

## Taxonomic studies on *Psathyrella* sect. *Spadiceae*

MARTINA VAŠUTOVÁ

Dept. of Biology, Pedagogical Faculty, University of South Bohemia, Jernýmova 10,  
CZ-371 15 České Budějovice, Czech Republic  
martina.vasut@seznam.cz

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Descriptions, figures of microscopic characters, data on ecology and distribution of four species of *Psathyrella* section *Spadiceae* known from the Czech Republic and Slovakia are given. These species are *P. spadicea*, *P. papyracea*, *P. pygmaea* and *P. spintrigeroides*. Type material of *P. variata*, *P. imleriana*, *P. olympiana* and *P. spintrigeroides* has been examined and the insufficiently known taxa *P. variata*, *P. imleriana*, *P. subcernua* and *P. sarcocephala* are discussed. The newly published combination *Psathyrella papyracea* (Pers.: Fr.) Vašutová is shown to be the correct name for a fungus currently named *P. cernua* (Vahl: Fr.) Hirsch. An identification key for *Psathyrella* species with thick-walled cystidia occurring in Central Europe is presented.

**Key words:** *Psathyrella*, Czech Republic, Slovakia, sect. *Spadiceae*, distribution, ecology.

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V příspěvku jsou publikovány popisy, nákresy mikroznaků, data o ekologii a rozšíření čtyř druhů křehutek (*Psathyrella*) ze sekce *Spadiceae* známých z České republiky a Slovenska: *P. spadicea*, *P. papyracea*, *P. pygmaea* a *P. spintrigeroides*. Zároveň byl studován typový materiál druhů *P. variata*, *P. imleriana*, *P. olympiana* a *P. spintrigeroides* a diskutovány problematické taxony *P. variata*, *P. imleriana*, *P. subcernua* a *P. sarcocephala*. Správným jménem pro druh dosud známý jako *P. cernua* (Vahl: Fr.) Hirsch. je *Psathyrella papyracea* (Pers.: Fr.) Vašutová. Součástí práce je klíč k určování křehutek s tlustostěnnými cystidami, které se vyskytují ve střední Evropě.

### INTRODUCTION

*Psathyrella* (Fr.) Quél. (*Psathyrellaceae*, *Agaricales*) is a worldwide-distributed genus of about 550 dark-spored saprotrophic taxa (Smith 1972, Kits van Waveren 1985). Many species have almost identical and variable macroscopic characters and so their identification is based on microscopic characters only. Modern infrageneric classifications were published by Smith (1972), Romagnesi (1982), Kits van Waveren (1985), and Singer (1986). Due to the fact that only Kits van Waveren published a monograph of the genus in Western Europe, his infrageneric classification became the most used there. However, current analyses of ITS and part of the LSU area of rDNA (Walther et al. 2005, Larsson and

Örstadius 2008, Padamsee et al. 2008, Vašutová et al. 2008) demonstrate that all these classifications based on morphological and anatomical characters are more or less artificial. To prepare a new infrageneric classification respecting the phylogeny of the genus, it is necessary to analyse more species and to support it by analyses of other DNA regions.

Section *Spadiceae* (Morgan) Kits van Wav. emend. is an artificial section (Vašutová et al. 2008), although well usable for identification, characterised as “having pleurocystidia muricate and thick-walled, walls at least 0.5 µm, but almost always more, up to 2–3.6 µm thick, either everywhere or only locally (apex, ventrical portion or/and in or near pedicel)” (Kits van Waveren 1985). As was supposed by Romagnesi (1982) in his classification and then supported by molecular analysis (Vašutová et al. 2008), thick-walled cystidia with crystals are probably a plesiomorphic character. Other species with slightly thick-walled cystidia (c. 0.5 µm only) and without crystals were placed by Kits van Waveren into the section *Pennatae* Romagn. emend. Kits van Wav. and *Hydrophilae* (Romagn.) ex Singer emend. Kits van Wav.

In the Czech Republic and Slovakia, section *Spadiceae* is represented by four species. The occurrence of the fifth species, *Psathyrella olympiana* A.H. Sm., has not been confirmed to date. Based on molecular data (Vašutová et al. 2008), section *Spadiceae* is composed of three unrelated, distinct groups of species. The core of the section *Spadiceae* consists of the non-velate species *P. spadicea* (P. Kumm.) Singer and *P. papyracea* (Pers.: Fr.) Vašutová (= *P. cernua* ss. auct.), distinguished by Romagnesi (1982) as subgenus *Homophron*. This group is a sister group of the genus *Lacrymaria* (Walther et al. 2005, Larsson and Örstadius 2008, Padamsee et al. 2008, Vašutová et al. 2008). The second group consists of the velate species *P. olympiana* A.H. Sm. belonging to section *Fatuae* Romagn. ex Romagn. (Romagnesi 1982), and *P. pygmaea* (Bull.: Fr.) Singer belonging to section *Pygmaeae* Romagn. The last group is represented by *P. spintrigeroides* P.D. Orton – a species the morphological characters of which place it on the border of sections *Spadiceae* and *Pennatae*. However, molecular data (Larsson and Örstadius 2008, Vašutová et al. 2008) strongly supported relations between *P. spintrigeroides* and section *Pennatae*.

The aim of this work is to contribute to the knowledge of species variability in section *Spadiceae* by providing descriptions and figures of micromorphological characters based on Czech and Slovak specimens and to summarise current information on their ecology and distribution in the Czech Republic and Slovakia. For the purpose of practical identification I have added an identification key including all species with thick-walled cystidia from sections *Spadiceae*, *Pennatae* and *Hydrophilae* occurring in Central Europe.

## METHODS

Descriptions of macromorphological characters are based on fresh basidiomata collected by the author in the years 2001–2006 in the Czech Republic and Slovakia, and are deposited in the author's herbarium (MV) or BRNM. Abbreviations of herbaria follow the Index Herbariorum (Holmgren and Holmgren 2003). Colours were compared with the colour tables by Küppers (1999). Microscopic observations were performed according to Kits van Waveren's method (Kits van Waveren 1971). At least ten randomly selected cheilocystidia, pleurocystidia, caulocystidia and basidia and 20 randomly selected mature spores were measured in each of three representative specimens of each species collected in the Czech Republic or Slovakia. The size of each microscopic structure is given as the 10- and 90-percentiles of all measurements, the 5- and 95-percentiles are given in brackets. All specimens listed under "Collections studied" were microscopically examined; any deviations were recorded and incorporated into the descriptions of the species. Description terminology is taken from Vellinga (1988) and Fouchier (1995). The term "subacute" for the apex of cystidia is used as a term intermediate between "acute" and "obtuse". Further, type specimens of *P. spintrigeroides* (K(M) 70569), *P. variata* (MICH 5379), *P. imleriana* (BR 46447-81, Volders 93222), *P. olympiana* (MICH 11991), *P. kauffmanii* (MICH 11962), *P. indecorosa* (MICH 11953), *P. avellaneifolia* (MICH, Smith 21463) and *Psathyrella artemisiae* var. *microspora* (L 54381) have been examined.

The synonymy of names published in *Psathyrella* is not complete because of the large number of existing *Psathyrella* names, which have moreover been mixed with names belonging to the current genera *Psilocybe*, *Hypholoma* and *Stropharia*. I have focused mainly on names published in the period 1753–1832 and verified only the synonyms of the presented species which are included in monographs of the genus (Kits van Waveren 1985, Enderle 1989, Örstadius 2001).

Notes on ecology and distribution of the species in Europe were taken from publications by monographers of the genus or in cooperation with them to make certain they belonged to the correct species (Enderle 1987, 1989, 2004; Enderle and Hübner 2005; Kits van Waveren 1985; Örstadius 2001; Legon and Henrici 2005; Tassi 1997; Arnolds et al. 1995). Localisation of the examined specimens is structured as follows: number of the phytogeographical unit according to the phytogeographical division of the Czech and Slovak Republics (Futák 1966, Skalický 1988, Vašutová 2006 – Figs. 1, 2), name of the locality, quadrat of Central European grid mapping (Q).

## RESULTS AND DISCUSSION

### Identification key for *Psathyrella* species with thick-walled cystidia (about 0.5 µm or more)

(Note: it is necessary to observe material in water or 10 % NH<sub>4</sub>OH, as crystals are missing in 5 % KOH)

- 1a Cystidia with distinct crystals at their tops ..... 2
- 1b Cystidia without distinct crystals at their tops (rarely few scattered small crystals measuring  
c. 1 µm are present on a few cystidia only) ..... 5
- 2a Basidiomata small (pileus up to 2 cm), resembling *Coprinus disseminatus*, pleurocystidia up to  
35 µm long; on decaying stumps of deciduous trees, rarely on soil with wood remnants  
..... 3. *P. pygmaea* (p. 151)
- 2b Not as above, basidiomata larger, pleurocystidia longer than 35 µm ..... 3
- 3a Species without veil; often in cavities or at bases of living deciduous trees ..... 4

- 3b Species with developed veil; on decaying trunks or stumps of deciduous trees. 4. *P. olympiana* (p. 154)  
 4a Cystidia utriform, crystals forming “caps” on cystidium tops, spores reddish brown, basidiomata becoming eburneous to sordid white when drying out ..... 2. *P. papyracea* (p. 145)  
 4b Cystidia versiform, crystals forming “stars” on cystidium tops, spores very pale, almost colourless, basidiomata becoming at most pale carneous beige when drying out ..... 1. *P. spadicea* (p. 141)

Note: A species with a pileus distinctively pruinose at margin in a young stage and with a mixture of lampro- and leptocystidia on the lamellae edge and on their surface is *P. variata* A.H. Sm. (p. 160). Species with characters between *P. cernua* and *P. spadicea* could be *P. sarcocephala* ss. auct. (p. 167).

- 5a Wall of cystidia thicker in upper part (0.5–2 µm, when rarely 0.5 µm thick only, the very top is almost thin-walled); on fallen trunks mostly of deciduous trees ..... 5. *P. spintrigeroides* (p. 156)  
 5b Wall of cystidia thicker in middle and lower part (0.5–1 µm), wall of upper part sometimes so thin as almost invisible at 200 × magnification ..... 6  
 6a Basidiomata growing on burnt places; spores dark reddish brown almost without germ pore and with distinct hilar appendix, cystidia mostly with acute apex ..... *P. pennata*  
 6b Not as above ..... 7  
 7a Small basidiomata (conical pileus up to 1.5 cm broad), spores pale brownish yellow without germ pore; pleurocystidia versiform, often with irregular apex, growing terrestrial in deciduous forests ..... *P. umbrina* (see note below)  
 7b Basidiomata medium to large-sized, spores with at least indistinct germ pore; pleurocystidia versiform or utriform, with regular or irregular apex, growing terrestrially or on wood ..... 8  
 8a Pleurocystidia mostly versiform to lageniform with regular subacute apex, pleurocystidioid cheilocystidia densely packed, spores slightly amygdaliform with distinct germ pore, dark reddish brown; growing on wood remnants or fallen trunks of deciduous or coniferous trees.. *P. artemisiae*  
 8b Pleurocystidia versiform, some utriform, apex often irregular, sometimes forked, subacute to obtuse, pleurocystidioid cheilocystidia not densely packed, spores slightly phaseoliform, germ pore distinct to indistinct, medium brown, growing on fallen trunks, rarely on wood remnants of *Fagus sylvatica* or *Acer pseudoplatanus* ..... *P. rostellata* (for description see Vašutová 2008)  
 8c Pleurocystidia utriform, apex almost subcapitate, pleurocystidioid cheilocystidia not densely packed – sphaeropedunculate cells prevail, germ pore indistinct to distinct, medium brown, growing terrestrially under beech, maple or oak ..... *P. kauffmanii*

Note: *P. umbrina* Kits van Wav. and *P. kauffmanii* A.H. Sm. have not been reported from the Czech Republic or Slovakia. *P. umbrina* is known in Central Europe from one locality in Austria (WU 16345) only. One collection (PRM 897750) similar to *P. kauffmanii* was found in the Šumava Mts. but its spores lack a germ pore. Its occurrence in Europe is doubtful. Enderle (1996) described the species from Germany but his species has cystidia closer to *P. rostellata* than to *P. kauffmanii*. I have studied only herbarium material of these species.

## Section *Spadiceae* (Morgan) Kits van Wav. emend. Kits van Wav.

*Psilocybe* [unranked] *Spadiceae* Morgan in J. Mycol. 13: 246. 1907. – *Drosophila* sect. *Spadiceae* (Morgan) Romagn. in Bull. Mens. Soc. Linn. Lyon 13: 52. 1944. – *Psathyrella* sect. *Spadiceae* (Morgan) Kits van Wav. emend. Kits van Wav. in Persoonia Suppl. Vol. 2: 280. 1985.

*Psilocybe* [unranked] *Spadiceae* Morgan consists of 16 species currently belonging to the genera *Psathyrella*, *Psilocybe* and *Panaeolus*. Kits van Wav. (1985) placed this section into the genus *Psathyrella* and reduced the number of species.

1. *Psathyrella spadicea* (P. Kumm.) Singer

Figs. 1, 10

*Agaricus spadiceus* Schaeff., Fung. Bavar. Palat. nasc., vol. 4: 27, 1774. (nom. illeg., non *Agaricus spadiceus* Scop., Fl. Carniol., 443, 1772); *Psilocybe spadicea* P. Kumm., Führer Pilzk. 71, 1871; *Psathyrella spadicea* (P. Kumm.) Singer, Lilloa 22: 468, 1951.

Synonyms: *Drosophila spadicea* (P. Kumm.) Quél., Enchir. fung.: 116, 1886; *Pratella spadicea* (P. Kumm.) J. Schröt. in Cohn, Krypt.-Fl. Schlesien: 568, 1889; *Psathyra spadicea* (P. Kumm.) Singer, Ann. mycol. 34: 33, 1936. – ?*Agaricus curvatus* Weinm., Hymen. Gasteromyc. 248, 1836.

Misapplied names: *Psathyrella sarcocephala* s. J.E. Lange, Fl. agaric. danic. 4: 80, pl. 148F, 1939; *Crepidotus palmatus* s. Bres., Icon. mycol. 16, t. 788, 1930.

"*Psathyrella spadicea*" auct. non (P. Kumm.) Singer: Bres., Icon. mycol. 18: pl. 859, 1931.

