

Phragmosporous *Nectria* species with *Cylindrocarpon* anamorphs

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Seven species of *Nectria* with phragmosporous ascospores are described or redescribed; five are proven to have *Cylindrocarpon* anamorphs and two are assumed to have *Cylindrocarpon* anamorphs. *Nectria laetidiscoides* (*Cylindrocarpon* sp.), *N. septospora* (*Cylindrocarpon septosporum*) are new species. *N. laetidisca* (*C. cf. bambusicola*), *N. phaeodisca* (*C. phaeodiscum*), and *N. fusispora* (*C. fusisporum*) are redescribed. *Cylindrocarpon* anamorphs have been linked to all of these species except *N. philodendri* and *N. vermisporea*, which have not been grown in pure culture but which are predicted to have *Cylindrocarpon* anamorphs. With the exceptions of *N. laetidisca* and *N. laetidiscoides*, the anamorphs are new species. Only *N. laetidiscoides* has microconidia. All of these species are tropical.

Keywords: *Nectria*, *Cylindrocarpon*, Hypocreales, anamorph, teleomorph.

Rossmann (1983) monographed the species of *Nectria* that have phragmosporous ascospores. Anamorphs of most of those species were either unknown or imperfectly known to her. Since that publication we have recollected three of the species described therein and two additional species that are undescribed, all of which are proven to have *Cylindrocarpon* anamorphs. We have collected two further undescribed species with phragmosporous ascospores but that did not grow in pure culture. Although not cultured, their similarity to species with *Cylindrocarpon* anamorphs leads us to predict that, if found, their anamorphs will also be in *Cylindrocarpon* and so we have included them in the present work. Thus, a total of five species of *Nectria* with phragmosporous ascospores and proven *Cylindrocarpon* anamorphs is known. There are undoubtedly more yet to be discovered. All of the known species occur in tropical areas. This is the third paper in a series dealing with *Nectria* and *Cylindrocarpon* (Samuels & Brayford, 1990; Brayford & Samuels, 1993).

The known teleomorphs of *Cylindrocarpon* are species of *Nectria* with red perithecia. These *Nectria* species have been distributed

among several groups (Booth, 1959; Samuels & Brayford, 1990; Brayford & Samuels, 1993). The species with phragmosporous ascospores discussed in this paper do not form a single natural group. They have counterparts among the *Nectria* species that have bicellular ascospores and belong to several *Nectria* groups. Thus *Nectria phaodisca* Rossman, a phragmosporous species, closely resembles the didymosporous *N. discophora* (Mont.) Mont. in perithecial anatomy, conidial morphology and colony pigmentation. These taxa belong to the *N. mammoidea* group *sensu* Booth (1959). The phragmosporous species *N. laetidisca* Rossman and *N. laetidiscoides* belong to the *N. veuillotiana* group (Brayford & Samuels, 1993) and so resemble the didymosporous *N. veuillotiana* Sacc. & Roum. and *N. jungneri* Hennings in perithecial morphology. *Nectria microdisca* Rossman (Rossman, 1983), which has yet to be linked to an anamorph, also belongs to this group. *Nectria fusispora* Rossman has a fringe of saccate cells around the perithecial apex and is thus similar to *N. coronata* Penzig & Sacc., which has 1-septate ascospores (Brayford & Samuels, 1993). These two species are also related to *N. veuillotiana*. *Nectria septospora* and *N. vermispota* have a perithecial anatomy similar to *N. rubrococca* Brayford & Samuels, a didymosporous species not currently placed in a known *Nectria* group (Brayford & Samuels, 1993). From all of these cases it may be concluded that formation of phragmosporous ascospores is a species character and does not define a group of related taxa.

The *Cylindrocarpon* anamorphs of these phragmosporous *Nectria* species lack microconidia and chlamydospores but are otherwise morphologically diverse. The anamorph of *N. septospora* has macroconidia similar in shape to those of *N. discophora*, but relatively broader (see Booth, 1966, as *N. mammoidea* Phill. & Plowr.). The macroconidia of *N. fusispora* are also typical in shape for *Cylindrocarpon*, but are amongst the largest conidia in the genus. However, the anamorphs of *N. laetidisca*, *N. laetidiscoides* and of *N. neblinensis* Brayford & Samuels (Brayford & Samuels, 1993), which has bicellular ascospores, have unusual macroconidia. These are morphologically intermediate between *Cylindrocarpon* and *Antipodium* Piroz. in forming very long, unbranched conidiophores and more or less papillate, fusiform conidia. *Nectria laetidisca* and *N. laetidiscoides* belong to the *N. veuillotiana* group (Brayford & Samuels, 1993), but *N. neblinensis* has a different perithecial structure and cannot be referred to any known *Nectria* group. Thus, the characteristic form of the macroconidia of these three species has no apparent phylogenetic significance. *Antipodium spectabile* Piroz., the only species of that genus, is the anamorph of *Ophionectria trichospora* (Berk. & Broome) Sacc. (Pirozynski, 1974; Rossman, 1983). We do not believe that this species is related to the present taxa.

Three previously described *Cylindrocarpon* species have macroconidia similar to, but distinct from, those of *N. laetidisca* and *N. laetidiscoides*. *Cylindrocarpon fusiforme* Matsushima (1975) was described as forming straight, cylindrical/fusiform macroconidia, with tapering apical and basal cells, arising from unbranched, elongated conidiophores. *Cylindrocarpon fusiforme* differs from the present taxa in forming abundant mycelial chlamydospores. *Cylindrocarpon bambusicola* Matsushima (1987) is possibly the anamorph of *N. laetidisca*. *Cylindrocarpon lichenicola* (C. Massal.) D. Hawksw. (1979) forms macroconidia with offset basal pedicels, arising from elongated conidiophores. However, the conidial apical cells are bluntly rounded rather than pointed or papillate and mycelial chlamydospores are formed abundantly. No teleomorphs are known for *C. fusiforme* or *C. lichenicola*.

Materials and methods

Perithecia from herbarium specimens were rehydrated briefly in 3% KOH. Anatomy of perithecial sections was observed in water or lactic acid by transmitted light and by epifluorescence in 0.5% w/v Calcofluor (Sigma Chemical Co.) in 0.1M sodium phosphate buffer at pH 8.0, using a Zeiss Axioplan Photomicroscope with planachromatic neofluor lenses and Zeiss "05" filter. Measurements of ascospores were made from water, whilst those of conidia were made from fresh mounts in lactofuchsin. Cotton blue stain [Le Gal (1947): 0.5 g cotton blue in 30 g lactic acid, boiled, filtered over 24 h] was used to reveal ascospore ornamentation.

Single ascospores were isolated on cornmeal dextrose agar (CMD, Difco Cornmeal agar plus 2 g l⁻¹ dextrose) with the aid of a micromanipulator. Characteristics of cultures were recorded from potato sucrose agar (PSA; Booth, 1971), potato dextrose agar (PDA; Booth, 1971), carnation leaf agar (CLA; Tio & al., 1977) and on SNAY, comprising SNA (Nirenberg, 1976) with filter paper and 0.1% Yeast Extract low in NaCl (Beta Lab, East Molesey, Surrey, UK; Brayford, 1992). Plates were incubated at 20 C in a 12h light/dark cycle of "daylight" fluorescent strip lamps and "black light" tubes emitting nUV (366 nm). Colony growth rates were measured on 90 mm plates of PSA, 5 mm deep, inoculated with a 4 mm mycelial plug. After 3 days growth, colony diameters were marked and the plates incubated for a further 5–10 days, depending on the speed of growth, before final diameters were scored and the growth rates calculated as mm.day⁻¹. Isolates were tested for chlamydospore production by placing 10 mm square blocks of culture taken from SNAY into 10 ml of sterile water and incubating for 2–3 weeks at 20 C.

Colour terminology follows Rayner (1970). Herbarium designations are taken from Holmgren & al. (1990). Collector's names are abbreviated as follows: K. P. Dumont (KPD), G. J. Samuels (GJS).

