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***Amanita aprica*—a new toxic species from western North America**

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Abstract—*Amanita aprica* is described as new based on material from the states of California, Oregon, and Washington in the U.S. and the province of British Columbia in Canada. Comments on some similar taxa are included: *Amanita breckonii*, *A. gemmata*, and entities commonly included in *A. muscaria*. Brief notes on the apparent toxicity of *A. aprica* are included.

Key words—*Amanitaceae*, taxonomy, mushroom poisoning

Our continuing studies in *Amanita* Pers. in the northwestern part of the contiguous 48 states of the U.S.A. indicate several undescribed taxa are present in this region. In this paper we describe one such assignable to *Amanita* section *Amanita*. In the past, *Amanita aprica* (Fig.1) may have been misdetermined as *A. gemmata* (Fr.) Bertillon in Dechambre or a variety of *A. muscaria* (L.:Fr.) Pers. For earlier reports on *Amanita* in the region of interest see (Tulloss 1994, 1998; Tulloss and Lindgren 1992, 1994).

Methods

The methods used in this paper follow those of Bas (1969) and Tulloss *et al.* (1992) as modified by Tulloss (1993, 1994, 1998, 2000). For the convenience of the reader, we repeat definitions of some biometric characters used in recent publications:

- L** = range of the average spore length computed per specimen examined
- L'** = average spore length computed for all spores measured
- W** = range of the average spore width computed per specimen examined
- W'** = average spore width computed for all spores measured
- Q** = observed range of the ratio of length/breadth for all spores measured
- Q** = range of the average value of Q computed per specimen examined
- Q'** = average value of Q computed for all spores measured
- w_{CS}** = width of the central stratum of a lamella
- w_{st-near}** = distance from an outer margin of the central stratum to the nearest base of a basidium

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w_{st-far} = distance from an outer margin of the central stratum to the farthest base of a basidium on the same side of the central stratum.

The term “subhymenial tree” is used for that portion of a lamella comprising diverging elements located between the central stratum and the hymenium. The subhymenial tree excluding the subhymenium is termed the “subhymenial base.”

Macrochemical spot tests for tyrosinase and laccase follow the methods of Marr (1979). Holmgren, Holmgren and Barnett (1990) are the source of herbarium name abbreviations used in this paper with two exceptions: JEL—private herbarium of Lindgren; RET—private herbarium of Tulloss. In descriptions of collecting localities, “BLM” stands for “Bureau of Land Management”; “MHNF,” for “Mount Hood National Forest”; and “GPNF,” for “Gifford Pinchot National Forest.”

