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A re-evaluation of thelotremoid *Graphidaceae* (lichenized Ascomycota: *Ostropales*) in India

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Abstract: An account of thelotremoid species of *Graphidaceae* in India is provided, which includes 124 species in 24 genera. *Ocellularia* and *Thelotrema* are the most diverse genera represented by 34 and 18 species, respectively. Type specimens were re-examined and additional samples studied morphologically and chemically. One new species, *Ocellularia upretii* S. Joshi, Divakar, Lumbsch & Lücking, is described; it is characterized by a greyish green thallus, porinoid ascomata, brown proper exciple, simple, carbonized columella, clear hymenium, transversely septate, amyloid ascospores of 110–125 × 15–20 µm and an absence of secondary metabolites. *Asteristion australianum*, *Astrochapsa mirabilis*, *Cruentotrema cruentatum*, *C. kurandense*, *Ocellularia violacea* and *Thelotrema adjectum* are reported as new to the country, and *Astrochapsa mirabilis*, *Melanotrema submicrosporoides*, *Ocellularia annuloelevata*, *O. subkeralensis* and *Rhabdodiscus verrucoisidiatus* are proposed as new combinations. *Diploschistes awasthii*, *Ocellularia gupeti*, *O. leucina*, *O. mahabalei*, *Thelotrema confertum* and *T. verrucorugosum* are synonymized under *D. scruposus*, *O. neomasonhalei*, *O. urceolaris*, *O. thelotremoides*, *Chapsa leprocarpoides* and *T. rugatulum*, respectively, with *Ocellularia canariana* and *O. verrucomarginata* reduced to synonymy with *O. allosporoides*.

Key words: Andaman & Nicobar Islands, Eastern Himalaya, keys, rainforest, Western Ghats

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Introduction

The lichen-forming fungal family *Graphidaceae* (Ascomycota: *Ostropales*) comprises *c.* 2100 species; however, it is predicted to contain more than 3500 species worldwide (Lücking *et al.* 2014). Together with *Parmeliaceae*, *Graphidaceae* represents over 20% of the total species diversity of lichen-forming fungi (Kraichak *et al.* 2014*a*; Lücking *et al.* 2017). Phylogenetic studies have changed the traditional concept of the family and the current classification recognizes three subfamilies, *Fissurinoideae*, *Graphidoideae* and *Redonographoideae*, with the previously included subfamily *Gomphilloideae* excluded (Rivas Plata & Lumbsch 2011; Rivas Plata *et al.* 2012*a*; Lücking *et al.* 2014, 2017; Medeiros *et al.* 2017). *Graphidoideae* is the largest subfamily, divided into eight tribes: *Graphideae*, *Ocellularieae*, *Thelotremateae*, *Acanthothecieae*, *Diploschisteae*, *Leptotremateae*, *Sanguinotremateae* and *Wirthiotremateae* (Rivas Plata *et al.* 2012*a*, *b*; Lumbsch *et al.* 2014; Lücking *et al.* 2015). Tribe *Graphideae* contains a large number of lirellate taxa, whereas the bulk of thelotremoid species is included in tribes *Ocellularieae* and *Thelotremateae*. The thelotremoid taxa contain over 900 species in 43 genera (Frisch *et al.* 2006; Rivas Plata *et al.* 2010*a*; Lumbsch *et al.* 2014; Lücking *et al.* 2017). Recent taxonomic studies on these lichens have shown their extraordinary diversity in the tropics, with thelotremoid *Graphidaceae* occurring mostly on bark in humid but semi-exposed, mature and old forests (Rivas Plata *et al.* 2008).

