

MYCOTAXON

Volume 101, pp. 113–136

July–September 2007

***Xerula hispida* and *Xerula setulosa* (comb. nov.), two similar subtropical New World agarics**

RONALD H. PETERSEN

repete@utk.edu

*Ecology and Evolutionary Biology, University of Tennessee
Knoxville, TN 37996-1100 USA*

&

TIMOTHY J. BARONI

*Department of Biological Sciences, SUNY – College at Cortland
Cortland, NY 13045 USA*

Abstract — *Gymnopus setulosus*, described from Jamaica, is now known from the Caribbean, Central and tropical South America. Apparently, *Lentinus pilosus* Rick, described from southern Brazil, is a synonym. The species belongs in *Xerula* sect. *Xerula*, and a new combination is proposed to accommodate this placement. *Xerula hispida*, described from Costa Rica, appears to be a 2-spored state of *X. setulosa*, and is reported here from northern South America for the first time.

Key words — biogeography, distribution, anamorphic state

Introduction

When William Alphonso Murrill wrote notes on the single basidiome of *Gymnopus setulosus* from Jamaica, he commented, “quite peculiar.” A small, gracile, spindly basidiome fruiting out of a wet clay bank, the entire outer surface of the pileus and stipe was covered with stiff, lanceolate setae, and the fruitbody formed a pseudorhizal extension of the stipe base.

Since that initial collection, no other basidiome has been accessioned under this name or its equivalent, *Collybia setulosa*. Its taxonomic placement has remained obscure in spite of Dennis’s voluminous literature on Venezuelan and Caribbean fungi and Pegler’s floristic work on the Lesser Antilles.

Somewhat later, Rick described *Lentinus pilosus* from southern Brazil. Pegler’s impression, taken from the original description, was that Rick’s specimen “almost certainly” represented a species of *Crinipellis*. Singer (1953)

examined the type specimen and concluded that it was a *Xerula*, closely related to *X. pudens*.

Much more recently, Halling & Mueller (1999) described *Xerula hispida*, a 2-spored, clampless species from *Quercus* forests of Costa Rica.

The intent of this paper is to describe *Xerula setulosa* (comb. nov.), inclusive of *X. pilosa*, and to redescribe *X. hispida* with additional geographical range.

Materials and methods

Abbreviations: TFB = Tennessee Field Book; comprising notes, photos and other tracking numbers, superceded by a TENN number, the accession number of the herbarium specimen. PhC = Phase Contrast Microscopy. Color terminology within quotation marks refer to Ridgway (1912).

Results

Xerula setulosa (Murrill) R.H. Petersen & T.J. Baroni, **comb. nov.** Figs. 1–8

MYCOBANK MB 510847

Basionym: *Gymnopus setulosus* Murrill 1916. North American Flora 9: 373.

= *Collybia setulosa* (Murrill) Murrill 1916. Mycologia 8: 219.

= *Marasmius setulosus* (Murrill) Singer 1951 ('1949'). Lilloa 22: 326

[non *M. setulosus* Murrill 1940. Bull. Torrey Bot. Club 67: 150].

= *Marasmius murrillianus* Singer, nom. nov. 1952. Lilloa 25: 488.

Holotype (des. Murrill): JAMAICA, Cinchona, 25.XII.1908-8.I.1909,

coll WA Murrill, Murrill 632 (NY!).

= *Lentinus pilosus* Rick 1938. Lilloa 2: 310, nom. illeg.

[non *Lentinus pilosus* (Fr.) Fr. 1838. Epicrisis Systematis Mycologici: 395].

= *Xerula pilosa* (Rick) Singer 1953. Lilloa 26: 86, nom. nov.

[see also Revue Mycol. 18: 6. 1953]

= *Oudemansiella pilosa* (Rick) Singer. 1962 ('1961'). Sydowia 15: 59 [see also:

Raithelhuber 1962. Fl. Mycol. Argentina, Hongos III (Stuttgart): 95].

Holotype (des Rick, teste Singer): Unspecified. [see Singer, 1953: BRAZIL, Rio Grande

do Sul, São Leopoldo, as *Lentinus pilosissimus*, Rick no 13.845 (PACA).

Basidiomata (Fig. 1) gracile, diminutive, collybioid, radicating. **Pileus** 7–20 mm diam, 1–6 mm high, plano-convex with truncate to mammilate umbo, rugose, occasionally delicately areolate, Isabel to raw umber (223) to deep gray-brown (6F5) over disc, outward gray-brown (6E4) fuliginous outward (drying to dark purplish brown), covered with white, tawny, rufous or brownish bristles up to 700 µm long; margin undulate, slightly incurved. Flesh thin (less than 1 mm thick), white, unchanging with bruising, with no odor or taste. **Lamellae** adnate to adnexed, non-collariate but sometimes seceding to a pseudocollarium, moderately broad (–1.5 mm broad), pruinose, non-marginate, pure white,

subdistant; edge concolorous. **Stipe** 40–60 × 0.5–2.5 mm, flattened, off-white apically, downward salmon colored, Isabel, or deep golden brown (5D7–6D7), pubescent with brown bristles (drying cinnamon brown), hollow, expanded at base; pseudorhiza abruptly tapered, furrowed, pubescent, brownish gold, radicating.

Habitat: Under broad-leaved trees; in Belize under *Quercus oleoides*, *Coccoloba brasiliensis* and mixed hardwoods.

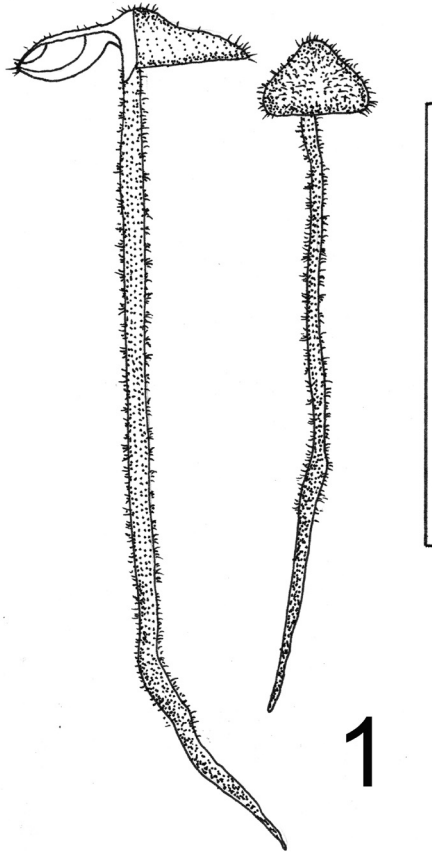


Fig. 1. *Xerula setulosa*. Basidiomata. Illustrative reconstruction.
Standard bar = 40 mm.

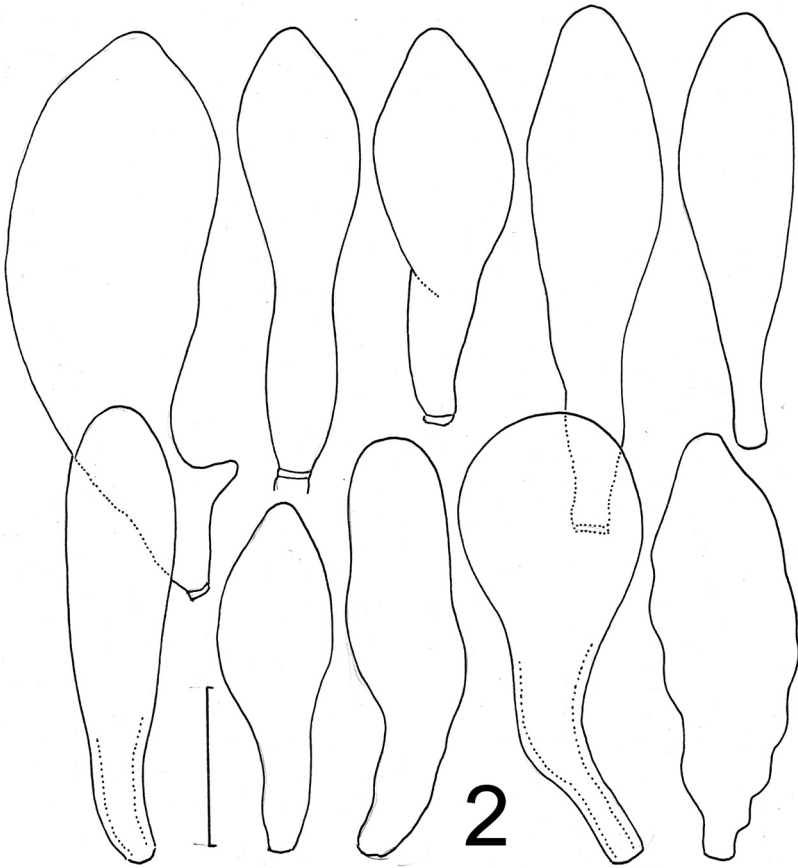


Fig. 2. *Xerula setulosa*. Pileocystidia. Holotype.
Standard bar = 20 μ m.

