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Two new foliicolous species of *Enterographa* (*Roccellaceae*) from Kenya

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Abstract: *Enterographa fellhaneroides* and *E. meklitiae* are described as new to science from Kakamega Forest in Western Kenya. The latter overgrows the thallus of a foliicolous non-filamentous *Coenogonium* and the former most probably has the same ecology. Both species appear to be closely related to *E. brezhonega* and *E. epiphyllum*.

Key words: *Coenogonium*, *Enterographa fellhaneroides*, *Enterographa meklitiae*, lichens, *Plectocarpon*, *Sclerophyton*

Introduction

The lichen genus *Enterographa* Fée (*Roccellaceae*) has been expertly monographed by Sparrius (2004) and is characterized by the following characters: crustose growth habit, photobiont *Trentepohlia* or *Phycopeltis*, rounded to elongate or punctiform ascomata, most usually immersed in the thallus, exciple poorly developed, hamathecium of branched and anastomosing paraphysoids, ellipsoid to cylindrical-clavate asci of the *Opegrapha*-type, ascospores usually fusiform with thin septa and perispore, without enlarged terminal cells, conidiomata punctiform, and bacilliform or filiform microconidia. As circumscribed, the genus comprises 35 species, while the related genus *Sclerophyton* Eschw. includes species with macrocephalic ascospores with relatively thick septa and ascomata included in pseudostromata, with well-known and widespread species such as *Enterographa elegans* (Eschw.) Tuck, and *E. extenuatum* (Nyl.) Redinger being transferred to *Sclerophyton*. Since the monograph by Sparrius (2004), 8 further new species have been described in the genus *Enterographa* and one species transferred into it (Ertz *et al.* 2005; Sparrius *et al.* 2006; Aptroot *et al.* 2007; Cáceres 2007; Sparrius & Aptroot 2007; Sparrius & Björk 2008; Jagadeesh Ram *et al.* 2008).

In spite of several detailed studies (Grube 1998; Myllys *et al.* 1999; Tehler 1990; Tehler *et al.* 1997) generic delimitation within the *Roccellaceae* is unsatisfactory and several genera are most probably polyphyletic or paraphyletic (D. Ertz, pers. comm.). A detailed phylogenetic study of two genes by Tehler & Irestedt (2007) could even demonstrate parallel evolution of the fruticose growth form in the supposedly well-circumscribed genera *Roccella* and *Roccellina*. The recent inclusion of *Chiodecton epiphyllum* Sérus., a species growing over a foliicolous species of *Coenogonium* in Papua New Guinea and the Neotropics, in *Enterographa* as a "better solution" than its earlier assignment to *Plectocarpon* Fée, shows that more data should be gathered to reach a well-supported delimitation of the genus (Ertz *et al.* 2005).

Santesson (1952) recognized three foliicolous species of *Enterographa*. Since then

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Vězda (1975), Sérusiaux (1984), Lücking (1991), Sérusiaux (in Aptroot *et al.* 1995), Lücking & Matzer (1996), Matzer (1996), Lücking *et al.* (1998), Herrera-Campos & Lücking (2002), Lücking *et al.* (2003), Lücking & Henssen (in Sparrius 2004) and Sparrius & Björk (2008) described further new species. A total of 15 foliicolous species of *Enterographa* are currently known, including 2 lichenicolous fungi on foliicolous lichens (Sparrius 2004; Ertz *et al.* 2005); most of them distributed in the Neotropics and eastern Palaeotropics. Only two species (*E. multiseptata* and *E. vezdai*) have so far been recorded from the African continent.

Here we describe two further foliicolous species belonging to *Enterographa*, discovered by the first author in Kakamega Forest (W Kenya) in August 2006. One was clearly overgrowing the thallus of a species of *Coenogonium* and the second most probably had the same ecology.

Materials and Methods

Morphological characters were studied on dry specimens under a dissecting microscope. Anatomical characters were measured using light and interference contrast microscopy on hand-cut sections and squash preparations mounted in water. Water solution of KOH (10%) and lactophenol-cotton blue were used for detailed observation of asci and hamathecial elements. Amyloidy of the tholus of asci and hymenium were tested with Lugol's solution.

