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One hundred fourteen years of *Pluteus* in Brazil: collections studied by Hennings and Rick

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Abstract — The re-examination of *Pluteus* collections from Brazil studied by P.C. Hennings and J. Rick during the early 20th century expands current Brazilian knowledge of the genus. Searches of the bibliographical and herbarium records revealed a total of 32 *Pluteus* names linked to specimens collected in Brazil and studied by Hennings and Rick. Of the ten species represented by Brazilian types, five types could not be located in any of the consulted herbaria and therefore must be treated as nomina dubia. None of previously published collections listed under five other names could be located. All other collections (in BPI, FH, PACA and SP) were studied for morphology. In all cases, European names originally attributed by Hennings and Rick have been found to be misapplied, and re-identifications based especially on species described from the Neotropics are suggested. Sections *Pluteus* and *Celluloderma* are represented by most collections.

Key words — biodiversity, *Pluteaceae*, taxonomy

Introduction

Pluteus Fr. (*Pluteaceae, Agaricales, Basidiomycota*) is a genus represented by approximately 300 species worldwide (Kirk et al. 2008). Although *Pluteus* species are easily recognizable by their free lamellae, pinkish spore print, inamyloid basidiospores, inverse hymenophoral trama, and the absence of annulus and volva (Singer 1986), modern molecular studies have helped resolve taxonomic inconsistencies, establish synonymies of species described multiple times, and enlarge the generic circumscription to include annulate species historically classified in the allied genus, *Chamaeota* (W.G. Sm.) Earle (Minnis et al. 2006, Justo et al. 2011ab, Vizzini & Ercole 2011). However, molecular tools are limited in their ability to resolve taxonomic problems in old

and especially poorly preserved collections. An accurate morphological study is an alternative in these situations, although it is not always possible to retrieve useful information from old collections in which the hymenial structures are frequently collapsed and not revivable.

Paul Christoph Hennings was the first author to describe a *Pluteus* species from Brazil, *P. scruposus* (Hennings 1900) based on material collected by R. Pilger in 1899. Hennings (1904a,b) also described *P. termitum* Henn. from material collected by E.H.G. Ule in 1901 and *P. cervinus* var. *griseoviridis* from material collected by A. Puttemans in 1903.

Hennings was a German mycologist who studied the fungi from Brazil in the late 19th and early 20th centuries. He examined materials collected in different regions of Brazil by many collaborators, including E.H.G. Ule, F.A.G.J. Möller, A.F.M. Glaziou, C.A.W. Schwacke, I.D.J. Huber, C.F. Baker, E.A. Goeldi, A. Puttemans, and R. Pilger (Fidalgo 1968). Hennings was born in 1841 in Heide (Germany) and from approximately 1885 onward devoted himself to the study of fungi from around the world, mainly those from German colonies and Brazil. He published more than 250 papers and brought together in Berlin one of the best fungal collections in the world (Perkins 1909). Many collections described by Hennings were deposited in herbarium B of the Botanical Museum Berlin-Dahlem, which was partly destroyed by fire in a bombing raid in 1943 (Merrill 1943, Hiepko 1987). However, several of Hennings' types were saved because duplicates of different fungal groups (especially Fungi Imperfecti and *Uredinales*) were deposited in other herbaria (Hiepko 1987, Hein 1988). Hein (1988) cited all species described by Hennings and data about the preservation states of these collections in B, but unfortunately no *Pluteus* collections survived the fire in B.

Among Henning's collaborators was Ernst Heinrich Georg Ule, an important and active collector of fungi in Brazil. Ule was born in 1854 in Halle an der Saale (Germany), and in 1883 he moved to Brazil, first living in Santa Catarina state before moving to Rio de Janeiro, where he became a traveling naturalist of the National Museum (Martius 1906, Fidalgo 1968). The *P. termitum* specimen described by Hennings (1904a) was collected during Ule's expedition to the Amazonian Forest in Fortaleza, Amazonas state (19.X.1901–18.XI.1901; Hennings 1904a, Martius 1906). Ule accumulated approximately 3361 species of fungi from the Brazilian States of Santa Catarina, Rio de Janeiro, Minas Gerais, Goiás, and Amazonas (Martius 1906). These collections were distributed to many mycologists, including G. Winter, F.O. Pazschke, H. Rehm, H. Sydow, P. Sydow, E. Jahn, P. Dietel, and P.C. Hennings (Fidalgo 1968).

Other collaborators in Henning's *Pluteus* studies were Robert Pilger and Arsène Puttemans. Pilger, who was born in 1876 in the Heligoland Archipelago (Germany), in 1899 conducted expeditions to the state of Mato Grosso, where

he collected the first *Pluteus* recorded from Brazil. Puttemans, born in Brussels (Belgium) in 1873, moved to Brazil in 1892, where he lived in Rio de Janeiro state for two years before moving to São Paulo. Puttemans, who is undoubtedly the most important name in Brazilian phytopathology, was also an important collector of various non-pathogenic fungi. Although many other collections sent to Germany were destroyed in the fire in B, fortunately duplicates of almost all of Puttemans' collections were deposited in other herbaria, and approximately 7000 samples were preserved at UFRJ of the 'Universidade Federal Rural do Rio de Janeiro' (Fidalgo 1968); additional collections of Puttemans are also preserved in other herbaria, including the type of *P. cervinus* var. *griseoviridis* now deposited in SP ("Instituto de Botânica").

As the study of Brazilian fungi began with foreign collectors, Johann Rick played an extremely important role and is considered the father of Brazilian mycology. In 1904, he started a series of mycological papers representing the beginning of the systematic study of fungi from Brazil (Fidalgo 1962, 1968). His collections brought together approximately 12,000–15,000 exsiccatae from the state of Rio Grande do Sul that are now deposited in PACA of the 'Instituto Anchietano de Pesquisas' (Fidalgo 1968). Rick described and recorded 21 *Pluteus* taxa from that state (Rick 1907, 1919, 1930, 1938, 1961), including seven new taxa from Brazil: *P. cristatulus*, "*P. exiguus* var. *venosa*," *P. fibrillosus*, *P. leptonia*, *P. sensitivus*, *P. straminellus*, and *P. velatus*.

Rick was born in Dornbirn (Austria) in 1869. Around 1896 he began to study fungi and came into contact with H. Rehm, G. Bresadola, and C.G. Lloyd. He shared many duplicates with Lloyd that formed what was most likely the largest collection of Brazilian fungi at the time in the 'Lloyd Herbarium' (Fidalgo 1962). These 'Lloyd Herbarium' collections are now part of the U.S. National Fungus Collections (BPI), which also includes recent collections and contributions from many collectors, giving BPI approximately 14,000 collections representing different groups of fungi from Brazil (Farr & Rossman 2013). After Rick arrived in Brazil in 1903, he was appointed a professor of the Jesuit College of São Leopoldo, Rio Grande do Sul State, where he collected most of his specimens (Fidalgo 1962), including what likely represents his first *Pluteus* specimen (dated 1906 and later identified as *P. cervinus;* Rick 1938, 1961). Rick continued studying Brazilian fungi until 1946, the year he died in Brazil.

Considering that foreign mycologists made the first studies of *Pluteus* from Brazil, many names proposed for European specimens were used for Brazilian materials. The current state of knowledge of *Pluteus* in South America is somewhat problematic, mainly due to the abundance of species described for this region (Singer 1959, Horak 1964) and to misapplied identifications in the past. Nevertheless, there has not yet been any publication correcting past

misapplications. With the aim of complementing the study of *Pluteus* from Brazil, we present our re-examination of historical *Pluteus* collections studied by Hennings and Rick and comment on the identifications. Undoubtedly, studies involving a combination of multiple methods and different types of evidence are relevant for insights into the evolution of the genus and to determine whether morphologically similar taxa from different continents are conspecific or distinct. However, where we have only old or poorly preserved collections, historical studies are equally important for correcting past mistakes involving European names misapplied to South American species and for halting dissemination of errors, such as those involving the geographical distribution of certain species.

Materials & methods

The materials examined herein include types and other *Pluteus* collections studied by Hennings and Rick and cited in their publications (Hennings 1900, 1904ab; Rick 1907, 1919, 1930, 1938, 1961). We also re-examined unpublished collections that they studied. To locate as many collections studied by them as possible, we consulted B, BPI, FH, K, KIEL, L, PACA, S, SP, and W; herbarium acronyms follow Thiers (2013). When necessary, additional collections were also studied to help identify specimens.

The taxa are arranged alphabetically according to the names used by Hennings and Rick. Collections studied by them under the name presented in the taxonomic header are listed under SPECIMEN(S) EXAMINED with previously published names followed by an asterisk (*). Under ADDITIONAL SPECIMEN(S) EXAMINED are listed the collections that share the same characters as the materials listed in SPECIMEN EXAMINED but preserved in herbaria under other names. Specimens that do not represent the species suggested for the other materials involved under this name are also listed in ADDITIONAL SPECIMEN(S) EXAMINED, but the correct identification and name are discussed in the text. For each taxon, we comment upon the name attributed by Hennings or Rick and about what these collections actually represent based on our morphological examination. Original descriptions are presented for the taxa described from Brazilian types as well as for published names for which we could not locate specimens. A summary is provided in TABLE 1. Generic and infrageneric concepts follow Singer (1959, 1986) as complemented by Justo et al. (2011a,b).

For microscopic analyses, the dried material was wetted with 70% ethanol and then rehydrated in 5% KOH or stained with Melzer's reagent to determine the amyloid reaction of the spores. The notation [a/b/c] preceding basidiospore measurements = (a) basidiospores were measured from (b) basidiomata taken from (c) collections; Q = range of the length/width ratio for all spores measured; Qm = average of all calculated Q values for all spores measured; and Lm (Wm) = the average of all the lengths (widths) of the measured basidiospores. At least 20 basidiospores from each basidioma were measured in lateral view, and the terms denoting basidiospore shape follow Bas (1969). For the pileipellis having a hymeniderm, the length of the pedicel was included in the measurement of the pileipellis elements, and its length is also reported separately.

Results

Of the 32 names of taxa associated with collections recovered, Hennings studied three and Rick the other 29 (Table 1). In addition to the 21 taxa published by Rick (1907, 1919, 1930, 1938, 1961), eight additional names were recovered from his unpublished materials. Of the ten taxa represented by Brazilian types, five were not found in any herbarium consulted, and we now regard these as nomina dubia. We were also unable to locate collections bearing five other names listed here. Our suggested identifications are based on species actually described from the Neotropics, making the European names originally applied by Hennings and Rick inappropriate in all cases.

Table 1: *Pluteus* species reported from Brazil by Hennings and Rick.

Species	References	Comments
"*P. brunneopictus*"*	Rick 1938, **1961**	Probably *P. tucumanus* and *P. cubensis*
"*P. cervinus*"	Rick 1938, **1961**	*P. xylophilus*
P. cervinus var. *griseoviridis*[B]	Hennings 1904b	Probably *P. angustisporus*
"*P. cervinus* var. *patricius*"	Rick 1907	Not found
P. cristatulus[B]	Rick 1938, 1961	Not found (nomen dubium)
"*P. dissimilis*"	Unpublished	Probably *P. angustisporus*
"*P. egregius*"	Unpublished	*P. xylophilus*
"*P. exiguus*"	Rick 1938, **1961**	Not found
"*P. exiguus* var. *venosa*"[B]	Rick 1961	Probably *P. jamaicensis*
"*P. eximius*"	Rick 1919, 1938, 1961	Not found
P. fibrillosus[B]	Rick 1938, 1961	Not found (nomen dubium)
"*P. fuscidulus*"	Unpublished	Insufficient for study
"*P. granulatus*"	Rick 1930, 1938, **1961**	Probably *P. glaucotinctus*
"*P. hispidulus*"	Rick 1919, 1938, **1961**	Probably *P. yungensis*
"*P. leoninus*"	Rick **1938**, **1961**	Probably *P. conizatus*
P. leptonia[B]	Rick 1938, **1961**	*Entoloma* s.l.
"*P. longistriatus*"	Unpublished	Probably a true *P. longistriatus*
"*P. melanodon*"	Rick 1938, 1961	Not found
"*P. murinus*"	Unpublished	*P. albostipitatus*
"*P. nanus*"	Rick 1919, 1938, **1961**	Probably *P. sapiicola*
"*P. nanus* var. *podospileus*"	Rick 1938, 1961	Not found
"*P. pellitus*"*	Rick 1930, 1938, **1961**	Probably *P. petasatus* or another sp. in sect. *Hispidoderma*
"*P. princeps*"	Unpublished	Probably *P. angustisporus*
"*P. phlebophorus*"*	Rick 1938, **1961**	Probably *P. sapiicola* and *P. tucumanus*
P. scruposus[B]	Hennings 1900	Not found (nomen dubium)
P. sensitivus[B]	Rick 1930, 1938, **1961**	Not found (nomen dubium)
"*P. sensitivus* var. *macrospora*"	Unpublished	*P. albostipitatus*
P. straminellus[B]	Rick **1961**	Nomen dubium
P. termitum[B]	Hennings 1904a	Not found (nomen dubium)
"*P. umbrosus*"	Rick 1919, 1938, 1961	Probably *P. angustisporus*
P. velatus[B]	Rick **1961**	Nomen dubium
"*P. wehlianus*"	Unpublished	*Bolbitiaceae* or *Strophariaceae*

[B] = type locality in Brazil; * = species represented by collections of two different species;
Bold font = references that provide collection/herbarium information.

