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DISSERTAÇÃO DE MESTRADO

“ESPÉCIES DE *HYPHOLOMA* (FR.) P. KUMM. E *STROPHARIA* (FR.)
QUÉL. (*STROPHARIACEAE*, *AGARICALES*)
NO RIO GRANDE DO SUL, BRASIL”

Vagner Gularte Cortez

Orientadora: Prof^ª. Dr^ª. Rosa Mara Borges da Silveira

Porto Alegre, RS, Brasil

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**ESPÉCIES DE *HYPHOLOMA* (FR.) P. KUMM. E *STROPHARIA* (FR.) QUÉL.
(*STROPHARIACEAE*, *AGARICALES*) NO RIO GRANDE DO SUL, BRASIL**

Dissertação apresentada ao Programa de Pós-Graduação em Botânica, Área de Concentração em Taxonomia Vegetal (Ficologia e Micologia), da Universidade Federal do Rio Grande do Sul (UFRGS), como requisito parcial para obtenção do grau de **Mestre em Botânica**.

Orientadora: Profa. Dra. Rosa Mara Borges da Silveira

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Resumo

Espécimes de *Hypholoma* (Fr.) P. Kumm. e *Stropharia* (Fr.) Quél., ambos pertencentes à família *Strophariaceae* Singer & A.H. Sm., de ocorrência no estado do Rio Grande do Sul foram estudados. O estudo baseou-se em coletas realizadas pelo autor no período entre março de 2004 e setembro de 2005, e também na revisão do material depositado em herbários do estado, Brasil e exterior. As análises macro e microscópica dos basidiomas foram realizadas segundo metodologia usual para estudo de fungos agaricóides, e todo o material coletado encontra-se preservado no Herbário do Departamento de Botânica da Universidade Federal do Rio Grande do Sul (ICN). Neste estudo, concluiu-se que o gênero *Hypholoma* está representado no Rio Grande do Sul pelas seguintes espécies: *H. aurantiacum* (Cooke) Faus, *H. ericaeum* (Pers.: Fr.) Kühner, e *H. subviride* (Berk. & M.A. Curtis) Dennis. Da mesma forma, o gênero *Stropharia* encontra-se representado no estado por: *S. acanthocystis* Cortez & R.M. Silveira, *S. aeruginosa* (Curtis: Fr.) Quél., *S. alcis* var. *austrobrasiliensis* Cortez & R.M. Silveira, *S. apiahyna* (Speg.) Cortez & R.M. Silveira, *S. araucariae* Cortez & R.M. Silveira, *S. coronilla* (Bull.: Fr.) Quél., *S. dorsipora* Esteve-Rav. & Barrasa, *S. earlei* Norvell & Redhead, *S. rugosoannulata* Farl. ex Murrill e *S. semiglobata* (Batsch: Fr.) Quél. Dentre estas, *Stropharia acanthocystis*, *S. alcis* var. *austrobrasiliensis* e *S. araucariae*, são descritos como novos táxons para a ciência; *S. apiahyna* é proposta como uma nova combinação; *S. dorsipora*, *S. aeruginosa* e *S. earlei* são citadas, respectivamente, pela primeira vez para a América do Sul, Brasil e Rio Grande do Sul. São apresentadas chaves de identificação, descrições e ilustrações macro e microscópicas de todas as espécies estudadas.

Palavras-chave: *Basidiomycota*, fungos neotropicais, cogumelos

Abstract

Specimens of the genera *Hypholoma* (Fr.) P. Kumm. and *Stropharia* (Fr.) Quél. (family *Strophariaceae* Singer & A.H. Sm.), from the Rio Grande do Sul State were studied. This survey was based on collections made by the author from March 2004 to September 2005, as well the revision of Brazilian and foreign herbaria. Macroscopic and microscopic study of the basidiomata followed usual techniques for the study of agarics, and all collected specimens are deposited in the Herbarium of the Department of Botany of the University of Rio Grande do Sul (ICN). We concluded that the genus *Hypholoma* is represented by the following species in the Rio Grande do Sul State: *H. aurantiacum* (Cooke) Faus, *H. ericaeum* (Pers.: Fr.) Kühner, and *H. subviride* (Berk. & M.A. Curtis) Dennis. The genus *Stropharia* comprised the species: *S. acanthocystis* Cortez & R.M. Silveira, *S. aeruginosa* (Curtis: Fr.) Quél., *S. alcis* var. *austrobrasiliensis* Cortez & R.M. Silveira, *S. apiahyna* (Speg.) Cortez & R.M. Silveira, *S. araucariae* Cortez & R.M. Silveira, *S. coronilla* (Bull.: Fr.) Quél., *S. dorsipora* Esteve-Rav. & Barrasa, *S. earlei* Norvell & Redhead, *S. rugosoannulata* Farl. ex Murrill, and *S. semiglobata* (Batsch: Fr.) Quél. The following taxa are described as new: *Stropharia acanthocystis*, *S. araucariae* and *S. alcis* var. *austrobrasiliensis*; the new combination for *S. apiahyna* is proposed; *S. dorsipora*, *S. aeruginosa*, and *S. earlei* are new records from South America, Brazil and Rio Grande do Sul State, respectively. Keys for identification, macro and microscopic descriptions and illustrations for all studied species are presented.

Key-words: *Basidiomycota*, neotropical fungi, mushrooms

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Apresentação

O presente trabalho constitui o resultado de um estudo taxonômico envolvendo os gêneros *Hypholoma* (Fr.) P. Kumm. e *Stropharia* (Fr.) Quéél. (*Strophariaceae* Singer & A.H. Sm.), coletados no estado do Rio Grande do Sul, o qual foi realizado como tema de dissertação de mestrado deste autor.

Este trabalho está apresentado na forma de capítulos, sendo que os dois primeiros capítulos, assim como o último, compõem o texto geral desta dissertação, e os demais correspondendo aos artigos que serão futuramente publicados. Desse modo, os capítulos 3 e 4 encontram-se redigidos em inglês e formatados de acordo com as normas estabelecidas pelos periódicos ao qual estão destinados. Esta estrutura foi escolhida de modo a agilizar o processo de publicação dos resultados obtidos, e para a escolha dos respectivos periódicos foi considerada, sobretudo, a relevância dos resultados apresentados em cada trabalho.

No Capítulo 1 realiza-se uma introdução acerca da família *Strophariaceae* e dos gêneros contemplados neste estudo, incluindo informações sobre a sua taxonomia, estudos prévios no Brasil, além de aspectos relevantes, como a importância econômica e ecológica destes.

No Capítulo 2 é apresentada a metodologia que foi adotada para o desenvolvimento deste trabalho, a qual encontra-se de maneira bastante resumida nos capítulos (artigos) seguintes.

Os capítulos 3-4 correspondem aos artigos que serão submetidos para publicação nos periódicos indicados.

O primeiro artigo (Capítulo 3) trata das espécies do gênero *Hypholoma* no Rio Grande do Sul, e encontra-se formatado de acordo com as normas do periódico ACTA BOTANICA BRASILIICA (São Paulo, Brasil), ao qual foi submetido.

O segundo (Capítulo 4) trata das espécies do gênero *Stropharia* e deverá ser submetido ao periódico MYCOTAXON (Ithaca, Estados Unidos), especializado em Taxonomia de Fungos, e o formato adotado segue, portanto, as normas definidas por este.

O Capítulo 5 realiza um apanhado geral sobre o trabalho desenvolvido, apresenta as conclusões e considera perspectivas para trabalhos futuros.

O estudo aqui apresentado não deve ser entendido como um estudo exaustivo do grupo, ao contrário, deve ser tratado como uma contribuição inicial, que naturalmente deverá

ser complementada com mais coletas, especialmente em regiões do estado que infelizmente não foram visitadas. Consideramos, entretanto, que os resultados aqui obtidos constituem uma boa contribuição ao conhecimento deste grupo no Brasil, como ficará explícito a seguir. A necessidade de estudos básicos em Micologia (Taxonomia) é imperativa e deve ser estimulada em nosso país, onde certamente muitas novidades taxonômicas aguardam para serem descobertas.

Para fins nomenclaturais, esta dissertação não deve ser tomada como publicação efetiva dos novos nomes (táxons e combinação novas) aqui apresentados, visto que os mesmos serão devidamente publicados em periódico de circulação internacional num futuro breve, cumprindo os trâmites legais para a validação de nomes de novos táxons.

Todos os nomes científicos mencionados neste texto (independentemente do nível taxonômico) encontram-se em itálico, uma prática não regulamentada pelo Código Internacional de Nomenclatura Botânica (ICBN), mas recomendada por este e seguida por inúmeros periódicos internacionais.

O Autor

Capítulo 1

INTRODUÇÃO

1.1. A família *Strophariaceae* Singer & A.H. Sm.

A família *Strophariaceae* Singer & A.H. Sm. pertence à ordem *Agaricales*, Filo *Basidiomycota*, e foi originalmente descrita por SINGER & SMITH (1946), que consideraram principalmente a cor da esporada, o tipo de hifas da superfície pilear, natureza e tipo dos basidiósporos e cistídios, como caracteres diagnósticos desta família. Estes autores consideraram os seguintes gêneros em seu conceito original da família: *Deconica* (W.G. Sm.) P. Karst., *Flammula* (Fr.) Quél., *Kuehneromyces* Singer & A.H. Sm., *Melanotus* Pat., *Naematoloma* (Fr.) P. Karst., *Pholiota* (Fr.) Quél., *Pleuroflammula* Singer, *Psilocybe* (Fr.) P. Kumm. e *Stropharia* (Fr.) Quél.

Ao longo dos anos, surgiram diferentes interpretações acerca da circunscrição dos gêneros e da própria família, de modo que um número entre 2 a 17 gêneros tem sido atribuído a esta família.

Na primeira edição de sua obra máxima, “The *Agaricales* (Mushrooms) in Modern Taxonomy”, SINGER (1951) reconhece as subfamílias *Stropharioideae* Singer (reunindo *Deconica*, *Melanotus*, *Naematoloma*, *Psilocybe* e *Stropharia*) e *Pholiotoideae* Singer (reunindo *Kuehneromyces*, *Pholiota* e *Pleuroflammula*), separadas principalmente pela coloração da esporada; na primeira a esporada apresenta-se com tonalidades mais vináceas a violáceas, enquanto que na segunda a esporada possui coloração com tons ferrugíneos a ocráceos. Estes conceitos permaneceram praticamente inalterados nas subseqüentes edições desta obra (SINGER, 1962, 1975).

KÜHNER & ROMAGNESI (1953) consideraram a família *Naucoriaceae* Kühner & Romagn. (“*Naucoriacées*”, *nom. inval.*), sendo formada pelas seguintes tribos: *Cortinariées*, *Géophilées* e *Bolbitiées*. *Strophariaceae* foi considerada na tribo *Geophilae*, com apenas dois gêneros: *Geophila* Quél. (abrangendo espécies de *Hypholoma*, *Deconica* e *Stropharia*) e *Dryophila* Quél. (abrangendo *Flammula* e *Pholiota*).

GLUCHOFF-FIASSON & KÜHNER (1977), com base em estudos sobre a estrutura química dos pigmentos, propuseram a inclusão de *Gymnopilus* P. Karst. em *Strophariaceae*, um gênero incluído pela maioria dos autores na família *Cortinariaceae* R. Heim ex Pouzar.

KÜHNER (1984) por sua vez, considerou *Strophariaceae* na ordem *Agaricales s. str.*, abrangendo ainda *Gymnopilus*, *Galerina* Earle (também atribuída a *Cortinariaceae* pela maioria dos autores) e *Panaeolus* (Fr.) Quél., este último até então incluído na família *Coprinaceae* Gäum.

JAHNKE (1984) realizou o primeiro estudo em nível molecular envolvendo membros de *Strophariaceae*, no qual analisou espécies de *Hypholoma*, *Kuehneromyces*, *Pholiota*, *Psilocybe* e *Stropharia*. Suas conclusões foram especialmente relacionadas a espécies do complexo *Psilocybe squamosa* (Pers.) P.D. Orton, anteriormente consideradas em *Stropharia* por alguns autores. A partir deste estudo, Jahnke considerou *Stropharia ochrocyanea* Bon sinônimo de *S. albocyanea* (Desm.) Quél., assim como *S. thrausta* (Schulz. ex Kalchbr.) Sacc. que foi reduzida ao status de variedade de *P. squamosa*.

Em SINGER (1986), a família *Strophariaceae* permaneceu dividida em duas subfamílias, *Stropharioideae* (Singer) Singer e *Pholiotoideae* (Imai) Singer. De acordo com este autor, *Stropharioideae* encerra os gêneros *Melanotus*, *Naematoloma*, *Psilocybe* e *Stropharia*; enquanto *Pholiotoideae* abrange *Kuehneromyces*, *Pachylepyrium* Singer, *Phaeomarasmius* Scherff., *Pholiota* e *Pleuroflammula*. Passadas duas décadas da publicação desta obra, é interessante observar que o sistema de Singer ainda é amplamente utilizado e apesar das diferentes interpretações posteriores à sua obra, a base de suas idéias e os conceitos formulados por ele ainda permanecem em uso.

WATLING & GREGORY (1987) consideraram apenas os gêneros *Hypholoma* (= *Naematoloma sensu* Singer), *Melanotus*, *Psilocybe* e *Stropharia* em sua monografia das espécies britânicas de *Strophariaceae*. Os conceitos genéricos apresentados por estes autores praticamente não diferem daqueles estabelecidos por SINGER (1986).

HAWKSWORTH et al. (1995) reconheceram *Strophariaceae* como uma família de *Agaricales*, composta pelos gêneros: *Anellaria* P. Karst., *Hemipholiota* (Singer) Romagn., *Hypholoma*, *Kuehneromyces*, *Melanotus*, *Mythicomyces* Redhead & A.H. Sm., *Nivatogastrium* Singer & A.H. Sm., *Pachylepyrium*, *Panaeolus*, *Phaeogalera* Kühner, *Phaeonaematoloma* (Singer) Bon, *Phlebophyllum* R. Heim, *Pholiota*, *Pleuroflammula*, *Psilocybe*, *Stropharia* e *Stropholoma* (Singer) Balletto.

WASSER & GRODZINSKAYA (1996) realizaram uma revisão bibliográfica sobre os gêneros atribuídos a esta família, contabilizando 30 nomes genéricos, dos quais apenas sete

foram aceitos por estes autores: *Kuehneromyces*, *Naematoloma*, *Pachylepyrium*, *Pholiota*, *Phaeomarasmius*, *Psilocybe* e *Stropharia*.

NOORDELOOS (1995, 1999), ao revisar as espécies holandesas, considerou apenas dois amplos gêneros em seu conceito de *Strophariaceae*: *Psilocybe s.l.* e *Pholiota s.l.* O conceito destes dois gêneros para este autor corresponde praticamente às subfamílias *Stropharioideae* e *Pholiotoideae* de SINGER (1986), respectivamente. Deste modo, os gêneros *Hypholoma*, *Melanotus*, *Psilocybe* e *Stropharia* foram considerados por Noordeloos em *Psilocybe s.l.*, enquanto que os gêneros *Hemipholiota* (Singer) Bon, *Kuehneromyces*, *Pholiota* e *Phaeonaematoloma* foram considerados em *Pholiota s.l.* Noordeloos baseou-se nas propostas de KÜHNER & ROMAGNESI (1953), SMITH (1979) e KÜHNER (1980), autores que defenderam a idéia de apenas dois gêneros em *Strophariaceae*, tendo em vista as grandes afinidades entre os gêneros aceitos por SINGER (1986). Alguns autores (KEIZER, 2000; STAMETS, 1996), adotaram a classificação proposta por Noordeloos, porém manifestações contrárias a esta proposta também foram apresentadas (BON & ROUX, 2003; MORENO & ALBERTÓ, 1996; NORVELL & REDHEAD, 2000).

Em KIRK et al. (2001), apenas oito gêneros de *Strophariaceae* são reconhecidos: *Leratiomyces* Bresinsky & Binder, *Mythicomyces*, *Nivatogastrium*, *Pachylepyrium*, *Pholiota*, *Pleuroflammula*, *Psilocybe* e *Weraroa* Singer. Nesta obra *Hypholoma*, *Melanotus* e *Stropharia* são reunidos em *Psilocybe*, como anteriormente proposto por NOORDELOOS (1995, 1999).

Recentemente BON & ROUX (2003) publicaram uma chave para os gêneros e espécies européias de *Strophariaceae*, na qual adotaram conceitos ainda bastante influenciados pela classificação de SINGER (1986).

Poucos estudos consideraram as formas gasteróides pertencentes a esta família, apesar de que atualmente pelo menos dois gêneros secotiídeos (basidiomas gasteróides dotados de estípite e com lamelas malformadas ou anastomosadas) são atribuídos a *Strophariaceae*: *Leratiomyces* (BRESINSKY & BINDER, 1998) e *Weraroa* (SINGER, 1958; SINGER & SMITH, 1958). Ainda que na análise molecular realizada por MONCALVO et al. (2002) ambos gêneros tenham sido agrupados no clado “*stropharioid*”, as relações entre estes e os demais gêneros agaricóides da família permanecem, todavia, pouco conhecidas. *Nivatogastrium*, descrito por SINGER & SMITH (1959), também é outro gênero secotiídeo relacionado a *Strophariaceae*, caracterizado pela ocorrência de crisocistídios.

Em estudo molecular recente realizado por MONCALVO et al. (2002) demonstrou que *Strophariaceae* compõe, de fato, um grupo homogêneo dentre os *Agaricales* (ou

“*euagarics*”, como referido por estes autores), porém o arranjo genérico requer profunda reformulação. Não existem dúvidas quanto à necessidade de revisão de conceitos genéricos para uma nova delimitação desta família, e certamente deverão ser propostos novos gêneros para acomodar determinados grupos, como por exemplo, as espécies de *Psilocybe* contendo psilocibina e psilocina, as espécies coprófilas de *Stropharia*, entre outros. Esta reformulação encontra-se ainda em preparação (S.A. Redhead, com. pessoal) e, em consequência disso, não foi possível considerá-la na preparação deste trabalho.

1.2. Os gêneros *Hypholoma* (Fr.) P. Kumm. e *Stropharia* (Fr.) Quéf.

Dentre os membros da subfamília *Stropharioideae*, os gêneros *Stropharia* e *Hypholoma* destacam-se por apresentarem um tipo especial de cistídio, na verdade um tipo de gloecistídio denominado crisocistídio, o qual não é observado em espécies de *Psilocybe* e *Melanotus* (se este for admitido). Este cistídio apresenta um conteúdo de aspecto oleoso e amorfo, o qual é facilmente observado em solução alcalina (hidróxido de potássio ou hidróxido de amônia), adquirindo uma coloração que varia do amarelo dourado a quase hialino. Esta estrutura, entretanto, não é exclusiva destes dois gêneros, sendo encontrada também em representantes de *Pholiota* e *Kuehneromyces* em *Strophariaceae* (subfamília *Phliotoideae*) e *Panaeolus* em *Bolbitiaceae* Singer. CLÉMENÇON (1995) realizou um estudo mais aprofundado sobre este tipo de cistídio, classificando-o em dois subtipos: tipo “semiovatus” (encontrado em membros de *Panaeolus*) e o tipo “fasciculare”, este sendo o tipo observado em membros de *Strophariaceae*.

Hypholoma e *Stropharia* são gêneros considerados muitos próximos morfológicamente, e muitas de suas espécies já transitaram entre ambos no passado. Foram diferenciados principalmente pela ocorrência de uma hipoderme diferenciada no primeiro e pela presença de anel bem desenvolvido no segundo (SINGER, 1986; WATLING & GREGORY, 1987). Entretanto, modernamente a principal característica considerada para separar as espécies de *Hypholoma* e *Stropharia* é a presença de um tipo especial de hifa denominado acantócito neste último. Estas estruturas foram observadas pela primeira vez por FARR (1980), que as considerou como exclusivas de *Stropharia*. Os acantócitos foram observados tanto em cultura quanto em espécimes frescos e desidratados estudados por FARR (1980); sua estrutura compreende uma hifa com projeções espinescentes e também cristalinas, e que são encontrados principalmente nas rizomorfias dos basidiomas. Posteriormente, vários pesquisadores adotaram este critério para reconhecer e também para excluir espécies deste

gênero (BANDALA et al., 2005; CLÉMENÇON, 2002; DESJARDIN & HEMMES, 2001; JAHNKE, 1984; NORVELL & REDHEAD, 2000; REDHEAD, 1984a, 1984b). Neste trabalho, adotamos este critério como diagnóstico para o gênero *Stropharia*, permitindo sua distinção de *Hypholoma*, *Pholiota* e *Psilocybe*. Na Tabela 1 são sumarizadas as principais diferenças entre estes dois gêneros, segundo os critérios adotados neste trabalho.

