

NOTULAE AD FLORAM AGARICINAM NEERLANDICAM—XII

Small, saprophytic *Volvariella* species in the Netherlands

T. BOEKHOUT

*Rijksherbarium, Leiden**

Characters used in current taxonomy of the genus *Volvariella* are discussed. Spore dimensions are a good additional character for distinguishing species. *Volvariella caesiointacta*, *V. hypopithys*, *V. murinella*, and *V. pusilla* are redescribed. *Volvariella murinella* f. *brevispora* is described and *V. taylori* is reduced to a variety of *V. pusilla*.

The genus *Volvariella* has been intensively studied during the last decades (e.g. Shaffer, 1957; Orton, 1974; Courtecuisse, 1984). During our investigations, however, we had problems in identifying small, saprophytic species of *Volvariella*, such as *V. murinella*, *V. hypopithys*, and *V. pusilla*. According to Orton (1974), the principal diagnostic features of this genus are the colour of the pileus and volva, the morphology of the volva (two-lobed versus four-lobed), the surface structure of the pileus and stipe, and the habitat. We carefully studied the material available from the Netherlands and tried to evaluate the characters used in current taxonomy of this genus.

MORPHOLOGY OF SPORES, VOLVA AND SURFACE STRUCTURES

Our observations indicate that in *Volvariella* the colour of both pileus and volva is rather variable. But the dimensions of the spores seem to be a good additional character for delimitating species (Figs. 1, 2). *Volvariella murinella* is well characterized by narrow, elongate ellipsoid to subcylindrical spores, $5.5\text{--}8.0 \times 3.0\text{--}4.5 \mu\text{m}$, $Q\ 1.5\text{--}2.3$ (Fig. 1). In one collection, the colour of the pileus of this species ranges from entirely white with a pale grey-brown umbo to grey-brown with a brownish grey centre (*Bas* 6596, L). In the same collection the colour of the volva varies from white to ochraceous and was found 2- to 4-lobate.

The spores of *V. murinella* agree fairly well with those of *V. surrecta*, which measure $5.0\text{--}7.0 \times 3.0\text{--}4.0 \mu\text{m}$, $Q\ 1.5\text{--}2.0$. The latter species, however, is characterized by its habitat on basidiocarps of *Clitocybe nebularis*.

The other *Volvariella* species with small basidiospores (less than $9.0 \mu\text{m}$ long) have considerably broader spores, e.g. *V. pusilla*, *V. caesiointacta*, *V. hypopithys*, and *V. bombycina* (Fig. 2). *Volvariella bombycina* seems not closely related with the other species men-

* Present address: Centraalbureau voor Schimmelcultures, Yeast Division, Julianalaan 67A, 2628 BC Delft, Netherlands.

tioned, because of the large size of its basidiocarps, its habitat on trees, the peculiar morphology of its volva, which can be up to 75(–120) mm long and may enclose up to half the length of the stipe, and its different pileipellis, which is a trichodermium composed of creeping to ascending hyphae, made up of long and wide elements (c. $1500 \times 40 \mu\text{m}$).

Among the remaining species, *V. hypopithys* is best characterized by its pale pileus and its entirely pubescent stipe. The volva is saccate, rather thick, whitish but soon becoming pale ochraceous-buff and 2- to 4-lobate.

The closely related *V. pusilla* differs mainly from *V. hypopithys* by the mature stipe being nearly glabrous. The stipe of young basidiocarps can be sparsely hairy as is also illustrated on Bulliard's (1787–1788) plate 330. The volva is saccate, thin, whitish or occasionally grey-brown and not or 2- to 4-lobate. Persoon (1799: pl. 4, figs. 4, 5) depicted *V. pusilla* with a distinctly radially striate pileus.

Specimens keyed out with Orton's key (1974) as *V. taylori* differ from *V. pusilla* only by slightly larger basidiocarps, a brown to ochraceous grey, irregularly 1- to 3- (5-) lobate volva and a pale buff-grey to grey centre of the pileus. Because the volva and the centre of the pileus of *V. pusilla* are occasionally brownish grey and because the margin of the pileus of *V. taylori* can be slightly striate, the two taxa are very close indeed and the latter species is reduced to a variety under *V. pusilla*. Our observations agree with the original description of *V. taylori* by Berkeley (1860: 140), in which the pileus is described as striato-rimose from the apex.

Volvariella caesiotincta is also related to *V. pusilla*, but differs from that species in its habitat on wood, a *Geranium robertianum*-like smell and an unpleasant, somewhat ad-

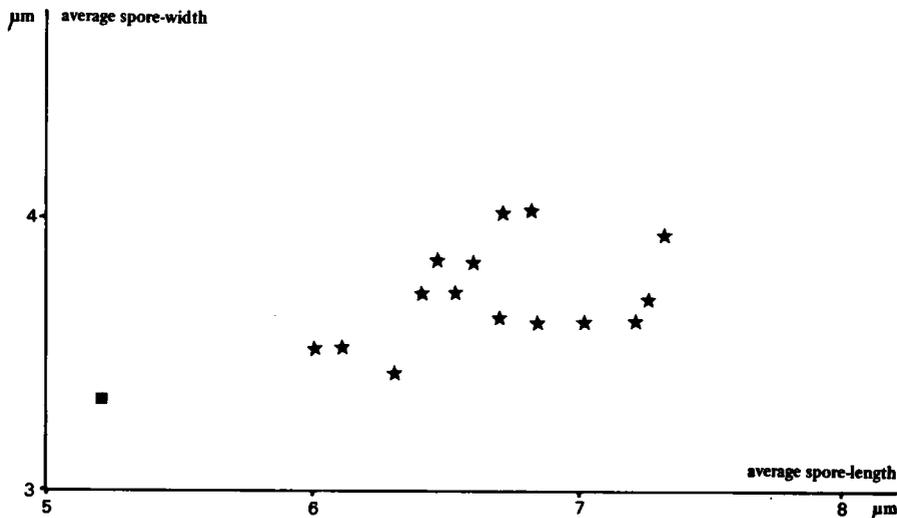


Fig. 1. Scatterdiagram of average spore-sizes of *Volvariella murinella f. murinella* (★) and *V. murinella f. brevispora* (■).

