

1 Short title: Miller et al: Pleurotoid *Lactarius* from Guyana

2 Russulaceae of the Pakaraima Mountains of Guyana I. New species of pleurotoid *Lactarius*.

3 Steven L. Miller¹

4 *Department of Botany, University of Wyoming, Laramie, Wyoming 82071*

5 M. Catherine Aime

6 *Department of Biology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia*

7 *24061*

8 Terry W. Henkel

9 *Department of Biology, Duke University, Durham, North Carolina 27708*

10 **Abstract:** Morphological and habitat descriptions, illustrations and taxonomic discussions are
11 presented for two newly described species of pleurotoid *Lactarius*, *L. brunellus* and *L.*
12 *multiceps*, from the Pakaraima Mountains of Guyana. A third species, *L. igapoensis*, is
13 synonymized with *L. panuoides*.

14 **Key Words:** basidiomycetes, neotropics, ectomycorrhiza

15 INTRODUCTION

16 Recent efforts to document ectomycorrhizal fungi from Guyana have focussed on taxa associated
17 with the ectotrophic legume genera *Dicycme* Spruce ex Benth. and *Aldina* (Benth.) Endl. in the
18 Pakaraima Mountains (Henkel 1999; Henkel et al 2000; Miller et al 2001; Simmons et al 2001).
19 During the course of these studies it became apparent that many species are undescribed and that
20 previously described but rarely collected species could benefit from additional detailed
21 morphological and habitat descriptions and illustrations. Many of these fungi belong to the
22 Russulaceae.

23 *Lactarius* section *Panuoides* was originally erected by Singer (1952) to accommodate
24 *Lactarius panuoides* Singer from Trinidad. Two additional species from the neotropics and one
25 from Japan were subsequently described (Singer 1984). The outstanding characters of section
26 *Panuoides* are the pleurotoid morphology of the small basidiomata, poorly developed
27 sphaerocytes, and a tendency to produce a subiculum of thick-walled hyphae, a character suite

28 highly atypical for *Lactarius* (Singer 1984). Henkel et al (2000) redescribed three pleurotoid
29 species of Russulaceae, transferring one from the genus *Lactarius* to the genus *Russula*, and
30 confirming an ectomycorrhizal habit for two of the species. Recent expeditions to Guyana have
31 uncovered two additional pleurotoid species associated with *Dicymbe corymbosa* Spruce ex
32 Benth. that are described here. The present paper is the first in a series that will describe or
33 redescribe and illustrate members of the Russulaceae from the Pakaraima Mountains of Guyana.
34 It is hoped that this work will facilitate the accurate recognition and documentation of these and
35 other members of the Russulaceae elsewhere in the neotropics.

36 MATERIALS AND METHODS

37 Collecting expeditions were made in May-Jun 1998 and 1999 to the Upper Ireng River Basin and
38 May-Jul 2001 to the Upper Potaro River Basin along Guyana's western border with Brazil in the
39 south-central Pakaraima Mountains (geographic coordinates: 5° 05' N; 59° 58' W). Basidiomata
40 were examined in the field for fresh characteristics. Color characteristics were coded according
41 to Kornerup and Wanscher (1981; code noted in parentheses) and described subjectively. Spore
42 deposits on acetate sheets were examined for fresh color characteristics and spore dimensions. A
43 large FeSO₄ crystal was rubbed directly on the stipe, lamellae and flesh and color changes noted.
44 Basidiomata were dried using large-bead silica gel and later placed in resealable plastic bags with
45 small-bead silica gel to prevent spoilage in the excessively humid conditions. Additional
46 basidiomata in various stages of development were preserved in FAA. Ectomycorrhizal rootlets
47 collected from the subicula of both species were also placed in FAA for subsequent anatomical
48 observations.

49 Dried and preserved basidiomata and ectomycorrhizae were observed under an Olympus
50 BH-2 microscope with bright-field optics and microscopical observations recorded. At least 20
51 individual basidiospores were observed and measured per collection.