Key to species of *Nectria* with phragmosporous ascospores and proven or presumed *Cylindrocarpon* anamorphs

- 1. Ascospores averaging > 10 µm wide 2
- 1. Ascospores averaging < 10 µm wide 3

- 2. Ascospores (55-)67-83(-97) x (8-)10.5-13.5(-15) µm *N. fusispora*
- 2. Ascospores (38-)50-67 x 10-14 µm *N. phaeodisca*

- 3. Ascospores averaging > 80 µm long 4
- 3. Ascospores averaging < 80 µm long 7

- 4. Ascospores averaging > 110 µm long 5
- 4. Ascospores averaging < 110 µm long 6

- 5. Ascospores 100-133(-158) x (4.5-)5.3-7.5(-7.7) µm, 5-8-septate
 *N. philodendri*
- 5. Ascospores (114-)125-143(-150) x 8-9(-10) µm, (9-)11(-13)-septate
 *N. vermispota*

- 6. Ascospores primarily 3-septate, (77-)82.6-91(-95) x (7.7-)8-9(-10)
 µm *N. laetidiscoides*
- 6. Ascospores primarily 7-septate, (68.2-)84.6-111.9(-121) x (6.6-)
 7.2-8.8 µm *N. septospora*

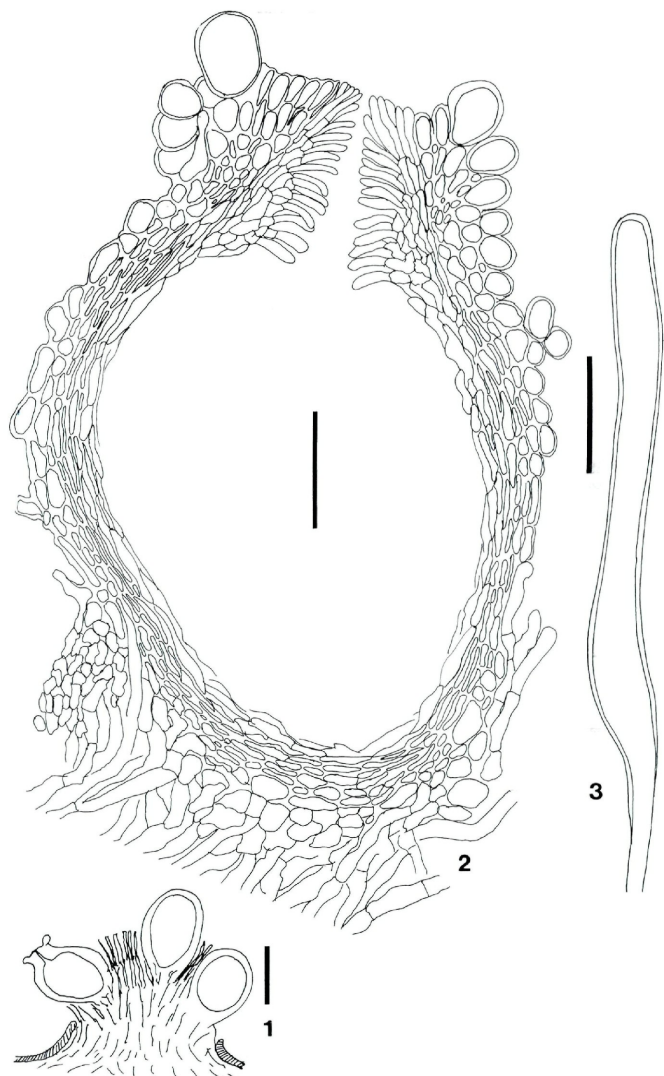
- 7. On bark of woody plants. Ascospores primarily 3-septate,
 42-65(-110) x 7-11 µm; perithecial apex with a fringe of saccate cells
 *N. microdisca* (Rossman, 1983)
- 7. On bamboo. Ascospores primarily 5-septate, (38.7-)50-72.4(-80.5) x
 (7-)7.5-9(-10) µm; perithecial apex of hyphal elements, saccate cells
 lacking *N. laetidisca*

Descriptions of the species

N. fusispora Rossman, Mycol. Pap. 150: 30. 1983. – Figs. 1-7.

Anamorph. – *Cylindrocarpon fusisporum* Samuels & Brayford, sp. nov. – Figs. 6, 7.

Coloniae in PSA cultae diebus 28 temperatura 20 C elapsis 37 mm diam attingentes, maturaе vinaceo-bubalinae, reversae castaneo-hinnuleae vel bubalinae. Microconidia nulla. Macroconidia curvata, infra medium latiora in apicem attenuata, pedicello carentia, (5-)6-7(-8)-septata, illa 6-septata (98-)100-104(-111) x



Figs. 1-3. - *Nectria fusispora*. - 1. Diagrammatic representation of three perithecia on an erumpent stroma. - 2. Median longitudinal section through a mature perithecium. - 3. Long, unbranched hypha from the stromal surface. - Figs. 1, 2 from KPD-EC 2011, 3 from KPD 5297. - Scale bars: 1 = 350 μ m; 2 = 50 μ m; 3 = 10 μ m.

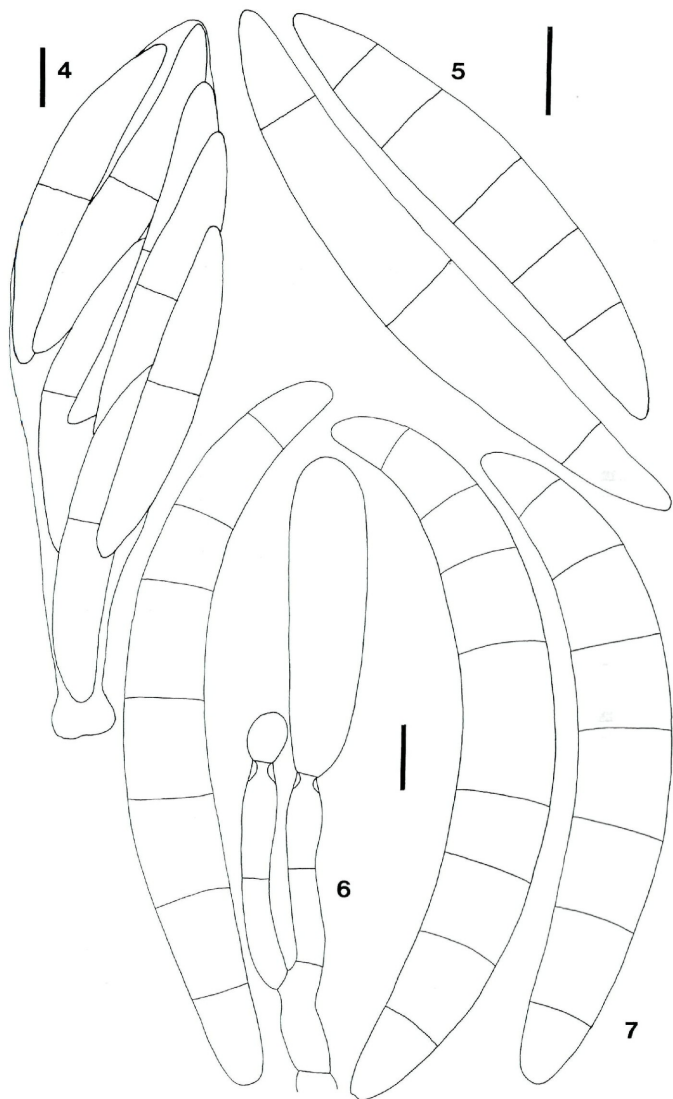
13.5–15.2(–16) μm , illa 7-septata (100–)105–115(–118) \times (13–)13.6–15.2(–16) μm .
Teleomorphosis: *Nectria fusispora* Rossman.

Holotypus: Culto agaro sicco *Nectria fusispora* Rossman (*GJS 90-233*: IMI 345092).

E t y m o l o g y . – Refers to the teleomorph.

T e l e o m o r p h . – Mycelium not visible. – Stroma consisting of individual erect, unbranched, septate, 100–200 μm long, 10 μm wide, hyaline hyphae. – Perithecia globose to subglobose, 270–400(–500) μm high, (210–)250–300(–450) μm wide, with a discoidal perithecial apex 100–200 μm diam, nonpapillate; red, not changing colour in 3% KOH, yellow in 100% lactic acid, becoming slightly laterally pinched or not collapsing when dry; scaly, scales concolorous; superficial or with base slightly immersed, occurring in groups of up to 15 around the periphery of an erumpent stroma. Cells at surface of perithecial wall circular to elliptic in outline, (15–)20–30 μm diam, walls 1–2 μm thick. Perithecial wall 20–30 μm wide, comprising two intergrading regions; outer region 15–20 μm wide, including scales, consisting of 1–2 layers of cells with circular to elliptic, ca 10 μm diam lumina and walls 1.5–2 μm thick; inner region of cells with flattened lumina and walls 1.5–2 μm thick; cells lining the locule thin-walled, flattened and compressed. Perithecial apex of large, 20–30 μm diam cells at the exterior arranged as an apical fringe, cells becoming progressively smaller, narrower and more hyphal toward the ostiolar canal where they merge with the periphyses. – Ascii clavate to fusiform, (90–)100–120(–130) \times (25–)30–35(–40) μm , thin-walled and dissolving early, apex simple; 8-spored, ascospores multiseriate, completely filling each ascus. – Ascospores fusiform, (55–)67–83(–97) \times (8–)10.5–13.5(–15) μm , (3–)5(–7)-septate, not constricted at the septa, smooth or finely spinulose, hyaline to pale brown.

