeinen Teil wird das neue System der Basidiomycota behandelt mit allen Gattungen der Brandpilze, deren Wirtspflanzen in Österreich vorkommen. Es folgt das Kapitel „Die bisherige Durchforschung Österreichs und ihre Mängel", in dem kurz die Geschichte der Sammeltätigkeit von Brandpilzen in Österreich geschildert wird. Am wenigsten durchforscht sind Vorarlberg und das Waldviertel in Niederösterreich. An der Durchforschung Österreichs haben auch einige deutsche Mykologen teilgenommen, z.B. P. Magnus, der unlängst verstorbene Dr. W. Brandenburger, Prof. H. und I. Scholz, Dr. H. Jage und W. Dietrich.

Nachstehend sind 3 Verbreitungskarten mit den einzelnen Bundesländern und den Höhenstufen aufgeführt. Die erste Karte zeigt die Verteilung aller erfassten Brandpilzfunde in Österreich mit Angabe ihrer Häufigkeit. In den Karten 2 und 3 sind diese Nachweise nach Funden vor und seit 1950 dargestellt. In der interessanten Tabelle 1 sind Anzahl der Brandpilzarten, deren Wirtspflanzen in Österreich vorkommen und Anzahl der aus Österreich nachgewiesenen Brandpilzarten aufgeführt. Überraschenderweise ist keine Art von *Doassansia* aus Österreich bekannt. In Mähren wurden 5 Arten gesammelt. Dagegen wurden in Österreich 26 Arten von *Anthracoidea* nachgewiesen und in Mähren nur 14. Im nächsten Kapitel sind die Unterlagen für die Bearbeitung des Katalogs erwähnt. Es wurden alle wichtigen österreichischen Herbarien ausgewertet, von ausserösterreichischen Herbarien wurde das Material der Botanischen Staatssammlung München (M) eingearbeitet. Daneben haben viele Mitarbeiter Unterlagen zur Auswertung geliefert.

Es folgt die Literatur, die für die Ausarbeitung des Katalogs benutzt wurde. Sie ist untergliedert in: 1. allgemeine Literatur und 2. floristische Literatur. Im ersten Teil sind 48 und im zweiten Teil 81 Arbeiten aufgeführt.

Der spezielle Teil beginnt mit der Erläuterung der Ordnung und Form der Darstellung, dann folgen Abkürzungen für Staaten, für die österreichischen Bundesländer, für Regionen der Nachbarstaaten und für die Gross-Naturräume in Österreich. Nachfolgend werden die einzelnen Gattungen in alphabetischer Reihenfolge behandelt. Bei einzelnen Gattungen wird immer die einschlägige Literatur angegeben. Es werden auch Brände, die in Österreich bisher nicht gefunden worden sind, aber vorkommen könnten, weil ihre Wirtspflanzen im Gebiet nachgewiesen sind, erwähnt. Auch grenznahe Fundorte aus Nachbarländern (z. B. Böhmen, Schweiz, Deutschland) werden angegeben. Alle in Österreich vorkommenden Arten werden den einzelnen Höhenstufen zugeordnet (z. B. collin bis submontan usw.). Bei einigen Bränden findet man wertvolle Detailanmerkungen. Wertvoll sind auch die Bemerkungen betreffs einiger falscher Angaben früherer Mykologen, z. B. über *Ustilago flosculorum*. Hier und da findet man einige kleine Druckfehler, z. B. auf S. 70 *Entyloma fischeri*: in den Blätter; S. 75 letzte Zeile: *Ranunculus scleratus* anstatt *sceleratus*, ähnlich auf S. 76 erste Zeile; S. 78 5. Zeile: Orginalbeschreibung u. a.

