

## Revisiones Generum Obscurorum Hyphomycetum: *Astrodochium* Ellis & Everhart

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*Astrodochium coloradense*, the only described species in the coelomycete genus *Astrodochium*, forms distinctive confluent spots on the adaxial leaf surface of *Populus angustifolia*. *Astrodochium* is considered a taxonomic synonym of *Discula* and the new combination *D. coloradensis* is proposed. The conidiogenous cells and conidia of *D. coloradensis* closely resemble those of *D. cytoporea*, which also forms adaxial leaf spots on *Populus* species.

Keywords: *Astrodochium coloradense*, *Discula*, coelomycete taxonomy, *Populus*.

***Astrodochium* Ellis & Everh. 1897. Amer. Nat. 31: 430.**

Type. – *A. coloradense* Ellis & Everh., l. c.

Holotype specimen. – USA: Colorado, Morrison, on fallen leaves of *Populus angustifolia*, E. Bethel, No. 170, December 23, 1896 (NY).

The holotype packet of *A. coloradense* consists of several leaf fragments. The host, listed as *Quercus undulata* in the protologue (Ellis & Everhart, 1897), is crossed out on the packet label and replaced with *Populus angustifolia*. A note (from E. Bethel?), with the location of Morrison and a date of December 31, 1896, reads „I suppose this is too old to be of any value. If it should be something that you want can probably get a quantity though I noticed only this one leaf.“ A second note in the packet, in different handwriting and presumably by Ellis, lists spores as „oblong, continuous“ with the dimensions 4–6 x 1.25–1.5  $\mu\text{m}$ . „Basidia“ (conidiogenous cells) are described as „simple, obclavate,“ and 12 x 2.5  $\mu\text{m}$ .

The correction of the host identification is explained in a note written on the label of a second packet of *A. coloradense* in NY (Fig. 1), also labeled as 170 but with a later collection date of November 20, 1897. The packet is stamped as „Type,“ but in the protologue, Ellis & Everhart (1897) clearly designated the December, 1896 specimen as type. A note on the label of the second packet reads: „170 *Astrodochium Coloradensis* [sic]. Morrison Nov. 20–97. The host

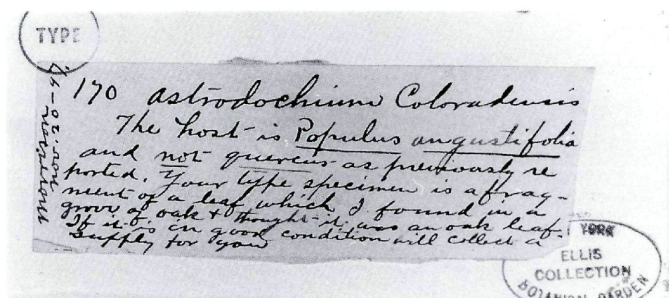
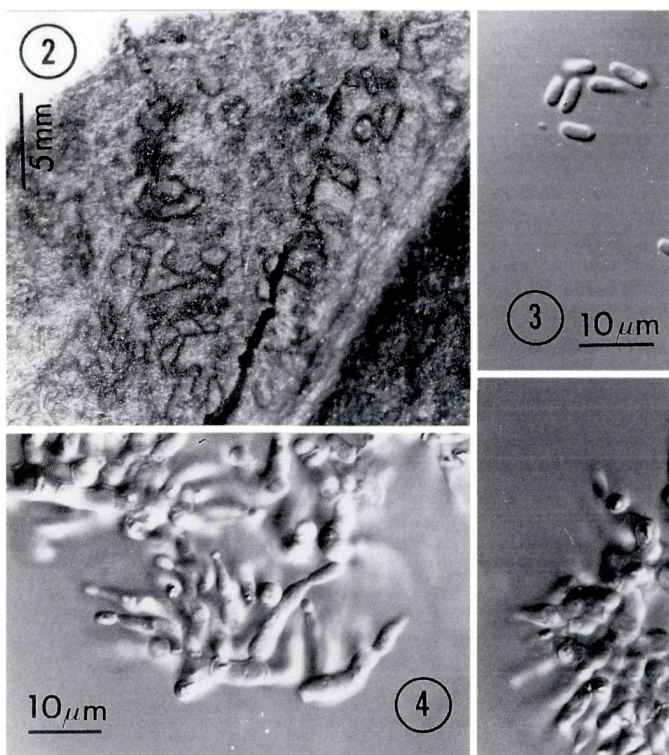


Fig. 1. – Packet label with correction of host identification. Specimen collected by E. Bethel, Nov. 20, 1897 (NY).

is *Populus angustifolia* and not *Quercus* as previously reported. Your type specimen is a fragment of a leaf which I found in a grove of oak and thought it was an oak leaf. If it is in good condition will collect a supply for you.“ A note in this packet in Ellis' handwriting reads „These spec. are old & poor“. The packet contains several leaves and leaf fragments. Leaf spots present in this material have a distinctive, confluent dark pattern on the adaxial leaf surface (Fig. 2). No conidiomata were found associated with the leaf spots in this packet.