A n a m o r p h . – Colonies on PSA 37 mm diam after 28 d at 20 C, initially with abundant, white, cottony aerial mycelium, darkening near the centre to a faint vinaceous buff colour at maturity. Colony reverse sepia to sepia/chestnut, fading through fawn to buff. Fertile *Nectria* perithecia forming after 4–6 weeks. – Macroconidia formed in aerial mycelium and around colony margin, in small, slimy, colourless droplets. On SNA, growth spreading, 60 mm diam after 28 d, with concentric rings of more densely branched hyphae. Perithecial and macroconidial formation sparse. – Microconidia or chlamydospores not seen. – Conidiogenous cells cylindrical, 14–20 \times 5–6 μm , with a single, apical conidiogenous locus, periclinal thickening and apical collarette. – Macroconidia strongly curved, mostly broader in their lower half, tapering towards



Figs. 4-7. - *Nectria fusispora*. - 4. Ascus with developing ascospores. - 5. Two discharged ascospores. - 6, 7. *Cyllindrocarpon fusisporum* anamorph. - 6. Conidiogenous cells. - 7. Macroconidia. - Figs. 4 from KPD-CO 5297, 5 from KPD-2101. - Scale bars = 10 μ m.

the apex; basal cells conical, rounded or bluntly flattened, lacking a pedicel; mostly 6–7 septate, 6-septate: (98–)100–104(–111) x 13.5–15.2 (–16) μm ; 7-septate: (100–)105–115(–118) x (13–)13.6–15.2(–16) μm .

Habitat. – Usually on woody branchlets, sometimes on herbaceous stems.

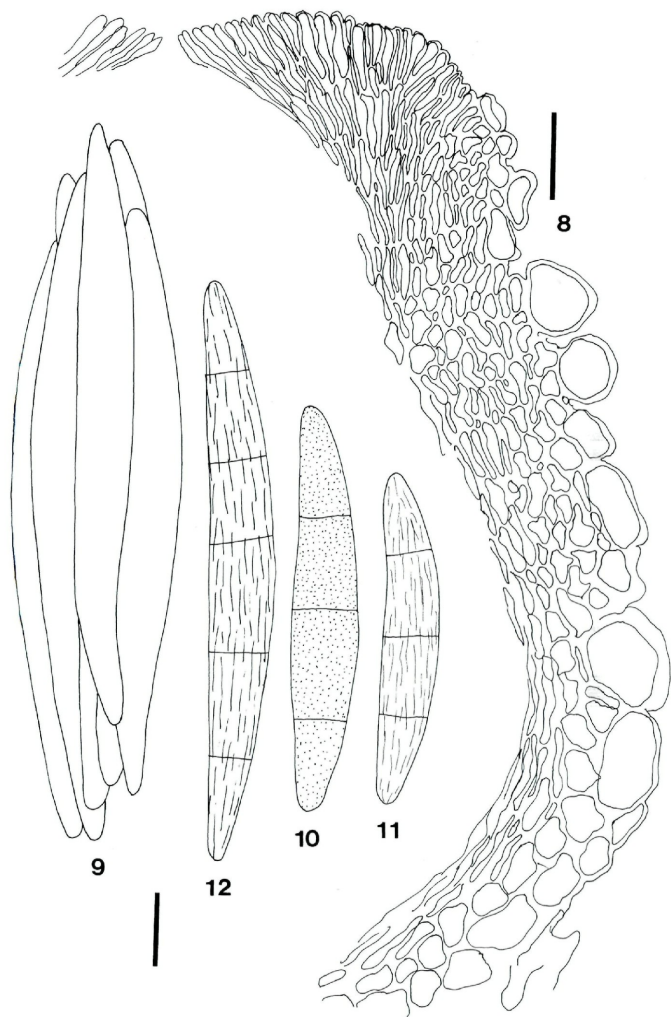
Known distribution. – Colombia, Dominica, Ecuador, Peru, Venezuela. Elevations greater than 1000 m.

Holotype. – COLOMBIA. Antioquia: Aljibe Prov, Providencia, Ancrí, above Río Ancrí, on branch, 6 Jul. 1974, KPD-CO 760 & al. (NY!).

Additional material examined. – COLOMBIA. Antioquia: Aljibe, Providencia Anorí, above Río Anorí, on branch, 6 Jul. 1974, KPD-CO 760 (NY); Medellín-Valdivia Rd., ca 136 km from Medellín, elev. 6900 ft, on bamboo, 13 Aug. 1976, KPD-CO 6296, S. E. Carpenter & M. A. Sherwood (NY); Boyacá: ca 63 km from Aquazul, on the Aquazul-Sogamosa Rd, elev. ca 5600 ft, 14 Jun. 1976, KPD-CO 5299 & al. (NY); second collection, same collecting data, KPD-CO 5297 (NY); Cundinamarca: ca 100 km from Bogotá, on Bogotá-Villavencia Rd, vic. Caqueza, on twig, elev. ca 4400 ft, 7 Jun. 1976, KPD-CO 2257, P. Buriticá & J. Luteyn (NY); Santander: vic. km post 120 from Tunja on the Pto. Berrío-Barbosa-Tunja Rd., elev. ca 6000 ft, on twig, 19 Aug. 1976, KPD-CO 6696, M. L. Sherwood & L. Velásquez (NY). ECUADOR. Cotopaxi: ca 98 km from Latacunya on the Latacunya-Quevedo Rd., elev. 8000 ft, on branch, 23 Jul. 1975, KPD-PE 1155, S. E. Carpenter & P. Buriticá (NY); Morona Santiago: ca 5 km from Limón (General Plaza Guitierrez) on the Limón-Méndez Rd, elev. ca 4000 ft, on twig, 3 Aug. 1975, KPD-PE 2011, S. E. Carpenter & P. Buriticá (NY); Tungurahua: ca. 59 km from Ambato on the Ambato-Puyo Rd, elev. 5400 ft, on twig, KPD-PE 1352, S. E. Carpenter & P. Buriticá (NY). PERU. Cuzco: along the Cuzco-Pilcopata Rd., at a point ca 165 km from the intersection with the Cuzco-Puno Rd, on herbaceous stem, 18 Jul. 1976, KPD-PE 1531 & al. (NY). VENEZUELA. Aragua: Parque Nacional Henri Pittier, Rancho Grande Biological Station, Toma Trail to water source, ca 10°21' N, 67°41' W, elev. 1200–1300 m, on branchlets of recently dead tree, 3 Dec. 1990, GJS 7883, B. Hein & S. M. Huhndorf (BPI, IMI 345091, VEN; GJS culture 90–220); same collecting data, on live orchid, GJS 7884 (BPI, IMI 345092, VEN; GJS culture 90–233, HOLOTYPE of *C. fusisporum*).

Description and illustrations. – Rossman (1983, Fig. 9, Pl. 4A, B).

This species is similar to *N. coronata* Penz. & Sacc. in ascomatal morphology and anatomy and in possessing a basal stroma with hyaline, erect hairs. The perithecial apex, with its fringe of inflated, saccate cells is distinctive and strikingly similar to the perithecial apex of *N. coronata* and *N. microdisca*. The ascospores of *N. coronata* are one-septate and markedly smaller than those of *N. fusispora*. Ascospores of *N. microdisca* are phragmosporous but smaller than those of *N. fusispora*. Macroconidia of *N. fusispora* are distinctly larger than those of *N. coronata* although they possess a somewhat similar shape.



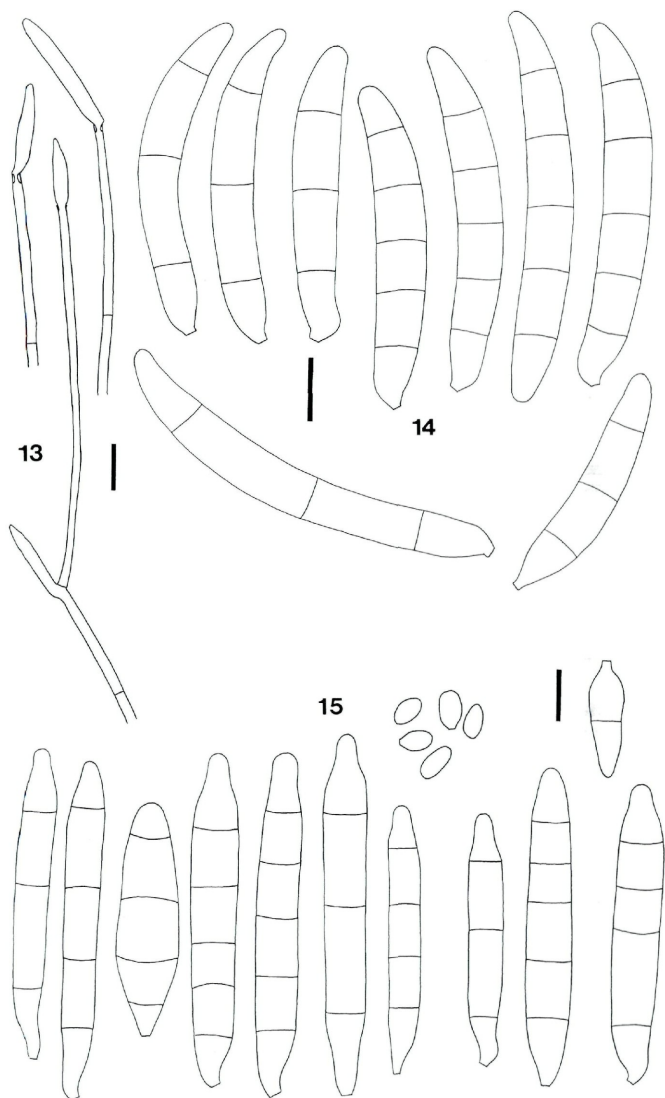
Figs. 8-12. - *Nectria laetidisca*. - 8. Median longitudinal section through a mature perithecium. - 9. Ascus with developing ascospores; ascus wall not visible. - 10-12. Ascospores. - 10. From the type collection. - 11. From CUP-MJ 790. - 12. From KPD-VE 2554. - Figs. 8, 9 from KPD-VE 2554. - Scale bars: 8 = 25 μ m; 9-12 = 10 μ m.

