



## Towards a natural classification of Dothideomycetes 5: The genera *Ascostratum*, *Chaetoscutula*, *Ceratocarpia*, *Cystocoleus*, and *Colensoniella* (Dothideomycetes *incertae sedis*)

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### Abstract

In the Outline of Ascomycota 2009, 116 genera were listed under Dothideomycetes, genera *incertae sedis*. In the present study, we re-examined the generic types of *Ascostratum*, *Chaetoscutula*, *Ceratocarpia*, *Cystocoleus* and *Colensoniella* which are relatively poorly documented. We re-described and illustrated the type species of these genera and suggest higher level placements based on a modern classification system. *Ascostratum* is placed in Myriangiaceae because of similarities with *Anhelia*, both genera have ascostromata with numerous locules in the upper part and 4–7 transversely septate ascospores. *Chaetoscutula* is similar to *Pododimeria* in having the same host and septate, olivaceous-brown ascospores and thus is transferred to Pseudoperisporiaceae. *Colensoniella* has apothecioid ascomata but 1-septate oblong, uniseriately ascospores that many break in the centre form part-spores and is referred to Patellariaceae. *Cystocoleus* is a typical of any family of Dothideomycetes, but phylogenetic analysis showed this genus to cluster in Capnodiales *incertae sedis*. *Ceratocarpia* has glabrous ascomata, muriform ascospores and evanescent pseudoparaphyses so placed in Chaetothyriaceae. By illustrating the genera we hope to stimulate fresh collections so that these genera can be epitypified and molecular data analyzed to establish a truly natural classification.

**Key words:** Capnodiales, Chaetothyriaceae, Myriangiaceae, Patellariaceae, Pseudoperisporiaceae, types

### Introduction

Dothideomycetes is the largest and most diverse class of the Phylum Ascomycota and comprises an estimated 19,000 species (Hyde *et al.* 2013, Kirk *et al.* 2008). Most members of the Dothideomycetes are pathogens, endophytes or epiphytes on living plants and lichens, and saprobes on dead or partially decaying plants in leaf litter or herbivore dung (Schoch *et al.* 2006, Hyde *et al.* 2013). The primary characters that define Dothideomycetes are ascolocular ascoma and bitunicate, usually fissitunicate asci (Nannfeldt 1932, Luttrell 1955, Eriksson 1981, Barr & Huhndorf 2001, Schoch *et al.* 2009a). However these characters especially the bitunicate or fissitunicate asci are also shared in other classes, such as Chaetothyriaceae in Eurotiomycetes (Chomnunti *et al.* 2011, 2012).

In recent years, there has been several studies using phylogenetic analysis that have provided groundwork towards the classification of the Dothideomycetes (Liew *et al.* 2000, 2002, Lumbsch & Lindemuth 2001, Nelsen *et al.* 2009, 2011, Schoch *et al.* 2009a, Zhang *et al.* 2012). In the Outline of Ascomycota 2009, Lumbsch and Huhndorf (2010) indicated that there are two subclasses and eleven orders in the class Dothideomycetes. However, a further two orders, 34 families and more than 100 genera were placed in Dothideomycetes *incertae sedis* because they could not definitely be accommodated in any family or order. We have been studying the genera and families of Dothideomycetes in order to provide a natural classification of this class (Boonmee *et al.* 2011, Hyde *et al.* 2013,

Liu *et al.* 2012, Wu *et al.* 2011, Zhang *et al.* 2012). Some studies did not consider morphological characterization but concentrated on molecular phylogenetic analysis (Schoch *et al.* 2009a, Nelsen *et al.* 2009, 2011). In this paper we re-examined the generic types of some of the poorly known genera, viz. *Ascostratum*, *Chaetoscutula*, *Ceratocarpia*, *Cystocoleus* and *Colensoniella* in Dothideomycetes *incertae sedis* and we described the generic type species of each family with illustrations and discussions and suggest appropriate familial arrangements. However, because of the lack of molecular sequence data (Hyde *et al.* 2013), and the importance of the asexual state (Crous *et al.* 2009, Zhang *et al.* 2009, 2011, Liu *et al.* 2011, Hyde *et al.* 2013), fresh collections are needed in order to obtain molecular data to provide a natural taxonomic classification.

## Materials and methods

### *Specimen examination*

Type specimens were obtained from S!, K!, NY! and B!. (for full names of herbarium see <http://sweetgum.nybg.org/ih/index.php>). One or two ascomata were transferred to a slide by fine forceps and rehydrated in 3% or 5% KOH, water, Congo red and Cotton blue prior to examination. The ascomata were sectioned by a razor blade and mounted in water. The hand sections were examined under a stereoscope (Nikon ECLIPSE 80i) and photographed by a Canon 550D digital camera fitted to the microscope. Measurements were made with Tarosoft (R) Image Frame Work and all plates used were processed with Adobe Photoshop CS3. For monotypic genera a species description only is given.

## Results and discussion

### Taxonomy

**Myriangiaceae** Nyl., Mém. Soc. Sci. nat. Cherbourg 2: 9 (1854) MycoBank: MB81866

For a review of Myriangiaceae see Dissanayake *et al.* (2014). Nylander (1854) introduced this family for taxa with relatively poorly developed, yellow to black ascostromata with minute ostioles which are saprobic on bark, leaves and branches. Asci are bitunicate and ascospores have 4–7 transverse septa or are muriform (Dissanayake *et al.* 2014). *Ascostratum* has similar characters, and we suggested to transfer the genus to the family Myriangiaceae in Dissanayake *et al.* (2014).