The study site

Kakamega Forest is located in Shinyalu Division of the Kakamega District in the Western Province of Kenya. It is situated about 40 km north-west of Lake Victoria between 0°10′ and 0°21′ N latitude and 34°47′ and 34°58′ E longitude and is made up of a main forest block covering 8500 ha surrounded by five forest fragments of various sizes (130–1400 ha; Farwig *et al.* 2006). The vegetation consists of a mosaic of primary rainforest, secondary forests at different stages of development, swamp and riverine forest, selectively logged forest, plantations of indigenous and exotic tree species, natural glades, and clearings resulting from anthropogenic disturbance (Tattersfield *et al.* 2001; Althof 2005). Kakamega Forest is the easternmost patch of the equatorial forests distributed over the Congo basin and the only tropical rainforest with a mixture of Guineo-Congolian and afromontane species in Kenya (Althof 2005).

The Species

Enterographa fellhaneroides Yeshitela, Eb. Fisch., Killmann & Sérus. sp. nov.

Differt ab omnibus speciebus foliicolis generis *Enterographa* ascomata apothecioideis vel breve lirelliformibus, disco fusco cum margine albido et ascosporibus 6-septatis fusiformibus apicibusque rotundatis. *Enterographa brezhonega* differt ab *E. fellhaneroides* ascomata longe lirelliformibus saepe ramificatis et disco atrofusco. *Enterographa seawardii* differt sporibus 7–11-septatis anguste fusiformibus et thallo cum Pd+ luteo.

Typus: Kenya, Western Province, Kakamega Forest, 00°21′.276″ N and 034°51′.519″ E, 1609 m, on living leaves of *Dracaena fragrans*, 14 August 2006, *Yeshitela* 349 (LG—holotypus).

(Figs 1 & 2)

Thallus absent, ascomata overgrowing the thallus of a non-filamentous *Coenogonium* which is continuous, smooth, greyish green, usually with a whitish prothallus, photobiont *Trentepohlia* with cells angular-rounded, 12–20 × 5–8 μm.

Ascomata sessile, ±aggregated, rounded to shortly lirelliform, constricted at base, 0·2–0·8 mm diam., rarely up to 0·6 mm long, 50–60 μm high; disc exposed, pale to dark brown; margin 40–50 μm thick, slightly raised, whitish. *Excipulum* 10–15 μm wide, formed by densely interwoven hyphae filled with large crystals, hyaline or pale straw in section. *Hypothecium* 120–155 μm high including a 100–130 μm socle (formed by densely intricate hyphae filled with large, angular and hyaline oxalate crystals), hyaline, K–. *Hymenium* 50–75 μm high, light brown in the upper part (*c.* 25 μm), otherwise hyaline, I+ blue, rapidly turning red, KI+ blue. *Epithecium* 5–8 μm high, orange-brown; K–. *Hamathecium* of branched and anastomosing paraphysoids, *c.* 1·5 μm thick, not swollen apically. *Asci* of the *Opegrapha*-type, ellipsoid to clavate, bitunicate, 30–35 × 7·5–10 μm, with apical KI+ blue ring. *Ascospores* 4–6 per ascus, fusiform, with rounded ends, 6-septate, not constricted at the septa, the median cell usually slightly enlarged, hyaline, 15–18 × 2·5–3 μm, perispore up to 0·5 μm thick.

Conidiomata not found.

FIG. 1. *Enterographa fellhaneroides* (holotype). A–C, habit of apothecia; D, section through the apothecium. Scales: A–C = 0·2 mm; D = 50 µm.

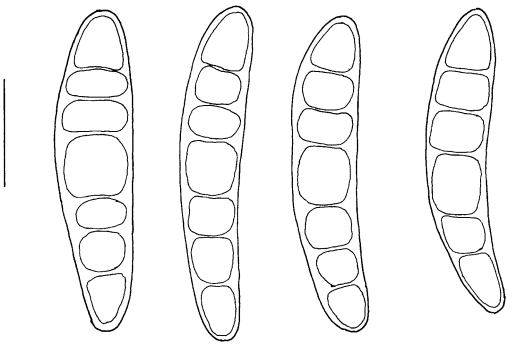

FIG. 2. *Enterographa fellhaneroides*, ascospores. Scale = 3 μm.