Sections *Pluteus* and *Celluloderma* are represented by the greatest number of collections; the number of sampled collections cited by Justo et al. (2012b) suggest that these two sections are probably the most representative of the genus. A current study (Menolli, Meijer & Capelari, unpublished data) including a morphological revision of *Pluteus* specimens collected during more than 30 years of random field trips throughout South Brazil also reveals a preponderance of species in these sections, further confirming observations on sections *Celluloderma* and *Pluteus* in the Neotropics by Singer (1959) and Horak (1964).

Taxonomy

"***Pluteus brunneopictus*** Berk." sensu Rick, Iheringia, Sér. Bot. 8: 420. 1961. Fig. 1

Specimen examined — Brazil. Rio Grande do Sul: Santa Maria, 1936, J. Rick s.n. (PACA14522*).

Basidiospores [20/1/1] 5.0–6.2(–7.5) × 3.7–5.0 µm [Q = 1.24–1.35 (–1.50); Qm = 1.31; Lm = 5.7 µm; Wm = 4.4 µm], broadly ellipsoid to ellipsoid, inamyloid, hyaline, smooth, thick-walled, guttulate. Pileipellis a hymeniderm, composed of sphaeropedunculate or clavate to clavate-pedicellate cells, 27–40 (–50) × 11.2–18.7(–22) µm, with a medium to long pedicel (5.0–17.5 µm long), thin-walled, with brown internal content, frequently condensed or sometimes dissolved. Pleuro- and cheilocystidia not recovered. Clamp connections absent.

Additional specimen examined — Brazil Rio Grande do Sul: São Leopoldo, 1943, J. Rick s.n. (PACA14531).

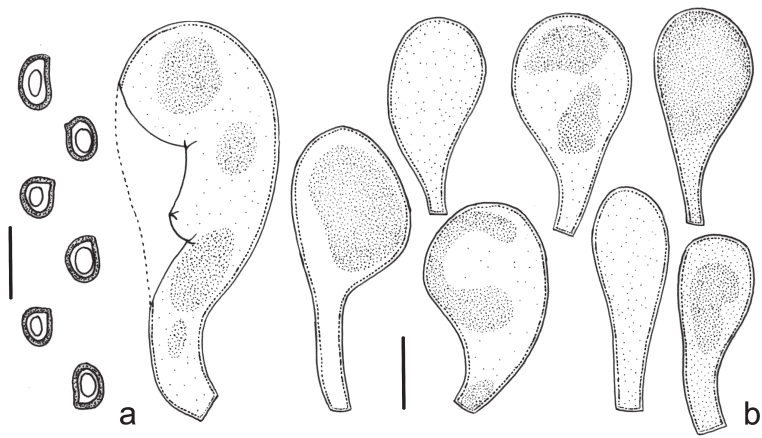

Figure 1. "*Pluteus brunneopictus*" (PACA14522).
a. Basidiospores; b. Pileipellis cells. Scale bars = 10 µm.

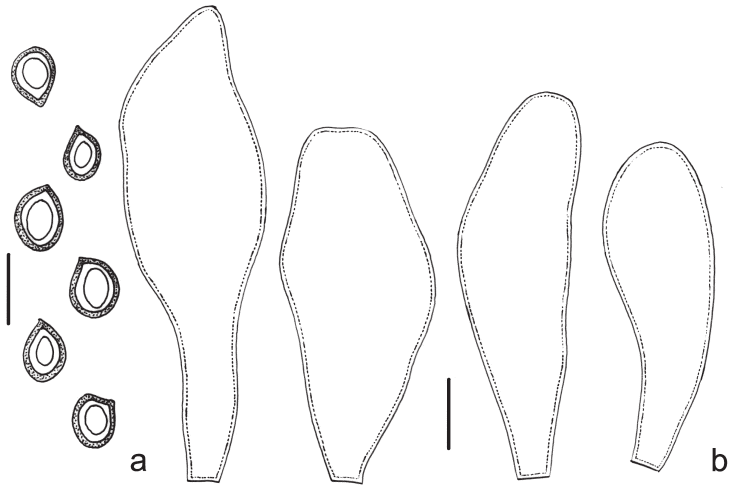

Figure 2. "*Pluteus brunneopictus*" (PACA14531).
a. Basidiospores; b. Pleurocystidia. Scale bars = 10 μm.

Comments — *Pluteus brunneopictus* (Berk. & Broome) Sacc. is an obscure species described from Sri Lanka based on one sample collected in 1868 (Berkeley & Broome 1871, Saccardo 1887). Although there are no recent collections, Singer (1956) and Pegler (1986) re-examined the type and confirmed the occurrence of broadly ellipsoid to ellipsoid basidiospores measuring 5.3–7.3 × 4.5–4.8 μm (Singer) and 7.0–9.0 × 5.0–6.0 μm (Pegler) and a cellular pileipellis composed of ellipso-pedicellate elements with brownish pigment. Although these data are similar to what we observed in the material studied by Rick (1938, 1961), they are not enough (mainly because pleuro- and cheilocystidia were not found) to correlate it to *P. brunneopictus*.

Moreover, considering the geographical distance, it is unlikely that the specimen collected by Rick in South America actually represents *P. brunneopictus*. Singer (1959) suggested that "*P. brunneopictus*" sensu Rick might be *P. umbrinoalbidus* Singer, *P. rimosoaffinis* Singer, or any other species in stirps *Pulverulentus*, *Jamaicensis*, or *Tucumanus*. Based on the insufficient information available because the hymenial structures were not recovered, we consider that this collection most likely represents *P. tucumanus* Singer, originally described from Argentina. According to Singer (1959), *P. tucumanus* has ellipsoidal basidiospores (3.8–5.5 × 2.7–3.8 μm) and subglobose-pedicellate pileipellis cells with dissolved or condensed intracellular pigment, and it represents one of the few South American species

in sect. *Celluloderma* characterized by a predominantly brown pileus color and ellipsoid basidiospores. More collections of *Pluteus* from Brazil and Argentina with these characteristics would be required to establish the actual relationship between Rick's collection and Singer's species and to confirm its occurrence in Brazil.

It is also important to note that Rick (1961) mentioned under *P. brunneopictus* two collections (PACA14522 and PACA14532) made in Santa Maria County in 1936. However, the exsiccata deposited at PACA mistakenly labeled as (PACA)14532 actually contains PACA14531 (Brazil. Rio Grande do Sul: São Salvador, 1943). PACA14531 (Fig. 2) represents an unpublished sample, and our re-examination showed it has broadly ellipsoid to rarely ellipsoid basidiospores measuring [20/1/1] 6.2–7.5(–8.7) × 5.0–6.2(–7.5) µm [Q = (1.16–)1.21–1.24 (–1.50); Qm = 1.24; Lm = 7.1 µm; Wm = 5.7 µm], clavate or elongate-ventricose pleurocystidia (47–68 × 15.0–22 µm), a pileipellis that seems to be a cutis with ascendant elements, and no clamp connections. Cheilocystidia were not found. Based on these characteristics and on a current study (Menolli, Meijer & Capelari, unpublished data) that includes a broad examination of collections of *P. cubensis* (Murrill) Dennis, this seems to be the better name for PACA14531. *Pluteus cubensis* is widely distributed in Central and South America, and its representatives display wide morphological variation, especially in basidiospore shape and size.

"***Pluteus cervinus*** Schaeff." sensu Rick, Iheringia, Sér. Bot. 8: 418. 1961. Fig. 3

Specimens examined — Brazil. Rio Grande do Sul: São Leopoldo, 1906, J. Rick s.n. (PACA14519*); 1934, J. Rick s.n. (PACA14516*); 1934, leg. Steffen, det. J. Rick (PACA14526).

Basidiospores [62/4/4] (5.0–)6.2–7.5(–8.7) × (3.7–)5.0–6.2 µm [Q = (1.21–)1.24–1.68; Qm = 1.45; Lm = 6.7 µm; Wm = 4.8 µm], broadly ellipsoid, ellipsoid to elongate, inamyloid, hyaline, smooth, thick-walled, guttulate. Pleurocystidia of three types: (I) the normal *Cervinus*-type, 58–76 × 15.0–17.5 µm, fusoid-ventricose, colorless, hyaline, with four to six apical to lateral prongs at the apices, thick-walled, the wall sometimes tapering toward the base, abundant to very abundant; (II) the modified *Cervinus*-type as the majority of those found in *P. harrisii* Murrill, 56–87 × 12.5–20 µm, fusoid-ventricose, colorless, hyaline, usually without prongs and a subcapitate apex or with two short lateral prongs and slightly strangulated at the apex, moderately thick-walled, common; and (III) the *Magnus*-type, 56–78 × 12.5–21 µm, lageniform to fusoid, with an acute apex, colorless, hyaline, moderately thick-walled, rare. Cheilocystidia not recovered. Pileipellis a cutis. Clamp connections absent.

Additional specimen examined — Brazil. Rio Grande do Sul: Pareci Novo, 1918, J. Rick s.n. (SP33928 as "*P. egregius*" Rick).

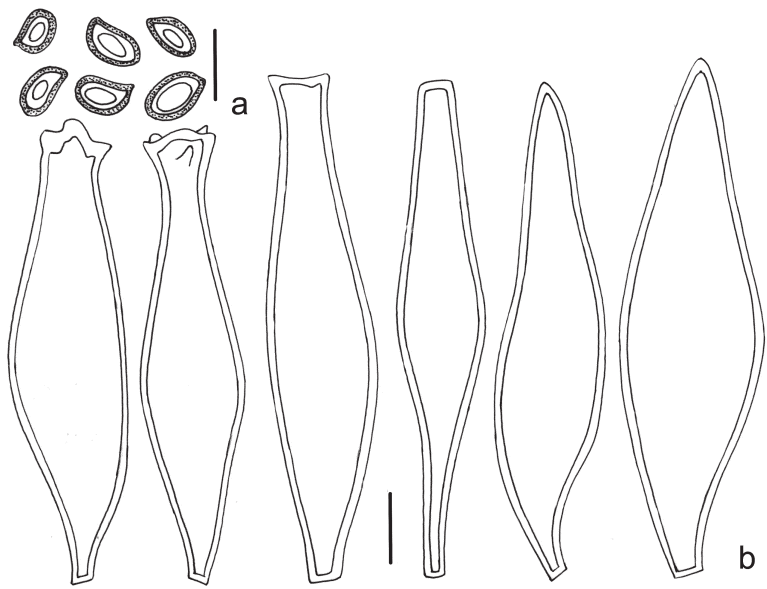

Figure 3. "*Pluteus cervinus*" (PACA14519).
a. Basidiospores; b. Pleurocystidia. Scale bars = 10 µm.

Comments — Our re-examination of Rick's collections identified as *P. cervinus* shows that they actually represent *P. xylophilus* (Speg.) Singer. Although we were unable to find any cheilocystidia, the characteristic pleurocystidia combined with the basidiospore size and shape and the macroscopic aspect of the pileus are distinctive enough to identify Rick's collections. *Pluteus xylophilus* can be easily recognized by its large pileus, the presence of three types of pleurocystidia, and the broadly ellipsoid to elongate basidiospores (Singer 1959, Menolli et al. 2010). There is much discussion about the identity and circumscriptions of *P. cervinus* (Schaeff.) P. Kumm., and it is likely restricted to the northern hemisphere, as shown in the phylogenetic analyses published by Justo et al. (2011b). As suggested by Singer (1959), almost all collections from Brazil referred to *P. cervinus* are probably *P. xylophilus*, a species well known in South America and which forms a distinct clade in sect. *Pluteus* (Justo et al. 2011b).

Another collection (PACA14529) of *P. cervinus* recorded by Rick (1961) was also not found; however, "PACA14529" may be a typographical error for the specimen PACA14526 that we studied.

Pluteus cervinus var. ***griseoviridis*** Henn., Hedwigia 43: 204. 1904. FIGS. 4, 5

SPECIMEN EXAMINED — Brazil. São Paulo: São Paulo, Serra da Cantareira, March 1903, A. Puttemans 871 (**Holotype**, SP141797).

