

MYCOTAXON

Volume 95, pp. 137–180

January–March 2006

A monograph of the genus *Cookeina* (Ascomycota, Pezizales, Sarcoscyphaceae)

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Abstract—Eight species of the wood inhabiting pantropical genus *Cookeina* are described and illustrated. The genus *Cookeina* is characterized by large, stipitate or sessile brightly colored apothecial ascoma, with or without hairs, and by distinctive, thick-walled asci that have eccentricly placed opercula. An overview of the morphology, development and life histories of the species are given along with discussion of their relationships. A new species, *C. colensoiopsis*, is described from Venezuela, *C. speciosa* is recognized as a species complex, and a lectotype is designated for *C. sinensis*.

Key words—Pezizomycetes, cup-fungi, taxonomy

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Introduction

In this monograph we present an account of the genus *Cookeina*, a member of the *Pezizales*, which is comprised of species with lowland tropical and subtropical distributions. Species in the genus inhabit recently fallen angiospermous woody substrates and are presumed to be saprotrophic. The apothecial ascomata are brightly colored, range in size up to about 3 cm in diameter and are often stipitate. Because they are large, brightly colored and sometimes occur in profusion in a single small area, members of this genus are frequently collected. Even so, distributional records are incomplete and primarily account for the common species. Nonetheless, the knowledge of the biology of the species is minimal.

The genus has been placed in the *Sarcoscyphaceae* by all modern authors (Denison 1967, Eckblad 1968, Korf 1970, 1972, 1973, Le Gal 1953, Rifai 1968) and it has been well characterized based on macro- and microscopic features. Circumscription has been debated only in regard to the placement of *Peziza insititia*. This taxon has been placed in *Cookeina* or alternatively in the monotypic genus *Boedijnopeziza* (Ito & Imai 1937). Recently, Melendez-Howell et al. (2003) and Weinstein et al. (2002) include *Boedijnopeziza* in *Cookeina*. Within the *Sarcoscyphaceae* *Cookeina* has been allied most closely to *Microstoma*. Together *Cookeina* and *Microstoma* form a monophyletic group that has been recognized formally as the tribe *Boedijnopezizeae* (Cabrello 1988, Harrington et al. 1999, Korf 1970, 1972, 1973).

In this work we summarize current knowledge about the genus and provide identification keys, descriptions, and commentaries. We bring together in a single source the literature related to this genus. We are aware of certain gaps related to distributional records, particularly regarding Africa.

Historical background

Dating from the earliest days of biodiversity exploration in the Caribbean, the history of the genus *Cookeina* spans three hundred years. In 1705 an illustration of *Peziza speciosa* from the West Indies was published (Plumier 1705). The figure caption in Latin and French, a polynomial and the only description we have of Plumier's collections, reads "*Fungoides cyathiforme coccineum, oris pilosis/Foungoide en manière de verre couleur d'écarlete, à bord velu.*" With this brief commentary, the defining macroscopic characters of this fungus and of the genus *Cookeina*, to which it would ultimately be referred, were set down. These fungi are goblet-shaped, scarlet to carmine, with hairs at the mouth or margin of the apothecial ascomata. Although recorded by Fries (1822) under *Peziza speciosa* this early record went largely unnoticed until Dennis (1994) provided an interpretation of Plumier's illustration that placed it in the genus *Cookeina*. Under the broad, inclusive genus *Peziza* other species sharing these characteristics were described in the years following Fries. As tropical areas of the world were explored during the middle years of the 19th century several species were added, which ultimately were treated in the genus *Cookeina*. The short descriptions from this period often lacked essential details of spore size and hair morphology resulting in the production of many synonymous names for the common species. In the late 19th century, as part of a trend toward erecting segregate genera for the larger members of the *Pezizales*, several authors

nearly simultaneously created genera to accommodate these distinctive species. Cooke (1879) placed *P. sulcipes*, *P. hindsii*, *P. tricholoma* and *P. insititia*, all referable to *Cookeina* today, in *Peziza* subgenus *Trichoscypha*. Saccardo (1889) raised Cooke's subgenus *Trichoscypha* to generic level but in doing so created a later homonym. *Trichoscypha* Hooker f. (Bentham & Hooker 1862) is a genus in the *Anacardiaceae*. Further confusion exists because Boudier (1885) used *Trichoscypha* as a generic name for inoperculate discomycetes mostly belonging to the genus *Lachnellula* (*Hyaloscyphaceae*). Saccardo (1889) included species with both operculate and inoperculate asci in *Trichoscypha*. When Kuntze (1891) erected the genus *Cookeina* his circumscription created a highly heterogeneous assemblage of taxa including members of both the *Pezizales* and *Helotiales* but encompassed those taxa previously treated in *Trichoscypha*. Finally, *Pilocratera* was described (Hennings (1891). It post-dates the creation of *Cookeina* but was in general use for a period. Seaver (1927) designated *P. tricholoma* as the type species of the genus *Cookeina*; all authors have followed this typification. *Cookeina*, *Trichoscypha* and *Pilocratera*, are all based on the same type species (Eckblad, 1968).

Seaver (1913, 1925, 1927, 1928, 1936, 1942) studied the American species and codified both the use of the name and the concept of the genus *Cookeina*. At the same time, Boedijn (1929, 1933) studied and described Asian materials. Boedijn's observations on spore germination and ascus construction contributed to the overall knowledge of the genus. With some hesitation Seaver (1925) added *C. tetraspora* to the genus. This species differs in construction of the excipulum and in spore morphology. Later, it was designated the type species of the genus *Nanoscypha* (Denison 1972). Le Gal (1953) regularized the taxonomy through study of type material and elucidated the ascus morphology, as discussed more fully below. Weinstein et al. (2002) discussed relationships of the species based on a molecular phylogenetic study. Several authors treated one or more species from specific geographical regions as follows: **Africa and Madagascar** (Alasoadudra 1972, Douanla-Meli & Langer 2005, Le Gal 1953, 1960, Moravec, 1997), **Indonesia** (Boedijn 1929,1933), the **Americas** (Calonge 1986, Chacón & Medel 1990, Denison 1963, 1967, Dennis 1970, Gamundí, 1957, 1959, 1971, Hanlin et al. 1991, Hanlin 1993, Romero & Gamundí 1986, Tobon 1991), the **West Indies** (Dennis 1954, Maldonado González 2000, Patouillard in Duss 1903, Pfister 1974, Seaver 1936, Vooren 2002, 2003), **Asia and India** (Durrieu et al. 1997, Liou & Chen 1977, Nagao 1997, Otani 1971, 1975, Pfister & Kausal 1984, Wang 1997, Wang 2001, Yang 1990) and **Australasia** (Rifai 1968).

Materials and methods

This study used herbarium specimens and living material, particularly from South America. Type specimens of all taxa were examined when available. A concerted effort was made to collect and document specimens during two summers in an Amazonian forest in the southern part of Venezuela. In that study color variation in *Cookeina speciosa* was a particular focus. Collections from that study were deposited in the following herbaria: FH, USB, VEN.

Dried specimens were prepared for microscopic examination by rehydrating a small portion of an apothecium in water for 1-2 hours. The sample was then oriented on the stage of a sliding freezing microtome, covered with 50% aqueous commercial mucilage

and frozen. Median sections 20 to 50 μm thick were made. Sections were removed from the blade with a small, wet brush and placed on a microscope slide, where they were either mounted directly for examination or left to air-dry on the slide. In either case sections were selected under the dissecting scope, transferred with an insect pin to a slide and mounted in water, Cotton Blue in lactic acid or Congo Red in ammonia. Where quality and condition allowed 10 to 30 measurements of each structure were recorded for each set of sections. Only asci that contained mature ascospores were measured. Ascus measurements do not include the thin hyphal base. Ascospore sizes are based on the measurement of discharged ascospores; colors are given for fresh, dry and re-hydrated material. Drawings were made using a measured free hand method.

Terminology for cell types and arrangements follows Korf (1952, 1973) and Pfister & Kimbrough (2001). Herbarium acronyms follow *Index Herbariorum* (www.nybg.org/bsci/ih/ih.html); author's names are abbreviated following *Authors of Fungal Names* (www.indexfungorum.org/AuthorsOfFungalNames.htm).

In the nomenclators the notation “!” following citations indicates, that holotype, neotype, or isotype material was examined. The notation “!” indicates that syntype, paratype, or other authentic material was examined. A question mark before a species name indicates that type material was not examined but that the indicated placement is probable. Specimens examined are cited with the data as they appear on the packet label, supplemental data are enclosed in square brackets. Other abbreviations used are HT = holotype, IT = isotype, PT = paratype, and NT = neotype. Over the course of these studies many collections were consulted most are listed in the specimen cited section but citations have been shortened and a few collections that were consulted incidentally have not been listed.

Results and general discussion

Macroscopic features

Apothecia of *Cookeina* species are relatively large, ranging up to 3 cm in diam. They are characteristically pliable, resilient and not easily broken by handling. Carotenoids are present (Arpin 1969) which give the hymenia colors ranging from yellow and orange to scarlet and dark tones of mauve (see figure 1). In a few cases ascomata are white; in others maroon to brown. Apothecia of *C. colensoi* and *C. venezuelae* have short stipes or are nearly sessile. When present, stipes may range in length up to 8 cm. The outer surface of the ascomata, or the receptacle, may have distinct hairs distributed either over the entire surface, as in *C. tricholoma* and *C. sinensis*, or at the margins, as in *C. insititia* and *C. speciosa*. *Cookeina colensoi*, *C. indica* and *C. venezuelae* lack prominent hairs. Hairs are composed of fascicles of fused hyphae originating from the ectal or the medullary excipulum. Receptacle surfaces of all species are to some degree tomentose due to the projecting free hyphae that arise from the ectal excipulum.

Figure 1. Habitat photographs of species of *Cookeina*. A. *C. tricholoma* TL-11427 (C). B. *C. tricholoma* TL 11409 (C). C. *C. speciosa* TL 8405 (C). D. *C. speciosa* TL – 11393 (C). E. *C. speciosa* TL- 11475 (C). F. *C. venezuelae* Halling 5452 (NY). A-E courtesy of Jens Petersen (copyright Jens H. Petersen/MycoKey) specimens from Ecuador, and F. was used with the permission of Roy Halling, specimen from Venezuela.



Asci

Asci are large, up to 550 μm long and 40 μm broad and have thick walls. No part of the wall colors blue in iodine solutions; wall layers are differentially stained in Congo red in ammonia and the operculum stains more deeply in Congo red than surrounding regions of the wall. The long cylindrical asci are rounded proximally and distally. Asci have prominent, apically thickened opercula eccentrically located at the ascus apex. The asci open along a line of dehiscence to form the operculum. The thickened operculum is hinged at the lower region and it folds back at the time of rupture. Samuelson (1975) described the apical apparatus using TEM and Melendez-Howell et al. (2003) gave detailed information on ascus wall-layering using TEM. The asci are produced from narrow ascogenous hyphae which expand abruptly at the base of the asci. This gives the asci a rounded base. No croziers were observed. Because of the thinness of the hyphae at the ascus base, the hymenium often separates from the subhymenium when preparing mounts for microscopy. In all species asci mature synchronously. Within a single ascoma all ascospores are at exactly the same stage of development. The controls involved in this process are unknown. Asci that are constricted basally and that mature simultaneously are known in *Cookeina*, its sister genus *Microstoma* and in *Chorioactis* Kupfer ex Eckblad (Pfister & Kurogi 2004) which is placed in the *Sarcosomataceae*.

Le Gal (1953), Eckblad (1968) and Samuelson (1975) discussed the construction of the ascus in *Cookeina* species with a particular emphasis on their apical structure. The eccentric position and thickening of the operculum have been variously interpreted. The notation of such asci as “suboperculate” has been discussed by these authors.

Ascospores

Ascospores are pink or buff in deposit and range up to 52 μm long and 21 μm wide. They are ellipsoid, fusoid, or naviculate often appearing flattened on one side or curved, as in *C. insititia*. In light microscopy ascospores are smooth or have low longitudinal ridges or grooves and occasionally have transverse folds. The ridges may be unbroken from pole to pole or they may form disjunct rows that may anastomose. Berkeley (1875), who was the first to observe the markings, mentioned that one specimen of *C. tricholoma* had “longitudinal dots as a Diatom.” SEM studies of the smooth-spored species show some divergence. Melendez-Howell et al. (2003) illustrated low ridges and reticulations on the surface of ascospores of *C. insititia* and Moravec (1997) depicted similar markings in *C. colensoi* but Weinstein et al. (2002) indicate that the spores are smooth.

In some species the ascospore walls are thickened at the poles, forming short apiculae. Apiculae are well developed in *C. speciosa* and *C. venezuelae*, whereas in *C. tricholoma* the walls are thickened but the spores are not conspicuously apiculate. In other species polar thickenings are variably present. Boedijn (1933) found that in these species germ tubes originated from the apiculae. He observed that *C. insititia* has a single wall layer; Pfister (1973) verified this and noted that the other species of *Cookeina*, including *C. colensoi* and *C. venezuelae*, all have double spore walls. Pfister (1973) stated that these walls separate readily in 10-15% KOH. Melendez-Howell et al. (2003) through TEM studies showed that the perispore layer of *C. insititia* is very thin and that the spores have one wall layer or “paroi proper” as compared to the multiple layers present in *C. tricholoma*. TEM studies of *C. speciosa* (as *C. sulcipes*) failed to show clear ascospore wall layers (Melendez-Howell et al. 2003).

Berthet (1964) reported, and Pfister (1978a) confirmed, that ascospores are multinucleate, a character of the family *Sarcoscyphaceae*. Ascospores always contain oil guttules. There may be a single guttule, several large guttules or numerous small droplets; guttulation is somewhat variable within a species. There is a tendency for the guttules to fuse and amalgamate in drying and rehydration and, although the presence or absence of guttules is an important character, their number and arrangement is not reliable, particularly in dried specimens.

Paraphyses

Paraphyses are 1-6 μm wide at the apex, hyphoid and are sometimes slightly thinner below the apex but are not prominently enlarged above. Their cells form lateral projections that frequently fuse with cells of adjacent paraphyses. The result is a tight, interwoven, three-dimensional network surrounding the asci, among which individual paraphyses are often difficult to discern. For this reason some authors have said that paraphyses are lacking. We have seen paraphyses in all material examined. The apices are free and in some collections extend above the hymenium. In *C. colensoiopsis* and *C. speciosa* the terminal cells form setae that project above the level of the hymenium. Berthet (1964) reports the cells of the paraphyses to be multinucleate.

Hairs and receptacle surface

In all taxa, the surface of the receptacle is minutely tomentose or granulose due to the presence of globose to angular cells on the outer surface. These cells give the receptacle a pruinose appearance. In addition, short projecting hyphae, only clearly seen under the microscope, produce a tomentum. The tomentum may show two morphologies: 1) individual monilioid processes that arise from the margin and the receptacle. These elements are composed of 2-5 short hyaline cells with thick and rugose walls; 2) fused triangular bundles of cells at the margin that are wide at the base and narrow towards the apex.

True hairs are easily seen with the unaided eye and may reach a length of 7 mm. They are composed of adherent hyphal filaments running parallel to one another. The hairs arise from the cells of the outer excipulum and are located in 3-5 rows at the margin of the disc except in *C. sinensis* and *C. tricholoma* where the hairs arise from the medullary excipulum and are more or less evenly distributed over the outside of the receptacle and the stalk (fig. 2).

Excipular construction

The patterns of excipular organization vary only in minor detail from species to species. The ectal excipulum is composed of two layers: an outer ectal excipulum up to 175 μm thick, of *textura globosa* to *textura angularis*, the cells of which are arranged in indistinct rows of 3 to 7 cells. These cells have thick walls, especially the cells toward the outer surface where they also become rounded. The inner ectal excipulum is a layer at the junction between the medullary and outer ectal excipulum. It is composed of *textura intricata* or *textura oblita*, of loosely interwoven, septate, branched, thin-walled hyphae. In some cases the hyphae are immersed in a distinct gelatinous matrix with hyphae oriented perpendicular to the surface of the receptacle. This gelatinous layer can be seen as a light refractive continuous band in median sections. A gel layer is present in *C. colensoi*, *C. colensoiopsis*, *C. insititia* and *C. venezuelae*. Despite its prominence gel has often been overlooked in these species. We occasionally saw gel in other species

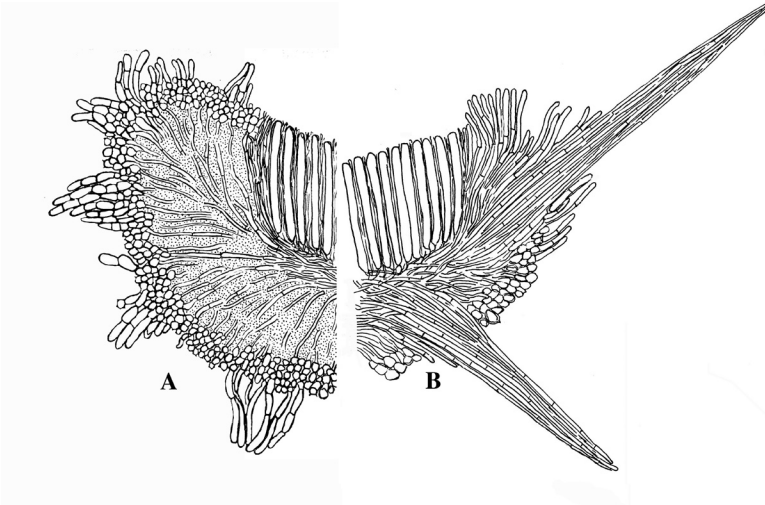


Figure 2. *Cookeina venezuelae* and *C. tricholoma*, cross sections of apothecia showing tissues and hairs. A. *C. venezuelae*, stipled regions indicate gelatinous tissues, hairs are superficial and arise from the ectal excipulum. B. *C. tricholoma*, no gelatinous tissues are present and hairs arise from the medullary excipulum.

but in those cases it occurred in isolated pockets within the excipulum rather than as a continuous, uniform layer and was variable within even a single collection.

The medullary excipulum, the innermost layer, which forms the core of the apothecium, is composed of *textura porrecta* to *textura intricata*. It is built up of narrow, septate, somewhat thick-walled hyphae that run parallel to the outer surface of the apothecium. The subhymenium, the layer beneath the hymenium, from which asci arise, is of dense *textura intricata*.