52 Herbaria designations are from Holmgren et al (1990) and include: BRG - University of
53 Guyana, Georgetown; DUKE - Duke University, Durham, North Carolina; VPI – Virginia

54 Polytechnic Institute, Blacksburg, Virginia; INPA - Instituto Nacional de Pesquisas de Amazonia,
55 Manaus, Brazil. Some collections are retained in Miller and Aime personal herbaria.

56 TAXONOMY

57 **Lactarius brunellus** S. L. Miller, M. C. Aime et T. W. Henkel sp. nov. Figs. 1--3, 4--10

58 *Etymology.* Latin *brunellus*, referring to the diminutive brown basidiomata.

59 Pileus 6--19 mm in diametro, conchatus ad dimidiatus, pallide brunneus ad brunneus, velutinus
60 ad hispidulus, siccus. Lamellae subdistantes, subdecurrentes, tenues, lamellulis singulis ad tribus
61 alternantes, albae ad cremeae. Stipes nullus vel 1--3 x 2--3 mm, cylindricus, excentricus vel
62 lateralis, albus, tomentosus ad fasciculatus. Sapor mitis. Contextus tenuis, cremeus. Latex
63 aqueus ad lacteus, in aëre aliquot minutis tingens carnem lamellasque castaneus. Sporae albae in
64 cumulo, 6.8--8.4 x (5.6) 6.0--7.2 μm (Q=1.13--1.16), subglobosae ad breviter ellipsoideae,
65 echinulatae spinulosae. Pseudocystidia infrequentia ad abundantia, 2.5--3.5 μm lata. Pileipellis
66 epithelium crassitie 2-5 cellularum, cellulis obovatis ad obpyriformibus trichomata multa
67 parietibus crassis producentibus. Fructificans e subiculo expanso hirta involvente truncos,
68 stipites, radicesque arborum in silvis tropicalibus humidis *Dicymbes corymbosae* Spruce ex
69 Benth. (Caesalpiniacearum) in montibus Pakaraima, Guyana, Maio et Julio 2000. HOLOTYPUS:
70 Henkel 7641 (BRG, DUKE).

71 *Pileus* 6--15 (19) mm broad, ungluate, conchate, flabelliform or dimidiate to substipitate,
72 young primordia white with brown disks, mature specimens brown (7E7) at disk fading to light
73 brown (6D6--8 to 6E6--8) at margin, extreme margin white when young, brown with age,
74 velutinous to hispidulous when young, smoother and occasionally shiny with age; margin entire,
75 inrolled when young, occasionally crenate when older; context thin, fragile, cream. *Stipe* present
76 or absent; if present short cylindrical, 1--2 mm broad, tomentose to fasciculate, white. *Odor* not
77 distinctive. *Taste* mild to strongly fungal. *Lamellae* off-white to light cream, subdistant, thin,
78 subdecurrent to decurrent, tomentose near base, multitiered with lamellulae irregularly
79 interspersed. *Latex* scant except when young and fresh, watery to milky, discoloring flesh and
80 lamellae reddish brown in several minutes.

