

NOTES ON SOME CORTICIOID LIGNICOLOUS FUNGI ASSOCIATED
WITH SNOWBANKS IN SOUTHERN ARIZONA¹

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(With seven Text-figures)

Seven species of corticioid Hymenomycetes that fruit on wood in snow or near the edges of snowbanks in southern Arizona are discussed. Basidiocarps of *Coniophora corrugis* and *Corticium lepidum* apparently develop only in snow. *Athelia decipiens*, *A. epiphylla*, *Leptosporomyces galzinii*, *Confertobasidium olivaceo-album*, and *Byssomerulius hirtellus* produce actively sporulating basidiocarps in snow, but also fruit readily during the late summer and fall rainy season.

One of the most fascinating elements of the fungal biota of western North America consists of species with fruiting bodies developing in snow or in close proximity to it. A large and diverse group of fungi has been observed to occupy this ecological habitat. Cooke (1944, 1955) and Miller (1965, 1967) have published accounts of snowbank fungi in western North America. Few corticioid fungi have been reported to fruit under these conditions.

This paper concerns observations on seven lignicolous corticioid Basidiomycetes, all found fruiting in snow or near the edges of snowbanks in southern Arizona. Although two of the mountain ranges in the area exceed 10,000 feet (3048 meters) in elevation and several are over 9,000 feet (2743 meters), snowfall is generally much less than at more northern latitudes in North America and the snow persists for a shorter time. Consequently, snowbank fungi in southern Arizona must be collected from January to May. In the northern Rocky Mountains snowbank fungi may be found throughout the summer at higher elevations.

One of the striking features of the complex of snowbank fungi in southern Arizona is the relative scarcity of agarics. Species such as *Lyophyllum montanum* A. H. Smith and *Lentinellus montanus* O. K. Miller, so prominent near snowbanks in the northern Rocky Mts., have not been found here.

Morphological data were obtained from free hand sections or crushed tissue mounted in 2 % KOH and stained with phloxine. Sections were also mounted in Melzer's reagent to disclose amyloid or dextrinoid reactions. Drawings were made with the aid of a camera lucida. Capitalized color names are from Ridgway (1912).

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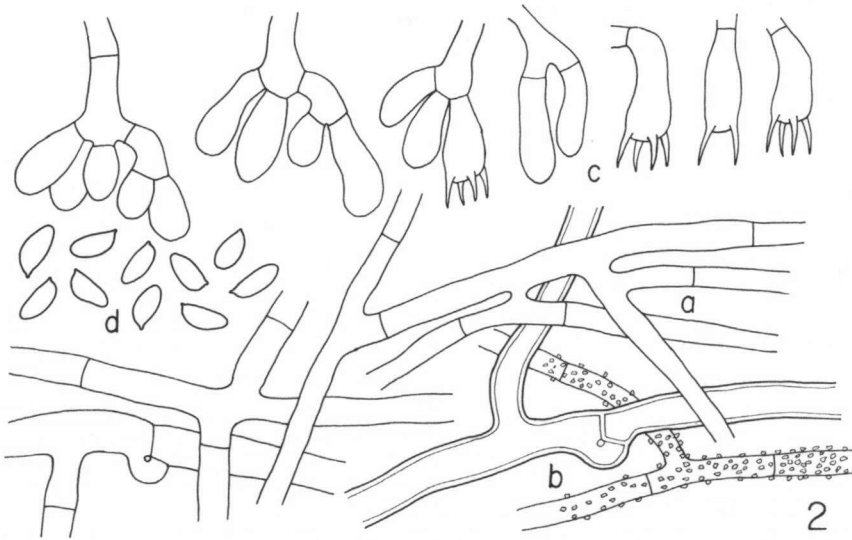
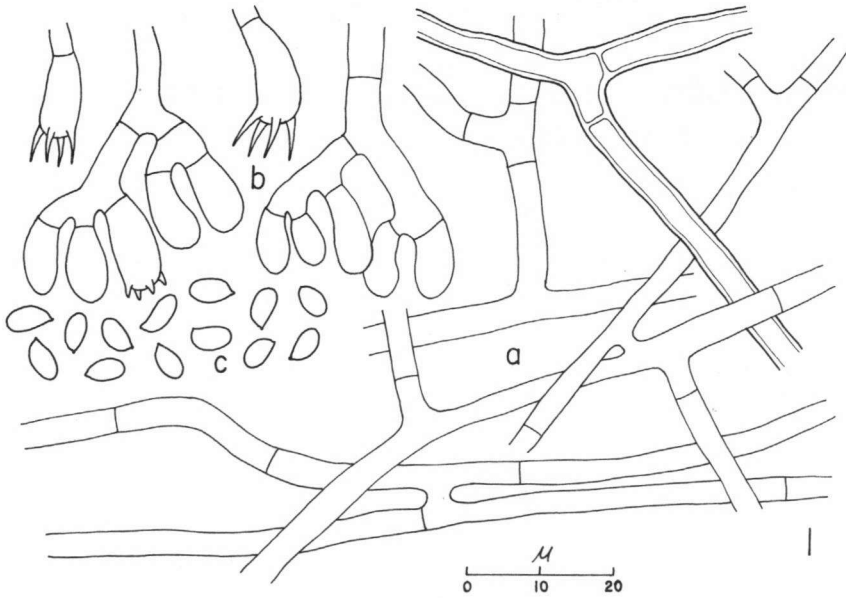


