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On some Colacogloea species from Canada

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Colacogloea allantospora is proposed as a new species. Canadian collections of *C. bispora* (Hauerslev) Oberw. et Bauer, *C. peniophorae* (Bourd. et Galzin) Oberw. et Bandoni and two unnamed *Colacogloea* spp. are discussed. All are intrahymenial parasites of *Hyphoderma*, *Tubulicrinis spp.*, of unidentified Corticiaceae s. l. In addition to budding, repetition, and germ tubes, *Colacogloea*, germination by a thin-walled vesicle was commonly observed. Weak Congo Red-KOH stained colacosomes intensely in a recent collection of *C. peniophorae*; those in two related but unnamed older collections stained weakly. A *Spiculogloea* (c.f. *S. minuta* Roberts), also grew in the type collection of *C. allantospora*.

Key words: Systematics, mycoparasites, *Colacogloea*, colacosomes, *Spiculogloea*

Bandoni R, Krug J. a Ginns J. (2002): O některých kanadských druzích rodu Colacoglea. – Czech Mycol. 54: 31–43

Je popisován nový druh *Colacoglea allantospora*. Jsou diskutovány kanadské nálezy druhů *C. bispora* (Hauerslev) Oberw. et Bauer, *C. peniophorae* (Bourd. et Galzin) Oberw. et Bandoni a dále dva dosud nepojmenopvané druhy rodu *Colacoglea*. Všechny tyto druhy jsou intrahymeniálními parasity na druzích rodů *Hyphoderma, Tubulicrinis* a na neurčeném druhu čeledi Corticiaceae s.l. Kromě klíčení opakováním a klíčení pomocí hyfy bylo pozorováno u rodu *Colacoglea* také klíčení pomocí tenkostěnných měchýřků. Byly také pozorovány slabě barvitelné colacosomy pomocí kongo červeně v KOH u *C. peniophorae*.

Among heterobasidiomycete collections made by R. F. Cain and now in the Royal Ontario Museum (TRTC), are several taxa he assigned to *Helicobasidium* Pat. Three of Cain's collections, one by J. Ginns, and another by A. & R. Bandoni, are treated here in the genus *Colacogloea* Oberw. et Bandoni (Oberwinkler et al., 1990). *Helicobasidium* species do not form a natural group, and those closely related to *Helicobasdium brebissoni* (Desm.) Donk (Donk, 1966), the type species,

are root parasites of vascular plants. *Colacogloea* species are mycoparasites, growing primarily intrahymenially in their host basidiomes. Their most distinctive feature is the colacosome (Bauer & Oberwinkler 1990; Oberwinkler et al. 1990), an organelle probably associated with absorption of nutrients from the host. Colacosomes develop within hyphae or vesiculose cells in contact with host structures, the walls of both organisms either becoming very thin or absent in the contact zone, the narrowed end of the colacosome actually contacting the host protoplast. Colacosomes are visible in stained preparations of North American collections of *C. peniophorae*, but they are not visible by light microscopy in species such as *C. bispora* (Hauerslev) Oberw. et Bauer (Oberwinkler et al. 1999). We have assigned our collections to *Colacogloea* on the basis of morphological similarities to *C. bispora* and the North American form of *C. peniophorae*, but without electron microscopy for colacosome observations. A distinctive type of germination of conidia and basidiospores was observed which might be useful in linking taxa discussed and described here to other fungi producing colacosomes.

MATERIALS AND METHODS

Microscopic features of the basidiomes were examined using 2% or 3% aqueous Potassium Hydroxide with or without aqueous Phloxine and/or Congo Red; alternatively, mounts were prepared using Melzer's reagent (Hawksworth et al. 1995), or 0.05% (w/v) Cotton Blue in lactic acid. For staining colacosomes in cells of *C. peniophorae* and related taxa, a weak Congo Red–KOH stain (WCR, Bandoni, submitted) was used. The stain solution consisted of 30 ml dist. water, 3 ml of 1% aqueous Congo Red in distilled water (w/v), and 3 ml glycerol. For staining, equal drops of WCR stain and 3% aqueous KOH were mixed on a slide; sections or other material to be stained were placed in the mixture. The preparations were left to stain for ca. 5–10 minutes before covering, and additional stain solution (or 10% aqueous glycerol) was added at the coverslip edge as evaporation occurred. Abbreviations for herbaria cited i. e. DAOM, TRTC, follow Holmgren et al. (1990).

TAXONOMY

Colacogloea allantospora Ginns et Bandoni, sp. nov. Fig. 1, Fig. 4, G-J.

