

***Flagelloscypha faginea*, an unusual basidiomycete new for Greece**

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Abstract – A rare basidiomycete, *Flagelloscypha faginea*, is presented from Greece with a detailed description, taxonomic notes and a discussion on related taxa. This is the first report of the genus for Greece.

Biodiversity / *Flagelloscypha* / *Lachnellaceae* / *Niaceae*

Résumé – Un basidiomycète rare, *Flagelloscypha faginea*, est présenté dans ce premier rapport du genre pour la Grèce, avec une description détaillée, des notes taxinomiques et une discussion des espèces proches.

Biodiversité / *Flagelloscypha* / *Lachnellaceae* / *Niaceae*

INTRODUCTION

Flagelloscypha is an unusual genus of minute, whitish, cyphelloid basidiomycetes that resemble small discomycetes. About 25 species are known to exist worldwide (Kirk *et al.* 2008). It was placed by Singer (1975) in the family *Tricholomataceae* tribus *Marasmiaceae* subtribus *Crinipellinae*, along with *Crinipellis*, *Chaetocalathus*, *Amylloflagella*, and *Lachnella*, and later transferred by Jülich (1981) to the family *Lachnellaceae*. More recently, molecular studies (Bodensteiner *et al.* 2004; Binder *et al.* 2006) showed that, along with the cyphelloid genera *Calathella*, *Cyphellopsis*, *Halocyphina*, *Lachnella*, and *Merismodes*, the corticioid genus *Dendrothele*, and the marine gasteroid fungus *Nia vibrissa*, *Flagelloscypha* belongs in the *Nia* clade, where it forms a monophyletic group together with *Lachnella*. Thus, in the latest edition of the Dictionary of Fungi (Kirk *et al.* 2008), *Flagelloscypha* is placed in the family *Niaceae*, albeit Matheny *et al.* (2006) prefer to retain the older name *Lachnellaceae* for the *Nia* clade as a whole. A connection between *Flagelloscypha* and the aero-aquatic anarmorphic fungus *Peyronelina glomerulata* was recently demonstrated, as specimens of *P. glomerulata* were found producing a *Flagelloscypha*-like teleomorphic state on decaying wood, and a phylogenetic analysis revealed *Peyronelina* to be clustered with *Flagelloscypha* in the *Nia* clade (Yamaguchi *et al.* 2009).

The main morphological differences between the closely related genera *Flagelloscypha* and *Lachnella* concern the morphology of the surface hairs and the size of the basidia. In particular, the surface hairs of *Flagelloscypha* are inamyloid

and have thin-walled, tapering, and mostly not encrusted apices, whereas in *Lachnella* they are pseudoamyloid, thick-walled, and encrusted throughout, ending in rounded apices. Also, the basidia of *Flagelloscypha* are short, usually shorter than 30 μm , and possess thin sterigmata, whereas in *Lachnella* they are significantly longer, generally 40–80 μm , and have stout, conical sterigmata (Donk 1959; Singer 1975; Agerer 1979b). However, the boundaries between the two genera are not clear-cut. Morphological studies have shown that there exist species with intermediate characters between *Lachnella* and *Flagelloscypha* (Agerer 1979b; Agerer 2002). Furthermore, recent phylogenetic analyses have suggested that *Flagelloscypha* is in fact paraphyletic (Bodensteiner *et al.* 2004). Future studies may deem it to be necessary either to integrate *Lachnella* and *Flagelloscypha* into a single large genus, or to adopt a narrow generic concept and thus segregate *Flagelloscypha* into smaller genera.

An uncommon representative of this unusual genus, *F. faginea* (Lib.) W.B. Cooke, was recently collected on fallen leaves of *Platanus orientalis* from central Greece, and is hereby presented. This species is closely related to the type species of the genus, *F. minutissima* (Burt) Donk, but it is distinct on account of both its ecology and its micromorphology. The scope of this work is to contribute to the knowledge on the morphology, ecology and distribution of *F. faginea*, a seemingly rare species that is apparently inadequately known in Europe. This is the first report of any species of *Flagelloscypha* from Greece.

