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# The *Cryptothecia candida* complex revisited

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**Abstract:** Revision of world-wide material of *Cryptothecia candida* sensu Santesson (1952) revealed that three different species are involved, differing in the shape of their ascomata, chemistry, and distribution. *C. candida* (Kremp.) R. Sant. s. str. [syn.: *Arthonia lacerata* Vain.; *C. epiphylla* R. Sant.] contains 2′-*O*-methylperlatolic acid and 2′-*O*-methylanziaic acid (thallus and ascomata C+ red) and has rounded to slightly irregular ascomata; it is a paleotropical species occurring in Africa and SE Asia (absent in Australia). All neotropical populations previously identified as *C. candida* contain perlatolic acid (thallus and ascomata C −) and are further characterized by their well-delimited, regularly rounded ascomata. The name *Cryptothecia filicina* (Ellis & Everh.) Lücking & G. Thor comb. nov. [bas.: *Ascomycetella filicina* Ellis & Everh.; syn.: *Myxotheca hypocreoides* Ferd. & Winge] is taken up for this taxon. A third species was discovered in material from Australia and China (Hong Kong) and is here described as *Cryptothecia irregularis* Lücking, Aptroot, Kalb & Elix sp. nov. Its ascomata are radiately elongate and it contains psoromic, subpsoromic, 2′-*O*-demethylpsoromic, and confluentic acids.

**Key words:** *Arthonia lacerata*, *Ascomycetella filicina*, *Cryptothecia irregularis*, foliicolous lichens, *Myxotheca hypocreoides*, Neotropics, Paleotropics

## Introduction

*Cryptothecia* Stirt. (with the type species *C. subnidulans* Stirt.) is a conserved name with two generic synonyms: *Myriostigma* Kremp. (antedates *Cryptothecia*) and *Myxotheca* Ferd. & Winge. The last two are based on a taxon given by Santesson (1952) as one of the most common and widespread species of the genus: the chiefly foliicolous *Cryptothecia candida* (Kremp.) R. Sant. Santesson (1952) described *C. candida* as a species with well-organized, white ascigerous areas (ascomata), sharply delimited from the usually greenish thallus, easily distinguished even from a distance, and 8-spored asci. He did not include chemical characters in his description.

In a revision of *Cryptothecia* from Australia and New Zealand, Thor (1997) described the new species *C. inexspectata* from Australia, differing from *C. candida* by its 1-spored asci, more irregular ascomata and exclusively hypophyllous growth. *Cryptothecia inexspectata* was found to contain gyrophoric acid, the thallus and ascomata reacting C+ orange-red, and since the same reaction was detected in *C. candida*, Thor (1997) concluded that the latter species also contained gyrophoric acid. However, in the framework of a Flora Neotropica monograph on foliicolous lichens, the first author studied a large number of collections reported from the Neotropics (e.g. Lücking 1995, 1998, 1999; Herrera-Campos *et al.* 2004), and spot tests and TLC revealed that gyrophoric acid was absent from these populations.

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We have now revised world-wide collections of *C. candida* sensu Santesson (1952), including the type material of most of its synonyms, and discovered that three different taxa are involved, distinguished by their chemistry, ascomata shape, and distribution. The three taxa are described and discussed herein, and a key to the species of the *C. candida* complex is presented. This group is here defined as including all species with greenish thallus, well-delimited, maculiform ascomata and 8-spored asci. Further foliicolous species of *Cryptothecia*, which do not belong to the *C. candida* complex, will be treated in a forthcoming paper.

### Key to the species of the *Cryptothecia candida* complex

1 Thallus and ascomata C+ red (2′-*O*-methylperlatolic and 2′-*O*-methylanziaic acids); ascomata rounded to slightly irregular, often forming aggregate patches. African and eastern Paleotropics (except Australia) . . . . . **Cryptothecia candida s. str.**

Thallus and ascomata C− . . . . . 2

2(1) Ascomata irregular in outline, often slightly radiately arranged; thallus PD+ yellow (psoromic acid as major and subpsoromic, 2′-*O*-demethylpsoromic, and confluentic acids as minor/trace). Eastern Paleotropics . . . . . **Cryptothecia irregularis**

Ascomata regularly rounded; thallus PD− (perlatolic acid). Neotropics . . . . . **Cryptothecia filicina**

## The Species

### Cryptothecia candida (Kremp.) R. Sant.

*Symb. Bot. Upsal.* **12**(1)**:** 65 (1952); *Myriostigma candidum* Kremp., *Lichenes Foliicolae Quos Legit O. Beccari Annis 1866–1867 In Insula Borneo*: 22 (1874); Krempelhuber, *Nuovo Gior. Bot. Ital.* **7:** 45 (1875); type: Malaysia (Borneo), *Beccari* 224aa (M—lectotype, here selected!), 224ab (paratype!).