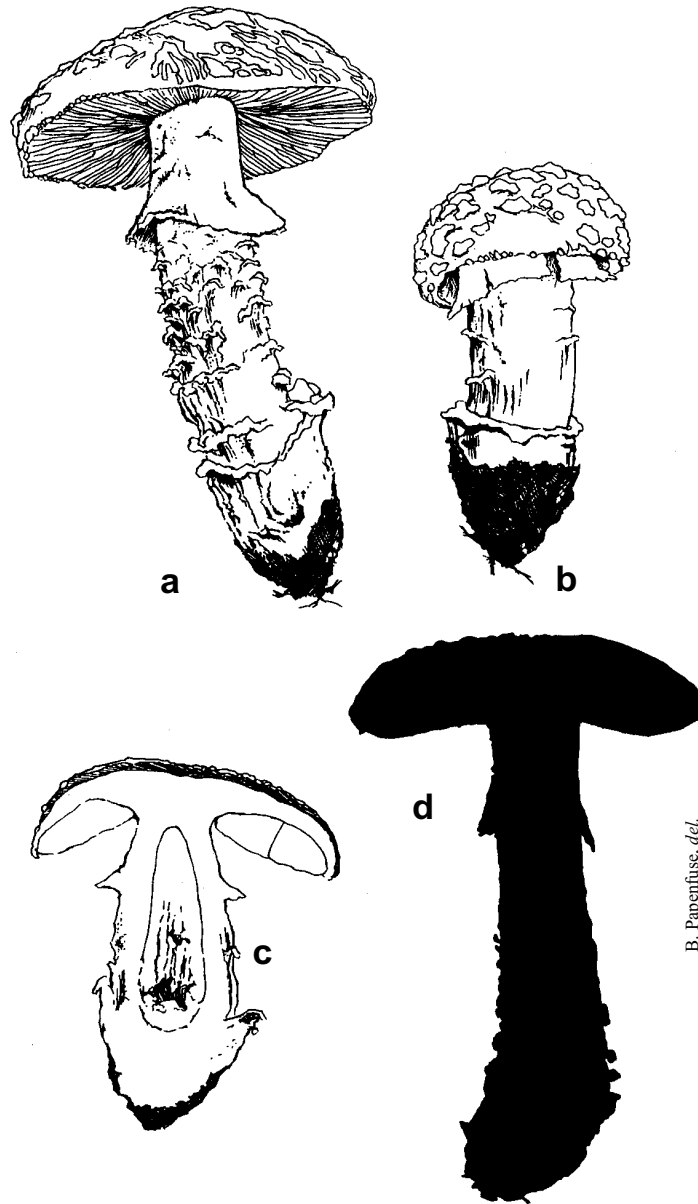
Taxonomic part

AMANITA APRICA J. Lindgr. & Tulloss *sp. nov.*

Pileus 50 - 150 mm *latus*, *flavissimus vel vitellinus vel citrinus vel aurantioflavus*, *initio globosus, demum convexus vel plano-convexus, postremo planus, subviscidus; margine non vel nonnihil striato, integro; carne alba*, 6 - 20 mm *crassa*. *Lamellae liberae vel secedentes, confertae vel subdistantes, albae vel eburneae*, 5 - 12 mm *latae, fimbriatae; lamellulae truncatae, numerosae*. *Stipes* 33 - 91 × 16 - 35 mm, *albus vel eburneus, plerumque cylindricus, pruinosus vel flocculosus, bulbo basali saepe indistincto*, 16 - 34 × 18 - 40 (-50) mm, *basi rotundata vel acuta; carne alba; annulo supero vel medio, albo vel eburneo, membranaceo, fragili, interdum evanido*. *In pileo, velum universale album vel eburneum, detersili, fibrilis tenuibus, appressis, verrucis parvis, floccosis vel tegmine floccoso-coacto, prope completo*. *In bulbo basali stipitis, velum universale margine libero, interdum annulis detersilibus in stipite inferno, albus vel eburneus*. *Sporae* (8.0-) 9.5 - 13.0 (-21) × (5.0-) 6.5 - 8.5 (-12.5) μm, *late ellipsoideae vel ellipsoideae* ($Q = (1.38-) 1.42 - 1.62 (-1.80)$), *inamyloideae*. *Fibulae infrequentes*. *Habitat in apricis*. *Holotypus*: UNITED STATES OF AMERICA, Washington, border of Klickitat & Skamania Cos., Trout Lk., 28.v.1994 J. E. Lindgren 94-07 (WTU).

Etymology: *apricus*, growing in the sunshine, exposed to the sun, sunny; because of the species' being found most often in places exposed to direct sun and because of the bright “apricot-like” color of the pileus.

PILEUS: 50 - 150 mm wide, bright yellow to egg yellow to lemon yellow or bright orangish yellow, occasionally orange (especially over disc), colors sometimes fading and becoming duller after exposure to sun, globose at first, then convex to plano-convex, finally plane with or without disc depressed, glabrous, tacky to subviscid where pileipellis exposed at maturity or in moist weather; *context* white, yellow under pileipellis, 6 - 20 mm thick at stipe, thinning evenly to less than 2 mm at margin; *margin* nonstriate or faintly striate (even in age), entire, inrolled at first, slightly uplifted in age, sometimes bearing fragments of partial veil; *universal veil* as thin appressed downy fibrils or small floccose warts or patches or as a nearly complete floccose-felted to “woolly-felted” covering, or as a nearly complete covering of confluent broadly subpyramidal warts, white to creamy white to yellowish white, detersile,



B. Papenfuss, del.

Fig.1. *Amanita aprica* habit (a & d, $\times 0.5$; b, $\times 0.9$; c, $\times 1$)

quite commonly remaining attached over much of pileipellis and becoming thinner as stretched by expanding pileus.

LAMELLAE: free to seceding, with faint decurrent lines on stipe apex, close to subdistant, white to creamy white in mass and in side view, unchanging when cut or bruised, 5 - 12 mm broad, broadest at midpoint, with fimbriate sometimes uneven edges; *lamellulae* truncate to excavate-truncate, numerous.

STIPE: 33 - 91 × 14 - 35 mm, white to cream to creamy tan, bruising light tan where handled, usually cylindrical, occasionally narrowing upward, surface pruinose to flocculose to scurfy below partial veil, flocculence in young specimens easily removed by handling; *bulb* often not distinct, merely clavate base of stipe, (10-) 16 - 34 × 18 - 40 (-50) mm, with either rounded or pointed base, sometimes slightly radiating; *context* white to pale yellow, infrequently with brownish stains in spots on cut surface, firmly stuffed with white tissue when young, becoming hollow or partially hollow; *partial veil* superior to median, white to cream, felted-membranous at first, soon fragile, skirt-like, sometimes collapsing on stipe, sometimes evanescent; *universal veil* as low free limb encircling top of bulb, white to cream to creamy tan to pale tan, seldom rolled outward, 1 - 3 mm thick at about half height of limb, 25 - 38 mm from base of bulb to highest point on limb, sometimes also as detersile rings on lower stipe above limb, also often left in soil or as patches or warts on stipe.

