

NEW SPECIES OF UREDINALES ON BIGNONIACEAE FROM BRAZIL

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ABSTRACT

Five new species of rust fungi (Uredinales) from Brazil parasitizing plant host species in the family Bignoniaceae are described. The new species are: *Porotenus bibasiporulus*, *Porotenus biporus*, and *Uredo amapaensis* on *Memora* spp.; *Prospodium amapaensis* on undetermined Bignoniaceae, and *Prospodium laevigatum* on *Mansoa* sp.

RESUMO

Cinco novas espécies de fungos (Uredinales) são descritos, provenientes do Brasil, parasitando espécies de plantas hospedeiras da família Bignoniaceae. As novas espécies são: *Porotenus bibasiporulus*, *Porotenus biporus*, e *Uredo amapaensis* em *Memora* spp., *Prospodium amapaensis* em Bignoniaceae indeterminada e *Prospodium laevigatum* em *Mansoa* sp.

INTRODUCTION

The Uropyxidaceae, a family of nearly 200 species of plant rust fungi (Uredinales) worldwide, is composed of eleven genera, eight of which are neotropical. About 70 species distributed in four genera infect hosts mainly belonging to the Bignoniaceae. As part of our continuing research to monograph the Uropyxidaceae for the Neotropics, we propose five new species.

Porotenus is a small neotropical genus of five species, two on *Memora* spp. and one on *Amphilophium* sp., hosts belonging to Bignoniaceae. Two other species parasitize *Lippia* in the Verbenaceae (Cummins & Hiratsuka 1983). We add two new species on *Memora*. The four species of *Porotenus* on *Memora* are known only from Brazil.

Uredo is an anamorphic rust genus. Anamorphic taxa are also referred to as "imperfect" and "form" taxa. Anamorphic taxa are used to classify fungal spore states that represent only a part of the life cycle of a species. Connections to other spore states in the life cycle may or may not be known (Cummins & Hiratsuka 1983). Both *Uredo huallagensis* P. Hennings, known

only from the type from Tarapoto, Peru, and *Uredo amapaensis*, which we describe below, have morphology and hosts (*Memora* spp.) that suggest they will belong to *Porotenus* when other spore states are discovered.

Prospodium, with nearly 65 species, is the largest genus of Uropyxidaceae. It is strictly American, extending from northern Argentina to southern Texas and Florida in the Northern Hemisphere. Like *Porotenus*, it also parasitizes some members of Verbenaceae (*Lippia*, *Aloysia*, and *Lantana*) but most species occur on at least 19 genera of Bignoniaceae (Cummins 1940; Cummins & Hiratsuka 1983). We add two new species of *Prospodium* on Bignoniaceae.

The Bignoniaceae, with about 100 genera and 800 species worldwide, is primarily tropical and especially abundant in northern South America (Cronquist 1981; Gentry 1980, 1992). In Brazil about 41 species of Uredinales are known to parasitize plants of the Bignoniaceae (Hennen et al. 1982).

Although species concepts of rust fungi are based primarily on morphology, the various host specificity patterns of rusts are useful traits for their taxonomy. Knowledge of host identity, at least to family or genus, is often necessary for efficient identification of rust species (Cummins 1971; Gallegos & Cummins 1981; Lindquist 1982; Hiratsuka, N. et al. 1992). To identify rust species on the family Bignoniaceae it is useful to know that even though the teliospores of *Porotenus*, *Prospodium*, and some other genera of rusts that infect bignoniaceous plants may resemble closely the teliospores of the genus *Puccinia*, no species of *Puccinia* are known to produce teliospores on members of this family. This kind of host relationship is especially important for identifying species of *Puccinia*, the largest genus of rusts with nearly 4,000 species worldwide.

Hennen and Buriticá (1980) discussed some ideas about the evolutionary pathway mechanisms of rusts, where the fungus-plant relationship appears to be a great influence in the evolutionary process.

MATERIALS AND METHODS

The data are based on specimens in herbaria of the Biological Institute of São Paulo, Brazil (IBI), the Emilio Goeldi Museum of Pará at Belém, Brazil (MG) and the Botanical Research Institute of Texas at Fort Worth, Texas (BRIT).

Semipermanent microscopic slide preparations of spores and sori were made by scrape mounts and freehand thin sections from herbarium specimens. Spores or thin sections were mounted in standard lactophenol solution, heated and sealed. For better germ pore visibility some preparations were mounted in a saturated solution of chloral hydrate. Photomicrographic illustrations were made with differential interference contrast optics (Nomarski) and Polaroid type 55 positive/negative film.

POROTENUS TAXONOMY

Telial traits in the four species of *Porotenus* on *Memora* are similar. Sori are scattered on the abaxial side of the leaflets, subepidermal in origin, erumpent, pulvinate, 0.1–0.5 mm across, and cinnamon-brown but become whitish as the spores germinate in situ. The spores are mostly two-celled, oblong-ellipsoid to cylindrical but often narrowed above, rounded below, somewhat constricted at the septa, and pedicellate; the walls are uniformly 1.0–1.5 μm thick, pale cinnamon-brown to nearly colorless, and smooth. Each probasidial cell has one germ pore at its distal end through which a metabasidium emerges on germination. Germination occurs without any noticeable dormancy period. Except for some overlapping spore size differences, telial traits are not useful for identifying species of *Porotenus* on *Memora*.

