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Two undescribed heterobasidiomycetes from Ontario

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Specimens of two heterobasidiomycetous species, collected in Ontario and studied respectively by H. S. Jackson and R. F. Cain, are described as new; they are *Platygloea jacksonii* and *Sigmogloea tremelloidea*. *P. jacksonii* is characterized by small basidia and basidiospores and by sympodially developing conidia. *Sigmogloea tremelloidea* is an anomalous taxon with cylindric, mostly transversely septate ("auricularioid") basidia, but some features suggest a possible relationship to the Tremellales.

Key Words——*Platygloea*; Platygloeales; *Sigmogloea*; taxonomy; Tremellales.

Among basidiomycetes collected by H. S. Jackson and R. F. Cain and now in the Cryptogamic Herbarium of the Royal Ontario Museum, are several undescribed auricularioid heterobasidiomycetous taxa. Included in this paper are two species, one collected by Jackson and referred to as a *Platygloea* J. Schröt., and a second collected by R. F. Cain and placed by him in *Helicobasidium* Pat. Cain's collection is here considered the basis for a new genus, *Sigmogloea*.

Materials and Methods

Microscope mounts were prepared using the reagents and stains described in Boidin (1958) and Hawksworth et al. (1995). The staining procedure described by Clémençon (1998) was used in an attempt to detect dolipore type septa.

All collections of newly described taxa are deposited in the Cryptogamic Herbarium of the Royal Ontario Museum (TRTC). Collection data are provided following species descriptions.

Taxonomy

Platygloea jacksonii Bandoni et J. C. Krug, sp. nov.

Fig. 1

Basidiomata nulla, in sporocarpii fungorum parasitica. Hyphae hyalinae, 2–4 μm crassae, fibulatae, sine haustoriis. Probasidia subglobosa vel ellipsoidea vel clavata, tenuiparietalia, 0.5 μm crasso, 5–12(–15) × 4–5 μm. Basidia 24–49 × 3.5–4.5 μm, tenuiparietalia, (3-) 4-cellulosa. Sterigmata 1–3 μm longa, basim versus 1.5–2 μm crassa, ad apicem ca. 1.0 μm crassa. Basidiosporae 4.5–5.5(–7) × 3.5–4.5 μm, ovoideae vel ellipsoideae, hyalinae. Cellulae conidiogenae primum probasidiis similes, demum apicem versus elongatae, 18–80 × 2–3 μm. Conidia apicalia, singulatim sympodialiter crescentes, globosa vel ellipsoidea, asperula, 5–6.5(–8) × 4–5 μm, pariete 1.0 μm crasso, hyalina. In sporocarpiis *Hyphodontii sambuci* crescentes.

Holotype: Canada: Ontario, York Co., North Toronto, Hogg's Hollow, 7 Sept. 1934; "associated with *Peniophora sambuci*" on *Rubus* stems; Coll. and Det. H. S. Jackson (TRTC 13692). **Paratype**: Ontario, Nipissing District, Lake Temagami, Bear Island; 24 Aug. 1939; associated with "*Peniophora*" on *Arctium* stems; Coll. and Det. H. S. Jackson (TRTC 14994).

Basidiome inconspicuous, growing within the host basidiocarp; hyphae thin-walled, 2–4 μm in diam, with frequent clamps, these single, paired at a single septum, or often in close sequential series of 2–3; hyphal anastomoses common, occurring through short lateral branches or occasionally through clamps of adjacent hyphae; fertile cells mostly single, scattered at first, later relatively abundant and then in clusters. Probasidia 5–12(–15) × 4–5 μm, subglobose to ellipsoid or clavate, the wall ca. 0.5 μm thick, smooth, plainly visible at the bases of most basidia (Figs. 1A, B). Basidia 24–49 μm long, the sporogenous part 3.5–4.5 μm in diam, cylindric, straight to curved, thin-walled, smooth, not cyanophilous, maturing (3-)4-celled; sterigmata up to 3 μm long, 1.5–2 μm wide basally, less than 1.0 μm wide elsewhere. Basidiospores (Fig. 1C) 4.5–5(–7) × 3.5–4.5 μm, ovoid to ellipsoidal, slightly flattened adaxially, apiculate, hyaline, smooth, thin-walled, the walls neither amyloid nor cyanophilous (with cotton blue); germination not seen. Conidiogenous cells first developing basally in the host basidiome, extending beyond the hymenial surface, later often present in groups or tufts, some originating near the host hymenial surface; individual conidiogenous cells mostly with a swollen basal portion (Fig. 1D) similar to the probasidium in form and dimensions, the entire conidiogenous cell 18–80 μm long, 2–3 μm wide above the basal swelling, pointed apically; conidia blas-