ORIGINAL DESCRIPTION — "*Pileo carnoso, convexo explanato, centro obtuso, laevi glabro, subglutinosulo, margine striatulo, griseo-viridi, 5–7 cm diam.; stipite solido, cylindraceo, pallido, laevi, glabro, 4–7 × 3–5 μ* [sic; = cm]*, basi incrassato; lamellis liberis, confertis, ventricosis, ca. 3–4 mm latis, flavido-incarnatis; sporis ellipsoideis, 1-guttulatis, carneis, 4–5 × 4 μ; cystidiis lageniformibus, apice 2-vel 3 dentato-hamatis, 40–60 ×15–20 μ.*"

BASIDIOSPORES [100/5/5] 5.0–7.5(–8.7) × (3.1–)3.7–5.0 μm [Q = 1.24–1.70(–2.03); Qm = 1.57; Lm = 6.3 μm; Wm = 4.1 μm], broadly ellipsoid, ellipsoid to elongate, rarely cylindrical, inamyloid, hyaline, smooth, thick-walled, guttulate. PLEUROCYSTIDIA 50–95 × 10.0–24 μm, fusoid-ventricose, colorless, hyaline, mostly of the *Cervinus*-type with four to six apical or lateral prongs, or like those found in *P. harrisii* that are usually without or with two short lateral prongs, sometimes with lateral secondary spinules such as those of *P. spinulosus* Murrill, thick-walled, abundant to very abundant. CHEILOCYSTIDIA not recovered in most collections but a clavate form (39 × 15.0 μm) was found in BPI770905. PILEIPELLIS a cutis. CLAMP CONNECTIONS absent.

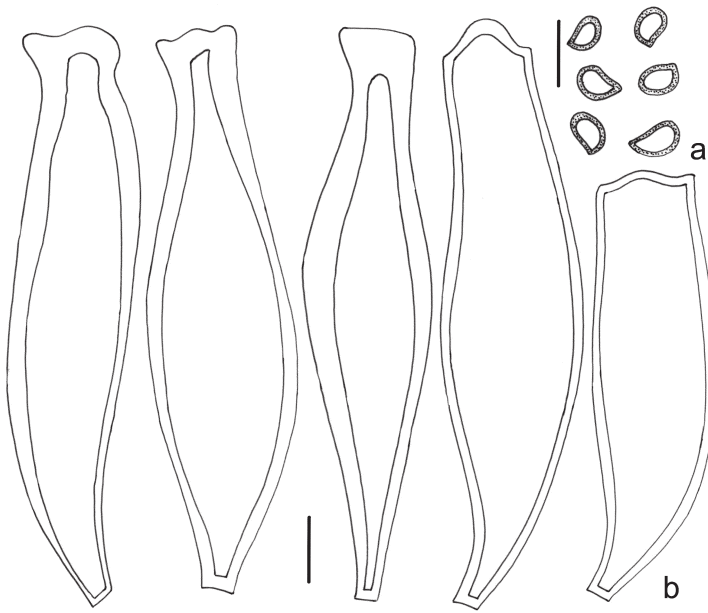

FIGURE 4. *Pluteus cervinus* var. *griseoviridis* (holotype, SP141797).
a. Basidiospores; b. Pleurocystidia. Scale bars = 10 μm.

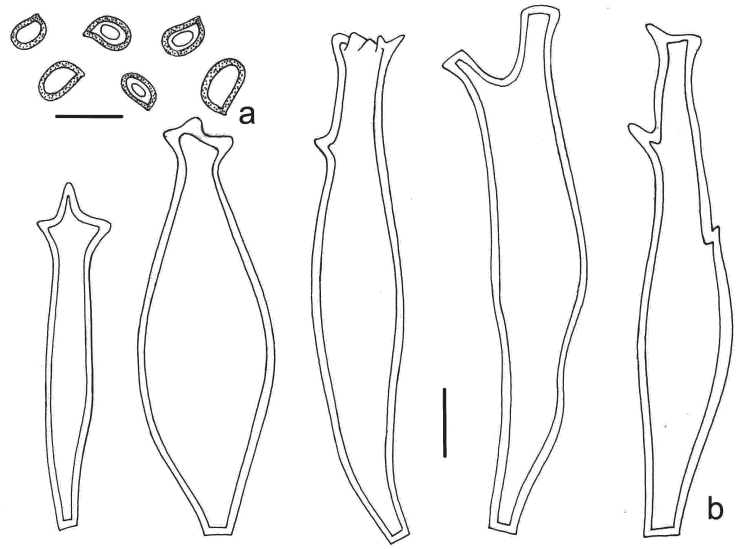

Figure 5. "*Pluteus cervinus*" (BPI770858).
a. Basidiospores; b. Pleurocystidia. Scale bars = 10 μm.

Additional specimens examined — Brazil. Rio Grande do Sul: Arroio do Meio, 1920, J. Rick s.n. (SP33926 as *P. cervinus*); 1920, J. Rick s.n. (BPI770858 as *P. cervinus*); 1920, J. Rick s.n. (BPI770893 as "*P. princeps*" Rick); 1920, J. Rick s.n. (BPI770905 as *P. umbrosus*); São Leopoldo, 1929, leg. Steffen, det. J. Rick (PACA14517 as "*P. dissimilis*" Rick).

Comments — Our re-examination of the holotype of *P. cervinus* var. *griseoviridis*, along with some unpublished collections identified by Rick as *P. cervinus* and *P. umbrosus* and others named as "*P. dissimilis*" and "*P. princeps,*" showed that they share some morphological features with *P. angustisporus* Singer described from Bolivia (Singer 1959).

Pluteus angustisporus is morphologically close to *P. xylophilus* and *P. harrisii*, from which it differs mainly by the narrow basidiospores and the absence of *Magnus*-type pleurocystidia as found in *P. xylophilus*. Although the collections we examined have large pilei, such as those observed in *P. xylophilus* (≤110 mm; Menolli et al. 2010) and much bigger than those reported for *P. angustisporus* (≤25 mm; Singer 1959), *Magnus*-type pleurocystidia were not found in any collection studied. In addition, Singer (1959) also reported pleurocystidia with polymorphic apices for *P. angustisporus* like those we observed (Fig. 5). However, due to the condition of the exsiccatae, it was not possible to confirm the presence of polymorphic cheilocystidia and pileipellis elements as reported by Singer (1959).

Although we cannot confirm the actual identity of these collections, the recovered data indicate that these collections are clearly close to or identical with either *P. angustisporus* or *P. xylophilus*, and we tentatively conclude that *P. angustisporus* is the most appropriate name.

It is important to note that although *P. cervinus* var. *griseoviridis* was described before *P. angustisporus*, if they are the same taxon, the earlier varietal name does not have priority at species rank.

"***Pluteus cervinus*** var. ***patricius*** Schulz.," sensu Rick, Brotéria, Sér. Bot. 6: 71. 1907.

> Original description — "*Pileo 1 dm. lato, crasso, firmo; stipite solido, usque 4 cm. lato, albido, griseo-squamoso. Differt a typo pileo albo, griseo-squamoso, primitus cinereo. Sporis 7–8 μ longis, 5–6 μ latis. Est varietas prorsus identica cum illa a cl. Schulzer in Hungaria lecta. Legi quoque typum.*"

Comments — The infraspecific taxon *P. cervinus* var. *patricius* (Schulzer) Massee (≡ *P. cervinus* subsp. *patricius* (Schulzer) Sacc.) was described from Europe. Although Rick (1907) recorded *P. cervinus* var. *patricius,* he did not cite the collection studied. No sample collected by Rick under this name was found in the herbaria, but it most likely also represents *P. xylophilus*.

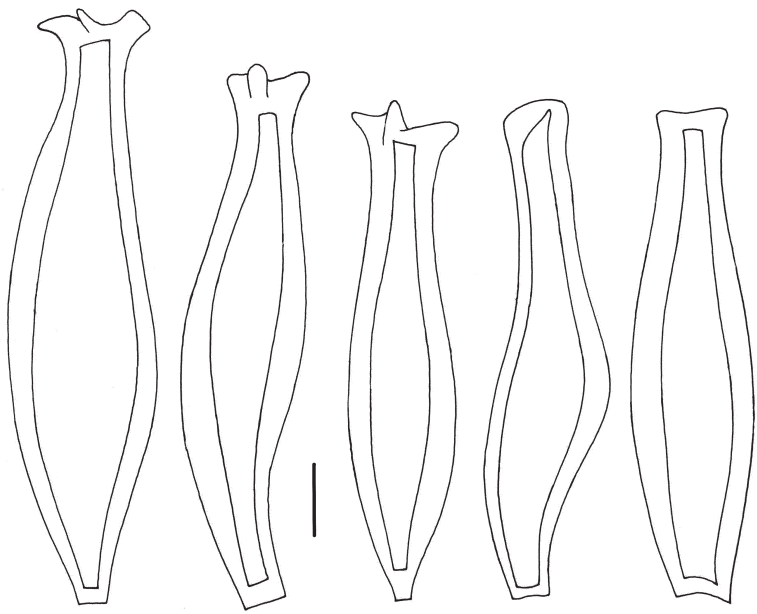

Figure 6. Pleurocystidia of "*Pluteus dissimilis*" (PACA14517). Scale bar = 10 μm.

Pluteus cristatulus Rick, Lilloa 3: 445. 1938.

Original description — "*Pileo membranaceo, albo-brunneo, innato-squamuloso, 1 cm. lato; stipites vitreo, albo-consperso, curto, 2 mm. lato, laterali; lamellis liberis, albis, ventricosis, subconfertis acie serrates, versus stipitem rotundatis; sporis 4.5 × 3 µ rubris. In trunco. Differt a Pl. exiguo lamellis albis serratis, pileo non striato et statura.* "

Comments — Rick (1938, 1961) did not mention the collection studied, and no sample collected by Rick under this name was found in the herbaria. We therefore regard this name as a nomen dubium.

"***Pluteus dissimilis*** Rick," nom. in herb. Fig. 6

Specimen examined — Brazil. Rio Grande do Sul: São Leopoldo, 1929, leg. Steffen, det. J. Rick (PACA14517).

Comments — See the description under *P. cervinus* var. *griseoviridis*, with which it shares the same features. It probably represents *P. angustisporus*.

"***Pluteus egregius*** Rick," nom. in herb. Fig. 7

Specimen examined — Brazil. Rio Grande do Sul: Pareci Novo, 1918, J. Rick s.n. (SP33928).

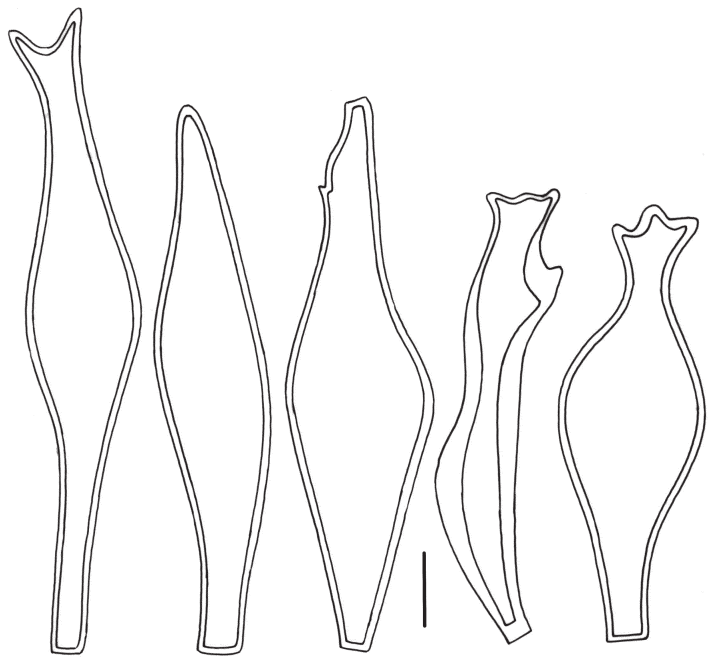

Figure 7. Pleurocystidia of "*Pluteus egregius*" (SP33928). Scale bar = 10 µm.

Comments — See the description under *P. cervinus*, with which it shares the same features. We feel it represents *P. xylophilus*.

"***Pluteus exiguus*** Pat." sensu Rick, Lilloa 3: 446. 1938.

Original description — "*Pileo convexo, dein plano, tenui, 1–2 cm. lato, initio laevi, dein margine striatulo, pilis brevissimis, erectis, brunneis, flocculosis, velutino, brunneo-rufo, centro obscuriore, lamellis rotundatis inaequalibus, a stipites remotis rufis; stipites fareto, 10–15 mm. longo, basi incrassato, albido, pruinose, non striato; sporis sphaeroides, 1-guttulatis, roseis 6–7 = [×] 3 µ. Ad terram. Pl. nano affinis.*"

Comments — Although Rick (1938) did not mention any collection studied, he (Rick 1961) later referred this name to PACA14518, but the package of this collection is labeled "*P. exiguus* var. *venosa*" (see below). The occurrence of *P. exiguus* (Pat.) Sacc. or any variety of this species in Brazil seems unlikely. It is important to consider that the description of *P. exiguus* presented in Rick (1938, 1961) is almost identical to that provided by Saccardo (1887) and that no other material under this name was located in the herbaria, making it difficult to confirm its occurrence in Brazil. In addition, as far as we know, *P. exiguus* appears to be restricted to Europe, where it has been rarely documented (Kühner & Romagnesi 1956, Orton 1986, Justo & Castro 2007a, Ripková 2009).