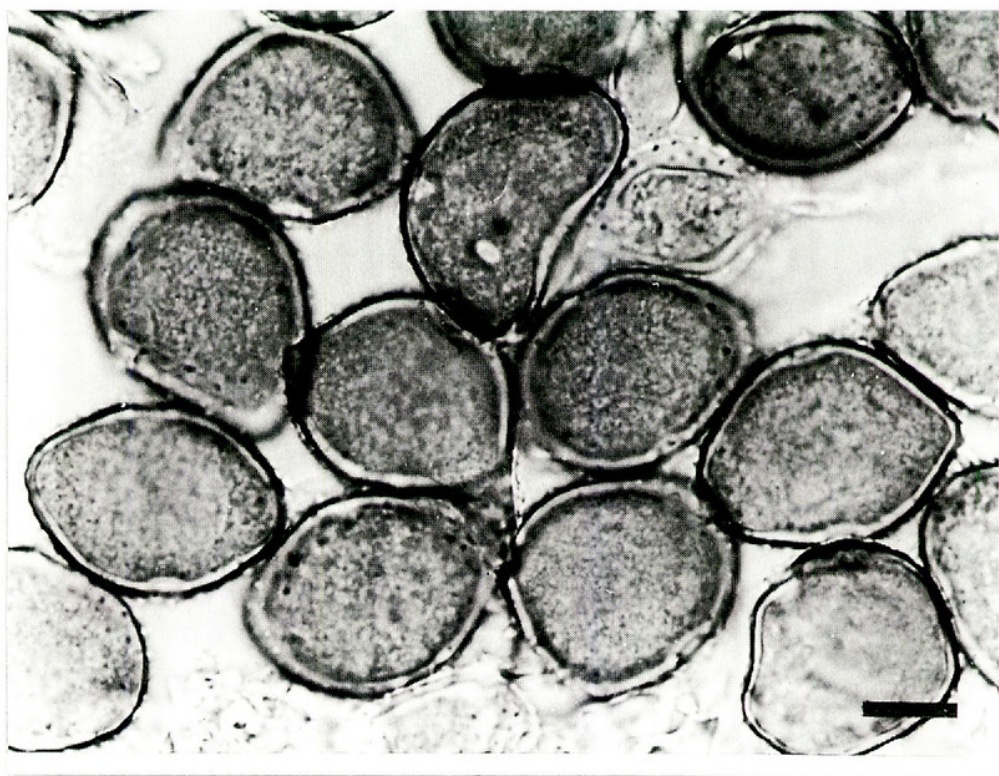
Variations in aecial and uredinial traits are more useful for characterizing these species. Sori are considered as aecial if they closely encircle small patches of spermogonia and develop from the same mycelium. In general, spermogonia and aecia are encountered much less frequently than uredinia. Uredinia are randomly scattered singly or in small irregular groups over the abaxial side of leaflets. They are not directly connected to spermogonia. Both aecia and uredinia are subepidermal in origin, become erumpent, with the broken epidermis usually remaining as a partial covering over the sorus. The sori are 0.1–0.5 mm across and somewhat powdery. The many loose spores produced in the sorus are chestnut-brown in mass. Each spore breaks off of its pedicel, leaving a definite scar termed a hilum at the proximal end of the spore. The spores are bilaterally symmetrical or radially asymmetrical usually with a convex and a concave side. The four species of *Porotenus* and one *Uredo*, including our new taxa on *Memora*, can be identified by their aeciospores or urediniospores using the following key.

1. Pores near the hilum 2
 2. Each spore with one pore on its convex, echinulate side, the concave side with a smooth patch *P. memorae* Albuquerque
 2. Each spore with two pores, both the convex and concave sides with a smooth patch *P. bibasiporulus* Hennen & Sotão
1. Pores on the sides of the spores, more or less equatorial 3
 3. Spore walls more or less evenly strongly echinulate, without smooth patches *U. amapaensis* Hennen & Sotão
 3. Spore walls with one or two smooth patches 4
 4. Wall with one smooth patch on the concave side, pores near the edge of the smooth patch *P. concavus* Viégas
 4. Wall with two smooth patches, one on the concave side, one on the convex side, pores in the echinulate area of the spore *P. biporus* Hennen & Sotão

