

## The taxonomy of *Pholiota fusus* – a critical evaluation

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*Pholiota fusus* (Batsch) Singer based on *Agaricus fusus* Batsch is included in most floras of the 19th century and appears in some works of the 20th century. Recent records documented by herbarium material were published by Bon, Tjallingii-Beukers and Noordeloos. A careful revision of these collections showed that they most probably represent an aberrant robust form of *Hypoloma sublateritium*. The original *Agaricus fusus* Batsch is hard to interpret. The species probably does not belong to *Pholiota* or not even to brown-spored fungi. Later interpretations of *Pholiota fusus* are dubious and cannot be verified due to the lack of any herbarium material. The concept of *Pholiota fusus* used by some authors of the 20th century follows that of Ricken. However, *Flammula fusa* sensu Ricken is probably a non-existing entity based on a mixture of characters taken from various species. There is no reliable evidence that a separate species of *Pholiota* corresponding to Batsch's original description or various later interpretations really exists. Consequently, the name *Pholiota fusus* must be considered a nomen dubium and should be rejected.

**Key words:** Fungi, basidiomycetes, *Agaricales*, *Agaricus fusus*, *Pholiota*, *Hypoloma*, taxonomy

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*Pholiota fusus* (Batsch) Singer založená na *Agaricus fusus* Batsch je druhem zahrnutým do většiny významných mykologických flór 19. století a objevuje se i v některých pracích z 20. století. Nálezy doložené herbářovým materiálem publikovali v poslední době Bon, Tjallingii-Beukers a Noordeloos. Revize tohoto materiálu prokázala, že se s největší pravděpodobností jedná o atypickou robustní formu druhu *Hypoloma sublateritium*. Původní *Agaricus fusus* je obtížně interpretovatelný druh, který zřejmě nepatří do rodu *Pholiota* a dokonce ani mezi hnědovtrusé houby. Pozdější interpretace jména *Pholiota fusus* jsou pochybné a navíc je nelze seriózně ověřit, protože chybí jakýkoli herbářový materiál. Pojetí druhu *Pholiota fusus* u většiny autorů 20. století vychází z Rickeny. Bohužel, *Flammula fusa* sensu Ricken je zřejmě neexistující druh, protože v jeho popisu se mísí znaky několika různých druhů. Nemáme také žádný spolehlivý důkaz, že existuje samostatný druh rodu *Pholiota*, který by odpovídal Batschovu původnímu popisu nebo některé z pozdějších interpretací. V důsledku toho je nutno považovat druh *Pholiota fusus* za pochybný a tolo jméno je třeba zavrhnout.

### INTRODUCTION

*Pholiota fusus* (Batsch) Singer or *Flammula fusus* (Batsch) P. Kumm. based on *Agaricus fusus* Batsch is included in most floras of the 19th century and appears in some works of the 20th century (the epithet is sometimes cited as

"fusa"). Records documented by herbarium material were recently published by Bon (1971), Tjallingii-Beukers (1987) and Noordeloos (1999). This paper aims to critically evaluate the taxonomic position and value of this less known species based on collections of the aforementioned authors.

## RESULTS

### *Pholiota fusus* (Batsch) Singer

*Agaricus fusus* Batsch, Elench. fung., Cont. secunda: column 13, 1789. – *Flammula fusus* (Batsch) P. Kummer, Führer Pilzk.: 82, 1871, "fusa". – *Dryophila fusus* (Batsch) Quél., Enchir. fung.: 70, 1886. – *Pholiota fusus* (Batsch) Singer, Lilloa 22: 516, 1951 ("1949"), "fusa".

Holotype: Batsch, Elench. fung., Cont. secunda, tab. 32, fig. 189a-c, 1789 (illustration serving as the holotype). Type locality: Germany, hill near Jena, in a pine wood, 20 Sep. 1788, leg. A. J. G. C. Batsch.

