



AMANITA LACTEA—THE STATE OF KNOWLEDGE OF A SPECIES RELATIVELY ISOLATED IN SECTION VAGINATAE

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SUMMARY

Recent collections motivated re-examination of the taxonomy of *Amanita lactea*. Data on collections from France, Germany, Italy, and Spain are combined with type study data. Pertinent information from G. Malençon's papers in the herbarium at Montpellier is discussed.

Recent collections of *Amanita lactea* (Fig. 1) have created an opportunity to expand the description of that species beyond data provided in the protologue and by Tulloss (1994). Our interest was further piqued by access to G. Malençon's papers at Montpellier (MPU). Herein, we gather the available information into a more thorough account of the species.

METHODS

The methods and terminology used in this paper follow those of Bas (1969, 1975) and Tulloss et al. (1992) as modified by Tulloss (1993, 1994). An extended summary of Tulloss' present methodological views including definitions of terms and variables is presented in the present volume. Holmgren, Holmgren and Barnett (1990) are the source of herbarium name abbreviations used in this paper.

TAXONOMIC PART

AMANITA LACTEA Malenç., Romagn. & Reid. 1968 ["1967"]. *Rev. Mycol. (Paris)* 32: 408, fig. 1-2.

Illus.: Merlo & Traverso. 1983. *Nostri Funghi Amanite*: 45.

Illus.: Traverso. 1999. *Gen. Amanita Italia*: 64.

PILEUS: 40 - 130 mm wide, pure white, sometimes with pale cream tint, becoming somewhat sordid ochraceous or slightly brownish or grayish in age—especially over disc, at first convex-hemispherical, then convex to plano-convex or planar, sometimes slightly depressed, shiny; *context* white, not taking on pink tint, sometimes straw colored or brownish locally, rather thick, firm; *margin* incurved at first, then decurved, more or less sulcate from the outset ($0.15^{\pm R}$), often splitting at maturity, nonappendiculate; *universal veil* absent or as occasional white membranous patch(es), sometimes nearly leath-

ery; *pileipellis* separable.



Photo: Achim Bollman

Fig. 1. German material of *Amanita lactea*.

LAMELLAE: free, rather close to distant, white, sometimes with pink tone in mass when collected, becoming sordid pale cream or pale ochraceous butter-colored in age, sometimes with faint pink tint when just dried, 8 - 10 mm broad, segmentiform, rather thick, sometimes forking, with farinose irregular edge whiter than lamella surface; *lamellulae* truncate at right angle, infrequent.