Basidiomata nulla, in sporocarpis fungi *Tubulicrinis calothrix* parasitica. Hyphae hyalinae, 1.5–3.0 μm crassae, parietibus tenuibus, ramosae, fibulatae, singulares aut interdum funiculosae. Basidia circa 15–20 × 2–3 μm magna, interdum basim probasidiiforme leviter inflata, basi plerumque 2 μm lata,

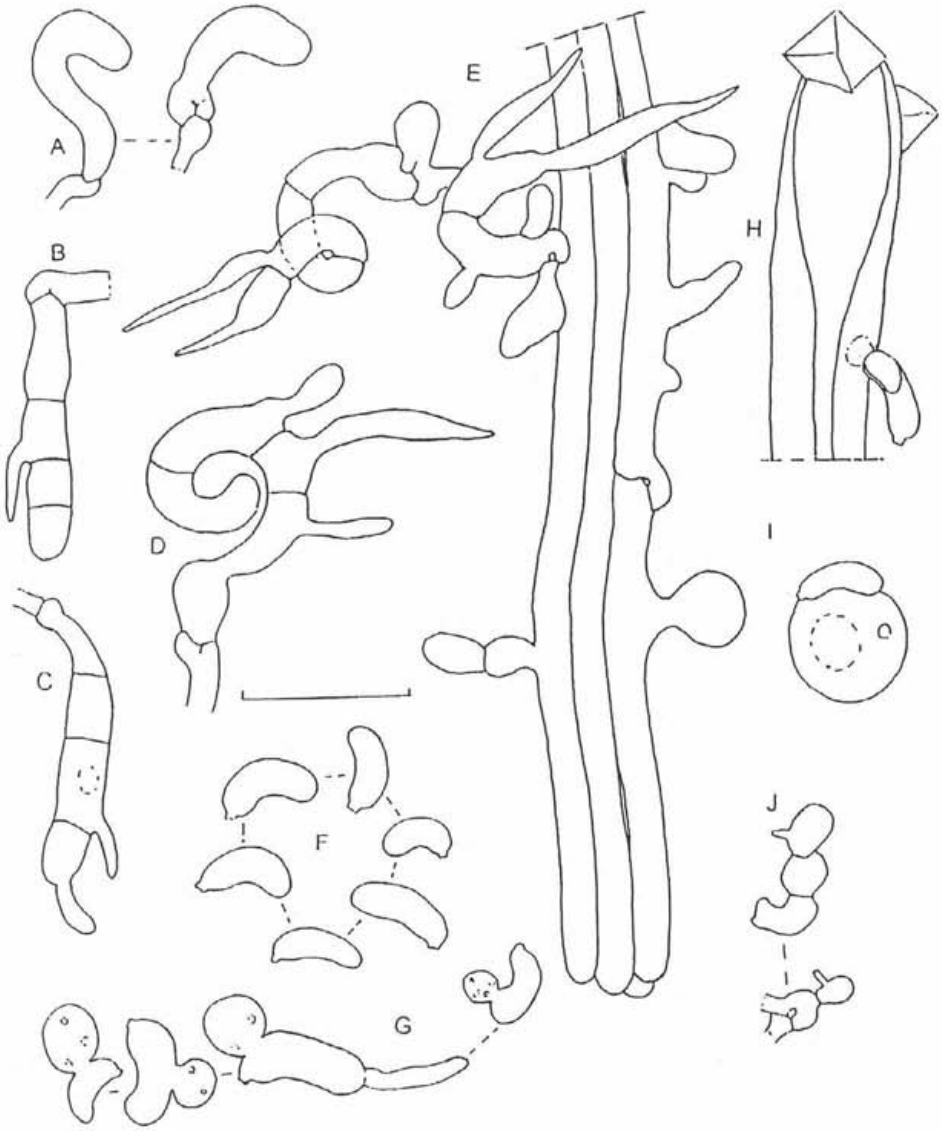

Fig. 1. A-J. *Colacogloea allantospora*, all from J. Ginns 7959 (HOLOTYPE), DAOM. **A.** Two probasidia, that on the right with a slight basal swelling. **B-D.** Mature septate basidia with developing epibasidia and, on **D.**, a developing basidiospore (note also the probasidium-like basal part). **E.** Hyphal strand bearing two basidia above, left. **F.** Basidiospores. **G.** Germinating basidiospores. **H.** Germinated basidiospore with vesicle adhering to host cystidium. **I.** Basidiospore and vesiculose cell of uncertain origin. **J.** Haustorium-like structures. (Bar = 10 μm)