### Description of recent collections identified as *Pholiota fusus*

The description of the macrocharacters is based on records annotated and published by Bon (1971), Tjallingii-Beukers (1987) and Noordeloos (1999) as I did not see any fresh collection of this taxon.

Pileus up to 10 cm, convex with strongly involute margin, expanding with age, sometimes trapezoidal in profile, finally slightly concave at centre, fleshy, not hygrophanous, not translucently striate, not scaly, smooth. Pileus cuticle slightly viscid when moist, slightly lustrous when dry, dark rusty-brown to red-brown or rather paler red-brown to brick-brown; fulvous to cream-rusty towards the margin, with fibrillose veil patches at margin (veil colour – Bon 1971: whitish to silvery, Noordeloos 1999: lemon to sulphur-yellow). Lamellae crowded, L=40–70, l=1–5, thin, adnate-emarginate or subdecurrent, greyish-yellowish to olivaceous-ochre when young, then grey-brown to chocolate-brown ("bistre-chocolaté" according to Bon 1971), edge remaining yellow, lemon yellow or olivaceous. Stipe 10–12 × 2.5–4 cm, cylindrical in upper part but distinctly tapering in basal part or the whole stipe gradually tapering downwards, with whitish evanescent fibrillose-submembranaceous annular zone, yellowish in upper part, towards the base gradually pale fulvous to dark brown-red or brownish-black at base (bistré), sometimes with several armillate traces at base. Context white, whitish or pale lemon-yellow in inner part of pileus, red brown in cortex of pileus, whitish to yellow in stipe, spongy, finally brownish in stipe base. Taste mild, sweetish, then

slightly bitterish after chewing, smell slightly aromatic on cross-section (like beer according to Bon 1971). Spore print colour unknown.

The description of the microcharacters is based on personal study of collections mentioned below. Spores  $5.2-6.0 \times (3.4-3.7-4.0(-4.3) \mu\text{m}$ , ellipsoid-ovoid, ovoid or almost subamygdaliform-ovoid, slightly inequilateral, smooth, rather pale, yellowish-brownish to greyish-ochre in KOH, wall yellow-brown, moderately thick, germ pore well distinct,  $0.6-1.0 \mu\text{m}$  broad, looking like a gap at the spore apex, the apex sometimes almost truncate but covered with a fine convex "cap" over the gap filled with a gelatinous substance. Basidia  $14-16 \times 5-6 \mu\text{m}$ , narrowly clavate, 4(2)-spored. Cheilocystidia forming a sterile band on the edge,  $23-34 \times 6-8 \mu\text{m}$ , narrowly cylindrical-clavate, narrowly clavate, sometimes also narrowly fusiform-lageniform or narrowly utriform, often constricted at several places and with a subcapitate apex, thin-walled, mostly hyaline but sometimes partly filled with a pale yellow homogeneous pigment. Pleurocystidia of the chrysocystidia type, very abundant,  $24-38 \times 10-15 \mu\text{m}$ , clavate or clavate-fusiform with a conical, mucronate to rostrate apex, with a refractive inclusion colouring yellow in a KOH solution or  $\text{NH}_4\text{OH}$  or almost completely filled with a yellow-rusty to rusty-brown refractive substance, thin-walled, absent on lamellae edge. Lamellar trama regular to slightly subregular, made up of hyphae  $3-15 \mu\text{m}$  broad, cells cylindrical to narrowly fusiform, sometimes slightly yellow-rusty membranous pigmented or filled with a pale yellow substance. Pileus cuticle a cutis, 2-layered, upper layer relatively pale, sometimes slightly gelatinised, made up of rather densely arranged, parallel to slightly interwoven cylindrical hyphae  $1.5-6.0 \mu\text{m}$  broad, with yellow-rusty membranous pigmentation and strong rusty-brown incrustations, gradually passing into the lower layer which is much darker (brown), made up of densely arranged parallel hyphae  $5-15(-23) \mu\text{m}$  broad, cells cylindrical, fusiform, barrel-shaped, broadly ellipsoid, ovate to almost subglobose ("subcellular hypodermium"), with yellow membranous pigment and strongly developed rusty-brown incrustations forming small "plates" on hyphae surface. Stipe cuticle a trichoderm made up of upturned, straight, curved or interwoven hyphae  $3-6 \mu\text{m}$  broad, terminal elements not cystidia-like, cell wall with a yellow membranous pigment and rusty-brown incrustations. Clamp connections present in all tissues.