Development

Only *C. tricholoma* has been studied in any detail regarding apothecial development (Pfister 1978a). Based on a study of primordia collected in the field the hymenium is exposed in the youngest material observed. Pfister (1978a) suggested that all *Sarcoscyphaceae* develop in agymnohymenial fashion; this has yet to be challenged or confirmed across the entire family. Boedijn (1933) reported that in juvenile states the hymenium of *C. insititia* is covered by a “nearly continuous subconical sheath, which by expansion of the cup ruptures radially and gives rise to a ring of hairs.” Wang (1997) made similar observations. We have made no attempt to comparatively study primordial states in this work.

Spore discharge

In all species asci mature simultaneously. Boedijn (1933) observed that ascospores were discharged mostly in an oblique direction due to the eccentricity of the ascus opening. Both Seaver (1928) and Boedijn (1933) commented on ascospore discharge in *Cookeina*, most probably in *C. speciosa*, based on their drawings of the ascospores.

Boedijn claimed that the ascus jet (ascospores and epiplasm) passed through the ascostome (ascus pore) all at once, while Seaver (1928) suggested there was a contraction between each individual spore ejection. In clarifying his earlier observation Seaver (1942) said that he had not stated there was a pause between each ascospore being ejected, as implied by Boedijn (1933), but that there was an expansion and contraction of the ascostome between each spore ejection.

Despite the uniform maturation of the asci, Boedijn (1933) noted that ascospores were discharged over a period of several days. Zoberi (1973) showed that as water evaporated from the apothecium, or when it was removed mechanically, ascospore discharge occurred. All spores were discharged within a 5-hour period.

One of our observations from the field relates to Zoberi's experimental work. In the stipitate taxa the cup may fill with water during rains. As these cups fill the added mass causes the tough and resilient stipes to bend and dump out the accumulated water. Because the stipes are resilient and flexible the cup resumes its previous position and is undamaged. Thus, the cups can fill, be emptied and be hydrated for ascospore discharge.

Anamorphic state, growth and cultivation

Boedijn (1929, 1933) reported germination of ascospores of *Cookeina tricholoma* and *C. speciosa* as *C. sulcipes*. He noted three types of germination. One in which one or two germ tubes were formed but no conidia, a second in which spores produced numerous short germ tubes, each of which bore several conidia, and a third type in which several germ tubes formed, elongated but only rarely produced conidia. Modes of germination in *Cookeina* species were studied by Paden (1975), Hanlin et al. (1991), Hanlin (1993) and Melendez-Howell (1986) and were found to conform to the original observation of Boedijn. The anamorphic states are similar to those of *Sarcoscypha* (Alexopoulos & Butler 1949, Harrington 1990, Rosinski 1953), *Phillipsia* (Paden 1975, 1984) and *Nanoscypha* (Pfister 1973).

Berthet (1964) stated that cultures were light in color, white or cream, never grey or black. He indicated that septal aureoles, thickenings associated with septa, are very well developed in cultures. Sánchez et al. (1993) and Sánchez Vázquez et al. (1995), investigating in Mexico the edible *Cookeina speciosa*, determined the conditions under which ascomata develop and the cultural requirements necessary for fruiting. Sánchez Vázquez et al. (1995) suggests this species causes a white rot which is in agreement with our general observations on the condition of wood associated with fruiting.

Distribution

Two species, *C. speciosa* and *C. tricholoma*, are pantropical but *C. speciosa* represents a species complex and there is variation within the complex (Weinstein et al. 2002). Other species seem to be more limited in distribution. *Cookeina colensoi* is primarily a southern hemisphere taxon occurring in subtropical zones. A few collections are known above the equator in Asia and the Americas. *Cookeina indica*, *C. insittia*, and *C. sinensis* are restricted to Asia. The range for *C. indica* has been expanded in recent years from India to Southwestern China (Yang 1997). In the Americas, *C. venezuelae* is known from northern South America, Central America and from the West Indies. Gamundí (1983) presented a distribution map for Central and South American species. In this paper *C. colensoiopsis* is described from Mexico and Venezuela.

Phylogeny and relationships

The genus *Cookeina* has been placed in the family *Sarcoscyphaceae* in modern treatments (Cabrello 1988, Eckblad 1968, Harrington et al. 1999, Korf 1970, 1972, 1973, Le Gal 1969, Weinstein et al. 2002). The family is recognized fundamentally in the sense of Korf (1970, 1972, 1973) as one of two families considered to have thick ascus walls and thickened opercular areas. The *Sarcoscyphaceae* are generally brightly pigmented and the *Sarcosomataceae* are generally dark in color. In all molecular phylogenetic studies a monophyletic *Sarcoscyphaceae* is recovered. Within the group, *Cookeina* and *Microstoma* form a well-supported clade. This group corresponds to the tribe *Boedijnopezizeae* as delimited by Korf (1970).

Weinstein et al. (2002) studied the species of *Cookeina* using ITS sequence data. Morphologically the species are distinguished by the combination of several features including ascospore shape and surface relief, presence and origin of apothecial hairs and presence or absence of gelatinous material within the cortical layer of the excipular tissue. The genus was shown to be monophyletic with several well-supported lineages that correspond to the morphological species concept traditionally used. Collections referred to as *C. speciosa* segregate within a clade. Hymenial color differences correlate with groups within that clade. In this work we consider *C. speciosa* to represent a species complex. Detailed populational studies will be necessary to understand fully relationships within this complex. The placement of *C. insititia* in the ITS study is ambiguous but falls within *Cookeina*. Thus, the genus *Boedijnopeziza*, with *C. insititia* as the type species, is not recognized.

Taxonomic treatment

Cookeina Kuntze, Rev. Gen. Pl. 2:849. 1891.

[= *Trichoscypha* (Cooke) Sacc., Syll. fung. 8: 160. 1889, non Hook. f. 1862.]

= *Pilocratera* Henn., Bot. Jahrb. Syst. 17: 9. 1891.

= *Boedijnopeziza* S. Ito & S. Imai, Trans. Sapporo Nat. Hist. Soc. 15: 58. 1937.

TYPE SPECIES: *Peziza tricholoma* Mont. (selected Seaver, 1927)

Apothecia medium to large, cupulate to funnel-shaped, sessile or stipitate. **Hymenium** white, pink, yellow, orange, salmon, rose, or chocolate. **Outer surface** of the apothecium concolorous or lighter than the hymenium, nearly glabrous to tomentose or with long, prominent fasciculate hairs on the margin. **Excipulum** of two distinct layers: an inner layer of *textura intricata* of rather narrow diameter and an outer layer of pyriform to globose cells which arise from hyphae originating in the medullary excipulum. The outer layer is constructed of two zones, the inner zone of which may contain gelatinous material. **Asci** cylindrical with a prominently thickened lateral operculum, J-, eight-spored, at the base abruptly connected to a narrow, long, hypha, all spores within a single apothecium at the same state of maturation. **Ascospores** hyaline, smooth or with longitudinal and rarely transverse markings, ellipsoid to fusoid, pinkish or buff in deposit, often bilaterally asymmetrical, guttulate. **Paraphyses** anastomosing to form a network around the asci, in some species developing apically to form setiform hairs.

STRATE: On decaying, generally recently dead, twigs, branches, and larger logs.

DISTRIBUTION: Species are found throughout the lowland tropics. *C. tricholoma* and *C. speciosa* are pantropical. Other species have restricted distributions.

Key to species of *Cookeina*

1. Outer surface of the ascomata with distinct hairs that are visible without a hand lens, with a well developed stipe 1
1. Outer surface of the ascomata lacking obvious hairs, lacking a stipe or with a short stipe..... 5
 2. Hairs arranged prominently at the margin of the apothecium, hairs pyramidal in form, apothecia narrow goblet form, gel layer present in the excipulum, ascospores narrow sub-fusoid to fusoid, asymmetrical and distinctly curved, with pointed ends *C. insititia*
 2. Hairs either grouped at the margin or more or less evenly distributed over the outersurface of the apothecium, apothecia widely flaring, ascospores ellipsoid to broadly fusoid..... 3
 3. Hairs forming distinct rows or ridges at the margin of the apothecia, hairs arising from the medullary layer, ascospores ellipsoid *C. speciosa* complex
 3. Hairs more or less evenly covering the outer surface of the apothecium, spores ellipsoid to broad fusoid..... 4
 4. Ascospores smooth *C. sinensis*
 4. Ascospores with longitudinal striations *C. tricholoma*
 5. Excipulum lacking gelatinous material, ascospores elliptical to broadly fusoid with longitudinal striations, flattened at one side, appearing sub-papillate ... *C. indica*
 5. Excipulum with gelatinous material 6
 6. Ascospores ornamented with both longitudinal and transverse folds, ellipsoid, apiculate at each end, bilaterally symmetrical or asymmetrical..... *C. venezuelae*
 6. Ascospores smooth (if considered short stipitate, *C. insititia* could key here) 7
 7. Paraphyses without setose projections, ascospores ellipsoid to subfusoid, sometimes short apiculi or papillae present at poles *C. colensoi*
 7. Paraphyses with setose projections, ascospores ellipsoid, smooth *C. colensoiopsis*

Descriptions of species

Cookeina colensoi (Berk.) Seaver, Mycologia 5: 191. 1913.

Fig. 3

- = *Peziza colensoi* Berk. in Hooker, Fl. nov.-zel. 2: 200. 1855 !! = *Sarcoscypha colensoi* (Berk.) Sacc., Syll. fung. 8: 157. 1889. = *Cookeina colensoi* (Berk.) Seaver, Mycologia 5: 191. 1913. [misapplied = *Cookeina venezuelae* (Berk. & M.A. Curtis.) Le Gal] = *Boedijnopeziza colensoi* (Berk.) Korf & Erb, Phytologia 21: 202. 1971.
- = *Peziza aluticolor* Berk., J. Linn. Soc., Bot. 13: 176. 1872 [1873] !! = *Geopyxis aluticolor* (Berk.) Sacc., Syll. fung. 8: 64. 1889. = *Ciboria aluticolor* (Berk.) Rick, Ann. Mycol. 2: 408. 1904.
- = *Geopyxis moelleriana* Henn., Hedwigia 41:30. 1902.
- = *Geopyxis ciborioides* Starbäck, Ark. Bot. 20 (2): 1. 1904. = *Geopyxis aluticolor* var. *ciborioides* (Starbäck) Rick, Brotéria Sér. Bot. 25: 81. 1931. = *Cookeina colensoi* var. *ciborioides* (Starbäck) Gamundí, Bol. Soc. Argent. Bot. 6: 218. 1957.

= *Ciboria sessilis* Starbäck, Ark. Bot. Utgivet. Avk. Svenska 2 (5): 3. 1904 !

= *Ciboria argentinensis* Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires III 19: 444. 1909
!!, !

[= *Peziza subtropica* Speg. in ed., fide Gamundi (1959)]

Apothecia scattered, short stipitate centrally, seldom sessile, deeply cup-shaped, when dry, 2–15 mm tall and 2–17 mm diam. **Disc** brighter colored than receptacle, when fresh, orange to orange-yellow, when dry, ochre, ochraceous or orange-ochraceous. **Margin** frequently in-rolled when dry, with 0–4 low circular ridges more evident when dry, with tomentum bundles originating from the outer excipulum. **Receptacle** when fresh, paler than disc, up to 25 mm tall and 2–20 mm diam; when rehydrated, orange to golden-yellow to yellow to light-yellow to cream; when dry, 10–17 mm diam, cream, light yellow, yellow, orange, ochre, beige, or brown; sometimes drying in a venose, convoluted, ribbed pattern, more evident at the base of the receptacle where it shows a ribbed or venous pattern, continuing as striations on the stipe; furfuraceous. **Stipe** short to substipitate, when fresh or re-hydrated light yellow to cream-colored to whitish and 2–20 x 1–3 mm, when dry yellow to orange, concolorous with dry receptacle and 2–15 x 1–2 mm, sub-cylindrical somewhat wider at the base with a disc-shaped “holdfast” reaching 2 mm diam, with longitudinal ridges and furrows when dry on all of its length and sometimes extending towards the receptacle. **Tomentum** of two types: 1) individual moniloid processes that arise from the margin and also sparsely covering all the receptacle giving it a furfuraceous appearance, composed of 3–5 short hyaline cells, cells 8–12 µm diam with thick and rugose walls, walls 2–4 µm wide, hairs 44–100 x 10–14 µm; 2) fused triangular-shaped bundles of cells present at the margin, 40–100 µm long, 34–64 µm wide at the base, and 8–22 µm wide at the apex. **Outer excipulum** of *textura primatica* to *textura angularis*, becoming globose on the outside, forming a 3–5 celled-layer of 20–40 µm thick, cells 8–14 x 8–16 µm, walls of outer cells roughened with brownish material, outer layer is irregularly thickened giving it a pruinose appearance. **Medullary excipulum** divided into two layers: the layer adjacent to the ectal excipulum of *textura oblita*, of thin-walled hyphae immersed in a gel and oriented perpendicular to the receptacle surface, (20-) 40–80 µm wide, hyphae 1–5 µm diam. The layer more proximal to the sub-hymenium of *textura porrecta* 60–90 µm thick, sometimes with gel in patches, long-celled, arranged parallel to the receptacle surface, cells 3–6 µm wide. **Subhymenium** *textura intricata*, 20–40 µm wide, somewhat gelatinized. **Hymenium** 280–350 µm thick, with no setae present. **Asci** cylindrical, base round to slightly tapering, (252-) 340–416 x 16–24 µm, abruptly arising from thin basal hyphae 8–32 x 4–8 µm, 8-spored located in the top 1/2 of the ascus, **Ascospores** obliquely uniseriate, broad elliptic-fusoid narrowing at the poles, unequal with a flatter side, sometimes short apiculi or papillae present, (0-)2(-3) large oil guttules and often several smaller ones, hyaline, smooth, 24–40 x 9–16 µm. **Paraphyses** filiform, septate, braching, with frequent anastomosis forming a dense network, agglutinated, 1.6–4 µm wide in the middle, enlarging at the apex to 4 µm, equal to the asci or exceeding them by 2–4 µm.

SUBSTRATE: on twigs 6–10 mm diam, on decomposed wood.

DISTRIBUTION: Australia, New Zealand, India, Madagascar, Samoa, China, Argentina, Brasil, Colombia, Jamaica, Mexico .

ILLUSTRATIONS: Hooker (1855) as *Peziza colensoi*, f. 5a-c; Cooke (1879) as *P. colensoi* fig 108, as *P. aluticolor* f. 198; Cooke (1892) as *Geopyxis aluticolor*, fig. 144; Masee (1896)

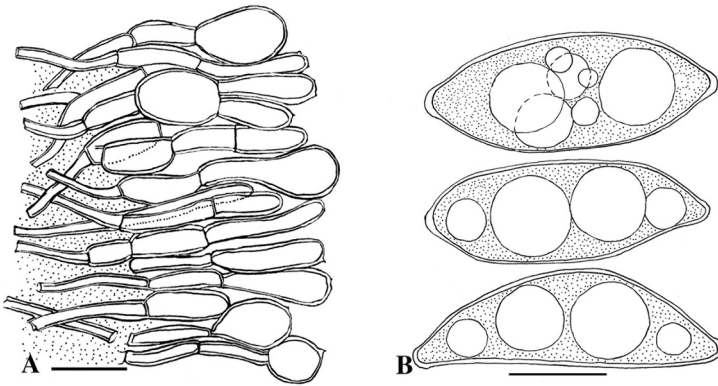


Figure 3. *Cookeina colensoi*. A. Cross section showing outer layer of the excipulum, bar = μm . B. Ascospores, bar = μm . New Zealand, Bay of Plenty, Kaimai Ranges, vic. Katikati, 15 Feb 1998, S. P. Mortimer (PDD 68535).

tab. 16, fig. 14-15; Starbäck (1904) as *Geopyxis ciborioides*, f. 1-3; Starbäck (1904) as *Ciboria sessilis*, figs 8, 9; Le Gal (1953) figs. 110-113;

Gamundí (1957) Lam. I; Rifai (1968) figs. 21, 22; Chacón & Medel (1990) figs. 17-20; Hood (1992) fig. 14 a; Weinstein et al. (2002) fig. 3E.

NOTES ON TYPE SPECIMENS AND NOMENCLATURE: The holotype specimen of *C. colensoi* from Berkeley's herbarium (K) has a drawing of a the characteristic spore on the packet. The specimen was placed in a type cover by R. W. G. Dennis (Brian Spooner, pers. com.) although it is note labeled as completely as the prologue suggests (see specimens cited below). Massee (1896) cites Colenso, no. 2810. His drawing and description accurately depict the structure of the outer excipulum and may be the first to describe and illustrate the anatomy of this species. After a study of the holotype of *Peziza aluticolor* we agree with Cooke (1879) and Saccardo (1889) that this material should be referred to *C. colensoi*. Seaver (1928) used the name *C. colensoi* for a different species, *C. venezuelae*, as pointed out by Le Gal (1953). The type specimen of *Geopyxis ciborioides* (Brazil, Rio Grande do Sul, col. Ijuhy, ad ramos mucoscentes humi jacentes in silva primaea, 4/4 1893, 323 B) was not located in our search. Gamundí (1957) also was unable to locate the type specimen and followed Rick (1931) in treating this as *G. aluticolor* var. *ciborioides*. Gamundí (1957) stated that *Geopyxis aluticolor* var. *ciborioides* differs from *Cookeina colensoi* only by the absence of paraphyses. In our experience, all species of *Cookeina* have paraphyses; we question the observation that they are absent in this taxon. We studied the holotype and isotype specimens of *Ciboria argentinensis* as did Gamundí, but found that Gamundí's (1957) measurements of ascospores and asci differed from ours, 24-28.8 x 8.4-9.6 μm vs. 24-32 x 8.8-13.6 μm for ascospores and 317-335 x 14.5-18.8 μm and 340-380 x 16-24 μm for asci. She stated that asci and ascospores of *C. argentinensis* are smaller than those found in other collections of *C. colensoi*. It is the case that asci and ascospores of *C. argentinensis* fall at the lower range for this species but they are not as small as she indicated. Based on the description, Le Gal (1953) thought *G. elata* was a synonym of *C. colensoi*, not of *C. sulcipes* as Boedijn

(1933) indicated. On reading the description, we can understand Le Gal's interpretation, since the evident marginal hairs and furrows of *C. speciosa* are not mentioned, though two of the characters that Masee (1898) describes are not at all typical of *C. colensoi*: the length of the stipe (6–8 cm) and its growing on the ground. We were able to examine the type specimen (NY) of this species, and determined it to be *C. speciosa*. It presents the following characters, typical of *C. speciosa*: marginal ridges (three in this specimen) with evident hairs, no gel in the excipular tissues, fine striations on the ascospores, and hymenial setae. It is likely that Masee's mention of this fungus growing on soil is based on material fruiting on buried twigs. We were unable to locate any of the original material of *Geopyxis moelleriana* (St. Cathar. bei Blumenau und Velha auf Holz, April 1891, 24 November 1891. No. 54b, 252, 903. Col. Möller). The holotype of *Ciboria sessilis*, from Brazil, consists on a few apothecia, all with short stipes (up to 5 mm), with the exception of one which has a stipe 15 mm long. The specific epithet "*sessilis*" may not have been particularly appropriate.