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India is situated in the Northern Hemisphere between 8°4′ and 37°6′N, and 68°7′ and 97°25′E, with a tropical climate in its southern and north-eastern parts. The dense tropical or evergreen rainforests harbour more than half of the total lichen diversity occurring within the country. Thelotremoid lichens have previously been studied in the southern and eastern parts of the country, collected in the Western Ghats, the Eastern Himalaya and the islands of Andaman and Nicobar (Patwardhan & Kulkarni 1977*a*, *b*; Patwardhan & Makhija 1980; Patwardhan & Nagarkar 1980; Nagarkar *et al*. 1985, 1986, 1987, 1988; Patwardhan *et al*. 1985; Sethy *et al*. 1987; Singh & Sinha 2010). From a global perspective, the knowledge of Indian lichens is still fragmentary, especially with regard to *Graphidaceae*. Recently, Joshi *et al*. (2012*a*, *b*) revised *Chapsa*, *Leucodecton* and *Myriotrema* species in India. Following the contemporary nomenclatural changes based on phylogenetic studies worldwide, in addition to the previously studied genera, the present work focuses on the taxonomy of known Indian thelotremoid *Graphidaceae*, including 24 genera: *Asteristion*, *Astrochapsa*, *Austrotrema*, *Chapsa*, *Chroodiscus*, *Cruentotrema*, *Diploschistes*, *Glaucotrema*, *Leucodecton*, *Melanotrema*, *Myriotrema*, *Nadvornikia*, *Nitidochapsa*, *Ocellularia*, *Pseudochapsa*, *Pseudotopeliopsis*, *Pycnotrema*, *Reimnitzia*, *Rhabdodiscus*, *Sanguinotrema*, *Stegobolus*, *Thelotrema*, *Topeliopsis* and *Wirthiotrema*. Type specimens of species described from India and China were re-examined, and the status and taxonomic placement of 124 species was assessed. Important diagnostic characteristics of each species in addition to the generic description are given.

Materials and Methods

More than 500 samples were studied and deposited in the herbarium of the CSIR-National Botanical Research Institute, Lucknow (LWG, LWG-AWAS, LWG-LWU, LWG-CAL and LWG-NRLC). Additionally, type material deposited in the herbaria of the Agharkar Research Institute, Pune (AMH) and the Museum of Natural History in Vienna (W) was re-examined. The morphology of the specimens was examined using a Magnus Zoom Stereo Trinocular (MSZ-TR) dissecting microscope using standard microscopy techniques. Thin hand-cut sections of the ascomata and thalli were mounted in tap water, cotton blue and 5% KOH, and observed using a compound microscope (LEICA DM 500). Lugol's iodine solution was used to check amyloidity of the hymenium, asci and ascospores. Chemical spot tests and TLC (using solvent system A) were conducted according to Orange *et al*. (2010). Terminology for ascomatal structure follows Rivas Plata *et al*. (2008, 2010a).

Taxonomy

Key to the genera of *Graphidaceae* present in India

1 Ascomata mazaedioid . . . . . **Nadvornikia (hawaiiensis)**
Ascomata not mazaedioid 2

2(1) Photobiont *Trebouxia*; growing on rock or soil . . . . . **Diploschistes**
Photobiont *Trentepohlia*; growing on bark or leaves, rarely on rock 3

3(2) Vegetative propagules (isidia, schizidia) present 4
Vegetative propagules absent or identification by means of ascomata 9

4(3) Disc-shaped schizidia present 5
Cylindrical isidia present 6

5(4) Foliicolous; schizidia at thallus level; stictic acid (section with K+ yellow efflux, medulla P+ orange) . . . . . **Chroodiscus (mirificus)**
Corticolous; schizidia on prominent warts; psoromic acid (section K−, medulla P+ yellow) . . . . . **Stegobolus (berkeleyanus)**

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6(4) Thallus with columnar clusters of crystals; no substances; ascomata chroodiscoid, lacking columella . . . . . **Reimnitzia (santensis)**
Thallus at best with irregular, small clusters of crystals; psoromic acid, notatic acid or cinchorum unknowns; ascomata ocellularioid, with columella 7

7(6) Psoromic acid (medulla P + yellow) . . . . . .**Rhabdodiscus (epitrypus, verrucoisidiatus)**
Notatic acid or cinchonarum unknowns (medulla P −) 8