Chemistry. No compounds detected by TLC.

Etymology. When we first observed the apothecia of this species, we considered it to be a poorly developed specimen of *Fellhanera* Vězda until the anatomical features pointed to *Enterographa*. Hence, the specific epithet is chosen to indicate this resemblance.

Notes. *Enterographa fellhaneroides* is easily distinguished from other foliicolous species assigned to the genus by its apothecioid or short lirelliform ascomata, with a pale brown disc and a whitish margin, and 6-septate, fusiform ascospores with rounded ends. Its closest related species appears to be the recently described *E. brezhonega* (Sparrius & Aptroot 2007), overgrowing the thallus of epiphytic *Porina rosei* in W France, and reported from the New Forest (S England) on the same host (Hitch 2008). This species is distinguished by its lirelliform, often branched ascomata with a dark brown to black disc. Otherwise both species are very similar, especially the ascospores.

Morphologically, *Enterographa fellhaneroides* looks similar to *E. seawardii* Lücking & Henssen, a recently described foliicolous species (in Sparrius 2004) and only known from the Seychelles, because of similar prominent, open, angular-rounded to shortly lirellate ascomata with pale orange discs. However, *Enterographa seawardii* is easily distinguished by its 7–11-septate, narrowly fusiform ascospores, 30–40 × 3–4 μm and its Pd+ yellow (probably psoromic acid) thallus.

Ecology and distribution. *Enterographa fellhaneroides* is so far known only from Kakamega Forest in Western Kenya in near primary and middle-aged secondary forest fragments. It is a lichenicolous species overgrowing thalli assigned to a *Coenogonium* sp. (poorly developed but typical apothecia seen). The species is a component of the foliicolous lichen flora of the understorey.

Selected specimens examined. **Kenya:** *Western Province*: Kakamega Forest, Kisere fragment 00°22′.966″ N, 034°53′.751″ E, 1594 m, on living leaves of *Chrysophyllum albidum*, 2006, *Yeshitela* 373 (KOBL); Kisere fragment, 00°23′.151″ N, 034°53′.595″ E, 1580 m, on living leaves of *Teclea nobilis, Dracaena fragrans* and *Cassipourea ruwenzorensis*, 2006, *Yeshitela* 538, 539 & 537 (KOBL); Isecheno fragment, 00°14′.522″ N, 034°51′.959″ E, 1580 m, on living leaves of *Cassipourea ruwenzorensis*, 2006, *Yeshitela* 484 & 493 (KOBL).

Enterographa meklitiae Yeshitela, Eb. Fisch., Killmann & Sérus. sp. nov.

Differt ab omnibus speciebus foliicolis generis *Enterographa* ascomata numerosis punctiformibus in pseudostromata immersis. *Enterographa epiphylla* differt ab *E. meklitiae* pseudostromata convexibus punctiformibus ad vix lirellatis vel irregularibus, ascomata nigricantibus et ascosporibus majoribus 6-septatis.

Typus: Kenya, Western Province, Kisere fragment of Kakamega Forest, 00°23′.151″ N and 034°53′.595″ E, 1612 m, on living leaves of *Dracaena fragrans*, 24 August 2006, *Yeshitela* 539 (LG—holotypus).

(Figs 3 & 4)

Thallus assumed to be absent, ascomata most probably overgrowing the thallus of a non-filamentous *Coenogonium* which is continuous, smooth, greyish green, photobiont *Trentepohlia* with cells angular-rounded, 12–20 × 3–7 μm.

