

FLAMMULINA IN WESTERN EUROPE

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A new species, *Flammulina fennae*, is described. *Flammulina velutipes* is subdivided into two varieties, var. *velutipes* and var. *lactea* (Quél.) comb. nov., and two formae, f. *velutipes* and f. *longispora* f. nov. Keys to the western European taxa of *Flammulina* are given.

Several authors (e.g. Métrod, 1952: 87; Arnolds, 1977: 36; Klán, 1978: 211) have drawn attention to the great variation in spore-sizes attributed to *F. velutipes* in current literature, the reported measurements of the length ranging from 5.5–6.5 to 8–10 μm and of the width from 2.5–4 to 5–6 μm .

There are at least two reasons for these incongruent reports. First an undescribed, well-characterized species with broad, relatively small spores is hiding in the *F. velutipes*-complex. Secondly within *F. velutipes* sensu stricto two variants differing in spore-shape can be distinguished.

Spore-size and -shape appear to be important characters in *Flammulina*. Some of the differences being, however, rather subtle, accurate measuring is required. Usually I measure spores taken from the lamellae (spore prints being too rarely present). But in *Flammulina* I found it very difficult to distinguish between mature and immature spores and therefore measured spores deposited on the pileal surface (where they are usually very abundant). To prevent mistakes these spores have always been compared with those on the lamellae. Because of the narrowness of the spores, measurements have to be carried out under 100 \times or 63 \times objectives. For comparable results, per sample at least 10 spores have to be measured. It should be avoided that germinating spores are included.

In the following descriptions the code of Munsell Soil Color Charts has been used for designating colours. Notations like [100/9/8] stand for: '100 spores measured from 9 basidiocarps from 8 collections'. 'Q' means the quotient of the length and the width of spores; 'average Q' is the average Q (per sample of at least 10 spores) per collection. 'R' is the radius of the pileus.

For the gelatinizing, more or less erect, hyphae-like, terminal elements in the pileipellis of *Flammulina* I use the term 'ixohyphidia', although I am aware of the fact that Donk (1956: 3, 1964: 229) introduced the term 'hyphidia' for terminal hypha-like elements in the hymenium of basidiomycetes. But as most hymenial elements are occasionally found in cortical layers of basidiomycetes, I see no objection against the application of this term to similar elements in cortical layers. It seems to me that the hair-like structures in the pileipellis of *Russulaceae* (Singer, (1975: 6): 'ciliate dermatocystidia') could be called hyphidia also.

All collections studied are deposited in the Rijksherbarium, Leiden, unless otherwise indicated.

KEY TO THE SPECIES OF FLAMMULINA IN WESTERN EUROPE

1. Basidiocarps on or near *Ononis spinosa* in poor grasslands on calcareous soil. Spores large and broad, $8.5-12.5 \times 4.5-5.5 \mu\text{m}$ *F. ononidis*
1. Basidiocarps on wood or seemingly terrestrial near shrubs or trees. Spores shorter than $8 \mu\text{m}$ or narrower than $4.5 \mu\text{m}$.
 2. Spores $6-8 \times 4-4.5(-5) \mu\text{m}$, average $Q 1.5^5-1.7$. Mature pileus white to yellowish buff with slightly darker ochraceous centre, often with brown spots. Pileocystidia at centre of expanded pileus very crowded and not or hardly interspersed with rather simple ixohyphidia. Basidiocarps often on subterranean wood *F. fennae*
 2. Spores $7-11 \times (2.5-3)3-4 \mu\text{m}$, average $Q 2.0-3.0$. Pileus yellow to red-brown or pileus and stipe completely white to cream. Pileocystidia at centre of expanded pileus interspersed with ixohyphidia branching at wide angles. Basidiocarps usually on stumps, stems or branches
F. velutipes

*Flammulina fennae*¹ Bas, *spec. nov.* — Figs. 1–4

Speciem nomine Flammulina velutipes simulans. Sporae $6-7.5 \times 4-4.5 \mu\text{m}$, ellipsoideae vel elongato-ellipsoideae (medium $Q 1.5^5-1.7$). Pileus albus vel pallidus centro plus minusve ochraceus. Centrum pileipellis pileocystidiis confertis compositum. Typus: 'C. Bas 7727, 19 Oct. 1980, Netherlands, prov. Zuid-Holland, Voorschoten, estate "Ter Wadding", (L)'.

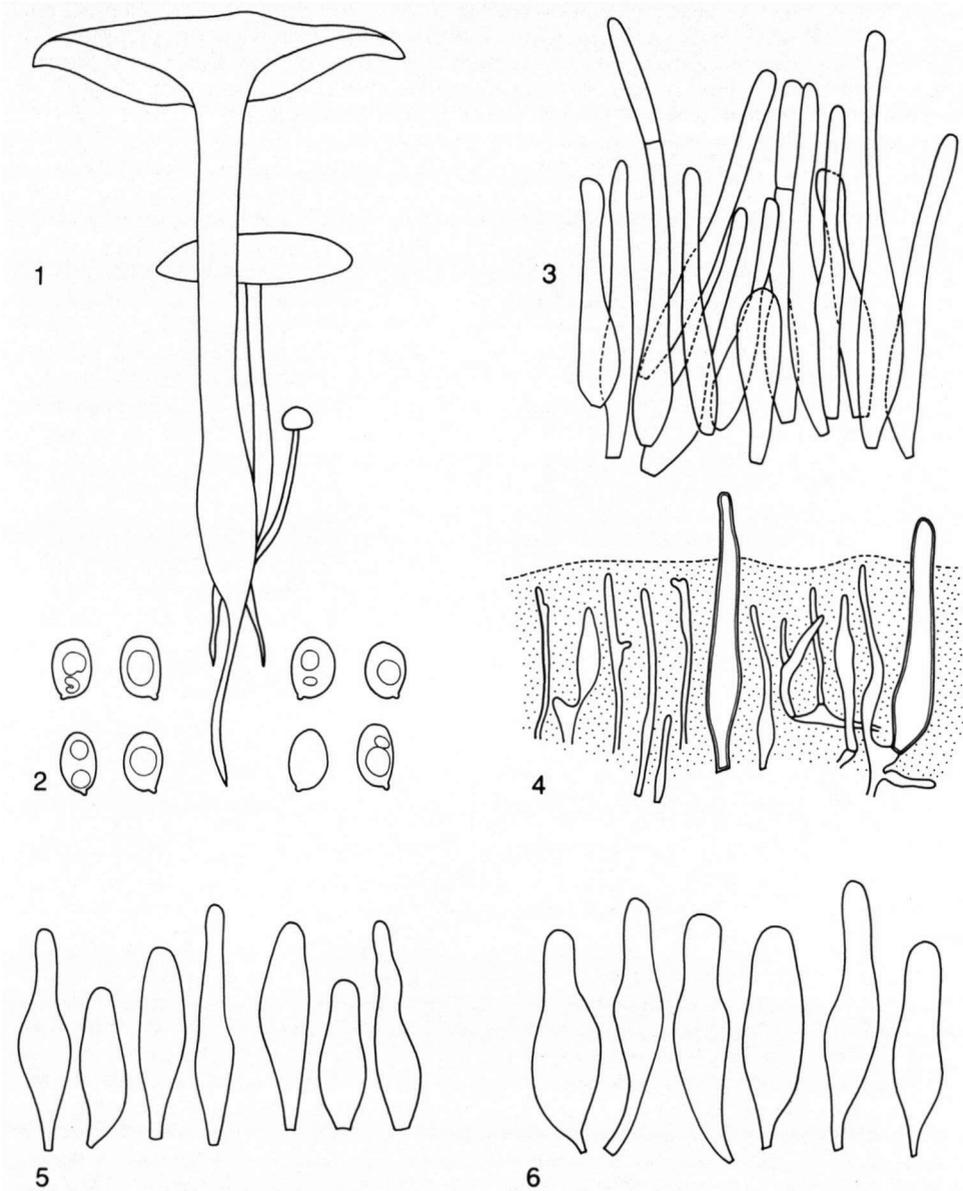
Basidiocarps single or in clusters of up to about 100 on subterranean roots, more rarely on stumps of broad-leaved trees.