Tabela 1. Principais diferenças entre *Hypholoma* e *Stropharia*

<i>Hypholoma</i>	<i>Stropharia</i>
Solitários a cespitosos	Solitários a gregários
Rizomorfias geralmente pouco desenvolvidas	Rizomorfias geralmente abundantes
Anel ausente; se presente, pouco desenvolvido (fibriloso)	Anel presente: glutinoso, membranoso ou carnosos
Crisocistídios presentes como pleurocistídios	Crisocistídios presentes como pleuro- ou queilocistídios ou ambos
Queilocistídios sempre como leptocistídios	Queilocistídios como leptocistídios ou crisocistídios, ou ambos
Hipoderme presente, celular ou filamentosa	Hipoderme ausente, se presente nunca do tipo celular
Acantócitos ausentes	Acantócitos presentes*

É de suma importância ressaltar o fato de que, apesar de apresentarem características típicas de *Stropharia* (anel no estípite, hipoderme indiferenciada), não são observados acantócitos nas espécies coprófilas deste gênero. Futuramente, este grupo (seção *Stercophila* Romagn. ex Noordel.) deverá ser segregado das demais espécies do gênero, constituindo um gênero à parte (S.A. Redhead, com. pessoal). Neste trabalho, estas espécies serão consideradas provisoriamente em *Stropharia*, até que seja proposto formalmente um novo gênero para acomodá-las.

1.3. *Hypholoma* e *Stropharia*: importância ecológica, econômica e biotecnológica

Do ponto de vista prático, algumas espécies de *Hypholoma* e *Stropharia* têm recebido especial atenção dada sua importância ecológica, econômica e biotecnológica, e desse modo inúmeras publicações têm focado estes aspectos. Alguns destes são brevemente ressaltados a seguir.

Sob o aspecto ecológico, as espécies pertencentes a estes gêneros desempenham função essencial na manutenção de nutrientes em ecossistemas florestais ou campestres, onde atuam na decomposição dos mais variados resíduos vegetais. Algumas espécies de *Stropharia* são coprófilas e atuam, assim, na decomposição deste tipo de substrato, o qual consiste basicamente de matéria orgânica vegetal. Poucas espécies de *Hypholoma* são encontradas associadas a musgos, porém não se trata de uma associação micorrízica, tendo em vista que as espécies de *Strophariaceae* não formam micorrizas (SINGER, 1986). Algumas espécies de *Hypholoma*, assim como de *Pholiota*, têm sido citadas como fazendo parte da dieta de animais em risco de extinção, como é o caso do esquilo voador norte-americano *Glaucomys sabrinus fuscus* (MITCHELL, 2001). Não existem, no entanto, dados a respeito da biologia e ecologia das espécies destes gêneros na América do Sul, justamente pelo próprio desconhecimento sobre as mesmas.

De maneira geral, poucas espécies pertencentes a *Hypholoma* e *Stropharia* têm sido consideradas comestíveis, e neste sentido não existem dúvidas de que *S. rugosoannulata* é o mais importante representante dentre as espécies destes gêneros. Trata-se de uma espécie comestível de excelente qualidade, cultivada em inúmeros países da Europa, Ásia e América do Norte – uma boa revisão foi publicada por PEGLER (2001). São muitos os estudos relatando técnicas de cultivo (BONENFANT-MAGNÉ et al., 1997b, 2000; FURLAN et al., 1997), composição química e nutricional (BONENFANT-MAGNÉ et al., 1997a), potencial de degradação de lignina e celulose (STEFFEN et al., 2001), propriedades terapêuticas e farmacológicas (GRODZINSKAYA et al., 1999; YAGI et al., 2000) desta espécie. No Brasil, entretanto é desconhecido o seu uso como alimento, provavelmente pela falta de conhecimento e pelo limitado uso de fungos na alimentação dos brasileiros.

Hypholoma fasciculare é considerada uma espécie tóxica, podendo causar síndrome gastrointestinal em humanos (BADALYAN et al., 1995; WRIGHT & ALBERTÓ, 2002). Por sua vez, numerosos estudos relatam suas propriedades no controle de fungos fitopatógenos (BADALYAN et al., 2002; CHAPMAN et al., 2004), atividade hipoglicêmica (BADALYAN & SERRANO, 1999), ação antioxidante (BADALYAN, 2003), biorremediação de solos contaminados com pesticidas (BENDING et al., 2002; DEMIRBAS, 2001) e metais pesados (FALANDYSZ et al., 2003), entre outras.

1.4. Conhecimento do gênero *Hypholoma* no Brasil

Poucos são os estudos modernos sobre a taxonomia dos *Agaricales* brasileiros, e no tocante àqueles pertencentes à família *Strophariaceae* estes são ainda mais raros. Conforme a revisão da literatura, são escassas as espécies do gênero *Hypholoma* registradas no território brasileiro, as quais são apresentadas a seguir de acordo com a respectiva região geográfica.

Para a região Norte, SINGER (1973) descreveu *Naematoloma nudum* Singer (Pará) e *N. amazonicum* Singer (Amazonas), esta última considerada por PEGLER (1983) como sinônimo de *H. trinitatensis* (Dennis) Pegler; SOTÃO et al. (1991) registraram a ocorrência de *H. subviride* (Berk. & M.A. Curtis) Dennis em áreas de manguezal no estado do Amapá.

Nas regiões Nordeste e Centro-Oeste são desconhecidos registros modernos de espécies de *Hypholoma*.

No Sudeste, *H. subviride* foi citado por BONONI et al. (1984) e PEGLER (1997) para o estado de São Paulo. *Hypholoma trinitatensis* também foi registrada para São Paulo por PEGLER (1997).

No Sul, existem registros para os estado do Paraná e Rio Grande do Sul. STIJVE & DE MEIJER (1993) citaram para o Paraná *Psilocybe alnetorum* Singer, o qual atualmente é considerado como *H. alnetorum* (Singer) Guzmán (GUZMÁN, 1999). Recentemente, DE MEIJER (2001) registrou a ocorrência de três espécies do gênero, mas listando apenas *H. subviride* e *Psilocybe ericacea* (Pers.: Fr.) Quél. [= *H. ericaeum* (Pers.: Fr.) Kühner].

No Rio Grande do Sul, várias espécies do gênero foram citadas e algumas descritas por RICK (1907, 1930, 1939), sendo sumarizadas em RICK (1961): *Hypholoma fasciculare* Huds., *H. intonsum* Passer., *H. cascum* Fr., *H. piluliforme* Bull., *H. lanaripes* Cooke, *H. solitarium* Rick, *H. appendiculatum* Bull., *H. hydrophilum* Bull., *H. dispersum* Fr. e *H. leucotephrum* Berk. A maioria destas espécies, entretanto, corresponde a sinônimos, inclusive de espécies pertencentes a outros gêneros como *Psilocybe* (*Strophariaceae*) e *Psathyrella* (Fr.) Quél. (*Psathyrellaceae*). SINGER (1953) registrou *Naematoloma subumbonatescens* (Murrill) Singer (= *H. ericaeum*), e recentemente CORTEZ & COELHO (2004) e SOBESTIANSKY (2005) registraram a ocorrência de *H. subviride* nas regiões de Santa Maria e Nova Petrópolis, respectivamente.

1.5. Conhecimento do gênero *Stropharia* no Brasil

Assim como *Hypholoma*, o gênero *Stropharia* também tem recebido pouca atenção por parte dos micólogos, de modo que pouquíssimas espécies deste gênero integram a lista dos *Agaricales* brasileiros.

Nas regiões Norte e Centro-Oeste não existem registros para o gênero.

No Nordeste, o único registro conhecido é o de *S. coronilla* (Bull.: Fr.) Quél., realizado por BATISTA & BEZERRA (1960).

Na região Sudeste, foram registradas *S. semiglobata* (Batsch: Fr.) Quél. (BONONI et al. 1984; PEGLER, 1997) e *S. rugosoannulata* (PEGLER, 1997) para o estado de São Paulo. *Stropharia grisea* P. Henn., provavelmente o primeiro registro do gênero no Brasil, corresponde a uma espécie do gênero *Agaricus*, renomeada por PEGLER (1997) como *A. puttemansii* Pegler. *Pholiota cubensis* Earle também aparece citada por PEGLER (1997), entretanto esta espécie também foi renomeada por NORVELL & REDHEAD (2000) como *Stropharia earlei* Norvell & Redhead, em razão de *Stropharia cubensis* Earle já ter sido ocupada como basônimo de *Psilocybe cubensis* (Earle) Singer.

No Sul do Brasil, STIJVE & DE MEIJER (1993) registraram *S. coronilla*, *S. rugosoannulata* e *S. semiglobata* para o estado do Paraná. Recentemente DE MEIJER (2001) citou também *S. aurantiaca* (Cooke) P.D. Orton, entretanto esta espécie pertence de fato ao gênero *Hypholoma* [= *H. aurantiacum* (Cooke) Faus].

Para o estado do Rio Grande do Sul, RICK (1907, 1920, 1939) registrou e inclusive descreveu novas espécies de *Stropharia*, porém a maioria delas corresponde a espécies de *Psilocybe*, *Hypholoma*, entre outros gêneros. São apresentadas as seguintes espécies em RICK (1961): *Stropharia coronilla* Bull., *S. thrausta* Kalchbr., *S. semiglobata* Batsch., *S. stercoraria* Fr., *S. merdaria* Fr., *S. crassa* Rick, *S. siccipes* var. *lugubris* Rick, *S. mephistopheles* Cooke e *S. subcyanescens* Rick. Recentemente, CORTEZ & COELHO (2004) registraram *S. coronilla*, *S. rugosoannulata* e *S. semiglobata* para a região de Santa Maria, e SOBESTIANSKY (2005) citou *S. aurantiaca* (= *H. aurantiacum*) e *S. rugosoannulata* para Nova Petrópolis.

1.6. Objetivo

Com base no limitado conhecimento dos gêneros *Hypholoma* e *Stropharia* no território brasileiro, pretende-se, com a realização deste estudo, investigar a ocorrência das

espécies destes gêneros no Rio Grande do Sul, proporcionando assim um incremento ao seu conhecimento taxonômico.

1.7. Referências Bibliográficas

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Capítulo 2

MATERIAIS E MÉTODOS

2.1. Coletas

Foram realizadas coletas entre os meses de Março de 2004 e Setembro de 2005, de modo a abranger o máximo possível de localidades em diferentes regiões fisiográficas do estado do Rio Grande do Sul, conforme caracterização apresentada por FORTES (1959). Assim, as regiões fisiográficas representadas neste estudo, incluindo espécimes de herbários, foram: Alto Uruguai (Maximiliano de Almeida), Depressão Central (Itaara, Porto Alegre, Santa Maria, Viamão), Campanha (Bagé), Campos de Cima da Serra (Cambará do Sul, Esmeralda, São Francisco de Paula), Encosta Inferior do Nordeste (Candelária, Canela, Gramado Xavier, Nova Petrópolis, Salvador do Sul, Santa Cruz do Sul, São Leopoldo, Venâncio Aires, Vera Cruz), Litoral (Capivari do Sul, Dom Pedro de Alcântara, Santa Vitória do Palmar, Torres), Planalto Médio (Passo Fundo) e Serra do Sudeste (Caçapava do Sul, Encruzilhada do Sul). Não foram realizadas coletas, nem estudados espécimes provenientes das regiões das Missões, Encosta do Sudeste e Encosta Superior do Nordeste.

2.2. Procedimento de coleta

Para a realização das coletas, foram utilizados os seguintes materiais: faca para a retirada do material do substrato; toalhas de papel ou papel higiênico para envolver e proteger o(s) espécime(s) recém coletado(s); e potes plásticos para acondicionar o material em segurança até o laboratório ou local para realização da análise macroscópica. Anotações sobre a natureza do substrato e demais observações dos espécimes foram tomadas no momento da coleta.

2.3. Análise macroscópica

A análise macroscópica de praticamente todo o material fresco foi realizada em laboratório ou quando necessário logo depois da coleta, compreendendo os seguintes itens:

- píleo (diâmetro, forma, superfície, coloração, viscosidade, margens, contexto);
- lamelas (inserção relativa com o estípite, consistência, coloração, borda);
- estípite (diâmetro e comprimento, forma, superfície, viscosidade, coloração, presença de anel);
- véu (presença, consistência, localização);
- anel (posição, consistência, coloração) e
- esporada (cor).

A nomenclatura desses itens foi baseada principalmente no trabalho de LARGENT (1977). Os termos e códigos aplicados às cores foram tomados da carta de cores de MUNSELL (1994). Quando a cor não era contemplada pela carta, foram então indicadas cores de acordo com a interpretação pessoal do autor (p. ex. amarelo sulfúreo).

2.4. Análise microscópica

A análise das microestruturas de todo o material examinado correspondeu a um número mínimo de 25 elementos (basidiósporos, basídios, cistídios e hifas), a menos que não encontradas em quantidades suficientes no material estudado. Tal situação foi bastante usual quando os espécimes eram muito antigos e/ou mal preservados, o que dificultou uma análise completa de todas as microestruturas. Foram tomadas as medições de comprimento e largura de basidiósporos, basídios e cistídios; nas medidas das hifas do píleo, estípite e lamelas foi considerado somente o seu respectivo diâmetro. Para os basidiósporos foram considerados o Q (variação do quociente entre o comprimento e largura de cada basidiósporo), o Q_m (valor médio de Q) e n (correspondendo ao número de basidiósporos medidos). A presença de acantócitos nas rizomorfas de espécimes preferencialmente frescos, também fora investigada. Para a montagem das lâminas, foram utilizados cortes manuais feitos com lâminas de barbear novas; os cortes obtidos foram montados em hidróxido de potássio 5% (KOH) isoladamente ou em consórcio como o corante vermelho Congo 2% (“Congo Red”). A metodologia e nomenclatura adotadas seguiram LARGENT et al. (1986).

2.5. Identificação das coletas

Para a identificação do material coletado, foram utilizados principalmente os trabalhos de BON & ROUX (2003), BREITENBACH & KRÄNZLIN (1995), DENNIS (1970),

KYTÖVUORI (1999), MOSER (1978), NOORDELOOS (1999), SMITH (1951), WATLING & GREGORY (1987) e WRIGHT & ALBERTÓ (2002).

2.6. Conservação dos basidiomas

A secagem do material foi feita após a análise macroscópica, sendo realizada em secador aberto sob temperatura aproximada de 40°C. Depois de desidratado, o material foi acondicionado em papel alumínio e toalhas de papel absorvente, e posteriormente envolvidos em envelope contendo naftalina. Estes envelopes foram identificados com a etiqueta do herbário do Departamento de Botânica da Universidade Federal do Rio Grande do Sul (ICN), onde o material coletado foi depositado.

2.7. Coleções examinadas

No total, cerca de 150 espécimes foram analisados para a realização do presente estudo. Além de todo material fresco coletado, foram analisados espécimes depositados nos seguintes herbários – listados por ordem alfabética do respectivo acrônimo (HOLMGREN & HOLMGREN, 1998-2005): F, HASU, HCB, ICN, LPS, NY, PACA, SMDB e SP. Espécimes do herbário RSPF (Museu Augusto Ruschi, Universidade de Passo Fundo), o qual não se encontra indexado, também foram analisados.

Além disso, foram também analisados espécimes europeus enviados por um colaborador (Dr. Stig Jacobsson, Universidade de Gotemburgo, Suécia), os quais serviram como material adicional tomado como referência para as determinações. Tais coletas estrangeiras também foram incorporadas ao acervo do herbário ICN.

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Capítulo 3

ARTIGO

Species of *Hypholoma* (Fr.) P. Kumm. (*Strophariaceae*, *Agaricales*)

from Rio Grande do Sul State, Brazil

submetido para publicação ao Periódico

ACTA BOTANICA BRASILICA

(São Paulo, Brasil)

**Species of *Hypholoma* (Fr.) P. Kumm. (*Strophariaceae*, *Agaricales*)
from Rio Grande do Sul State, Brazil¹**

Vagner Gularte Cortez²

Rosa Mara Borges da Silveira³

RESUMO – (Espécies de *Hypholoma* (Fr.) P. Kumm. (*Strophariaceae*, *Agaricales*) no Rio Grande do Sul, Brasil). Neste trabalho são apresentadas descrições, ilustrações e discussões para todas as espécies do gênero *Hypholoma* (Fr.) P. Kumm. conhecidas no estado do Rio Grande do Sul. A partir das coletas realizadas pelos autores, bem como estudo do material depositado nos principais herbários do estado e do país, verificou-se a ocorrência das seguintes espécies: *Hypholoma aurantiacum* (Cooke) Faus, *H. ericaeum* (Pers.: Fr.) Kühner e *H. subviride* (Berk. & M.A. Curtis) Dennis. É apresentada uma chave para identificação dos táxons estudados, além de uma revisão do material de *Hypholoma* presente na coleção Fungi Rickiani.

Palavras-chave – *Basidiomycota*, *Agaricomycetidae*, *Stropharioideae*, *Naematoloma*, micobiota brasileira

ABSTRACT – (Species of *Hypholoma* (Fr.) P. Kumm. (*Strophariaceae*, *Agaricales*) from Rio Grande do Sul State, Brazil). The known species of the genus *Hypholoma* (Fr.) P. Kumm. from the Rio Grande do Sul State are presented: *Hypholoma aurantiacum* (Cooke) Faus, *H. ericaeum* (Pers.: Fr.) Kühner, and *H. subviride* (Berk. & M.A. Curtis) Dennis. This study was based on own authors' collections and revision of the herbaria. A key for identification, detailed descriptions and illustrations of all studied species are presented, as well the result of our revision of the *Hypholoma* specimens deposited in the collection Fungi Rickiani.

Key words – *Basidiomycota*, *Agaricomycetidae*, *Stropharioideae*, *Naematoloma*, Brazilian mycobiota

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² Bolsista do CNPq. Universidade Federal do Rio Grande do Sul, Programa de Pós-graduação em Botânica, Av. Bento Gonçalves, 9500, CEP: 91501-970, Porto Alegre, RS, Brasil. E-mail: cortezvg@yahoo.com.br (autor para correspondência).

³ Professora do Departamento de Botânica, Universidade Federal do Rio Grande do Sul. E-mail: rosa.silveira@ufrgs.br

Introduction

The genus *Hypholoma* (Fr.) P. Kumm. belongs to the family *Strophariaceae* Singer & A.H. Sm. (*Agaricales*, *Basidiomycota*), subfamily *Stropharioideae* (Singer) Singer, and is characterized by the presence of well-pigmented pileus, variably developed veil, but never forming a membranous annulus on the stipe, spore print violaceous to purplish, basidiospores with a thickened wall and a conspicuous germ-pore, presence of chrysocystidia (Pegler 1983; Singer 1986; Smith 1951; Watling & Gregory 1987). The absence of acanthocytes in the rhizomorphs separates it from the closest genus *Stropharia* (Fr.) Quéf. (Farr 1980; Norvell & Redhead 2000). The presence of chrysocystidia is a distinguish character from *Psilocybe* (Fr.) P. Kumm., another related genus in the family (Guzmán 1980, 1983, 1999). According to Hawksworth *et al.* (1995), *Hypholoma* comprises about 30 species worldwide, distributed from temperate to tropical areas, growing on decomposing wood, living trees, mosses or soil (Singer 1986).

The nomenclature of the genus was debated for several years by different authors (Baletto 1989; Dennis *et al.* 1954; Farr & Farr 1981; Singer & Smith 1946). Thus, several *Hypholoma* species were attributed in the past to the genus *Naematoloma* P. Karst. (Singer 1986; Smith 1951), which finally suffered nomenclatural rejection (Korf 1986). Currently, species of the genus were considered by Noordeloos (1995, 1999) as subgenera of *Psilocybe s.l.*, following Smith (1979) and Kühner (1980), but this proposal has not received good acceptance among mycologists (Bon & Roux 2003; Norvell & Redhead 2000) and overall not supported by recent molecular studies (Moncalvo *et al.* 2002). Following Moncalvo *et al.* (2002), *Hypholoma* is recognized as an independent clade, composed by the most of its species, except by *H. subericaeum* (Fr.) Kühner and *H. aurantiacum* (Cooke) Faus [as *S. aurantiaca* (Cooke) M. Imai], which have an uncertain position in the “stropharioid” clade.

