Studies in the Genus *Phylacia* (Xylariaceae)

Katia F. Rodrigues and Gary J. Samuels

Rodrigues, Katia F. and **Gary J. Samuels** (The New York Botanical Garden, Bronx, NY 10458, U.S.A.). Studies in the genus *Phylacia* (Xylariaceae). Mem. New York Bot. Gard. **49**: 290–297. 1989. **Phylacia bomba** var. **macrospora** is described as new. *Phylacia globosa, P. poculiformis,* and *P. bomba* var. *bomba* are redescribed. *Geniculosporium* anamorphs developed in cultures derived from single ascospore isolations of *Phylacia globosa* and *P. bomba* var. *macrospora. Geniculosporium* conidiophores developed on young sexual stromata of *P. poculiformis* in nature. These anamorphs indicate that the genus *Phylacia* is a member of the Xylariaceae. Asci of *P. bomba* var. *macrospora* and *P. poculiformis* are described, as are asci, croziers, and ascogenous hyphae of *P. poculiformis.*

Uma nova variedade é descrita, **Phylacia bomba** var. **macrospora.** *Phylacia globosa, P. poculiformis* e *P. bomba* var. *bomba* são redescritas. Anamorfos pertencentes ao gênero *Geniculosporium* desenvolveram-se em culturas derivadas de isolamentos de ascosporos singulares de *P. globosa* e *P. bomba* var. *macrospora.* Conidióforos de *Geniculosporium* foram encontrados na natureza, crescendo em estroma sexual juvem de *P. poculiformis.* Estes anamorfos indicam que o gênero *Phylacia* pertence à Xylariaceae.

Key Words: Xylariaceae, *Phylacia, Geniculosporium,* taxonomy

Introduction

Phylacia Lév. is a genus of unusual and highly distinctive tropical ascomycetes. Ascomata in the genus are black and carbonaceous. Asci are globose and arranged without apparent order within the young ascomatal locule; they are evanescent, breaking down early in development and leaving the ascomatal locule filled with a powdery mass of ascospores. Ascospores are oblong to ellipsoidal, translucent yellowish brown, and lack germ pores or germ slits. Ascomata of *Phylacia* species are cleistothecial in that they lack an ostiolar canal; instead, they open by regular, circumscissile rupture of the ascomatal apex to reveal the powdery ascospores.

The characters presented by *Phylacia* species are generalized and do not reveal the relationship of these fungi. Brown ascospores, globose asci, and carbonaceous ascomata are common to unrelated ascomycetes. The asci of *Phylacia,* which apparently have been rarely seen [e.g., Ellis & Everhart, 1892, for *Phylacia sagraeana* (Mont.) Mont. (pl. 38, fig. 4 as *Camillea sagraeana* (Mont.) Berk. & Curt.); Dennis, 1957, for *P. turbinata* (Berk.) Dennis; and Speer, 1980, for *Phylacia pseudohypoxylon* Speer and *P. glandulina* Speer], lack an apical discharge mechanism and thus do not suggest taxonomic relationships for *Phylacia* species. Because asci of species of *Phylacia* are rarely seen, doubt has been expressed as to whether the genus is even ascomycetous. Because asci have not been seen in the type species, *Phylacia globosa* Lév., Patouillard (1903, see summary in Dennis, 1957) believed that *Phylacia* species were anamorphs of *Hypoxylon* species. Dennis (1957) accepted that the spores of *Phylacia* species are borne in asci that deliquesce,

and referred the genus to the Xylariaceae. He (Dennis, 1961) later excluded *Phylacia* from the Xylariaceae because of its saccate asci; however, he did not indicate any alternative family. Silveira and Rodrigues (1985) and Eriksson and Hawksworth (1987) referred the genus to the Xylariaceae, while Speer (1980) placed the genus in the Phylaciaceae. Dennis (1971) declined to place *Phylacia* in any existing order but compared the genus to *Camillea* of the Xylariaceae, to the Melanosporaceae because of its evanescent asci, and to the Coronophoraceae because the ascospores are not discharged through an ostiole.