81 *Basidiospores* white in fresh deposit, 6.8--8.4 x (5.6)6.0--7.2 μm (Q=1.13--1.16), subglobose to
 82 short ellipsoid, hyaline with amyloid echinulate-spinuose ornamentation; ornamentation 0.5--
 83 1.5(--2) μm high, usually acute with rare connectives; hilar appendix prominent 3--4 x 1.5--2 μm ,
 84 hyaline; suprahilar plage large, nonamyloid. *Basidia* clavate, 43--53 x 9--10.5 μm , 4-spored;
 85 sterigmata 7--9 x 1--2 μm . *Pseudocystidia* infrequent to abundant, 2.5--3.5 μm wide, cylindrical
 86 or irregularly contorted, rounded or blunt-pointed at the apex, frequently branching at or below
 87 the level of the hymenium, not emergent, connected deeply to laticiferous hyphae in the trama;
 88 walls usually thin; contents similar to laticifer contents, refractive, negative in sulfovanillin.
 89 *Pleurocystidia* absent. *Hymenophoral trama* composed of interwoven, hyaline, thin-walled
 90 hyphae, 2--4 μm wide with scattered inflated cells 8--10 μm wide; lactiferous hyphae scattered,
 91 8--11 μm wide with refractive guttate contents; sphaerocytes rare or absent. Subhymenial layer
 92 not well developed. *Pileipellis* a 2--5 cell thick epithelium composed of obovate, napiform to
 93 obpyriform or clavate thin-walled cells 10--20 μm wide with brownish contents in KOH, giving
 94 rise to scattered to abundant thick-walled hairs, the hairs 40--120 x 4--7 μm , cylindrical to
 95 slightly contorted, frequently with swollen bases, walls 1--2 μm thick, hyaline in KOH, negative
 96 in sulfovanillin. *Stipitipellis* a dense covering of erect hairs that are often tightly fasciculate, 500-
 97 -1000 x 2--6 μm , and with 2--2.5 μm thick walls, straight or irregularly contorted, occasionally
 98 with irregular branches or knob-like termini, often irregularly septate, pseudocystidia 8--12 μm
 99 wide projecting above surface, irregularly contorted, pointed to irregular at the apex; walls
 100 usually thin; contents refractive, negative in sulfovanillin, connected deeply to laticiferous
 101 hyphae. *Subiculum* usually extensive, shaggy, off-white to greyish cream, composed of fascicles
 102 of hyaline, linear hyphae and hairs, 2--8 μm wide, thick walls 2--2.5 μm . *Clamp connections* not
 103 observed.

104 *Macrochemical observations.* FeSO_4 --lamellae and flesh quickly dull green.

105 *Habit, habitat, and distribution.* Solitary to gregarious on lower trunks of saplings, larger
 106 trees, stumps and other elevated positions, arising from a shaggy, often deep and extensive
 107 persistent subiculum which enshrouds living and dead objects above the surface of the ground

108 and which is often interspersed with or overriding bryophyte growth, subtended by
 109 ectomycorrhizal rootlets; found May through early July during wet weather in forests dominated
 110 by *D. corymbosa*. Collected near the Upper Potaro River, and observed but not collected by
 111 Henkel in the adjacent upper Ireng River Basin.

112 *Specimens examined.* GUYANA. Pakaraima Mountains, Upper Potaro River, 19 May
 113 2000, Miller 10028 (Miller personal herbarium), 24 May, Aime 1016 (Aime personal herbarium),
 114 30 May 2000, Miller 10076 (Miller personal herbarium), 24 Jun 2000, Miller 10168 (Miller
 115 personal herbarium); 18 Jul 2000, *Henkel 7641* (HOLOTYPE, BRG; DUKE ISOTYPE).

116 *Commentary.* *Lactarius brunellus* is one of at least three small pleurotoid subiculate
 117 *Lactarius* species found western Guyana forests. *Lactarius brunellus* is distinguished in the field
 118 by the ungulate, brown basidiomata with white margins, which arise from a shaggy fasciculate
 119 subiculum. The subiculum enshrouds bases of adjacent living or dead tree saplings, bases of
 120 large tree boles, stumps, horizontal roots and rocks. Several individual subicula observed were
 121 extensive, with aboveground contiguous portions measuring over 15 m in diameter. Alternating
 122 layers of bryophyte and subiculum growth observed suggested competition for space by the
 123 subicula with leafy liverworts and other bryophytes. Such layering may indicate phenological
 124 differences for the two organisms or may reflect an ongoing struggle for position. *Lactarius*
 125 *multiceps* (described below) has a similar subiculum, which also may occupy large areas; it
 126 however has only been observed to enshroud smaller diameter saplings and produces yellow
 127 basidiomes. *Lactarius panuoides*, also present in this area, has off-white to dull tannish-orange
 128 basidiomes that often form large imbricate troops on lower trunks of saplings and larger trees.
 129 The subiculum of *L. panuoides* is much more densely interwoven and more sponge-like in
 130 texture.