8(7) Notatic acid; ascospores large, over 80 µm; columella finger-like. . . . . .**Ocellularia (karnatakensis)**
Cinchonarum unknowns; ascospores small, under 20 µm; columella reticulate. . . . . .**Rhabdodiscus (indicus)**

9(3) Excipulum carbonized (black in surface view). 10
Excipulum not carbonized (white to brown in surface view) 13

10(9) Ascomata chroodiscoid, with a long persistent roof resembling a disc; ascospores I −, with diamond-shaped lumina. . . . . **Cruentotrema**
Ascomata ocellularioid, with the disc more or less exposed or pore-like; ascospores I + violet-blue, with lens-shaped to rounded lumina 11

11(10) Thallus ecorticate, more or less endoperidermal; columella broad stump-shaped; no substances or lichexanthone. . . . . **Melanotrema**
Thallus corticate, more or less epiperidermal; columella variable, if broad stump-shaped then with protocetraric acid 12

12(11) Columella lobate to reticulate or fissured; ascospores small, usually under 20 µm; psoromic acid or rarely cinchonarum unknowns and then with isidia. . . . . .**Rhabdodiscus**
Columella finger-like to plug-shaped or rarely becoming irregular or broad stump-shaped; ascospores small to large, usually over 20 µm; chemistry variable including psoromic acid, if cinchonarum unknowns then lacking isidia and with yellow medulla . . . . . .**Ocellularia**

13(9) Foliicolous; ascomata chroodiscoid, lacking periphysoids; ascospores with thin walls and septa, hyaline. . . . . .**Chroodiscus**
Corticolous or rarely on rocks; ascomata variously shaped, if chroodiscoid then with distinct periphysoids and/or ascospores with thickened septa and/or brown 14

14(13) Periphysoids present; ascomata chroodiscoid, topeliopsidoid or thelotremoid with double margin, usually large and conspicuous 15
Periphysoids absent; ascomata ocellularioid to myriotremoid, if chroodiscoid then with large clusters of vertical columnar crystals, if with double margin then small 22

15(14) Ascomata chroodiscoid, with fused margin. 16
Ascomata thelotremoid, with double margin (sometimes with lobulate thalline margin) or topeliopsidoid 19

16(15) Thallus corticate, with dense cortex; ascospores often brown 17
Thallus ecorticate or with loose cortex; ascospores always hyaline. 18

17(16) Ascoma margin felty; thallus brown . . . . . **Nitidochapsa (leprieurii)**
Ascoma margin smooth; thallus green to grey . . . . . **Astrochapsa**

18(16) Ascospores with thickened septa, I+ violet-blue . . . . . **Pseudochapsa (pseudoexanthismocarpa)**
Ascospores with thin septa, I− . . . . . **Chapsa**

19(15) Ascoma opening pore-like; margin fissured to lobulate but incurved, often layered (topeliopsidoid) 20
Ascoma opening broader; margin entire, if fissured to lobulate, then erect to recurved, not layered (thelotremoid) 21

20(19) Ascomata erumpent, with distinct thalline margin . . . . . **Pseudotopeliopsis (laceratula)**
Ascomata prominent to sessile, with basal thalline margin . . . . . **Topeliopsis**

21(19) Thallus with thick, dense cortex, shiny brown; thalline margin often fissured . . . . . **Asteristion**
Thallus ecorticate or with loose cortex, usually yellowish grey to whitish . . . . . **Thelotrema**

22(14) Ascospores brown 23
Ascospores hyaline 28

23(22) Ascomata chroodiscoid, with widely open disc . . . . . **Reimnitzia (santensis)**
Ascomata ocellularioid to myriotremoid 24

24(23) Thallus hollow beneath, fragile, with pockets of red crystals in the medulla . . . . . **Sanguinotrema (wightii)**
Thallus directly on the substratum, lacking red crystals 25

25(24) Thallus containing stictic or norstictic acid, in section with K+ yellow efflux (forming red crystals when norstictic acid is present) 26
Thallus containing protocetraric acid or lacking substances, in section K− 27