Anamorphs can be useful in determining relationships of fungi, but there are no previous reports of anamorphs for *Phylacia.* We have isolated ascospores of *P. globosa* and *P. bomba.* (Mont.) Pat. var. *macrospora,* and have observed anamorphs in pure cultures. We have also found an anamorph on the surface of developing stromata of *P. poculiformis* (Mont.) Mont. The anamorphs that we observed are species of *Geniculosporium* (*sensu* Petrini & Petrini, 1985) and are wholly consistent with anamorphs that have previously been described for the family Xylariaceae (Petrini & Petrini, 1985; Rogers, 1985). Because *Geniculosporium* anamorphs are limited in their taxonomic distribution to the Xylariaceae and its close relatives, and because of the overall similarity of the ascomata and habitat of *Phylacia* species to more typical members of the Xylariaceae, we have no hesitation in assigning *Phylacia* to that family in the order Xylariales.

Do these anamorphs indicate any relationship to other genera of the Xylariaceae? Rogers (1985) made a distinction between *Xylaria* and *Hypoxylon* on the basis of anamorphs. The anamorphs of most species of *Xylaria* form on young sexual stromata or on distinct asexual stroma (*Xylocoremium* Rogers). In contrast, the anamorphs of *Hypoxylon* may form on young sexual stromata, but they may also form free of stromata on the substrate. *Phylacia poculiformis* is the only species in the genus the anamorph of which is known from nature, and its conidiophores form over the surface of the young sexual stromata. Thus, at least *P. poculiformis* is more similar to *Xylaria* than to *Hypoxylon* with respect to the anamorphs.

Phylacia globosa and *P. bomba* var. *macrospora* are the only taxa of the genus known to produce anamorphs in pure culture, and those anamorphs are similar to each other. Although we have grown *P. poculiformis,* it did not produce conidia in culture, and its anamorph in nature cannot be compared to anamorphs formed in culture by other taxa.

In addition to observing their anamorphs, we have seen asci of *P. bomba* var. *macrospora* and of *P. poculiformis.* Following are descriptions of *P. globosa,* which is the type species of the genus, *P. bomba* var. *bomba, P. bomba* var. *macrospora,* and *P. poculiformis* and their anamorphs.

Materials and Methods

Single ascospores of *Phylacia* species were isolated with the aid of a micromanipulator. Germination occurred within 18 hours on Cornmeal dextrose agar (CMD, Difco). Observation of cultures were made on Oatmeal agar (OA, Difco).

Descriptions of the Species

1. *Phylacia globosa* Lév., Ann. Sci. Nat. Bot. Sér. 3, **3:** 61. 1845. Fig. 14.

≡*Camillea globosa* (Lév.) Lloyd, Mycological Notes 5, Large Pyrenomyc. 8. 1917.

Anamorph. *Geniculosporium* sp.

Ascomata solitary to gregarious, erumpent through bark, becoming superficial, subglobose, 7–10 mm high × 8–11 mm broad, constricted at base and with a stalk ca. 3 × 2 mm, black, hard, carbonaceous, surface slightly roughened, apex broadly rounded, disintegrating with age in a sharply defined circular area to expose the ascospores. Perithecia cylindrical, ca. 3 mm long, numerous, densely compacted in the top of the stroma, separated by very thin walls. Asci not seen. Ascospores oblong to broadly ellipsoidal, (11–)11.8–14(–15) × (7.5–)8–9 μm, wall 0.5 to 1 μm thick, smooth, pale translucent brown, lacking germ slit.

CHARACTERISTICS IN CULTURE. Colonies grown 10 days at 15–18°C. CMD: spreading rapidly, transparent, nearly invisible, with scant aerial mycelium. OA: >9 cm diam., mottled green and white, aerial mycelium abundant, densely compacted, many hyphae with green walls and producing much branched lateral branches. Conidiophores on CMD forming profusely from surface of agar, on OA arising in aerial mycelium; non-

descript, indefinite in length, often >100 μm, ca. 3 μm wide, pale cinereous, smooth or with hemispherical incrustations. Conidiogenous cells on OA integrated and terminal, on CMD terminal and intercalary, smooth. Conidia clavate to broadly ellipsoidal, (4.5–)5.3–7(–8) × 3–3.2(–4) μm, with a protuberant, frilled, refractive, basal abscission scar, unicellular, smooth, hyaline or green, produced singly.

HABITAT. On wood.