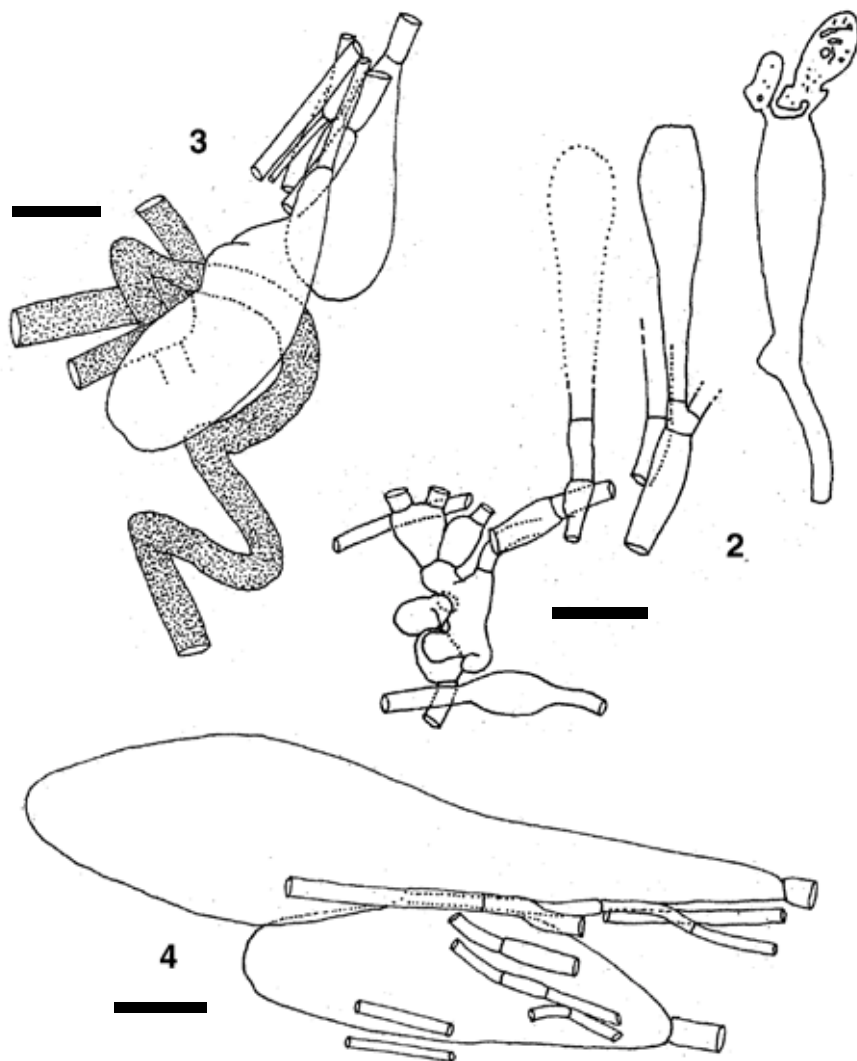
STIPE: 50 -120 × 10 - 30 mm, white, becoming slightly sordid in age, cylindric, with apex slightly expanded in older material, base pointed or even somewhat radicating, satiny-silky below remnants of partial veil; *context* white, stuffed with pale cream material, becoming hollow; *partial veil in Moroccan specimens* moderately well formed as matte cottony soft narrow adnate ring, striate above, about median in young specimens, but eventually about four-fifths of way down stipe and then incomplete and loosely attached; *partial veil in European collections* often less coherent and often ephemeral, often as granular-farinose mass (in one exsiccatum, appearing as subfelted covering from apex to mid-point of stipe portion exposed above volval sac and having marked, thickened edge) or only pruinose remains near apex with farinose crumbs on lower half of stipe, with some such remains near apex faintly or distinctly striate; *universal veil* as thick membranous white saccate volva reminiscent of that of *A. ovoidea* (Bull.:Fr.) Link, becoming stained by soil or sometimes with small ochraceous spots, ovoid in button stage, up to 45 × 20 mm, up to 3[±] mm thick near attachment to stipe; *limbus internus* small, incomplete, at juncture of stipe and volval limb and leaving one or two small rings on lower part of stipe (perhaps not persisting as long as portion adnate to volva).

Odor and taste not distinctive.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 75 - 125 μ m thick, somewhat browner than adjacent pileus context, with surface gelatinized to depth of only 5 - 15 μ m; filamentous, undifferentiated hyphae 2.5 - 8.0 μ m wide, subradially arranged, interwoven, sometimes in fascicles, with some having yellowish subrefractive walls; refractive hyphae (possibly gelatinized filamentous, undifferentiated hyphae) 7.0[±] μ m wide. PILEUS CONTEXT: filamentous, undifferentiated hyphae 2.0 - 10.5 μ m wide, frequently branching, loosely interwoven, occasionally in fascicles, with some having yellowish subrefractive walls; acrophysalides common, thin-walled, narrowly clavate to clavate to ventricose-rostrate to narrowly ellipsoid to ovoid, up to 78 × 34 μ m; vascular hyphae up to 16.8 μ m wide, sinuous, sometimes

branching. LAMELLA TRAMA: bilateral, with diverging elements making angle of up



Figs. 2-4. *Amanita lactea* (Romagnesi 66.620, holotype). 2. Elements of hymenium and subhymenium. 3. Elements of partial veil. 4. Elements of universal veil (interior) from stipe base. Scale bars are equivalent to 20 μm .