26(25) Thallus with dense, internally splitting, shiny cortex . . . . . **Wirthiotrema**
Thallus with loose, opaque cortex . . . . . **Leucodecton**

27(25) Thallus with dense, shiny cortex; ascomata opening with narrow pore (myriotremoid) . . . . . **Leucodecton (compunctum)**
Thallus with loose cortex; ascomata opening with broader pore (ocellularioid) . . . . . **Ocellularia (bahiana, urceolaris)**

28(22) Thallus containing stictic acid, in section with K+ yellow efflux 29
Thallus containing other substances or lacking substances, in section K− 31

29(28) Thallus with dense, internally splitting, shiny cortex . . . . . **Wirthiotrema (glaucopallens)**
Thallus with loose, opaque cortex 30

30(29) Ascospores small, under 25 µm, transversely septate. . . . . **Austrotrema (terebrans)**
Ascospores medium-sized, over 50 µm, muriform. . . . . **Leucodecton (anamalaiense)**

31(28) Ascospores large; ascomata ocellularioid, mostly with columella. . . . **Ocellularia**
Ascospores small; ascomata and columella variable 32

32(31) Ascomata opening with wider pore, usually over 0.2 mm, erumpent to prominent; columella present 33
Ascomata opening with narrow pore, usually up to 0.1 mm, immersed; columella absent. 35

33(32) Columella simple; thallus with protocetraric acid, medulla P + orange. . . . . **Ocellularia (violacea)**
Columella irregular to reticulate; thallus with psoromic acid, medulla P + yellow. 34

34(33) Columella distinct, reaching down to hypothecium, reticulate; prominent schizidia often present. . . . . **Stegobolus (berkeleyanus)**
Columella irregular, usually only developing above the hymenium; schizidia absent. . . . . **Glaucotrema (glaucophaenum)**

35(32) Ascomata with brownish rim around the pore; thallus lacking substances . . . . **Pycnotrema (pycnoporellum)**
Ascomata more or less concolorous with thallus; thallus with psoromic or olivaceic acid, rarely lacking substances . . . . . **Myriotrema**

Asteristion Leight.

Trans. Linn. Soc. London **27:** 163 (1870).

This genus was recently resurrected to accommodate seven species previously placed in the genera *Chapsa*, *Ocellularia*, *Phaeotrema* and *Thelotrema* (Medeiros *et al.* 2017). Four species are currently known from India. Characteristic features include: Ascomata are round to angular immersed to erumpent ascomata, disc covered to exposed, flesh-coloured to brown, white pruinose, proper exciple fissured to recurved, separated from the thalline margin by a narrow slit (double margin) forming a prominent rim around the disc, thalline margin white to pale brown, entire to recurved, hymenium clear, lacking columellar structures, ascospores hyaline to brown, transversely septate to muriform, and the presence of stictic acid and associated satellite substances.

Key to species of the genus *Asteristion* from India

1 Ascospores brown, transversely 3-septate, faintly amyloid, 11–15 × 4–6 µm . . . . . **A. platycarpum**
Ascospores hyaline, submuriform to muriform 2

2(1) Ascospores non-amyloid, 30–60 × 10–15 µm . . . . . **A. leucophthalmum**
Ascospores strongly amyloid. 3

3(2) Ascospores 10–15 × 5–8 µm . . . . . **A. alboannuliforme**
Ascospores 15–23 × 5–7 µm . . . . . **A. australianum**

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Asteristion alboannuliforme (Nagarkar *et al.*) I. Medeiros *et al.*

Fieldiana Life and Earth Sciences **9:** 7 (2017).

Thallus olivaceous.

Ascomata semi-emergent, lepadinoid with white margins; proper exciple free; asci 8-spored; ascospores 10–15 × 5–8 µm with 3 transverse and 0–1 longitudinal septa per segment.

Chemistry. Stictic acid chemosyndrome.