GENERAL NOTES: This species is easily recognized because of its lack of hairs, presence of a gelatinous excipular layer and ascospores that appear smooth under the light microscope. The ascospore surface was shown by Weinstein et al. (2002) to be smooth under SEM examination; this conforms to the standard interpretation of the species. Moravec (1997) described the spore ornamentation under light microscopy as wrinkled and under SEM showed low, interconnected ridges and channels. His material was from Madagascar and has not been reexamined by us. Le Gal (1953) indicated that ascospores were smooth in the materials she examined from Madagascar. Neither Moravec nor Le Gal mentioned the presence of a gelatinous layer. As fresh material from Madagascar becomes available it might be worthwhile to reexamine it critically and to consider the possibility that the Madagascar specimens represent a distinct, undescribed species.

There are several variable features among collections. In some specimens, the cells of both types of tomentum were covered with an amorphous material or deposition. These deposits give the cells a rugose appearance. There is variation in spore and ascus size. For example, a collection from Sao Leopoldo, Brazil, from the Lloyd herbarium (BPI) has spores 13–14 x 5–6 μm ; these are smaller than we recorded but the other characters match well *C. colensoi*. Le Gal (1953) reported asci up to 440 μm , triangular hairs up to 160 μm tall and 100 μm wide at the base. These are larger than we found for these structures. Rifai's (1968) measurements of hairs are larger as well, 150 μm long and 80 μm at the base. But he reports asci and paraphyses that are thinner: asci 14–18 μm , paraphyses 1–1.8 μm . Korf & Erb (Korf 1971) transferred *C. colensoi* to *Boedijnopeziza* and later Korf (1973) used the character of presence of a gelatinous layer to distinguish the genus *Boedijnopeziza*. Examination of their material showed it to be *C. venezuelae* rather than *C. colensoi*. The gel layer as a character for distinguishing the genus *Boedijnopeziza* has been the subject of considerable debate over the years. For a more detailed discussion of the confusion surrounding *Boedijnopeziza* and gelatinous material see the introduction.

SPECIMENS EXAMINED. ARGENTINA. BUENOS AIRES: Punta Lara, ad ramenta arborum sempervirentium in silva marginali, locis umbrosis, 9 Jun 1949, *R. Singer* 2129 (CUP); TUCUMÁN: ramas muertas putrescentes, *Celtis* sp., 16 April 1906, *C. Spegazzini* 4107 (LPS, HT with Spegazzini's drawings of asci, ascospores and paraphyses,

IT (2 packets) of *Ciboria argentinensis*); Anta Muerta, Sierra de San Javier, on old fallen branches, 24 Apr 1949, *Singer & Digilio 2116* (CUP); Quebrada de Lules, ad ramos emortuos, 2 Apr 1949, *R. Singer 2114* (CUP); 35km del camino a Tafi del Valle, 26 Feb 1949, *R. Singer 2115* (CUP). AUSTRALIA. NEW SOUTH WALES: Clarence River, HT of *Peziza aluticolor* (K, NY-G. Masee Herb.); Bobong Creek, Wild Cattle Creek State Forest, near Cascade, on undetermined wood, 11 Feb 1984, *R. Coveny 38/1984* (DAR 63642a); Dorrigo, Dorrigo National Park, on undetermined wood, 12 Feb 1984, *R. Covey 56/1984* (DAR 63646a). BRASIL. MATO GROSSO: Sta. Anna de Chapada, in silva ad lignum. 23 Feb 1894, *Madine 546* (B); HT of *Ciboria sessilis* Starbäck (S); *G. O. Malme*, 546B (S); NOVA PETROPOLIS: 1923, *Rick* (FH); SANTA CATARINA: Porto Novo, Sta. Catharina, 1928, *Rick 531* (FH) [as *Geopyxis aluticolor*]; Sao Leopoldo, in ramis frequentissima, 1903, *Rick 14* Austro-Americani (NY, FH, FH-Pat) [as *Ciboria aluticolor*]; Feb 1904 (FH) [as *Ciboria aluticolor*]; Sao Leopoldo, Rio Grande do Sul, 1925, *Rick* (FH) [as *Geopyxis aluticolor*]; Sao Leopoldo, *J. Dutra 33* (NY); S. Salvador, 4 Jan 1944, *Rick 20803* (NY) [as *Ciboria*], packet is empty. CHINA. GUIZHOU: on twigs, 4 Aug 1988, *Li Yu Zong, Yu-chen & Ying Jian-zhe 59537* ex HMAS (FH), Xishungbanna, Menlen, ex situ of endangered plants area, 500 m. alt, on rotten wood. *M. Zang 11532*, 25 X 1988 (HKAS 20381). COLOMBIA. MAGDALENA: Sierra Nevada de Santa Marta, Cerro Quemado trail, 1500-2300m, 24 Aug 1935, *G. W. Martin 3714* (FH). INDIA. West Kameng, A. P., on wood in an angiospermous forest, 5 Sept 1981, *Rishi Kaushal 18556* (FH); as previous, *Rishi Kaushal 18557* (FH). MEXICO. TAMAULIPAS: Rancho del Cielo, on fallen limb, 29 Jul 1974, *A. J. Sharp 62500* [ex Herb. Univ. Tenn. 39652] (CUP 62500) (FH 39652). NEW ZEALAND. SOUTHERN NORTH ISLAND.: On dead sticks, near the River Manawatu, Colenso, holotype of *P. colensoi* (K), (NY-G. Masee Herb) [as *Peziza colensoi*, *Peziza aluticolor*]; AUCKLAND: Hunua Ranges, Cossey's Track, on wood, 9 May 1996, *1996 Fungal Foray* (PDD66040); BAY OF PLENTY: Kaimai Ranges, Timms Road, vic. Katikati, on decorticated wood, 15 Feb 1998, *S. P. Mortimer* (PDD 68535); COROMANDEL: Kauaeranga Valley, vic. Thames, on decorticated wood, 1 Apr 1981, *G. J. Samuels & H. Thiers* (PDD 42052); On decorticated wood, 1 Apr 1981, *G. J. Samuels, H. Thiers*, (PDD 42053); Kopu-Tairua Road, Kaitarakahi Summit Track, 37 08'S, 175 41'E, on decorticated wood, 14 Mar 1998, *P. R. Johnston, R. E. Beever, S. L. Stephenson* (PDD 68628); vic. Port Charles, track from Stoney Bay to Fletcher Bay, on wood, 25 Feb 1989, *P. R. Johnston* (PDD 55306); NORTHLAND: Mangamuka Scenic Reserve, on wood, 8 May 1983, *G. J. Samuels, T. Matsushima, R. H. Petersen* (PDD 46278); Omahuta S. E., Omahuta Kauri Sanctuary vic. Mangamuka Bridge, on wood, 10 May 1981, *G. J. Samuels, E. Horak* (PDD 42049); WAIKATO: vic. Otorohanga, Native Forest Restoration Trust, Owen Lewis Reserve, 220m, on blackened, decorticated wood, 24 May 2000, *P. R. Johnston* (PDD 71534); Waitomo, on bark and decort. wood, 26 Apr 1983, *G. J. Samuels, P. R. Johnston, R. H. Petersen* (NY, PDD 46838). SAMOA. *C. G. Lloyd 5020* (FH-Pat) [as *Peziza* (*Geopyxis*) *aluticolor*]; Jan 1900, *C. G. Lloyd 5020* (NY); 1904-5, *C. G. Lloyd 5021* (NY), infertile.

***Cookeina colensoiopsis* Iturriaga & Pfister, sp. nov.**

Fig. 4

Haec species C. colensoi similitudine ex strato gelatinoso, tomento et ascosporis laevibus adest, sed haec differt eo setas in hymenio habet. Holotypus: Cerro El Avila, on wood, Norte de Caracas, Agosto 2002, Tamia Souto (FH)

Apothecia scattered, centrally stipitate, deeply cup-shaped, up to 20 mm tall when fresh, and 14–15 mm tall when dry. **Receptacle**, when fresh, 17 mm tall and 2–15 mm diam, when dry 6–8 mm tall and 15–20 mm diam; when fresh lighter colored

than the disc, when rehydrated, light yellow receptacle and margin; when dry, beige; drying in a venose-ribbed pattern at the base, which continues with striation in the stipe, furfuraceous uniformly because of white hair-like projections. **Stipe** cream-colored (fresh), sub-cylindrical, somewhat wider at the base, 3-13 x 1-3 mm (fresh) and up to 2 x 9 mm (dry), longitudinally ribbed when dry, furfuraceous with white hair-like projections. **Disc** darker colored than receptacle, bright yellow to orange (fresh), ochre (dried), orange (rehydrated). **Margin** concolorous to receptacle when fresh or dry, ribbed with three striations or ridges, presenting the two types of tomentum. **Tomentum** of two types, originating from the outer excipulum: 1) individual monilioid processes, minute, as hair-like projections, covering margin, receptacle and stipe, giving it a furfuraceous appearance, 30-92 x 10-24 μm , 2-10 cells tall, cells round or elongated with thick-rugose walls, cells 10-22 x 8-16 μm ; 2) short and whitish triangular-shaped bundles consisting of 5-12 fused individual monilioid *gosto 2002, Tamia Souto (FH)* processes, only present on marginal ridges. **Outer ectal excipulum** of *textura globulosa* to *textura prismatica*, 4-5-celled layer 30-90 μm wide, cells 8.0-14 μm diam. **Medullary**

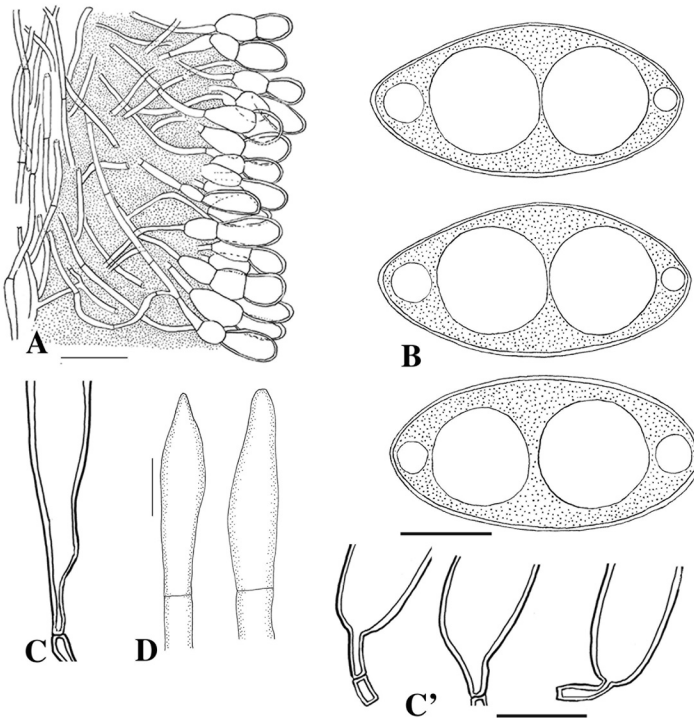


Figure 4. *Cookeina colensoiopsis*. A. Cross section showing outer layer of the excipulum, bar = 25 μm . B. Ascospores, bar = 10 μm . C, C'. Ascus bases, bar = 25 μm . D. Setose apices of paraphyses, bar = 25 μm . Caracas, Venezuela; on decaying wood, 1903, A. F. Blakeslee (FH).

excipulum divided into two layers: the layer proximate to the ectal excipulum of *textura oblita*, thin-walled hypha immersed in a gel and oriented outwards perpendicular to the receptacle's surface, layer 50–100 μm wide, hyphae 2–4 μm diam. The layer proximate to the sub-hymenium (or more distant to the ectal excipulum) of *textura porrecta*, long-celled, layer 60–100 (–600) μm wide, cells 4–6 μm wide. **Subhymenium** *textura intricata*, somewhat gelatinized, layer 4550 μm wide. **Hymenium** 380–450 μm thick. **Hymenial setae** present, intemixed with asci and paraphyses, brownish, 430–440 x 2 μm , with lanceolate terminal cell, exceeding hymenial elements by 10–20 μm . **Asci** long cylindrical with a round base, 340–420 x 10–20 μm , ending in an abrupt manner to connect with hyphal-like basal appendage, a few times tapering slightly at base, basal appendage 4–28 x 4 μm . **Ascospores** obliquely uniseriate broad elliptic, unequally sided, narrowing slightly at ends, with a short apiculum present at both ends, mostly 2 large central oil guttules with two smaller ones at ends, hyaline, smooth walled, with no wall markings, 30–34 x 12–14 μm . **Paraphyses** filiform, septate, branching, anastomosing to form a network, agglutinated, 2–4 μm wide in the middle, enlarging in a clavate shape at the apex to 4.0 μm .

SUBSTRATE: on decaying wood.

DISTRIBUTION: known from Venezuela, possibly only from El Ávila National Park.

GENERAL NOTES: Our attention was caught by an unusual specimen identified as *C. colensoi*. Denison (1967) studied this collection and wrote that “a single collection [of *C. colensoi*] is known from Venezuela, which suggests that it may yet be found in Central America.” In order to determine if this specimen really belonged to *C. colensoi*, it was re-examined and found to differ in form of the paraphyses from *C. colensoi*. This specimen was collected by A. F. Blakeslee in 1903, in Caracas, Venezuela, on decaying wood (FH). Specimen annotations by Blakeslee indicated that “it is not *P. venezueliana* [sic]” and that ascospores are 40–45 x 14–16 μm (our measurements from the same specimen were 30–34 x 12–14 μm). The species was known only from that single collection from the Caracas region, and we do not know the exact locations Blakeslee visited. Since the Caracas area is reasonably well collected and in view of the urban expansion, we assumed that the species no longer existed. Those initial conclusions proved to be wrong. In August 2002 a *Cookeina* specimen collected from Parque Nacional El Ávila massif, located at the northern side of the city of Caracas was brought to the senior author for determination. It proved to be this species that we have now described as *C. colensoiopsis*.

Measurements from the recent collection (Paratype: PT) are larger than those from Blakeslee (HT): outer ectal excipulum layer 40–50 μm wide (HT), 30–90 μm (PT); inner ectal excipulum gelatinized, 30–40 μm wide (HT) and 50–100 μm (PT); medullary excipulum non-gelatinized 60–100 μm wide (HT) and 470–600 μm (PT); asci up to 360 μm (HT) and to 420 μm (PT).

This species resembles *C. colensoi* in the presence of a gel layer, tomentum and smooth ascospores, but differs from it in having hymenial setae. Such setae were observed previously only in *C. speciosa*.

SPECIMENS EXAMINED. VENEZUELA. FEDERAL DISTRICT: Caracas, on decaying wood, 1903, A. F. Blakeslee, Det.: D. H. Linder. [as *Cookeina colensoi*] (FH). Holotype; Cerro El Ávila, on wood, Norte de Caracas, Agosto 2002, Tamia Souto (FH).

Apothecia scattered to gregarious, cupulate, disc-shaped when dry, centrally to slightly eccentrically stipitate, sub-stipitate, or sessile, with a narrow point of attachment, up to 35 mm high and up to 30 mm in diam, tough in consistency. **Receptacle** concolorous with the disc, yellow when fresh, when dry, orange to blackish, light ochre when re-hydrated, nearly smooth except at the margin. **Stipe**, when present, solid, terete, whitish, smooth, up to 22 mm long and up to 1.5 mm thick, short or often reduced to a narrow point of attachment of 1 x 1 mm. **Disc** deeply concave, yellow when fresh, smooth. **Margin** entire, minutely tomentose. **Tomentum** as hair-like processes arising from the cells of the outer excipulum, composed of up to 4 round cells, 40–80 × 10–14 µm. **Ectal excipulum** of *textura angularis* to *textura globulosa*, of 3–6 cell layers, 40–50 µm thick, cells 10–25 × 14.5–25 µm. **Medullary excipulum** divided into two layers: the layer proximate to the ectal excipulum of *textura porrecta*, long and parallel, without a gel. The layer proximate to the subhymenium of *textura intricata* to *textura porrecta*, up to 160 µm thick, of interwoven hyphae in a more or less parallel arrangement at the junction between the medullary and outer layers, 4–6 µm diam. **Subhymenium** of *textura intricata* of loosely interwoven septate and branched hyphae 2–2.7 µm diam. **Asci** long cylindrical, apices obtuse, at the base usually abruptly contracted or attenuated into a narrow basal hyphal extension, 300–370 × 14–20 µm, thick-walled, with 8 ascospores. **Ascospores** ellipsoid to broad elliptic-fusoid to fusiform in face view, in side view, flattened at one side narrowing towards the poles, in both views appearing sub-papillate; wall 1.0–1.5 µm, thicker at the poles; hyaline, ornamentation of fine longitudinal, parallel ridges approximately 1 per µm that sometimes anastomose; guttules arranged in four possible ways: 1) with 3 guttules, 2) 1–2 central guttules with smaller surrounding guttules, 3) two large central guttules, two of middle size accompanied by smaller ones toward the poles, or 4) numerous guttules; (18-) 26.5–40.0 (–47) × 10–15 (–17) µm, usually obliquely uniseriate. **Paraphyses** thread-like, delicate, septate, frequently anastomosing, sometimes constricted at septa, (–2.5) 3–4 (–4.5) µm in the middle, branching more often at the apex, and presenting varied types of apices, sometimes several types can be present in one apothecium: 1) swollen-clavate apices up to 5 µm. 2) mucronate apices with 5 µm at its widest diameter ending in a somewhat pointed apex of 1 µm diameter, or 3) irregular up to 4 µm wide; the mucronate type apices (2) projects slightly beyond the ascus tips.

SUBSTRATE: On angiospermous wood.

DISTRIBUTION: India, West Kameng (holotype and paratype locality), and China, Yunnan (Yang 1990).

