

Observations in *Pluteus* section *Pluteus* in Spain: two new records for Europe

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Abstract — *Pluteus atropungens* and *Pluteus brunneidiscus* are recorded for the first time in Europe. Both are described and briefly discussed. Based on the revision of the type collections, *Pluteus washingtonensis* is considered a synonym of *P. brunneidiscus*.

Key words — *Pluteaceae*, biodiversity

Introduction

The genus *Pluteus* Fr. (*Agaricales*, *Basidiomycota*) has received little attention in studies of fungal biodiversity in the Iberian Peninsula (Spain, Portugal) and Balearic Islands (Spain). The records of *Pluteus* are often included in general checklists. Prior to our study the only monographic paper on this genus was an article by Muñoz-Sánchez (1991) dealing with species of section *Pluteus*, mainly based on collections from the Basque Country (northern Spain). Regional studies on *Pluteus* within the Iberian Peninsula have been published in recent years, as a part of the “Flora Mycologica Iberica” project (Justo & Castro 2004; Justo et al. 2005a, b, 2006).

After revising the collections deposited in the Iberian herbaria and newly collected material, an annotated checklist of the genus in our area has been published (Justo & Castro 2007). According to our revision 33 taxa of *Pluteus* occur in the Iberian Peninsula and Balearic Islands.

Here we present the most interesting results concerning section *Pluteus*, characterized by the presence of metuloid pleurocystidia and pileipellis arranged as a cutis (Vellinga & Schreurs 1985).

Pluteus atropungens and *Pluteus brunneidiscus* are recorded for the first time in Europe. Type collections of both species have been studied, and closely related taxa are discussed. A key to all members of section *Pluteus* in the Iberian Peninsula and Balearic Islands is provided.

Material and methods

Standard methods for describing the basidiocarps were applied, using the terminology of Vellinga (1988, 1990). Color annotations in the macroscopical descriptions are from Munsell soil color charts (2000). Terminology for describing the pleurocystidia follows Singer (1986) and Bonnard (1988): cervinus-type cystidia are generally fusiform, provided with 2-4 (6) apical hooks; magnus-type cystidia lack apical hooks and usually have a rather acute apex; intermediate cystidia is the term used for the pleurocystidia situated near the lamella edge. The notation [90, 5, 3] indicates that measurements were made in 90 spores in 5 samples in 3 collections. All structures were measured in Congo Red or an equal mixture of Congo Red and KOH (5%). The following abbreviations are used: avl for average length, avw for average width, Q for quotient of length and width and avQ for average quotient.

Taxonomic descriptions

1. *Pluteus atropungens* A.H. Sm. & Bartelli, Michigan Botanist 4: 61. 1965. Fig. 1

Type study—**Basidiospores** [30, 1, 1] 5.5-9.0 × 4.8-7.0 μm, avl × avw = 7.3 × 5.9 μm, Q = 1.0-1.53, avQ = 1.24, mostly (broadly) ellipsoid but (sub)globose spores also present. **Basidia** 20-32 × 6-9 μm, mostly 4-spored but 2- and 1-spored basidia also present, broadly clavate. **Pleurocystidia** 58-80 × 15-28 μm, metuloid, (narrowly) fusiform, narrowly lageniform or (narrowly) clavate, mostly with rounded apex and without hooks, rarely with 1-3 short hooks at apex, with up to 3 μm thick wall. **Intermediate cystidia** without apical hooks, with obtuse apex, some very thin-walled except at apex, and there up to 2 μm thick. **Cheilocystidia** 40-110 (140) × 15-30 μm, (narrowly) clavate, spheropedunculate, lageniform, cylindrical or flexuous, with brown pigment. **Pileipellis** a cutis; hyphae 5-25 μm wide, cylindrical, with brown pigment; terminal elements 75-190 μm long, cylindrical to fusiform, usually tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 5-20 (25) μm wide, cylindrical, colorless or with brown pigment. **Clamp connections** present in all tissues.