Nectria laetidisca Rossman, Mycol. Pap. 150: 36. 1983. – Figs. 8–14.

Anamorph. – *Cylindrocarpon* cf. *bambusicola* Matsushima, Matsushima Mycol. Mem. 5: 9. 1987. – Figs. 13, 14.

Teleomorph. – Mycelium not visible. – Perithecia pyriform, 300–580 μm high, 250–415 μm wide, with a broadly rounded, 150–180 μm diam apex, nonpapillate; red, not changing colour in 3% KOH, yellow in 100% lactic acid, not collapsing when dry; smooth; solitary to gregarious in groups of 3–4, superficial or with base slightly immersed, seated on a minute basal stroma of densely compacted, nonpigmented hyphal cells, stromal cells growing within cortical cells of host. Cells at surface of perithecial wall with hyphal characteristics, or circular to elliptic, 25–45 μm diam, walls 2–2.5 μm thick. Perithecial wall 25–45 μm wide, comprising two or three intergrading regions; outer region, present and covering the entire perithecium below the apex, or lacking, 15–20 μm wide, consisting of 1–2 layers of circular to elliptic cells with lumina 10–15 μm diam, walls 1.5–3.5 μm thick and pigmented; middle region 15–20 μm wide, cells lacking a definite outline, walls ca 3.5 μm thick, pigmented; inner region 10–15 μm wide, cells flattened and compressed. Perithecial apex formed of vertically elongated files of 3–3.5 μm wide, hyphal elements forming a palisade; becoming progressively more narrow toward the ostiolar canal and merging with the periphyses. – Asciclavate, 100–130 x 15–35 μm , enlarging considerably as ascospores develop, eventually becoming very thin walled and bursting readily in microscopic preparations, apex simple; 8-spored, ascospores arranged parallel to each other, completely filling each ascus. – Ascospores fusiform, (38.7–)50–72.4(–80.5) x (7–)7.5–9(–10) μm , (3–)5-septate, not constricted at the septa, smooth or with short striations, hyaline to pale brown.

Anamorph. – Colonies on PSA 10–20 mm diam after 10 d; aerial mycelium abundant, floccose, white, becoming hazel to umber near the inoculum; reverse brown vinaceous to sepia in the center with margin ochraceous fading to white. On SNA growth spreading through agar, no pigment formed, aerial mycelium sparse and sporulation weak except close to the inoculum where erect conidiophores with macroconidia develop. – Conidiophores abundant in the aerial mycelium, erect, mononematous, 230–320 μm long, 5–7 μm wide at base, 4–6-septate, hyaline, smooth, unbranched, terminating in a single phialide and bearing conidia in colourless slime. – Sporodochia absent. – Phialides 90–100 μm long, tip 3 μm wide, with visible periclinal thickening, not flared. – Conidia cylindrical to fusiform, (1–)3–5(–7)-septate, (39–)43.8–65.8(–75) x (6–)6.4–9.8(–10) μm , straight, typically slightly constricted behind the tip, thus appearing



Figs. 13-15. - *Cylindrocarpon* anamorphs. - 13, 14. *Cylindrocarpon* cf. *bambusicola*, anamorph of *N. laetidisca*. - 13. Erect conidiophores. - 14. Macroconidia. - 15. *N. laetidisoides*, macro- and microconidia. - Scale bars: 13 = 20 μ m; 14, 15 = 10 μ m.

papillate, base with or without a slightly protuberant, flat, 1 μm wide abscission scar, or rounded. – Chlamydospores not observed.

Habitat. – Decaying bamboo culms.

Known distribution. – Jamaica, Venezuela. In moist forests.

Holotype. – JAMAICA. St. Andrew Parish: Trail between Holywell and source of Wagwater River, on bamboo, 11 Jan. 1971, R. P. Korf & al. (CUP-MJ 768) (NY, Rogerson culture 71-11, IMI 246526).

Paratypes. – JAMAICA. data as holotype, CUP-MJ 770 (NY, Rogerson culture 71-14, IMI 329016). VENEZUELA. Edo. Merida: ca 63 km W of Merida, Univ. Los Andes Forest Reserve, on bamboo, 20 Jul. 1971, KPD-VE 2554 & al. (NY).

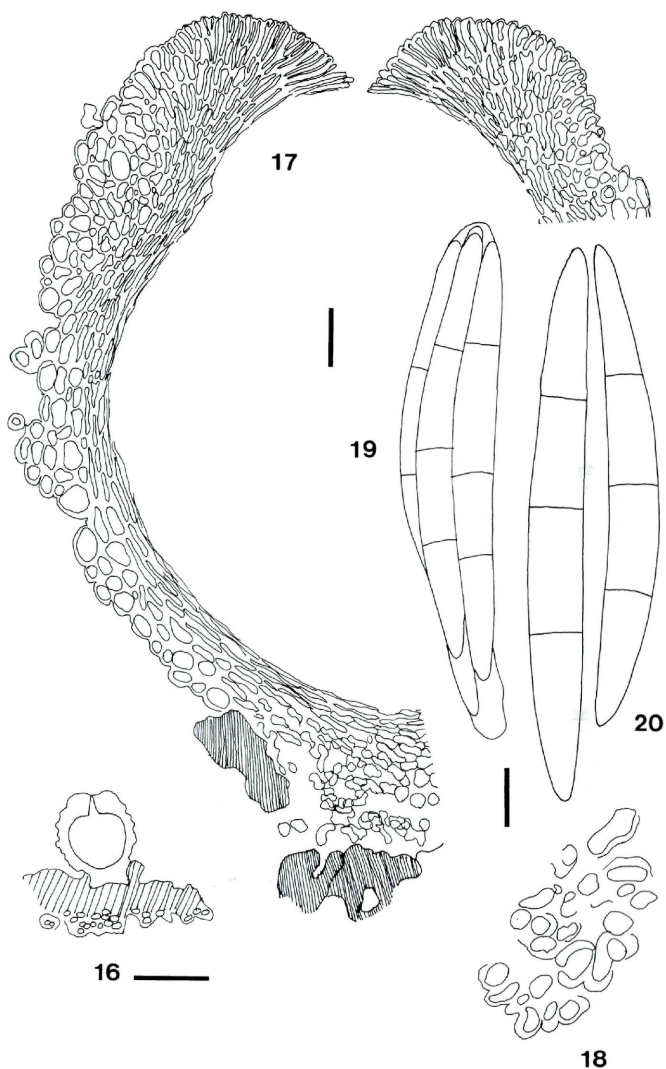
Description and illustration. – Rossman (1983, Fig. 14, Pl. 5 C-E).

The anamorph of *N. laetidisca* conforms with the description of *C. bambusicola* Matsushima, except that the conidiophore of the *Nectria* anamorph is branched rather than simple.

There are inconsistencies among the three collections of *N. laetidisca*. Cells at the surface of the perithecial wall of the Jamaican specimens have hyphal characteristics whereas cells at the perithecial surface of the Venezuelan collection are distinctly circular to elliptic in outline. The lateral wall of perithecia of the Jamaican specimens is of intertwined hyphae; the lateral wall of perithecia of the Venezuelan specimen has an outer layer of large cells that is underlain by a region of intertwined hyphae. Ascospores of the type specimen are pale brown (Fig. 10) and spinulose. Ascospores of the second Jamaican specimen (Fig. 11) and of the Venezuelan collection (Fig. 12) are pale brown and are covered with very short striations. Cultures of the Jamaican collections are identical; the Venezuelan collection was not cultured. Ascospores of the Jamaican collections [$n=29$, (38.7–)47.7–60.8(–65.1) \times (7–)7.9–9.2(–10) μm] are shorter than ascospores of the Venezuelan collection [$n=22$, (53.2–)62.4–75.6(–80.5) \times (6.3–)7.1–8.9(–9.8) μm].

Nectria laetidiscoides Samuels & Brayford, sp. nov. – Figs. 15–20.