Pileipellis hymeniform, constructed of two elements. **Pileocystidia from disc** (Fig. 2) 28–70 \times 9–15 μ m, clavate, fusoid-ventricose, lageniform, subglobose or fusiform, thick-walled (wall consistently 1.2 μ m thick), with outer limit of wall indistinct (but inner surface distinct), arising from somewhat inflated, thick-walled subpellis cells, without clamp connections; contents uniformly pallid olive-brown, inamyloid; **pileosetae from disc** (Fig. 3) rudimentary, up to 85 μ m long, appearing ochraceous orange (PhC). **Pileocystidia from**

pileus margin 26–56 × 15–33 μm, hardly pedicellate, subsphaeropedunculate, arising from inflated subpellis hyphae, usually with thickened basal septum, firm-walled; contents usually heterogeneous, occasionally homogeneous and then uniformly deep olive-brown; **pileosetae from pileus margin** 63–180(–800) × 7–28 μm, arising with single base (not basally furcate) but sometimes with 1–3 small proximal knobs, cylindric-acuminate or lanceolate, obtuse,

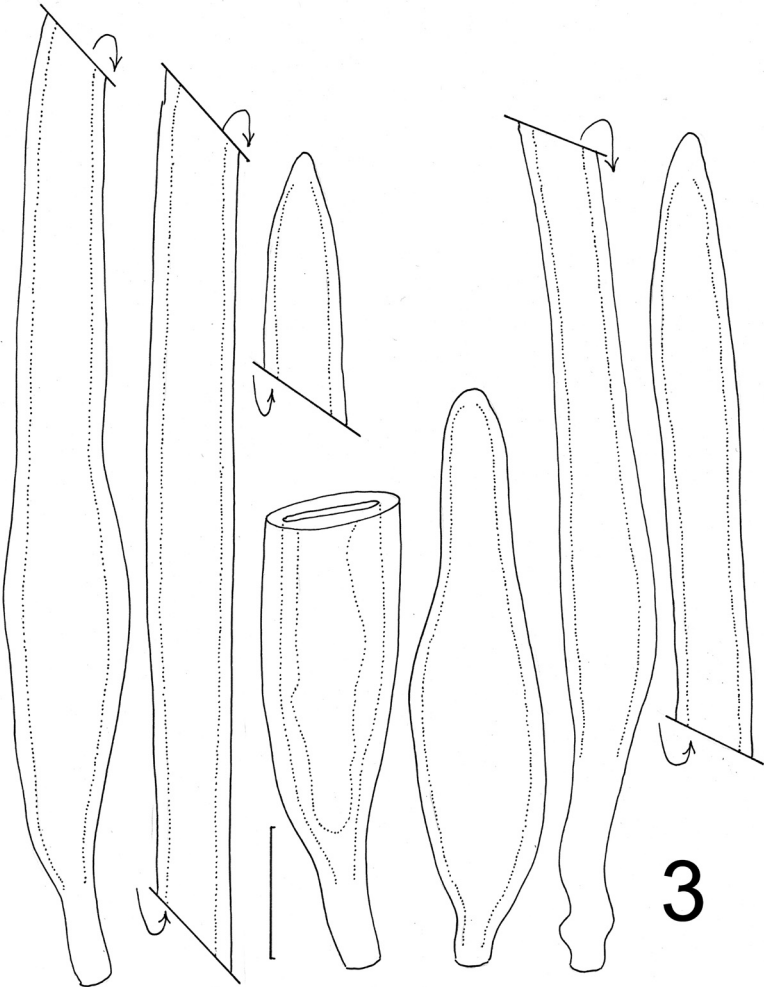


Fig. 3. *Xerula setulosa*. Pileosetae. TJB 7239.
Standard bar = 20 μm.

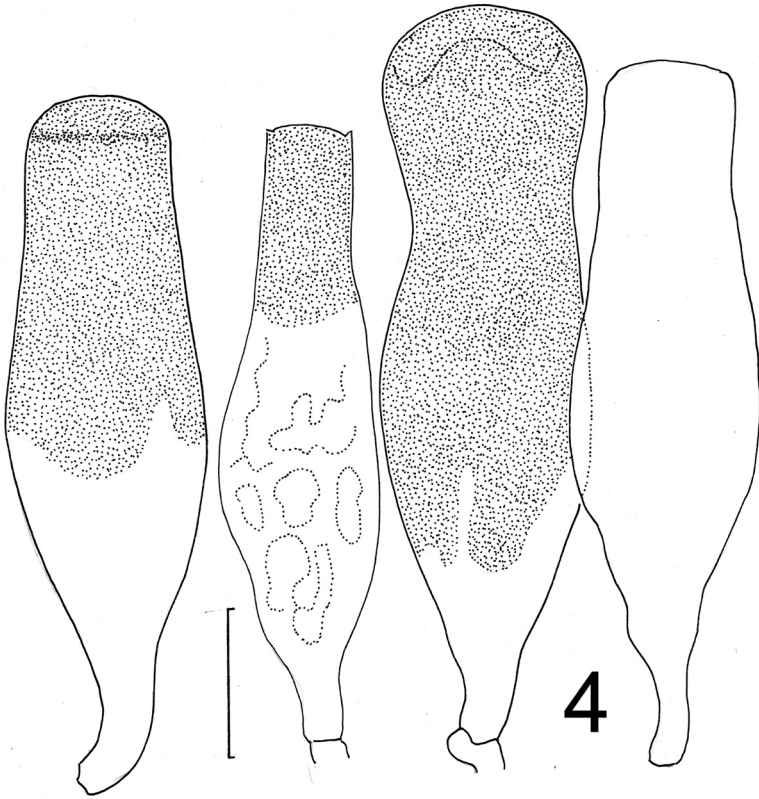


Fig. 4. *Xerula setulosa*. Pleurocystidia. Holotype.
Standard bar = 20 μ m.

subacute or acute, melleous or brownish orange, tawny or ferruginous, thick-walled (wall 3–8 μ m thick), inamyloid. Pileus trama interwoven, sarcodimitic. **Pleurocystidia** (Figs. 4, 5) 60–130 \times 12–33 μ m, thin-, firm-, or thick-walled, especially over pedicel, ventricose or broadly lageniform, with bluntly rounded apex, often long-pedicellate, hyaline, firm- to thick-walled (especially over proximal inflation), without clamp connections; contents heterogeneous, with apical 1/3–2/3 minutely multigranular, hardly refringent, and the lower portion with coagulated protoplasm. **Hymenophoral trama** bilateral, with wide mediostratum and narrow divergent lateral strata, subgelatinous; hyphae inamyloid, without clamp connections, of two cell types: 1) greatly inflated,

catenulate, up to 75 μm long, up to 40 μm diam, firm-walled but easily collapsed, hyaline, clampless; contents homogeneous; and 2) slender (3.5–4.5 μm diam), interwoven, thin-walled, hyaline; contents homogeneous. Basidioles subclavate or ventricose, hyaline, thin-walled. **Basidia** (Fig. 6) 30–60 \times 10–19 μm , (2-, 3-)4-spored, clavate from somewhat pinched base, rarely obviously clamped; contents multiguttulate when immature, becoming several-guttulate by maturity. **Basidiospores** (Fig. 6) (7–)10–12.8(–14) \times (7–)9–12 μm (E = 1.00–1.40;