131 ***Lactarius multiceps*** S. L. Miller, M. C. Aime et T. W. Henkel sp. nov. Figs. 11--14, 15--20

132 *Etymology.* Latin *multiceps*, referring to the numerous basidiomata arising from a single
 133 subiculum.

134 Pileus 5--25 mm in diametro, unguatus ad subreniformis, applanatis ad irregularis et sursum
 135 flexus, aureus ad fuscato-aurantiacus, juventute velutinus ad hispidulus, senectute praeter
 136 marginem glaber. Lamellae subdistantes ad distantes, subdecurrentes, tenues, lamellis singulis
 137 ad tribus alternantes, ex aurantiaco albae. Stipes 1--5 x 2--3 mm, cylindricus, excentricus ad
 138 lateralis, arcuatus, pallide flavus sub tomento albo. Sapor acerrimus. Contextus tenuis, fragilis,
 139 pallide flavus. Latex parvus, aqueus. Sporae albae in cumulo, 7.2--9.2 x 6.4--8.0 μm (Q=1.12--
 140 1.15), subglobose ad breviter ellipsoideae, ornamentatione verrucarum magnarum connexarum a
 141 reticulo completo e rugis et tenuibus connectivis composito. Pseudocystidia abundantia, 4.8--6.5
 142 μm lata. Pileipellis epithelium crassitie 2--5 cellularum, cellulis obovatis ad obpyriformibus
 143 trichomata sparsa ad abundantia parietibus crassis producentibus. Fructificans e subiculo tenui
 144 hirtio involvente truncos arborum parvarum et radices in silvis tropicalibus humidis *Dicymbes*
 145 *corymbosae* Spruce ex Benth. (Caesalpiniacearum) in montibus Pakaraima, Guyana, Junio ad
 146 Julio 2000. HOLOTYPUS: Henkel 7656 (BRG, DUKE).

147 *Pileus* 5-25 mm broad, unguate, conchate, dimidiate or subreniform, convex to applanate
 148 to upturned with age, golden yellow, orange or brownish orange (5B7--8 to 6C--8) fading to
 149 yellowish white to light yellow (4A2--4) at margin, pale yellow to light yellow (4A3--4) with age,
 150 velutinous to hispidulous overall when young, hispidulous at margin in age; margin entire,
 151 inrolled when young, irregularly and obscurely sulcate due to underlying lamellae when older;
 152 context thin, fragile, pale yellow. *Stipe* eccentric, 1--5 mm long x 2--3 x mm wide, tomentose to
 153 fasciculate, pale yellow beneath white tomentum. *Odor* not distinctive. *Taste* strongly acrid.
 154 *Lamellae* orange white, subdistant to distant, thin, subdecurrent to decurrent, tomentose near
 155 base, multitiered with irregularly interspersed lamellulae. *Latex* scant, watery.
 156 *Basidiospores* white in fresh deposit, 7.2--9.2 x 6.4--8.0 μm (Q=1.12--1.15), subglobose to short
 157 ellipsoid, hyaline with amyloid ornamentation; ornamentation 0.5--1.0(1.5) μm high, large
 158 verrucae connected by complete reticulum of ridges and fine connectives; hilar appendix
 159 prominent 2--3 x 1.5--2 μm , hyaline; suprahilar plage large, with minute verrucae forming a
 160 faintly amyloid subreticulate pattern. *Basidia* clavate 44--48 x 8--13 μm , 4-spored; sterigmata