*Arthonia lacerata* Vain., *Catal. Welw. Afr. Pl.* **2:** 446 (1901); Santesson, *Symb. Bot. Upsal.* **12**(1)**:** 66 (1952); type: Angola, *Welwitsch* 317 (LISU—holotype!).

*Cryptothecia epiphylla* R. Sant., *Svensk. Bot. Tidskr.* **39:** 4 (1945); Santesson, *Symb. Bot. Upsal.* **12**(1)**:** 66 (1952); type: Indonesia (Sumatra), *Schröter* 1 (S—holotype!).

(Fig. 1A & B)

*Thallus* foliicolous or corticolous on smooth bark or bamboo, epiphyllous or sometimes hypophyllous, continuous but marginally often effuse, smooth to indistinctly farinose-byssoid, 10–50(–80) mm across and 15–25 µm thick, ecorticate, pale greyish green, matt, with colourless, hydrophobic crystals dissolving in K. *Photobiont* a species of *Trentepohlia*, cells rounded to oblong, 8–13 × 5–8 µm, in irregular plates or short threads leaving large interspaces.

*Ascomata* (ascigerous areas) erumpent, slightly raised above thallus level, rounded to angular or irregular in outline, 0·5–2·5 mm diam. and 100–120 µm high, white to pale greenish or yellowish white and with darker dots indicating individual asci. *Ascigerous layer* covered by 15–25 µm high, algiferous thallus layer. *Ascigerous layer* 70–100 µm high, dark grey due to inspersion of paraphyses with numerous small crystals (dissolving in K), I+ bluish, KI+ blue then greenish. *Asci* obovate to globose, shortly stalked, 70–95 × 60–80 µm, I−, KI−. *Ascospores* (6–)8 per ascus, oblong-ellipsoid, muriform, with very slight constrictions at septa, 45–65 × 15–25 µm, 2·5–3·5 times as long as broad, colourless.

*Pycnidia* not observed.

*Chemistry.* 2′-*O*-methylperlatolic and 2′-*O*-methylanziaic acids (thallus and ascomata C+ red because of the latter).

