

## ***Frantisekia* – a new polypore genus (*Polyporales*, Basidiomycota)**

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Spirin W. and Zmitrovich I. (2007): *Frantisekia* – a new polypore genus (*Polyporales*, Basidiomycota). – Czech Mycol. 59(2): 141–151.

The new genus *Frantisekia* Spirin et Zmitr. is described, and three species are included in it – *Frantisekia fissiliformis* (Pilát) Spirin et Zmitr. comb. nov. (type of the genus), *Frantisekia mentschulensis* (Pilát ex Pilát) Spirin comb. nov., and *Frantisekia ussurii* (Y. C. Dai et Niemelä) Spirin comb. nov. These species are described, and their identity, ecology and distribution are briefly discussed. *Tyromyces aurantiacus* (Komarova) Komarova is regarded to be a synonym of *Frantisekia mentschulensis*.

**Key words:** *Frantisekia*, polypores, taxonomy.

Spirin W. a Zmitrovich I. (2007): *Frantisekia* – nový rod chorošů (*Polyporales*, Basidiomycota). – Czech Mycol. 59(2): 141–151.

Je popsán nový rod *Frantisekia* Spirin et Zmitr., do něhož jsou zařazeny tři druhy chorošů – *Frantisekia fissiliformis* (Pilát) Spirin et Zmitr. comb. nov. (typový druh rodu), *Frantisekia mentschulensis* (Pilát ex Pilát) Spirin comb. nov. a *Frantisekia ussurii* (Y. C. Dai et Niemelä) Spirin comb. nov. Tyto druhy jsou popsány a krátce je diskutována jejich taxonomie, ekologie a rozšíření. *Tyromyces aurantiacus* (Komarova) Komarova je považován za synonymum druhu *Frantisekia mentschulensis*.

### INTRODUCTION

The polypore *Poria fissiliformis* was described by Pilát (1940), based on a single specimen from North America. Later this species was reported from Europe (Kotlaba and Pouzar 1988), and described in some recent publications (Ryvarden and Gilbertson 1993, Bernicchia 2005). However, the identity and possible relations of *Poria fissiliformis* have remained obscure to date; its taxonomic position is uncertain, too (Gilbertson and Ryvarden 1985, 1987; Kotlaba and Pouzar 1988; Dai and Niemelä 1997; Spirin 2001; Miettinen et al. 2006). This paper deals with a study of *Poria fissiliformis* and some of its satellites, and is dedicated to Dr. František Kotlaba on the occasion of his 80th birthday.

## MATERIAL AND METHODS

Specimens from the herbaria of the National Museum (PRM, Prague, Czech Republic), Finnish Museum of Natural History (H, Helsinki, Finland), and Komarov Botanical Institute (LE, St. Petersburg, Russia), were studied. Microscopic characters were observed under a Leitz Diaplan microscope and measured in Cotton Blue (Merck 1275), using of an oil immersion lens.

## RESULTS

***Frantisekia* Spirin et Zmitr., gen. nov.**

Basidiomata annua, pileata ad resupinata, cremea ad pallide-ochracea, in vivo spongioso-carnosa, exsiccatione cornescentia et brunnescentia. Hymenophorum tubulosum, cerreum, exsiccatione gelatinescens. Pori minuti, ad 6 per mm. Systema hypharum pseudodimiticum. Hyphae generatoriae fibulatae, hyalinae vel partim flavidae, tenuitunicatae ad leniter crassitunicatae. Hyphae pseudosceleticae in carne (et quandoque in trama tubularum), crassitunicatae, irregulariter septatae, fibrosae vel irregulariter inflatae, cyanophilae. Basidiosporae tenuitunicatae, ellipsoideae ad cylindratae, inamyloideae et acyanophilae. Ad ligna arborum frondosarum, putredinem albidam provocant.

Typus generis: *Poria fissiliformis* Pilát

Etymology: according to the first name of the Czech mycologist František Kotlaba on the occasion of his 80th birthday in 2007.