Einige Bemerkungen und Ergänzungen zu den einzelnen Brandpilzarten: bei den Abkürzungen ist nicht erklärt, was bedeutet E bei den Fundorten (z. B. E Laakirchen). Wahrscheinlich bedeutet es east (englisch östlich). Meiner Meinung nach wäre es besser, im deutschen Text deutsche Abkürzungen (z. B. Ö = östlich) zu benutzen. *Anthracoidea arenaria*: auf *Carex brizoides* ist diese Art im Böhmerwald (Šumava) häufig. Es ist interessant, dass *Anthracoidea caricis* auf *Carex montana*, die in der collinen Region häufig ist, oft in subalpinen Lagen gefunden wurde, z. B. in Tirol bis 1850 m ü. M. Ähnlich auch auf *Carex pilulifera*: bis in 1800 m ü. M. Bemerkenswert ist das häufige Vorkommen von *Anthracoidea elynae* in den österreichischen Alpen. *Anthracoidea heterospora* fand ich auf *Carex nigra* im Böhmerwald. *A. rupestris* wurde von Dr. Holub auf *Carex rupestris* in der Velká Fatra in der Slowakei gefunden. *A. sempervirentis* ist auf *Carex sempervirens* auch im slowakischen Teil der Hohen Tatra häufig. *A. tomentosae* wurde auch in Mähren gefunden (siehe z. B. Picbauer 1929). *Entyloma fergussonii* auf *Myosotis sylvatica* fand ich auch im Mährischen Karst (siehe Müller 2000). In Brno (Brünn) und Umgebung habe ich vielmals auf dem häufigen *Erigeron annuus* die zweifelhafte *Entyloma fischeri* vergeblich gesucht. *Entyloma linariae* auf *Linaria vulgaris* wurde auch in Mähren (siehe z. B. Müller 2000) gefunden. *Entyloma matricariae* auf *Tripleurospermum inodorum* kommt ziemlich häufig in Mähren vor (siehe z. B. Müller 2000). *Glomosporium leptideum* wurde in Mähren insgesamt auf 21 Lokalitäten gesammelt (siehe Baudyš et Picbauer 1924, Picbauer 1929, 1931, 1932, 1933, 1937, Zacha 1948). *Microbotryum major* soll richtig *M. majus* heissen (siehe Vánky in Mycotaxon 67 (1998): 35). Die Lokalität Načeratice ist richtig: es ist ein Dorf unweit südöstlich von Znojmo (Znaim). *Microbotryum parlatorei* auf *Rumex maritimus*: Břeclav: richtig „Žižkov", gegenwärtig Moravský Žižkov. Vánky (1985) führt das Funddatum 1.IX.1925 auf. *M. violaceum* s.l. auf *Dianthus pontederae* ist in Mähren ziemlich häufig. Warum *Tilletia* cf. *contraversa* auf *Elymus hispidus* subsp. *hispidus* aus Niederösterreich? Wenn eine *Tilletia* in den Ovarien dieser Wirtspflanze Sori ausbildet, dann muss es *T. contraversa* sein. *Urocystis avenastri* auf *Avenula pubescens* wurde von Baudyš und Picbauer am 9.VI.1926 auf dem Hügel Hornek bei Brno-Líšeň gefunden und bei Vánky (1985) publiziert. Am 9.VI.1988 konnte ich diesen Brand auf dem Gipfel des Hornek sammeln (siehe Müller 2000), der Beleg befindet sich in meinem Herbarium. *Urocystis leimbachii* auf *Adonis aestivalis* wurde auch in Böhmen gefunden (siehe Bubák 1912). *U. pulsatillae*: ein weiterer Wirt in Europa ist: *Pulsatilla patens* (L.) Mill. (siehe Bubák 1912). *Ustilago calamagrostidis* auf *Calamagrostis epigejos* kommt auch in Mähren vor und zwar ziemlich häufig. *U. striiformis* auf *Arrhenatherum elatius* tritt auch in Mähren auf (siehe Müller 2000). *Ustilentyloma brefeldii* auf *Holcus mollis* wurde auch von Dietrich und Müller (2001) vom tschechischen Erzgebirge publiziert.

Informativ sind die Angaben im V. Kapitel: Die Verbreitung der Gattung *Anthracoidea* und ihrer Wirtspflanzen im Vergleich. In Österreich wurden insgesamt 765 Funde von *Anthracoidea*-Arten gemacht; davon in der planaren-collinen-submontanen Höhenstufe 103 Funde und in der montanen-subalpinen-alpinen Höhenstufe 625 Funde. Dann folgen 24 ausgewählte farbige Verbreitungskarten mit Bezeichnung der Höhenstufen. Durch Versehen sind die Karten von *Anthracoidea caryophylleae*, *A. caricis* und *A. caricis-albae* doppelt gedruckt. Nützlich ist der Wirt-Parasit-Index: alphabetisches Verzeichnis aller Gefässpflanzen Österreichs, an denen bisher in Europa Brandpilze festgestellt werden konnten. Die Namen in Klammern beziehen sich auf Funde ausserhalb Österreichs. Nach diesem Index kann man die Brände vorläufig bestimmen. Zum Schluss werden der Index der Synonyme und ein Register mit allen im Text verwendeten lateinischen Namen der Pilztaxa in alphabetischer Reihenfolge aufgeführt.