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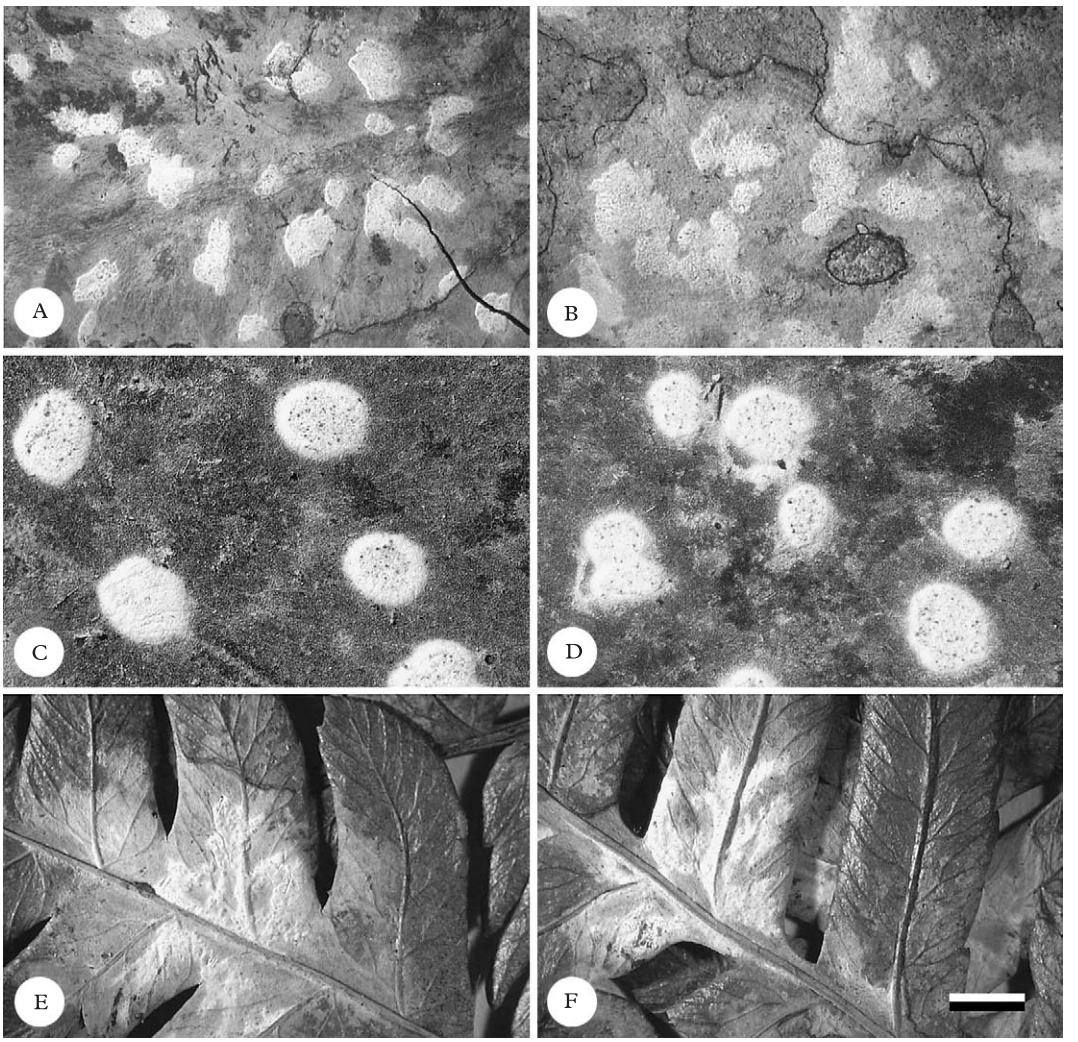



FIG. 1. The *Cryptothecia candida* complex, habit of the species. A & B. *C. candida* s. str. (A, lectotype; B, holotype of *C. epiphylla*). C & D. *C. filicina*. E & F. *C. irregularis* (paratype). Scale=2 mm in A, B, C, D; =1 mm in E & F.

*Distribution*. African and Eastern Paleotropics (except Australia). Specimens have been reported (most of them checked by us) from Democratic Republic of Congo [*Lisowski* 44844 (M); *Lisowski* 45079 (Vězda: *Lich. Sel. Exs.* 1601)], Angola [the holotype of *Arthonia lacerata*], Sri Lanka [*Almquist* s.n. (S)], Malaysia (Malaya; Borneo) [*Ceni & Vězda* s.n. (Vězda: *Lich. Rar. Exs.* 312); the lectotype], Indonesia (Sumatra, Java, Borneo) [holotype of *Cryptothecia epiphylla*; *Palm* 39a, 52 (UPS); *Schröter* 2a (UPS); *Massart* 845 (UPS); *Nyman* 28a, 78d, 84a (all UPS), s.n. (M); *Elmer* 21824 (S)], the Philippines [*Nyman* 844a (UPS); *Robinson* s.n. (UPS)], and Papua New Guinea (New Guinea, Bismarck Archipelago) [*Clemens* s.n. (UPS); *Nyman* 57a (UPS); *Rechinger & Rechinger* 5184 (W)]. Specimens reported from the Neotropics by Santesson (1952) belong to *Cryptothecia filicina*; some other specimens, for example from Uganda [*Hedberg* 804:11b (UPS)], do not belong to species of the

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*C. candida* aggregate (for collection details see Santesson 1952: 68).

*Notes*. *Cryptothecia candida* is recognized by its C+ red thallus and ascomata, which are often irregularly aggregated. *Cryptothecia inexspectata* G. Thor (Thor 1997) from Papua New Guinea (E. Sérusiaux, pers. comm. 2003) and Australia also has C+ red thallus and ascomata, but its ascomata are irregulary dispersed, its asci are 1-spored, and the C-reaction is caused by gyrophoric acid.

We analyzed a number of specimens of *Cryptothecia candida* from the Paleotropics and, to our surprise, none of them contained gyrophoric acid, although there is always a distinct C+ red reaction of the thallus and apothecia. This reaction is caused by 2′-*O*-methylanziaic acid, a rare substance otherwise known from the unrelated genera *Lecidea* and *Hypotrachyna*.

