



## Towards a natural classification of Dothideomycetes 3: The genera *Muellerites*, *Trematosphaeriopsis*, *Vizellopsis* and *Yoshinagella* (Dothideomycetes *incertae sedis*)

DONG-QIN DAI<sup>1,3,4,5</sup>, ALI H. BAHKALI<sup>2</sup>, D. JAYARAMA BHAT<sup>3,6</sup>, YUAN-PING XIAO<sup>7</sup>, EKACHAI CHUKEATIROTE<sup>3,4</sup>, RUI-LIN ZHAO<sup>5</sup>, ERIC H.C. MCKENZIE<sup>8</sup>, JIAN-CHU XU<sup>1,9</sup> & KEVIN D. HYDE<sup>1,3,4</sup>

<sup>1</sup>Key Laboratory for Plant Diversity and Biogeography of East Asia, Kunming Institute of Botany, Chinese Academy of Science, Kunming 650201, Yunnan, China

email: J.C.Xu@cgiar.org (corresponding author)

<sup>2</sup>Department of Botany and Microbiology, College of Sciences, King Saud University, Riyadh, KSA

<sup>3</sup>Institute of Excellence in Fungal Research and <sup>4</sup>School of Science, Mae Fah Luang University, Chiang Rai, 57100, Thailand

<sup>4</sup>School of Science, Mae Fah Luang University, Chiang Rai 57100, Thailand

<sup>5</sup>The State Key Lab of Mycology, Institute of Microbiology, Chinese Academic of Science, Beijing 100101, China

<sup>6</sup>No. 128/1-J, Azad Housing Society, Curca, P.O. Goa Velha 403108, India

<sup>7</sup>Guizhou Biochem-engineering Research Center, Guizhou University, 550025, Guiyang China

<sup>8</sup>Manaaki Whenua Landcare Research, Private Bag 92170, Auckland, New Zealand

<sup>9</sup>World Agroforestry Centre, East and Central Asia, Kunming 650201, China

### Abstract

We re-examine the generic types of genera with unclear placement in Dothideomycetes. These genera were hitherto poorly illustrated or described. Following examination their appropriate familial or ordinal level placements based on modern morphology concepts may be better understood. The generic types of *Muellerites*, *Trematosphaeriopsis*, *Vizellopsis* and *Yoshinagella* were re-examined in this study. *Muellerites* is placed in *Dothidotthiaceae*, *Vizellopsis* in *Asterinaceae*, while *Trematosphaeriopsis* and *Yoshinagella* are retained in *Dothideomycetes incertae sedis*, as they are not typical of any existing families of Dothideomycetes. By illustrating and redescribing the genera we expect renewed interest for recollection and molecular study so that these dothideomycetous genera can be placed in a natural taxonomic framework.

**Key words:** Ascomycota, *Dothideomycetes*, taxonomy, types

### Introduction

Dothideomycetes, the largest and most diverse class of Ascomycota (Hyde *et al.* 2013, Kirk *et al.* 2008, Schoch *et al.* 2006), is characterized by ascolocular ascoma development and bitunicate (or/and fissitunicate) asci (Hyde *et al.* 2013). The well known members of this class such as the species of *Capnodia*, *Botryosphaeria* and *Venturia* and the asexual genera *Diplodia*, *Fusicladium* and *Phyllosticta* are important plant pathogens (Chomnunti *et al.* 2011, Liu *et al.* 2012, Parisi *et al.* 1993). Most described species and genera are found as endophytes, saprobes or epiphytes growing on woody plant debris, decaying leaves or herbivore dung (Hyde *et al.* 2013, Malloch & Cain 1971). A smaller number are symbiotic as lichens (Lücking & Sérusiaux 2013, Lücking *et al.* 2013). Only one species, *Cenococcum geophilum* Fr. has been established as mycorrhizal with plant roots (LoBuglio *et al.* 1996). Lumbsch & Huhndorf (2010) included two subclasses and eleven orders in the class Dothideomycetes, whereas two orders, 34 families and around 184 genera were placed in *Dothideomycetes incertae sedis*.

We are in the process of studying genera of Dothideomycetes in order to provide a natural classification of this large class (Ariyawansa *et al.* 2013, Boonmee *et al.* 2011, Dai *et al.* 2012, Liu *et al.* 2011, 2012, Wu *et al.* 2011a, 2011b, Zhang *et al.* 2011, 2012, Hyde *et al.* 2013). These studies involved examination of type specimens of the genera, provision of modern descriptions and illustrations or photomicrographs and, wherever possible, linking to their asexual states, resulting with appropriate placement at the family and ordinal levels. In this study, we re-examined the type species of genera *Tirisporella*, *Trematosphaeriopsis*, *Vizellopsis* and *Yoshinagella*.

## Materials and methods

### *Examination of specimens*

Type specimens were obtained from FH, S, URM and ZT (abbreviations according to Index Herbariorum 2013). The study methods followed are those reported in Chomnunti *et al.* (2011, 2014) and Liu *et al.* (2012). Fruiting bodies were rehydrated in water and/or 5% KOH prior to examination and sectioning. Hand sections of the ascomata were mounted in water or lactic acid for microscopic studies and photomicrography. The materials were examined by a Nikon ECLIPSE 80i compound microscope and photographed by Canon 550D digital camera fitted to the microscope. Measurements were made with the Tarosoft (R) Image Frame Work program and images used for figures were processed with Adobe Photoshop CS3, Extended version 10.0 software (Adobe Systems, USA). Genus and species descriptions are given for all accepted genera.

## Results and discussion

There is no sequence data for any members of these genera in GenBank and the data given below are based on morphology.

## Taxonomy

***Dothidotthiaceae*** Crous & A.J.L. Phillips, in Phillips *et al.*, *Persoonia* 21: 35 (2008) MycoBank: MB 511706

The family *Dothidotthiaceae* was introduced by Phillips *et al.* (2008) containing the single genus *Dothidotthia*. *Dothidotthia* was originally placed in *Botryosphaeriaceae* by Barr (1987). However, *Dothidotthia* formed a separate familial clade of the order Pleosporales in multi-gene phylogenetic analysis (Phillips *et al.* 2008, Zhang *et al.* 2012). *Dothidotthiaceae* is characterized by gregarious, erumpent, globose ascomata, hyaline, septate pseudoparaphyses, 8-spored, bitunicate, clavate asci bearing ellipsoid, 1-septate ascospores (Hyde *et al.* 2013). The asexual state is *Thyrostroma* (Phillips *et al.* 2008).

