

## Anamorphs of pyrenomycetous ascomycetes II. *Porosphaerella* gen. nov. and its *Cordana* anamorph

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**Zusammenfassung.** — Ein sowohl in Neu-Seeland wie in der Schweiz gefundener Pyrenomyces wurde innerhalb der Trichosphaeriaceae als neue Gattung und Art, *Porosphaerella cordanophora*, erkannt und beschrieben. Reinkulturen, isoliert aus in Neu-Seeland und der Schweiz gesammelten Ascosporen bildeten als Anamorph *Cordana pauciseptata* PREUSS. Damit liess sich zum ersten Mal die Zugehörigkeit einer Art der Gattung *Cordana* zu einem Ascomyceten feststellen. Die Verwandtschaft von *Porosphaerella* mit anderen Gattungen der Trichosphaeriaceae wird diskutiert.

**Summary.** — *Porosphaerella cordanophora* gen. et spec. nov. is proposed. Colonies derived from ascospores isolated from Swiss and New Zealand collections produced a *Cordana pauciseptata* PREUSS anamorph. This is the first report of a teleomorph for a species of *Cordana*. The relationship of *Porosphaerella* to other genera of the Trichosphaeriaceae is discussed.

### Introduction

Collections of an as yet undescribed pyrenomycetous ascomycete were made on rotting wood in New Zealand and Switzerland. Single ascospores, isolated from each collection, gave rise to identical cultures and an anamorph that is morphologically the same as *Cordana pauciseptata* PREUSS (see ELLIS, 1971) and is the only species of *Cordana* known to have a teleomorph.

In ascomatal morphology and anatomy this species should be placed in the Trichosphaeriaceae alongside genera such as *Chaetosphaeria* L.-R. & C. TULASNE or *Porosphaerellopsis* SAMUELS & MÜLLER (SAMUELS & MÜLLER, 1978; as *Porosphaeria*). Ascomata are small, black, carbonaceous, superficial, non-stromatic spheres that contain unitunicate asci interspersed with apically free sterile filaments. It, however, represents a distinct genus within the Trichosphaeriaceae. It differs from *Chaetosphaeria* in having brown ascospores with a pore at each end. *Porosphaerellopsis* has brown, 3-septate ascospores

and is suggestive of our unidentified ascomycete but ascomata of the type species of *Porosphaerellopsis*, *P. sporoschismophora* SAMUELS & MÜLLER, have branching paraphyses, multicellular ascospores and the anamorph is a species of *Sporoschismopsis* HENNEBERT & HOLUBOVÁ-JECHOVÁ. Furthermore, the ascomatal wall of the *Cordana* teleomorph is anatomically more simple than is the wall of production by soft-rot fungi: the formation of discrete cavities within the walls of wood cells as the hypha bores through the walls, and erosion of the cell walls from within. Although some fungi were capable of mounting either one or the other type of attack, *C. pauciseptata* was capable of both. NILSSON (1976) further demonstrated the production of cellulase xylanase and mannase by fungi that produce both types of attack in birch wood.

### Descriptions

*Porosphaerella* MÜLLER & SAMUELS gen. nov. (Ascomycetes, Trichosphaeriaceae).

Perithecia globosa, superficialia, apicaliter ostiolata, canalis periphysatis perforata; asci unitunicati, cylindracei; paraphyses filiformes; ascosporae ellipsoideae vel fusiformes, in medio septatae, fuscae, in extremis utrinque poro germinativo praeditae. Typus generis: *Porosphaerella cordanophora* MÜLLER & SAMUELS.

*Porosphaerella cordanophora* MÜLLER & SAMUELS, sp. nov. — Fig. 1.

Anamorph: *Cordana pauciseptata* PREUSS (1851), *Linnaea* 24: 129.

Perithecia solitaria vel gregaria, superficialia, sessilia, parvis stromatibus in substratum immersis, globosa, glabra, nigra, apicaliter breve papillata et canalis periphysatis perforata, 80–280  $\mu\text{m}$  diam.; peridium ascomatum 8–10  $\mu\text{m}$  crassum, cellulis ellipsoideis vel isodiametricis, 4–6  $\times$  2–4  $\mu\text{m}$  magnitudinis compositum; asci unitunicati, cylindracei, 70–90  $\times$  6–7  $\mu\text{m}$ , 8-sporei; paraphyses filiformes, septatae, 2–3  $\mu\text{m}$  crassae; ascosporae uniseriatae, ellipsoideae vel ellipsoideo-fusiformes, 9–12  $\times$  3,5–5  $\mu\text{m}$ , circa medium septatae, non constrictae, in extremis utrinque poro praeditae, glabrae, primum hyalinae demum fuscae. Hab. in ligno *Carpini betuli* L., Helvetia, Kt. Zürich, Zweidlen, 8. VI. 1980 (ZT).