Species of *Hypholoma* are not edible, instead, those belonging to the group of *H. fasciculare* (Huds.: Fr.) P. Kumm. are considered poisonous (Badalyan *et al.* 1995). This species also has been investigated due to its antioxidant (Badalyan 2003) and hypoglycemic (Badalyan & Serrano 1999) activities. As active wood and litter decomposers, they also play an important role in forest ecosystems, being currently used in bioconversion of cellulosic, fabric and dye industrial residues (Hofrichter & Fritsche 1997; Steffen *et al.* 2000), and also in biological control of phytopathogenic fungi (Badalyan *et al.* 2002; Chapman *et al.* 2004).

In Brazil, a few studies referred to species of *Hypholoma*. Singer (1973) described *Naematoloma amazonicum* Singer and *N. nudum* Singer from the north Brazil; Pegler (1997)

reported *H. subviride* (Berk. & M.A. Curtis) Dennis and *H. trinitatensis* Pegler from the state of São Paulo; Stijve & de Meijer (1993) cited *Psilocybe alnetorum* Singer, in fact *H. alnetorum* (Singer) Guzmán (Guzmán 1999) from the State of Paraná.

From Rio Grande do Sul State, several species were reported by Rick (1907, 1930, 1939, 1961), however, the most of them are synonyms of species belonging to other agaric genera, especially *Psilocybe* (*Strophariaceae*) and *Psathyrella* (Fr.) Quél. [*Psathyrellaceae* (Singer) Vilgalys, Moncalvo & Redhead]. Other important records were given by Singer (1953), who studied some Rick's collections, and more recently Cortez & Coelho (2004) and Sobestiansky (2005) reported the occurrence of *H. subviride* from the regions of Santa Maria and Nova Petrópolis, respectively.

In the present work we revised the known species of *Hypholoma* from Rio Grande do Sul State, based own authors' collections and material deposited in regional and national herbaria, especially those of the collection Fungi Rickiani.

Materials and methods

Specimens were collected from March 2004 to September 2005, in different localities from the Rio Grande do Sul State (Fig. 1). Materials deposited in the following herbaria, listed according the *Index Herbariorum* (Holmgren & Holmgren 1998-2005), were also studied: HASU, HCB, ICN, PACA, SMDB, and SP. All collected material is deposited in the herbarium ICN.

For the macroscopic analysis was followed Largent (1977), while the microscopic study of the basidiomata followed Largent *et al.* (1986). As mounting media were used the 5% KOH (potassium hydroxide) alone or with the 1% Congo Red. Line drawings were made with a camera lucida in a Leica DM LS2 optical microscope. In the basidiospores descriptions, 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), unless not indicated. All scientific names, independent of their taxonomic rank are italicized, following Hawksworth (2001), and all taxonomic authorities are abbreviated according to the *Authors of Fungal Names* (CABI 2005).

Results and discussion

In this study, three species of the genus *Hypholoma* were recognized as occurring in Rio Grande do Sul. The following key is provided for their identification.

Key for the known species of *Hypholoma* from Rio Grande do Sul State, Brazil

1. Basidiomes cespitose on wood; pileus sulphur-yellow; basidiospores 6-8 μm long**3. *H. subviride***
1. Basidiomes not cespitose; pileus with other colors; basidiospores larger than 10 μm long ..**2**
2. Pileus yellowish brown, dry; veil absent or poorly developed; growing on wet soil, among grasses and mosses**2. *H. ericaeum***
2. Pileus dark red to red, subviscid to viscid; veil forming white scales in the pileus margin and a fibrillose annulus in the stipe; growing on fallen branches and leaves**1. *H. aurantiacum***

1. *Hypholoma aurantiacum* (Cooke) Faus, Bol. Soc. Micol. Castell. 7: 70, 1982. Fig. 2-8, 24
Agaricus squamosus var. *thraustus* f. *aurantiacus* Cooke, Handb. Br. Fungi 2: 199, 1884.

Stropharia aurantiaca (Cooke) M. Imai, J. Agric. Hokk. Imp. Univ. 43: 267, 1938.

S. aurantiaca (Cooke) P.D. Orton, Trans Br. Mycol. Soc. 43: 181, 1960. (superfl. comb.).

Naematoloma aurantiacum (Cooke) Guzmán, Beih. Nova Hedw. 51: 114, 1975 (comb. inval.).

N. aurantiacum (Cooke) Guzmán ex Singer, Agaric. Mod. Taxon.: 564, 1986.

Psilocybe aurantiaca (Cooke) Noordel., Persoonia 16: 128, 1995.

Pileus 18-39 mm in diameter, convex to flattened, umbonate; color dark red (10R 3/6) in young basidiomes, becoming red (10R 4/8) in age; surface smooth, viscid to subviscid; margin regular, striate, with appendiculate white scales; context fleshy and whitish. **Lamellae** adnexed, close; color light brownish gray (10YR 6/2) when young, to dark yellowish brown (10YR 4/6) in maturity; margin regular, whitish. **Stipe** 40-87 x 3-5 mm, central, cylindrical, with a curved and expanded base; color white in young stages, becoming reddish (2.5YR 4/8) towards the base; surface dry, squamulose to fibrillose; consistency fibrous, hollow; rhizomorphs and basal mycelium very abundant, white. **Veil** present; in the pileus it produces

whitish scales adhered to margin, which are rarely present in older basidiomes; in the stipe it produces a fibrillose annular zone, also seen only in younger basidiomata. **Spore print** violaceous brown.

Basidiospores (9.5-) 11-15 (-17) x (6.5-) 7-8.5 μm , ($Q=$ 1.57-2.20, $Q_m=$ 1.78, $n=$ 85); ellipsoid in side view, to slightly ovoid in frontal view; smooth and thickened wall, with a truncate germ-pore; yellowish brown in KOH. **Basidia** 22-33 x 9-13 μm ; clavate, hyaline, with a thin wall, bearing four sterigmata. **Pleurocystidia** (26-) 35-55 x 10-14 (-17) μm ; as chrysocystidia, fusiform with a rostrate apex or clavate with a mucronate apex; thin and smooth wall, hyaline, but with amorphous yellowish contents under KOH. **Cheilocystidia** 23-42 (-53) x 4-8 μm ; as leptocystidia, cylindrical and sinuous, to sublageniform with a rounded to subcapitate apex; thin and smooth wall, hyaline, without contents; very numerous in the gill edge. **Pileipellis** is a ixocutis, composed by interwoven and gelatinized hyphae, which presents thin and non-incrusted walls, 2.5-8 μm in diameter, with a rounded the terminal portion, clamped. **Hypodermium** cellular, formed by subglobose, 22-45 μm in diameter hyphae, with irregularly thickened and yellowish walls. **Context** composed by inflated hyphae, with smooth and thin walls, 6-16 μm in diameter. **Hymenophoral trama** regular, formed by parallel, inflated to filamentous hyphae, 8-18 μm in diameter, with smooth and slightly thickened walls, hyaline. **Stipitipellis** composed by parallel, non-gelatinized, hyaline, 3-8 μm in diameter hyphae, with smooth and thin walls. **Caulocystidia** 35-71 x 5-13 μm ; as leptocystidia, ventricose-rostrate to cylindrical, with a subcapitate apex, similar to the cheilocystidia; thin and smooth walled, hyaline, without yellowish contents; disposed in fascicles in the stipe apex. **Clamp connections** present in the most septa.

Habitat: gregarious on plant debris (little branches, fallen leaves) in disturbed forests and parks.

Distribution: Africa (Reid & Eicker 1999), Asia (Guzmán 1975), Australasia (Grgurinovic & Simpson 2001; Segedin & Pennycook 2001), Europe (Noordeloos 1999; Watling & Gregory 1987), North America (Guzmán 1975), and South America (Singer 1969; Wright & Albertó 2002).

Material examined: **BRAZIL. Rio Grande do Sul:** Maximiliano de Almeida, Usina Hidrelétrica de Forquilha, 09/VII/2005, *M.S. Rother 072* (ICN); Porto Alegre, Parque Farroupilha, 13/V/2005, *Cortez 039/05* (ICN); São Francisco de Paula, Floresta Nacional do

IBAMA, 07/VI/1996, *Sulzbacher et al.* (HCB 16.694), Veraneio Hampel, 04/VI/2004, *Cortez 028/04* (ICN 139.011); São Leopoldo, 1905, *Rick 15.228* (PACA 9.378); Viamão, Parque Estadual de Itapuã, 10/IX/2005, *M.S. Rother 082* (ICN), Parque Saint-Hilaire, V/1995, *R.T. Guerrero & R.M. Silveira* (ICN 102.574), III/1996, *R.T. Guerrero & R.M. Silveira* (ICN 102.550).

Discussion: This species is frequently referred in the European literature as *Stropharia aurantiaca* (Cooke) M. Imai (Pegler & Legon 1998) or *S. aurantiaca* (Cooke) P.D. Orton (Watling & Gregory 1987) due the presence of a fibrillose annulus, but the absolute lack of acanthocytes in its rhizomorphs excludes it from that genus. *Flammula puiggarii*, described by Spegazzini (1889) has been used in South-American literature to call this mushroom (Raithelhuber 1985; Wright & Albertó 2002; both as *Hypholoma puiggarii*). However, the holotype of Spegazzini is identical to *Stropharia rugosoannulata* Farl. ex Murril, as previously indicated by Singer (1950) and Pegler (1997). Since the Spegazzini's *F. puiggarii* (1889) is an older name than *S. rugosoannulata* (Murrill 1922), but the latter is a well-known name used for a cultivated mushroom, we have proposed the rejection of the former and conservation of the name *S. rugosoannulata* (Cortez *et al.* in prep.) to avoid nomenclatural disturbance (Hawksworth 2005). The materials studied by Singer (1969) as *Naematoloma puiggarii* (Speg.) Singer, except for the type of *F. puiggarii*, possibly corresponds to *H. aurantiacum* as here presented.

The purplish color of the basidiomata and the viscid to subviscid pileus surface, as well the fibrillose annulus and the presence of abundant rhizomorphs are characteristics for this species. Scanning electron-microscopy studies performed by Farr (1985) revealed the presence of a singular ornamentation of the basidiospore wall, composed by slightly rugulate and baculate elements, however under light microscope the basidiospores are smooth. Studies of molecular systematics have pointed that *H. aurantiacum* has close affinities with the mushroom *Stropharia magnivelaris* Peck and the secotioids *Leratiomyces similis* (Pat.) Bresinsky & Binder and *Weraroa erythrocephala* (Tul. & C. Tul.) Singer & A.H. Sm., suggesting its exclusion from the genus *Hypholoma* (Moncalvo *et al.* 2002).

In Brazil, *H. aurantiacum* was reported firstly from Rio Grande do Sul State by Rick (1907) as *Stropharia thrausta* Kalchbr. Guzmán (1975) cited the Rick's collection as *Naematoloma* sp., however we confirmed the specimens as *H. aurantiacum* as described above. It was also cited by Sobestiansky (2005) from the region of the Meridional Plateau of Rio Grande do Sul (Nova Petrópolis) and by de Meijer (2001) from the state of Paraná, both

as *S. aurantiaca*. The latter author also reported *H. puiggarii* in the same paper, but he did not discuss the differences among these two names.

Stropharia coccinea Pearson ex Pegler, an African species described by Pegler (1996) should be compared, being a probable synonym of this species.

2. *Hypholoma ericaeum* (Pers.: Fr.) Kühner, Bull. Soc. Mycol. Fr. 52: 23, 1936. Fig. 9-15, 25

Agaricus ericaeus Pers.: Fr., Syst. Mycol. 1: 291, 1821.

Psilocybe ericaea (Pers.: Fr.) Quéél., Mém. Soc. Émul. Montbél. Sér. II, 5: 333, 1873.

Stropharia subumbonatescens Murrill, Mycologia 33: p. 280, 1941.

Naematoloma subumbonatescens (Murrill) Singer, Lilloa 22: 220, 1951.

N. ericaeum (Pers.: Fr.) A.H. Sm., Mycologia 43: 485, 1951.

Pileus 9-34 mm in diameter, campanulate, plano-convex to umbonate, with a low, rounded to acute umbo; color yellowish brown (10YR 5/6-5/8) in the center to yellow (10YR 7/8) towards the margin; surface smooth, subviscid to dry, non-hygrophanous; margin curved, with little velar fibrils in young basidiomes; context fleshy, firm, whitish to yellowish. **Lamellae** adnexed, close; color light brownish gray (10YR 6/2) when young, then reddish black (2.5YR 2.5/1) to black (5YR 2.5/1) in maturity; margin regular, whitish, pulverulent under a stereoscopic microscope, due the presence of numerous cheilocystidia. **Stipe** 41-85 (-112) x (1.5-) 2-5 mm, central, cylindrical, sometimes sinuous, with a subbulbous base; color yellow (2.5Y 7/6) to olive yellow (2.5Y 6/6); surface longitudinally striate, dry to somewhat humid; consistency fibrous, hollow; rhizomorphs and basal mycelium poorly developed, usually absent. **Veil** absent to very inconspicuous, forming a vestigial annular zone on the stipe apex and leaving some remnants in the pileus margin. **Spore print** violaceous brown.

Basidiospores 12-15 (-16) x 7.5-9 μm ($Q= 1.44-1.88$, $Q_m= 1.68$, $n= 103$), ellipsoid in side view to slightly ovoid in face view; smooth and thickened wall, with a truncate germ-pore; color yellowish brown in KOH. **Basidia** 24-41 x 8-11 μm ; utriform to subclavate, with a medial constriction; smooth and thin walled; bearing four sterigmata. **Pleurocystidia** 30-54 x 9-17 μm ; as chrysocystidia, fusiform, with mucronate apex, sometimes rostrate; smooth and thin walled, with amorphous yellowish contents. **Cheilocystidia** (22-) 27-44 (-52) x 6-10 μm , subcylindrical to lageniform, subcapitate, hyaline, smooth and thin-walled, numerous. **Pileipellis** is an ixocutis, comprising filamentous, interwoven and slightly gelatinized hyphae, 3-7 μm in diameter, with smooth and thin walls. **Hypodermium** formed by short or

filamentous hyphae, 8-13 μm in diameter, with strongly incrustated walls by yellowish pigment. **Context** formed by inflated, hyaline, smooth and thin-walled hyphae, 7-13 μm in diameter. **Hymenophoral trama** regular, formed by cylindrical, smooth and thin-walled hyphae, 6-13 μm in diameter. **Stipitipellis** composed by parallel, non-gelatinized, smooth to slightly yellowish incrustated and thin-walled hyphae, 3-10 μm in diameter. **Caulocystidia** (21-) 25-39 (-45) x (5-) 8-12 μm ; as leptocystidia, subcylindrical, lageniform to subcapitate, similar to cheilocystidia; smooth and thin-walled, hyaline, without contents; present on stipe apex. **Clamp connections** present in most septa.

Habitat: growing gregariously on wet soils, some sandy soils, among grasses and mosses, in meadows.

Distribution: Europe (Noordeloos 1999; Watling & Gregory 1987), North America (Smith 1951), South America (Delgado & Urdaneta 2002).

Material examined: **BRAZIL. Rio Grande do Sul:** Bagé, Campus Rural URCAMP, 30/V/2004, *L.F.P. Lima 010* (ICN 139.033); Caçapava do Sul, Guaritas, 30/IV/2005, *Cortez 031/05* (ICN); Cambará do Sul, Parque Nacional da Serra Geral, 19/XII/2004, *G. Coelho s/n°* (ICN 139.036), Parque Nacional dos Aparados da Serra, 03/IV/2005, *leg. M.A. Reck, Cortez 009/05* (ICN); Santa Maria, Camobi, 10/VI/2003, *Cortez 016/03* (SMDB 9.613); São Francisco de Paula, CPCN Pró-Mata (PUCRS), 10/VI/2005, *Cortez 069/05* (ICN), Floresta Nacional IBAMA, 14/V/2005, *Cortez 040/05* (ICN), Loteamento Colinas, 06/II/1987, *M. Amaral* (HCB 13.639), Tainhas, 18/XI/2004, *E. Musskopf & L.F.P. Lima* (ICN 139.035); São Leopoldo, *Rick 15.235* (PACA 9.373 – as *Stropharia squamosa* Fr.); Viamão, Parque Estadual de Itapuã, Lagoa Negra, 22/V/2004, *Cortez 021/04* (ICN 139.008), *Cortez 022/04* (ICN 139.009) e *Cortez 023/04* (ICN 139010), 17/VII/2004, *Cortez 047/04* (ICN 139.023).

Discussion: In Brazil, *H. ericaeum* was only reported for the states of Paraná (de Meijer 2001) and Rio Grande do Sul; in the latter, it was cited by Rick (1961) as *Psilocybe ericaea* Pers. and Rick (1939) as *P. tortipes* Speg., and also by Singer (1953) as *Naematoloma subumbonatescens* (Murrill) Singer, whose basonym (*Stropharia subumbonatescens* Murrill) was considered by Smith (1951) as a synonym of *Naematoloma ericaeum* (Pers. : Fr) A.H. Sm. Rick's materials of *P. ericaea* and *P. tortipes* were not received from herbarium PACA, but the specimens labeled as *Stropharia squamosa* Fr. (*Rick 15.235*) are in fact *H. ericaeum*.

In spite of proposing the new combination, Kühner (1936) described specimens of *H. ericaeoides* P.D. Orton, a similar species, with shorter basidiospores (9-12 µm long) and yellowish gills (Orton 1960; Noordeloos 1999). Another similar and frequently confounded species is *H. subericaeum* (Fr.) Kühner which has basidiospores 7-9 µm long (Noordeloos 1999).

This species has been reported as common in Europe (Noordeloos 1999), but Smith (1951) considered it rare in North America. We also considered it a common agaric in Rio Grande do Sul, fruiting mainly in the autumn months.

3. *Hypholoma subviride* (Berk. & M.A. Curtis) Dennis, Kew Bull. 15: 134, 1961. Fig. 16-23, 26

Agaricus subviridis Berk. & M.A. Curtis, J. Linn. Soc. 10: 292, 1868.

Psilocybe subviridis (Berk. & M.A. Curtis) P. Sacc., Syll. Fung. 5: 1051, 1887.

Naematoloma subviride (Berk. & M.A. Curtis) A.H. Sm., Mycologia 43: 519, 1951.

H. fasciculare var. *subviride* (Berk. & M.A. Curtis) G. Krieglsteiner, Beitr. Z. Kennt. Pilze Mitteleuropas 2: 144, 1986.

Pileus 4-35 (-45) mm in diameter, firstly conical, convex, then finally flattened, with or without an umbo; color yellow (5Y 7/6-7/8) only in young stages then sulphur yellow; surface smooth, subviscid to dry; margin regular, little or not striate, rarely bearing velar remnants; context thin, greenish. **Lamellae** adnate, close; color firstly sulphur yellow, then dark reddish brown (5YR 2.5/2-3/2) with the basidiospores maturity; margin regular, with the same color of the sides. **Stipe** (7-) 14-66 x 1-4 mm, central, cylindrical, with a few expanded base; color sulphur yellow; surface dry to little humid, longitudinally striate; basal mycelium whitish, poorly developed, rhizomorphs absent. **Veil** arachnoid, much ephemeral, observed in earlier stages and absent in adult basidiomata. **Spore print** dark vinaceous brown.