Remarks. This species is similar to *A. australianum* in ascomatal morphology and the distinctly amyloid ascospores; however, the latter differs in producing comparatively longer and thinner submuriform ascospores. *Asteristion alboannuliforme* has been described from Tamil Nadu in the Western Ghats by Nagarkar *et al.* (1985), as *Thelotrema alboannuliforme* Nagarkar *et al.* The species appears to be endemic to India.

Specimen examined. **India:** *Tamil Nadu*: Tirunelevelli District, Singhalamtheri, Kalakkudu primary rainforest, elev. *c.* 1200 m, *P. G. Patwardhan & M. B. Nagarkar* 84–9 (AMH).

Asteristion australianum I. Medeiros *et al.*

Fieldiana Life and Earth Sciences **9:** 8 (2017).

Thallus olivaceous, thin, corticate.

Ascomata conspicuous, emergent; proper exciple free; ascospores small, 15–23 × 6–8 µm, with 4–6 transverse and 0–1 longitudinal septa per segment.

Chemistry. Stictic acid chemosyndrome.

Remarks. Asteristion platycarpoides (Tuck.) I. Medeiros *et al.* is apparently similar in ascomatal morphology but produces brown, predominantly transversely-septate ascospores. Material belonging to *A. australianum* was previously reported from the Western Ghats (Karnataka) as *Ocellularia albo-olivacea* (Vain.) Zahlbr. by Patwardhan & Kulkarni (1977*a*); the latter name must therefore be removed from the Indian lichen biota and *A. australianum* is a new record for the Indian subcontinent.

Specimens examined. **India:** *Kerala*: Wayanad District, Kalpetta, back side of Banasura sagar, 2013, *A. R. Logesh* s. n. (LWG). *Tamil Nadu*: Palni Hills, on way from Perumalmalai to Oothu near Mulaiyar, elev. *c.* 1350 m, *Kr. P. Singh* 70–1167 (LWG–LWU).

Asteristion leucophthalmum (Nyl.) I. Medeiros *et al.*

Fieldiana Life and Earth Sciences **9:** 10 (2017).

Thallus different shades of yellow, green and grey with a waxy and loosely corticate texture.

Ascomata large, numerous; proper margins lacerate, separated from lobate thalline margins with a split (double margins); asci 6–8-spored; ascospores non-amyloid, moderately large, hyaline, muriform, 30–60 × 10–15 µm.

Chemistry. Stictic acid chemosyndrome.

Remarks. In India, *A. leucophthalmum* has so far been reported only from the Andaman and Nicobar Islands by Sethy *et al.* (1987), as *Thelotrema leucophthalmum* Nyl.

Asteristion platycarpum (Tuck.) I. Medeiros *et al.*

Fieldiana Life and Earth Sciences **9:** 12 (2017).

Thallus dark olive-green to olive-brown or pale yellowish-brown.

Ascomata erumpent, rounded to slightly irregular apothecioid to chroodiscoid, with double margins; asci 8-spored; ascospores faintly amyloid, grey-brown, transversely 3-septate, ellipsoidal to fusiform, 11–15 × 4–6 µm.

Chemistry. Stictic acid chemosyndrome.

Remarks. This species was previously known from the Western Ghats (Kerala) as *Phaeotrema platycarpum* (Tuck.) Zahlbr. (Patwardhan & Kulkarni 1977*a*). The distinct double margins separate this species from otherwise similar taxa in the genera *Astrochapsa* and *Nitidochapsa*.

Astrochapsa Parnmen *et al.*

PLoS ONE **7:** e51392, 8 (2012).

The genus was recently described to accommodate species differing phylogenetically from

Chapsa s. str., usually featuring a densely corticate thallus and almost exclusively subdistoseptate, non-amyloid ascospores. Parnmen *et al.* (2012) included 18 species, five of which occur in India that were previously classified in *Chapsa* (Joshi *et al.* 2012*a*).