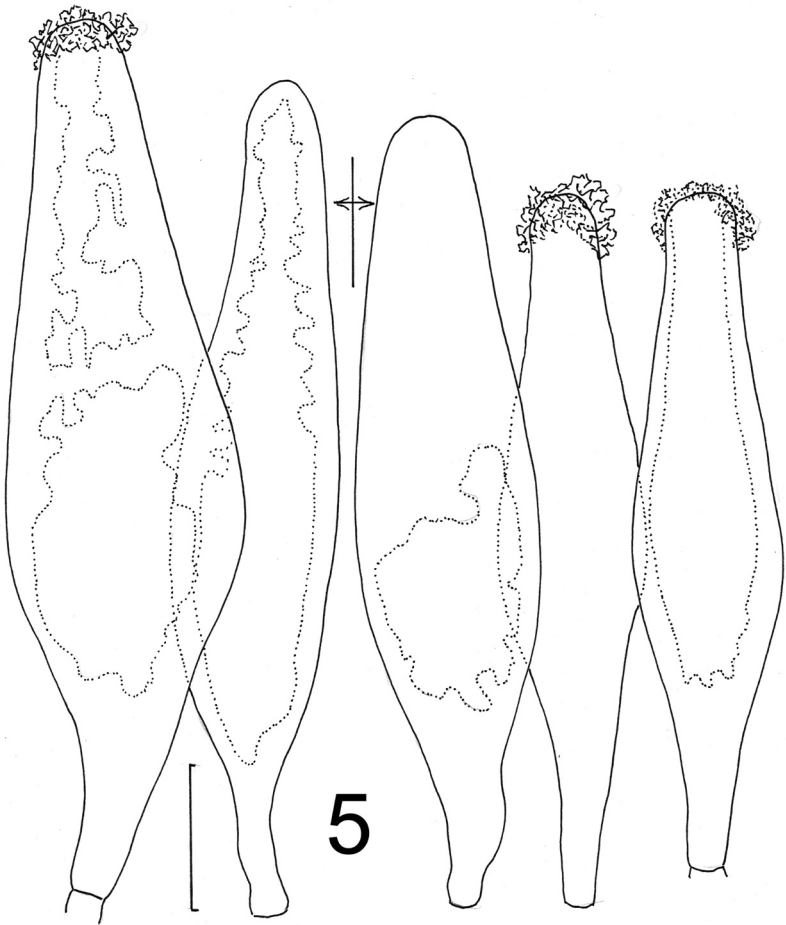


Fig. 5. *Xerula setulosa*. Pleurocystidia. Left; TJB 7239. Right; Ventura 1891.
Standard bar = 20 μm .

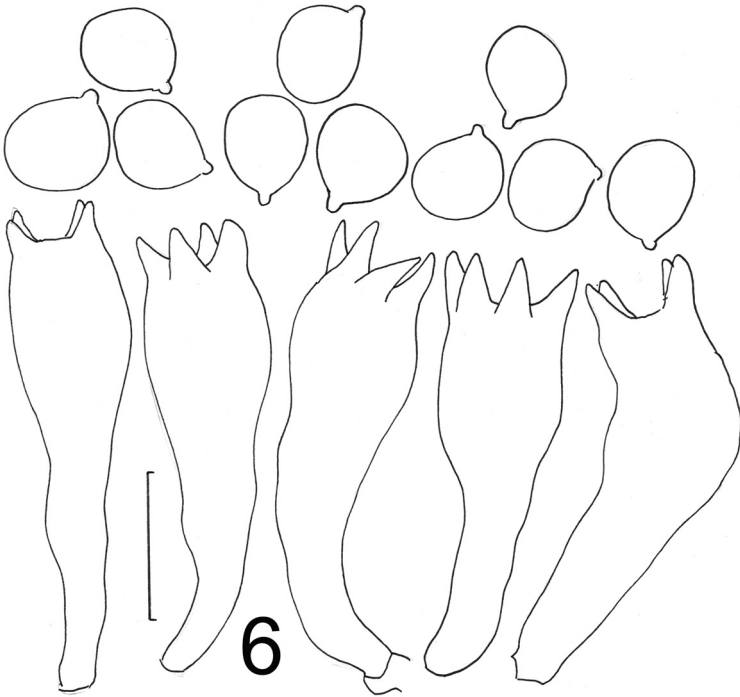


Fig. 6. *Xerula setulosa*. Basidia and basidiospores. Holotype.
Standard bar = 20 μ m.

Em = 1.17; Lm = 12.20 μ m), globose to subglobose, smooth to delicately puckerred, hyaline; contents opalescent to granular, yellowish in iodine. Lamellar margin fertile, with scattered cheilo- and pleurocystidia. **Cheilocystidia** (Fig. 7) 49–76 \times 10–24 μ m, short-pedicellate, utriform, fusiform, lecithiform, or subulate, hyaline; contents homogeneous. **Stipe apex** outer cortex of hyphae with reddish-brown walls; hyphae 3–8 μ m diam, thick-walled (wall up to 1 μ m thick); inner stipe apex hyphae of two types: 1) inflated, unbranched, 5–16 μ m diam; and 2) infrequently branched, 1.5–4 μ m diam. Stipe midsection with surface layer of straw-colored, slender (4–8 μ m diam), thick-walled (wall up to 1.5 μ m thick), simple-septate, apparently coherent hyphae, with inner flesh hyphae similar but hyaline; stipe surface beset with blond setae, in clusters including abortive, hyaline individuals and 1–3 well-developed individuals. **Stipe surface** of two elements: 1) caulocystidia 10–32 \times 5.5–8 μ m, cylindric or subclavate, obtuse, rarely lobed, hyaline or yellowish, inamyloid, thick-walled (wall up to 1 μ m thick); and 2) caulosetae (Fig. 8) 100–460 \times

10–20 μm , lanceolate, melleous, reddish brown to burnt orange-ochre near base, soon yellow-ochre, then pallid yellow and finally subhyaline at apex, thick-walled (wall 1–7 μm thick), similar to pileisetae or longer, somewhat flexuous.

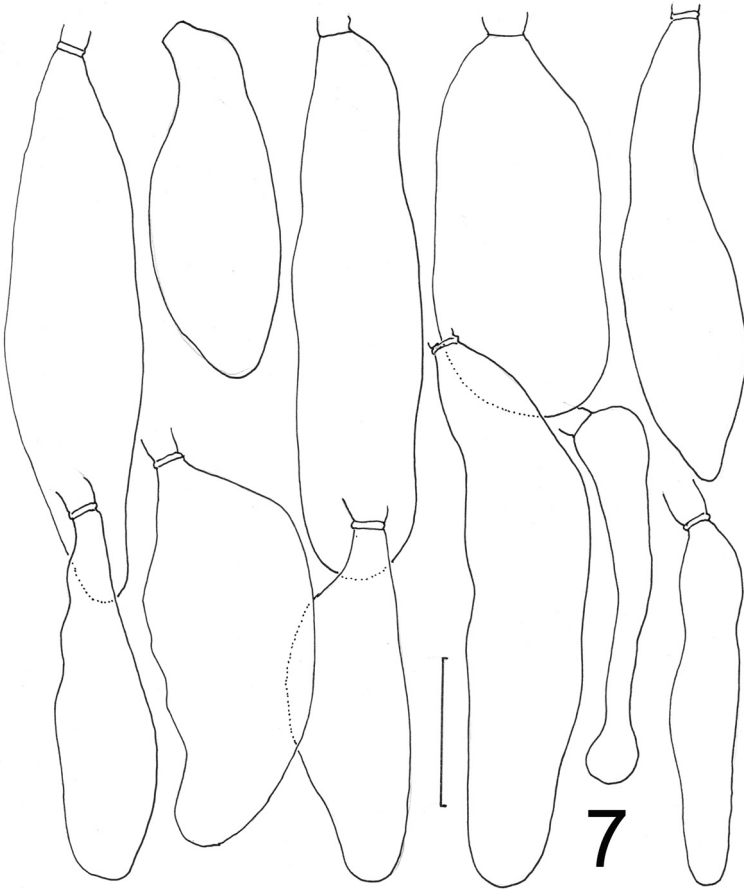


Fig. 7. *Xerula setulosa*. Cheilocystidia. TJB 7239.

Standard bar = 20 μm .

Commentary: Material with the type specimen at NY includes three annotations as well as Murrill's original notes. When collated, Alexander Smith's informal notes on the type specimen, his published observations (Smith 1938), Desjardin's (1989) observations, a brief annotation by Gilliam,

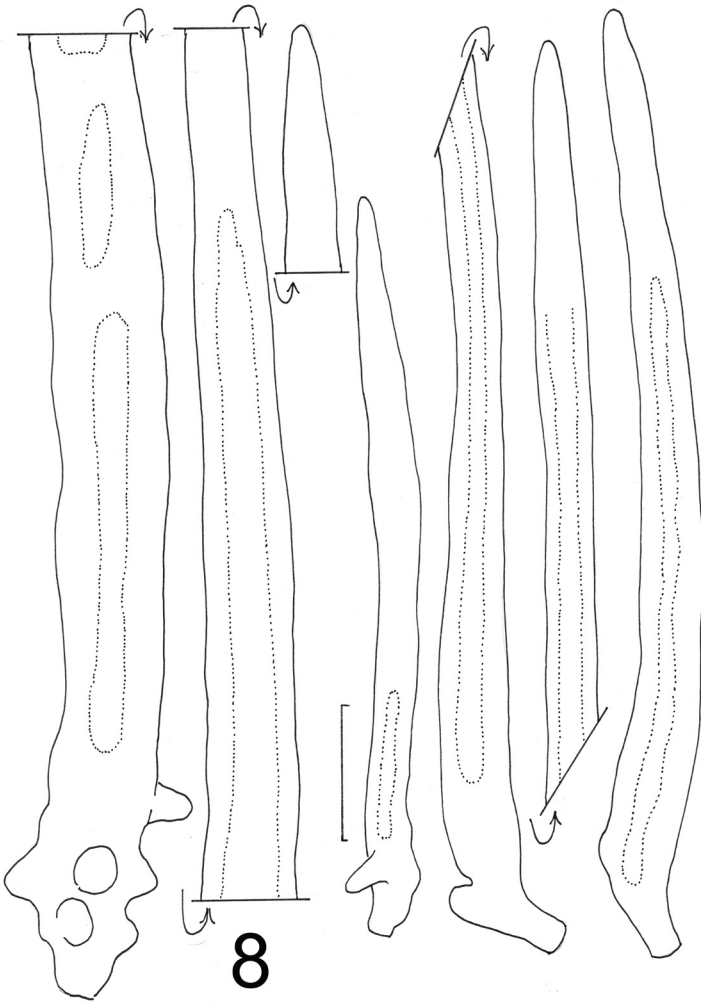


Fig. 8. *Xerula setulosa*. Mid-stipe cauloetae. Holotype.
Standard bar = 20 μ m.

and our examination of the type specimen, a rather complete description of the basidioma can be extrapolated. Although originally published as a *Gymnopus* species, the epithet was not taken up by Halling (1983).