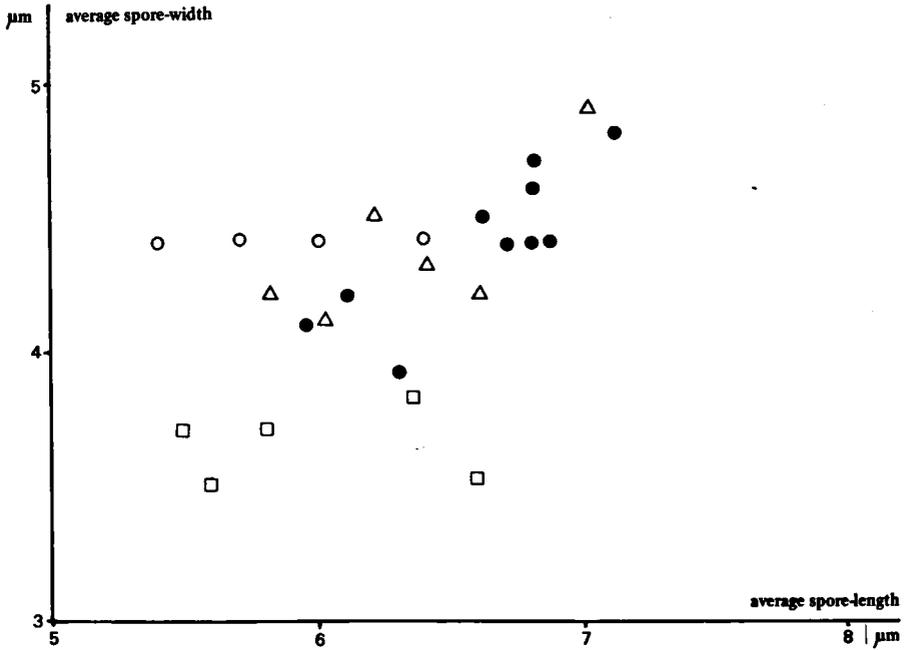


Fig. 2. Scatterdiagram of average spore-sizes of *Volvariella hypopithys* (●), *V. pusilla* var. *pusilla* (○), *V. pusilla* var. *taylora* (△), and *V. surrecta* (□).

stringent taste. The volva of *V. caesiointincta* is saccate, thin, greyish brown and 2- to 3-(5-) lobate and the centre of the pileus is rather dark grey-brown.

DESCRIPTIONS OF SOME SPECIES

Volvariella caesiointincta P. D. Orton—Fig. 3

Volvariella caesiointincta P. D. Orton in Bull. mens. Soc. linn. Lyon 43 (Num. spéc.): 319. 1974.

Volvariella murinella var. *umbonata* J. Lange, Fl. agar. dan. 5: 97. 1940.

Misapplied name.—*Volvariella murinella* sensu Kühn. & Romagn., Fl. anal. Champ. sup. 426. 1953.

Selected illustrations.—Bull. trimest. Soc. mycol. Fr. 43, Atl. pl. 21. 1927; J. Lange, Fl. agar. dan. 5, pl. 200B. 1940.

Selected descriptions.—Malençon & Bertault, Flore Champ. Maroc 1: 108. 1970 (as *Volvariella murinella* var. *umbonata* Lange); P. D. Orton in Bull. mens. Soc. linn. Lyon 43 (Num. spéc.): 319. 1974.

Basidiocarps medium-sized, solitary or in small groups. Pileus 30–60(–90) mm, convex to applanate, frequently with low broad umbo, pale greyish cream to grey-brown (Munsell 10 YR 8/2; 2.5 YR 6–7/2), with darker grey-brown centre, dry, densely felted



TB
RC
1983

Fig. 3. *Volvariella caesiotincta*. — Habit ($\times 1$), spores ($\times 1500$), and cheilocystidia ($\times 1000$).

hairy at centre, appressed radially fibrillose near margin. Lamellae crowded, free, rather broadly ventricose, up to 10 mm wide, whitish when young, finally flesh-pink, with whitish flocculose edge. Stipe 35–80 \times 5–10 mm, cylindrical with a clavate base, up to c. 20 mm broad, solid, whitish but soon with a yellowish brown tinge, innately fibrillose-striate, entirely pubescent when young, mostly the greater part soon glabrous. Volva membranous, saccate, up to 30 mm high, with 2–3(–5) lobes, greyish brown, with sub-tomentose felted outer surface. Context white, becoming pale dingy straw yellow. Smell faint to rather strong, reminiscent of *Geranium robertianum*. Taste rather strong, unpleasant, somewhat adstringent.

Spores 5.3–7.3(–7.8) \times 3.5–4.8 μm , $Q = 1.3$ –1.8(–20), ellipsoid to elongate, sometimes tending to elongate-ovoid. Basidia 20–35 \times 7–10 μm , clavate, 4-spored. Cheilocystidia 35–85 \times 15–30 μm , clavate, frequently with apical papilla or with finger-like appendages (up to c. 20 μm long) or ventricose-lageniform. Pleurocystidia rather rare, 40–70 \times 10–35 μm , clavate to ventricose lageniform. Hymenophoral trama made up of 5–20 μm wide, cylindrical to subfusiform hyphae. Pileipellis a cutis, made up of hyphae consisting of cylindrical cells, 60–160 \times 10–30 μm , with intracellular grey-brown pigment; hairs at centre of pileus slender cylindrical, up to 300 μm long. Hairs at apex of stipe slender cylindrical, up to c. 200 μm long.

Habitat & distribution.—Epixyloous, on decaying trunks of broad-leaved trees (e.g. *Fagus*); rare, in the Netherlands known from five localities.

Material examined.—NETHERLANDS: prov. Overijssel, Diepenveen, estate 'Nieuw Rande', 6 Aug. 1972, G. & H. Piepenbroek; prov. Noord-Holland: Bergen, 1 Aug. 1967, F. A. van der Bergh; isle of Texel, Oudeschild, 13 July 1983, M. Groenendaal; prov. Zeeland, Axel, Axelse Bos, 8 June 1981, A. de Meyer 285b; prov. Limburg: Linne, along Vlootbeek, 6 Sept. 1963, C. Ph. Verschueren; ditto, 13 July 1966, C. Ph. Verschueren (all in L).