***Ascostratum*** Syd. & P. Syd., Annl. mycol. 10(1): 41 (1912) MycoBank: MB 380

**Notes:**—*Ascostratum*, introduced by Sydow & Sydow (1912), is typified by *A. insigne* Syd. & P. Syd. The genus was placed in Dothideomycetes, genera *incertae sedis* by Lumbsch & Huhndorf (2010) while Index Fungorum (2013) accommodates the genus in family *incertae sedis* and MycoBank (2013) in the order Dothideales. *Ascostratum* is characterized by erumpent or superficial ascostromata with numerous locules scattered in the upper part of substrate, oval to globose asci, and 7–8 transverse septate, hyaline ascospores (Sydow & Sydow 1912). At present, the family Myriangiaceae, with four genera *Anhelia*, *Diplothea*, *Myriangium* and *Diplothea*, is separated from Elsinoaceae based on molecular evidence (Schoch *et al.* 2006, Hyde *et al.* 2013, Dissanayake *et al.* 2014). *Ascostratum* shows similarities with *Anhelia* in the family Myriangiaceae as both genera have numerous locules, scattered ascostromata in the upper part, and 4–7 transverse septate ascospores. The position of *Anhelia* was uncertain in Lumbsch & Huhndorf (2010), however, Danilo *et al.* (2012) accommodated this genus in Myriangiaceae based on phylogenetic analyses. The difference between these two genera is the colour and shape of the ascospores (ellipsoid to fusiform, and hyaline in *Ascostratum*, versus ovoid to oblong and brown in *Anhelia*). The type species of *Ascostratum*, *A. insigne* Syd. & P. Syd. is distinguished from *Anhelia tristis* Racib. The type of *Anhelia*, by their completely different habits (saprobic on bark of *Euphorbia* in *Ascostratum* and parasitic on the host leaves in *Anhelia*).

*Ascostratum* includes only two species in Index Fungorum (2013) viz *A. insigne* Syd. & P. Syd. and *A. cainii* Bat. & H. Maia and no phylogenetic analysis is available for either species. Based on above characters, we place *Ascostratum* in Myriangiaceae.

**Type species:** *Ascostratum insigne* Syd. & P. Syd., Anns mycol. 10(1): 41 (1912)

MycoBank: MB 214383

**Pseudoperisporiaceae** Toro, in Seaver & Palacios Chardon, Scient. Surv. P. Rico 8(1): 40 (1926) MycoBank: MB 81227

Pseudoperisporiaceae was introduced by Toro in Seaver & Chardón (1926) with the genus *Pseudoperisporium* as type and based on *Dimeriella erigeronicola* F. Stevens (Seaver & Chardón 1926) which is the type species of *Pseudoperisporium*. *Pseudoperisporium* is synonym of *Lasiostemma*, an earlier generic name. Barr (1987, 1997) finally accepted the genus *Pseudoperisporium* as a correct name for *Lasiostemma*. This family is characterized by superficial ascomata surrounded by brown mycelium at the base, with or without setae, and fusoid-ellipsoid, minutely verrucose ascospores with rounded and subacute ends (Seaver & Chardón 1926). The asexual state is *Chaetosticta* (coelomycetes), which is related to *Lasiostemma* and *Nematostoma* (Kirk *et al.* 2008; Hyde *et al.* 2013). Lumbsch & Huhndorf (2010) listed 22 genera in the family Pseudoperisporiaceae placed in Dothideomycetes *incertae sedis*. However, most genera lack molecular data and their inclusion is presently based on morphology. Molecular data is, however, available for *Brychiton* and *Lizonia* which are clearly separated in the clades Capnodiales and Pleosporales (Stenroos *et al.* 2010).