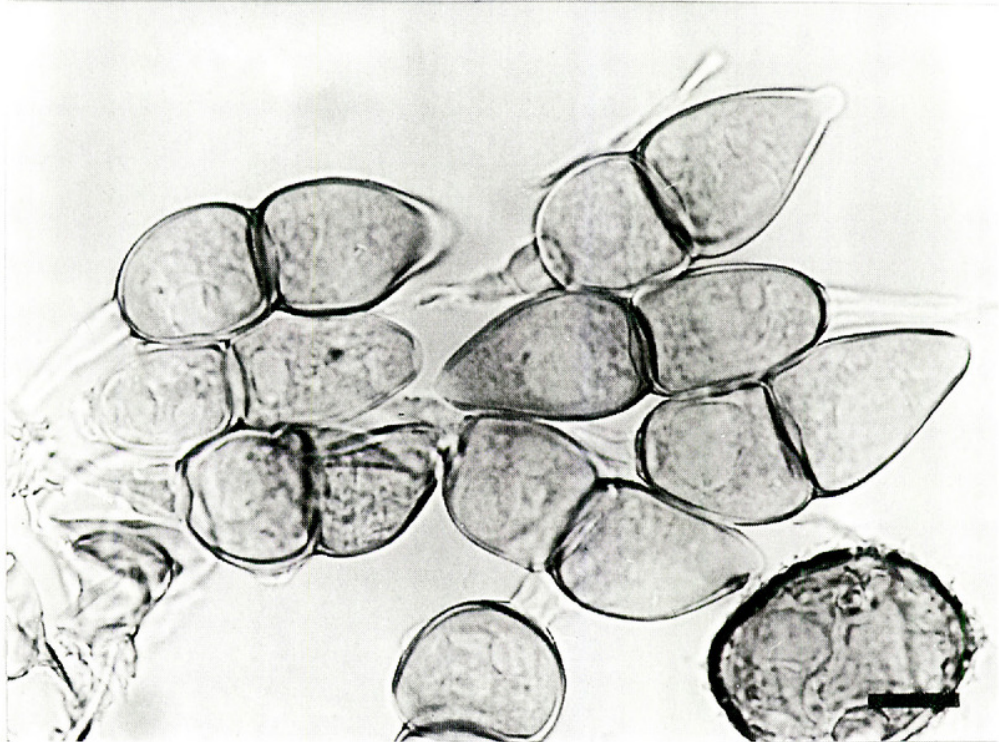
***Porotenus biporus* Hennen & Sotão, sp. nov. (Figs. 1, 2)**

Spermogonia amphigena in gregis. Aecia spermogonia cingentia, sporis urediniosporis similibus. Uredinia hypophylla; sporis (33–)35–40(–42) \times 24–30(–33) μm asymmetricis

1 ►



2 ►



FIGS. 1, 2. *Porotenus biporus*. Fig. 1. Urediniospores, median focus. Fig. 2. Teloisporae. Bar = ca 13 μ m.

late ellipsoidea vel ovoidea; poris 2, equatorialibus. Telia hypophylla; sporis (36–)40–49 \times 17–22 μ m oblongo-ellipsoidea vel plus minusque cylindrica; episporio 1–1.5 μ m crasso, brunneolo vel praecipue hyalino laevi in cellula quaque poro apicali; pedicello tenuitunicato hyalino typice in fragmento curto; sporis non dormientibus.

Spermogonia amphigenous in groups on discolored areas that finally fall from the leaf leaving a little hole. Aecia arranged around the spermogonia, brown, spores pedicellate, similar to the urediniospores. Uredinia hypophyllous, scattered, dark brown, spores (33–)35–40(–42) \times 24–30(–33) μ m, asymmetrical, broadly ellipsoid or oval with pores in optical section, slightly reniform with pores in the optical axis, wall 1.5–2 μ m thick, dark cinnamon-brown, with a longitudinal irregular band of echinulae in which there are two more or less equatorial pores. Telia hypophyllous, brownish, pulvinate, spores (36–)40–49 \times 17–22 μ m, oblong-ellipsoid or more or less cylindrical, wall 1–1.5 μ m thick, pale brownish to essentially colorless, smooth, pore apical in each cell, pedicel thin-walled, colorless, usually broken short, spores germinate without dormancy.

TYPE: BRAZIL. PARÁ: near Belém, Mocambo Forest Preserve, on *Memora flavida* (A. DC.) Bureau & K. Schumann, 9 Jul 1979, J.F. & M.M. Hennen 79-153 (HOLOTYPE: IBI; ISOTYPE: BRIT).

Additional specimens examined: BRAZIL. Amapá: Maruanum, 27 Dec 1989, J. Hennen & H. Sotão 89-175 (BRIT, IBI); Serra do Navio, 7 Jan 1990, J. Hennen & H. Sotão 90-22 (BRIT, IBI). Distrito Federal: DF Hwy 15, 12 Feb 1981, E.P. Heringer et al 6195 (BRIT). Maranhão: São Luis, forest in Sacavem (CAEMA), 20 Jan 1990, J. Hennen & H. Sotão 90-61 (BRIT, IBI). Minas Gerais: 40 km E of Lavras on BR Hwy 116, 12 Mar 1984, J. & M. Hennen 84-250 (BRIT, IBI); 40 km E of Lavras, J. & M. Hennen 83-351 (BRIT, IBI). Pará: Belém, on *Memora flavida* (A. DC.) Bureau & Schumann, 5 Nov 1967, Albuquerque s.n. (PUR F17762); Belém, on the grounds of EMBRAPA, on *Memora* sp., 17 Jan 1990, J. Hennen & H. Sotão 90-43 (BRIT, IBI); Caxiuanã, Estação Científica Ferreira Penna, May 1994, J. & M. Hennen & H. Sotão 94-172 (BRIT, IBI).