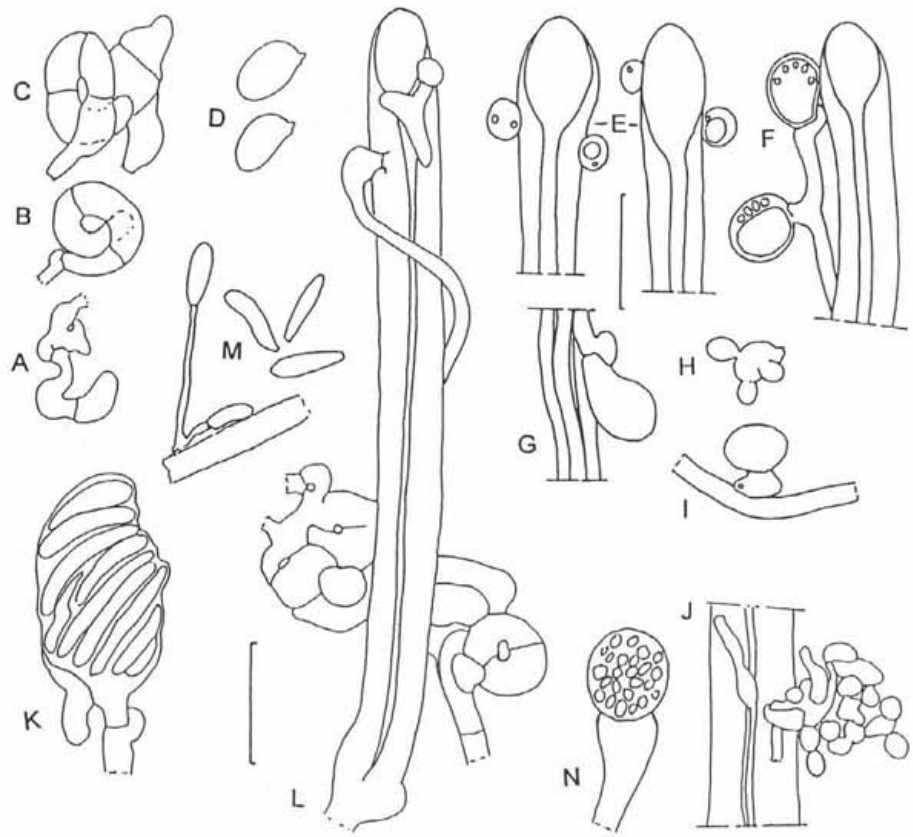

Fig. 2. A-N. *Colacogloea bispora*, from TRTC 20116. **A-C.** Mature probasidia. **D.** Basidiospores. **E.** Small globose cells (of the parasite?) associated with host cystidia. **F.** Hypha and vesiculose cells of parasite associated with host cystidium. **G.** Small portion of hyphal strand with enlarged vesiculose cell arising from one hypha. **H.** Budding basidiospore. **I.** Basidiospore germinating by thin-walled vesicle. **J.** Hypha, presumably of the parasite, growing within lumen of host cystidium, extending through the wall and budding on the right. **K.** Large vesicle possibly representing a host cell in which a coiled (? *Colacogloea*) hypha is present. **L.** Hyphae of parasite associated with host cystidium below; hyphae above without visible clamp connections and possibly not of the *Colacogloea*, one either extending into or out of the cystidium at the upper left. **M.** Conidia of unknown origin from within host basidiome, two apparently germinating and their tubes fused. **N.** Cell containing spore-like bodies, of uncertain origin and function. (Bars = 10 μm; that on the upper right for figures E-I. only; all others, lower left bar).

distale 4 ad 3 μm lata, recta vel curvata aut spiralia, maturitate e cellulis 2–4 composita; epibasidia ad 24 μm longa, 1–2 μm crassa, tubiformia vel fusiformia, aut epibasidia interdum nulla et dein sterigma e cellula basidii crescens. Basidiosporae (4.5–)5.5–8 × 2–3 μm magnae, allantoideae, hyalinae, laeves, non amyloideae nec cyanophilae, repetitione aut fistula aut vescicula germinantes.

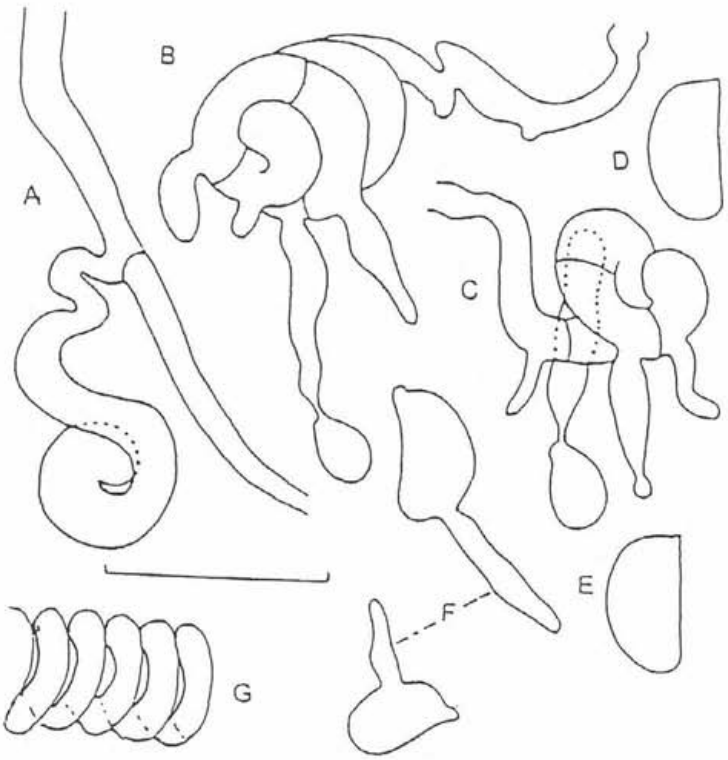

Fig. 3. *Colacogloea bispora* from TRTC 20116, drawn by R. F. Cain. **A.** Young probasidium. **B, C.** Septate basidia with epibasidia and developing spores. **D, E.** Basidiospores. **F.** Germinating basidiospores. **G.** Coiled hypha. (Bar = ca 10 μm)

Holotypus: Canada, Yukon 29. 6. 1989, leg. J. Ginns (DAOM 221328).