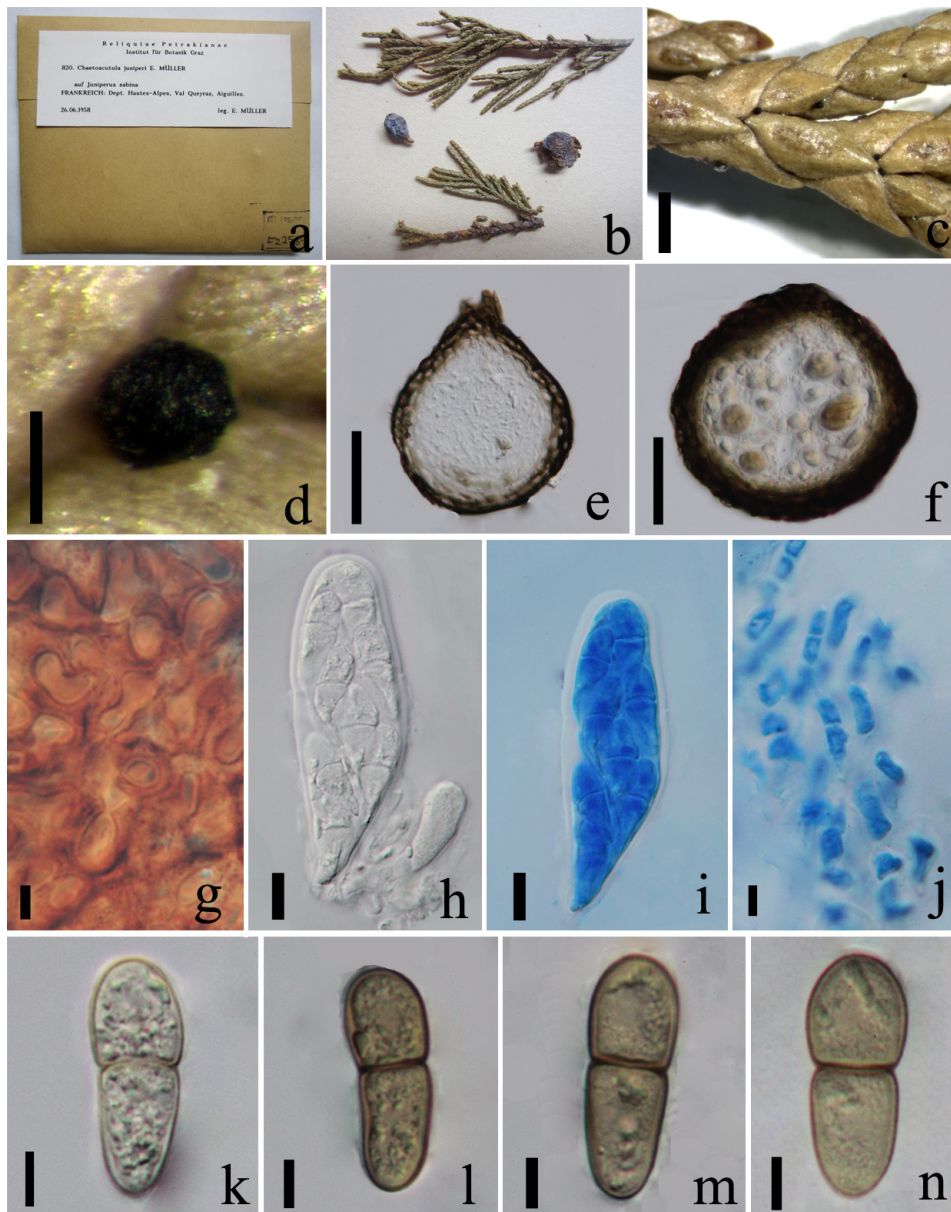
***Chaetoscutula*** E. Müll., Sydowia 12 (1–6): 190 (1959) [1958] MycoBank: MB 967 (Fig. 1)

**Notes:**—A full description of this monotypic genus is given by Müller (1958). The genus is characterized by hemispherical ascomata with long and brown dense, setiferous hyphae without hyphopodia and 2-celled, olivaceous-brown, ovoid to ellipsoidal ascospores. The relationship of this taxon to other fungi within the class is uncertain as indicated in Lumbsch & Huhndorf (2010), while Index Fungorum (2013) places the genus in family *incertae sedis* and MycoBank (2013) in the order Dothideales. No molecular data is available for this genus. *Chaetoscutula* is similar to *Pododimeria* in Pseudoperisporiaceae as ascomata are superficial, with or without setae, ascospores 1-septate, olivaceous-brown and both subsist on the same host, *Juniperus* sp. (Müller 1958, Hyde *et al.* 2013), and also the type species *C. juniperi* shares the same host *Juniperus* sp. with *Muellerites juniper*, the latter being placed in Dothidotthiaceae (Dai *et al.* 2014). *C. juniperi* has broadly clavate asci and 1-septate ascospores with rounded ends, and is similar to *Pododimeria gallica*. Based on the combination of the above characters, we transfer the genus to the family Pseudoperisporiaceae. Although we did not examine the holotype collected by E. Müller, the specimen in S that we examined was collected by the same collector and describing author from the same host two years later and can therefore be considered authentic.

**Type species:**—*Chaetoscutula juniperi* E. Müll., Sydowia 12(1–6): 191 (1959) [1958] MycoBank: MB 294737

*Parasitic* or *saprobic* on leaves of *Juniperus sabina*. Sexual state: *Ascomata* 92–127  $\mu\text{m}$  ( $\bar{x}$  = 95  $\mu\text{m}$ ,  $n$  = 8) diam., 94–200  $\mu\text{m}$  high, solitary, scattered, superficial on the leaves and easily removed, globose to subglobose, black, sometimes with long and brown setae. *Ostiole* inconspicuous. *Peridium* 17–37  $\mu\text{m}$  thick at the base, 26–38  $\mu\text{m}$  at the sides, thinner at the apex, 1-layered, composed of small, brown, thick-walled cells of *textura angularis*, with cells up to 5  $\times$  8  $\mu\text{m}$ . *Hamathecium* composed of 2–3  $\mu\text{m}$  broad, transversely septate, long, branched or simple, cellular, hypha-like pseudoparaphyses, encircling the asci and embedded in a gelatinous matrix. *Asci* 55–73  $\times$  18–25  $\mu\text{m}$  ( $\bar{x}$  = 65  $\times$  22  $\mu\text{m}$ ,  $n$  = 10), 8-spored, bitunicate, cylindrical to broadly clavate or ellipsoid, short-pedicellate, without a conspicuous ocular chamber. *Ascospores* 23–27  $\times$  7–10  $\mu\text{m}$  ( $\bar{x}$  = 24  $\times$  9  $\mu\text{m}$ ,  $n$  = 10), bi-seriate, ellipsoid to fusiform, 1-septate, constricted at the septum, with dark septum, rounded at both ends, with upper wider cell and lower narrow and longer cell, hyaline, later turning brown on senescence, 2-walled, with outer thick and smooth wall, guttulate. Asexual state: Unknown.

**Material examined:**—FRANCE. Alpes-Côte d’Azur: Frankreich, Dept. Hautes-Alpes, Val Queyras, Aiguilles, on the living leaves of *Juniperus sabina* (Cupressaceae), 26 June 1958, E. Müller (S F225899!).