Odor and *taste* not distinctive.

MACROCHEMICAL TESTS: 10-20% KOH - partial veil turning orange in less than 5 min., context of pileus and stipe pale yellowish. NH₄OH - context of pileus and stipe slightly yellow in 5 min., fading. H₂SO₄ (dilute) - negative. FeSO₄ - negative. Ethanol - negative. Phenol - wine red spot in pileus context and upper stipe after 10 min. Spot test for tyrosinase (paracresol) - positive (reddish brown) in stipe context near stipe base, partial veil, and pileus context in 10 min. Spot test for laccase (syringaldazine) - negative throughout basidiocarp. Macrochemical test voucher: Lindgren 92-5. **POISONOUS:** producing nausea, vomiting, intestinal cramps, muscle spasms, diarrhea, disorientation, and hallucinations, with these accompanied by drowsiness and the desire to sleep.

PILEIPELLIS: 295 - 300 μm thick at approximately midradius, up to 440 (-535) μm thick in disc, entirely ungelatinized well beyond initiation of sporulation in most specimens and, hence, lacking distinctive supra-/subpellis, with most elements subradially oriented, with occasional regions below upper surface having many elements distinctly nonradial; filamentous, undifferentiated hyphae 1.8 - 7.0 μm wide, branching, densely packed vertically, with many at and near upper surface connected to universal veil well into maturity in most specimens, with hyphae and inflated cells like those of universal veil sometimes arising below uppermost hyphal layers (Fig. 2b); vascular hyphae 3.0 - 19.6 μm wide, branching, sinuous, scattered to locally common, sometimes entangled, occasionally crossing ungelatinized into universal veil well into maturity. **PILEUS CONTEXT:** filamentous, undifferentiated hyphae 0.6 - 9.3 μm wide, branching rather frequently, plentiful, sometimes in fascicles, sometimes with yellowish subrefractive walls, forming open lattice-like structure; acrophysalides plentiful, terminal and soli-

tary, narrowly clavate to clavate (up to $222^{\pm} \times 51^{\pm} \mu\text{m}$) or broadly clavate to ellipsoid (up to $108 \times 47 \mu\text{m}$); vascular hyphae $3.0 - 23 \mu\text{m}$ wide, branching, sinuous, infrequent, locally common (especially in upper part of context). LAMELLA TRAMA: bilateral, markedly divergent, rather broad; $w_{\text{CS}} = 95 - 135 \mu\text{m}$ (very good rehydration); central stratum including numerous intercalary partially inflated to narrowly ventricose cells (e.g., $154 \times 18.2 \mu\text{m}$); angle of divergence from very shallow to about 45° ; filamentous, undifferentiated hyphae $1.0 - 10.5 \mu\text{m}$ wide, frequently branching, sometimes with yellowish tint, sometimes with constrictions at septa, occasionally markedly changing diameter at septa; divergent inflated cells broadly to narrowly clavate to narrowly ventricose to only slightly inflated, sometimes slightly curved, up to $117 \times 32 \mu\text{m}$ (commonly about half this size), apparently all intercalary; vascular hyphae $4.5 - 9.3 \mu\text{m}$ wide, rare; clamps infrequent in subhymenial base, not observed elsewhere. SUBHYMENIUM: $w_{\text{st-near}} = 80 - 115 \mu\text{m}$ (very good rehydration); $w_{\text{st-far}} = 100 - 135^{\pm} \mu\text{m}$ (very good rehydration); (-) 3 - 4 (-5) layers of cells thick, with basal layer cells arising from hyphal segments or inflated intercalary cells, generally appearing subcellular to cellular, with (however) basidia arising from both subglobose to barrel-shaped cells and occasionally from only slightly inflated hyphal segments; clamps infrequent to rare. BASIDIA: $48 - 70 \times 10.0 - 11.5 \mu\text{m}$, projecting up to $12.0 - 16.0 \mu\text{m}$ beyond surrounding basidioles, dominantly 4-, occasionally 2-sterigmate; sterigmata up to $5.8 \times 4.0 \mu\text{m}$; clamps and proliferated clamps unevenly distributed, infrequent, sometimes small and very thin-walled, requiring persistent search. UNIVERSAL VEIL: *On pileus*: with substantial number of filamentous, undifferentiated hyphae and some vascular hyphae connecting to pileipellis often well into maturity, with gelatinization beginning in hyphae near base simultaneously with some hyphae of pileipellis surface, with elements having subvertical to vertical orientation; filamentous, undifferentiated hyphae $3.0 - 8.0 \mu\text{m}$ wide, branching, plentiful to dominant in base, plentiful above basal region; inflated cells plentiful, terminal singly, broadly to narrowly ellipsoid (up to $78 \times 40 \mu\text{m}$), broadly to narrowly clavate (up to $105 \times 50 \mu\text{m}$), sometimes slightly constricted; vascular hyphae $4.2 - 11.5 \mu\text{m}$ wide, scattered to locally clustered, sinuous, occasionally branching, occasionally entangled locally. *On stipe base, exterior surface*: filamentous, undifferentiated hyphae in broad (but not very thick) interwoven fascicles, partly gelatinized. *On stipe base, interior*: filamentous undifferentiated hyphae $1.8 - 12.6 \mu\text{m}$ wide, branching, dominating, sometimes constricted at septa, sometimes with yellowish walls, plentiful, often dominating; inflated cells terminal, singly or in chains of two, globose to broadly globose to pyriform (up to $55 \times 52 \mu\text{m}$) or broadly ellipsoid to broadly clavate to ellipsoid to elongate (up to $64 \times 39 \mu\text{m}$), plentiful; vascular hyphae not observed. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae $1.4 - 9.1 \mu\text{m}$ wide, branching, sometimes in narrow fascicles, sometimes with yellowish subrefractive walls, dominantly longitudinally oriented, dominating near surfaces, plentiful in interior; acrophysalides plentiful, smaller and less frequent toward surfaces, plentiful in interior, up to $195 \times 37 \mu\text{m}$; vascular hyphae $3.2 - 28 \mu\text{m}$ wide, sinuate to hypersinuate, sometimes loosely coiled (corkscrew-like), unevenly distributed, scattered to locally common, yellowish.