Pileus 20–50(–70) mm in diameter, from convex with inflexed outermost margin when very young to plano-convex with vague umbo, finally more or less flat with slightly deflexed margin and vague umbo sometimes with a slight depression in the middle, in very young stages (up to 2.5 mm diam.) rusty ochraceous to pale ochraceous brown (Munsell from between 5 YR 6/8 and 7.5 YR 6/8 to c. 7.5 YR 6/6), but soon white to pale yellow or yellowish buff, (from pure white to nearly 10 YR 8/6), sometimes almost uncoloured but mostly with a pale ochraceous brown centre (between 7.5 YR 6/6 and 10 YR 7/8 or 10 YR 6/8), sometimes with conspicuous red-brown spots, when moist short translucently striate (up to 0.2 R) at margin of mature basidiocarps, smooth, minutely pruinose when very young but later on minutely velvety to glabrous and dry to greasy (in dry weather) to viscid (when wet), very long remaining minutely pruinose to minutely subgranular at centre, thick-fleshed, rather elastic.

Lamellae from very crowded in young to very distant in large pilei (from 16 to 6 per 10 mm half-way R), from nearly free to sinuately or emarginately adnate, or narrowly adnexed, sometimes uncinately, moderately broad (up to 8 mm wide), white or whitish cream to pale cream (near 10 YR 8/2 to 8/4 but paler) sometimes bruising slowly but rather vividly yellow-brown, often with conspicuous red-brown spots, very elastic, with concolorous, even edge, with 1–3 lamellae between each pair.

Stipe 25–120 \times 1–10 mm, cylindrical but often with fusiform subbulbous base, solid to stuffed, tough, connate at base when growing in clusters, with one or more

¹ Named after the author's wife, Fenna Moes, in gratitude for help and forbearance.



Figs. 1-6. *Flammulina fennae*. — 1. Basidiocarp $\times 1$. — 2. Spores, $\times 1250$. — 3. Radial section of pileipellis at centre of pileus, $\times 500$. — 4. Radial section of pileipellis 1/3 R from centre, $\times 500$. — 5. Cheilocystidia, $\times 500$. — 6. Pleurocystidia, $\times 500$. (Figs. 1-3, 5 from type; 4, 6 from Balke 1965).

pseudorhiza when growing on subterranean or rotten wood, whitish to pale buffy ochraceous (10 YR between 8/6 and 8/8) colour of apex downwards passing gradually into dull reddish brown to nearly blackish colour of lower 2/3 or 4/5 (5 YR between 3/2 and 3/3 to 10 YR 4/4), often with a narrow to broad brighter yellow-brown, orange-brown or red-brown zone in between, with very minute white to red-brown dots on pale apex, downwards with minutely subvelutinous-subtomentose covering concolorous with or somewhat paler than dark red-brown background, in large specimens with a few conspicuous longitudinal grooves, elastic.

Context white, with somewhat yellowish tinge in centre of pileus, yellowish buff to brownish ochraceous in lower 2/3 to 1/3 of stipe, dark red-brown in cortex of stipe. Smell rather typical, like fermenting fruits with a resinaceous component (also recorded as sweetish fungoid), sometimes tending to fish-like when crushed. Taste fungoid-subadstringent or mild. Spore print cream-white to pale cream, 1b(-2a) in *Russula*-scale of Romagnesi (1967), soon darkening when kept.

Spores [125/12/12] (5.5-)6-7.5(-8) × (3.5-)4-4.5(-5) μm, Q 1.4-1.8(-1.95), average Q 1.55-1.7, ellipsoid to elongate-ellipsoid, rarely elongate, thin-walled, smooth, colourless, usually containing one or two refractive droplets, with abrupt small apiculus. Basidia 30-35 × 4.8-6.0 μm, 4-spored, with clamp. Cheilocystidia abundant but intermixed with basidia, (35-)40-80(-115) × (8-)10-16(-21) μm lageniform or ventricose-lageniform, more rarely utriform or ventricose-fusiform, with 4-9(-12) μm wide neck and obtuse apex, thin- to slightly thick-walled, colourless to somewhat yellowish. Pleurocystidia very scarce to abundant, 40-70 × 12-18 μm, subutriform-sublageniform, sometimes utriform or lageniform, nearly always with broadly rounded apex, thin- to slightly thick-walled, colourless. Trama of lamellae regular but 4.5-20 μm wide hyphae somewhat undulating, with very slightly thickened walls, colourless to pale yellowish. Subhymenium narrow, 15-20 μm thick, composed of 1-2 μm wide densely ramose hyphae. Pileipellis with pileocystidia at centre very crowded and seemingly the only constituents but towards margin gradually more and more interspersed with thin, c. erect, gelatinizing hair-like elements (ixohyphidia); pileocystidia (55-)70-14 × (6-)8-15 μm, slenderly lageniform, sometimes septate, thin- to slightly thick-walled (wall up to 0.4 μm thick) colourless to yellowish or pale brown; ixohyphidia 0.5-1.5(-3.6) μm thick, often very long, sparsely branching at narrow angles, colourless, thin-walled. Clamps abundant.

Habitat & distribution.—On subterranean roots and at the base of stems and stumps of deciduous trees (*Fagus*, *Fraxinus*, *Populus*, *Platanus* and possibly *Ulmus*) on rich, often clayey or loamy soil, from April to October; known to occur in the Netherlands, France, Czechoslovakia, and Hungary, but probably widespread.