The conidiomata in the type packet are acervular, subepidermal, circular to irregular; aggregate and confluent conidiomata radiate outward from a central, discrete conidioma forming a more or less circular, composite structure. The conidiophores (Figs. 4 and 5) arise from a layer of hyaline, parallel hyphae 3.5–4.0  $\mu\text{m}$  diam. and are hyaline, branched and septate. Conidiogenous cells are hyaline, phialidic, discrete, determinate, lageniform and 6–13  $\times$  2–3  $\mu\text{m}$ . Conidia (Fig. 3) are hyaline, cylindrical to bacilliform, aseptate and 4–5  $\times$  1.5–2.0  $\mu\text{m}$ . Fungal hyphae are present in some mesophyll cells in the material examined, indicating that the fungus grew subepidermally within the host. It was not possible to determine more precisely the nature of the conidioma relative to the host tissue due to the limited amount of material and poor condition of this specimen.

Ellis & Everhart (1897) noted that *Astrodochium* has the „general aspect“ of *Asteroma*. *Asteroma* is a large genus of over 150 species, most of which are probably not congeneric with the type species, *A. padi* DC.: Fr. (Sutton, 1980). *Asteroma* is characterized by acervular conidiomata described as being subcuticular, with phialidic conidiogenous cells formed directly from pseudoparenchyma, and fusiform to acicular conidia. *Discula*, a morphologically similar genus, is distinguished from *Asteroma* by the formation of



Figs. 2-4. - *Astrodochium coloradense* on *Populus angustifolia*. - 2. Leaf discoloration associated with conidiomata (Specimen collected by E. Bethel, Nov. 20, 1897 in NY). - 3. Conidia. - 4. Conidiogenous cells, numbered and fig. to right, at same mag. - Figs. 3 and 4 from type material, E. Bethel No. 170, December 23, 1896 (NY).

subepidermal acervuli and conidiogenous cells borne on branched, septate conidiophores (Petraik, 1962; Sutton, 1980).

Examination of specimens of *A. padi* cited by Sutton (1980; IMI 30606, 13019, 1630, 20865) revealed some discrepancies with the generic concept. The host cuticle mostly remains intact beneath the conidiomata, and the pigmented upper wall of the acervuli, which has been attributed to the host cuticle (Sutton, 1980) appears to be of fungal origin. The conidiogenous cells are formed on septate, branched conidiophores, similar to those in *Astrodochium*

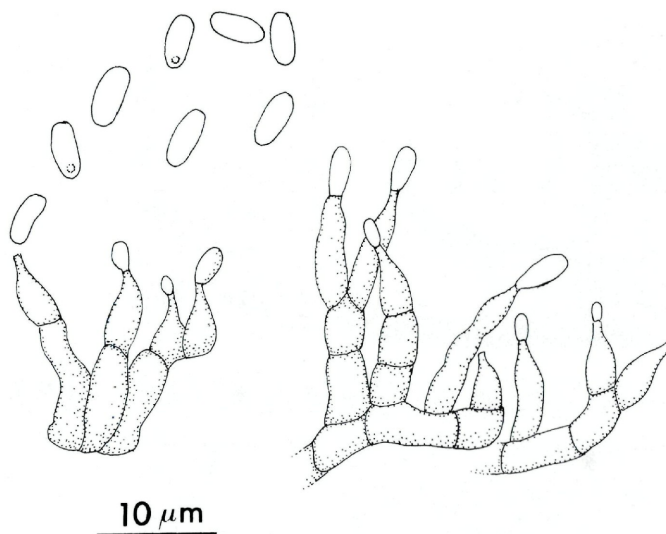
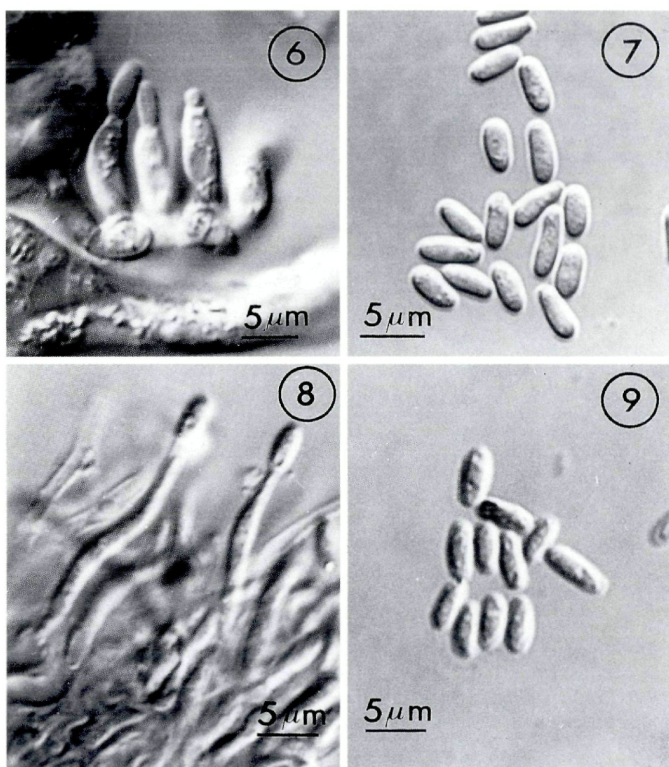