Volvariella caesiointincta is closely related to *V. pusilla* var. *taylori*, from which it differs mainly by its epixyloous habitat. Less pronounced differences are its *Geranium robertianum*-like smell and unpleasant taste. As Orton (1974: 320) pointed out, the epixyloous *V. bombycina* differs by its more yellow, distinctly scaly pileus and by larger spores. We also found differences in the structure of the pileipellis of these two species. The cutis of *V. caesiointincta* consists of rather short, cylindrical cells, while that of *V. bombycina* is made up of very long (up to 1500 μm) cells.

Volvariella hypopithys (Fr.) Shaffer—Fig. 4

Agaricus hypopithys Fr., Hymenomyc. eur.: 183. 1874. — *Volvaria hypopithys* (Fr.) P. Karst., Ryssl. Finl. Skand. Halfons Hattsvamp.: 251. 1879. — *Volvariella hypopithys* (Fr.) Mos., Blätter- und Bauchpilze. In Gams, Kl. Kryptog. Fl. 2: 110. 1953 (not val. publ.: no basionym mentioned). — *Volvariella hypopithys* (Fr.) Shaffer in Mycologia 49: 572. 1957.

Volvaria plumulosa Lasch ex Quéf. in Bull. Soc. bot. Fr. 24: 320. (1877) 1878. — *Volvariella plumulosa* (Lasch ex Quéf.) Sing. in Lilloa 22: 401. 1951.

Agaricus pubescentipes Peck in Rep. N. Y. St. Mus. nat. Hist. 29: 39. 1878. — *Volvaria pubescentipes* (Peck) Sacc. (as *V. pupipes*), Syll. Fung. 5: 658. 1887. — *Volvariopsis pubescentipes* (Peck) Murrill in N. Amer. Fl. 10: 141. 1917. — *Volvariella pubescentipes* (Peck) Singer in Lilloa 22: 401. 1951.

Volvaria parvula var. *biloba* Masee, Brit. Fung. Fl. 296. 1893. — *Volvaria pusilla* var. *biloba* (Masee) J. Lange, Fl. agar. dan. 2: 80. 1936.

Misapplied name.—*Volvariella pusilla* sensu Kühn. & Romagn., Fl. anal. Champ. sup.: 426. 1953.

Selected illustrations.—Dähnke & Dähnke, 700 Pilze: 267 (as *V. pusilla*). 1979; Konr & M., Ic. sel. Fung. 1, pl. 17, fig. 1. 1928; J. Lange, Fl. agar. dan. 2, pl. 68D (as *V. pusilla* var. *biloba*). 1936; Michael, Hennig & Kreisel, Handb. Pilzfr. 3, pl. 38. 1979.

Selected descriptions.—Kühn. & Romagn. in Bull. trim. Soc. mycol. Fr. 72: 240. 1956; P. D. Orton in Trans. Br. mycol. Soc. 43: 384. 1960; Shaffer in Mycologia 49: 572. 1957.

Basidiocarps small to medium-sized. Pileus (10–)20–65 mm, at first hemispherical or conical, becoming plano-convex to plano-concave, with low broad umbo, with inflexed margin slightly exceeding lamellae, thin-fleshed to rather fleshy, white but centre soon becoming pale pinkish buff to pale buff (Mu. 10 YR 8/4), dry, shiny, radially fibrillose with tips of fibrils slightly ascending. Lamellae rather crowded, free, rather remote from stipe, ventricose, up to c. 6 mm broad, cream when young (Mu. 2.5 YR 8/2), finally pale flesh pink to flesh pink (Mu. 7.5 YR 7/4), with slightly paler, somewhat fimbriate edge. Stipe 30–65 \times 2–6(–10) mm, mostly somewhat broadening towards base, solid, whitish, but soon becoming pale isabella, entirely pubescent, innately longitudinally fibrillose. Volva saccate, rather thick, white but soon becoming pale ochraceous buff

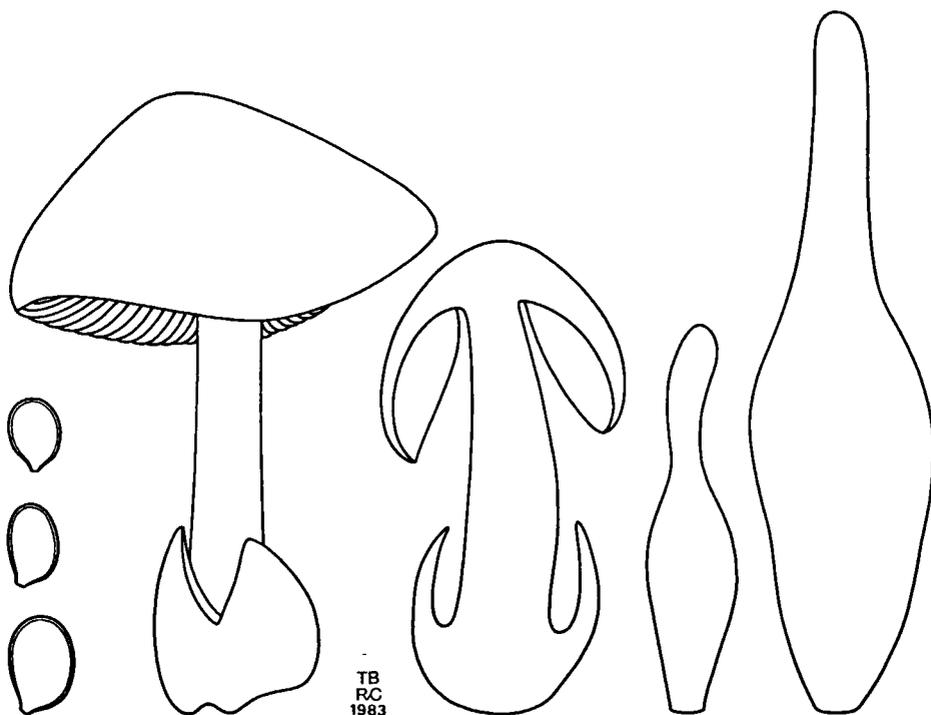


Fig. 4. *Volvariella hypopithys*. — Habit ($\times 1$), spores ($\times 1500$), and cheilocystidia ($\times 1000$).

(Mu. 10 YR 6–7/4), 2- to 4-lobate, with felted outer surface. Context dull white to pale yellow, in stipe becoming pale brownish. Smell indistinct. Taste weak, slightly raphanoid or bitterish. Spore-print pinkish brown (Mu. 7.5 YR 6/4).