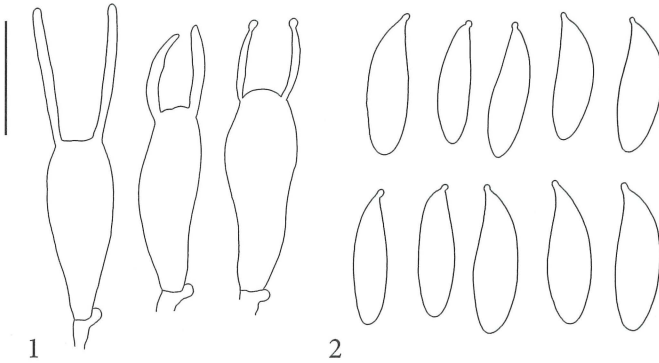
MATERIALS AND METHODS

Microscopic observations were made using a Zeiss Axioimager Differential Interference Contrast (DIC) microscope. Sections of dried material were mounted in Melzer's reagent for observation, measurements and photography. Microscopic photographs were taken with a Zeiss AxioCam MRC digital camera. Spore sizes are given as: (MIN) [mean-2 \times stdev]–[mean+2 \times stdev] (MAX), followed by the number of spores measured (n), their length-width ratio (Q), and the mean values of spore length (L'), width (W'), and length-width ratio (Q'). MIN stands for the lowest value measured and MAX for the highest; these values are presented only when they exceed [mean-2 \times stdev] or [mean+2 \times stdev], respectively. Habitat references refer exclusively to the collected material. Greek localities are transliterated to Latin according to ISO 843: 1997 (E). Authorities' abbreviations are in accordance with Kirk & Ansell (1992). The examined specimens are deposited at the Mycethoteca of the University of Athens (ATHU-M).

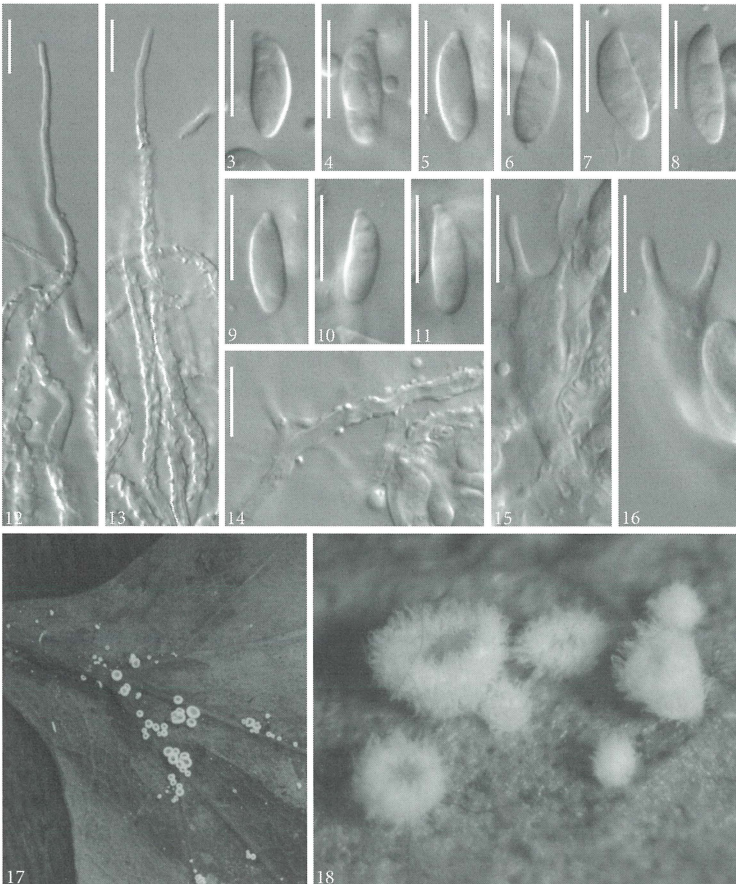
TAXONOMY

Flagelloscypha faginea (Lib.) W.B. Cooke, *Beih. Sydowia* 4: 60 (1961)
= *Cyphella faginea* Lib., *Pl. crypt. Arduenna*, fasc. (Liège) 4: no. 331 (1837)
= *Cyphella rosicola* Pilát, *Ann. mycol.* 22: 208 (1924)
= *Cyphella peckii* Sacc., *Syll. fung.* (Abellini) 6: 684 (1888)

Fruitbody 0.5-3.0 mm, cupulate, sessile to substitipate, pure white; outer surface minutely strigose-hairy throughout. Stipe absent or rudimentary (Figs 17-18).



Figs 1-2. *Flagelloscypha faginea*: **1.** Basidia; **2.** Basidiospores. Scale bar = 10 μ m.