Was die technische Bearbeitung betrifft, ist das Buch ansprechend ausgestattet, auf dem Titelbild sind schöne Farbfotos von *Anthracoidea sempervirentis* auf *Carex ferruginea* und *Microbotryum violaceum* auf *Saponaria officinalis* abgebildet.

Das Buch ist sehr ausführlich bearbeitet mit der neuesten in den letzten Jahren und noch gegenwärtig sich durchgreifend ändernden Nomenklatur der Brandpilze. Auch aus diesem Grunde kann man das Buch empfehlen nicht nur den Brandpilz-Spezialisten, sondern auch den praktischen Phytopathologen und Lehrern des Pflanzenschutzes und der Botanik.

Jiří Müller

CZECH MYCOL. 57(1–2): 175, 2005

Book Review

T. LÆSSØE and J. H. PETERSEN

MycoKey 1.0. Keys to 528 genera of Basidiomycota from Northern Europe.
CD ROM published by the authors supported by the Tuborg Foundation, the University of Aarhus, the University of Copenhagen and the Danish Mycological Society. ISBN 87-984481-6-1. Price € 54 (about 62 USD).

MycoKey is a synoptical key covering 528 genera of Basidiomycota occurring in northern Europe (i.e. Europe north of the Alps). It includes all carpophores forming Basidiomycota, excluding smut and rust fungi, *Exobasidiaceae* and *Filobasidiaceae*.

The input part consists of a series of more than 120 fully illustrated search layouts presenting different macroscopic and microscopic characters. Data can be entered either by check-boxes or pop-up menus. Depending on the choices made, the system will lead by various paths to the relevant characters up to the final genus (genera). The identification starts with a selection of the type of carpophores, then its pileus, hymenophore, stipe, etc., continuously reducing the number of possible genera (the number of remaining genera is visible at any stage of the identification process). All characters are demonstrated in drawings or photographic details, and it therefore enables a good selection of the requested features. The user can use either a full mode for advanced (more screens with macroscopic and also microscopic characters) or an easy mode for beginners (presenting a simple screen with only basic macroscopic characters). The easy mode is even recommended for children aged 10 years and up.

MycoKey contains almost than 2000 colour photographs of representative species, more than 5000 references, descriptions, information on generic types, authors, synonyms and the number of species. All illustrating photos, made by numerous photographers, are of an excellent quality.

MycoKey works on both Personal (Windows 98, 2000, XP, Millenium) and Macintosh (OS X or OS 9.1) computers and monitors with 16-bit colours in at least 800 x 600 (Macintosh) or 1024 x 768 pixels (Windows). I recommend to copy all files from the CD to the hard disk drive and to start the program from your computer (we have problems to start it from the CD). More information as well as an upgrade to version 1.1 is available on web page http://www.mycokey.com/. As a next step, the publication of a new version (2.0) is planned in 2005; this version will also contain about 350 genera of discomycetes.

Mycokey fills a gap in illustrated keys and is user-friendly. I can highly recommend it to all mycologists working on Basidiomycota and not only on them.

Vladimír Antonín

Czech Mycology, published by the Czech Scientific Society for Mycology. DTP by S. Zrno, STAPS. Printed by Čihák Press, Praha 10. Distributed by the Czech Scientific Society for Mycology, P. O. Box 106, 111 21 Praha 1, and Kubon & Sagner, P. O. Box 340108, 80328 München, Germany. Annual subscription: Vol. 57, 2005: US $ 86,–; EUR 83,–

INSTRUCTIONS TO AUTHORS

Preparation of manuscripts. Manuscripts are to be submitted in English, German or French. The text should be written on one side of white paper (A4, 210 × 297 mm) with broad margins (maximum 30 lines per page). Each manuscript must include an abstract (in English) not exceeding 150 words and a maximum of five key words. The paper will be followed by an abstract in Czech (or Slovak). The journal is responsible, however, for the translation of abstracts into Czech for foreign authors. Send *two copies* of the typescript and *computer files* as e-mail attachments. Finally, the authors are asked to submit all computer files with the *accepted manuscript* (on floppies, CDs or as e-mail attachments). The files should be in MS Word, graphs in MS Excel. Avoid any special type of text formatting except for italic and bold options.