Basidiocarps annual, pileate, effused-reflexed or resupinate, cream to pale ochraceous and fleshy in fresh condition, often darkening and fragile when dry. Hymenophore poroid, tubes strongly agglutinated in herbarium specimens; pores small, 6–10 per mm. Hyphal structure pseudodimitic; generative hyphae clamped, hyaline or yellowish, thin- to somewhat thick-walled, pseudoskeletal hyphae present in context and (or) tubes, thick-walled, with rare clamps and septa, even or inflated, often weakly cyanophilous. No cystidia; cystidioles sometimes present. Basidia narrowly clavate, four-spored, clamped. Basidiospores thin-walled, oblong ellipsoid to cylindrical, negative in both Melzer's reagent and Cotton Blue. Causes white rot in dead hardwoods.

The best diagnostic characters of *Frantisekia* are the pseudodimitic hyphal structure, narrowly clavate basidia, and small spores. Relatives of *Frantisekia* might be found among *Ceriporiopsis* species, with which it shares fleshy resupinate basidiocarps, agglutinated tubes, predominance of thin-walled generative hyphae and the type of rot. However, the genus *Ceriporiopsis* is evidently heterogeneous (Zmitrovich et al. 2006, Tomšovský 2007), and needs to be split into small homogeneous genera.

Species: *Frantisekia fissiliformis* (Pilát) Spirin et Zmitr., *Frantisekia mentschulensis* (Pilát ex Pilát) Spirin, *Frantisekia ussuri* (Y. C. Dai et Niemelä) Spirin (see below).

After its description, *Poria fissiliformis* was classified into different polypore genera – *Perenniporia* Murrill (Gilbertson and Ryvarden 1985), *Antrodiella* Ryvarden et I. Johans. (Gilbertson and Ryvarden 1987), and *Tyromyces* P. Karst. (Kotlaba and Pouzar 1988, Spirin 2001). *Poria mentschulensis* Pilát is often treated as its synonym (Kotlaba and Pouzar 1988). At present, *P. fissiliformis* is commonly regarded as a member of *Antrodiella* (Ryvarden and Gilbertson 1993, Dai and Niemelä 1997, Bernicchia 2005), alongside its closest relative *Antrodiella ussuri* Y. C. Dai et Niemelä. However, there are some reasons to exclude it from *Antrodiella*, or even *Tyromyces*. *Antrodiella* species are strongly dimitic or trimitic in both context and tubes, while *Poria fissiliformis* has a highly peculiar hyphal structure called herein “pseudodimitic”. This term was first introduced by Parmasto (1970), and now means a hyphal structure composed by thin-walled, clamped or regularly septate generative hyphae, and thick-walled, irregularly septate and often somewhat inflated pseudoskeletal hyphae (Cléménçon 2004, Zmitrovich et al. 2004, Wasser et al. 2006, Zmitrovich et al. 2007). At first sight, pseudoskeletal hyphae might be mistaken with true skeletal hyphae; however, a careful examination always reveals the presence of rare clamps or septa. This phenomenon was discussed by Vampola (1996) for *Pilatoporus ibericus* (Melo et Ryvarden) Kotl. et Pouzar. *Tyromyces chioneus* (Fr.) P. Karst., the type of *Tyromyces* P. Karst., is characterised by a dimitic tube trama with true skeletal hyphae; this feature rules out its close relationships with *Poria fissiliformis*.

The affinities of *Frantisekia* with other polypore genera are unclear. Species of the *Ceriporiopsis resinascens* complex (*C. pseudogilvescens* (Pilát) Niemelä et Kinnunen and *C. resinascens* (Romell) Domański, see Kinnunen and Niemelä 2005) are similar in having strongly agglutinated brownish tubes and a pseudodimitic context with faintly cyanophilous hyphae. However, their tissues exude numerous oily globules in microscopic mounts, and basidia and spores are much larger than in *Poria fissiliformis*. Another *Ceriporiopsis* species, *C. subrufa* (Ellis et Dearn.) Ginns ( $\equiv$  *Pouzaroporia subrufa* (Ellis et Dearn.) Vampola), has strongly thick-walled, clampless hyphae in its trama, and is therefore sometimes considered dimitic (Vampola 1992, Pieri and Rivoire 1996). We agree with those opinions, and regard *Poria fissiliformis* and *Pouzaroporia subrufa* to be dissimilar.