In herb. Kew, no specimen exists under the binomial *G. setulosus*, but a sheet with aquarelle, drawings, and notes is available. Pertinent notes (some apparently in the hand of RWG Dennis) and other material follows:

- 1) note: "Cinchona, 25 Dec – 8 Jan, 1908-9. About 1500 m. WA and EL Murrill 632;"
- 2) "Fig. 116. Wet bank. Radicate in mossy clay. Irreg. conic. 1.6 [cm] d[iam], 6 [mm] high, top truncate, cap rugose & uneven, Isabel at top, rest fulig[ineous], all covered with white to brownish bristles, many undulate, sl[ightly] incurved, gills pure white, 1 mm apart, free it seems, stem flattened, Isabel with brown bristles, hollow, 5 cm long. .25 [cm] d[iam] at center, enlarged at base and radicate like *Collybia radicata* & tough too. Very peculiar. (Collector's notes with type);"
- 3) [spores] globose, smooth, hyaline, granular, 7-11 μ ;
- 4) [Murrill's notes] "the few spores found on the gill – though immature – are consistent with this. Trama of apparently non-gelatinized, non-amyloid but hypodermium is reddish in Melzer. Too few spores to determine iodine reaction;"
- 5) drawings of typical pleuro- and cheilocystidia, 2-4-spored basidia, pileipellis and pileosetae, plus aquarelle of basidiomata. The aquarelle closely resembles the aquarelle at NY and surely is a copy of it.

We conclude that Dennis examined the type specimen of *G. setulosus*, probably as part of his work on tropical South American fungi. The name, however, was not taken up in Dennis's (1951, 1961, 1968, 1970) publications which included agarics from the region, nor is there a reference to it by Pegler (1983a) for the Lesser Antilles.

The cumulative description above closely resembles that of *X. hispida* except for 4-spored basidia. Desjardin specifically noted that hyphae were clampless, and this would not ordinarily accompany 4-spored basidia. Murrill illustrated a short, tapering pseudorhiza, while basidiomata of *X. hispida* usually bear rather long, gradually tapering pseudorhiza.

Murrill (1916a) published *Gymnopus setulosus* for a single specimen from Cinchona, Jamaica. Later (Murrill 1916b) he published a long list of "currently accepted generic names" for species published in NAF. These names cannot be accepted as "simultaneous names" in the sense of the ICBN. Therefore, *Collybia setulosa* is a nomenclatural synonym of *Gymnopus setulosus*.

Later (Murrill 1940), Murrill described *Marasmius setulosus* as a separate taxon.

Singer (1951) transferred Murrill's *Gymnopus setulosus* to *Marasmius*, but later found that the combination was preoccupied by Murrill's 1940 name. Singer (1952), therefore, proposed a nomen novum for his sense of *Marasmius setulosus*, and he chose *Marasmius murrillianus*.

Smith's (1938) report of the type specimen indicated a single, well-preserved fruit-body, while Desjardin found only 1/3 of a single pileus and some additional fragments. Smith reported on basidia and basidiospores, while Desjardin saw none of either. Now, the type specimen has been reduced to five

small fragments, two of pileus + lamellae (but with lamellar edges absent), the others of stipe. The largest fragment remaining is of the pseudorhiza, also beset with setae. The stipe seems quite slender (although only a couple longitudinal fragments remain). An approximation of the cap might be 2 cm broad (see Murrill's notes). Information may be sought at <http://sweetgum.nybg.org/vh/specimen.php?im=579487>.

It is probable, based on the few specimens reported here, that *X. setulosa* produces smaller and more gracile basidiomata than its 2-spored analog, *X. hispida*. A very similar organism, *X. sinopudens* R.H. Petersen & Nagas., also 4-spored, forms gracile, spinulose fruitbodies. Both Baroni specimens exhibited a mixture of 2- and 4-spored basidia, an unusual situation, especially with tramal hyphae and basidia without clamp connections.

In TJB 7289, the pileus surface is delicately shagreened to areolate, with the underlying flesh straw colored, overlaid by the outer layer of dark olive. The umbo is solidly so (i.e. not cracked and uniform in color). Areolation is more and more delicate outward, with the pileus margin extremely delicately so. The first appearance of setae (20X) is on the pileus limb, half way to the margin, and the margin is the most setose area of the pileus. This seems typical of basidiomata of *Xerula* sect. *Xerula*.

Specimens examined: BELIZE, Cayo District, Banglor d'Silva Forestry Station, 13.I.2002, coll TJ Baroni, TJB 7289 (CORT). JAMAICA, Cinchona, 25.XII.1908-8.I.1909, coll WA Murrill, Murrill 632 (holotype of *G. setulosus*, NY!). MEXICO, Est. Hidalgo, km 4 de la desviación hacia El Mineral del Chico, 18.IX.1983, coll R Valenzuela (as *Oudemansiella*), Valenzuela 2547 (ENCB); Est. Puebla, Carretere Tezuitlan a Tlapacoyan, Puente Colorado, 30.VII.1970, coll F Ventura, Ventura 1891 (ENCB) [annot. "revisó y determinó" E. Perez Silva, 1985, as *O. pilosa*]. UNITED STATES, PUERTO RICO, Palo Hueco, east of Rio Espiritu Santo, N 18° 18' 51", W 65° 49' 21", 550 m, 16.VII.1998, coll SA Cantrell & C Laboy, det DJ Lodge (as *Xerula* sp), TJB 4899 (CORT).

Xerula pilosa

According to Singer (1953: 86), a specimen deposited by Rick as *Lentinus pilosissimus* (Rick 13845) and published by Rick (1938: 310) as *Lentinus pilosus*, is a *Xerula*, "closely related to *Xerula pudens* (Pers. ex S.F. Gray) Sing." Singer (1953, 1962, 1964) furnished three descriptions of the species, but at least two of these (Singer 1953, 1964) cited only the type specimen as the source. Singer's generic concept changed over the years, and the terminal stop for the epithet was as *Oudemansiella pilosa* (Rick) Singer (1962). Dörfelt (1985) examined the type specimen and augmented Singer's descriptions somewhat. Combining these sources, a comprehensive description of the type specimen can be offered. Dörfelt's (1985) description appears in Roman type; Rick's (1938) description is in italics; and Singer's (1964) description is in bold face.