161 6.5--10 x 1--2 μm . *Pseudocystidia* abundant, 4.8--6.5 μm wide, cylindrical or irregularly
162 contorted, rounded or blunt-pointed at the apex, occasionally emergent, connected deeply to
163 laticiferous hyphae in the trama; walls usually thin; contents similar to laticifer contents,
164 refractive, negative in sulfovanillin. *Pleurocystidia* absent. *Hymenophoral trama* composed of
165 interwoven, hyaline, thin-walled hyphae, 2--4 μm diam; lactiferous hyphae 4--6 μm wide,
166 contents refractive and guttate; sphaerocytes rare, when present in nests at interface of pileus
167 trama and lamellae, each sphaerocyte 8--20 μm diam. Subhymenial layer not well developed.
168 *Pileipellis* a 2--5 cell thick epithelium composed of globose, mostly thin-walled cells that are 10--
169 25 μm diam and hyaline in KOH that gives rise to scattered to abundant thick-walled hairs, 40--
170 220 x 4--7 μm , cylindrical to slightly contorted, frequently with swollen bases, walls 1--3.5 μm
171 thick, hyaline in KOH, negative in sulfovanillin. *Stipitipellis* a dense covering of erect hairs,
172 these 500--1000 x 4--5 μm with irregularly thickened 2--3.5 μm thick walls, straight or
173 irregularly contorted, irregularly deeply branched and irregularly septate. *Subiculum* shaggy, off-
174 white to greyish cream, composed of fascicles of hyaline, straight hyphae and hairs, 4--8 μm
175 diam, walls 2--3.5 μm thick. *Clamp connections* not observed.

176 *Macrochemical observations.* FeSO_4 -- flesh dull green.

177 *Habit, habitat, and distribution.* Gregarious on lower trunks of saplings and fine pendant
178 roots, arising from a shaggy, persistent subiculum; found June through July during wet weather in
179 forests dominated by *D. corymbosa* Spruce ex Benth.

180 *Specimens examined.* GUYANA. Pakaraima Mountains, Upper Ireng River, 15 Jun 1999,
181 *Henkel 7213* (BRG, DUKE); Upper Potaro River--4 km upstream from Ayanganna airstrip near
182 base camp, 14 Jun 2000, *Miller 10136* (Miller personal herbarium); Blackwater Creek, *Dicymbe*
183 *corymbosa* research site "Paluway #3", 19 Jun 2000, *Miller 10146* (Miller personal herbarium), 20
184 Jul 2000, *Henkel 7656* (HOLOTYPE BRG; ISOTYPE DUKE), 21 Jun 2001, *Henkel 8343* (BRG,
185 DUKE).

186 *Commentary.* *Lactarius multiceps* is distinguished in the field by the numerous golden
187 yellow to brownish orange basidiomes developing from a shaggy fasciculate subiculum. The

188 subiculum is similar in appearance to that of *L. brunellus* although not as extensive in the
 189 collected representatives of *L. multiceps*, and was restricted to covering the bases of small
 190 diameter saplings and fine pendant roots. The stipe of *L. multiceps* is often well developed, and
 191 the mature basidiome may be eccentric rather than truly pleurotoid.

192 *Lactarius multiceps* most closely resembles *L. epitheliosus* Buyck and Courtecuisse (in
 193 Courtecuisse and Buyck 1991) which was collected in humid forests of French Guyana. Both
 194 species share diminutive size, yellow to yellow brown coloration, total lack of hymenial cystidia,
 195 and spore size and ornamentation. Unlike *L. multiceps*, *L. epitheliosus* exhibits a pronounced
 196 pleurotoid to eccentric habit and its pileipellis consists of an epithelium from which abundant
 197 thick-walled hairs arise. No mention is made of a subiculum in the original description of *L.*
 198 *epitheliosus* and the taste, which in *L. multiceps* is strongly acrid, was unfortunately not tested in
 199 *L. epitheliosus*.

200 *Lactarius panuoides* Singer Kew Bull. 7:300. 1952. Figs. 21--22

201 \equiv *Lactarius igapoensis* Singer Nova Hedwigia 40:441. 1984.

202 An earlier paper redescribing several pleurotoid species from Guyana (Henkel et al 2000), we
 203 recognized the possibility raised by Verbeken (1998) that *L. panuoides* and *L. igapoensis*, similar
 204 in many respects, might be synonymous. After additional collecting in the field and careful
 205 examination of type material of *L. igapoensis* (Singer B 10299, INPA), we have concluded that *L.*
 206 *panuoides* and *L. igapoensis* are in fact, synonymous.