**FIGURE 1.** *Chaetoscutula juniper* (S F225899) a, b. Herbarium material. c, d. Ascomata on the host surface or embedded in the leaves of *Juniperus sabina*. e, f. Hand section of perithecium. g. Peridium cells. h, i. Asci with ascospores. j. Hamathecium. k–n. Ascospores. Scale bars: c = 1000 µm, d = 100 µm, e, f = 50 µm, g, j–n = 5 µm, h, i = 10 µm.

### Capnodiales Woron., *Annls mycol.* 23(1/2): 177 (1925)

Woron (1925) introduced the order Capnodiales and which incorporates pathogens, endophytes, saprobes and epiphytes and several lichenized species (Schoch *et al.* 2006, 2009a).

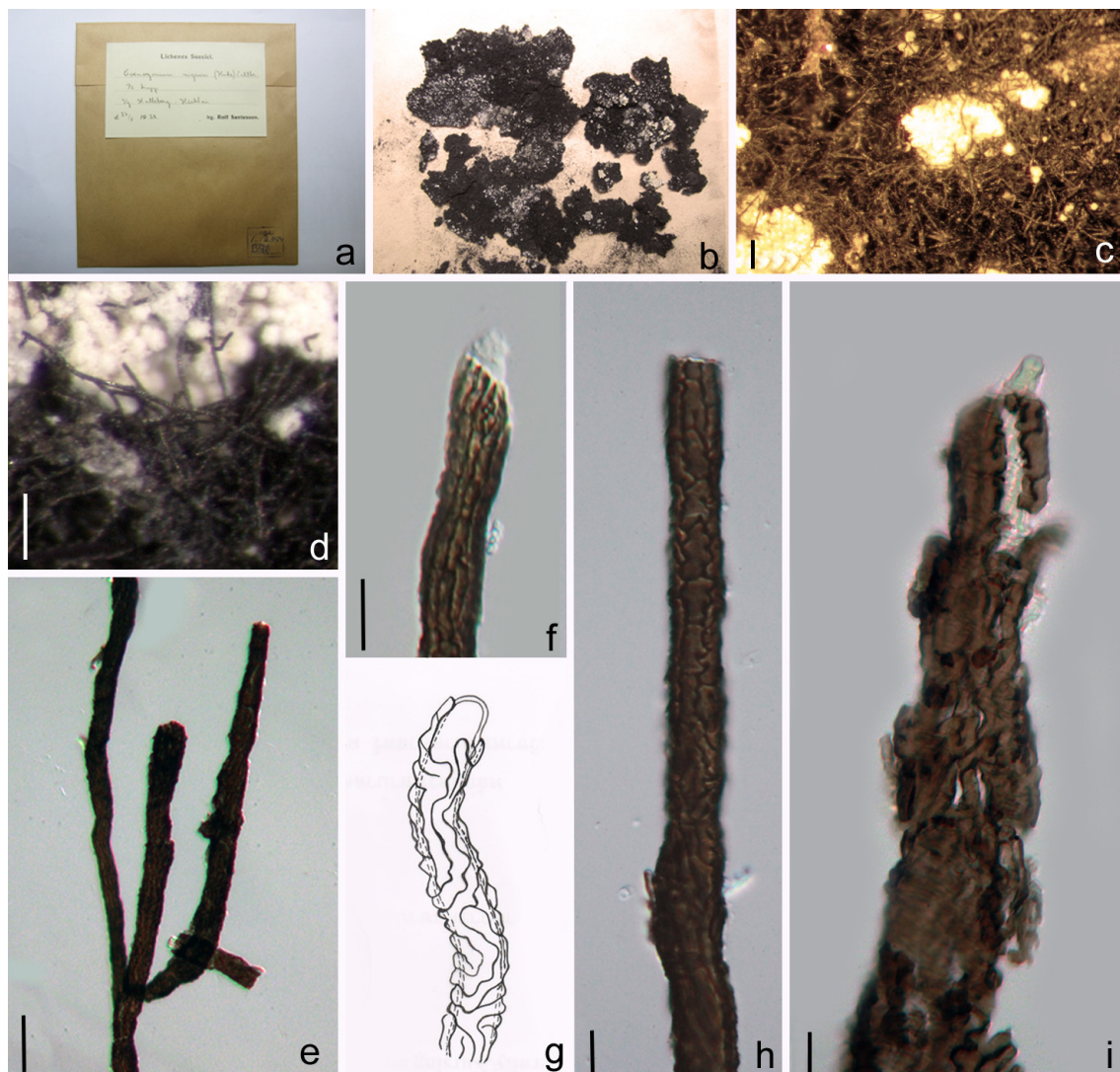
### *Cystocoleus* Thwaites, *Ann. Mag. nat. Hist., Ser. 2* 3: 241 (1849) MycoBank: MB 7892 (Fig. 2)

*Thallus* superficial, dense, fluffy, pale to fuscous, brown or black, filamentous. *Filaments* sub-erect, decumbent or spreading on the surface, sympodially branched, narrow, brittle and surrounded by contorted, nodulose, hyaline, thick- and smooth-walled, undulate to corrugated fungal hyphae, running the length of filaments of the photobiont, *Trentepohlia*. Spines lacking.