"***Pluteus exiguus*** var**. *venosa***" Rick, Iheringia, Sér. Bot. 8: 417. 1961, nom. inval. Fig. 8

specimen examined — Brazil. Rio Grande do Sul: Marcelino Ramos, 1936, J. Rick s.n. (PACA14518, as *P. exiguus* var. *venosa*).

Original description — "*Pileo brunneo, venoso, lamellis mediis, densis, stipite vitreo. Sporis 4–5 my* [µm]. *Ad ligna.*"

Basidiospores [20/1/1] 5.6–7.5 × (4.6–)5.0–6.2 µm [Q = (1.09–)1.12–1.24); Qm = 1.20; Lm = 6.3 µm; Wm = 5.3 µm], subglobose to broadly ellipsoid, inamyloid, hyaline, smooth, thick-walled, guttulate. Pileipellis a hymeniderm, composed of subglobose to spheropedunculate cells, 26–37 × 18.7–26.5 µm, almost non-pedicellate or with a short pedicel (1.2–3.7 µm long), thin-walled, with brown dissolved content. Pleuro- and cheilocystidia not recovered. Clamp connections absent.

Comments — Although PACA14518 is labeled "*P. exiguus* var. *venosa*," in the protologue Rick (1961) cited this collection under *P. exiguus*, not under the variety "*venosa*." As no holotype was designated for the variety, the name is not validly published.

The proposal of a new variety by Rick (1961) seems inappropriate because PACA14518 has a hymenidermal pileipellis more typical of sect. *Celluloderma* than sect. *Hispidoderma* under which *P. exiguus* is classified. The scarce morphological data obtained from Rick's collection are insufficient to designate a correct name for it, but we agree with Singer (1959) that Rick most likely had

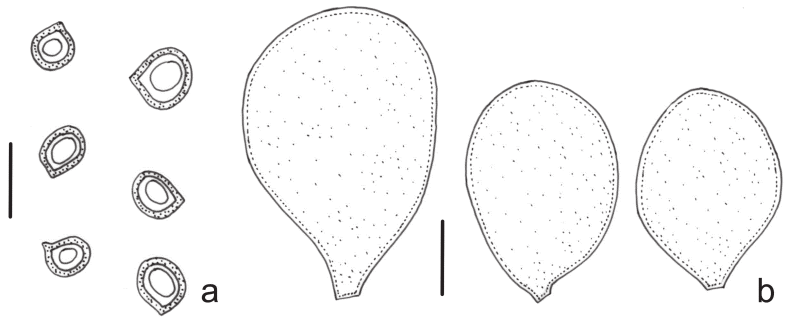

Figure 8. "*Pluteus exiguus* var. *venosa*" (PACA14518).
a. Basidiospores; b. Pileipellis cells. Scale bars = 10 μm.

P. jamaicensis Murrill, which is characterized by non-globose basidiospores [5.0–6.8(–7.5) × 4.5–6.2 μm] and pileipellis cells (21–60 × 20–45 μm) with brown dissolved content (Singer 1956, 1959; Smith & Stuntz 1958; Horak 1964; Pegler 1983; Banerjee & Sundberg 1993; Menolli et al. 2010).

"***Pluteus eximius*** Saund. et Sm." sensu Rick, Lilloa 3: 445. 1938.

Original description — "*Pileo laevi, pellicula separabili viscida tecto, rufescenti-umbrino; stipites fibrilloso, demun nigricante. In serragine. Maximus speciosus. Est forma luxurians Pl. cervini.*"

Comments — The English infraspecific taxon *P. cervinus* var. *eximius* (W. Saunders & W.G. Sm.) Massee (≡ *P. cervinus* subsp. *eximius* (W. Saunders & W.G. Sm.) Sacc.) has never been raised to species rank. Rick (1919, 1938, 1961) did not mention the collection studied, and no sample collected by Rick was found in the herbaria under this name.

Pluteus fibrillosus Rick, Lilloa 3: 444. 1938.

Original description — "*Pileo conico, carnoso, fibrilloso, atro-brunneo, fibris glandulosis ab umbone usque ad margine picto et albo-rimoso usque 5 cm. lato; stipites 1 dm. longo virgineo, laevi, lamellis remotis, confertis, vix ventricosis, versus stipitem liberis et rotundatis; sporis sphaerics 5 μ. Ad terram. Videtur Pl. psichiophoro, albo-lineato et apilopu affinis. Est varietas Pl. longestriati Peck. Hi omnes exceptis 2 primis videntur unam sister speciem proximan Pl. nano Europaeo.*"

Comments — Rick (1938, 1961) did not mention the collection studied, and no sample collected by Rick was found in the herbaria under this name. We therefore regard this name as a nomen dubium.

"***Pluteus fuscidulus*** Fr.," nom. in herb.

Specimen examined — Brazil. Rio Grande do Sul: São Salvador, 22 Jul 1944, J. Rick s.n. (PACA20926).

Comments — This collection is in too poor condition for study of any microstructures or to gain insights about its identification. Moreover, there is no *Pluteus* (nor *Agaricus*) named by Fries as '*fuscidulus*.' Because the collection is unfit for study and the name not attributable to Fries, we have nothing to add to this record.

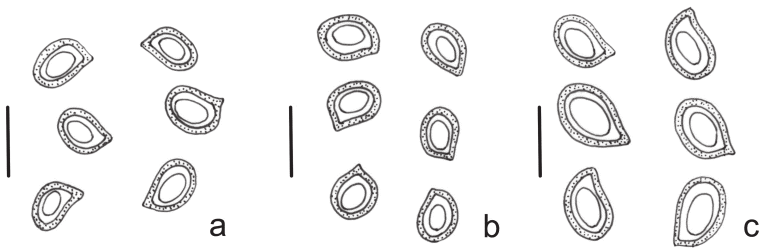

Figure 9. Basidiospores. a. "*Pluteus granulatus*" (PACA14523); b–c. "*Pluteus hispidulus*" (b. PACA14528; c. PACA14532). Scale bars = 10 μm.

"***Pluteus granulatus*** Bres." sensu Rick, Iheringia, Sér. Bot. 8: 418. 1961. Fig. 9a

Specimen examined — Brazil. Rio Grande do Sul: São Leopoldo, 1929, J. Rick s.n. (PACA14523*).

Basidiospores [20/1/1] 6.2–7.5 × 5.0–6.2 μm (Q = 1.21–1.50; Qm = 1.28; Lm = 7.2 μm; Wm = 5.7 μm), preponderantly broadly ellipsoid or sometimes ellipsoid, inamyloid, hyaline, smooth, thick-walled, guttulate. Pileipellis composed of hyphal elements typical of a cutis but it is too difficult to be recovered. Pleuro- and cheilocystidia not recovered. Clamp connections not observed.

Comments — *Pluteus granulatus* Bres. is a rarely recorded mushroom that seems to be restricted to Europe (Saccardo 1887, Kühner & Romagnesi 1956, Orton 1986). It is considered a synonym of *P. plautus* (Weinm.) Gillet, in a broad sense (Vellinga & Schreurs 1985, Legon & Henrici 2011).

Singer & Digilio (1952) recorded *P. plautus* from Argentina, but Singer (1959) later re-identified the collection as *P. argentinensis* Singer. According to Singer (1959), Rick's collection was misidentified, and our re-examination suggests that it most likely represents some species with a cutis-like pileipellis characterized by an umber fibrillose pileus and broadly ellipsoid to ellipsoid basidiospores. It is possible that Rick had *P. argentinensis*, *P. fastigiatus* Singer,

P. fuliginosus Murrill, or (most likely) *P. glaucotinctus* E. Horak that was recently recorded from Brazil (Justo et al. 2011a,b).

"***Pluteus hispidulus*** Fr." sensu Rick, Iheringia, Sér. Bot. 8: 419. 1961. Fig. 9b, c

Specimens examined — Brazil. Rio Grande do Sul: São Leopoldo, Rick s.n. (PACA14528*); 1932, Rick s.n. (FH00301668); São Salvador, 1943, Rick s.n. (PACA14532*).

Basidiospores [60/3/3] 6.2–10.0 × 5.0–7.5 µm (Q = 1.16–1.50; Qm = 1.30; Lm = 7.8 µm; Wm = 6.0 µm), broadly ellipsoid to ellipsoid, inamyloid, hyaline, smooth, thick-walled, guttulate. Pileipellis and hymenial structures not recovered. Clamp connections not observed.

Additional specimen examined — Brazil. J. Rick s.n. (BPI839783).

Comments — Originally described from Europe, *P. hispidulus* (Fr.) Gillet has not yet been definitively recorded from South America. Because our recovered data are insufficient to allow our renaming of Rick's collections, it is not possible to determine what species Rick had collected.

Singer (1959) suggested that this might be a species of sect. *Hispidoderma* (stirps *Fuliginosus*). The most probable species might be *P. yungensis* Singer, which has the biggest basidiospores comparable in size to those observed in Rick's collections. Modern collections with these characteristics are needed to clarify whether *P. yungensis* really occurs in Brazil. We revised another unpublished collection (BPI839783), labeled by Rick as *P. hispidulus*, that actually represents *Entoloma* s.l.

"***Pluteus leoninus*** Schaeff." sensu Rick, Iheringia, Sér. Bot. 8: 417. 1961. Fig. 10

Specimen examined — Brazil. Rio Grande Sul: São Leopoldo, 1932, J. Rick s.n. (FH00301669).

Basidiospores [20/1/1] 5.0–6.2(–7.5) × 3.7–4.6(–5.0) µm [Q = (1.09–) 1.22–1.51(–1.68); Qm = 1.37; Lm = 5.7 µm; Wm = 4.2 µm), broadly ellipsoid to ellipsoid, rarely subglobose or elongate, inamyloid, hyaline, smooth, thick-walled, guttulate. Pleurocystidia 52–87 × 12.5–26 µm, fusoid-ventricose to lageniform, usually with a rounded apex, metuloidal with thickened wall and lacking any apical or lateral horns, frequently with pale straw or colorless internal condensed or dissolved content. Cheilocystidia not recovered. Pileipellis difficult to recover but apparently a cutis composed of hyphae with pale brown pigment. Clamp connections absent.

Comments — *Pluteus leoninus* (Schaeff.) P. Kumm. belongs to sect. *Hispidoderma* and is apparently restricted to the northern hemisphere. The species is characterized by golden yellow basidiomata and thin-walled pleurocystidia with little excrescences at the apex (Singer 1956, Vellinga & Schreurs 1985, Orton 1986, Takehashi & Kasuya 2007). However, "*P. leoninus*"

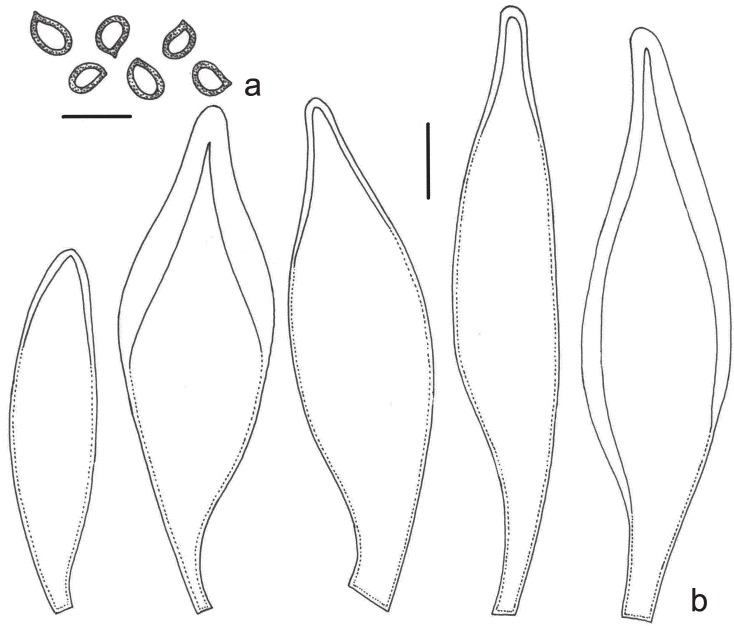

Figure 10. "*Pluteus leoninus*" (FH00301669).
a. Basidiospores; b. Pleurocystidia. Scale bars = 10 μm.

sensu Rick has thick-walled pleurocystidia. Considering other species with yellowish basidiomata and non-horned metuloidal pleurocystidia, it is likely that Rick had *P. conizatus* (Berk. & Broome) Sacc. or *P. amphicystis* Singer, which differ from each other in pileipellis structure and the absence of metuloid caulocystidia in *P. conizatus* (Singer 1956, 1959; Pegler 1983, 1986; Pradeep et al. 2002). Because the pileipellis in Rick's collection was not well characterized, we verified that the caulocystidia are absent in this collection. We believe that Rick probably had *P. conizatus* instead of *P. leoninus*.