Perithecia stromate minuto immerso insidentia, superficialia, solitaria, subglobosa, ovoidea vel pyriformia, (265–)300–390(–420) μm alta, (207–)250–320(–330) μm lata, rubra, laevia vel squamulosa, non papillata, apice peritheciali obtuso discoideo, 120–155 μm diam. Asci clavati, 80–100 \times 14–20 μm , deliquescentes, 4-sporei, apice simplices. Ascosporeae fusiformes, acutae vel subacutae, (77–)82.6–91(–95) \times (7.7–)8–9(–10) μm , (1–2–)3-septatae, ad septa non constrictae, laeves, hyalinae. Anamorphosis: *Cylindrocarpon* sp.



Figs. 16-20. - *Nectria laetidiscoides*. - 16. Diagrammatic representation of a perithecium on bark. - 17. Median longitudinal section through a mature perithecium. - 18. Cells at surface of perithecial wall. - 19. Ascus with developing ascospores. - 20. Two discharged ascospores. All from GJS 2890. Scale bars: 16 = 300 μ m; 17, 18 = 25 μ m; 19, 20 = 10 μ m.

Holotypus: FRENCH GUIANA. ca 15 km SW of Saül toward Mt. Galbao, elev. 600–650 m, on bark of recently dead tree, Jan. 1986, GJS (2890) & J. Boise (NY, ISOTYPES CAY, IMI; culture 86–61).

E t y m o l o g y . – Refers to a similarity to *N. laetidisca* Rossman.

A n a m o r p h . – *Cylindrocarpon* sp. – Fig. 15.

T e l e o m o r p h . – Mycelium not visible. – Perithecia solitary, superficial, seated on a minute, immersed stroma with cells growing within cortical cells of host, subglobose, ovoidal to pyriform, (265–)300–390(–420) μm high, (207–)250–320(–330) μm wide, perithecial apex broad, blunt and discoidal, 120–155 μm diam, not collapsing when dry, red or orange with a red apex when dry, uniformly dark red in 3% KOH, yellow in 100% lactic acid; smooth to scaly. Cells at surface of perithecial wall lacking a definite outline or circular to elliptic, to 10 μm diam, fine pores joining adjacent lumina of surface or subsurface cells, walls 2–2.5 μm thick. Perithecial wall 45–50 μm wide, comprising three intergrading regions; outer region, including scales, to 25–35 μm wide, consisting of circular to elliptic cells, walls ca 2–2.5 μm thick and pigmented; middle region ca 15 μm wide, cells with broadly to narrowly elliptic lumina, 9–15 x 1–4.5 μm , walls 2–2.5 μm thick and pigmented; inner region 6–8 μm wide, cells flattened and compressed, walls <1 μm thick, nonpigmented. Perithecial apex formed of vertically elongated hyphal elements with terminal cells 15–20 μm long, 4–5 μm wide with walls ca 2–2.5 μm thick; elements continuous with the middle region of the perithecial wall and protruding through the outer region, becoming progressively narrower and merging with the periphyses within. – A s c i clavate, 80–100 x 14–20 μm , enlarging considerably as ascospores develop, eventually becoming very thin-walled and bursting readily in microscopic preparations, apex simple; 4-spored, ascospores arranged parallel to each other, completely filling each ascus. – A s c o s p o r e s fusiform with ends acute to subacute, (77–)82.6–91(–95) x (7.7–)8–9(–10) μm , (1–2–)3-septate, not constricted at the septa, smooth, hyaline.

A n a m o r p h . – Colonies grown 7 d, 20 C, diffuse daylight. CMD: 7–10 mm diam, barely transparent, aerial mycelium cottony, white, conidial production beginning. Colonies eventually reaching a maximum of 20 mm, aerial mycelium cottony, white, submerged mycelium light brown with diffuse, light brown pigment. – C o n i d i o p h o r e s arising directly from the surface of the agar and from the aerial mycelium. Macroconidiophores morphologically distinct from microconidiophores. – M i c r o c o n i d i o p h o r e s arising from aerial mycelium 35–55 μm long, branching irregularly, each branch terminating in a single phialide; phialides cylindrical,

9–12 x ca 2.5 μm . – Macroconidiophores 70–255 μm long, 5–9 μm wide at base, 3.5(–5) μm wide at the tip, 3–4-septate, hyaline, smooth; tip with visible periclinal thickening, not flared. – Microconidia ellipsoidal, 7–8(–10) x 3.5–5 μm , unicellular, with a protuberant, flat basal abscission scar, smooth, hyaline. – Macroconidia cylindrical to narrowly fusiform, straight, typically slightly constricted behind the tip, thus appearing \pm papillate, base with or without a slightly protuberant, flat, 1 μm wide abscission scar, or rounded, (1–)3–5-septate, 3–4 septate (42–)52.4–63(–79) x (7–)8.4–11(–12) μm , 5-septate (56–)58–70.8(–79) x (7–)8.8–12(–13) μm . – Chlamydospores not observed.

Habitat. – Bark of recently dead trees and on vines.

Known distribution. – French Guiana, known only from the type locality.

Holotype. – FRENCH GUIANA. ca 15 km SW of Saül toward Mt. Galbao, elev. 600–650 m, on bark of recently dead tree, Jan. 1986, GJS (2890) & J. Boise (NY, ISOTYPES CAY, IMI; culture 86–61).

Paratype. – Data as holotype, on vine, GJS (3396) & J. Boise (CAY, NY; culture 86–138).

Nectria laetidiscoides differs from *N. laetidisca* in having larger ascospores and in its substratum, a non monocotyledonous woody plant. *Nectria laetidisca* is known only from three collections on bamboo in Jamaica and Venezuela and is probably restricted to that substratum. The anamorphs of the two species are indistinguishable and are morphologically similar to *Cylindrocarpon bambusicola*. *Cylindrocarpon fusiforme* also has similarly shaped macroconidia, but forms abundant chlamydospores. The only known isolates of *N. laetidiscoides* are no longer viable.

Nectria phaeodisca Rossman, Mycol. Pap. 150: 38. 1983. – Figs. 21–25. Syn.: *Calonectria discophora* Höhnelt, Sitzungsber. Kaiserl. Akad. Wiss., Math. – Naturwiss. Kl., 1, 125: 532. 1916. Non *Nectria discophora* (Mont.) Mont., 1856.

Anamorph. – *Cylindrocarpon phaeodiscum* Samuels & Brayford, sp. nov. – Figs. 24, 25.

Coloniae in CMD cultae diebus septem temperatura 20 C elapsis 10 mm diam attingentes, vinaceo-brunneae, pigmento pallide purpureo expresso. Microconidia nulla. Macroconidia cylindrica (62.5–)68.5–82.3(–91) x (8–)9–10.4(–11) μm , apice quam basi truncato abruptius curvata, 3–5(–6) septata. Chlamydosporae haud observatae. Teleomorphosis: *Nectria phaeodisca* Rossman.

Holotypus: Culto agaro sicco *Nectria phaeodisca* CUP-MJ 802 (IMI 332121, Rogerson culture 71–60, ATCC 48128).

Etymology. – Refers to the teleomorph.

Teleomorph. – Mycelium not visible. – *Perithecia* globose to subglobose, 250–400 μm high, 270–430 μm wide, with a discoidal, 100–140 μm diam apex, nonpapillate; red with apical disc near black, becoming uniformly dark red in 3% KOH, yellow in 100% lactic acid, becoming cupulate or not collapsing when dry; scaly to warted, scales and warts white; solitary, superficial, seated on a basal stroma of pseudoparenchymatous cells, stromal cells growing within cortical cells of host. Cells at surface of perithecial wall circular to angular in outline, 15–30 μm diam, walls 1–2 μm thick. Perithecial wall 20–60 μm wide, comprising three intergrading regions; outer region, 25–35 μm wide, including scales, consisting of 1–2 layers of circular cells with lumina 12–20 μm diam, walls ca 1.5 μm thick and pigmented; middle region ca 20 μm wide, cells with hyphal characters and arranged perpendicular to the surface of the perithecium, forming a palisade; inner region 10–15 μm wide, cells flattened, compressed and thin-walled toward the locule. Perithecial apex formed of vertically elongated files of hyphal elements ca 3.5 μm wide, continuous with the inner region of the perithecial wall, protruding through the middle region and merging with the periphyses. – *Asci* clavate, 90–120 x 22–30 μm , thin-walled and dissolving early, apex simple; 8-spored, ascospores biseriate, completely filling each ascus. – *Ascospores* fusiform, (38–)50–67 x 10–14 μm , 3(–4)-septate, not constricted at the septa, smooth, hyaline to pale brown.