SPECIMEN EXAMINED. BRAZIL. AMAZONAS: Serra Aracá, base of west facing talus slope, nr. central portion of serra about 45 min walk from lower airstrip, 60 m, 00°49′N, 63°19′W, on wood, 13 Mar 1984, *Samuels 884* (INPA, NY).

NOTES. Dennis (1957) summarized the view that *Phylacia globosa* is a synonym of *P. poculiformis*. On the basis of morphological information he was unable to make a conclusive decision. We have isolated ascospores from several collections of *P. poculiformis*. Because these colonies remained sterile, and were distinct from those of *P. globosa*, we consider *P. globosa* and *P. poculiformis* to be distinct species.

Dennis (1957) has redescribed and illustrated *P. globosa*.

2. *Phylacia poculiformis* (Mont.) Mont., Ann. Sci. Nat. Bot. Sér. 4, **3:** 135. 1855. Figs. 1–5, 16.

≡*Hypoxylon poculiforme* Mont., Ann. Sci. Nat. Bot. Sér. 2, **13:** 354. 1840.
≡*Xylaria poculiformis* (Mont.) Berk. & Curt., J. Acad. Nat. Sci. Philadelphia, Ser. 2, **2:** 285. 1853.
≡*Camillea poculiformis* (Mont.) Lloyd, Mycological Notes 5, Large Pyrenomyc. 9. 1917.

Anamorph. *Geniculosporium* sp.

Conidial stromata arising among overmature stromata, erumpent through bark, columnar, 2–5 mm high × 1.5 mm diam., covered over the length with powdery, tan conidia. Conidiophores arising from pseudoparenchymatous cells at surface of stroma, 30–70 μm high × 2–2.5 μm wide, cylindrical, smooth, pale green in 3% KOH, pale red in 100% lactic acid, branched or unbranched, each branch terminating with several cicatrized conidiogenous loci, conidiophores apparently proliferating sympodially beyond the aggregate of conidiogenous loci and forming another aggregate of conidiogenous loci at a higher level. Conidia ellipsoidal, (4.5–)5–6.2(–7.2) × 2.5–3 (–3.6) μm, with a protuberant, refractive, frilled, basal abscission scar, pale green in 3% KOH, pale red in 100% lactic acid. Conidiogenous stromata apparently ultimately developing into sexual stromata.

Sexual stromata solitary to gregarious, erumpent through bark, becoming superficial, pyriform, (5–)7(–10) mm high × (3–)4–5(–7) mm wide, widest below at point of attachment to stalk, stalk 3(–10) mm high × 1.5–2 mm wide, black, hard, carbonaceous, surface slightly roughened, apex constricted, disintegrating with age in a sharply defined circular area to expose the ascospores. Perithecia cylindrical, ca. 3 mm long, numerous, densely compacted in the top of the stroma, peridium of carbonized, parallel, 3–4 μm wide hyphae. Asci saccate, 25–30 × 10–13 μm, apex simple, J−; 8-spored, ascospores multiseriate, completely filling each ascus; asci arising singly from croziers along the length of ascogenous hyphae of indefinite length. Ascospores oblong to broadly ellipsoidal, (10–)11–13.3(–16) × (5–)5.7–7.7(–9) μm, wall 0.5 to 1 μm thick, smooth, pale translucent brown, lacking germ slit.

HABITAT. Wood.

SPECIMENS EXAMINED. GUYANA. EAST BERBICE-CORENTYNE REGION, VI; SUBREGION 5: Canje R, 1 km N of Ekwarun Creek, 05°20′N, 57°38′W, 0–25 m, on wood, 9, 10 Apr 1987, *Samuels 5365, Pipoly, Gharbarran & Bacchus* (BRG, NY).