Figs 3-18. *Flagelloscypha faginea*: **3-11.** Basidiospores; **12-13.** Surface hyphae showing flagellate distal end; **14.** Thin-walled base of surface hypha; **15-16.** Basidia; **17.** Basidiocarps on a leaf of *Platanus orientalis*, 2 \times life size; **18.** Dried basidiocarps under the stereoscope, 15 \times life size. Scale bars = 10 μ m.

Basidiospores 9.3-12.3 (-12.8) \times 3.5-4.5 (-4.6) μm , $n = 37$, $Q = 2.21-3.28$, $L' = 10.8 \mu\text{m}$, $W' = 4.0 \mu\text{m}$, $Q' = 2.6$, ellipsoid-cylindrical to subfusiform, more or less asymmetrically drop-shaped, hyaline, smooth, inamyloid, usually with numerous small guttules that occasionally merge into a single, large oil drop (Figs 1; 3-11). **Basidia** 13-24 \times 5.2-5.7 μm , clavate to suburniform, 2-spored, clamped; sterigmata occasionally markedly long, reaching or even exceeding 10 μm in length (Figs 2; 15-16). **Cystidia** absent. **Tramal hyphae** 2.0-4.0 (-5.0) μm wide, thin-walled, with clamp-connections at most septa. **Surface hairs** 2.5-4.0 μm wide, thick-walled at their medial part and heavily encrusted with crystals, arising from a more or less thin-walled base (Fig. 14) and ending in a tapering, flagellate, thin-walled apex (Figs 12-13); wall up to 1 μm thick at the medial part; non-encrusted apical part mostly 1.4-1.8 μm wide and 20-45 μm long, occasionally reaching 60 μm ; crystals acicular to rhomboid, up to 3.0 μm long and 1.0 μm wide at their widest part.

Habitat: Gregarious on dead leaves of *Platanus orientalis*.

Material studied: Greece, Evrytania, Ag. Nikolaos, stands of *Platanus orientalis*, on dead, fallen leaves of *P. orientalis*, leg. E. Kapsanaki-Gotsi & I. Pyrri, det. P. Delivorias, 23 Oct 2010, ATHU-M 6842; *Ibid.*, leg. E. Kapsanaki-Gotsi, det. P. Delivorias, ATHU-M 6843.

DISCUSSION

The presence of 2-spored basidia is considered a significant taxonomic feature in *Flagelloscypha*, as it is shared by only a few species, such as *F. faginea*, *F. minutissima*, and the recently described *F. japonica* T. Handa & Y. Harada. Occasionally, 4-spored basidia may also be found in these species (Agerer 1975; Agerer 1978; Handa & Harada 2005), a fact that was not observed in our specimens.

F. faginea is distinguished from the similar and much more widespread *F. minutissima* by the different habitat (fallen leaves as opposed to dead twigs and branches) and, more importantly, by the larger and differently shaped basidiospores. Although the particular ecology of *F. faginea* is an important feature from a taxonomic standpoint, it should not be considered decisive, as specimens of *F. minutissima* may also occasionally be found growing on leafy substrates (Agerer 1979b). On the other hand, the differences in the size and shape of the basidiospores provide grounds for a safe identification. The spore length of *F. minutissima*, as reported in the literature, rarely exceeds 10.5 μm , bearing a mean value distinctly smaller than 10 μm (Agerer 1975; 1978; 1979a; 1983), whereas the spores of *F. faginea* are considerably larger, with a mean length exceeding 10 μm (Tab. 1). Furthermore, the length-width ratio (Q) of *F. minutissima* is markedly smaller than that of *F. faginea* [Q ca (1.5) 1.7-2.0 (2.2) as opposed to Q ca 2.9-3.0, Agerer 1975]. Our spore measurements fit well with Agerer's (1975) measurements for *F. faginea*, both as regards the spore size and the length-width ratio.

Few data exist surrounding this fungus. It was originally described from Belgium, on fallen beech leaves, as *Cyphella faginea*. Its substrates include leaves of *Fagus*, *Betula*, *Quercus*, *Humulus*, and ferns (Agerer 1975; 1979a). As far as we know, it has not been reported on *Platanus*. In recent years, apart from the work

Table 1. Comparison between *F. faginea* and *F. minutissima* with respect to their spore-size.