Description of all collections

Pileus (40) 50-80 (100) mm hemispherical when young, later appanate or plano-convex, with or without low obtuse umbo at centre, slightly depressed at centre in older specimens; surface innately fibrillose, specially at centre, dry, brown to blackish brown [approx. 7.5YR 2.5/1 to 2.5/3]; margin translucently striate, in older specimens becoming rimose and showing white context underneath. **Lamellae** L = 58-92, l = (0)1-3, moderately crowded, free, ventricose, up to 9 mm broad, white when young, later pink to vinaceous, with blackish brown edge, flocculose under lens. **Stipe** 50-100 × 10-20 mm, cylindrical, subequal or

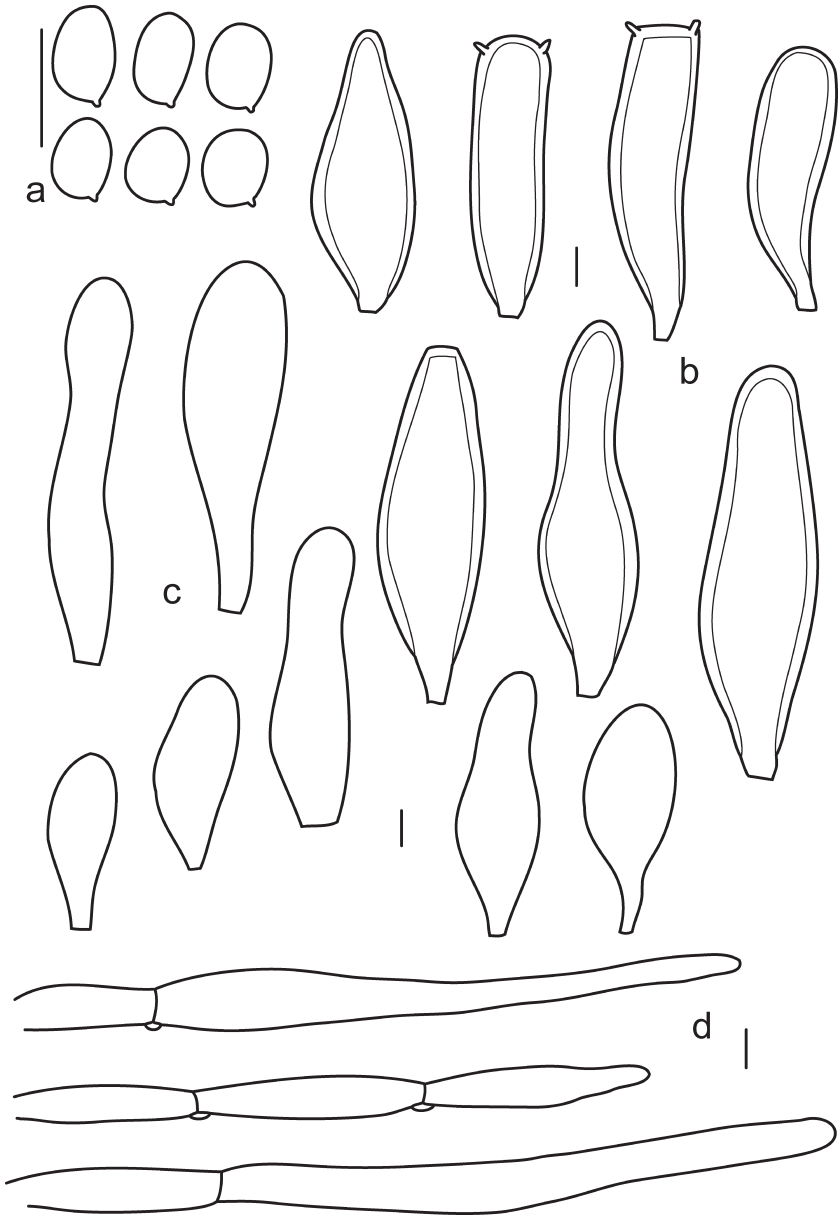


Fig. 1: *Pluteus atropungens*—a: spores (from holotype and MA-54269); b: pleurocystidia (from holotype and MA-54269); c: cheilocystidia (from holotype); d: pileipellis (from holotype).