*Tyromyces wynnei* (Berk. et Broome) Donk, once included into *Antrodiella* (Spirin 2001), is pseudodimitic, too; however, its possible relations with *Frantisekia* have to be examined in more detail.

Below we describe three species included by us into *Frantisekia*.

***Frantisekia fissiliformis* (Pilát) Spirin et Zmitr., comb. nov.**

Fig. 1

Basionym: *Poria fissiliformis* Pilát, Stud. Bot. Čechica 3: 1, 1940.

Holotype: USA. Missouri: Creve Coeur Lake, *Acer sp.*, 26. IX. 1926, L. O. Overholts (PRM 842754, studied).

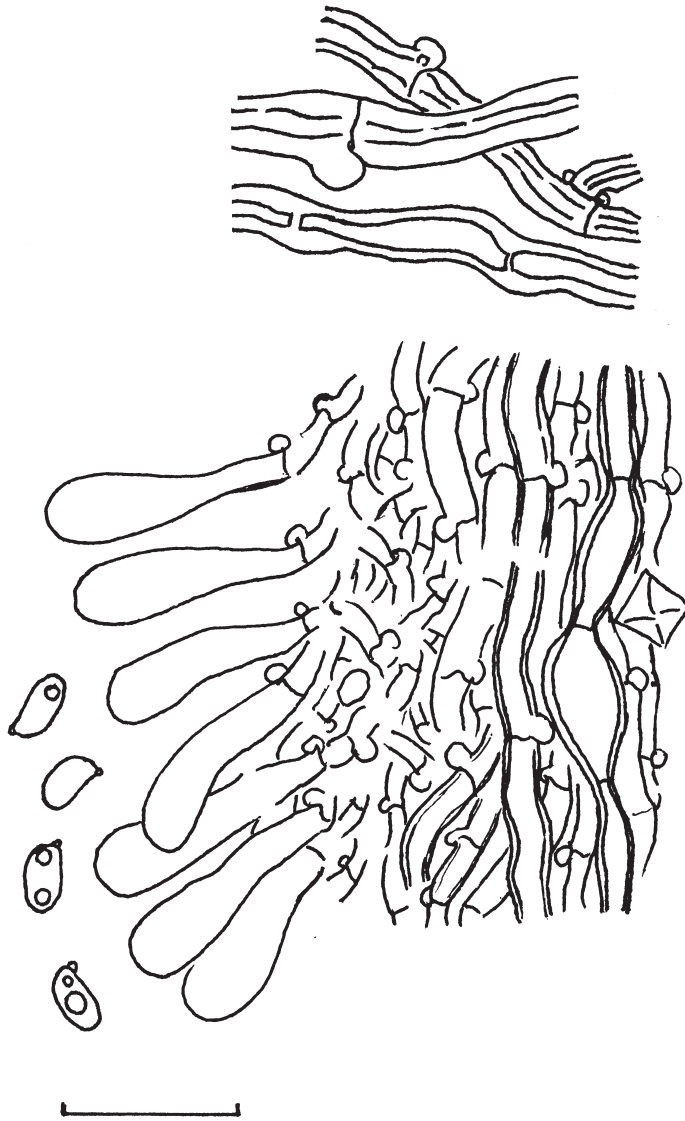
Basidiocarps annual, resupinate, widely effused (up to 10 cm in widest dimension), sometimes fusing together. Margin floccose, whitish, later pale ochraceous, often indistinct. Pore surface even, at first yellowish, later ochraceous to brownish; pores roundish to angular, clearly shrinking after drying, with thin entire or minutely lacerate edges, (7–)8–10 per mm. Section: subiculum fleshy, fragile when dry, whitish to ochraceous, indistinct, up to 0.3 mm thick; tubes first fleshy, yellowish to pale ochraceous, later fragile, strongly agglutinated, ochraceous to brownish, 1–7 mm thick (up to 15 mm thick according to Pilát's description).

