

The agaric genus *Stropharia* (*Strophariaceae*, *Agaricales*) in Rio Grande do Sul State, Brazil

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A survey of the genus *Stropharia* in the Brazilian State of Rio Grande do Sul revealed the occurrence of the following species: *S. acanthocystis*, *S. aeruginosa*, *S. alcis* var. *austrobrasiliensis*, *S. apiahyna*, *S. araucariae*, *S. coronilla*, *S. dorsipora*, *S. earlei*, *S. rugosoannulata*, and *S. semiglobata*. The new taxa and combination are introduced: *S. araucariae* sp. nov., *S. alcis* var. *austrobrasiliensis* var. nov., and *S. apiahyna* comb. nov. *Stropharia dorsipora* is recorded for the first time in South America; *S. aeruginosa* is a new Brazilian record; *S. earlei* is a new record from Rio Grande do Sul State. All species are described in detail, fully illustrated, and its taxonomy is discussed.

Key words: *Basidiomycota*, Brazilian mycobiota, new records, new species, *Stropharioideae*

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Introduction

There has been recent interest in studying the agarics of Central and South America (Desjardin *et al.*, 2005, 2006, 2007; Lechner *et al.*, 2006; Ovrebo and Baroni, 2007; Ortiz-Santana *et al.*, 2007) and in this study we report on some collections of *Stropharia* (Fr.) Quél. from Brazil. *Stropharia* is the type genus of the agaric family *Strophariaceae* Singer & A.H. Sm. and subfamily *Stropharioideae* (Singer) Singer (*Agaricales*, *Basidiomycota*). It is characterized by the presence of a membranous to glutinous annulus, the purplish brown to violaceous spore print, basidiospores with a smooth and thickened wall, usually with a well-developed germ-pore, chrysocystidia as pleurocystidia, and sometimes also as cheilocystidia, pileipellis formed by prostrate, gelatinized filamentous hyphae, without a cellular hypodermium (Singer, 1986; Watling and Gregory, 1987). Singer (1986) recognized 20 species worldwide, but Hawksworth *et al.* (1995) attributed 15 species for the genus. A checklist by Wasser and Grodzinskaya (1996) listed 111 names in *Stropharia*, of which 28 are

currently in use.

In a modern sense, the presence of a particular type of hyphae (acanthocytes) in the basal mycelium and rhizomorphs has been considered a good generic character (Farr, 1980), and being used by modern authors to delimit taxa of the genus (Jahnke, 1984; Redhead, 1984a,b; Norvell and Redhead, 2000; Desjardin and Hemmes, 2001; Bandala *et al.*, 2005;). These structures are probably involved in the protection of rhizomorphs against soil fauna, especially nematodes (Luo *et al.*, 2006). The group of coprophilous species (subgenus *Stercophila* Romagn. ex Noordel.) probably will be excluded from *Stropharia* because they lack true acanthocytes, a position indeed demonstrated by a recent molecular study (Moncalvo *et al.*, 2002). Awaiting the formal proposal of a new generic name we consider this group provisionally under *Stropharia*.

There is fragmentary information about the South American species of *Stropharia*; most of them were reported in general works on agarics, as for example those of Dennis (1961, 1970) from Venezuela, Horak (1979), and Singer and Digilio (1952) from Argentina



Fig. 1. Map of South America showing Brazil and Rio Grande do Sul State (RS) location.

among others.

In Brazil, sporadic reports of the genus are known. The probable first record of a *Stropharia* species was given by Hennings (1904), who described *Stropharia grisea* Henn. from São Paulo State, later renamed by Pegler (1997) as *Agaricus puttemansi* Pegler. Several species were reported by Rick (1907, 1920, 1930, 1939, 1961) from Rio Grande do Sul State, but most of species he described or reported are currently synonyms or misidentifications. Singer (1953) studied several Rick's types and collections and also collected in some localities in Rio Grande do Sul, but listed only *S. coronilla* (Bull. ex DC.) Quél. for the State. Batista and Bezerra (1960) reported the

only record of a *Stropharia* species from northeastern Brazil, *S. coronilla*, from Pernambuco State. Stijve and de Meijer (1993) reported *S. coronilla*, *S. rugosoannulata* Farl. ex Murrill and *S. semiglobata* (Batsch) Quél. from the State of Paraná, in south Brazil, and later de Meijer (2001) reported five *Stropharia* species from the State. Pegler (1997) reported *S. rugosoannulata* and *S. semiglobata* from São Paulo State; Cortez and Coelho (2004) cited *S. coronilla*, *S. rugosoannulata*, and *S. semiglobata* from the region of Santa Maria, in central Rio Grande do Sul; Sobestiansky (2005) reported *S. rugosoannulata* in the region of Nova Petrópolis. More recently, Silva *et al.* (2006) reported the occurrence of *S. alcis*

Kytöv. based on materials collected on cow dung and soil, and Cortez and Silveira (2007) described *S. acanthocystis*, an unusual and exannulate species in the genus and Cortez (2008) recombined *Pholiota varzeae* Singer, from Amazonas, to *Stropharia*.

Thus, the knowledge of *Stropharia* in Brazil is scanty and limited to a few and common species. With the aim to improve the knowledge of the genus *Stropharia* in Rio Grande do Sul State we proposed the present study.

Materials and methods

The specimens were collected in several localities of the Rio Grande do Sul State, from March 2004 to September 2005. Rio Grande do Sul is the southernmost Brazilian State (Fig. 1), and is situated at 27°3'42"-33°45'34" S and 53°3'24"-53°23'22" W, comprising an area of 281.734 km². It is located in a transitional area between the tropical and subtropical climatic zones, with the predominance of the Cfa (subtropical humid) type, according the Köppen's climatic classification. The vegetation comprises dense ombrophilous forests, mixed ombrophilous forests, deciduous seasonal forests, semi-deciduous seasonal forests, riverine forests, coastal vegetation ("restingas"), and native meadows covering especially areas toward the south but also present in the Meridional Plateau of the State (Porto and Menegat, 2002; Marchiori, 2004).

All collected material by the authors is deposited in the herbarium ICN. Materials deposited in the following herbaria were studied: F, HASU, HCB, ICN, LPS, NY, PACA, SMDB, and SP (Holmgren and Holmgren, 1998-2005). Specimens from the herbarium RSPF (Museu Augusto Ruschi, Universidade de Passo Fundo), which is not indexed, were also examined.

Macroscopic analysis of the basidiomata followed Largent (1977), while the microscopic study followed Largent *et al.* (1986). As mounting media were used the 5% KOH alone or in consortium with 1% Congo Red solution. Line drawings were made with a light tube in a Leica DM LS2 optical microscope. In basidiospores description, Q is the quotient between the length and width, Q_m is the medium value

of Q , and n is the number of measured basidiospores. Color terminology was taken from Munsell (1994).

Results

Key to the species of *Stropharia* from Rio Grande do Sul State, Brazil:

1. Stipe viscid to glutinous; on cow or horse dung or enriched soil 2
1. Stipe dry to subviscid, not glutinous; on other substrata than dung 4
2. Basidiospores 10-15 µm long 3. *S. alcis* var. *austrobrasiliensis*
2. Basidiospores 15-22 µm long 3
3. Basidiospores with an eccentric germ-pore 7. *S. dorsipora*
3. Basidiospores with a central germ-pore 10. *S. semiglobata*
4. Annulus absent or floccose to membranous, smooth on both sides 5
4. Annulus fleshy, usually grooved on upper surface 8
5. Hymenial acanthocytes present; annulus absent 1. *S. acanthocystis*
5. Hymenial acanthocytes absent; annulus present 6
6. Pileus greenish with yellowish margin 2. *S. aeruginosa*
6. Pileus other colors than green 7
7. Annulus floccose to membranous, fugacious; on soil and litter 8. *S. earlei*
7. Annulus membranous, persistent; on decomposing wood 4. *S. apiahyna*
8. Pileus yellowish; basidiospores 6-10 µm long; in lawns 6. *S. coronilla*
8. Pileus brownish; basidiospores 10-14 µm long; in forests 9
9. Pileus reddish brown, 60-170 mm in diam.; cheilocystidia as chrysocystidia 9. *S. rugosoannulata*
9. Pileus dark brown, 39-68 mm in diam.; cheilocystidia as both lepto- and chrysocystidia 5. *S. araucariae*

Description of the studied taxa

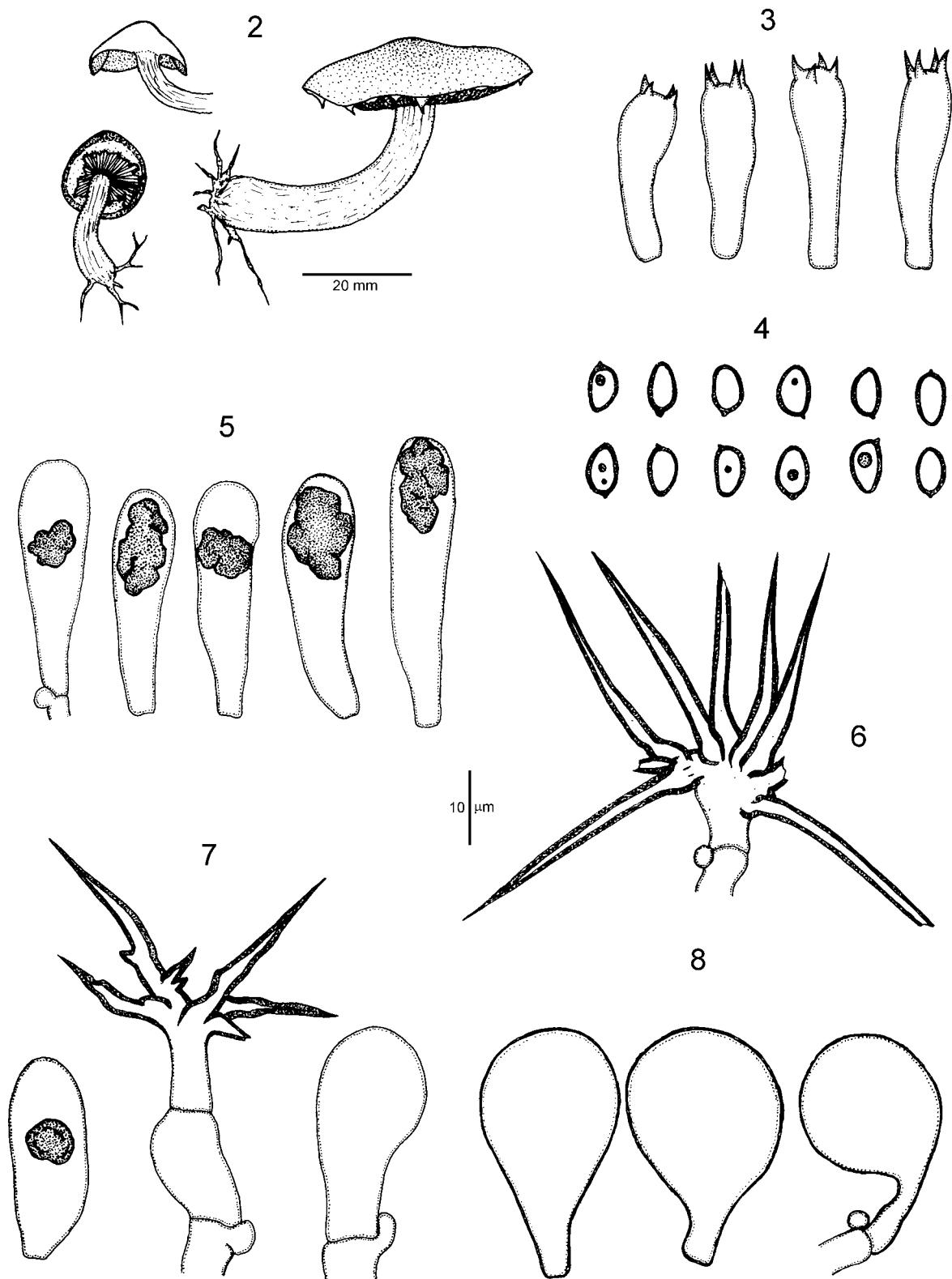
Stropharia acanthocystis Cortez & R.M. Silveira, Mycologia 99: 135 (2007).

(Plate 1a, Figs 2-8)

Pileus 17-40 mm in diameter, convex, umbonate; reddish brown (2.5YR 4/4), red (2.5YR 4/6) to yellowish red (5YR 4/6)



Plate 1. *Stropharia* species. a) *Stropharia acanthocystis*. b) *Stropharia alcis* var. *austrobrasiliensis*. c) *Stropharia coronilla*. d) *Stropharia earlei*. e) *Stropharia rugosoannulata*. Scale bars: a-d = 20 mm, e = 50 mm.



Figs 2-8. *Stropharia acanthocystis*. 2. Basidiomata. 3. Basidia. 4. Basidiospores. 5. Pleurocystidia. 6. Hymenial acanthocystide. 7. Caulocystidia (three types: chrysocystidia, acanthocystide, leptocystidia). 8. Cheilocystidia.

colored; surface slightly humid, cottony toward the margin, especially in younger basidiomata, due the presence of whitish floccose remains; margin non-striate, slightly involute, with abundant velar remnants appendiculate; context white to cream color, fleshy and soft (5-7 mm wide). *Lamellae* adnexed; light gray (2.5Y 7/1-7/2) to pale brown (10YR 6/3) in mature basidiomes, close, with a paler margin. *Stipe* 23-62 × 4-9 mm, central, cylindrical, but sinuous to incurved, pale yellow (2.5Y 8/2-8/4), with a white or pale lilaceous color; surface longitudinally striate, dry to humid; base expanded, with abundant white rhizomorphs, annulus absent. *Veil* not forming an annulus, but leaving abundant remnants appendiculate in the pileus margin, with a membranous consistency, pale yellow (2.5Y 8/2-8/3). *Spore print* dark brown (10YR 3/3) to dark yellowish brown (10YR 3/4).