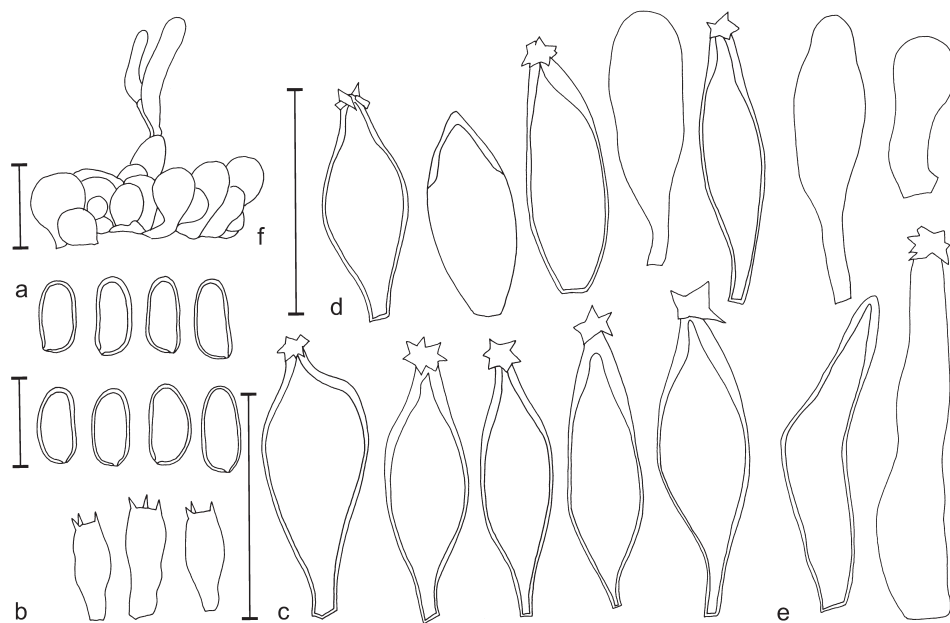
Type specimen: not preserved. Lectotype (selected by Örstadius 2001): Schaeffer, Fung. Bavar. Palat. nasc., vol. 1: pl. 60, figs. 4 et 6, 1762. Epitype (selected by Örstadius 2001): Germany, Bavaria, floodplain forests near Leipheim-Riedheim, growing caespitose at the base of a big poplar, 11 Nov. 1998, leg. et det. M. Enderle [GB – LÖ 205-98, isoeptype M].

Selected illustrations: Kits van Waveren, Persoonia Suppl. Vol. 2: figs. 208–212, 1985; Enderle, Beitr. Kenntn. Pilze Mitteleurop. 5, 1989; Ricken, Die Blätterpilze (*Agaricaceae*) I: pl. 66, fig. 7, 1915; Konrad and Maublanc, Ic. sel. Fung.: pl. 46, 1928, Lange, Fl. agaric. danic.: pl. 148F as *P. sarcocephala*, 1939.

Selected literature: Kits van Waveren, Persoonia Suppl. Vol. 2: 161–164, 1985.

Characteristics in brief. Basidiomata medium to large-sized, growing mostly in clusters, without veil, pileus drying out to carneous beige, lamellae brick-beige to brick-brown. Spores medium- to large-sized,  $8\text{--}9.5 \times 4\text{--}5 \mu\text{m}$ , very pale, slightly phaseoliform, without germ pore. Cystidia broadly versiform, distinctly thick-walled in upper part, with crystals forming "stars". Growing often at bases or in cavities of living deciduous trees.

Description. Basidiomata caespitose. Pileus in young stage paraboloid to convex, some basidiomata with broad umbo, 13–27 mm, at maturity plano-convex to plane, rarely broadly conico-paraboloid, 20–52 mm, old pilei plane, often with undulate, even reflexed margin, 72–130 mm. Surface hygrophanous, smooth, in very young stage slightly pruinose in narrow zone along margin (c. 1 mm); in young stages deep brown with vinaceous tint (S90Y40M40, S80Y50M60), later brown to reddish brown (S70Y50M50), medium brown, slightly irregularly coloured (S50Y50M50, S50Y40M40), pinkish brown (S50Y50M40), brick-beige (S40Y60M50), brownish pink (S40Y50M40), drying out from the centre, at margin remaining darker, when dry pale carneous beige (S20Y30–40M20, S10Y40M10). Veil absent. Lamellae crowded, L = 24–32, l = 3–5, 2–9 mm broad; narrowly adnate, ventricose, at maturity disrupting transversely, in young stages pale ochre-beige with pinkish hue, pale brick-beige (S20Y40M30–40), later pale brick-brown (S40Y70M50); with fimbriate edge, white in young stages, later concolorous. Stipe 34–150  $\times$  3–7 mm, cylindrical or tapering to base, often twisted, hollow, creamy, later pale beige with pale pinkish ochre shade; surface fibrillose, at apex pruinose, at base whitish tomentose. Flesh in pileus 3–7 mm broad, white to pale creamy. Smell indistinct. Spore print brick-beige (S40Y60M50).



**Fig. 1.** *Psathyrella spadicea* (P. Kumm.) Singer (MV06/118): a – spores, b – basidia, c – pleurocystidia, d – cheilocystidia, e – caulocystidia, f – pileipellis. Bars = 10 µm for spores, 50 µm for other microscopic structures.

Spores  $8\text{--}9.5 \times 4\text{--}5$  µm, average  $8.7 \times 4.7$  µm,  $Q = 1.6\text{--}2.2(-2.3)$ ; slightly phaseoliform in side view, ellipsoid in front view; without germ pore, with indistinct to small hilar appendix; in water very pale with pink tint, pale beige-ochraceous pink (S20Y20M10, S10Y30M10); in 5 % KOH colourless with slightly reddish shade or pale beige-ochraceous pink (S20Y20M10); in 10 %  $\text{NH}_4\text{OH}$  very pale with pink tint, pale beige-ochraceous pink (S10Y30M10, S40Y20M10). Basidia  $(21.5\text{--})22\text{--}26 \times (6\text{--})6.5\text{--}8$  µm, 4-spored, narrowly clavate. Pleurocystidia fairly numerous,  $(51\text{--})52\text{--}64 \times 16\text{--}21(-22)$  µm; broadly fusiform with subacute apex, cystidium wall in the middle up to 1 µm thick, in upper part 1–3 µm (thickening starts just below apex), sometimes entire apex filled with wall structure (up to 15 µm from the top); with crystals forming “stars” at apex, dissolving in KOH; colourless in 10 %  $\text{NH}_4\text{OH}$ . Edge of lamellae consisting of: (1) numerous pleurocystidioid cheilocystidia,  $45\text{--}74 \times 14\text{--}20$  µm, broadly fusiform, with wall up to 1 µm thick in the middle, 1–3 µm in upper part (thickening starts just below apex), sometimes entire apex filled with wall structure (up to 15 µm from the top); (2) scarce utriform cystidia,  $37\text{--}55 \times 17\text{--}20$  µm, with wall up to 1 µm thick in middle and upper parts; (3) scarce (up to 15 %) clavate leptocystidia,  $43\text{--}57 \times 14\text{--}17$  µm.



Hymenophoral trama in 10 %  $\text{NH}_4\text{OH}$  yellowish, parallel, subhymenium brownish. Pileipellis a transition between a hymeniderm and an epithelium, consisting of colourless cells,  $25\text{--}37 \times 18\text{--}27 \mu\text{m}$ , with  $0.5 \mu\text{m}$  thick walls, hairs rare. Caulocystidia scattered to numerous, versiform pleurocystidioid caulocystidia  $36\text{--}70 \times 11\text{--}18 \mu\text{m}$ , with wall up to  $1 \mu\text{m}$  thick, utriform caulocystidia  $42\text{--}85 \times 11\text{--}21 \mu\text{m}$ , with wall up to  $0.5 \mu\text{m}$  thick, clavate cells  $37\text{--}45 \times 14 \mu\text{m}$ , thin-walled. Clamp-connections present.

**Ecology.** *Psathyrella spadicea* is known as a species growing on stumps but also at the foot and on trunks of deciduous trees (*Fagus sylvatica*, *Populus nigra*, *Castanea*, *Betula*, *Ulmus*, *Aesculus*) (Kits van Waveren 1985, Enderle 1989, Arnolds et al. 1995). Legon and Henrici (2005) reported the species to be growing around the bases of living deciduous trees and very occasionally on decaying trunks or logs. Collections from the Czech Republic and Slovakia were made on various living trees (*Populus tremula*, *Acer pseudoplatanus*, *Betula*, *Quercus Populus alba*, *P. canadensis*, *Aesculus xcarnea*, *A. pavia*, *Fraxinus excelsior*) preferably at their base. Few records are from decaying wood of *Populus*, *Fagus*, *Betula*, *Carpinus*, *Quercus* and *Salix*. Several records concerned terrestrial growth but the basidiomata always occurred near a tree, and so connection with tree roots is supposed. For its affinity to living trees I assume *P. spadicea* to be a saproparasite.

*Psathyrella spadicea* occurs in near-natural mixed or deciduous forests but also in anthropogenic habitats, such as quarries, alleys, parks and fishpond dams.

It grows from the lowlands to the montane belt, most collections were found in the colline to supracolline belt.

**Phenology.** Apr. – Dec., mostly in Sept. and Oct., often in May and June.

**Distribution.** Rather common in the Czech Republic, scattered in Slovakia. Considered rather common in the Netherlands (Arnolds et al. 1995), occasional in England (Legon and Henrici 2005), and also reported from France and Germany (Kits van Waveren 1985, Enderle 1989).

**Discussion.** *Psathyrella spadicea* is distinguished by its rather large-sized basidiomata, brick-brown lamellae and growth mostly on living deciduous trees. Microscopically it is characterised by almost colourless spores and fusiform cystidia with crystals forming “stars”.

Örstadius (2001) found out that *P. spadicea* was not described validly in 1762 as *Agaricus spadiceus*, as was stated by earlier authors. The description by Schaeffer (1762) lacks a Latin species name, which is present in his later description (Schaeffer 1774). However, this name is illegitimate, because there is an earlier homonym *Agaricus spadiceus* described by Scopoli in 1772. Scopoli's species is certainly not a *Psathyrella* – it has lemon-yellow lamellae and a lemon-yellow stipe. The epithet *spadicea* became legitimate thanks to Kummer (1871). I fully

agree with Enderle (1989) and Örstadius (2001), who regard the holotype (iconotype) to be a mixture of several species.

Smith (1972) distinguishes four species in this group (*P. littennii* A.H. Sm., *P. sublateritia* A.H. Sm., *P. conissans* (Peck) A.H. Sm. and *P. spadicea* (Fr.) Singer) based on the colour of the spore deposit, caulocystidium shape and cystidium content, which come very close to the European *P. spadicea*. I have not studied his material. His *P. spadicea* has a wood-brown spore deposit and is therefore probably not identical with the European type.

*P. spadicea* was often identified as *P. sarcocephala* by Czech and Slovak mycologists (see discussion under *P. sarcocephala*) because they used the work by Lange (1939), where they are confused.

Two collections morphologically very similar to *P. spadicea* were found at the foot of *Picea abies* (MV, CB). More specimens are needed to solve their taxonomic value.

#### Collections studied

Czech Republic: **7d**, Prague, Břevnov, Q: 5952a, on base of trunk of *Populus* sp., 5 Oct. 1941, J. Herink (PRM 735900 as *Psilocybe sarcocephala*) – **8**, Karlštejn, Q: 6051c, 24 June 1943, Mr. Šinták (PRM 735906 as *Psilocybe sarcocephala*). – Prague–Bráník, Q: 5952, on wood of *Populus canadensis*, 8 Oct. 1950, J. Kubička (PRM 735899 as *Psilocybe sarcocephala*). – Roblín, Q: 6051ab, 26 Sept. 1943, I. Charvát (PRM 735904 as *Psilocybe sarcocephala*). – **9**, Bohnice, Čimický háj forest, Q: 5852, 12 May 1943, J. Malina (PRM 735919). – Ibid., 7 Oct. 1943, J. Malina (PRM 735917 as *Psilocybe spadicea*). – Prague, Malá Strana, Q: 5952a, on base of *Aesculus pavia*, 16 Nov. 1963, E. Wichanský (PRM 600818 as *Psilocybe spadicea*). – Prague, Kinského sady park, Q: 5952a, on base of trunk of living *Acer pseudoplatanus*, 30 Oct. 1969, E. Wichanský (PRM 685620). – Ibid., on soil, 27 May 1970, E. Wichanský (PRM 709979). – **10a**, Čimice near Prague, Q: 5852d, on (burnt) roots of *Betula*, 13 May 1948, J. Malina (PRM 735907 as *Psilocybe sarcocephala*). – **10b**, Prague, Hodkovičky, Q: 5952cd, on foot of *Betula*, 29 May 1952, J. Miškovský (PRM 703994 as *Psilocybe sarcocephala*). – **15c**, Stéblová, near Pardubice, Q: 5960a, 2 Nov. 1945, K. Kult (PRM 735905 as *Psilocybe sarcocephala*) – **16**, Tulešice, forest with *Populus tremula*, Q: 6963c, 18 Juni 1967, L. Čech (BRNM 331956). – **18b**, Bzenec-Prívov, Q: 7069, 15 July 2006, J. Polčák (MV06/146). – **20b**, Kobylí, near Hustopeče, Q: 7067c, on ceiling and walls of wine cellar, 13 Oct. 1971, E. Hadač (PRM 715642). – Žarošice, Q: 6967d, near stump of *Carpinus betulus* (?), 16 Sept. 1945, V. Vacek (PRM 735925 as *Psilocybe spadicea*). – **21b**, Tovačov, dam of Donbas pond, Q: 6569, at base of living *Populus alba*, 2 Dec. 2006, M. Vašutová et J. Polčák, (MV06/118). – **35d**, Písek, Q: 6650, on roots of *Populus tremula*, 2 May 1974, Kuber (PRM 822335). – **37i**, Český Krumlov, Vyšenské kopce national nature reserve, Q: 7151, on base of trunk of *Populus tremula*, 17 July 2004, M. Beran (CB). – **37p**, Klení, on E bank of Velký Klenský rybník pond, Q: 7253, 31 May 2008, T. Papoušek (CB as *P. sarcocephala*). – **39**, Turovec, dam of Luční pond, Q: 6654a, on stump of *Quercus*, 1 June 1989, J. Valter (CB 6577). – **41**, Písek, near a site called “U Vodáka”, on dam of small fishpond, Q: 6650d, at base of *Quercus*, 31 Aug. 1979, A. Štěpánek et J. Kubička (CB 2125). – Čerňovice na Sázavě, settlement called Poříčko, *Piceetum*, Q: 6155, on decaying trunk of deciduous (?) tree, 29 Oct. 1944, J. Herink (PRM 735903 as *Psilocybe spadicea*). – Zbraslav, Q: 6052a (PRM 735901 as *Psilocybe sarcocephala*). – **42**, Tábor, botanical garden, Q: 7554, on wood of *Salix*, 24 Sept. 1993, M. Beran (CB as *P. sarcocephala*). – Ibid., on base of trunk of *Betula* sp., 12 Oct. 2007, M. Beran et M. Vašutová (MV07/371). – **47**, Kamenná Horka, near Krásná Lípa, Q: 5053c, on stump of *Populus tremula*, 21 Aug. 1961, M. Svrček (PRM 616657 as *Psilocybe sarcocephala*). – **50**, Turnov, park, Q: 5456b, on decaying trunk of *Betula* sp., 9 Sept. 1945, J. Herink (PRM 735908 as *Psilocybe sarcocephala*). – Ibid., on strongly decayed trunk of deciduous tree, 7 July 1946, J. Herink (PRM 520223 as *Psathyrella sarcocephala*). – **51**, Kokořínsko, Libovice, Vrátná hora,