Spores $(5.6-6.2-7.8(-8.1) \times 3.5-5.0 \mu\text{m})$, $Q = 1.35-1.7(-2.0)$, ellipsoid to elongate. Basidia $20-30(-40) \times 7-10 \mu\text{m}$, clavate, 4-spored. Cheilocystidia $40-110(-140) \times 10-35 \mu\text{m}$, variable in shape, clavate, fusiform to sublageniform. Pleurocystidia similar to cheilocystidia. Hymenophoral trama made up of $5-30 \mu\text{m}$ wide, thin-walled hyphae. Pileipellis a cutis made up of short-celled hyphae with cells measuring $50-170 \times 5-30 \mu\text{m}$, pigment absent. Hairs of stipe cylindrical, $100-450 \times 5-12 \mu\text{m}$.

Habitat & distribution.—Terrestrial in broad-leaved forests, on litter, on rich or rather rich soils; fairly frequent, seems to occur in all parts of the Netherlands.

Material examined.—NETHERLANDS: prov. Flevoland: Oostelijk Flevoland, Biddinghuizen, along Strandgaperweg, 8 Oct. 1981, *C. Bas 7811*; Dronten, Bremerbergbos, 10 Oct. 1980, *J. Daams 80-13*; Roggebotsbos, 24 Oct. 1976, *Langevoord & Boezewinkel*; prov. Gelderland: Nijmegen, Heilige Landstichting, 2 Oct. 1955, *J. Kalf*; Winterswijk, Bekendelle, 19 Oct. 1981, *J. Schreurs 310*; prov. Utrecht, Bunnik, Fort Rhijnauwen, 22 Oct. 1977, *M. van Vuure*; prov. Zeeland, Axel, Axelse Bos, 8 June 1981, *A. de Meyer 302*; prov. Limburg, St. Geertruid, Savelsbos, 5 Aug. 1981, *J. Schreurs 596* (all in L).

Volvariella pusilla is closely related to *V. hypopithys*, but differs from it by a nearly glabrous stipe and generally somewhat smaller basidiocarps. White forms of *V. murinella* differ from *V. hypopithys* mainly by their narrow, elongate to subcylindrical spores (Figs. 1 and 2).

Volvaria plumulosa Lasch ex Quél. (1878: 320) seems conspecific with *V. hypopithys*. However, the original descriptions of *Agaricus plumulosus* Lasch could not be located. Oudemans (1867: 25) cited *A. plumulosus* Lasch as a synonym of *A. parvulus* var. *major*. If *Agaricus plumulosus* Lasch, which seems to turn up for the first time in synonymy of *Agaricus parvulus* in Fries (1838: 139), is somewhere validly published and if the original description of *A. plumulosus* should point to the fungus described here, then the epithet *plumulosa* would have priority.

Volvariella murinella (Quél.) Mos. ex Courtecuisse

Volvaria murinella Quél. in C.r. Ass. franç. Av. Sci. (La Rochelle, 1882) 11: 391. 1883. — *Volvariella murinella* (Quél.) Mos., Blätter- und Bauchpilze. In Gams. Kl. Kryptog. Fl. 2: 110. 1953 (not val. publ.: no basionym mentioned). — *Volvariella murinella* (Quél.) Mos. ex Courtecuisse in Bull. Soc. mycol. Nord 34: 19. 1984.

Excluded.—*Volvariella murinella* sensu Kühn. & Romagn., Fl. anal. Champ. sup.: 426. 1953 (= *V. caesiotincta*).

Volvariella murinella forma *murinella*—Fig. 5

Selected illustrations.—J. Lange, Fl. agar. dan. 2, pl. 67B. 1936; Michael, Hennig & Kreisel, Handb. Pilzfr. 3, pl. 33. 1979; Quél. in C.r. Ass. franç. Av. Sci. (La Rochelle, 1882) 11, pl. 11, fig. 6. 1883.

Basidiocarps small, solitary. Pileus 10–55 mm, conico-convex, convex to applanate, frequently with low broad umbo, thin-fleshed, whitish grey to grey (Mu. 10 YR 7/2–3), with a darker grey-brown centre (Mu. 10 YR 4–5/3), dry, hairy at centre, radially silky fibrillose to subsquamulose towards margin. Lamellae crowded, free, rather remote from stipe, ventricose, thin to rather thick, pale when young, becoming flesh-pink, with slightly paler edge. Stipe 15–70 × 1–5 mm, with subbulbose base up to 10 mm broad, solid, whitish, shiny, entirely pubescent when young, but soon glabrous in lower part, innately longitudinally fibrillose. Volva thin, membranous, saccate, whitish, but soon sordid grey-brown, 2–4 lobate, with slightly felted outer surface. Context white to pale greyish, in the stipe slightly turning ochraceous yellow. Smell weak, faintly aromatic herbaceous (reminding of *Pelargonium*). Taste unpleasant, somewhat sourish-acrid fungoid.

Spores 5.5–7.7(–8.3) × 3.0–4.4 μm, Q = 1.5–2.3, elongate ellipsoid to subcylindrical. Basidia 20–30(–35) × 7–10 μm, clavate, 4-spored. Cheilocystidia 40–100 × 10–30(–50) μm, variable in shape, clavate, fusiform or ventricose-lageniform. Pleurocystidia similar to cheilocystidia. Hymenophoral trama made up of thin-walled, c. 5–20 μm wide hyphae. Pileipellis a cutis made up of short-celled hyphae, 10–20(–35) μm wide, with intracellular grey-brown pigment; hairs at centre of pileus slender cylindrical, up to 230 μm long. Hairs on stipe slender cylindrical, up to c. 270 μm long.

Habitat & distribution.—Terrestrial on rich soils (e.g. loam, clay) in broad-leaved and coniferous forests and in grasslands: not common.