Fig. 1. Microscopic characters of *Athelia decipiens* (RLG 8512). — a. Subicular hyphae. — b. Basidia. — c. Basidiospores.

Fig. 2. Microscopic characters of *Athelia epiphylla* (RLG 8527). — a. Simple-septate subicular hyphae. — b. Subicular hyphae with clamp connections. — c. Basidia. — d. Basidiospores.

ATHELIA DECIPIENS (Höhn. & Litsch.) J. Erikss.—Fig. 1

Corticium decipiens Höhn. & Litsch. in Sber. Akad. Wiss. Wien (Math.-naturw. Kl.) 117 (1): 116. 1908. — *Athelia decipiens* (Höhn. & Litsch.) J. Erikss. in Symb. bot. upsal. 16 (1): 86. 1958.

Basidiocarps resupinate, becoming widely effused, thin, fragile, easily separable from substratum; hymenial surface white to grayish-white, smooth, cracking on drying; hymenial layer a very thin, discontinuous pellicle on a delicate whitish, arachnoid subiculum; in some areas the subiculum so inconspicuous the hymenial layer appears to be directly on the substratum.

Hyphal system monomitic; subicular hyphae simple-septate with no clamp connections, thin- to moderately thick-walled, often incrustated, with frequent branching, 2–5 μ in diam., branches usually at a right angle or nearly so (Fig. 1a); cystidia lacking; basidia in candelabrums, compactly arranged in a euhymenium, clavate, 10–14 \times 4–5 μ , 4-sterigmate, with a basal septum (Fig. 1b); basidiospores oblong to ellipsoid, hyaline, smooth, negative in Melzer's reagent, (4-)5–6.5 \times 2–3 μ , with a small but prominent apiculus (Fig. 1c). Associated with a white rot.

Athelia decipiens is also found fruiting on conifers and hardwoods during the late summer fruiting season in Arizona. It is characterized by the very thin, grayish-white basidiocarp, simple-septate hyphae with no clamps and the oblong, apiculate basidiospores.

SPECIMENS EXAMINED: RLG 8512 on log of ponderosa pine (*Pinus ponderosa* Laws.) in snow, Rustler Park, Chiricahua Mts., Cochise County, Arizona, April 25, 1969; RLG 7571, on ponderosa pine log, Rustler Park, October 5, 1967; RLG 8201, on ponderosa pine log, Rustler Park, August 27, 1968; RLG 7930, on ponderosa pine log, Rustler Park, July 25, 1968.

ATHELIA EPIPHYLLA Pers.—Fig. 2

Athelia epiphylla Pers., Mycol. europ. 1: 84. 1822.

Basidiocarps resupinate, becoming widely effused, thin, fragile, easily separated from substratum; hymenial surface white to grayish or bluish-white, smooth; hymenial layer very thin, pelliculose, discontinuous over a very thin, arachnoid subiculum or appearing to develop directly on the substratum.

Hyphal system monomitic; subicular hyphae hyaline, mostly simple-septate, with frequent branching, 2.5–4.5 μ in diam., some lightly incrustated with fine crystalline material (Fig. 2a); also some larger hyphae with clamp connections, these moderately thick-walled, 4–6 μ in diam., also with frequent branching (Fig. 2b); cystidia lacking; basidia in candelabrums, cylindric to clavate, mostly 4-sterigmate, but some 2-sterigmate, 12–15 \times 5–8 μ , with a basal septum (Fig. 2c); basidiospores cylindric or slightly fusiform, hyaline, smooth, negative in Melzer's reagent, 5–7 \times 2.5–3 μ (Fig. 2d). Associated with a white rot.