Basidiospores 6-7(-8) × 4-5 µm, $Q = 1.33-1.75$, $Q_m = 1.51$, $n = 50$, ovoid to ovoid-ellipsoid in face view to reniform or subellipsoid in side view; smooth and thickened wall, with a reduced germ-pore; yellowish brown in KOH. *Basidia* 20-28 × 7-9 µm, clavate, thin-walled, bearing four sterigmata. *Pleurocystidia* (23-)26-33(-41) × 8-10(-11) µm, as chrysocystidia, clavate, very rarely presenting a mucronate apex; smooth and thin-walled, with an amorphous yellow content in KOH. *Cheilocystidia* (18-)22-33 × 10-15(-18) µm, as leptocystidia, mainly pyriform, some clavate; smooth but slightly thickened wall, hyaline; very abundant, making the gill edge sterile. *Pileipellis* composed by non-gelatinized clamped hyphae, with their walls slightly thickened and incrusted, brownish to yellowish, (5-)8-10(-13) µm in diameter. *Context* formed by interwoven, hyaline, thin-walled, and clamped hyphae, 6-13 µm in diameter. *Gill trama* regular, with hyaline, thin-walled, cylindrical to inflated hyphae, (6-)7-12 µm in diameter. *Stipitipellis* composed by hyaline, non-gelatinized, thin-walled hyphae, 6-12 µm in diameter. *Caulocystidia* of three types: 1) *chrysocystidia*, 22-28 × 9-12 µm, clavate, similar to the pleurocystidia; 2) *leptocystidia*, 23-45 × 8-15 µm, clavate, similar to the cheilocystidia; 3) *acanthocytes*. *Acanthocytes* present in the hymenium, mixed with basidia and cystidia (including the cheilocystidia), in the form of cystidoid

structures; the acanthocyte comprises a basal and clamped hyphae, from where arises 7-11 rays, with thickened walls. *Clamp connections* present.

Habitat: Gregarious on the base of a decomposing angiosperm, in mixed ombrophilous forest vegetation.

Known distribution: known only from type locality.

Material examined: BRAZIL, Rio Grande do Sul State, São Francisco de Paula, FLONA, 14 May 2005, V.G. Cortez 053/05 (ICN 139131- holotype).

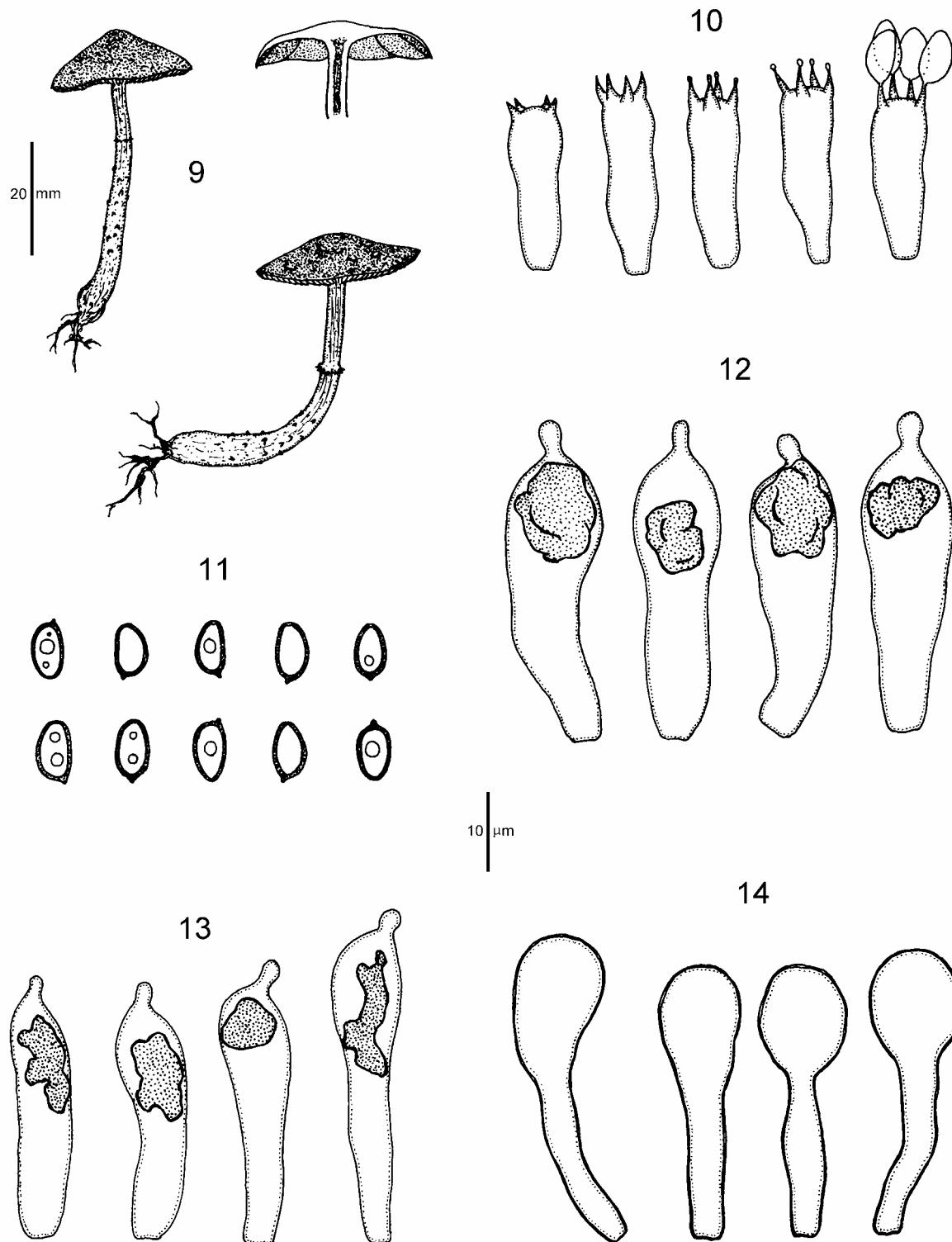
Notes: *Stropharia acanthocystis* differs from all *Stropharia* species by the presence of cystidium-like acanthocytes in the hymenium, stipe surface and rhizomorphs and by the lack of an annulus on the stipe. These structures were checked from all five basidiomes of the type collection. The lack of an annulus would suggest its placement in *Hypholoma*, and *H. trinitense* (Dennis) Pegler seems to have similar basidiospores and cheilocystidia, however this species lacks hymenial acanthocytes and the chrysocystidia are ventricose to lageniform, 38-55 µm (Pegler, 1983). More recently, Cortez (2008) after study of the holotype proposed its recombination to *Stropharia* based on the presence of acanthocytes. *Stropharia variicolor* Desjardin & Hemmes from Hawaii is also microscopically similar, but this species presents tricholomatoid basidiomes, does not have cheilocystidia and grows in horticultural areas on woodchip debris (Desjardin and Hemmes, 2001). Another unusual, exannulate species is *S. cifuentesii* Bandala, Montoya & Jarvio, recently described from Mexico (Bandala *et al.*, 2005), presenting similar pleurocystidia, but lacking cheilocystidia. The type of *S. acanthocystis* was collected in the region of Meridional Plateau of Rio Grande do Sul State, an area covered by *Araucaria angustifolia* (Bertol.) Kuntze forests (mixed ombrophilous forest), at 912 m altitude, which has a rich and unexplored mycobiota. For more detailed discussion see Cortez and Silveira (2007).

Stropharia aeruginosa (Curtis) Quél., Mém. Soc. Émul. Montbéliard, Sér. II, 5: 141 (1872).

(Figs 9-14)

≡ *Agaricus aeruginosus* Curtis, Fl. Londin. 2: tab. 210 (1786).

≡ *Psilocybe aeruginosa* (Curtis) Noordel., Persoonia 16: 128 (1995).



Figs 9-14. *Stropharia aeruginosa*. **9.** Basidiomata. **10.** Basidia. **11.** Basidiospores. **12.** Pleurocystidia. **13.** Caulocystidia. **14.** Cheilocystidia.

Pileus 13-45 mm in diameter, initially convex to finally flattened, umboonate; color dark grayish green (1 Gley 3/2) to grayish green (1 Gley 4/2) with the margin fading yellowish in older basidiomes; surface viscid,

smooth, or with scattered yellowish scales radially disposed from the center towards the margin; margin regular, non-striate, slightly incurved; context fleshy, white. *Lamellae* sinuate to adnexed, close; color light to pinkish

gray (7.5YR 7/1-7/2) in young stages, becoming brown (7.5YR 4/2) to dark brown (7.5YR 3/2-3/3); membranous, margin with a whitish color, smooth to irregular. *Stipe* 16-71 × 2-7 mm; central, cylindrical, with a little expanded base; color white or whitish; surface striate in the apex, fibrillose to scaly from the middle to the base, dry; hollow, with abundant white rhizomorphs. *Veil* forming a fibrillose and fugacious annulus in the middle of stipe and sometimes it produces whitish membranous remnants on pileus margin. *Spore print* very dark brown (7.5YR 2.5/2).

Basidiospores 6.5-8(-9) × 4-5 µm, $Q = 1.33-2$, $Q_m = 1.66$, $n = 112$; ovoid to slightly reniform in side view, ovoid in frontal view; wall smooth and little thickened, with a reduced germ-pore, color yellowish brown in KOH. *Basidia* 19-25.5 × 5-8 µm, clavate, bearing four sterigmata. *Pleurocystidia* 30-59 × 7-14 µm, as chrysocystidia, clavate, with a mucronate apex; thin-walled, but with an amorphous yellowish content. *Cheilocystidia* 25.5-50 × 6.5-14.5 µm, clavate with a capitate apex; hyaline to slightly brownish, but without amorphous content, wall slightly thickened; very numerous in the gill edge. *Pileipellis* is an ixocutis, formed by prostrate, gelatinized hyphae, (2.5)-4-9 µm in diameter, with yellowish irregularly incrusted pigment. *Context* formed by inflated, interwoven, (8)-10-16(-19) µm in diameter hyphae, with hyaline, smooth and thin-walled. *Gill trama* regular to subregular, composed by inflated, hyaline, smooth and thin-walled, 11-18 µm in diameter. *Caulocystidia* 22-43 × 7-9 µm, as chrysocystidia, fusoid to clavate, with mucronate apex, similar to pleurocystidia, scattered in the upper stipe surface. *Stipitipellis* formed by parallel, hyaline, smooth and thin-walled hyphae, 3-6 µm in diameter. *Acanthocytes* present in basal mycelium and rhizomorphs. *Clamp connections* present.

Habitat: Solitary to gregarious, on much decomposed wood, in semi-deciduous seasonal forest.

Known distribution: Europe (Watling and Gregory, 1987; Noordeloos, 1999), North America (Harper, 1914; Stamets, 1996), South America (Singer, 1969).

Material examined: BRAZIL, Rio Grande do Sul State, Santa Maria, Morro do Elefante, 04 May 2002, F. Wartchow and V.G. Cortez 035/02 (SMDB 9.573), V.G. Cortez 037/02 (SMDB 9.575); 12 April 2003, V.G.

Cortez 007/03 (SMDB 9.604); 11 April 2005, Cortez 011/05 (ICN 139.098). Salvador do Sul, 23 March 1945, Rick 22.832 (PACA 9.367).

Additional specimens examined: SWEDEN, Province of Hallands, Vallda, 25 October 1976, S. Jacobsson 76.247 (ICN).

Notes: This interesting species is very common in northern hemisphere, but has been sporadically reported outside from Europe and North America. Singer (1969) reported this species for the first and probably only time in South America, with the description of *S. aeruginosa* var. *neuquenensis* M.M. Moser & Singer, from Neuquén, Argentina. This is the first record of this species from Brazil. *Stephanopus stropharioides* E. Horak (Cortinariaceae R. Heim ex Pouzar) from the Andean-Patagonian forests, is a macroscopically similar taxon, but differs in mycorrhizal habit and several microscopic characters (e.g., ornamented basidiospores with a plage, cystidia – Gamundi and Horak 1995).

The Brazilian specimens present a fibrillose annulus instead of a membranous one, and lack bluish shades in the pileus, which are seen in most of northern specimens. However, all microscopic data matches with those of *S. aeruginosa* ss. *auct.* “*Stropharia merdaria* Pers.” as cited by Rick (1961) corresponds to *S. aeruginosa* after study of Rick’s material deposited at PACA. The specimens reported by Rick (1939) as *S. merdaria* are *Psilocybe argentina* (Speg.) Singer following Guzmán (1983), but unfortunately such specimens were not studied for us.

Stropharia alcis var. *austrobrasiliensis* Cortez & R.M. Silveira, var. nov.