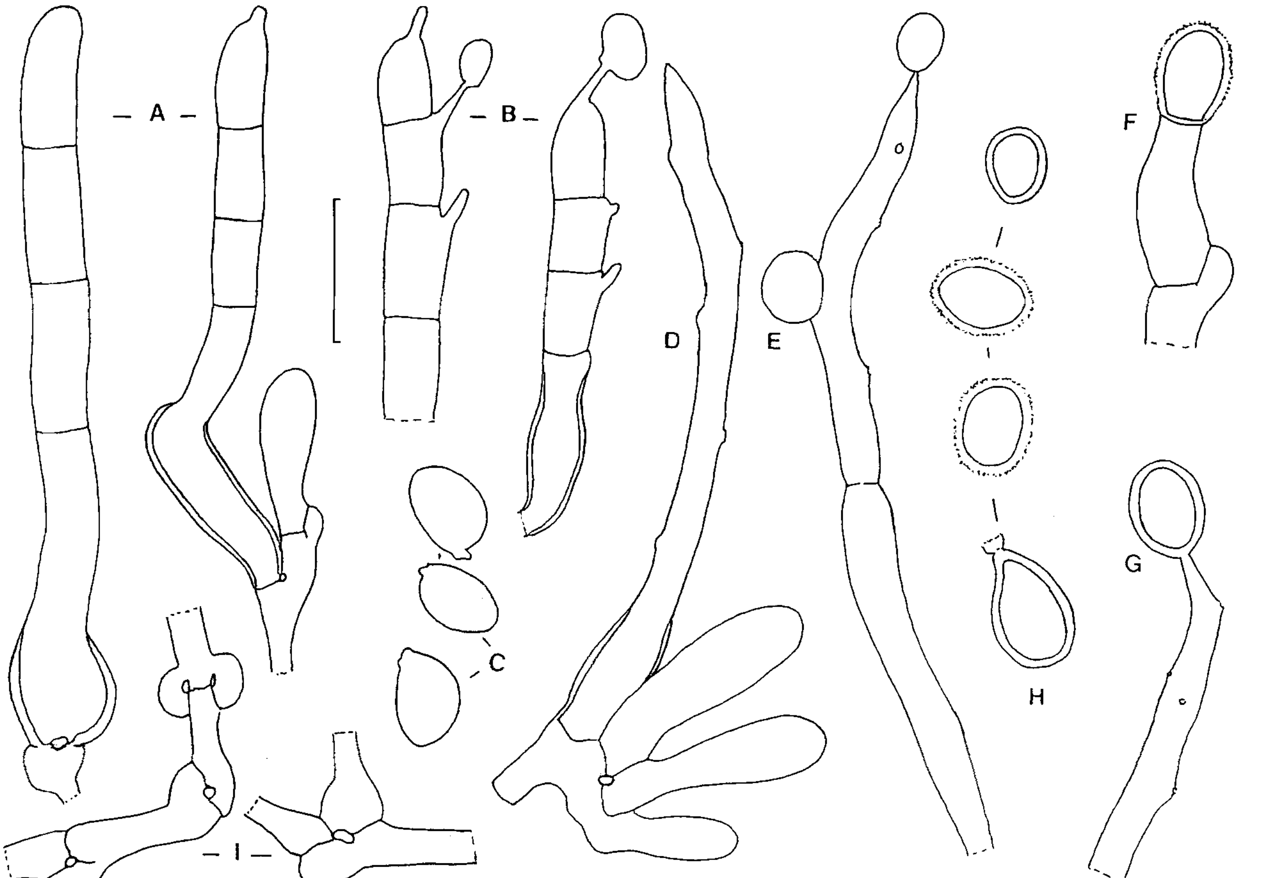

Fig. 1. A–I, *Platygloea jacksonii* (from coll. TRTC 13692). A, B, young and mature basidia with developing sterigmata and basidiospores (note thick-walled probasidia). C, basidiospores. D, E, conidiogenous cells (note a thick-walled probasidium-like base in D) with small raised scars marking points of conidial production. F, single conidium on nonproliferating conidiogenous cell. G, apex of conidiogenous cell with single attached conidium. H, mature conidia with and without asperulate walls. I, hyphae with clamps, the uppermost paired at a septum. (Bar=10 μm).

tic, developing sympodially, a single conidium formed at each locus, the sporogenous cell often bent slightly at each locus and the latter marked by a scar after secession. Conidia (Fig. 1H) globose or subglobose to ellipsoidal or ovoid, 5–6.5(–8)×4–5 μm, the mature wall to ca. 1.0 μm thick, hyaline, the surface typically asperulate, usually with an inconspicuous attachment scar, sometimes with a short wall vestige at the attachment point; occasional conidia broadly attached (Figs. 1E, F), these with a truncate attachment scar, but otherwise similar to the above.

Habitat: Growing in basidiocarps of *Hyphodontia sambuci* (Pers.: Fr.) J. Erikss. on *Arctium* and *Rubus* spp.

Collections of this species were labelled "*Platygloea microspora*" by Jackson, but that combination was used by McNabb (1965) for another species, requiring selection of a new epithet here. The presence of *P. jacksonii* does not initially cause conspicuous damage to the host, the only visible alteration in its hymenium being the presence of scattered inconspicuous conidiogenous cells. Where more abundant growth of the *Platygloea* has occurred, however, staining of host cells (KOH-Phloxine-Congo Red) suggests extensive killing by the parasite. Haustoria were not found.