Hyphal structure pseudodimitic in both subiculum and tubes; generative hyphae with clamp connections, inamyloid. Subicular hyphae thick-walled (wall up to 2 µm thick); generative hyphae hyaline, 3–5 µm in diam., acyanophilous, pseudoskeletal hyphae hyaline, with rare simple septa, 3.5–6 µm in diam., cyanophilous (reaction weak but clear). Tramal hyphae subparallel. Generative hyphae dominating, thin- or slightly thick-walled, yellowish, 2–4 µm in diam., acyanophilous; pseudoskeletal hyphae present in mature basidiocarps, scattered, thick-walled (walls up to 1 µm wide), yellowish, even or irregularly inflated, 2.5–5.5 µm in diam., acyanophilous. Cystidia absent, rhomboid or amorphous crystal clusters present. Basidia narrowly clavate, four-spored, clamped, 10–15 × 3–4 µm. Basidiospores oblong-ellipsoid to short-cylindrical, thin-walled, (3.0–)3.1–4.0(–4.2) × (1.6–)1.7–2.0(–2.1) µm, with occasional oil-drops, unchanging in Melzer's reagent, acyanophilous (Fig. 1).

Specimens examined. USA. See holotype. USA. New York: Warrensburg, on a hardwood log, 24. VIII. 1942, J. L. Lowe (H, LE ex SYR).

Discussion. This species was described from the USA (Pilát 1940), and later found there several times (Lowe 1966). Lowe (1966) and Gilbertson and Ryvarden (1987) gave modern descriptions of *F. fissiliformis*; however, the latter authors erroneously reported its skeletal hyphae to be dextrinoid. Later they (Ryvarden and Gilbertson 1993) repeated this opinion in their European polypore flora. As stated above, thick-walled hyphae of *F. fissiliformis* are not true skeletal, and the term "pseudodimitic" is more correct; these hyphae were indextrinoid in all collections we studied.

In the original description (Pilát 1940), *F. fissiliformis* was compared with resupinate forms of *Leptoporus fissilis* (Berk. et M. A. Curtis) Bourdot et Galzin (current name *Aurantioporus fissilis* (Berk. et M. A. Curtis) H. Jahn). The latter species is characterised by much larger pores (2–3 per mm), a thicker context, and a reddish hymenophore; its spores are ellipsoid.



**Fig. 1.** *Frantisekia fissiliformis* (holotype): subiculum (above), hymenium and spores (below). Scale bar = 10  $\mu$ m.

*Frantisekia fissiliformis* was also reported from some European countries (Kotlaba and Pouzar 1988, Ryvarden and Gilbertson 1993); in our opinion, the European taxon is another species, *F. mentschulensis* (see below). These species are quite similar; however, some clear differences could be found. First, *F. fissiliformis* seems to be a strictly resupinate species with poorly visible context, while *F. mentschulensis* is more flexible in its gross morphology, often being pileate or effused-reflexed, more rarely resupinate, and its context is well seen, strongly contrasting with the darker tubes. Further, *F. mentschulensis* has slightly larger pores, 6–8 per mm (versus 8–10 per mm in *F. fissiliformis*), but this difference is somewhat critical. Tubes in mature basidiocarps of *F. fissiliformis* are pseudodimitic, with wide and thick-walled pseudoskeletal hyphae, scattered here and there among thin-walled generative hyphae, while it stays monomitic in *F. mentschulensis*. The main differences, however, are the spore shape and size – the basidiospores of *F. fissiliformis* are oblong-ellipsoid, not exceeding 4 µm long, whereas they are cylindrical and longer in *F. mentschulensis*.

*Junghuhnia micropora* Spirin, Zmitr. et V. Malysheva, recently described from European Russia (Spirin et al. 2007), is very similar to *Frantisekia fissiliformis* macroscopically, having the same colour, consistence, and number of pores per mm. However, *Junghuhnia micropora* is characterised by a dimitic hyphal structure and presence of skeletocystidia.

Distribution and ecology. *Frantisekia fissiliformis* sensu stricto is a North-American species, known from the eastern United States (see Lowe 1966, Gilbertson and Ryvarden 1987). It develops on hardwoods, and causes white rot. It seems that *F. fissiliformis* has no successional connections with other wood-inhabiting fungi, typical of many *Antrodiella* species. More collections and field observations are needed to clarify its ecological preferences and distribution area.