mixed forest, under *Populus tremula* and *Acer platanoides*, Q: 5553c, 18 July 1998, V. Antonín (BRNM 642347). – **61c**, Hoděšovice, deciduous forest 2.5 km SE of the village, Q: 5861, 22 July 1984, M. Dobešová (HR, P250/84; P33557). – **64a**, Průhonice, Q: 6053a, in cavity of roots of *Aesculus carnea*, 6 Oct. 1989, F. Kotlaba (PRM 867702). – **68**, Lelekovice, Mt. Bábí lom, *Abieto-Piceetum*, Q: 6665, 7 Nov. 1954, F. Šmarda (BRNM 331950). – Ibid., 21 May 1961, F. Šmarda (BRNM 225197). – Kuřim, Šiberná forest, *Quercetum*, Q: 6765a, 17 Juni 1962, Pospíšilová (BRNM 331954). – Ibid., on stump of decaying deciduous tree, 17 Juni 1962, F. Šmarda (BRNM 331957). – Ořešín, Q: 6765, 19 Nov. 1961 (BRNM 331959). – Ibid, Kuřimská hora, Q: 6765a, 21 Juni 1952, F. Šmarda (BRNM 331951). – **70**, Mokrá u Brna, Mokerský les, quarry with *Carpinetum*, *Quercu-Carpinetum* and *Piceetum*, Q: 6766da, at base of living *Populus tremula*, 10 Aug. 2000, A. Vágner (BRNM 665300). – **71a**, Javoříčko, Špraněk national nature reserve, *Fagetum*, Q: 6367a, at base of *Acer pseudoplatanus*, 19 Oct. 2004, M. Vašutová (MV04/572). – Mladeč, Třesín nature monument, fragment of alluvial forest, Q: 6268c, on base of trunk of *Fraxinus excelsior*, 27 Oct. 2007, M. Beran et M. Vašutová (MV07/510). – **77a**, Zdravá Voda near Žarošice, Q: 6967b, on base of tree, 7 Sept. 1949, V. Vacek (PRM 703995 as *Psilocybe spadicea*). – **78**, Tvarožná Lhota, Čertoryje nature reserve, Carpathian meadows, alluvium of the Járkovec stream, Q: 7170, on living *Quercus*, 16 Aug. 2000, A. Vágner (BRNM 665313). – **88**, Frymburk, Rašeliniště Bobovec nature monument, Q: 7251c, on trunk of deciduous tree, 9 Oct. 2004, N. Matočec, A. Mešic et Z. Tkalčec (BRNM 705636). – **89**, Pohorská Ves, Žofínský prales national nature reserve, Q: 7354a, in frost cavity of living *Acer pseudoplatanus*, 5 Oct. 2004, M. Vašutová (MV04/402).

Slovakia: **6**, Bratislava, Q: 7868b, 22 June 1965, I. Fábry (BRA 121). – Ibid., 5 Sept. 1965, J. Vojtašek (BRA 121). – Ibid, on foot of *Populus*, 16 Nov. 1987, L. Anovčin (BRA 426). – Rača, Q: 7768d, 10 Sept. 1965, I. Fábry (BRA 121). – Ibid., 18 Sept. 1966, I. Fábry (BRA 121). – Myslenice, Q: 7769a, 14 Sept. 1968, I. Fábry (BRA 121). – Svätý Jur, Šúr national nature reserve, Q: 7769c, 3 Sept. 1968, I. Fábry (BRA 121). – **10**, Marianka, Svätý vrch, part called Biely kríž, Q: 7768a, terrestrial near *Populus tremula* (near *Quercus*), 25 Apr. 1992, L. Hagara (herb. Hagara). – **31**, Nová Sedlica, Stuzica national nature reserve, Q: 0169a, on decaying trunk of *Fagus*, 17 Oct. 1989, J. Kuthan (BRA 407).

## 2. *Psathyrella papyracea* (Pers.: Fr.) Vašutová **comb. nov.** Figs. 2, 9, 11 (Mycobank MB512853)

*Agaricus papyraceus* Pers., Syn. meth. fung. 2: 425. 1801 (basionym); *Agaricus papyraceus* Pers.: Fr., Syst. mycol. 1: 305. 1821; *Psathyrella papyracea* (Pers.: Fr.) M.M. Moser in Gams, Kleine Kryptogamenflora 2: 208. 1953 (combination not valid: basionym not cited).

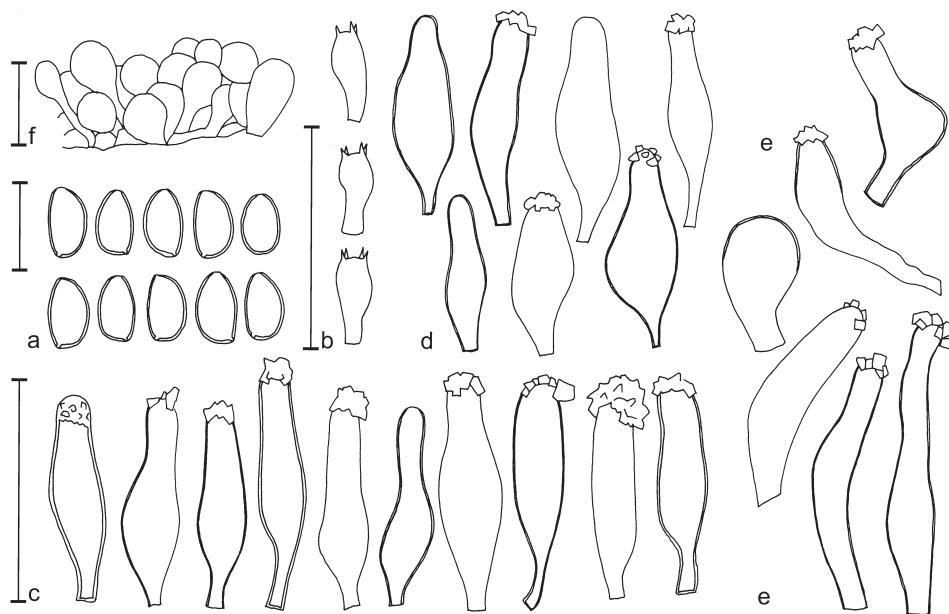
Synonyms: *Prunulus papyraceus* (Pers.: Fr.) Gray, Nat. Arr. Brit. Pl.: 631. 1821; *Coprinarius papyraceus* (Pers.: Fr.) P. Kumm., Führer Pilzk.: 68. 1871; *Psilocybe papyracea* (Pers.: Fr.) J. Lange in Dansk Bot. Ark. 9(1): 32. 1936. – *Agaricus farinulentus* Schaeff., Fung. Bavar. Palat. nasc. Vol. 4: 45 (Index). 1774; *Psilocybe farinulenta* (Schaeff.) Sacc., Flora italica cryptogama: 829. 1915. – *Psilocybe cernua* var. *farinulenta* (Schaeff.) Killerm. in Denkschr. Regensburg. Bot. Ges. 6(20): 74. 1936. – *Agaricus alneti* Schumach., Enum. plant. 2: 280. 1803. – ?*Psathyrella ivoeënsis* Örstadius, Windahlia 16: 155. 1986.

Misapplied names: *Agaricus cernuus* Vahl: Fr., Syst. mycol. 1: 298. 1821; *Psathyra cernua* (Vahl: Fr.) P. Kumm., Führer. Pilzk.: 70. 1871; *Psilocybe cernua* (Vahl: Fr.) Quél. in Mém. Soc. Émul. Montbéliard, sér. II, 5: 147. 1872; *Drosophila cernua* (Vahl: Fr.) Quél., Enchir. fung.: 117. 1886; *Pratella cernua* (Vahl: Fr.) Kirchner & Eichler in Jahresh. Vereins Vaterl. Naturk. Württemberg 50: 448. 1894; *Psathyrella cernua* (Vahl: Fr.) Hirsch in Wiss. Z. Friedrich-Schiller-Univ. Jena, Math.-Naturwiss. Reihe 33: 815. 1984.

Type specimen: Not preserved. Holotype (iconotype): Bolton, Hist. fung. Halifax 1: t. 11. 1788.

Selected illustrations: Kits van Waveren, Persoonia Suppl. Vol. 2: figs. 203–207. 1985 (as *P. cernua*).

Selected literature: Kits van Waveren, Persoonia Suppl. Vol. 2: 160–161. 1985 (as *P. cernua*).



**Fig. 2.** *Psathyrella papyracea* (Pers.: Fr.) Vašutová (MV06/117): a – spores, b – basidia, c – pleurocystidia, d – cheilocystidia, e – caulocystidia, f – pileipellis. Bars = 10 µm for spores, 50 µm for other microscopic structures.

**Characteristics in brief.** Basidiomata medium-sized, growing mostly in clusters, without veil, pileus drying out to eburneous white, lamellae creamy to reddish. Spores medium-sized,  $7\text{--}8 \times 4\text{--}5$  µm, reddish brown, with germ pore. Cystidia utriform, distinctly thick-walled, with crystals forming “caps”. Growing often at bases or in cavities of living deciduous trees, especially *Fagus sylvatica* and *Acer pseudoplatanus*.

**Description.** Basidiomata caespitose to subcaespitose. Pileus in young stages conico-paraboloid to convex, later conico-convex to convex, some basidiomata with broad umbo, 6–50 mm, at maturity plano-convex to plane, with often undulate and reflexed margin, 60–80 mm. Surface hygrophanous, smooth, in dry conditions slightly wrinkled in the centre, at the margin sometimes translucently striate; in young stages medium brown (S60Y30M30) to reddish brown (S70Y40M40), later reddish beige (S60Y30M40) or greyish beige (S70Y40M20, S60M50C50, S40Y60M40), during drying process discolouring to eburneous to sordid white with brownish shade, yellowish in the centre (S10Y50M10), greyish creamy, yellowish creamy to eburneous white. Sometimes pilei eburneous white in young stages and darkening with age. Veil absent. Lamellae crowded to subcrowded, L = 26–32, l = 3, 1–8 mm broad; narrowly adnate to adnate,

ventricose; in young stage creamy, creamy with reddish shade, pale brown, later brick-brown (S60Y50M40), reddish (S70Y70M50), or dark reddish (S80Y90M70); edge white or concolorous, minutely fimbriate. Stipe 12–87 × 1.5–12 mm, cylindrical or tapering to base, sometimes applanate, hollow, white, whitish, creamy or eburneous, at apex pruinose to minutely floccose, surface slightly fibrillose, at base white tomentose. Flesh whitish to ochraceous creamy in pileus, creamy in stipe. Smell indistinct, once a parsley smell was noticed, once a slightly flowerish smell. Spore print purple-black (S99Y80M50).

Spores 7–8 × 4–5 µm, average 7.7 × 4.3 µm, Q = 1.7–1.9; slightly amygdaliform in side view (some slightly depressed), ellipsoid in front view; with distinct to indistinct 1–1.5 µm wide germ pore and small hilar appendix; in water reddish brown (S60Y60M50, S50Y80M50, S70Y80M50) to dark brown (S80Y60M50–S80Y60M50); in 5 % KOH greyish brown (S60Y30M10, S70Y20M10, S80Y50M30); in 10 % NH<sub>4</sub>OH reddish brown to dark brown (S70Y60M40, S80Y60M50, S80Y70M50). Basidia (18–)19–25(–26) × (6.5–)7–8 µm, 4-spored, narrowly clavate. Pleurocystidia mostly scarce, sometimes fairly numerous to numerous, (42–)43–53(–55) × (10–)11–15(–16) µm; utriform, with obtuse apex, wall in the middle up to 0.5 µm thick, in upper part mostly thin-walled, exceptionally up to 2 µm thick; with crystals at apex forming “caps”, dissolving in KOH; hyaline. Edge of lamellae consisting of (1) numerous to densely packed pleurocystidioid cheilocystidia, (27–)29–49(–50) × 11–15(–17) µm, utriform, with wall up to 0.5 µm thick in middle and upper parts, at apex with crystals forming “caps” dissolving in KOH; (2) rare to lacking clavate or sphaeropedunculate cells, 16–34 × 7–15 µm, thin-walled. Hymenophoral trama in 10 % NH<sub>4</sub>OH yellowish to colourless, parallel. Distinct colour differentiation between subhymenium (brown) and hymenium (yellowish). Pileipellis a transition between a hymeniderm and an epithelium, formed of colourless cells, 31–50 × (15.5–)16–28(–31) µm, with 0.5 µm thick walls. Pileocystidia scattered. Caulocystidia rare to numerous, consisting of three types: (1) utriform with crystals, 33–66 × 10–17 µm; (2) utriform without crystals, 36–48 × 9–15 µm; (3) clavate to sphaeropedunculate, 23–37 × 11–19 µm. Walls variably thick between collections, but mostly up to 0.5 µm thick, rarely up to 1 µm. Clamp-connections present.

**Distribution.** In the Czech Republic and Slovakia rather common in suitable habitats. Rather rare in the Netherlands (Arnolds et al. 1995), rare in the UK (Legon and Henrici 2005), also reported from France and Germany (Kits van Waveren 1985, Enderle 1989).

**Ecology.** *P. papyracea* grows mostly on bases or in frost cracks of trunks of living trees, mainly *Fagus sylvatica* and *Acer pseudoplatanus*, less frequently on *Tilia*, *Populus*, *Ulmus glabra*, *Acer campestre*, *Aesculus hippocastanus*, *Alnus glutinosa* and *Quercus cerris*, but is found also on decaying stumps or fallen decaying trunks of *Fagus*, *Ulmus glabra*, *Tilia*, *Fraxinus excelsior*, *Aesculus*

*hippocastanum* and *Carpinus betulus*. Similarly to *P. spadicea*, *P. papyracea* seems to be a saproparasitic species. In Europe the species is reported either from stumps or wood of deciduous trees, especially *Fagus sylvatica* and *Populus* (Kits van Waveren 1985, Legon and Henrici 2005) or at the base of living deciduous trees, particularly *Populus* and *Fraxinus excelsior* (Enderle 1989). One collection concerned a group growing from an old house brick discarded in woodland (Legon and Henrici 2005).

Comparing to *P. spadicea*, *P. papyracea* is stronger associated with natural forests. It occurs mostly in deciduous and mixed forests; rarely in alleys.

It grows from the lowlands to the montane belt, most collections were found in the colline and the montane belts.

Phenology. Sept.–Dec., mostly in Oct., once collected in Jan.

Discussion. *P. papyracea* is an easily recognisable species with medium-sized pale-coloured basidiomata, growing mostly on living deciduous trees. Microscopically it is characterised by utriform cystidia with crystals forming “caps” on their top.