Growing as a saprophyte on wood of deciduous trees, for instance *Betula* (Noordeloos 1999). Fructification: September-October.

Brief survey of the most important characters of *Pholiota fusus* sensu Bon, Tjallingii-Beukers and Noordeloos

Fruitbodies moderately large to large, pileus fleshy, smooth, not scaly, dark rusty-brown to red-brown, paler red-brown or brick-brown; fulvous to cream-rusty towards the margin, lamellae at first greyish-yellowish, olivaceous-ochre or greyish

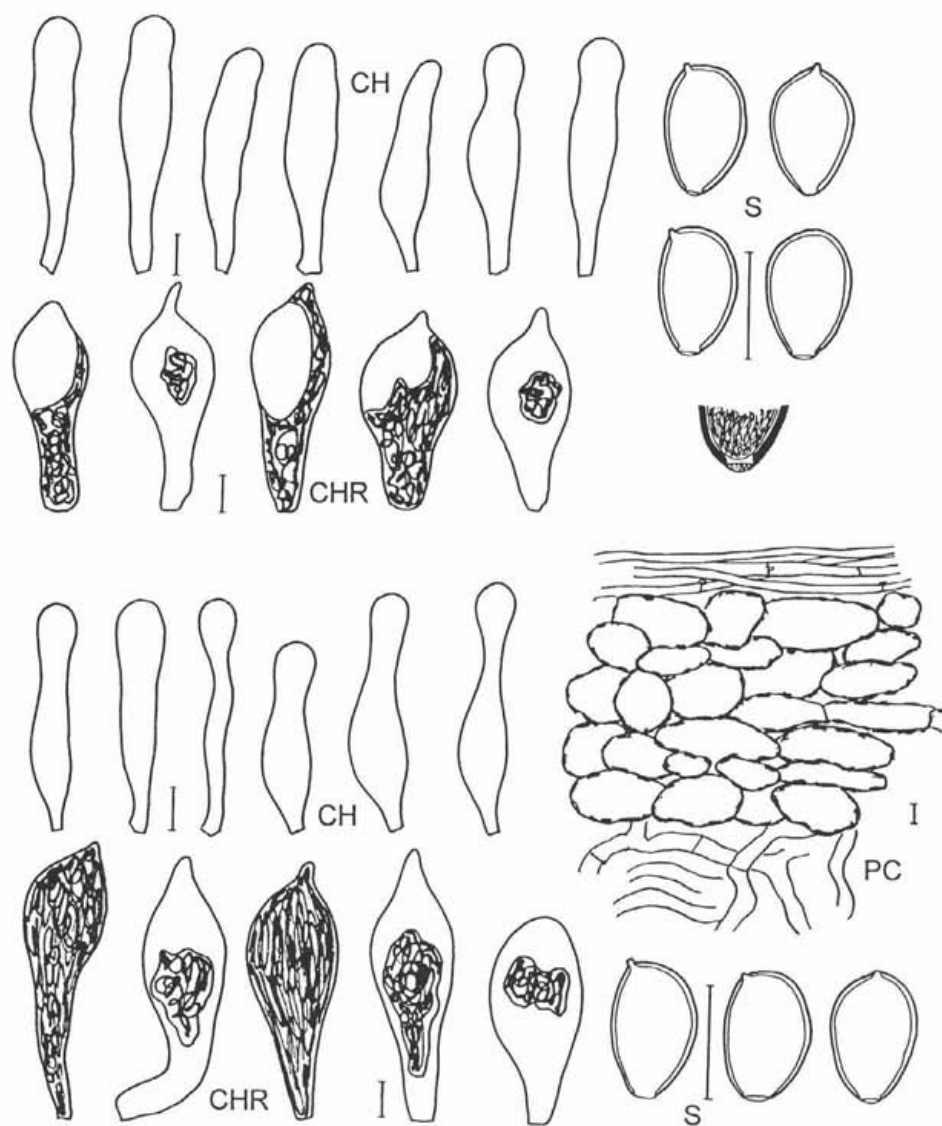


Fig. 1. France: Fresnes-sur-Escaut, near Bon Secours, on trunk (deciduous tree?), Oct. 1969, leg. Coppin (herb. Bon 91090).

The Netherlands: Prov. Utrecht, Huis ter Heide, on stump of *Betula*, 20 Oct. 1956, leg. J. A. R. v. Stolk (L 956.140 380).

CH: cheilocystidia, CHR: chrysocystidia, S: spores, PC: pileus cuticle. Scale bar = 5  $\mu$ m. Ill. J. Holec.

-greenish, then grey-brown to chocolate-brown, stipe cylindrical in upper part but distinctly tapering in basal part or the whole stipe gradually tapering downwards. Spores  $5.2-6.0 \times (3.4-3.7-4.0(-4.3)) \mu\text{m}$ , ellipsoid-ovoid, ovoid or almost subamygdaliform-ovoid, germ pore well distinct,  $0.6-1.0 \mu\text{m}$  broad, cheilocystidia cylindrical-clavate, narrowly clavate, sometimes also narrowly fusiform-lageniform or narrowly utriform, often constricted at several places and with a subcapitate apex, chrysocystidia present at lamellae surface, pileus cuticle a cutis, 2-layered, upper layer formed by cylindrical, fusiform, barrel-shaped, broadly ellipsoid, ovate to almost subglobose cells  $5-15(-23) \mu\text{m}$  broad ("subcellular hypodermium"). Growing as a saprophyte on wood of deciduous trees.