(Plate 1b, Figs 15-20)

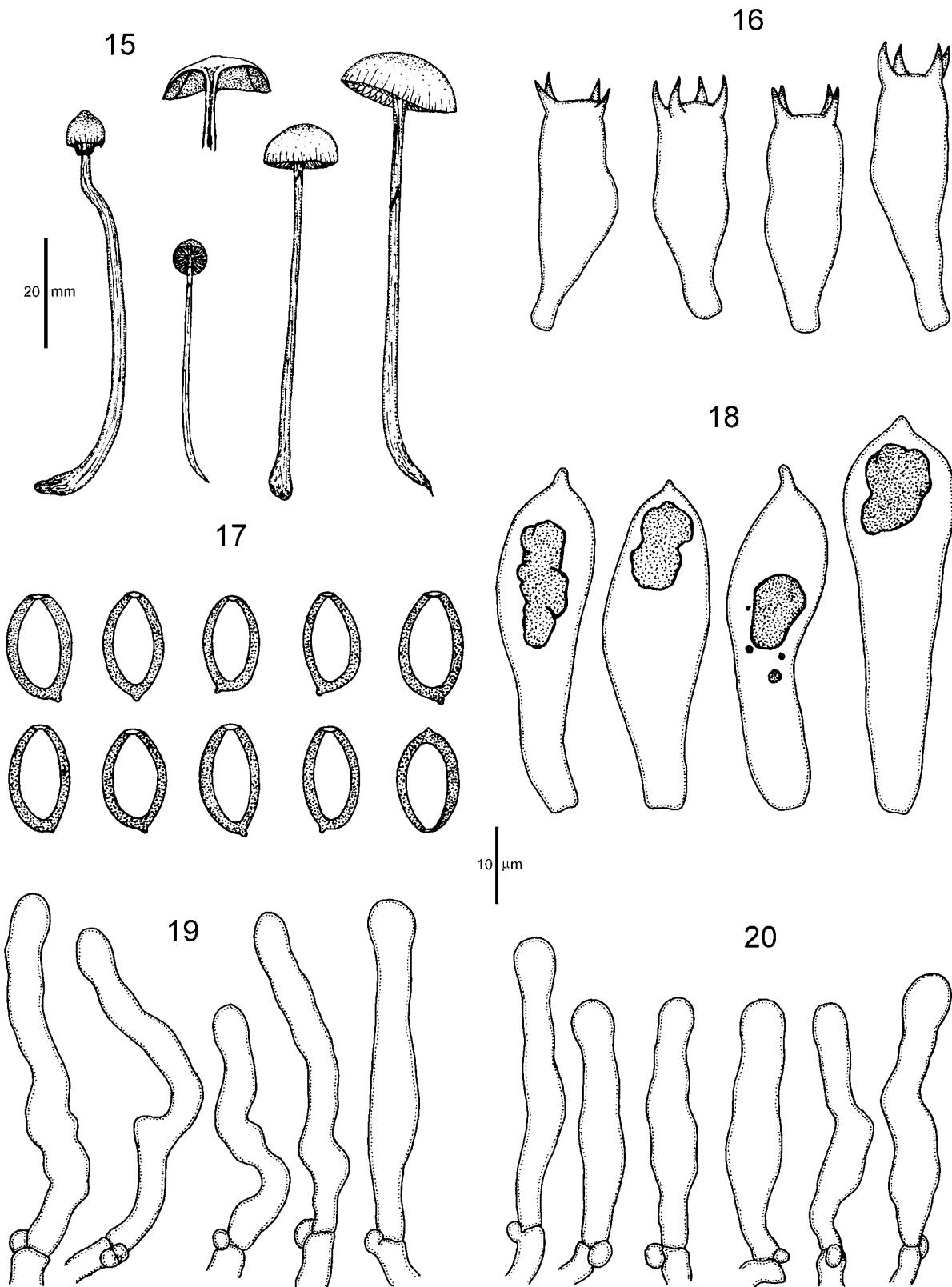
MycoBank: 510846

Etymology: The name refers to a south Brazilian distribution of the taxon.

A Stropharia alcis Kytöv. differt in habitu ad fimum vaccinum, non ad fimum alceis.

Holotype: BRASILIA, província Rio Grande do Sul, Santa Maria, in fimo vaccuno, 24.IV.2004, legit V. G. Cortez 006/04, in herbario ICN conservatur.

Pileus (4)-8-20(-37) mm, hemispheric to convex, usually umbonate, rarely flattened; color yellowish brown (10YR 5/8) to olive yellow (2.5Y 6/8) in the centre, yellow (5Y 7/8-8/8) in the margin; surface viscid when fresh, smooth; margin strongly striate and hygrophanous, with little velar remnants appendi-



Figs 15-20. *Stropharia alcis* var. *austrobrasiliensis*. **15.** Basidiomata. **16.** Basidia. **17.** Basidiospores. **18.** Pleurocystidia. **19.** Caulocystidia. **20.** Cheilocystidia.

culate; context thin (< 2 mm thick), whitish. *Lamellae* adnate, with decurrent tooth, close, membranous; color light brownish gray (2.5Y 6/2) to black (7.5YR 2.5/1), with whitish edges. *Stipe* 50-85 (-102) × (1-) 2-3 (-4) mm, central, cylindrical and elongated, with an incurved little expanded base; color yellow (2.5Y 7/-8/8) to olive yellow (2.5Y 6/8); surface viscid, smooth, non-striate or scales; basal mycelium and rhizomorphs poorly developed. *Veil* present; on pileus margin it leaves little dark velar remnants appendiculate; on stipe, it produces a glutinous, violaceous apical annulus. *Spore print* black (7.5YR 2.5/1).

Basidiospores (10.5-) 12-14.5 (-15) × (6.5-) 7-8 (-9) µm, $Q = 1.44-2.11$, $Q_m = 1.73$, $n = 316$, ellipsoid in side view, subellipsoid in face view; smooth and thick-walled, with a conspicuous apical germ-pore, making the basidiospore truncate; color yellowish brown in KOH. *Basidia* 23-32 (-40) × (7-) 9-13 µm, utriform, forming four sterigmata. *Pleurocystidia* 31-55 × 11-17 µm, as chrysocystidia, fusoid to clavate, with a mucronate apex; amorphous internal content present, yellowish in KOH; smooth and thin-walled. *Cheilocystidia* (22-) 27-38 (-45) × (5-) 6-10 (-12) µm, leptocystidia, cylindrical, sinuate, with rounded to subcapitate apex; hyaline, without contents, smooth and thin-walled; very numerous in the gill edge. *Pileipellis* is a strongly gelatinized ixocutis, about 280-400 µm thick, composed by hyphae with little incrusted walls by yellowish pigment, 2-6 µm in diameter. *Context* formed by interwoven, hyaline, smooth and thin-walled hyphae, 6-10 µm in diameter. *Gill trama* regular, formed by cylindrical to inflated, hyaline, smooth and thin-walled hyphae, (4-)7-12 µm in diameter. *Stipitipellis* is strongly gelatinized, composed by parallel, smooth and thin-walled hyphae, 2-6 µm in diameter. *Caulocystidia* (30-)37-49(-62) × 5-7(-8) µm, cylindrical to sinuate, with a rounded or sometimes capitate apex, similar to the cheilocystidia; hyaline, without contents, smooth and thin-walled; disposed in fascicles on stipe apex. *Acanthocytes* absent. *Clamp connections* present in most septa.

Habitat: Gregariously on cow dung or soil among grasses, especially meadows, but also into forests with the presence of cattle.

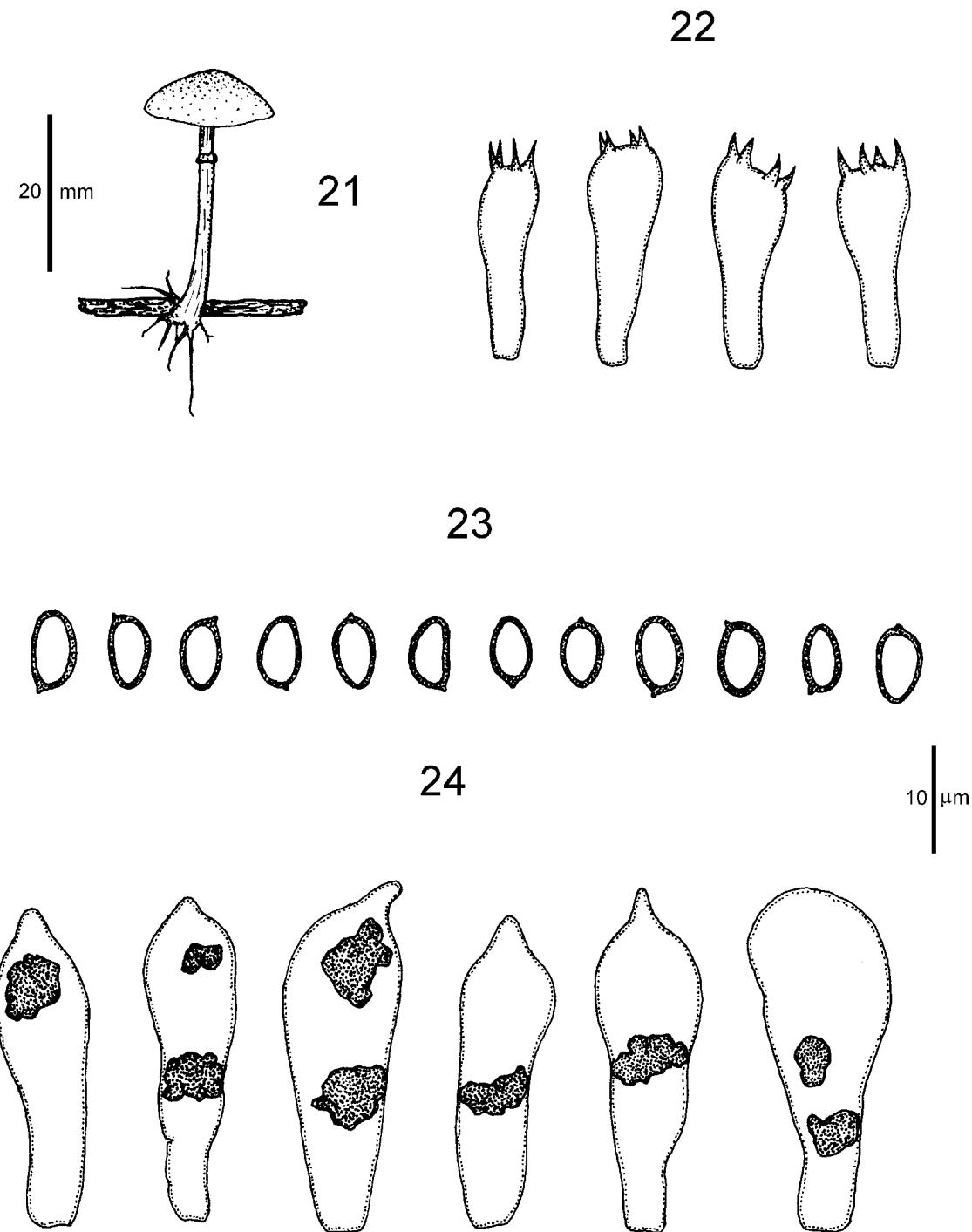
Known distribution: Rio Grande do Sul, Brazil.

Material examined: BRAZIL, Rio Grande do Sul State. Caçapava do Sul, Guaritas, 30 April 2005, V.G. Cortez 020/05 (ICN 139.103), V.G. Cortez 022/05 (ICN 139.105), V.G. Cortez 024/05 (ICN 139.106), V.G. Cortez 026/05 (ICN 139.108). Cambará do Sul, RS 020, 02 April 2005, V.G. Cortez 007/05 (ICN 139.094), V.G. Cortez 008/05 (ICN 139.095). Capivari do Sul, Fazenda dos Touros, 28 May 2004, F. Caporal (ICN 139.034). Gramado Xavier, source of Pardinho River, 04 May 1993, Kappes *et al.* (HCB 16.388). Passo Fundo, Campus of Universidade de Passo Fundo, 22 April 2003, M.S. Rother and B.M.A. Severo (RSPF 334). Salvador do Sul, 29 April 1944, Rick 20.990 (PACA 9.369 – as *S. semiglobata*). Santa Maria, Campus of Universidade Federal de Santa Maria, 10 April 2001, V.G. Cortez 017/01 (SMDB 9.541); Água Boa, 19.VI.2003, V.G. Cortez 032/03 (SMDB 9.629); Morro do Elefante, 24 April 2004, V.G. Cortez 006/04 (ICN 139.000 – holotype here designated) and V.G. Cortez 011/04 (ICN 139.002). Santa Vitória do Palmar, Mangueira Lagoon, 13 January 1998, A. Spielmann *et al.* (HCB 17.068); 02 May 1998, J. Putzke *et al.* (HCB 17.072). São Francisco de Paula, FLONA, 25 June 1980, A. Batista (ICN 6.887 – as *Naematoloma* sp.). São Leopoldo, 1908, Rick 15.226 (PACA 9.361 – as *S. 'semiglobosa'* var. *strictipes*); September 1932, Rick 15.236 (PACA 9.375 – as *S. stercoraria*). Viamão, Itapuã State Park, 16 April 2005, M.A. Reck and P.S. Silva 109/05 (ICN 139.083).

Additional specimen examined of S. alcis Kytöv.: SWEDEN, Province of Dalarnas, St. Kopparberg, 20 September 1980, S. Jacobsson (ICN), on elk dung in spruce forest.