The conidia predominantly develop from the narrowed apex of the conidiogenous cell (Figs. 1E, G), but occasional individuals of similar morphology are broadly attached to determinate sporogenous cell apices (Fig. 1F), or are broadly attached on the sympodially developing conidiogenous cells (Fig. 1E, central conidium). The walls of such conidia are of similar thickness to conidia produced on the pointed apices of conidiogenous cells; their surface is also asperulate, but the base is truncate rather than pointed. Infrequent short chains of cells, possibly functioning as conidia, are present in the host hymenium. These might also belong to the *Platygloea*, but this could not be established with certainty.

Basidia of *P. jacksonii* resemble those of *Platygloea disciformis* (Fr.) Neuh. in having a conspicuous probasidial structure, but other features do not suggest a close relationship. The genera of Platygloeoid intrahymenial mycoparasites were briefly summarized by Langer and Oberwinkler (1998), who discussed the occurrence of *Spiculogloea occulta* P. Roberts, an intrahymenial parasite of *Hyphoderma argillaceum* (Bres.) Donk and *Hyphodontia sambuci*. *Spiculogloea occulta* lacks the probasidial structure found in *P. jacksonii*, and the walls of its basidia and basidiospores are minutely spiculose and cyanophilous (Roberts, 1997); those in *P. jacksonii* are neither positively cyanophilous nor thick-walled and roughened, although the mature conidial surface is asperulate.