Separate basidiocarps lacking, hyphae growing within basidiomata of *Tubulicrinis calothrix* (Pat.) Donk, the basidia mostly developing external to those of the host. Hyphae 1.5–3 μm in diam., hyaline, thin-walled, branched, with clamp connections; structures resembling tremelloid haustoria infrequent (Fig. 1J); hyphal strands (Fig. 1E) scattered, composed of closely adherent parallel hyphae, walls of some thin, others slightly thickened and without cytoplasm. Basidia (Fig. 1A-E) ca. 15–20 × 2–3 μm, some with a slight basal probasidial swelling, but most only 2 μm at the base, up to 3 μm in diam. elsewhere, straight to hooked or coiled, 2–4–celled, occasionally borne on strand hyphae (Fig. 1E); epibasidia up to 24 μm long including tapered sterigma, 1–2 μm in diam., tubular to fusiform, sometimes absent and the sterigma arising directly from the basidial cell. Basidiospores (4.5–)5.5–8 × 2–3 μm, allantoid (Fig. 1F), the diameter slightly greater distally than proximally, the wall smooth, non-amyloid, non-cyanophilous;

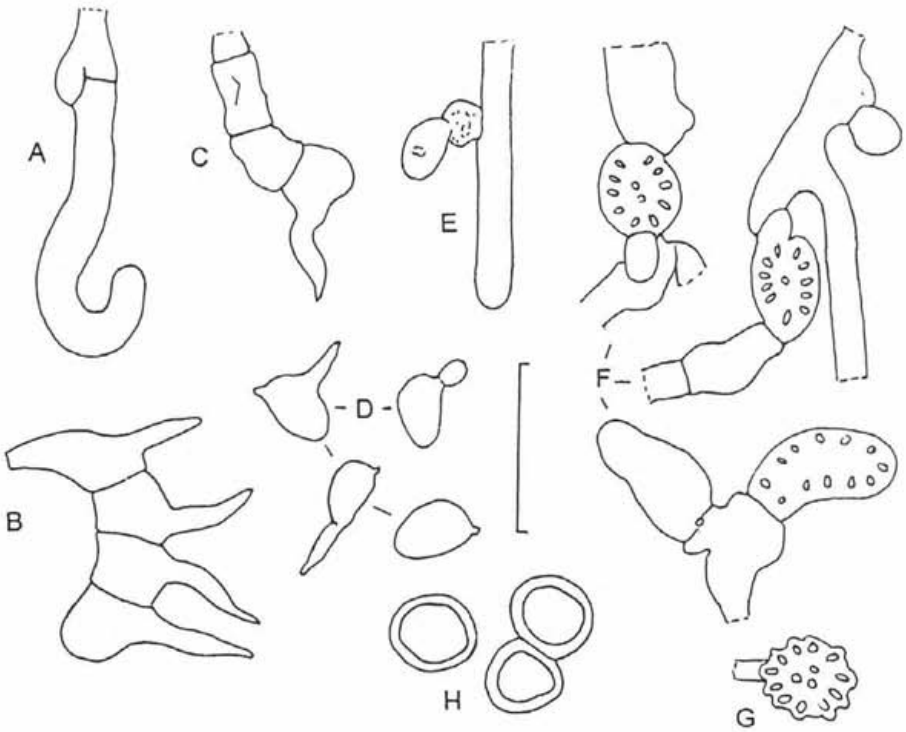

Fig. 5. *Colacogloea* spp. (A-H, from TRTC 31243). **A.** Probasidium. **B, C.** Basidia with epibasidia. **D.** Basidiospores, two germinating by repetition and a third by (?)budding. **E.** Basidiospore germinating by vesicle formation, the vesicle appressed to a (?)host hypha. **F, G.** Cells thought to be sites of colacosomes. The vesiculose cell in **G** is thin-walled (?naked), lobed, and with guttules or vacuoles situated in each lobe. **H.** Thick walled conidia of unknown origin. (Bar = 10 μm)

germination by repetition, by germ tube (Figs. 1G), or by vesicle (Fig. 1G, H; Fig. 4G, H)

Habitat: Growing within basidiomata of *Tubulicrinis calothrix* (Pat.) Donk on wood of *Picea*.

Specimen examined: Canada: Yukon Territory, Highway 2, km 562, Moose Creek Campground. 29 June 1984. Coll. J. Ginns 7959, HOLOTYPE, (DAOM 221328).

No external indication of the presence of the parasite was seen in dried specimens, and only scattered patches of the *Colacogloea* were found in the host hymenium. The hyphal strands, large enough to be seen under high power with a dissecting microscope, are inconspicuous but are sometimes seen extending across crevices in the host hymenium.