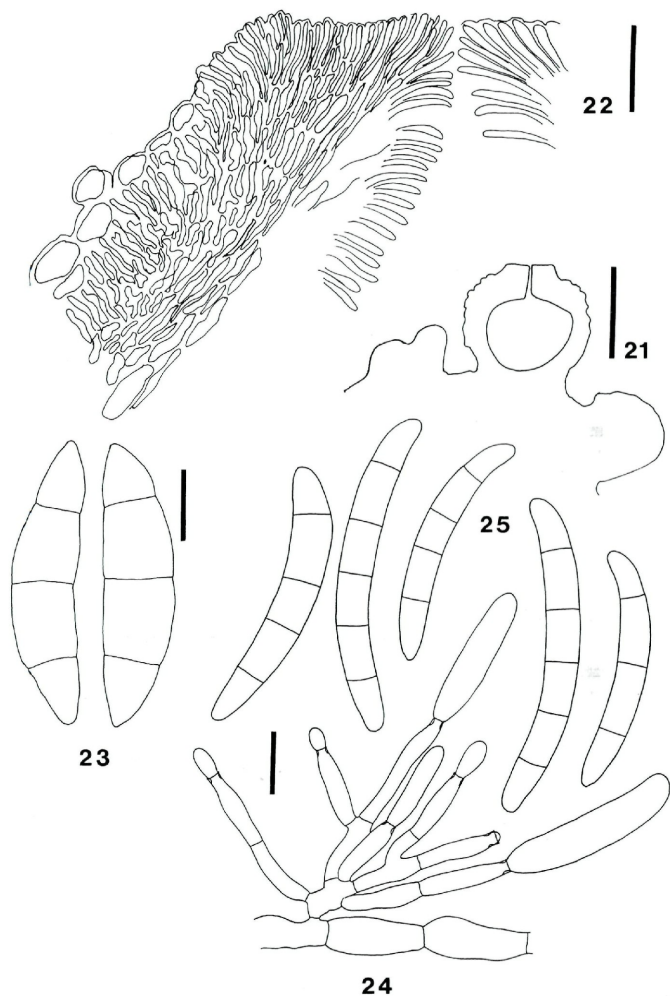
Anamorph. – Colonies grown 7 d, 20 C, diffuse daylight. CMD: 10 mm diam, barely transparent, violaceous brown, aerial mycelium lacking. PDA: colonies 10 mm diam, opaque, pale violaceous. Colonies reaching 2.5–3 cm diam after 3 weeks, overall purple with purple pigment spreading into the medium on PDA and with discrete to confluent, pale violaceous to white slimy stromata on CMD and PDA, aerial mycelium lacking. – *Conidiophores* fasciculate in pionnotes; phialides terminating short branches, solitary or in 2's or 3's, cylindrical, 18–25 x 4–5 μm , collarete slightly thickened, not flared. – *Microconidia* not formed. – *Macroconidia* (62.5–)68.5–82.3(–91) x (8–)9–10.4(–11) μm , cylindrical, curved more sharply at the tip than at the base, base truncate, 3–5(–6)-septate. – *Chlamydospores* not observed.

Habitat. – On peeling bark of dicotyledonous plants.

Known distribution. – Colombia, Jamaica, Indonesia (Java). Known from elevations of 1000–1500 m.

Holotype. – INDONESIA. Java: Tjibodas, on rotting, almost decorticated wood, 1909, Höhnelt (FH-Höhnelt *vide* Rossman, 1983).

Specimens examined. – COLOMBIA. Intendencia Caqueta: ca 32 mi from Florencia, on the Florencia-El Doncello Rd., elev. ca 4800 ft, on wood, 18 Jan. 1976, KPD-CO 2996 & al. (NY). JAMAICA. St. Andrew Parish: vic. Dick's Pond, W



Figs. 21–25. – *Nectria phaeodisca*. – 21. Diagrammatic representation of a perithecium on a stroma. – 22. Section of a perithecial apex. – 23. Two discharged ascospores. – 24, 25. *Cylindrocarpon phaeodiscum* anamorph. – 24. Conidiogenous cells. – 25. Macroconidia. – All from CUP-MJ 802. Scale bars: 21 = 250 μ m; 22 = 25 μ m; 23–25 = 10 μ m.

of Hardwar Gap, near Holywell Recreation Area and Wag Water River, elev. 2800–3000 ft, on rotting wood, 11 Jan. 1971, Korf et al., CUP–MJ 782 (NY, Rogerson culture 71–37); second collection, CUP–MJ 802 (NY, Rogerson culture 71–60 = ATCC 48128).

Description and illustrations. – Rossman (1983, Fig. 15, Pl. 5 G).

The above description is based on that published by Rossman (1983). We have examined the same Colombian and Jamaican collections cited by Rossman (1983). The description of the anamorph given herewith augments the description provided by her for the species and is based upon the culture from the Jamaican collection (CUP–MJ 802 = CTR 71–60 = IMI 332121) that she cited. Perithecial wall anatomy and colony pigmentation indicate close relationship to *N. discophora*.

Nectria philodendri Samuels & Brayford, sp. nov. – Figs. 28, 29, 36–38.

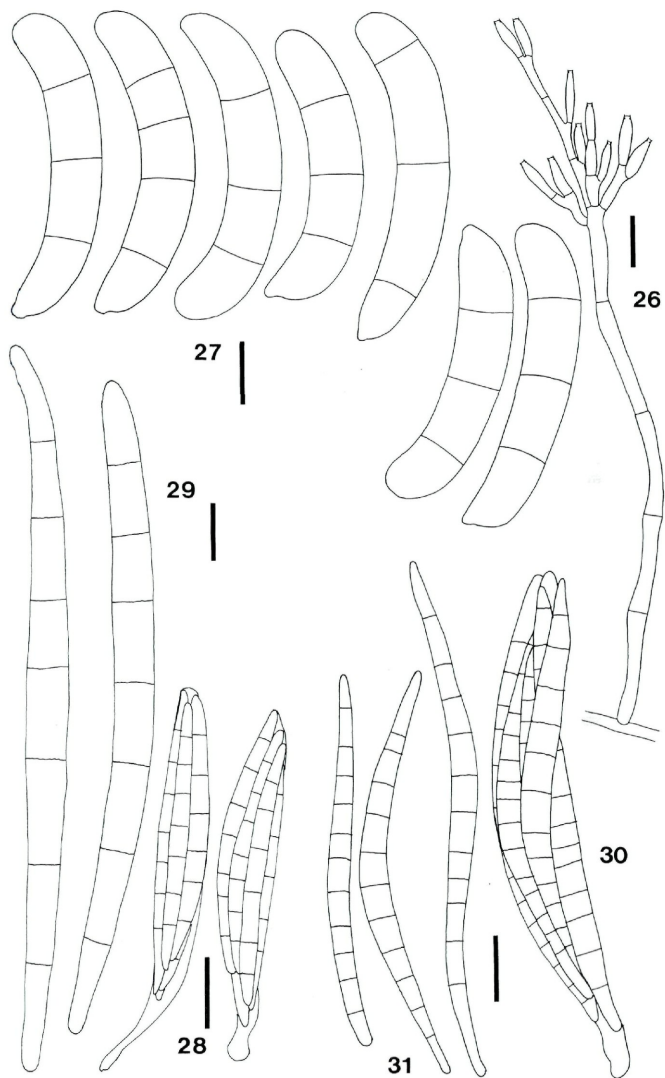
Nectriae jungneriae Hennings similis nisi ascosporae fusiformes 100–133(–158) x (4.5–)5.3–7.5(–7.7) μm , 5–8-septatae, ad septa haud constrictae, hyalinae, laeves. Anamorphosis ignota.

Holotypus: VENEZUELA. Amazonas: Dpto. Río Negro, Cerro de la Neblina, summit camp #5, valley at north base of Pico Phelps, 00°49'N, 66°00'W, elev. 1000–1250 m, on decaying stem of *Philodendron* sp., 12, 13 Apr. 1984, GJS 1343 (VEN; isotype, NY).

Etymology. – Refers to the host.

Anamorph. – None known.

Teleomorph. – Mycelium not visible. – Perithecia solitary, superficial, seated on an immersed stroma with pseudo-parenchymatous stromal cells growing within epidermal cells of host, pyriform, 330–420 μm high, 198–308 μm wide, perithecial apex broad, 130–160 μm diam, nonpapillate, not collapsing when dry, red, darker red in 3% KOH, yellow in 100% lactic acid; smooth. Cells at surface of perithecial wall with meandering lumina and unevenly thickened walls, lumina of adjacent cells joined by fine pores. Perithecial wall ca 30 μm wide laterally, comprising one to two regions. Outer region 20–25 μm wide, formed of interwoven hyphae with walls ca 3 μm thick and pigmented; these hyphal elements ca 7 μm wide and parallel to each other in the perithecial apex to form the ostiolar disc; innermost elements of the perithecial apex merging with the periphyses. Inner wall region ca 10 μm wide, cells flattened and compressed, thick-walled and pigmented at the exterior and thin-walled and non-pigmented adjacent to the perithecial locule. – Ascii clavate, 130–175 x 20–26 μm , apex simple; 4–8-spored, ascospores arranged



Figs. 26-31. - *Nectria* species. - 26, 27. *Cylindrocarpon septosporum*, anamorph of *N. septospora*. - 26. Prostrate conidiophore with conidiogenous cells. - 27. Macroconidia. - 28, 29. *N. philodendri*. - 28. Two asci. - 29. Two discharged ascospores. - 30, 31. *N. vermispora*. - 30. Ascus with ascospores. - 31. Three discharged ascospores
Scale bars: 26-29 = 10 μ m; 30, 31 = 20 μ m.

parallel to each other, completely filling each ascus. – Ascospores fusiform, 100–133(–158) x (4.5–)5.3–7.5(–7.7) μm , 5–8-septate, not constricted at the septa, smooth, hyaline.

