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On some species of *Mycogloea*

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Three new species of *Mycogloea* are described and illustrated; they are: *M. amethystina* from Canada, *M. nipponica*, from Japan, and *M. bullata* from Thailand. *Mycogloea tahitiensis* is reported from Japan and additional undescribed taxa in the genus are briefly noted. Some characteristics of the genus are discussed, and a key is provided for six species recognized at this time.

Key Words——*Mycogloea*; *Platygloea*; Platygloeaceae; Platygloeales; taxonomy.

Olive (1950) erected the genus *Mycogloea* which he based upon *M. carnosa* L.S. Olive; he later (Olive, 1958) described a second species, *M. tahitiensis* L.S. Olive. Two species, *M. macrospora* (Berk. & Br.) McNabb (McNabb, 1965), and *M. orthospora* McNabb ex Dingley (Dingley, 1989) have since been reported. Although few species are known, and those have been rarely reported, there is a possibility that additional taxa have been described but were incorrectly placed, as with the last two named above. Also, in spite of the absence of reports, *Mycogloea* spp. are frequently encountered. Three new taxa are described here and the known range of *M. tahitiensis* is extended to Japan; additional collections of unnamed taxa also are noted briefly.

Materials and Methods

Slides were prepared from thin sections of dried material cut with a razor blade, the process being carried out under low magnification of a dissecting microscope. Sections were mounted in water, or in 3% KOH with a drop of Phloxine solution and/or an equal amount of Congo Red solution, the solutions prepared as indicated by Boidin (1958), Hawksworth et al. (1995) and Hjortstam et al. (1987). Observations on basidiospore production in several species were carried out on MYPT (Bandoni, 1972). Color names followed by (R) are from Ridgway (1912). Herbaria in which collections are deposited are indicated following descriptions of each species; abbreviations used for herbarium names are from Holmgren et al. (1990), with the exception of the National Institute of Genetic Engineering and Biotechnology Herbarium, Bangkok, which is listed as NCGEB.

The terminology used here differs from that of Olive (1950), McNabb (1965), and Dingley (1989). In this study, "probasidium" is used instead of Olive's term, "sub-basidial" cell as, although the basidia are deciduous, the probasidial structure does not appear to differ from that in other auricularioid fungi. I have used "basidium" in the place of "metabasidium," as the latter seems superfluous and does not always refer to homologous structures. Sterile hyphal elements in the hymenium were called "paraphyses" by Olive and "dikaryophyses" by McNabb and Dingley; these are now generally referred to as "hyphidia" (Hawksworth et al., 1995).

Descriptions

Mycogloea amethystina Bandoni, sp. nov. Fig. 1 A–G

Gelatinosa, vinacea vel amethystina, tuberculata, usque ad 3.5 mm diam, 1.5 mm alta, sicco inconspicua. Hyphae (1.5–)2–3.5(–7)μm diam, sine fibulis. Probasidia clavata vel cylindracea; basidia 36–54 × 3–4(–5)μm, cylindracea, 4-cellularia, decidua. Sporidia ellipsoidea vel fusoidea, 6–13 × 2–5 μm. In ramo demortuo Sambuci spp. crescent, stromata Diaporthe sociabilis Nit. consociata. (TYPE: on dead branches of *Sambucus racemosa* var. *pubens* Michx, University of British Columbia, Vancouver, South Campus, 26 Mar. 1988. Coll. R. Bandoni and Lee Hanson, no. 7984, DAOM 225536).