Fig. 5. – *Astrodochium coloradense* from type material. – Conidiogenous cells and conidia.

*coloradense*. The overall appearance of the lesions on the leaf caused by *A. padi* is similar to that of *Astrodochium coloradense*, although the acervuli of *A. padi* in general are formed along the leaf veins, whereas those of *A. coloradense* are formed over the surface of the leaf blade. The acervuli of *A. padi* develop as a pigmented, slightly thick-walled layer of *textura angularis* on top of the host cuticle; fungal development is restricted to the leaf surface and no hyphae are evident in the leaf mesophyll. Conidiophores arise directly from the epicuticular layer of fungal cells; the conidiophores are 0–1 septate, branched at the base, with terminal conidiogenous cells. Based upon these observations, *Astrodochium* is distinct from *Asteroma*.

The acervuli of *Discula umbrinella* (Berk. & Br.) Morelet, the type species of *Discula*, have a similar morphology to *Astrodochium coloradense*, although *Discula* species in general can exhibit great morphological variation (von Arx, 1970). A survey of *Discula* species treated by von Arx (1957, 1970) revealed *D. cytosporea* (Pass.) von Arx, a species described as *Gloeosporium cytosporum* Passerini in 1890 from leaves of *Populus canescens*. Von Arx (1970) described the fungus as forming dark, lightly and sharply marginate leaf spots



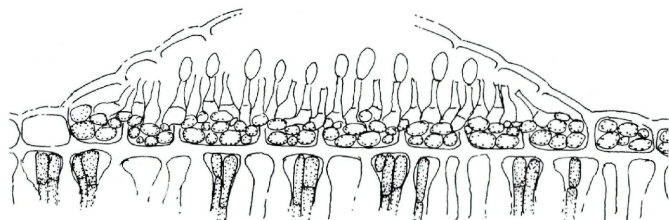


Figs. 6, 7. – *Discula cytospora* on *Populus alba* (WSP 2720). – 6. Conidiogenous cells. – 7. Conidia.

Figs. 8, 9. – *Astrodochium coloradense* on *Populus grandidentata* (DAOM 211157). – 8. Conidiogenous cells. – 9. Conidia.

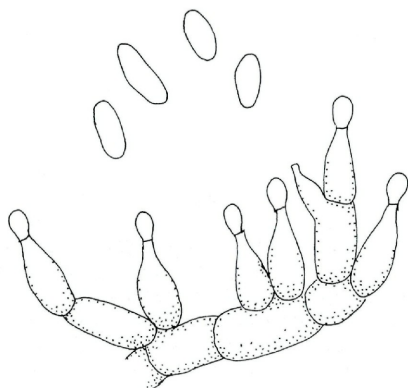
3–6 mm in diameter with the acervuli developing epiphyllously in the epidermal cells. A specimen in Herb. WSP (WSP 2720) labeled as *D. cytospora* on leaves of *Populus alba*, collected in Cambridge, Massachusetts in 1889 by Roscoe was examined and annotated by J. A. von Arx. The leaf spots in the WSP specimen are on the adaxial leaf surface, small (<3 mm diam), discrete to coalescing, uniformly brown, scattered over the leaf blade; each leaf spot has a central, usually elongated and irregular conidioma. The conidiophores arise

A



45  $\mu$ m

B



10  $\mu$ m

Fig. 10. *Discula cytospora* (WSP 2720). – A. Conidioma. – B. Conidiogenous cells and conidia.