Ascomata perithecial, solitary or gregarious in scattered groups of a few, superficial or with base slightly immersed, seated on a small, immersed basal stroma, globose with a short, conical papilla, 80–280  $\mu\text{m}$ , diam, smooth, black. Ascomatal wall 8–10  $\mu\text{m}$  wide, comprising a single region of elliptical to rectangular, 4–6  $\times$  2–4  $\mu\text{m}$  cells. Ostiolar canal periphysate.

Asci cylindrical, 70–90  $\times$  6–7  $\mu\text{m}$ , unitunicate, apex with non-amyloid ring, 8-spored, ascospores uniseriate with overlapping ends, forming throughout the entire ascus; asci forming a hymenium over the lower third of the ascomatal wall. Paraphyses forming between asci, unbranched, filiform, septate, straight, 2–3  $\mu\text{m}$  wide, apically

free and slightly longer than asci, forming over the entire inside of the ascomatal wall and continuous with the paraphyses in the ostiolar canal. Ascospores elliptical to elliptic-fusiform,  $9-12 \times 3.5-5.0 \mu\text{m}$  equally 2-celled, not constricted at the septum, with a pore at each end, remaining hyaline for a long time but becoming brown, smooth.

Characteristics of cultures. — Ascospores readily germinating on malt agar. Colonies grown 7 da on cornmeal dextrose agar (CMD, Difco, at ca.  $20^\circ\text{C}$ , 12 h darkness, 12 h near-ultraviolet light + cool white fluorescent light) 1.5–2 cm diam., flat, velvety with no aerial mycelium, dull black with a white margin. Conidophores forming within 3–4 da, completely covering the surface of the colony, brown, erect, unbranched, with a few rhizoidal hyphae arising from the base, bearing a dry, terminal head of conidia, less frequently also with an intercalary cluster of conidia;  $60-100(-115) \mu\text{m}$  long  $\times$  ca.  $5 \mu\text{m}$  basally, 2–3(–6)-septate, conidia produced singly on successively produced,  $1 \mu\text{m}$  wide, flat denticles that arise from the subglo-

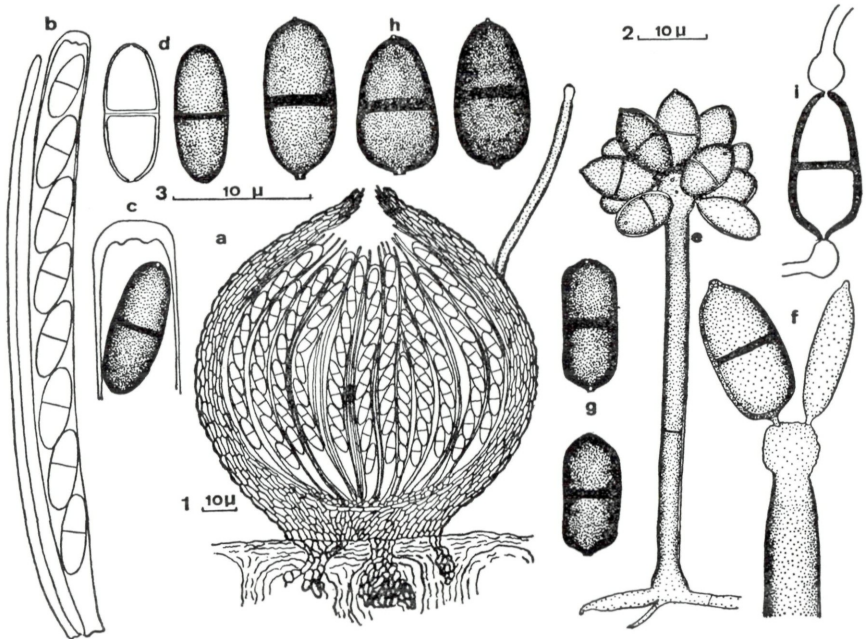


Figure 1. *Porosphaerella cordanaphora*: a: median section through an ascoma (scale 1); b: ascus with ascospores still hyaline paraphysis (scale 2); c: ascus apex with nonamyloid ring and one mature ascospore (scale 3); d: ascospores, left: median section, right: entire (scale 3); e: conidiophore with apical cluster of conidia (scale 2); f: apical protruding meristem of conidiophore with developing conidia (scale 3); g: conidia from New Zealand collection (scale 3); h: conidia from Swiss collection (scale 3); i: germinating conidium with germ tubes formed at both ends (scale 3)