#### DISCUSSION

1. Recent records named *Pholiota fusus* (Batsch) Singer from France (Bon 1971) and the Netherlands (Tjallingii-Beukers 1987, Noordeloos 1999; these two descriptions are based on the same collection, see Collections studied) are quite identical in macro- and microcharacters. The main diagnostic characters are summarized above. These characters are in contradiction to the original description of *Agaricus fusus* Batsch. His fungus is small, has a rimose pileus surface and pale lamellae (see also Figs. 189 a, b, c by Batsch). It was found on soil among needles in a pine wood. These discrepancies are so distinct that the name *A. fusus* cannot be used as a basionym for the aforementioned collections which represent a rather fleshy lignicolous fungus with glabrous pileus and rather dark coloured lamellae.

2. In my opinion, the records published by Bon (1971), Tjallingii-Beukers (1987) and Noordeloos (1999) do not belong to the genus *Pholiota*. This opinion is based mainly on the presence of ellipsoid, ovate to almost subglobose cells in the lower layer of the pileus cuticle. Bon (1971: 51) called this structure a "hypocutis pseudoparenchymateux". This character is quite atypical of the genus *Pholiota* where the lower layer of the pileus cuticle is formed by cylindrical or at least narrowly barrel-shaped cells without coarse incrustations. The "hypodermium forming a subcellular layer" is even an important diagnostic feature of the genus *Hypholoma* sensu Singer (1986, as *Naematoloma*). If compared with species of this genus (considered a subgenus of *Psilocybe* by Noordeloos 1999), the recent records named *Pholiota fusus* are almost identical with *Hypholoma sublateritium* (= *Psilocybe lateritia* sensu Noordeloos 1999). I found no substantial difference in microcharacters. Concerning the macrocharacters, the colours also are identical and the robust stature and distinctly tapering stipe in "*Pholiota fusus*" are the only differences. Unfortunately, the spore print colour was not observed in recent records of "*P. fusus*". However, the lamellae colour given by Bon (1971: ochre-olivaceous or grey-greenish, then dark chocolate-brown) and Noordeloos (1999: greyish-yellowish then grey-brown) better corresponds to a *Hypholoma* than to *Pholiota*. The