Basidiomata erumpent, to 3.5 mm in diam and 1.5 mm high, at first tuberculate to hemispheric, smooth to irregularly ridged, gelatinous, Amethyst to Hydrangea Pink, Pale Vinaceous or Vinaceous (R), rupturing apically along one or two lines at maturity, often splitting in a roughly stellate pattern, the edges recurving, exposing the inner gelatinous matrix with its abundant detached basidia; basidiome becoming cupulate as the matrix dissolves and basidia are released; dried basidiomata horny, faintly yellow, retracted into the openings in the bark and inconspicuous. Context hyphae (1.5–)2–3.5 μm in diam, without clamps (large hyphae, 5–7 μm in diam, and narrow hyphae, 1–1.5 μm, scattered in basidiomes, but their relationship to the *Mycogloea* not known); fertile hyphae forming a dense palisade-like zone of basidiogenous cells (probasidia), these producing terminal probasidia, then proliferating laterally immediately below the latter, extending only a short distance before producing another probasidium and lateral extension, often step-like, each step bearing either a probasidium or the

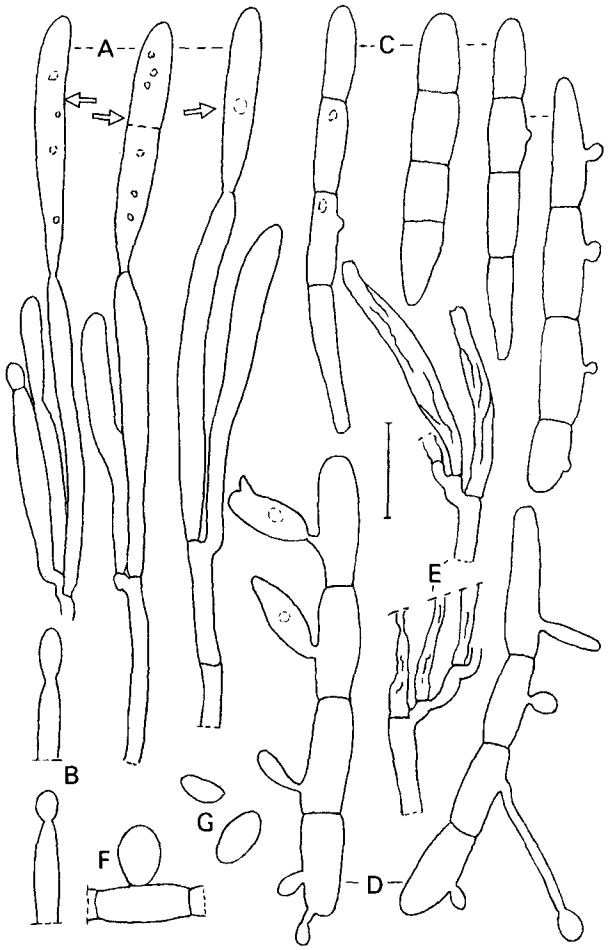

Fig. 1. *Mycogloea amethystina* (from 7984, TYPE).
A. Fertile hyphae and probasidia with young developing basidia (arrows). B. Two probasidia with bud-like basidial initials. C. Mature, detached basidia. D. Basidia producing spores. E. Fertile hyphae showing proliferation and resulting step-like levels with spent probasidial cells. F. Single basidial cell with developing spore. G. Basidiospores after release. Bar = 10 μm. (Figs. D, F, G, from material streaked on MYPT and incubated at 15°C.)

emptied vestige of one, sometimes extending for some distance, then producing more probasidia. Probasidia 34–50 μm long, 2–3 μm apically, narrowly clavate to subcylindric, mostly tapered to 1.5–2 μm basally, sometimes constricted at the base or above it; each probasidium giving rise to a single basidium apically. Hyphidia sparse, 1–2.5 μm in diam, septate, infrequently branched, straight or spirally coiled. Basidium initially bud-like, extending, typically narrowly clavate, 36–54 μm long, 3–4(–5) μm in diam near the apex and 1.5–2 μm in diam basally, some released before septa appear, the emptied basidiogenous cell collapsing and remaining on the fertile hypha; mature, freed basidia straight or often curved, (3–)4-celled, each cell budding at one locus or infrequently two, the buds sessile, borne on short sterigma-like tubes, or sterigmata sometimes tubular and up to 15 × 1–1.5 μm in diam, each tipped by a sporidium. Sporidia 6–13 × 2–5 μm, ellipsoid to almost fusiform; ballistospores not seen. Haploid phase a yeast.