**Notes:**—Typified by *Cystocoleus ebeneus* (Dillwyn) Thwaites, *Cystocoleus* was introduced by Thwaites (1849). The genus is characterized by forming thalli comprising small black, dense, brown to dark fluffy patches and brittle filaments surrounded by contorted, nodulose hyphae. The genus presently comprises three species (Index Fungorum 2013). *Cystocoleus ebeneus* can be compared with *Racodium rupestre* Dill. as both have orange-pigmented *Trentepohlia* photobionts, but the hyphae of *C. ebeneus* are shorter and less contorted (Muggia *et al.* 2008). In a phylogenetic analysis, *C. ebeneus* is not close to lichenized members and rather belongs to Capnodiales (Muggia *et al.* 2008). Crous *et al.* (2009) subsequently conducted a more detailed analysis of Capnodiales and found it clustered in Teratosphaeriaceae. However, Hyde *et al.* (2013), following a phylogenetic analysis, suggested that *Cystocoleus* should be placed in Capnodiales *incertae sedis*. The specimens that we examined is not the holotype, but it was collected by Rolf Santesson.

**Type species:**—*Cystocoleus ebeneus* (Dillwyn) Thwaites, Ann. Mag. nat. Hist., Ser. 2, 3: 241 (1849) MycoBank: MB384110



**FIGURE 2.** *Cystocoleus ebeneus* (S L12854) a, b. Herbarium material. c, d. Detail of lichenized thallus on the host surface. e–f, h–i. Filament. g. Detail of dentate hyphal walls (redrawing from Smith 1911). Scale bars: c, d = 200 µm, e = 50 µm, f–i = 10 µm.

*Thallus* superficial, dense, fluffy, similar to patches of sparse, fuscous brown to black, filamentous. *Filaments* 9–21 µm wide ( $\bar{x}$  = 16 µm, n = 10), decumbent or spreading on the surface, brittle, spiky branched, with outer wall undulating and irregularly corrugated. *Single filament* ensheathed by fungal hyphae. *Hyphae* in a single layer, 3–7 µm wide, hyaline, nodulose, forming associations with orange-pigmented *Trentepohlia* algae and running the

length of filaments of the photobiont, thick- and smooth-walled, forming tight sheaths around them, undulate to corrugated. Spines lacking. No spores reported and observed.

**Material examined:**—SWEDEN. Västergötland: Halleberg, Häcklan, on stairs, 24 May 1932, *Rolf Santesson* (S L12854!).

**Patellariaceae** Corda, *Icones Fungorum* 2: 37 (1838) MycoBank: MB 81111

Synonym:

Lecanidiaceae O.E. Erikss., *Op. bot. Soc. bot. Lund* 60: 78 (1981)

Patellariaceae may have a close relationship with Hysteriaceae because of the bitunicate ascal character (Luttrell 1951). Thus the family Patellariaceae was placed in Pleosporales by Luttrell (1951, 1955, 1973) based on bitunicate asci. Müller & von Arx (1962) and von Arx & Müller (1975) suggested that Patellariaceae should be placed in Dothiorales, and Barr (1979) reinstated *Patellaria* in Patellariaceae together with five other genera followed by the arrangement in Dothiorales. Hawksworth and Eriksson (1986) transferred Patellariaceae to Patellariales and this was accepted by Barr (1987). The genera of Patellariaceae have been revised by several researchers (Samuels *et al.* 1979, Pirozynski & Reid 1966, Petrini *et al.* 1979, Hafellner 1979, Eriksson & Hawksworth 1993). Kutorga & Hawksworth (1997) monographed twelve accepted genera in Patellariaceae. Zhang & Hyde (2009) transferred *Pseudoparodia* into Patellariaceae. Boehm *et al.* (2009) and Schoch *et al.* (2009b) exclude *Rhytidhysterion* and *Banhegyia* from Patellariaceae, the latter based on bristle-like ascospore appendages (Sanderson *et al.* 2009). At present, there are 15 genera listed in Patellariaceae (Lumbsch & Huhndorf 2010). Patellariaceae is characterized by superficial, dark, cup-shaped or discoid apothecia with carbonaceous peridia, bitunicate, cylindrical to clavate asci and obovoid or oblong, hyaline to light brown ascospores (Hyde *et al.* 2013).

**Colensoniella** Hafellner, *Nova Hedwigia*, Beih. 62: 160 (1979) MycoBank: MB 1172 (Fig. 3)

*Saprobic* on bark in terrestrial habitats. Sexual state: *Apothecia* 900–2400 µm wide × 400–800 µm high ( $\bar{x}$  = 2000 × 650 µm, n = 10), superficial, dense, gregarious or solitary, discoid to circular, sometimes variable in shape, brown to black, with slightly raised margins. *Hymenium* up to 573 µm, thicker at base, thinner at apex and sides, composed of sterile filaments and asci, supported within an excipulum composed of sparingly branched anchoring hyphae emerging from the underside of fruiting structure, with globose and subglobose cells forming a flattened *textura globulosa*. *Hamathecium* comprising long, dense, septate, hyaline pseudoparaphyses, apically filaments forming a reddish-brown epithecium above the asci, immersed in mucilage. *Asci* 95–219 × 7–13 µm ( $\bar{x}$  = 156 × 10 µm, n = 10), 8-spored, bitunicate, clavate to cylindrical, long pedicellate, apically rounded with an indistinct ocular chamber. *Ascospores* 8–11 × 5–7 µm ( $\bar{x}$  = 10 × 6 µm, n = 10), uniseriate or overlapping uniseriate, oblong, one-septate, obtuse at both ends, light brown to dark brown, thick- and smooth-walled, breaking in the centre to form cuneiform part-spores. Asexual state: Unknown.

**Notes:**—Hafellner (1979) introduced the genus *Colensoniella* based on *C. torulispora* (= *Patellaria torulispora*). The genus is monotypic and referred to Dothideomycetes, genera *incertae sedis* (Cooke 1886, Dennis 1961, Hafellner 1979, Lumbsch & Huhndorf 2010). This genus is saprobic on bark in terrestrial habitats and characterized by superficial apothecia with raised margins, 8-spored asci, oblong ascospores which break into two part spores at maturity (Cooke 1886, Hafellner 1979).