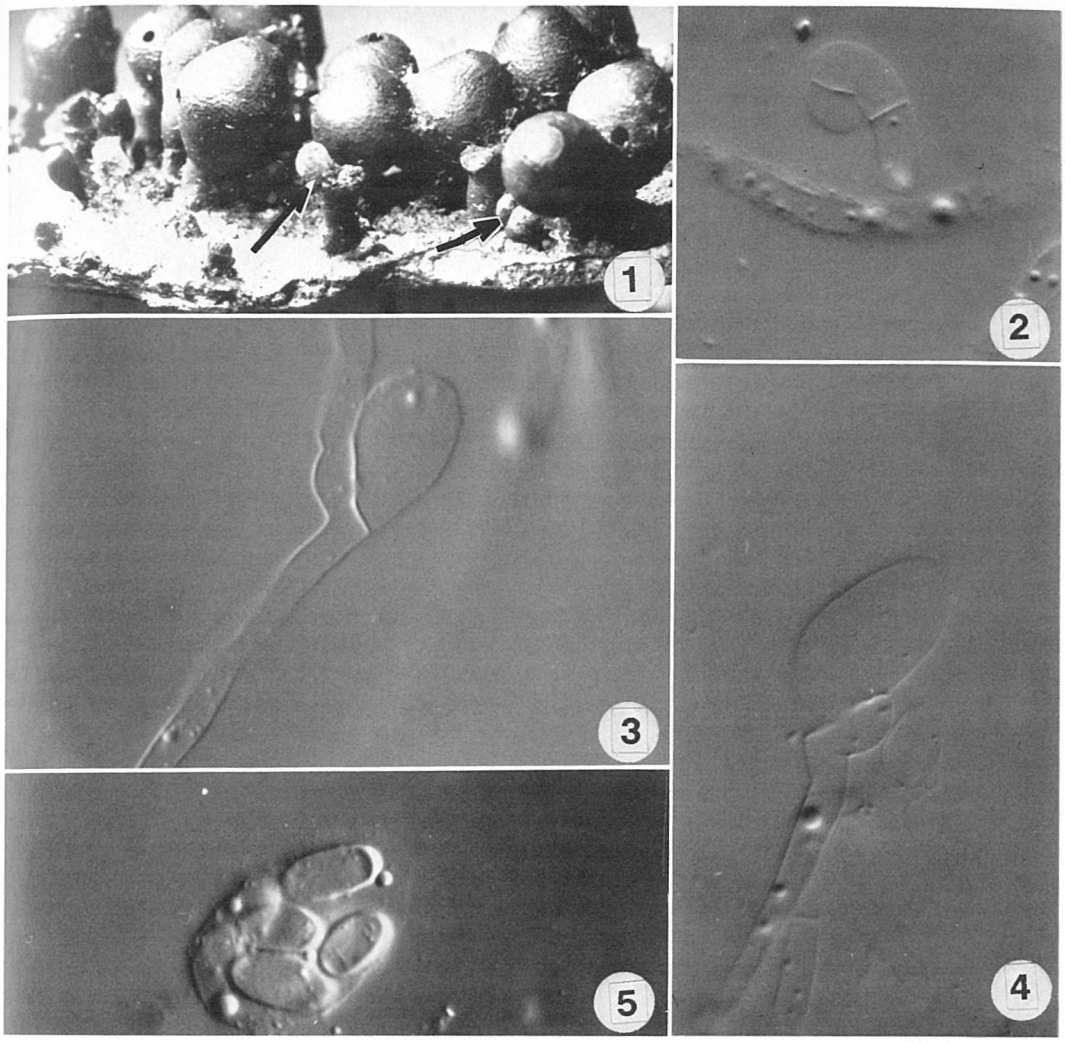
BRAZIL. AMAZONAS: Serra Aracá, track leading SE from camp, vic., Rio Janari, igapo, ca. 60 m, on log, 15 Mar 1984, *Samuels 939 & E. Cooper* (INPA, NY). RORAIMA: Municipio de Alto Alegre, Furo do Firmino, lado W. da Ilha de Maracá, 03°21′N, 61°31′W, on dead trunk, 10 June 1986, *K. F. Rodrigues 886* (NY, RB); Mun. de Alto Alegre, Ilha de Maracá, 03°21′N, 61°31′W, on dead trunk, *K. F. Rodrigues 935 et al.* (NY, RB).

3. *Phylacia bomba* (Mont.) Pat. *in* Duss, Crypt. des Antilles, Champ. 74. 1903 var. *bomba*. Fig. 6.

≡*Hypoxylon bomba* Montagne in Sagra, Flora Cubana 1 208. 1853.
≡*Camillea bomba* (Mont.) Lloyd, Mycological Notes 5, Large Pyrenomyc. 8. 1917.