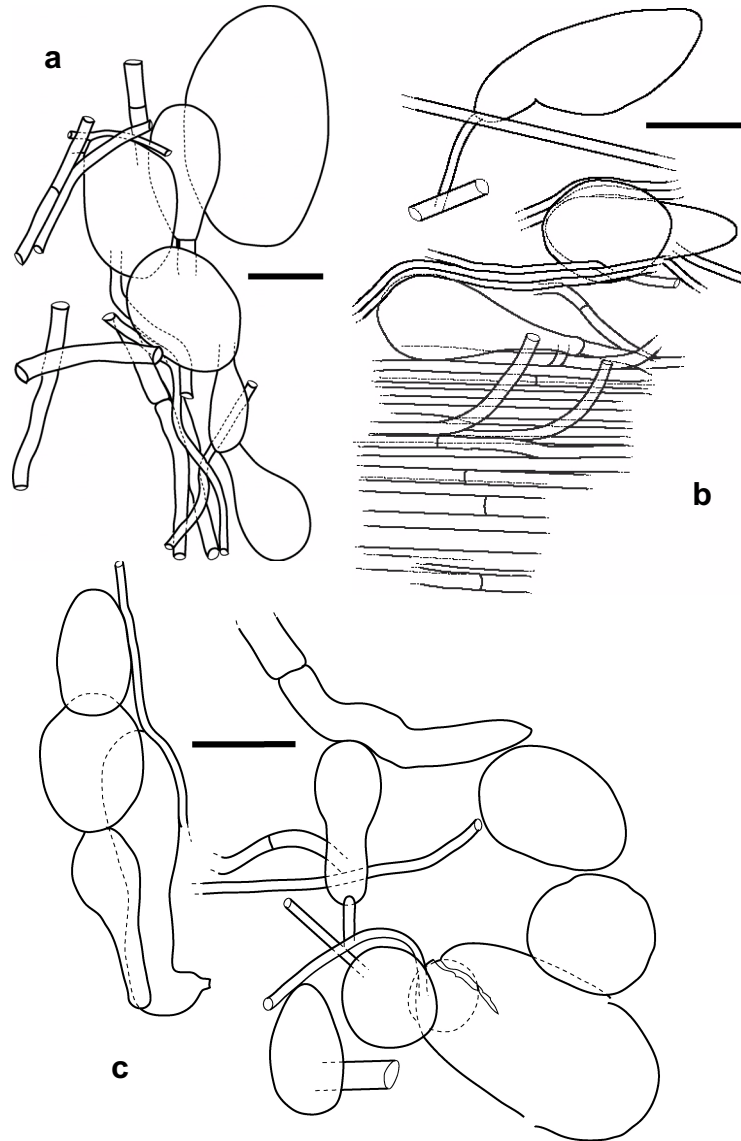


Fig.2. *Amanita aprica* (holotype). (a) Elements of universal veil from interior of limb above bulb on stipe base (crush mount with some hyphae not shown). (b) Elements of base of universal veil from pileus showing connection to pileipellis. (c) Elements of universal veil from pileus (upper portion, crush mount, some hyphae not shown). Scale bars equal 20 μm .