Pluteus leptonia Rick, Lilloa 3: 445. 1938.

Specimen examined — Brazil. Rio Grande do Sul: São Leopoldo, 1936, J. Rick s.n. (**Holotype**, PACA14525*).

Original description — "*Pileo conico, demum expanso-fisso, carnoso, 3–4 cm. lato, subumbonato, laevi, minute ruguloso, exstrio; lamellis aperte liberis, densis, subventricosis, evidenter erosis carneis; stipite usque 1 dm. Longo 5 mm lato, firmo, demum cavo, nudo, striato, cartilagineo; sporis angulatis 7–10 micr. apiculatis. Omnibus partibus pulcherrime*

lazulinus aut coeruleus exceptis lamellis carneis e carne carnea. Odore et sapore nullo. In terra inter Bambusas. Pluteus phaeus Sacc. XVI et sine dubio proximus nisi identicus, sed mea species non crescit in ligno, sed in terra."

Comments — The type of *P. leptonia* is not a *Pluteus*; it is actually a member of *Entolomataceae*. Its basidiospores are predominantly isodiametric, with 5–7 angles. Singer (1956, 1959) mentioned the presence of typical *Rhodophyllus* basidiospores, and he suggested that Rick's collection might represent *Nolanea howellii* Peck or another allied species.

"***Pluteus longistriatus*** (Peck)," nom. in herb.

Specimen examined — Brazil. Rio Grande Sul: São Leopoldo, 1932, J. Rick s.n. (FH00301670).

Basidiospores [20/1/1] 6.2–7.5 × 5.0–6.8 µm (Q = 1.07–1.24; Qm = 1.19; Lm = 7.0 µm; Wm = 5.9 µm), subglobose to broadly ellipsoid, inamyloid, hyaline, smooth, thick-walled, guttulate. Pileipellis and hymenial structures not recovered. Clamp connections not observed.

Comments — *Pluteus longistriatus* (Peck) Peck, which is common in subtropical and temperate areas of North and South America, is usually recognized by a pileus with a deeply sulcate-striate margin and a hymenidermal pileipellis with heteromorphic elements (Singer 1959, Menolli & Capelari 2010). The macroscopic appearance of FH00301670 suggests that it had a sulcate-striate pileus when fresh, and the basidiospore size and shape agree with those usually reported for *P. longistriatus* (Singer 1959, Menolli & Capelari 2010). Based on these data, we suspect that Rick's collection is actually *P. longistriatus*, but we cannot confirm the identification and the occurrence of this species from the state of Rio Grande do Sul with certainty because the pileipellis and the hymenial structures were not recovered from this collection.

"***Pluteus melanodon*** Secr." sensu Rick, Iheringia, Sér. Bot. 8: 418. 1961.

Original description — "*Stipite cavo; lamellis acie atris, incises; an P. umbrosus? Ad lignum.*"

Comments — The European species invalidly described by Secretan was subsequently named as *P. melanodon* (Fr.) Sacc. Rick (1938, 1961) did not mention the collection studied, and no sample collected by Rick under this name was found in the herbaria.

"***Pluteus murinus*** Bres.," nom. in herb. Fig. 11

Specimen examined — Brazil. J. Rick s.n. (BPI770882).

Basidiospores [40/2/2] (6.2–)7.5–8.7 × (5.0–)6.2–7.5 µm [Q = (1.00–)1.16–1.24(–1.60); Qm = 1.19; Lm = 7.6 µm; Wm = 6.4 µm), preponderantly broadly ellipsoid or sometimes globose or ellipsoid, inamyloid, hyaline, smooth, thick-

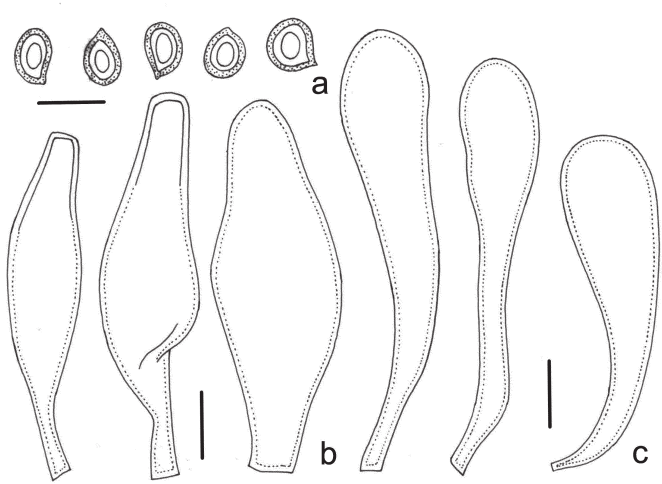

Figure 11. "*Pluteus murinus*" (BPI770882).
a. Basidiospores; b. Pleurocystidia; c. Cheilocystidia. Scale bars = 10 µm.

walled, guttulate. Pleurocystidia 51–69(–86) × 10.0–22.5 µm, elongate-clavate or slightly ventricose, thin- to relatively thick-walled, sometimes with a colorless internal condensed content. Cheilocystidia 50–66 × 12.5–15 µm, clavate with a well-developed pedicel at the base, thin-walled, colorless and hyaline. Pileipellis a cutis composed of hyphal elements with a rounded apex and brownish dissolved pigment. Clamp connections not observed.

Additional specimen examined — Brazil. Rio Grande do Sul: São Salvador, 1944, J. Rick s.n. (PACA20770 as *P. sensitivus* var. *macrospora*).

Comments — *Pluteus murinus* Bres., apparently restricted to Europe (Singer 1956, Orton 1986, Banerjee & Sundberg 1993), is considered a synonym of *P. ephebeus* (Fr.) Gillet (Vellinga & Schreus 1985). The data recovered from Rick's collections indicate that it shares the main characteristics found in *P. albostipitatus* (Dennis) Singer, a widely distributed and commonly cited species with some synonyms and wide morphological variation: mainly the presence of fibrils on the pileus, pleurocystidial wall thickness, and basidiospore size and shape (Menolli et al. 2010; Justo et al. 2011b).

"***Pluteus nanus*** Pers." sensu Rick, Iheringia, Sér. Bot. 8: 418. 1961. Fig. 12

Specimens examined — Brazil. Rio Grande do Sul: Marcelino Ramos, 1936, Rick s.n. (FH00301671); São Salvador, 29 Feb. 1944, Rick s.n. (PACA22618*).

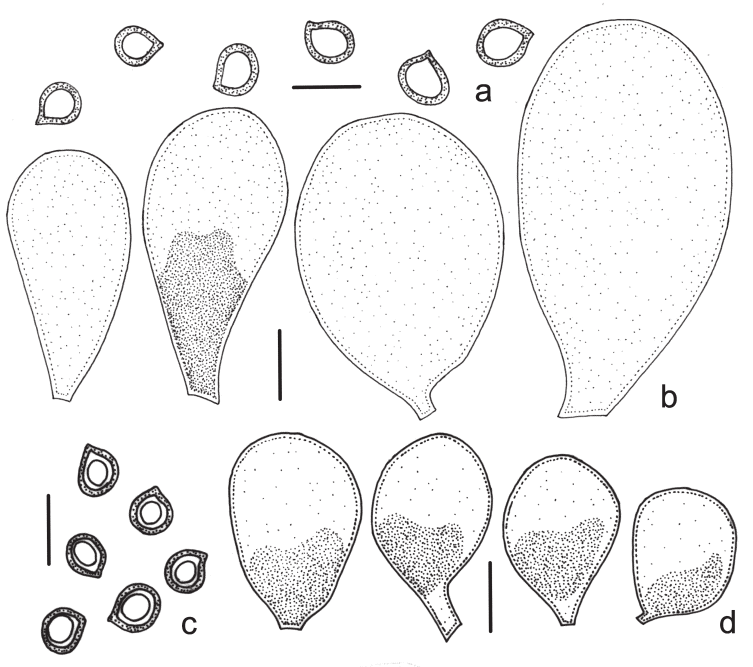

Figure 12. "*Pluteus nanus*". (a–b. FH00301671) a. Basidiospores; b. Pileipellis cells. (c–d. PACA22618) c. Basidiospores; d. Pileipellis cells. Scale bars = 10 μm.

Basidiospores [40/2/2] 5.0–7.5 × 5.0–6.2(–7.5) μm [Q = 1.00–1.12(–1.24); Qm = 1.08; Lm = 6.3 μm; Wm = 5.9 μm], globose or occasionally broadly ellipsoid, inamyloid, hyaline, smooth, thick-walled, guttulate. Pileipellis a hymeniderm composed of subglobose cells, 20–59 × 15.0–34 μm, with a short to moderately long pedicel (1.2–10.0 μm long), thin-walled, with brownish condensed or dissolved content. Pleuro- and cheilocystidia not recovered. Clamp connections not observed.

Comments — *Pluteus nanus* (Pers.) P. Kumm. is a species with many interpretations and seems to be restricted to Europe (Vellinga & Schreurs 1985, Orton 1986, Justo et al. 2007, Justo et al. 2011b). Although there is a suspect record from North America (Homola 1972), it remains unclear if *P. nanus* is really found in the USA according to any of these interpretations (Minnis & Sundberg 2010). Singer (1959) considered Rick's identification to be dubious. Considering the rugose-venose pileus, globose basidiospores, and pileipellis cells with brownish condensed or dissolved content, it is possible that Rick had

P. pulverulentus Murrill or (most likely) *P. sapiicola* Singer, a species known to occur in Brazil (Menolli, Meijer & Capelari, unpublished data). However, other species with pigmented cystidia, such as *P. beniensis* Singer, *P. eliae* Singer, *P. rimosoaffinis*, and *P. riograndensis* Singer, should also be considered.

"***Pluteus nanus*** var. ***podospileus*** (Sacc. et Cub.)" sensu Rick, Lilloa 3: 444. 1938.

Original description — "*Differt stipite brunneo.*"

Comments — *Pluteus podospileus* Sacc. & Cub. is a widespread European species, distinct from *P. nanus*; it is unlikely that Rick would have collected authentic material in Brazil. Rick (1938, 1961) did not mention the collection studied, and no sample collected by Rick under this name was found in the herbaria.

"***Pluteus pellitus*** Pers." sensu Rick, Iheringia, Sér. Bot. 8: 418. 1961. Fig. 13

Specimens examined — Brazil. Rio Grande do Sul, São Leopoldo, Rick s.n. (PACA14524*); 1931, Rick s.n. (FH00301673); 1932, Rick s.n. (PACA14530*); Sep. 1933, Rick s.n. (FH00301672).

Basidiospores [80/4/4] (5.6–)6.2–7.5(–8.7) × (3.7–)5.0–6.2 µm [Q = 1.21–1.51(–1.68); Qm = 1.28; Lm = 6.7 µm; Wm = 5.3 µm], preponderantly broadly ellipsoid or sometimes ellipsoid, rarely elongate, inamyloid, hyaline, smooth, thick-walled, guttulate. Pleurocystidia 61–78 × 16.2–18.7 µm, slightly ventricose to lageniform, with an amorphous pale straw content, pigmentation usually concentrated at apex and base, thin-walled (recovered only in FH00301673). Cheilocystidia and pileipellis not recovered. Clamp connections not observed.

Comments — Although there are many concepts of *P. pellitus* (Pers.) P. Kumm., Justo & Castro (2007b) and Justo et al. (2011b) accepted it as a species apparently restricted to Europe and characterized mainly by the white basidiomata, a habitat on angiosperm wood, basidiospores of 5.0–7.5 × 3.5–5.0 µm, and the presence of clamp connections. Singer (1959) mentioned that "*P. pellitus*" sensu Rick "is obviously *P. viscidulus*," although he did not cite Rick's collection in the 'examined material' for this species. *Pluteus viscidulus* Singer, another species with white basidiomata but that lacks clamp connections was described from Argentina (Singer 1959) and recorded also from Brazil (from the same State from which Rick's material was collected). Singer (1959) also recorded *P. viscidulus* from the U.S.A. (Florida), although he mentioned that the North American collection had bigger basidiospores and that this character can be used to separate it from *P. viscidulus*.