Anamorph. Not known.

Stromata densely gregarious, erumpent through bark, becoming superficial, hemispherical to pulvinate, 1–2(–3) mm high × (2–)3–5(–7) mm broad, sessile, black, hard carbonaceous, apex smooth to slightly roughened, plane, disinte-



FIGS. 1–5. *Phylacia poculiformis.* **1.** Ascomata with a young conidiogenous stroma (arrows); note circumscissile rupture at the apex of some ascomata (*Rodrigues 886*). **2.** Crozier. **3, 4.** Developing asci. **5.** Ascus with ascospores. (2–4: *Samuels 939*). Magnifications: 1 = ×3; 2–5 = ×1200 (approx.).

grating with age to expose the brown mass of ascospores. Stromata with a single large locule, individual perithecia not seen. Asci not seen. Ascospores oblong, (9–)10.8–13.7(–14.4) × (4–)4.7–6.3 μm, smooth, yellow to pale translucent brown, germ slit lacking.

HABITAT. On wood.

SPECIMENS EXAMINED. BRAZIL. RORAIMA: Mun. de Alto Alegre, 14 km do Furo do Maracá, vic. Boqueirão (estrada do Tepequém), 03°18′N, 61°20′W, on dead trunk, 21 Jun 1986, *K. F. Rodrigues 1084* (NY, RB).

4. **Phylacia bomba** (Mont.) Pat. var. **macrospora** K. F. Rodrigues & Samuels, var. nov.
Figs. 7–13, 15.

Phylacia bomba (Mont.) Pat. var. *bomba* similis sed ascosporae 13.5–15.5(–16.2) × 5.4–7 (–7.2) μm.

Holotypus. *Samuels 5556* (NY).
Anamorph. *Geniculosporium* sp.

Stromata gregarious, erumpent through bark, becoming superficial, and with small pieces of