Basidiospores (5.5-) 6-8 (-9) x 3.5-5 µm, ($Q=1.50-2.00$, $Q_m=1.71$, $n=148$), ellipsoid to slightly ovoid both in side and face view; smooth and thickened wall, with a truncate germ-pore; color yellowish brown in KOH. **Basidia** 15-23 x 4.5-7 µm, clavate, bearing four sterigmata. **Pleurocystidia** (19-) 25-38 (-47) x (5.5-) 8-12 µm, as chrysocystidia, fusoid to clavate, with a mucronate apex; smooth and thin-walled, with yellowish amorphous content, numerous in the gill sides. **Cheilocystidia** (13-) 18-22 (-26) x 6-8 µm, as leptocystidia, utriform to cylindrical, with a rounded apex; hyaline, lacking yellowish contents; hard to find in dry specimens. **Pileipellis** composed by parallel, poorly gelatinized hyphae, 5-9 µm in

diameter, with little thickened walls incrustated by yellowish pigment. **Hypodermium** cellular, formed by subglobose, 15-29 μm in diameter hyphae, with thickened, incrustated and yellowish pigmented walls. **Context** composed by interwoven, hyaline, smooth and thin-walled hyphae, 5-10 μm in diameter. **Hymenophoral trama** regular, formed by hyphae with little incrustated walls, yellowish in KOH, 3-7 (-10) μm in diameter. **Stipitipellis** composed by parallel, smooth and thin-walled, measuring 3-7 μm in diameter. **Caulocystidia** 30-44 (-60) x 8-10 μm , as chrysocystidia, similar to the pleurocystidia; scattered in the stipe apex, hard to find in dry specimens. **Clamp connections** present in the most septa.

Habitat: growing cespitose to fasciculate on wood of *Eucalyptus* spp., *Araucaria angustifolia* (Bertol.) O. Ktze., *Prunus sellowii* Hoehne, among others.

Distribution: Widespread in tropical and subtropical areas of Africa (Pegler 1977; Reid & Eicker 1999), Asia (Pegler 1986), Central America (Pegler 1983), Europe (Krieglsteiner & Enderle 1986), North America (Smith 1951), South America (Dennis 1970; Pulido 1983).

Material examined: **BRAZIL. Rio Grande do Sul:** Canela, Parque Estadual do Caracol, 06/V/.2000, *M. Vergara* (HASU 8.747); Esmeralda, Estação Ecológica de Aracuri, 24/XI/2004, *Cortez 051/04* (ICN 139.026); Nova Petrópolis, VII/1996, *R.T. Guerrero & R.M. Silveira* (ICN 102.555), Mato do Lenz, 18/VI/2004, *Cortez 031/04* (ICN 139.013), Parque do Imigrante, 18/VI/2004, *Cortez 032/04* (ICN 139.014); Porto Alegre, Belém Novo, VI/1992, *M.S. Hamme* (ICN 80.992); Santa Maria, Campus UFSM, 29/VIII/2000, *Cortez 041/00* (SMDB 9.226), Jardim Botânico UFSM, 12/VIII/2002, *Cortez 047/02* (SMDB 9.585), Morro do Elefante, 09/V/2001, *Cortez 024/01* (SMDB 9.244), 21/VII/2001, *Wartchow 007* (SMDB 9.190); Salvador do Sul, 27/IV/1943, *Rick 13.330* (PACA 8.678), 1943, *Rick 20.232* (PACA 8.681); São Francisco de Paula, CPCN Pró-Mata (PUCRS), 10/VI/2005, *Cortez 070/05* (ICN) and *Cortez 075/05* (ICN), Floresta Nacional do IBAMA, 21/V/1980, *A. Batista* (ICN 6.885), 23/VII/1980, *A. Batista* (ICN 6.888), 11/IX/1980, *A. Batista* (ICN 6.889), 23/IV/1996, *R.T. Guerrero & R.M.B. Silveira* (ICN 102.571), 07/VI/1996, *Sulzbacher et al.* (HCB 16.787), 14/V/2005, *Cortez 042/05* (ICN), 11/IX/2005, *leg. M.A. Reck, Cortez 084/05* (ICN), Loteamento Colinas, 21/V/1987, *Marlene* (HCB 13.640), Veraneio Hampel, 04/VI/2004, *Cortez 029/04* (ICN 139.012); São Leopoldo, 1929, *Rick 13.340* (PACA 8.680); Sinimbu, Cava Funda, 16/VII/2001, *M. Sulzbacher 25* (HCB 17.516); Torres, Roça da Estância, 08/VI/1987, *M.S.K. Alves* (HCB 13.305), 07/VIII/1987, *M.S.K. Alves* (HCB 14.844).

Additional material examined: **BRAZIL. Santa Catarina:** Florianópolis: Morro do Baú, 25/VII/2005, (FLOR). **São Paulo:** Campos do Jordão, Parque Estadual de Campos do Jordão, 08/VII/1985, *M. Capelari* 391 (SP 193.938); Cananéia, Ilha do Cardoso, 17/XI/1982, *Guzmán et al.* (SP 177.888); Santo André, Reserva Biológica do Alto da Serra de Paranapiaçaba, 08/V/1989, *M. Capelari* 2.026 (SP 250.493); São Paulo, *leg. Hoehne, Rick* 13.333 (PACA 8.679).

Additional specimens of *Hypholoma fasciculare*: **MÉXICO.** San Pedro de Atlapulco, La Marquesa, VIII/1962, *Guzmán* (SP 84.069). **MOLDAVIA.** District Suceava, 06/IX/1962, *T. Chifu* (SP 211.974).

Discussion: In spite of being a common mushroom, *H. subviride* was only recently reported from Rio Grande do Sul by Cortez & Coelho (2004) and Sobestiansky (2005). The materials recorded by Rick (1939, 1961) as *H. fasciculare* are *H. subviride* in the present concept, based on study of Rick's collections, compared with northern specimens of *H. fasciculare* (see additional specimens examined). There are doubts about the true specific differences between *H. fasciculare* and *H. subviride*. We followed Smith (1951), Dennis (1970) and Pegler (1977, 1983, 1986), who used the size of the basidiomes to separate both taxa: pileus up to 30 mm in *H. subviride*, against pileus larger than 30 mm in *H. fasciculare*. Another feature we have noted is a more developed veil in *H. fasciculare*, frequently forming a blackish annular zone on the stipe apex and also on the pileus margin; this condition, however, is never found in *H. subviride*. Molecular analysis performed by Moncalvo *et al.* (2002) also suggested close relationships between these species. *Hypholoma subviride* is also known in the Brazilian states of Amapá (Sotão *et al.* 1991), Paraná (de Meijer 2001), Santa Catarina (probable first record), and São Paulo (Bononi *et al.* 1984; Pegler 1997).

Synonyms, excluded or doubtful species

***Hypholoma appendiculatum* Bull.** – The mushroom reported by Rick (1939, 1961) is probably a *Pholiota* sp., due the fasciculate habit, absence of rhizomorphs, ellipsoid basidiospores (7-7.5 x 4-4.5 µm) with a wide germ pore, presence of chrysocystidia, and undifferentiated hypodermium. Material examined: **BRAZIL. Rio Grande do Sul:** São Leopoldo, 1930, *Rick* 13.339 (PACA 8.674).

H. candolleianum Fr. – The studied material corresponds to *Psathyrella candolleiana* (Fr.) Maire, a common lignicolous to sublignicolous species in the State. Material examined: **BRAZIL. Rio Grande do Sul:** São Leopoldo, 1936, *Rick 13.338* (PACA 8.677).

H. cascum Fr. – Cited by Rick (1961) but without specimens indicated, probably no material preserved in the herbarium PACA. If correctly identified, the species refers to a member of the genus *Psathyrella*.

H. dispersum Fr. – No material preserved in the herbarium PACA and also specimens not cited in Rick (1961) in his report. If Rick identified correctly the specimens, this would represent a fourth species of the genus in Rio Grande do Sul, however we consider it a doubtful species in the present.

H. fasciculare Huds.: Fr. – Reports given by Rick (1939, 1961) are s *H. subviride*, see discussion above.

H. hydrophilum Bull. – Probably no material preserved in the herbarium PACA and specimens not indicated in Rick (1961). If correctly identified, the species refers to a member of the genus *Psathyrella*.

H. intonsum Passer. – This is a doubtful species or a possible synonym in his original sense because there are not modern information about this name. The material reported by Rick (1961) is in fact a *Stropharia* sp. due the presence of abundant acanthocytes in its rhizomorphs; his description (Rick 1907, 1939, 1961) is identical (if not a transcription) of those presented by Saccardo (1887). Material examined: **BRAZIL. Rio Grande do Sul:** Esteio, 1939, *Rick 13.332* (PACA 8.692).

H. lanaripes Cooke – Probably no material preserved and specimens were not indicated in the report by Rick (1961). This could to represent *H. lanaripes* (Cooke) Fr., but without preserved material, we consider it a doubtful species.

H. leucotephrum Berk. – The mushrooms belong to *Psathyrella*, possibly *P. leucotephra* (Berk. & Br.) P.D. Orton or *P. candolleiana*, but the badly preserved specimens did not

allowed a complete study. Material examined: **BRAZIL. Rio Grande do Sul:** São Leopoldo, 10.1929, *leg. Steffen, Rick 13.336* (PACA 8.684).

***H. piluliforme* Bull.** – Probably a *Psathyrella* sp., however it was not possible to confirm it as *P. piluliformis* (Bull.: Fr.) P.D. Orton due the bad conditions of the basidiomata. Material examined: **BRAZIL. Rio Grande do Sul:** Lajeado, 15.07.1919, *Rick* (SP 33.909).

***H. solitarium* Rick** – The holotype described by Rick (1961) did not presents chrysocystidia, and the cheilocystidia were not observed, but the basidiospores are rhomboid in frontal view (9-10 µm). These data suggests a member of *Psilocybe* sect. *Cordisporae* Guzmán, however was not possible to identify the material in specific level because it is completely mouldy. Material examined: **BRAZIL. Rio Grande do Sul:** Esteio, 1930, *Rick 13.341* (PACA 8.685).

***Naematoloma* sp.** – *Hebeloma miserum* Rick was described by Rick (1930), however Singer (1953) after the study of the holotype determined it as *Naematoloma* sp. The material indicated by Rick and Singer was not received from the herbarium PACA.

***Psilocybe ericaea* Pers.** – Material under this name was not received from the herbarium PACA, but Singer (1953) reported these materials as *Naematoloma subumbonatescens* Murrill, a synonym of *H. ericaeum* – see discussion under this species.

***P. tortipes* Speg.** – Singer (1953) studied collections under this name and concluded to be the same as *N. subumbonatescens* (= *H. ericaeum*).

***P. uda* Pers.** – *Psilocybe uda* is currently known as *H. udum* (Pers.: Fr.) Kühner, however authentic material reported by Rick (1939, 1961) was not received from the herbarium PACA. Singer (1953) collected specimens in Rio Grande do Sul under this name, which were subsequently described as a new species (*Psilocybe paupera* Singer) by Singer (1955). Singer (1953) considered wrong the Ricks' determination of *P. uda*.

***Stropharia squamosa* Fr.** – The material collected but not published by Rick under this name is in fact *H. ericaeum* (see discussion under this species). Material examined: **BRAZIL. Rio Grande do Sul:** São Leopoldo, *Rick 15.235* (PACA 9.373).

S. thrausta Kalchbr. – Cited by Rick (1907), we considered this is a true *H. aurantiacum* (see discussion under this species). *Psilocybe squamosa* var. *thrausta* (Schulzer ex Kalchbr.) Guzmán, reported in the checklist of *Psilocybe* from Brazil by Guzmán & Cortez (2004) based on Rick's report, should not be considered.

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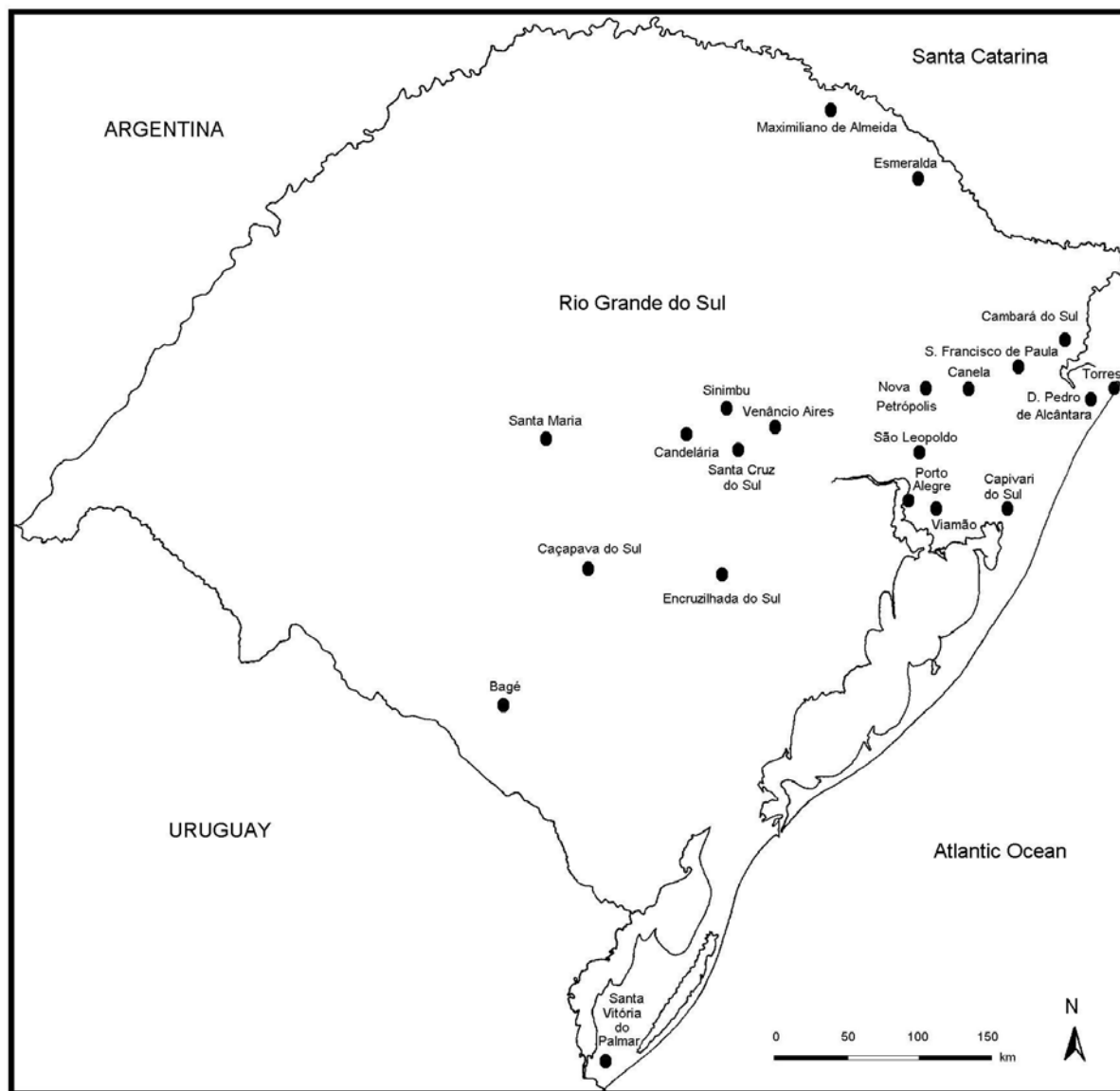
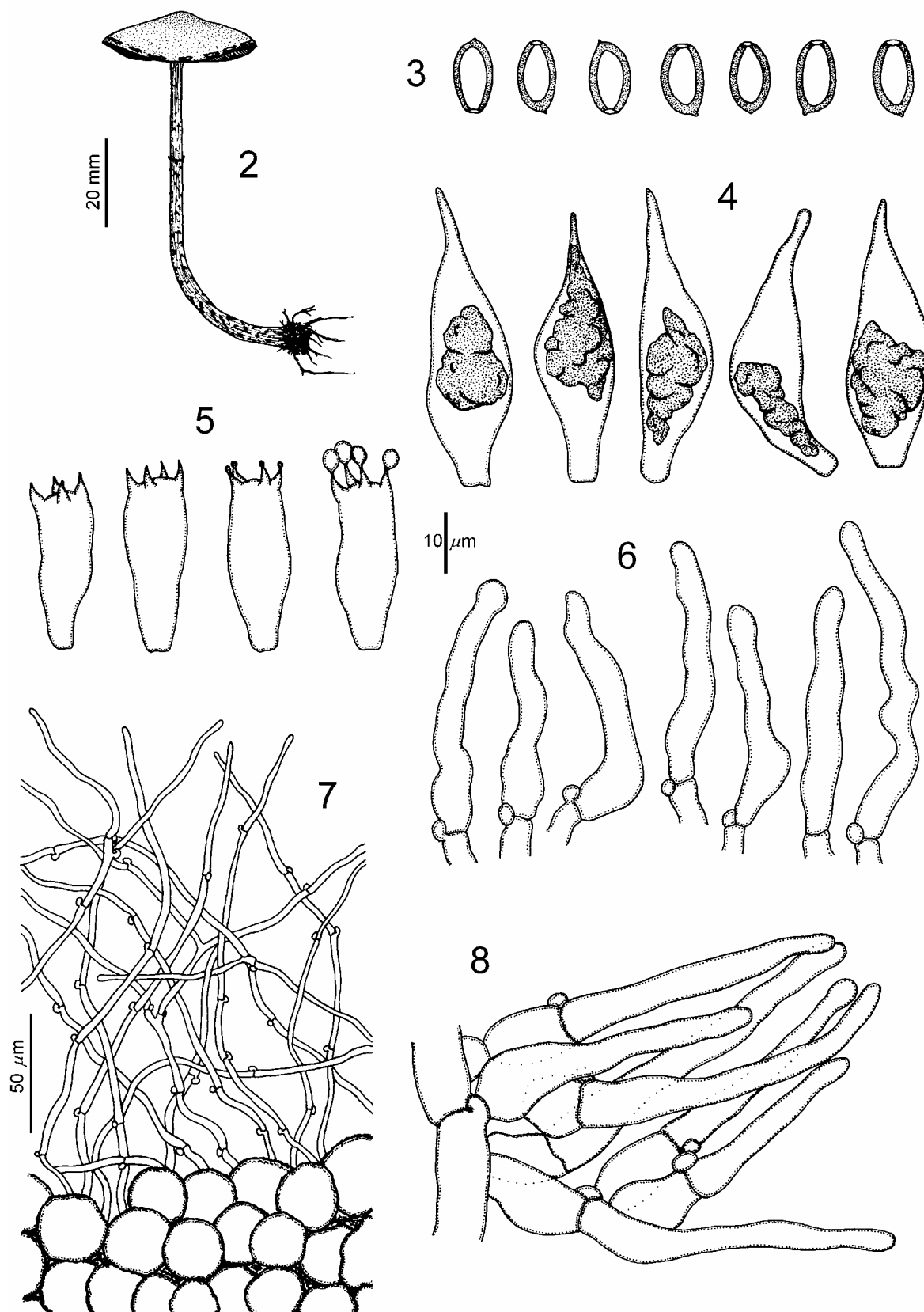
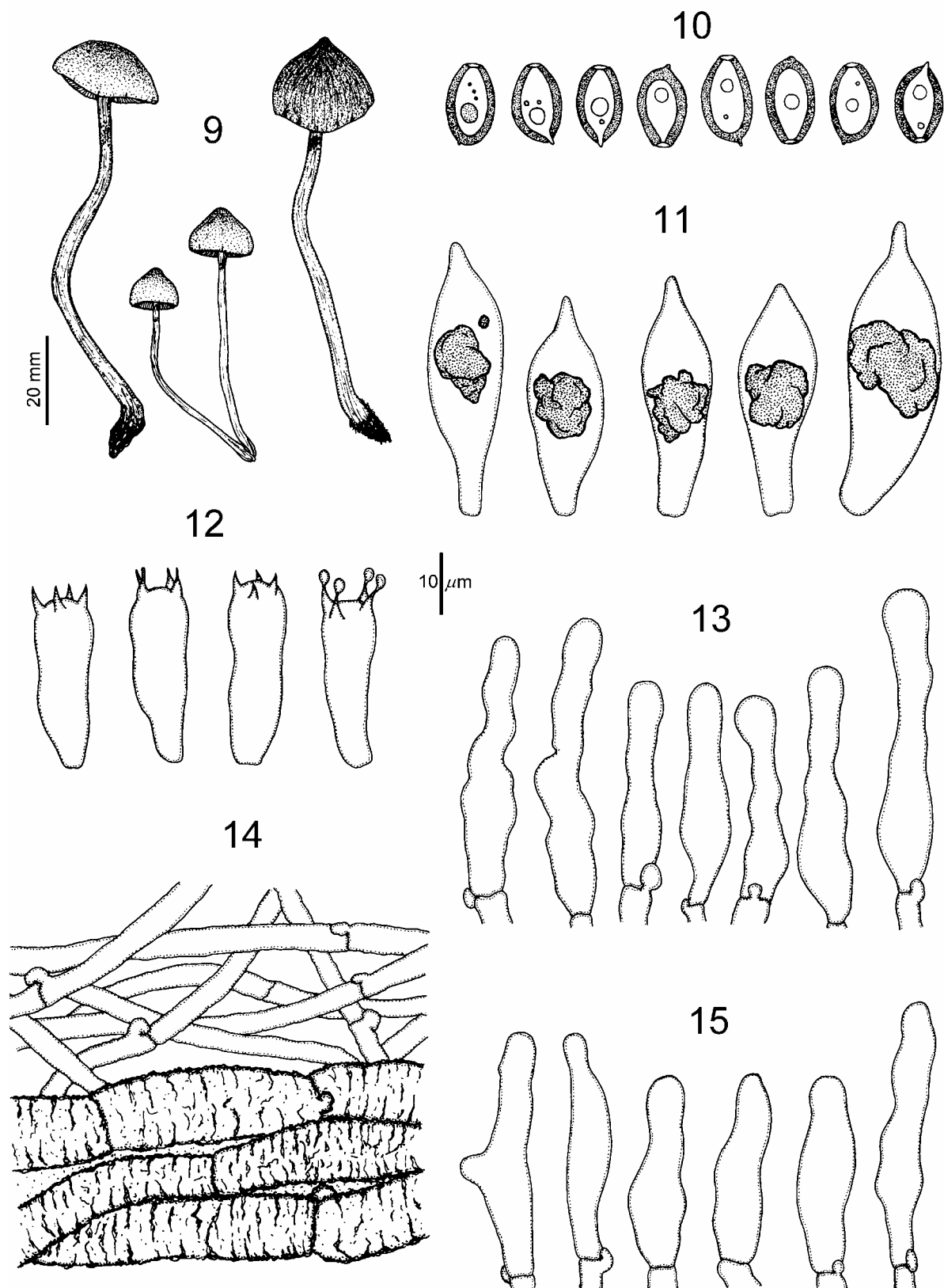