According to Kits van Waveren (1985), spores of *P. papyracea* (as *P. cernua*) are  $6.5\text{--}7 \times 4.2\text{--}4.5 \mu\text{m}$  in size, reddish yellow in water, and possess a small ( $\pm 1 \mu\text{m}$ ) but fairly distinct germ pore. Enderle (1989) reported spores  $7\text{--}8.5 \times 4.2\text{--}5.1 \mu\text{m}$  large, dark brown, with an indistinct germ pore. I observed variability in spore size and distinctiveness of the germ pore between collections. Also the number of pleurocystidia is very variable (from numerous to even absent). As I did not find any correlation between these characters and moreover, due to the fact that carpophores occur late in the year and characters could be influenced by extreme weather conditions, I consider the above-mentioned differences to fall within the species’ variability. In my opinion, *P. papyracea* is a variable species rather than a complex of microspecies.

The pattern in cystidium wall thickness is not in agreement with that observed by Kits van Waveren (1985): “with wall very slightly thickened up to  $0.5 \mu\text{m}$ , rarely  $1 \mu\text{m}$  at very apex.” It is necessary to note that due to the presence of crystals at the cystidium top, it is difficult to measure the cystidium wall thickness there.

#### Collections studied

Czech Republic: **8**, Srbsko, Q: 6050d, on trunk of living *Ulmus glabra*, 18 Sept. 1965, M. Svřček et J. Herink (PRM 610800). – **9**, Prague, Bubeneč, Q: 5852, on (burnt) roots of *Aesculus hippocastanum*, 8 Nov. 1941, J.A. Herink (PRM 735915 as *Psilocybe spadicea*). – Ibid., Dienzenhoferovy sady park, Q: 5852a, on trunk of living *Acer campestre*, 18 Nov. 1962, E. Wichanský (PRM 568670). – Ibid., on superficial cut of living *Acer campestre*, 19 Nov. 1963, E. Wichanský (PRM 600609). – Ibid., Kinského sady park, Q: 5952a, on soil, around trunk of *Tilia*, 15 Nov. 1962, E. Wichanský, (PRM 568629, smaller spores than usual). – Ibid., 20 Dec. 1964, E. Wichanský (PRM 735903 as *Psilocybe cernua*). – Ibid., Královská obora park, Q: 5852cd, near cavity of trunk of *Tilia*, 17 Oct. 1941, J.A. Herink (PRM 735918 as *Psilocybe cernua*). – **14a**, Jičín, Q: 5658c, on trunk of *Tilia*, 14 Nov. 1948, A. Příhoda (PRM 609505 as *Psathyrella spadicea*). – **21a**, Náměšť na Hané, Terežské valley, Q:

6468a, in frost crack of trunk of living *Tilia*, 22 Oct. 2003, M. Vašutová (MV03/452). – **21b**, Tovačov, dam of Donbas pond, Q: 6569, at base of trunk of living *Populus alba*, 2 Dec. 2006, M. Vašutová et J. Polčák (MV06/117). – **37e**, Krajníčko, under Helfenburk ruin, Q: 6850c, on trunk of *Acer pseudoplatanus*, 27 Sept. 1976, J. Kubička (CB 2124). – **39**, Příbraz, Fabián nature reserve, Q: 7055b, in cavity of trunk of living *Acer pseudoplatanus*, 30 Oct. 2005, M. Beran (CB). – Klikov, Bukové kopce nature reserve, Q: 7055d, on base of trunk of living *Fagus*, 13 Oct. 2007, M. Beran (MV07/362). – **41**, Tábor, left bank of Lužnice river, Q: 6553, at base of *Tilia platyphyllos*, 14 Jan. 2007, M. Beran et M. Vašutová (MV07/004). – Čerčovice na Sázavě, settlement called Poříčko, Q: 6155, on decaying trunk of *Carpinus betulus*, 29 Oct. 1944, J. Herink et J. Kubička (PRM 735922 as *Psilocybe spadicea*). – **42**, Tábor, botanical garden, Q: 6554, on base of *Populus ×canadensis*, 12 Oct. 2007, M. Beran et M. Vašutová (MV07/370). – **50**, Turnov, Rývový sady park, along Jizera river, Q: 5456b, near cavity at base of *Ulmus*, 14 Nov. 1948, J. Herink (PRM 609504 as *Psathyrella spadicea*). – **67**, Hodonín u Kunštátu, Údolí Hodoňky nature reserve, Q: 6564a, on living *Alnus glutinosa*, 6 Oct. 1999, A. Vágner (BRNM 648528). – **68**, Vranov n. Dyjí, deciduous forest, Q: 7160b, at base of standing *Populus*, 19 Oct. 2002, L. Zelený (MV02/530). – **78**, Strání, Velká Javořina national nature reserve, Q: 7172a, on fallen trunk of *Fagus sylvatica*, 15 Oct. 2004, M. Vašutová, J. Wolfová, K. Bučinová et J.W. Jongepier (MV04/500). – **88a**, Železná Ruda, near Čertovo jezero lake, on slope of Mt. Jezerní hora, SW of the lake, deciduous forest (*Picea*, *Fagus*), Q: 6845a, at base of living *Fagus sylvatica*, 16 Oct. 1995, J. Holec (PRM 885578). – **88d**, Lenora, Mt. Zátoňská hora, on SW slope, deciduous virgin forest, Q: 7048, terrestrial by trunk of *Ulmus glabra*, 14 Oct. 1996, J. Holec (PRM 889514). – České Žleby, Mt. Spáleniště, young *Fagetum* with *Sorbus aucuparia*, *Ulmus glabra*, *Acer pseudoplatanus*, on SW slope, on trunk of *Fraxinus excelsior*, 22 Sept. 1998, J. Holec (PRM 897350). – Volary, Mt. Stožec, Medvědice nature reserve, Q: 7148b, on trunk of living *Fagus sylvatica*, 15 Oct. 1996, J. Holec (PRM 889545). – Zátoň, Boubínský prales national nature reserve, Q: 7048b, on fallen trunk of *Fagus sylvatica*, 17 Oct. 1979, J. Kubička (PRM 822049 as *Psilocybe sarcocephala*). – **89**, Pohorská Ves, Žofínský prales national nature reserve, Q: 7354a, at base of standing *Fagus sylvatica*, 26 Sept. 2003, J. Lederer (BRNM 705614). – Ibid., on base of living trunk of *Ulmus glabra*, 30 Oct. 2004, M. Beran (CB). – Ibid., on trunks of living *Fagus* tree, from base up to a height of 1.5 m, 6 Oct. 2005, M. Beran (CB). – Ibid., in cavity of trunk of living *Acer pseudoplatanus*, 25 Oct. 2005, M. Beran (CB 14532). – Ibid., in cavity of living trunk of *Fagus*, 25 Oct. 2005, O. Jindřich (CB). – Ibid., in cavity of fallen decaying trunk of *Fagus*, 25 Oct. 2005, M. Beran (CB 14532). – Ibid., in cavity of trunk of living *Acer pseudoplatanus*, 25 Oct. 2005, M. Beran (CB). – **91**, Čachnov, Q: 6262, in cavity of living *Fagus*, 21 Oct. 2007, M. Vašutová (MV07/440). – **95a**, Orlické Záhoří, Trčkov national nature reserve, Q: 5664, in cavity of trunk of *Acer pseudoplatanus*, 25 Sept. 2007, M. Vašutová (MV07/219) – Ibid., in cavity of *Fagus*, 25 Sept. 2007, M. Vašutová (MV07/221). – **99a**, Horní Lomná, Mionší national nature reserve, Q: 6578a, at base of living *Acer pseudoplatanus*, 31 Oct. 2002, M. Vašutová et R. Vašut (MV02/582).

**Slovakia:** **2**, Hrachovo, Svetlianská cerina nature reserve, Q: 7585ab, at base of living *Quercus cerris*, 24 Oct. 2002, M. Vašutová (MV02/541). – **22**, Magurka, Mt. Mestská hora, Q: 8270d, on trunk of living *Fagus sylvatica*, 27 Sept. 1989, J. Holec (PRM 887948 as *Psathyrella subcernua*). – **28**, Žilina, Q: 6778, in tree-top of *Aesculus hippocastanum*, on decaying bark, 30 Oct. 1982, J. Gáper (BRA 334). – **31**, Kalná Ráztoka, Havešová nature reserve, Q: 9970, on fallen trunk of *Fagus*, 4 Oct. 1989, J. Kuthan (BRA 342 as *P. spadicea*). – Nová Sedlica, surrounding of Stuzica national nature reserve, Q: 0169, in cavity of *Fagus* trunk, 17 Oct. 2002, S. Adamčík (MV02/511). – Ibid., at base of *Acer pseudoplatanus*, 17 Oct. 2002, M. Vašutová (MV02/512, MV02/513). – Ibid., Stuzica national nature reserve, on slope of Hrubky hill, on decaying trunk of *Fagus*, 28 Sept. 1988, J. Kuthan (BRA 335). – Ibid., on slope of Príkrý hill, on decaying trunk of *Fagus*, 11 Oct. 1990, J. Kuthan (BRA 367 as *P. subcernua*). – Ibid., Jarabá skala nature reserve, on hill slope, on fallen trunk of *Ulmus glabra*, 11 Oct. 1990, J. Kuthan (BRA 367, 90/65, as *P. subcernua*).



## Nomenclature

*Psathyrella papyracea* is known as *P. cernua* in European literature (e. g. Kits van Waveren 1985). Nevertheless the name *P. cernua* cannot be used for this fungus as it is based on *Agaricus cernuus* Vahl which is not *P. cernua* ss. auct. – see below.

### *Agaricus cernuus* Vahl

*Agaricus cernuus* Vahl, Fl. Dan. 6(17): 9, 1790; *Agaricus cernuus* Vahl: Fr., Syst. mycol. 1: 298. 1821.

Type specimen: not preserved. Holotype (iconotype): Vahl, Fl. Dan. 6(17): pl. 1008, 1790.

*Agaricus cernuus* Vahl is described as a species growing “in pratis stercoratis” and the picture represents a species with a veil, which is probably *P. candolleana*. The wrong interpretation came from Fries (1815), whose description, especially the substrate “ad truncorum radices” fits well *P. cernua*, but he referred to Vahl and therefore added “in fimo” to the substrate. Vahl’s picture is surely not *P. cernua* ss. auct.

Another name sanctioned by Fries (1821) which could be a synonym of *Psathyrella cernua* ss. auct. is *Agaricus papyraceus* Fr.

### *Agaricus papyraceus* Pers.: Fr.

*Agaricus papyraceus* Pers., Syn. meth. fung. 2: 425. 1801; *Agaricus papyraceus* Pers.: Fr., Syst. mycol. 1: 305. 1821.

Type specimen: Not preserved. Holotype (iconotype): Bolton, Hist. fung. Halifax 1: t. 11. 1788.

The name *Agaricus papyraceus* was proposed by Persoon but its taxonomic concept was derived from Bolton’s illustration (Bolton 1788), which is very similar to *P. cernua* ss. auct. Bolton stated that “gills turns quite black in decay”, and Fries (1821) even stated “lamellae diffuentes”. This could mean that Bolton’s species is in fact a *Coprinus* and the name cannot be used. Therefore the main question is how to interpret the expression “turn black in decay”. Bolton (1788) published twelve species probably belonging to the current genera *Coprinus* s. l., *Panaeolus*, *Anellaria* and *Psathyrella*. He described their lamellae either as dissolving or turning black in decay or did not describe them in such a way (*Panaeolus*, *Anellaria*). He used the term “dissolving” for short-lived *Coprinus* species, the expression “turn black in decay” for the species in question (named membranous agaric), bell agaric (= *Coprinus* aff. *auricomus*), domestic agaric (= *Coprinus domesticus*), striated agaric (*Coprinus* sp.) and shield or buckeler agaric (mixture of *Panaeolus* and *Coprinus* species, possibly *Conocybe* species). These are, except for *Coprinus domesticus*, species with non-dissolving lamellae. Unfortunately he did not describe any other current *Psathyrella* which would make it possible to compare the description of their lamellae with the “membranous agaric”. Although it cannot be fully excluded that Bolton’s species



was a *Coprinus*, regarding the shape of the pileus it is very unlikely. The fact that lamellae of old basidiomata of *P. cernua* are never black but only purplish brown at most, is not so important. At that time Bolton did not use these terms precisely, so I do not consider it as a major discrepancy. Therefore I suggest using the name *Agaricus papyraceus* as a basionym for name of the species currently but erroneously known as *P. cernua* ss. auct.

### 3. *Psathyrella pygmaea* (Bull.: Fr.) Singer

Figs. 3, 12

*Agaricus pygmaeus* Bull., Herb. France: pl. 525, fig. 2. 1790; *Agaricus pygmaeus* Bull.: Fr., Syst. mycol. 1: 263. 1821; *Psathyrella pygmaea* (Bull.: Fr.) Singer, Lilloa 22: 467. ('1949') 1951.

Synonyms: *Naucoria pygmaea* (Bull.: Fr.) Gillet, Hyménomycètes: 544. 1876; *Psathyra pygmaea* (Bull.: Fr.) Quél., C. R. Ass. Franç. Av. Sci. 9: 664. 1881; *Drosophila pygmaea* (Bull.: Fr.) Quél., Enchir. fung.: 117. 1886. – *Psathyra consimilis* Bres. & P. Henn., Verh. Bot. Ver. Prov. Brandenb. 31: 178. 1889. – *Hypholoma minutellum* Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1. 116: 98.

Type specimen: not preserved. Holotype (iconotype): *Agaricus pygmaeus* Bull., Herb. France: pl. 525 fig. 2. 1790.

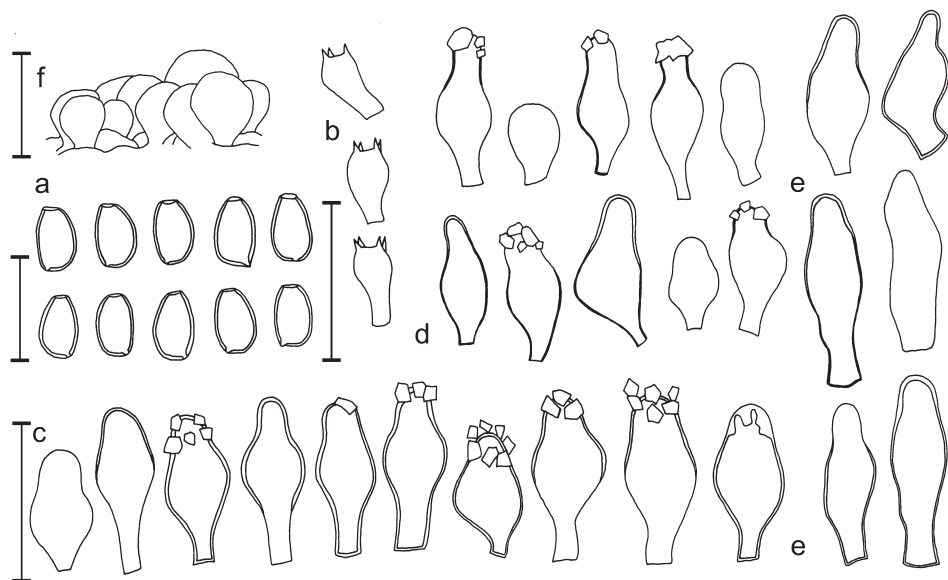
Selected illustrations: Enderle, Die Pilzflora des Ulmer Raumes: p. 417. 2004; Enderle and Hübner, Beitr. Kenntn. Pilze Mitteleurop. 19. 2005; Breitenbach and Kränzlin, Pilze der Schweiz vol. 4: fig. 354. 1995; Kits van Waveren, Persoonia Suppl. Vol. 2: figs. 193–196. 1985; Moser and Jülich, Farbatlas der Basidiomyceten: *Psathyrella* 9, 1995; J.E. Lange, Fl. agaric. danic.: pl. 151 B – caespitose basidiomata. 1939.