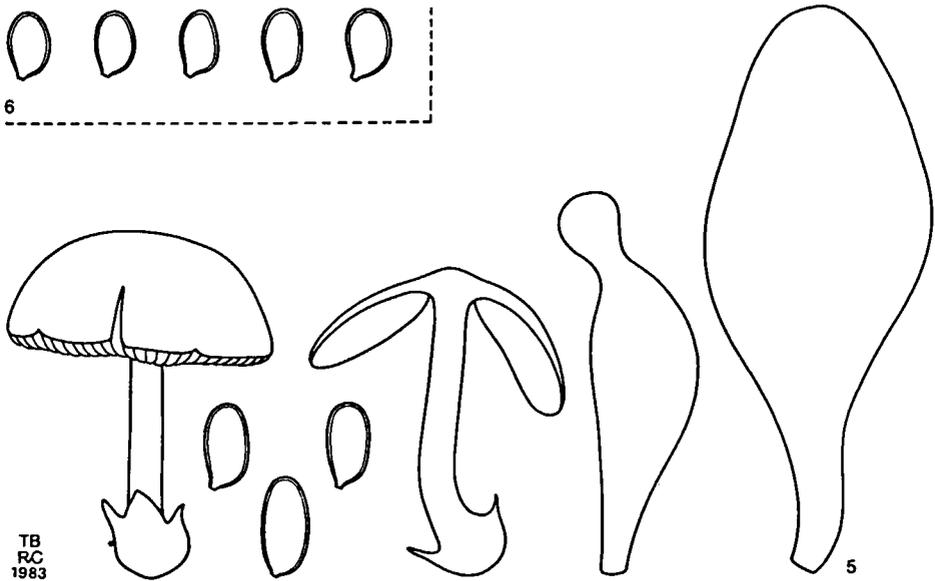


Fig. 5. *Volvariella murinella* f. *murinella*. — Habit ($\times 1$), spores ($\times 1500$), and cheilocystidia ($\times 1000$).

Fig. 6. *Volvariella murinella* f. *brevispora*. — Spores ($\times 1500$).

Material examined.—NETHERLANDS: prov. Overijssel, Deventer, estate 'Wijtenhorst', 15 Nov. 1970, *G. & H. Piepenbroek*; prov. Gelderland, Winterswijk, 20 Sept. 1975, *J. Schreurs* s.n.; prov. Utrecht, Bunnik, Rhijnauwen, 22 July 1954, *C. Bas* 533; prov. Zuid-Holland, Rockanje, Quackjeswater, 12 Nov. 1954, *C. Bas* 616; prov. Zeeland: Axel, Axelse bos, 26 May 1981, *A. de Meyer* 285; Kruijningen, 21 Nov. 1982, *H. Adema*; prov. Limburg: St. Geertruid, Savelsbos, 13 Aug. 1980, *J. Schreurs* 434; ditto, 13 Sept. 1980, *J. Schreurs* 498; ditto, 24 Sept. 1981, *J. Schreurs* 641 (all in L).

Volvariella murinella is well characterized by narrow, elongate to subcylindrical spores (Fig. 1) and a generally pale volva. Typical specimens have a rather uniform greyish pileus. Some of the specimens studied differ by a nearly white pileus (e.g. *Schreurs* s.n., 20 Sept. 1975, L). This white variant of *V. murinella* differs from other white-capped *Volvariella* species (e.g. *V. hypopithys* and *V. pusilla*) mainly by its narrow spores (Fig. 1). *Volvariella cinerescens* (Bres.) Mos. seems closely related, but differs by a smooth surface of the pileus, which is distinctly translucently striate (Bresadola, 1929, pl. 82). Within the material studied we observed a short-spored form which is described below.

***Volvariella murinella* forma *brevispora* Boekhout, forma nov.—Fig. 6**

A *Volvariella murinella* f. *murinella* differt sporis brevioribus, ellipsoideis vel elongatis, $4.8-5.6 \times 2.9-3.6 \mu\text{m}$. — Holotypus: *C. Bas* 617, lectus in silva decidua solum arenosum occupante, prov. Zuid-Holland, Rockanje, Quackjeswater (L).

Pileus up to 50 mm, plano-convex with a low umbo, pale brownish grey with a slight olivaceous tinge, paler towards margin, distinctly radially fibrillose with centre subviscid and with edge fringed with fibrils. Lamellae free, ventricose, pale flesh pink with slightly paler flocculose edge. Stipe up to 70 × 6–9 mm, with clavate, up to 15 mm wide base, solid, white, shiny, glabrous, finely longitudinally fibrillose. Volva saccate, up to c. 27 mm high, white, irregularly lobed, with felted outer surface. Smell not reported. Taste not reported.

Spores 4.8–5.6 × 2.9–3.6 μm , Q = 1.4–2.0, ellipsoid to elongate. Basidia 19–25 × 6–7 μm , clavate, 4-spored. Cheilocystidia 45–65 × 12–20 μm , clavate, subfusiform or ventricose lageniform. Pleurocystidia not observed. Pileipellis a cutis made up of short-celled hyphae up to 20 μm wide.

Habitat & distribution.—Terrestrial, on sandy soil under broad-leaved trees (e.g. *Betula*, *Ligustrum*, and *Quercus*); very rare, up to now only known from the type locality.

Material examined.—NETHERLANDS, prov. Zuid-Holland, Rockanje, Quackjeswater, 12 Sept. 1954, C. Bas 617 (L).

Volvariella murinella f. *brevispora* is characterized by its small spores. The specimens differ slightly from typical *V. murinella* by their subviscid centre of the pileus.

Volvariella smithii Shaffer (1957: 568) seems closely related to *V. murinella* f. *brevispora* because of the small spores, the same size of the basidiocarps and the same colour of the pileus, but differs by its densely pubescent stipe and its ochraceous to pale cinnamon volva.

Volvaria nauseosa Romagn. (Romagnesi, 1937: 93) also has some resemblance to *V. murinella* f. *brevispora* because of its small spores (5.7–6.5 × 3.5–3.7 μm) and glabrous stipe. It differs, however, by the white fibrils covering the pileus (Romagnesi compared *V. nauseosa* to *V. hypopithys* and *V. pubipes*!) and the spore morphology. The spores of *V. nauseosa* have their largest width in the lower part (see Romagnesi, 1937, fig. 3, Sp2), while those of *V. murinella* f. *brevispora* are more ellipsoid and have their largest width in or near the middle. It remains uncertain whether the unpleasant smell of *V. nauseosa* differs from the up to now unknown smell of *V. murinella* f. *brevispora*.

Volvariella pusilla (Pers.: Fr.) Sing.