Habitat: Growing on stromata of *Diaporthe sociabilis* Nit. on dead branches of *Sambucus* spp. In addition to the type, noted above, two additional collections were made, as follows: 7986 (UBC), collected at the same time and locality as the type; R.J. and A.-A. Bandoni 8163 (UBC), California, Humboldt Co., Hgwy 1, 2 mi. so. of Van Damm State Park, on *Sambucus* sp., associated with perithecia of *D. sociabilis*, Feb. 28, 1989.

Cross walls in some stained preparations (Congo Red-KOH) of the type collection resembled dolipore septa, although such structures would not be expected here. The fertile hyphae proliferate in the same step-wise arrangement as the fertile hyphae in *Naiadella fluitans* Marvanová & Bandoni (Marvanová and Bandoni, 1987), a basidiomycetous anamorph of unknown relationship, and the probasidia are of similar form to the monoblastic conidiogenous cells in that species. Also, an inconspicuous frill is sometimes present at the bases of the *Mycogloea* basidia, and on bases of conidia in *N. fluitans*. The conidiogenous cell in *N. fluitans*, and the probasidium in the *Mycogloea* give rise to a single disseminule, emptying during the process and then collapsing, the empty wall remaining attached below. *Naiaclella fluitans* is a probable mycoparasite (Marvanová and Bandoni, 1987), the hyphae bearing *Tremella*-like haustorial structures. Haustorial branches were not found in *M. amethystina*, but they might be produced only in the dense interface with the associated pyrenomycete.

Basal portions of the basidiomata often have dematiaceous structures incorporated which may be vestiges of host perithecia. Foreign hyphae were found growing through the basidiomata, as were extremely narrow (?Actinomycete) filaments. The California collection, which did not differ significantly from the British Columbia material, occurred on a decorticate branch of a *Sambucus* sp., developing on stromata of *D. sociabilis*. The basal layer of hyphae was somewhat more compact than that in the B.C. collections, the fertile hyphae parallel and closely appressed. But basidial development was as in the type collection; the anomalous hyphae present in B.C. collections also are present in this California material. Two ballistospores were found in the hymenium and these resembled basidiospores illustrated for other species of *Mycogloea*. They were ovoid, 9–10 × 5–5.5 μm.

Mycogloea nipponica Bandoni, sp. nov. Fig. 2 A–G

Basidiomata tuberculata, orbiculata, usque ad 8 mm in diam, gelatinosa, flava; sicco discoidea, fulva. Hyphae compactae, 2–4 μm diam, efibulatae. Hyphidia septata, 1.2 μm diam. Probasidia clavata, (6–)15–25 × 2.5–4 μm; basidia angusta clavata, 40–51 × 3–4.5 μm, 4-cellularia; sterigmata 4–5 × 1.5–2 μm. Basidiosporae (5–)7–10 × 3.5–4.5 μm, ovoideae. Truncicola, cum stromata ascomycetum concrescens. (TYPE: Japan, Kagoshima Pref., Yakushima, Botanical Garden, 8 June 1990, A.-A. and R. Bandoni 8992, TNS).