Selected literature: Kits van Waveren, Persoonia Suppl. Vol. 2: 156–157. 1985.

Characteristics in brief. Basidiomata small-sized, often gregarious, reminding *Coprinus disseminatus*. Spores small-sized,  $6\text{--}7 \times 3.5\text{--}4\text{ }\mu\text{m}$ , medium brown, with distinct germ pore. Cystidia utriform, distinctly thick-walled, with crystals. Growing often on decaying stumps of deciduous trees.

Description. Basidiomata solitary to caespitose. Pileus paraboloid, soon conico-paraboloid, at maturity convex to plano-convex, some basidiomata with small umbo, 4–11 mm. Surface hygrophanous, smooth, at margin translucently striate; brownish beige (S10Y50M30), medium brown to brownish (S20Y50M20), paler towards margin, later creamy with ochre shade (S10Y50M10). Veil a network of fibrils on pileus, visible in young stages only, later absent. Lamellae crowded,  $L = 14\text{--}22$ ,  $l = 1\text{--}3$ , 1–1.5 mm broad; narrowly adnate to adnate; in young stage creamy, later pale greyish beige (S20Y40M20), finally brown (S50Y40M30). Stipe  $11\text{--}22 \times 0.5\text{--}2$  mm, cylindrical with enlarged base, hollow, white to creamy, pruinose. Smell indistinct. Spore print not observed.

Spores  $6\text{--}7 \times 3.5\text{--}4\text{ }\mu\text{m}$ , average  $6.4 \times 3.9\text{ }\mu\text{m}$ ,  $Q = 1.5\text{--}1.86(-2)$ ; slightly phaseoliform in side view, ellipsoid in front view; with distinct  $1.5\text{--}2\text{ }\mu\text{m}$  broad germ pore and small hilar appendix; in water medium brown with reddish shade (S50Y50M40); in 5 % KOH greyish brown (S60Y20M0–30); in 10 %  $\text{NH}_4\text{OH}$  reddish brown (S60Y40M40–S70Y50M40). Basidia  $(12.5\text{--})13\text{--}17 \times 6\text{--}7\text{ }\mu\text{m}$ , 4-spored, narrowly clavate, rarely clavate. Pleurocystidia numerous to fairly numerous,



**Fig. 3.** *Psathyrella pygmaea* (Bull.: Fr.) Singer (herbarium H. Deckerová): a – spores, b – basidia, c – pleurocystidia, d – cheilocystidia, e – caulocystidia, f – pileipellis. Bars = 10 µm for spores, 50 µm for pileipellis, 30 µm for other microscopic structures.

(25–)27–32(–33) × 12–16(–16.5) µm; broadly fusiform, utriform to broadly utriform, with broadly obtuse apex, wall in the middle 0.3–0.5 µm thick, sometimes up to 1 µm thick, in upper part up to 1 µm thick; with distinct crystals at apex dissolving in KOH, hyaline. Edge of lamellae consisting of (1) numerous pleurocystidioid cheilocystidia, 18–27 × (8–)9–12(–14) µm, broadly fusiform to utriform, thin-walled or with a wall up to 0.3 µm thick, thicker at apex (up to 0.5 µm); (2) scarce sphaeropedunculate cells, 16.5–19 × 11–14 µm, thin-walled, sometimes slightly thick-walled (up to 0.3 µm). Hymenophoral trama in 10 % NH<sub>4</sub>OH colourless to pale yellowish brown, parallel. Pileipellis a hymeniderm, formed of colourless cells, 32–44 × 25–41 µm, with 0.5–1 µm thick walls. Caulocystidia scattered to numerous, of two types: (1) pleurocystidioid caulocystidia, 22–37 × 9–15 µm, broadly versiform to utriform, with wall up to 0.5 µm thick in central part, up to 2 µm in upper part; (2) clavate cells, 18–22 × 11–22 µm, with wall up to 1 µm thick in central part and up to 1.5 µm in upper part. Veil not observed. Clamp-connections present.

**Ecology.** In the Czech Republic and Slovakia *P. pygmaea* grows gregariously on stumps, trunks, and wood remnants or at the base of deciduous trees (*Ulmus*, *Quercus*, *Alnus*, *Salix*), rarely in grass (presence of wood chips is not excluded).

Kits van Waveren (1985) reported the species from stumps of deciduous species, Enderle (2005) from mossy stumps of various deciduous trees (*Alnus*, *Fraxinus*, *Populus*, *Salix*, *Acer*, *Ulmus*, *Fagus*), especially on places with a high groundwater level, once at the mossy base of a living deciduous tree, once on a grass-plot with compost. Legon and Henrici (2005) mention it from decaying wood of a deciduous tree, usually on large logs or stumps, occasionally mixed with *Coprinus disseminatus*.

*P. pygmaea* occurs in deciduous forests, mostly in alluvial forests but is sometimes found in anthropogenic habitats such as parks or gardens.

It is known from the lowlands to the submontane belt, most collections were found in lowlands and the colline belt.

Phenology. June–Oct.

Distribution. Scattered, but probably overlooked. Reported from the Netherlands as rather common (Arnolds et al. 1995) and occasional but widespread in England (Legon and Henrici 2005). Known also from France (Kits van Waveren 1985), Germany (Enderle 2005) and other European countries (see Enderle 2005).

Discussion. Although the iconotype of *Psathyrella pygmaea* is quite schematic, it shows the main characters of the species well. The basidiomata grow gregariously on wood and have a plano-convex pileus and pale lamellae. Also Bulliard's later description agrees with the fungus currently known as *P. pygmaea*. A detailed description of the species was given by Kits van Waveren (1985). Czech collections differ in the absence of pink shades in the lamellae, a slightly smaller range of spore size, which are also a little darker, and cystidia having thicker walls. The percentage of sphaeropedunculate cells is rather low. There is no visible difference in microscopical characters between collections growing on wood in alluvial forests and those growing terrestrially in man-made habitats. Differences in macroscopical characters cannot be evaluated because macroscopic descriptions are often absent in herbaria. Also an analysis of ITS rDNA from two specimens of *P. pygmaea*, each from a different habitat, did not reveal any differences (unpublished data). More data are needed to solve this question.

According to Enderle (Enderle and Hübner 2005), a velum universale of *Psathyrella pygmaea* was once observed. It was composed of cylindrical to versiform, yellow, thick-walled elements. I found a similar structure in *Psathyrella candolleana* (Fr.) Maire. These structures are probably remnants of the velum universale and could be used (similarly as in *Coprinus* s.l.) for infrageneric classifications. Due to their ephemerality they have not been studied yet.

**Collections studied**

Czech Republic: **7d**, Dolany near Unhošť, Q: 5850d, on decaying trunk of deciduous tree, 19 July 1941, J.A. Herink (PRM 735358 as *Psathyra consimilis*). – **11b**, Lysá n. Labem, Stratov, Q: 5855a, on decaying trunk and roots(?) of *Ulmus*, 17 Oct. 1961, M. Svrček (PRM 616623; Svrček 1960). – **16**, Brno, Arboretum VŠZ, Q: 6765d, on *Salix* stump, 18 Juni 1993, A. Vágner (BRNM 590179). – Brno-Lesná, Q: 6765d, on stump of *Acer pseudoplatanus* or *Fraxinus*, 2 July 1993, A. Vágner (BRNM 590154). – Vranovice nad Svratkou, Plačkův les nature monument, Q: 7065d, on decaying stump of deciduous tree, 26 July 2000, A. Vágner (BRNM 664988). – **18a**, Lanžhot, Ranšpurk national nature reserve, Q: 6676a, on root swellings of *Quercus robur*, 12 Oct. 2001, M. Vašutová (MV01/469). – **20b**, Žarošice, Q: 6967d, on trunk of *Alnus glutinosa*, 13 Aug. 1946, V. Vacek (PRM 735359 as *Psathyra consimilis*). – Ibid., on trunk of *Alnus*, 19 Aug. 1947, V. Vacek (PRM 735357 as *P. consimilis*). – **21b**, Litovelské Pomoraví Protected Landscape Area, on stump of deciduous tree, L. Kašpárek (MV06/062b). – **37**, Frymburk, green in centre of square, Q: 7351a, terrestrial in grass, 4 Oct. 2004, M. Vašutová et A. Vágner (BRNM 705629). – **83**, right bank of Odra river, between the villages of Starý Bohumín and Kopytov, Q: 6076c, on decaying wood of deciduous tree, 8 June 2004, H. Deckerová (herbarium H. Deckerová).

Slovakia: **5**, Bratislava-Rusovce, Dolná Sihoť, bank of Dunaj river oxbow, Q: 7969a, in grass, 22 July 2003, J. Červenka (herbarium J. Červenka).

**4. *Psathyrella olympiana* A.H. Sm.**

Fig. 4

*Psathyrella olympiana* A.H. Sm., Contr. Univ. Michigan Herb. 5: 36: 1941.

Type specimen: USA, Olympic National Park, Jackson Guard Station, 6 June 1939 [MICH 11991 (Sm 14118)].

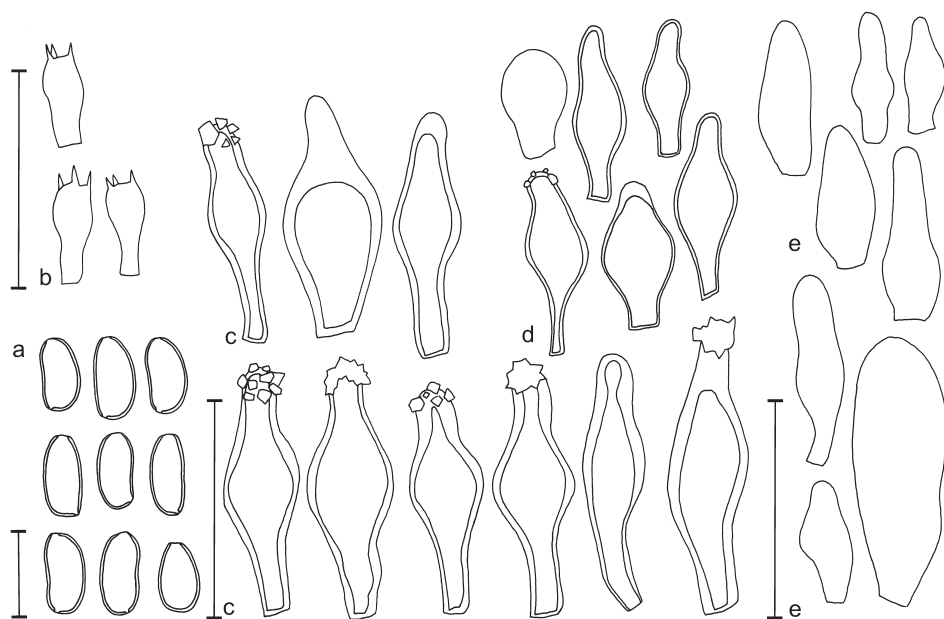
Selected illustrations: Enderle, Die Pilzflora des Ulmer Raumes: 418. 2004; Ludwig, Pilzkompedium, t. 379, f. 98.41D. 2007; Tassi, Bull. Soc. Mycol. France 113: t. 329. 1997; Kits van Waveren, Persoonia Suppl. Vol. 2: figs. 213–217. 1985; Breitenbach and Kränzlin, Pilze der Schweiz 4: fig. 341. 1995.

Selected literature: Smith, Mem. New York Bot. Gard. 24: 256–257. 1972; Kits van Waveren, Persoonia Suppl. Vol. 2: 167–168. 1985; Derbsch, Zeitsch. f. Pilzkunde 43: 183. 1977.

Although *P. olympiana* is reported from several countries of Central Europe, it has not been found in the Czech Republic or Slovakia yet. Therefore the description is only based on my own study of type material and Smith's description of macrocharacters.

**Characteristics in brief.** Basidiomata medium-sized, growing solitary to gregarious, pileus brown, with distinct veil. Spores large-sized, 9–10.5 × 4.5–5.5 µm, reddish brown, with indistinct germ pore. Cystidia mainly broadly versiform with obtuse apex, thick-walled (up to 2.5 µm), especially in pedicel and upper part, with crystals. Growing on decaying stumps or trunks of deciduous trees.

**Description of macroscopic characters** [based on descriptions by Smith (1941, 1972), structure adapted to the pattern used in this paper]. Basidiomata solitary to gregarious. Pileus obtusely conical to convex, later plane, 1–4 cm. Surface smooth or slightly rugulose, pileus margin in mature stage translucently striate; dark rusty brown, drying out to sordid pinkish buff or dull dirty tan. Veil covering the pileus a thin layer of fibrils in young stage, later margin decorated with scattered remains of the thin veil. Lamellae crowded, L = 29–35, 0.3 cm broad, broadly adnate to adnate, pallid brownish, later greyish brown, with white edge. Stipe 3–5 × 0.2–0.5 cm, equal, hollow, white, upper part fibrillose-squamulose to coarsely pruinose and faintly striate, densely white



**Fig. 4.** *Psathyrella olympiana* A.H. Sm. Type specimen (MICH 141118): a – spores, b – basidia, c – pleurocystidia, d – cheilocystidia, e – caulocystidia. Bars = 10 µm for spores, 50 µm for other microscopic structures.

fibrillose over the lower part. Flesh dark brown, drying out pallid. Smell indistinctive.

Description of microscopic characters (based on personal study of the type material). Spores  $9\text{--}10.5 \times 4.5\text{--}5.5$  µm, average  $9.7 \times 5$  µm,  $Q = 1.8\text{--}2.2$ ; phaseoliform in side view, ellipsoid in front view; germ pore indistinct, c. 1 µm wide, with indistinct to small hilar appendix; in water reddish brown (S60Y50M40); in 5 % KOH greyish brown (S30Y00-10M00); in 10 %  $\text{NH}_4\text{OH}$  reddish brown (S60Y50M40). Basidia  $20\text{--}22 \times 8\text{--}9$  µm, 4-spored, narrowly clavate. Pleurocystidia fairly numerous,  $50\text{--}60 \times 13\text{--}21$  µm, versiform to broadly versiform, rarely utriform with obtuse apex, wall in the middle as well as in pedicel up to 2.5 µm thick, in upper part 1–2.5 µm, sometimes whole apex up to 15 µm from the top full of wall structure; with crystals at apex dissolving in KOH, colourless in 10 %  $\text{NH}_4\text{OH}$ . Edge of lamellae consisting of (1) numerous pleurocystidioid cheilocystidia,  $31\text{--}42 \times 11\text{--}14$  µm, fusiform to broadly fusiform, rarely utriform, with wall up to 1 µm in the middle, up to 1.5 µm in upper part; (2) scattered to scarce sphaeropedunculate cells,  $26\text{--}28 \times 13\text{--}16$  µm, thin-walled. Caulocystidia scattered, versiform, utriform, clavate to sphaeropedunculate,  $26\text{--}44 \times 9\text{--}19$  µm, thin-walled, rarely with wall up to 2 µm in upper part. Clamp-connections present.