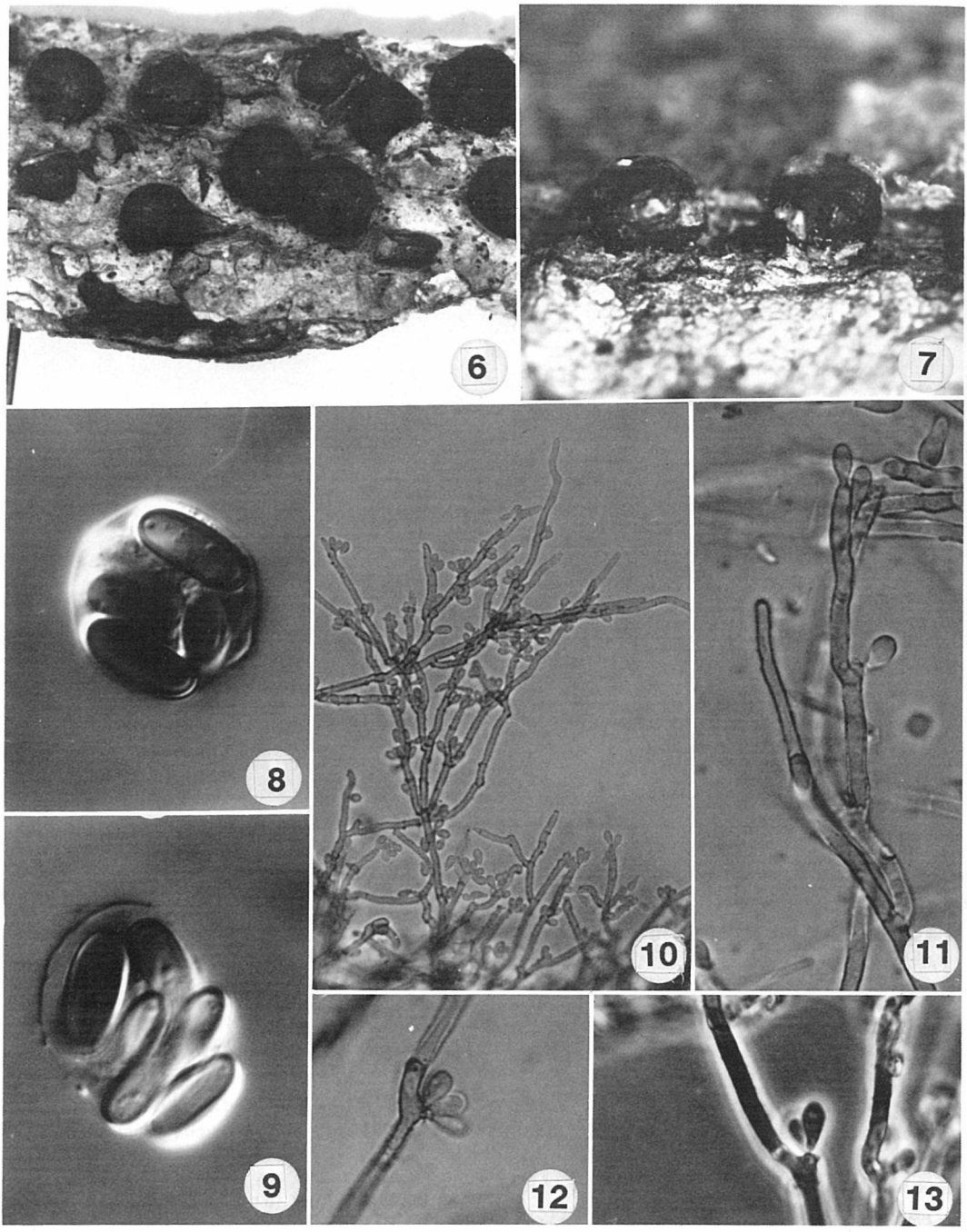


FIG. 6. *Phylacia bomba* var. *bomba,* habit (*Rodrigues 1084*). FIGS. 7–13. *Phylacia bomba* var. *macrospora.* 7. Habit (*Samuels 5381*). **8, 9.** Asci (*Samuels 5379*). **10–13.** *Geniculosporium* anamorph found in pure culture (*Samuels 5556*). Magnifications: 6 = ×3; 7 = ×5.5; 8, 9 = ×1200; 10 = ×600; 11–13 = ×1200.

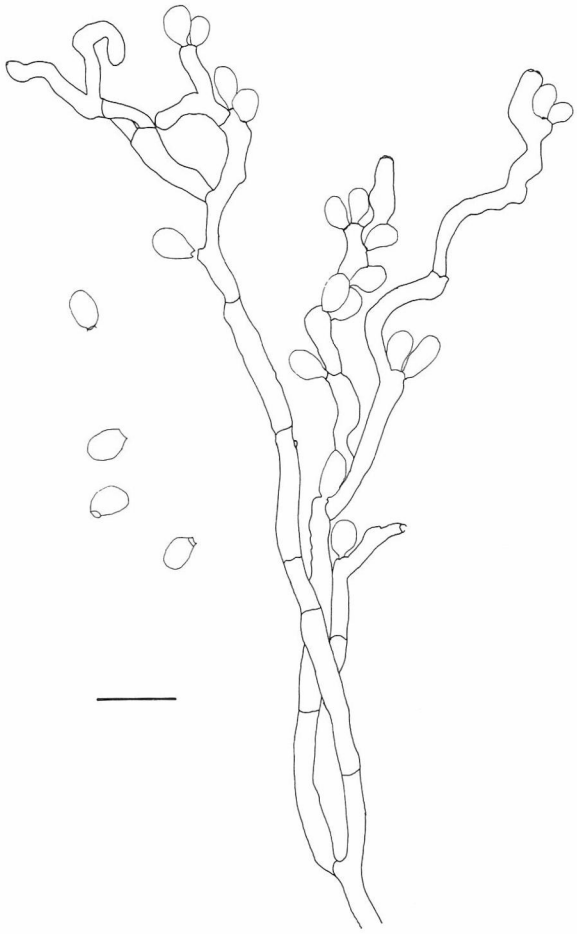


FIG. 14. *Phylacia globosa,* anamorph from culture (*Samuels 884*). Scale bar = 10 μm.

wood adhering, subglobose to hemispherical, 1–2 mm high × 2–3 mm broad, sessile, black, hard carbonaceous, surface roughened, apex broadly rounded, disintegrating with age in a sharply defined circular area to expose the brown mass of ascospores. Upper half of stromata with a single large locule, individual perithecia not seen. Asci subglobose, (13.5–)15–18 × 13.7–16 μm, sessile, 8-spored, evanescent, with a very thin wall, apical discharge mechanism lacking. Ascospores oblong, 13.5–15.5(–16.2) × 5.4–7(–7.2) μm, smooth, yellow to pale translucent brown, germ slit lacking.