Illustrations and tables. All tables, black and white photographs and figures (in black indian ink on a separate sheet) combined with the legends should be self-explanatory. Legends to the figures must be typed on a separate sheet. Colour photographs can be accepted but the authors will be responsible for the costs. All drawings or photographs of microstructures should be provided with a scale. All illustration should be submitted as the *original drawing and one clear copy.* Outputs from computer graphics programmes produced on plotters or laser printers as well as high-resolution graphic files (TIFF or JPEG) are acceptable. The dimension of any figure should not exceed 180 x 260 mm in size. References to illustrative matter in the text should be in parentheses, e.g. ... spore sizes (Tab. 1) or ... as shown in Fig. 2 ... Figs. 1-5 ... Map 1 ...

Nomenclature. Latin names should conform to the International code of botanical nomenclature. New taxa must be substantiated by a Latin diagnosis including a reference to the public herbarium where the type specimen is deposited. The authors are asked to use only the acronyms listed in the Index Herbariorum.

References. References are to be listed in alphabetical order according to the surnames of the first authors. The bibliography should be written as follows:

Moravec J. (1984): Two new species of *Coprobia* and taxonomic remarks on the genera *Cheilymenia* and *Coprobia* (Discomycetes, *Pezizales*). – Čes. Mykol. 38: 146-155. *(journal article)*

Ryvarden L. (1978): The *Polyporaceae* of North Europe, Vol. 2. *Inonotus-Tyromyces.* – 507 p. Oslo. *(book)*

Tommerup I.C., Kuek C. and Malajczuk N. (1987): Ectomycorrhizal inoculum production and utilization in Australia. – In: Sylvia D.M., Hung L.L. and Graham J.H. (eds.), Proceedings of the 7th North American Conference on Mycorrhizae, p. 93-295, Gainesville. *(book chapter, abstract, article in proceedings)*

The references *in text* should be Moravec (1984), or (Moravec 1984), or Kühner and Romagnesi (1974). When there are three or more authors use the form Tommerup et al. (1987).

Manuscript evaluation. All manuscripts will be reviewed by one or two reviewers, and the authors informed about their acceptance, rejection or necessary revisions within three months. If a manuscript is returned for revision, the authors should submit a revised version within one month.
Authors should preferably have their English language texts approved by a native – English speaker.

Proof corrections, reprints. Proofs of the paper will be sent to authors via air mail or as a PDF file. If not returned within two weeks, the proof correction will be carried out by the editor. The principal author will receive 30 reprints and a final PDF file free of charge.

Correspondence. All correspondence concerning the journal should be sent to the following address: Czech Mycology (Česká mykologie, National Museum, Mycological Department, Václavské náměstí 68, 115 79 Praha 1, Czech Republic. Phone: 00420/224 497 259, fax: 00420/224 222 550, e-mail: jan.holec@nm.cz, http://www.natur.cuni.cz/cvsm/

Czech Mycology, published by the Czech Scientific Society for Mycology. DTP by S. Zrno, STAPS. Printed by Čihák Press, Praha 10. Distributed by the Czech Scientific Society for Mycology, P. O. Box 106, 111 21 Praha 1, and Kubon & Sagner, P. O. Box 340108, 80328 München, Germany. Annual subscription: Vol. 57, 2005: US $ 86,–; EUR 83,–

CZECH MYCOLOGY / ČESKÁ MYKOLOGIE

is an international scientific journal publishing papers in all aspects of mycology including taxonomy, ecology, physiology and mycofloristics as well as mycological topics in forestry, agriculture and medicine. Czech Mycology will publish full length papers and short communications reporting original research which make a significant contribution to mycology. Review articles are also published.

CONTENTS