The type specimens of *Myriostigma cardinale* Kremp. and *Arthothelium dictyophorum* Müll. Arg., listed as possible synonyms of *Cryptothecia candida* by Santesson (1952), do not belong to that taxon, nor to the other species of the *C. candida* complex; they do not have the compact, maculiform ascomata of the species of the *C. candida* complex and seem to be more closely related to corticolous taxa with asci scattered over the thallus. There are also at least two further foliicolous species with C+ red reaction of thallus and ascomata in the Paleotropics, but these have a different morphology and will be treated in a forthcoming paper.

The type material of *Myriostigma candidum* in M was indicated as 'holotype' by Santesson (1952). According to annotation slips present in the type collection, Groenhart revised the material in 1959 and observed that it consists of several collections, which he separated as 224a–g; he then designated 224a as lectotype (unpublished) and 224b–g as isolectotypes. Our revision revealed that the type material is composed of collections from three different leaves: 224a consists of one piece of an aroid and another piece of a cyclanthoid or palm leaf, while 224b–g represent several pieces of a single dicotyledonous leaf. Both pieces of collection 224a carry well-developed and typical thalli of *M. candidum*, while those of 224b–g are depauperate and difficult to identify with certainty, although most probably representing a species different from collection 224a. According to ICBN Art. 9.4, all these collections are to be considered syntypes, which requires the selection of a lectotype (here designated). Since the lectotype selected by Groenhart (224a) consists of two pieces of leaves from two different phorophyte plants and is thus heterogeneous, even if both pieces carry the same lichen species, we selected the larger aroid leaf piece (224aa) as lectotype. The remainder of Groenhart's lectotype (224ab) then becomes a paratype, as do 224b–g.

## Cryptothecia filicina (Ellis & Everh.) Lücking & G. Thor comb. nov.

*Ascomycetella filicina* Ellis & Everh., *J. Mycol.* **2:** 247 (1893); Santesson, *Symb. Bot. Upsal.* **12**(1)**:** 66 (1952); type: Jamaica, *Henderson* s.n. (n.v.).

*Myxotheca hypocreoides* Ferd. & Winge, *Bot. Tidskr.* **30:** 212 (1910); Santesson, *Symb. Bot. Upsal.* **12**(1)**:** 66 (1952); type: Trinidad, *Lassen* s.n. (C—holotype).

(Fig. 1C & D)

*Thallus* foliicolous or corticolous on smooth bark or bamboo, epiphyllous or often hypophyllous, continuous but marginally often effuse, smooth to indistinctly farinose-byssoid, 10–50 mm across and 15–35 μm thick, ecorticate, pale greyish green, matt, with colourless, hydrophobic crystals dissolving in K. *Photobiont* a species of *Trentepohlia*, cells rounded to oblong, 8–15 × 4–6 μm, in irregular plates or short threads leaving large interspaces.

*Ascomata* (ascigerous areas) erumpent, slightly raised above thallus level, rounded to somewhat irregular in outline, 0·8–3 (–5) mm diam. and 100–140 μm high, white to pale greenish white and usually with darker dots indicating individual asci. *Ascigerous layer* covered by 15–25 μm high, algiferous thallus layer. *Ascigerous layer* 70–110 μm high, dark grey due to inspersion of paraphyses with numerous small crystals

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(dissolving in K), I+ bluish, KI+ blue then greenish. *Asci* obovate to globose, shortly stalked, 60–90 × 50–70 µm, I −, KI −. *Ascospores* (6–)8 per ascus, oblong-ellipsoid, muriform, with very slight constrictions at septa, 40–80 × 15–25 µm, 2·5–3·5 times as long as broad, colourless.

*Pycnidia* not observed.

*Chemistry*. Perlatolic acid (thallus and ascomata C −).

*Distribution*. Neotropical. Specimens have been reported from Mexico, Costa Rica, Panama, Cuba, Guadeloupe, Trinidad and Tobago, Colombia, Venezuela, Guyana, French Guiana, Ecuador, Peru, and Brazil. For an extensive list of specimens revised, see Lücking (2006).