As noted above, *P. jacksonii* does not appear to be closely related to *P. disciformis*. On the basis of what is known at this time, the species is equally distant from the other genera of intrahymenial parasites summarized by Langer and Oberwinkler (1998). Tremelloid haustoria are found in the species of *Occultifur* Oberw., *Spiculogloea* P. Roberts, and *Zygogloea* P. Roberts, but they were not seen in *P. jacksonii*. Haustorial branches often are obscure and are sometimes limited to the host-parasite interface; therefore, they might have been overlooked in our study of *P. jacksonii*. Hyphae of *P. jacksonii* have abundant clamps that sometimes are paired at a septum, features which distinguish it from *Phragmoxenidium* Oberw., and its hyphae lack the peculiar gall-like cells characteristic of *Colacogloea peniophorae* (Bourd. et Galz.) Oberw. et Bandoni. *Platygloea* long contained a heterogeneous assortment of species, although some clearly distinct taxa had been placed in other genera by Oberwinkler (1990). Following Donk (1966), some unrelated species were transferred to *Achroomyces* Bonord. by Hauerslev (1993) and Wojewoda (1981), thus making the latter genus equally heterogeneous. The type species of *Achroomyces, A. tumidus* Bonord., was believed by Donk to be identical to *P. disciformis*. However, Bonorden gave *Betula* as the substrate for his species; *P. disciformis* is common on fallen branches of *Tilia* in Europe and Japan, but it has not been reported on *Betula*. Even if one accepts Donk's interpretation of the literature (Bonorden's specimens have not been found and his illustrations are not clearly basidiomycetous), *Achroomyces* would be inappropriate for most of the *Platygloea* spp. (Aoki et al., 1986; Oberwinkler, 1990). We have therefore elected to include this species in *Platygloea* until molecular data and septal pore ultrastructure can be studied, and until clear generic limits are established for fungi now included in the Platygloeales and Atractiellales.

Conidia resembling those described and illustrated here for *P. jacksonii* were reported by Hauerslev (1987) in *Hyphoderma sambuci* (Pers.) Jül. [=*Hyphodontia sambuci* (Pers.: Fr.) J. Erikss.]. Hauerslev considered them to be chlamydospores produced by the *Hyphodontia*, but their resemblance to those of *P. jacksonii* suggests the possibility that a similar species is present in the Danish material. The evidence for production by *P. jacksonii* rather than the *Hyphodontia* includes closely similar hyphal dimensions and branching patterns, and form and size of young conidiogenous cells and probasidia. Direct connections between conidiogenous cells and basidia were not seen, however.

Sigmogloea Bandoni et J. C. Krug, gen. nov.

Genus fungorum Heterobasidiomycetorum. Basidiomata gelatinosa, tenuia, effusa; hyphae hyalinae, tenuiparietales, fibulatae, haustoriis obscuris, infrequenter praeditae; probasidia primum ellipsoidea vel pyriformia, demum cylindracea, sigmoidea, (3-)4-cellulosa; epibasidia cylindracea vel inflata; basidiosporae leves, ovoideae vel ellipsoideae, hyalinae, repetitione germinantes; conidia cellulis brevibus hyphoideis exorientia, singularia vel papilionacea, plerumque conjungentia.

Basidiomata gelatinous, thin, effused over the host; hyphae hyaline, thin-walled, with clamps and with infrequent, inconspicuous haustoria; probasidia at first ellipsoid to obovoid, then pyriform, sometimes umbonate, elongating, then bent cylindrical, mostly sigmoid, (3-)4-celled; epibasidia cylindric to inflated, the apices truncate after spore release; basidiospores ovoid to ellipsoidal, smooth, hyaline, inamyloid, not cyanophilous; germination by repetition; conidia budded from short hyphal cells, single or more commonly paired and conjugating before release, germination not seen.

Typus generis: *Sigmogloea tremelloidea* Bandoni et J. C. Krug.

Etymology: Greek, sigma = 18th letter of Greek alphabet (basidial shape), and *gloiôs* = sticky substance, glue-like.

Sigmogloea tremelloidea Bandoni et J. C. Krug, sp. nov. Figs. 2, 3

Basidiomata minuta, albida, tenuia, effusa, gelatinosa, parasitica; hyphae hyalinae, tenuiparietales, fibulatae, ramis haustoriorum inconspicuis infrequenter praeditae; probasidia primum obovoidea vel pyriformia, demum cylindracea, sigmoidea; basidia 20–30 × 6–8 μm, plerumque transversaliter septata, (3-)4-cellulosa; epibasidia 5–25 × 1–3.5 μm, cylindracea vel inflata; basidiosporae 9–12 × 4.5–6 μm, ovoideae vel ellipsoideae, leviter curvatae, hyalinae; conidia inconspicua, basidiomatibus consociata, plerumque cellulis conidiogenis brevibus hypharum exorientia, interdum ad apicem cellulae hypharum vel cellulis fibulae hypharum exorientia, hyalina, 4.5–6 × 3–3.5 μm, plerumque conjungentia, anguste obovoidea, demum papilionacea. In ascomatibus *Coniochaetae* parasitica.