Athelia epiphylla is similar to *A. decipiens*, but the latter species has no clamp connections on any hyphae and has slightly smaller basidiospores. The incidence of clamp connections seems to vary considerably among specimens of *A. epiphylla* from relatively rare to rather frequent and conspicuous.

SPECIMENS EXAMINED: RLG 7796, on dead, fallen, silver leaf oak (*Quercus hypoleucoides* Camus), in snow, General Hitchcock Picnic Area, Santa Catalina Mts., Pima County, Arizona, January 31, 1969; RLG 7864, on ponderosa pine (*Pinus ponderosa* Laws.) log, East Side Game Road, Kaibab Plateau, Coconino County, Arizona, June 5, 1968; RLG 8527, on Arizona alder (*Alnus oblongifolia* Torr.) log, Palisades, Santa Catalina Mts., Pima County, Arizona, May 8, 1969.

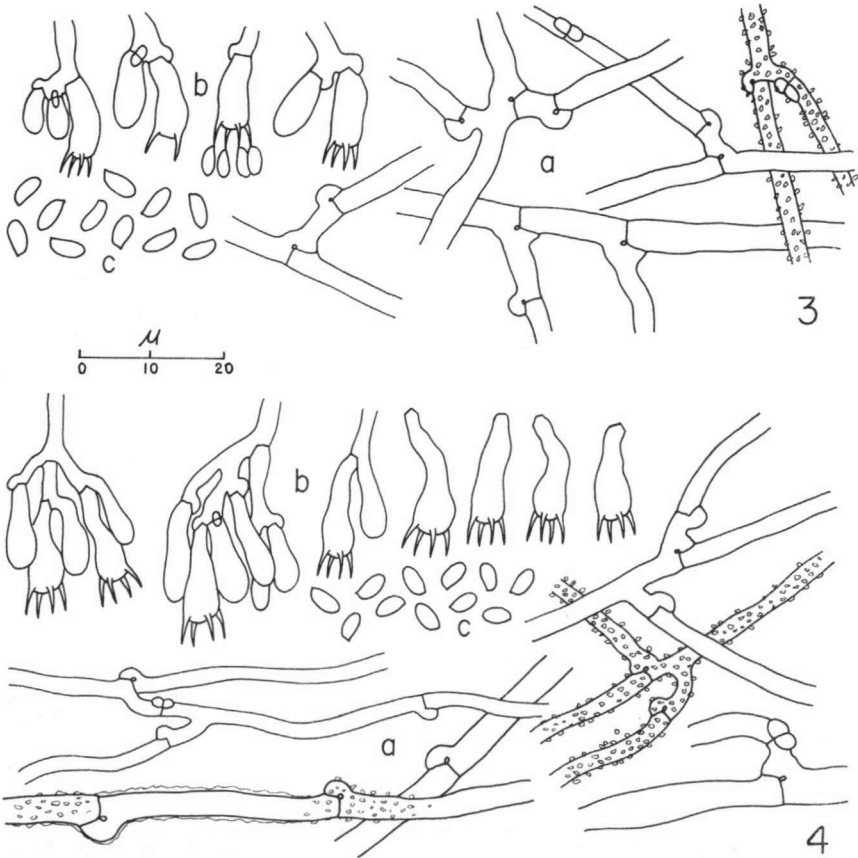


Fig. 3. Microscopic characters of *Leptosporomyces galzinii* (RLG 9370). — a. Subicular hyphae. — b. Basidia. — c. Basidiospores.

Fig. 4. Microscopic characters of *Confertobasidium olivaceo-album* (ABB 1498). — a. Subicular hyphae. — b. Basidia. — c. Basidiospores.

LEPTOSPOROMYCES GALZINII (Bourd.) Jülich—Fig. 3

Corticium galzinii Bourd. in Revue scient. Bourbon. Cent. Fr. 23: 11. 1910. — *Athelia galzinii* (Bourd.) Donk in Fungus 27: 12. 1957. — *Leptosporomyces galzinii* (Bourd.) Jülich in Willdenowia Beih. 7: 192. 1972.

Basidiocarps resupinate, becoming widely effused, very thin, fragile, easily separated from substratum; hymenial surface white to grayish or slightly bluish-white, hymenial layer loosely pelliculose or finely tomentose, interrupted, very thin; subiculum inconspicuous in some specimens or virtually lacking with the hymenial layer appearing to develop directly on the substratum.