to 45^{\pm} deg. with central stratum, with $w_{cs} = 55^{\pm}$ μm (good rehydration); filamentous, undifferentiated hyphae 2.5 - 7.5 μm wide, frequently branching, locally dominating in subhymenial base even in mature basidiocarps, relatively commonly having yellowish subrefractive walls; inflated cells thin-walled, ovoid to clavate to fusiform, intercalary, up to 47×22 μm , predominantly with diam. ≤ 14.0 μm , plentiful in central stratum, also occurring in subhymenial base; vascular hyphae not observed. SUBHYMENIUM: w_{st} -

near = 40 - 55 μm (good rehydration); $w_{\text{st-far}}$ = 70 - 80 μm (good rehydration); comprising frequently branching structures originating roughly perpendicular to central stratum, with branched elements spreading broadly and interweaving, with some hyphae running parallel to central stratum; at first, with basidia arising from short, uninflated, sometimes branched hyphal segments perpendicular to central stratum, with some such segments partially inflated or (less commonly) inflated later in development. BASIDIA: 51 - 97 \times 10.0 - 16.0 μm , mostly 2- and 4-sterigmate in type, dominantly 4-sterigmate in mature material, occasionally 1- or 3-sterigmate, thin-walled; clamps not observed. UNIVERSAL VEIL: *At stipe base, exterior surface*: filamentous, undifferentiated hyphae 2.5 - 6.0 μm wide, in gelatinized fascicles (mostly longitudinally to sublongitudinally arranged), otherwise loosely interwoven; vascular hyphae 2.5 - 6.0 μm wide, not common, mostly below surface hyphae. *At stipe base, interior*: filamentous, undifferentiated hyphae 1.8 - 13.5 μm wide, loosely interwoven, often in fascicles, branching, sometimes loosely coiling, plentiful to locally dominant, with those of larger diameters having slightly thickened walls, frequently constricted at septa, sometimes with yellowish sub-refractive walls; inflated cells thin-walled, narrowly clavate to clavate to subpyriform to subglobose to globose, up to 163 \times 40 μm (most < 100 μm long), plentiful; vascular hyphae 1.8 - 7.5 μm wide, branching, infrequent to common to locally plentiful, sometimes tangled or knotted. *At stipe base inner surface*: thin layer reminiscent of pileipellis, often lost or in scattered patches; filamentous, undifferentiated hyphae partially gelatinized, longitudinally arranged, closely packed, 1.2 - 5.5 μm wide; vascular hyphae uncommon or absent. *On pileus*: lower (inner) layer very thin and entirely composed of filamentous, undifferentiated hyphae, indistinguishable from pileipellis in some regions and separated by very narrow gelatinized layer in others; outer surface similar to that at stipe base, very slightly or not gelatinized; interior very similar to that on stipe base except for being compressed vertically, with inflated cells very common just above the inner surface layer, with vascular hyphae up to 9.5 μm wide. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 2.5 - 10.0 μm wide, branching; acrophysalides clavate, thin-walled, up to 222 \times 39 μm ; vascular hyphae 2.5 - 10.2 μm wide, sinuous, common, sometimes branching, plentiful and rather densely tangled in stipe apex and there infrequently terminating in identically refractive and identically colored acrophysalides. PARTIAL VEIL: filamentous, undifferentiated hyphae 1.5 - 13.0 μm wide, plentiful, often in fascicles, dominantly radially oriented; inflated cells plentiful, thin-walled, broadly clavate to clavate to subfusiform (up to 85 \times 41 μm) or broadly ellipsoid (up to 51 \times 42 μm), with clavate form dominant; vascular hyphae 3.8 - 12.7 μm wide, common to plentiful, branching, sometimes coiled and tangled, disposed very similarly to vascular hyphae in stipe apex.