ILLUSTRATIONS: Pfister & Kaushal (1984), fig 1; Weinstein et al. (2002), fig. 3B.

NOTES ON TYPE SPECIMENS AND NOMENCLATURE: Specimens examined are mostly those studied by Pfister & Kaushal (1984). No specimens of *Cookeina mundkurii* S. C. Kaushal have been available for study but we suspect it is *C. indica*.

GENERAL NOTES: *Cookeina indica* has narrow ellipsoid to fusoid, often inequilateral, ascospores that are narrower than those found in either *C. sulcipes* or *C. tricholoma*, the other species with longitudinally striate ascospores. The striations in *C. indica* form more or less continuous bands on the spores. This species is characterized further by having a smooth receptacle, with only minute marginal hair-like projections. There is no

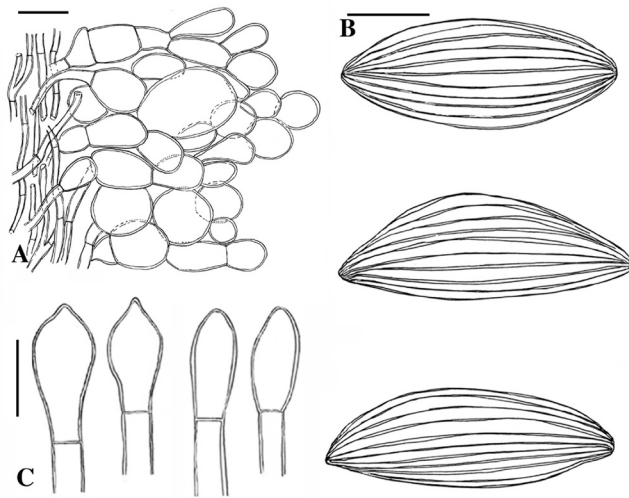


Figure 5. *Cookeina indica*. A. Cross section showing outer layer of the excipulum, bar = 25 µm. B. Ascospores, bar = 10 µm. C. Apices of paraphyses, bar = 10 µm. Yunnan, China; 5 Nov 1999, 119 (HMAS).

gelatinous material in the ascomata. A distinctive feature for this species is the variety of shapes of the apical cells of the paraphyses. Mucronate and irregular cell shapes such as these are only present in this species. The typical filiform, slightly clavate, paraphyses found in all species of the genus and are also present in *C. indica*. Yang (1990) suggested that Teng (1963) reported *C. indica* under the name *C. colensoi*.

SPECIMENS EXAMINED. CHINA. YUNNAN: On wood, 5 Nov 1999, 119 ex HMAS (FH); On wood, 5 Nov 1999, 119 (HMAS). INDIA. West Kameng, A. P. [Arunachal Pradesh], Tipi, on wood in an angiospermous forest, (alt. 300 m), 16 Sept 1981, *Rishi Kaushal 18611*, Holotype (FH); Photo of isotype specimen [as *Cookeina insititia*] at PAN (FH) (not examined at this time previously examined by Pfister & Kaushal (1984)); Dehra, on *Dalbergia* sp., 2 Sept 1952, *K. S. Thind 572400*, Paratype (BPI) [as *Cookeina colensoi*] slide made from Paratype specimen (FH).

Cookeina insititia (Berk. & M.A. Curtis) Kuntze, Revis. gen. pl. 2: 849. 1891. **Fig. 6**

= *Peziza insititia* Berk. & M.A. Curtis, Proc. Amer. Acad. Arts 4: 127. 1860! !! = *Trichoscypha insititia* (Berk. & M.A. Curtis) Sacc., Syll. fung. 8: 161. 1889. = *Pilocratera insititia* (Berk. & M.A. Curtis) Sacc. & Traverso, Syll. fung. 20: 412. 1911. = *Boedijnopeziza insititia* (Berk. & M.A. Curtis) S. Ito & S. Imai, Trans. Sapporo. Nat. Hist. Soc. 15: 58. 1937. = *Microstoma insititia* (Berk. & M.A. Curtis) Boedijn, Sydowia 5: 212. 1951.
 = *Trichoscypha magnispora* Lloyd, Mycol. Writings 6: 1050. 1921!
 = *Boedijnopeziza sphaeroidospora* Y. Otani in Kobayasi et al., Bull. Natl. Sci. Mus. 14(3): 407. 1971!

Apothecia scattered to gregarious, centrally stipitated, 9–25 mm tall when dry, mostly not exceeding 1 cm in length when fresh (fide Boedjin, 1933). **Disc** deeply concave, white to pale cream, when dry concolorous or lighter than dry receptacle. **Receptacle** deep-cup shaped, infundibuliform, urceolate to turbinate, seated on a well defined stipe, white to whitish, to pale cream colored, paler than the disc; when dry beige or yellow-ochre, 5–12 mm tall and 4–11 mm diam. **Margin** sometimes flesh-colored or concolorous with the receptacle, with white, erect, triangular-flattened hairs. **Stipe** terete whitish, when dry 3–16 mm long by 1–2 mm diam, when fresh up to 40 mm long fide Boedjin (1933), drying in a venose pattern due to contraction of the gel, covered by tomentum, sometimes with a disc-shaped point of attachment. **Hairs** of three types, all originated from outer ectal excipulum cells: 1) marginal twisted (when dry) hairs, light yellow, triangular and flattened, in 1–2 rows, up to 2 mm long and 0.5 mm at the base and gradually tapering towards the pointed apex; when young these hairs totally cover the hymenium in a nearly continuous sub-conical sheath, which later opens as the disc expands, splitting into 4–5 separate compound hairs positioned in an imbricate fashion then dividing at maturity in to many compound hairs, each formed by bundles of parallel, septate, unbranched, sub-hyaline hyphae; 2) hairs, straight, in the margin intermixed with the twisted hairs, and covering mainly the upper part of the receptacle, though some cover the receptacle, flat, half the size of the marginal ones, but similar in structure to them, composed of bundles of parallel, septate, unbranched, sub-hyaline hyphae 4–9 μ m diam, turning wider and shorter, up to 14 μ m wide, at the base of the bundle. 3) a tomentum composed of hyphal projections of th outer cells of the excipulum covering receptacle and stipe. **Ectal excipulum** composed of two layers: **Outer ectal excipulum** *texturaglobulosa* to *angularis*, layer of 30–50 μ m thick, composed of two to four or sometimes more layers of globose, sub-globose or rarely polygonal cells 9–24 μ m diam; the most external cells are globose, up to 28 μ m diam, with thick and sometimes warted walls 2–3 μ m wide. In some cases these cells aggregate to form masses of loosely connected cells, which appear as irregular small projections at surface view. **Inner ectal excipulum** of *textura oblita*, of loosely interwoven, delicate, septate, branched, thin-walled hyphae immersed in a distinct gelatinous matrix and oriented perpendicular to the receptacle's surface, layer (20–)40–80 μ m thick, hyphae 1.0–5.0 μ m diam. **Medullary excipulum** of *textura porrecta* to *intricata*, of parallel hyphae running parallel to the outer surface of the receptacle, 1.8–6.3 μ m diam, septate, typically unbranched and becoming intricate near the margin. **Subhymenium** of *textura intricata*, composed of loosely interwoven septate and branched hyphae 2–2.7 μ m diam. **Hymenium** about 390 μ m thick. **Asci** cylindrical, tapering to a long thin obconical base, 400–453 x 12–16 μ m, thick-walled, wall 1.5–2 μ m wide, with 8 ascospores. **Ascospores** usually obliquely uniseriate, narrow sub-fusoidal to fusoidal, asymmetrical or distinctly curved, with pointed ends, hyaline, smooth-walled under light microscope, containing numerous guttules, 36–47(–52) x 8.0–16 μ m. **Paraphyses** filiform, delicate, septate, branched and irregularly anastomosing, hyaline, 1–2.0 μ m diam, sometimes with irregular swellings; their apices profusely divided forming a small number of short branches, 1.5 μ m diam, forming a dense irregular network. **SUBSTRATE:** on wood, on decomposed wood.

DISTRIBUTION: China, Indonesia, Japan, Phillipines, Samoa.

ILLUSTRATIONS: Berkeley & Broome (1875) as *Peziza insititia*, tab. 5, fig 21; Boedjin (1933) figs. 2D–E, 3F, I; Lloyd (1921) as *Trichoscypha magnispora*, plate 179, fig. 1950;

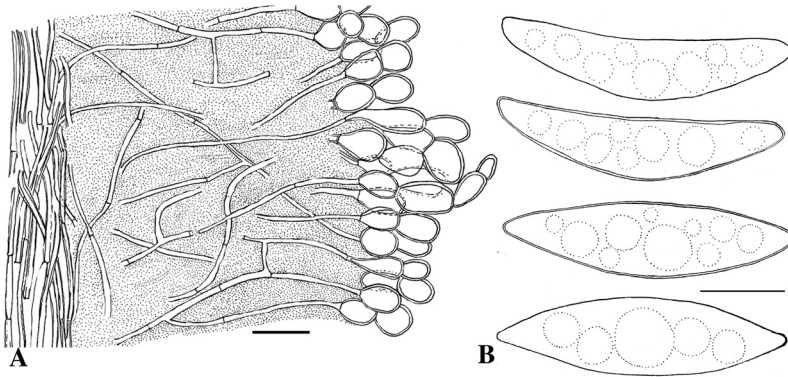


Figure 6. *Cookeina insititia*. A. Cross section showing outer layer of the excipulum, bar = 20 µm. B. Ascospores, bar = 10 µm. Yunnan, China; 17 Oct 1980, *Zang Mu* (CUP-CH 2527, HKAS 7240).

Masse (1896) as *P. insititia*, tab. 16, fig. 26–27; Melendez-Howell et al. (2003) figs. 8A–G, 9A–B, 10A–C and 11A–G; Otani (1971) figs. 17, 18; Rifai (1968) fig 23–25; Seaver (1928) fig 17i; Weinstein et al. (2002) fig. 3G.

NOTES ON TYPE SPECIMENS AND NOMENCLATURE: Both the holotype (K) and the isotype (FH-Curt.) of *Peziza insititia* were examined. Charles Wright collected the specimens on the U.S. North Pacific Exploring Expedition under Commanders Ringgold and Rodgers, but they have slightly different data on their labels. This is not unusual because of labeling for distribution. A primary set of specimens was given to Asa Gray who sent specimens to Curtis who in turn sent portions of them to Berkeley. Often only abbreviated information was provided to Berkeley. The holotype (K) bears the number 148 on the packet, which is the species number as originally listed for *P. insititia* by Berkeley & Curtis. Other data given are “on dead wood, Bonin Islands” but no further data on substrate or specific collecting date it states 1853-1856. The isotype (FH-Curt.) bears a more precise collecting date (Oct. 1854) and information on substrate (ad lign. inter folia dejecta), as well as the number 367 (C. Wright’s collecting number). Wright and Small collected in the Bonin Islands between October 19 and November 1, 1954 (Pfister, 1978b). Berkeley & Curtis indicate as well that this species is allied to *P. tricholoma* Mont.

Ito & Imai (1937) erected *Boedijnopeziza* as a separate genus for *C. insititia* because of two features: the presence of a gel layer in the excipulum and smooth ascospores. The genus *Boedijnopeziza* is still a question of debate, being accepted by some investigators, such as Rifai (1968), Korf (1971, 1972, 1973) and Otani (1972) and not by others as Seaver (1928), Le Gal (1953), Denison (1967), Eckblad (1968), Pfister (1973), and Weinstein et al. (2000). Boedjin (1951) did not agree on the placement of *C. insititia* in the genus *Boedijnopeziza*, and considered it a member of the genus *Microstoma* stating that it had the characters of that genus: a gel layer, large fusoid spores, and anatomosing paraphyses. More recently a subgenus *Bedijnopeziza* was created in *Cookeina* for *C. insititia* (Melendez-Howell et al. 2003). This was based on SEM and TEM data related

to wall layering and formation of ascospores and asci. It should be pointed out that Melendez-Howell used original material collected by Wright in the Bonin Islands (PC) in 1854 for their study. This appears to be an isotype. *Cookeina* and *Microstoma* resolve as sister groups in several analyses (Harrington et al. 1999). Weinstein et al. (2002) used *Microstoma* as an outgroup in their study of *Cookeina*.

Boedijnopeziza sphaeroidospora (Otani 1971) was studied by DHP (unpublished) who concluded that the type specimen was an immature specimen of *Cookeina insititia*, and hence the round ascospores were immature. Otani (1975) came to the same conclusion after studying a series of developing apothecia of *C. insititia* in the field.

GENERAL NOTES: We have not seen fresh material of this species; data on fresh specimens has been incorporated from Boedjin (1933), Rifai (1968), and Durrieu et al. (1997). The spores are smooth when viewed with the light microscope but they show low convolute markings under SEM (Melendez-Howell et al. 2003). Bi et al. (1993) mention that some spores are faintly ribbed but we have not seen such markings. It had been thought that among all the other species in the genus, a unique characteristic of *C. insititia* was the presence of a single ascospore wall layer (Boedjin, 1933; Pfister 1973). Melendez-Howell et al. (2003) studied the wall composition of ascospores of *C. insititia*, *C. speciosa* (as *C. sulcipes*) and *C. tricholoma*. The “paroi propre,” or proper wall together with the perispore, are the two layers seen in all the ascospores of the *Cookeina* species studied by them. They showed that the structure of the “paroi propre” in *C. insititia* is less complex than in the other two species. The difference between species is not in the number of wall layers (as was previously thought), but in the complexity of the “paroi propre.” The three species all have proper wall and a perispore, which are similar in thickness in the three species. The proper wall is more complex with at least three different layers in *C. tricholoma* and *C. speciosa* than in *C. insititia* (Melendez-Howell et al., 2003). Melendez-Howell et al. (2003) found the ascus apex to differ from the other species of *Cookeina* and the absence of the d2 wall layer distinguishes *C. insititia* from the other species. We do not find compelling evidence for the segregation in a separate genus of *C. insititia* particularly in light of the phylogenetic study (Weinstein et al. 2002).

SPECIMENS EXAMINED. CHINA. HAINAN: Chang-Kiang, 12 Nov 1934, S. Q. Deng 6374 (CUP-CH 1386); Tan-hsien, 24 Oct 1943, S. Q. Deng 5564 (CUP-CH 1363); as above, 30 Oct 1934, S. Q. Deng 5790 (CUP-CA 620); Ting-an, on wood, 18 Nov 1934, S. Q. Deng 6681 (CUP-CH 622); as above, 13 Nov 1934, S. Q. Deng 6453 (CUP-CH 621). YUNNAN: Hsichung Panna Autonomous, Prefecture, of Tai Nationality Region, Monlin, Nature Reserve, on rotten wood, 17 Oct 1980, Zang Mu (CUP-CH 2527, HKAS 7240). INDIA: Photo of India specimen at PAN (FH). INDONESIA. JAVA: Somarang, Di van Leeuwen 82 (NY). JAPAN. BONIN ISLANDS: On dead wood, C. Wright 148, U. S. Pacific Exploring Expedition, [holotype of *Peziza insititia*] (K); ad lign. inter folia dejecta, Oct. 1854, U.S. Pac. Ex. Ex., C Wright (367) (FH, FH-Curt.), [isotype of *Peziza insititia*] (FH-Curt.); 6 Oct 1915, A. Yasuda 332 [very fragmented] (NY); Titizimia Island, Renzyudani, 23 Nov 1936, Y. Kobayasi 664 (CUP-JA 664). PHILIPPINES: Six collections without collection data in OSC, W. C. Denison; On dead wood, Denison 3941 = OSC 24420; Denison 3942 (OSC 67796, 24419); Laguna, Los Baños, on dead wood, 24 Oct 1921, Colin G. Welles 11671 (NY); Luzon, Mt. Maguiling, on dead wood, 26 Oct 1920, A. Abesanis 10460 (FH-Pat); Oct 1920, O. A. Reinking 10252 (FH-Pat); 28 Sept 1920, O. A. Reinking 28341 (BPI-Lloyd) [holotype of *Trichoscypha magnispora*]; 25 Oct

1920, *P. Malabassan 10447* (FH-Pat); Bois pourris de arbres, 19 Oct 1887, *Balansa 43* (FH-Pat); Palo, on fine damp sticks, Jan 1906, *A. D. E. Elmer 7205* (NY). SAMOA: 1904-5, *C. G. Lloyd 5019* (NY).

Cookeina sinensis Z. Wang, Mycotaxon 62: 293. 1997 !!

Apothecium solitary or scattered, cupulate, centrally stipitate, up to 25 mm high and 50 mm diam when dry. **Receptacle** concolorous or paler than the disc, cinnamon-buff when dry, covered more or less uniformly with conspicuous long hairs. **Stipe** short, when rehydrated 8 x 1–2 mm and brownish-orange to cinnamon-buff, concolorous with receptacle, sub-cylindrical, somewhat wider at the base, with longitudinal ridges and furrows when dry over its length and sometimes extend to the receptacle. **Disc** deeply concave, pinkish, pinkish orange, buff to salmon, ochraceous-orange when dry. **Margin** with somewhat inrolled. **Hairs** fasciculate, white to brownish, arising from the medullary excipulum, composed of bundles of parallel, septate, thick-walled hyphae, stiff, bristle-like, 3–7 mm long, individual hyphae 6–8 µm diam, walls 1.5–2.5 µm wide. **Tomentum** not seen. **Outer excipulum** of *textura globulosa*, layer (50–) 80–175 µm wide, cells arranged perpendicularly to the surface of the receptacle, 8–24 µm diam, cells thick-walled, particularly the most external ones, walls 1.5–2.5 µm thick, hyaline. In some cases these cells aggregate to form masses of loosely connected cells, which gives the receptacle a pruinose surface. **Inner ectal excipulum** a thin layer of loose *textura porrecta* to *intricata* of thin-walled hyphae, layer 64–80 µm wide, hyphae 4–11 µm diam, no gel present. **Medullary excipulum** of *textura intricata*, 230–300 µm thick, hyphae septate, 2.5–10 µm wide. **Subhymenium** of *textura intricata*, indistinguishable from the medullary excipulum, 20–40 µm wide. **Hymenium** 500–525 µm thick, easily separated from the excipular layer. **Asci** cylindrical, long, 280–387 x 16–20 µm, narrow-hyphoid at base, thick-walled, 2–3 µm thick, 8 ascospores. **Ascospores** broad sub-fusoid to lemon-shaped, pointed at both ends, pale yellow when mature, smooth-walled, 0- to biguttulate, 25–40 x 12–17 µm. **Paraphyses** moniliform, slender, septate, branched and anastomosing, 2.5–4 µm.