Scale bars = 10 μ m.

with broad bulbous base, white but covered with longitudinal blackish brown fibrils, solid. **Context** in pileus white or blackish near pileipellis; in stipe white to pale cream near base. **Smell** of crushed context strongly pungent. **Taste** very unpleasant. **Spore print** not recorded.

Basidiospores [90, 5, 3] 5.5-8.5 (9.0) \times 4.5-6.5 (7.0) μm , $\text{avl} \times \text{avw} = 7.2\text{-}7.7 \times 5.2\text{-}5.9 \mu\text{m}$, $Q = (1.0)1.1\text{-}1.6$ $\text{av}Q = 1.24\text{-}1.5$, subglobose to ellipsoid, rarely globose. **Basidia** 20-38 \times 6-11 μm , mostly 4-spored but 2- and 1-spored basidia also present, broadly clavate. **Pleurocystidia** 60-110 \times 15-35 μm , metuloid, (narrowly) fusiform, narrowly lageniform or (narrowly) clavate, mostly with rounded apex and without hooks, rarely with 1-3 short hooks at apex, with up to 4 μm thick wall. **Intermediate cystidia** without apical hooks, with obtuse apex, some very thin-walled except at apex (up to 2 μm thick), colorless or with brown pigment. **Cheilocystidia** (20) 25-110 (140) \times 10-30 μm , (narrowly) clavate, sphaeropedunculate, lageniform, cylindrical or flexuous, with brown pigment. **Pileipellis** a cutis; hyphae 5-25 μm wide, cylindrical, with brown pigment; terminal elements 40-190 (210) μm long, cylindrical to fusiform, usually tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 5-20 (25) μm wide, cylindrical, colorless or with brown pigment. **Clamp connections** present in all tissues.

Habitat and distribution—Gregarious or solitary, on wood of broad-leaved trees (*Populus*) or on sawdust. Known from the U.S.A and Spain, possibly also from Chile. October-November.

Collections examined—**SPAIN**: Ávila: Peguerinos, on wood of unidentified broad-leaved tree, 24.X.1976, F.D. Calonge, MA-Fungi 4633; Valladolid: Laguna de Duero, on *Populus* stump, 19.XI.1994, A. García Blanco et al., MA-Fungi 54269; **U.S.A**: Michigan: Marquette Co., Marquette, 20.X.1959, I. Bartelli, coll. A.H. Smith 62033 (MICH, Holotype).

Comments—The above description is based on the Spanish collections and the holotype. Data on smell and taste were not recorded for the Spanish collections so they are taken from the original description (Smith & Bartelli 1965).

Our collections have fewer (sub)globose spores than the type but otherwise fit well with the original description macro and microscopically. The type collection was recorded on sawdust while the Spanish collections grew on wood of broad-leaved trees.

Pluteus atropungens is characterized by the following combination of characters: pleurocystidia mostly without apical hooks, cheilocystidia pigmented, caulocystidia absent, clamp connections present and habitat on sawdust or wood of broad-leaved trees. Up to now it is only known from the U.S.A and Spain. Other species of sect. *Pluteus* with pigmented cheilocystidia are discussed below.

Pluteus atromarginatus (Singer) Kühner grows on coniferous wood and has hooked pleurocystidia. It is widely distributed in Europe and North America (Singer 1956, Vellinga 1990, Banerjee & Sundberg 1995).