207 The original descriptions of *L. igapoensis* (Singer 1984) and *L. panuoides* (Singer 1952)
 208 differ in three characters: habitat, color of the basidiomata, and height of spore ornamentation.
 209 The specific epithet "*igapoensis*" refers to the occurrence of this species in frequently flooded
 210 lowland habitats or "igapo." During a recent expedition to Guyana (May-Jul of 2000), large
 211 fruitings of *L. panuoides* near the banks of the Potaro River were observed to be frequently
 212 submerged following extensive rainstorms upriver. While submersion appeared to have little
 213 effect on fruiting of this fungus, basidiomata present before the flood and observed after the
 214 waters had receded were uniformly darker in color. The color of *L. panuoides* basidiomata is

215 highly variable; young fresh basidiomata are pale while older ones stain variably or uniformly
216 reddish brown upon injury, in age, or after flooding. Large fruitings of *L. panuoides* upon
217 individual subicula can contain uniformly young, uniformly old, or -more typically- a mixture of
218 young and senescent basidiomata. It is likely that collections that Singer described as *L.*
219 *igapoensis* were composed of young basidiomata that had recently been inundated by floodwater.

220 The type material of *L. igapoensis* is in a poor state of preservation and direct comparison
221 of all important microscopic morphological characters is not possible. Verbeken (1998) correctly
222 noted that the type specimens of *L. igapoensis* were immature. Most spores we found were
223 amorphous or broken and stained only slightly in Melzer's reagent, suggestive of premature or
224 interrupted development. After numerous attempts, we found a few mature basidiospores in one
225 basidiome from the type collection. From these we find that mature basidiospores of both *L.*
226 *panuoides* and *L. igapoensis* are subglobose, 7.5--9.5 x 7--8 μm , hyaline with amyloid
227 ornamentation composed of numerous crowded verrucae joined by an almost complete reticulum
228 (Figs. 21-22). The ornamentation height (0.5--1 μm high for both species) is at the higher end of
229 the range in the few *L. igapoensis* spores observed and the reticulum mesh is slightly more coarse
230 than in *L. panuoides*. However, both of these characters are within the range exhibited by mature
231 *L. panuoides* spores examined from spore prints taken from several collections. In addition, the
232 basidiospores of both species are characterized by a suprahilar plage with thickened, darkly
233 amyloid, central spot.

234 Other phenotypic similarities exist between *L. panuoides* and *L. igapoensis*. Both produce
235 their basidiomata on an extensive subiculum described by Singer (1984) as "tough-fleshy and
236 thick-membranous-crustaceous, dry, white or pallid but at least in parts blue-green from algal
237 cells; subglabrous." Basidiomata of both species have an epithelium giving rise to abundant
238 thick-walled hairs, both have white latex, and both have abundant and similarly sized
239 pseudocystidia. For these reasons, we conclude that *L. igapoensis* is synonymous with *L.*
240 *panuoides*.

241 ACKNOWLEDGMENTS

242 This work was made possible by grants from the National Geographic Society's Committee for
243 Research and Exploration to Henkel, NSF DEB-9974018 and USDA competitive grant 2000-
244 02861 to Miller, and an Explorers Club of Virginia grant to Aime. Field assistance was provided
245 in Guyana by Mimi Chin, Leonard Williams, Christopher Andrew, and Benny Cheong. This
246 paper is number ____ in the Smithsonian Institution's Biological Diversity of the Guianas Program
247 publication series.

248 LITERATURE CITED

249 Courtecuisse R, Buyck B. 1991. Eléments pour un inventaire mycologique des environs du Saut
250 Pararé (Arataye) et de l'Inselberg des Nouragues (Guyane Française) IV. Russulaceae.
251 Mycologica Helvetica 4: 209--225.

252

253 Henkel TW. 1999. New taxa and distribution records for *Tylophilus* from *Dicymbe* forests of
254 Guyana. Mycologia 91:655--665.