Hyphal system monomitic; subicular and subhymenial hyphae with clamp connections at all septa, hyaline, thin-walled, with frequent branching, often branching from a clamp, 2–4 μ in diam. (Fig. 3a); cystidia lacking; basidia in candelabrams, cylindric to clavate, mostly 4-sterigmate but a few 2-sterigmate, with a basal clamp connection, compactly arranged in a euhymenium, 9–12 \times 3.5–4 μ (Fig. 3b); basidiospores hyaline, smooth, cylindric to oblong, negative in Melzer's reagent, with a small apiculus, 4–4.5 \times 2 μ (Fig. 3c). Associated with a white rot.

Three macroscopically similar athelioid fungi are common in Arizona forests. These are *Athelia decipiens*, *A. epiphylla*, and *L. galzinii*. The latter can be recognized by the clamp connections at all septa and at the base of the basidia, and the smaller basidiospores. *Leptosporomyces galzinii* is also found during the rainy season in late summer.

SPECIMENS EXAMINED: RLG 8370, on crustose vegetative tissue of *Fomes annosus* (Fr.) Karst. on white fir [*Abies concolor* (Gord. & Glend.) Lindl.] log in snow, Summerhaven, Santa Catalina Mts., Pima County, Arizona, May 13, 1970; RLG 7784, on silver leaf oak (*Quercus hypoleucoides* Camus), General Hitchcock Picnic Area, Santa Catalina Mts., June 31, 1968; RLG 8177, on white fir log, Marshall Gulch, Santa Catalina Mts., August 26, 1968.

CONFERTOBASIDIUM OLIVACEO-ALBUM (Bourd. & Galz.) Jülich—Fig. 4

Corticium olivaceo-album Bourd. & Galz. in Bull. trimest. Soc. mycol. Fr. 27: 239. 1911. — *Athelia olivaceo-alba* (Bourd. & Galz.) Donk in Fungus 27: 12. 1957. — *Confertobasidium olivaceo-album* (Bourd. & Galz.) Jülich in Willdenowia Beih. 7: 167. 1972.

Corticium fuscostratum Burt in Ann. Mo. bot. Gdn 13: 299. 1926. — *Athelia fuscostrata* (Burt) Donk in Fungus 27: 12. 1957.

Basidiocarps resupinate, becoming widely effused, soft, easily separated from substratum; hymenial layer a thin, compact, Light Buff to Ivory Yellow (Cinnamon Buff to Clay Color) colored pellicle, cracking on drying to expose the pale-brownish to pale buff, arachnoid subiculum; margin thinning out, usually with fine cream-colored rhizomorphs.

Hyphal system monomitic; subicular hyphae with abundant clamp connections, those in the subhymenial layer hyaline, thin-walled, loosely arranged, with frequent branching, hyaline to pale yellowish in KOH, 2–3 μ in diam.; those in the basal brown layer with thin to moderately thickened walls, light brown in KOH, 3–5 μ in diam., some lightly to heavily incrustated with a fine, pale brownish crystalline

material (Fig. 4a); cystidia lacking; basidia clavate, 4-sterigmate, $10-12 \times 4-4.5 \mu$ (Fig. 4b); basidiospores hyaline, smooth, negative in Melzer's reagent, ellipsoid to short-cylindric, flattened on one side, $3-4 \times 2-2.5 \mu$ (Fig. 4c). Associated with a white rot. Gum guaiac reaction positive on fresh hymenial surface.

Confertobasidium olivaceo-album is also found fruiting in late summer. It is distinguished by the cream to buff, pellicular hymenial layer, the pale brownish arachnoid subiculum, and nodose-septate subicular hyphae.

SPECIMENS EXAMINED: RLG 9363, on corkbark fir log [*Abies lasiocarpa* var. *arizonica* (Merriam) Lemm.] under snow, Mt. Lemmon, Santa Catalina Mts., Pima County, Arizona, May 8, 1970; ABB 1496, on Rocky Mountain maple (*Acer glabrum* Torr.), in snow, Mt. Bigelow, Santa Catalina Mts., January 29, 1970; ABB 1498, on quaking