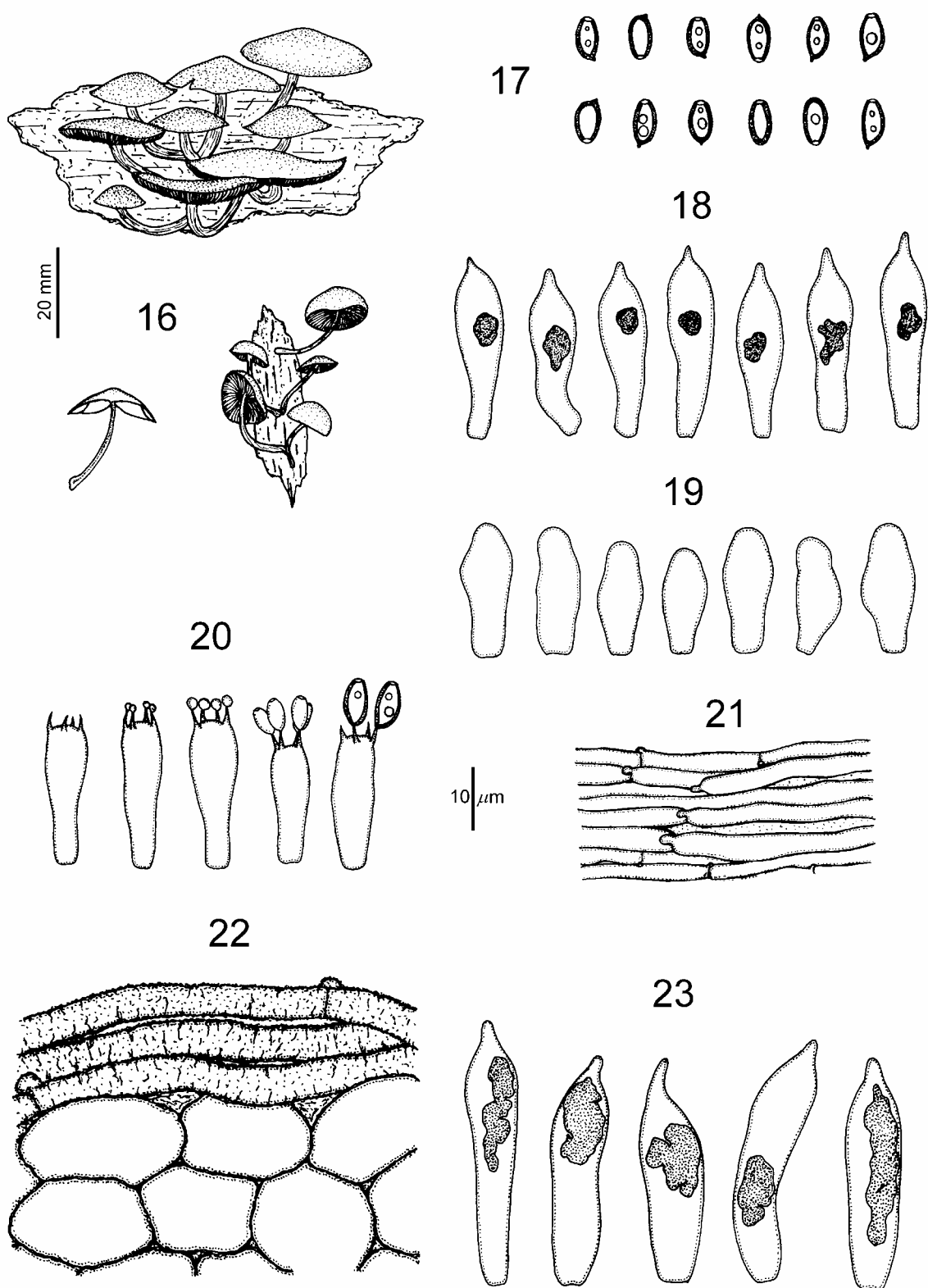
Figure 1. Map of Rio Grande do Sul State, showing the collecting sites of the studied taxa.



Figures 2-8. *Hypholoma aurantiacum*. 2. Basidioma. 3. Basidiospores. 4. Pleurocystidia. 5. Basidia. 6. Cheilocystidia. 7. Pileipellis and hypodermium. 8. Caulocystidia.



Figures 9-15. *Hypholoma ericaeum*. 9. Basidiomata. 10. Basidiospores. 11. Pleurocystidia. 12. Basidia. 13. Cheilocystidia. 14. Pileipellis and hypodermium. 15. Caulocystidia.



Figures 16-23. *Hypholoma subviride*. 16. Basidiomata. 17. Basidiospores. 18. Pleurocystidia. 19. Cheilocystidia. 20. Basidia. 21. Hymenophoral trama. 22. Pileipellis and hypodermium. 23. Caulocystidia.



Figures 24-26. Basidiomata of *H. aurantiacum* (24), *H. ericaeum* (25) and *H. subviride* (26).
Scale bar: 20 mm.

Capítulo 4

ARTIGO

Species of *Stropharia* (*Strophariaceae*, *Agaricales*)

from Rio Grande do Sul State, Brazil

a ser submetido para publicação ao Periódico

MYCOTAXON

(Ithaca, EUA)

Species of *Stropharia* (*Strophariaceae*, *Agaricales*) from Rio Grande do Sul State, Brazil¹

VAGNER G. CORTEZ & ROSA M. B. SILVEIRA

E-mail: cortezvg@yahoo.com.br

Universidade Federal do Rio Grande do Sul, Programa de Pós-graduação em Botânica

Av. Bento Gonçalves, 9500, CEP: 91501-970, Porto Alegre, RS, BRAZIL

Abstract— A taxonomic survey of the genus *Stropharia* in the southernmost 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 following novel taxa and combination are introduced: *S. acanthocystis* sp. nov. ined., *S. araucariae* sp. nov. ined., *S. alcis* var. *austrobrasiliensis* var. nov. ined., and *S. apiahyna* comb. nov. ined. *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.

Keywords— *Strophariaceae*, *Agaricales*, *Basidiomycota*

Introduction

Stropharia (Fr.) Quél. 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). Following Singer (1986), 20 species are recognized worldwide,

¹ Extracted from the Dissertation of the senior author presented to the Universidade Federal do Rio Grande do Sul as partial fulfillment of the requirements for the degree of Master of Botany.

but Hawksworth et al. (1995) attributed only 15 species for the genus. A checklist by Wasser & Grodzinskaya (1996) listed 111 names in *Stropharia*, of which 28 are currently in use.

In the present sense, the occurrence of a particular type of crystalline hyphae called acanthocyte has been considered a good generic character for the genus (Farr 1980), and being used by different authors to delimit taxa of the genus (Bandala et al. 2005, Desjardin & Hemmes 2001, Jahnke 1984, Norvell & Redhead 2000, Redhead 1984a, 1984b). Based on this feature, the group of coprophilous species (subgenus *Stercophila* Romagn. ex Noordel.) should be excluded from *Stropharia* because they lack acanthocytes, a position indeed demonstrated by recent molecular studies (Moncalvo et al. 2002). Awaiting the formal proposal of a new generic name (S.A. Redhead, pers. comm.), we consider this group provisionally under *Stropharia*.

The taxonomy of the genus has been a matter of little interest among agaricologists, and it has been considered in sporadic papers dealing particular species groups (Benedix 1960, Esteve-Raventós & Barrasa 1995, Kreisel 1980, Kytövuori 1999, Orton 1976) or in monographic studies of the *Strophariaceae* restricted to some European (Bon & Roux 2003 from France, Jahnke 1984 from Germany, Noordeloos 1999 from Netherlands, Watling & Gregory 1987 from UK) and North American (Harper 1914, Murrill 1922, both from USA) countries. There is fragmentary information about the South American species; the most of them were reported in general works on agarics by Dennis (1961, 1970) from Venezuela, Horak (1979) and Singer & Digilio (1952) from Argentina, 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* P. Henn. from the state of São Paulo. This species, however, was later renamed by Pegler (1997) as *Agaricus puttemansii* Pegler. Several species were reported by Rick (1907, 1920, 1930, 1939, 1961) from the state of Rio Grande do Sul, the southernmost in Brazil. The most of species described or reported by Rick (as it will be discussed later) are currently synonyms or misidentifications, and many holotypes of his new species were lost, unfortunately. Singer (1953) studied several Rick's types and collections and also collected in some localities in Rio Grande do Sul, but he listed only *S. coronilla* (Bull.: Fr.) Quél for the State. Batista & Bezerra (1960) reported the only record of a *Stropharia* species from northeastern Brazil, *S. coronilla*, from Pernambuco State. Stijve & de Meijer (1993) reported *S. coronilla*, *S. rugosoannulata* Farl. ex Murrill and *S. semiglobata* (Batsch : Fr.) Quél. from the State of Paraná, in south Brazil, and later de Meijer (2001) reported the occurrence of five *Stropharia* species, although he cited only four – the three above-cited plus *S. aurantiaca* (Cooke) P.D. Orton, which

actually is an *Hypholoma*. Pegler (1997) reported *S. rugosoannulata* and *S. semiglobata* from São Paulo State; Cortez & Coelho (2004) cited *S. coronilla*, *S. rugosoannulata*, and *S. semiglobata* from the region of Santa Maria, in central Rio Grande do Sul; recently Sobestiansky (2005) reported the occurrence of *S. rugosoannulata* in the region of Nova Petropolis, also in Rio Grande do Sul State.

Thus, the knowledge of *Stropharia* in Brazil is scanty and limited to a few and well-known species. For this reason we propose this study, which aims to improve this knowledge with a taxonomic survey of the genus in the State of Rio Grande do Sul.

Materials and Methods

Specimens were collected in different localities of the Rio Grande do Sul State, from March 2004 to September 2005. Rio Grande do Sul is the southernmost Brazilian state (Figure 1), and is situated at $27^{\circ}3'42'' - 33^{\circ}45'34''$ S and $53^{\circ}3'24'' - 53^{\circ}23'22''$ 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, semideciduous 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 (Marchiori 2004, Porto & Menegat 2002).



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

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

For the macroscopic analysis of the basidiomata was followed Largent (1977), while the microscopic study followed Largent et al. (1986). As mounting media were used the 5% KOH (potassium hydroxide) alone or in consortium with the 1% Congo Red. Line drawings were made with a light tube in a Leica DM LS2 optical microscope. In the basidiospores descriptions, 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), unless not followed by color notations. Taxonomic authorities are abbreviated according to the *Authors of Fungal Names* (CABI 2005).

Results and Discussion

Key for 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; growing on other substrata than dung | 4 |
| 2. Basidiospores 10-15 μm long | 3. <i>S. alcis</i> var. <i>austrobrasiliensis</i> |
| 2. Basidiospores 15-22 μm long | 3 |
| 3. Basidiospores with a central germ-pore | 10. <i>S. semiglobata</i> |
| 3. Basidiospores with an eccentric germ-pore | 7. <i>S. dorsipora</i> |
| 4. Veil absent on stipe or forming a floccose, fibrillose or membranous, smooth annulus | 5 |
| 4. Veil forming a fleshy annulus, usually grooved on upper surface | 9 |
| 5. Hymenial acanthocytes present; annulus absent | 1. <i>S. acanthocystis</i> |
| 5. Hymenial acanthocytes absent; some kind of annulus present | 6 |

6. Pileus greenish with yellowish margin; clavate cheilocystidia **2. *S. aeruginosa***
6. Pileus other colors than green **7**
7. Annulus (if present) floccose to membranous, fugacious; on fallen leaves, soil .. **8. *S. earlei***
7. Annulus membranous, persistent; on decomposing wood **4. *S. apiahyna***
9. Pileus yellowish; basidiospores 6-10 μm long; in lawns **6. *S. coronilla***
9. Pileus brownish to reddish brown; basidiospores 10-14 μm long; in forests **10**
10. Pileus 60-170 mm in diam.; cheilocystidia as chrysocystidia **9. *S. rugosoannulata***
10. Pileus 39-68 mm in diam.; cheilocystidia as leptocystidia and chrysocystidia **5. *S. araucariae***

Descriptions of the studied species

1. *Stropharia acanthocystis* Cortez & R.M. Silveira, sp. nov. ined. FIG. 2-8, PL. 1A

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) 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 x 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) x 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 x 7-9 μm , clavate, thin-walled, bearing four sterigmata. **Pleurocystidia** (23-) 26-33 (-41) x 8-10 (-11) μm , as chrysocystidia, clavate, very rarely presenting a mucronate apex; smooth and thin-walled, with an amorphous yellowish content in KOH. **Cheilocystidia** (18-) 22-33 x 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 x 9-12 μm , clavate, similar to the pleurocystidia; **2) leptocystidia**, 23-45 x 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 cystidioid structures; the acanthocyte comprises a basal and clamped hyphae, from where came 7-11 rays, with thickened walls. **Clamp connections** present.

Ecology: Gregarious at the base of a decomposing angiosperm, in mixed ombrophilous forest vegetation.

Distribution: known only from type locality.

Specimens examined: BRAZIL. Rio Grande do Sul State. São Francisco de Paula: Floresta Nacional do IBAMA, 14.V.2005, V.G. Cortez 053/05 (ICN 139131), holotype.

Remarks: *Stropharia acanthocystis* differs from all *Stropharia* species by the presence of acanthocytes in the hymenium as cystidia, stipe surface and rhizomorphs and by the lack of an annulus on the stipe. These structures were checked from all five specimens of the type collection. The lack of an annulus would suggest its placement in *Hypholoma*, and *H. trinitatensis* (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). *Stropharia variicolor* Desjardin & Hemmes from Hawaii is also microscopically similar, but this species presents tricholomatoid basidiomes and grows in horticultural areas on woodchip debris (Desjardin & 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.) O. Kze. forests (mixed ombrophilous forest), at 912 m altitude, which has a rich and unexplored mycobiota.

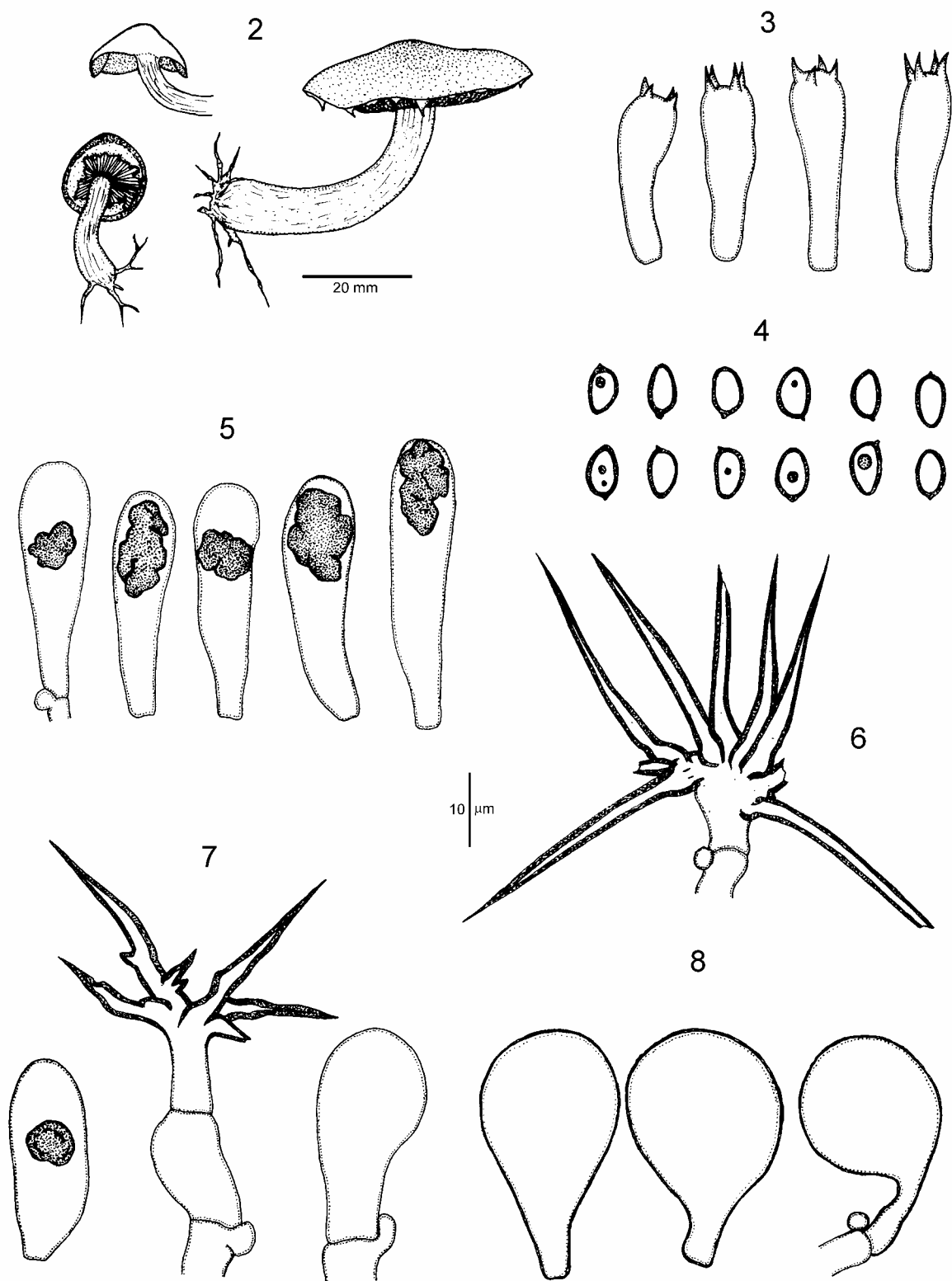


Figure 2-8. *Stropharia acanthocystis*. 2. Basidiomata. 3. Basidia. 4. Basidiospores. 5. Pleurocystidia. 6. Hymenial acanthocyte. 7. Caulocystidia (three types). 8. Cheilocystidia.

2. *Stropharia aeruginosa* (Curtis: Fr.) Quél., Mém. Soc. Émul. Montbéliard, Sér. II, v. 5: 141, 1872. FIG. 9-14

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

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

Pileus 13-45 mm in diameter, initially convex to finally flattened, umbonate; 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 x 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 the stipe and sometimes it produces white and membranous remnants in the pileus margin. **Spore print** very dark brown (7.5YR 2.5/2).