BASIDIOSPORES: [200/10/6] (10.1-) 11.0 - 15.5 (-21.0) \times (6.5-) 7.8 - 10.3 (-15.2) μm , (**L** = 11.1 - 13.9 (-14.6) μm ; **L'** = 13.1 μm ; **W** = (8.2-) 8.6 - 9.4 μm ; **W'** = 8.9 μm ; **Q** = (1.17-) 1.25 - 1.70 (-1.92); **Q** = 1.28 - 1.52 (-1.68); **Q'** = 1.48), thin-walled or (rarely) with walls up to 0.8 μm thick, smooth, hyaline, colorless, inamyloid, mostly ellipsoid, occasionally broadly ellipsoid or occasionally elongate; irregularly shaped spores not uncommon in some collections (all seen still attached to sterigmata), some malformed [quite consistently in every basidiocarp examined from type, "Y"-shaped or shaped like a triangular headed flatworm (planarian) with truly lateral apiculus as in Fig. 2]; apiculus almost always sublateral, rather broad, truncate-conic to cylindrical; contents guttulate to granular; white in deposit.

Habitat and distribution: Solitary to subgregarious. France: On ferruginous or calcareous soils under *Q. ilex* L. Germany: At 390 m elev. In mixed forest including *Fagus sylvatica* L. and *Pinus sylvestris* L. on neutral to slightly acid soil and occurring with *Cortinarius rubicundulus* (Rea) A. Pearson. Italy: At 300[±] m elev. Under *Q. ilex* and *Q. pubescens* Willd. close to a thicket of *Pistacia terebinthus* L. Morocco: In sandy soil among *Q. suber* L. Spain: Under *Quercus*. Also reported from Greece in protologue. Occurring in south-central and southern Europe from May to early November.

Collection examined: **FRANCE:** BOUCHES-DU-RHÔNE—la Crau, Région de Mailane, 4.xi.1961 L. Rioussset *s.n.* [H. Romagnesi 66.620] (holotype, PC (*n.v.*); isotype, *in herb.* Romagnesi (probably now in PC); isotype, L). VAUCLUSE—Avignon, Veudaines, 13.x.1976 L. Rioussset *s.n.* [M. Bon 761013] (*in herb.* M. Bon). **GERMANY:** BADEN-WÜRTTEMBERG—Bebenhausen, below Sulzplatte at the Kirnberg [MTB 7420/1.4234 (“Grenze zu .4242”), 16.vii.1994 A. Müller *s.n.* [Gminder 94/351] (*in herb.* Gminder, *in herb.* Tulloss), 1.viii.1996 A. Bollman & A. Gminder [Gminder] 96/193 (*in herb.* Gminder; *in herb.* V. Migliozi; *in herb.* Tulloss). **ITALY:** LIGURIA—*ca.* Genoa, Appennino Ligure, 23.ix.1981 Tarcisio Mogni *s.n.* (*in herb.* Tulloss). **SPAIN:** locality unknown, vi.1990 Caballero-Moreno 324 (*in herb.* M. Bon).

DISCUSSION

Results of a type study by Tulloss (1994) failed to define clearly the position of the present species in section *Vaginatae*. Even if the ephemeral nature of the partial veil is set aside, the plentitude of uninflated hyphal segments in the subhymenium and the lack of basidial clamps segregates *A. lactea* from stirps *Caesarea* and stirps *Hemibapha* as defined by Tulloss (1998).

As observed in the cited type study, the presence of deformed and “giant” spores in the reviewed specimens of the type collection and the rather large number of two-spored basidia with variably shaped sterigmata both suggest that the material was in an early stage of sporulation when it was dried. The values of **L**, **W**, and **Q** are notably smaller in mature material than the values reported from two isotypes by Tulloss (1994).