***Muellerites*** L. Holm, *Svensk bot. Tidskr.* 62: 231 (1968) MycoBank: MB 3285

**Type species:** *Muellerites juniperi* (E. Müll. & Arx) L. Holm, *Svensk bot. Tidskr.* 62: 231 (1968) MycoBank: MB 297818 (Fig. 1)  
**Basionym:** *Gibberidea juniperi* E. Müll. & Arx, *Phytopath. Z.* 24: 359 (1955)

*Saprobic* on needle-like leaves of cypress. Sexual state: *Ascomata* forming at the base of the leaves, 400–650 µm diam., solitary to gregarious, superficial, coriaceous, globose, black, with indistinct ostiole, easily removed. *Peridium* 50–70 µm thick, comprising a single layer composed of thick-walled, brown cells of *textura angularis*. *Hamathecium* of ca. 1 µm wide dense, septate, branch pseudoparaphyses. *Asci* 170–218 × 25–29 µm ( $\bar{x}$  = 197.8 × 27.1 µm, n = 20), 8-spored, bitunicate, fissitunicate, cylindrical, with a short pedicel, apically rounded with an ocular chamber. *Ascospores* 40–46 × 10.5–12 µm ( $\bar{x}$  = 43.2 × 11.6 µm, n = 20), 2-seriate, ellipsoid to fusiform, dark brown, 3–4-septate, straight to curved, rounded or with acute ends, smooth-walled, surrounded by a mucilaginous sheath. Asexual state: Unknown.

**Notes:**—The type species of the monotype genus *Muellerites* was originally described by Holm (1968) from the collection of *Gibberidea juniperi* E. Müll. & Arx (1955). This genus is characterized by globose, small and black ascomata forming at the base of the cypress leaves, and cylindrical asci containing eight, dark brown ascospores with 3–4 septa. The peridium is comprises one layer composed of thick-walled, brown, cells of *textura angularis*. Based on these characters, we place *Muellerites* in the family *Dothidotthiaceae*. *Dothidotthia* grows on wood, has clustered, erumpent, ascomata with central ostioles, and ellipsoid, 1-septate, brown to chestnut or pale brown ascospores (Hyde *et al.* 2013). *Muellerites* differs in having solitary, somewhat gregarious ascomata with indistinct ostioles, forming on pine leaves and fusiform, 3–4-septate, dark brown ascospores.

**Material examined:**—SWITZERLAND. Airolo: Raetia, Ramosch, Lunga, 1900 m, on leaves of *Juniperus nana* Willd. (*Cupressaceae*), 16 July 1949, E. Müller (ZT Myc 49038!, holotype).



**FIGURE 1.** *Muellerites juniperi* (holotype). a, b. Herbarium specimens. c–d. Ascomata on host. e, f. Sections of ascomata. g, h. Peridium. i–m. Asci with pseudoparaphyses. n–t. Ascospores. Scale bars: c, d = 500  $\mu$ m, e–g = 50  $\mu$ m, i–m = 10  $\mu$ m, n–t = 5  $\mu$ m.

*Asterinaceae* Hansf., Mycol. Pap. 15: 188 (1946) MycoBank: MB 80492

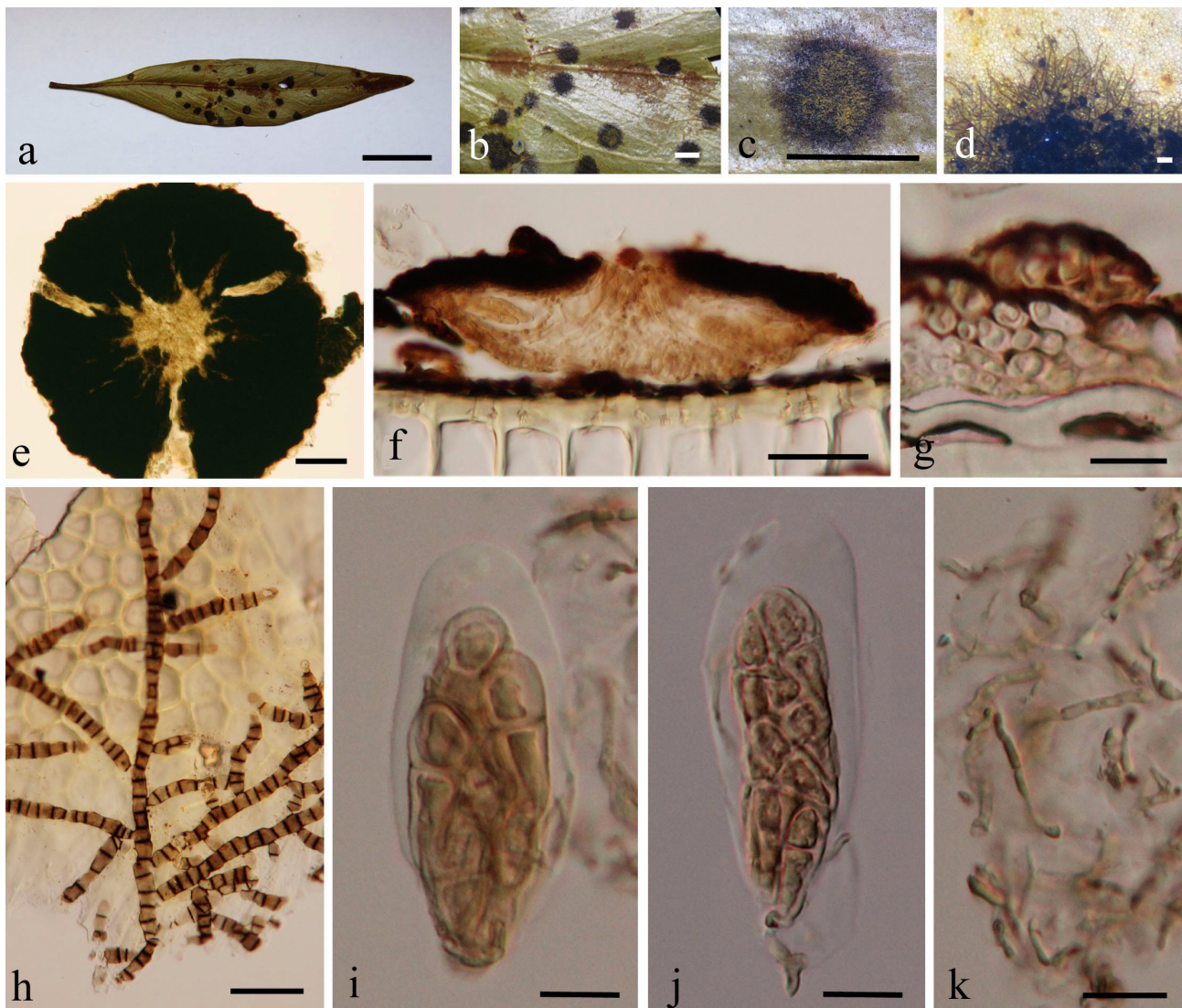
The family *Asterinaceae* was introduced by Hansford (1946) and, is typified by *Asterina* Lév. The important features of *Asterinaceae* are the superficial, web-like, black colonies that form on the upper and lower surface of living leaves and are typical of *Asterinaceae* (Hofmann 2010, Hofmann *et al.* 2010, Hosagoudar *et al.* 2013, Hyde *et al.* 2013). The superficial, small, black thyriothecia open in the centre by radial or star-like splitting (Hosagoudar 2012), and grow below the radial mycelium which frequently produce hyphopodia (Hyde *et al.* 2013). Thyriothecia of this family are closely attached to the host plant cuticle and have an upper dark wall (scutellum) which is one cell layer thick and composed of isodiametrical or cylindrical cells (Hofmann *et al.* 2010), however the lower