Holotype: Canada: Ontario, Ontario Co., south of Uxbridge, 10 June 1958; overgrowing perithecia of *Coniochaeta* sp. beneath the bark of a *Pinus strobus* L. stump, the latter cut 2–3 yr prior to the collection date; Coll. R. F. Cain (TRTC 33710).

Basidiome white, effused, very soft gelatinous, covering the host perithecia, drying to a vernicose film; in section, 20–65 μm thick, neither hyphae nor basidia compactly arranged, but basidia numerous in spots. Hyphae 2–3 μm in diam, hyaline, thin-walled, with clamps; inconspicuous and infrequent haustorial branches present in host/parasite interface. Probasidia (Fig. 3A) initially obovoid to pyriform, sometimes with a thickened umbo, probasidium elongating to curved cylindric, the umbo, if present, displaced laterally and seated on the outer curvature (Fig. 3A, arrows) of probasidia; mature basidia

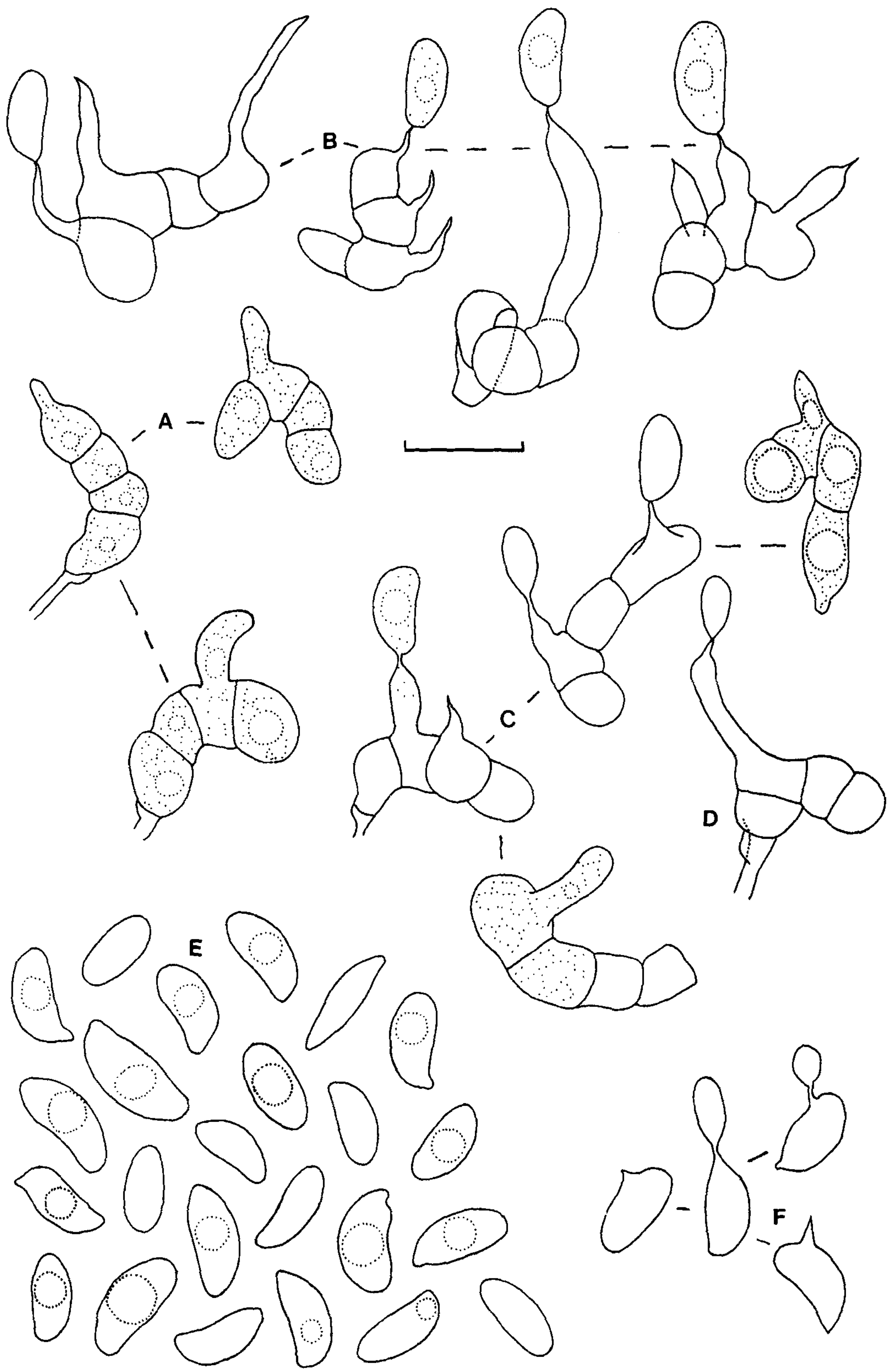

Fig. 2. A–F, *Sigmogloea tremelloidea* (from coll. TRTC 33710; figures drawn by R. F. Cain). A, basidia, each with a single developing epibasidium. B, C, basidia with developing epibasidia and basidiospores. D, mature basidium (note orientation of lower two septa). E, basidiospores. F, basidiospores germinating by repetition. (Bar=ca. 10 μm)