Key to species of the genus *Astrochapsa* from India

1	Ascospores transversely 4–6-septate, hyaline, 12–16 µm long	**A. platycarpella**
	Ascospores (sub)muriform	2
2(1)	Ascospores hyaline	3
	Ascospores brown	4
3(2)	Stictic acid present	**A. recurva**
	Secondary metabolites absent	**A. pseudophlyctis**
4(2)	Ascospores 88–135 × 22–30 µm	**A. stellata**
	Ascospores 40–70 × 10–15 µm	**A. mirabilis**

Astrochapsa mirabilis (Zahlbr.) Lücking & S. Joshi comb. nov.

MycoBank No.: MB 826953

Phaeographina mirabilis Zahlbr., *Symb. Sinic.* **3:** 62 (1930); type: China, Fukien, Gu-shan near Fudshou, elev. 500–600 m, 1926, *F. Chung* 387 (W—holotype).

Thallus corticate, olive-green to dull greyish green.

Ascomata angular to shortly lirellate with recurved margins; disc, blackish, densely covered with white pruina; hymenium inspersed with oil droplets; asci 8-spored; ascospores brown, muriform; 65–80 × 14–17 µm.

Chemistry. Stictic acid.

Remarks. This species is a new record for India, reported recently from the Eastern Himalayan region (Manipur).

Specimens examined. **India:** *Manipur*: Ukhrul District, Lunghar Village, elev. 1789 m, *K. K. Ingle* 17–031802 (LWG); Lungchap Village, elev. 1338 m, *K. K. Ingle* 17–031801 (LWG).

Astrochapsa platycarpella (Vain.) Parnmen *et al.*

PLoS ONE **7:** e51392, 9 (2012).

Thallus olive-green to pale green, cartilaginous.

Ascomata scattered to aggregate, round to angular with a thin, fissured to lobed, recurved margin; disc white pruinose blackish; proper exciple ± hyaline; asci 8-spored; ascospores hyaline, transversely 3–5-septate, fusiform, 12–16 × 3–5 µm.

Chemistry. No substances detected.

Remarks. This species has been reported from evergreen tropical forest in the Western Ghats.

Specimen examined. **India:** *Kerala*: Idukki District, Adimali Forest Range, Thondi Kappu, *B. Haridas* 06–009598 (LWG).

Astrochapsa pseudophlyctis (Nyl.) Parnmen *et al.*

PLoS ONE **7:** e51392, 9 (2012).

Thallus whitish grey to pale grey.

Ascomata round to angular with jagged, often eroded margins; asci 2–6-spored; ascospores hyaline, muriform, 36–60 × 16–24 µm.

Chemistry. No substances detected.

Remarks. Astrochapsa recurva is similar but can be readily distinguished by the presence of stictic acid. *Astrochapsa pseudophlyctis* was first reported from the Eastern Himalaya

(Meghalaya and Sikkim) by Jagadeesh Ram & Sinha (2009) under the genus *Chapsa*. *Thelotrema subhiatum* Patwardhan & Kulkarni described from India (Patwardhan & Nagarkar 1980) has been included in the synonymy of *A. pseudophlyctis* (Buaruang *et al*. 2017). The species is also known from Nagaland in the Eastern Himalaya, and the Andaman and Nicobar Islands.

Specimen examined. **India:** *Nagaland*: Dimapur-Kohima road, near Ghaspani, *P. G. Patwardhan & M. B. Nagarkar* 77–1403 (AMH).

Astrochapsa recurva (G. Salisb.) Parnmen *et al.*

PLoS ONE **7:** e51392, 9 (2012).

Thallus corticate, whitish grey, smooth.

Ascomata numerous, solitary, round to elongated, semi-emergent, chroodiscoid; asci 2–4-spored; ascospores hyaline, muriform, ≥ 68 µm long.

Chemistry. Stictic acid.

Remarks. Nagarkar *et al*. (1986) reported this species (as *Thelotrema recurvum* G. Salisb.) from the Andaman and Nicobar Islands.

Astrochapsa stellata (Hale) Parnmen *et al.*

PLoS ONE **7:** e51392, 9 (2012).

Thallus greenish, glaucous, continuous, mostly epiperidermal.