Pluteus martinicensis Singer & Fiard comes very close to *P. atropungens* as it also has unhooked pleurocystidia, however it has distinct tufts of caulocystidia and indistinct smell. This species is only known from Martinique and India (Pegler 1983, Pradeep et al. 2002). The type collection [MARTINIQUE: Bois inférieur de la Vallée de la Rivère du Lorrain, 100 m, 4.V.1975, Fiard, 489 Coll A (F, Holotype)] was examined and the following observations were made:

Basidiospores [30, 1, 1] 6.5-7.5 (8.0) × (5.5) 6.0-7.0 μm, avl × avw = 7.1 × 6.3 μm, Q = 1.0-1.2, avQ = 1.12, globose to broadly ellipsoid. **Basidia** 20-35 × 6-10 μm, 4-spored, broadly clavate. **Pleurocystidia** 78-100 × 18-25 μm, metuloid, (narrowly) fusiform, clavate or narrowly lageniform, mostly with rounded apex and without hooks, rarely with 1-3 short hooks at apex, with up to 4 μm thick wall. **Intermediate cystidia** mostly without apical hooks, with obtuse apex, colorless or rarely with brown pigment. **Cheilocystidia** 50-88 × 10-20 μm, (narrowly) clavate, lageniform, narrowly utriform or fusiform, with brown pigment. **Pileipellis** a cutis; hyphae 5-20 μm wide, cylindrical, with brown pigment; terminal elements 87-112 μm long, cylindrical to fusiform, usually tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 5-20 μm wide, cylindrical, colorless or with brown pigment. **Caulocystidia** 50-70 × 14-18 μm, in prominent tufts, clavate to lageniform, some with subcapitate apex, colorless or with brown pigment. **Clamp connections** present in all tissues.

Pluteus spgazzinianus Singer, *Pluteus aporpus* Singer and *Pluteus eucryphiae* Singer are three closely related taxa with colored cheilocystidia that grow on wood of angiosperms. All three species differ from *P. atropungens* because of the cervinus-type pleurocystidia. These species are known from several countries in South America (Singer 1958, 1961, 1986).

The herbarium of New York Botanical Garden harbors a collection from Chile (NY 77425) labeled as "*Pluteus coprophilus* Singer ined". The collection was recorded on ox dung, and initially submitted to NY as a possibly new species. However, before the name was published Singer changed his mind and considered it identical with *Pluteus atropungens*. After revising the collection we agree with Singer's opinion, however we have not included this collection in the above description because it lacks notes on the macroscopical characters. It should be noted that the habitat on dung is rather unusual for a *Pluteus* species; if more collections on the same habitat are recorded its relation with *Pluteus atropungens* should be reevaluated. The original notes and our own observations on the collection are available at <http://sweetgum.nybg.org/vh/specimen.php?irn=751>.

2. *Pluteus brunneidiscus* Murrill, N. Amer. Fl. 10: 131. 1917

Fig. 2

Pluteus washingtonensis Murrill, N. Amer. Fl. 10: 135. 1917

Type study of *Pluteus brunneidiscus*—**Basidiospores** [30, 1, 1] $6.5\text{--}8.6 \times 4.5\text{--}6.5 \mu\text{m}$, $av_l \times av_w = 7.6 \times 5.5 \mu\text{m}$, $Q = 1.29\text{--}1.47$, $avQ = 1.38$, (broadly) ellipsoid. **Basidia** $18\text{--}30 \times 6\text{--}10 \mu\text{m}$, 4-spored broadly clavate. **Pleurocystidia** $64\text{--}95 \times 18\text{--}24 \mu\text{m}$, abundant but many collapsed, metuloid, (narrowly) fusiform, with 2-4 hooks at apex, with up to $1.5 \mu\text{m}$ thick wall. **Intermediate cystidia** mostly collapsed, similar to pleurocystidia, some without hooks. **Cheilocystidia** $35\text{--}47 \times 15\text{--}20 \mu\text{m}$, abundant but mostly collapsed, clavate or sphaeropedunculate, colorless. **Pileipellis** a cutis of cylindrical hyphae, with brown pigment or colorless; terminal elements difficult to observe, cylindrical to fusiform. **Stipitipellis** a cutis; hyphae $5\text{--}20 \mu\text{m}$ wide, cylindrical, colorless or with brown pigment. **Clamp connections** present at least in pileipellis and at base of cheilocystidia.