Notes: Kytövuori (1999) described this species based on materials collected on elk dung in northern Europe. The author emphasized the close relationship of the mushroom with its specific substrate (elk dung), and according to his notes, this species does not occur outside of the regions where the elk lives. It is separated from the other coprophilous species of the genus by presenting shorter basidiospores (< 15 µm). The Brazilian specimens agree in all aspects with the description given by Kytövuori (1999), except for the substrate (cow dung or enriched soil). We compared our materials with the Swedish ones of *S. alcis* on elk dung, and did not find any significant morphological differences. We believe that substrate differences (kind of dung) could indicate a specific separation rather in a physiological than a morphological way; however, we expect to perform a biosystematic or molecular study in order to understand the relationships among Brazilian and Northern European materials.

For this reason, we prefer to maintain the Brazilian cow dung inhabitant mushrooms under the specific name *S. alcis*, with the proposal of a new variety to accommodate



Figs 21-24. *Stropharia apiahyna*. 21. Basidioma. 22. Basidia. 23. Basidiospores. 24. Pleurocystidia.

them. It is possible that future molecular studies prove that Brazilian specimens represent another species; on the contrary, it will be only confirmed to be an interesting disjunction of a species able to colonize distinct types of substrata. This is the most common coprophilous species of *Stropharia* in Rio Grande do Sul.

Stropharia apiahyna (Speg.) Cortez & R.M. Silveira, comb. nov. (Figs 21-24)
MycoBank: 510883
≡ *Pholiota apiahyna* Speg., Bol. Acad. Nac. Cienc. Córdoba 23: 392 (1919) basonym.
= *Pholiota carneola* Rick, Brotéria Sér. Bot. 24: 108 (1930).

Pileus 15-30 mm in diam., hemispheric to expanded, sometimes umbonate; color yellowish-brown; surface subtomentose to glabrous; margin entire, non-striate; context fleshy, color. *Lamellae* adnate to sinuate, close, membranous; color reddish-brown with whitish and entire edges. *Stipe* 30-40 × 5-8 mm, central, with a slightly expanded base, annulate, color; fibrous; basal mycelium and rhizomorphs well developed, white. *Veil* forming a membranous and persistent annulus on stipe. *Spore print* not seen.

Basidiospores 6-8 × 3.5-5 µm, $Q = 1.30-1.75$, $Q_m = 1.60$, $n = 55$, ellipsoid to ovoid in both side and face view; smooth and slightly thick-walled, with a minute germ-pore; color pale yellow in KOH. *Basidia* 18-22 × 5-8 µm, clavate, bearing four sterigmata. *Pleurocystidia* 24-39 (-43) × (7-) 9-12 (-15) µm, as chrysocystidia, fusoid to clavate, with an obtuse and rounded but non-mucronate apex; smooth and thin-walled, with yellowish to greenish contents in KOH. *Cheilocystidia* not found, collapsed in the studied material - Singer (1951) reported from the holotype long cheilocystidia, without enclosures, then not of the chrysocystidia type. *Pileipellis* composed by yellowish, thin-walled, 3-5 µm in diameter hyphae, forming a prostrate layer. *Context* collapsed. *Gill trama* not studied. *Stipitipellis* not studied. *Caulocystidia* not studied. *Acanthocytes* present on rhizomorphs, and some also scattered present in the hymenium. *Clamp connections* present.

Habitat: Gregarious or solitary on wood in subtropical forest.

Known distribution: South Brazil (Rio Grande do Sul and São Paulo States).

Material examined: BRAZIL, Rio Grande do Sul State, São Leopoldo, 1939, Rick 14.635 (PACA 9.190 – holotype of *Pholiota carneola* Rick). São Paulo State, Apiaí, June 1889, Puiggari 56 (LPS 18.268 – holotype).

Additional specimens examined: COLOMBIA, Cali, 15 April 1968, Singer B6164 (F 1014404).

Notes: This species was originally described by Spegazzini (1919), and later its holotype was studied by Singer (1950), who confirmed it as a good *Pholiota* species. Singer (1953) considered it conspecific with *Pholiota carneola*, described by Rick (1930). Based on the study of both types we are in agreement with Singer, but we propose the transference of the taxon to *Stropharia* based on the presence

of white rhizomorphs bearing abundant acanthocytes. They were also found scarcely in the hymenium, reminding those of *S. acanthocystis*, from which it differs in several macro (pileus color, annulus) and microscopic characters (pleurocystidia, cheilocystidia). We also studied the specimens cited by Singer (1978), from Colombia and Ecuador. The Ecuadorian material (F 1017958) represents a probably undescribed species, presenting entirely yellow basidiomata, absent annulus, clavate and non-mucronate pleurocystidia. Singer (1986) placed this species in *Pholiota* sect. *Albivelatae* A.H. Sm. & Hesler, whose most species were transferred to *Stropharia* by Norvell and Redhead (2000).

The macroscopic description was based on those from Spegazzini (1919) and Rick (1961), including their used color terms. Some microscopic details (e.g. cheilocystidia) were also taken from Singer (1950, 1953) because they could not to be studied due the poor conditions of both type specimens. *Stropharia earlei* differs in basidiomata stature, pileus color, annulus, and basidiospore size (Pegler, 1997). *Stropharia apiayana* is known from the states of São Paulo (Pegler, 1997) and Rio Grande do Sul (Singer, 1953), in Brazil.

Stropharia araucariae Cortez & R.M. Silveira, sp. nov. (Figs 25-31)

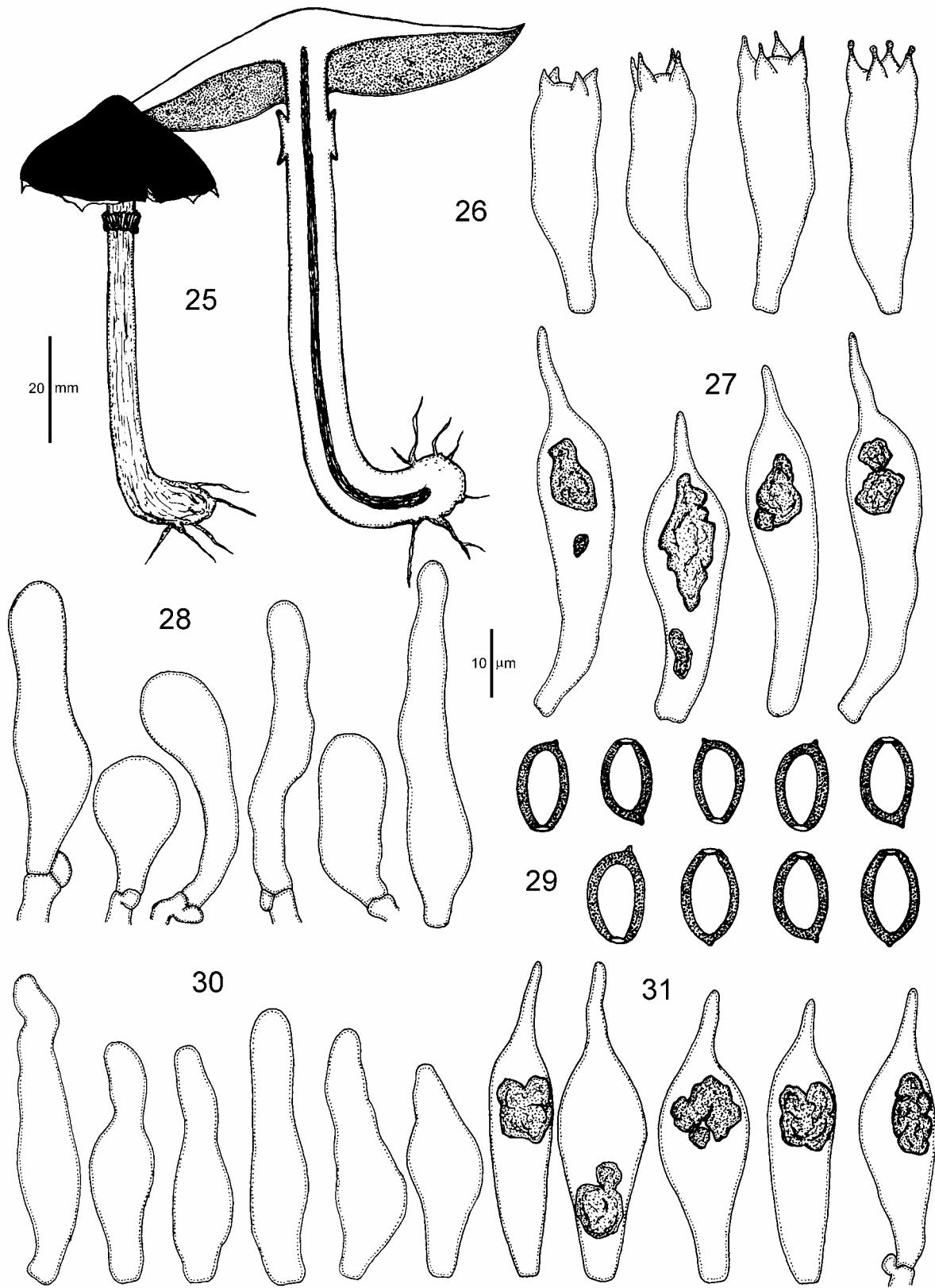
MycoBank: 510884

Etymology: The name refers to the habitat in *Araucaria angustifolia* (Bertol.) Kuntze forest.

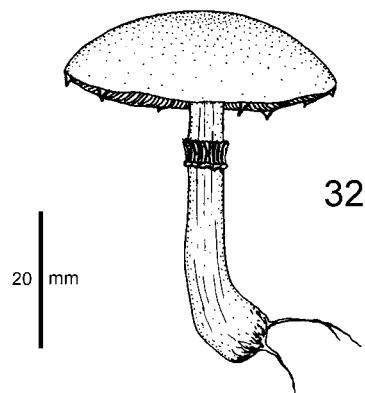
Pileus fuscus, campanulatus vel umbonatus, velo albo appendiculato in margine. *Stipes* albus, annulatus, rhizomorphis numerosus. *Basidiosporis* ovoidis vel ellipsoidis, (10.5-)12-13 × (6.5-)7-8 (-8.5) µm. *Pleurocystidiis* fusoideis et crisocystidiis. *Cheilocystidiis* dimorphis: a) crisocystidiis fusoideis et b) leptocystidiis lageniformibus. *Acanthocystis* in rhizomorphis adsunt.

Holotypus: BRASILIA, provicia Rio Grande do Sul, São Francisco de Paula, FLONA, 14.IV.2005, V.G. Cortez 044/05, in herbario ICN conservatur.

Pileus 39-68 mm in diameter, initially campanulate, becoming flattened, with a low and broad umbo; color very dark grayish brown (10YR 3/2), slightly darker in the centre than margin; surface viscid and smooth; margin regular, non-striate, with whitish velar remnants appendiculate; context flesh and soft, color white. *Lamellae* adnate, with decurrent tooth, close; color firstly gray (10YR 5/1) then reddish black (2.5YR 2.5/1) in maturity;

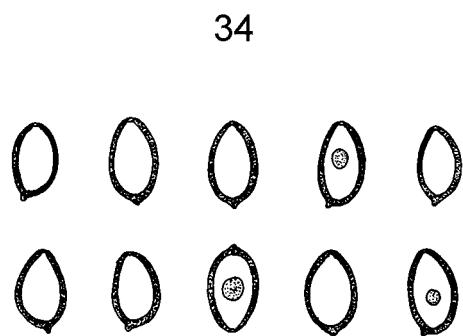
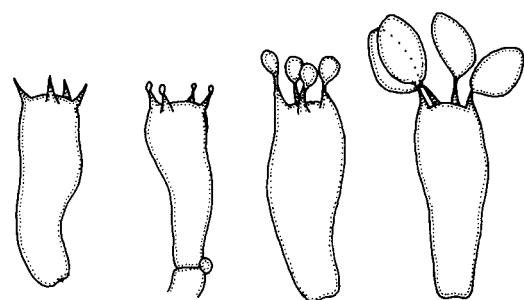


Figs 25-31. *Stropharia araucariae*. 25. Basidiomata. 26. Basidia. 27. Pleurocystidia. 28. Caulocystidia. 29. Basidiospores. 30. Cheilocystidia (leptocystidia type). 31. Cheilocystidia (chrysocystidia type).