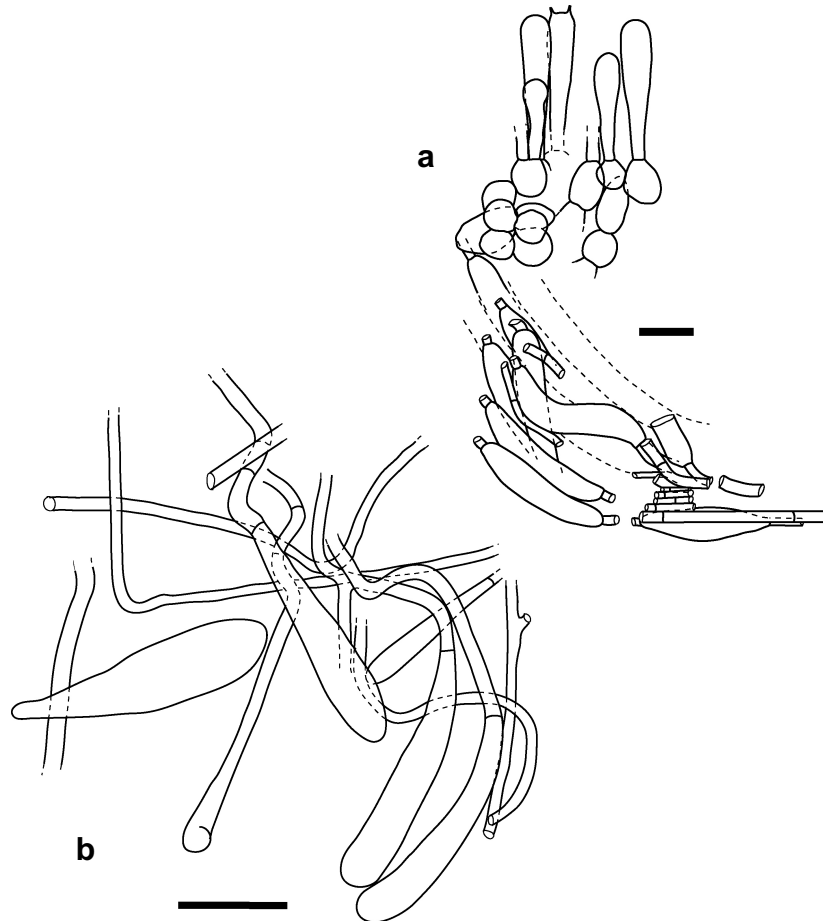


Fig.3. *Amanita aprica*. (a) Elements of hymenium and lamella trama (holotype, with elements occasionally displaced by sectioning—*e.g.*, apparently sinuate intercalary element in subhymenial base). (b) Elements of partial veil excluding any cells remaining from former attachment to edges of lamellae (Trudell 96-165-01, crush mount, some hyphae omitted).

PARTIAL VEIL: filamentous, undifferentiated hyphae 2.1- 4.4 μm wide, branching, dominating, disordered except for occasional fascicles up to 10 hyphae wide, sometimes with yellowish subrefractive walls; inflated cells plentiful, narrowly cavate, terminal, usually singly, occasionally subtended by a smaller somewhat inflated hyphal segment, up to $88 \times 17.6 \mu\text{m}$ wide, infrequently producing hyphae laterally or apically; vascular hyphae not observed.

BASIDIOSPORES: [1331/66/27] (8.0-) 9.5 - 13.0 (-21) \times (5.0-) 6.5 - 8.5 (-12.5) μm , (**L** = (9.8-) 10.1 - 12.2 (-13.1) μm ; **L'** = 11.1 μm ; **W** = (6.6-) 6.8 - 8.1 (-8.4) μm ; **W'** = 7.4 μm ; **Q** = (1.22-) 1.35 - 1.71 (-2.13); **Q'** = (1.38-) 1.42 - 1.62 (-1.80); **Q''** = 1.52), hyaline, colorless, smooth, thin-walled, inamyloid, ellipsoid to elongate, occasionally broadly ellipsoid, often adaxially flattened, sometimes swollen at one end, occasionally langeniform, infrequently "giant"; apiculus sublateral, cylindrical to truncate-conic, proportionately rather large; contents granular to mono- or multiguttulate, dominantly monoguttulate with additional small granules; white to creamy white in deposit.

Distribution and habitat: Solitary to gregarious, at 600 - 1850 m elev. Often in sunny locations such as road cuts, along trails, campgrounds, and under other breaks in the forest canopy; occurring with conifers, mainly *Pseudotsuga menziesii* (Mirb.) Franco, less frequently with *Pinus* (e.g., *P. contorta* Dougl. ex Loud., *P. monticola* Dougl. ex D. Don, and *P. ponderosa* Dougl. ex Laws.). For example, basidiocarps of Lindgren 90-23 collected under *P. monticola* with understory of *Achlys triphylla* (Sm.) DC, *Pachistima myrsinites* (Pursh) Raf., *Vaccinium sp.*, *Pyrola sp.*, and grass; quite common in the Cascade Mountains of Oregon and Washington.