bose, 5–6  $\mu\text{m}$  diam., lightly pigmented apex of the conidiophore; conidia apparently produced simultaneously and remaining attached to form a dry, radiating head of conidia. Conidia elliptic to oblong, 9.0–13.2(–19.0)  $\times$  (4.0–)4.5–5.3(–6.0)  $\mu\text{m}$ , equally 2-celled, rarely 2-septate, septa dark brown and band-like, not constricted at the septa brown, smooth, with a single germ-pore at each end of each conidium.

*Porosphaerellopsis sporoschismophora*. The differences in anamorph, ascospores and ascomatal anatomy suggest that *Porosphaerellopsis* and the *Cordana* teleomorph are generically distinct and may even belong in different developmental lines within the Trichosphaeriaceae.

Because of these differences, we propose the new genus *Porosphaerella* MÜLLER & SAMUELS with *P. cordanophora* MÜLLER & SAMUELS as its type species. The relationship of *Porosphaerella* to *Porosphaerellopsis* is analogous to the relationship of *Chaetosphaerella* MÜLLER & BOOTH (1972) to *Chaetosphaeria*.

Conidia of the *Cordana pauciseptata* phase of *Porosphaerella cordanophora* arise from successively produced denticles on the proliferated apex of the conidiogenous cell; they remain attached to the apex and form dry, radiating heads. In nature the conidiophore usually bears one terminal and one intercalary cluster of conidia whereas in culture intercalary clusters are uncommon. The general aspect of *C. pauciseptata* is suggestive of *Chloridium virescens* (PERSOON) GAMS & HOLUBOVÁ-JECHOVÁ, the anamorph of *Chaetosphaeria vermicularioides* (SACCARDO & ROUMEGUÈRE) GAMS & HOLUBOVÁ-JECHOVÁ. HAMMILL (1972) and COLE & SAMSON (1979) have shown that conidia of *Chloridium virescens* are produced in sympodial succession on the proliferated apex of a conidiogenous cell and that the proliferated apex forms above a typically phialidic collarete. In *Cordana pauciseptata* the wall of the conidiogenous cell is apparently continuous with the wall of the proliferated apex; there is no suggestion of a collarete when viewed with the scanning electron microscope (SEM). The tip of each denticle, when viewed with SEM, has a convex center surrounded by a raised rim. This aspect is consistent with that illustrated by COLE & SAMSON (1979) and ONOFRI & CASTAGNOLA (1982) for a variety of sympodially proliferating hyphomycetes that are said to have holoblastic conidiogenesis.

*Cordana pauciseptata* is a cosmopolitan species and is commonly found on decaying wood. NILSSON (1976) described two patterns of decay and enzyme. Aleuriospores forming on vegetative hyphae, solitary, 0–1-septate, dark brown to black, 8–10  $\times$  4–5  $\mu\text{m}$ .

Habitat. — On decaying, decorticated wood.

Holotype. — SWITZERLAND: Kt. Zürich, small forest near railway station Zweidlen near the Rhine River, on decorticated wood, leg. MÜLLER, 8 Jun. 1980 (ZT).

Additional Specimen examined. — NEW ZEALAND: Nelson, Eve's Bush Reserve, on decorticated wood, leg. SAMUELS (75—343), 17. Nov. 1975 (PDD 36618; ZT).

Notes. — Conidia of the New Zealand specimen are oblong while those of the Swiss collection are more elliptical; the two collections are otherwise identical.

Conidia germinate by producing a germ tube from either end but more frequently from the apical end (fig. 1, i). In a sample of 200 conidia, 16% germinated on malt agar after 18 h at 20° C. A germ-tube arose from the apical end of each conidium but in only 12% of the germinating conidia did a germ-tube also arise from the conidial base.