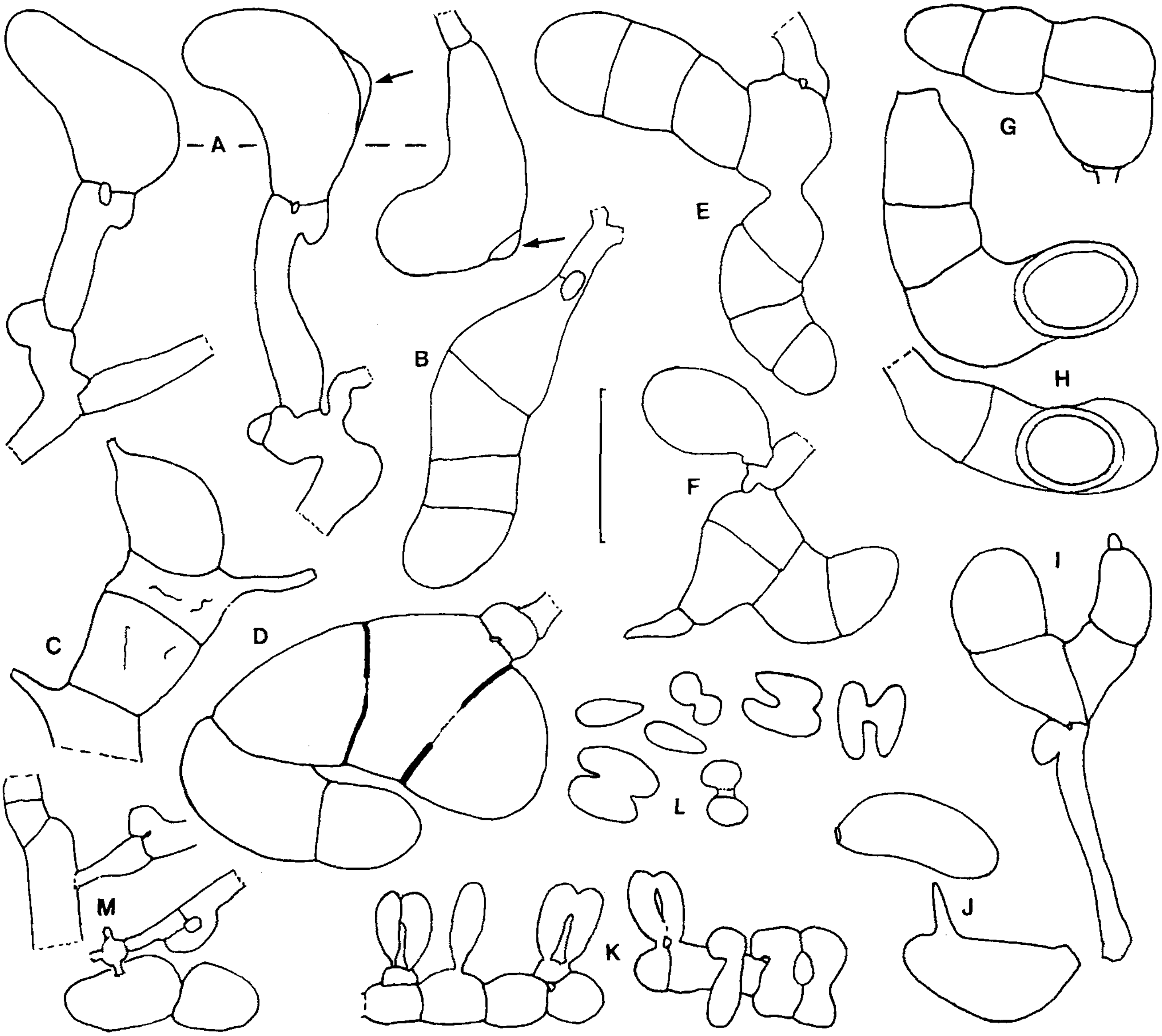

Fig. 3. A–M, *Sigmogloea tremelloidea* (from coll. TRTC 33710; drawn by R. J. B.). A, young probasidia, two of which have thickened umbos (arrows). B, mature sigmoid probasidium. C, spent basidium, the epibasidia of which have truncate (apparently asterigmate) apices. D, mature probasidium, two crosswalls of which are thickened and appear to be incomplete. E, paired mature probasidia, the lower one arising from the lowest cell of the larger basidium. F, G, two probasidia, each with the basal septum at right angles to that immediately distal to it. H, two mature probasidia, each containing a large chlamydospore. I, mature probasidium, the attachment suggesting bidirectional growth from a central cell. J, basidiospores, germination in the lowermost possibly repetitive. K, conidiogenous cells bearing both single and paired blastic conidia. L, conidia. M, haustorial branches attached to host cells. (Bar = 10 μm)

mostly sigmoid, (3-)4-celled (Figs. 2A, B; 3B). Mature basidia 20–30 × 6–8 μm, the base tapering downward or rounded below, rounded distally, most basidia bent near the basal cell apex, the remainder of the basidium straight to spirally curved, the curvatures of adjacent basidia not similarly oriented with respect to the basidiome surface, septa typically transverse, but one septum sometimes at right angles to other septa (Figs. 3F, G); infrequent