Collections examined: **CANADA:** BRITISH COLUMBIA—Brackendale, 2.v.1993 P. Kroeger 1658 (DAVFP (*n.v.*); RET; UBC (*n.v.*)). **UNITED STATES:** CALIFORNIA—Sierra Co. - N of Downieville, ca. Hwy. 49, 5.vii.2003 Mark Lockaby "A" (RET); Sierra Nevada Field Camp on Hwy. 49, 6.vi.1986 R. E. Halling 4659 (NY). Tulare Co. - ca. Sequoia Nat. Pk., 14.ix.1991 Bruce Kuechman *s.n.* [Lindgren 91-28] (RET). No county given—Sierra Nevada, 5.vi.2003 Mark Lockaby "B" (RET). OREGON—Clackamas Co. - BLM Table Rock Tr., 8.vi.1994 J. E. Lindgren 94-8 (JEL; RET); MHNF, Salmon Butte Tr., 16.vi.1990 J. E. Lindgren 90-7 (JEL; RET); MHNF, Salmon R. Tr., 5.vi.1991 J. E. Lindgren 91-19 (JEL; RET). Hood River Co. - MHNF, Pebble Ford Campgrd., 27.vi.1990 Dick Bishop *s.n.* [Lindgren 90-11] (JEL; RET); MHNF, Rd. 48, 19.v.1994 J. E. Lindgren 94-4 (JEL; RET); MHNF, Surveyor's Ridge, 1991 J. E. Lindgren 91-21 (JEL; RET). Multnomah Co. - ca. Portland, 30.v.1990 poisoning victim (Bulgarian immigrant) *s.n.* [Lindgren 90-13] (JEL; RET). County & locality unknown, 3.v.1988 member of Oregon Mycol. Soc. *s.n.* [Lindgren 116] (JEL; RET). WASHINGTON—Chelan Co. - Wenatchee Nat. For., at boundary of Glacier Peak Wilderness, ca. tr. to Twin Lakes, 14.vi.1997 J. E. Lindgren 97-2 (JEL; RET). King Co. - Mt. Baker-Snoqualmie Nat. For., E of Enumclaw & W of Mt. Ranier Nat. Pk. entrance, St. Hwy. 410, Dalles Campgrd., 30.iv.1992 Steve Trudell *s.n.* [Lindgren 92-16] (JEL; RET); Snoqualmie Nat. For., on Rd. 54, 1.6 km S of Stampede Pass (1.3 km S of Lizard Lk.), less than 0.2 km from point where power lines cross rd., 13.vi.1996 Steve Trudell 96-165-01 (JEL; RET). Kittitas Co. - Wenatchee Nat. For., E of Snoqualmie Pass, 5.4 mi NE of U.S. Interst. Hwy. 90 on For. Rd. 228, Kachess Campgrd., 11.v.1992 Steve Trudell *s.n.* [Lindgren 92-18] (JEL; RET). Border Klickitat & Skamania Cos. - Trout Lk., 30.v.1987 J. E. Lindgren *s.n.* [Tulloss 5-30-87-JL1] (JEL; RET); 28.v.1994 J. E. Lindgren 94-07 (holotype, WTU; isotype, JEL; isotype, L; isotype, NY; isotype, RET). Skamania Co. - GPNF, 6.5 km N of Beacon Rock St. Pk., 22.v.1997 J. E. Lindgren 97-4 (JEL; RET); GPNF, ca. Goose Lk., 18.vi.1990 J. E. Lindgren 90-23 (RET); GPNF, Rd. 80 to Morrison Crk. Campgrds., ca. Trout Lk., 5.vi.1990 J. E. Lindgren 90-18 (JEL; RET); GPNF, Morrison Crk., Road 80, 7.vi.1990

J. E. Lindgren 90-19 (JEL; RET); GPNF, Takhlakh Lk., 8.vi.1989 J. E. Lindgren 139 [89-39] (JEL; RET); GPNF, Trout Lk., vi.1991 J. E. Lindgren 91-18 (JEL; RET), 23.v.1995 J. E. Lindgren 95-3 (JEL; RET); GPNF, Trout Lk. Cr. valley, Rd. 8810, 2.v.1992 J. E. & P. Lindgren & Frank Kopecky [Lindgren 92-17] (JEL; RET); GPNF, Trout Lk. Ranger Distr., Rd. 23, 22.v.1994 Shirley Boothby *s.n.* [Lindgren 94-05] (JEL; RET); GPNF Trout Lk. Ranger Distr., Rd. 23 & Rd. 8040, 7.vi.1991 J. E. Lindgren 91-20 (JEL). Thurston Co. - Olympia, Evergreen St. Coll. parking area, 1992 Michael Beug *s.n.* [Lindgren 92-5] (JEL; RET).