Two basidiomata. Small, thin-fleshed (*elastico, submembranaceo*), dark brown agaric from *Crinipellis* habitat. **Pileus** 0.5-1 cm diam (*1 cm. lato*; **10 mm broad**), subumbonate (*papillato*; **with papilla**) to nearly plane (*plano-depresso*; **flat to depressed**), chocolate brown (*brunneo*; **brown, not striate**) with disc darker; surface dry (**dry**), densely prickly through macrosetae (*setuloso, setulis magnis*; **beset with setulose brown hairs**); macrosetae on cap surface 300–450(–1200) μm long. **Lamellae** free (!) to attached (?) (*ventricosis, adnatis, inaequalibus confertis, albis; albis notabilis*; **white, ventricose, polydymous, adnate, close**), in dried specimen brownish-white, seceded. **Stipe** (*ferrugineo-setuloso*; **rusty-brown, setose-pilose**), 4.5–6 cm long (!) (*1 dm longa*; **about 100 mm long**), (1–)2–2.5 mm thick (cap diameter: stipe length, 1:10), basally clearly straight (**subequal**), twisted when dry; ground color of stipe surface chocolate brown; macrosetae concolorous but shining; pseudorhiza broken off, up to 2 cm long and then broken (*radicante*), appearing like the stipe. **Veil none. Context white, thin, elastic in pileus, toughish in stipe.**

Spores almost round to broadly ellipsoid (*ovato-sphaericis, apiculatis, 12 \mu*; **broadly ellipsoid**), 9.5–12 μm diam and/or 10–16 \times (8.5–)9.5–14 μm , mostly 13 \times 11 μm (!) (**about 10.2 \times 6.9 μm**): basidia 30–36(–40) \times (7–)10–20 μm (!) (*magnis clavatis*; **about 40 \times 7 μm or more broad**); cystidia 37–83 \times 17–24 μm (S) (37–83 \times 17–24 μm), rotund to flask-shaped or apically broadly rounded off (*paucis magnis, lageniformibus*), sometimes apically encrusted or with crystals, these more seldom than in *Xerula pudens* [**with rounded tips, reminiscent of those of *Inocybe*, ampullaceous-ventricose, with thick (at least 2 μm) wall, smooth or somewhat hyaline-incrusted, metuloid, somewhat opalescent, hyaline, sometimes compressed and thus shortened above, on edges and sides of lamellae**]; macrosetae [cheilocystidia] always pointed, smaller mostly tapering, larger usually abrupt with tips appearing like fence slats, in the middle (10–)13–16(–19) μm thick, base to 22 μm ; wall (1.5–)2.5–7 μm thick, very seldom under 1 μm (!). **Hyphae hyaline, inamyloid with clamp connections.** Macrosetae of pileus surface [pileisetae] seldom inserted in the cells of the hymeniderm, most in the “mesopileus” range of the cap trama, arising in the subhymenial range and erupting through the cap trama and hymenoderm [these “hairs” (i.e. pileosetae) 300–450 \times 13.4–20 μm , thick-walled (wall 2.7–7 μm thick), rarely entirely subhyaline, mostly melleous to castaneous-succineous, gradually tapering and becoming lighter colored toward the needle- sharp, acute tip, usually more pigmented in the inner layer of the complex wall, inamyloid (not pseudoamyloid!)]; hymenoderm irregular and as all *Xerula* taxa, deviating from a strict cutis and/or trichoderm-type structure (teste Singer: “not forming a true hymeniform layer...”). Elements of upper pileus surface not regularly inserted in a layer, stalked, apically inflated or somewhat subglobose (vaguely pear-shaped), 8–16 μm diam, with brown

intracellular pigment; stipe surface of long, parallel hyphae outward forming a plectenchymatous rind, macrosetae inserted relatively superficially.

Pérez-Silva & Aguirre-Acosta (1985) included a brief description of *O. pilosus* from Puebla and Veracruz, Mexico, adopting Singer's concept of the species. Although illustrating some important characters (i.e. pileipellis elements, cystidium, spores), the number of sterigmata per basidium was not reported. Their description could refer to diminutive basidiomata of *X. hispida*.

Putzke & Pereira (1988) redescribed *X. pilosa* from fresh material from near its topotype area. Not only do their observations on microscopic characters match the descriptions of type material (i.e. basidia 4-spored, cystidia metuloidal, basidiomata very slender, gracile, pilei- and cauloseae lanceolate, blond) but their illustration of basidiomata comes very close to the illustration furnished above. Their reported collections were from São Francisco de Paula, Rio Grande do Sul, Brazil, which, together with the type specimen, represent the southernmost stations for the species. Lately, Meijer (2002) included the species (as *X. pilosa*) in a floristic study of macromycetes of Paraná, Brazil, but without description. This entry was repeated in a new report (Meijer 2006). Pegler did not mention the epithet in any of his floristic publications, but in the monograph of *Lentinus* (Pegler 1983b: 251) he reported: "On the basis of the original description, this tiny fungus almost certainly represents a species of *Crinipellis*," an impression reported by Singer and appearing on a herbarium sheet at Kew.

Unfortunately, Rick's type specimen was unavailable for our study, so a final judgment as to its identity cannot be rendered. From its diminutive, gracile stature, semi-tropical topotype, and comprehensive data from other authors (see above), we conclude that it is a synonym of Murrill's *Gymnopus setulosus*. As a later name, consideration of *Xerula pilosa* does not threaten Murrill's epithet.

Xerula hispida Halling & G.M. Muell. 1999. Mycotaxon 71:105.

Figs. 9–15

Holotype (des. Halling & Mueller 1999): COSTA RICA, Prov. San José, San Gerardo de Dota, Albergue de Montaña, 10.VI.1994, Mueller 4696 (US); isotype F[!].

Basidiomata (Fig. 9) diminutive, gracile, pseudorhizal. **Pileus** 8–45 mm broad, umbonate to depressed-umbonate, dry, fibrillose-hispid, sometimes hygrophanous, usually radially puckered, striate; umbo "olive brown," "dark olive," "olive buff," "saya brown," "buffy brown" (6-7E–F5-7); margin "tawny olive," "olive buff," to cream with yellow-brown streaks, ciliate with "tawny" pileisetae; trama white, thin. **Lamellae** up to 5 mm deep, white, free to subadnexed, subdistant, tough, eventually pallid cream with age and after drying; margin blunt, not marginate, sometimes fringed with white cheilocystidia (15X). **Stipe** 30–85 × 2–4.5 mm, velutinous, "light olivaceous



Fig. 9. *Xerula hispida*. Basidiomata. TFB 10881.
Standard bar = 40 mm.

buff" (5A4) apically, downward "ochraceous tawny," "tawny" to "saya brown," (6D8, 5D6-8), profoundly hollow; **pseudorhiza** 15-35 mm long, hardly expanded upward, tapering downward gradually, velutinous, concolorous with stipe base. **Odor** negligible; **taste** negligible.

Distribution: Central America and northern South America, apparently associated with *Quercus* (*Q. rapurahuensis*, *Q. seemannii*, *Q. copeyensis*, *Q. humboldtii*); solitary to gregarious; pseudorhizal in humus or soil.

Pileipellis (Fig. 10) constructed of two discrete elements. **Pileocystidia** 50-83 × 12-32 μm, sphaeropedunculate to broadly clavate, pedicellate, often with a

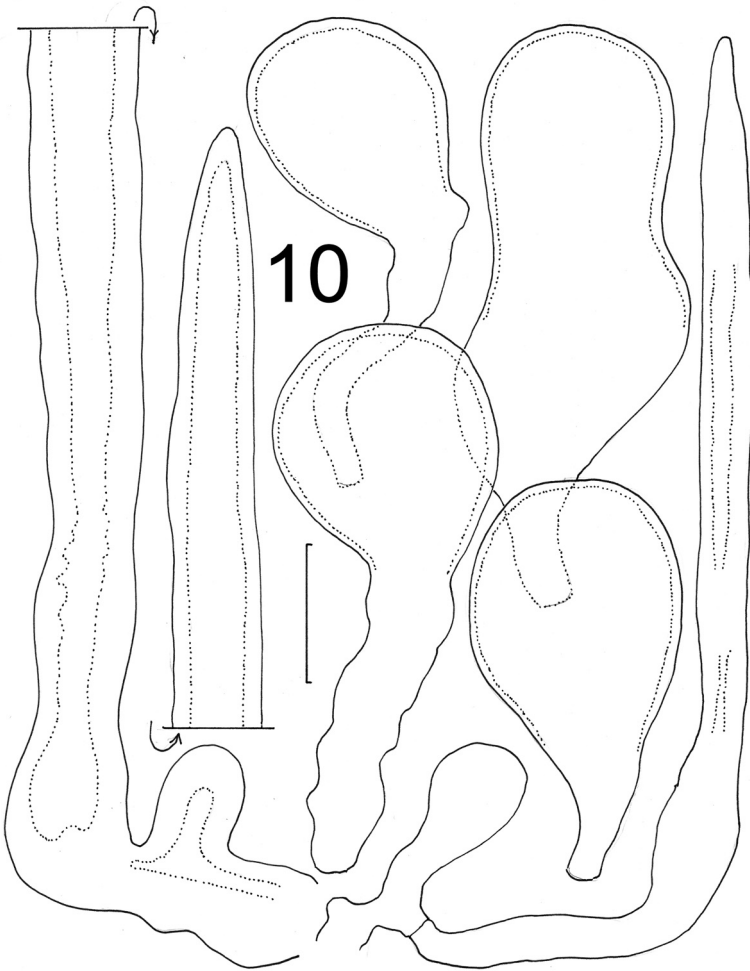


Fig. 10. *Xerula hispida*. Pileipellis structures. TFB 10881.
Standard bar = 20 μm .