Collections examined.—NETHERLANDS: prov. Gelderland, Beesd, estate 'Mariënwaard', 1 Oct. 1980, *W. V. Rubers 8160* (herb. Rubers); prov. Utrecht: Breukelen, estate 'Nijenrode', 27 Sept. 1980, *J. Daams*; Breukelen, estate 'Boom en Bosch', 16 Sept. 1982, *Th. Kuijper 2220*; prov. Noord-Holland, Vogelenzang, A.W.-dunes, 14 Oct. 1980, *E. Arnolds*; prov. Zuid-Holland, Voorschoten, estate 'Ter Wadding', 19 Oct. 1980, *C. Bas 7727* (holotype); Rotterdam, Kralingse bos, medio Aug. 1965, *N.P.W. Balke*; prov. Zeeland, Zeeuws Vlaanderen: Kloosterzande, 10 May 1981, *A. de Meijer 149C*; Sas van Gent, Braakmanpolder, 'Bos van Barbé', 27 June 1981, *A. de Meijer 319A*; prov. Limburg, Gronsveld, Savelsbos, 17 Oct. 1970, *F. Benjaminsen 701029* (herb. Benjaminsen).—CZECHOSLOVAKIA, between Bubovice and Hostin (c. 20 km SSW of Prague). 4 Sept. 1981, *Th. W.M. Kuyper 1709*.—HUNGARY, Budapest, Városliget, 8 Oct. 1971, *M. Babos*.

Note: The macroscopic description is based mainly on the rich type-collection and *Kuijper 2220*, as most collections cited reached the author in dried state and often without notes or with short descriptions only.

This taxon is more than just a variant of *F. velutipes* with small broad spores, as it differs from that species also in several other respects.

In its most typical form *F. fennae* is easy to recognize by the slender fruit-bodies, white to pale colours of at least the margin of the pileus and the early fruiting.

In border-line cases between *F. fennae* and the short-spored form of *F. velutipes* the structure of the pileipellis was decisive. In *F. velutipes* the pileocystidia are clearly interspersed with ixohyphidia also at the centre of the pileus and quite a few of these hyphidia have a characteristic shape. They are frequently branching often at rather wide angles, slightly thick-walled and have somewhat moniliform terminal branches tapering towards their apex.

A collection made by E. Arnolds (Vogelenzang, 14 Oct. 1980) is aberrant because of the bright orange-brown pileus with more yellowish margin and the ochraceous yellow gills. It has spores within the range of *F. fennae*: $5.5-8(-8.5) \times (3.5-4)4-4.5 \mu\text{m}$. $Q (1.45-1.55-195(-2.1))$, average $Q 1.7$. Its pileipellis consists at the centre of the pileus of very crowded pileocystidia and very few ixohyphidia which have a simple, c. hair-like shape and agrees in these respects with *F. fennae*. But the pileocystidia are strongly coloured and often have a crooked base, which are *F. velutipes* characters. Because of the spores and the composition of the pileipellis I consider this collection to represent a strongly coloured form of *F. fennae* but it may be another underscribed taxon. Unfortunately this collection could not be taken in culture.

It is probable that the fungus mentioned by Kühn. & Romagn. (1953: 95) under the name *Collybia velutipes* var. *lactea* Quél. is identical with *F. fennae* as it is said to have a whitish to pale margin of the pileus, to fruit early in the season and to grow also on subterranean wood.

The taxon described by Quélet (1881: 663) as *Pleurotus velutipes* var. *lacteus* represents, however, an albino variant of the true *F. velutipes* (see elsewhere in this paper).

A species possibly related to *F. fennae* is *Agaricus laxipes* Fr. (1838: 86).

Fries, who had not seen the species himself, based his description mainly on Battara's description and figure (1755: 46, pl. 9, fig. 1) of '*Monomyces pedunculo longissimo*' and referred in addition to Sowerby's (1800: pl. 263) illustration of *A. velutipes*.

The specimens depicted by Sowerby on the cited plate are densely fasciculate, have long curved red-brown stipes and pale yellow-buff pilei. The very young pilei have the same colour as the expanded ones. The specimens were collected in a wood-shed and probably represent a somewhat etiolated form of *F. velutipes*.

Battara's uncoloured figure shows one single basidiocarp with a very long, somewhat undulating stipe (105×4 mm in the drawing and yet apparently not drawn in its full length) and a small, flat pileus with a short sulcate margin and broad, distant gills. It is described by Battara as growing on roots of *Quercus*, having a uniformly milk white pileus with a pectinate margin, a very long rigid stipe, solid and white inside, with a rufous silky to hirsute covering.

Perhaps Battara's species is a mediterranean taxon of *Flammulina* (unfortunately the nature of the pileal surface is described merely as 'laevis'). *Flammulina fennae* differs

from it by its coloured pileal centre, its straight and not unusually long stipe and the buff to ochraceous context in the stipe.

It is possible that Battara's species was rediscovered by Quélet (1873: 342, pl. 2, fig. 2), who gave a description and coloured picture of a similar fungus. Quélet's material had subglobose spores, a separable velutinous cortex, and was found growing on buried twigs in woods.