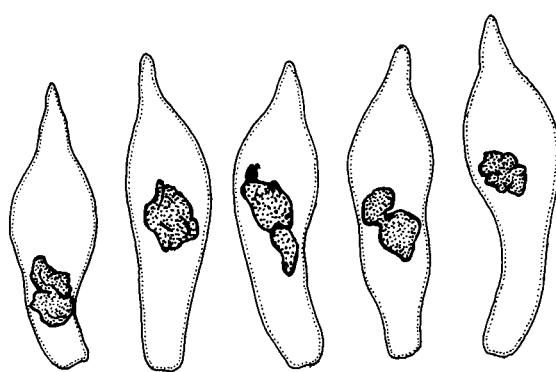
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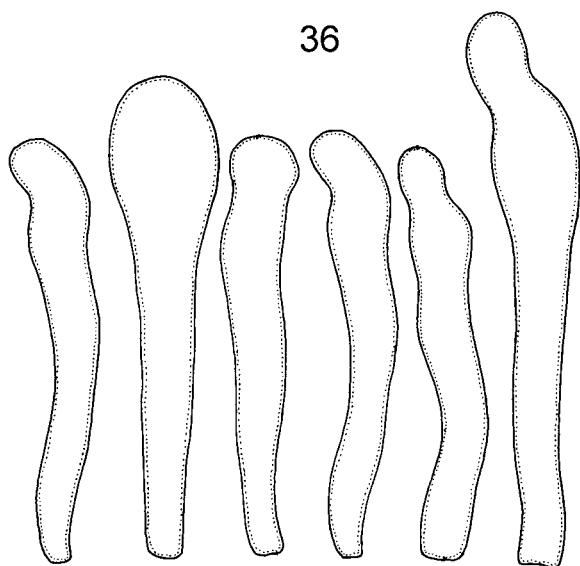


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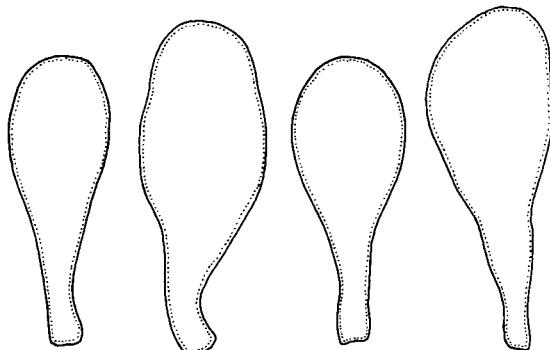


36



10 μm

37



Figs 32-37. *Stropharia coronilla*. **32.** Basidioma. **33.** Basidia. **34.** Basidiospores. **35.** Pleurocystidia. **36.** Caulocystidia. **37.** Cheilocystidia.

margin regular and conspicuously whitish. *Stipe* 70-111 × 7-9 mm, central, cylindrical to clavate, with a little expanded base, slightly incurved; color white (5Y 8/1) in the apex to pale yellow (5Y 8/2) toward the base; surface dry to slightly fibrillose, striate above the annulus; fistulous, with numerous white rhizomorphs. *Veil* present; in the pileus it forms a membranous, yellowish to whitish appendiculate remnants in the margin; on the stipe it produces a fleshy, grooved annulus, whitish below and violaceous in the upper surface. *Spore print* not seen.

Basidiospores (10.5)-12-13 × (6.5)-7-8(-8.5) µm, $Q = 1.44-1.79$, $Q_m = 1.64$, $n = 53$; ellipsoid to slightly ovoid in both side and face view; smooth and thick-walled, with a conspicuous germ-pore, making the apex truncate; color dark brown in KOH. *Basidia* 28-37 × (8-)10-11 µm, subclavate, bearing four sterigmata. *Pleurocystidia* (31)-38-47(-54) × 9-12 µm, as chrysocystidia, fusoid to clavate, with a long mucronate to rostrate apex; smooth and thin-walled, but with yellowish amorphous content in KOH. *Cheilocystidia* of two types: 1) *chrysocystidia*: (26)-34-42(-51) × 9-12 µm, fusoid, with a rostrate to mucronate apex, with yellowish internal incrustation; 2) *leptocystidia*: (26)-30-40(-44) × (6)-8-11 µm, lageniform, cylindrical or fusoid, with subcapitate apex, without any contents, hyaline, smooth and thin-walled. *Pileipellis* formed by radially disposed hyphae, strongly gelatinized, hyaline, ramified, with smooth and thin walls, (5)-8-11(-14) µm in diameter. *Context* composed by interwoven, hyaline, smooth and slightly thick-walled, (7)-8-11(-14) µm in diameter hyphae. *Gill trama* regular, composed by inflate hyphae, smooth and little thickened walls, (5)-8-12 µm in diameter. *Stipitipellis* composed by parallel, smooth and thin-walled hyphae, 4-8 µm in diameter. *Caulocystidia* (16)-26-37(-57) × (6)-8-11(-13) µm, as leptocystidia, without yellowish contents, very variable in shape: clavate, cylindrical, lageniform, utriform to pyriform, capitate or not; hyaline, with smooth and thin walls; numerous in the stipe apex. *Acanthocytes* present in the rhizomorphs. *Clamp connections* present in the most septa.

Habitat: Gregarious or solitary on soil, among grasses and fallen leaves, in *Araucaria angustifolia* forest (ombrophilous mixed forest).

Known distribution: South Brazil (Rio Grande do Sul).

Material examined: BRAZIL, Rio Grande do Sul State, São Francisco de Paula, FLONA, 14 May 2005, V.G. Cortez 044/05 (ICN 139.122 – holotype here designated), V.G. Cortez 050/05 (ICN 139.128) and V.G. Cortez 056/05 (ICN 139.134).

Notes: This species is macroscopically similar to *S. rugosoannulata* due the habit, the grooved annulus, and similar basidiospores, however it differs significantly in basidioma stature, as well other microscopic features like type, size and shape of the cheilocystidia and caulocystidia. The northern temperate *S. hornemannii* (Fr.) S. Lundell & Nannf. seems to be also related, but differs in the absence of chrysocystidia as cheilocystidia (Jahnke, 1984; Watling and Gregory, 1987; Noordeloos, 1999).

The most distinguishing characters of this new species are the membranous and grooved annulus, abundant velar remnants appendiculate in the pileus margin, the dimorphic cheilocystidia, and the caulocystidia not as chrysocystidia. It was found also growing in forests with *Araucaria angustifolia*, at altitude near to 900 m, in the region of the Meridional Plateau of the Rio Grande do Sul.

Stropharia coronilla (Bull. ex DC.: Fr.) Quél., Mém. Soc. Émul. Montbéliard, Sér. II, 5: 255 (1872). (Plate 1c, Figs 32-37)

≡ *Agaricus coronilla* Bull. ex DC., Fl. Franç. 2: 202 (1805).

≡ *Psilocybe coronilla* (Bull. ex DC.) Noordel., Persoonia 16: 128 (1995).

Pileus (16)-20-55 mm in diameter, hemispheric when young becoming convex to flattened or sometimes depressed in later stages; color yellow (2.5Y 7/8-8/8) frequently paler towards the margin; surface smooth, subviscid in fresh basidiomata; margin non-striate, bearing velar remnants; context fleshy, soft, white. *Lamellae* adnate, with decurrent tooth, close; firstly light gray (2.5Y 7/1-7/2), to light brownish gray (2.5Y 6/2) and finally black (10YR 2/1), with a whitish margin. *Stipe* (18)-37-51 × (3)-6-8-(12) mm, central, cylindrical, with a sub-bulbous base; color white to cream; surface humid, striate above the annulus, squamulose towards the base; basal mycelium and rhizomorphs white, abundant. *Veil* present; on pileus margin it forms whitish membranous remnants appendiculate; on stipe it produces a

fleshy and grooved apical annulus. *Spore print* black (7.5YR 2.5/1).

Basidiospores (6.5)-7-9(-10.5) × (4.5)-5-6(-6.5) µm, $Q = 1.33\text{-}2.17$, $Q_m = 1.59$, $n = 133$, sub-ellipsoid in side view, ovoid in face view; smooth and thick-walled, with an inconspicuous germ-pore. *Basidia* 19-28 × 6.5-9.5 µm, clavate, bearing four (sometimes two) sterigmata. *Pleurocystidia* 28-40(-48) × 7-12(-15) µm, as chrysocystidia, fusoid to clavate, with a mucronate apex; smooth and thin-walled, with amorphous internal incrustation yellowish in KOH. *Cheilocystidia* (21)-26-43(-56) × (8)-10-14(-16) µm, as leptocystidia, clavate to pyriform; smooth and slightly thickened walls; hyaline to yellowish, without yellowish contents. *Pileipellis* composed by filamentous, prostrate hyphae, with incrusted walls by yellowish pigment, 4-8 µm in diameter. *Context* formed by interwoven, smooth and somewhat thickened walled hyphae, 10-16 µm in diameter. *Gill trama* regular, composed by inflated, little thickened walled, 9-17 µm in diameter. *Stipitipellis* formed by hyaline, smooth and thin-walled, non gelatinized hyphae 3-7 µm in diameter. *Caulocystidia* (33)-40-64 × 6-11(-13) µm, as leptocystidia, cylindrical to clavate, with subcapitate apex (sometimes forked); hyaline, without contents, smooth and thin-walled, disposed in fascicles on stipe apex. *Acanthocytes* present on rhizomorphs and basal mycelium. *Clamp connections* present.

Habitat: Gregarious or solitary on soil among grasses in lawns and gardens.

Known distribution: Africa (Pegler, 1977), Australasia (Grgurinovic and Simpson, 2001; Segedin and Pennycook, 2001), Europe (Noordeloos, 1999; Watling and Gregory, 1987), North America (Murrill, 1922) and South America (Wright and Albertó, 2002).

Material examined: BRAZIL, Rio Grande do Sul State. Caçapava do Sul, Guaritas, 30 April 2005, V.G. Cortez 028/05 (ICN 139.110). Dom Pedro de Alcântara, 20 May 2005, V.G. Cortez 066/05 (ICN 139.144). Porto Alegre, Campus of Universidade Federal do Rio Grande do Sul, 06 May 2004, V.G. Cortez 015/04 (ICN 139.003). Salvador do Sul, 26 March 1944, Rick 21.013 (PACA 9.358). Santa Maria, Camobi, 26 February 2003, V.G. Cortez 003/03 (SMDB 9.600); Campus of Universidade Federal de Santa Maria, 27 March 2002, V.G. Cortez 017/02 (SMDB 9.557); Tancredo Neves, 07 April 2002, V.G. Cortez 027/02 (SMDB 9.566); Vila Caramelo, 02 May 2001, V.G. Cortez 021/01 (SMDB 9.243). Venâncio Aires, Sociedade dos Motoristas, 31 March 1985, Pilz (HCB 10.047, HCB 10.048). Vera

Cruz, Linha Número Um, 15 June 1986, J. Putzke (HCB 10.533); 08 October 1986, J. Putzke *et al.* (HCB 16.693). Viamão, Itapuã State Park, 08 May 2004, P.S. da Silva 063 (ICN 139.075).

Additional specimen examined: BRAZIL. São Paulo State. Itu, 20 November 1982, Guzmán (SP 178.187).

Notes: *Stropharia coronilla* is a common lawn-inhabitant mushroom in the State, macroscopically recognized by the yellowish pileus color, the appendiculate veil and grooved annulus. In Brazil it is known from the states of Paraná (Stijve and de Meijer, 1993), Pernambuco (Batista and Bezerra, 1960), Rio Grande do Sul (Rick, 1907; Cortez and Coelho, 2004), and São Paulo.

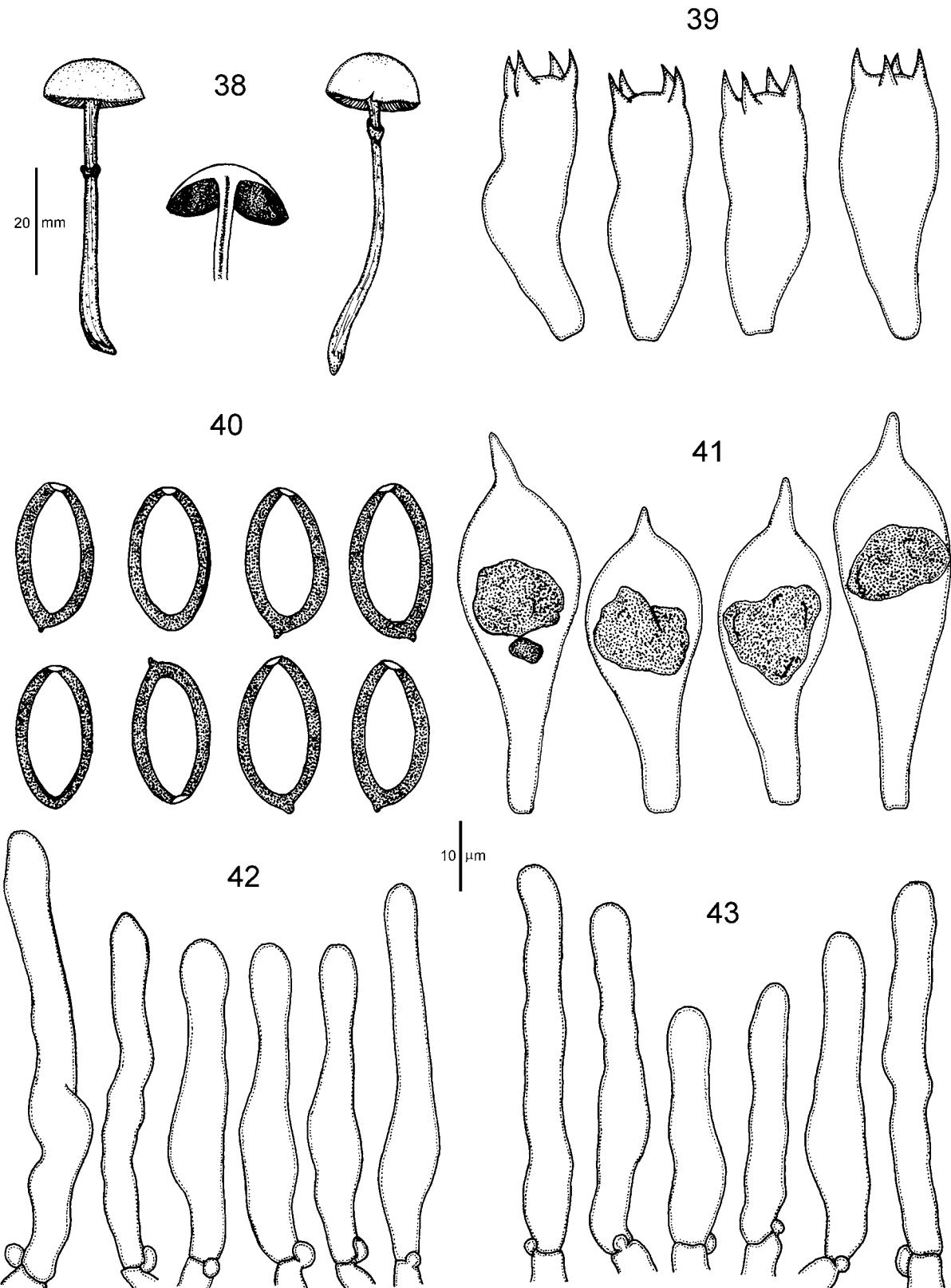
Stropharia dorsipora Esteve-Rav. & Barrasa, Rev. Iberoam. Micol. 12: 71 (1995).