Photographs of microscopical characters are available at <http://sweetgum.nybg.org/vh/specimen.php?irn=519097>

Type study of *Pluteus washingtonensis*—**Basidiospores** [30, 1, 1] $6.5\text{--}9.6 \times 5.3\text{--}7.1 \mu\text{m}$, $av_l \times av_w = 8.1 \times 6.2 \mu\text{m}$, $Q = 1.18\text{--}1.42$, $avQ = 1.30$, (broadly) ellipsoid. **Basidia** $20\text{--}33 \times 6\text{--}10 \mu\text{m}$, 4-spored, broadly clavate. **Pleurocystidia** $50\text{--}68 \times 12\text{--}20 \mu\text{m}$, abundant but many collapsed, metuloid, (narrowly) fusiform, with 2-4 hooks at apex, with up to $2 \mu\text{m}$ thick wall. **Intermediate cystidia** mostly collapsed, similar to pleurocystidia, some without hooks. **Cheilocystidia** $32\text{--}50 \times 15\text{--}20 \mu\text{m}$, abundant but mostly collapsed, clavate or sphaeropedunculate, colorless. **Pileipellis** a cutis of cylindrical hyphae, with or without brown pigment; terminal elements difficult to observe, cylindrical to fusiform. **Stipitipellis** a cutis; hyphae $5\text{--}20 \mu\text{m}$ wide, cylindrical, colorless or with brown pigment. **Clamp connections** present at least in pileipellis and at base of cheilocystidia.

Photographs of microscopical characters are available at <http://sweetgum.nybg.org/vh/specimen.php?irn=807168>

Description of all collections

Pileus (15) $30\text{--}55$ (80) mm hemispherical when young, later applanate or plano-convex, without umbo, slightly depressed at centre in older specimens; surface innately fibrillose, especially at centre, becoming rimose towards margin, dry or slightly viscid when moist, brown (7.5YR 4/3-4/6, 5/3-5/8), darker at centre (7.5YR 2.5/2-2.5/3, 3/3-3/4); margin translucently striate. **Lamellae** $L = 55\text{--}78$, $l = (0)1\text{--}3$, (moderately) crowded, free, ventricose, up to 5 mm broad, white when young, later pink, with whitish even edge, flocculose under lens. **Stipe** $30\text{--}50$ (90) $\times 5\text{--}15$ mm, cylindrical, subequal or with broad bulbous base, white