Basidiospores 6.5-8 (-9) x 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 x 5-8 μm , clavate, bearing four sterigmata. **Pleurocystidia** 30-59 x 7-14 μm , as chrysocystidia, clavate, with a mucronate apex; thin-walled, but with an amorphous yellowish content. **Cheilocystidia** 25.5-50 x 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 incrustated 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 x 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.

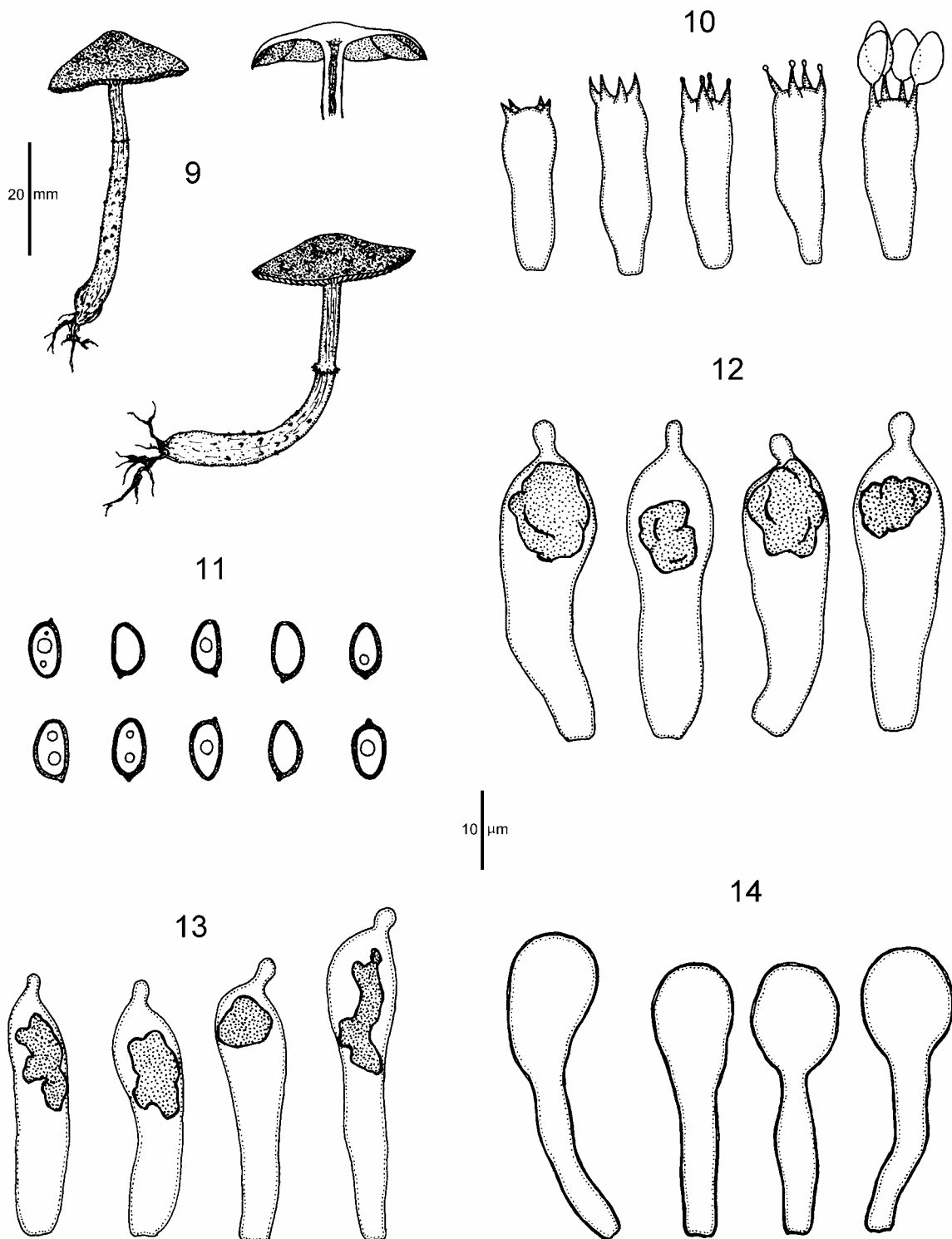


Figure 9-14. *Stropharia aeruginosa*. 9. Basidiomata. 10. Basidia. 11. Basidiospores. 12. Pleurocystidia. 13. Caulocystidia. 14. Cheilocystidia.

Ecology: growing solitary to subgregarious, on much decomposed wood, in semi-deciduous seasonal forest.

Specimens examined: BRAZIL. Rio Grande do Sul State: **Santa Maria:** Morro do Elefante, 04.V.2002, leg. Cortez & F. Wartchow, Cortez 035/02 (SMDB 9.573), Cortez 037/02 (SMDB 9.575); 12.IV.2003, Cortez 007/03 (SMDB 9.604); 11.IV.2005, Cortez 011/05 (ICN 139.098). **Salvador do Sul:** 23.III.1945, Rick 22.832 (PACA 9.367).

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

Distribution: Europe (Noordeloos 1999, Watling & Gregory 1987), North America (Harper 1914, Stamets 1996), South America (Singer 1969).

Remarks: 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. 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 several microscopic characters (e.g., ornamented basidiospores with a plage, cystidia – Gamundí & Horak 1995).

The Brazilian specimens present a fibrillose annulus instead of a membranous one, and they lack bluish shades in the pileus, which are seen in most of northern specimens. However, all microscopic data match with those of *S. aeruginosa*, and we consider these differences as mere geographical variation of the species. The material cited by Rick (1961) as *Stropharia merdaria* Pers. corresponds to *S. aeruginosa* after our study of Rick's material deposited at PACA. But the specimens reported by Rick (1939) as *S. merdaria* are *Psilocybe argentina* Speg. following indication by Guzmán (1983). Unfortunately, such specimens studied by Guzmán were not studied for us.



Plate 1. A: *Stropharia acanthocystis*. B: *Stropharia alcis* var. *austrobrasiliensis*. Scale bar: 20 mm.

3. *Stropharia alcis* var. *austrobrasiliensis* Cortez & R.M. Silveira, var. nov. ined. FIG. 15-20, PL. 1B

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 appendiculate; 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) x (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) x (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) x (7-) 9-13 μm , utriform, forming four sterigmata. **Pleurocystidia** 31-55 x 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) x (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 incrustated 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) x 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.

Ecology: growing gregariously on cow dung or soil where the cattle circulates, especially meadows, but also into forests with the presence of cattle.

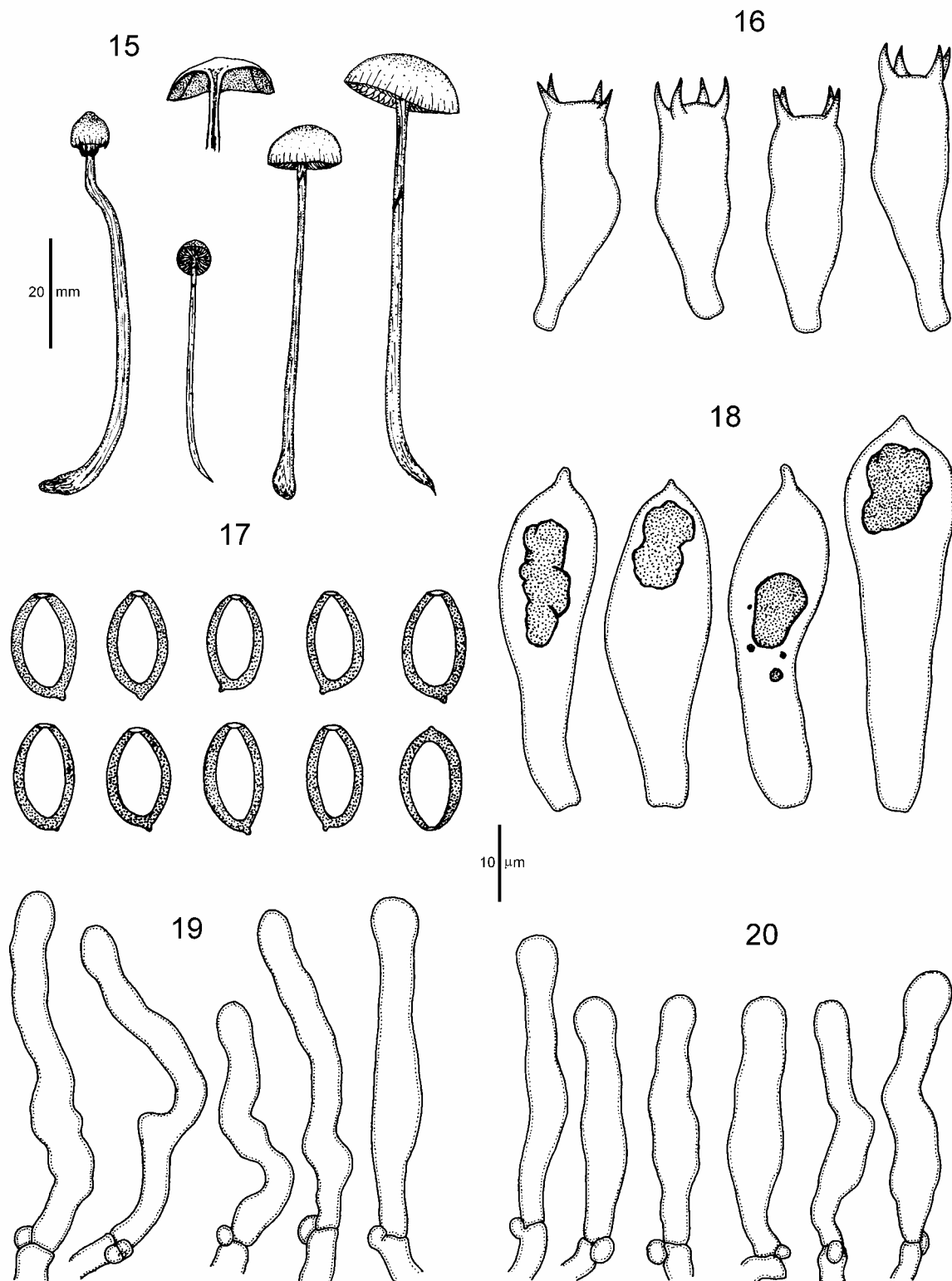


Figure 15-20. *Stropharia alcis* var. *austrobrasiliensis*. 15. Basidiomata. 16. Basidia. 17. Basidiospores. 18. Pleurocystidia. 19. Caulocystidia. 20. Cheilocystidia.

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

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

Distribution: Rio Grande do Sul, Brazil.

Remarks: This species was described by Kytövuori (1999) 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, not larger than 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 Swedish material identified as *S. alcis* collected 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, to separate both Brazilian and Northern European materials as distinct species based only in substrate difference seems to be risky, since no biosystematic or molecular study was performed. For

this reason, we prefer to maintain the Brazilian mushrooms under the specific name *S. alcis*, with the proposing of a new variety to accommodate the South American cow dung inhabitant specimens. It is possible that future studies in molecular level 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 undoubtedly the most common coprophilous species of *Stropharia* in Rio Grande do Sul.

4. *Stropharia apiahyna* (Speg.) Cortez & R.M. Silveira, comb. nov. ined. FIG. 21-24

≡ *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 x 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 x 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 x 5-8 μm , clavate, bearing four sterigmata. **Pleurocystidia** 24-39 (-43) x (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 in 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 in the rhizomorphs and some scattered in the gill tissue. **Clamp connections** present.

Ecology: gregarious or solitary on wood in subtropical forest.

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

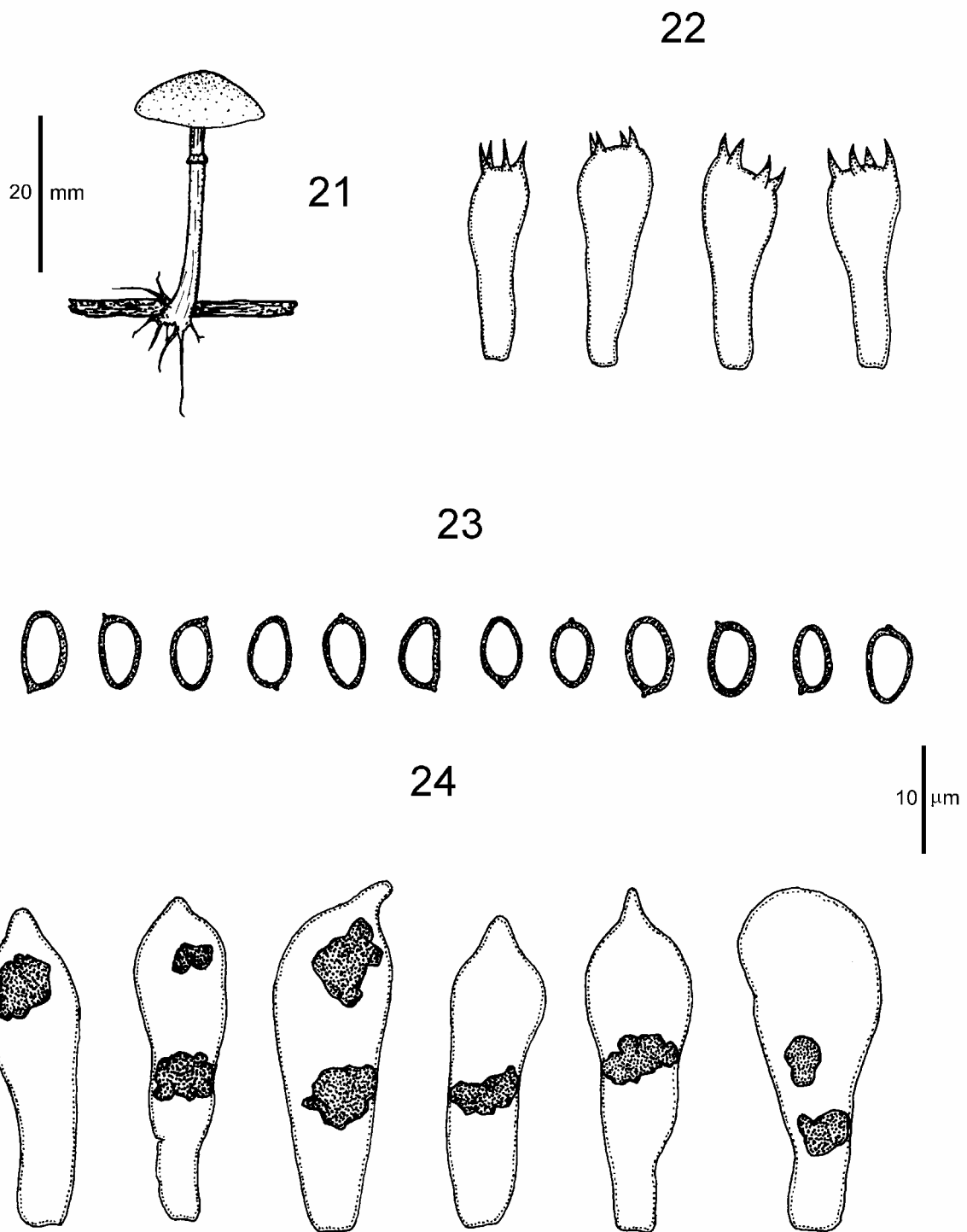


Figure 21-24. *Stropharia apiahyna*. 21. Basidioma. 22. Basidia. 23. Basidiospores. 24. Pleurocystidia.

Additional material examined: COLOMBIA. **Cali:** 15.IV.1968, *Singer B6164* (F 1014404).

Distribution: Brazil and Colombia (Singer 1978).

Remarks: This species was originally described by Spegazzini (1919), and later its holotype was studied by Singer (1950), who confirmed it as a good *Pholiota*. 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, and additionally we propose the transferring of this species from to *Stropharia* based on the presence of white rhizomorphs bearing abundant acanthocytes. We also studied the specimens cited by Singer (1978), from Colombia and Ecuador. The Ecuadorian material (F 1017958) represents another species, probably undescribed, presenting entirely yellow basidiomata, absent annulus, clavate and non-mucronate pleurocystidia. Singer (1986) placed this species in *Pholiota* sect. *Albivelatae*, a group whose most species were transferred to *Stropharia* by Norvell & Redhead (2000).

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

5. *Stropharia araucariae* Cortez & R.M. Silveira, sp. nov. ined.

FIG. 25-31

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; margin regular and conspicuously whitish. **Stipe** 70-111 x 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.

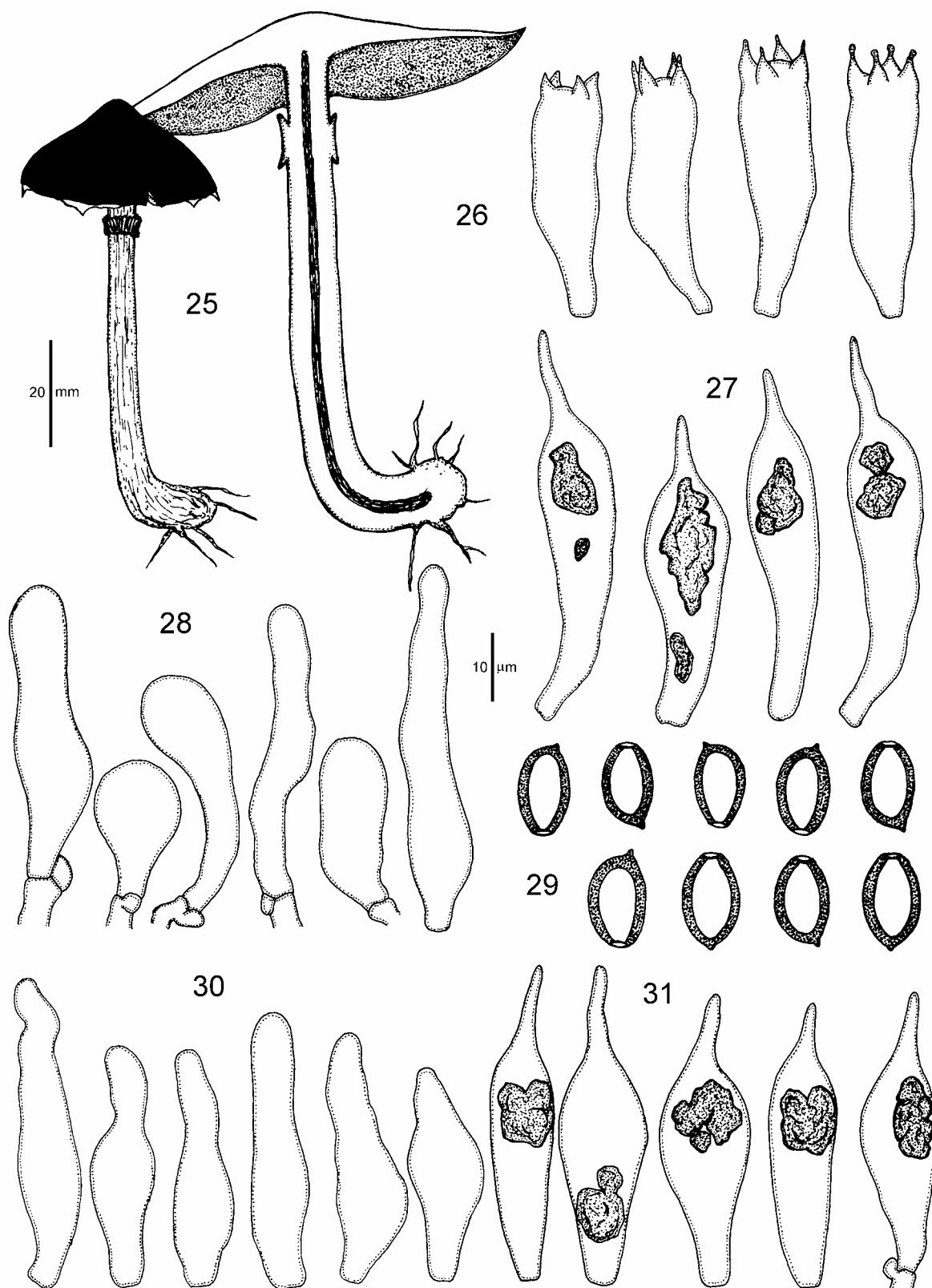


Figure 25-31. *Stropharia araucariae*. 25. Basidiomata. 26. Basidia. 27. Pleurocystidia. 28. Caulocystidia. 29. Basidiospores. 30. Cheilocystidia (leptocystidia type). 31. Cheilocystidia (chrysocystidia type).