ascoma wall is poorly developed. Pseudoparaphyses are frequently inconspicuous or missing (Hofmann 2010). Asci are globose to clavate, bitunicate, which produce brown, mostly two-celled ascospores (von Arx & Müller 1975, Hofmann 2010, Hyde *et al.* 2013). Asexual states of *Asterinaceae* have been reported in *Acarella*, *Asterostomella*, *Asterostomula*, *Asterostromina*, *Clasterosporium*, *Elachopeltis*, *Eriothyrium*, *Leprieurina*, *Mahanteshamomyces*, *Peltasterella*, *Pirozynskia*, *Septothyrella*, *Sirothyriella*, *Thyrinula* and *Triposporium*, but this need to be confirmed (Hyde *et al.* 2013).

*Vizellopsis* Bat., J.L. Bezerra & T.T. Barros, Publções Inst. Micol. Recife 637: 5 (1969)  
 MycoBank: MB 5748

**Type species:**—*Vizellopsis grevilleae* Bat., J.L. Bezerra & T.T. Barros, Publções Inst. Micol. Recife 637: 5 (1969) MycoBank: MB 325517 (Fig. 2)



**FIGURE 2.** *Vizellopsis grevilleae* (holotype). a. Herbarium material. c, d. Colonies on the host. e, f. Superficial mycelium on host. g. Thyriothechia with slit-like opening ostiole. h. Upper wall of thyriothechia. i. Section of thyriothechia. k. Section of immature thyriothechia. l. Branched mycelium with strongly thick septa. m. Pseudoparaphyses. n, o. Asci with ascospores. Scale bars: b = 20 mm, c–f = 2 mm, g–k = 50 µm, l–o = 10 µm.

*Epiphytic* on upper surface of living leaves. *Colonies* 1–2 mm diam., superficial, thin, circular, dark brown to black, without hyphopodia. *Hyphae* long, 7–13 µm wide, flexuous, reticulately branched, septate, dark brown, strongly constricted and dark at the septa, straight or curved. Sexual state: *Thyriothechia* forming below the mycelium, 250–350 µm diam., scattered to gregarious, superficial, aggregated in the center of colonies, orbicular,

flattened, black, ostiolate in the center, opening by irregular splitting when mature, membranaceous to slightly coriaceous, easy removed from host surface. *Upper wall* comprising cells of *textura prismatica*, radiating outwardly in parallel rows from the central ostiole, basal wall layer poorly developed. *Hamathecium* composed of dense, septate, branched pseudoparaphyses and asci inclined from the base and rim towards the central ostiole. *Asci* 55–70 × 22–24 μm ( $\bar{x}$  = 64.7 × 24.3 μm, n = 10), 8-spored, bitunicate, clavate, pedicel poorly developed, apically rounded with an ocular chamber. *Ascospores* 20–25 × 5–8 μm ( $\bar{x}$  = 23.1 × 7.6 μm, n = 10), 2–3-seriate, irregularly arranged, broad fusiform to long obovoid, brown, 1-septate, smooth-walled. Asexual state: Unknown.

**Notes:**—*Vizellopsis* was introduced by Batista *et al.* (1969) and is typified by *V. grevilleae* Bat. This monotypic genus is characterized by black colonies on the leaf surface formed by a brown mycelium with flexuous hyphae which have strongly constricted and dark septa. Batista *et al.* (1969) placed *Vizellopsis* in the family *Microthyriaceae*, according to the black, circular, flattened thyrtothecia. Lumbsch & Huhndorf (2010) included this genus as *Dothideomycetes incertae sedis*, as the morphological characters are not similar to *Microthyriaceae*. Based on the small, black thyrtothecia, forming below the dark brown mycelium, comprising radiating cells and having concentrically ridged surface, we place *Vizellopsis* in the family *Asterinaceae*. *Vizellopsis* has strongly thickened and septate mycelium which is different from other genera of *Asterinaceae*.

**Material examined:**—NEW CALEDONIA. South Province: Yate, on leaves of *Grevillea exul* Lindl., 11 September 1966, *B. Huguenin* 76.296 (URM 655060!, holotype).

### ***Dothideomycetes incertae sedis***

Lumbsch & Huhndorf (2010) listed 184 genera in *Dothideomycetes incertae sedis* because familial placements are unclear. These doubtful genera lack molecular data in GenBank and need phylogenetic analyses to establish which families they belong to. We have examined the type materials of *Trematosphaeriopsis* and *Yoshinagella* and although we can make suggestions as to their familial relationships, we leave them in this group as it is not obviously apparent where the genera can be placed.