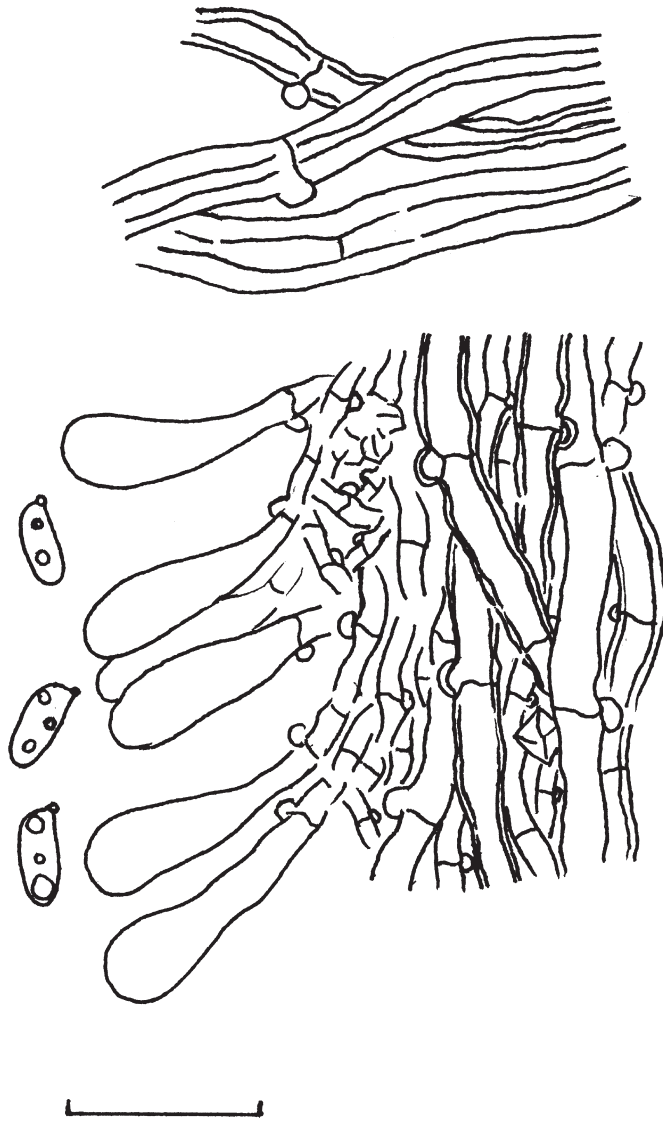
***Frantisekia mentschulensis* (Pilát ex Pilát) Spirin, comb. nov.**

Fig. 2

Basionym: *Poria mentschulensis* Pilát ex Pilát, Sborn. Nár. Mus. Praha 9(B), 2(1): 105, 1953.

Holotype: Ukraine. Zakarpatska Reg.: Trebušany (Dilove at present), Mt. Menchul, *Fagus sylvatica*, VIII. 1934, A. Pilát (PRM 611302, studied).

Basidiocarps annual, pileate to effused-reflexed or resupinate, often fusing together in large imbricate groups, 1.5–4.5 cm wide and 3–15 mm thick, resupinate fruitbodies up to 20 cm in widest dimension. Upper surface firstly finely tomentose, cream with yellow or orange tinge, later glabrous, agglutinated and covered by a thin cuticle, dirty orange, ochraceous or brownish, in herbarium specimens sometimes striate and wrinkled. Pileal margin thin to somewhat blunt, even, often involuting and agglutinated when drying, concolorous with pileal surface, fertile;



**Fig. 2.** *Frantisekia mentschulensis* (holotype): context (above), hymenium and spores (below). Scale bar = 10  $\mu$ m.



margin of resupinate parts sharply delimited from substrate, whitish, floccose, sterile. Pore surface even, firstly white to cream, later distinctly darkening, ochraceous orange to reddish brown; pores angular, with thin entire dissepiments, (4–)6–7(–8) per mm. Section: context fleshy, indistinctly fibrillose and hygrophanous when fresh, fragile when dry, white to cream, 2–5 mm thick, contrasting with the darker tube layer; tubes fleshy and cream, later more or less agglutinated, white to cream when fresh, then dirty orange to brownish, 1–10 mm thick. No distinct odour, taste slightly bitter.