<i>Species</i>	<i>Basidiospores</i>	<i>Reference</i>
<i>F. faginea</i>	(8) 9-13 (15) × 3-4.5 (5) μm	Agerer 1975
	9.3-12.3 (-12.8) × 3.5-4.5 (-4.6) μm	Present study
<i>F. minutissima</i>	(5) 7-10.5 (12) × (3) 4-5.5 (7) μm	Agerer 1975
	(7.5) 8.5-10 (10.5) × (4) 4.5-5.5 (6) μm	Agerer 1978
	6.5-8 × 4-5 μm (4-spored type)	Agerer 1978
	7-10.5 × 4-5.5 μm	Knudsen 1992
	7-10 × 3.5-4.5 μm	Breitenbach & Kränzlin 1986
	7.0-9.0 × 3.5-4.5 μm	Piątek & Cabała 2004

of Agerer (1975; 1979a; 1983) it is hardly mentioned by other authors. It is known from few countries of Northern Europe, such as Belgium and Germany (Agerer 1975). A few reports also exist from England and Scotland, but these are accepted dubiously by Legon & Henrici (2005), with the note that the species is rarely reported and that collections require re-examination, due to possible confusion with *F. minutissima*. If the synonymy proposed by Agerer (1975) with *Cyphella rosicola* Pilát is accepted, then the hosts of *F. faginea* also include *Rosa canina*, and its range of distribution encompasses the Czech republic (Mnichovice) and Armenia. Although Pilát (1924), in his original description of *C. rosicola*, reported much smaller spores (*ca* 8 × 3.5 μm) than would suit *F. faginea*, Agerer's later examination of the type revealed quite larger spores [with a length of (9.8) 10.4-11.9 μm and a Q ratio of (2.3) 2.5-2.9, Agerer 1975], befitting *F. faginea*. Furthermore, if the synonymy with *Cyphella peckii* Sacc. is also accepted, as proposed by Agerer (1979a), then *F. faginea* is to be found in North America as well, since *C. peckii* was originally described from New York (Saccardo 1888). Both synonymies are indeed accepted here, based on Agerer's arguments, so *F. faginea* is believed to have a mostly central European distribution (Belgium, Germany, Czech republic), while reaching Armenia in the east and extending to the east coast of the U.S. in the west. Nonetheless, in this wide area it is known from very few countries. For instance, it is not included in databases of fungi from Ukraine (Andrianova *et al.* 2006) and Georgia (Gvritishvili *et al.* 2007), nor in a recent check-list of agarics from Croatia (Tkalčec & Mešić 2002). It is apparently not known from the Nordic countries, as it is not included in the voluminous *Funga Nordica* (Knudsen & Vesterholt 2008). Even in Germany it is considered rare, and it was recently included in a red-list of *Agaricales* of North Rhine-Westphalia (Siepe *et al.* 2009). One must bear in mind, however, that due to their very small size, the basidiocarps of *F. faginea* are easily overlooked, and thus the distribution of the species may be much wider than is currently known. To our knowledge, this is the first report of *F. faginea* from the Mediterranean region, and the first worldwide report on *Platanus*.

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REFERENCES

- AGERER R., 1975 — *Flagelloscypha*. Studien an cyphelloiden Basidiomyceten. *Sydowia* 27: 131-265.
 AGERER R., 1978 — Cyphelloide Pilze aus Teneriffa. *Nova Hedwigia* 30: 295-341.