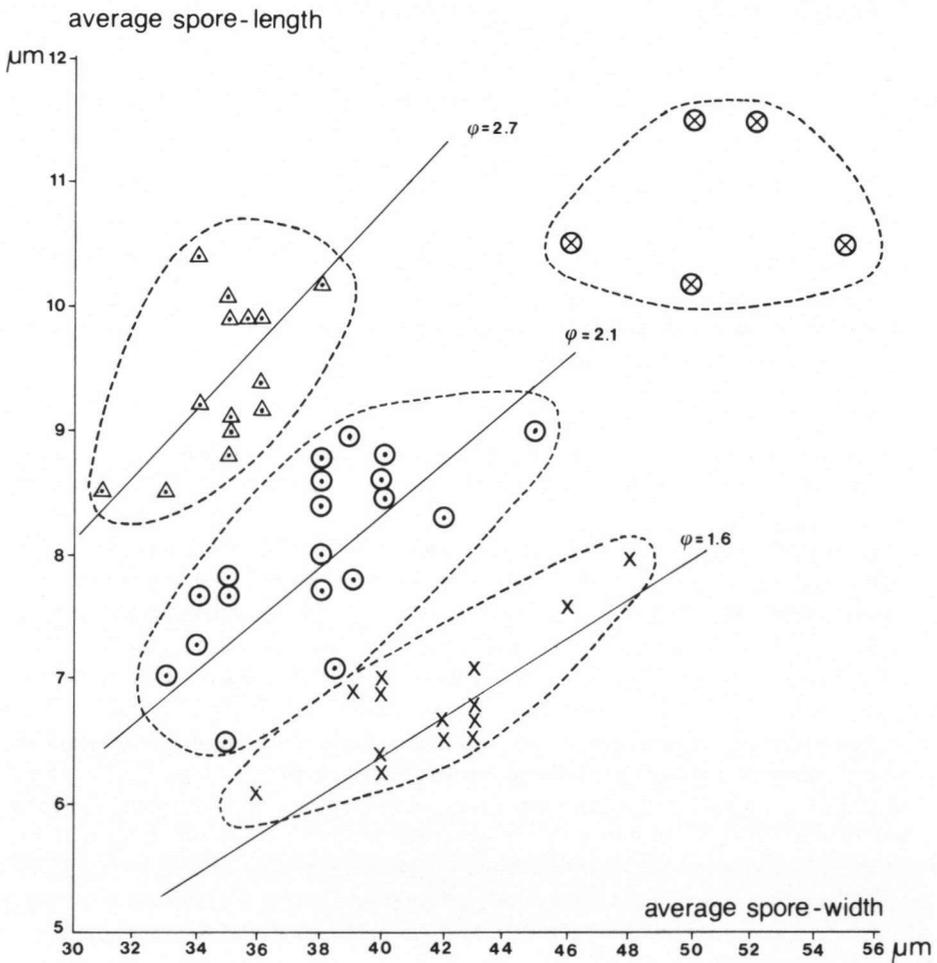


Fig. 7. Scatter diagram of average length and width of basidiospores of *Flammulina fenae* (x), *F. velutipes f. velutipes* (O) and *f. longispora* (Δ), and *F. ononidis* (⊗).

Another taxon to be considered in connection with *F. fennae* is *Agaricus sphinx* Batsch (1786: 145, pl. 22 fig. 112). It is described and depicted with a pale pileus with a rusty yellow centre not unlike that of *F. fennae*, but with a stipe that is not velutinous but 'pruinato-scaber'.

It is clear that now spore-shape and -size and the microscopic structure of the pileipellis appear to play an important role in the taxonomy of *Flammulina*, most of the older European names, particularly of varieties and forms of *F. velutipes* have to be disregarded if no types are available, and that *Agaricus sphinx* is one of these.

Flammulina velutipes var. *radicans*, illustrated and briefly but validly described by Wichansky (1968: 70) bears some resemblance to *F. fennae* because of the long *pseudorhizae* connected with subterraneous wood. This taxon has been described without notes on the colour of the pileus and without microscopical data. A study of the type at PR (Wichansky 682577, 1 Febr. 1968, Prague, Kinskélo sady), kindly sent on loan, revealed that this variety represents a rooting form of the true *F. velutipes* and that its spores ($7.1-8.9 \times 2.7-3.7$, Q 2.3-3.0, aver. Q 2.6) fit in the range of *F. velutipes* f. *longispora* (see elsewhere in this paper).

In 1922 Singer published *Collybia velutipes* f. *aestivalis* characterized by early fruiting (July-August) and an at first glabrous but later thinly velutinous stipe remaining glabrous at the apex. This forma has however colours typical for *F. velutipes*. Later Singer (1964: 183) reported that the type of this forma has been lost, identified South American material with it, and depicted spores of that material which are too slender (Q 2.45-2.55) for *F. fennae*. Therefore it is unlikely that Singer's forma *aestivales* is synonym of *F. fennae*.

Dr. J. Stalpers (C.B.S., Baarn) was so kind as to bring *F. fennae* in culture and to carry out interfertility-tests between this species and *F. velutipes*. He generously allowed me to publish the outcome of his experiments.

'Because of the very low viability and the long dormancy of the basidiospores of *F. fennae* (less than 0,1% and about 3 weeks compared with more than 50% and 1-2 days in *F. velutipes*) only 14 monokaryons could be obtained. These have been mated with each other and with both monokaryotic and dikaryotic strains of *F. velutipes*.

The intraspecific matings resulted in 4 mating types which differed also in growth rate.

The matings with monokaryotic strains of *F. velutipes* were consistently negative; neither anastomoses nor clamp connections were observed. Di-mon matings with dikaryotic *F. velutipes*-strains never resulted in the formation of clamp connections in the hyphae of *F. fennae*. There were, however, other interactions. The monokaryotic strains of *F. fennae*, which are easily distinguishable from those of *F. velutipes* by the slower growth rate, the lack of arthroconidia and the very scanty aerial mycelium, penetrated and killed the colonies of both mono- and dikaryotic *F. velutipes*. The contact zone was marked by a yellow discolouration, which gradually disappeared. Slides showed healthy mycelium of *F. fennae* and only empty hyphae of *F. velutipes*. Strains of *F. fennae* used in matings:

monokaryotic: mating types of *Kuijper 2220*.

Strains of *F. velutipes* used in matings:

dikaryotic: CBS 439.79 (sent by R. Kühner) and *Bas 7758* (f. *velutipes*).

monokaryotic: CBS 435.79, 436.79, 438.79, mating types of CBS 439.79 and of *Bas 7758* (f. *velutipes*).

Thus the specificity of *F. fennae* is firmly supported by cultural characters and inter-fertility tests with *F. velutipes*. Its aggressive behaviour against cultures of *F. velutipes* is an interesting aspect of its biology.

Flammulina ononidis Arnolds — Fig. 11

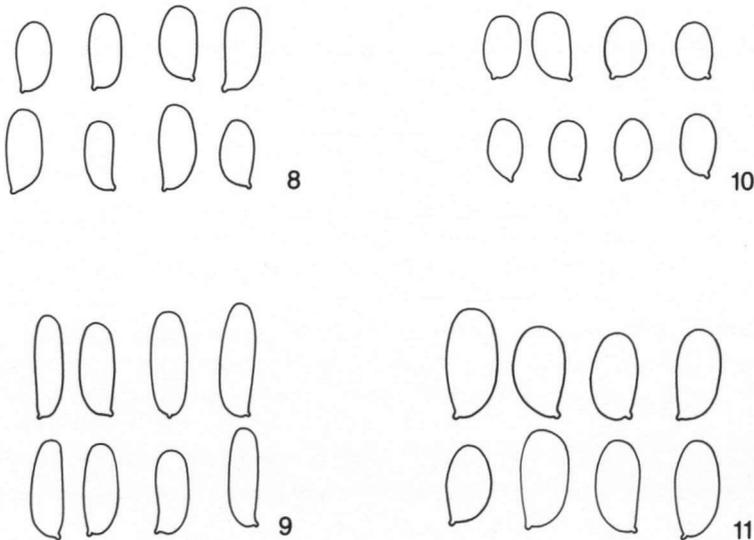
Flammulina ononidis Arnolds in Westf. Pilzbr. 11: 33. 1977.

Collybia velutipes var. *pratensis* Schieferdecker in Z. Pilzk. 21: 21. 1949 (not val. publ.; no latin).