**Ecology.** Smith (1941) reported the species as growing scattered to gregarious on old wood and debris of alder and cottonwood. In Europe, Derbsch (1977) found it growing on wood remnants, Kits van Waveren (1985) on and against stumps of deciduous trees, Enderle (1987) near and on mossy wood remnants, Legon and Henrici (2005) on buried wood. It occurs in near-natural forests (alluvial forest – WU 18520, WU 26910; deciduous forest with *Quercus*, *Carpinus* and *Fagus* – Derbsch 1977) as well as in man-made ones – “Fichtenparzelle” as reported by Enderle (1987).

**Distribution.** Not found in the Czech Republic or Slovakia. Known from Germany (Derbsch 1977, Enderle 1987), Austria, Hungary, and the UK (Legon and Henrici 2005). Rather rare in the Netherlands (Arnolds et al. 1995), also reported from France (Tassi 1997).

**Discussion.** According to my observations, the type material has larger spores than described by Smith (1941) and distinctively broader cystidia. The broader cystidia were found in their material also by Kits van Waveren (1985) and Enderle (1987). Both emphasised the extremely thick-walled pedicel of the pleurocystidia, which I found in specimen of Enderle too, but in the case of the type material this character was not so distinct. I have not seen the type material of *P. cloverae* A.H. Sm. Therefore I cannot confirm their conspecificity as stated by Kits van Waveren (1985).

#### Collections studied

USA: type [MICH 11991]. – Austria: Kärnten, Völkermarkt, Kleindorf II, alluvial forest, 16 Sept. 1998, A. Hausknecht (WU 18520). – Hungary: Szabolcs-Szatmár-Bereg megye, Fényi erdő nature reserve, c. 2 km S of the village of Bátorliget, alluvial forest, wood of a deciduous tree, 27 Oct. 2006, I. Rimóczi (WU 26910). – Germany: Bavaria, near Unterfahlheim, floodplain forests of Danube, under *Picea abies*, on and near decaying wood (of *Picea* or broad-leaved tree?), 17 Aug. 1985, M. Enderle.

#### 5. *Psathyrella spintrigeroides* P.D. Orton

Figs. 5, 6, 13

*Psathyrella spintrigeroides* P.D. Orton, Trans. Brit. Mycol. Soc. 43: 377. 1960.

Type specimen: UK, England, Surrey, Shepleas (Mountain Wood): near West Horstley, 5 Nov. 1955, leg. P.D. Orton [K(M) 70569].

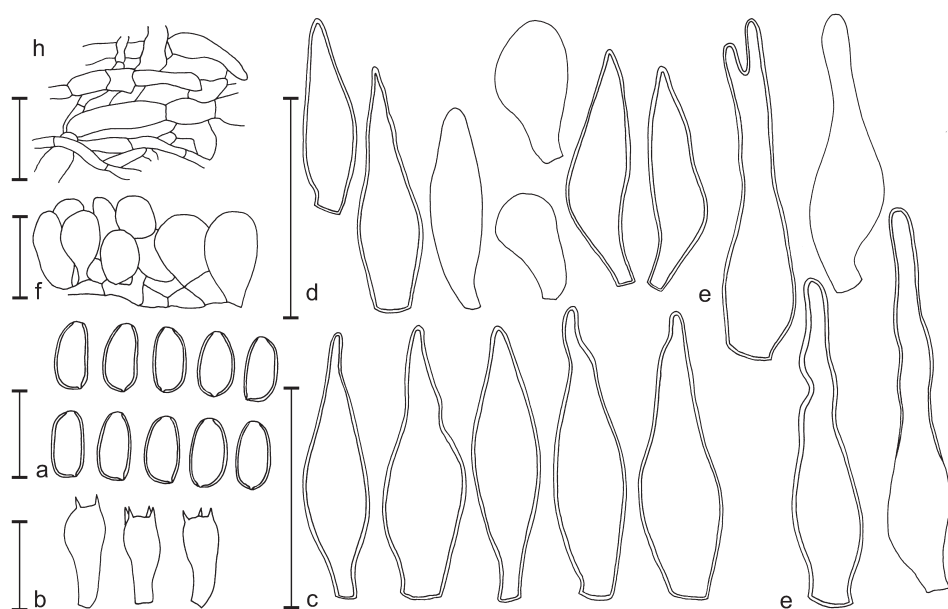
Selected illustrations: Enderle, Die Pilzflora des Ulmer Raumes: 418. 2004.

Selected literature: Derbsch, Zeitsch. f. Pilzkunde 43: 183. 1977; Enderle, Beitr. Kenntn. Pilze Mitteleurop. 5: 68–70. 1989.

**Characteristics in brief.** Basidiomata medium-sized, growing solitary, pileus brown, with distinct veil. Spores medium-sized, (7–)7.5–8 × 4–4.5 µm, yellowish brown to brown, with indistinct germ pore. Cystidia versiform with often irregular apex, rather thick-walled (0.5–1.5 µm), especially in upper part, without crystals at the top, if so, then only small and scattered. Growing on decaying stumps or trunks of deciduous trees.

**Description** (based only on young and mature basidiomata; old basidiomata were not found). Basidiomata solitary. Pileus in young stage paraboloid, 0.8–1.1

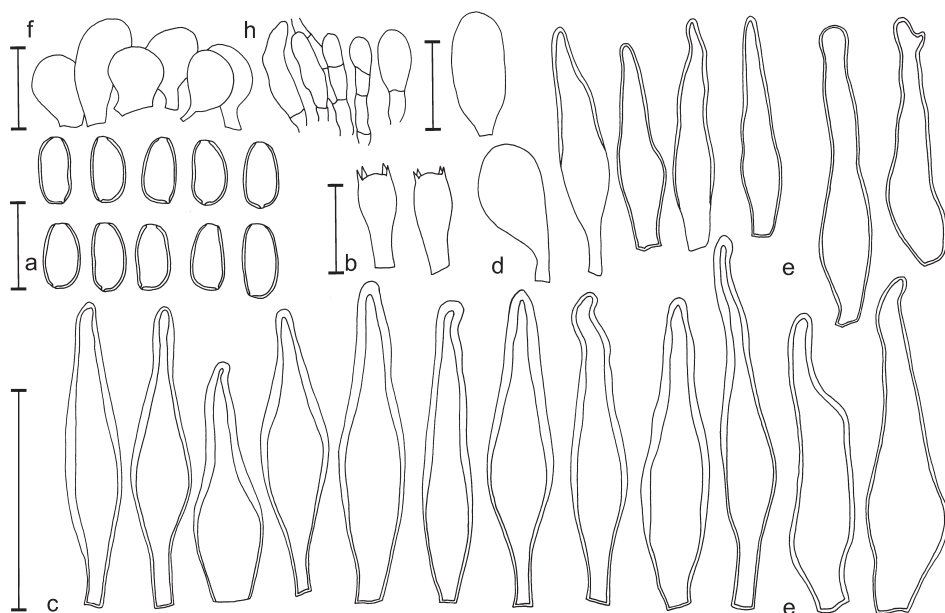




**Fig. 5.** *Psathyrella spintrigeroides* P.D. Orton (BRNM 705638): a – spores, b – basidia, c – pleurocystidia, d – cheilocystidia, e – caulocystidia, f – pileipellis, h – veil. Bars = 10 µm for spores, 20 µm for basidia, 50 µm for other microscopic structures.

cm broad, at maturity convex, later broadly convex, 1.3–2.5 cm. Surface smooth or slightly rugulose, pileus margin in mature stage translucently striate; pale brownish (S50Y50M40), medium brownish (S50Y90M50) to dark brown (S90Y90M60), drying out to ochre (S20Y50M20). Veil distinct; filamentous, white; entire pileus covered with dispersed fibrils at first, later persisting on wide pileus margin as small rather indistinctive squamules. Veil connecting pileus with stipe in young stage, remains as distinct scales on margin at maturity. Lamellae subcrowded, L = 22–32, l = 1–5; 0.2–0.6 cm broad, adnate to broadly adnate, pale brown (S50Y40M20) to brown (S70Y50M30–40), with minutely fimbriate white edge. Stipe 3.2–5 × 0.35–0.4 cm, cylindrical, hollow, white to creamy, pale beige at base, apex markedly striate from lamella base and with small white squamules, entire stipe fibrillosely scaly to slightly filamentous from veil. Flesh in pileus 0.1–0.25 cm thick, concolorous, pale beige. Smell indistinctive.

Spores (7–)7.5–8 × 4–4.5 µm, average 7.8–4.2 µm, Q = (1.6–)1.7–2; some very slightly phaseoliform in side view, ellipsoid in front view; germ pore indistinct, 1–1.5 µm broad; with small hilar appendix; in water yellowish brown (S60Y50M40) to brown (S70Y90M50), in 5 % KOH greyish brown (S80Y40–20M10–20), in 10 % NH<sub>4</sub>OH brown (S80Y40M40). Basidia (15–)16–20(–22) × (6–)7–9 µm, 4-spored (rarely 2-spored), narrowly clavate. Pleurocystidia numerous to very nu-



**Fig. 6.** *Psathyrella spintrigeroides* P.D. Orton. Type specimen (K(M) 70569): a – spores, b – basidia, c – pleurocystidia, d – cheilocystidia, e – caulocystidia, f – pileipellis, h – veil. Bars = 10  $\mu$ m for spores, 20  $\mu$ m for basidia and cheilocystidia, 50  $\mu$ m for other microscopic structures.

merous, (58–)59–72(–76)  $\times$  11–17(–18)  $\mu$ m; lageniform, fusiform to broadly fusiform, often with irregular, curved apex, with wall 0.5–1  $\mu$ m, thickening up to 2  $\mu$ m in upper part; sometimes with small crystals at apex dissolving in KOH, slightly pink or pale brown in 10 %  $\text{NH}_4\text{OH}$ . Edge of lamellae consisting of (1) numerous to very numerous, densely packed pleurocystidioid cheilocystidia, (37–)38–53(–54)  $\times$  9–14(–15)  $\mu$ m, fusiform, rarely lageniform, with wall in the middle up to 0.5  $\mu$ m thick, rarely thickening to 0.5–1  $\mu$ m in upper part; (2) numerous sphaeropedunculate cells, not prevailing, 20–37(–48)  $\times$  (10–)11–18(–19)  $\mu$ m, thin walled or with wall max. 0.5  $\mu$ m thick. Hymenophoral trama in  $\text{NH}_4\text{OH}$  pale yellowish brown (S20–30Y30M10). Pileipellis a transition between a hymeniderm and an epithelium, consisting of a 2–3 cells deep layer of colourless cells, 23–50  $\mu$ m  $\times$  21–47  $\mu$ m in diam., with wall up to 1  $\mu$ m thick. Caulocystidia numerous, (31–)38–84(–90)  $\times$  (9–)11–17(–19)  $\mu$ m, mostly lageniform with elongated neck, with 0.5–1  $\mu$ m thick wall sometimes in lower part thickening to 1  $\mu$ m. Veil composed of colourless thin-walled hyphae ending with chains of broad cells or enlarged cells. Clamp-connections present.

**Ecology.** *P. spintrigeroides* was described as a saprophyte growing on beech twigs and logs and in beech leaves (Orton 1960). Specimens from Germany were surprisingly reported also from a mossy spruce stump and from the ground

in a young spruce forest (Enderle 1989); the Hungarian record is from an alluvial forest. Records from the Czech Republic and Slovakia are from fallen mossy trunks (*Fagus sylvatica*) in natural deciduous forests in the montane belt.

**Distribution.** Rare (Czech Republic: 2 localities, Slovakia: 1 locality), included in the Red list of fungi of the Czech Republic (Holec and Beran 2006). Reported as rare also from the rest of Europe: Germany (3 localities; Enderle 1989, Derbsch 1977), Austria (1 locality – WU 17247), Hungary (1 locality – BRNM), United Kingdom [1 locality – Orton (1960), few other records – herbarium material not preserved (Legon and Henrici 2005)]. In Sweden rather common (Örstadius, in litt.).

**Phenology.** Sept.–Oct.

**Discussion.** *P. spintrigeroides* has medium-sized basidiomata and a well-developed veil. The key character are its cystidia thickened in upper part. The wall thickness is variable between collections: the type material has rather thick-walled cystidia (1.6 µm on average), the Czech collections 0.8 and 1.8 µm on average, respectively. However, this variability is not correlated with molecular characters (unpubl. data) and therefore I consider it of no taxonomical importance. Rarely only slightly thick-walled cystidia are thin-walled at the top.

Although German records do not support the presumption of a strong association with deciduous natural forests, more data are needed to verify this. Confusion is possible with *P. rostellata* Örstadius and *P. artemisiae* (Pass.) Konrad et Maubl. The main difference is in pattern of thickness of the cystidium wall. While the cystidium wall in *P. spintrigeroides* is the thickest on or just below the top, in *P. rostellata* and *P. artemisiae* this wall is the thickest in the middle. The American species *Psathyrella avellaneifolia* A.H. Sm. and *Psathyrella indecorosa* A.H. Sm. are morphologically similar. The first one differs by smaller spores (6.5–)7–7.5(–8) × (3.5–)4(–4.5) µm, the second by a triangular spore shape and occurrence on alder logs.

#### Collections studied

Czech Republic: **88d**, České Žleby, Žlebský vrch nature reserve, on fallen trunk of deciduous tree (*Fagus sylvatica*?), 6 Oct. 2004, M. Vašutová (BRNM 705638). – **89**, Pohorská Ves, Žofínský prales national nature reserve, on fallen *Fagus* trunk, 23 Sept. 2003, M. Vašutová (BRNM 705639). – Slovakia: **31**, Kalná Ráztoka, Havešová nature reserve, Q: 9970b, on stump of *Fagus*, 5 Oct. 1992, J. Terray (BRA 407). – Germany: Donau-Auwald near Unterfahlheim, in man-made *Picea* forest, on mossy *Picea* stump, 1 Nov. 1987, M. Enderle (herbarium M. Enderle). – Hungary: Szabolcs-Szatmár-Bereg megye, Fényi erdő nature reserve, c. 2 km S of the village of Bátorliget, alluvial forest with *Fraxinus angustifolia* and *Quercus robur*, on decaying trunk of *Fraxinus angustifolia*, 26 Oct. 2006, V. Antonín (BRNM, 06.174). – Austria: North Austria, Gföhl, Dobrasperre, on *Fagus* wood, 13 July 1997, A. Hausknecht and F. Reinwald (WU 17247, as *P. artemisiae* var. *microspora*, Hausknecht et al. 2006). – United Kingdom: type [K(M) 70569].