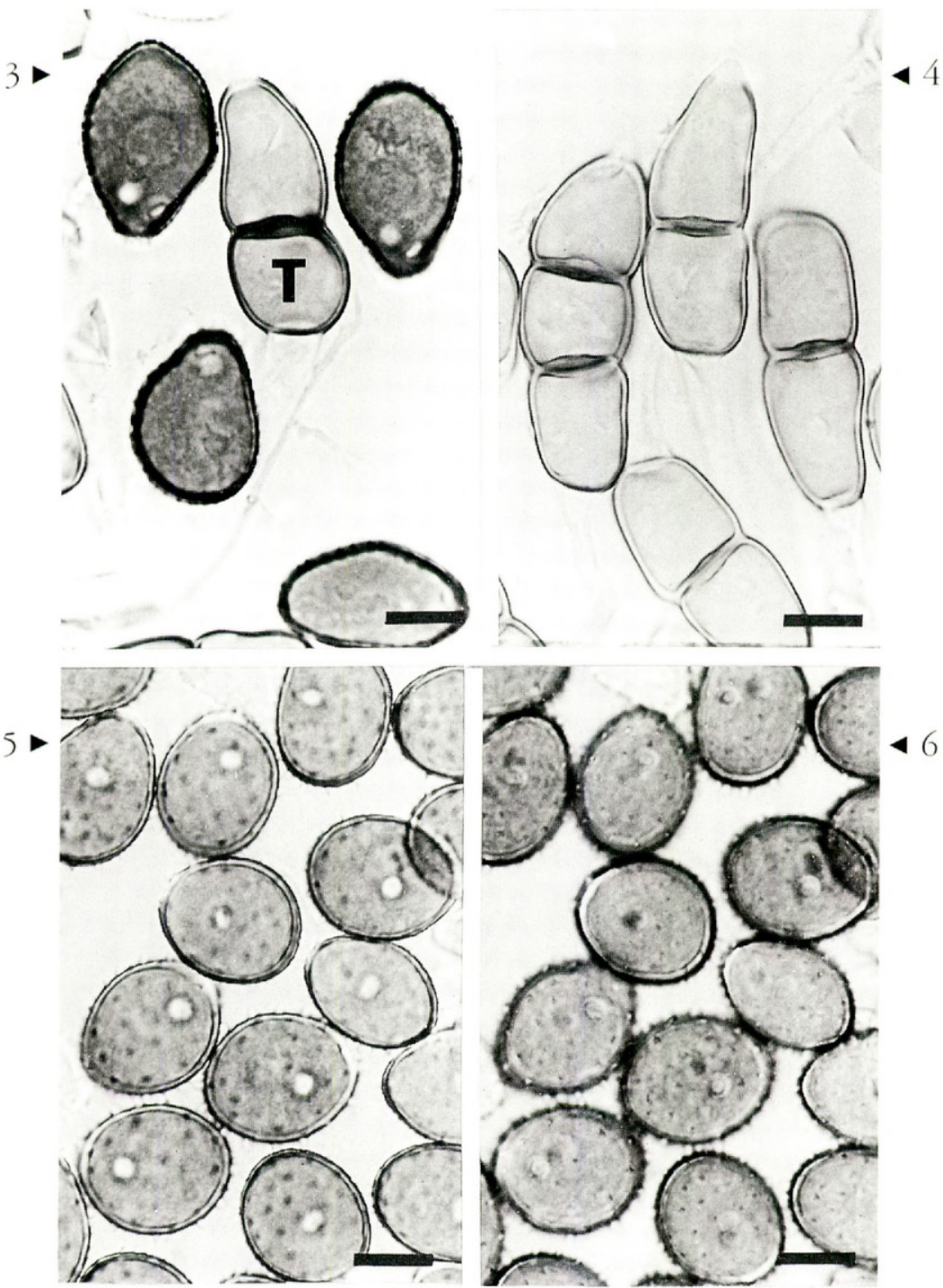
Etymology.—The specific epithet refers to the two pores in the urediniospores.

Distribution.—*Porotenus biporus* seems to be widespread in northeastern Brazil on several species of *Memora* from the cerrado and Amazon forest regions. Further field work is necessary, especially in the Amazon area to learn the full extent of its geographic and host range.

The concave and convex sides of the anamorph spores have large irregular smooth patches. The germ pores are along the sides opposite each other in the irregular echinulate band that surrounds the spore and separates the two smooth areas. Careful focusing on the spore surfaces is required for observing these traits.