— *Collybia velutipes* subsp. *pratensis* Schieferdecker apud Schieferdecker & Müller in Z. Pilz. 29: 109. 1963 (not val. publ.; no type).

Pileus 5–35(–45) mm wide, convex to plano-convex, sometimes with umbo, honey yellow to pale orange-brown with darker orange-brown centre, translucently striate when moist, viscid. Lamellae distant, adnate, from yellowish-whitish to pale ochraceous yellow. Stipe 15–55(–80) × 1–4 mm, attenuate downwards, from pale yellow at apex via orange-brown and red-brown to dark brown at base, completely velutinous, frequently with blackish pseudorhiza.

Spores (7.5–)8.5–12.5(–14) × (4–)4.5–5.5(–6) μm, Q (1.6–)1.7–2.4⁵, average Q 1.9–2.3, elongate to cylindrical, basidia 4-spored. Cheilocystidia 30–55(–60) ×



Figs. 8–11. Basidiospores, × 1250. — 8. *Flammulina velutipes* f. *velutipes*. — 9. *F. velutipes*, f. *longipes*. — 10. *F. fennae*. — 11. *F. ononidis*. (Fig. 8 from *Bas 7730*; 9 from *Van Crevel, 31. XII. 1979*; 10 and 11 from type.)

5–15 μm , abundant, utriform to lageniform, thin-walled. Pleurocystidia scattered (sometimes absent?), similar to cheilocystidia. Pileipellis gelatinous, with c. erect embedded 1–2.5 μm wide branching ixohyphidia and large, partly projecting, lageniform, fusiform or subcylindrical pileocystidia (45–)50–100(–110) \times (3–)6–11(–17) μm , with thickened brown walls but usually colourless and thin-walled apex. Stipitepellis with hairs and caulocystidia. Clamps present.

The description given here is merely a compiled characteristic. *Flammulina ononidis* has extensively been described and discussed by Arnolds (l.c.), Klán (1978: 205), Krieglsteiner (1978: 1), Schieferdecker (l.c.), and Schieferdecker & Müller (l.c.). It is fully characterized by its large, broad spores and its habitat. This species has been recorded from dry, poor, calcareous grasslands, always on or near *Ononidis spinosa*, in West- and East-Germany and Czechoslovakia.

Flammulina velutipes (Curt.: Fr.) Sing.

Agaricus velutipes Curt., Fl. Londin. 4: 212, pl. 70. 1777. — *Agaricus velutipes* Curt.: Fr., Syst. mycol. 1: 119. 1821. — *Collybia velutipes* (Curt.: Fr.) Kumm., Führ. Pilzk. 116. 1871. — *Neurotus velutipes* (Curt.: Fr.) Quél., Enchir.: 147. 1886. — *Gymnopus velutipes* (Curt.: Fr.) Murrill, N. Amer. Fl. 9: 361. 1916. — *Myxocollybia velutipes* (Curt.: Fr.) Sing. in Schweiz. Z. Pilz. 17: 72. 1939 (inval. name).¹ — *Flammulina velutipes* (Curt.: Fr.) Sing. in Lilloa 22: 307. ('1949') 1951. — Lectotype (select. mihi): Curtis, l.c. pl. 70.

Agaricus nigripes Bull., Herb. France: pl. 344. 1788.

Collybia veluticeps Rea in Trans. Brit. mycol. Soc. 1: 157. 1900. — *Collybia eriocephala* Rea apud A.L. Smith & Rea in Trans. Brit. mycol. Soc. 3: 46. 1908 (inval. name change, superfluous name).²

KEY TO THE INFRASPECIFIC TAXA OF VELUTIPES

1. Pileus yellow to red-brown. Stipe pale yellow to dark brown var. *velutipes*
2. Spores 6–9.5 \times 3–4 μm , average Q (1.8–)2.0–2.3 f. *velutipes*
2. Spores 8–11.5 \times 3–4 μm , average Q 2.5–3.0⁵ f. *longispora*
1. Pileus and stipe white to cream and remaining so var. *lactea*

var. *velutipes*

Basidiocarps in small to large clusters on wood, more rarely gregarious or solitary. Seldom on subterranean wood.

Pileus (8–)15–45(–95) mm wide, from convex soon plano-convex, finally sometimes plano-concave, often with low umbo or with flattened to slightly depressed centre, with margin at first inflexed but later straight or slightly reflexing and then often undu-

¹ *Myxocollybia* (1936) has been published without Latin and has not been validated since.

² This name has incorrectly been introduced by Rea for his *C. veluticeps* because of the existence of the Australian *Agaricus (Collybia) veluticeps* Cooke & Mass. apud Cooke (in Grevillea 17: 30. 1887). Rea's description seems to apply to old midwinter specimens of *F. velutipes*. The spore-size given (7–8 \times 3–4 μm) fits forma *velutipes*.

lating; from golden yellow (2.5 Y 8/8) or ochraceous yellow (10 YR 8/8–8/7), rarely more greenish yellow (5 Y 8/8), to ochraceous brown (10 YR 6/8) or orange-red-brown (5 YR 5/8 to 7.5 YR 5/8), and sometimes uniformly so, but usually with darker ochraceous brown to orange-red-brown or dark red-brown (5 YR 4/4) centre and paler yellow margin, more rarely uniformly greenish yellow or buff (5 Y 8/6, 2.5 Y 8/6, 2.5 Y 7/8–7/6), somewhat hygrophanous, slightly fading when drying up, when moist often outermost margin darker and short translucently striate (up to 0.2 R), densely pubescent when very young, later subpubescent to glabrous, greasy to very viscid when moist, subviscid to dry when dehydrated; pileipellis not peeling at first but easily peeling later on.

Lamellae moderately crowded to very crowded, in large old specimens sometimes very distant (10–16, rarely 6–8 per 10 mm half-way R), adnate, sinuate or (deeply) emarginate, sometimes nearly free, rarely seceding and forming a pseudocollarium, rather narrow to moderately broad (2.5–7 mm), elastic, whitish, pale buffy cream (2.5 Y 8/4), ochraceous yellow (10 YR 8/8–7/8), more rarely ochraceous buff to sordid buff (2.5 Y 8/6, 7/6, 7/4) sometimes even brownish ochre (10 YR 6/6), sometimes with brown spots, with slightly irregular but entire edge; (1–)2–3 tiers of lamellulae and these occasionally anastomosing.

Stipe (15–)20–50(–155) × (1.5–)2.5–6(–18) mm, cylindrical or attenuate downwards, rarely slightly broadening downwards, sometimes rooting (pseudorhiza up to 65 × 3 mm), sometimes with subbulbous base, connate below, frequently somewhat flattened, fistulose to hollow, usually in the very beginning cream to pale yellow (2.5 Y 8/6), soon darkening from base upwards and then via ochraceous yellow (10 YR 7/8), yellow-brown and rusty ochraceous (7.5 YR 5/8) to reddish brown or dull dark (red-) brown (5 YR 3/4, 10 YR 3/4, 3/2), outermost apex long remaining pale yellow but finally completely blackish brown, densely concolorously pubescent to velutinous but pale apex sometimes red-brown punctate, at base occasionally hirsute with pale hairs.