Amanita pusilla Pers., Obs. mycol. 2: 36. 1799. — *Agaricus pusillus* Pers.: Fr., Syst. mycol. 1: 279. 1821. — *Volvariella pusilla* (Pers.: Fr.) Quél., Fl. mycol. 189. 1888. — *Volvariopsis pusilla* (Pers.: Fr.) Murrill in N. Am. Fl. 10: 141. 1917. — *Volvariella pusilla* (Pers.: Fr.) Sing. in Lilloa 22: 401. 1951.

Agaricus parvulus Weinm., Hymen. Gaster. Rossico: 238. 1836. — *Volvaria parvula* (Weinm.) Kumm., Führer Pilzk.: 99. 1871. — *Volvariella parvula* (Weinm.) Speg. in Boln Acad. nac. Ciénc. Córdoba 28: 309. 1926.

Agaricus taylori Berk., Outl. Brit. Fungol.: 140. 1860. — *Volvaria taylori* (Berk.) Gillet, Hyménomycètes: 386. 1878. — *Volvariella taylori* (Berk.) Sing. in Lilloa 22: 401. 1951.

(For further synonyms see Shaffer, 1957: 570.)

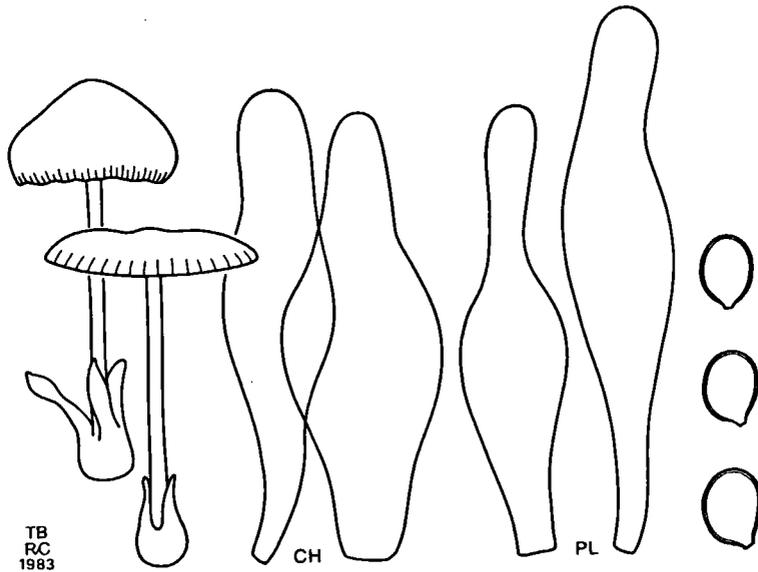


Fig. 7. *Volvariella pusilla* var. *pusilla*. — Habit ($\times 1$), spores ($\times 1500$), and cheilocystidia ($\times 1000$).

***Volvariella pusilla* var. *pusilla*—Fig. 7**

Amanita pusilla Pers. — *Agaricus pusillus* Pers.: Fr. — *Volvaria pusilla* (Pers.: Fr.) Quéf. — *Volvariopsis pusilla* (Pers.: Fr.) Murrill.

Selected illustrations.—Bresadola, Iconogr. mycol. 11, pl. 533. 1929; Konr. & M., Ic. sel. Fung. 1, pl. 18. 1927; J. Lange, Fl. agar. dan. 2, pl. 68C. 1936; Michael, Hennig & Kreisel, Handb. Pilzfr. 3, pl. 35 (as *V. parvula*). 1979.

Selected descriptions.—Kühner & Romagn. in Bull. trimest. Soc. mycol. Fr. 72: 242. 1956; Shaffer in Mycologia 49: 570. 1957.

Basidiocarps small, solitary. Pileus 10–35 mm, at first convex, becoming plano-convex, subumbonate, white or occasionally silvery greyish (Mu. 10 YR 7–8/1), finally at the centre very pale beige (Mu. 10 YR 8/3–4), subviscid when very young, later appressedly silky-fibrillose, with radially sulcate margin. Lamellae crowded, free, up to c. 6 mm broad, ventricose, pale sordid pink (Mu. 75 YR 7/2) when young, later becoming brownish pink (Mu. 5 YR 6/6), with concolorous, minutely fimbriate edge. Stipe 15–40 \times 1.0–2.5 (–6.0) mm, with clavate base, solid, white, when very young with scattered hairs, but soon becoming glabrous. Volva saccate, whitish, sometimes becoming pale grey-brown, not or 2- to 4-lobate. Context white. Smell faint, sweet fungoid. Taste absent.

Spores 5.5–7.2 \times 4.1–5.5 μm , $Q = 1.2$ –1.5 (–1.65), broadly ellipsoid to ellipsoid. Basidia 20–30 \times 7–10 μm , clavate, 4-spored. Cheilocystidia 45–85 \times 10–20 μm , clavate, fusiform to ventricose-lageniform. Pleurocystidia similar to cheilocystidia. Hymenopho-

ral trama made up of c. 5–15 μm broad hyphae. Pileipellis a cutis, made up of cylindrical hyphae, c. 10–20 μm wide, with very pale intracellular pigment.

Habitat & distribution.—Terrestrial in broad-leaved forests on clayey soil, also in greenhouses; rare, only known from Amsterdam (Amsterdamse Bos), Loenen (estate 'Valburg'), and greenhouses in Kortenhoef.

Material examined.—NETHERLANDS: prov. Gelderland, Loenen estate 'Valburg', 23 Aug. 1980, *J. Wisman* s.n.; prov. Utrecht: Kortenhoef, 9 Oct. 1970, *J. Daams* 70–36; ditto 26 May 1971, *J. Daams* 384; ditto, 16 Jan. 1973, *J. Daams* 780 (all in L).

This species is closely related to *V. hypopithys*, which differs mainly by its distinctly and completely pubescent stipe. In very young basidiocarps of *V. pusilla*, however, the stipe can also be sparsely hairy. Bulliard's (1787–1788) plate 330 shows that *V. pusilla* can be slightly pruinose at the apex of the stipe. His plate also indicates that the basidiocarps vary from small to rather small. This is also reported by Berkeley (1860: 140), who described *V. pusilla* as 'very variable in size, from a few lines to 2 inches'. Plate 4, figures 4 and 5 of Persoon (1799) illustrate a distinctly radially striated pileus.

Shaffer (1962: 563) reduced *V. argentina* Speg. (type of the genus) to the synonymy of *V. pusilla*.