(Figs 38-43)

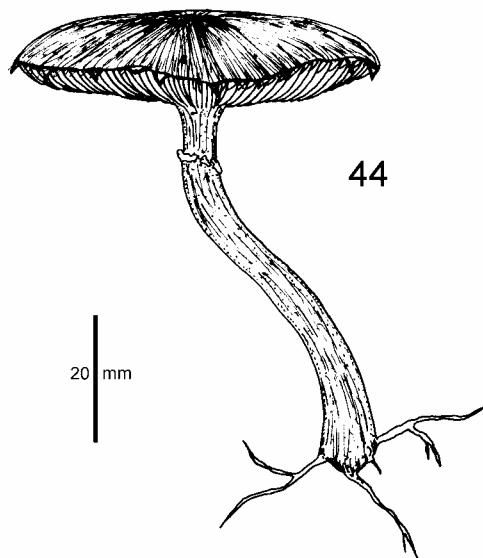
≡ *Psilocybe dorsipora* (Esteve-Rav. & Barrasa) Noordel., Persoonia 17: 246 (1999).

Pileus 13-23 mm in diameter, hemispheric to convex, umbonate; color pale yellow (2.5Y 8/4) to yellow (2.5Y-5Y 8/8), with a slightly paler margin; surface viscid, smooth, non-hygrophanous; margin regular, little or not striate; context thin, firm, whitish. *Lamellae* adnate, with decurrent tooth; color firstly light brownish gray (2.5Y 6/2) to black (7.5YR 2.5/1), with distinctly whitish edges; margin regular and conspicuously whitish; close, membranous. *Stipe* 46-58 × 2-3 mm; central, cylindrical, with a slightly expanded base; color yellow (2.5Y 8/6), more intense around the annulus; surface viscid, longitudinally striate and with little whitish fibrils on the base; basal mycelium white, not abundant, rhizomorphs not seen. *Veil* forming a glutinous to submembranous annulus on the upper stipe surface, color black (5YR 2.5/1). *Spore print* black (7.5YR 2.5/1).

Basidiospores (16.5)-18-21(-22) × (9)-10-12(-13) µm, $Q = 1.62\text{-}2$, $Q_m = 1.7$, $n = 78$; ellipsoid in both side and face views; smooth and thick-walled, with a conspicuous and eccentric germ-pore (more visible in side view); color dark brown in KOH. *Basidia* 26-36(-45) × (10)-12-16(-18) µm, clavate, bearing four sterigmata. *Pleurocystidia* 35-62 × 14-19 µm, as chrysocystidia, fusoid to clavate, with a mucronate apex, sometimes rostrate; smooth and thin-walled, but presenting amorphous content yellowish in KOH. *Cheilocystidia*

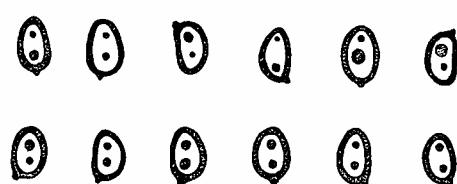
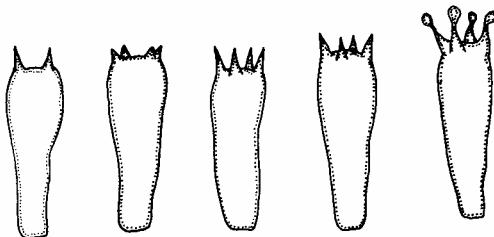


Figs 38-43. *Stropharia dorsipora*. 38. Basidiomata. 39. Basidia. 40. Basidiospores. 41. Pleurocystidia. 42. Caulocystidia. 43. Cheilocystidia.

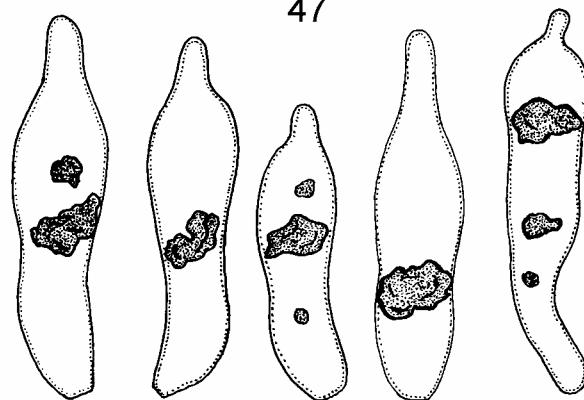


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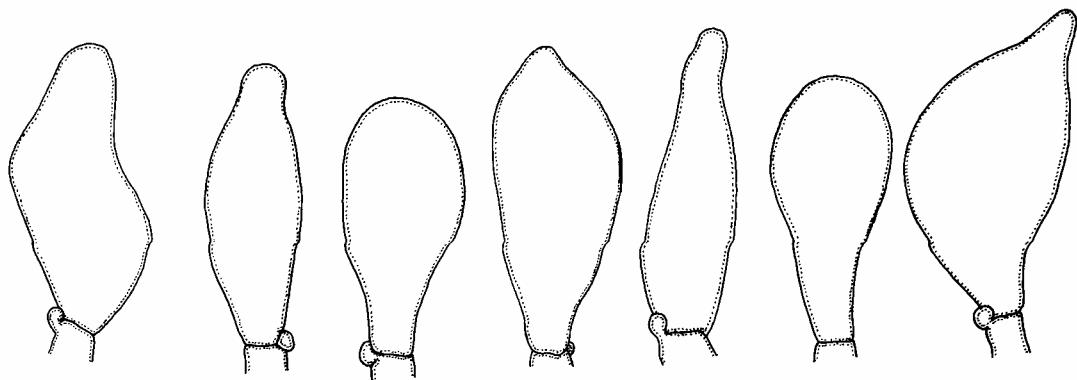
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47



48



Figs 44-48. *Stropharia earlei*. 44. Basidioma. 45. Basidia. 46. Basidiospores. 47. Pleurocystidia. 48. Cheilocystidia.

(26-)33-46(-52) × 6-11 µm, as leptocystidia, cylindrical to sublageniform, with a rounded to slightly subcapitate apex; hyaline, without yellowish contents; smooth and thin-walled; numerous in the gill edge. *Pileipellis* is an

ixocutis, formed by strongly gelatinized, ramified hyphae, 2-4 µm in diameter, with little incrusted walls by yellowish pigment in KOH. *Context* formed by interwoven, inflated, smooth and thin-walled hyphae, 6-16 µm in diameter.

Gill trama regular, composed by filamentous, smooth and thin-walled hyphae, (4-)6-12(-15) μm in diameter. *Stipitipellis* formed by parallel, little ramified, gelatinized hyphae, 3-6 μm in diameter, smooth and thin-walled. *Caulocys-tidia* (25-)28-41(-50) \times (4-)6-9(-10) μm , as leptocystidia, cylindrical to sublageniform, with a rounded to subcapitate apex; smooth and thin-walled, without contents, similar to cheilocystidia, disposed in fascicles on the stipe apex. *Acanthocytes* absent. *Clamp connections* present in the most septa.

Habitat: Solitary on cow dung in pastures.

Known distribution: Brazil, Europe (Kytövuori 1999, Noordeloos 1999), North America (Noordeloos 1999), probably widespread but confounded with *S. semiglobata*.

Material examined: BRAZIL, Rio Grande do Sul State. Encruzilhada do Sul: Fazenda Xafri, 10 July 2004, Cortez 039/04 (ICN 139.117) and Cortez 040/04 (ICN 139.118). São Leopoldo: 1934, leg. Steffen, Rick 15.225 (PACA 9.374 – as *S. stercoraria*).

Additional specimens examined: BRAZIL. São Paulo State. Campos do Jordão, Campos do Jordão State Park, 29 November 1982, Guzmán *et al.* (SP 177.730 – as *S. semiglobata*). SWEDEN. Småland. Femsjö: 25 September 1959, F. Karlvall (ICN).

Notes: The main taxonomic difference of this species from *S. semiglobata* is the eccentric germ pore of the basidiospores, which is central in the latter (Esteve-Raventós and Barrasa, 1995). Kytövuori (1999) considered the lack of chrysocystidia on stipe another important feature to separate it from *S. semiglobata*, which presents them. Noordeloos (1999) also emphasized the size and shape of the cheilocystidia as other taxonomic features to separate these close species: 20-40 μm , clavate to lageniform in *S. dorsipora* against 40-100 μm , cylindrical-flexuous to lecythiform in *S. semiglobata*. The Brazilian specimens presented slightly larger cheilocystidia 26-52 μm long, in agreement to those described by Kytövuori (1999).

Among the materials cited by Rick (1961), we found *S. dorsipora* identified as *S. stercoraria*, and specimens from São Paulo State, cited by Bononi *et al.* (1984) and Pegler (1997) both as *S. semiglobata*, also belong to this species. This is the first South American record of *S. dorsipora*, where it is probably widespread but overlooked and confused with *S. semiglobata*.

Stropharia earlei Norvell & Redhead, Mycotaxon 76: 317 (2000).

(Plate 1d, Figs 44-48)

\equiv *Pholiota cubensis* Earle, Inf. An. Estac. Centr. Agron. Cuba 1: 242 (1906) [non *Stropharia cubensis* Earle, Inf. An. Estac. Centr. Agron. Cuba 1: 240 (1906)].
= *Psilocybe cubensis* (Earle) Singer, Sydowia 2: 37 (1948).]

Pileus 46-73 mm, plano-convex to depressed in maturity; color yellowish brown (10YR 5/6) to dark yellowish brown (10YR 4/4-4/6); surface subviscid in fresh specimens, with little yellowish scales form center towards the margin; margin crenate, with whitish and membranous velar remnants appendiculate, mostly found in young specimens; context fleshy to spongy, pale yellow (2.5Y 8/2). *Lamellae* adnexed to subdecurrent; color yellowish brown (10YR 5/6-5/8) to dark yellowish brown (10YR 3/4-3/6), including the margin; close, membranous, with a smooth edge. *Stipe* 56-76 \times 5-8 mm, central, cylindrical to almost clavate; color pale yellow (2.5Y 8/2-8/3); surface longitudinally striate from the apex towards the base, with scattered whitish squamules; rhizomorphs white, abundant. *Veil* present; on pileus margin it leaves whitish scales appendiculate; on stipe it produces a membranous to floccose whitish annulus, easily detachable from the stipe, which can be absent in older basidiomes. *Spore print* brown (7.5YR 4/2) to dark brown (7.5YR 3/2).

Basidiospores (5.5-)6-7(-7.5) \times 3.5-4.5 μm , $Q = 1.1$ -1.88, $Q_m = 1.46$, $n = 95$; reniform to subellipsoid in side view, ovoid in face view; smooth and thick-walled, with a reduced but distinct germ-pore; color brownish in KOH. *Basidia* 17-23(-26) \times 5.5-7(-8) μm , clavate, bearing four (rarely two) sterigmata. *Pleurocystidia* (23.5-)28-36(-44) \times 8-13 μm , as chrysocystidia, clavate, with a rounded apex, rarely mucronate; smooth and thin-walled, but presenting a yellowish amorphous inclusion in KOH. *Cheilocystidia* (18-)20-28(-33) \times (8-)10.5-16 μm , as leptocystidia, with a variable shape: pyriform, ventricose, lageniform to fusoid, some with a subcapitate to capitate apex; hyaline, without yellowish contents, smooth and thin-walled; hard to observe in dry specimens. *Pileipellis* formed by prostrate, little gelatinized, cylindrical hyphae, with smooth and thin walls, 7-14 μm in diameter. *Context* formed by inflated to filamentous,

hyaline, smooth and thin-walled hyphae, (8-) 11-14 (-18) μm in diameter, hyaline. *Gill trama* regular, composed by inflated, slightly thick-walled, 3-12 μm in diameter, hyaline hyphae. *Stipitipellis* composed by parallel, hyaline, smooth and thin-walled hyphae, (4-)5-8(-9) μm in diameter. *Caulocystidia* 27-57 \times 8-14 μm , leptocystidia, subfusoid, sublageniform, capitate, hyaline. *Acanthocytes* present on rhizomorphs. *Clamp connections* present.

Habitat: Solitary on soil, litter, into a seasonal semideciduous forest.

Known distribution: Central (Pegler 1983) and South America (Brazil - Pegler 1997).

Material examined: BRAZIL. Rio Grande do Sul State. Itaara: Balneário Parque Pinhal, 23 February 2002, V.G. Cortez 007/02 (SMDB 9.550); 14 April 2005, V.G. Cortez 014/05 (ICN 139.100). Santa Maria, Morro do Elefante, 24 April 2004, V.G. Cortez 008/04 (ICN 139.001). São Francisco de Paula, FLONA, 19 March 1980, A. Batista (ICN 6.899). Torres, Roça da Estância, 06 April 1987, M.S.K. Alves (HCB 12.940), 10 April 1987, M.S.K. Alves (HCB 12.951), 15 May 1987, M.S.K. Alves (HCB 12.945).