Discussion

Amanita aprica is assignable to *Amanita* section *Amanita*. For many years in the Pacific Northwest of the U.S.A., *A. aprica* has been identified as other taxa of that section: *Amanita muscaria* var. *formosa* Pers., *A. gemmata*, or *A. jonquillea* Quél.—also spelled “*junquillea*”—a posterior synonym of *A. gemmata*. It seems very likely to have been treated by Nakamura (1965) as both a “form” of *A. jonquillea sensu* Nakamura having ellipsoid spores and as “form B” of *A. muscaria* var. *formosa sensu* Nakamura. Regrettably, none of Nakamura’s personal collections are to be found at WTU.

Although its macroscopic appearance sometimes suggests otherwise (and, indeed, some collections thought at first to be *A. aprica* and examined during the work on this paper proved to be *A. muscaria* subsp. *flavivolvata* Singer), *A. aprica* is readily segregatable from all the described varieties of *A. muscaria* and phenetically closely related taxa by the fact that these all bear common to plentiful basidial clamps.

One collection thought at first to be *A. aprica* proved to be *A. breckonii* Thiers & Ammirati (1982). Tulloss has examined the type of *A. breckonii* and found the latter species differs from *A. aprica* at least in having

- spores proportionately narrower, with $Q = (1.51-) 1.52 - 1.74 (-1.85)$ and $Q' = 1.63$
- locally common basidial clamps
- submedian partial veil
- pileus margin becoming distinctly tuberculate-striate in age
- pileus disc often becoming *Cinnamon Buff* (1Y 7.2/6.0) in age.

The supposed double annulus of *A. breckonii* comprises a weakly structured partial veil and, below this, a substantial ring of tissue of the *limbus internus* of the universal veil. The latter has a triangular cross-section having its apex pointing upward—strongly suggesting a second partial veil at first glance. In the several exsiccata of *A. breckonii* examined by Tulloss, the “lower annulus” is not always present.

Amanita gemmata (the European “taxon” may be a complex of several entities) can be distinguished from *A. aprica* by means of the following characteristics:

- spores proportionately broader than those of *A. aprica*, having $Q = 1.29 - 1.36$ (Tulloss and Gulden 1999) or with $Q = 1.42 \pm 0.13$ (Yang and Doi 1999) or with $Q' = 1.31$ based on data of Neville and Poumarat (2004: 381) or, estimating from data of Breitenbach and Kränzlin (1995), having Q approximately 1.25 - 1.27.

- universal veil on pileus dominated by filamentous, undifferentiated hyphae disordered or with subradial orientation and also including scattered or locally fairly abundant inflated cells (Yang 1997: 51).
- pileus color ranging from yellow-orange (material of southern France) to tannish shades of yellow to pale tan (material of Norway) to nearly white with tan restricted to disc (material of Turkey)
- pileus margin distinctly striate
- basidiocarps more gracile and with cap width reaching only about a bit more than half (Marchand 1971; Neville and Poumarat 2004: 380) to two-thirds the maximum size of those of *A. aprica* (Bresinsky and Besl 1990; Persson 1992; Breitenbach and Kränzlin 1995).

Kauffman (1926: 122-123) describes material from Mt. Hood determined by him as *A. jonquillea* with spores $10-12 \times 7-8$ μm (his comments indicate that he excludes extremes of length and, hence, presumably, width). It is very possible that Kauffman's material determined as *jonquillea* is assignable to *A. aprica*.

The habit and spores described for *A. muscaria* var. *formosa sensu* Nakamura are rather good matches to the habit and spores of *A. aprica*. In addition, Nakamura's "form B" is the only yellow entity of *Amanita* section *Amanita* described by Nakamura that occurs in the April-June period—apparently the most common fruiting period for *A. aprica*—indeed, all our collections from Oregon and Washington were made in this period.

While accepting with minimal comment Nakamura's observations on *A. muscaria*, Breckon (1968: 51-57) appears to have interpreted *A. aprica* as "montane specimens" of "*Amanita jonquillea sensu* A. H. Sm." Among the characters noted for the "montane specimens," Breckon includes a pileus with nonstriate margin and universal veil tending to cover much of the surface. The fruiting period for these specimens is described as "late spring through the autumn," which is compatible with the dates of collection of the California paratypes of *A. aprica*.

North American taxa referred to *A. gemmata* include *A. russuloides* (Peck) Sacc. 1887 (Jenkins 1977), *A. xylinivolve* Tulloss, Ovrebo and Halling (1992), and several apparently distinct, undescribed species. Both of the above-named species are smaller and more gracile than *A. aprica*; both have striate margins; and both have proportionately broader spores.

Asian species, including those recently described by Zhu L. Yang and others, do not include any taxa that are comparable with *A. aprica* in all of the following: color, stature, form of universal veil, and spore dimension and shape.