At present, the placement of *Colensoniella* is uncertain. Based on the combination of above primary characters, *Colensoniella* shares similar characters with the members of family Patellariaceae. Both *Colensoniella* and *Patellaria* have scattered, apothecioid, superficial ascomata, isodiametric, thick-walled, dark brown exciple cells, and filiform, hyaline pseudoparaphyses forming an epithecium around the asci. *Colensoniella* differs from other genera in Patellariaceae in having uniseriate, oblong ascospores with 1 septa, breaking in the centre to form cuneiform part-spores.

Presently, *Colensoniella* is monotypic and molecular data is lacking. We therefore placed *Colensoniella* in Patellariaceae based on similarities in morphology.



**Type species:**—*Colensoniella torulispora* (W. Phillips) Hafellner, Beih. Nova Hedwigia 62: 160 (1979)  
MycoBank: MB 311449

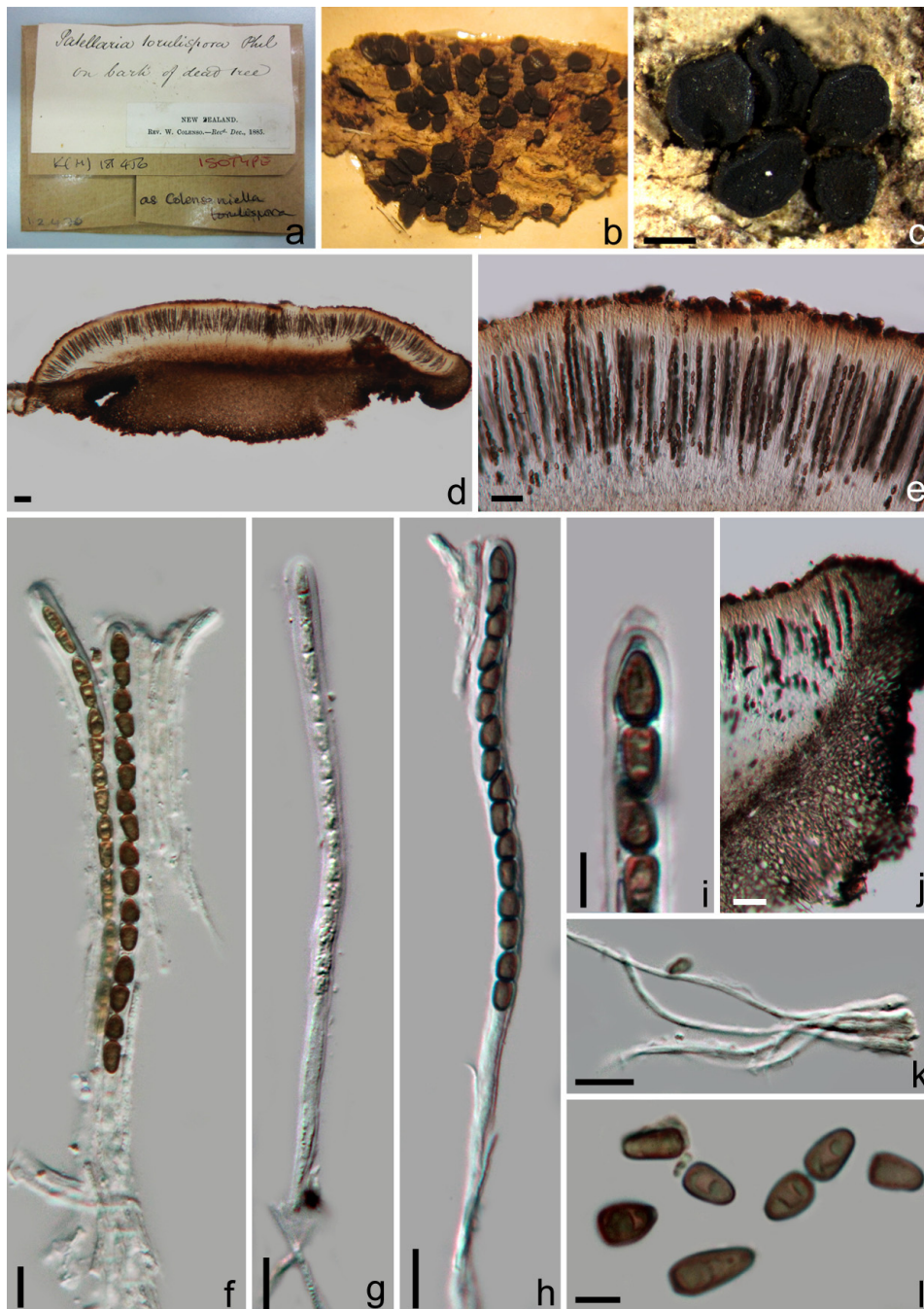
Synonym:

*Eutrybliella torulispora* (W. Phillips) Dennis, Kew Bull. 15(2): 316 (1961)

*Karschia torulispora* (W. Phillips) Sacc., Syll. fung. (Abellini) 8: 781 (1889)

*Patellaria torulispora* W. Phillips, Grevillea 15(73): 16 (1886)

**Material examined:**—NEW ZEALAND. On dead bark, December 1885, *William Colenso 144* (K(M) 181456!, isotype).



**FIGURE 3.** *Colensoniella torulispora* (K(M) 181456, isotype) a, b. Herbarium material. c. Apothecia on host surface. d–e. Hand section of mature apothecium. f–i. Asci with ascospores. j. Subhymenium and excipulum cells. k. Hamathecium. l. Part ascospores. Scale bars: c = 1000  $\mu$ m, d = 50  $\mu$ m, e, j = 20  $\mu$ m, f–h, k = 10  $\mu$ m, i, l = 5  $\mu$ m.