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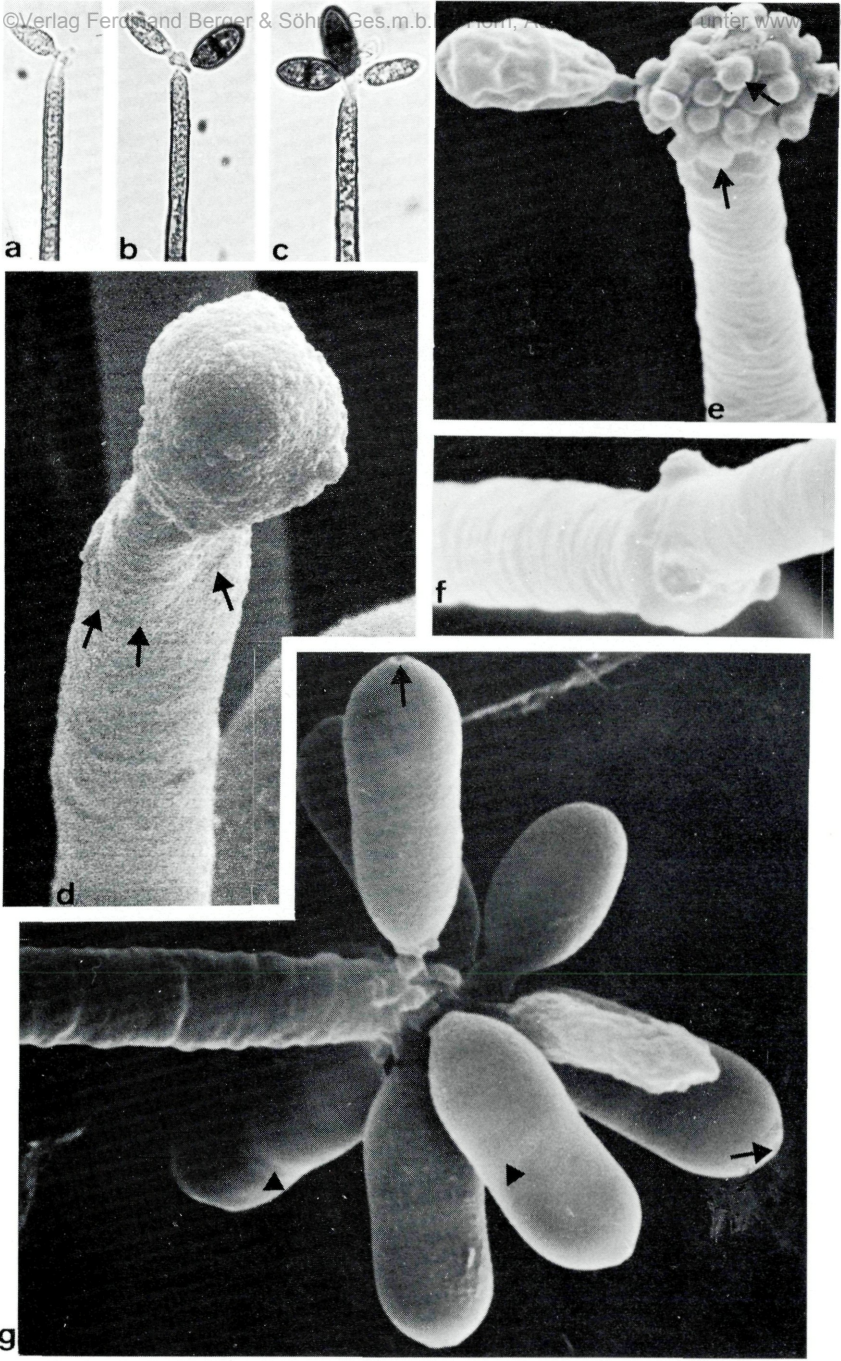


Figure 2. *Cordana*-state of *Porosphaerella cordanophora*: a—c: different stages of symphyal development of two-celled conidia (light microscope,  $\times 1400$ ); d: conidiophore with young protruded meristem above an inconspicuous collar (arrow) (SEM,  $\times 10,000$ ); e: conidiophore with older protruded meristem, one conidium still attached, a number of denticles distinctly visible (arrows), (SEM,  $\times 8500$ ); f: intercalary conidiogenous meristem (SEM,  $\times 7000$ ); g: conidiophore with conidiogenous meristem and attached conidia with apical germ-pores (arrows) and marks of septa (arrowheads) (SEM,  $\times 7000$ ). — Photographs: a—c: P. CRIVELLI, Mikrobiol. Inst. ETH-Zürich; d: D. STUDER, Mikrobiol. Inst./Inst. für Zellbiologie, ETH-Zürich; e—g: Mrs. D. BUCHANAN, Auckland

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