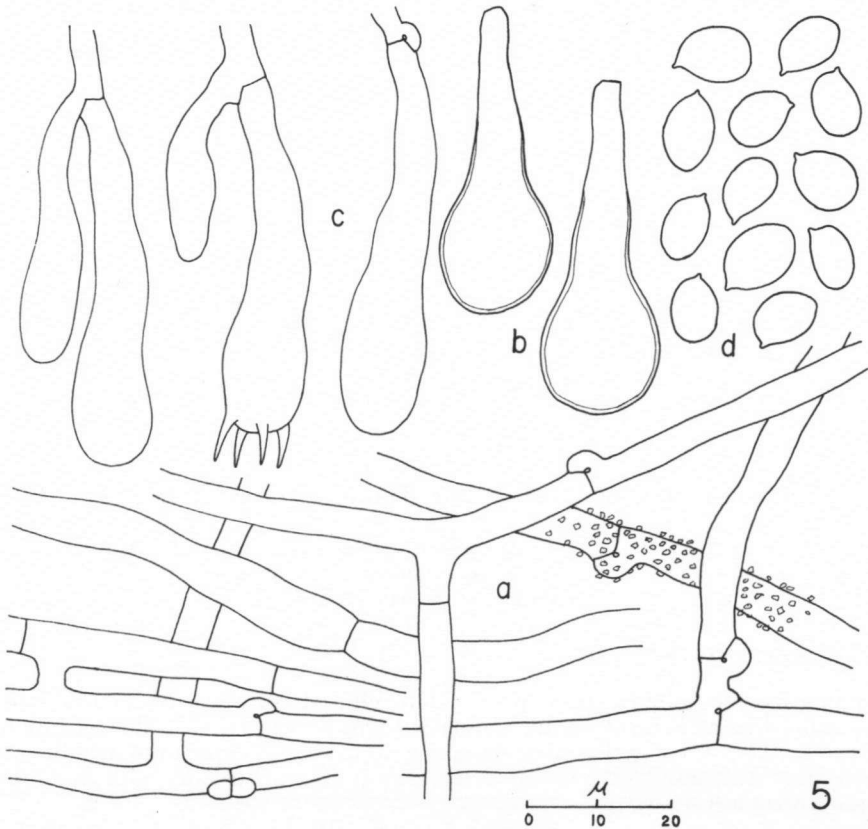


Fig. 5. Microscopic characters of *Coniophora corrugis* (RLG 5988). — a. Subicular hyphae — b. Cystidia. — c. Basidia. — d. Basidiospores.

aspen (*Populus tremuloides* Michx.) log, Mt. Lemmon, Santa Catalina Mts., May 28, 1970; ABB 1002 and 1003, on ponderosa pine, Palisades, Santa Catalina Mts., May 11, 1969; ABB 1106 on ponderosa pine, Schultz Pass. Rd., San Francisco Peaks, Coconino County, Arizona, August 7, 1969; ABB 1135, on Douglas fir [*Pseudotsuga menziesii* (Mirb.) Franco], Snow Bowl Rd., San Francisco Peaks, August 7, 1968.

CONIOPHORA CORRUGIS Burt—Fig. 5

Coniophora corrugis Burt in Ann. Mo. bot. Gdn 13: 310. 1926.

Basidiocarps resupinate, becoming widely effused, easily separated; hymenial surface meruloid to smooth, pale tan to darker brown (Ochraceous-Tawny to Cinnamon-Brown), hymenial layer compact and pelliculose on a thin, soft, white, floccose to arachnoid subiculum which extends beyond the hymenial layer at the margin.

Hyphal system monomitic; subicular hyphae thin-walled, with occasional branching, with abundant clamp connections and also simple septa, 4–6 μ in diam., some lightly to heavily incrustated with coarse crystalline material (Fig. 5a); cystidia broadly clavate with a greatly expanded apex with distinctly thickened wall, hyaline, projecting slightly or imbedded; 40–45 μ long and up to 18 μ in diam. at apex (Fig. 5b); basidia compactly arranged in a typical euhymenium, clavate, 4-sterigmate, with a basal clamp connection, up to 60 μ long and 8–12 μ in diam. (Fig. 5c); basidiospores broadly ellipsoid, hyaline, or slightly yellowish in KOH when mature, negative in Melzer's reagent, 7–10 \times 5–7 μ (Fig. 5d). Associated with a white rot.

Coniophora corrugis was placed in that genus by Burt because of a slight pigmentation of mature spores apparently observed in only one of several specimens. However, the basidial and pore characters are not typical of *Coniophora* as exemplified by *Coniophora puteana* (Schum. ex Fr.) Karst. or *Coniophora arida* (Fr.) Karst., common species in Arizona. Rogers & Jackson (1943) state that *C. corrugis* "is probably a member of Bourdot and Galzin's section Membranacea." Burt (1926) also stated that *C. corrugis* "seemed related to *C. polyporoidea*", a reference to *Corticium polyporoideum* Berk. & Curt. However, Petersen (1971) has concluded that *C. polyporoideum* should be placed in the genus *Cristella* Pat., and *Coniophora corrugis* does not show close relationships to species of *Cristella*. *Coniophora corrugis* commonly develops profusely in snow over the surfaces of living plants and foliage of fallen conifers as well as on dead branches and other dead wood on the ground. It is a common fungus in and around snowbanks at high elevations throughout the coniferous forests of western North America.