**Chaetothyriales** M.E. Barr, Mycotaxon 29: 502 (1987)

The order Chaetothyriales was introduced by Barr (1987) and incorporated eight families. Chaetothyriales is characterized by erumpent to superficial ascomata formed on a subiculum, with a periphysate ostiole (Kirk *et al.* 2001). Asci are saccate to clavate, with a fissitunicate mode of dehiscence and an ocular thickening in the apical region. Spores are hyaline to pale grey, and transversally septate to muriform. Taxa in this group have fissitunicate, bitunicate asci which is the central character of members of the Dothideomycetes. However, according to molecular data, Chaetothyriales is more closely related to Eurotiales and was therefore transferred to the class Eurotiomycetes (Spatafora *et al.* 1995, Berbee 1996, Winka *et al.* 1998, Haase *et al.* 1999). This taxonomic position has been confirmed in recent molecular studies (Miadlikowska & Lutzoni 2004, Lutzoni *et al.* 2004, Reeb *et al.* 2004, Schoch *et al.* 2006). At present, the order Chaetothyriales includes two families of non-lichenized ascomycetes, the Chaetothyriaceae and Herpotrichiellaceae (Geiser *et al.* 2006, Kirk *et al.* 2008).

**Chaetothyriaceae** Hansf. ex M.E. Barr, Mycologia 71(5): 943 (1979) MycoBank: MB 80584

Chaetothyriaceae was introduced by Hansford (1946). Species of Chaetothyriaceae are characterized by dark mycelium which are adpressed to the surface of leaves and stems but do not penetrate the host tissues. Ascomata form beneath an external hyphal mat and have or lack setae (Batista & Ciferri 1962, Pereira *et al.* 2009, von Arx & Müller 1975). As Chaetothyriaceae shared bitunicate asci with members of the Dothideomycetes, Eriksson (1982) referred the family to the order Dothideales. However, in recent years, a number of studies provided molecular data to confirm the placement of Chaetothyriales away from Dothideomycetes in the Eurotiomycetes. Other newly described species clustered in the Chaetothyriaceae providing much needed confirmatory data for the family (Badali *et al.* 2008, Berbee 1996, Chomnunti *et al.* 2012 b, Haase *et al.* 1999, Gueidan *et al.* 2008, Schoch *et al.* 2006, Spatafora *et al.* 1995, Untereiner 2000, Winka *et al.* 1998). Currently, there are nine genera listed in Chaetothyriaceae, we also include *Ceratocarpia* following the present study.

**Ceratocarpia** Rolland, Bull. Soc. mycol. Fr. 12: 2 (1896) MycoBank: MB 884 (Fig. 4)

*Saprobic* on twigs in terrestrial habitats. Sexual state: *Ascomata* numerous, gregarious, sub-immersed in *thallus* of dark brown or black subiculum, not easily removed, globose to subglobose. *Ostiole* inconspicuous, black. *Peridium* comprising two layers, outer layer consisting of heavily pigmented pseudoparenchymatous dark brown cells, inner layer composed of wide, light brown cells of *textura angularis*. *Pseudoparaphyses* lacking or evanescent, asci embedded in mucilage. *Asci* 8-spored, bitunicate or fissitunicate, clavate to broadly clavate, pedicellate, lacking a distinct ocular chamber. *Ascospores* bi-seriate or multi-seriate, ellipsoid to fusiform, dictyosporous, constricted at central septum, light brown to brown, with long germ tube-like protuberance at each end. Asexual state: Unknown.