Basidiomata superficial, tuberculate at first,

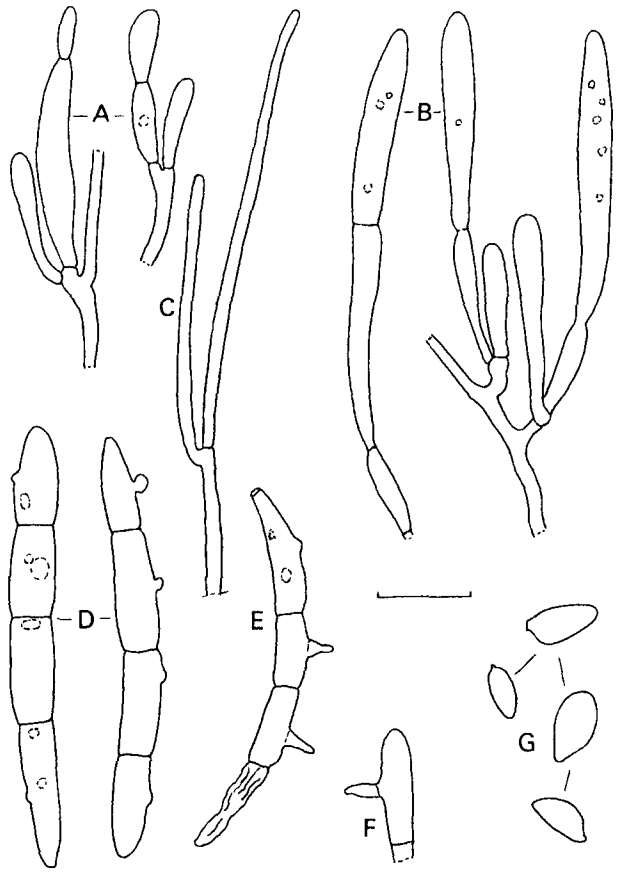

Fig. 2. *Mycogloea nipponica* (From 8992, TYPE).
A, B. Fertile hyphae, probasidia, and developing basidia. C. Hyphidium. D. Two mature (released) basidia, several cells of which have commenced spore production. E. Basidium, the terminal cell (below) of which has produced a spore and collapsed. F. Single cell with sterigma (note septum present at the base of this structure and bases of the two sterigmata in E). G. Basidiospores. Bar = 10 μm.

anastomosing, spreading, up to 8 mm in diam, the margins remaining rounded, abrupt, the surface with lines suggesting points of anastomosis, attached to the edge to the substrate but not strongly so, gelatinous, yellow; discoid, horny yellowish brown and inconspicuous when dry. In section, ca. 0.5–1.0 mm thick, consisting of a compact basal layer of irregularly arranged hyphae above which are one or more zones of hyphae that are predominantly parallel to one another and at right angles to the substratum and surface, the zonate appearance apparently arising from development of successive hymenial zones. Hyphae 2–4 μm in diam, the walls mostly thickened, sometimes exceeding 1 μm, branched, with frequent septa, without clamps. Hymenium composed of abundant narrow hyphidia interspersed with probasidia and basidia, the hyphidia 1.5–2.5 μm in diam, infrequently septate and branched, the apices exceeding the developing basidia and typically curved. Probasidia mostly clavate, the size variable, (6–)15–25 × 2.5–4 μm, each giving rise to a single basidium apically, then collapsing. Basidia at first bud-like, elongating, 40–51 × 3–4.5 μm, most narrowly clavate and widest near the apex, sometimes at the second cell, tapered below, often slightly curved, becoming 4-celled. Mature basidial cells producing short sterigmata, 4–5 × 1.5–2 μm, slightly swollen above the base and tapered from there to the apex, with a basal septum and plasmatic after spore release, the producing cell then empty. Basidiospores ovoid, the apiculus prominent to inconspicuous but with a conspicuous refractile point in either case, (5–)7–10 × 3.5–4.5 μm; germination not seen.

Habitat: On a thin stromatic layer, possibly belonging to an associated (?)*Hypoxylon* sp. on the outer surface of decaying bark; stromata of a *Diatrype* also closely situated.

The species resembles *M. tahitiensis* in general appearance, in lacking clamp connections, and in the form of the hyphidia. It differs from that species in basidial and basidiospore dimensions, and in the form of the latter cells.

Mycogloea bullatospora Bandoni, sp. nov. Fig. 3 A–H

Basidiomata pustulata, ad 1 mm diam, gelatinosa, plurimum punicea vel pallide ochracea, sicco inconspicua. Probasidia clavata, 27–40 × 5–6 μm; basidia (30–) 38–51 × 5–6(–7) μm, angusta clavata vel cylindracea, arcuata, 4-cellularia. Basidiosporae 7–9 × 6–8 μm, bullatae. In ramo frondoso demortuo crescent, cum ascocarpo Rhytidhysterii sp. consociata. (TYPE: Thailand: Phang-Nga Prov., Phang-Nga Summit, 13 Sept. 1993, on fallen branch, R. J. and A.-A. Bandoni, and T. Flegel, 10030, Herb. of N.C.G.E.B, Bangkok; a portion also deposited in UBC).