- AGERER R., 1979a — A new combination in the genus *Flagelloscypha* and a contribution to the identity of *Cyphella peckii*. *Mycotaxon* 9 (2): 464-468.
- AGERER R., 1979b — *Flagelloscypha* sect. *Lachnelloscypha*, a link between the genera *Lachnella* and *Flagelloscypha*. *Persoonia* 10 (3): 337-346.
- AGERER R., 1983 — Typusstudien an cyphelloiden pilzen IV. *Lachnella* Fr. s.l. *Mitteilungen der Botanischen Staatssammlung München* 19: 163-334.
- AGERER R., 2002 — *Flagelloscypha crassipilata* sp. nov., a species from Peru with extremely thick surface hyphae and big basidia. *Mycological Progress* 1 (2): 225-228.
- ANDRIANOVA T.V., DUDKA I.O., HAYOVA V.P., HELUTA V.P., ISIKOV V.P., KONDRATIUK S.Y., KRIVOMAZ T.I., KUZUB V.V., MINTER D.W., MINTER T.J., PRYDIUK M.P. & TYKHONENKO Y.Y., 2006 — *Fungi of Ukraine*. www.cybertruffle.org.uk/ukrafung/eng (accessed 26 August 2011).
- BODENSTEINER P., BINDER M., MONCALVO J.-M., AGERER R. & HIBBETT D.S., 2004 — Phylogenetic relationships of cyphelloid homobasidiomycetes. *Molecular Phylogenetics and Evolution* 33 (2): 501-515.
- BINDER M., HIBBETT D.S., WANG Z. & FARNHAM W.F., 2006 — Evolutionary relationships of *Mycaureola dilseae* (Agaricales), a basidiomycete pathogen of a subtidal rhodophyte. *American Journal of Botany* 93 (4): 547-556.
- BREITENBACH J. & KRÄNZLIN F., 1986 — *Fungi of Switzerland Vol. 2*. Verlag Mykologia, Lucerne.
- DONK M.A., 1959 — Notes on 'Cyphellaceae'. *Persoonia* 1 (1): 25-110.
- GVRITISHVILI M.N., HAYOVA V.P., KRIVOMAZ T.I. & MINTER D.W., 2007 — *Electronic Distribution Maps of Georgian Fungi*. www.cybertruffle.org.uk/gruzmaps (accessed 26 August 2011).
- HANDA T. & HARADA Y., 2005 — *Flagelloscypha japonica*: a new species of minute basidiomycete (*Niaceae*) from Japan. *Mycoscience* 46: 265-267.
- ISO 843:1997 (E) — Information and documentation: Conversion of Greek characters into Latin characters. International Organization for Standardization.
- JÜLICH W., 1981 — *Higher taxa of Basidiomycetes*. Bibliotheca Mycologica 85. J. Cramer, Vaduz.
- KIRK P.M. & ANSELL A.E., 1992 — *Authors of fungal names*. Index of fungi supplement. C.A.B. U.K.
- KIRK P.M., CANNON P.F., MINTER D.W. & STALPERS J.A., 2008 — *Dictionary of the Fungi. 10th Edition*. CABI Europe, UK.
- LEGON N.W. & HENRICI A., 2005 — *Checklist of the British & Irish Basidiomycota*. Royal Botanic Gardens, Kew.
- KNUDSEN H., 1992 — *Flagelloscypha* Donk. In: HANSEN L. & KNUDSEN H. (eds.) *Nordic Macromycetes Vol. 2. Polyporales, Boletales, Agaricales, Russulales*. Nordsvamp, Copenhagen.
- KNUDSEN H. & VESTERHOLT J., 2008 — *Funga Nordica*. Nordsvamp, Copenhagen.
- MATHENY P.B., CURTIS J.M., HOFSTETTER V., AIME M.C., MONCALVO J.-M., GE Z.-W., YANG Z.-L., SLOT J.C., AMMIRATI J.F., BARONI T.J., BOUGHER N.L., HUGHES K.W., LODGE D.J., KERRIGAN R.W., SEIDL M.T., AANEN D.K., DENITIS M., DANIELE G.M., DESJARDIN D.E., KROPP B.R., NORVELL L.L., PARKER A., VELLINGA E.C., VILGALYS R. & HIBBETT D.S., 2006 — Major clades of Agaricales: a multilocus phylogenetic overview. *Mycologia* 98 (6): 982-995.
- PIĄTEK M. & CABAŁA J., 2004 — *Flagelloscypha minutissima* (Basidiomycetes), a new for Poland minute cyphelloid fungus. *Acta Societatis Botanicorum Poloniae* 73 (4): 331-334.
- PILÁT A., 1924 — Beiträge zur Kenntnis der Theleporaceen: I. Die Cyphellaceen. *Annales Mycologici* 22 (1): 204-218.
- SACCARDO P.A., 1888 — *Sylloge Fungorum omnium hucusque cognitorum VI*. Patavii, sumptibus auctoris.
- SIEPE K., WÖLFEL G. & WEHR K., 2009 — *Rote Liste und Artenverzeichnis der Blätterpilze – Agaricales – in Nordrhein-Westfalen*. http://www.lanuv.nrw.de/natur/arten/rote_liste/pdf/RL-NW10-PILZE/RL-NW10-8-Blaetterpilze.pdf (accessed 5 March 2011).
- SINGER R., 1975 — *The Agaricales in modern taxonomy, 3rd edition*. J. Cramer, Vaduz.
- TKALČEC Z. & MEŠIĆ A., 2002 — Preliminary checklist of *Agaricales* from Croatia. I. Families *Pleurotaceae* and *Tricholomataceae*. *Mycotaxon* 81: 113-176.
- YAMAGUCHI K., DEGAWA, Y. & NAKAGIRI A., 2009 — An aero-aquatic fungus, *Peyronelina glomerulata*, is shown to have teleomorphic affinities with cyphelloid basidiomycetes. *Mycoscience* 50: 156-164.