255

256 Henkel TW, Aime MC, Miller SL. 2000. Systematics of pleurotoid Russulaceae from Guyana
257 and Japan, with notes on their ectomycorrhizal status. Mycologia 92:1119--1132.

258

259 Holmgren P, Holmgren N, Barnett LC. 1990. Index Herbariorum part I. The herbaria of the
260 world. Regnum Veg 120:1--693.

261

262 Kornerup A, Wanscher JH. 1981. Methuen handbook of colour. 3rd ed. London: Eyre Methuen.
263 252 p.

264

265 Miller OK, James TY, Miller SL, Henkel TW. 2001. *Pseudotulostoma*, a new genus in the
266 Elaphomycetaceae from Guyana, South America. Mycological Research (in press)

267

268 Simmons C, Henkel TW, Bas K.. 2001. The genus *Amanita* in the Pakaraima Mountains of
269 Guyana. *Persoonia* 17: (in press).

270

271 Singer R. 1952. Russulaceae of Trinidad and Venezuela. *Kew Bull* 7:295--301.

272

273 --. 1984. Tropical Russulaceae II. *Lactarius* section *Panuoidei*. *Nova Hedwigia* 40:435--447.

274

275 Verbeken JA. 1998. Studies in tropical African *Lactarius* species. 6. A synopsis of the subgenus
276 *Lactariopsis* (Henn.) R. Heim emend. *Mycotaxon* 66:387-418.

277

278 Figs. 1--3. *Lactarius brunellus* habit (*Miller 10028*). 1. Basidiomata arising from shaggy
279 subiculum enshrouding base of *Dicymbe* sapling, X 0.6. 2. Three developmental stages of
280 basidiomata on subiculum, X 2.1. 3. Pleurotoid habit with eccentric stipe. Note the lamellae
281 exuding latex from fresh cut, X 2.0.

282

283 Figs. 4--10. Microscopic features of *Lactarius brunellus* (*Miller 10028*). Scale bars = 10
284 μm . 4. Pileipellis epithelium composed of thick-walled hairs and brownish polymorphic cells.
285 5. Thick-walled hairs (left) and brownish thin-walled polymorphic cells (right) from the
286 pileipellis. 6. Pseudocystidia. 7-8. Elements of the stipitipellis. 7. Thick-walled hairs. 8.
287 Irregularly shaped pseudocystidia. 9. 4-sterigmate basidia. 10. Basidiospores with amyloid
288 non-reticulate ornamentation and hyaline suprahilar plage.

289

290 Figs. 11--14. *Lactarius multiceps*. 11. Basidiomata arising from shaggy subiculum
291 enshrouding *Dicymbe* saplings (*Henkel 7656*). Note extensive development of the subiculum on
292 leaf bases in the image at left, X 0.5. 12. Older basidiomata on subiculum (*Henkel 7656*), X 0.8.

293 13-14. Older basidiomata on subiculum. Note primordia and immature basidiomata at left, fully
294 mature basidiomata on right. 13. Henkel 7213, X 1.0. 14. Henkel 8343, X 2.0.

295
296 Fig. 15--20. Microscopic features of *Lactarius multiceps* (Miller 10146). Scale bars = 10
297 μm . 15. Pileipellis epithelium composed of thick-walled hairs and polymorphic cells. 16. Thick-
298 walled hairs in pileipellis. 17. Thick-walled hairs. in the stipitipellis. 18. Irregularly shaped
299 pseudocystidia. 19. 4-sterigmate basidia. 20. Basidiospores with amyloid reticulate
300 ornamentation and lightly amyloid and ornamented suprahilar plage.

301
302 Figs. 21--22. Microscopic features of *Lactarius panuoides* (\equiv *L. igapoensis*) basidiospores. 21.
303 Basidiospores of *Lactarius igapoensis* Singer (HOLOTYPE, *Singer B12099*). 22. Basidiospores
304 of *Lactarius panuoides* (Miller 10099).

305 ¹E-mail: fungi@uwyo.edu

306