Ascomata dispersed, slightly immersed, chroodiscoid with recurved margins; disc white pruinose; proper exciple ±fused, brown; asci 1-spored; ascospores ellipsoidal, olivaceous to brownish, muriform, 88–135 × 22–30 µm.

Chemistry. No substances detected.

Remarks. This taxon was previously recognized as *Leptotrema stellatum* Hale from Meghalaya in the Eastern Himalayan region (Patwardhan & Nagarkar 1980).

Austrotrema I. Medeiros *et al.*

Fieldiana Life and Earth Sciences **9:** 14 (2017).

This genus is separated mainly on characters such as small, barely emergent ascomata with double margins, non-amyloid to faintly amyloid ascospores, and the presence of stictic acid. It is separated from *Thelotrema* by having a dense, prosoplectenchymatous cortex, and from *Asteristion* by the small, pore-like ascomata. The similar genus *Wirthiotrema* produces a glossy thallus with a cortex that splits internally. Three species are included within the genus, with a single species known from India.

Austrotrema terebrans (Nyl.) I. Medeiros *et al.*

Fieldiana Life and Earth Sciences **9:** 17 (2017).

Thallus shiny, warty, yellowish grey to straw-coloured.

Ascomata immersed; proper exciple pale yellow; asci 8-spored; ascospores transversely 5–12-septate, hyaline, non-amyloid to weakly amyloid, 15–22 × 5–7 µm.

Chemistry. Stictic acid chemosyndrome.

Remarks. This species was previously recorded as *Thelotrema bicinctulum* Nyl. (Mangold *et al*. 2009; Singh & Sinha 2010) which has a restricted distribution in Australia and adjacent areas. *Austrotrema terebrans* has been reported from the Andaman and Nicobar Islands as *Ocellularia terebrans* (Nyl.) Zahlbr by Nagarkar *et al*. (1988). In addition, it is commonly found in different parts of the Western Ghats (Karnataka, Kerala, Maharashtra and Tamil Nadu).

Specimen examined. **India:** *Andaman & Nicobar Islands*: Middle Andaman, Long Island, *A. Singh* 61–52959 (LWG).

Chapsa A. Massal.

Atti Reale Ist. Veneto Sci. Lett. Arti, sér. 3 **5:** 256 (1860).

The genus *Chapsa* was introduced by Massalongo in 1860 and resurrected by Frisch *et al*. (2006) to accommodate species characterized by a thin, corticolous, endoperidermal to epiperidermal thallus, chroodiscoid ascomata with a fused to ± free proper exciple internally lined by periphysoids, and thin-walled ascospores (Mangold

et al. 2009; Rivas Plata *et al*. 2010*a*). This genus is suspected to be polyphyletic since its resurrection. Consequently, in more recent studies, molecular evidence and re-examination of phenotypic characters recognized several clades that resulted in the segregation of various genera from *Chapsa* s. l., viz., *Astrochapsa*, *Crutarndina*, *Gintarasia*, *Pseudochapsa*, *Pseudotopeliopsis*, *Myriochapsa* and *Nitidochapsa* (Parnmen *et al*. 2012, 2013; Kraichak *et al*. 2014*b*). Sixteen species of *Chapsa* s. l. had been recorded from India previously (Joshi *et al*. 2012*a*). However, after the segregation of other genera, only eight of these belong in *Chapsa* s. str. Generally, *Chapsa* and allied genera are most diverse in the southern and eastern regions of the country, usually distributed at altitudes below 1000 m. The rainforests of the Western Ghats and the Eastern Himalaya with their semi-exposed and humid climate provide suitable habitats for the species.