SPECIMENS EXAMINED: RLG 7881, on spruce twigs (*Picea* sp.), in snow, East Side Game Rd., Kaibab Plateau, Coconino County, June 6, 1968; ABB 1016 and 1021, on quaking aspen (*Populus tremuloides* Michx.), Snow Bowl Rd., San Francisco Pks., Coconino County, June 17, 1968; RLG 7858, on Rocky Mountain maple (*Acer glabrum* Torr.), Mt. Lemmon, Santa Catalina Mts., Pima County, May 15, 1968; P. D. Keener, on corkbark fir [*Abies lasiocarpa* var. *arizonica* (Merriam) Lemm.], Pt. Sublime Rd., North Rim, Grand Canyon Nat. Park, June 25, 1957.

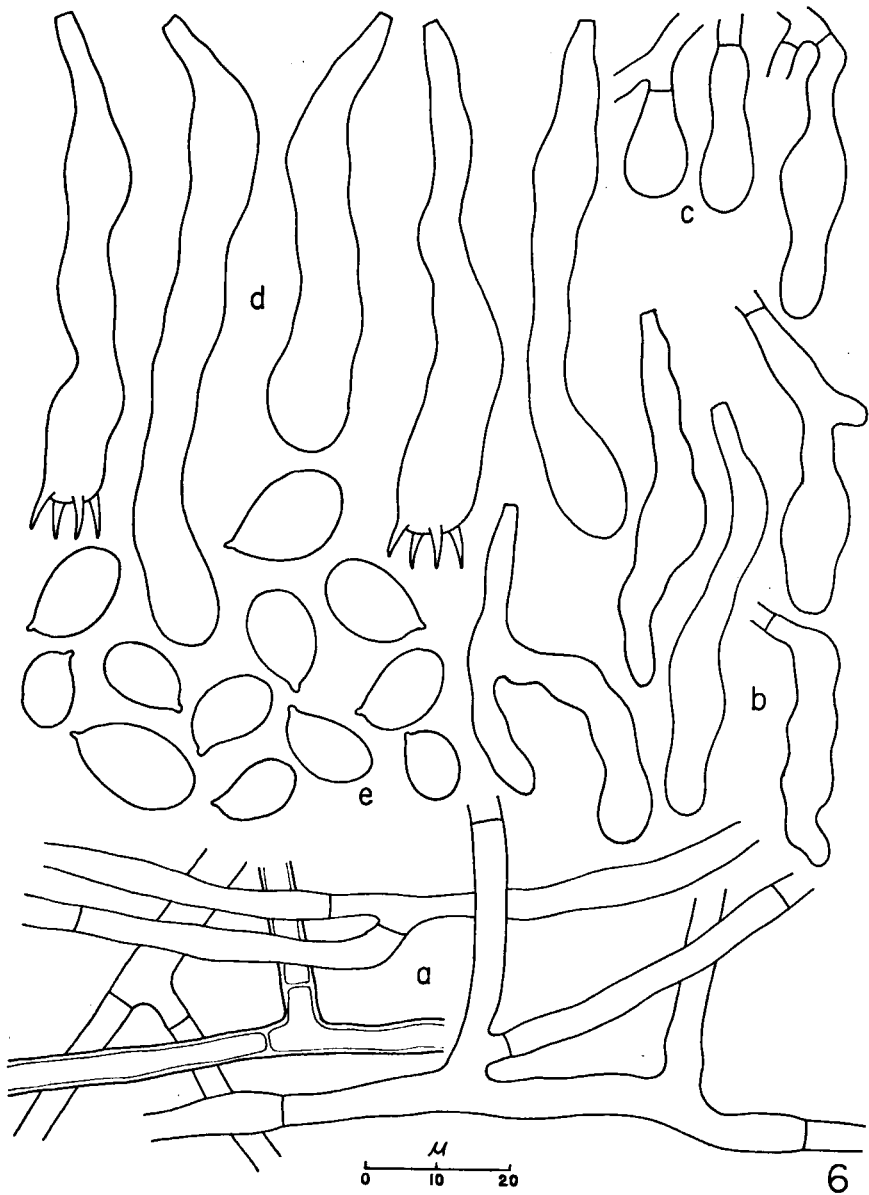


Fig. 6. Microscopic characters of *Corticium lepidum* (RLG 9356). — a. Subicular hyphae. — b. Imbedded sterile elements from hymenial region. — c. Basidioles. — d. Basidia. — e. Basidiospores.