Ascomata punctiform, 0·05–0·1 mm diam., arranged in groups of 8–12(−20) in pseudostromata, visible as punctiform (30–50 μm diam.) brownish spots. *Pseudostromata* rounded or irregular in outline, imarginate, convex to ± plane, 0·2–0·5 mm diam., up to 75 μm high, surface greyish green to whitish, not constricted at base, in section encrusted with large, angular and

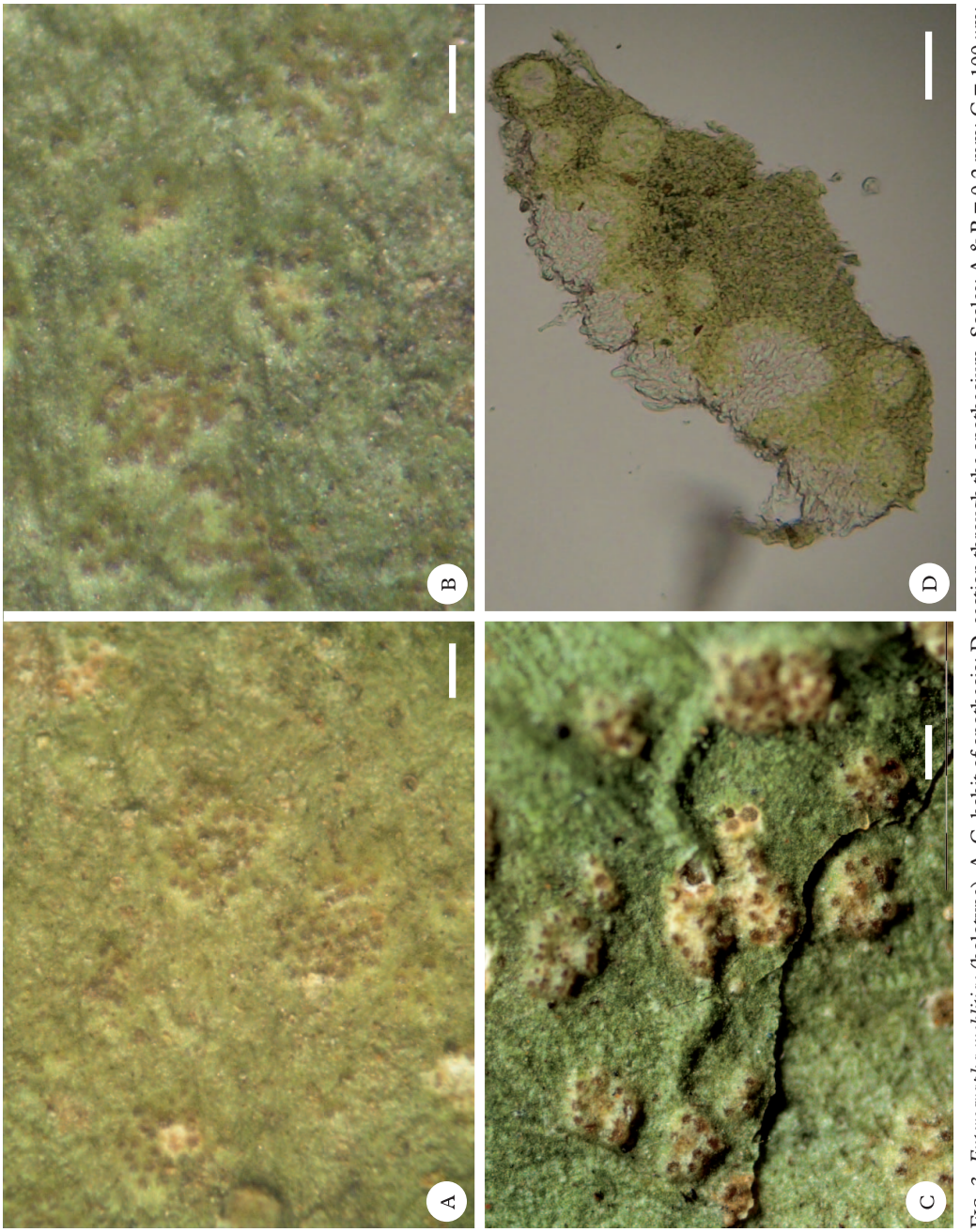

FIG. 3. *Enterographa meklitiae* (holotype). A–C, habit of apothecia; D, section through the apothecium. Scales: A & B = 0·2 mm; C = 100 µm; D = 50 µm.