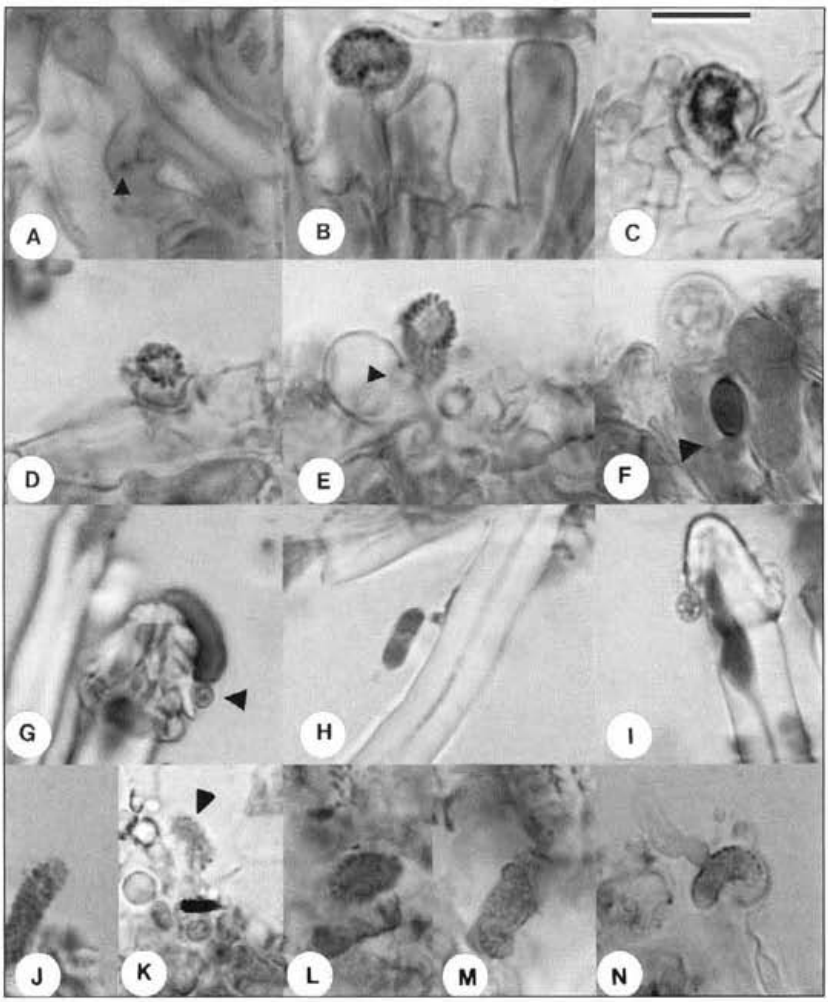

Fig. 4. A-F. *Colacogloea peniophorae* (from A. & R. Bandoni, 13041); **G, H, J.** *Colacogloea allantospora* (from J. Ginns, 7595, Holotype); **I.** *C. bispora* (from TRTC 20116). **K, L.** *Platygloea* sp. (from TRTC 31243); **M.** *Platygloea* sp. (from TRTC 31246); *Spiculogloea* cf. *minuta* Roberts (from the Holotype of *C. allantospora*) **A.** Hyphae of host showing dolipore septum (arrow). **B, C.** Vesiculose ("gall-like") cells containing membranes and attached colacosomes. **D.** Ruptured gall-like cell, the cupulate wall remnant visible immediately below the membrane and colacosomes. **E.** Ruptured cell (arrow within cell wall points to opening) and extruded membrane with attached colacosomes. **F.** Conidium germinating by a vesicle (arrow) which appears to be adhering to a host basidium; a wall vestige is faintly visible at the opposite end (base) of the conidium. **G, H.** Spores from *C. allantospora* germinating by vesicle formation, the vesicles in contact with host cystidia. **I.** Globose cell attached to host cystidium of *C. bispora*, the protoplast possibly in contact with that of the host structure. **J, K.** Extruded protoplasts, in J. Ginns 7595 and TRTC 31243, respectively, resembling those in *C. peniophorae* preparations, above. **L, M.** Colacosomes in gall-like cells, from TRTC 31243 and TRTC 31246, respectively (those in M stained very weakly). **N.** Basidium of *Spiculogloea* cf. *minuta* Roberts; note conspicuous rough wall above. (All figures at same magnification. Bar in C = 10 μm)

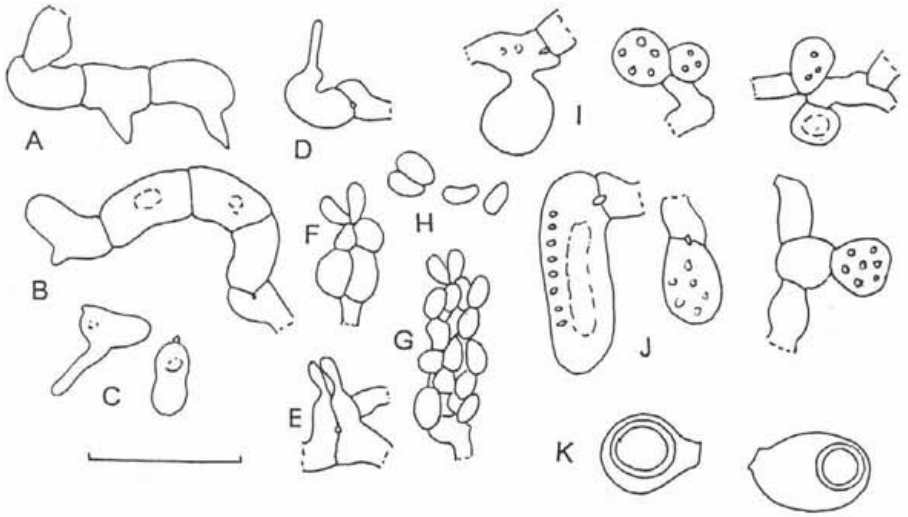

Fig. 6. *Colacogloea* sp. (Figures all from TRTC 31246). **A, B.** Basidia with developing epibasidia. **C.** Basidiospores possibly belonging to this unidentified species. **D.** Structure resembling tremelloid haustorium. **E, F.** Conidiogenous cells bearing conidia. **G.** Elongate cluster of conidia, the type of development not known. **H.** Conidia. **I, J.** Vesiculose cells, possibly sites of colacosomes. **K.** Structures of unknown origin and function, possibly chlamydospores developed in vesiculose cells. (Bar = 10 μm)