Habitat. – Decaying stem of *Philodendron* sp.

Known distribution. – Venezuela (Amazonas), known only from the type collection.

Holotype. – VENEZUELA. Amazonas: Dpto. Río Negro, Cerro de la Neblina, summit camp #5, valley at north base of Pico Phelps, 00°49' N, 66°00' W, elev. 1000–1250 m, on decaying stem of *Philodendron* sp., 12, 13 Apr. 1984, GJS 1343 (VEN; isotype, NY).

Our attempt to germinate ascospores of *N. philodendri* on CMD was unsuccessful. *Nectria philodendri* is clearly related to *N. jungneri* Henn. It differs from *N. laetidisca* and *N. phaeodisca* in having larger ascospores. It differs from *N. laetidiscoides* in having a smooth perithecium and in having slightly longer, more highly septate ascospores. This species differs from *N. vermisporea* in wall anatomy and in having smaller ascospores.

Nectria septospora Samuels & Brayford, sp. nov. – Figs. 26, 27, 32–35.

Perithecia solitaria vel gregaria, stromatica, superficialia, pyriformia vel obovoidea, 310–400 μm alta, 265–400 μm lata, apice mammiformia, haud collabentia, verruculosa. Asci fusiformes, 88–120 x 15–25 μm , apice simplices. Ascospores fusiformes, (68.2–)84.6–111.9(–121) x (6.6–)7.2–8.8 μm , (3–)7-septatae, ad septa non constrictae, laeves, hyalinae. Anamorphosis: *Cylindrocarpon septosporum* Samuels & Brayford.

Holotypus: French Guiana. ca 15 km SW of Saül toward Mt. Galbao, 600–650 m, on decaying stem of *Piper* sp., 19 Jan. 1986, GJS 3108 & J. Boise (NY, ISOTYPE CAY).

Etymology. – In reference to the septate ascospores.

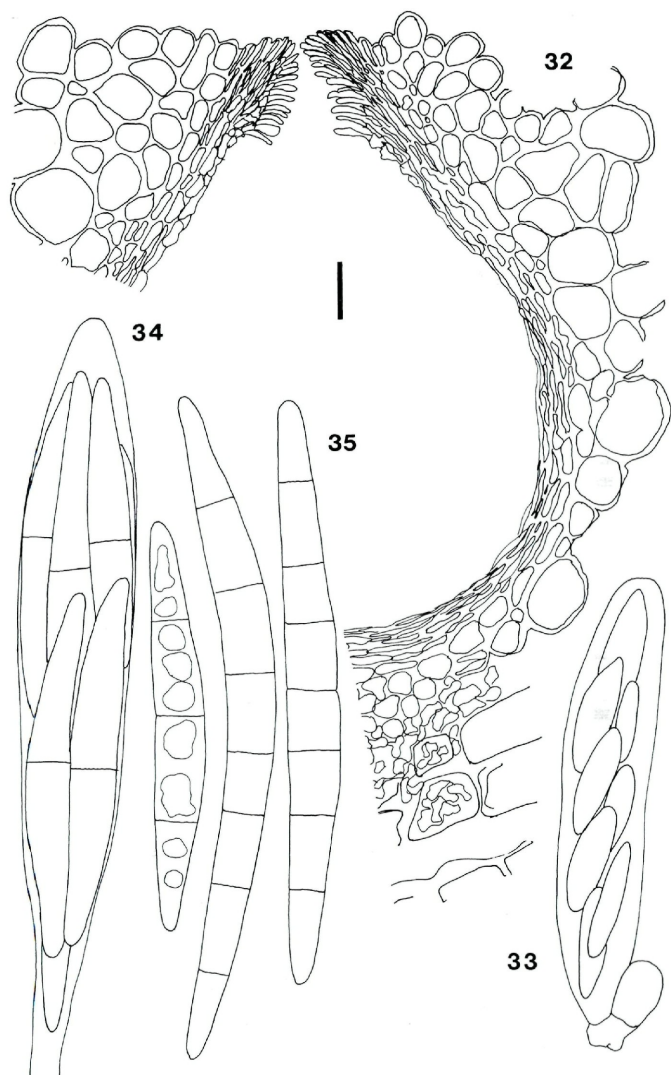
Anamorph. – *Cylindrocarpon septosporum* Samuels & Brayford, sp. nov. – Figs. 26, 27.

Coloniae in PSA cultae tardae, sanguineae, reversae castaneae. Microconidia nulla. Macroconidia cylindrica, curvata, apice obtuse rotundata, 3(–4, raro 5)-septata, illa 3-septata (44–)46.7–53.3(–56) x (8–)8.5–9.5(–10) μm . Teleomorphosis: *Nectria septospora* Samuels & Brayford.

Holotypus: Culto agaro sicco *Nectria septospora* GJS 3108 (IMI 325852).

Etymology. – In reference to the septate conidia.

Teleomorph. – Mycelium not visible. – Perithecia solitary to gregarious in groups of 3–4, superficial, seated on an



Figs. 32–35. – *Nectria septospora*. – 32. Median longitudinal section through a mature perithecium. – 33. Immature ascus with developing ascospores. – 34. Sporiferous part of an ascus with developing ascospores. – 35. Three discharged ascospores. All from GJS 3108. Scale bar: 32 = 25 μ m; 33–35 = 10 μ m.

immersed stroma with stromal cells growing within epidermal cells of host, pyriform to ovoidal, 310–400 μm high, 265–400 μm wide, perithecial apex mammiform, nonpapillate, not collapsing when dry, red, not changing colour in 3% KOH, yellow in 100% lactic acid; warted, warts to 45 μm high. Cells at surface of perithecial wall and warts conspicuous, circular, ca 35 μm diam, walls 1 μm thick; cells immediately below the surface layer lacking a definite outline, walls unevenly thickened and lumina of adjacent cells joined by fine pores. Perithecial wall 55–100 μm wide, including warts, comprising three intergrading regions; outer region, including warts, 33–88 μm wide, consisting of 1–2 layers of circular, 20–30 μm diam cells with walls 2–2.5 μm thick and pigmented, these cells forming warts; middle region ca 15 μm wide, cells with approximately elliptical lumina measuring 10–25 μm long, 3.5–5 μm wide, walls 2–2.5 μm thick and pigmented; inner region ca 10 μm wide, cells elongated and thin-walled, walls nonpigmented, cells becoming increasingly more thin-walled toward the perithecial locule. Perithecial apex formed of vertically elongated hyphal elements; elements continuous with the middle region of the perithecial wall and protruding through the outer region, becoming increasingly more narrow and merging with the periphyses within. – *Asci* fusiform, 88–120 x 15–25 μm , enlarging considerably as ascospores develop, eventually becoming very thin-walled and bursting readily in microscopic preparations, apex simple; 8-spored, ascospores arranged parallel to each other, completely filling each ascus. – *Ascospores* fusiform, (68.2–) 84.6–111.9(–121) x (6.6–)7.2–8.8 μm , (3–)7-septate, not constricted at the septa, smooth, hyaline.

Anamorph. – Colonies on PSA slow growing, slimy, blood colour, with chestnut reverse. Colonies on SNA remaining extremely restricted, hardly growing from the inoculum block. On SNAY, growing slowly with sparsely spreading mycelium, after ca 3 weeks forming small, scattered, white, slimy sporodochia on the agar surface. – *Conidiogenous* cells borne in irregularly or penicillately branching clusters formed apically on swollen lateral hyphae lying prostrate on the agar surface, faintly pigmented and with slightly thickened walls; hyaline, 18–28 x 4–5 μm , cylindrical, slightly swollen in their middle or lower third, tapering to the tip, with periclinal thickening and sometimes a small collarette. – *Microconidia* absent. – *Macroconidia* collecting in slimy clusters, cylindrical, curved with a bluntly rounded apical cell, basal cell with a protruding pedicel, often offset towards the ventral side of the spore, 3(–4, rarely 5)-septate: 3-septate, (44–)46.7–53.3(–56) x (8–)8.5–9.5(–10) μm , 4-septate, (47–)50–56(–58) x (8–)8.5–9.5(–10) μm , 5-septate (one seen), 57 x 9 μm . – *Chlamydospores* not seen.