Context elastic, white to yellowish in pileus and upper part of stipe, sometimes darker under pileipellis, sordid yellowish to greenish yellow to brownish yellow in lower part of stipe. Smell rather typical, pleasant, somewhat fruity with a resinaceous component; when crushed sourish fungoid. Taste indistinct to fungoid, sometimes slightly bitterish. Spore deposit cream-white to pale cream, 1b–(2a) in *Russula*-scale of Romagnesi (1967).

Spores (5.5–)6–11.5(–12) × (2.5–)3–4(–5) μm , Q 1.6⁵–3.4⁵(–3.8), mean Q 2.0⁵–3.0⁵, elongate-ellipsoid to cylindrical or even bacillar, sometimes slightly bent, with small abrupt apiculus, colourless to very pale yellowish in NH₄OH, thin-walled, inamyloid, non-cyanophilous, easily germinating. Basidia 25–36 × 5.5–7.2 μm , 4-spored (in some collections a small percentage 5-spored¹), with clamp. Cheilocystidia scarce and scattered to rather abundant, 32–62(–70) × 6–16 μm , utriform to lageniform, intermixed with basidia, thin- to slightly thick-walled, colourless to somewhat yellowish-brownish. Pleurocystidia very scarce to fairly abundant, 35–70(–90) × (7–)10–21 μm , from cylindrico-clavate or broadly utriform to slenderly lageniform or fusiform, slightly thick-walled, colourless. Lamellitrama regular, but when young outer layer in upper part diverged, composed of 3–11 μm wide, colourless, thin-walled hyphae. Pileipellis an ixotrichoderm with pileocystidia and ixohyphidia; pileocystidia abundant to very rare, (30–)50–110(–140) × 5–13 μm , slenderly lageniform to hair-shaped, often with crooked base, sometimes septate, sometimes capitate, from colourless to yellow-brown or red-brown, with up to 0.4 μm thick walls, with their lower 1/3 to 2/3 embedded in gelatinous substance; ixohyphidia abundant, thin-walled and colourless to slightly thick-walled and (yellow-)brown in lower part, branching at wide angles and narrow branches

¹ Dr. D. Pegler, Kew, was so kind to draw my attention to this phenomenon; later I observed it in several collections.

often submoniliform, tapering to a less than $1\ \mu\text{m}$ thick apex, completely embedded in gelatinous substance. Covering of stipe made up of: (i) at apex large, up to $160\ \mu\text{m}$ long, lageniform, colourless or at the base brown or entirely brown, sometimes somewhat encrusted caulocystidia, usually intermixed with colourless, pale brown or golden yellow-brown $2\text{--}5\ \mu\text{m}$ wide hairs tapering towards frequently colourless apices; (ii) in the middle $2\text{--}7\ \mu\text{m}$ wide (colourless to predominantly) red-brown hairs mixed with rare to rather abundant caulocystidia; (iii) at base very long $2\text{--}4.5\text{--}(7)\ \mu\text{m}$ wide, red-brown, agglutinate hairs in bundles. Stipitetrata composed of parallel $7\text{--}16\ \mu\text{m}$ wide, cylindrical hyphae with slightly thickened yellowish walls, sometimes intermixed with a few golden yellow to red-brown straight vascular hyphae. Clamps abundant.

Habitat & distribution.— Throughout the year but abundant only from September to March; on stumps, stems (also of living trees) and fallen branches of deciduous, very rarely coniferous trees, only occasionally on subterranean wood; in the material studied showing a preference for *Salix*, *Populus*, *Fraxinus* and *Sambucus*¹. In the Netherlands abundant in areas with rich alluvial soils, particularly clay, but rather rare and locally lacking in those with poor diluvial soils.

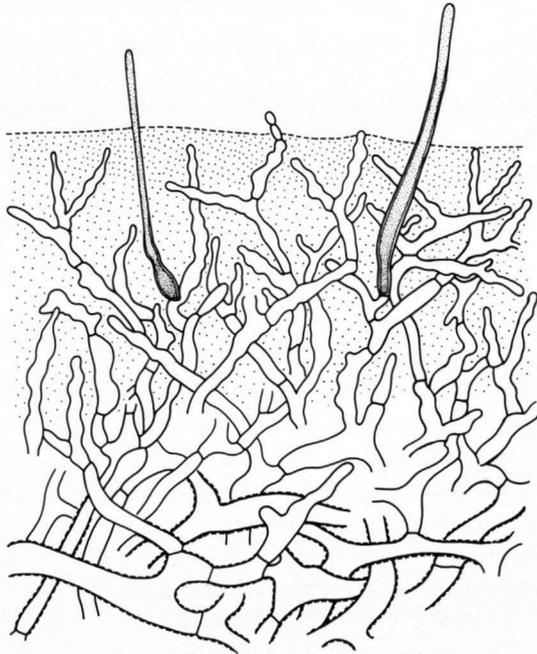


Fig. 12. *Flammulina velutipes* f. *velutipes*, radial section of pileipellis near centre of pileus, $\times 500$. (From Bas 7730).

¹ An extensive list of hosts (but probably including those of *F. fenae*) has been published by Kreisler (1961: 68).

forma *velutipes* — Figs. 8, 12

Spores [200/23/20] $6-9.5 \times (2.5-3-4(-5)) \mu\text{m}$, average Q (1.85-)2.0-2.3. Very common from August to March, occasionally also in summer. Found on *Ulmus*, *Populus*, *Fraxinus*, *Alnus*, *Fagus*, *Betula*, *Juglans*, *Rosa*, *Passiflora* and *Picea*.