Porotenus bibasiporus Hennen & Sotão, sp. nov. (Figs. 3, 4)

Spermogonia et aecia amphigena in areis parvis nigrescentibus hypertrophicatis, ad 5 mm diam.; aeciosporis et urediniosporis similibus. Uredinia hypophylla sparsa fuligenea; sporis



FIGS. 3, 4. *Porotenus bibasiporulus*. Fig. 3. Urediniospores and one teliospore. Fig. 4. Teliospores, note the unusual three-celled spore. Figs. 5, 6. *Uredo amapaensis*. Fig. 5. Spores, median focus. Fig. 6. Same as Fig. 5 but surface focus, note distribution of echinulae. Bar = ca 13 μ m.

(31–)34–43(–48) \times (14–)18–24 (–25) μm , plerumque ellipsoideis 22–24 μm latis; telia hypophylla sparsa cinnamomea, coacti-pulveracea; sporis bilocularibus (parce trilocularibus), (40–)45–55(–66) \times (15–)18–23 μm , plerumque fere cylindricis, leniter constrictis ad septum; episporio constanter 1–1.5 μm crasso laevi avellino vel fere hyalino; poro in cellula quaque apicali; pedicello hyalino tenuitunicato ad 50 μm longo.

Spermogonia and aecia amphigenous in small, blackened, hypertrophied areas to more or less 5 mm diam; aeciospores similar to urediniospores. Uredinia hypophyllous, scattered, dark brown, spores (31–)34–43(–48) \times (14–)18–24(–25) μm , mostly ellipsoid and 22–24 μm wide with pores in the optical axis, strongly uniform and (14–)17–20 μm wide with pores lateral, thus conspicuously asymmetrical radially, wall uniformly 1.5 μm thick, chestnut-brown, echinulate except with two irregular smooth areas near the pores, pores 2, near the hilum. Telia hypophyllous, scattered, cinnamon-brown, felty-pulvinate, spores 2-celled (rarely 3-celled), (40–)45–55(–66) \times (15–)18–23 μm , mostly nearly cylindrical except constricted at septa, wall uniformly 1–1.5 μm thick, smooth, pale golden to nearly colorless, pore apical in each cell, pedicel colorless, thin-walled, to 50 μm .

TYPE: BRAZIL. GOIÁS: dirt road off of Hwy 153 between Rialma and Rianópolis, on *Memora nodosa* (Manso) Miers, 15 Jul 1979, M.M. & J.F. Hennen 79-182 (HOLOTYPE: IBI; ISOTYPE: BRIT).

Additional specimens examined: BRAZIL. Dist. Federal: Brasília, on *Memora nodosa*, 20 May 1981, E.P. Heringer 2023 (BRIT). Goiás: Luziânia, on *Memora* sp., 20 May 1982, E.P. Heringer 2219 (BRIT); 18 km SSW of Jataí, km 364, 18 Jul 1988, J.F. Hennen & M.M. Hennen & R.M. Lopez 88-58 (BRIT, IBI). Minas Gerais: Três Marias, 25 Jun 1972, Inneco 4 (MO 2630750, BRIT-leaf fragment); 13 km SE of Paracatu, 19 Nov 1983, J.F. & M.M. Hennen 83-758 (BRIT, IBI).

Etymology.—The specific epithet refers to the two pores in the lower part of the urediniospores.

Uredo huallagensis P. Hennings (Hedwigia 43:161. 1904) on *Memora* sp., from Tarapoto, Peru, *Ule s.n.*, 1902 (in *Ule's exsiccata*, *Mycotheca brasiliensis*, n.23), also has two basal pores but perhaps is not synonymous, the pigmentation being much paler and the radial asymmetry much less pronounced.

Uredo amapaensis Hennen & Sotão, sp. nov. (Figs. 5, 6)

Spermogoniis, aecidia et teliis ignotis. Soris anamorphis hypophyllis, sparsis, 0.01 mm diam., cinnamomeus-brunneus, erumpentibus; sporis 26–31(–33) \times 17–23(–24) μm , asymmetric, late ellipsoideis, ovatis vel badius, echinulatis, 2 poris germinationis plus minusve equatorialibus.

Spermogonia, aecia and telia unknown. Sori hypophyllous, scattered, 0.1 mm across, cinnamon-brown, pulverulent, ruptured epidermis evident; spores 26–31(–33) \times 17–23(–24) μm , asymmetrical, broadly ellipsoid or oval with pores in optical section, slightly reniform with pores in optical

axis, wall 1–1.5 μm thick, pale chestnut-brown, more or less evenly strongly echinulate, pores 2, more or less equatorial.

TYPE: BRAZIL. AMAPÁ: Camaipí, on *Memora* cf. *magnifica* (Martius ex A. DC.) Bureau, 15 Nov 1987, J.F. Hennen & H. Sotão 87-124 (HOLOTYPE: IBI; ISOTYPES: BRIT, MG).