Lindgren 92-5 and 94-08 and Lockaby "A" (so marked by Tulloss) comprise immature material.

In correspondence and keys, we have used the code "*Amanita* sp. NW2" for *A. aprica*.

In several sections of *Amanita*, there have been noted taxa that characteristically fail to produce, or delay in producing, a gelatinizing zone allowing separation of pileipellis and universal veil.

In subsection *Vittadiniae* Bas of *Amanita* section *Lepidella*, as well as in other notable species of that section such as *A. rhoadsii* (Murrill) Murrill and *A. magniverrucata* Thiers & Ammirati, the universal veil remains long attached to the pileus context and a pileipellis is reduced to a layer of context including rather densely placed hyphae or, quite often, is entirely absent.

In other sections, a freshly opened pileus may have a frosty appearance caused by the dense distribution of hyphal stubs projecting upward from the ungelatinized or minimally gelatinized pileipellis after a submembranous or membranous universal veil has been pulled away during expansion of the basidiome.

In section *Amanita*, in particular, there are a number of taxa that retain much of the universal veil on the pileus because of delayed or absent gelatinization—as has been noted in *A. aprica*. Some examples are *A. basiana* Tulloss & M. Traverso, *A. farinosa* Schwein., *A. friabilis* (Karst.) Bas, *A. nehuta* G. S. Ridl., and *A. xerocybe* Bas. The long-term attachment of pileipellis and universal veil does not appear to be a character that should be considered justification for grouping *A. aprica* taxonomically with these other taxa. The above group is characterized by the following: Significantly smaller basidiomes (and consequent markedly striate pileus margins), frequent absence of a partial veil (in the single exception, *A. basiana*, the partial veil is very weakly structured and detersile), powdery universal veil, and spores with **Q** between 1.0 and 1.35 (95% of *A. aprica* spores have **Q** falling above this range).

Observations on toxicity

We know of one poisoning involving the present species. On May 30, 1990, Lindgren was involved as the mushroom identifier in a case involving an 80 year-old Bulgarian immigrant who spoke no English. He had eaten a frying pan full of *A. aprica* spread over both breakfast and lunch and, possibly, sampled the mushroom the previous day. The number of fruiting bodies ingested was not established. There were four remaining mushrooms cleaned, but uncooked upon which the determination was based (Lindgren 90-13).

One and one-half hours after lunch, the victim began to feel ill with symptoms that included nausea, vomiting, intestinal cramps, muscle spasms, hallucinations, disorientation, and diarrhea. The exact order of progression of symptoms is not known. Drowsiness and the desire to sleep accompanied the other symptoms. When the victim was taken to the hospital that afternoon, a mild heart attack was suspected at first, but no irregularities were seen on an EKG. By 10:30 pm the same day, the victim was very tired and sleepy, still had diarrhea; and an uncontrollable twitching was observed in his arms, shoulders, and chest. Unfortunately, method of treatment and length of hospital stay are both unknown in this case.

While the victim's son did not seek medical treatment, he apparently ingested a small piece of mushroom on May 29, 1990; and, at 10 pm the following day, complained of his tongue "feeling strange" and pain near his liver.

The symptoms manifested in the above case are similar to those of *A. muscaria* intoxication; and, considering the taxonomic placement of *A. aprica* in section *Amanita*, ibotenic acid and muscimol are possibly to be found when the species is assayed for toxins. The similarity to *A. gemmata* both macro- and microscopically suggested to us that we should check literature concerning toxins in the latter species. The literature is confusing and possibly involves at least some misidentifications. Basically, we have to assume that the toxins in *A. aprica* and similar taxa are unknown through most, if not all, of the world.

The European species is said to be edible by Marchand (1971), although he did record a case of ingestion of *A. gemmata* involving sweating, flatulence, and vomiting. Breitenbach and Kränzlin (1995) state that the species is poisonous, but not deadly, while stating that *A. muscaria* is considered deadly by them. Bresinsky and Besl (1990) say that ibotenic acid was reported from something determined as "*A. gemmata*" in the U.S., while a "neuroactive substance behaving pharmacologically like ouabain has been obtained" from Chilean material of the very poorly known *A. toxica* Lazo *nom. inval.*, which was originally determined in Chile as *A. gemmata* or a variety of that species. In a book widely used for diagnosing mushroom poisonings in the U.S., Benjamin (1995) states that the toxic content of [the one or more taxa called] *A. gemmata* in the U.S. is unknown. He also cites reports that the U.S. "*A. gemmata*" is sometimes poisonous and sometimes not. Since we believe that there are four or more taxa misdetermined as "*A. gemmata*" in the U.S. in recent literature and that all differ from *A. aprica*, it is possible that at least one of them has *not* been causing toxic reactions.

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