small spur proximal to inflated apex, thick-walled (wall up to 1.5 μm thick); contents homogeneous, hyaline to distinctly pigmented olive-tan. **Pileosetae** 150–600 \times 10–23 μm , sagittate, lanceolate (especially acute when small), often with basal spur or lobe, thick-walled (wall up to 6 μm thick, occluding cell lumen distally), yellow to ochraceous orange (PhC), refringent; in some specimens (including the type) small, aborted pileosetae abundant. Pileosetae and pileocystidia arise from same hyphae; clamp connections absent. **Pleurocystidia** (Figs. 11, 12) without clamps, of two types: 1) 95–120(–185

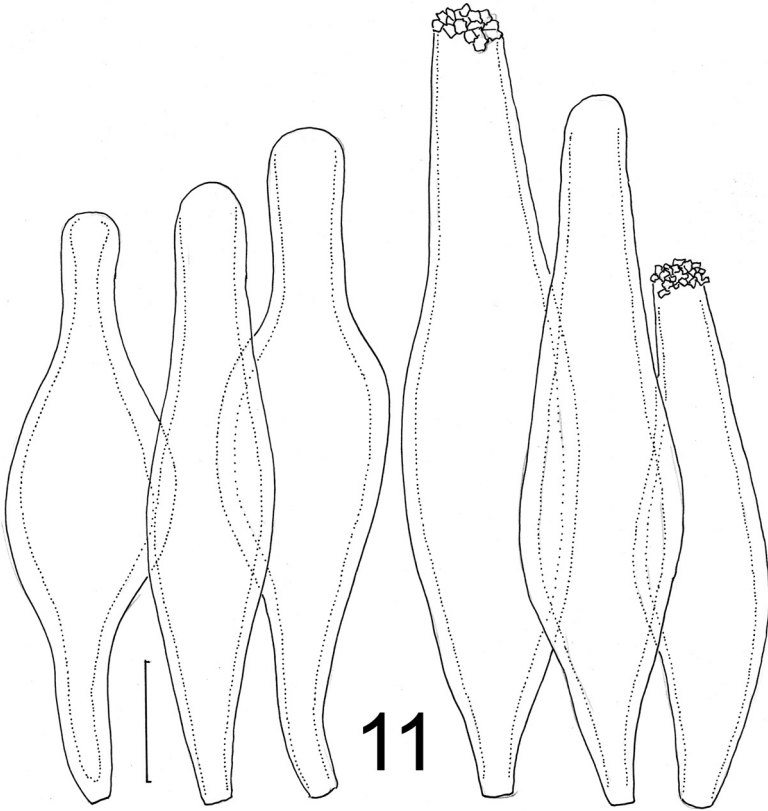


Fig. 11. *Xerula hispida*. Pleurocystidia. Left; TFB 10881. Right; TFB 9463.
Standard bar = 20 μ m.

$\times 20\text{--}30 \mu\text{m}$, narrowly ten pin-shaped, thick-walled (wall up to $6 \mu\text{m}$ thick in median portion, thinner over capitulum and at base), refringent, sometimes with apical crystalline deposit or (in fresh condition) apical droplet; and 2) $53\text{--}72 \times 13 \mu\text{m}$, fusiform with lanceolate apex, obscurely thick-walled, refringent. **Basidia** (Fig. 13) $38\text{--}62 \times 10\text{--}13 \mu\text{m}$, clavate, arising from pinched base, without clamps, 2-spored (sterigmata up to $9 \mu\text{m}$ long); contents multiguttulate, with 2-4 major guttules. **Basidiospores** (Fig. 13) $11\text{--}14 \times 8\text{--}12 \mu\text{m}$ ($E = 1.08\text{--}1.50$; $Em = 1.26$; $Lm = 12.53 \mu\text{m}$) subglobose to ovoid, slightly flattened adaxially, smooth to very delicately dimpled, hyaline; contents uniguttulate, strongly refringent under phase contrast. **Lamellar margin** apparently fertile, hardly extended in KOH, punctuated by differentiated cheilocystidia. **Cheilocystidia**

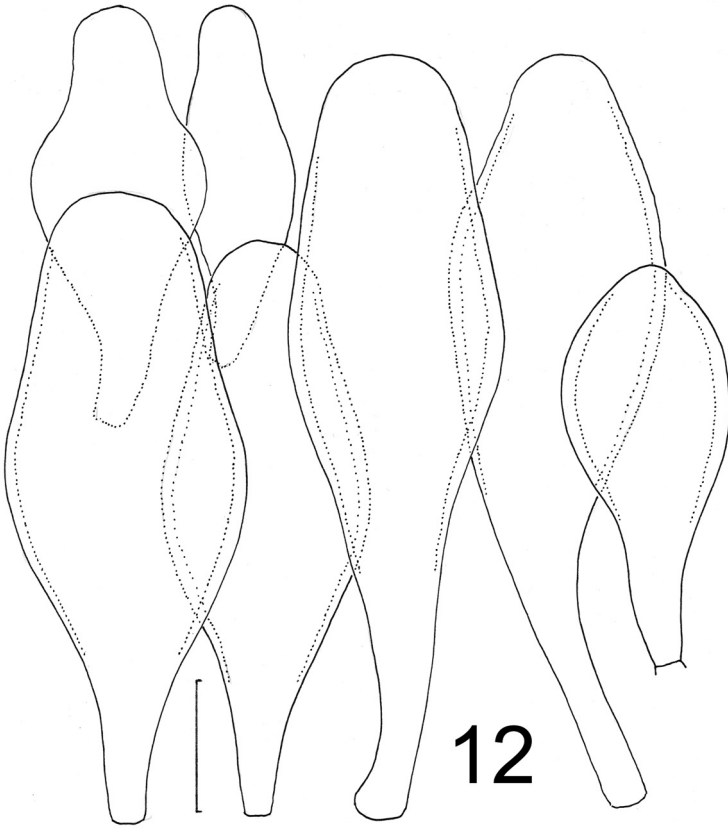


Fig. 12. *Xerula hispida*. Pleurocystidia. Guzmán 11300.
Standard bar = 20 μm .

of two types: 1) (Fig. 14) 28–50 \times 8–15 μm , fusiform to clavate, hyaline, thin-walled, without clamp connection; and 2) cheiloseetae occasional, 45–82 \times 10–25 μm , setiform, similar to pleurocystidia but smaller, lanceolate apically, hyaline, thick-walled (wall up to 2 μm thick in larger individuals), without clamp connection. **Upper stipe surface** a textura of lobose cells producing two types of cystidia: 1) caulocystidia 30–75 \times 8–14 μm ; and 2) cauloseetae up to 450 μm long, 10–14 μm broad, ochraceous (PhC), thick-walled (wall up to 5 μm thick, obscurely so in proximal area), in fascicles, arising from surface hypha, sometimes with a proximal lobe or spur. **Caulocystidia from mid-stipe** (Fig. 15) a lawn of gnarled, hyaline, digitate to clavate hyphal tips, and fascicles

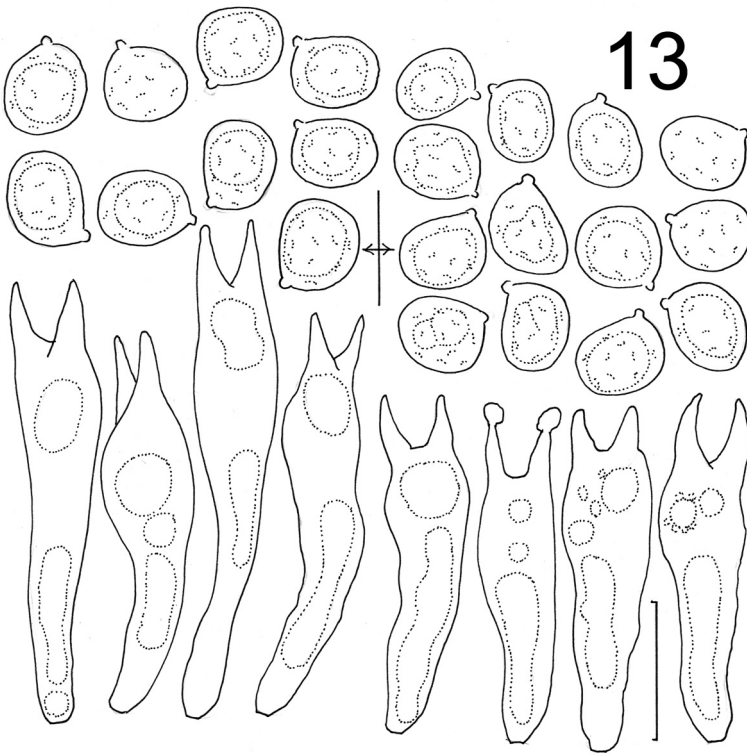


Fig. 13. *Xerula hispida*. Basidia and basidiospores. Left; TFB 10881. Right; TFB 9463. Standard bar = 20 μ m.