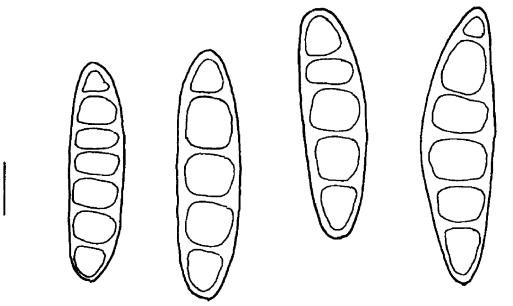

FIG. 4. *Enterographa meklitiae*, ascospores. Scale = 3 μm.

hyaline Ca oxalate crystals, K–. *Excipulum* very thin, *c.* 5 μm wide, pale straw. *Hypothecium* 10–15 μm high, pale straw, K–, I+ blue rapidly turning red, KI+ blue. *Hymenium* hyaline, I+ blue rapidly turning red, KI+ blue, 50–60 μm high. *Hamathecium* of branched and anastomosing paraphysoids, *c.* 1·5 μm thick, not swollen apically. *Epithecium* indistinct. *Asci* of the *Opegrapha*-type, ellipsoid to clavate, bitunicate, 37–50 × 7–10 μm, with apical KI+ blue ring. *Ascospores* 4 per ascus, 4–5-septate, ellipsoid to fusiform, with rounded ends, the median cell sometimes slightly enlarged, (13–)15–17 × 2·5–3 μm, not constricted at the septa, perispore < 5 μm thick.

Conidiomata not observed. *Conidia* sometimes produced from tissue inside ascomata (probably the excipulum), simple, *c.* 2·5 × 1 μm, bacilliform, hyaline.

Chemistry. No compounds detected by TLC.

Etymology. This species is dedicated to Meklit, the daughter of the first author.

Notes. *Enterographa meklitiae* can easily be distinguished from other foliicolous species of *Enterographa* by its numerous, punctiform ascomata immersed in pseudostromata. At first glance, it looks like the conidiomata of the Neotropical *Phyllobathelium leguminosae* (Cavalc. & A. A. Silva) Lücking & Sérus. (see fig. 7E in Lücking *et al.* 1998). It is close to *Enterographa epiphylla* (Sérus.) Ertz *et al.*, which overgrows the foliicolous lichen *Coenogonium flavicans*, and which can be distinguished by its convex pseudostromata, punctiform to slightly lirellate, or irregular, and blackish ascomata, and its larger ascospores (17–22 × 3–4·5 μm) with consistently 6 septa.

Ecology and distribution. Enterographa meklitiae is so far recorded only from Kakamega Forest in Western Kenya. The type locality is a near-primary rain forest dominated by *Strychnos usambarensis, Uvariopsis congensis, Pouteria altissima* (=*Aninngeria altissima*), *Cassipourea ruwensorensis, Dracaena fragrans, Funtumia africana, Diospyros abyssinica*, and *Heinsenia dieverilleoides*. There is no strong evidence that it is a lichenicolous species overgrowing the thallus of a non-filamentous *Coenogonium*, but it is assumed to have such an ecology. Indeed, its 'thallus' is very similar to that of *Enterographa fellhaneroides* (in one collection, both species grow over the same thallus), and all genuinely lichenized foliicolous species of *Enterographa* have *Phycopeltis* as photobiont (Sparrius 2004).

Selected specimens examined. **Kenya:** *Western Province*: Kakamega Forest, Isccheno, 00°14′.522″ N, 034°51′.959″ E, 1580 m, on living leaves of *Cassipourea ruwensorensis*, 2006, *Yeshitela* 484 (KOBL).

Discussion

As with most other genera in the *Roccellaceae*, the delimitation of the genus *Enterographa* requires further studies, hopefully based on molecular sequences from several genes. Nevertheless, the four species described or discussed in this paper (*Enterographa epiphylla, E. brezhonega, E. fellhaneroides* and *E. meklitiae*) characterized by their lichenicolous habit on thalli with *Trentepohlia* as photobiont and 4(–6) fusiform ascospores with rounded ends per ascus, an even number of septa and the median cell slightly enlarged, seem to be closely related. It is premature to suggest the taxonomic recognition of that group but equally, its inclusion in *Enterographa, Plectocarpon* or *Sclerophyton* is not fully satisfactory.

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