***Trematosphaeriopsis*** Elenkin, *Izv. Imp. St.-Peterburgsk. Bot. Sada* 1(4): 146 (1901)  
MycoBank: MB 5523

**Type species:** *Trematosphaeriopsis parmeliiana* Jacz. & Elenkin, *Izv. Imp. St.-Peterburgsk. Bot. Sada* 1(4): 146 (1901)  
MycoBank: MB 221591 (Fig. 3)

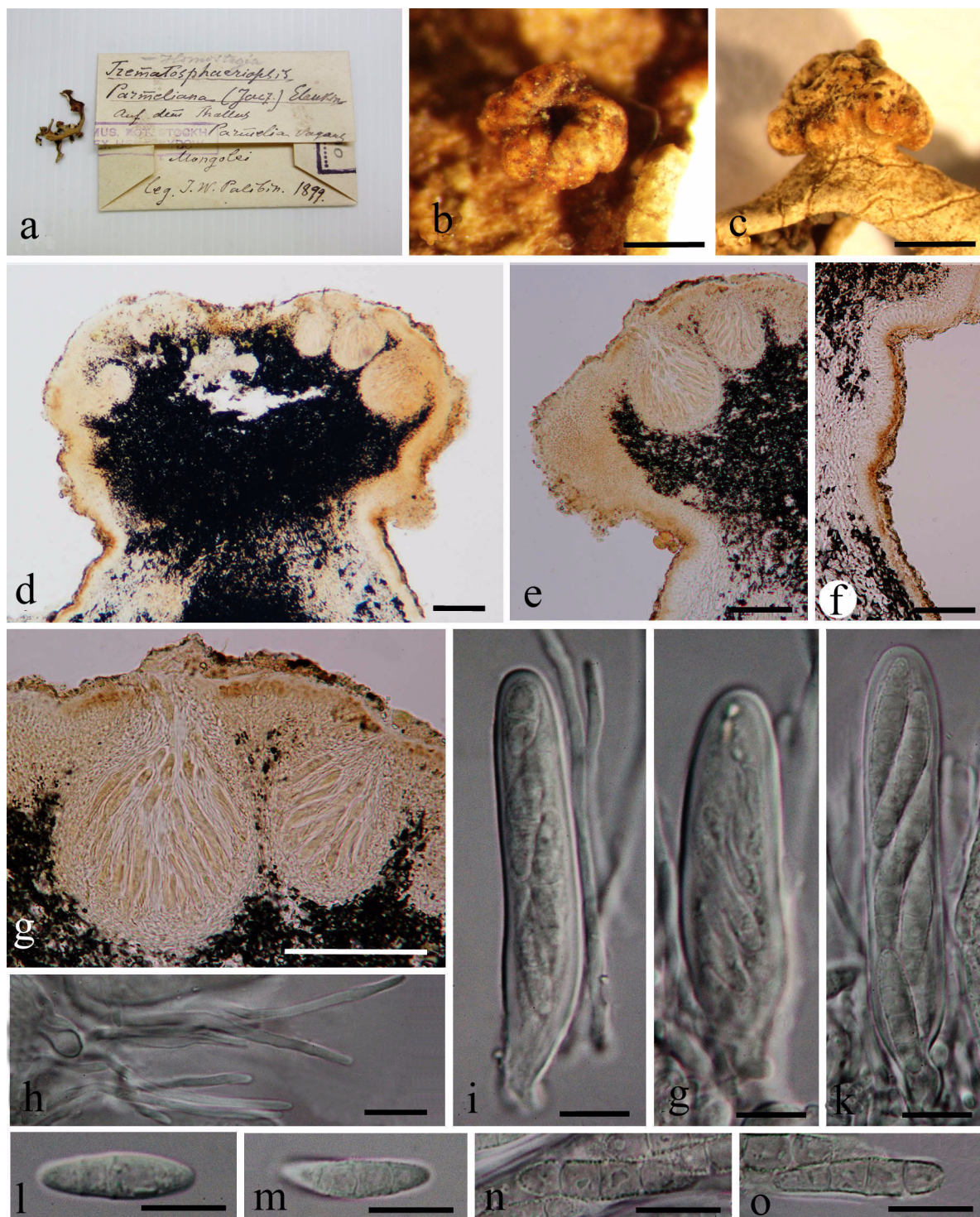
Probable synonymy: *Homostegia parmeliiana* (Jacz. & Elenkin) Vouaux, *Bull. Soc. mycol. Fr.* 28: 198 (1912)  
*Trematosphaeris parmeliiana* (Jacz. & Elenkin) Clem., *Gen. fung. (Minneapolis)*: 35 (1909)

*Lichenicolous* on thallus. Sexual state: *Ascstromata* 1–1.5 mm high, 1–2.5 mm diam., solitary, scattered, superficial, subglobose, depressed in the center, reddish-yellow, coriaceous, lacking an ostiole. Wall of ascostromata, thick, three layered, with an outer thin layer composed of fragmented or disintegrated tissue, with middle 40–120 μm wide layer composed of orange to reddish-yellow cells of *textura angularis*, and thick inner layer composed of reddish-yellow to hyaline cells of *textura oblita* and becoming black when dry; peridium surrounding the locules, 20–30 μm thick, composed of hyaline small cells intermixed with ascogenous hyphae and pseudoparaphyses. *Locules* 100–200 μm high, 80–150 μm diam., immersed in the upper part of ascostromata, globose to subglobose, some with narrow necks. *Peridium* of locules 10–25 μm thick, composed of small pale reddish yellow cells of *textura oblita*. *Hamathecium* of dense, 1–2 μm wide, hyaline, non-septate, unbranched, pseudoparaphyses. *Asci* 60–80 × 10–12 μm ( $\bar{x}$  = 70.8 × 11.8 μm, n = 20), 8-spored, bitunicate, cylindrical, with a short pedicel; apical chamber not observed. *Ascospores* 18–26 × 4–5.5 μm ( $\bar{x}$  = 21.9 × 5.1 μm, n = 20), 2-seriate, ellipsoid to fusiform, sometimes slightly curved, hyaline to pale yellow, 3-septate when mature, smooth to verrucose, with rounded ends. Asexual state: Unknown.