Hyphal structure pseudodimitic in context, monomitic in tubes, hyphae inamyloid or only slightly amyloid; generative hyphae with clamp connections. Context hyphae thick-walled, branching at right angles; generative hyphae hyaline, 4–6.5 µm in diam., acyanophilous, pseudoskeletal hyphae strongly thick-walled (walls up to 2 µm wide), with rare simple septa, 4.5–7 µm in diam., faintly cyanophilous. Tramal hyphae subparallel. Generative hyphae thin- to slightly thick-walled, yellowish, 2.2–6.5 µm in diam., strongly agglutinated and intermixed with amorphous substance and crystal agglomerations, acyanophilous; pseudo-skeletal hyphae not found. Cystidia absent; hyphoid cystidioles sometimes present, 12–20 × 4–5 µm. Basidia clavate, four-spored, 10–16 × 3.5–4.5 µm. Basidiospores cylindrical, thin-walled, (3.4–)3.5–5.1(–5.2) × 1.7–2.1(–2.2) µm, sometimes with small oil-drops, inamyloid and acyanophilous (Fig. 2).

Specimens examined. Belarus. Brest Reg.: Luninetsky Distr., *Carpinus betulus*, 1. X. 1954, E. Komarova (MSK, LE 208342); Ivanovsky Distr., *Acer platanoides*, 29. VIII. 1958, E. Komarova (LE 208343). Czech Republic. Moravia: Hostýnské vrchy, Čerňava Virgin Forest, *Fagus sylvatica*, 9. VIII. 1973, T. Niemelä, F. Kotlaba & Z. Pouzar (H); Jihlava, Velký Špičák, *F. sylvatica*, 5. VIII. 1989, P. Vampola (H ex MJ – Polyporales Exsiccati Českoslovaciae No. 14). Russia. Nizhny Novgorod Reg.: Lukoyanov Distr., Kurley, *Populus tremula*, 14. VIII. 2005, W. Spirin (H, LE). Samara Reg.: Stavropol' Distr., Zhigulevsky Nat. Res., *Tilia cordata*, 10. IX. 2006, V. Malysheva & I. Zmitrovich (LE). Slovakia. Kremnické Pohorie, Harmanec, *Fagus sylvatica*, 6. VIII. 1973, T. Niemelä, F. Kotlaba & Z. Pouzar (H). Ukraine. See holotype.

Discussion. The first description of *Poria mentschulensis* Pilát was made in French, and appeared in “Atlas des Champignons de l'Europe” (Pilát 1941 in Pilát 1936–1942). Later Pilát (1953) re-described it in Latin and so validated this name. The description of *Poria mentschulensis* was based on a single resupinate collection from the Carpathian Mts. (at the time Czechoslovakia, now Ukraine). However, Pilát erroneously reported the spore measurements (3–4 × 0.8–1 µm; Pilát 1941 in Pilát 1936–1942), and this error was repeated by Bondartsev (1953). Kotlaba and Pouzar (1988) restudied a holotype of *P. mentschulensis*, and regarded it a synonym of *Tyromyces fissiliformis* (Pilát) Kotlaba et Pouzar. Also they briefly described pileate collections of *T. fissiliformis*, found in Eastern Eu-



rope (these specimens represent *Frantisekia mentschulensis* in the current sense). We restudied the types of both *Poria fissiliformis* and *P. mentschulensis*, as well as some additional collections, and prefer to keep them separately.

*Frantisekia mentschulensis* was also described as *Tyromyces albellus* (Peck) Bondartsev et Singer f. *aurantiacus* Komarova (Komarova 1959: 254). Five years later Komarova raised this form to the species rank by creating the new combination *Tyromyces aurantiacus* (Komarova) Komarova (1964: 89). However, an indication of the type material was omitted in the form description as well as in the species diagnosis. So, *Tyromyces aurantiacus* must be considered an invalid name (Donk 1974: 288). This fact was evidently overlooked in the CBS ([www.cbs.knaw.nl](http://www.cbs.knaw.nl)) and MycoBank ([www.mycobank.org](http://www.mycobank.org)) databases where *T. aurantiacus* is regarded as validly published.