Basidiomata pustulate, < 1 mm in diam, most arising around the margins or on apothecia of an associated fungus, gelatinous, pink to pale salmon, ochraceous or gray; drying horny brown, inconspicuous. In section, the basal hyphae irregular, 2–4 μm in diam, with clamp connections. Hymenium of radiating hyphae bearing abundant developing probasidia and vestiges thereof; probasidia 27–40 × 5–6 μm, mostly in clusters of 2–3, clavate, sometimes curved or bent, with prominent oil guttules, giving rise to a single apical basidium; empty and collapsing after release of the basidia but remaining conspicuous. Basidia (30–)38–51 × 5–6(–7) μm, narrowly clavate or subcylindric to fusiform, commonly tapered at both ends, the apex rounded, the base truncate, 4-celled at maturity, each cell with a one or more large oil guttules at maturity; sterigmata 4–6 × 1.5–2 μm, tapering above the middle. Basidiospores 7–9 × 6–8 μm bullate, flattened abaxially, the prominent apiculus opposite the flattened zone; germination by repetition. Budding cells in the hymenium 2.5–6 × 2–4 μm, globose to ellipsoid, the budding locus small but plainly visible and apiculus like.

Habitat: Associated with apothecia of a *Rhytidhysteron* sp. on a recently fallen angiosperm branch.

The relationship to the associated apotheciate fungus is not known, but mycoparasitism is possible. The species differs from all others thus far described in the

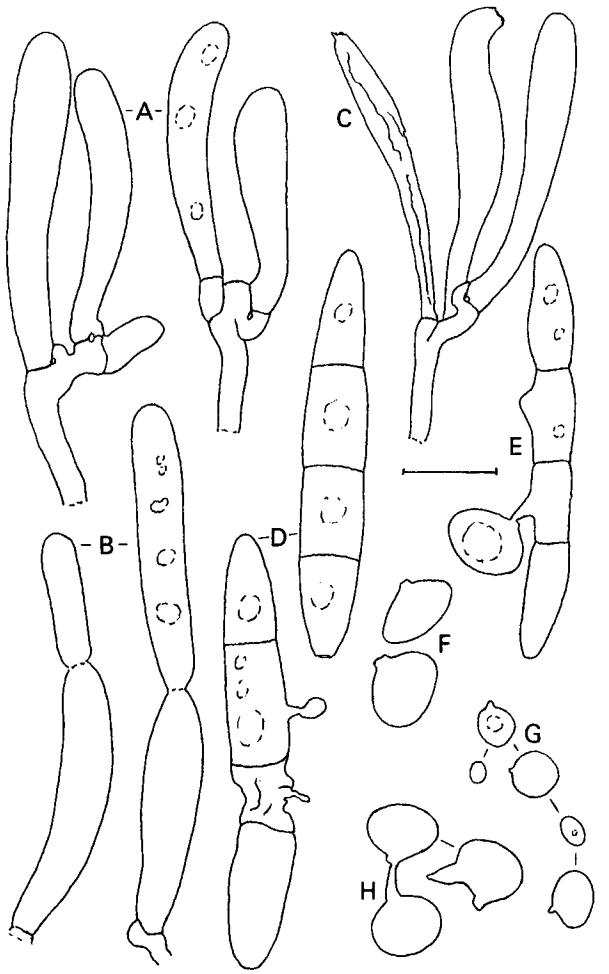

Fig. 3. *Mycogloea bullatospora* (from 10030, TYPE). A. Fertile hyphae with clamps and probasidia. B. Two mature probasidia with developing basidia. C. Fertile hypha bearing two spent probasidia and a mature probasidium. D. Two basidia, the uppermost prior to spore initiation, that on the lower left with one empty, partially collapsed cell, and a second cell that bears a developing spore. E. Sporulating basidium with attached spore (probable ballistospore). F. Basidiospores (ballistospores). G. Budding cells from surface of basidiome. H. Germination by repetition. Note the large oil guttules present in all structures with cytoplasm. Bar = 10 μm.