In Malençon's notes on a drawing of the spores of the type in a dossier at MPU, he noted that some spores are not what he considered normal; and he marked with an “X” the ones he considered to fall within his concept of normal spores for the species. He clearly marked the other spores as “anomalous.” In addition, Malençon wrote on the drawing: “[Spores du] Type normal = 11.4 - 12.3 - 13.3 × 7.1 - 7.6 - 8.2 µm. Sporée hétérogène comprenant d'assez nombreuses spores géants et ± renflés piriformes.” In context, it appears that he is not giving a range of measurements for all normal spores he had seen, but only for those from the holotype that he considered within his (otherwise determined) normal range. It is a pity that a collection was selected as type that appears not to include any mature, “normal” basidiocarps. Luckily, there is other evidence as to what Malençon considered the normal range of dimensions for spores of the present species. His dossiers (MPU) include extensive notes and correspondence on two additional collections (Malençon 2909 and 5813) that can be considered to be original material as they predate the collection of the type. In his notes on a collection of *A. lactea* from near Rabat (no. 5813), Malençon recorded measurements for 12 spores. The distribution of length suggests a statistically normal distribution. It is not clear that he consistently measured spores in lateral view. Summarizing the data from these spores: [12/1/1] 12.0 -

13.4 (-13.9) × (8.8-) 9.4 - 10.0 (-10.2) μm, (**L** = 12.7 μm; **W** = 9.8 μm; **Q** = 1.30). Examination of more recent collections of *A. lactea* by Merlo & Traverso (1983: 45), Traverso (1999: 64), the authors working independently, and other workers have yielded spore dimension data much like a combination of Malençon's two sets of data just cited. Unfortunately, because of the way in which his measurements were recorded, correspondence between length and width measurements for individual spores cannot be reconstructed. Hence, it is not possible to compute values of **Q** for Malençon's twelve spores.

Given current understanding of *Amanita* section *Vaginatae*, there are still no other taxa in the section known to present strong phenetic similarity with *A. lactea*.

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LITERATURE CITED

- Bas, C. 1969. Morphology and subdivision of *Amanita* and a monograph of its section *Lepidella*. *Persoonia* 5: 285-579.
- _____. 1975. A comparison of *Torrendia* (Gasteromycetes) with *Amanita* (Agaricales). *Studies on the Higher Fungi*. H. Bigelow & H. D. Thiers, ed. *Beih. Nova Hedwigia* 51: 53-60, pl. 11.
- Holmgren, P. K., N. H. Holmgren and L. C. Barnett. 1990. Index herbariorum. Part I. The herbaria of the world, 8th ed. *Regnum Veg.* 120: 1-693.
- Malençon G., H. Romagnesi and D. A. Reid. 1968 ["1967"]. Une nouvelle amanite méridionale: *Amanita lactea*. *Rev. Mycol. (Paris)* 32: 408-413.
- Merlo, E. G. and M. Traverso. 1983. *I nostri funghi—le amanite*. (SAGEP Ed., Genoa). 151 pp.
- Traverso, M. 1999. *Il genere Amanita in Italia*. (Assoc. Micol. Ecol. Romana). 182 pp.
- Tulloss, R. E. 1993. *Amanita pachysperma*, *Amanita subvirginiana*, and *Amanita virginiana* (taxonomy and distribution) with notes on description of the lamella trama in *Amanita*. *Mycotaxon* 49: 449-475.
- _____. 1994. Type studies in *Amanita* section *Vaginatae* I: Some taxa described in this Century (studies 1-23) with notes on description of spores and refractive hyphae in *Amanita*. *Mycotaxon* 52: 305-396.
- _____. 1998 ["1997"]. Provisional world key to species closely related to *Amanita hemibapha* with notes on the slender Caesar's mushrooms of eastern North America.

McIlvainea 13(1): 46-53. [A revision of this paper may be downloaded from the following URL: <<http://pluto.njcc.com/~ret/amanita/hemibaph.pdf>>.

Please note that Acrobat® Reader® version 3.0 or later is required to read the file.]

_____, C. L. Ovrebo, and R. E. Halling. 1992. Studies on *Amanita* (Agaricales) from Andean Colombia. *Mem. New York Bot. Gard.* 66: 1-46.