**Notes:**—*Trematosphaeriopsis*, introduced by Elenkin (1901), is monotypic and represented by *T. parmeliiana*. This fungus is characterized by large ascostromata, growing superficially on lichens and producing 10–25 locules formed only under the periphery of upper wall. *Trematosphaeriopsis* is similar with the genera in *Trypetheliaceae* by having the globose, orange ascostromata forming on lichens (Hafellner 2001, Hyde *et al.* 2013, Lücking *et al.* 2007). However, *Trematosphaeriopsis* differs by having ascostromata with the cupped-socket area in centre and



producing fusiform ascospores with 1 to 4 septa (Hafellner 2001). Genera in *Trypetheliaceae* have the ascostromata with central ostiole, and with fusiform-ellipsoid to oblong ascospores with distosepta and sometimes additional eusepta (Aptroot 1991, Hyde *et al.* 2013). The morphologic characters of this genus do not fit well in any existing Dothideomycete families and we therefore retain it in Dothideomycetes, genera *incertae sedis*.

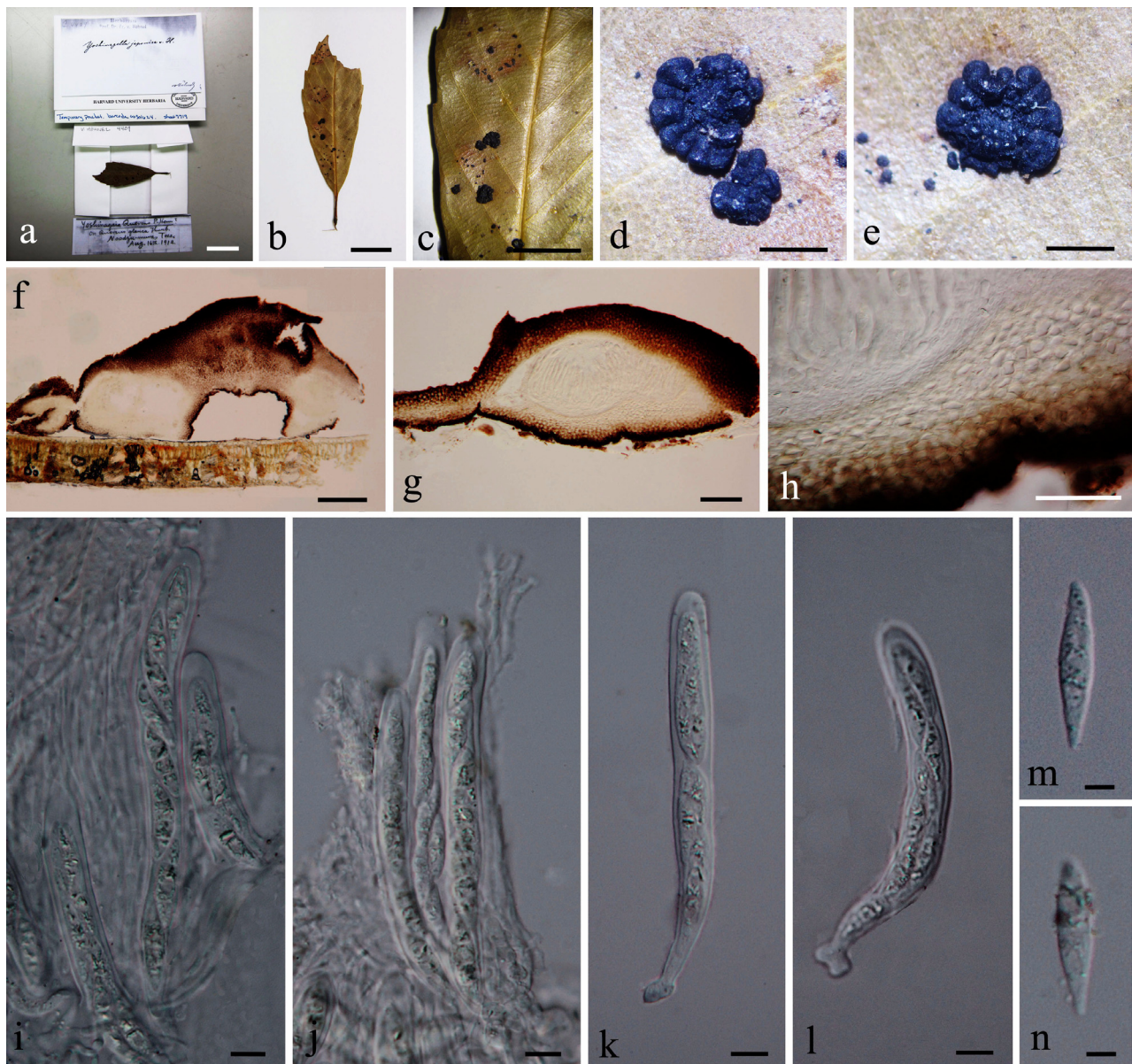


**FIGURE 3.** *Trematosphaeriopsis parmeliana* (isotype). a. Herbarium material. b, c. Reddish yellow ascostromata on the host. d, e. Section of ascostroma. f. Wall of ascostroma. g. Ascostroma with locules. h. Pseudoparaphyses. i–k. Asci with ascospores. l–o. Ascospores. Scale bars: b, c = 1 mm, d–g = 100  $\mu$ m, h–o = 10  $\mu$ m.

**Material examined:**—MONGOLIA. Hentiy: Kerulen River, on the thallus of *Parmelia molliuscula* var. *vagens* (Nyl.) Nyl., 1899, *J.W. Palibin* (S F45300!, isotype).



*Parasitic* on upper surface of living leaves. Sexual state: *Ascostromata* solitary, scattered to gregarious, superficial, cushion-like, flat, rounded, irregular at the margin, black, coriaceous, flattened at the centre. *Locules* immersed in the ascostromata, arranged in a circular margin, globose to irregular. Wall of ascostromata thick, two layered, with outer layer composed of black and thin tissue; inner layer composed of light brown to hyaline, large cells of *textura angularis*; peridium that surrounds the locules, composed of small hyaline cells intermixed with ascogenous hyphae and pseudoparaphyses. *Hamathecium* composed of dense, septate, branched, pseudoparaphyses, branching above the asci. *Asci* 8-spored, bitunicate, cylindrical, with a short furcate pedicel, apically rounded with an apical ocular chamber. *Ascospores* 1-seriate, fusiform, pointed at the ends, hyaline, 3-septate, smooth-walled. Asexual state: Unknown.