The spores assumed to belong to the *Colacogloea* are very close in size and form to those of *T. calothrix*, the host. Basidiospore size in the latter was given as (4.5–)5–7 × (1.5–)2–3 μm by Weresub (1953), (4.5–)5.5–7.5 × (1.5–)2–2.5(–3) μm by Jülich and Stalpers (1980), and 6–7(–8) × 1.5–1.8(–2) μm by Hjortstam et al. (1988). Basidiospores of *T. calothrix* are described as "allantoid" in Hjortstam et al. (1988), but their figures show spores with only slight curvature near the proximal end of the spore. *Colacogloea allantospora* basidiospores are bent centrally and the curvature is typically greater than illustrated in the figures cited. Basidiospore measurements are further complicated by the presence of another intrahymenial parasite, a species of *Spiculogloea* (Fig. 4N) possibly *S. minuta* Roberts (Roberts 1997). Basidiospores assumed to belong to this fungus were few, 6.5–8.5 × (2.5–)3.5–4 μm, bent fusiform, tapered especially proximally, the distal end rounded and only slightly narrower than the central region, maturing 1–septate. Because of the similar size and general form, it is possible that our measurements include some basidiospores of the host and both parasites.

Although structures resembling tremelloid haustoria (Fig. 1J) were found, none were attached to host hyphae. It is known that *Spiculogloea* species do have such haustoria (Roberts 1997); those seen here could belong to the *Spiculogloea* present or might simply be artifacts.

Colacogloea allantospora closely resembles *C. bispora* in its hyphal strands, basidia, and spore germination; the Holotype also grew on the same host species as the Canadian collection of *C. bispora*. It differs in the form and size of the basidiospores.

Colacogloea bispora (Hauerslev) Oberw. et Bauer, Kew Bull. 54: 764,1999. Figs. 2, 3; 4I.

= *Platygloea bispora* Hauerslev, Friesia XI: 331, 1987.

= *Achroomyces bisporus* (Hauerslev)Hauerslev, Mycotaxon 49:218. 1993.

A specimen given a tentative new name in *Helicobasidium* by R. Cain (TRTC 20116) differs little from *Colacogloea bispora* (Hauerslev) Oberw. et Bauer (Oberwinkler et al., 1999); we consider it to be conspecific with *C. bispora*. In Cain's collection, the hyphae are mostly 1.5–2 μm in diam., thin-walled, with clamp connections. Hyphae often are associated with host cystidia, (Fig. 2F, G, L) and sometimes grow within the cystidial lumen (Fig. 2J), but some of these might belong to other species. Hauerslev (1987) reported tightly coiled hyphae in his material, and Cain illustrated such hyphae in his collection (Fig. 3G). Hyphal strands, indistinguishable from those found in *C. allantospora* (Fig. 1E), but without basidia, were also found in this collection. The basidia are 2–4–celled, curved to coiled (Fig. 2A-C; Fig. 3A-C); the basidiospores are 5–7 × 3–4 μm, ovoid to suballantoid (Fig. 2D; 3D-F); germination is by budding (Fig. 2H), by repetition (Fig. 3F), or by formation of a thin-walled vesicle (Fig. 2I). The germ vesicles typically occur in contact with host structures, as in Fig. 2I; it usually is flattened in the contact zone and sometimes contains a single refractive or dark granule (Fig. 2I). Blastic conidia (Fig. 2J) were observed on hyphae associated with host cystidia, and the numerous spheroidal cells adhering to host cystidia (Figs. 2E; 4I) could originate from those conidia or from budding basidiospores. Anomalous structures present in the host basidiome (Figs. 2K, M, N), are of unknown origin, although that in Fig. 2K could consist of coiled hyphae of the parasite growing within a host cell. Habitat: Intrahymenial on basidiomata of *Tubulicrinis calothrix* (Pat.) Donk growing on wood of *Pinus banksiana*.

Collection examined: Canada: Ontario; Thunder Bay District, Little Dog Lake, 11 Sept. 1944. Coll. R. F. Cain (TRTC 20116).

Colacogloea peniophorae (Bourd. et Galzin) Oberw. et Bandoni, Can. J. Bot. 68: 2534, 1990

= *Platygloea peniophorae* Bourd. et Galzin, Bull. Soc. Mycol. Fr. 25: 17, 1909

Material stained with WCR is illustrated in Fig. 4A-F. Many host cells can be distinguished from those of the parasite on the basis of either form, e.g., basidia

and cystidia, or by dolipore septa which are stained by WCR (Fig. 4A) in this host. Colacosome-containing vesiculose hyphal cells (Fig. 4B, C) are also plainly visible. In these, it can also be seen that colacosomes occur in large numbers, they are in evenly spaced patterns, and they are attached to membrane systems within their cells. Tapping microscope preparations, or applying pressure to the coverslip, results in release of some protoplast and membrane systems (Fig. 4D, E). Extruded membranes bear the colacosomes on their outer (exposed) surfaces, and the organelles are then more clearly visible than those within the cells. Presumably, the extruded protoplasts are those of the host; as the colacosomes are oriented with their pointed apices attached to the membrane, but TEM studies obviously are necessary to obtain a clear picture of the interface of the host and parasite.