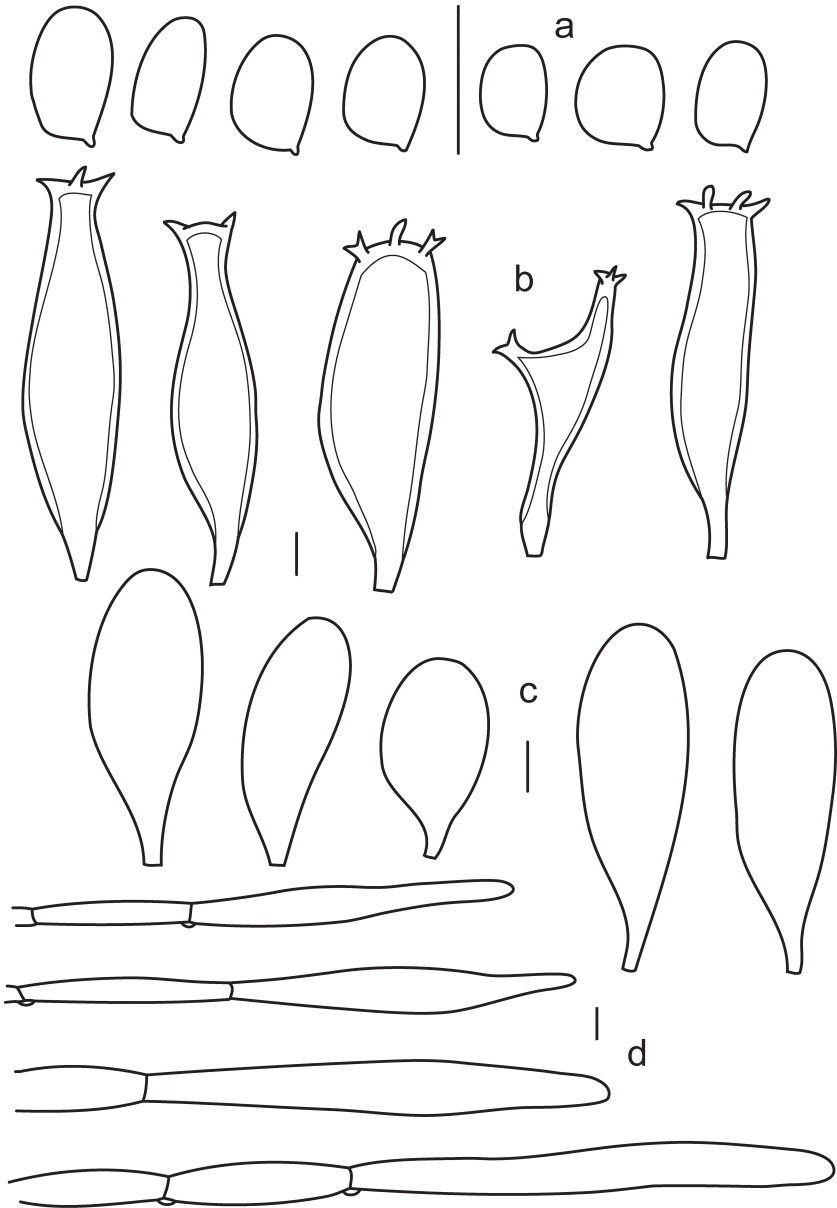


Fig. 2: *Pluteus brunneidiscus*—a: spores (from FS Earle 524 and WA Murrill 348); b: pleurocystidia (from ARAN-5006001 and N1263); c: cheilocystidia (from ARAN-5006001); d: pileipellis (from ARAN-5006001).
Scale bars = 10 μ m.

but covered with longitudinal brown fibrils, solid. **Context** in pileus white or pinkish near lamellae; in stipe white. **Smell** indistinct to subraphanoid. **Taste** as smell. **Spore print** not recorded.

Basidiospores [240, 9, 7] (5.5) 6.0-9.5 × (4.0) 4.5-6.5 (7.0) μm, avl × avw = 7.3-8.1 × 4.7-6.2 μm, Q = (1.10) 1.15-1.6 (1.7), avQ = 1.30-1.45, (broadly) ellipsoid, a few subglobose or oblong. **Basidia** 17-35 × 6-12 μm, 4-spored, broadly clavate. **Pleurocystidia** 65-95 × 15-25 μm, metuloid, (narrowly) fusiform to cylindrical, some with long peduncle, with 2-5 acute or obtuse, sometimes bifid, hooks at apex, with up to 3 μm thick wall. **Intermediate cystidia** similar to pleurocystidia, some very thick walled (up to 6 μm), others thin walled, some with bifid hooks at apex. **Cheilocystidia** 30-70 (80) × 15-30 μm, (narrowly) clavate or spheropedunculate, colorless. **Pileipellis** a cutis; hyphae 5-25 (30) μm wide, cylindrical, with brown pigment; terminal elements 50-180 μm long, cylindrical to fusiform, usually tapering towards obtuse apex. **Stipitipellis** a cutis; hyphae 5-25 μm wide, cylindrical, colorless or with brown pigment. **Clamp connections** present in all tissues.

Habitat and distribution—Solitary, on wood of broad-leaved trees (*Fagus*, *Quercus*). Known from the U.S.A and Spain. June-November.