SUBSTRATE: On dead twigs and debris.

DISTRIBUTION: Only known from China.

ILLUSTRATIONS: Wang (1997) fig. 2.; Wang (2001) fig. 1; Weinstein et al. (2002) fig. 3F.

NOTES ON TYPE SPECIMENS AND NOMENCLATURE: The designated holotype from HMAS 70088 has no ascospores. The type specimen being infertile, we designate here an epitype, HKAS 14679, a paratype collected in the same area.

GENERAL NOTES: *Cookeina sinensis* is very similar to *C. tricholoma*, the difference being that the ascospores of *C. sinensis* are smooth, and those of *C. tricholoma* are striate. There are apparently few collections of this fungus and its range to date is limited to China, including Taiwan (Wang 2001). We were only able to obtain three collections on loan. Molecular data show it is part of a larger group that contains *C. tricholoma*, but it appears to be distinctive from *C. tricholoma* (Weinstein et al., 2002).

SPECIMENS EXAMINED. CHINA. YUNNAN: MENLEN: Xishuangbanna: On twig, 8 Jun 1986, *Li Yu 372* [70088] (HMAS) without ascospores, holotype of *Cookeina sinensis*; as above, *72003* (HMAS); Limestone Hill, 1200 m, on rotten wood, 15 Aug 1985, *Zang Mu 10398, 14679* (HKAS) [epitype].

Cookeina speciosa (Fr. : Fr.) Dennis, Mycotaxon 51: 239. 1994. **Figs. 1 C-E, 7**

- = *Peziza speciosa* Fr., Syst. Mycol. 2: 84. 1822 [Type is illustration by Plumier cited by Dennis (1994) as listed above.] !
- = *Peziza sulcipes* Berk., London J. Bot. 1: 141. 1842. [Type specimen: Surinam Hostin. (K.) infertile, no spores] ! = *Trichoscypha sulcipes* (Berk.) Sacc., Syll. fung. 8: 161. 1889. = *Cookeina sulcipes* (Berk.) Kuntze, Revis. gen. pl. 2: 849. 1891. = *Pilocratera sulcipes* (Berk.) Sacc. & Traverso, Syll. fung. 20: 413. 1911.
- = *Peziza hindsii* Berk., London J. Bot. 1: 456. 1842. [Type specimen: on dead wood, New Ireland, July] (K!) = *Lachnea hindsii* (Berk.) Pat., Bull. Soc. Mycol. France 4: 98. 1888. = *Trichoscypha hindsii* (Berk.) Sacc., Syll. fung. 8: 161. 1889. = *Cookeina hindsii* (Berk.) Kuntze, Revis. gen. pl. 2: 849. 1891. = *Pilocratera hindsii* (Berk.) Henn., Hedwigia 32: 225. 1893.
- = *Peziza (Aleuria) javanica* Nees ex Lévy, Ann. Sci. Nat. Bot. Ser 3 3: 39. 1845. [Type specimen: Java, ad palmas, herb. Blume] PC! = *Trichoscypha javanica* (Nees ex Lévy.) Sacc., Syll. fung. 8: 162. 1889. = *Cookeina javanica* (Nees ex Lévy.) Kuntze, Revis. gen. pl. 2: 849. 1891. = *Aleuria javanica* (Nees ex Lévy.) Overeem & D. Overeem, Bull. Jard. Bot. Buitenzorg. III 4: 12. 1922.
- = *Peziza (Lachnea) amoena* Lévy, Ann. Sci. Nat. Bot. III 3: 39. 1845. [Type specimen: Guiana ad truncos] = *Trichoscypha amoena* (Lévy.) Sacc., Syll. fung. 8: 161. 1889. = *Cookeina amoena* (Lévy.) Kuntze, Revis. gen. Pl. 2: 849. 1891.
- = *Peziza afzelii* Fr., Nova Acta Regiae Soc. Sci. Upsal. III 1: 121. 1851. [type specimen: ad terra in Guinea, not found at UPS.] = *Trichoscypha afzelii* (Fr.) Sacc., Syll. fung. 8: 161. 1889. = *Cookeina afzelii* (Fr.) Kuntze, Revis. gen. pl. 2: 849. 1891. = *Pilocratera afzelii* (Fr.) Sacc. & Traverso, Syll. fung. 20: 412. 1911.
- = *Peziza (Geopyxis) hindsii* var. *beccariana* Ces., Atti Accad. Sci. Fis. 8 (4): 11. 1879. [Type specimen: lignicola, Ceylon] = *Trichoscypha hindsii* var. *beccariana* (Ces.) Sacc, Syll. fung. 8: 162. 1889.
- = *Pilocratera engleriana* Henn., Bot. Jahrb. Syst. 14: 363. 1892. (tab. 6, fig. 9.) (!) [Lectotype: designated here because holotype lost, Kamerun, Zenker (B)] ! = *Trichoscypha engleriana* (Henn.) Sacc., Syll. fung. 11: 398. 1895.
- = *Geopyxis elata* Masee, Bull. Misc. Inform. 138: 123. 1898! [Type specimen: On the ground, Kumusi River, W. Fitzgerald, New Guinea (K)]
- = *Pilocratera maxima* P. Syd., Ann. Mycol. 10: 82. 1912. [Type specimen: ad ligna vel ramos(?), Süd-Ost-Borneo. Hayoep, 18. 6. 1908, leg H. Winkler no. 2531]
- = *Pilocratera novoguianensis* Ramsb. in Gibbs, Fl. Arfak Mts. p. 185. 1917. [Holotype: In ligno putrido. Manokoeari, sec. jungle, edge of "korang" forest, 200. Jan 1914, Gibbs 6152] !
- = *Cookeina sumatrana* Boedijn, Recueil Trav. Bot. Néerl. 26: 407. 1929. [Type specimen: auf vermoderten Baumstammen im Walde zu Soengai Pantojer (Deli) but a specimen is not particularly noted] = Have not examined type. Le Gal (1953) has it as a synonym of *Cookeina sulcipes*.
- [= *Geopyxis striatospora* Maubl. & Roger, Bull. Soc. Mycol. France 52: 83. 1936 (teste Le Gal, 1953). Nom. inval. No Latin description or diagnosis given] [no specimen in PC] [Type specimen: leg. A. Mallamaire, Cote-d'Ivoire, 1934]
- = *Cookeina sulcipes* var. *fusca* Alas., Nova Hedwigia 23: 771. 1972. [Type specimen: U.I.B./L. 176 but this seems to refer to a series of collections from 1963 and 1964].
- = *Cookeina globosa* Douanla-Meli, Mycotaxon 92: 225. 2005.

Apothecia solitary or clustered, centrally stipitate to rarely sessile, deep cupulate to goblet shaped, leathery, becoming wrinkled with age, 10–50 mm broad, 12–80 mm tall.

Receptacle cup shaped or rarely funnel shaped, sometimes whitish, minutely scurfy except around the margin where there are usually up to 5 distinct concentric ridges from which compound hairs arise in mature specimens, in young specimens the ridges are absent and the hairs are arranged around the margin as a single row, variable in color, concolorous or much paler than the disc; when rehydrated light-brown, light-yellow, light yellowish-beige, yellow, yellowish-brown to ochraceous-yellow, ochraceous-orange to even white, and brown; when dry, beige to beige-orange, to light-brown, to dark brown, when dry 6–25 mm diam and 6–14 mm tall; when rehydrated 16–50 mm diam and 8–20 mm tall. **Stipe** terete or compressed, sometimes grooved, slender, hollow, slightly attenuate below and often forming a disc-like holdfast at the bottom, concolorous or even paler than the receptacle, 3–40(–75) x 1–6 mm. **Disc** deeply concave, appears smooth to the unaided eye, when fresh pink or salmon, or light-coral to coral to deep coral, orange, yellow, mauve or light-brown. **Margin** not inrolled at maturity, when dry inrolled, when fresh concolorous to receptacle, brown to light yellow when rehydrated, provided with several rows of long hairs. **Tomentum** of two types: 1) individual moniloid processes that are present on the margin and as well covering sparsely all the receptacle giving it a furfuraceous appearance, composed of 2–5 short hyaline cells, cells 20–30 µm diam with thick and rugose walls, walls 2–5 µm thick. 2) fused triangular-shaped bundles of cells present at the margin, 40–100 µm long, 34–64 µm wide at the base, and 8–22 µm wide at the apex. **Hairs** located in 2–5 concentric ridges or rows around the margin, approximate distance between rows. µm wide, hyphae 2–3 µm wide, not staining with Congo Red. **Medullary excipulum** *textura porrecta* not 0.25–0.75(–1) mm; all hairs of approximate the same length, 0.25–1 mm long when dry, 0.75–1.25 mm long when rehydrated, each hair composed of fascicles of hyphae which are longitudinally fused, the exterior hyphae shorter than the others so the compound hair has a broad base up to 200 µm diam, diminishing in width up to a pointed apex, individual hyphae white to beige 4.5–9.0 µm diam. **Outer ectal excipulum** *textura globosa* to *angularis* or *prismatica*, layer (28–) 30–60 (–80) µm wide, composed by a few cell layers not staining with Congo Red, lying perpendicular to the surface of the receptacle, outer cells round to elongated, (15–)16–30 x (9–)12–24 µm, cells becoming rounder and thicker-walled towards the flanks, at the surface of the receptacle groups of thick-walled and sometimes warted, globose or pyriform cells are often irregularly aggregated causing the pruinose appearance of the receptacle; internal cells are smaller and prismatic. **Inner ectal excipulum** *textura intricata* to lax *intricata*, without a gel; this layer is gelatinized only in infertile young specimens, disappearing at maturity, layer (20–) 30–80 gelatinized, layer (30–) 40–300 µm wide, composed of long compressed parallel hyphae, 2–4 (–5) µm wide, not staining with Congo Red. **Subhymenium** 15–30 µm thick of *textura intricata* to *porrecta*, gelatinized in immature specimens, hyphae irregular, thread-like and loosely intertwined with each other. **Hymenium** 200–390 µm tall, with interspread setae present. **Setae** sometimes dark, tortuose, thick-walled, exceeding the hymenium by 22–40 µm. **Asci** long cylindrical, (61.6–)250–430(–460) x 10–30(–40) µm, thick-walled, walls 2 µm thick; with 8 spores located in the top 2/3 on the ascus, round at the base and abruptly contracted into a basal hyphal appendix, appendix 6–24(–40) x 2–6(–10) µm. **Ascospores** uniseriate, ellipsoid to broad elliptic fusoid to subfusoid, somewhat asymmetrical, sometimes one end more pointed and the other rounder, with more or less projecting apiculi at the poles, subhyaline under the

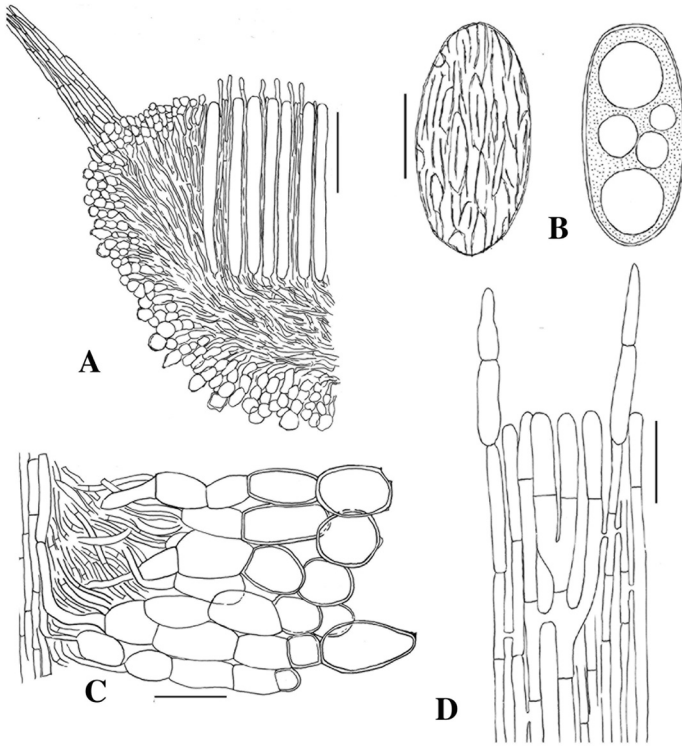


Figure 7. *Cookeina speciosa*. A. Cross section of an apothecium, bar = 120 μm . B. Ascospores, bar = 10 μm . C. Cross section showing outer layer of the excipulum, bar = 25 μm . D. Portion of hymenium with setose paraphyses, bar = 10 μm . Yutajé, Venezuela; T. Iturriaga & K. Samuels, 4A-D4; 4 Jul -7Jul 1997 (FH).

microscope, thick-walled, wall 1 μm thick, with 0-2(-multi) guttules, mostly with two large central guttules and numerous smaller oil drops, at maturity appearing striate from the presence of fine, rarely anastomosing parallel striate low ridges 1(-2) per μm , spores 20-36 \times 10-18(-20) μm . **Paraphyses** filiform, thread-like, delicate, simple or branching, anastomosing and forming a network of thin, septate, hyphae, sometimes with irregular peg-like and one-sided swellings at their middle, more profusely branched at their apex, ending in rounded clavate tips up to 3 μm diam, containing fine granules; same height as the asci, or exceeding them slightly, (1-)2-3 μm wide in the middle, 1-5(-7) μm wide at the apex.

SUBSTRATE: on wood, on fallen logs, twigs or branches.

DISTRIBUTION: Distributed throughout the tropics in both the new and the old world.

ILLUSTRATIONS: Plumier (1705) tab. 168, fig. C; Berkeley (1842) as *Peziza hindsii*, pl. 15; Berkeley (1852) as *P. hindsii*, tab. 15, fig. 4; Fries (1860) as *Peziza afzelii*, pl. 12, fig.

28; Cooke (1874) as *P. hindsii*, plate 27, fig 3; Cooke (1879) as *Peziza sulcipes* fig. 199, as *P. hindsii* fig. 200; Cooke (1892) as *Trichoschypha hindsii*, fig. 153; Hennings (1892) as *Pilocratera engleriana*, pl. VI, fig. 9 a, b; Seaver (1928, 1942) as *C. sulcipes*, pl. 18, fig. 1; Le Gal (1953) as *C. sulcipes*, figs. 114–119; Rifai (1968) as *C. sulcipes*, figs 18–20; Nagao (1997) as *C. sulcipes*, fig. 1; Vooren & Lopez (2002) fig. 2; Melendez-Howell et al. (2003) as *C. sulcipes*, fig. 1, 3–5, 7.

NOTES : *Peziza speciosa* was based on Plumier's Tab. 168 Fig C, as pointed out by Dennis (1994). Prior to Dennis's observation this species was generally known under the name *C. sulcipes* and *C. hindsii*. The number of synonyms for this species is no doubt related to the diffuse mycological literature of the early to mid 19th century and also to the variability of this species in hymenial color. In an ITS sequence analysis all collections referred to *C. speciosa* fall within a monophyletic clade. Within that clade there is phylogenetic structure that indicates some genetic variation that correlates as well with color differences. It is perhaps best to consider this as a species complex until such time as more complete population studies are done. This and *Cookeina tricholoma* are the most common species of the genus in most parts of the tropics. The hairs in rows at the margin of the disc serve to distinguish this species from *C. tricholoma*.

For those who might wish to segregate color forms the following guide to the application of names might be followed: 1) *Pilocratera engleriana* is the oldest name for an orange–yellow species. It has not been combined in *Cookeina*. 2) *Peziza javanica* and *Peziza amoena* were both described in the same publication, one from Java and one from Guiana but both were described as yellow. 3) fawn or darker forms from Africa were referred to as *C. sulcipes* var. *fusca*. Our morphological studies did not find distinctions in size of asci, ascospores or apothecia to warrant recognition of these taxa.

GENERAL NOTES: In parts of Mexico *C. sulcipes* is used as a food as summarized by Villarreal & Pérez-Moreno (1989) and is listed among those fungi known and used by indigenous people in Mexico (Chacon 1988). It is used medicinally in Cameroon, Africa (Dijk et al. 2003).