**Insufficiently known taxa*****Psathyrella variata* A.H. Sm.**

Fig. 7

*Psathyrella variata* A.H. Sm., in Mem. New York Bot. Gard. 24: 238, 1972.

Type specimen: USA, Priest Lake, Bonner Co., Idaho, on cottonwood, 6 Oct. 1964, leg. A.H. Smith [MICH 5379 (Smith 71092)].

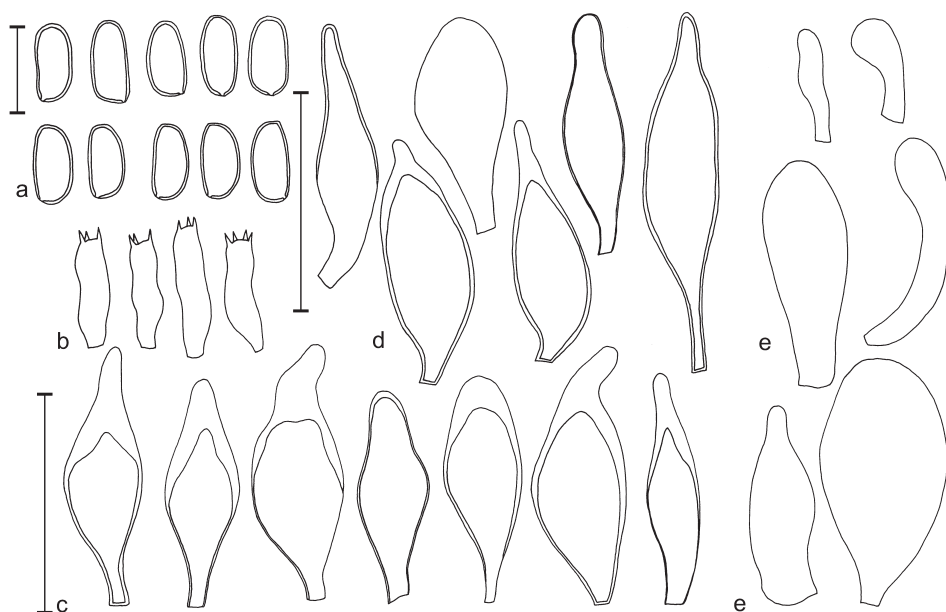
Selected illustrations: Smith, Mem. New York Bot. Gard. 24: figs. 446–452. 1972; Kits van Waveren, Persoonia Suppl. Vol. 2: figs. 197–202. 1985; Hausknecht et Krisai-Greilhuber, Fungi non delineati 2: figs. 8a–g. 1997.

Selected literature: Smith, Mem. New York Bot. Gard. 24: 238–239. 1972; Hausknecht et Krisai-Greilhuber, Fungi non delineati 2: 26–28. 1997.

**Discussion.** *Psathyrella variata* is a species very close to *P. spadicea*, which was distinguished by Smith according to the presence of a mixture of leptocystidia and lamprocystidia on one lamella (Smith 1972). My study of the type material confirms this character in the case of cheilocystidia only, although Örstadius (2001) has seen pleuroleptocystidia as well. This could be due to the fact that I received only a part of the type material from MICH and the character could be very variable between single basidiomata, or the type is a mixture of species. Kits van Waveren (1986) found just a few pleuroleptocystidia in his material, and he reported the presence of hairs at the pileus margin to be a good character. Hausknecht (in Hausknecht et Krisai-Greilhuber 1997) did not observe pleuroleptocystidia but confirmed cheiloleptocystidia and hairs in his material.

Örstadius (2001) considers *P. variata* to be a synonym of *P. spadicea*. According to him, the thickness of the cystidium wall is not so taxonomically important and hairs are found on the pileus of very young species of *P. spadicea*, too. I have confirmed this finding. Moreover, few cheiloleptocystidia are present in *P. spadicea* as well (see Kits van Waveren 1986, fig. 210). The ratio of cheiloleptocystidia varies between collections; it is even possible to find “transitional forms” between *P. spadicea* and *P. variata*. The conspecificity of the above-mentioned species is supported by current molecular data (Vašutová et al. 2008) but due to the fact that only one specimen of *P. variata*, one of *P. spadicea* and one transitional form was used for DNA analysis, it is premature to draw this conclusion yet.

One of my personal collections could be labelled as *P. variata*. It differs from the type by an absence of pleuroleptocystidia. There are also small differences in colour; I did not see such dark chocolate lamellae at maturity as mentioned by Smith (1972) and Kits van Waveren (1985). Macroscopically, the Czech collection is closest to the Austrian one. Smith described the germ pore as very small, while the other authors state it is missing. The collection is described below:



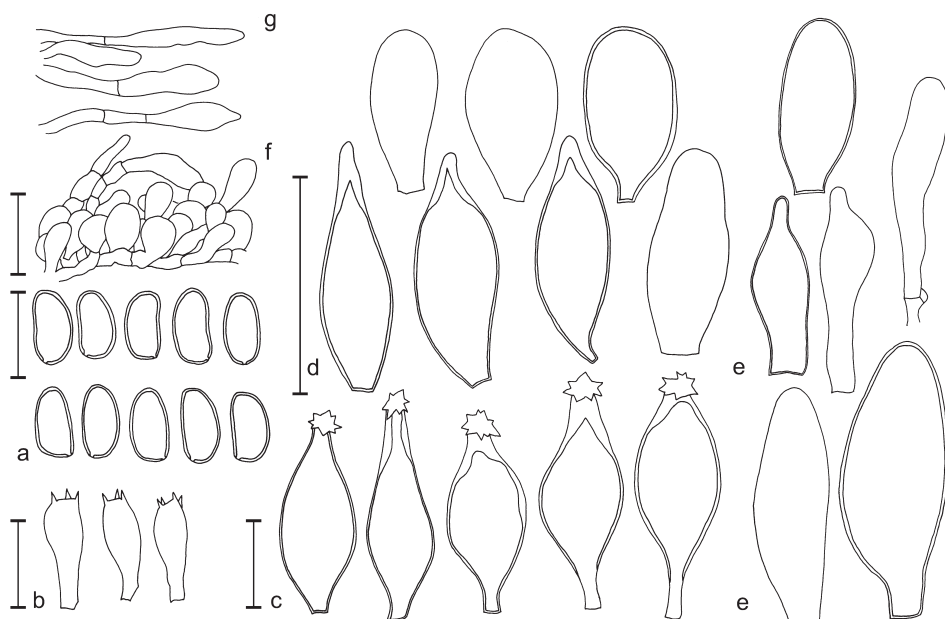
**Fig. 7.** *Psathyrella variata* A.H. Sm. Type specimen (MICH 5379): a – spores, b – basidia, c – pleurocystidia, d – cheilocystidia, e – caulocystidia. Bars = 10  $\mu$ m for spores, 50  $\mu$ m for other microscopic structures.

***Psathyrella cf. variata* A.H. Sm. (MV06/025)**

Figs. 8, 14

**Description.** Basidiomata caespitose. Pileus conico-paraboloid to convex, 3.7–5 mm, with broad low umbo. Margin involute at first, later inflexed. Some basidiomata with undulate margin. Surface hyrophphanous, smooth, young basidiomata distinctly pruinose at margin. This pruinosity is caused by dense, minute, colourless hairs. When young dark chestnut-brown (S99Y90M60, S90Y99M60–70), later with paler margin (S80Y70M60), during drying irregularly coloured, discolouring to reddish brown (S70Y60M50, S70Y50M50), beige (S50Y50M50), brownish beige (S50Y50M50), pinkish beige (S4Y50M40) or pinkish (S20Y40M30, S10Y30M10). Veil absent. Lamellae very crowded,  $L = 30\text{--}35$ ,  $l = 3$ , 2–3.5 mm broad; narrowly adnate; in young stage pale isabelline to beige (S30Y30M20), towards edge paler, later beige with brick shade (S40Y60M40–60). Stipe 25–53  $\times$  3–9 mm, tapering towards base, hollow, white, whitish or creamy, at apex distinctly pruinose, entire surface fibrillose, at maturity fibrils becoming brownish. Base slightly tomentose. Consistency fairly cartilaginous. Flesh in pileus 3–5.5 mm broad, whitish. Smell indistinct. Spore print pale reddish (S40Y50M40).

**Spores** (8–)8.5–9  $\times$  4–5  $\mu$ m, average 8.6  $\times$  4.4  $\mu$ m,  $Q = 1.8\text{--}2$ ; phaseoliform in side view, ellipsoid in front view; without germ pore, hilar appendix indistinct; in water very pale, slightly pinkish; in 5% KOH almost colourless, slightly brownish; in 10%  $\text{NH}_4\text{OH}$  almost colourless, slightly brownish. **Basidia** 20–25  $\times$  7–8  $\mu$ m, 4-spored, narrowly clavate. **Pleurocystidia** numerous to fairly numerous, (39–)41–52(–53)  $\times$  15–19  $\mu$ m; fusiform to broadly fusiform, with subacute apex, wall in the middle 0.3–1  $\mu$ m thick (average 0.5  $\mu$ m), in upper part distinctively thicker, 2–4  $\mu$ m, later whole apex full of wall structure (up to 10  $\mu$ m from the top); with distinct crystals forming “stars” at apex dissolving in KOH, hyaline. Edge of lamellae consisting of (1) numerous pleurocystidioid cheilocystidia, 39–58  $\times$  16–20  $\mu$ m, fusiform to broadly fusiform, thick-walled, approx. 0.5  $\mu$ m thick, in the middle, distinctively thicker, 1–4  $\mu$ m, in upper part, later entire apex, full of wall structure (up to 15  $\mu$ m from the top), with



**Fig. 8.** *Psathyrella* cf. *variata* A.H. Sm. (MV06/025): a – spores, b – basidia, c – pleurocystidia, d – cheilocystidia, e – caulocystidia, f – pileipellis, g – hairs. Bars = 10 µm for spores, 20 µm for basidia, 50 µm for other microscopic structures.

distinct crystals forming “stars” at apex dissolving in KOH; intermixed with (2) numerous utriform cystidia,  $30\text{--}48 \times 14\text{--}21$  µm, thin-walled, sometimes thick-walled (up to 1 µm thick), without crystals. Hymenophoral trama in 10 %  $\text{NH}_4\text{OH}$  pale yellowish brown, parallel. Pileipellis a transition between a hymeniderm and an epithelium, formed of colourless cells,  $41\text{--}58 \times 23\text{--}35$  µm, with up to 0.5 µm thick walls, hairs formed of 1–4 cells,  $53\text{--}129 \times 13\text{--}19$  µm. Caulocystidia numerous, predominately clavate,  $23\text{--}70 \times 9\text{--}25$  µm, some broadly fusiform, resembling pleurocystidia,  $38\text{--}70 \times 10\text{--}31$  µm, with crystals. Thickness of cystidium walls variable; up to 1 µm thick. Clamp-connections present.

**Ecology.** *Psathyrella variata* was described as a saprotrophic species growing on a cottonwood log (Smith 1972). Dutch and Austrian collections concern terrestrial growth in rich soil under *Fagus* (Kits van Waveren 1986, Hausknecht and Krisai-Greilhuber 1997). The Czech collection originates from remnants of an old birch stump in an alley in the supracolline belt.

**Phenology.** September.

**Distribution.** Rare but probably overlooked. One locality in the Czech Republic. Reported also from the Netherlands and Austria (Kits van Waveren 1986, Hausknecht and Krisai-Greilhuber 1997).

#### Collections studied

Czech Republic: **63**, Česká Třebová, Max Švabinský Avenue, roadside, on remnants of old *Betula* stump, 17 Sept. 2006, M. Vašutová et V. Antonín (MV06/025). – Austria: Lower Austria, Wolkersdorf, Hornsburg, 2 May 1995, A. Hausknecht (WU 13716). – USA: type [MICH 5379].





**Fig. 9.** *Psathyrella papyracea* (Pers.: Fr.) Vašutová, Žofínský prales, 30 Sept. 2008, photo J. Burel.



**Fig. 10.** *Psathyrella spadicea* (P. Kumm.) Singer, Troubky, 2 Dec. 2006, leg. M. Vašutová et J. Polčák (MV06/118), photo M. Vašutová.



**Fig. 11.** *Psathyrella papyracea* (Pers.: Fr.) Vašutová, Troubky, 2 Dec. 2006, leg. M. Vašutová et J. Polčák (MV06/117), photo M. Vašutová.





**Fig. 12.** *Psathyrella pygmaea* (Bull.: Fr.) Singer, Frymburk, 4 Oct. 2004, leg. M. Vašutová et A. Vágner (BRNM 705629), photo M. Vašutová.



**Fig. 13.** *Psathyrella spintrigeroides* P.D. Orton (BRNM 705638), Žofínský prales, 23 Sept. 2003, leg. M. Vašutová (BRNM 705640), photo M. Vašutová.



**Fig. 14.** *Psathyrella* cf. *variata* A.H. Sm. (MV06/025), Česká Třebová, 12 Sept. 2006, leg. M. Vašutová et V. Antonín (MV06/025), photo M. Vašutová.

### ***Psathyrella imleriana* Volders**

*Psathyrella imleriana* Volders, in Sterbeekia 17: 70, 1997 [1996].

Type specimen: Belgium, Antwerpen Prov., Retie, Prinsenveld, at the base of a sawn off *Populus*, 11 Nov. 1993 [BR46447-81, Volders 93222].

Selected illustrations: Volders, Sterbeekia 17: fig. 1. 1997.

Selected literature: Volders, Sterbeekia 17: 70–76. 1997.

**Discussion.** Volders (1997) found one fruitbody identical with the collection of *P. variata* collected by Kits van Waveren (1985). He revised the type material of *P. variata* and found several small differences between the American and European material. Therefore he considers European collections to be a new species – *Psathyrella imleriana* and he designated his collection the type specimen.

Based on my own study of the type material of *P. variata*, I do not confirm Volder's study of the type material of *P. variata*, especially concerning data on spore width and their colour in  $\text{NH}_4\text{OH}$ , the extreme width of thin-walled cheilocystidia, high ratio of thin-walled pleurocystidioid cheilocystidia and distinctively lageniform cystidia. The difference in size of basidia may depend on



their position on the lamellae – moreover data from collections from Austria and the Czech Republic are in agreement with Smith's species. Volder noticed that type material of *P. variata* is without crystals but these are often disappearing with age. Also macroscopic characters (compactness, surface of stem, and cavity or solidity of stem) can be variable and depend on age of basidiomata and growth conditions. The same counts for ecology. My study of the type specimen of *P. imleriana*, of which only part of a pileus is preserved now, did not reveal any important differences between this specimen and the type of *P. variata*. At the moment I consider *P. imleriana* to be a synonym of *P. variata* and if the conspecificity of *P. spadicea* and *P. variata* is proven, also a synonym of *P. spadicea*.