CHARACTERISTICS IN CULTURE. Colonies grown three weeks at ca. 20°C on CMD 3 cm diam., at first with some yellow coloration in the center of the colony, later becoming uniformly gray. Conidiophores forming in small tufts on the surface of the agar, mononematous, macronematous, to 200 μm long × 223 μm wide. Conidiogenous cells integrated, terminal and intercalary, smooth. Conidia ± clavate, (3–)4.7–6.5 × 2.5–3.8(–5.5) μm, with a protuberant, 1 μm wide, refractive, frilled basal abscission scar, unicellular, smooth, pale brown, produced singly.

HABITAT. On wood.

HOLOTYPE. Guyana. East Berbice-Corentyne Region, VI; Subregion 5: Canje R, 1 km N of Ekwarun Creek, 05°20′N, 57°38′W, 0–25 m, on log, 9, 10 Apr 1987, *Samuels 5379, Pipoly, Gharbarran & Bacchus* (NY; isotype BRG).

ADDITIONAL SPECIMENS EXAMINED: GUYANA. EAST BERBICE-CORENTYNE REGION, VI; SUBREGION 5: Canje R, 1 km N of Ekwarun Creek, 05°20′N, 57°38′W, 0–25 m, on recently dead tree, 9, 10 Apr 1987, *Samuels*