**FIGURE 4.** *Yoshinagella japonica* (lectotype). a, b. Herbarium material. c–e. Black ascostromata on host. f, g. Section of ascostroma. h. Wall of ascostromata and peridium surrounding the locules. i–l. Asci with pseudoparaphyses. m, n. Ascospores. Scale bars: a = 50 mm, b = 25 mm, c = 5 mm, d, e = 1mm, f = 250  $\mu$ m, g = 100  $\mu$ m, h = 50  $\mu$ m, i–l = 10  $\mu$ m, m, n = 5  $\mu$ m.

**Notes:**—*Yoshinagella*, introduced by Höhnel (1913), is typified by *Yoshinagella japonica* Höhn. This genus is defined by large, black ascostromata with irregular margins containing locules which are globose to irregular. *Yoshinagella* contains three species: *Y. japonica* Höhn. and *Y. nuda* F. Stevens growing on the leaves of *Quercus glauca* Thunb. and *Cibotium chamissoi* Kaulf., respectively (Höhnel 1913, Stevens 1925), and *Y. phyllostachydis* I.

Hino & Katum. on dead stems of *Phyllostachys bambusoides* Siebold & Zucc. (Hino & Katumoto 1955). *Yoshinagella* can be compared with *Coccoidea* and *Cookella*, two genera that have superficial, circular to subcircular, pulvinate to effuse discoid, and cushion-like, pigmented ascostromata. *Coccoidea* differs as the locules grow upwards from the basal portion linearly, and opening with an apical ostiole (Eriksson 1981, Inácio & Cannon, 2002). In *Cookella*, locules are small, and scattered in the ascostromata (Hyde *et al.* 2013). In *Yoshinagella* locules are only arranged in a circle at the periphery of the ascostromata. *Yoshinagella* may be similar with *Parmularia* in having large, black ascostromata with locules lined at the surface. The ascostromata in *Parmularia* have radially raised areas from the centre (Hyde *et al.* 2013, Inácio & Cannon 2008). However, in *Yoshinagella*, ascostromata are only raised at the margins, and are thicker. Species in *Yoshinagella* can also be compared with *Yoshinagaia quercus* which has ascostromata directly formed on leaves and produces elliptical ascospores without septa (Sivanesan & Hsieh 1995). *Yoshinagella* might be placed in *Botryosphaeriaceae* or Dothideales. However, fresh collections and molecular analyses are needed to confirm the relationships. Thus we remain *Yoshinagella* in Dothideomycetes genera *incertae sedis*. We examined good material of one specimen, herein designated as lectotype.

**Type species:** *Yoshinagella japonica* Höhn., Fragm. Mykol. 122: 293 (1913) MycoBank: MB 248507 (Fig. 4)

**Parasitic** on upper surface of living leaves. Sexual state: *Ascostromata* 0.5–0.7 mm high, 1–2.5 mm diam., solitary, scattered to gregarious, superficial, cushion-like, flat, rounded, irregular at the margin, black, coriaceous, with flattened centre. *Locules* 200–250 µm high, 400–500 µm diam., immersed in the ascostromata, arranged in a circle at the margin, globose to irregular. Wall of ascostromata thick, two layered, with outer layer composed of black and thin tissue; inner layer 80–150 µm thick, composed of light brown to hyaline, large cells of *textura angularis*; peridium surrounding the locules, 15–20 µm thick, composed of hyaline small cells intermixed with ascogenous hyphae and pseudoparaphyses. *Hamathecium* composed of 1 µm wide, dense, septate, pseudoparaphyses, branching above the asci. *Asci* 90–120 × 9–15 µm ( $\bar{x}$  = 109.1 × 12.7 µm, n = 20), 8-spored, bitunicate, cylindrical, with a short furcate pedicel, apically rounded with an apical ocular chamber. *Ascospores* 18–24 × 4.5–6 µm ( $\bar{x}$  = 22.3 × 5.3 µm, n = 20), 1-seriate, fusiform, pointed at the ends, hyaline, 3-septate, smooth-walled. Asexual state: Unknown.

**Material examined:**—JAPAN. Kochi: Tosa, Noodzu-mura, on leaves of *Quercus glauca* Thunb. (*Fagaceae*), 16 August 1912, (FH 00301624!), **lectotype, here designated**).

## Acknowledgments

This project was supported by King Saud University, Deanship of Scientific of Research, College of Sciences Research Center. The authors would like to thank the CGIAR Research Program 1.2 - Humidtropics: Integrated systems for the humid tropics, for partially funding this work. Kevin D. Hyde thanks the Chinese Academy of Sciences, project number 2013T2S0030, for the award of Visiting Professorship for Senior International Scientists at Kunming Institute of Botany.

## References

- Aptroot, A. (1991) A monograph of the *Pyrenulaceae* (excluding *Anthracotheceum* and *Pyrenula*) and the *Requienellaceae*, with notes on the *Pleomassariaceae*, the *Trypetheliaceae* and *Mycomicrothelia* (lichenized and non-lichenized Ascomycetes). *Bibliotheca Lichenologica* 44: 1–178.
- Ariyawansa, H.A., Maharachchikumbura, S.S.N., Karunarathne, S.C., Chukeatirote, E., Bahkali, A.H., Kang, J.C, Bhat, J.D. & Hyde, K.D (2013) *Deniquelata barringtoniae* from *Barringtonia asiatica*, associated with leaf spots of *Barringtonia asiatica*. *Phytotaxa* 105(1): 11–20.  
<http://dx.doi.org/10.11646/phytotaxa.105.1.2>
- Arx, J.A. von & Müller, E. (1975) A re-evaluation of the bitunicate ascomycetes with key to families and genera. *Studies in Mycology* 9: 1–159.
- Barr, M.E. (1987) *Prodomus to class Loculoascomycetes*. Published by the author, Amherst.
- Batista, A.C., Bezerra, J.L., Barros, T.T. & Leal, F.B. (1969) [1970] Sobre um novo gênero de Microthyriaceae da Nova Caledônia. *Publicações. Instituto de Micologia da Universidade Federal de Pernambuco* 637: 1–11.
- Boonmee, S., Zhang, Y., Chomnunti, P., Chukeatirote, E., Tsui, C.K.M., Bahkali, A.H. & Hyde, K.D. (2011) Revision of lignicolous *Tubeufiaceae* based on morphological reexamination and phylogenetic analysis. *Fungal Diversity* 51: 63–102.  
<http://dx.doi.org/10.1007/s13225-011-0147-4>