Collections examined—**SPAIN:** Huelva: Aracena, La Galbana, in mixed forest of *Quercus ilex* subsp. *ballota* & *Quercus suber*, on wood, 8.XI.2003, L. Romero de la Osa, JA-CUSSTA 3069; **Navarra:** Donamaria, on *Fagus sylvatica* wood, 11.VII.1999, J.M. Lekuona, ARAN 5006001; **U.S.A:** **Connecticut:** Redding, 20.VII. 1902, F.S.Earle 524 (NY, Holotype of *P. brunneidiscus*); **Michigan:** Emmet Co., west branch of the Maple River, 2.IX.1957, A.H. Smith 57824 (MICH); Emmet Co., Tahquamenon Falls State Park, 13.VII.1953, R. Singer, N1263 (F); ibidem, 20.VI.1953, N81 (F); **Washington:** Seattle, 20.X. 1911-1.XI.1911, WA Murrill 348 (NY, Holotype of *P. washingtonensis*); ibidem, WA Murrill 705 (NY).

Comments—*Pluteus brunneidiscus* and *Pluteus washingtonensis* are both characterized by the small to medium-sized basidiocarps, with brown pileus usually darker at centre, cervinus-type cystidia and clamp connections. Singer (1956) and Banerjee & Sundberg (1995) already pointed at the similarity between the two species, and Singer (1986) cited *P. washingtonensis* as “probably conspecific with *P. brunneidiscus*”. The only difference observed between the type collections of both taxa was the slightly bigger spores of *P. washingtonensis* (see above).

Banerjee & Sundberg (1995) described the terminal elements on pileipellis of *P. brunneidiscus* as “narrow with rounded ends” and the same elements in *P. washingtonensis* as “versiform”. This was the only character used to separate them in the key elaborated by those authors. In the type collections the terminal elements were difficult to observe, but in modern collections (see description above) the shape of these elements was found to be variable within the same basidiocarp and with the same range of variation observed in most members of

sect. *Pluteus*. As no morphological characters were found to separate the two, *P. brunneidiscus* and *P. washingtonensis* are considered here synonymous.

The two Spanish collections fit well with the observations on the type material, and with the macroscopical characters of modern descriptions (Singer 1956, Banerjee et Sundberg 1995).

Several species, very similar or perhaps identical with *P. brunneidiscus*, were placed together by Singer (1986) in stirps *Subcervinus*; they are briefly discussed here:

Pluteus subcervinus (Berk. & Broome) Sacc., described from Sri Lanka has been suggested to be synonymous with *P. brunneidiscus* and *P. washingtonensis* (Singer 1956). The type collection [SRI LANKA: Central Province, Kandy District, year 1869, GHK Thawaites 9717 (K, Holotype)] has been studied, but unfortunately it is in very bad condition. The following observations were made:

Basidiospores [30, 1, 1] 5.4-8.5 × 4.4-5.5 μm, avl × avw = 6.9 × 5 μm, Q = 1.16-1.63, avQ = 1.39, (broadly) ellipsoid. **Basidia** not observed. **Pleurocystidia** 55-70 × 15-20 μm, abundant but many collapsed, metuloid, (narrowly) fusiform, with 1-3 hooks at apex; with up to 2 μm thick wall. **Intermediate cystidia** not observed. **Cheilocystidia** not observed. **Pileipellis** not observed. **Stipitipellis** not observed. **Clamp connections** not observed.

A modern description of this taxon can be found in Pradeep et al. (2002) and little differences were observed with our concept of *P. brunneidiscus*. Size of basidiocarps ("pileus 5.5-8 cm") and shape of the cheilocystidia ("often with a short neck or capitulum") are the most deviating characters. This could not be checked because the collection [K(M)90736] has been mislaid (Dr. Aguirre-Hudson (Kew Gardens), pers. comm.)

The synonymy of *P. subcervinus* and *P. brunneidiscus* remains unresolved. More collections from South Asia should be revised and compared with the above description of *P. brunneidiscus* before a final decision is made. It should be noted that the epithet *subcervinus* is the oldest available of all the taxa included in stirps *Subcervinus*.