SPECIMENS EXAMINED. AFRICA. CAMEROON: Zenker Nr. P41, from alcohol (B), Zenker, Aus der Alkoholsammlung, P41 (B) [holotype of *Pilocratera engleriana*]; Mount Cameroon (IDENAU. lava floco) on leaf litter, coffee colour from transparencies inside packet, 1922, Alt (m): 2, S. Dawson 45, K (M): 57300. LIBERIA. CENTRAL PROVINCE: Gbanga, 20 Sept 1926, D. H. Linder 726 (FH); 7 Sept 1926, D. H. Linder 392 (FH); as above, 23 Sept 1926, D. H. Linder 392 (FH); Kassa Ta, 29 Sept 1926, D. H. Linder 392A (FH); Mount Barclay, 20 Jul 1926, D. H. Linder (FH); Pehata, 8 Oct 1926, D. H. Linder (FH); UGANDA: Uganda Protectorate, decaying log. [400 Ft], Mt. Nayge, greyish ochre, abril 1916, R. Dummer 2845 (K). BRAZIL. AMAZONAS: On rotten wood, June 1901, 2811 (FH). CHINA. YUNNAN: Monlin, Hsichuang Panna Autonomous Prefecture of Tai Nationality, on rotten wood, 17 Oct 1980, Zang Mu 7240 (FH); Xishungbanna, Menlen, ex situ of endangered plants area, 500m alt, on rotten wood, 25 Oct 1988, Zang Mu 11532, 20381 (HKAS). COLOMBIA. MAGDALENA: San Sebastian, Ruth Aldava 296 (FH). COSTA RICA. Cartago, Forest of Turrialba Instituto, 1700 ft, 17 Sept 1964, W. C. Denison, et al. 2354, 2359, 2360, 2363, 2364 (=OSC 21542, 21547, 58562, 67758, 67760); as above, on stick, 19 Sept 1964, Denison, et al. 2389 (= OSC 67770); as above, 1700ft, 19 Sept 1964, Denison, et al. 2394 (= OSC 67772); LIMÓN PROVINCE: Finca Castilla, 30m, 23, 25, 26, 29 Jul 1936, C. W. Dodge & V. F. Goerger 9314 (FH); Guapiles, Finca Diamante, on dead wood, 18 Sep 1964., Denison, et al. 2376

(= OSC 67767); as above, 400ft, on dead wood, 18 Sept 1964, *W. C. Denison, et al.* 2375, 2376, 2386 (= OSC 21516, 67766, 67768); as above, 700ft, dead stick, 18 Sept 1964, *Denison, et al.* 2386 (= OSC 21548); Portete, 50ft, sticks, 26 Aug 1964, *Denison et al.* 2111 (= OSC 67717); Westphalia, 10ft, 26 Aug 1964, *Denison et al.* 2118 (= OSC 67719); PUNTARENAS: Coto, United Fruit Co., Finca 59, 75ft, on limb, 3 Oct 1964, *Denison* 2462 (= OSC 67784, 21531); as above, on rotting wood, 3 Oct 1964, *Denison* 2453 (= OSC 67781, 21549); as above, 75ft, dead wood, 3 Oct 1964, *Denison* 2452 (= OSC 67780); as above, 75ft, 3 Oct 1964, *Denison, et al.* 2454 (= OSC 67782); Golfito, Ravine back of Balneario, rotting wood, 2 Oct 1964, *W. C. Denison* 2448, 2449 (= OSC 21512, 21550, 67777, 67778); Above Golfito, 150ft, on rotten wood, 29 Aug 1964, *Denison et al.* 2158 (= OSC 67720, 21530); Gorge back of Golfito, 150ft, dead wood, 30 Aug 1964, *Denison, et al.* 2162 (= OSC 67723, 21544); Hills above Golfito, 200ft, stick, 30 Aug 1964, *Denison, et al.* 2179, 2181 (= OSC 67726, 67727); Guanacaste, Tilaran, 1700ft, rotten limb, 15 Sept 1964, *Denison, et al.* 2330 (= OSC 67753, 21517); as above, Rotting wood, 15 Sept 1964, *Denison et al.* 2329 (= OSC 67752); Alajuela, hot springs near La Marina, 1400ft, branch on ground, 11 Sept 1964, *Denison et al.* 2262 (= OSC 67742); as above, 1500ft, rotting wood, 11 Sept 1964, *Denison et al.* 2257, 2258 (= OSC 21518, 67739); Palmar Norte, 200ft, 30 Aug 1964, *Denison, et al.* 2186 (= OSC 67729, 21532); Gorge just north of Palmar Norte, 175ft, 31 Aug 1964, *Denison, et al.* 2195 (= OSC 67731, 21515); as above, 175ft, stick, 31 Aug 1964, *Denison, et al.* 2197 (= OSC 67732); PanAm Highway north of Palmar Norte, 200ft, on stick in cacao plantation, 1 Oct 1964, *Denison* 2444 (= OSC 67774); San Jose, University of Costa Rica, 3500ft, standing dead tree, 25 Aug 1964, *W. Westman, Denison* 2109 (= OSC 67716, 21521). CUBA. 1856-7, *C. Wright* (FH); *C. Wright* (FH). DOMINICAN REPUBLIC. SEIBO: Canada Hondo, on dead sticks, Nov 1946, *R. A. & E. S. Howard* (FH); Higuey, on fallen logs in dense woods, Nov 1946, *R. A. & E. S. Howard* (FH). FRENCH GUIANA: Vicinity of Cayenne, taken from material in 418, 1921, *W. E. Broadway* 418b (FH). GUATEMALA. 'Alsacia' Mountains, 1200ft, in wet ravine, 17 Jul 1936, *Winslow Hatch* 411 (FH). GUYANA. Plantation Vryheid, 2 Feb 1924, *D. H. Linder* 843 (FH); Bartica, 9 Dec 1923, *D. H. Linder* 464 (FH). JAMAICA. Portland, Blue Mountains, Stony River Base Camp, 1250ft, in woodland, on scree, on fallen branch, 13 Dec 1973, *B. D. Morley & C. Whiteford* 505 (FH); Jul 1902 (FH); Port Antonio, Road to Park Mount, 6 Feb 1906, *A. E. Wight* 218 (FH); St. Margaret's Bay, 26 Feb 1906, *A. E. Wight* (FH). PANAMA. Barro Colorado Island (FH); On spring palm stem, 12 Dec 1928, *W. H. Weston* 3298 (FH); Dec 1928 (FH); Canal Zone, trail below Madden Dam, 250ft, on branch, 7 Oct 1964, *Denison* 2465, 2466 (= OSC 67787, 67788, 67792, 21541); Las Cruces Trail, 400ft, on rotting wood, 7 Oct 1964, *Denison* 2471, 2474 (= OSC 67790, 67792). PAPUA NEW GUINEA: Kumusi River, 1859, *W. Fitzgerald* 58274 (K); New Ireland, *R. B. N.* 58275 (K). PHILIPPINES. ISABELA PROVINCE: Luzon Island, Planan, Sitio Dipaguiden, Branagay San Isidro, on decayed log in shade, 16 Apr 1991, *Benito C. Tan* 361 (FH); Laguna, Los Baños, on dead wood, 24 Oct 1921, *C. G. Wells* 11670 (NY); Island of Luzon, Los Baños (Mt. Maquiling), Province of Laguna, June-July 1917, 18329 (FH); On dead wood, 24 Oct 1921, *Colin G. Welles* (CUP 11683); University of the Philippines Campus, College of Agriculture, on dead wood, Dec 1958, *Lewis A. Schafer* (NY); Mud Spring, on wood, 24 Nov 1966, *Denison* 3938 (= OSC 24423); as above, Dead branches, 27 Nov 1966, *Denison* 4730 (= OSC 28876); as above, Wood, 24 Nov 1966, *Rebeca de Guzman, Denison* 3943 (= OSC 24418); as above, On dead logs, 23 Aug 1966, *Denison* 4706 (= OSC 27971); Quarry, in bark of dead wood, 13 Oct 1966, *Denison* 3940 (= OSC 24421). SURINAM. Tafelberg, 390m, 11 Aug 1944, *Bassett Maguire* 24312 (FH). TRINIDAD. Arima, Verdant Vale, 1913, *R. Thaxter* (FH); Arima Valley, Jan 1975, *Sylvia Stein* (NY); 1879, *Rev. M. J. Berkeley* 35303 (K); Maravel Valley,

on wet decaying wood at border of brook, 18 Aug 1923, *D. H. Linder* 66 (FH); Port of Spain, 1912–13, *R. Thaxter* 3698 (FH); 1913, *R. Thaxter* 3699 (FH). VENEZUELA. AMAZONAS: Oeste del Caño Yutajé, 1km NE del Campamento Yutajé, Bosque de las Ceibas, pie de monte, 5°35'N, 66°10'O, tronco muerto, 21 Jun 1996, *Teresa Iturriaga y colaboradores* 2721, 2722, 2723 (USB); NE del Campamento Yutajé, Bosque en el lado norte del río Yutajé, 5°36'51"N, 66°6'85"W, madera muerta, 15 Jun 1996, *Teresa Iturriaga y colaboradores* 2596 (USB); Yutajé, Bosque primario donde está localizada la parcela 'FEX', madera en descomposición, 17 Jun 1996, *Teresa Iturriaga y colaboradores* 2610, 2612, 2613 (USB); Yutajé, 80 collections by *K. Samuels* as part of an ecological study, 4 Jul–7 Jul 1997 (FH, USB); BOLIVAR: Sifontes, Tumeremo, Carretera Tumeremo – Bochinche, Campamento maderero de INTECMACA, orillas del Río Botaramo, sobre tronco, 17–19 Nov 1994, *T. Iturriaga, L. Bracamonte, L. Ryvardeen, O. Holmquist* 2167, 2170, 2180, 2185 (USB); MIRANDA: Parque Nacional Guatopo, 10°03'N, 66°26'W, 500–600m, on decorticated wood, 27–30 Nov 1990, *G. J. Samuels, B. Hein, S. M. Huhndorf* 7680 (FH); *G. J. Samuels, B. Hein, S. M. Huhndorf* 7681 (FH).

Cookeina tricholoma (Mont.) Kuntze, Revis. Gen. Pl. 2: 849. 1891. **Figs. 1 A, B, 2**

≡ *Peziza* (*Lachnea*) *tricholoma* Mont., Ann. Sci. Nat. Bot. II 2: 77. 1834 !! ≡ *Lachnea tricholoma* (Mont.) Pat., Bull. Soc. Mycol. France 4: 98. 1888. ≡ *Trichoscypha tricholoma* (Mont.) Sacc., Syll. fung. 8: 160. 1889. ≡ *Pilocratera tricholoma* (Mont.) Henn., Bot. Jahrb. Syst. 17: 9. 1891.

≡ *Peziza tricholoma* [var.] *β minor* Mont., Ann. Sci. Nat. Bot. II 2: 77. 1834.

≡ *Peziza hystrix* Berk. Ann. Mag. Nat. Hist. II 9: 201. 1852 !!

≡ *Pilocratera tricholoma* var. *celebica* Henn., Monsunia 1: 33. 1900.

≡ *Peziza medusina* Speg. Anales Mus. Nac. Hist. Nat. Buenos Aires III 1: 78. 1902 !! ≡ *Pilocratera medusina* (Speg.) Sacc. & D. Sacc., Syll. fung. 18: 32. 1906 !!

≡ *Peziza* (*Sarcoscypha*) *striispora* Ellis & Everh. Bull. Lab. Nat. Hist. Iowa State Univ. 4: 69. 1896. ≡ *Sarcoscypha striispora* (Ellis & Everh.) Sacc., Syll. fung. 14: 754. 1899.

Apothecia solitary or gregarious, deep cupulate, centrally stipitated to rarely sessile, frequently elongated on one side being then suboblique, leathery, receptacle and stipe covered with long conspicuous hairs more abundant at margin specially in young apothecia, when dry 7–25 mm tall and (5–)10 x 35(–50) mm diam, when rehydrated 20–25 mm tall. **Receptacle** when fresh 10–40 mm diam and 5–15 mm deep, paler than the disc, orange to yellowish-orange, to reddish, to pinkish, to coral red; when drying 5–20 mm diam and light reddish-brown to beige, when rehydrated 10–35(–50) mm diam, orange to yellow-ochraceous to yellowish brown. **Stipe** central or slightly eccentric, slender, concolorous with receptacle, when fresh fleshy, white, orange-buff to salmon-orange to beige, when dry tough, 2–35(–50) x 1–4 mm, cylindrical or compressed, with hairs mainly present on the upper half, these being shorter than the ones in the receptacle. **Disc** smooth, variable in color, concolorous with receptacle or lighter, when fresh pale orange, to buff-orange to rose-orange, in old specimens nearly whitish, when rehydrated light yellow. **Margin** enrolled in dry specimens, covered with abundant long conspicuous hairs especially in young apothecia and by short hairs (tomentum). In young apothecia the hairs form an in-curved border that close the apothecium. **Hairs** whitish (especially in younger specimens) to brownish-yellow to brown, when dry cream-colored to beige,

fasciculate, darker at the base, covering all margin and receptacle, composed of septate parallel hyphae 2–4 μm wide, arising from the inner ectal excipulum and breaking through the outer ectal excipulum at a right angle. Marginal hairs up to 7 mm long and up to 250 μm diam, twice as wide as the receptacle hairs, abundant, 2 per mm. Receptacle hairs located on the upper 1/3 of the receptacle or covering it completely, 2–4 mm long and 64–90 μm diam in the middle of the fascicles, widening up to 90–130 μm diam at the base. Hairs originate from the medullary excipulum and penetrate the ectal excipulum extending obviously above the receptacle's surface. **Tomentum**, of two types: 1) individual monilioid processes that arise from the margin and also sparsely cover the receptacle, these cells produce the pruinose appearance of the receptacle, these catenulate processes composed of 3–5 short hyaline cells, cells 10–20 μm diam, outermost cells with thick and rugose brownish thick walls, hairs 40–80 x 7–10 μm . 2) fused triangular-shaped bundles of the catenulate (monilioid) cells present at the margin. **Outer ectal excipulum** of a few layers of cells of *textura globulosa* to *angularis*, 10–72(–100) μm wide, cells arranged perpendicularly to the surface of the receptacle, cells 7–25 x (5.5–) 7–18(–20) μm . Outer cells with thick walls which are roughened become loose and grouped, giving the receptacle a pruinose appearance. **Inner ectal excipulum** of loose *textura intricata* of thin-walled hyphae oriented perpendicular to the receptacle's surface, layer 30–60 μm wide, hyphae 2–4 μm wide, no gel present. This layer is almost non-existent in wholly mature specimens, but can be evident in young specimens, where some gelatinization of this layer may be present as well. **Medullary excipulum** *textura porrecta* without gel of 160–200 μm wide, parallel or seldom branching septate hyphae composed of long cells with some spaces occasionally between them, hyphae of 2–7.5 μm diam. **Subhymenium** loose *textura intricata*, layer 40–60 μm wide, hyphae up to 5–6 μm diam. **Hymenium** 260–440 μm thick. **Asci** cylindrical, with rounded blunt base, 255–390 x 10–30 μm , walls up to 2 μm wide, connecting to short, narrow basal hyphae, 6–14(–30) x (1–) 4–6 μm , with 8 ascospores. **Ascospores** uniseriate, elliptic-fusoid, apiculate at both ends though one end frequently is more pointed than the other, subhyaline, (0–) 2 large guttules and several smaller ones may be present as well; with an inner and outer wall, at maturity distinct markings present, consisting of fine parallel longitudinal, low, ridges which sometimes anastomose 1–2 per μm , wall 1 μm diam, 25–39 x 12–21 μm , normally restricted to the top 160–190 μm of the ascus. The ornamentation is only seen in mature spores. **Paraphyses** filiform, septate, hyaline, branched and frequent anastomosing to form a dense network, especially very profusely near the apex where they form short erect branches and end in a compact layer, 1.5–4.5 μm in the middle, enlarging at the apex in a clavate shape to 2–6 μm , exceeding the asci.

SUBSTRATE: On wood, on fallen logs, twigs or branches.

DISTRIBUTION: Throughout the lowland tropics, both new and old world. The species has on occasion been collected in Florida.

ILLUSTRATIONS: Montagne (1834) as *Peziza tricholoma*, Plate 4, fig. 2; Cooke (1874) as *P. tricholoma*, pl. 27, fig. 4, as *P. hystrix* pl. 27, fig. 12; Cooke (1879) as *Peziza tricholoma* f. 202; Ferdinandsen & Winge (1910) fig. 4, page 218; Seaver (1913) fig. 1, 2; Seaver (1928, 1942) pl. 18, fig. 2; Boedijn (1933) as *C. tricholoma*, fig. 2b, 3h, 4a, 4e; Le Gal (1953) fig. 105–108; Dennis (1954) as *C. tricholoma*, fig. C; Gamundí (1959), fig. 1–8; Denison (1967) fig. 3, 5–6; Rifai (1968) fig. 15–17; Dennis (1970) fig. 7U; Otani (1971) plate 3 c, fig. 15, 16; Gamundí (1983) map 6, distribution map for neotropics; Weinstein

et al. (2002) fig. 3D; Vooren & Lopez (2002) fig. A; Melendez-Howell et al. (2003) fig 3c, 7e–g, 14.

NOTES ON TYPE SPECIMENS AND NOMENCLATURE: Montagne's description of *P. tricholoma* is based on material from Brazil from the herbarium of Gaudichaud collected in 1831/1832 around Rio de Janeiro and labeled no. 44. There are three collections at PC that fit this information. All match the original description and all are labeled number 44. After examining the three collections we have selected one as lectotype because of its good state of preservation and maturity.

Peziza tricholoma var. *minor* was described at the same time as *P. tricholoma* by Montagne (1834), he mentioned that this variety was different from *P. tricholoma* because it is almost glabrous with few setae “setis raris vel nullis” and that it is smaller. From Montagne's description, it is evident that β minor was collected in or at the vicinity of Rio de Janeiro, Brazil. There is one collection in Montagne's herbarium that does not bear a collection number, collected by Gaudich, and it is from Rio de Janeiro. We designate this collection as the lectotype of var. *minor*.

Peziza hystrix was erected by Berkeley (1852) in the belief that *P. tricholoma* was a smaller species, that the external surface was costate, and that the hairs in *P. tricholoma* covered only the margin as shown in Montagne (1834) figure 2a (see list of illustrations below). Montagne did mention that there were some hairs on the external surface, but that these were mainly present, and in a higher number, at the margin. Cooke (1879) examined Montagne's specimen and found that the hairs covered the receptacle and stipe. Having seen both Montagne's and Berkeley's collections, Cooke concluding that *P. hystrix* was a synonym of *P. tricholoma*.

Peziza (Pilocratera) medusina was considered to have smooth ascospores (Spegazzini 1902). We examined the type specimen of *P. medusina* and have observed striations present on the ascospores. We conclude that this is a synonym of *C. tricholoma*, as Gamundí (1959) had already stated.

GENERAL NOTES: *Cookeina tricholoma* and *C. speciosa* are the commonest species of *Cookeina* encountered. In parts of Mexico *C. tricholoma* is used as a food as summarized by Villarreal & Pérez-Moreno (1989) and is listed among those fungi know and used by indigenous people in Mexico (Chacon 1988). It is used medicinally in Cameroon, Africa (Dijk et al. 2003). *C. tricholoma* can be easily distinguished by the more or less uniform covering of hairs on the outer surface of the apothecium. Boedjin (1933) indicated that ascospores are faintly rose in color, and that spore deposits of this species were pink. Spore prints are not routinely made of discomycetes and so we do not have comparative data on spore colors in other species. Alasoadura (1972) indicates that the hairs are covering the “mouth” of the apothecium at night and early morning, that is, when spore discharge is not appreciable, at other times the hairs point upwards leaving the “mouth” of the cup open. Boedijn (1933) indicates that the ascospore has a thick inner and a thinner outer wall; he observed that for a long time the outer spore wall remained smooth, but when fully ripe, the outer wall shows a delicate longitudinal striation, caused by low, sparingly anastomosing ridges. Melendez-Howell et al. (2003) have made a comprehensive study of wall layers in asci, paraphyses and ascospores, as well as SEM ascospore observations. They show that ascus walls in *C. tricholoma* are thick; that there is a gel layer that covers the ascus, thinning out towards the apex, that there are multiple randomly located germ pores on ascospores of *C. tricholoma*, and that the low

ridges that form the ascospore ornamentation have a slightly spinose surface (see list of photographs below). They state that ascospores may be covered by the perispore, which masks somewhat the ornamentation of the “paroi propre.”