tapering stipe is known from *H. sublateritium* (see e.g. Noordeloos 1999: 70). I compared several collections of *H. sublateritium* with specimens of "*P. fusus*" from France and the Netherlands. They were proven to be completely identical in microcharacters. Based on all these facts, I consider *Pholiota fusus* sensu Bon, Tjallingii-Beukers and Noordeloos an aberrant robust form of *Hypholoma sublateritium* (Fr.) Quél.

3. There are various interpretations of the name *Pholiota fusus* (Batsch) Singer in literature. The original *Agaricus fusus* by Batsch is hard to interpret (see above, point 1). Most probably it does not belong to *Pholiota* and not even to brown-spored fungi because the lamellae are described as "pallentes" or "von blasser Farbe" and the habitus is quite atypical of *Pholiota*. Figure 189 by Batsch is also difficult to interpret.

4. Plate 398 by Bulliard (Herb. France, vol. 9, 1789) is often mentioned as typical of *Pholiota fusus* (e.g. Fries 1838: 186, 1874: 247; Gillet 1874: 535; Bon 1971: 51; Noordeloos 1999: 91). Bulliard himself named the fungus in this plate *Agaricus hybridus*. It is also difficult to interpret this illustration. The fungus is rather robust, has yellow subdecurrent lamellae, white membranaceous partial veil, a distinctly downwards tapering stipe and grows on soil or in caves of old trunks. It is said to be extremely rare. I have no idea which species the table represents. It is worth mentioning that *P. fusus* is not included in the Flore analytique by Kühner and Romagnesi (1953). There is only a short discussion on page 332 and Bulliard's plate is not mentioned at all.

5. The species is included in old British floras (Cooke 1883: 169, Masee 1893: 134, Smith 1908: 151, Rea 1922: 317) and depicted by Cooke in plate 433 and 434 (Ill. Brit. fung., 1884). Plate 433 is cited by Bon (1971) as characteristic of his record. In my opinion, this illustration somewhat resembles old robust fruitbodies of *Pholiota lubrica*. The second one (pl. 434) certainly is something else because the lamellae are pure yellow and deeply decurrent. In his description, Cooke (1883) described the lamellae as ferruginous when mature so that his *A. fusus* cannot be a *Hypholoma* species. Concerning the later descriptions, it is not clear if the authors saw fresh material (except for that by Rea who added "v.v." = vidi vivo; however, his description is partly taken from Ricken). The descriptions seem to be a mixture of data taken from other works (Batsch, Bolton, Fries, Cooke; see Masee 1893: 134). The spore print colour is never mentioned. With regard to these obscurities and lack of any herbarium material these interpretations cannot be identified with certainty. Similarly, in the British check-list (Dennis et al. 1960), *Flammula* or *Pholiota fusus* is "excluded pending clearer definition". However, it is clear that the British *Flammula fusus* is something else than the original *Agaricus fusus* Batsch.

6. The concept of *Pholiota fusus* used by some authors of the 20th century follows that of Ricken (1915: p. 206, Fig. 58/4, as *Flammula fusa*). A careful review of his description shows that it is probably based on fruitbodies of more than one