basidia occur in tandem (Fig. 3E), or have internal chlamydospores (Fig. 3H). Epibasidia 5–25 × 1–3.5 μm, cylindric or irregularly inflated, mostly truncate apically. Basidiospores (Figs. 2E, 3J) 9–12 × 4.5–6 μm, most with a blunt, flat apiculus, rounded distally, ovoid to ellipsoid or allantoid, the adaxial surface flat to slightly curved, hyaline, the wall neither amyloid nor cyanophilous; germination possibly by repetition (Figs. 2F, 3J). *Conidia usually present in basidiomes,* mostly borne on short conidiogenous cells arising from hyphae (Fig. 3K), but some arising directly from clamps or from apices of hyphal cells; conidia (Fig. 3L) narrowly obovoid, hyaline, 4.5–6 × 3–3.5 μm, most closely paired and conjugating before release and then H-shaped, those developing singly presumably are monokaryotic when released; germination not seen.

Habitat: Overgrowing perithecia of *Coniochaeta* sp. beneath the loosened bark of a *Pinus strobus* stump.

An unusual feature of this taxon is the remarkable variability in basidial form and structure (Figs. 2, 3), including variations in septal arrangement (Figs. 2D, 3F, G), and production of incomplete septa (Fig. 3D) and chlamydospores in some basidia (Fig. 3H). Although our observations do not suggest abstriction of basidiospores, possible evidence of basidiospore germination by abstricted repetitive spores was observed by Cain and by us.