A germinating conidium of *C. peniophorae* (Fig. 4F) shows a vesicle (arrow) at what appears to be the distal end of a conidium and an irregular vestige of the parent wall at the proximal end. The latter vestige regularly is present at the attachment point, its form ranging from narrow, pointed to flap-like (as in Fig. 4F). The germ vesicle is in contact with a host basidium.

Habitat: On *Hyphoderma* (?) *argillaceum* (Bres.) Donk on decaying logs of *Populus trichocarpa*.

Collection examined: Canada: British Columbia; Delta, South Arm Marsh Wildlife Reserve, Ferry Rd., Ladner. 27 April 2001. A. & R. Bandoni 13041 (DAOM).

Most features of the specimen examined appeared to fit descriptions for the North American form of *C. peniophorae*. However, the closely situated pairs of conidia tend to remain attached to one another when released from the conidiogenous cells in most collections. In this collection, however, the conidia develop in close pairs, but generally separate after release.

ADDITIONAL COLLECTIONS

Two additional collections made by R. Cain were examined, but the material is scanty and not well preserved. Consequently, we have labeled them only as *Colacogloea* species. They are as follows:

Colacogloea sp. TRTC 31243. Fig. 4K, L; Fig. 5

This is a small collection with inconspicuous discolored areas inhabited by the *Colacogloea*. Few basidia (Fig. 5A-C) were found, and they were mostly incomplete. Basidiospores (Fig. 5D), equally infrequent, were 4.5–5.5 × 2–3 μm, reniform to suballantoid, germinating by repetition, by budding, or by a thin-walled vesicle (Fig. 5E). Hyphal cells (Fig. 5F), many closely resembling the colacosome-containing "gall" cells and hyphae of C. *peniophorae*, are present. Staining with WCR

did show colacosomes in such cells (Fig. 4L) although staining was weak. Among these cells are some with extremely thin walls protruding around organelles as shown in Fig. 5G (lower right). Basidiospore form (Fig. 5D) is similar to that in C. *peniophorae* but the spores are smaller; conidia of the *C. peniophorae* type were absent. Chlamydospores (Fig. 5H) were abundant; these were 5–6 μm in diam, the wall ca. 1 μm thick, the surface sometimes minutely roughened, the spores single or catenate. Their origin could not be found and they probably are extraneous.

Habitat: On "*Peniophora suboryanella* Rogers ined.", on *Abies balsamea*.

Collection examined: Canada: Ontario: Lake Timagami, Kokoko Bay, 27 Aug. 1946, Coll. R. F. Cain. (TRTC 31243).

Colacogloea sp. TRTC 31246. Fig. 4M, Fig. 6.

As with collection TRTC 31243, above, this collection is small and the mycoparasite is not abundant, although it is readily found in discolored spots on the host hymenium. The hyphae are 2–3 μm in diam., with clamp connections; they bear conidia which often arise initially, one each from the clamp apex and from the subtended cell apex (Fig. 6E). Development of this initial pair resembles that of conidia in most North American collections of *C. peniophorae*, but in that species, the pairs often adhere because of the basal wall vestiges. In TRTC 31246, successive conidia develop and adhere to one another, producing an elongate clump (Fig. 6G). The type of proliferation responsible for such clump formation is not known. Few basidia (Fig. 6A, B) were found, most of these were curved to coiled, ca. 24–26 × 3(–4) μm; epibasidia mostly short, conical. The basidiospores are 5–7 × 2–3 μm, allantoid in side view, peanut shaped when viewed dorsally or ventrally (Fig. 6C). The hyphae bear abundant vesiculose cells (Fig. 6I, J), many of which resemble those containing colacosomes in *C. peniophorae*. Stained with WCR, these cells did have colacosomes, but they did not stain intensely (Fig. 4M). Two swollen terminal vesicles (Fig. 6K) were seen in which chlamydospore-like structures had developed, but it is not clear that they were produced by the parasite. Subglobose *Tremella*-like basidiospores were also present; they were mostly 4 × 3–4 μm. The host fungus was in poor condition and was not identified.

Habitat: Intrahymenial in the basidiome of a resupinate species of Corticiaceae s. l. on *Populus* sp.

Specimen examined: Canada: Ontario; Renfrew Co., Chalk River, Petawawa Forest Experiment Station. 16 Oct. 1953. Coll. R. F. Cain (TRTC 31246).

DISCUSSION

Species of *Colacogloea* differ from many superficially similar mycoparasites in producing colacosomes at their host/parasite interfaces rather than haustoria. Colacosomes occur abundantly in hyphae contacting host hyphae or other

structures; hyphae in some such associations loosely coiled around one another (Bauer and Oberwinkler, 1990). The individual organelles are globose to ellipsoid, narrowed to a short point on the side toward the host, this narrowed portion (axial core) actually penetrating the host wall (Bauer & Oberwinkler, 1990). Colacosome size ranges from ca. 0.5 μm in diam. for globose forms to almost 1.0 μm in the longest dimension for ellipsoidal types (see Figs. 4 D,E for the latter). North American collections of *C. peniophorae,* currently considered conspecific with the European form, differ from the latter in having colacosomes in conspicuous cells referred to by Martin (1940) as 'gall-like' cells. Colacosomes also occur in narrow hyphae associated with host structures in the North American form of the species. Although small, the colacosomes of this form are visible (Fig. 4B-E) both within the enlarged cells and when they and their associated membranes are extruded from such cells. This form of *C. peniophorae* was examined here in order to determine whether features visible by light microscopy could be used in assigning unknown specimens lacking the "galls" to this genus without prior electron microscope study.