species. Based on my experience with *Pholiota* and *Hypholoma*, it is impossible that within one species the colour of mature lamellae is either rusty-yellow ("schliesslich rostgelb") or grey-olive to brown-olive ("aber auch grauoliv schl. braunoliv"). This is a mixture of pholiotoid and hypholomoid characters. The pholiotoid ones are represented by rusty-yellow lamellae and the spore print colour which is not purple according to Ricken. Hypholomoid characters are the grey and olive tinge of the lamellae and the nature of the veil on the pileus surface. In my opinion, figure 58/4 by Ricken represents dull coloured fruitbodies of *Hypholoma sublateritium* with grey-olive lamellae (compare Ricken's almost identical picture of *H. sublateritium* in Fig. 65/2). However, the spore size given by Ricken ( $8-9 \times 4-5 \mu\text{m}$ ) does not fit any of the species mentioned. During the work on *Pholiota* I did not find any fruitbodies or herbarium collections corresponding to Ricken's description of *Flammula fusus*. Herbarium specimens labelled with this name (from M and IB) appeared to be either *P. lubrica* or *P. pinicola*. Considering all the facts summarized here, *F. fusa* sensu Ricken is a non-existing entity based on a mixture of characters taken from various species. The possibility that his *F. fusa* is an unknown new species is unlikely.

7. Ricken's concept of *Pholiota fusus* has been used by Moser (1953, 1955, 1967, 1978, 1983; as *P. fusa*) in all editions of his key. No specimen of *Pholiota* corresponding to this concept was found among Moser's collections kept in IB. Due to the facts summarized in the previous paragraph, the real existence of this taxon is doubtful. The "species" is included in the flora by Kreisel et al. (1987) with a note that the fungus originally depicted by Batsch is certainly another species than *P. fusa* sensu modern authors (= Ricken, Moser etc.).

8. The illustration in Fries (Ic. hymenomyc. 2, Tab. 117: fig. 1, 1878) is designated as typical of *P. fusa* by Tjallingii-Beukers (1987) and Noordeloos (1999). Fries himself named this fungus *Agaricus fusus* Batsch \* *filius* Fr. In my opinion, this taxon has nothing in common with the original *A. fusus* Batsch and with *Pholiota fusa* sensu Bon (1971), Tjallingii-Beukers (1987) and Noordeloos (1999). It is a clear *Pholiota* with a slender fistulose stipe and buff ("gilvus") pileus with rufous centre. Orton transferred the Friesian name to *Pholiota* as *P. filia* (Fr.) P. D. Orton. In my opinion, *Agaricus fusus* \* *filius* is very close or even identical with *Pholiota mixta* (Fr.) Kuyper et Tjall.-Beuk.

#### CONCLUSIONS

The characters of recent records of *Pholiota fusus* (Batsch) Singer published by Bon (1971), Tjallingii-Beukers (1987) and Noordeloos (1999) do not agree with the original *Agaricus fusus* Batsch. The records most probably represent an aberrant robust form of *Hypholoma sublateritium* (Fr.) Quél.

The original *Agaricus fusus* Batsch is hard to interpret. The species probably does not belong to *Pholiota* or not even to brown-spored fungi.

Later interpretations of *Agaricus* (*Flammula*, *Pholiota*) *fuscus* are dubious. It is not clear if the authors saw fresh material. Due to the lack of any herbarium material, their identity can not be verified.

The concept of *Pholiota fuscus* used by some authors of the 20th century (Moser, Kreisel etc.) follows that of Ricken which is probably based on fruitbodies of more than one species. During my work on *Pholiota* I did not find any fruitbodies or herbarium collections corresponding to Ricken's description. Consequently, *Flammula fusa* sensu Ricken is considered a non-existing entity based on a mixture of characters taken from other species.

There is no reliable evidence (herbarium specimens or well-documented descriptions) that a separate species of *Pholiota* corresponding to Batsch's original description or various later interpretations really exists. Consequently, the name *Pholiota fuscus* (Batsch) Singer must be considered a nomen dubium.

Collections studied: France: Fresnes-sur-Escaut, near Bon Secours, on trunk (deciduous tree?), Oct. 1969, leg. Coppin (herb. Bon 91090). – The Netherlands: Prov. Utrecht, Huis ter Heide, on stump of *Betula*, 20 Oct. 1956, leg. J. A. R. v. Stolk (L 956.140 380, L 973.123 503).

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