($\times 15$) of cauloseetae; caulocystidia clavate to digitate or substrangulate, thin-walled, hyaline, arising from a textura of gnarled or lobose cells; cauloseetae in stellate fascicles with one or two dominant, sclerified, pigmented individuals and several hyaline, thick-walled individuals arising from hyaline, superficial stipe surface hyphae; cauloseetae type 1): 15–50 \times 5–8 μ m, hyaline, sinuous, thick-walled (wall up to 1.5 μ m thick at proximal end); type 2) 150–400 \times 7–18 μ m, setiform, ochraceous yellow, thick-walled (wall up to 6 μ m thick, obscurely so proximally and thinning distally); base usually pinched but in one specimen with abortive sclerified knobs as though multi-rooted.

Commentary: Initial description and acceptance of *X. hispida* raises the issue of possible anamorphs within the International Code of Botanical Nomenclature. A self-cross pairing experiment using TFB 10881 (data not shown) showed that only one mating type was present in the population of 12 SBIs, an indication that basidiospores from that basidioma were unisexual, probably the products

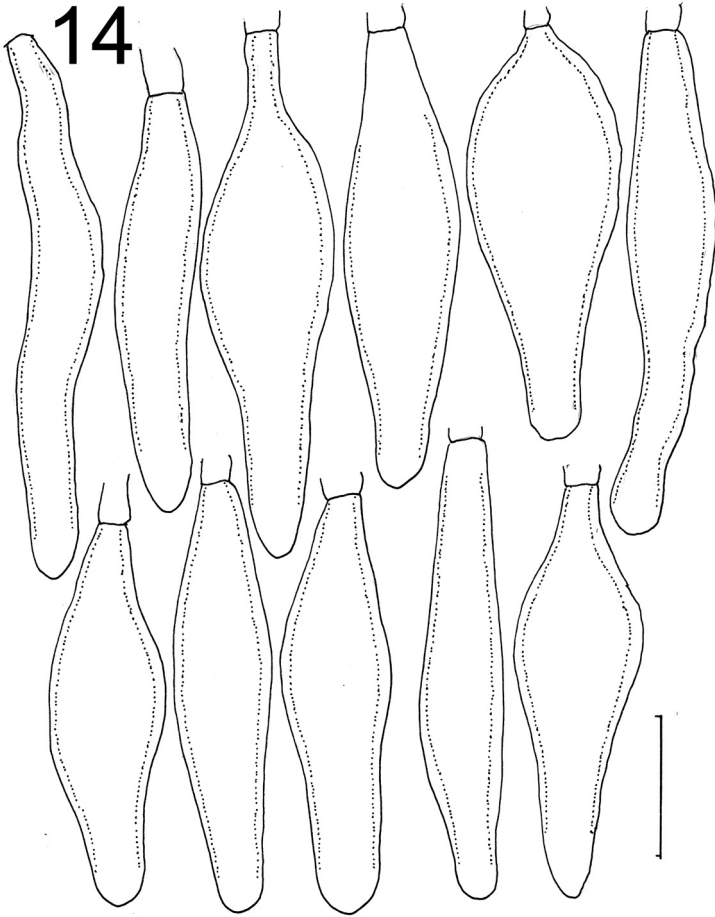


Fig. 14. *Xerula hispida*. Cheilocystidia. Upper; TFB 10881. Lower; DED 4838.
Standard bar = 20 μ m.

of mitosis, not meiosis. This was shown to be the case in *X. radicata* f. *bispora* by Petersen & Methven (1994), and might be assumed in other 2-spored forms as recently surmised (Petersen & Nagasawa 2006). In some cases, the 4-spored taxon was described prior to the 2-spored (i.e. *X. radicata* is prior to *X. radicata* f. *bispora*). In uncommon instances, however, the 2-spored (assumed asexual) form was named prior to the 4-spored (i.e. *X. raphanipes* as 2-spored; *X. chiangmaiae* as 4-spored). In the latter case, Petersen & Nagasawa (2006) chose to coin a binomial combination for the 4-spored taxon (*X. chiangmaiae*)

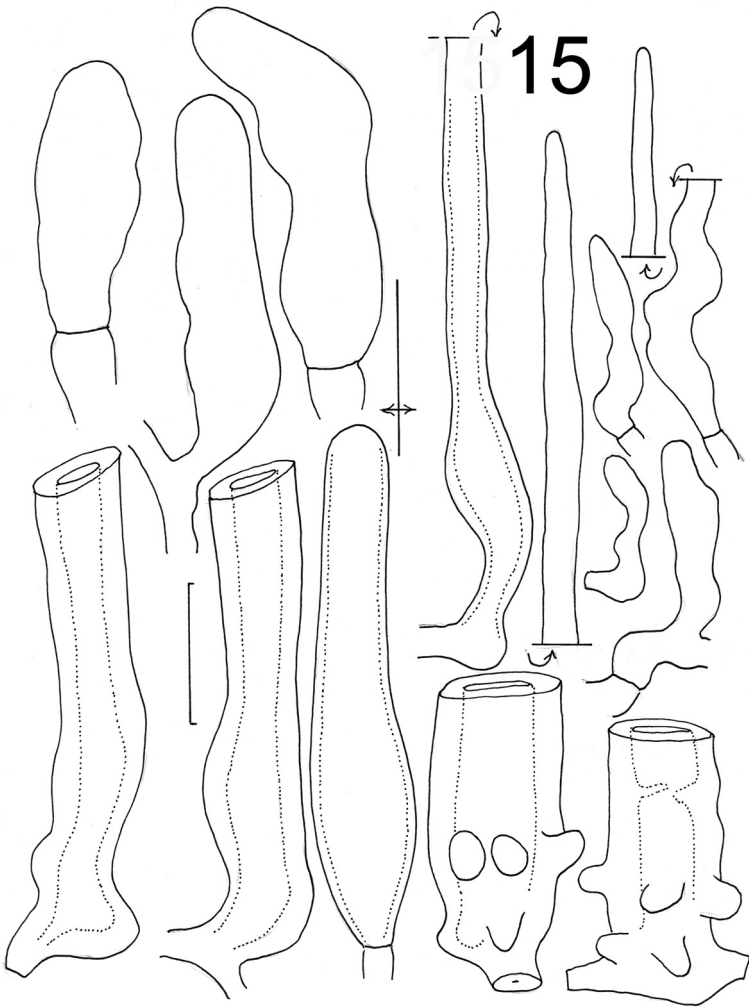


Fig. 15. *Xerula hispida*. Cauloetae.
Left; stipe apex; TFB 10881. Right; stipe midsection, TFB 9463.
Standard bar = 20 μ m.

and to place the prior name as a synonym (*X. chiangmaiae* var. *raphanipes*). If the basidiomata represented by *X. chiangmaiae* var. *raphanipes* are asexual, then the asexual organism should be treated as a “form taxon” under Article 59, not conforming to the Linnaean sexual system of nomenclature. In the case of *X. hispida*, the 4-spored analog exists and its epithet is priorable, making

nomenclatural treatment straightforward. The question, with the allegedly asexual *X. hispida* already in the literature, is how to deal with the assumedly asexual *X. hispida*. Future workers may wish to propose *X. hispida* as an infraspecific taxon under *X. setulosa*.

Halling & Mueller describe cheilocystidia of *X. hispida* as “similar to pleurocystidia but generally smaller.” Most are so, but some cheilocystidia are mucronate at apex, not subcapitate or truncate as pleurocystidia.

Pilei- and cauloseatae across *Xerula* sect. *Xerula* are consistently similar. Bases may be bifurcate (i.e. arising as a side branch of subsetal hypha) or, more typically, a hyphal tip, arising from the same inflorescence as pilei- or caulocystidia. Likewise, pileicystidia are similar in general formation, but differ somewhat in shape, wall thickness and length of pedicel.

The pleurocystidia of *X. hispida* are unique in our experience. Although apically rounded, the apex is bluntly so, and the presence of crystalline material after prolonged storage is also unique. Halling & Mueller (1999) correctly described the pleurocystidia as “setiform,” referring to wall thickness and stiffness. The term “metuloid” could also be applied. Most similar are those of *X. sinopudens*, similar in shape, but considerably thinner-walled.

The stipitipellis in *X. hispida* is considerably more complex than that of *X. americana*. In *X. americana*, cauloseatae occur as a lawn or turf, but without many intermediate or aborted individuals. In *X. hispida*, hyaline, gnarled outgrowths of surface hyphae occur as small as lateral knobs or even mere protuberances. Short, very acute setae arise as lateral branches of surface hyphae, but the large setae, while apparently arising as terminal structures, often produce knobs at the base as though multi-rooted.