CORTICIUM LEPIDUM (Rom.) Bourd. & Galz.—Fig. 6

Merulius lepidus Rom. in Ark. Bot. 11 (3): 29. 1911. — *Corticium lepidum* (Rom.) Bourd. & Galz., Hym. Fr. 187. 1928.

Basidiocarps resupinate, developing under snow, enveloping twigs, conifer needles, and other litter and growing over logs, stumps and on the base of standing living trees; in small patches or becoming widely effused; hymenial surface bright orange when fresh (Apricot-Orange to Light Salmon-Orange), fading slightly on drying, shallowly meruloid to smooth, hymenial layer pelliculose on a loose, white, cottony subiculum which extends beyond the hymenial layer to form a white, cottony, sterile, margin.

Subicular hyphae loosely arranged, with abundant septa but no clamp connections, with frequent branching, thin- to thick-walled, 3–5.5 μ in diam (Fig. 6a); cystidia not present; imbedded, elongated sterile elements abundant in hymenial region, very irregular in shape, 4–10 μ in diam. (Fig. 6b); basidia developing in a cata-hyemenium, originating as imbedded spherical to pyriform basidioles (Fig. 6c), these giving rise to mature basidia that are utriform to clavate, elongated and often contorted, 4-sterigmate, 60–85 μ long and 8–12 μ wide at the expanded apex (Fig. 6d); basidiospores hyaline, smooth, negative in Melzer's reagent, ellipsoid to ovoid, some slightly curved, with a large blunt apiculus, highly variable in size 9–19 \times 5–12 μ (Fig. 6e).

The basidiocarps of *C. lepidum* develop under snow in the winter or early spring in the mountains of southern Arizona and are associated with copious white mycelium growing over conifer needles and wood on the ground. They deteriorate rather rapidly and cannot be found by midsummer.

Peniophora laurentii Lundell, as discussed by Eriksson (1950), is very similar to our Arizona fungus but has incrustated cystidia. Eriksson states that *C. lepidum* is a synonym of *P. laurentii*. If this is the case, Romell's name would be the correct basionym. No incrustated cystidia could be found in our Arizona specimens. The catahymenial structure of *C. lepidum* and the large ellipsoid to ovoid basidiospores with larger apiculus are characters found in the genus *Laeticorticium* Donk. However, the absence of typical dendrohyphidia and clamp connections in *C. lepidum* mitigate against placing it in *Laeticorticium*.

SPECIMENS EXAMINED: RLG 7886, on base of living Douglas fir [*Pseudotsuga menziesii* (Mirb.) Franco], Treasure Park, Pinaleno Mts., Graham County, June 16, 1968; RLG 7883, on conifer needles on the ground, Riggs Flat Lake, Pinaleno Mts., June 15, 1968; RLG 9356, on Douglas fir twigs on ground, Summerhaven, Santa Catalina Mts., Pima County, May 18, 1970; RLG 9393, on base of living Douglas fir, Riggs Flat Lake, June 5, 1970; RLG 7839, on Douglas fir branches under snow, Bear Wallow, Santa Catalina Mts., April 29, 1968; ABB 1499, on quaking aspen (*Populus tremuloides* Michx.), Mt. Lemmon, Santa Catalina Mts., May 28, 1970.

BYSSOMERULIUS HIRTELLUS (Burt) Parm.—Fig. 7

Merulius hirtellus Burt in Ann. Mo. bot. Gdn 4: 335. 1917. — *Byssomerulius hirtellus* (Burt.) Parm. in Ecsti NSV Tead. Akad. Toim. (Biol.) 16: 384. 1967.

Basidiocarps resupinate, soft, becoming widely effused; hymenial surface becoming distinctly merulioid, white to very pale pinkish or cinereous, distinctly cystidiate at $30\times$; sterile margin white to pale pinkish, soft, cottony; subiculum very thin, white, soft-cottony to almost arachnoid; basidiocarps associated with abundant sterile, pinkish (Rhodonite Pink to Pale Rhodonite Pink) cottony mycelium growing over twigs, leaves and other litter under snow.

Hyphal system monomitic; hyphae of sterile pink mycelium incrusting, $3-5\ \mu$ in diam., a few with constricted portions with greatly thickened to almost solid walls; subicular hyphae with abundant simple septa, thin- to moderately thick-walled, with occasional branching, $3-4\ \mu$ in diam., some lightly to heavily incrusting (Fig. 7a); cystidia abundant, cylindrical, or rarely swollen at the apex, thin-walled, $3-4\ \mu$ in diam. and projecting to $35\ \mu$ (Fig. 7b); basidia clavate, 4-sterigmate, with a basal septum, in candelabrums, $20-25 \times 3-4\ \mu$ (Fig. 7c); basidiospores hyaline, smooth, negative in Melzer's reagent, short-cylindric, slightly curved, $4-5 \times 2-2.5\ \mu$ (Fig. 7d). Associated with a white rot. Gum guaiac reaction negative on fresh hymenial surface after 15 minutes.