Because of the related host fungi, we first compared *S. tremelloidea* with descriptions and material of *Kriegsteinera lasiosphaeriae* Pouzar (Pouzar, 1987) (=*Jacobia conspicua* Arnaud; Arnaud, 1951), growing on perithecia of *Lasiosphaeria ovina* (Pers.: Fr.) Ces. et De Not. However, we could find little resemblance between the two taxa and there are numerous noteworthy differences. The minute cylindrical basidia (13–18 μm long) of Pouzar's species are borne in groups on massive basidiophores. An obscure anamorph consists of percurrently proliferating conidiogenous cells bearing successive conidia, with clamp vestiges marking sites of conidial development. Pouzar also reported repeated spore production by basidia cells in *K. lasiosphaeriae*, and our observations suggest budding of basidiospores while still enclosed in a slime droplet associated with the basidia.

Like *Atractocolax pulvinatus* R. Kirschner, R. Bauer et Oberw. (Kirschner et al., 1999), *S. tremelloidea* developed beneath the bark in association with obvious insect (bark beetle) activity. Basidiospores of *A. pulvinatus* germinate by budding, and the buds may conjugate to yield H-shaped cells. Although the conjugated yeast cells resemble conidia of *S. tremelloidea*, the latter conjugate while still attached to their parent cells.

Basidiospores are statismospores in both *A. pulvinatus* and *K. lasiosphaeriae*; our observations indicate similar spore release in *S. tremelloidea*. However, Cain's drawings (Figs. 2B, D) suggest abstriction. We found only broad attachment points on basidiospores (Fig. 3F) and what appear to be asterigmate epibasidial tips (Fig. 3C). Additional observations on fresh collections are therefore necessary to determine whether the basidiospores are ballistospores or statismospores, and to verify production of ballistic repetitive spores. *Atractocolax pulvinatus* has been shown to be transported by beetles, and this may also be true for *S. tremelloidea*.

Sigmogloea tremelloidea has "auricularioid" basidia superficially resembling those seen in species of *Platygloea* (s. lat.) and *Helicobasidium*, but they are unusual in several respects, i.e., occasional orientation of one septum at right angles to others (Figs. 3F, G), occasional partial septation (Fig. 3D), infrequent connate basidia (Fig. 3E) and rare Y-shaped basidia (Fig. 3I), formation of internal chlamydospores in some basidia, and frequent presence of a thickened umbo in the wall (Fig. 3A). This umbo probably develops terminally on very young probasidia, then is laterally displaced by cylindric extension of the developing basidium. Similar thick-walled umbos are characteristic of certain *Tremella* spp., especially *Tremella moriformis* (Fr.) Berk. and *T. indecorata* Sommerf.: Fr., species thought to be closely related to those of *Sirobasidium* Lagerh. et Pat. (Bandoni, 1984). That is, the umbo probably represents a vestige of siroidal basidial development from contiguous hyphal cells, as in *Sirobasidium* spp. In *S. tremelloidea*, the upper cylindric part of the basidium develops as a comparatively broad tubular structure originating to one side of the umbo or at an angle to the probasidial apex in the absence of the umbo. This angle and further curvature above the center of the basidium results in the sigmoid shape. The umbo, arrangement of the cells in some basidia, conidial development, and haustorial branches conceivably indicate a relationship to the Tremellales s. str. rather than the Platygloeales or Atractiellales. Conidial form and development is similar to that in *Trimorphomyces papilionaceus* Bandoni et Oberw. (Oberwinkler and Bandoni, 1983) or in species of *Syzygospora* G. W. Martin.. The conjugating pairs do not form thick walled "zygoconidia" after conjugating, however, but retain the form of the original conjugating cells, as in *T. papilionaceus*. Some conidia (Fig. 3K) develop singly rather than in conjugating pairs.

Because of the narrow hyphae, staining with Congo Red-SDS (Clémençon, 1998) did not prove conclusive in determining the type of septal pores, but occasional septa at basidial bases were suggestive of dolipores when stained in this way. TEM observations and/or molecular data are therefore needed to determine where this species should be classified.

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