***Psathyrella sarcocephala* (Fr.: Fr.) Singer**

*Agaricus sarcocephalus* Fr., Observ. mycol. 1: 51. 1815; *Agaricus compactus* [unranked] *sarcocephalus* (Fr.: Fr.) Fr., Syst. mycol. 1: 290. 1821; *Psathyrella sarcocephala* (Fr.: Fr.) Singer ss. Singer non Fr. 1815, Lilloa 22: 468. ('1949') 1951.

Type specimen: not preserved.

Misapplied names: "*Agaricus sarcocephalus*" auct. non Fr., Epicr. syst. mycol.: 228. 1838; Monogr. hymenomycet. Suec.: 429. 1857; Hymenomyc. eur.: 297. 1874; Ic. Hymenomyc. 2: pl. 135, fig. 1. 1879.

**Discussion.** The name *Agaricus sarcocephalus* is linked to the description by Fries (1815), sanctioned by him (1821) at variety level as *A. compactus*  $\beta$  *sarcocephalus*. This fungus should be a "vera omnino Pratellae" species with "carnoso flavescens" pileus and "flavescens" stipe. As was already mentioned by Enderle (1989), there is no known similar *Psathyrella* species to which the description could fit. Therefore the epithet "*sarcocephalus*" is not usable for any *Psathyrella*.

As was already published by Örstadius (2001), Fries wrote in his later publications (1857, 1874) that *Agaricus compactus*  $\beta$  *sarcocephalus* is a "forma dubius" and modified his description of *Agaricus sarcocephalus*. The modified description agrees with the figure published in Icones (Fries 1879). This was probably the starting point for following interpretations of *Agaricus sarcocephalus*. The picture of *Agaricus sarcocephalus* (Fries 1879) represents young basidiomata of a species macroscopically intermediate between *Psathyrella papyracea* (*P. cernua* ss. auct.) and *P. spadicea*. Noteworthy are small squamules depicted on pilei of *Agaricus sarcocephalus* by Fries (1879), never mentioned by later authors. If this species exists, it cannot be named *A. sarcocephalus*. A similar fungus was depicted by Cooke (1886, t. 567), Bresadola (1930, t. 855) and Konrad and Maublanc (1929, t. 45). Örstadius (2001) pointed out that the picture of *Psilocybe sarcocephala* by Konrad and Maublanc is *Psathyrella cernua* ss. auct., and a picture of *Psilocybe sarcocephala* by Bresadola (1930) cannot be interpreted, because of missing crystals on the cystidia. I have studied one specimen morphologically reminding *P. sarcocephala* sensu Fries 1879 (MV07/138) but molecular data confirm its conspecificity with *P. spadicea* (Vašutová and Urban, unpubl.).

On another of Cooke's tables (Cooke 1886, t. 620) other basidiomata named *P. sarcocephala* are shown, which look more like *P. spadicea* but their basidiomata are larger, browner and have darker spores. This concept was followed by Lange (1939, unfortunately he confused the pictures of *P. spadicea* and *P. sarcocephala*) and e. g. Michael and Hennig (1967), and Kits van Waveren (1985), who also wrote an extensive discussion on interpretations of the name *Psathyrella sarcocephala* by various authors.

According to Kits van Waveren (1985) there are only few collections known from Europe. The first one sensu Fries 1879 comes from a site near Geneva and was described by Konrad and Maublanc (1929), the second sensu Cooke (1886, t. 620) by Monti (1978) from Italy, the third by Weholt from Norway (seen by Kits van Waveren 1985). Surprisingly, Legon and Henrici (2005) reported the species as widespread in the British Isles. I have not revised these specimens from Britain yet. Czech authors identified *Psathyrella spadicea* as *P. sarcocephala* sensu Cooke (1886, t. 620), because of a wrong interpretation by Lange (1939). Until a well-documented collection is found, I consider this species (in both interpretations), due to inconsistent descriptions based on material not preserved in a herbarium, to be non-existent.

### ***Psathyrella subcernua* (Schulzer) Singer**

*Agaricus (Nolanea) subcernuus* Schulzer, Verh. Zool.-Bot. Ges. Wien 26: 427. 1877; *Psathyrella subcernua* (Schulzer) Singer, Mycologia, 36: 364. 1944.

Synonym: *Psathyra subcernua* (Schulzer) Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 66: 99. 1907.

Type specimen: not preserved.

**Discussion.** The name *Psathyrella subcernua* became known among mycologists thanks to Moser (1953), who included it into his keys. As was correctly stated by Enderle (1989), the name is based on a description which clearly described a *Nolanea* species, not a *Psathyrella*: “Die unregelmässig-kugligen Sporen dürften sich bei stärkerer Vergrößerung wohl als fünfeckig erweisen” (Schulzer 1877). The wrong interpretation came from Höhnelt (1907). According to him, Bresadola thought that *Agaricus subcernuus* was identical to *Clitopilus connissans* Peck. Therefore Höhnelt studied specimens of *Clitopilus connissans* and decided to place *Agaricus subcernuus* as an earlier synonym of *Clitopilus connissans* into the genus *Psathyra*.

According to Moser, *Psathyrella subcernua* should be close to *Psathyrella pygmaea*. In his earlier keys (Moser 1953, 1967) he described its spores as “4–7 µm, fast rundlich”, later (Moser 1978, 1983) he mentioned a size of 6.5–8 × 3–3.5(–4) µm. I have never come across a species like that. In my opinion, Moser's description of *P. subcernua* represents old basidiomata of *P. pygmaea* and therefore I consider this species to be non-existent.



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## REFERENCES

- ARNOLDS E., KUYPER T. W. and NOORDELOOS M. E. (1995): Overzicht van de paddestoelen in Nederland. – 871 p. Wijster.
- BOLTON J. (1788): An history of fungusses, growing about Halifax. Vol. 1. – 44 p. Halifax.
- BRESADOLA J. (1930): Iconographia mycologica. Vol. 16. – 50 pl. Mediolani.
- COOKE M. C. (1886): Illustrations of British fungi. Vol. 4. – London.
- DERBSCH H. (1977): Seltene *Agaricales* Arten aus dem Saarland. – Z. Pilzk. 43: 175–186.
- ENDERLE M. (1987): Bemerkenswerte *Agaricales* (*Psathyrella*)-Funde IV. – Beitr. Kenntn. Pilze Mitteleurop. 3: 241–260.
- ENDERLE M. (1989): Bemerkenswerte *Agaricales* (*Psathyrella*)-Funde VIII. – Beitr. Kenntn. Pilze Mitteleurop. 5: 55–74.
- ENDERLE M. (1996): Studien in der Gattung *Psathyrella* IV. – Beitr. Kenntn. Pilze Mitteleurop. 10: 35–58.
- ENDERLE M. and HÜBNER H. J. (2005): Studien in der Gattung *Psathyrella* IX. – Beitr. Kenntn. Pilze Mitteleurop. 19: 53–65.
- FOUCHIER F. (1995): Le genre *Psathyrella* (Fries) Quélet. Flore des espèces européennes et méditerranéennes (avec clés dichotomique d'après Kits van Waveren). – Monogr. Mycol. 1: 1–97.
- FRIES E. (1815): Observationes mycologicae. – 230 p. Kjøbenhavn.
- FRIES E. (1821): Systema mycologicum. Vol. 1. – 520 p. Lund.
- FRIES E. (1857): Monographia hymenomycetum Sueciae. Vol. 1. – 484 p. Uppsala.
- FRIES E. (1874): Hymenomycetes europaei. – 755 p. Uppsala.
- FRIES E. (1879): Icones selectae Hymenomycetum nondum delineatorum. Vol. 2. – pl. 131–140. Stockholm.
- FUTÁK J. (1966): Flóra Slovenska I. – 602 p. Bratislava.
- HAUSKNECHT A. and KRISAI-GREILHUBER I. (1997): Some rare *Agaricales* with brown or darker spores. – Fungi non delineati 2: 1–31.
- HAUSKNECHT A., PIDLICH-AIGNER H. and FORSTINGER H. (2006): Ergebnisse des Mykologischen Arbeitstreffens in Langschlag (Waldviertel, Niederösterreich) im September/Oktober 2005. – Österr. Z. Pilzk. 15: 149–179.
- HÖHNEL F. X. R. von (1907): Fragmente zur Mykologie III. – Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1. 116: 83–162.
- HOLEC J. and BERAN M., eds. (2006): Červený seznam hub (makromycetů) České republiky. [Red list of fungi (macrofungi) of the Czech Republic]. – Příroda, Praha 24: 1–282. [in Czech with English summary]
- HOLMGREN P. K. and HOLMGREN N. H. (2003): Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. – <http://sweetgum.nybg.org/ih>.

- KITS VAN WAVEREN E. (1971): Notes on the genus *Psathyrella* – I. *Psathyrella gracilis* and *P. microrrhiza*. – Persoonia 6(2): 249–280.
- KITS VAN WAVEREN E. (1985): The Dutch, French and British species of *Psathyrella*. – Persoonia Suppl. Vol. 2: 1–300.
- KONRAD P. and MAUBLANC A. (1929): Icones selectae Fungorum. Vol. 1 – Paris.
- KUMMER P. (1871): Führer in die Pilzkunde. Der Anleitung zum methodischen, leichten und sichern Bestimmen der in Deutschland vorkommenden Pilze, mit Ausnahme der Schimmel- und allzu winzigen Schleim- und Kern-Pilzchen. – 146 p. Zerbst.
- KÜPPERS H. (1999): DuMont's Farbenatlas. – 165 p. Köln.
- LANGE J. E. (1939): Flora agaricina danica. Vol. 4. – 119 p., 40 pl. Copenhagen.
- LARSSON E. and ÖRSTADIUS L. (2008) : Fourteen coprophilous species of *Psathyrella* identified in the Nordic countries using morphology and nuclear rDNA sequence data. – Mycol. Res. 112(10): 1165–1185.
- LEGON N. W. and HENRICI A. (2005): Checklist of the British and Irish Basidiomycota. – 517 p. Kew.
- LUDWIG E. (2007): Pilzkompedium. Vol. 2. Abbildungen. – 209 p. Berlin.
- MICHAEL E. and HENNIG B. (1967): Handbuch für Pilzfreunde 4. Blätterpilze. – 326 p. Greifswald.
- MONTI G. (1978): Considerazioni morfologiche e tassonomiche su *Psilocybe sarcocephala* (Fr.) Gillet, specie nuova per la Toscana. – Micol. Ital. 7: 45–48.
- MOSER M. (1953): Die Blätter- und Bauchpilze. – In: Gams H., Kleine Kryptogamenflora von Mitteleuropa, Vol. 2, p. 1–282, Jena.
- MOSER M. (1967): Die Röhrlinge und Blätterpilze. – In: Gams H., Kleine Kryptogamenflora, Vol. 2b/2, p. 1–443, Stuttgart.
- MOSER M. (1978): Die Röhrlinge und Blätterpilze. – In: Gams H., Kleine Kryptogamenflora, Vol. 2b/2, p. 1–532, Jena.
- MOSER M. (1983): Die Röhrlinge und Blätterpilze. – In: Gams H., Kleine Kryptogamenflora, Vol. 2b/2, p. 1–533, Stuttgart.
- ORTON P. D. (1960): New checklist of British agarics and boleti. Part III. Notes on the genera and species in the list. – Trans. Brit. Mycol. Soc. 43: 159–439.
- ÖRSTADIUS L. (2001): *Psathyrella spadicea* – taxonomy and nomenclature. – Windahlia 24: 19–24.
- PADAMSEE M., MATHENY P. B., DENTIGER B. T. M. and McLAUGHLIN D. J. (2008): The mushroom family *Psathyrellaceae*: Evidence for large-scale polyphyly of the genus *Psathyrella*. – Mol. Phyl. Evol. 46(2): 415–429.
- ROMAGNESI H. (1982): Études complémentaires de quelques espèces de *Psathyrella* ss. lato (*Drosophila* Quélet). – Bull. Soc. Mycol. France 98(1): 5–68.
- SCHAEFFER J. C. (1762): Fungorum qui in Bavaria et Palatinatu circa Ratisbonam nascuntur icones nativis coloribus expressae. Vol. 1. – Regensburg.
- SCHAEFFER J. C. (1774): Fungorum qui in Bavaria et Palatinatu circa Ratisbonam nascuntur icones nativis coloribus expressae. Vol. 4. – Regensburg.
- SCHULZER VON MÜGGENBURG S. (1877): Mykologische Beiträge. – Verh. Zool.-Bot. Ges. Wien 26: 415–433.
- SINGER R. (1944): New genera of fungi. – Mycologia 36: 358–368.
- SINGER R. (1986): The *Agaricales* in modern taxonomy. Ed. 4. – 981 p. Koenigstein.
- SKALICKÝ V. (1988): Regionálné fytogeografické členění. – In: Hejný S. and Slavík B., Květena České republiky, Vol. 1, p. 103–121, Praha.
- SMITH A. H. (1941): Studies of North American Agarics. – Contr. Univ. Michigan Herb. 5: 1–73.
- SMITH A. H. (1972): The North American species of *Psathyrella*. – Mem. New York Bot. Gard. 24: 1–633.
- SVRČEK M. (1960): Eine mykofloristische Skizze der Umgebung von Karlštejn (Karlstein) im Mittelböhmen. – Česká Mykol. 14(2): 67–86.
- TASSI G. (1997): Espèces rares ou intéressantes du genre *Psathyrella* (Fr.) Quélet. – Bull. Soc. Mycol. France 113: 117–124.

- VAŠUTOVÁ M. (2006): Preliminary checklist of the genus *Psathyrella* in the Czech Republic and Slovakia. – Czech Mycol. 58(1-2): 1–29.
- VAŠUTOVÁ M. (2008): *Psathyrella rostellata* in the Czech Republic and Slovakia. – Biologia 63(4): 487–492.
- VAŠUTOVÁ M., ANTONÍN V. and URBAN A. (2008): Phylogenetic studies in *Psathyrella* focusing on sections *Pennatae* and *Spadiceae* – new evidence for the paraphyly of the genus. – Mycol. Res. 112(10): 1153–1164.
- VELLINGA E. C. (1988): Glossary. – In: Bas C., Kuyper T. W., Noordeloos M. E. and Vellinga E. C. (eds.), Flora Agaricina Neerlandica, Vol. 1, p. 54–64, Leiden.
- VOLDERS J. (1997): *Psathyrella imleriana* spec. nova (Streepsteelfranjehoed). – Sterbeeckia 17: 70–76.
- WALTHER G., GARNICA S. and WEIS M. (2005): The systematic relevance of conidiogenesis modes in the gilled *Agaricales*. – Mycol. Res. 109(5): 525–544.