Our re-examination of the Brazilian collection determined by Singer as *P. viscidulus* (Fig. 14) [Brazil. Rio Grande do Sul: São Salvador, 9 Nov. 1951, Singer B111 (LIL)] showed that it has broadly ellipsoidal to elongate basidiospores, [20/1/1] (5.6–)6.2(–7.5) × 3.7–5.0 µm [Q = 1.24–1.68; Qm = 1.35; Lm = 6.3 µm;

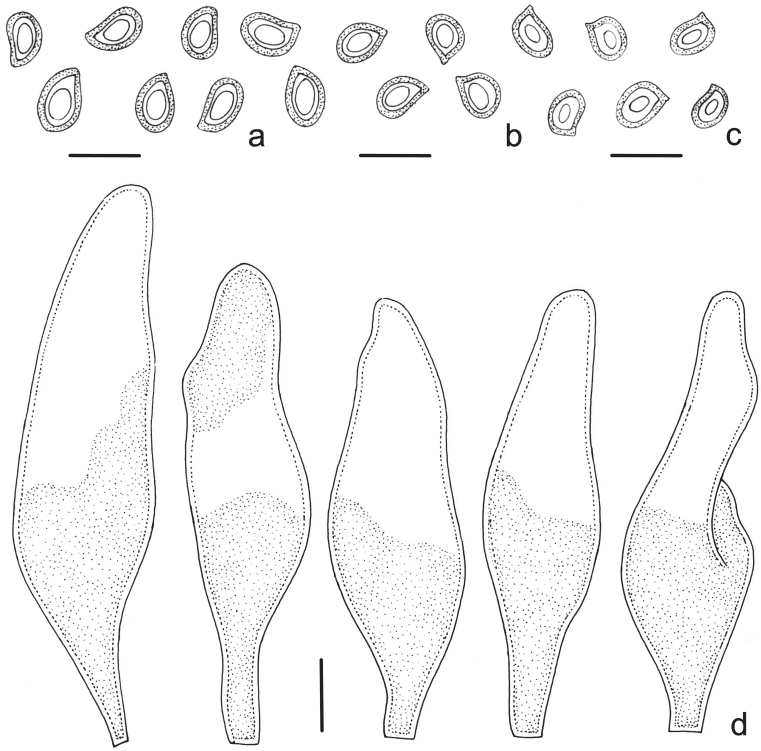

Figure 13. "*Pluteus pellitus*". a–c. Basidiospores (a. PACA14524; b. PACA14530; c. FH00301673); d. Pleurocystidia. (FH00301673). Scale bars = 10 µm.

Wm = 4.7 µm], fusoid-ventricose pleurocystidia (69–83 × 11.2–25 µm) with thick walls and apices with 2–4 lateral prongs, clavate cheilocystidia (37–61 × 12–15 µm), cutis-like pileipellis, and no clamp connections. Justo & Castro (2007b) found similar features in the isotype of *P. viscidulus*. Until very recently, *P. viscidulus* was thought to represent an authentic South American species with white basidiomata and without clamp-connections; however, molecular analyses by Justo et al. (2011b) place *P. viscidulus* within the molecular variation of *P. petasatus* (Fr.) Gillet, and it is now treated as a synonym of *P. petasatus*. Although *P. petasatus* (= *P. viscidulus*) can be confirmed from Brazil based on Singer's collection, its morphological diagnostic characters were not seen in Rick's collections; the unpublished FH00301673 has thin-walled pigmented pleurocystidia, not the horned pleurocystidia typical of sect. *Pluteus* found

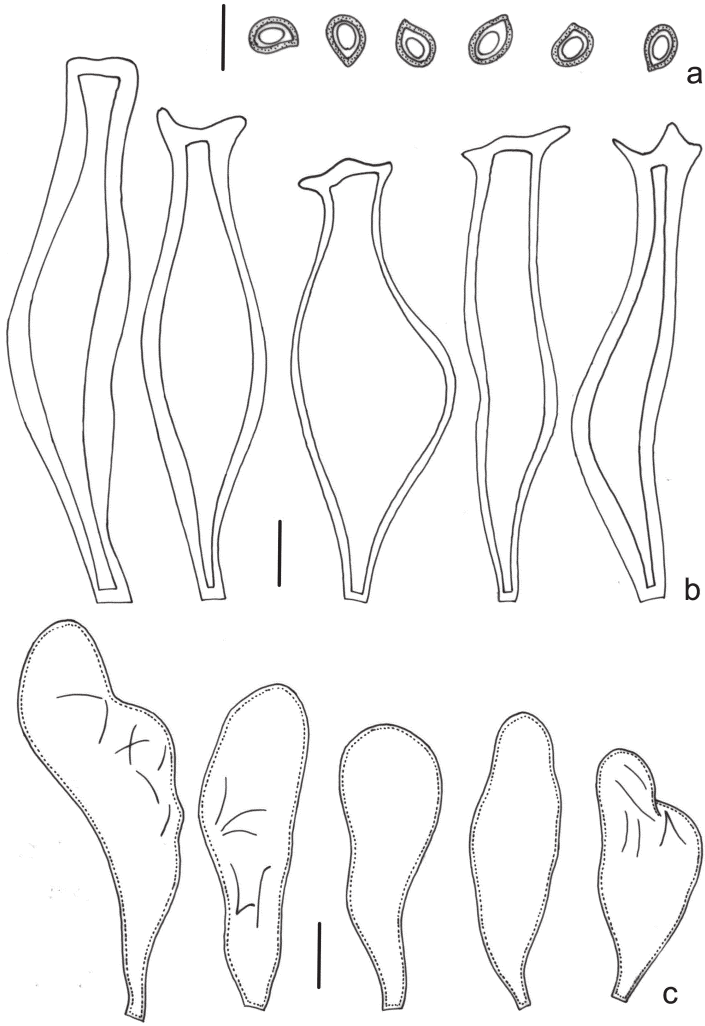

Figure 14. *Pluteus viscidulus* (Singer B111, LIL).
a. Basidiospores; b. Pleurocystidia; c. Cheilocystidia. Scale bars = 10 µm.

in *P. pellitus, P. petasatus,* and allied species. In addition, according to notes for FH00301673, Rick denoted it as *P. pellitus* '*videtur*,' which indicates that although it resembles *P. pellitus*, a different allied species can also be considered. Because there are no pileus color notes for FH00301673, it is difficult to suggest a name for it. There are no previously published species that combine

broadly ellipsoid basidiospores and pigmented pleurocystidia with a whitish pileus. However, because there is no mention whether the pileus is actually whitish, if we consider only the species of sect. *Hispidoderma* with pigmented pleurocystidia, FH00301673 might represent any species from stirps *Aethalus*, *Circumscissus*, or *Plautus*, according to Singer's classification (Singer 1959).

Although no reliable conclusion can be made about the identity of Rick's collections, we suggest that they do not represent *P. pellitus*. We should not disregard the possibility that the collections (PACA14524, PACA14530) published in Rick (1961) could be *P. petasatus*, and FH00301673 is most likely a species of sect. *Hispidoderma*.

"***Pluteus princeps*** Rick," nom. in herb. Fig. 15

Specimen examined — Brazil. Rio Grande do Sul: Arroio do Meio, 1920, J. Rick s.n. (BPI770893).

Comments — See the description under *P. cervinus* var. *griseoviridis*, with which it shares the same features. The above collection probably represents *P. angustisporus*.

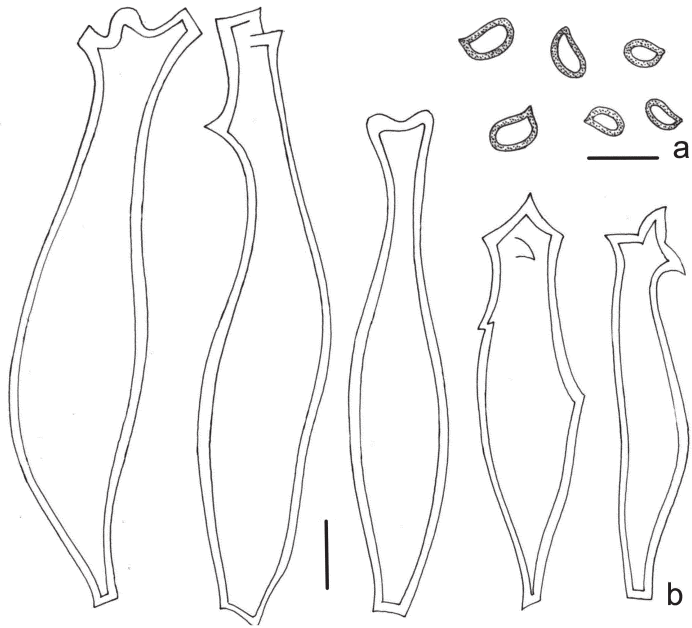

Figure 15. "*Pluteus princeps*" (BPI770893).
a. Basidiospores; b. Pleurocystidia. Scale bars = 10 µm.

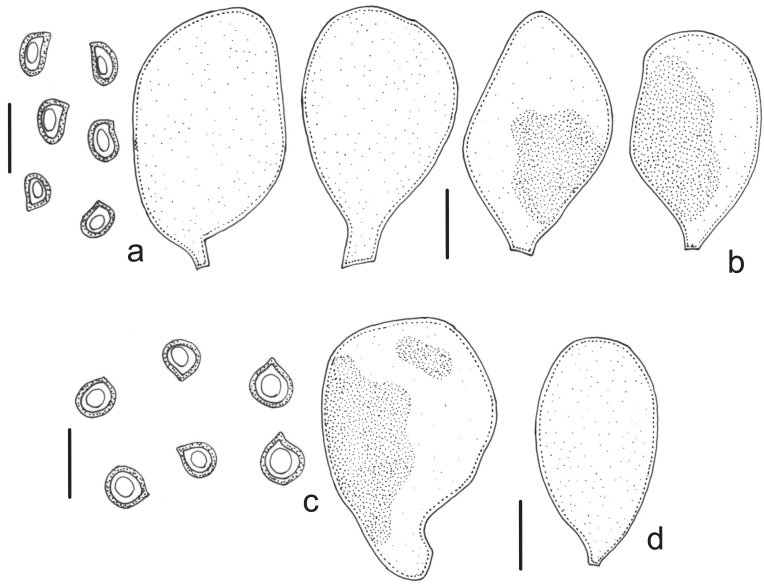

Figure 16. "*Pluteus phlebophorus*". (a–b. PACA14520) a. Basidiospores; b. Pileipellis cells. (c–d. PACA20895) c. Basidiospores; d. Pileipellis cells. Scale bars = 10 μm.

"***Pluteus phlebophorus*** Dittm." sensu Rick, Iheringia, Sér. Bot. 8: 419. 1961. Fig. 16

Specimens examined — Brazil. Rio Grande do Sul: São Leopoldo, 1934, leg. Steffen, det. J. Rick (PACA14520*); São Salvador, 28 Jan 1944, J. Rick s.n. (PACA20895).

(PACA14520) — Basidiospores [20/1/1] 5.0(–6.2) × 3.7(–5.0) μm [Q = (1.24–)1.35(–1.68); Qm = 1.39; Lm = 5.2 μm; Wm = 3.8 μm], preponderantly ellipsoid or sometimes broadly ellipsoid or elongate, inamyloid, hyaline, smooth, thick-walled, guttulate. Pileipellis a hymeniderm composed of subglobose cells, 24–36 × 18.7–22 μm, with a short pedicel (2.5–3.7 μm long), thin-walled, with brownish condensed content. Pleuro- and cheilocystidia not recovered. Clamp connections not observed.

(PACA20895) — Basidiospores [20/1/1] 5.0–6.2 × 5.0–6.2 μm (Qm = 1.00; Lm = 5.7 μm; Wm = 5.7 μm), globose, inamyloid, hyaline, smooth, thick-walled, guttulate. Pileipellis a hymeniderm composed of subglobose cells, 31–36 × 16.2–25 μm, with a short to moderately long pedicel (2.5–12.5 μm long), thin-walled, with brownish condensed or dissolved content. Pleuro- and cheilocystidia not recovered. Clamp connections not observed.

Comments — These two collections studied by Rick have different anatomical characters and represent two species, although they were both listed as *P. phlebophorus* (Ditmar) P. Kumm. Singer (1959) suggested that "*P. phlebophorus*" sensu Rick is likely *P. jamaicensis*, which is characterized by non-globose basidiospores of 5.0–6.8(–7.5) × 4.5–6.2 µm (Singer 1956, 1959; Smith & Stuntz 1958; Horak 1964; Pegler 1983; Menolli et al. 2010) differing in size and shape from those observed in both of Rick's collections. PACA14520, which shares characteristics with PACA14522 named by Rick as *P. brunneopictus,* most likely represents *P. tucumanus* (see discussion under *P. brunneopictus*). PACA20895, which most likely represents *P. sapiicola*, is similar to PACA22618, referred by Rick to *P. nanus* (see discussion under *P. nanus*).

Pluteus scruposus Henn., Beibl. Hedwigia 39: 136. 1900.

Original description — "*Pileo carnoso, campanulate, obtuso, scruposo, verrucis crassis atrobrunneis tecto, 2½–3 cm diametro, brunneo; stipites farcto, tereti, albido, laevi, 3½ cm longo, 5 mm crasso, basi bulboso tomentosulo ca. 1 cm incrassato; lamellis liberis, confertis lanceolatis pallidis, dein subincarnatis, cystidiis lanceolatis vel clavate-lageniformibus 55–90 × 25–35 µ; basidiis clavatis 35–45 × 15–20; sporis globosis intus flavido-subincarnatis 15–17 µ.*"

Comments — As we could locate no specimens, we regard this name as a nomen dubium.