Notes: Originally described as *Pholiota cubensis* Earle, with type material collected in Cuba. This name was used by Smith and Hesler (1968) and Pegler (1983, 1997). After the type study of *Ph. cubensis*, Norvell and Redhead (2000) found acanthocytes in their rhizomorphs, transferring it to *Stropharia*. As *S. cubensis* Earle is the basonym of the hallucinogenic mushroom *Psilocybe cubensis* (Earle) Singer, the authors renamed *Ph. cubensis* as *S. earlei* Norvell & Redhead. This species is close to *S. apiahyna*, from which differs on pileus color, annulus and slightly shorter basidiospores (Pegler, 1997). In Brazil, it was reported from São Paulo State by Pegler (1997 – as *Ph. cubensis* Earle); this is the first report from Rio Grande do Sul State.

Stropharia rugosoannulata Farl. ex Murrill, Mycologia 14: 139 (1922).

(Plate 1e, Figs 49-54)

= *Flammula puiggarii* Speg., Bol. Acad. Nac. Cienc. Córdoba 11: 418 (1889).

= *Anellaria sanguineopurpurea* Rick, Iheringia, Sér. Bot. 8: 432 (1961). syn. nov.

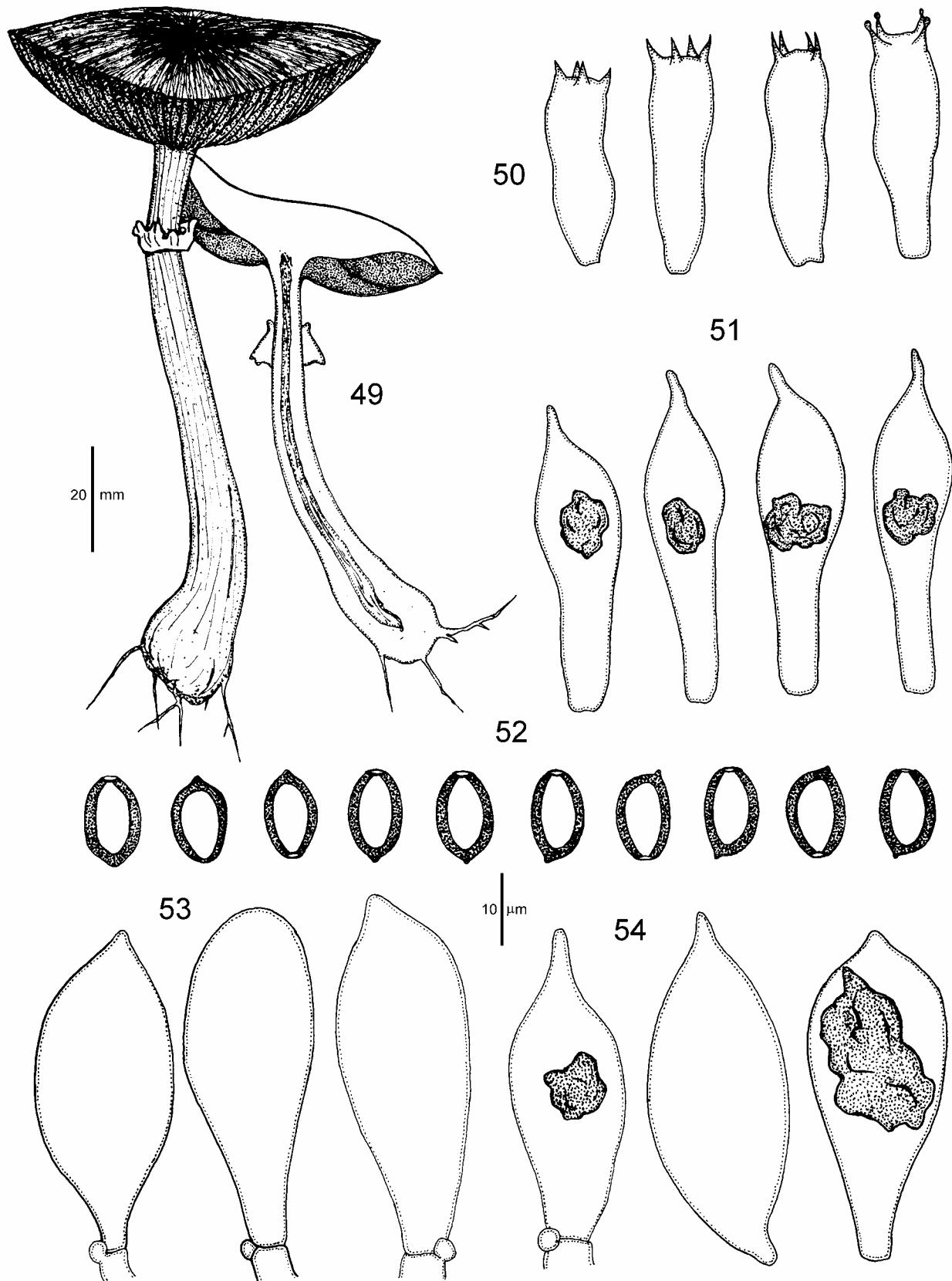
= *S. sanguineopurpurea* (Rick) Raithelh., Metrodiana 23: 9 (1995).

≡ *Psilocybe rugosoannulata* (Farl. ex Murrill) Noordel., Persoonia 16: 129 (1995).

Pileus 55-172 mm in diameter, firstly convex, becoming flattened then finally sub-

depressed; color dark red (2.5Y 3/6) to dark reddish brown (5YR 3/3-3/4), becoming more brownish in age; surface humid to slightly subviscid, squamulose to almost smooth; margin slightly incurved, crenate, with velar remnants appendiculate; context fleshy, firm, whitish. *Lamellae* adnexed with decurrent tooth; firstly the color is gray (2.5Y 5/1-6/1), soon becoming black (7.5YR 2.5/1) with the maturity; margin whitish, irregular. *Stipe* 61-174 \times (6-)9-16(-28) mm; central, clavate or with a sub-bulbous base; color white (5Y 8/1) in the apex to yellowish brown (10YR 5/4-5/8) towards the base; surface dry, longitudinally striate with brownish fibrils below the annulus; basal mycelium white, with numerous and well-developed whitish rhizomorphs. *Veil* present; on pileus margin it is present as membranous and whitish velar remnants appendiculate; on stipe it produces a fleshy and white annulus, grooved and violaceous on upper surface. *Spore print* black (7.5YR 2.5/1).

Basidiospores (9.5-)11-12.5(14.5) \times 6.5-8 μm , $Q = 1.25-2$, $Q_m = 1.59$, $n = 92$; ellipsoid to ovoid in side view, ovoid to slightly subhexagonal in face view; smooth and thick-walled, with a conspicuous germ-pore, which makes the basidiospore truncate; color dark brown in KOH. *Basidia* 21-32(-38) \times 8-12 μm , subclavate, with a medial constriction, and bearing four sterigmata. *Pleurocystidia* (25-)38-55 \times (6.5-)9-13.5(-15) μm , as chrysocystidia, fusoid to clavate, with a mucronate apex or not; smooth and thin-walled, but presenting a yellowish amorphous inclusion. *Cheilocystidia* (21-)35-46.5 \times 9.5-13.5(-17.5) μm , fusoid to ventricose, sometimes with a mucronate apex, as chrysocystidia or leptocystidia with the same shape but with little or without yellowish contents; smooth and thin-walled. *Pileipellis* composed by prostrate, little gelatinized hyphae, with smooth and slightly thickened walls, color light brown, 7-14 μm in diameter. *Context* formed by hyaline, smooth and thin-walled hyphae, (7-)11-12(-15) μm in diameter. *Gill trama* regular, formed by inflate, hyaline, smooth and slightly thick-walled hyphae, (16-)18-30 μm in diameter. *Stipitipellis* composed by hyaline, smooth and thin-walled hyphae, 8-11 μm in diameter. *Caulocystidia* 42-48 \times 18-20 μm , as leptocystidia, clavate to subfusoid, hyaline, smooth and thin-walled, scattered on



Figs 49-54. *Stropharia rugosoannulata*. **49.** Basidiomata. **50.** Basidia. **51.** Pleurocystidia. **52.** Basidiospores. **53.** Caulocystidia. **54.** Cheilocystidia.

the stipe apex. *Acanthocytes* present in rhizomorphs. *Clamp connections* present.

Habitat: Solitary to gregarious into forests or lawns in forest board, on fallen leaves or rarely much decomposed wood.

Known distribution: Europe (Watling and Gregory, 1987; Noordeloos, 1999), North America (Murrill, 1922), South America (Wright and Albertó, 2002).

Material examined: BRAZIL. Rio Grande do Sul State. Candelária, M. Sulzbacher and A. Spielmann (HCB). Canela, Caracol State Park, 02 April 2000, Micheline (HASU 8.744). Dom Pedro de Alcântara, 20 May 2005, V.G. Cortez 062/05 (ICN 139.140). Esmeralda, Ecological Station of Aracuri, 24 November 2004, V.G. Cortez 060/04 (ICN 139.031). Santa Cruz do Sul, Cinturão Verde, 06 June 1997, C. Trentin and J. Soares 378 (HCB 17.011); 08 May 2001, C. Trentin 102 (HCB 17.511) and C. Trentin 104 (HCB 17.513); Parque da Gruta dos Índios, 24 June 1995, A. Spielmann (HCB 16.767). Santa Maria, Água Boa, 09 May 2003, V.G. Cortez 011/03 (SMDB 9.608) and V.G. Cortez 012/03 (SMDB 9.609), 12 June 2003, V.G. Cortez 022/03 (SMDB 9.619); Morro do Elefante, 09 May 2001, V.G. Cortez 027/01 (SMDB 9.247) and V.G. Cortez 028/01 (SMDB 9.248); 04 May 2002, V.G. Cortez 039/02 (SMDB 9.577). São Francisco de Paula, FLONA, 13 May 2005, V.G. Cortez 060/05 (ICN 139.138). São Leopoldo, 1932, Rick 12.025 (PACA 8.424 – holotype of *Anellaria sanguineopurpurea* Rick). Viamão, Saint-Hilaire Park, 13 July 1978, M.H. Homrich and R.T. Guerrero (ICN 102.124).

Additional specimens examined: BRAZIL. São Paulo State. Apiaí: 1881, J. Puiggari 1.529 (LPS 37.612 – holotype of *Flammula puiggarii* Speg.). Guapiara: Fazenda Intervales, 03 July 1989, M. Capelari and R. Maziero (SP 233.269). UNITED STATES. Massachusetts. Waban: 13 September 1905, G.E. Morris (NY 761.568 – paratype).

Notes: *Stropharia rugosoannulata* will be proposed as a conserved name (Cortez *et al.*, in prep.) because *Flammula puiggarii* Speg. (Spegazzini, 1889) from Brazil, is an older name for the species. This synonymy was previously indicated by Singer (1950) and Pegler (1997), but these authors maintained the Spegazzini's mushroom under *Naematoloma ferrii* (Bres.) Singer and *S. rugosoannulata*, respectively. The conservation will be proposed to safeguard the widely known name for a mushroom with commercial value, in order to avoid a nomenclatural change (Hawksworth, 2005). This edible mushroom is characterized by the robust basidiomes, with a pileus up to 20 cm, sub-bulbous stipe, fleshy and grooved annulus.

There are reports from Brazil in the states

of Paraná (Stijve and de Meijer, 1993; de Meijer, 2001), São Paulo (Pegler, 1997), and Rio Grande do Sul (Cortez and Coelho 2004). *Anellaria sanguineopurpurea* Rick (1961) was concluded to represent an additional synonym for this species after study of the type material; consequently, *S. sanguineopurpurea* (Rick) Raithelh. (Raithelhuber, 1995) also falls into synonymy. Furlan *et al.* (1997) made cultivation studies of *S. rugosoannulata* in Santa Catarina State, but they used commercial European strains instead of indigenous sources.

***Stropharia semiglobata* (Batsch) Quél., Mém. Soc. Émul. Montbéliard, Sér. II, 5: 143 (1872).**

(Figs 55-59)

= *Agaricus semiglobatus* Batsch, Elenchus Fungorum Contin. 1: 141 (1786).