Mueller et al. (2001) found that *X. hispida* from Costa Rica and putatively from China formed a monophyletic clade in phylogenetic reconstructions of wider taxonomic breadth. Only two collections were sequenced, and no other similar basidiomata (i.e. *X. americana*, *X. causei*, etc.) were included. The monophyletic clade, therefore, is subject to question, especially since the commonly found 4-spored Asian analog has been described under a separate binomial as *X. sinopudens* (Petersen & Nagasawa 2006). A 2-spored variant of *X. sinopudens* is known but has not been described.

With exclusively 2-spored basidia, Guzmán 11300 (ENCB) cannot qualify as *X. setulosa*. It is closer to *X. hispida*, but with somewhat foreshortened pleurocystidia (but similar to those illustrated from TFB 10881; Fig. 10). Spore dimensions and statistics agree with other observations on the species. The specimen comes from the northern Mexican state of Nuevo Leon, and therefore represents the northernmost station for *X. hispida*.

Specimens examined: COLOMBIA, Dpto. Nariño, La Josefina, 17 km S of Pasto, 23.XI.1988, coll E Franco, det DE Desjardin (as *Pseudohiatula*), DED 4880 (SFSU); same

location, 20.XI.1988, coll DE Desjardin & RE Halling (as *Pseudohiatula* cf. *setulosa*), DED 4838 (SFSU). COSTA RICA, Prov. San José, vic. Empalme, "Jardin de Dota," N 9° 42.667', E 83° 58.277', 25.VI.00, coll. JL Mata, TFB 10871 (TENN 58735); Prov. San José, San Gerardo, forest at Rio Savegre, 9° 33.020' N, 83° 48.489' W, 26.VI.00, coll. R.E. Halling, TFB 10881 (TENN 58745, TOPOTYPE); Prov. San José, San Gerardo, forest at Rio Savegre, 9° 33.020' N, 83° 48.489' W, 26.VI.00, coll. RHP, TFB 10882 (TENN 58746; TOPOTYPE); Prov. San José, San Gerardo, 5 km SW Cerro de la Muerte, 9° 33.020' N, 83° 48.489' W, 26.VI.00, coll. K Shanks, TFB 7890 (TENN 53746); Prov. San José, Dota Co., Jardin de Dota, 1.VII.98, coll. RHP, TFB 9463 (TENN 56437); Prov. San José, Dota, San Gerardo, more or less 5 km SW of Cerro de la Muerte, Albergue de la Montaña, Savegre, 9° 32'2" N, 83° 48' 27" W, 2500 m, 11.VI.2003, coll Halling et al, Halling no 8382 (NY, TOPOTYPE); Prov. San José, Dota, San Gerardo, more or less 5 km SW of Cerro de la Muerte, Albergue de la Montaña, Savegre, 9° 32'2" N, 83° 48' 27" W, 2500 m, 10.VI.1994, coll Halling & Baroni, Halling no 7270 (NY, TOPOTYPE, annot. Michael Weiss, Universität Tübingen. Dec. 11, 2000); same location, 8.VI.1994, coll Halling & Baroni, Baroni 7482 (CORT; TOPOTYPE); Prov. San José, El Jaular, Est. Biol Cuericí, N 9° 33' 17 " ; W 83° 40' 15", 2900 m, 24.VIII.1995, leg AE Franco-Molano, AE F-M no. 1443 (NY). MEXICO, Est. Nuevo Leon, vic Monterrey, Villa Santiago, Posada del Maestro, 16.VIII.1973, coll. G. Guzmán (as *Oudemansiella*), Guzmán 11300 (ENCB) [rev. E. Pérez-Silva, 1985 as *O. longipes*]. VENEZUELA, Parque Nac. Henry Pittier, Pasade Portachuelo, 15.VII.1987, leg RE Halling (as *Pseudohiatula dorotheae*), Halling 5386a (NY).

Acknowledgements

Information for this publication provided by TJ Baroni was made possible by a grant from the National Science Foundation, Biodiversity Surveys and Inventories Program to the State University of New York, College at Cortland (DEB-0103621) in collaboration with the Center for Forest Mycology Research, USDA-Forest Service, Forest Products Laboratory. The International Institute of Tropical Forestry, USDA-Forest Service, provided facilities in Puerto Rico for specimen analysis and processing. TJB also received a grant from the Gertrude S. Burlingham Fund of the New York Botanical Garden for field work in Costa Rica and wishes to thank Dr. J Carranza (Universidad de Costa Rica), Milagro Mata (INBIO), Loengrin Mata (INBIO) and Dr. Juan Luis Mata (University of South Alabama) for providing logistical support and guidance during field work in Costa Rica. The authors extend thanks to Drs. Gregory Mueller and Roy Halling for expediting loans of appropriate specimens, as well as to Dr. Joaquin Cifuentes and Dr. Ricardo Valenzuela Garza for facilitating loan of specimens from ENCB and FCME. We thank Dr. Roy Halling and Dr. Clark Ovrebo for presubmittal reviews.

References

- Dennis RWG. 1951. Some *Agaricaceae* of Trinidad and Venezuela. Leucosporae: Part I. Trans. Brit. Mycol. Soc. 34: 411–482.
- Dennis RWG. 1961. Fungi Venezueli: IV. Kew Bull. 15: 67–156.
- Dennis RWG. 1968. Some *Agaricales* from the blue Mountains of Jamaica. Kew Bull. 22: 73–85.
- Dennis RWG. 1970. Fungus flora of Venezuela and adjacent countries. Kew Bull, addit. Ser. III 531 pp. London.

- Desjardin DE. 1989. The genus *Marasmius* from the southern Appalachian Mountains. Dissertation, ined., Univ. Tennessee. 837 pp.
- Dörfelt H. 1985. Taxonomische Studien in der Gattung *Xerula* R. Mre. (X). Feddes Rept. 96: 235–240.
- Halling RE. 1983. The genus *Collybia* (*Agaricales*) in the northeastern United States and adjacent Canada. Mycologia Mem. 8. 148 pp.
- Halling RE, Mueller GM. 1999. A new species and a new record for the genus *Xerula* (*Agaricales*) from Costa Rica. Mycotaxon 71: 105–110.
- Meijer AAR de. 2002. Mycological work in the Brazilian state of Paraná. Nova Hedwigia 72: 105–159.
- Meijer AAR de. 2006. Preliminary list of the macromycetes from the Brazilian state of Paraná. Bol. Mus. Bot. Municipal (Curitiba) 68: 1–55.
- Mueller GM, Wu Q-X, Huang Y-Q, Guo S-Y, Aldana-Gomez R, Vilgalys R. 2001. Assessing biogeographic relationships between North American and Chinese macrofungi. J Biogeog 28: 271–281.
- Murrill WA. 1916a. *Agaricaceae* (pars). North American Flora 9(5): 297–374.
- Murrill WA. 1916b. *Pleurotus*, *Omphalia*, *Mycena*, and *Collybia* published in North American Flora. Mycologia 8: 218–221.
- Pegler DN. 1983a. Agaric flora of the Lesser Antilles. Kew Bull, addit. Ser. IX: 668 pp. HMSO.
- Pegler DN. 1983b. The genus *Lentinus*, a world monograph. Kew Bull, addit. ser. X: 281 pp. HMSO.
- Pérez-Silva E, Aguirre-Acosta E. 1985. Las especies del genero *Oudemansiella* (*Tricholomataceae*, *Agaricales*) en Mexico. Rev. Mex. Micol. 1: 243–257.
- Petersen RH, Methven AS. 1994. Mating systems in the *Xerulaceae*: *Xerula*. Canad. J. Bot. 72: 1151–1161.
- Petersen RH, Nagasawa E. 2006. The genus *Xerula* in temperate east Asia. Rep.Tottori Mycol. Inst. 43: 1–49.
- Putzke J, Pereira AB. 1988. O gênero *Oudemansiella* Speg. no Rio Grande do Sul, Brasil. Caderno de Pesquisa Universidade Federal de Santa Cruz do Sul, Ser. Bot. 1: 47–69.
- Rick J. 1938. Agarici Riograndenses. Lilloa 2: 3–311.
- Ridgway R. 1912. Color standards and color nomenclature. Washington, DC.
- Singer R. 1951 '1949'. The *Agaricales* in modern taxonomy. Lilloa 22: 1–832.
- Singer R. 1952. Type studies on Basidiomycetes VI. Lilloa 26: 57–159.
- Singer R. 1962. Diagnoses fungorum novorum Agaricalium II. Sydowia 15: 45–83.
- Singer R. 1964. *Oudemansiellinae*, *Macrocystidinae*, *Pseudohiatulininae* in South America. Darwiniana 13: 145–190.
- Smith AH. 1938. New and unusual agarics from North America – I. Mycologia 30: 20–41.