Additional specimens examined: BRAZIL. Pará: Caxiuanã, Estação Científica Ferreira Penna, on *Memora* cf. *magnifica* (Martius ex A. DC.) Bureau, 2 May 1994, J.F. & M.M. Hennen & H. Sotão 94-173 (BRIT, IBI, MG); Caxiuanã, IBAMA, 3 May 1994, J.F. & M.M. Hennen & H. Sotão 94-182 (BRIT, IBI, MG); 20 Nov 1995, H. Sotão et al 95-308 (BRIT, IBI, MG).

Etymology.—The specific epithet refers to the Brazilian state of Amapá.

This species is closely allied to the three species of *Porotenus* on *Memora*. The more or less evenly and strongly echinulate urediniospores differ from other species, all of which have irregular smooth areas. The three specimens from Caxiuanã (J.F. Hennen & H. Sotão 94-173, 94-182, 95-308) have larger spores than those from the type, 33–48(–51) \times (15–)18–35(–38) μm .

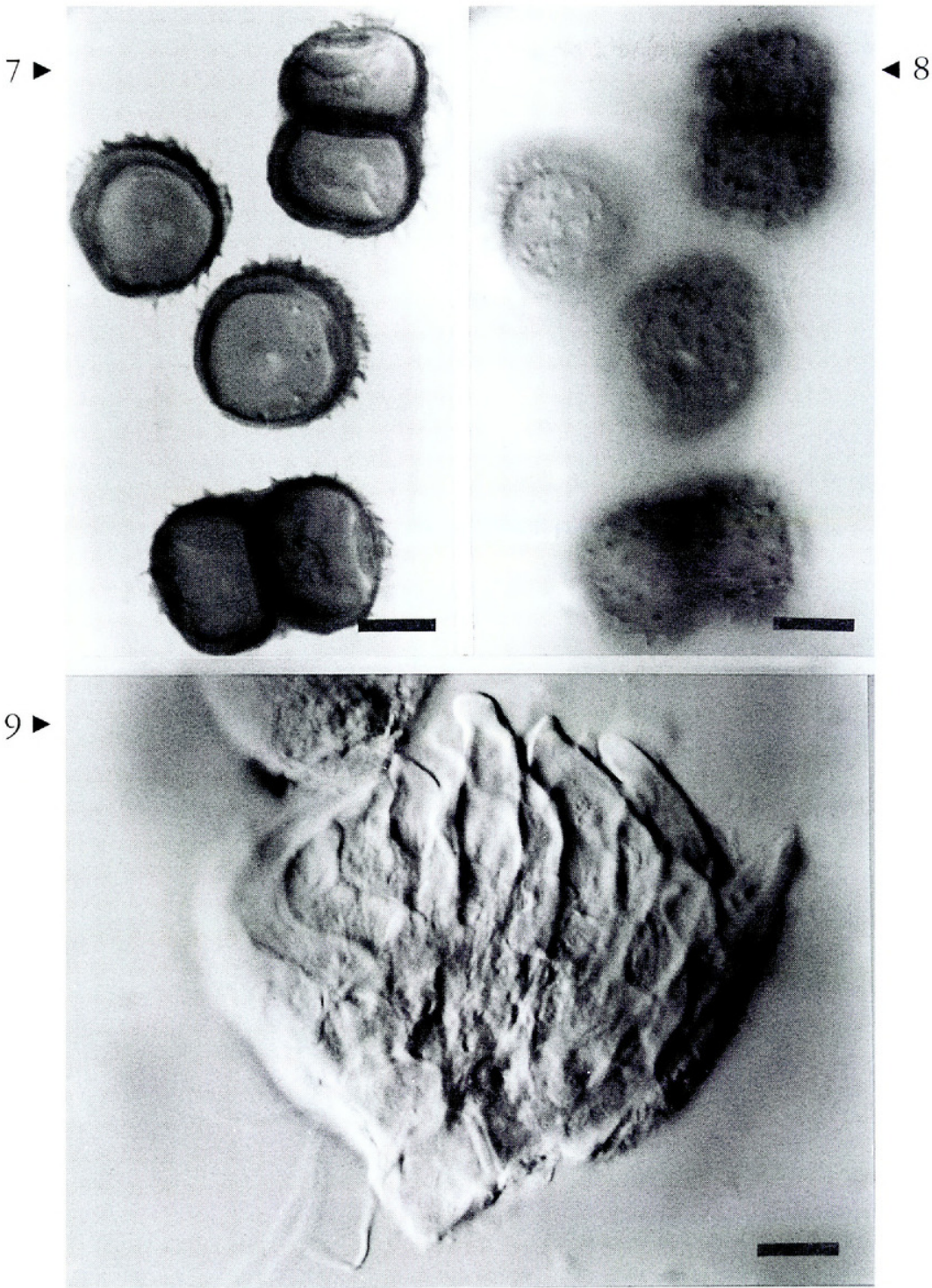
PROSPODIUM TAXONOMY

Three informal groups of species were recognized by Cummins (1940) based on soral traits and kind of life cycle: 1) aecia, uredinia, and telia subepidermal in origin and erumpent, *Euprospodium*; 2) aecia subepidermal—erumpent, but uredinia and telia suprastomatal, *Cyathopsora*, 3) microcyclic, only spermogonia and telia, *Nephlyctis*. Our two new species belong to *Cyathopsora*, a group of about 15 species characterized by a sorus that develops as a minute basket-like structure from hyphae that emerge through stomata (suprastomatal).