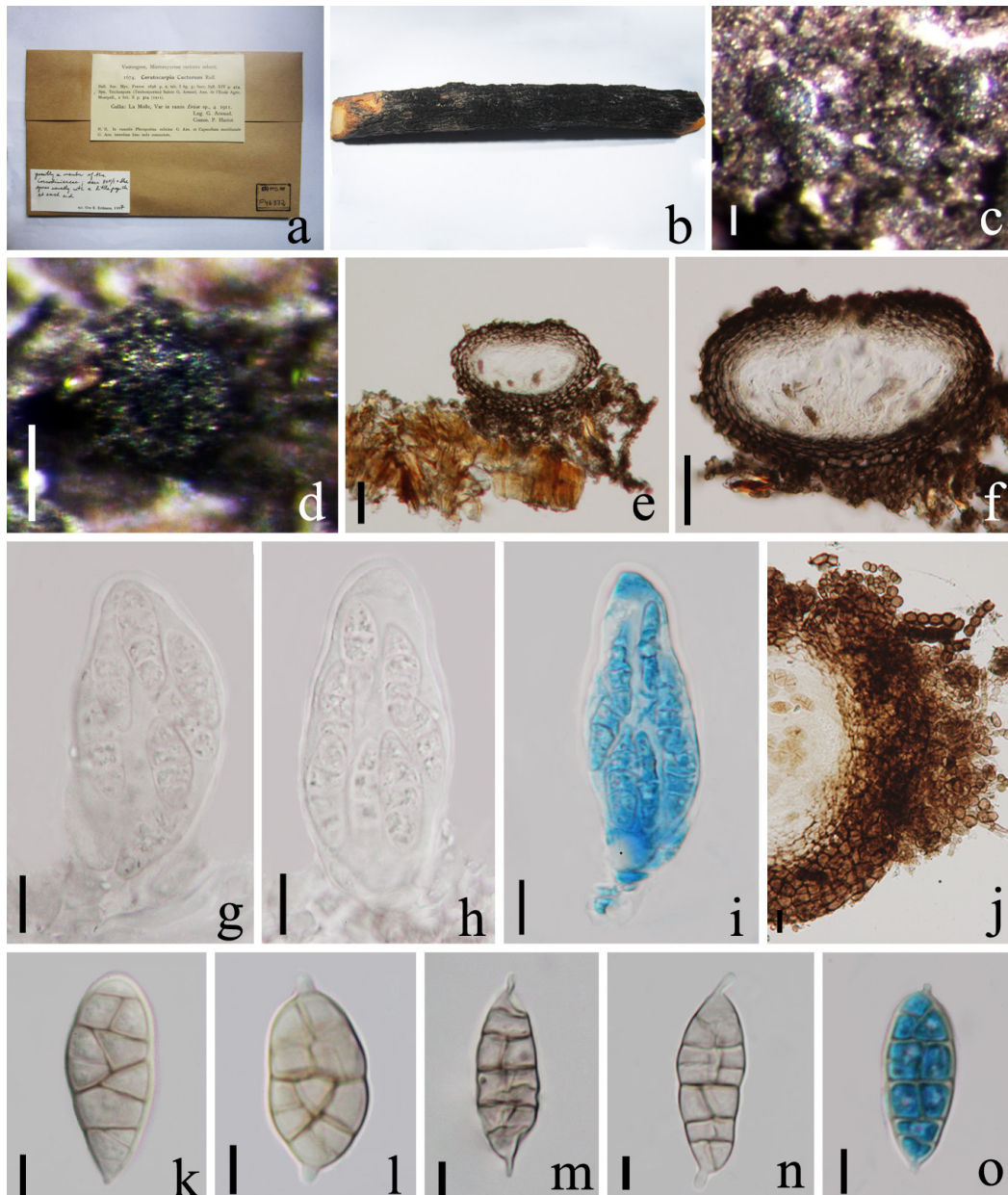
**Notes:**—*Ceratocarpia* was introduced by Rolland (1896) and is represented by *C. cactorum* Rolland. This genus is characterized by dark mycelium adpressed to the host cuticle, ascomata formed beneath an external hyphal mat and lacking setae, bitunicate or fissitunicate asci, muriform, light brown ascospores (Rolland 1896). The genus was placed in Dothideomycetes, genera *incertae sedis* by Lumbsch & Huhndorf (2010). Three species are listed in Index Fungorum (2013). No molecular data is available for any of these species. *Ceratocarpia* shares several similar characters with the family Chaetothyriaceae. Based on morphological features, *Ceratocarpia* is related to *Chaetothyrium*, both having similar glabrous ascomata, muriform ascospores and evanescent pseudoparaphyses. Accordingly we suggest that *Ceratocarpia* be referred to family Chaetothyriaceae where it is related to *Chaetothyrium*. However, in the absence of fresh collections and molecular data, we refrain from synonymizing this genus under *Chaetothyrium*. We could not locate the type of Rolland and examined a later collection of G. Arnaud.

**Type species:**—*Ceratocarpia cactorum* Rolland, Bull. Soc. mycol. Fr. 12: 2 (1896) MycoBank: MB 217302



*Saprobic* on twigs in terrestrial habitats. Sexual state: *Ascomata* 102–234  $\mu\text{m}$  diam  $\times$  113–187  $\mu\text{m}$  high ( $\bar{x}$  = 169  $\mu\text{m}$   $\times$  128  $\mu\text{m}$ ,  $n$  = 10), dense, gregarious, sub-immersed in *thallus* of dark brown or black subiculum, not easily removable, globose to subglobose. *Ostiole* inconspicuous. *Peridium* 22–35  $\mu\text{m}$  ( $\bar{x}$  = 31  $\mu\text{m}$ ,  $n$  = 10) wide, comprising two layers, outer layer consisting of heavily pigmented pseudoparenchymatous of dark brown cells, inner layer composed of wide, light brown cells of *textura angularis*. *Pseudoparaphyses* lacking or evanescent, asci embedded in mucilage. *Asci* 30–65  $\times$  12–32  $\mu\text{m}$  ( $\bar{x}$  = 41  $\times$  18  $\mu\text{m}$ ,  $n$  = 10), 8-spored, bitunicate or fissitunicate, clavate to broadly clavate, pedicellate, lacking a distinct ocular chamber. *Ascospores* 20–32  $\times$  8–11  $\mu\text{m}$  ( $\bar{x}$  = 27  $\times$  10  $\mu\text{m}$ ,  $n$  = 10), bi-seriate or multi-seriate, ellipsoid to fusiform, dictyosporous, constricted at central septum, light brown to brown, with up to 4  $\mu\text{m}$  long germ tube-like protuberance at each end. Asexual state: Unknown.

**Material examined:**—FRANCE. La Molle: Var, in the branches of *Erica* sp., April 1911, G. Arnaud (S F46332!)



**FIGURE 4.** *Ceratocarpia cactorum* (S! F46332) a, b. Herbarium material. c, d. Ascomata on twigs. e, f, j. Section of ascoma. g–i. Asci with ascospores. k–o. Ascospores. Note the germ tube-like hypha on both ends. Scale bars: c, d = 100  $\mu\text{m}$ , e, f = 50  $\mu\text{m}$ , g–i = 10  $\mu\text{m}$ , j = 20  $\mu\text{m}$ , k–o = 5  $\mu\text{m}$ .

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