Collections examined.—NETHERLANDS: prov. Noord-Holland: Amsterdam, 16 Febr. 1981, *R. van Crevel*; Velzen, 3 Nov. 1982, *A. G. Becker*; Haarlem, 18 Jan. 1981, 11 Febr. 1981, *E. Vellinga*; Vogelenzang, 20 Oct. 1980, *C. Bas 7730*; prov. Zuid-Holland: Leiden, 7 Jan. 1981, 11 Jan. 1981, 30 Jan. 1981, *C. Bas 7751, 7756, 7758*; Gouda, 16 March 1980, *C. M. den Held-Jager*; De Vliet, 20 Sept. 1976, *C. M. den Held-Jager*; prov. Zeeland: Houtenisse, 21 Sept. 1981, *A. de Meijer*; Koewacht, 21 Oct. 1981, *A. de Meijer*; Hengstdijk, 10 Oct. 1981, *A. de Meijer*; Sas van Gent, 28 June 1981, *A. de Meijer 318*, Kloosterzande, 10 May 1981, *A. de Meijer 142b*.—FINLAND, Inari-Lappland, Kevo, 16 Aug. 1978, *M. E. Noordeloos*.—ENGLAND; North Harrow, 15 Jan. 1981, *J. Burns*; East London, Wanstead Flats, 25 Jan. 1981, *F. W. K. Young*.—BELGIUM, Hasselt, Bolderberg, 27 Sept. 1981, *F. Benjaminsen 810911*.—CZECHOSLOVAKIA, Karlstejn, 7 Sept. 1981, *Th. Kuijper*.

forma *longispora* Bas¹ — Fig. 9

Spores [140/16/16] $(75-8-11.5(-12)) \times (2.3-3-4(-4.7)) \mu\text{m}$, average Q 2.5-3.0⁵. Rather common from November to April. Collected on *Salix*, *Ulmus*, *Populus*, *Fraxinus* and *Alnus*.

Collections examined.—NETHERLANDS: prov. Gelderland: Winterswijk, ultimo 1980, *J. Schreurs*; Buren, 13 Dec. 1972, *H. S. C. Huijsman*; prov. Utrecht, Linschoten, 21 April 1977, *J. Schreurs & al.*; prov. Noord-Holland: Amsterdam, 'Klein Danzig', 16 Febr. 1981, *R. van Crevel*; Heemskerk, North-Holland dune reserve, 27 Nov. 1980, *Th. Kuijper* (type); Vogelenzang, 8 March 1981, *C. Bas 7758*; prov. Zuid-Holland: Noordwijk, Vogelenveld, 7 March 1981, *E. C. Vellinga*; Sassenheim, 'Klinkenberg', 18 Jan. 1953, *R. A. Maas Geesteranus 9296*; Leiden, 22 Dec. 1980, *Th. Kuijper*; Leiden, 11 Jan. 1981, *C. Bas 7753, 7754, 7755*; Leiden, 28 Nov. 1964, *R. A. Maas Geesteranus 14466*; Numansdorp, 12 Nov. 1970, *P. A. Slim*; prov. Noord-Brabant, Budel, 31 Dec. 1979, *R. van Crevel*; prov. Limburg, Margraten, 23 Jan. 1982, *E. Vellinga*.—SWITZERLAND, Colombier, Planeyse, 30 Jan. 1967, *H. S. C. Huijsman 67002*.—CZECHOSLOVAKIA, Prague, Febr. 1968, *E. Wichanský* (type of *F. velutipes* var. *radicans*; PR).

Even after the segregation of *F. ononidis*, *F. fennae* and *F. velutipes* var. *lactea*, the remaining *F. velutipes* var. *velutipes* is still a highly variable taxon.

Measuring the spores of a few decades of collections of var. *velutipes* I came to the conclusion that there are a short-spored and a long-spored variant, a fact visualized by the two clouds of dots in the scatter diagram setting out average length against average width of the spores of the collections studied (Fig. 7).

Trying to correlate this difference in spore-shape with other characters, I studied: (i) abundance, shape, septation, and colouration of the pileocystidia; (ii) shape, size, and

¹ *Flammulina velutipes* forma *longispora* Bas, *f. nov.* A typo differens sporis cylindraceutis vel bacillariformibus; medium Q 2.5-3.0⁵. Typus: 'Th. Kuijper, 27.XI.1980, Netherlands, prov. Noord-Holland, Heemskerk, North-Holland dune reserve' (L).

distribution of cheilo- and pleurocystidia, and (iii) shape, colouration, and distribution of hairs and cystidia of the stipe. I found all these features to vary to a great extent, but failed to correlated these variations with the spore-characters. Therefore I decided to recognize these variants only on the level of formae. It is remarkable, however, that the long-spored form has been found only from November to April and the short-spored form almost all through the year. In winter I collected both forms at several localities on one day.

The decision to indicate the short-spored variant as the typical form (forma *velutipes*) is based on the fact that it is the most common of the two and the fact that two collections from the surroundings of London (where Curtis collected the original material of his *Agaricus velutipes*), kindly sent to me by Dr. D. Pegler, Kew, represent this form.¹

Buch (1952: 100) invalidly published *Collybia velutipes* forma *macrospora*, found on stumps of deciduous trees in alluvial woods in Saxony. He gave the spores as measuring 9–12 × 5–6 μm, which is even slightly larger than in *F. ononidis*.

The collection of *F. velutipes* with the longest spores (9.5–11.6 μm) studied by me has relatively very narrow spores (2.9–3.9 μm, Q 2.6⁵–3.8, average Q 3.0⁵). This collection (*Maas Geesteranus 9296*) is moreover marked by large pilei, deeply rooting stipes and above all by very distant lamellae (c. 6–8 per 10 mm half-way). As the distance between the lamellae is also in the rest of *F. velutipes* a rather variable character (although I saw them nowhere else so widely separated) I have included the collection in f. *longispora*, but it may represent a separate taxon.

Flammulina velutipes var. *lactea* (Quél.) Bas, *comb. nov.* — Figs. 13–20

Pleurotus velutipes var. *lacteus* Quél. in C.R. Ass. franç. Av. Sci. (Reims 1880) 9: 663. 1881 (basonym). — *Collybia velutipes* var. *lactea* (Quél.) Rea., Brit. Basid.: 332. 1922. — *Collybia lactea* (Quél.) Sacc., Syll. Fung. 5: 212. 1887.

Excluded. — *Collybia velutipes* var. *lactea* sensu Kühn. & Romagn., Fl. anal. Champ. sup.: 95. 1953 (= *F. fennae*).

Carpophores in small clusters on stumps, sometimes together with var. *velutipes*. Pileus 5–25 mm wide, convex with margin inflexed with young, somewhat hygrophalous, when moist ivory (creamy pale buff, e.g. Munsell 2.5 Y 8/4), short translucently striate and viscid, when dry white, subviscid and under strong lens minutely pubescent, particularly when very young. Lamellae adnexed, somewhat distant, relatively broad, white with yellowish reflexion, sometimes formed or anastomosing, with one tier of lamellulae. Stipe 4–20 × 0.8–2.5 mm, cylindrical, bent, white to pale cream at apex to ivory at base, but sometimes slightly brownish at base when old, densely and minutely white pubescent. Context white. Smell indistinct. Taste unknown. Spore print whitish cream.

Spores [30/3/3] 7.3–10.1(–10.6) × (2.7–)2.9–4.0 μm, Q 2.0–3.0(–3.3), average Q 2.1⁵–2.8, cylindrical, rarely bacillar. Basidia 4-spored, with clamp, 29–36 × 6.0–7.2

¹ I refrained from designating one of these collections as neotype, because I received them dried and without descriptive notes. In my opinion, neotypes of fleshy fungi consisting of recently collected material have to be extensively annotated and illustrated and should include a spore print.