Pluteus sensitivus Rick, Brotéria, Sér. Bot. 24: 104. 1930.

Original description — "*Pileo 1 cm lato, campanulato, striato usque ad centrum, membranaceo, viscido, centro brunneo-squamuloso, ceterum fibrilloso, margine hyalino, lamellis confertis, linearibus, acie serratis, rubescentibus, liberis; stipites filiformi 1 mm. lato, 3 cm. alto, vitreo, consperso; spora 4–5 µ, subangulata, grosse guttulata.*"

Comments — Although Rick (1930, 1938) described *P. sensitivus* without indicating a holotype, he later (Rick 1961) cited PACA20770 as the material studied for this species. However, according to the exsiccata notes, PACA20770 represents an unpublished variety, "*P. sensitivus* var. *macrospora*" (see below); moreover, as this specimen was collected in 1944, it cannot be the material on which Rick (1930) based his original description. As no other collection has been found for the epithet *sensitivus,* we regard this name as a nomen dubium.

"***Pluteus sensitivus*** var. ***macrospora*** Rick," nom. in herb. Fig. 17

Specimen examined — Brazil. Rio Grande do Sul: São Salvador, 1944, J. Rick s.n. (PACA20770).

Comments — See the description under *P. murinus*, with which it shares the same features. Although PACA20770 was published under *P. sensitivus* (Rick 1961), the specimen notes cite it as "*P. sensitivus* var. *macrospora.*" Based on

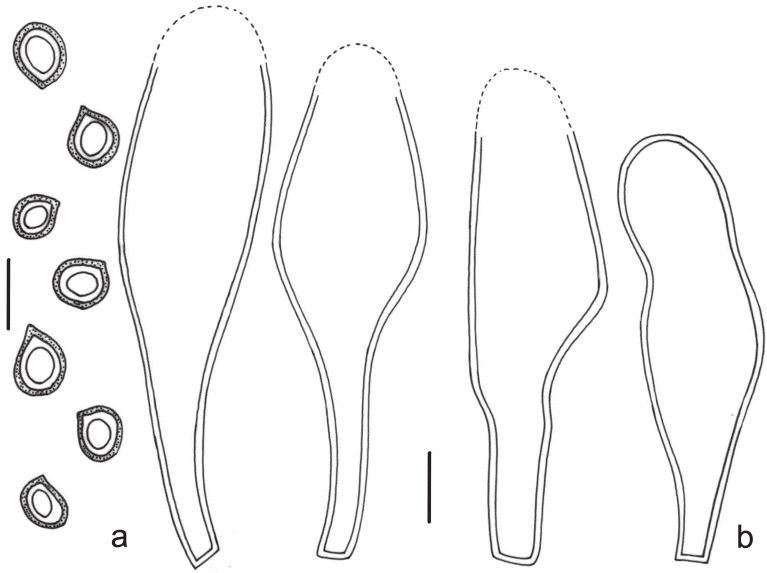

Figure 17. "*Pluteus sensitivus* var. *macrospora*". (PACA20770).
a. Basidiospores; b. Pleurocystidia. Scale bars = 10 µm.

the data recovered from the specimen, we suggest that it may actually represent *P. albostipitatus* (see discussion under *P. murinus*).

Pluteus straminellus Rick, Iheringia, Sér. Bot. 8: 417. 1961.

Specimen examined — Brazil. Rio Grande do Sul: São Leopoldo, 1930, J. Rick s.n. (**Holotype**, PACA15531*).

Original description — "*Pileo stramineo, innato-squamuloso, centro lurido, stipite brevi, aquoso; lamellis densis, arcuatis, carneolis, liberis. Sporis 4 × 3 my* [µm]. *Ad lignum.*"

Basidiospores [20/1/1] 3.7(–4.4) × 2.5(–3.1) µm [Q = (1.42–)1.48; Qm = 1.48; Lm = 3.7 µm; Wm = 2.5 µm), ellipsoid, inamyloid, hyaline, smooth, thick-walled, guttulate. Pileipellis and hymenial structures not recovered. Clamp connections not observed.

Comments — Based only on basidiospore size and shape, it is not possible to establish *P. straminellus* as sufficiently well known, leading us to treat it as a nomen dubium. If there were data about the pileipellis and hymenial structures and pileus color, it might be possible to suggest a morphological relationship between *P. straminellus* and other small-spored species, such as *P. microsporus* (Dennis) Singer, *P. ugandensis* Pegler, or *P. unakensis* Murrill.

Pluteus termitum Henn., Hedwigia 43: 183. 1904, as "*termitarum.*"

> Original description — *"Pileo carnosulo, campanulato, vertice umbonato-obtuso, brunneolo, radiatim substriato, albido, 3–4 cm diam., stipites fistuloso, tereti, substriato, laevi basi interdum curvulo incrassato, pallido-brunneolo, 4–5 cm longo, 2–3 mm crasso; lamellis liberis, confertis, ventrocsis, ca. 3 mm latis, pallidis dein flavidis; sporis ellipsoideo-fusoideis utrinque acutiusculis, 1–2 guttulatis, episporio pallide incarnate, laevi, 7–10 × 4–5 µ."*

Comments — No specimens can be located. We therefore regard this name as a nomen dubium.

"***Pluteus umbrosus*** Pers." sensu Rick, Iheringia, Sér. Bot. 8: 418. 1961. Fig. 18

> Specimen examined — Brazil. Rio Grande do Sul: Arroio do Meio, 1920, J. Rick s.n. (BPI770905).

Comments — See the description under *P. cervinus* var. *griseoviridis*, with which it shares the same features. The name attributed by Rick (1919, 1938, 1961)

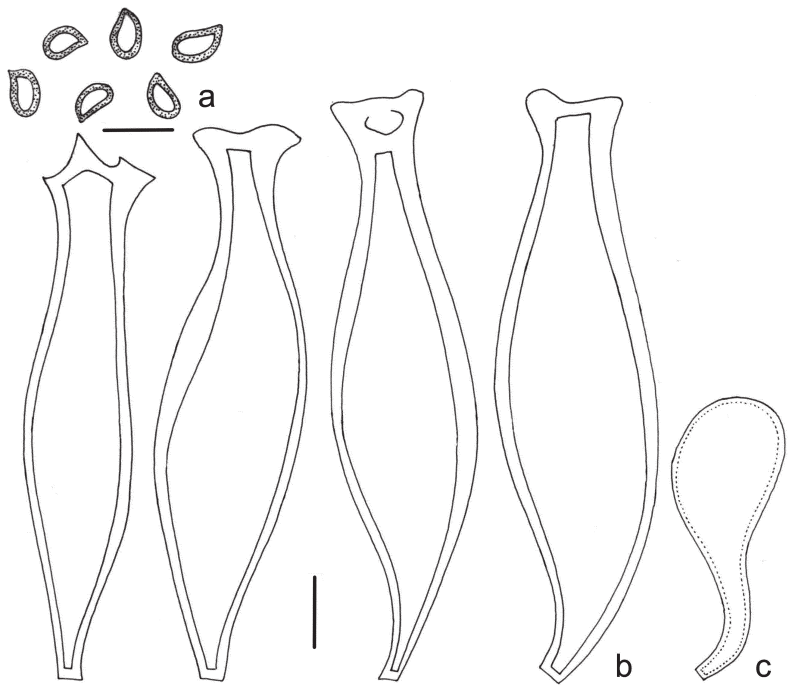

Figure 18. "*Pluteus umbrosus*" (BPI770905).
a. Basidiospores; b. Pleurocystidia; c. Cheilocystidia. Scale bars = 10 µm.

Figure 19. *Pluteus velatus* (holotype, PACA14527).
a. Basidiospores; b. Pleurocystidia. Scale bars = 10 μm.

is obviously inaccurate because *P. umbrosus* (Pers.) P. Kumm. represents sect. *Hispidoderma* (Singer 1956, Vellinga & Schreurs 1985, Orton 1986) whereas the above collection has the horned pleurocystidia typical of sect. *Pluteus*. Our morphological examination indicates that Rick's collection probably represents *P. angustisporus* (see discussion under *P. cervinus* var. *griseoviridis*).

Pluteus velatus Rick, Iheringia, Sér. Bot. 8: 417. 1961. Fig. 19

Specimen examined — Brazil. Rio Grande do Sul: São Leopoldo, 1939, J. Rick s.n. (**Holotype**, PACA14527* as *P. velutinus*).

Original description — "*Campanulatus, 3 cm latus, griseo-brunneus, membranaceus, squarrosulus ad marginem, secus nudus, fere usque ad centrum leviter striatus; lamellis liberis, ventricosis, densis, albis, margine rubro. Basidiis brevibus, cystidiis paucis, latis; stipite 6 cm alto, 3 cm lato, subtus crassiore, albo-lanoso, ceterum nudo, striatulo, pallido, velo arachnoideo. Sporis 6–10 × 5–10 my* [μm], *polygonalibus, rubris. Ad lignum putridum.*"

Basidiospores [20/1/1] (6.2–)7.5–8.7(–10.0) × 5.0–6.2(–7.5) μm [Q = (1.16–)1.21–1.50(–1.61); Qm = 1.32; Lm = 7.9 μm; Wm = 6.0 μm), broadly ellipsoid to

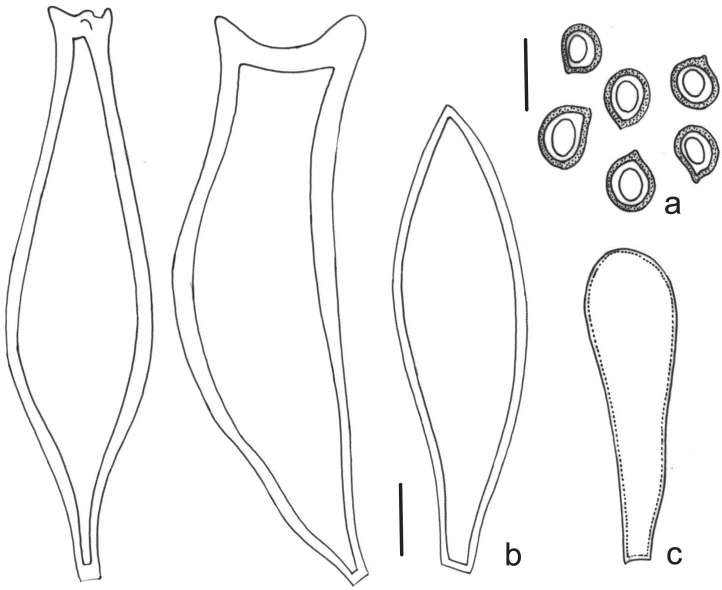

Figure 20. *Pluteus fibulatus* (isotype, Singer T141, MICH).
a. Basidiospores; b. Pleurocystidia; c. Cheilocystidia. Scale bars = 10 μm.

ellipsoid or rarely almost elongate, inamyloid, hyaline, smooth, thick-walled, guttulate. Pileipellis composed of hyphal elements typical of a cutis but it is too difficult to be recovered. Pleurocystidia 56–69(–87) × (13.7–)18.7–24 (–30) μm, clavate or slightly ventricose, thin-walled. Cheilocystidia not recovered. Clamp connections not observed.

Comments — Singer (1953, 1959) recognized Rick's collection as representing *P. fibulatus* Singer (described from Argentina; Singer & Digilio 1952). Although it is not clear whether Singer actually examined this collection, he did mention that, "the indication of a veil in the unpublished notes must be due to an error." *Pluteus velatus* was published in Rick's posthumous paper (Rick 1961), and according to Singer (1953, 1959), *P. velatus* should be considered a synonym of *P. fibulatus*. However, our re-examination of the two types confirms that they represent different species.

Pluteus fibulatus is typical of sect. *Pluteus*, characterized by a fibrillose deep-colored pileus, clamp-connections, and horned metuloid pleurocystidia

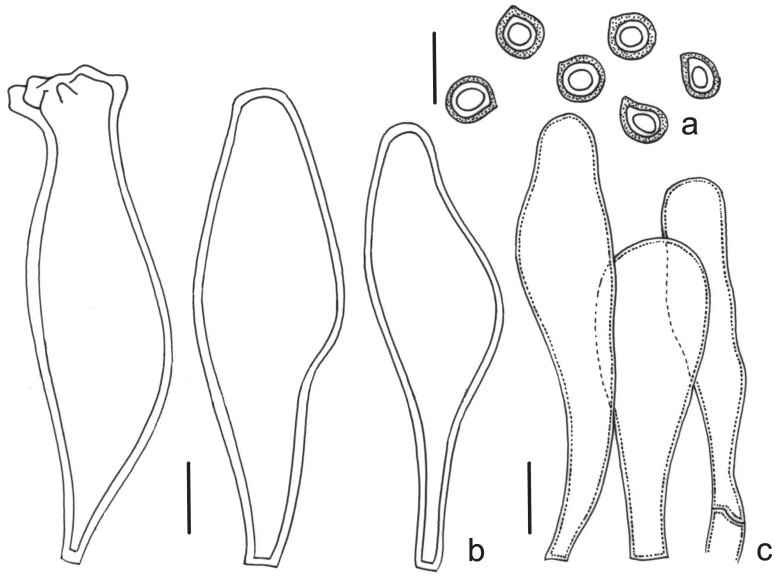

Figure 21. *Pluteus fibulatus* (Pegler et al. 3899, K(M)41525).
a. Basidiospores; b. Pleurocystidia; c. Cheilocystidia. Scale bars = 10 μm.