Prospodium amapaensis Hennen & Sotão, sp. nov. (Figs. 7–9)

Spermogonia et aecia ignota. Uredinia hypophylla sparsa, suprastomatales, 0.2–0.5 mm diam., cyathiformes, cum paraphysibus 31–40 \times 6–9 μm ; sporis late globoideis vel globosis, poris 2, aequatorialis, poris a latere visis, episporio bilaminato, bicapitato, strato exteriori aculeato. Telia instar uredinearum; sporis 33–47 \times 24–29 μm , ad septum leniter constrictes ad septum apicem, episporio constanter 2–3 μm crasso.

Spermogonia and aecia unknown. Uredinia scattered on adaxial side of leaflets, suprastomatal, 0.2–0.5 mm across, brown, pulverulent; sori composed of a circular basal peridium surmounted with paraphyses around the margin, paraphyses 31–40 \times 6–9 μm ; spores 21–30 \times 19–29 μm ; globoid to broadly ellipsoid, wall 1–1.5 μm thick, yellowish-brown incompletely two layered, the outer layer forming a longitudinal ring of irregularly interconnected spines, the ring divides distally to form a low crown (Cummins & Hiratsuka 1983, use the term “bicapitate” for this trait). The area of the lateral walls between the ring has widely spaced spines and two equatorial and opposite germ pores. Telia like the uredinia but light chestnut brown; spores 37–47 \times 24–29 μm , broadly ellipsoid, broadly rounded above and



FIGS. 7–9. *Prospodium amapaensis*. Fig. 7. Two urediniospores, center, and two teliospores, median focus, note “halo” of echinulations around urediniospores. Fig. 8. Same as Fig. 7 but surface focus, note that some echinulae are joined to each other. Fig. 9. Suprastomatal basket-like soral peridium, lateral view. Bar = ca 13 μ m.

below, with a small umbo above and slightly constricted at the septum; wall evenly 2–3 μm thick, echinulate with echinulae irregularly and widely spaced with echinulae sometimes basally interconnected; pore apical in upper cell and near the pedicel in the lower cell; pedicel usually without appendages and broken near spore.

TYPE: BRAZIL. AMAPÁ: ca 10 km from Mazagão (ca 40 km SW of Macapá), on undetn. Bignoniaceae, 14 Nov 1987, *J.F. Hennen & H. Sotão* 87-120 (HOLOTYPE: IBI; ISOTYPES: BRIT, MG).

Etymology.—The specific epithet refers to the Brazilian state of Amapá.