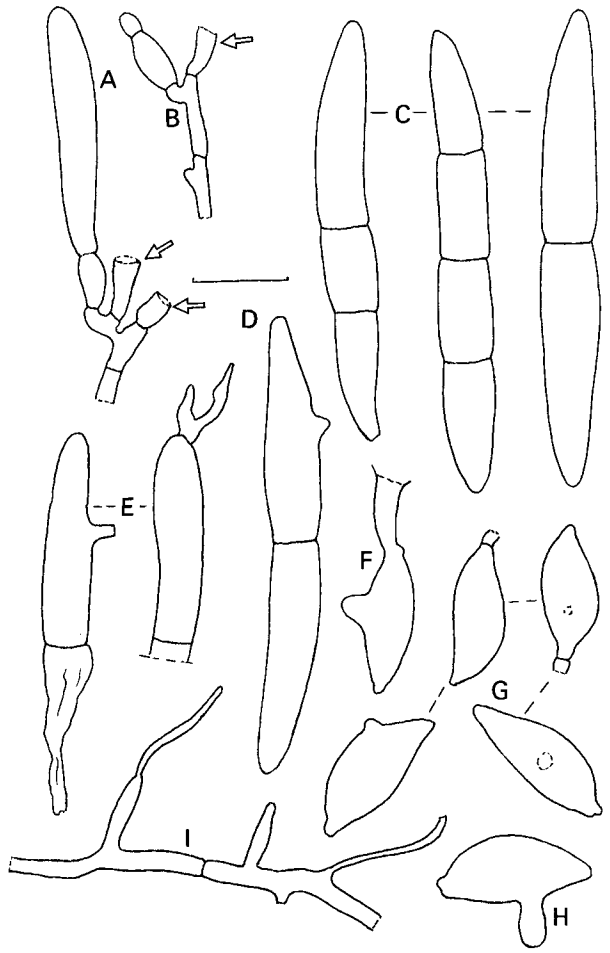

Fig. 4. *Mycogloea tahitiensis* (from RJB 7270). A, B. Fertile hyphae with spent, emptied probasidia (arrows) and two probasidia with developing basidia. C. Three mature basidia showing variations in septation. D. Mature two celled basidium, the uppermost cell with a developing sterigma. E. Basidial cells with sterigmata. F. Sterigma with developing ballistospore (note thin septum at base of sterigma and apparent germination of the spore while still attached). G. Basidiospores, that on the lower left germinating, the upper two spores with short appendages at the attachment point, indicating passive release. H. Germinating basidiospore. I. Foreign hypha with elongate conidium found in hymenium. Bar = 10 μm.

form of its basidiospores; other features, e.g., basidiome color, presence of clamp connections, and probasidial form, resemble those of *M. carnosa*.

Mycogloea tahitiensis L.S. Olive Fig. 4 A–I

A collection identified as *M. tahitiensis* differed only in minor details from the description by Olive (1958), the main features being as follows: Basidiomata sordid white to pale yellowish, tuberculate, the individuals less than 1 mm in diam but aggregated, coalescing, then up to 10 mm, drying horny, pale yellow or almost white in spots. Hyphae mostly 1.5–3.5 μm, a few 6–7 μm in diam without clamps, the walls thickened to 1 μm or greater in some, walls even and structures essentially cylindric for most, but larger hyphae often constricted at the septa and the latter often frequent, the most basal hyphae very irregular, compactly arranged. Hymenium consisting of scattered hyphidia, short probasidia, and readily detached basidia. Probasidia 5–8(–10) × 2.5–3.5 μm, narrowly clavate, giving rise an apical bud-like basidial initial; basidia 43–54 × 5–6 μm, widest near the center and tapering to both ends, 2–4-celled, slightly constricted at the septa, often curved, each cell producing a sessile basidiospore or a short sterigma and basidiospore. Basidiospores 15–18(–20) × 5–7(–8) μm, appearing ovoid and biapiculate, flattened along one side and tapered to

the apex and base; germination by budding. The basidiomata developed on perithecia of a *Diaporthe* on a dead *Wistaria floribunda* (Willd.) DC. vine, Japan: Ibaraki Pref., Mt. Makabe, 20 August 1983, R. Bandoni 7270 (TNS).