(Singer 1959). Our re-examination of the isotype of *P. fibulatus* [Argentina. Prov. Tucuman: Capital, 22 Feb. 1949, Singer T141 (MICH)] (Fig. 20) showed globose to broadly ellipsoidal (rarely ellipsoidal) basidiospores, [20/1/1] (5.6–) 6.2–7.5(–8.7) × (5.0–)5.6–6.8(–7.5) μm [Q = 1.00–1.24(–1.40); Qm = 1.16; Lm = 7.1 μm; Wm = 6.1 μm]; fusoid-ventricose pleurocystidia (65–88 × 17.5–28.7 μm) with thickened to moderately thickened walls and apices with 2–4 apical prongs (although sometimes without prongs and with an acute to rounded apex), clavate cheilocystidia (44 × 13.7 μm), a cutis-like pileipellis that was difficult to recover, and difficult to detect clamp connections. Similar features were also found in the collection of *P. fibulatus* (Fig. 21) recorded by Pegler (1997) from the state of São Paulo, Brazil [Brazil. São Paulo: Mogi Guaçu, 30 Jan. 1987, Pegler et al. 3899 (K(M)41525)].

However, globose basidiospores and metuloid or horned cystidia were not found in our re-examination of the holotype of *P. velatus*. All pleurocystidia observed in *P. velatus* had thin walls, suggesting that the specimen represents sect. *Hispidoderma* rather than *P. fibulatus* or another species in sect. *Pluteus*. Thus, although we can confirm the occurrence of *P. fibulatus* in Brazil, the

data recovered from Rick's collection are not sufficient to confirm the identity of *P. velatus*, which remains a nomen dubium. Taking into consideration the macroscopic characteristics described by Rick (1961), such as pileus color and lamellae with colored edges ('*margine rubro*'), as well as the size and shape of the basidiospores and pleurocystidia described herein, it is likely that the material collected by Rick represents *P. fernandezianus* Singer, originally described from Chile (Singer 1959).

"***Pluteus wehlianus*** Müller," nom. in herb.

Specimen examined — Brazil. Rio Grande do Sul: São Leopoldo, 1939, J. Rick s.n. (PACA14529).

Basidiospores [4/1/1] 16.2–20 × 11.2–12.5 µm (Q = 1.4–1.6; Qm = 1.51; Lm = 18.4 µm; Wm = 12.2 µm), ellipsoid with germ pore. Pileipellis & hymenial structures not recovered. Clamp connections not observed.

Comments — Although referred to *P. wehlianus* (F. Muell.) Sacc., this unpublished collection obviously does not represent a *Pluteus* species due to the large basidiospores with germ pore. It is likely a species of *Bolbitiaceae* or *Strophariaceae*.

Conclusion

Among the names published by Hennings and Rick, only three collections referred to *P. cervinus* could be assigned to the correct name, *P. xylophilus*. Three other unpublished collections could be correctly identified: "*P. egregius*" as *P. xylophilus* and "*P. murinus*" and "*P. sensitivus* var. *macrospora*" as *P. albostipitatus*. Materials were not found for ten taxa, of which we consider five to be nomina dubia. We also regard *P. straminellus* and *P. velatus* as nomina dubia because the morphological data recovered from Rick's collections are insufficient to confirm their identity.

Of the remainder, we only suggested another name for the collections of Hennings and Rick when it was not possible to recover complete morphological data for a correct identification, although the data available were sufficient to reject the originally applied names. Finally, there is insufficient material of "*P. fuscidulus*" for study, *P. leptonia* belongs to *Entolomataceae*, and "*P. wehlianus*" belongs to *Bolbitiaceae* or *Strophariaceae*.

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Literature cited

Banerjee P, Sundberg WJ. 1993. Reexamination of *Pluteus* type specimens: types housed at the New York Botanical Garden. Mycotaxon 49: 413–435.

Bas C. 1969. Morphology and subdivision of *Amanita* and a monograph on its section *Lepidella*. Persoonia 5: 285–579.

Berkeley MJ, Broome CE. 1871. The fungi of Ceylon (*Hymenomycetes*, from *Agaricus* to *Cantharellus*). J. Linn. Soc., Bot. 11: 494–567.

Farr DF, Rossman AY. 2013. Fungal Databases, Systematic Mycology and Microbiology Laboratory, ARS, USDA. http://nt.ars-grin.gov/fungaldatabases/. Accessed February 2013.

Fidalgo O. 1962. Rick, o pai da micologia brasileira. Rickia 1: 3–11.

Fidalgo O. 1968. Introdução à história da micologia brasileira. Rickia 3: 1–44.

Hein B. 1988. Liste der Arten und infraspecifischen Taxa von P. Hennings. Englera 10: 1–374.

Hennings P. 1900. Fungi mattogrossenses a Dr. R. Pilger collecti 1899. Beiblatt zur Hedwigia 39: 134–139.

Hennings P. 1904a. Fungi amazonici I. a cl. Ernesto Ule collecti. Hedwigia 43: 154–186.

Hennings P. 1904b. Fungi S. Paulenses III a cl. Puttemans collecti. Hedwigia 43: 197–209.

Hiepko P. 1987. The collections of the Botanical Museum Berlin-Dahlem (B) and their history. Englera 7: 219–252.

Homola RL. 1972. Section *Celluloderma* of the genus *Pluteus* in North America. Mycologia 64: 1211–1247. http://dx.doi.org/10.2307/3757960

Horak E. 1964. Fungi austroamericani II. *Pluteus* Fr. Nova Hedwigia 8: 163–199.

Justo A, Castro ML. 2007a. An annotated checklist of *Pluteus* in the Iberian Peninsula and Balearic Islands. Mycotaxon 102: 231–234.

Justo A, Castro ML. 2007b. *Pluteus nothopellitus* sp. nov. and a review of white species of *Pluteus* section *Pluteus*. Mycotaxon 102: 221–230.

Justo A, Castro ML, Rodríguez-Ramos N, Infante F. 2007. La familia *Pluteaceae* (*Basidiomycetes*) en la Provincia de Sevilla (España); comentarios corológicos y taxonómicos. Acta Bot. Malacitana 32: 41–48.

Justo A, Vizzini A, Minnis AM, Menolli Jr N, Capelari M, Rodriguez O, Malysheva E, Contu M, Ghignone S, Hibbett DS. 2011a. Phylogeny of the *Pluteaceae* (*Agaricales*, *Basidiomycota*): taxonomy and character evolution. Fungal Biology 115: 1–20. http://dx.doi.org/10.1016/j.funbio.2010.09.012

Justo A, Minnis AM, Ghignone S, Menolli Jr N, Capelari M, Rodriguez O, Malysheva E, Contu M, Vizzini A. 2011b. Species recognition in *Pluteus* and *Volvopluteus* (*Pluteaceae, Agaricales*): morphology, geography and phylogeny. Mycol. Progress 10: 453–479. http://dx.doi.org/10.1007/s11557-010-0716-z

Kirk PM, Cannon PF, Minter DW, Stalpers JA (eds.). 2008. Ainsworth & Bisby's dictionary of the fungi, 10th edn. CAB International, Wallingford.

Kühner R, Romagnesi H. 1956. Compléments a la Flore Analytique VIII) Espèces nouvelles, critiques ou rares de Volvariacées. Bull. Trimest. Soc. Mycol. Fr. 72: 181–253.

Legon NW, Henrici A. 2011 (continuously updated). Checklist of the British & Irish *Basidiomycota.* Royal Botanic Gardens. http://www.basidiochecklist.info. Accessed February 2012.

Martius KFP. 1906. Flora Brasiliensis 1: 1–268.

Menolli Jr N, Capelari M. 2010. Notes on *Pluteus* (*Pluteaceae*, *Agaricales*) from Brazil including two new species and a new record. Mycologia 102: 697–707. http://dx.doi.org/10.3852/09-200

Menolli Jr N, Asai T, Capelari M. 2010. Records and new species of *Pluteus* from Brazil based on morphological and molecular data. Mycology 1: 130–153. http://dx.doi.org/10.1080/21501203.2010.493531

Merrill ED. 1943. Destruction of the Berlin Herbarium. Science 98: 490–491. http://dx.doi.org/10.1126/science.98.2553.490

Minnis AM, Sundberg WJ. 2010. *Pluteus* section *Celluloderma* in the U.S.A. N. Amer. Fungi 5: 1–107.

Minnis AM, Sundberg WJ, Methven AS, Sipes SD, Nickrent DL. 2006. Annulate *Pluteus* species: a study of the genus *Chamaeota* in the United States. Mycotaxon 96: 31–39.

Orton PD. 1986. British fungus flora, agarics and boleti 4: *Pluteaceae*: *Pluteus* and *Volvariella*. Royal Botanic Garden, Edinburgh.

Pegler DN. 1983. Agaric flora of the Lesser Antilles. Kew Bull., Additional Ser. 9: 1–668.

Pegler DN. 1986. Agaric flora of Sri Lanka. Kew Bull., Additional Ser. 12: 1–519.

Pegler DN. 1997. The agarics of São Paulo. Royal Botanic Gardens, Kew.

Perkins J. 1909. Paul Hennings. Botanical Gazette 47: 239–241. http://dx.doi.org/10.1086/329853

Pradeep CK, Vrinda KB, Abraham TK. 2002. *Pluteus* section *Pluteus* from Kerala State, India. Mycotaxon 83: 59–66.

Rick J. 1907. Contributio ad monographiam Agaricacearum et Polyporacearum Brasiliensium. Brotéria, Série Botânica 6: 65–92.

Rick J. 1919. Contributio II ad monographiam Agaricinorum Brasiliensium. Brotéria, Série Botânica 17: 101–111.

Rick J. 1930. Contributio IV ad monographiam Agaricacearum Brasiliensium. Brotéria, Série Botânica 24: 97–118.

Rick J. 1938. Agarici riograndenses. Lilloa 3: 399–455.

Rick J. 1961. *Basidiomycetes* eubasidii in Rio Grande do Sul – Brasilia. 5. *Agaricaceae*. Iheringia, Série Botânica 8: 301–449.

Ripková S. 2009. *Pluteus exiguus* – a threatened or overlooked species? Catathelasma 11: 49–52.

Saccardo PA. 1887. Sylloge fungorum omnium hucusque cognitorum, vol. 5. Patavii.

Singer R, Digilio APL. 1952 ["1951"]. Pródomo de la flora Agaricina Argentina. Lilloa 25: 5–461.

Singer R. 1953. Type studies on *Basidiomycetes* VI. Lilloa 26: 57–159.

Singer R. 1956. Contributions towards a monograph of the genus *Pluteus*. Trans. Br. Mycol. Soc. 39: 145–232. http://dx.doi.org/10.1016/S0007-1536(56)80001-6

Singer R. 1959 ["1958"]. Monographs of South American *Basidiomycetes*, especially those of the east slope of the east slope of the Andes and Brazil. 1. The genus *Pluteus* in South America. Lloydia 21: 195–299.

Singer R. 1986. The *Agaricales* in modern taxonomy, 4th edn. Koeltz Scietific Books, Koenigstein.

Smith AH, Stuntz DE. 1958. Studies on the genus *Pluteus* I. Redescriptions of American species based on a study of type specimens. Lloydia 21: 115–136.

Takehashi S, Kasuya T. 2007. First record of *Pluteus chrysophaeus* and reexamination of *Pluteus leoninus* from Japan. Mycoscience 48: 321–325.

Thiers B. 2013 (continuously updated). Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Accessed February 2013. http://sweetgum. nybg.org/ih/.

Vellinga EC, Schreurs J. 1985. Notulae ad floram agaricinam neerlandicam – VIII *Pluteus* Fr. in West-Europe. Persoonia 12: 337–373.

Vizzini A, Ercole E. 2011. A new annulate *Pluteus* variety from Italy. Mycologia 1034: 904–911. http://dx.doi.org/10.3852/10-382

Wartchow F, Cortez VG, Coelho G. 2006. New records of *Pluteus* (*Pluteaceae*, *Agaricales*) from Brazil. Mycotaxon 96: 241–252.