- Chomnunti, P., Schoch, C.L., Aguirre-Hudson, B., Ko-Ko, T.W., Hongsanan, S., Jones, E.B.G., Kodsueb, R., Phookamsak, R., Chukeatirote, E., Bahkali, A.H. & Hyde, K.D. (2011) *Capnodiaceae*. *Fungal Diversity* 51: 103–134.  
<http://dx.doi.org/10.1007/s13225-011-0145-6>.
- Chomnunti, P., Hongsanan, S., Aguirre-Hudson, B., Tian, Q., Peršoh, D., Dharmi, M.K., Alias, A.S., Xu, J.C., Liu, X.Z., Stadler, M. & Hyde, K.D. (2014) The sooty moulds. *Fungal Diversity* (In Press).
- Dai, D.Q., Bhat, J.D., Liu, J.K., Chukeatirote, E., Zhao, R.L. & Hyde, K.D. (2012) *Bambusicola*, a new genus from bamboo with asexual and sexual morphs. *Cryptogamie Mycologie* 33(3): 363–379.  
<http://dx.doi.org/10.7872/crym.v33.iss3.2012.363>
- Elenkin, A.A. (1901) Fakultativnie lischainiki (I). *Izvēstiya Imperatorskago S.-Petersburgskago Botanicheskago Sada* 1(4): 129–154, tab.
- Eriksson, O. (1981) The families of bitunicate ascomycetes. *Nordic Journal of Botany* 1(6): 7–218.  
<http://dx.doi.org/10.1111/j.1756-1051.1981.tb01167.x>
- Hafellner, J. (2001) Studies in lichenicolous fungi and lichens. XII: On the genus *Trematosphaeriopsis* (Dothideales). *Mycotaxon* 80: 381–387.
- Hansford, C.G. (1946) The foliicolous Ascomycetes, their parasites and associated fungi. *Mycological Papers* 15: 1–240.
- Hino, I. & Katumoto, K. (1955) Illustrationes fungorum bambusicolorum. II. *Bulletin of the Faculty of Agriculture Yamaguchi University* 5: 213–234.
- Hofmann, T.A. (2010) Plant parasitic *Asterinaceae* and *Microthyriaceae* from the Neotropics (Panama). PhD thesis. The Faculty of Biological Sciences at the J.W. Goethe-University Frankfurt am Main, Germany. 408 pp.
- Hofmann, T. A., Kirschner, R. & Piepenbring, M. (2010) Phylogenetic relationships and new records of *Asterinaceae* (Dothideomycetes) from Panama. *Fungal Diversity* 43(1): 39–53.  
<http://dx.doi.org/10.1007/s13225-010-0042-4>
- Holm, L.M. (1968) Taxonomical notes on Ascomycetes. VI. On the genus *Gibberidea* Fuck. and some alleged relatives. *Svensk Botanisk Tidskrift* 62: 217–242.
- Hosagoudar, V. (2012) Asterinales of India. *Mycosphere* 2(5): 617–852.
- Hosagoudar, V., Sabeena, A. & Mathew S.P. (2013) Additions to *Asterinaceae* (Ascomycetes) fungi in India. *Journal of Threatened Taxa* 5(2): 3670–3672.  
<http://dx.doi.org/10.11609/JoTT.o3228.3670-72>
- Höhnelt, F. von. (1913) Fragmente zur Mykologie (XV. Mitteilung, Nr. 793 bis 812). *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften Math.-naturw. Klasse Abt. I*, 122: 255–309.
- Hyde, K.D., Jones, E.B.G., Liu, J.K., Ariyawansa, H.A., Boehm, E., Boonmee, S., Braun, U., Chomnunti, P., Crous, P.W., Dai, D.Q., Diederich, P., Dissanayake, A., Doilom, M., Doveri, F., Hongsanan, S., Jayawardena, R., Lawrey, J.D., Li, Y.M., Liu, Y.X., Lücking, R., Monkai, J., Muggia, L., Nelsen, M.P., Pang, K.L., Phookamsak, R., Senanayake, I., Shearer, C.A., Suetrong, S., Tanaka, K., Thambugala, K.M., Wijayawardene, N.N., Wikee, S., Wu, H.X., Zhang, Y., Aguirre-Hudson, B., Alias, S.A., Aptroot, A., Bahkali, A.H., Bezerra, J.L., Bhat, D.J., Camporesi, E., Chukeatirote, E., Gueidan, C., Hawksworth, D.L., Hirayama, K., Hoog, S.D., Kang, J.C., Knudsen, K., Li, W.J., Li, X.H., Liu, Z.Y., Mapook, A., McKenzie, E.H.C., Miller, A.N., Mortimer, P.E., Phillips, A.J.L., Raja, H.A., Scheuer, C., Schumm, F., Taylor, J.E., Tian, Q., Tibpromma, S., Wanasinghe, D.N., Wang, Y., Xu, J.C., Yan, J.Y., Yacharoen, S. & Zhang, M. (2013) Families of Dothideomycetes. *Fungal Diversity* 63: 1–313.  
<http://dx.doi.org/10.1007/s13225-013-0263-4>
- Inácio, C.A. & Cannon, P.F. (2008) The genera of the *Parmulariaceae*. *CBS Biodiversity Series* 8. CBS Fungal Biodiversity Centre Utrecht, the Netherlands.
- Inácio, C.A. & Cannon, P.F. (2002) Re-interpretation of *Cocconia palmae*, with description of the genus *Dianesea* (Ascomycota: Dothideomycetidae). *Fungal Diversity* 9: 71–79.
- Index Fungorum (2013) <http://www.indexfungorum.org/names/Names.asp>
- Index Herbariorum (2013) <http://sweetgum.nybg.org/ih/>
- Kirk, P.M., Cannon, P.F., Minter, D.W. & Stappers, J.A. (2008) *Dictionary of the fungi*. 10<sup>th</sup> edn. CABI Bioscience, UK.
- Liu, J. K., Phookamsak, R., Jones, E.B.G., Zhang, Y., Ko-Ko, T.W., Hu, H.L., Boonmee, S., Doilom, M., Doilom, M., Chukeatirote, E., Bahkali, A.H., Wang, Y. & Hyde, K.D. (2011) *Astrophaeriella* is polyphyletic, with species in *Fissuroma* gen. nov., and *Neastrophaeriella* gen. nov. *Fungal Diversity* 51: 135–154.  
<http://dx.doi.org/10.1007/s13225-011-0142-9>
- Liu, J.K., Phookamsak, R., Doilom, M., Wikee, S., Li, Y.M., Ariyawansa, H., Boonmee, S., Chomnunti, P., Dai, D.Q., Bhat, J.D., Romero, A.I., Zhuan, g W.Y., Monkai, J., Jones, E.B.G., Chukeatirote, E., Ko-Ko, W.T., Zhao, Y.C., Wang, Y. & Hyde, K.D. (2012) Towards a natural classification of Botryosphaeriales. *Fungal Diversity* 57: 149–210.  
<http://dx.doi.org/10.1007/s13225-012-0207-4>
- LoBuglio, K.F., Berbee, M.L. & Taylor, J.W. (1996) Phylogenetic origins of the asexual mycorrhizal symbiont *Cenococcum geophilum* Fr. and other mycorrhizal fungi among the ascomycetes. *Molecular Phylogenetics and Evolution* 6(2): 287–94.  
<http://dx.doi.org/10.1006/mpev.1996.0077>
- Lücking, R. & Sérusiaux, E. (2013) *Phyllobathelium nudum* Zahlbr. is a second species in the genus *Phyllocratera* (lichenized Ascomycota: *Strigulaceae*). *The Lichenologist* 45(5): 691–693.  
<http://dx.doi.org/10.1017/S0024282913000388>