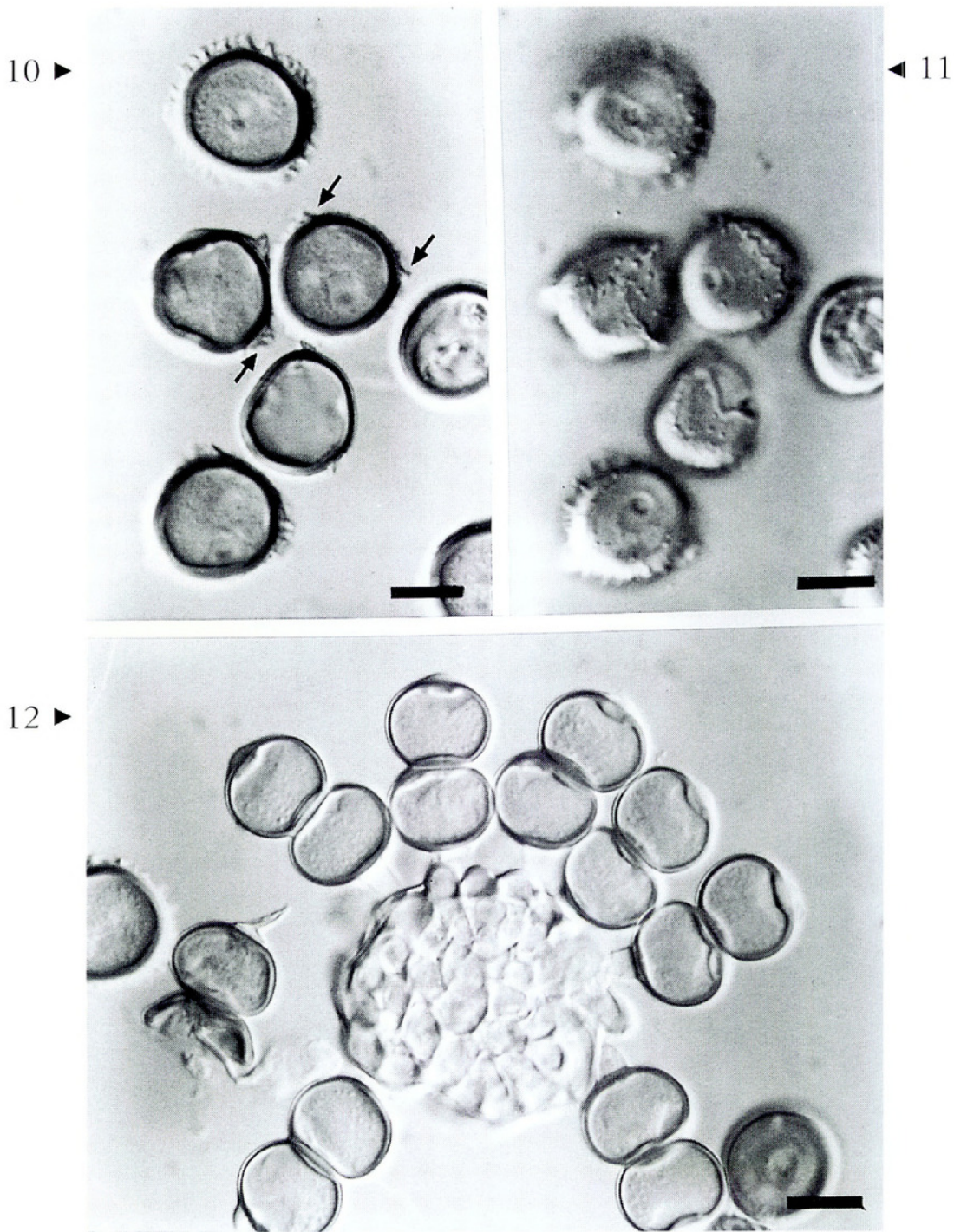
Prospodium amapaensis belongs to a group of six other *Prospodium* species which are characterized by suprastomatal sori that are “basket like” (section “*Cyathopsora*,” Cummins 1949), and the urediniospores have an apical corona (“bicapitate,” Cummins 1949). Within this group, *P. amapaensis* is most similar to *P. tabebuicola* on *Tabebuia* from Puerto Rico but *P. tabebuicola* has teliospores that are larger, not so obtuse above and below, and are obviously constricted at the septum. Their walls are bilaminar, the outer layer thin, translucent, and noticeable especially at the septum.

Prospodium laevigatum Hennen & Sotão, sp. nov. (Figs. 10–12)

Spermogonia plerumque epiphyllis. Aecia hypophyllis, confluentia, pulverulentia, cinnamomea-brunnea; sporis 21–24 \times 20–23 μm . Uredinia ignota. Telia hypophyllis, sparsa, suprastomatales; peridium flavidum, 40–55 μm crasso; sporis 28–35 \times 17–21 μm , oblongus ellipsoideus et valde constrictus ad septum, episporio 1.5 μm crasso, aureus vel pellucidus cinnamomeus-brunneus, levis.

Spermogonia mostly epiphyllous, few in a group. Aecia hypophyllous opposite the spermogonia, confluent in a more or less circular group, pulverulent, cinnamon-brown; spores mostly 21–24 \times 20–23 μm , globoid or essentially so, the inner wall clear chestnut-brown, the outer layer apically coronate, absent over the pores, beset with bacilliform papillae, forming a complete halo when pores are in face view, but showing only as two caps or “ears” laterally from the apex; pores 2, equatorial in the smooth sides. Uredinia not seen, probably not produced. Telia hypophyllous, scattered suprastomatal, cyathiform with a basal, yellowish peridial cup 40–55 μm diam., the rim of the cup with low knobs (scarcely paraphyses); spores mostly 28–35 \times 17–21 μm , oblong-ellipsoid and strongly constricted at septum, the cells nearly globoid, wall uniformly 1.5 μm thick, golden or clear cinnamon-brown, smooth, with a low lenticular, hyaline umbo over each pore, pore apical in upper cell, at septum in lower cell; pedicel thin-walled, colorless, fragile, about 25 μm long, without appendages; germination occurs without dormancy.

TYPE: BRAZIL. PARÁ: Belém, Mocambo Forest Preserve, on *Mansoa kerere* (Aublet) A. Gentry, 9 Jul 1979, *J.F. & M.M. Hennen* 79-153A (HOLOTYPE: IBI; ISOTYPE: BRIT).



FIGS. 10–12. *Prospodium laevigatum*. Fig. 10. Aeciospores, median focus, note (arrows) the apical corona that has a bicapitate or “two eared” appearance. Fig. 11. Same as Fig. 10 but surface focus. Fig. 12. Suprastomatal telial sorus. View of bottom of sorus with teliospores emerging from top. Bar = ca 13 μ m.

Etymology.—The specific epithet refers to the smooth walled teliospores.

Prospodium laevigatum is the only species of the *Cyathopsora* group with smooth teliospores and coronate aeciospores. Only four other species of *Prospodium* have teliospores with smooth walls. Uredinia are probably lacking from the life cycle.

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