SPECIMENS EXAMINED. AFRICA. CAMEROON: Sakbayene, 1926, *Rev. Charles Schwab* (FH); June 1918, 28 (FH-Pat); Sur un bronc pourrissant d'un Eryshrina caralledenstrae, 1483 (FH-Pat); June 1918, 21 (FH-Pat); June 1918, 19 (FH-Pat). CONGO: Nov 1893-Mar 1894, *Dybowski* (FH-Pat); LIBERIA: Gbanga, 20 Sept 1926, *D. H. Linder* 727 (FH); Sept 1926, *D. H. Linder* 392 (FH). ARGENTINA. S/ramas muertas, Misiones, Puerto Pampa, 8-4-1901, Leg. E. Kermes [holotype of *Peziza medusina*] (Packet from LPS bears the number 28026) BRAZIL: Ad ligna, Rio de Janeiro, Brazil, Gaudich. no 44 (PC), [lectotype of *Peziza (Lachnea) tricholoma*, designated by Iturriaga & Pfister] (PC); Rio de Janeiro, 1831-33, 44, [isolectotype of *Peziza (Lachnea) tricholoma*, designated by Iturriaga & Pfister] (PC); 1831-33, [isolectotype of *Peziza (Lachnea) tricholoma*, designated by Iturriaga & Pfister] (PC); ad ligno, Rio de Janeiro, Exdono Gaudichii, (as *Peziza tricholoma*) [lectotype of *Peziza tricholoma* var. β minor, designated by Iturriaga & Pfister], Rio de Janeiro (PC), Crypt. Guyani 444, sur le petioles pourris de l'...carium vulgare, 890 (PC); Crypt. Guyani 444, 891 (PC); Guyani (PC); Amazonas, Mowary, Juruá, auf vermodertom Hok, Sept 1900, 2812 (FH); Porto Novo, Sta. Catharina, 1978 (FH); on rotting log, bank of brook in shady gully, 5 Jan 1906, *A. E. Wight* 137 (FH); St. Catharina, mar 1888 (FH). CHICALAPA. Sur le bois pourri dans les grandes forêts, ils sous eouges ou violes et en forme de vase, Dec 1857, *Sallé* 303 (FH-Pat); JAVA: Iter javanicum secundum, *H. Zollinger* 2042 (FH-Pat); Ile Sansos Hebrides, Jul 1906, *Le Rat* 12 (FH-Pat). CHINA. KWANGSI PROVINCE: Ta Chai Shan, 1933, *S. Y. Cheo* 2391 (FH); YUNNAN: Hsichuang Panna, Monlin, Calcareous Mountain, on rotten twigs, 3 Sept 1974, *Zang Mu* 1171 (FH); Mengla, on rotten wood, *Zhuliang Yang* 23238 ex HMAS (FH); On wood, 1 Nov 1999, ex HMAS (FH). COSTA RICA. LIMON: Portete, 50ft, on stick, 26 Aug 1964, *Denison et al.* 2112 (= OSC 67718); Guapiles, Finca Diamante, 700ft, stick, 18 Sept 1964, *Denison et al.* 2387 (= OSC 67769); PUNTARENAS: Pan-American Highway South of Buenos Aires, 430ft, in a ravine with waterfall, 29 Aug 1964, *Denison et al.* 2160 (= OSC 67722); San Jose, 15 km. South of San Isidro del Gen., 1600ft, stick, 29 Aug 1964, *Denison et al.* 2159 (= OSC 67721); Guanacaste, El Silencio, 2500ft, on large limbs, 15 Sept 1964, *Denison et al.* 2319 (= OSC 67751); San Vito, Oxañ's, 4000ft, on sticks, 22 Oct 1964, *W. C. Denison* 2536, 2537 (= OSC 67794, 67795); Cartago, Turrialba, forest at Instituto, 1700ft, on wood, 17 Sept 1964, *Denison et al.* 2351 (= OSC 67754); as above, Dead wood, 17 Sept 1964, *Denison et al.* 2352, 2357 (= OSC 67755, 67757); Guanacaste, north of Puntarenas, 100ft, wood, 13 Sept 1964, *Denison et al.* 2285 (= OSC 67745); PanAm Highway, 100ft, on rotten wood, 13 Sept 1964, *Denison et al.* 2284 (= OSC 67744); near Santa Cruz, 100ft, wood, 14 Sept 1964, *Denison et al.* 2295 (= OSC 67747); as above, Sticks, 14 Sept 1964, *Denison et al.* 2316 (= OSC 67750); Santa Cruz, 100ft, on rotten limbs, 14 Sept 1964, *Denison et al.* 2315 (= OSC 67749); Caña, 150ft, 13 Sept 1964, *Denison et al.* 2288 (= OSC 67746); Rio Pobrenos, 350ft, 13 Sept 1964, *Denison et al.* 2306 (= OSC 67748); Alajuela, La Marina, Hot Springs, 1500ft, 11 Sept 1964, *Denison, Jiménez et al.* 2256, 2261, 2264 (= OSC 67738, 67741, 67743); as above, On stick, 11 Sept 1964, *Denison, Jiménez et al.* 2259 (= OSC 67740); as above, 1500ft, rotten wood, 10 Sept 1964, *Denison et al.* 2252 (= OSC 67736); as above, On dead branch, 11 Sept 1964, *Denison et al.* 2255 (= OSC 67737); Alajuela, Buena Vista, Finca Ensayña, 2800ft, 10 Sept 1964, *Denison et al.* 2246 (= OSC 67734); as above, On rotten wood, 10 Sept 1964, *Denison, Jiménez, et al.* 2247 (= OSC 67735); Gorge near Golfito, 150ft, on sticks, 30 Aug 1964, *Denison et al.* 2163 (= OSC 67724); as above, 200ft, 30 Aug 1964,

Denison et al. 2183 (= OSC 67728); as above, 30 Aug 1964, *Denison et al.* 2168 (= OSC 67725); Golfito, near Hotel Balneario, 50ft, on rotten wood, 2 Oct 1964, *Denison* 2446 (= OSC 67775); Ravine back of Balneario, 50ft, dead wood, 2 Oct 1964, *Denison* 2447 (= OSC 67776); Coto, United Fruit Co., Finca 59, 75ft, wood, 3 Oct 1964, *Denison* 2451, 2455 (= OSC 67779, 67783); Palmar Norte, 175ft, 31 Aug 1964, *Denison et al.* 2192 (= OSC 67730). CUBA. Trinidad Mountains, Sierra de San Juan, Mina Carlota, on log, 5 Jul 1941, *W. L. White* 722 (FH); Amazon Basin, 1000 ft, on old rotten log in forest, 19 Jan 1922, *O. E. White* 2358 (FH); *C. Wright* 664 (FH); *C. Wright* 665 (FH); *C. Wright* (FH-Pat); *C. Wright* 657 (FH); *C. Wright* (FH); SANTA CLARA: Soledad, La Veguita de San Antonio, 17-23 Aug 1935, *D. H. Linder* 72 (FH). DOMINICAN REPUBLIC. On dead wood, Salle, no. 35, St. Domingo [holotype of *Peziza hystrix*] (K); Seibo, on humus in deep woods, Nov 1946, *R. A. & E. S. Howard* (FH). FRENCH GUIANA. Vicinity of Cayenne, on ground beneath trees, 6 Jul 1921, *W. E. Broadway*, 692 (FH). GUADELOUPE. Capesterre, 100-250 m, on twig in banana plantation, 10 Jan 1974, *D. H. Pfister*, *S. Carpenter*, *M. Sherwood* 1190 (FH); Pointe-Noire, sur les peliles branches pourries, 61 (FH-Pat); Sur un morcean bois pourri d'un Cheobroma Cacao, *Duss* 980 (FH-Pat); Sur un branc pourri de Megrisleca moscati, *Duss* 998 (FH-Pat); Sur un éclas de bois pourrissant, 1902, *Duss* 623 (FH-Pat). GUATEMALA. Alta Verapaz, on decaying fallen log, 27 Jul 1936, *Winslow Hatch* 413 (FH); Los amates, 'Alsacia' Mountains, on decaying wood, 17 Jul 1936, *Winslow Hatch* 412 (FH). GUINÉE FRANCAISE. Simbaïa, 20 Apr 1909, *Duport* (FH-Pat); St. Domingo, 58273 (K). GUYANA. Bartica, Dec 1923, *D. H. Linder* (FH). INDIA. KERALA: Wynad, Periya Reserve Forest, on fallen twigs on forest floor, 23 Aug 1984, *P. Manimohan* (FH). INDONESIA. JAVA: *Tjiboya* 2042 (FH-Pat) [as *Peziza aurantia* var. *stipitata*]; Iter javanicum secundum, *H. Zollinger* 2039 (FH-Pat). JAMAICA. 1909, *A. E. Wight* (FH). MEXICO. Circa le Alagirines, S.L.P. 11 Aug 1891, 7084 (FH-Pat). VERACRUZ. Sur des branches de bois mort à terre dans la forêt, Oct 1854, *Sallé* 50 (FH-Pat). OUBANGUI. 1891, *Dybowski* (FH-Pat); Bois mort, 1891, *Dybowski* (FH-Pat). PANAMA. Canal Zone, on dead log, 8 Oct 1946, *N. L. H. Krauss* 76 (FH); Canal Zone, Las Cruces Trail, 7 Oct 1964, *Denison* 2475 (= OSC 67793); as above, Dead wood, 400ft, 7 Oct 1964, *Denison* 2473 (= OSC 67791); Alahuela, Madden Dam, Azote Caballo Road, 90-100m, 27 Nov 1934, *C. W. Dodge* 8952 (FH); Trail below Madden Dam, 250ft, stick, 7 Oct 1964, *Denison* 2463, 2464 (= OSC 67785, 67786); Madden Dam, 250ft, 7 Oct 1964, *W. C. Denison* 2467 (= OSC 67789); Sabanas near Chepo, 30m, 20 Jan 1935, *A. A. Hunter & P. H. Allen* 8584 (FH); Barro Colorado Island, *Seephot* 3385 (FH). PHILIPPINES. RIZAI: Luzon, Aug 1913, *M. Ramos* 21945 (FH); Luzon, Mt. Maguiling, on dead wood, 4 Oct 1920, *Medina* 10291 (FH-Pat); 26 Oct 1920, *R. Reyes* 10408 (FH-Pat); 25 Oct 1920, *P. Malabassan* 10444 (FH-Pat); 23 Sept 1917, *S. Marquez* 3393 (FH-Pat); Oct 1920, *O. A. Reinking* 10269 (FH-Pat); 24 Oct 1920, *F. Bernardo* 10446 (FH-Pat); 20 Oct 1920, *A. Abesamis* 10417 (FH-Pat); 29 Aug 1917, *R. Reyes* 3324 (FH-Pat); 30 Aug 1917, *S. Marquez* 3393 (FH-Pat); 25 Oct 1920, *P. Malabassan* 10459 (FH-Pat); 11 Oct 1920, *P. Lisou* 10295 (FH-Pat); Mud Spring, along trail, 27 Aug 1966., *Denison* 4728 (= OSC 28874); Mt. Mekiling, Decaying bark of palms, 8 Oct 1966, *B. D. Ona*, *Denison* 3946 (= OSC 67797). PUERTO RICO. Rio Sabana, 65°43'30"W 18°21'N, on partially buried twigs, 17 Jan 1996, *D. H. Pfister*, *F. A. Harrington*, *D. J. Lodge* (FH); On decaying wood, 17 Jan 1996, *D. H. Pfister & F. A. Harrington* (FH); On decaying wood, 17 Jan 1996, *D. H. Pfister & F. A. Harrington* (FH); Rio Pedras, 19 Dec 1911, *J. R. Johnston* 173 (FH). TRINIDAD. Port of Spain, on partly submerged wood, 8 Aug 1923, *D. H. Linder* 32 (FH); Port of Spain, 1912-1913, *R. Thaxter* 3734 (FH); Port of Spain, Maraval, 1912, *R. Thaxter* (FH); St. Anne's Valley, on dead wood, 22 Aug 1923, *D. H. Linder* 106 (FH); *R. Thaxter* (FH); 1913, *R. Thaxter* 3802 (FH). USA. FLORIDA: Dade

County, Castellow County Park, on sticks, 10 Oct 1997, *J. Trappe 19953* (= OSC 60205). VENEZUELA. AMAZONAS: Yutajé, 5–7 Jul 1997, *K. Samuels*, 18 collections in USB; Oeste del Caño Yutajé, 1km NE del Campamento Yutajé, Bosque de las Ceibas, pie de monte, 5°35'N, 66°10'O, rama Muerta, 21 Jun 1996, *T. Iturriaga y colaboradores 2705* (USB); Madera en descomposición, 21 Jun 1996, *T. Iturriaga y colaboradores 2738* (USB); 21 Jun 1996, *T. Iturriaga y colaboradores 2738* (USB); 21 Jun 1996, *T. Iturriaga y colaboradores 2705* (USB); SOLANO: San Carlos trail, 100–130 m, on dead branches, 1959, *J. J. Wurdack & L. S. Adderley 43401* (FH); Tobagan de la Selva, Caño Coromoto, 75m, on a rotten trunk, 17 Oct 1988, *G. A. Romero 1772* (FH); Entre Maypures et San Fernando, sur branche pourrie, Aug 1887, *242* (FH-Pat); Entre Maypures et San Fernando, 27 Aug 1887, *Gaillard 243* (FH-Pat).

Cookeina venezuelae (Berk. & M.A. Curtis ex Cooke) Le Gal, Prodr. Flore Madagascar 4: 241. 1953. Figs. 1 F, 2, 8

= *Peziza venezuelae* Berk. & M.A. Curtis ex Cooke, Mycographia p. 120. 1875! = *Phillipsia venezuelae* (Berk. & M. A. Curtis ex Cooke) Masee, J. Linn. Soc. 31: 473. 1896.

= *Discina pululahuana* Pat., Bull. Soc. Mycol. France 9: 145. 1893!

= *Discina epixyla* Pat. in Duss, Énumération méthodique des champignons recueillis à la Guadeloupe et à la Martinique p. 63. 1903!, !! (paratype)

Apothecia solitary to clustered, slightly to deeply cupulate, sessile to subsessile, when fresh up to 30 mm diam, when dry up to 20 mm diam. **Receptacle** concolorous or slightly lighter than the disc, frequently drying in a venose, convoluted-cerebriform ribbed pattern, more evident at the base of the receptacle where it shows a ribbed or venose pattern; apparently smooth but when closely examined minutely pubescent, and under the dissecting scope one observes that it is covered by a fine tomentum. **Stipe** present or lacking (sessile), when present central or slightly excentric, obconic, very short, 1–3 x 2 mm, concolorous to receptacle. **Disc** glabrous; when fresh, salmon to rose pinkish, when dry, cream colored to beige to light yellowish to ochraceous to light brown. **Margin** with 1–4 low circumferential ridges, which become more evident when dry, when rehydrated only uppermost ridge remains evident; under magnification appearing downy, and under the compound microscope there are evident short bundles, each bundle 30–120 µm long by 20–50 µm wide at the base, by 10–20 µm wide at the apex, each composed of several monilioid processes that cluster together; each monilioid process is formed by 4–5 round to ellipsoid cells in a filament, terminal cell of the filament round or tapering to a blunt point, cell walls thick and rugose due to encrustation or deposition, cells 60–70 x 10 µm. These bundles are more evident on the uppermost ridge of the margin. **Outer ectal** of the following: a) occasional groups of 5–12 thick-walled globose or elongate cells which extend to form pustules b) 2-celled short hairlike processes with globose, clavate or pyriform terminal cells c) monilioid filamentose hairlike processes composed of 3–5 round to ellipsoid cells; the two last ones (b & c) extend to form short hairs or “hairlike processes” as seen on the receptacle surface under a hand lens or dissecting scope 2) **Inner ectal excipulum** gelatinized, 66–88 µm thick, hyphae 1.5–4 µm in diameter, parallel to one another, but perpendicular to the outside of the apothecium and surrounded by refractive gelatinous material, which does not stain in cotton-blue lactophenol. **Medullary excipulum** 80–90 µm thick of *textura porrecta* with hyphae parallel to one another and also parallel to the outer surface of the apothecium, 3.0–

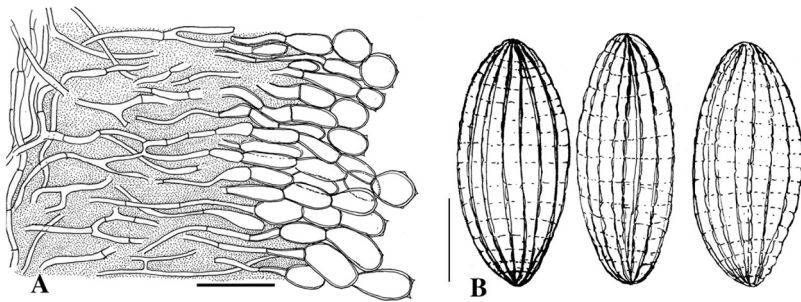


Figure 8. *Cookeina venezuelae*. A. Cross section showing outer layer of the excipulum, bar = 50 μm . B. Schematic representation of ascospores with longitudinal and transverse markings, bar = 10 μm . Haut Matouba, Guadeloupe, FWI; 9 Jan 1974, D. H. Pfister, S. Carpenter, M. Sherwood 1161 (FH).

3.5 μm in diam. **Subhymenium** *textura intricata* to *porrecta*, not a well defined layer. **Asci** cylindrical, base round to slightly tapering, 275–550 \times (10–) 20–30 μm , abruptly rising from thin basal hyphae (8–)12–32(–38) \times 2–6 μm , 8 spores located at top 1/2 of the ascus. **Ascospores** elliptic fusoid, apiculate at each end, bilaterally symmetrical or asymmetrical, pale yellow, (24–)30–43 \times (9.0–)14–18 μm , ornamentation consisting of few longitudinal ribs separated 3–4 μm from each other, and these connected by many fine transverse interconnected ridges, (0–)2(–3) large central guttules surrounded by smaller ones towards both ends, uniseriate. **Paraphyses** filiform, septate, simple to branching, highly anastomosing, forming an interconnecting network, 2–5 μm diam in the middle, sometimes slightly enlarging at apex to 5 μm diam. **Excipulum** of *textura globulosa* to *angularis*, 3–5 cells thick, cells 6–20(–24) μm diam, radially arranged, outer layer of cells giving rise to one or several

SUBSTRATE: On decorticated wood, on wood and branches.

DISTRIBUTION: Known from Central America, northern South America (Venezuela is the type locality of *P. venezuelae*), Jamaica, Puerto Rico and Guadeloupe (type locality of *D. epixyla*).