Pluteus fibulatus Singer differs from *P. brunneidiscus* mainly by the strongly fibrillose surfaces of pileus and stipe. It is only known from Argentina and Brazil (Singer 1958, 1961).

Pluteus nigropallescens Singer has a black pileus, the stipe lacks longitudinal fibrils, and it has a terrestrial habitat. It is known from Venezuela (Singer 1961).

Pluteus mesosporus Singer has broader spores, "6.8-9 μm" according to Singer (1961); it is known from Venezuela. More research, and new collections, in this group of South American species are needed to test their relation with *P. brunneidiscus*.

The last species included by Singer (1986) in stirps *Subcervinus* is *Pluteus shii* Hongo. No information about this species could be retrieved in Japanese literature (Dr. Kobayashi, pers. comm.) and the name is not included in the Index Fungorum databases.

The European *Pluteus brunneoradiatus* Bonnard comes also very close to *P. brunneidiscus* but differs in the length of cheilocystidia (up to 105 (120) µm) and the scarcity of clamp connections: only 10% of the septa have a clamp (Bonnard 1987, 1993; Citérin & Eyssartier 1998). This species is known from Switzerland and Spain (Justo et al. 2007).

Future studies in this group, preferably combining molecular, morphological and biogeographical data, should address the significance of clamp-connections and other morphological characters for specific delimitation.

**Key to the species of *Pluteus* sect. *Pluteus*
present in the Iberian Peninsula and Balearic Islands**

- 1. Clamp connections present2
- 1. Clamp connections absent10
- 2. Lamella edge brown. Cheilocystidia with brown pigment3
- 2. Lamella edge concolorous or whitish. Cheilocystidia colorless4
- 3. On coniferous wood. Pleurocystidia mostly with 2-4(5) hooks at apex
..... *P. atromarginatus*
- 3. On angiosperm wood. Pleurocystidia mostly without hooks at apex
..... *P. atropungens*
- 4. On coniferous wood5
- 4. On angiosperm wood (rarely terrestrial)6
- 5. Pileus greyish brown. *P. pouzarianus* Singer var. *pouzarianus*
- 5. Pileus white *P. pouzarianus* var. *albus* Bonnard
- 6. Cheilocystidia up to 100-120 µm long7
- 6. Cheilocystidia up to 70 µm long8
- 7. Pileus brown [7.5YR 2.5/2-4/6], strongly radially fibrillose.
Clamp connections present only at 10 % of septa ... *P. brunneoradiatus* Bonnard
- 7. Pileus cream or ochraceous [10YR 7/3-7/4, 8/3-8/4], squamose at centre.
Clamp connections common in all tissues *P. sandaliticus* Contu & Arras
- 8. Basidiocarp white *P. pellitus* (Pers.: Fr) P. Kumm
- 8. Basidiocarp pigmented.9
- 9. Pileus and/or stipe with blue-green tinges [Gley1 5/1-5/2; Gley2 8/1].
Spores, avl × avw = 8.5-9.5 × 6.4-6.7 µm. *P. salicinus* (Pers.: Fr.) P. Kumm
- 9. Pileus and stipe without blue-green tinges.
Spores, avl × avw = 7.3-8.1 × 4.7-6.2 µm. *P. brunneidiscus* Murrill

10. Pileus brown [7.5YR 3/3-3/4, 4/6, 5/8, 10YR 2/2-7/3].
 Smell raphanoid *P. cervinus* (Schaeff.) P. Kumm
10. Pileus entirely white or only ochraceous at centre [10YR 8/2-8/6].
 Smell sweet-nauseating or indistinct 11
11. Smell sweet-nauseating. Cheilocystidia scarce or absent, lamella edge totally
 or partially gelatinized. Spores, avl × avw = 6.1-7.0 × 4.3-4.8 μm
 *P. petasatus* (Fr.) Gillet
11. Smell indistinct. Cheilocystidia abundant, lamella edge not gelatinized.
 Spores, avl × avw = 7.3-8.0 × 5.1-5.8 μm . . . *P. nothopellitus* Justo & M.L. Castro

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