Volvariella pusilla var. *taylori* (Berk.) Boekhout, *comb. nov.*

Agaricus taylori Berk., Outl. Brit. Fungol.: 140. 1860 (basionym). — *Volvaria taylori* (Berk.) Gillet. — *Volvariella taylori* (Berk.) Sing.

Misapplied names.—*Volvaria parvula* sensu Kühn. & Romagn., Fl. anal. Champ. sup.: 426. 1953; in Bull. trimest. Soc. mycol. Fr. 72: 244. 1956.

Volvaria plumulosa sensu Lange, Fl. agar. dan. 2: 79. 1936.

Selected illustrations.—Bresadola, Iconogr. mycol. 11, pl. 527. 1929; J. Lange, Fl. agar. dan. 2, pl. 68A (as *V. plumulosa*), pl. 68F (as *V. taylori*). 1936; Michael, Hennig & Kreisel, Handb. Pilzfr. 3, pl. 34. 1979.

Selected descriptions.—Kühn. & Romagn. in Bull. trimest. Soc. mycol. Fr. 72: 244. 1956; Shaffer in Mycologia 49: 565. 1957.

Basidiocarps small to medium, solitary or in small groups. Pileus (20–)30–50 mm, conical, plano-conical or convex, finally somewhat undulating, with margin inflexed when young, at centre pale buffy grey to grey (Mu. 10 YR 7/3–4, 8/2–3, 5/3), paler towards margin, radially silky fibrillose, with margin fibrillosely fringed when young and not or only vaguely and short-striate. Lamellae crowded to fairly distant, free, sometimes rather remote from stipe, ventricose, up to 8 mm wide, pale to brownish pink (Mu. 5 YR 7/4–6), with nearly concolorous, entire edge. Stipe (10–)30–70 \times (2.0–)4.0–7.0 mm, not or somewhat broadening towards base, up to 7–11 mm, solid, white but soon with ochraceous to buff tinge, very minutely downy at apex (under lens), glabrous below. Volva saccate, up to c. 13 mm high, brown to ochraceous grey (Mu. 10 YR 5–6–7/4, 6/3), somewhat paler towards base, irregularly lobate with 1–3(–5) lobes, with subfelted outer surface. Context white, becoming pale buff in base of stipe. Smell indistinct. Taste weak, fungoid.

Spores 5.5–7.6(–8.3) \times 3.6–4.9(–5.5) μm , Q = 1.3–1.8, ellipsoid. Basidia 25–35 (–45) \times 7–10 μm , clavate, 4-spored. Cheilocystidia 40–70 \times 10–30(–40) μm , clavate

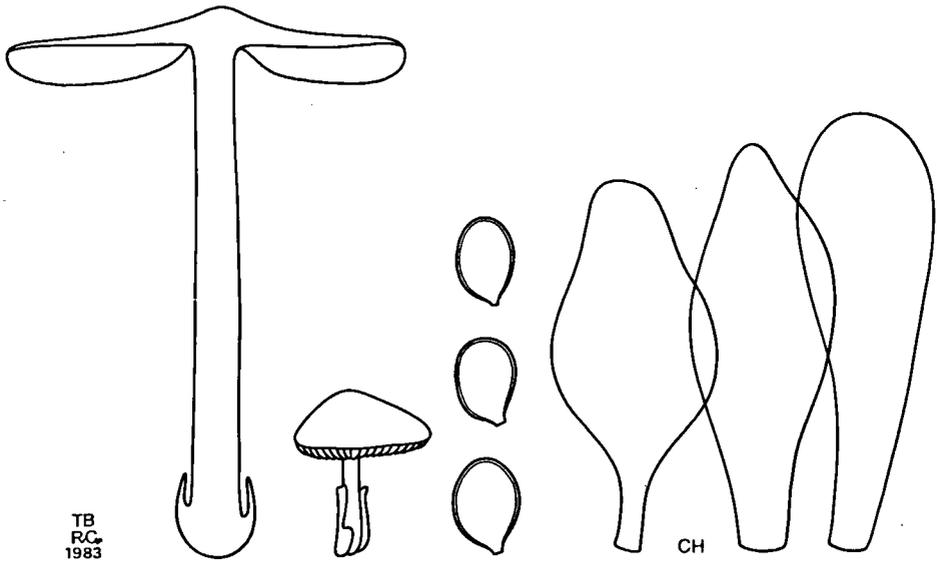


Fig. 8. *Volvariella pusilla* var. *taylori*. — Habit ($\times 1$), spores ($\times 1500$), and cheilocystidia ($\times 1000$).

to ventricose lageniform. Pleurocystidia similar to cheilocystidia. Hymenophoral trama consisting of 10–20 μm broad, thin-walled hyphae. Pileipellis a cutis made up of 1–20 μm broad hyphae, with intracellular grey-brown pigment.

Habitat & distribution.—Terrestrial in grasslands on clayey soil (*F. A. van der Bergh* s.n., 12 June 1972 was collected in a dune area, but there the soil was artificially raised with clay). Occasionally also gathered from a cellar. Rather rare, known from Bergen (N.-H.), Drimmelen, 's-Gravenhage, Leiden, Olst, and Texel.

Material examined.—NETHERLANDS: prov. Overijssel, Olst, Hengforder Waarden, 5 Oct. 1975, *G. & H. Piepenbroek* 975; ditto, 19 Sept. 1976, *G. & H. Piepenbroek* 999; prov. Noord-Holland: Petten, near Reactor Centre Nederland, 12 June 1972, *F. A. van der Bergh* s.n.; Texel, Waddijk, 5 Sept. 1982, *M. Groenendaal* s.n.; prov. Zuid-Holland: 's-Gravenhage, estate 'Clingendael', 12 Aug. 1963, *M. A. Donk*; Leiden, 15 Aug. 1966, *R. A. Maas Geesteranus* 14832; prov. Noord-Brabant, Drimmelen, 10 July 1956, *H. Rijkhoek* s.n. (all in L).

No authentic material of *Agaricus taylori* is present in the Kew herbarium. We regard our specimens identical with Berkeley's fungus.

Dutch specimens of *Volvariella pusilla* var. *taylori* differ from the typical variety of *V. pusilla* by a brown to grey volva, slightly larger basidiocarps and a more brown-grey centre of the pileus.