Basidiospores (10.5-) 12-13 x (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 x (8-) 10-11 μm , subclavate, bearing four sterigmata. **Pleurocystidia** (31-) 38-47 (-54) x 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) x 9-12 μm , fusoid, with a rostrate to mucronate apex, with yellowish internal incrustation; **2) leptocystidia**: (26-) 30-40 (-44) x (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) 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) x (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.

Ecology: growing solitary on soil, among grasses and fallen leaves, in *Araucaria angustifolia* (Bertol.) O. Kze. forest (ombrophilous mixed forest).

Material examined: BRAZIL. Rio Grande do Sul State. **São Francisco de Paula**: Floresta Nacional do IBAMA, 14.V.2005, *Cortez 044/05* (ICN 139.122 – holotype), *Cortez 050/05* (ICN 139.128) and *Cortez 056/05* (ICN 139.134).

Distribution: Known only from the type locality (Meridional Plateau of Rio Grande do Sul, Brazil).

Remarks: This species is macroscopically similar to *S. rugosoannulata* due the brownish color of the pileus, grooved annulus, and similar basidiospores, however it differs significantly in basidioma stature, non-fleshy annulus, as well other microscopic features like type, size and shape of the cheilocystidia and caulocystidia. *Stropharia hornemanii* (Fr.: Fr.) S. Lundell & Nannf. seems to be also related, but differs in the absence of chrysocystidia as

cheilocystidia (Jahnke 1984, Noordeloos 1999, Watling & Gregory 1987). The most distinguishing characters of this 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*, at altitude near to 900 m, in the region of the Meridional Plateau of the Rio Grande do Sul.

6. *Stropharia coronilla* (Bull.: Fr.) Quél., Mém. Soc. d'Émul. Mont. Sér. II, v. 5: 110, 1872. FIG. 32-37, PL. 2A

≡ *Agaricus coronillus* Bull., Hist. Champ. Fr. 2: 633, 1812.

≡ *Psilocybe coronilla* (Bull.: Fr.) 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 x (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) x (4.5-) 5-6 (-6.5) μm , $Q=1.33-2.17$, $Q_m=1.59$, $n=133$, sub-ellipsoid in side view, ovoid in face view; smooth and thick-walled, with an inconspicuous germ-pore. **Basidia** 19-28 x 6.5-9.5 μm , clavate, bearing four (sometimes two) sterigmata. **Pleurocystidia** 28-40 (-48) x 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) x (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 incrustated 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, slightly thick 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 x 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.

Ecology: growing solitary to gregarious in lawns, gardens.

Material examined: BRAZIL. Rio Grande do Sul State. **Caçapava do Sul:** Guaritas, 30.IV.2005, *Cortez 028/05* (ICN 139.110). **Dom Pedro de Alcântara:** 20.V.2005, *Cortez 066/05* (ICN 139.144). **Porto Alegre:** Campus UFRGS, 06.V.2004, *Cortez 015/04* (ICN 139.003). **Salvador do Sul:** 26.III.1944, *Rick 21.013* (PACA 9.358). **Santa Maria:** Av. Roraima, Camobi, 26.II.2003, *Cortez 003/03* (SMDB 9.600); Campus da Universidade Federal de Santa Maria, 27.III.2002, *Cortez 017/02* (SMDB 9.557); Passo dos Ferreiros, Tancredo Neves, 07.IV.2002, *Cortez 027/02* (SMDB 9.566); Vila Caramelo, 02.V.2001, *Cortez 021/01* (SMDB 9.243). **Venâncio Aires:** Sociedade dos Motoristas, 31.III.1985, *Pilz* (HCB 10.047, HCB 10.048). **Vera Cruz:** Linha Número Um, 15.VI.1986, *J. Putzke* (HCB 10.533); 08.X.1986, *J. Putzke et al.* (HCB 16.693). **Viamão:** Parque Estadual de Itapuã, Praia da Pedreira, 08.V.2004, *P.S. da Silva 063* (ICN 139.075).

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

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

Remarks: *Stropharia coronilla* is one of the most common lawn-inhabitant mushrooms in the State. It is easily macroscopically recognized by the yellowish pileus color, the grooved annulus and rhizomorphs on stipe base, but can be confounded with members of *Agrocybe* Fayod (*Bolbitiaceae* Singer) and *Agaricus* Fr. (*Agaricaceae* Chevall.), from which differs in several microscopic characters (basidiospores, cystidia, and pileipellis structure). In Brazil it is known from the states of Paraná (Stijve & de Meijer 1993), Pernambuco (Batista & Bezerra 1960), Rio Grande do Sul (Rick 1907, Cortez & Coelho 2004), and São Paulo (possibly the first record for the State).

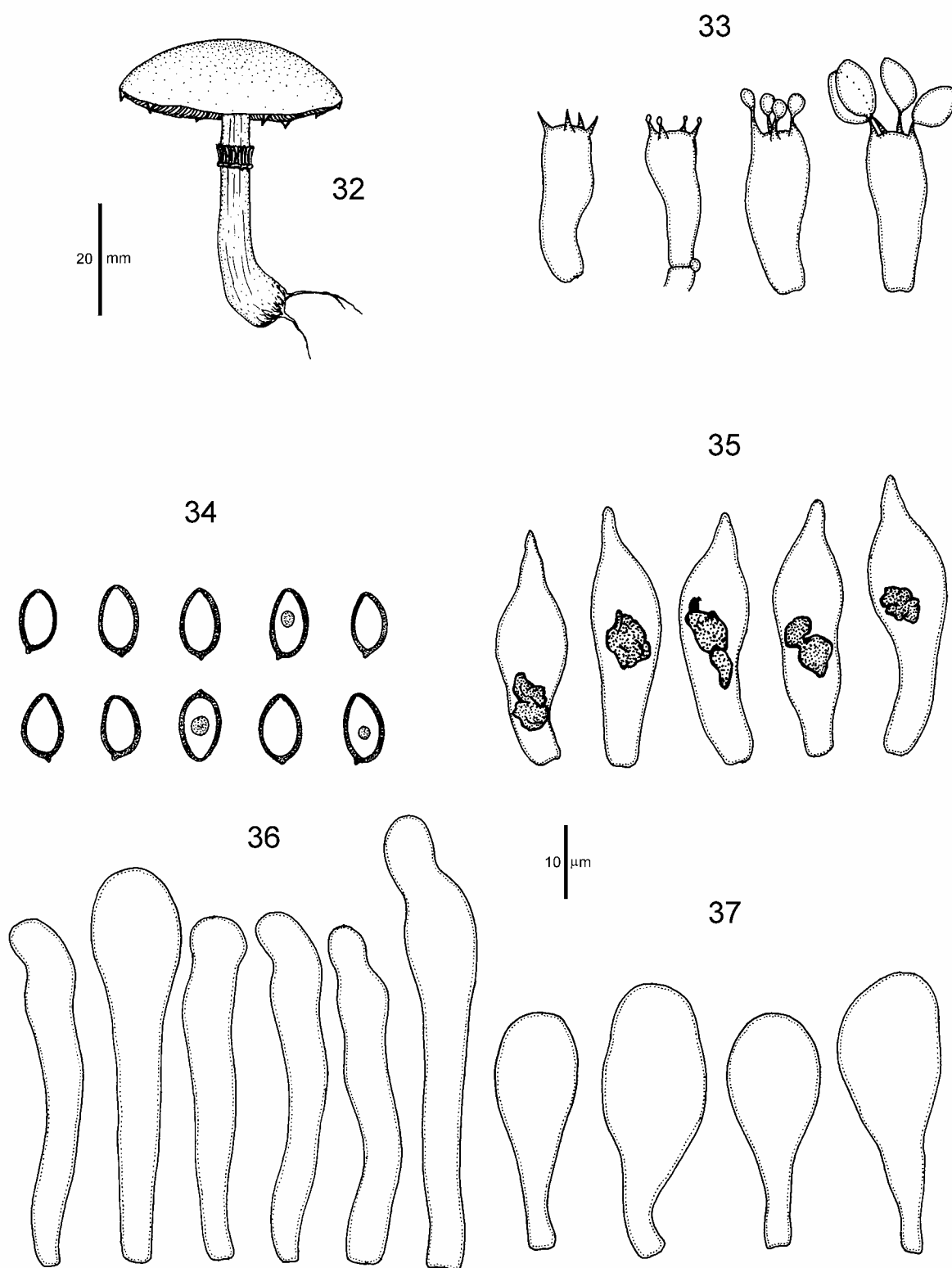


Figure 32-37. *Stropharia coronilla*. 32. Basidioma. 33. Basidia. 34. Basidiospores. 35. Pleurocystidia. 36. Caulocystidia. 37. Cheilocystidia.

7. *Stropharia dorsipora* Esteve-Rav. & Barrasa, Rev. Iberoam. Micol. 12: 71, 1995. FIG. 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 x 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) x (9-) 10-12 (-13) μm , $Q= 1.62-2$, $Q_m= 1.7$, $n= 78$; 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) x (10-) 12-16 (-18) μm , clavate, bearing four sterigmata. **Pleurocystidia** 35-62 x 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** (26-) 33-46 (-52) x 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 incrustated 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. **Caulocystidia** (25-) 28-41 (-50) x (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** not seen. **Clamp connections** present in the most septa.

Ecology: growing solitary on cow dung in pastures.

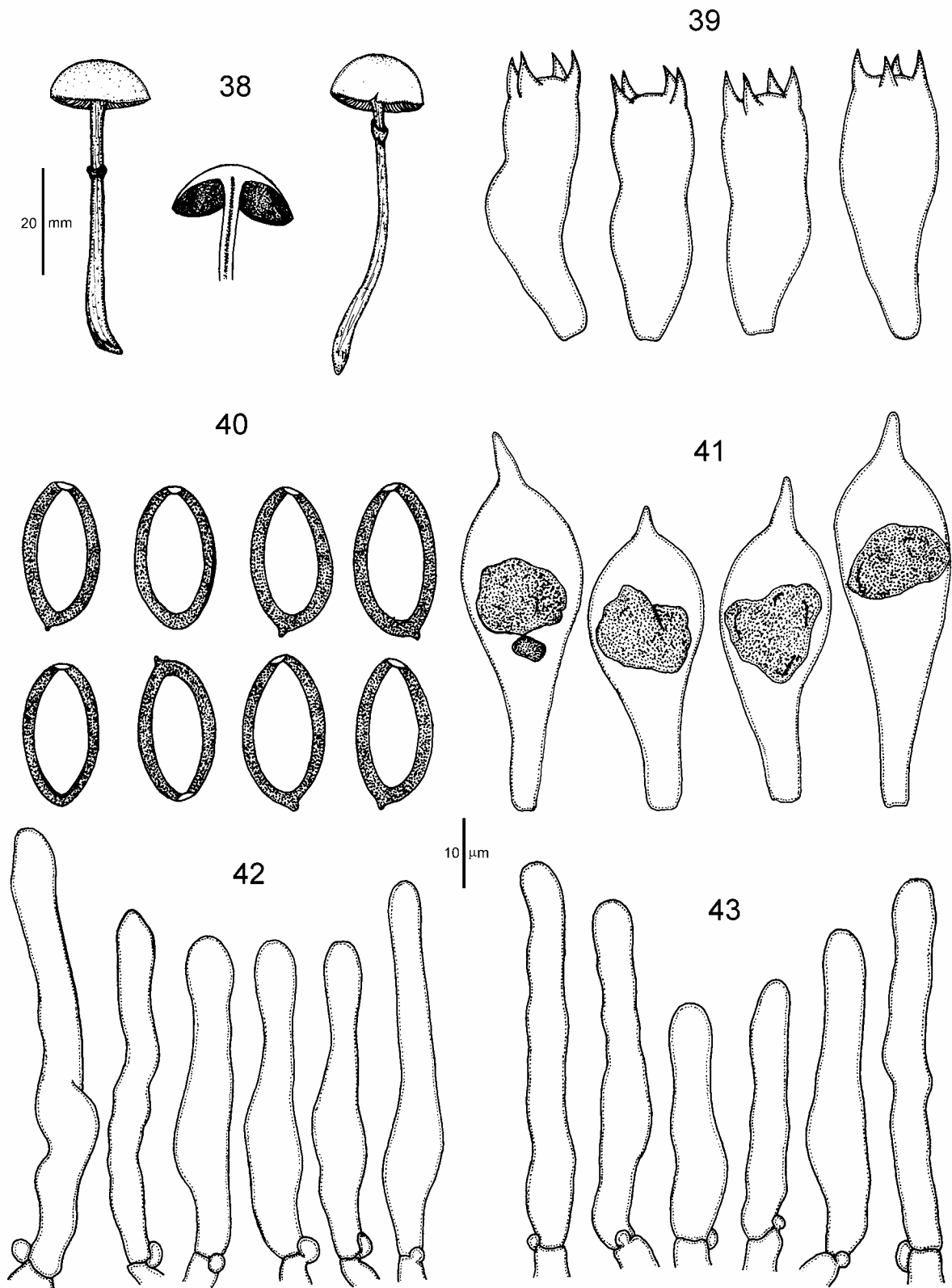


Figure 38-43. *Stropharia dorsipora*. 38. Basidiomata. 39. Basidia. 40. Basidiospores. 41. Pleurocystidia. 42. Caulocystidia. 43. Cheilocystidia.

Material examined: BRAZIL. Rio Grande do Sul. **Encruzilhada do Sul:** Fazenda Xafri, 10.VII.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* Fr.).

Additional specimens examined: BRAZIL. São Paulo. **Campos do Jordão:** Parque Estadual de Campos do Jordão, 29.XI.1982, *Guzmán et al.* (SP 177.730 – as *S. semiglobata*). SWEDEN. Småland. **Femsjö:** 25.IX.1959, *F. Karlvall* (ICN).

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

Remarks: 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 & 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 lecithiform 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* Fr., and specimens collected in São Paulo State, cited by Bononi et al. (1984) and Pegler (1997) both as *S. semiglobata*, which 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*.

8. *Stropharia earlei* Norvell & Redhead, Mycotaxon 76: 317, 2000. FIG. 44-48
 ≡ *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: 27, 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 x 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) x 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) x 5.5-7 (-8) μm , clavate, bearing four (rarely two) sterigmata. **Pleurocystidia** (23.5-) 28-36 (-44) x 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) x (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 x 9-11, ventricose to sublageniform, with a rounded to subcapitate apex; some resembling chrysocystidia, similar to the cheilocystidia. **Acanthocytes** present on rhizomorphs. **Clamp connections** present.

Ecology: growing solitary on soil, among fallen leaves, into a seasonal semideciduous forest.

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

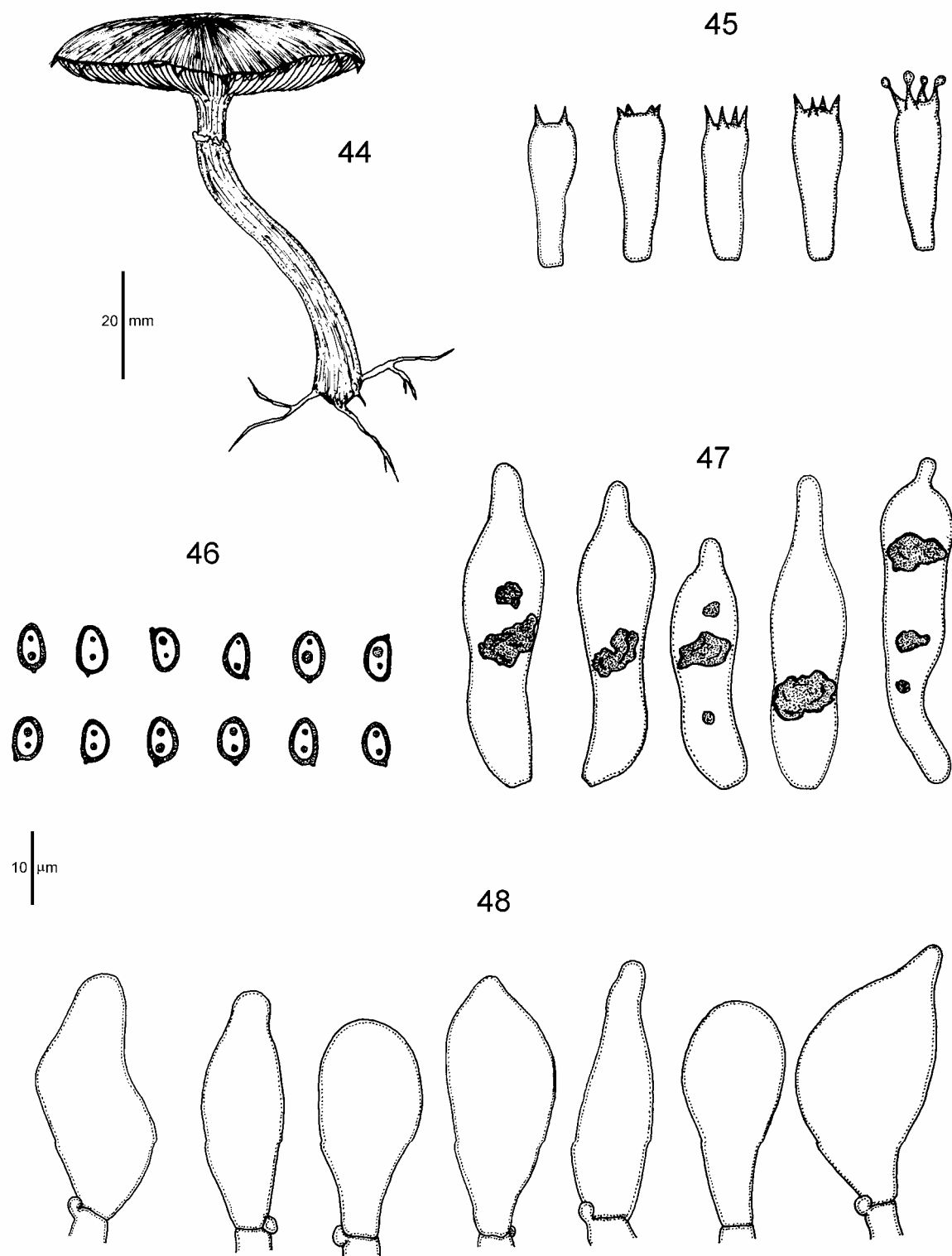


Figure 44-48. *Stropharia earlei*. 44. Basidioma. 45. Basidia. 46. Basidiospores. 47. Pleurocystidia. 48. Cheilocystidia.



Plate 2. A. *Stropharia coronilla*. B. *Stropharia rugosoannulata*. Scale bar: 20 mm.

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

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

9. *Stropharia rugosoannulata* Farl. ex Murrill, Mycologia 14: 139, 1922. FIG. 49-54, PL. 2B
 = *Flammula puiggarii* Speg., Bol. Acad. Nac. Cienc. Córdoba 11: 418, 1889.
 = *Annelaria 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 x (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) x 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) x 8-12 μm , subclavate, with a medial constriction, and bearing

four sterigmata. **Pleurocystidia** (25-) 38-55 x (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 x 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 x 18-20 μm , as leptocystidia, clavate to subfusoid, hyaline, smooth and thin-walled, scattered on the stipe apex. **Acanthocytes** present in rhizomorphs. **Clamp connections** present.

Ecology: growing solitary to gregarious into forests or lawns in forest board, on fallen leaves or rarely much decomposed wood.