- Lücking, R., Sipman, H.J.M., Umaña, L., Chaves, J.L. & Lumbsch, H.T. (2007) *Aptrootia* (Dothideomycetes: *Trypetheliaceae*), a new genus of pyrenocarpous lichens for *Thelenella terricola*. *Lichenologist* 39: 187–193.  
<http://dx.doi.org/10.1017/S0024282907006445>
- Lücking, R., Tehler, A., Bungartz, F., Plata E.R. & Lumbsch H.T. (2013) Journey from the West: did tropical *Graphidaceae* (lichenized Ascomycota: Ostropales) evolve from a saxicolous ancestor along the American Pacific coast? *American Journal of Botany* 100(5): 844–856.  
<http://dx.doi.org/10.3732/ajb.1200548>
- Lumbsch, H.T. & Huhndorf, S.M. (2010) Myconet Volume 14. Part one. Outline of Ascomycota 2009. Part two. Notes on Ascomycete systematics. Nos. 4751–5113. *Fieldiana Life and Earth Sciences* 1: 1–64.  
<http://dx.doi.org/10.3158/1557.1>
- Malloch, D. & Cain, R. (1971) Four new genera of cleistothecial Ascomycetes with hyaline ascospores. *Canadian Journal of Botany* 49(6): 847–854.  
<http://dx.doi.org/10.1139/b71-125>
- Müller, E. & Arx J.A. von (1955) Einige Beiträge zur Systematik und Synonymie der Pilze. *Phytopathologische Zeitschrift* 24: 353–372.
- Parisi, L., Lespinasse, Y., Guillaumes, J. & Krüger, J. (1993) A new race of *Venturia inaequalis* virulent to apples with resistance due to the Vf gene. *Phytopathology* 83(5): 533–537.
- Phillips, A.J.L., Alves, A., Pennycook, S.R., Johnston, P.R., Ramaley, A., Akulov, A. & Crous, P.W. (2008) Resolving the phylogenetic and taxonomic status of dark-spored teleomorph genera in the *Botryosphaeriaceae*. *Persoonia* 21: 29–55.  
<http://dx.doi.org/10.3767/003158508X340742>
- Schoch, C.L., Shoemaker, R.A., Seifert, K.A., Hambleton, S., Spatafora, J.W. & Crous, P.W. (2006) A multigene phylogeny of the Dothideomycetes using four nuclear loci. *Mycologia* 98: 1041–1052.  
<http://dx.doi.org/10.3852/mycologia.98.6.1041>
- Sivanesan, A. & Hsieh, W. (1995). A re-appraisal of the systematic status of the ascomycete genus *Yoshinagaia*. *Mycological Research* 99(11): 1295–1298.  
[http://dx.doi.org/10.1016/S0953-7562\(09\)81210-0](http://dx.doi.org/10.1016/S0953-7562(09)81210-0)
- Stevens, F.L. (1925) Hawaiian fungi. *Bulletin of the Bernice Bishop Museum, Honolulu, Hawaii* 19: 1–189.
- Wu, H.X., Hyde, K.D. & Chen, H. (2011a) Studies on *Microthyriaceae*: placement of *Actinomyxa*, *Asteritea*, *Cirsosina*, *Polystomellina* and *Stegothyrium*. *Cryptogamie, Mycologie* 32(1): 3–12.
- Wu, H.X., Schoch, C. L., Boonmee, S., Bahkali, A.H, Chomnunti, P. & Hyde, K.D. (2011b) A reappraisal of *Microthyriaceae*. *Fungal Diversity* 51(1): 189–248.  
<http://dx.doi.org/10.1007/s13225-011-0143-8>
- Zhang, Y., Crous, P. W., Schoch, C.L., Bahkali, A.H., Guo, L.D. & Hyde, K.D. (2011) A molecular, morphological and ecological re-appraisal of Venturiales—a new order of Dothideomycetes. *Fungal Diversity* 51(1): 249–277.  
<http://dx.doi.org/10.1007/s13225-011-0141-x>
- Zhang, Y., Crous, P.W., Schoch, C.L. & Hyde, K.D. (2012) Pleosporales. *Fungal Diversity* 53: 1–221.  
<http://dx.doi.org/10.1007/s13225-011-0117-x>