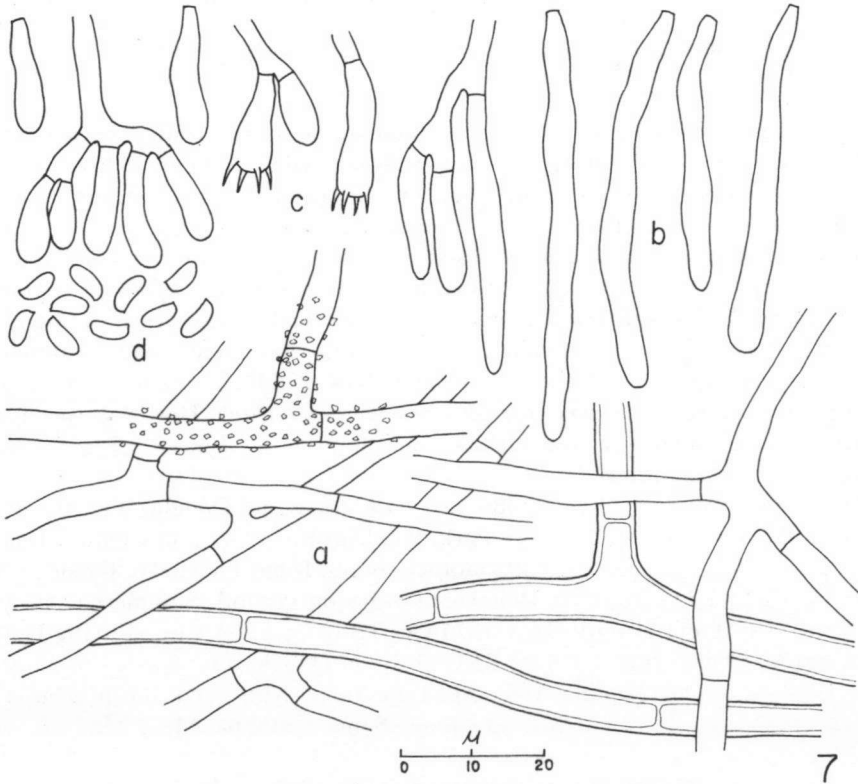


Fig. 7. Microscopic characters of *Byssomerulius hirtellus* (RLG 9375). — a. Subicular hyphae. — b. Cystidia. — c. Basidia. — d. Basidiospores.

The application of this name to the specimens cited is made with some reservations. Ginns (1968) has provided a description based on the holotype (BPI) and isotype (FH) of *M. hirtellus* and my observations of those specimens are in agreement with his. The basidiospores in our Arizona collections are slightly narrower and more distinctly curved than in the types of *M. hirtellus* and in a collection of mine from New York (RLG 5477, on *Picea rubens* Sarg., Saranac Lake, Sept. 11, 1965). The basidiospores as described and illustrated in this paper are more like those of *Merulius armeniacus* Bres., a species also placed in *Byssomerulius* by Parmasto. However, we have specimens of *M. armeniacus* in our Arizona collections that agree very well with the type of that species (BPI, Weir 15306). They differ from the specimens identified here as *M. hirtellus* in having a brightly colored hymenial surface (Vinaaceous-Rufous to Hay's Russet) and a gelatinizing layer in the subhymenium. Until the range of variation in *B. hirtellus* and *B. armeniacus* is better understood, we will refer our Arizona specimens with pale pinkish to cinereous hymenial surface and non-gelatinized subhymenial layer to *B. hirtellus*.

Byssomerulius hirtellus also fruits in abundance in the summer rainy season in southern Arizona. The pinkish to gray colors and the strongly cystidiate hymenium are diagnostic characters.

SPECIMENS EXAMINED: RLG 9368 and 9375, on fallen twigs and branches of corkbark fir in snow, Mt. Lemmon, Santa Catalina Mts., Pima County, May 9, 1970; RLG 8375, on ponderosa pine, Long Park, Chiricahua Mts., Cochise County, Arizona, August 30, 1968; RLG 10626, on Douglas fir log, Mt. Bigelow, Santa Catalina Mts., July 26, 1972; RLG 10621, on Engelmann spruce log (*Picea engelmannii* Parry), Treasure Park, Pinaleno Mts., Graham County, Arizona, July 19, 1972.

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