The specimen differed from Olive's description only in having smaller basidia and basidiospores (i.e., within the range given by Olive, but not reaching the maximum sizes he indicated). Olive described the basidia of *M. tahitiensis* as 4-celled; the Japanese collection had many 2-celled basidia as well as some 4-celled and infrequent 3-celled ones. Observations in this study suggest that 2-celled basidia are abundant in some basidiomes in species with predominantly 4-celled basidia, perhaps because of the developmental state at the time of drying.

Foreign hyphae are often present in basidiomes of *Mycogloea* spp., including the material of *M. tahitiensis*. The hypha shown in Fig. 4–I, with elongate conidia, is similar to those seen in basidiomata of several species.

In the course of this study, a collection of *M. orthospora* (Syd.) McNabb ex Dingley (Dingley, 1989) was examined, but this did not appear to differ in any significant way from McNabb's description (McNabb, 1965) of *M. macrospora* (Berk. & Broome) McNabb. The following notes were prepared from the Dingley collection; synonymy lists are given by Dingley (1989) and McNabb (1965) and are not repeated here.

Mycogloea macrospora (Berk. & Br.) McNabb, Trans. Br. Mycol. Soc. **48**: 187. 1965.

=*Mycogloea orthospora* (H. Sydow) McNabb ex Dingley, Mem. New York Bot. Gard. **49**: 206. 1989.

Basidiocarps to 3 mm in diam, erumpent, basically pustulate but often roughly lunate or with a deep, regular central depression when dried, aggregated in groups of up to 6 and becoming confluent basally, vinaceous pink, translucent, gelatinous, drying horny, yellow, remaining conspicuous when dry. In section, basidiomata with a distinct outer gelatinous zone and a small fleshy central zone. Hyphae 2–4 μm in diam, mostly thin-walled, the basal ones with clamps. Probasidia inconspicuous, ca. 5–7 × 1–2 μm, cylindric; basidia (40–)55–66(–70) × 3–5 μm, cylindric to slightly fusoid, the diameter most often greatest in the region of the second cell from the apex but sometimes narrowly clavate or subcylindric, slightly constricted at the septa, straight when in the compact hymenium, mostly curved and lunate to strongly hook shaped or sometimes sigmoid when free and at the outer limits of the matrix, 4-celled, typically with a flap at the detachment end. Hyphidia ca. 4 μm basally, the wall there thickened, filamentous, infrequently branched and narrower above, often with short lateral branches that appear to bear conidia, the apices often curved or the entire structure helically curved.

Dingley did not observe basidiospores; I found them to be relatively abundant, 8–12 × 4–5.5 μm, vs 10–13 × 4.4–5.5 μm for *M. macrospora* by McNabb and as he illustrated for that species.

Specimen examined: New Zealand: Waimea, Eve's Bush, on *Nothofagus* sp. 2.3. 1967; coll. J. Dingley; det. R. McNabb, PDD 25629. Dingley (1989) suggested that *M. orthospora* (H. Sydow) McNabb ex Dingley might be identical to *M. macrospora* (Berk. & Br.) McNabb; I could find no noteworthy differences between her collection and description and McNabb's description of *M. macrospora*.