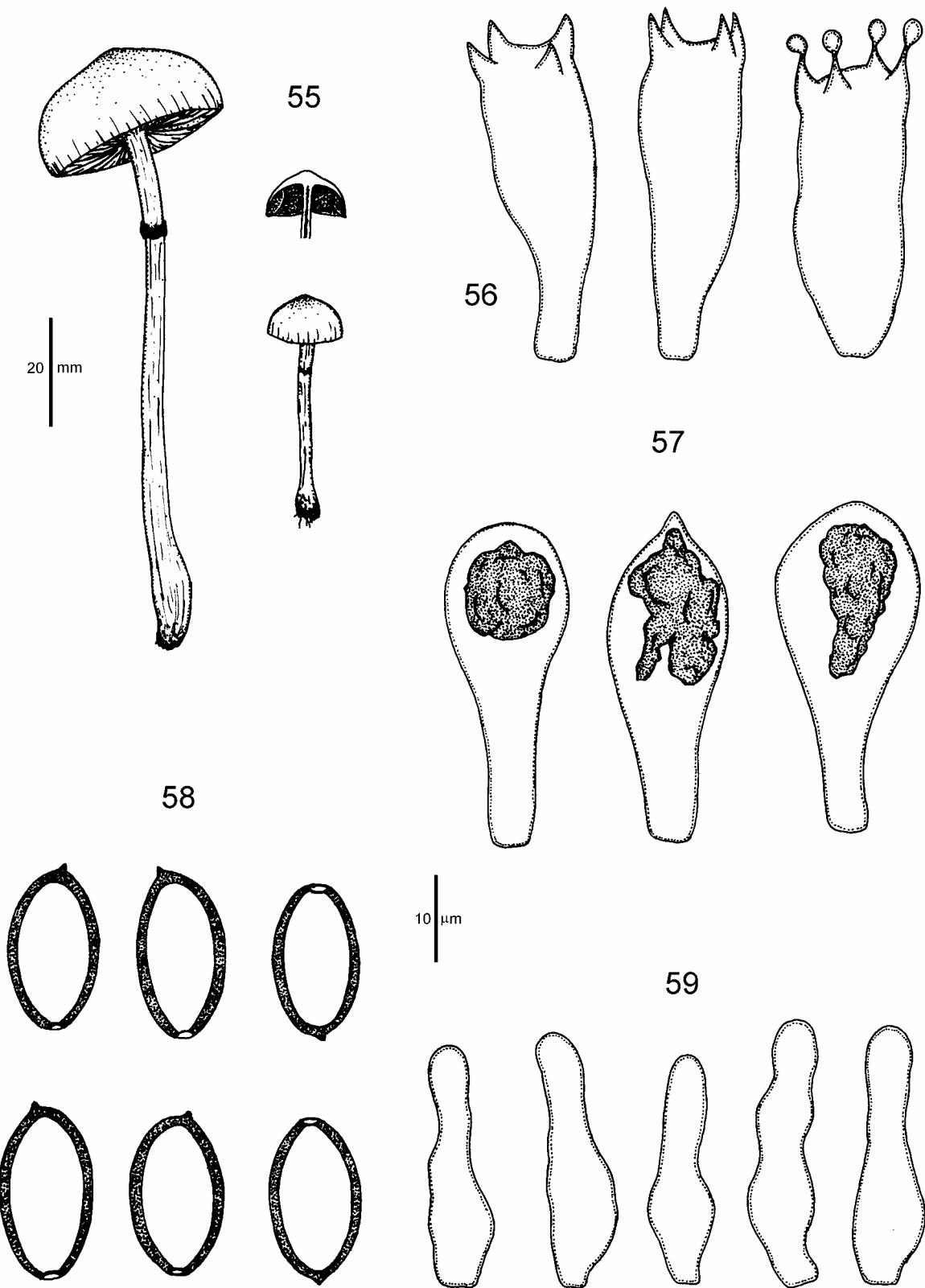
= *S. stercoraria* (Schumach.) Quél., Mém. Soc. Émul. Montbéliard, Ser. II, 5: 143 (1872).

= *S. semiglobata* var. *stercoraria* (Schumach.) J.E. Lange, Fl. Agar. Danica 4: 67 (1939).

= *Psilocybe semiglobata* (Batsch) Noordel., Persoonia 16: 129 (1995).

Pileus 10-33 in diameter, hemispheric to convex, umbonate; color olive yellow (2.5Y 6/8) to yellow (2.5Y 7/8-8/8), more pigmented in the centre; surface viscid, smooth, non-hygrophanous; margin regular, little striate; context thin, firm, whitish. **Lamellae** adnate, with decurrent tooth; color firstly light brownish gray (2.5Y 6/2) to black (7.5YR 2.5/1) when mature; margin regular and conspicuously whitish; close, membranous. **Stipe** 82-104 × 2-4 mm; central, cylindrical, with a slightly expanded base; color yellow (2.5Y 8/6-7/8); surface viscid, longitudinally striate and with little whitish fibrils on the base; basal mycelium white, not abundant, rhizomorphs absent. **Veil** forming a glutinous to submembranous annulus on the upper stipe surface, color violaceous. **Spore print** black (7.5YR 2.5/1).

Basidiospores (14.5-)18-20.8 × (9-)10-12(-13) µm, $Q = 1.61\text{-}2.08$, $Q_m = 1.82$, $n = 35$; ellipsoid in both side and face views; smooth and thick-walled, with a conspicuous and central germ-pore; color dark brown in KOH. **Basidia** (28-)33-38.4(-41) × (10.8-)12-15 µm, clavate, bearing four sterigmata. **Pleurocystidia** (29.8-)34-51(-52) × 12-19.2 µm, as chrysocystidia, fusoid to clavate, with a mucronate apex, sometimes rostrate; smooth and thin-walled, but presenting amorphous content yellowish in KOH. **Cheilocystidia** 25-34 × 8-11 µm, as



Figs 55-59. *Stropharia semiglobata*. **55.** Basidiomata. **56.** Basidia. **57.** Pleurocystidia. **58.** Basidiospores. **59.** Cheilocystidia.

leptocystidia, cylindrical to sublageniform; hyaline, without yellowish contents; smooth and thin-walled; numerous in the gill edge. *Pileipellis* is an ixocutis, formed by strongly gelatinized, branched hyphae, 2-4 µm in diameter, with little incrusted walls by yellowish pigment in KOH. *Context* not studied. *Gill trama* regular, composed by filamentous, smooth and thin-walled hyphae. *Stipitipellis* formed by parallel, little branched, gelatinized hyphae, 2-4 µm in diameter. *Caulocystidia* not studied. *Acanthocytes* absent. *Clamp connections* present in most septa.

Habitat: Solitary on cow dung, in pastures.

Known distribution: South America (Singer and Moser, 1964; Wright and Albertó, 2002), Australasia (Segedin and Pennycook, 2001), Europe (Kytövuory, 1999; Noordeloos, 1999), North America (Stamets, 1996).

Material examined: BRAZIL. Rio Grande do Sul. Salvador do Sul, 30 March 1944, Rick 20.955 (PACA 9.368). Santa Maria, Morro do Elefante, 23 September 2000, Cortez 048/00 (SMDB - material lost).

Notes: *Stropharia semiglobata* differs from the other dung-inhabiting species of the genus by the larger and centrally germ-pored basidiospores (Kytövuori, 1999; Noordeloos, 1999). It seems to be the less common coprophilous species of the genus in Rio Grande do Sul, in spite of being considered common in several countries of North Hemisphere.

The differences in cheilocystidia size and shape to separate it from *S. dorsipora*, indicated by Noordeloos (1999), were not observed in our materials and also those described by Kytövuori (1999). Both types of caulocystidia (lepto- and chrysocystidia) occur on stipe of *S. semiglobata* (Kytövuori, 1999), however, we have not studied the caulocystidia in the scarce materials available.

Previous reports in Brazil are those from São Paulo State by Pegler (1997 – the referred collection is actually *S. dorsipora*), Stijve and de Meijer (1993) from Paraná State, and Cortez and Coelho (2004) from Rio Grande do Sul. *Stropharia semiglobata* and *S. stercoraria sensu* Rick (1907-1961) are a mixture of *S. alcis* var. *austrobrasiliensis*, *S. dorsipora* and *S. semiglobata*.

Excluded or Doubtful Taxa

(Note: The names listed below are indicated as they were originally reported in the respective papers).

"*Stropharia aurantiaca* (Cooke) P.D. Orton" – The material cited by Sobestiansky (2005) was not studied, but if correctly identified, this mushroom must to be referred as *Hypholoma aurantiacum* (Cooke) Faus, a species occurring in Rio Grande do Sul State. See Cortez and Silveira (2007) for a detailed discussion and description of it.

***Stropharia crassa* Rick** – After study of the type material deposited in the herbaria PACA and SP, and based on a photo published in Rick (1907), we concluded that this species refers to an *Agaricus* sp.

Material examined: BRAZIL. Rio Grande do Sul State. Arroio do Meio, 1920, Rick (SP 33.910). São Leopoldo, 1907, Rick 15.232 (PACA 9.359 - holotype).

***Hypholoma intonsum* Pass.** – The material collected by Rick is in fact a *Stropharia* sp., because it presents chrysocystidia as pleurocystidia, acanthocytes on stipe base and ellipsoid basidiospores 6.5-7.2 µm. Unfortunately, Rick transcribed literally the description of Saccardo (1887). In spite of our efforts to collect current information about this name, nothing was found about it. The name in its original sense is a probable synonym of some European species.

Material examined: BRAZIL. Rio Grande do Sul State. Esteio, 1939, Rick 13.332 (PACA 8.692).

***Stropharia inuncta* ss. Rick** – Material deposited in Rick's herbarium under this name is actually *Psilocybe caeruleoannulata* Singer ex Guzmán, a common grassland inhabitant and hallucinogenic mushroom in south Brazil (Guzmán, 1978, 1983). *Material examined:* BRAZIL. Rio Grande do Sul. São Leopoldo, 08 August 1934, leg. Steffen, Rick 15.229 (PACA 9.362).

"*Stropharia mephistopheles* Cooke" – The material illustrated in Rick (1907) seems to belong to the genus *Agaricus*. The studied specimen, collected in 1932 by Rick and subsequently published (1939, 1961), also suggests to be an *Agaricus*; it presents short-ellipsoid basidiospores 4.5-5.5 µm long without germ-pore and the pleurocystidia are lacking, however the bad conditions of the specimen did not allow a complete study.

Material examined: BRAZIL. Rio Grande do Sul State. São Leopoldo, 1932, Rick 15.237 (PACA 9.366).

"*Stropharia merdaria* Fr." – The materials reported by Rick (1939) refers to *Psilocybe argentina*, as discussed Guzmán (1983); however these materials were not received

from the herbarium PACA. But the material cited and described in Rick (1961) is in fact *S. aeruginosa* (see discussion and examined material under this species). In this work, Rick wrote: “*Colore olivaceo-brunneo, aut olivaceo-flavo, aut olivaceo-viridi; in juvenile margine appendiculato*”.

“*Stropharia ochreata* Holmsk.” – Two materials were received from the herbarium PACA. The former (PACA 9.363) was cited by Rick (1939), and is a probable *Stropharia* species, presenting basidiospores $7-8 \times 4.5-5$ μm with a wide germ-pore, pleurocystidia $24-30 \times 8-10$ μm clavate to fusoid chrysocystidia, cheilocystidia also as chrysocystidia $28-41 \times 7-10$ μm . The stipe base is absent in this collection, not allowing to check the presence of acanthocytes. The other specimen (PACA 9.364) hardly belongs to the same species, and neither is a strophariaceous mushroom. It probably belongs to *Agaricus*, due the free gills, but the entirely mouldy specimens did not allowed a detailed study.

Material examined: BRAZIL. Rio Grande do Sul. São Leopoldo, 1934, leg. Steffen, Rick 15.232 (PACA 9.363); 1940, Rick 15.233 (PACA 9.364).

Stropharia ‘semiglobosa’ var. strictipes – Study of Rick’s material preserved at PACA revealed to be *S. alcis* var. *austrobrasiliensis* – see discussion and material examined there. There’s not any indication of the authorship of this variety, and the record of this material probably was never published.

Stropharia siccipes var. *lugubris* Rick – This is a well known synonym of *Psilocybe caeruleoannulata* Singer ex Guzmán (Guzmán, 1978; Guzmán and Cortez, 2004).

Material examined: BRAZIL. Rio Grande do Sul State. Santa Maria, 1936, Rick 15.238 (PACA 9.372).

“*Stropharia squamosa* Fr.” – The studied specimens from herbarium PACA are *Hypholoma ericaeum* (Pers.) Kühner, a common species in Rio Grande do Sul. See Cortez and Silveira (2007) for detailed description and discussion of this species from there.

Material examined: BRAZIL. Rio Grande do Sul State. São Leopoldo, Rick 15.235 (PACA 9.373).

“*Stropharia stercoraria* Fr.” – This is currently accepted as a synonym of *S. semiglobata*, but the material present in Rick’s collection under this name is a mixture of *S. dorsipora* and *S. alcis* var. *austrobrasiliensis*, therefore see

above the discussion and examined specimens under these two specific names.

Stropharia subcyanescens Rick – As demonstrated by several authors (Singer, 1953; Guzmán, 1978), this is another synonym of the hallucinogenic mushroom *Psilocybe cubensis*.

Material examined: BRAZIL. Rio Grande do Sul State. Santa Maria, Rick 15.227 (PACA 9.376 - neotype).

“*Stropharia subrufescens* Peck var. *angustifolia*” – Probably the Rick’s citation was a mistake, once this name was not found in the *Index Fungorum* database. The material collected and reported by Rick (1907) is in poor condition, and by its macroscopic aspect, free gills and basidiospores, we concluded that it is not a member of *Strophariaceae*, but possibly a species of the genus *Agaricus*. If correctly identified, the specimens could to belong to *A. subrufescens* Peck, however we are not able to establish this.

Material examined: BRAZIL. Rio Grande do Sul State, 1905, Rick 15.230 (PACA 9.377).

“*Stropharia thrausta* Kalchbr.” – As demonstrated by Cortez and Silveira (2007) the mushroom reported by Rick (1907, 1939, 1961) is *H. aurantiacum*.

Material examined: BRAZIL. Rio Grande do Sul State. São Leopoldo, 1905, Rick 15.228 (PACA 9.378).

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