*Notes*. *Cryptothecia filicina* is distinguished from *C. candida* s. str. by its C − thallus and ascomata, which are also more regularly rounded and more prominent. Both taxa also have non-overlapping distribution patterns, *C. filicina* being widely distributed in the Neotropics but absent from the Paleotropics. The eastern paleotropical *C. irregularis* also has C − thallus and ascomata but a different chemistry (psoromic, subpsoromic, 2′-*O*-demethylpsoromic, and confluentic acids) and more irregular ascomata which are often radiately arranged.

*Cryptothecia filicina* is among the most common lichen species in neotropical lowland and lower montane rainforests. It is particularly abundant on leaves of *Araceae* (*Anthurium*, *Monstera*, *Philodendron*), palms and epiphytic *Cactaceae*; well-developed specimens can also be commonly found on the rachis of palm leaves, on bamboo culms, and on thin, smooth twigs. There are a few other foliicolous species of *Cryptothecia* in the Neotropics that can be distinguished by their morphology and do not belong to the *C. candida* aggregate; they will be treated in a forthcoming paper. The most common is the possibly pantropical *C. effusa* (Müll. Arg.) R. Sant., which has individual asci arranged in more or less radiating rows or very irregular patches and contains two further, unknown substances besides perlatolic acid.

## Cryptothecia irregularis Lücking, Aptroot, Kalb & Elix sp. nov.

Sicut *Cryptothecia filicina* sed apotheciis irregularibus et acidum psoromicum continente differt.

Typus: Australia, Queensland, Barron Falls Station of the skyrail, a few km N of Cairns, in submontane tropical rainforest with *Araucaria cunninghamii*, *Cyathea cooperi*, *Ficus destruens*, *Alstonia* sp., *Xanthostemon* sp., 16°50′50″S, 145°40′15″E, 500 m, 29 August 2002, *Kalb* 34945 (CANB—holotypus; hb. Kalb—isotypus); China, Hong Kong, New Territories, Tai Po Kau, 22°25′N, 114°11′E, 150 m, near Nature Trail, in secondary forest, on leaves, 9 July 2000, *Aptroot* 48821 (ABL − paratypus).

(Fig. 1E & F)

*Thallus* foliicolous, epiphyllous, continuous, smooth to indistinctly farinose-byssoid, 10–30 mm across and 10–20 µm thick, ecorticate, greenish grey, matt, with colourless, hydrophobic crystals dissolving in K. *Photobiont* a species of *Trentepohlia*, cells rounded to oblong, 7–12 × 5–8 µm, in irregular plates or short threads leaving large interspaces.

*Ascomata* (ascigerous areas) erumpent, slightly raised over thallus level, irregular in outline and usually radiately elongated, 0·5–2·0 mm diam. and 120–150 µm high, white and with darker dots indicating individual asci. *Ascigerous layer* covered by 15–25 µm high, algiferous thallus layer. *Ascigerous layer* 70–100 µm high, dark grey due to inspersion of paraphyses with numerous small crystals (dissolving in K), I+ bluish, KI+ blue then greenish. *Asci* obovate to globose, shortly stalked, 100–150 × 40–70 µm, I −, KI −. *Ascospores* 8 per ascus, oblong-ellipsoid, muriform, with very slight constrictions at septa, 50–70 × 15–30 µm, 2·5–3·5 times as long as broad, colourless.

*Pycnidia* not observed.

*Chemistry*. Psoromic acid (major), subpsoromic acid (minor), 2′-*O*-demethylpsoromic acid (minor), confluentic acid (trace; thallus and ascomata C −).

*Distribution*. Eastern Paleotropics (including Australia). The collections previously

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reported as *Cryptothecia candida* from Hong Kong (Aptroot & Sipman 2001) belong to this species, while those reported from Australia (Vězda & Kalb 1991) belong in part to this species and in part to *C. effusa* (Müll. Arg.) R. Sant. (*C. candida* s. str. apparently does not occur in Australia).

*Notes*. This new species differs from *Cryptothecia candida* s. str. by its C − thallus and ascomata and the presence of psoromic acid and three further substances. In addition, the ascomata are more irregular in outline and often radiately elongated. The species resembles *C. effusa* and *C. exilis* G. Thor (Santesson 1952; Thor 1997), but the last two have individual asci arranged in irregular to radiate rows and a different chemistry; *C. effusa* containing perlatolic acid and two unknown substances, while *C. exilis* contains psoromic acid only. The neotropical *C. filicina* also has a C– thallus but has regularly rounded ascomata and contains perlatolic acid.

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