The differences of *Frantisekia mentschulensis* from its closest relative *F. fissiliformis* were discussed in notes to the latter one. Superficially, pileate specimens of *F. mentschulensis* resemble some species of genera *Oligoporus*, *Postia*, or *Tyromyces*. The angiosperm-dwelling *Oligoporus* and *Postia* species (i. e. *Oligoporus balsameus* (Peck) Gilb. et Ryvardeen, *Oligoporus immitis* (Peck) Niemelä, *Postia alni* Niemelä et Vampola, *P. lactea* (Fr.) P. Karst., and *P. tephroleuca* (Fr.) Jülich) are not so bright-coloured as *Frantisekia mentschulensis*, and they are brown-rot fungi. The strongly agglutinated trama is the first feature, by which *F. mentschulensis* can be recognised under the microscope, and a careful examination of the spore variability might confirm its identification (its spores are wider than those of *Postia* species but narrower and longer than in *Oligoporus balsameus* or *O. immitis*). *Tyromyces chioneus* has whitish basidiocarps with wider and more irregular pores and its trama is dimitic. Fresh basidiocarps of *Tyromyces kmetii* (Bres.) Bondartsev et Singer are similar to those of *Frantisekia mentschulensis* in having an orange cap surface and paler tubes; however, its colours do not change so strongly during drying, and the spores are broadly ellipsoid.

Distribution and ecology. *Frantisekia mentschulensis* is an European species, known from Ukraine (type locality), Belarus (as *Tyromyces aurantiacus* – Komarova 1964), Czech Republic, Slovakia, Croatia, Poland, and Italy (as *Antrodiella fissiliformis* – Ryvardeen and Gilbertson 1993, Vampola and Pouzar 1996, Bernicchia 2005). Recently it was found in southern Sweden (Heilmann-Clausen 2006), and is reported here as new to Russia. It prefers deciduous forests, dominated by *Fagus sylvatica*, *Quercus robur*, or *Tilia cordata*, and its host set includes many deciduous trees.

***Frantisekia ussurii*** (Y. C. Dai et Niemelä) Spirin, **comb. nov.**

Basionym: *Antrodiella ussurii* Y. C. Dai et Niemelä, Mycotaxon 64: 74, 1997.

Holotype: China. Jilin Prov.: Antu County, Changbaishan Forest Res., *Populus* sp., 5. IX. 1993, Y. C. Dai (H, studied).

This species was thoroughly described by Dai and Niemelä (1997). It produces extensive fruitbodies on fallen logs of many angiosperm trees. Pileate specimens of *Frantisekia ussurii* come close to *F. mentschulensis*; however, the caps of the first one are much thinner, more leathery, and the pores are very small, (7–)8–10 per mm. *Frantisekia ussurii* is pseudodimitic in both context and tubes. Its hyphae are relatively narrow, 1.8–4 µm, and very densely packed, hence its hyphal structure looks like dimitic. However, the thick-walled “skeletal-like” hyphae bear rare clamps, and therefore must be regarded as pseudoskeletal hyphae. The basidiospores of *F. ussurii* are oblong-ellipsoid, (2.9–)3.0–4.0 × (1.4–)1.5–2.0 µm; their shape and size is similar to those of *F. fissiliformis* s. str.

*Frantisekia ussurii* is widely distributed in China and the Russian Far East, and probably not rare (Dai and Niemelä 1997, Dai and Penttilä 2006, Dai et al. 2006).

Specimens examined. China. See holotype. China. Jilin Prov.: Fushong, Shuguang, *Populus* sp., 20. VII. 1993, Y. C. Dai (H).

ACKNOWLEDGEMENTS

We are very grateful to Prof. Tuomo Niemelä (Helsinki, Finland) for detailed discussions on this group of polypores. Author W. S. is greatly indebted to Dr. Jan Holec and Mrs. Lenka Edrová (Prague, Czech Republic) who organised his visit to the mycological herbarium of the National Museum (PRM). Ms. Vera Malysheva (St. Petersburg, Russia) provided us with her collection of *Frantisekia mentschulensis*.

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