ILLUSTRATIONS: Cooke (1875) pl. 69, fig 305; Cooke (1879) tab. 69, fig. 305. Cooke (1879) as *Peziza venezuelae* f.; Masee (1896) as *Phillipsia venezuelae*, tab. 16, fig. 4–5; Seaver (1928, 1942) as *Cookeina colensoi*, pl. 17, fig. 3; Le Gal (1953) fig. 109; Dennis (1954), fig. G; Gamundí (1957), Lam. II; Denison (1967) fig. 2, 4; Dennis (1970), fig. 7W; Pfister (1974), Fig. 1; fig. 9–11; Gamundí (1983) map 6, distribution in neotropics; Weinstein et al. (2002), fig. 3C.

NOTES ON TYPE SPECIMENS AND NOMENCLATURE: Some apothecia of the holotype of *Peziza venezuelae* (K) are sterile, but at least one of the apothecia is fertile, in good condition and many ascospores were seen by Le Gal (1953) and by us. Several parts of Fendler's original collection exist. One in the Sprague Herbarium (FH) is immature, a collection in the Ellis Herbarium (NY) is mature and these are assumed to be parts of the same gathering and are presumed isotypes.

Some commentary on the names listed among the synonyms may aid further investigators. The holotype material of *Discina pululahuana* is housed at FH but is

in poor condition; therefore it is recommended that the slide that accompanies this specimen be examined. We confirmed that tissues and striate ascospores are identical to those of *C. venezuelae* as was suggested by Pfister (1974). Two specimen numbers are mentioned in the original description of *D. epixyla*, 249 and 527 and both specimens are in FH. We designate here specimen number 249 as the lectotype of *D. epixyla*, since number 527 is immature. The designated lectotype has a drawing by Patouillard of three ascospores on the packet. Patouillard (in Duss 1903) noted that this species was very close to *D. pululahuana*, mentioned above, the differences being that the latter had larger ascomata and ascospores, as well as a reddish color. This was confirmed in examination of material, our measurements of ascospores of *D. pululahuana* are 40 x 14 (though they are described as 35–42 x 12–16 µm) and *D. epixyla* is reported as being 33 x 13–15 µm. We consider these differences irrelevant. Dennis (1954) first suggested that *D. epixyla* might be a synonym. Pfister (1974) examined Patouillard's specimen and proved that Dennis was correct.

GENERAL NOTES: Seaver (1913,1928) treated this species as *Cookeina colensoi*. Le Gal (1953) pointing out that the ascospores of *C. colensoi* are smooth whereas those in *C. venezuelae* are distinctively marked with longitudinal ribs as Seaver has described for West Indian collections. Korf (1971, 1973) placed *C. colensoi* in the genus *Boedijnopeziza*, a previously monotypic genus. Based on a study of the specimens Korf had at hand, Pfister (1974) determined that Korf, like Seaver had confused *C. colensoi* and *C. venezuelae*. This is understandable since both species are hairless and have stipes. Both also have gelatinous material in the inner ectal excipulum. The recognition of the genus *Boedijnopeziza* has not been accepted by Le Gal (1953), Denison (1967), Pfister (1974), Pfister & Kaushal (1984) and Weinstein et al. (2002). Le Gal states that the shape and size of ascospores in *C. venezuelae* and *C. colensoi* are similar, but there are differences between them with regard to the ornamentation and apiculations. The spores of *C. colensoi* are smooth and have apiculate ascospores; *C. venezuelae* has striate non-apiculate ascospores. Le Gal illustrates *C. venezuelae* ascospores as narrowing at the poles, but with no apiculum present, whereas her illustrations of *C. sulcipes*, and *C. colensoi* show apiculi formed by a [stated by her as a mucilaginous] perispore. In some cases the perispore layer is uniform as Le Gal states, but we disagree with her, since we have observed that in other cases the perispore layer thickens clearly at the poles forming apiculi (one at each end) which seem to be formed by wall material and not gel.

SPECIMENS EXAMINED. COLOMBIA: Trail between Hacienda Cincinnati and Jamonical, 100-1250m, 12 Aug 1935, G. W. Martin 3312 (NY). ECUADOR. Sur la terre [probably on buried wood or wood fragments], Cratère de Pululahuana, Lagerheim, Equador, Feb 1892 (holotype of *Discina pululahuana*) (FH-Pat). GUADELOUPE: Sur loutes sartes de branches mortes, Bois de la Rivière Saint-Louis, Guadeloupe, Février 1901, Duss 249, [Lectotype of *Discina epixyla*] (FH-Pat); Camp Jacob, sur bois pourri jeune coffee arabica, Fèv 1902, 527 [paratype of *Discina epixyla*] (FH-Pat) [as *Peziza* peut-être *Discina epixyla*]; Haut Matouba, Victor Hughes Trail, 700-1071m, on twigs and fallen branches, 9 Jan 1974, D. H. Pfister, S. Carpenter, M. Sherwood 1161 (FH); Grand Matouba, Victor Hughes Trail, 700m, on twigs, 8 Jan 1974, D. H. Pfister, S. Carpenter, M. Sherwood 1107 (FH); Saint Claude, Camp Jacob, 500-550m, on twigs and larger pieces of wood, 7 Jan 1974, D. H. Pfister, S. Carpenter, M. Sherwood 1033 (FH); Montagne de St. Louis, 1902, P. Duss (NY). JAMAICA. Chester Vale, 3000-4000ft, 21-24 Dec 1908, W. A. Murrill & Edna L. Murrill 349 (NY); Chestervale, 3000ft, 7 Feb 1903,

L. M. Underwood 1160 (NY); Morce's Gap, 5000ft, 29-30 Dec 1908, 2 Jan 1909, *W. A. & Edna L. Murrill 669* (NY), infertile but with asci; Rose Hill, 3500ft, on dead wood, 20 Oct-24 Nov 1902, *F. S. Earle 51* (NY); On wood, along trail between Woodcutter's Gap and ruins of Major Wallin's House, vicinity of Newcastle, Portland, Parish, 9.I.1971, *R.P. Korf et al.* (CUP-MJ-139); On twigs, along Lady's Mile Trail to just south of Woodcutter's Gap, vicinity of Newcastle, border of St. Andrew and Portland Parishes, 9.I.1971, *R.P. Korf et al.* (CUP-MJ-146, CUP-MJ-176); along Ulster Road Trail, Newcastle, St. Andrew Parish, 9.I.1971, *R.P.Korf et al.* (CUP-MJ-197); On wood, *Cecropia peltata* and other substrates, Chesterville Youth Development Camp, above Newcastle, St. Andrew Parish, 8.I.1971, *R.P.Korf et al.* (CUP-MJ-1, OSC 30140); On wood, near Dick's Pond, west of Hardwar Gap, near Holywell Recreation Area, St. Andrew Parish, elev. 2800-3000'; 11.I.1971, *R.P.Korf et al.* (CUP-MJ-326); On twigs, Cinchona Botanical Gardens, St. Andrew Parish, elev. 4750'; 8.I.1971, *R.P.Korf et al.* (CUP-MJ-53); On twigs, Cinchona Botanical Gardens, St. Andrew Parish, elev. 4750'; 8.I.1971, *R.P.Korf et al.* (CUP-MJ-47). PANAMA. CHIRIQUI: Llanos del Volcan, 1100-1200m, in forest, 13 Jul 1935, *G. W. Martin 2782* (FH). PUERTO RICO: Cordillera Central, Toro Negro, Mun. de Juan Diaz, Long. 66°32'8" Lat. 18°9'10", on big log, 24 Jun 1996, *S. A. Cantrell 3381* (FH). VENEZUELA. On the ground, unlocalized, year 1855, *Leg. A. Fendler 282*, Venezuela (holotype of *Peziza venezuelae*) (K); Venezuela, *Fendler 282*, (isotype of *Peziza venezuelae*) Curtis Herbarium (FH); *Fendler* [probably an isotype of *Peziza venezuelae*, but with no number,], in an immature specimen with asci but no ascospores (Sprague Herbarium-FH), ; *Fendler* (NY) [as *Peziza venezuelae*, *Cookeina colensoi*], [probably an isotype of *Peziza venezuelae*, but with no number,], Ellis (NY); AMAZONAS: Sobre ramita caída, 25 Oct 1997, *T. Iturriaga 6065* (FH); ARAGUA: Maracay, Camino de Interpretación de la Naturaleza 'Andy Fields', Parque Nacional Henry Pittier, Estación Biológica Rancho Grande, sobre corteza de madera, 24 Nov 1994, *T. Iturriaga, L. Bracamonte, L. Ryvarden, O. Holmquist 2257* (VEN); Maracay, Camino de Interpretación de la Naturaleza 'Andy Fields', Estación Biológica Rancho Grande, Parque Nacional Henry Pittier. DISTRITO FEDERAL: On unidentified mossy log, trail from Quebrada Mariperez, through Vivero El Cuno and El Papelon to ca. 1 km. below Hotel Humboldt, El Avila, Parq. Nac. El Avila, Dto. Fed., *K.P. Dumont (VE-6194)*, *R.F. Cain & G.J. Samuels, 27.VII.1972* (NY); On unidentified wood, along trail 1-2 km above las [Los] Venados, El Avila, Parq. Nac. El Avila, Dto. Fed., *K.P. Dumont (VE-5828)*, *R.F. Cain, G.J. Samuels & B. Manara, 24.VII.1972* (NY); On unidentified wood, vicinity refugio "No te Apures", south facing slope of La Silla, Parq. Nac. El Avila, Edo. Miranda [Dto. Fed.], *K.P. Dumont (VE-3810)*, *G.J. Samuels & B. Manara, 30.VI.1972* (NY); On unidentified wood, between refugio "No te Apures" and Quebrada Los Palos Grandes, south facing slope of La Silla, Parq. Nac. El Avila, Edo. Miranda [Dto. Fed.], *K.P. Dumont (VE-3743)*, *G.J. Samuels & B. Manara, 30.VI.1972* (NY). MIRANDA: Baruta, Sartenejas, sobre corteza rama caída, Oct 1997, *T. Iturriaga 6066* (immature), *6034* (FH); Baruta, Sartenejas, sobre corteza rama caída, Oct 1997, *O. del Guidice 6033* (FH).

Misapplied Names, Synonyms, and Doubful or Excluded Species

GENERAL NOTE: There are many *Trichoscypha* species that are not accounted for in this synonymy list. Most are combined in the genus *Trichoscyphella*, a genus of the *Hyaloscyphaceae*.

abnormis – *Pilocratera abnormis* Peck, N. Y. St. Educ. Dept. Bull 495: 37. 1911.

This is on *Betula* in New York and is an inoperculate discomycete.

afzelii – *Peziza afzelii* Fr. = *Cookeina speciosa*

aluticolor – *Peziza aluticolor* Berk. = *Cookeina colensoi*

amoena – *Peziza amoena* Lév. = *Cookeina speciosa*

antillarum – *Peziza venezuelae* var. *antillarum* Pat. in Duss, Énum. Champ. Guadeloupe, p. 64. 1903. [sur le sol dans une caféyere FH] !

This is *Phillipsia domingensis* (Berk.) Berk.

beccariana – *Peiza hindsii* var. *beccariana* Ces. = *Cookeina speciosa*

argentinensis – *Ciboria argentinensis* Speg. = *Cookeina colensoi*

calyciformis – *Trichoscypha calyciformis* (Willd.) Grélet, Rev. Mycol. (Paris) (NS) 16: 87. 1951.

This is an inoperculate discomycete.

calycina – *Trichoscypha calycina* (Schumach.) Vuill., Bull. Soc. Mycol. Fr. 1: 117. 1885.

This is an inoperculate discomycete.

celebica – *Pilocratera tricholoma* var. *celebica* Henn. = *Cookeina tricholoma*

ciborioides – *Geopyxis ciborioides* Starbäck = *Cookeina colensoi*

colensoi – *Cookeina colensoi* (Berk.) Seaver sensu Seaver = *Cookeina venezuelae*

crocina – *Peziza hindsii* var. *crocina* (Mont. & Fr.) Cesati, Atti Reale Accad. Sci. Fis. 8: 11. 1878 [1879].

This small species, originally described from France as *Peziza crocina* is mostly likely referable to a group of inoperculate discomycetes.

discifera – *Cookeina discifera* (Haszl.) Kuntze, Rev. gen. Pl. 849.1891 = *Craterium disciferum* Hazsl., Verh. K.K. zool.- Bot. Ges. Wien 37: 167. 1887) = *Trichoscypha discifera* (Haszl.) Sacc., Syll. fung. 8:163. 1889 = *Pilocratera discifera* (Haszl.) Sacc. & Traverso, Syll. fung. 20: 412. 1911.

This is a species of *Helvella* judging by the illustration and since the material is from Hungary, an unlikely location for a species of *Cookeina* to occur, it is excluded.

elata – *Geopyxis elata* Masee = *Cookeina speciosa*

engleriana – *Pilcratera engleriana* Henn. = *Cookeina speciosa*

epixyla – *Discina epixyla* Pat. = *Cookeina venezuelae*

fusca – *Cookeina sulcipes* var. *fusca* Alas. = *Cookeina speciosa*

fusispora – *Sarcoscypha fusispora* Sawada, Special Publication, College of Agriculture, National Taiwan University 11: 49. 1959.

Published without a Latin description or diagnosis this is a nomen nudum that refers to *Cookeina insititia*.

globosa – *Cookeina globosa* Douanla-Meli = *Cookeina speciosa*

This taxon was described and illustrated with a fringe of marginal hairs as in *C. speciosa* but as having globose to subglobose ascospores. Our attempt to obtain the specimen has been unsuccessful. Judging by the illustrations and descriptions it seems clear that this species is based on immature specimens of *C. speciosa*. The spores are small 12-15 x

10-12 µm and thin-walled. Since asci mature simultaneously it is often possible, with a single collection as is the case here, to misjudge maturation. Without the specimen our recourse has been to treat this as a synonym of *C. speciosa*.

hindsii – *Peziza hindsii* Berk. = *Cookeina speciosa*

hystrix – *Peziza hystrix* Berk. = *Cookeina tricholoma*

insititia – *Peziza insititia* = *Cookeina insititia*

javanica – *Peziza javanica* Nees ex Lév. = *Cookeina speciosa*

magnispora – *Trichoscypha magnispora* Lloyd = *Cookeina insititia*

maxima – *Pilocratera maxima* P. Syd. = *Cookeina speciosa*

minor – *Peziza tricholoma* var. *minor* Mont. = *Cookeina tricholoma*

medusina – *Peziza medusina* Speg. = *Cookeina tricholoma*

moelleriana – *Geopyxis moelleriana* Henn. = *Cookeina colensoi*

mundkurii – *Cookeina mundkurii* S. C. Kaushal, J. Indian Bot. Soc. 65: 405. 1986.

Specimens of this species have not been available to us for study. Based on the description it is likely that this represents a collection of *C. indica*. It agrees with that species in lacking obvious hairs, in the long ellipsoidal ascospores with longitudinal striations that do not anastomose. The name *C. indica* (Pfister & Kaushal 1984) has priority and *C. mundkurii* is considered a synonym.

notarisiana – *Peziza notarisiana* Bagnis, Atti Reale Accad. Lincei 8: 15. 1876–1877. *Trichoscypha notarisiana* (Bagnis) Sacc., Syll. fung. 8: 162. 1889. = *Cookeina notarisiana* (Bagnis) Kuntze, Revis. gen. pl. 849. 1891. = *Pilocratera notarisiana* (Bagnis) Sacc. & Traverso, Syll. fung. 20: 413. 1910.

This is an inoperculate discomycete.

novoguianensis – *Pilocratera novo-guianensis* Ramsb. = *Cookeina speciosa*

pululahuana – *Discina pululahuana* Pat. = *Cookeina venezuelae*

sessilis – *Ciboria sessilis* Starbäck = *Cookeina colensoi*

sphaeroidospora – *Boedijnopeziza sphaeroidospora* Y. Otani = *Cookeina insititia*

striatospora – *Geopyxis striatospora* Maubl. & Roger

This is a nomen nudum; the description refers to *Cookeina speciosa*.

striispora – *Peziza striispora* Ellis & Everh. = *Cookeina tricholoma*

subfloccosa – *Plectania subfloccosa* Hazsl. Magyar. Discomyc., tab. 5 fig. 29 = *Pilocratera subfloccosa* (Hazsl.) Sacc. & Traverso, Syll. fung. 20: 413. 1911.

sulcipes – *Peziza sulcipes* Berk. = *Cookeina speciosa*

sumatrana – *Cookeina sumatrana* Boedijn = *Cookeina speciosa*

tetraspora – *Cookeina tetraspora* Seaver, Mycologia 17: 45. 1925 = *Phillipsia tetraspora* (Seaver) Le Gal, Prodr. Flore Mycol. Madagascar, 262. 1953. = *Sarcoscypha tetraspora* (Seaver) Denison, Rev. Biol. Trop. 11: 107. 1963. = *Nanoscypha tetraspora* (Seaver) Denison, Mycologia 64: 619. 1972.

This species is the type species of *Nanoscypha* Denison (1972).

tricholoma – *Peziza tricholoma* Mont. = *Cookeina tricholoma*

viridirubescens – *Trichoscypha viridirubescens* (Bagnis) Sacc., Syll. fung. 8: 162. 1889. = *Peziza viridirubescens* Bagnis, Atti Reale Accad. Lincei 8: 15. 1876-1877. = *Cookeina viridirubescens* (Bagnis) Kuntze, Revis. gen. pl. 2: 849. 1891. = *Pilocratera viridirubescens* (Bagnis) Sacc. & Traverso, Syll. fung. 20: 413. 1911.

This is an inoperculate discomycete.

Acknowledgments

This work was supported by NSF grants DEB-9521944 and DEB-0315940 to Donald Pfister and by a grant from the David Rockefeller Center for Latin American Studies of Harvard University which supported Teresa Iturriaga during an extended study leave at Harvard. We wish to thank Richard N. Weinstein, for work done on the project during a post-doctoral fellowship, and Karen Hansen, with whom we were able to discuss various aspects of the project. Richard Korf and Amy Rossman reviewed a draft and Jack D. Rogers and Sharon Cantrell served as formal reviewers. Shaun Pennycook provided us with valuable nomenclatural and technical advice. We thank Jens Petersen, Thomas Læssøe, and Roy Halling for photographs. We owe a debt to the curators of the following herbaria who allowed access to specimens: B, BPI, CUP, K, NY, PC, OSC, PDD, S, USB, VEN.

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