Typical *V. pusilla* has a pileus with a striate margin, while striation has been claimed to be absent in *V. taylori* (compare for example Bresadola, 1929, pl. 527 (= *V. taylori*))

and pl. 533 (= *V. pusilla*). Berkeley (1860: 140), however, described the pileus of *A. taylori* as 'striato-rimose from the apex'. The original descriptions of *Agaricus taylori* Berk. and *Amanita pusilla* Pers. are compared in Table I.

Table I. Original descriptions of *Amanita pusilla* and *Agaricus taylori*

Am. <i>pusilla</i> Pers. (1799: 36–37)	Ag. <i>taylori</i> Berk. (1860: 140)
Pileus 0.5 unc. latus, disco planus, incarnato-albido, margine reflexus, circa umbonem, qui brevis et obtusus, depressus, pilus sericeis adpressis et obtusus, fragilis, et subliquescens quasi, ob lamellas transparentes, colore subincarnatus.	Pileus thin, conical, obtuse, livid, striato rimose from the apex.
Stipes semiunciam ad unciam altus, cylindricus, candidus, pellucidus.	Stem pale, solid, nearly equal.
Volva radicalis caliciformis, persistens, ut plurimum quadrifidus: lobis erectis, apice subincurvis, 2 lin. magnis, externe sericeus.	Volva lobed, brown, small.
Lamellae inter se distantes, liberae s. stipiti vix annexae.	Gills uneven, broad in front, attenuated behind, rose-coloured.

The original description of *Ag. taylori* closely agrees with that of *Am. pusilla*. The only differences found are the livid, conical, obtuse pileus, the brown volva, and the uneven lamellae in the former. We noted a great variability concerning the first character. The pileus of *V. pusilla* var. *taylori* varies from conical, plano-conical to convex and finally becomes undulate. The lamellae in both species are similar. Thus, the colour of the pileus and volva and the slightly larger basidiocarps remain as the main differentiating characters. It is important to note that Bulliard's (1787–1788) plate 330 and Cooke's (1883) plate 300 of *V. pusilla* show a yellowish brown outer surface of the volva. Kühner & Romagnesi (1956, l.c.) described the volva of *V. pusilla* as 'brun ou gris brun à l'extérieur', while that of *V. taylori* (as *V. parvula*) is described as follows: 'Volve au début nettement brune ou brun-grisâtre, mais souvent pâlisant'. This is in agreement with our observations on the colour of the volva of *V. pusilla*, which can vary from whitish to grey-brown. According to most authors the pileus of *V. taylori* is somewhat darker if compared with the pileus of *V. pusilla* (Table II).

Table II. Descriptions of the colour of the pileus of *V. pusilla* and *V. taylori*

<i>V. pusilla</i>	<i>V. taylori</i>	Source
White, somewhat tinged with yellow or brown.	Livid.	(Berkeley, 1860)
White.	Dingy whitish (somewhat darker, livid argillaceous at the disc).	(J. Lange, 1936)
D'un blanc pur, même au centre seulement à la fin légèrement jauni ou sali à cet endroit, mais ne présentant pas de teinte grise.	D'abord blanc de neige, mais déjà avec le centre légèrement touché de gris brunâtre très dilué, puis cette teinte se précise et s'entend de plus en plus jusqu'à devenir brunâtre, mais le bord demeure très longtemps blanc et ce n'est que sur les exemplaires vétustes que toute la surface est paille brunâtre sale.	(Kühner & Romagnesi, 1956)
White, occasionally tinged with grey, especially on the disc.	Grey with avellaneous areas or greyish avellaneous overall.	(Shaffer, 1957)
White, sometimes tinged ivory or pale cream when old (in key).	Paler or darker grey, grey olivaceous hazel, sometimes creamy or pale buff at centre.	(Orton, 1974)
White, occasionally silvery greyish, finally at centre pale beige (Mu. 10 YR 8/3-4).	Centre pale buffy grey to brown-grey, paler towards margin (Mu. 10 YR 7/3-4, 8/2-3, 5/3).	(our observations)

The colour of the pileus of *V. pusilla* thus ranges from white to cream, beige, yellowish, or greyish. Whereas in *V. taylori* it varies from white, greyish, avellaneous to livid. There is hardly a discontinuous range of variation in the colour of the pileus of these two taxa. *Volvariella taylori* represents a more pigmented form of *V. pusilla*. Because of these great similarities between the two taxa, we reduce *V. taylori* to a variety of *V. pusilla*.

REFERENCES

- BERKELEY, M. J. (1860). *Outlines of British Fungology*. London.
 BRESADOLA, J. (1929). *Iconographia Mycologia II*. Mediolani.
 BULLIARD, M. (1787-1788). *Herbier de la France*. Paris.
 COOKE, M. C. (1883). *Illustrations of British Fungi*, vol. 3. London.

- COURTECUISSÉ, R. (1984). Notes de reconnaissance macroscopique des principales espèces de champignons du Nord de la France IV: Le genre *Volvariella* Speg. In Bull. Soc. mycol. Nord. 34: 14–25.
- FRIES, E. M. (1838). *Epicrisis systematis mycologici*. Upsaliae.
- KÜHNER, R. & ROMAGNESI, H. (1956). Espèces nouvelles, critiques ou rares de *Volvariaceae*. In Bull. trimest. Soc. mycol. Fr. 72: 181–249.
- LANGE, J. (1936). *Flora agaricina danica* 2. Copenhagen.
- ORTON, P. D. (1974). The European species of *Volvariella* Spegazini. In Bull. mens. Soc. Linn. Lyon 43 (Num. spéc.): 311–321.
- OUDEMANS, C. A. J. A. (1867). Matériaux pour la flore mycologique de la Néerlande. In Archs neerl. Sci. 2: 1–65.
- PERSOON, C. H. (1799). *Observations mycologicae* II. Lipsiae et Lucernae.
- QUÉLET, L. (1878). Les champignons du Jura et des Vosges, Suppl. 5. In Bull. Soc. bot. Fr. 24: 317–332, 1878 ('1877').
- ROMAGNESI, H. (1937). Florule des bois de la Grange et de l'Étoile (Seine-et-Oise). Basidiomycètes. In Rev. Mycol. 2: 85–95.
- SHAFFER, R. L. (1957). *Volvariella* in North America. In Mycologia 44: 545–579.
- (1962). Synonyms, new combinations, and new species in *Volvariella* (Agaricales). In Mycologia 54: 563–572.