Illustrations from reported electron microscope observations (Oberwinkler and Bauer 1990; Oberwinkler et al. 1990, 1999) show direct contact of colacosomes and host protoplasts via areas of either very thin walls or no walls at the interface. Rupture of such cells and protoplast release might therefore be expected if pressure is applied to coverslips of microscope slide preparations of the *C. peniophorae* material. The technique appears to be of some value with relatively recent collection of this species, but yielded few such protoplasts in the two unnamed taxa with similar "gall" cells (Fig. 4 L, M) and in *C. allantospora* (Fig. 4J) which lacks the "gall" cells.

Colacogloea species thus far described are intrahymenial parasites mainly of species of *Hyphoderma* and *Tubulicrinis*. The type species, *C. peniophorae,* has also been reported on hosts in other genera, but it is unclear whether a single taxon or several distinct ones are involved in such reports. Nor is it certain that that the North American form is conspecific with the European *C. peniophorae.* Differences occur between the two in conidiogeny (Bandoni 1973; Oberwinkler et al. 1990), some features of the basidiome, and in the absence of the gall-like cells in the European form (Oberwinkler et al. 1999). These total differences suggest the probability that the North American and European forms are not conspecific. Conidial development in *Colacogloea* sp. 31246 (Fig. 6E-G) suggests a close relationship to the North American *C. peniophorae.*

Structures resembling tremelloid haustoria have been observed in specimens examined here (e.g. in Figs. 1J, 6D). Whether these function as haustoria, or are simply haustorium-like artifacts, is not known, and the production of functional tremelloid haustoria by *Colacogloea* species cannot yet be ruled out. In the case of the *C. allantospora* collection, *Spiculogloea* species are known to produce

tremelloid haustoria and the species present could have produced the structures seen. In specimens with two simple-pored "auricularioid" parasites such as this, the origin of such structures might be difficult to determine even in TEM micrographs.

In electron micrographs of *C. bispora* by Oberwinkler et al. (1999), some colacosome-containing cells have an extremely thin, lobed wall (ca. 0.1 μm thick). For example, in their Figures 2B and 2D, it can be seen that such thin-walled lobes mark the presence of internal colacosomes. A superficially similar cell, i.e., as seen by light microscopy, is shown here in Figure 5G of *Colacogloea* sp. 31243, the wall thin or absent, the margin lobed, and each lobe with an internal clear spot. The germination of basidiospores and conidia by an external vesicular extension (Figs. 1G, H; 2H, I; 4F-H), also thin-walled, the shape conforming with the host surface in some in some instances, e.g., Fig. 2I, 4M, suggests the possibility of this being a colacosome-containing vesicle. Colacosomes contact host protoplasts and presumably interact with the host (Oberwinkler and Bauer 1990) in gaining nutrients from the latter. Thus, early development of colacosomes , i.e., at germination of basidiospores and conidia, would be advantageous. Although germination by vesicle formation was observed in all species discussed here, the structures were examined only by light microscopy and it is not known whether colacosomes actually occur in the vesicles. The small refractive or dark spots visible in some instances (Figs 1G, 2I) might be colacosomes, but TEM study is required for their identification. Globose cells attached to host cystidia (Fig. 2E, 4I) could also represent similar development from the yeast states via direct transformation of the cell itself. There is a need for TEM studies of germinating *Colacogloea* basidiospores and conidia in the presence of host hyphae to determine the nature of the germ vesicles.

Key to taxa discussed

1. Basidiospores ovoid to reniform ... 2
1. Basidiospores allantoid; host = *Tubulicrinis calothrix* ... *C. allantospora*
   2. Intrahymenial in *Tubulicrinis* spp.; basidiospores 1. ovoid, 5–7 × 3–4 μm ... C. *bispora*
   2. Intrahymenial in other corticioid species ... 3
3. Conidia produced, each subtended by a clamp connection or arising as a pair from the clamp and its subtended cell ... 4
3. Conidia unknown; basidiospores ovoid to reniform, 4.5–5.5 × 2–3 μm ... *Colacogloea* sp. (31243)
   4. Hymenial conidia closely paired, originating one each from a clamp and its subtended cell ... 5
   4. Conidia borne singly, proliferation through the clamp (mainly European collections) ... C. *peniophorae*

5. Conidia paired or single when freed into the mucedinoid surface layer (mostly N. American) ... C. *peniophorae*
5. Conidia initially paired, adhering in complex columns ... *Colacogloea* sp. (31246)

Acknowledgments

Fig. 3 was photocopied from drawings by the late Roy F. Cain; the copy is presented without modification. We thank the Natural Sciences and Engineering Research Council of Canada for support of portions of this study. We thank Dr. Jean Mouchacca (Paris) for a loan of *Helicobasidium* collections examined in the initial part of this study but not cited in the paper. We also thank E. Jovel and A.-A. Bandoni for assistance with manuscript preparation.

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