Discussion

Mycogloea is placed in the Platygloeaceae (Platygloeales) by Hawksworth et al. (1995), but the species is only remotely related to *Platygloea disciformis* (Fr.) Neuhoff, the type species of the genus upon which the two higher taxa are based. Spores of *P. disciformis* do not germinate by budding (Aoki et al., 1986); the basidiomata have well developed exposed hymenia, basidia that remain attached to their probasidia, and ballistic basidiospores. On the other hand, *Mycogloea* spp. are dimorphic, they have gasteroid basidiomes (passively released basidia being the first disseminules) and basidial dispersal by water. Ballistic basidiospores can be produced, as noted by Olive (1950), but blastic spores appear to be more commonly produced and a yeast state is initiated. *Mycogloea* basidia do not form an exposed external layer, and although a peridium is lacking, a gelatinous layer may function as such. In *M. amethystina*, the basidiomata rupture irregularly to more or less stellately at maturity, exposing many basidia. From the standpoint of dimorphism, *Mycogloea* species are similar to some Cystobasidioid fungi, e.g., *Platygloea fimetaria* (Schum. ex Pers.) Höhn., which has a yeast state and is mycoparasitic. *Mycogloea* species have been noted to occur on pyrenomycete structures by several authors (Olive, 1958; McNabb, 1965; Dingley, 1989), and in the three species described in this report. At this time, it can only be said with certainty that the species are fungicolous, but dimorphism and mycoparasitism are linked in many other simple pored auricularioid fungi.

One of the most distinctive features of *Mycogloea* spp. is the manner in which basidia develop. Although swollen probasidia are present in some species of *Platygloea*, *Cystobasidium*, *Platycarpa*, and other auricularioid fungi, the probasidial structure remains a part of the functional basidium in these taxa and is typically continuous with the basal sporogenous cell. The *Mycogloea* probasidium is thin walled and does not function as a "resting spore," but it resembles that (teliospore) of smuts in which mature basidial attachment is often very weak. Deciduous basidia are known in *Platygloea pustulata*, a species not closely related to either *P. disciformis* or the *Mycogloea* spp. *Platygloea pustulata* does not have a yeast state, its basidia are not produced on probasidia, and the basidiospores are abstricted. Basidia of *Mycogloea* species produce abstricted or blastic, passively released basidiospores, depending upon conditions (Olive, 1950), but the blastic ones are most commonly seen. I believe that *Mycogloea* species are unique among "auricularioid" fungi and eventually they will be placed in a separate family.

It is not clear whether the six species described to

date form a homogeneous group. Differences include the presence or absence of clamps and hyphidia, differences in probasidial size and form, and differences in proliferation of fertile hyphae. Septal pore differences might also be found, as the septa of *M. amethystina* in stained preparations resembled dolipore septa in some instances. Oberwinkler (in Oberwinkler and Bandoni, 1982) reported simple septal pores for *Mycogloea*.

I have collected additional specimens, some of which will be described in a later paper; F. Oberwinkler (personal com.) has also found several undescribed taxa in the group. One additional species was found in Japan (RJB 7207A, on hypodermataceous fungus on a *Sasa* sp. culm, Sugadaira, Nagano Pref., Japan, TSN) but the collection was extremely small and was virtually all utilized for microscope preparations. Since the Code now precludes descriptions of species without an actual type collection, I believe it best not to described it at this time. Two additional species are known from North America, one resembling *M. carnosa* in color and form, but without clamps (RJB 6992, on *Cornus nuttallii* Audub., Vancouver, B. C., UBC) and a second collection (G. D. Darker (7705), on dead bark of *Acer*?, Hamilton, Mass, DAOM 73087). The first of these consists of a single basidiome with only a few basidia remaining; the second collection is large, but was either poorly dried or was not in good condition when collected; it resembles *M. amethystina* in some respects and could be that species.

The known species are separated as indicated in the following key

Key to the known species

Clamps lacking
- Hyphidia abundant; basidiospores 5–8 × 3.5–4.5 μm, ovoid ..... *M. nipponica*
- Hyphidia few, basidiospores mostly >8 μm long
  - Probasidia 34–50 × 3–5 μm; basidiospores 6–13 × 2–5 μm, ellipsoid ..... *M. amethystina*
  - Probasidia 5–10 × 2.5–3.5 μm; basidiospores 15–20 × 5–7 μm ..... *M. tahitiensis*

Clamps present
- Basidiospores bullate-subglobose, 7–9 × 6–7(–8)μm ..... *M. bullatospora*
- Basidiospores narrow ovoid-fusiform
  - Basidia 21–50 μm long; basidiospores under 8.5 μm long ..... *M. carnosa*
  - Basidia 38–60 μm long; basidiospores 10–13 μm long ..... *M. macrospora*

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