Material examined: BRAZIL. Rio Grande do Sul State. **Candelária:** *M. Sulzbacher & A. Spielmann* (HCB). **Canela:** Parque Estadual do Caracol, 02.IV.2000, *Micheline* (HASU 8.744). **Dom Pedro de Alcântara:** 20.V.2005, *Cortez 062/05* (ICN 139.140). **Esmeralda:** Estação Ecológica de Aracuri, 24.XI.2004, *Cortez 060/04* (ICN 139.031). **Santa Cruz do Sul:** Cinturão Verde, 06.VI.1997, *C. Trentin & J. Soares 378* (HCB 17.011), 08.V.2001, *C. Trentin 102* (HCB 17.511) e *104* (HCB 17.513); Parque da Gruta dos Índios, 24.VI.1995, *A. Spielmann* (HCB 16.767). **Santa Maria:** Água Boa, 09.V.2003, *Cortez 011/03* (SMDB 9.608) e *Cortez 012/03* (SMDB 9.609), 12.VI.2003, *Cortez 022/03* (SMDB 9.619); Morro do Elefante, 09.V.2001, *Cortez 027/01* (SMDB 9.247) e *028/01* (SMDB 9.248); 04.05.2002, *Cortez 039/02* (SMDB 9.577). **São Francisco de Paula:** Floresta Nacional do IBAMA, 13.V.2005, *Cortez 060/05* (ICN 139.138). **São Leopoldo:** 1932, *Rick 12.025* (PACA 8.424 – holotype of *Anellaria sanguineopurpurea* Rick). **Viamão:** Parque Saint-Hilaire, 13.VII.1978, *M.H. Homrich & R.T. Guerrero* (ICN 102.124).

Additional specimens examined: BRAZIL. São Paulo State. **Apiáí:** 1881, *J. Puiggari 1.529* (LPS 37.612 – type of *Flammula puiggarii* Speg.). **Guapiara:** Fazenda Intervalles, 03.VII.1989, *M. Capelari & R. Maziero* (SP 233.269). UNITED STATES. Massachusetts. **Waban:** 13.IX.1905, *G.E. Morris* (NY 761.568 – paratype).

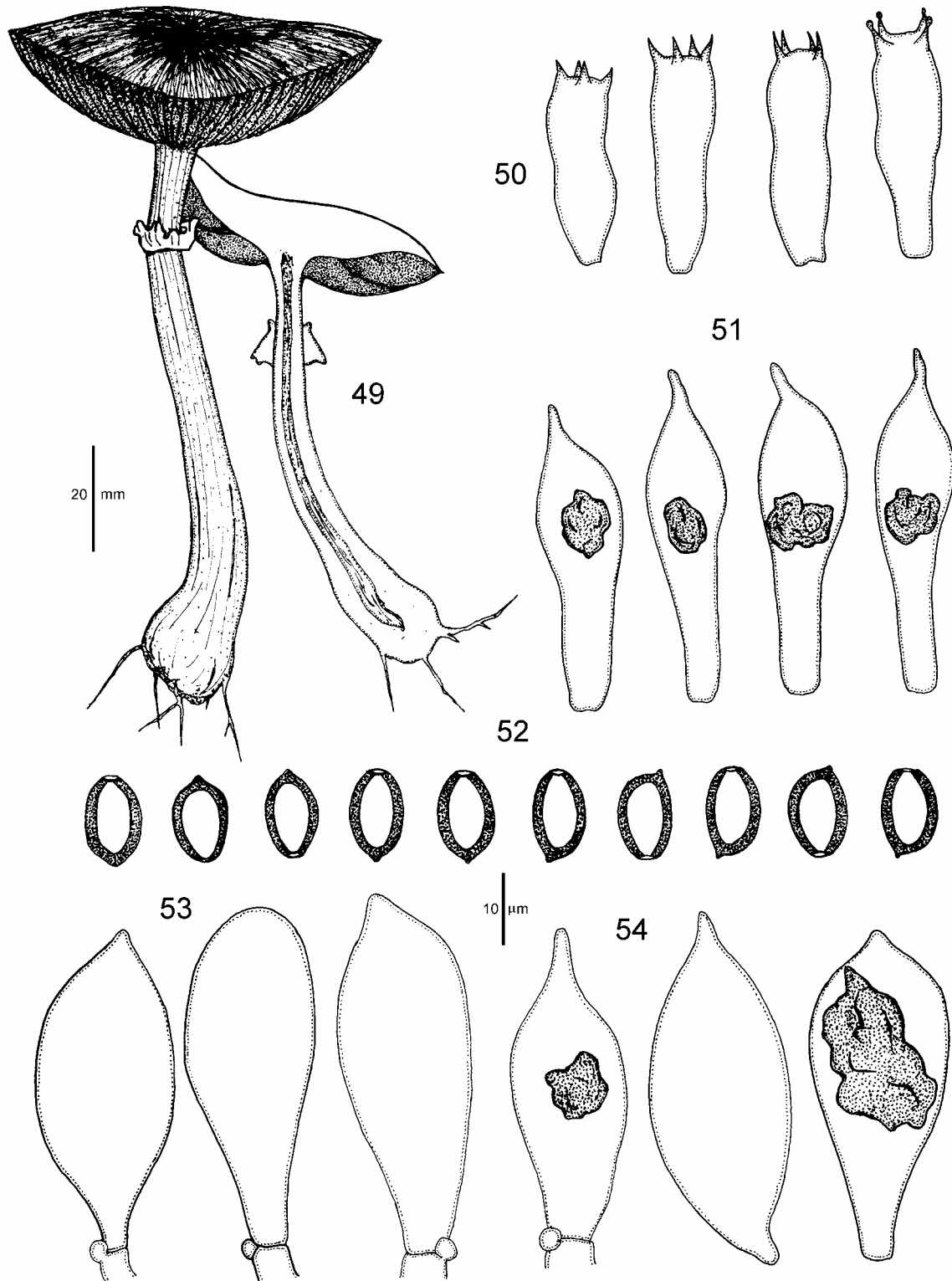


Figure 49-54. *Stropharia rugosoannulata*. 49. Basidiomata. 50. Basidia. 51. Pleurocystidia. 52. Basidiospores. 53. Caulocystidia. 54. Cheilocystidia.

Distribution: Europe (Noordeloos 1999, Watling & Gregory 1987), North America (Murrill 1922), South America (Wright & Albertó 2002).

Remarks: *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 was proposed to safeguard the epithet '*rugosoannulata*', a name widely known of 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.

In Brazil, there are known reports from the states of Paraná (de Meijer 2001, Stijve & de Meijer 1993), São Paulo (Pegler 1997), and Rio Grande do Sul (Cortez & Coelho 2004). *Anellaria sanguineopurpurea* Rick described by 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.

10. *Stropharia semiglobata* (Batsch: Fr.) Quél., Mém. Soc. d'Émul. Mont. Sér. II, v. 5: 112, 1872. FIG. 55-59

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

= *S. stercoraria* (Schum. ex Fr.) Quél., Mem. Soc. d'Emul. Mont., Ser. II, v. 5: p. 112, 1872.

≡ *S. semiglobata* var. *stercoraria* (Schum.: Fr.) Lange, Fl. Agar. Danica 4: p. 67, 1939.

≡ *Psilocybe semiglobata* (Batsch ex Fr.) Noordel., Persoonia 16: p. 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 x 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 x (9-) 10-12 (-13) μm , $Q=$ 1.61-2.08, $Q_m=$ 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) x (10.8-) 12-15 μm , clavate, bearing four sterigmata. **Pleurocystidia** (29.8-) 34-51 (-52) x 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 x 8-11 μm , as 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 incrustated 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.

Ecology: growing solitary on cow dung in pastures.

Material examined: BRAZIL. Rio Grande do Sul. **Salvador do Sul:** 30.03.1944, *Rick* 20.955 (PACA 9.368). **Santa Maria:** Morro do Elefante, 23.09.2000, *V.G. Cortez* 048/00 (SMDB - material lost).

Distribution: South America (Singer & Moser 1964, Wright & Albertó 2002), Australasia (Segedin & Pennycook 2001), Europe (Kytövuori 1999, Noordeloos 1999), North America (Stamets 1996).

Remarks: *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 those described by Kytövuori (1999). We also have not studied the caulocystidia in the scarce materials available; both types of caulocystidia (lepto- and chrysocystidia) occur on stipe of *S. semiglobata* (Kytövuori 1999).

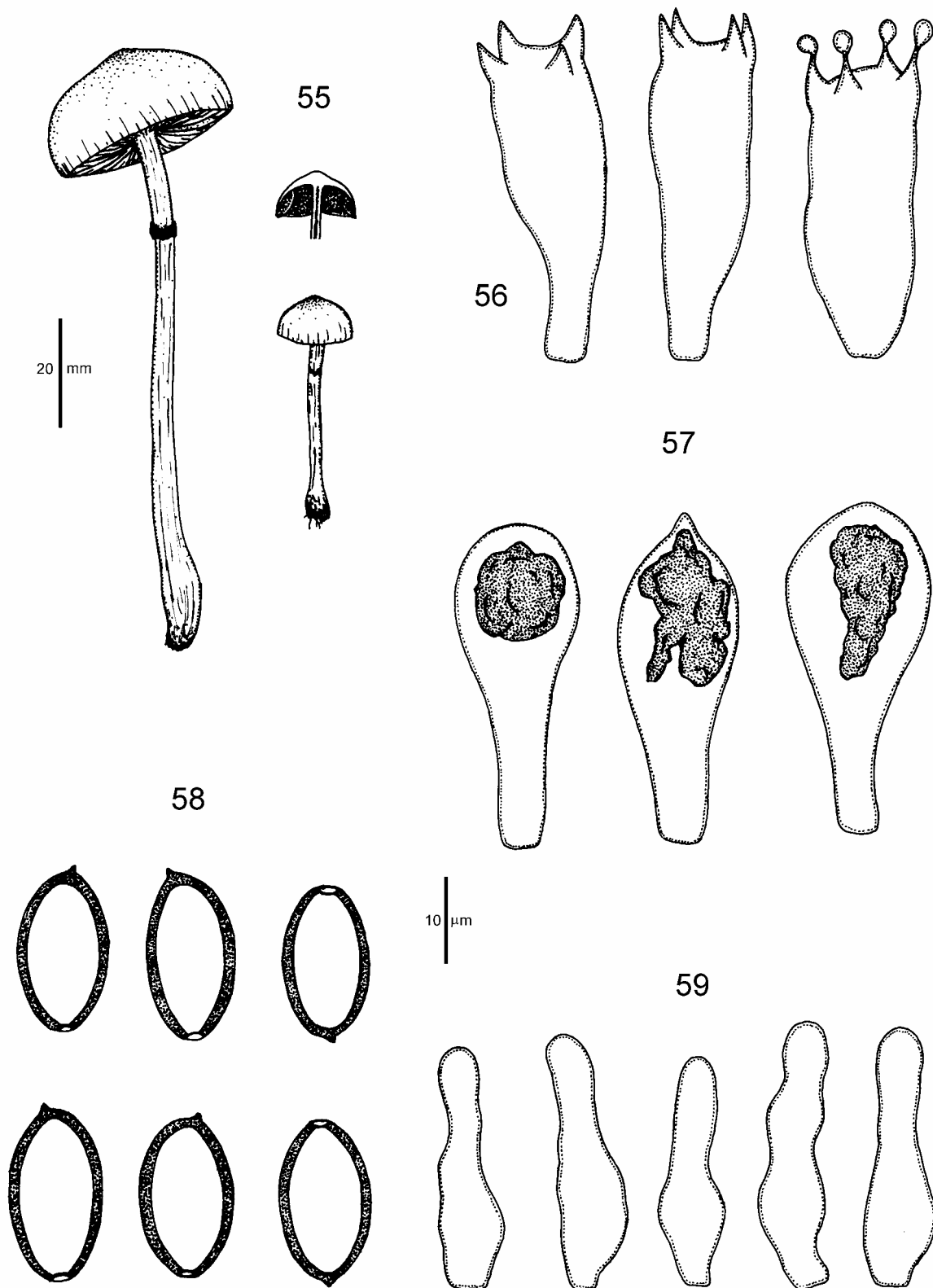


Figure 55-59. *Stropharia semiglobata*. 55. Basidiomata. 56. Basidia. 57. Pleurocystidia. 58. Basidiospores. 59. Cheilocystidia.

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

Excluded or Doubtful Taxa

***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. See Cortez & Silveira (2006) for a detailed discussion and description of it.

***Stropharia crassa* Rick** – After study of the type material deposited in the herbaria PACA 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. **Arroio do Meio:** 1920, *Rick* (SP 33.910). **São Leopoldo:** 1907, *Rick* 15.232 (PACA 9.359 - holotype).

***Hypholoma intonsum* Pass.** – In spite of our efforts to collect current information about this name, nothing was found about it. The name, in its original sense, probably is a synonym. 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). Material examined: BRAZIL. Rio Grande do Sul. **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:** 08.08.1934, *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 was 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 allowed a complete study. Material examined: BRAZIL. Rio Grande do Sul. **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). 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 x 4.5-5 μm with a wide germ-pore, pleurocystidia 24-30 x 8-10 μm clavate to fusoid chrysocystidia, cheilocystidia also as chrysocystidia 28-41 x 7-10 μm . The stipe base is absent in this collection, not allowing to check the presence of acanthocytes. The second material (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 revealed to be *S. alcis* var. *austrobrasiliensis* – see discussion and material examined there.

***Stropharia siccipes var. lugubris* Rick** – This is a well known synonym of *Psilocybe caeruleoannulata* Singer ex Guzmán (Guzmán 1978, Guzmán & Cortez 2004). Material examined: BRAZIL. Rio Grande do Sul. **Santa Maria:** 1936, *Rick 15.238* (PACA 9.372).

***Stropharia squamosa* Fr.** – The studied specimens from herbarium PACA correspond to *Hypholoma ericaeum* (Pers.: Fr.) Kühner, a common species in Rio Grande do Sul. See Cortez & Silveira (2006) for detailed description and discussion of this species in Rio Grande do Sul. Material examined: BRAZIL. Rio Grande do Sul. **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 (Cortez & Coelho 2004, Guzmán 1978, Singer 1953), this is another synonym of the Pantropical hallucinogenic mushroom *Psilocybe cubensis*. Material examined: BRAZIL. Rio Grande do Sul. **Santa Maria:** Rick 15227 (PACA 9.376 - neotype).

Stropharia subrufescens* Peck var. *angustifolia – Probably the Rick's citation was a mistake, since 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 belong to *A. subrufescens* Peck, however we are not able to establish this. Material examined: BRAZIL. Rio Grande do Sul: 1905, Rick 15.230 (PACA 9.377).

***Stropharia thrausta* Kalchbr.** – As demonstrated by Cortez & Silveira (2006) the mushroom reported by Rick (1907, 1939, 1961) is *H. aurantiacum*. Material examined: BRAZIL. Rio Grande do Sul. **São Leopoldo:** 1905, Rick 15.228 (PACA 9.378).

Conclusive Remarks

The genus *Stropharia* is represented in Rio Grande do Sul for at least 10 species, from which 3 taxa were described as new (*S. acanthocystis*, *S. alcis* var. *austrobrasiliensis*, *S. araucariae*), one species was cited for the first time in South America (*S. dorsipora*), one was cited for the first time in Brazil (*S. aeruginosa*), and one represented a new record for the Rio Grande do Sul State (*S. earlei*). These results show a greater diversity than previously expected, since in the current literature a number of 15 species worldwide is accepted for the genus (Hawksworth et al. 1995) and corroborates the need of more intensive taxonomic studies in Brazil. With the present work, we believe to have given the first step to know the diversity of this genus in a regional scale, but towards a future monographic study of the

Brazilian species and possibly also in a South American scale, which certainly would reveal a greater diversity in this interesting genus.

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Capítulo 5

Considerações Finais

A execução deste trabalho possibilitou ampliar o conhecimento das espécies dos gêneros *Hypholoma* e *Stropharia*, não apenas a nível estadual, mas certamente a nível nacional, em função dos resultados obtidos que adicionaram espécies ao catálogo agaricológico brasileiro. Também foi possível revisar espécimes depositados na coleção de Rick, o que nos possibilitou resultados importantes, notavelmente sinonímias e redeterminações. Foram examinadas aproximadamente 150 exsicatas, coletadas pelo autor e também provenientes de herbários do Brasil, Argentina, Estados Unidos, e Suécia. Deste número, foi possível reconhecer três espécies pertencentes ao gênero *Hypholoma* e 10 ao gênero *Stropharia*, totalizando 13 espécies contempladas por este estudo.

Stropharia acanthocystis Cortez & R.M. Silveira e *S. araucariae* Cortez & R.M. Silveira são apresentadas como novas espécies para a ciência.

Stropharia alcis var. *austrobrasiliensis* Cortez & R.M. Silveira foi proposta como uma nova variedade para a espécie.

Stropharia apiahyna (Speg.) Cortez & R.M. Silveira, baseada em *Pholiota apiahyna* Speg., é também proposta como nova combinação.

Stropharia dorsipora Esteve-Rav. & Barrasa é citada pela primeira vez para a América do Sul.

Stropharia aeruginosa (Curtis: Fr.) Qué. representa uma nova citação para o território brasileiro.

Stropharia earlei Norvell & Redhead constitui nova citação para o Rio Grande do Sul.

Stropharia sanguineopurpurea (Rick) Raith. (= *Anellaria sanguineopurpurea* Rick) foi reduzida à sinonímia de *S. rugosoannulata*, a partir do estudo de seu holótipo depositado no herbário PACA.

Hypholoma puiggarii (Speg.) Raith. [= *Flammula puiggarii* Speg., *Naematoloma puiggarii* (Speg.) Singer] foi considerado sinônimo de *S. rugosoannulata*, que apesar de ser um nome posterior ao de Spegazzini encontra-se em vias de ser conservado. Esta proposta encontra-se em preparação e envolve uma questão nomenclatural importante, uma vez que o nome *S. rugosoannulata* encontra-se amplamente difundido como um cogumelo cultivado e

de valor comercial e medicinal. A fim de preservar o nome de uma espécie de valor econômico (HAWKSWORTH, 2005), decidiu-se solicitar a rejeição do nome de Spegazzini em favor da conservação de *S. rugosoannulata*, a qual será futuramente submetida à apreciação do Comitê de Nomenclatura de Fungos, na forma de uma proposta em preparação para a revista *Taxon*.

Estes números, sem sombra de dúvida, devem constituir um número preliminar, e um incremento ao catálogo destes gêneros no Estado deverá naturalmente acontecer à medida que novas coletas forem sendo realizadas, especialmente em regiões que não foram visitadas durante este trabalho. Com relação a este último ponto, cabe salientar que regiões importantes como as regiões do Alto Uruguai, Campanha e Missões praticamente não foram amostradas, o que certamente ampliaria o conhecimento da micobiota destas regiões, ainda inexploradas do ponto de vista micológico. A carência de coletas nestas regiões, entretanto, advém da falta de micólogos em atividade na área, do reduzido tempo para a realização das coletas, e também pela falta de recursos para excursões e trabalhos de inventário biológico. Este problema, por mais incrível que possa parecer, não se restringe ao terceiro mundo, mas afeta também países ricos do Hemisfério Norte, como discute KORF (2005) em seu ensaio sobre a atual situação da taxonomia micológica.

O material disponível nos herbários do Estado carece, infelizmente, de maiores informações como o tipo de substrato e muitas vezes encontram-se em péssimas condições de conservação. Vários herbários do Rio Grande do Sul sequer mantêm uma coleção de fungos, fato que também dificultou a amostragem em regiões onde não fora possível coletar.

Além disso, é sabido que o estudo dos fungos encontra suas limitações nas condições climáticas desfavoráveis, falta de chuvas dos dias antecedentes às coletas, substrato adequado, entre outras, o que muitas vezes torna frustrante uma viagem de coleta pelo seu insucesso. As espécies destes gêneros não são comuns na sua maioria, exceção feita a *H. ericaeum*, *H. subviride*, *S. alcis* var. *austrobrasiliensis* e *S. coronilla*, que são freqüentes nos meses de outono principalmente, mas que podem também serem coletadas em vários meses do ano.

Apesar disso acreditamos, ao final deste trabalho, que se realizou uma boa contribuição ao conhecimento destes dois gêneros no Estado, e que certamente este possibilitará futuras discussões, interpretações e críticas, sejam elas positivas ou mesmo contrárias a algumas das idéias apresentadas, conseqüências naturais de qualquer trabalho científico.

Finalmente, nos inspiramos nas palavras de HAWKSWORTH (2001, 2003) e KORF (2005), em seus apelos para que estudos taxonômicos em áreas pouco exploradas sejam cada

vez mais estimulados em detrimento de estudos não-taxonômicos – os quais são igualmente importantes, porém na maioria das vezes totalmente dependentes da atividade árdua e infelizmente desvalorizada do taxonomista. Somente assim, apesar de todas as dificuldades enfrentadas, poderemos continuar a desbravar a micobiota de nosso estado, de nosso país, certamente uma das mais ricas e belas deste mundo.

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