Habitat. – Decaying stem of *Piper* sp.

Known distribution. – French Guiana, known only from the type collection.

Holotype. – French Guiana. ca 15 km SW of Saül toward Mt. Galbao, 600–650 m, on decaying stem of *Piper* sp., 19 Jan. 1986, GJS (3108) & J. Boise (NY, ISOTYPE CAY).

This species is distinguished from *Ophionectria magniverrucosa* Rossman which has striate ascospores of a similar size and much larger warts on the perithecium.

Nectria vermisporea Samuels & Brayford, sp. nov. – Figs. 30, 31, 39–42.

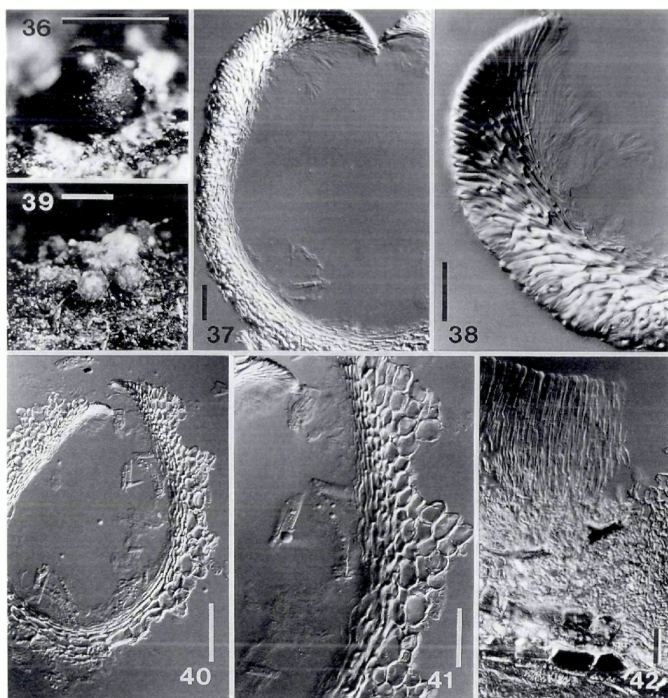
Perithecia stromatica, erumpentia, gregaria, globosa vel obpyriformia, ca 400 µm diam, scabrida, non papillata, apice subacuta vel subdiscoidea, rubra. Asci clavati vel fusiformes, 90–150 x 20–24 µm, deliquescentes, apice simplices. Ascosporeae vermiformes, (114–)125–143(–150) x 8–9(–10) µm, 9–11-septatae, hyalinae, laeves. Anamorphosis ignota.

Holotypus: FRENCH GUIANA. Piste de Saint-Elie, km 16 on road between Sinnamary and St. Elie, ECEREX, ORSTOM research area, 05°20' N, 53° W, on living vine, Feb., Mar. 1986, GJS 4016 (NY, ISOTYPE CAY).

Etymology. – Refers to the ascospore morphology.

Anamorph. – None known.

Teleomorph. – Stroma becoming erumpent, composed of erect, unbranched, septate, thin-walled hyphae, 200 µm long x 15 µm wide at the tip, colourless. – Perithecia gregarious, clustered around the periphery of the stroma; globose to obpyriform, ca 400 µm diam, nonpapillate; perithecial apex sub-acute to sub-discoidal, 75 µm diam; not collapsing on drying, red, darkening in 3% KOH, yellow in lactic acid; scaly, the scales lighter in colour than the perithecial wall. Cells at surface of perithecial wall and scales circular to elliptic, 20–40 µm in diam, walls 1.5–2 µm thick. Warts 40–60 µm high. Perithecial wall to 120 µm wide laterally including warts, comprising three regions. Outer region, including warts, to 90 µm wide, cells near circular, 15–25 µm diam, walls 1.5 µm thick and pigmented. Middle region 15–20 µm wide, cells tangentially flattened with lumina ca 15 x 6–7 µm and walls 3 µm wide and pigmented. Inner region ca 10 µm wide, cells tangentially flattened and compressed, walls < 1 µm thick and nonpigmented. Ostiolar region continuous with the middle region of the perithecial wall and protruding through the circular cells of the outer region; consisting of a palisade of ca 15 µm long, 6–8 µm wide, narrowly clavate elements with walls 1.5–2 µm thick and pigmented; the innermost elements merging with the periphyses. – Asci clavate to fusiform, 90–150 x 20–24 µm, thin-walled and



Figs. 36-42. - *Nectria* species. - 36-38. *N. philodendri*. - 36. Habit of perithecium. - 37. Median longitudinal section through a mature perithecium. - 38. Section through perithecial apex. - 39-42. *N. vermispora*. - 39. Habit of perithecium. - 40. Median longitudinal section through a mature perithecium. - 41. Section through perithecial wall. - 42. Stroma with long, unbranched hyphae. - Figs. 36-38 from GJS 3108; 39-42 from GJS 4016. - Scale bars: 36, 39 = 0.5 mm; 37 = 40 μ m; 38, 40, 41 = 50 μ m; 42 = 100 μ m.

deliquescing early, apex simple; 8-spored, ascospores multiseriate, completely filling each ascus. - Ascospores vermiform, (114-)125-143(-150) \times 8-9(-10) μ m, (9-)11(-13)-septate, hyaline, smooth, tapering slightly from tip to base.

Habitat. - On living vine.

Known distribution. - French Guiana, known only from the type collection.

Ascospores of *N. vermispota* did not germinate on CMD, and we have not observed an anamorph associated with perithecia in nature. While we have not observed an anamorph for this fungus, we believe that it is most similar to species proven to have *Cylindrocarpon* anamorphs than to *Nectria* species that have other anamorphs. It has, however, not been possible to place *N. vermispota* in any currently recognized *Nectria* group. It is most similar to *N. rubrococca* Brayford & Samuels (Brayford & Samuels, 1993) and *N. septospora* in wall anatomy, but differs in its ascospore morphology. The anamorph of *N. septospora* is a *Cylindrocarpon* (see above). The perithecial structure of *N. vermispota* is similar to that of *N. haematococca* Berk. & Broome, and *Ophionectria trichospora*, species that have *Fusarium* and *Antipodium* anamorphs respectively. The ascospores are similar in shape to those of *Ophionectria magniverrucosa* Rossman, but are longer, more septate and lack striations. *Ophionectria magniverrucosa* has not been linked to an anamorph.

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Literature cited

- Booth, C. (1959). Studies of Pyrenomycetes: IV. *Nectria* (Part I). – Mycol. Pap. 73: 1–115.
- (1966). The genus *Cylindrocarpon*. – Mycol. Pap. 104: 1–56.
- (1971). The Genus *Fusarium*. – Commonwealth Mycological Institute, Kew, U.K. 237 p.
- Brayford, D. (1992). *Cylindrocarpon*. In: Singleton, L. L., J. D. Mihail & C. M. Rush (Eds.) Methods for research on soilborne phytopathogenic fungi. – American Phytopathological Society, St. Paul, Minnesota: 103–106.
- & G. J. Samuels (1993). Some didymosporous species of *Nectria* with non-microconidial *Cylindrocarpon* anamorphs. – Mycologia, in press.
- Hawksworth, D. L. (1979). The lichenicolous hyphomycetes. – Bull. Brit. Mus. (Nat. Hist.) 6: 183–300.
- Holmgren, P. K., N. H. Holmgren & L. C. Barnett (1990). Index Herbariorum Part I: The herbaria of the world. – Regnum Vegetabile 120: 1–693.

- Le Gal, M. (1947). Recherches sur les ornementsations sporales des Discomycètes operculés. – Ann. Sci. Nat. Bot. sér. 11, 8: 73–297.
- Matsushima, T. (1975). Icones microfungorum a Matsushima lectorum. Published by the author, Kobe, Japan. 209 p + 415 pls.
- (1987). – Matsushima Mycol. Mem. 5: 1–100.
- Nirenberg, H. (1976). Untersuchungen über die morphologische und biologische Differenzierung in der *Fusarium*-Sektion *Liseola*. – Mitt. Biol. Bundesanstalt für Land- und Forstwirtschaft, Berlin-Dahlem 169: 1–117.
- Pirozynski, K. A. (1974). *Antipodium*, a new genus of Hyphomycetes. – Canad. J. Bot. 52: 1144.
- Rayner, R. W. (1970). A mycological colour chart. – CMI, Kew, Surrey, UK.
- Rossmann, A. Y. (1983). The phragmosporous species of *Nectria* and related genera. – Mycol. Pap. 150: 1–164.
- Samuels, G. J. & D. Brayford (1990). Variation in *Nectria radicularis* and its anamorph, *Cylindrocarpon destructans*. – Mycol. Res. 94: 433–442.
- Tio, M., L. W. Burgess, P. E. Nelson & T. A. Toussoun (1977). Techniques for the isolation, culture and preservation of the Fusaria. – Aust. Plant Path. Soc. Newsl. 6: 11–13.

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