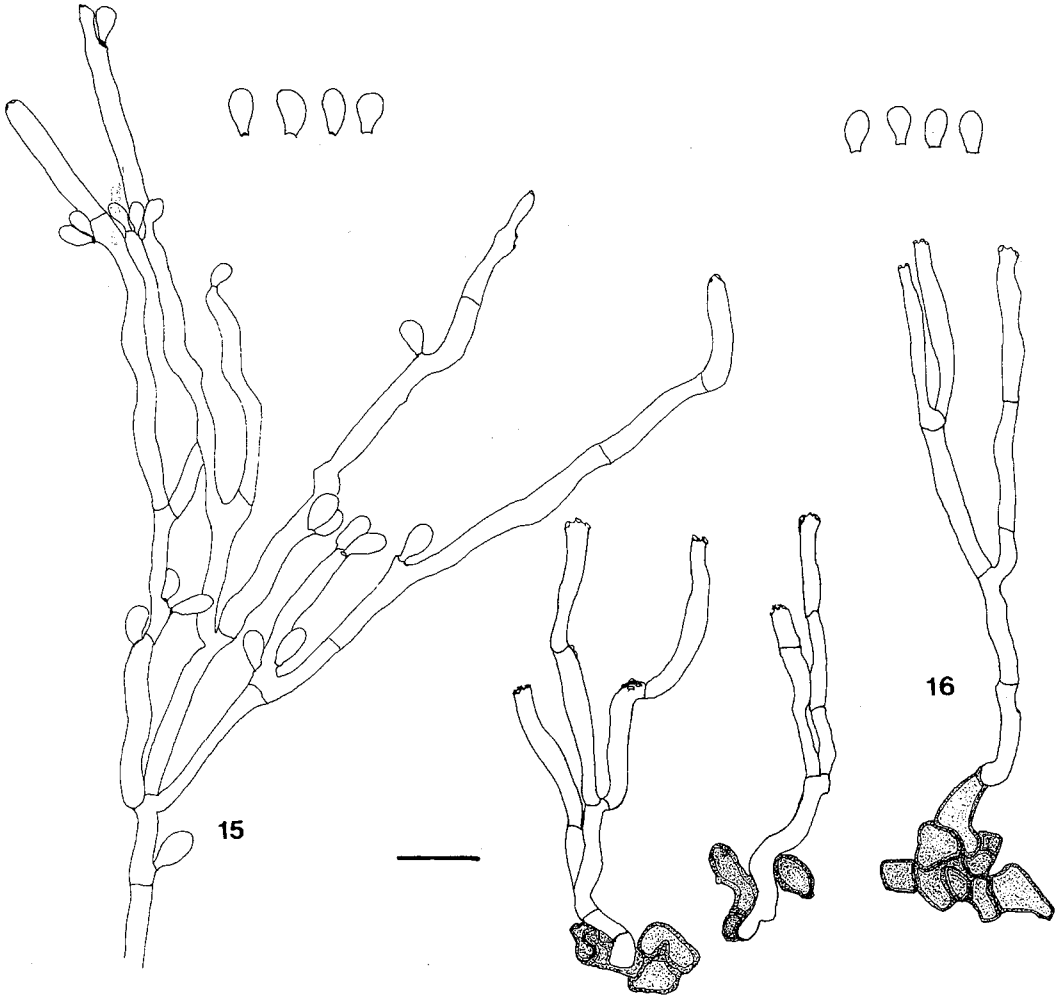


FIG. 15. *Phylacia bomba* var. *macrospora, Geniculosporium* anamorph from culture (*Samuels 5556*). FIG. 16. *Phylacia poculiformis, Geniculosporium* anamorph from nature (*Rodrigues 886*). Scale bar = 10 μm.

5381, Pipoly, Gharbarran & Bacchus (BRG, NY). DEMERARA-MAHAICA REGION, IV, MAHAICA SUBREGION, IV-1: Linden Hwy., Yarowkabra Forestry Station, 06°30'N, 58°15'W, 50–100 m, on decaying wood, 26, 27 Apr 1987, *Samuels 5556, Pipoly* (BRG, NY).

NOTES. We have isolated ascospores from only one collection, *Samuels 5556*. Because this specimen was overmature and had no asci, we have not designated it the holotype. Asci are present in the holotype collection.

Phylacia bomba var. *bomba* and *P. bomba* var. *macrospora* are readily distinguished through their stromal form, stromata of var. *bomba* being pulvinate with adjacent stromata tending to be confluent, rather than subglobose to hemispherical and remaining discrete. In addition, ascospores of var. *macrospora* are longer and broader than those of var. *bomba.*

Phylacia bomba is anatomically much more simple than other members of the genus (Dennis,

1957). The frutification comprises a single locule within which the asci form, and there is no tissue below the locule.

Acknowledgments

We dedicate this work to our friend and teacher, Clark Rogerson.

Part of this research was undertaken in the laboratory of Prof. J. D. Rogers, to whom we express our appreciation. We thank Dr. Roy E. Halling for reviewing the manuscript. Rodrigues and Samuels each benefitted from the support of National Science Foundation grants to the New York Botanical Garden for Projeto Flora Amazonica (NSF INT 77-7704, DEB 8106632). Samuels was supported in part by National Science Foundation Grant BSR 8500236, and by a grant from the National Geographic Society (2736-83).

Literature Cited

Dennis, R. W. G. 1957. Further notes on tropical American Xylariaceae. Kew Bull. **1957:** 297–332.

———. 1961. Xylarioideae and Thamnomycetoideae of Congo. Bull. Jard. Bot. État. **31:** 109–154.

———. 1971. Fungus flora of Venezuela and adjacent countries. Kew Bull. Additional Ser. III. J. Cramer, Lehre.

Ellis, J. B. & B. M. Everhart. 1892. North American Pyrenomycetes. Published by the authors, Newfield, New Jersey.

Eriksson, O. & D. L. Hawksworth. 1987. An alphabetical list of the generic names of ascomycetes—1987. Syst. Ascomycetum **6:** 1–109.

Patouillard, N. 1903. Note sur trois champignons des Antilles. Ann. Mycol. **1:** 218–219.

Petrini, L. & O. Petrini. 1985. Xylariaceous fungi as endophytes. Sydowia **38:** 216–234.

Rogers, J. D. 1985. Anamorphs of *Xylaria*: Taxonomic considerations. Sydowia **38:** 255–262.

Silveira, V. D. & K. F. Rodrigues. 1985. Levantamento preliminar de Xylariaceae da Amazonia. Acta Amazonica, Supl. **15:** 7–27.

Speer, E. O. 1980. Recherches sur la position systématique du genre *Phylacia* (Phylaciaceae, fam. nov.), et description de deux expèces nouvelles. Bull. Soc. Mycol. France **96:** 135–143.