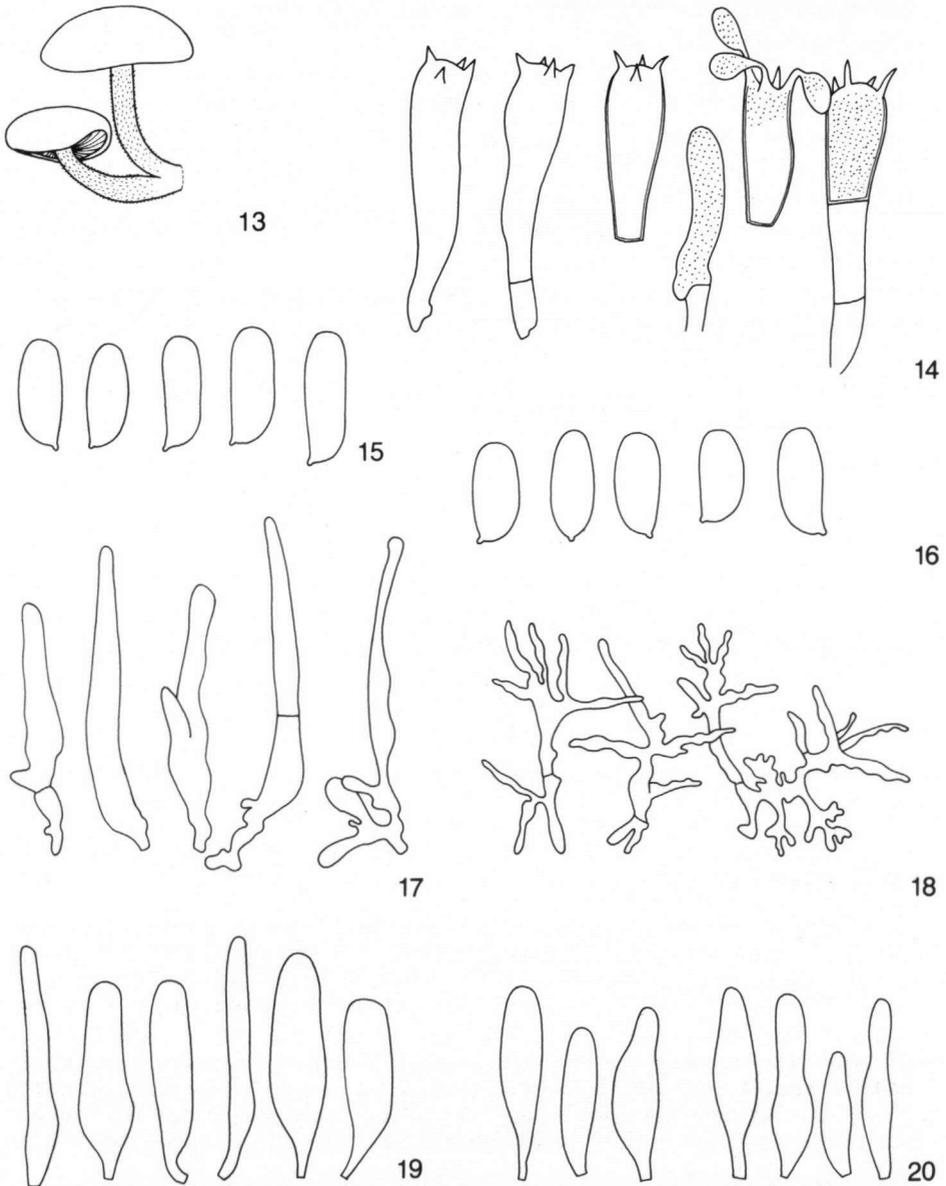


Fig. 13–20. *Flammulina velutipes* var. *lactea*. — 13. Basidiocarp, $\times 2\frac{1}{2}$. — 14. Incidental septate basidia with thickening walls, $\times 1250$. — 15–16. Basidiospores, $\times 1250$. — 17. Pileocystidia, $\times 500$. — 18. Ixohyphidia from pileipellis, $\times 500$. — 19. Pleurocystidia, $\times 500$. — 20. Cheilocystidia, $\times 500$. (Figs. 13, 15, 19 from *De Meyer*, 23.XI.1981; 14, 16, 20 (right 4 figs.) from *Freese-Woudenberg*, 19.XII.1971; 17, 18, 20 (left 3 figs.) from *Jansen*, 14.I.1978).

μm , sometimes shortened by secondary septation and then slightly thick-walled and easily detachable in squashed mounts (Fig. 14). Cheilocystidia 30–54(–68) \times 8–14 μm , abundant, utriform to lageniform, more rarely clavate or subcylindrical, sometimes strangulate, usually with obtuse apex, with colourless, slightly thickened wall. Pleurocystidia 50–65 \times 7.5–15 μm , scarce to fairly abundant, mostly utriform to clavate or broadly cylindrical with broadly rounded apex but more rarely also slenderly lageniform, colourless and slightly thick-walled. Pileipellis an ixotrichoderm, strongly gelatinized, with dendroid to coralloid, thin-walled to slightly thick-walled ixohyphidia and rather scattered slightly thick-walled, colourless to slightly brownish, irregularly shaped, sublageniform pileocystidia (Fig. 17), 30–95 \times 6–12 μm . Clamps present.

Habitat & distribution.—Probably with same distribution as var. *velutipes*, but rare. At one of its known Netherlands' localities growing on *Sambucus nigra*, at the other two on unidentified stumps. Late autumn and winter.

Collections examined.—NETHERLANDS: prov. Noord-Holland, Amsterdam, Slotervaart, 19 Dec. 1971, *W. Freese-Woudenberg*; prov. Zeeland, Zeeuws Vlaanderen, Vogelwaarde, 23 Nov. 1981, *A. de Meijer*; prov. Noord-Brabant, Terheijden, Eendekooi, 17 Dec. 1977 and 14 Jan. 1978, *P. B. Jansen*.

It is possible that var. *lactea* can be divided into a short- and a long-spored form, just as var. *velutipes*, but the small number of collections studied does not allow a definite conclusion. The spores of the Zeeland collection agree with those of var. *velutipes* f. *longispora*, the spores of the other collections with those of f. *velutipes*.

Basidiocarps of var. *lactea* are sometimes so small that they are mistaken for those of *Marasmiellus* or *Mycena* species.

Dr. J. Stalpers at Baarn cultured this taxon from a tissue sample of the Zeeland collection. Basidiocarps produced in petri dishes were very similar to those of the original collection with exception of the much longer stems, the more ochraceous centre of the pileus and the very densely pubescent pileipellis.

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