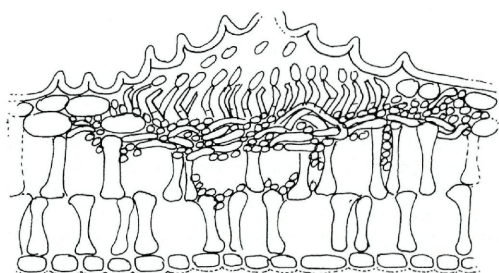
from a layer of pale brown *textura globosa* which developed within the host epidermal cells (Fig. 10a). The phialidic conidiogenous cells (Figs. 6 and 10b) are  $4.4\text{--}8.8 \times 2.6\text{--}3.5 \mu\text{m}$ . Although the epidermal cells appeared to delimit the base of the conidiomata, intracellular hyphae also are present in the mesophyll cells beneath the conidiomata. The conidia, likewise similar in size and shape to those of *A. coloradense*, are  $5.3\text{--}6.2 \times 1.8 \mu\text{m}$  (Fig. 7).

Based on these observations, *Astrodochium* can be separated from *Discula* only by the aggregate, confluent and outwardly radiating nature of the conidiomata in the holotype specimen on *Populus angustifolia*; the conidiogenous cells and conidia are morphologically similar to those of *Discula cytosporaea sensu* von Arx. However, the type specimen of *D. cytosporaea* was not examined in this study and it is not clear whether von Arx (1957, 1970) examined Passerini's material. Von Arx (1970) noted the variability of *Discula* species, some of which can be differentiated into leaf and twig forms, some into summer and winter forms. These different forms previously were assigned to their own genera (von Arx, 1970). It is likely that the differences in appearance of the leaf spots on the different *Populus* species are host dependent. The minor variation in the leaf spots may be insufficient to maintain *Astrodochium coloradense* as a distinct species. However, because of the paucity of material in Ellis and Everhart's type specimen of *A. coloradense* and the inability to compare this material with Passerini's type material of *D. cytosporaea*, it is premature to consider the two fungi as conspecific. The following taxonomic disposition is proposed:

***Discula coloradensis*** (Ellis & Everh.) L. M. Carris, comb. nov.

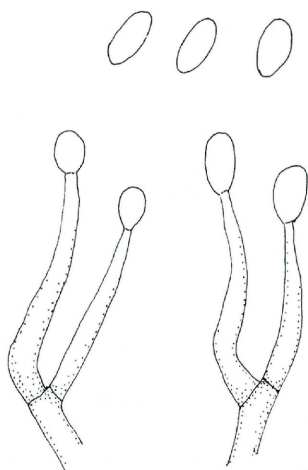
Basionym: *Astrodochium coloradense* Ellis & Everh. 1897. Amer. Nat. 31: 430.

*Astrodochium coloradense* had not been reported in the literature since its original description by Ellis & Everhart (1897) until a fungus resembling *A. coloradense* was associated with leaf yellowing and premature fall coloration of *Populus grandidentata* in four counties in southwestern Nova Scotia, Canada between 1986 and 1992 (Harrison, 1993). The overall appearance of leaf spots in the Canadian specimens differed from Ellis and Everhart's collections. The leaf spots from the Nova Scotia collections (DAOM 211157, 212558) consisted of a dark brown discoloration with a distinct border between the necrotic and green leaf tissue. The conidiomata, produced on the abaxial surface, were evident as discrete, cream-colored, circular, applanate pustules less than  $200 \mu\text{m}$  diam, with a slight darkening associated with the border. The conidiomata lacked the distinctive, confluent nature of the holotype material on *P. angustifolia* leaves. The individual



A

45  $\mu$ m



B

10  $\mu$ m

Fig. 11. *Astrodochium coloradense* (DAOM 211157). – A. Conidioma. – B. Conidiogenous cells.



conidiomata were unilocular, initially covered by both host epidermis and cuticle, with dehiscence by irregular rupture of the host epidermis and cuticle. The conidiomata were formed from pigmented, slightly thick-walled *textura globulosa* to *textura angularis* 3–5 cells thick; the conidiomatal base was indistinct, with subtending fungal hyphae extending into the leaf mesophyll (Fig. 11a). The conidia (Fig. 9) were similar to those in Ellis and Everhart's specimen, but the conidiogenous cells (Figs. 8 and 11b) were longer and narrower (10.6–18.5 × 1.8–2.6 µm). Although the differences in the appearance of the leaf spots in Ellis and Everhart's and the Canadian specimens may be a result of the different *Populus* species and/or the different leaf surfaces on which they occur, the discrepancy in the shape and size of the conidiogenous cells raises doubt as to the conspecificity of these fungi. The Canadian leaf spotting fungus appears to belong in *Discula*, but is not conspecific with *D. coloradensis* or *D. cytosporae*.

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