Key to species of the genus *Chapsa* from India

1	Ascospores transversely septate, hyaline	2
	Ascospores (sub)muriform, brown or hyaline	3
2(1)	Ascospores (40–)70–120 µm long, 20–30-septate	**C. indica**
	Ascospores 17–22 µm long, 5–9-septate	**C. alborosella**
3(1)	Ascospores brown, 27–46 × 11–16 µm	**C. meghalayensis**
	Ascospores hyaline	4
4(3)	Ascospores ≤ 60 µm long.	5
	Ascospores > 60 µm long.	7
5(4)	Proper exciple fused; ascomata solitary; ascospores 30–60 × 12–20 µm	**C. discoides**
	Proper exciple free; ascomata often aggregate; ascospores 14–40 × 4–12 µm	6
6(5)	Ascospores 14–16 × 4–7 µm	**C. hiata**
	Ascospores 30–40 × 10–12 µm	**C. leprocarpoides**
7(4)	Ascospores 80–125 µm long; ascomatal margin recurved	**C. patens**
	Ascospores 60–110 µm long; ascomatal margin erect	**C. leprocarpa**

Chapsa alborosella (Nyl.) Frisch

Biblioth. Lichenol. **92:** 90 (2006).

Thallus ecorticate, pale olive-green.

Ascomata round to angular or shortly elongate, pale brown, level with the thallus; asci 8-spored; ascospores hyaline, transversely septate, fusiform to clavate or oblong, I−.

Chemistry. No substances detected.

Remarks. Patwardhan & Kulkarni (1977*a*) and Nagarkar *et al*. (1988) reported this species from south India as *Ocellularia alborosella* (Nyl.) R. Sant. It is known from the tropical evergreen forests of the Eastern Himalaya and the Western Ghats.

Specimen examined. **India:** *Mizorum*: Champhai District, Murlen National Park, elev. 1668 m, *A. R. Logesh & M. Chinlampianga* 14–031438 (LWG).

Chapsa discoides (Stirt.) Lücking

Phytotaxa **55:** 35 (2012).

Thallus ashy white, smooth, partly hypophloeodal.

Ascomata semi-emergent with chroodiscoid, erect to recurved margins; proper

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exciple brown, fused to free; hymenium hyaline; asci 4–8-spored; ascospores hyaline, ellipsoid, muriform.

Chemistry. No substances detected.

Remarks. This species has incorrectly been reported as *Thelotrema velatum* Müll. Arg. and *Chapsa velata* (Nyl.) Cáceres & Lücking from the Andaman and Nicobar Islands and the Eastern Himalayan region (Patwardhan & Makhija 1980; Singh & Sinha 2010; Joshi *et al.* 2012*a*).

Specimens examined. **India:** *Assam*: Nagaon District, Chapanala, elev. 60 m, *A. Dey* 13–021806 (LWG). *West Bengal*: West Medinipur District, Mohanpur, IISER Kolkata campus, *T. Hembram* 14–024653 (LWG).

Chapsa hiata (Hale) Sipman

Phytotaxa **55:** 38 (2012).

Thallus ecorticate.

Ascomata wide and open, with recurved margins; proper exciple free; asci 4–8-spored; ascospores small, hyaline, muriform, I−, 14–16 × 4–7 µm.

Chemistry. No substances detected.

Remarks. *Astrochapsa pseudophlyctis* is similar to *C. hiata* in having an ecorticate thallus lacking lichen compounds but it has larger ascospores and a fused proper exciple. The species was originally described as *Thelotrema hiatum* Hale (Hale 1978*b*; Patwardhan *et al.* 1985) and occurs in the Eastern Himalaya and the Eastern and Western Ghats.

Specimens examined. **India:** *Assam*: Nagaon District, Misa Village, *A. Dey* 12–020496 (LWG). *Karnataka*: South Canara District, Hebri, *P. G. Patwardhan & U. V. Makhija* 80–517 (AMH). *Orissa*: Ganjam District, Barhampur University campus, near guest house, *D. D. Awasthi et al.* 86–044 (LWG–LWU).

Chapsa indica A. Massal.

Atti I. R. Ist. Veneto Sci. Lett. Arti, sér. 3 **5:** 257 (1860).

Thallus ecorticate, brownish white to olive-grey.

Ascomata level with the thallus, rounded to angular or shortly elongated and slightly branched; asci 6–8-spored; ascospores large, hyaline, transversely 20–30-septate, oblong-fusiform.

Chemistry. No substances detected.

Remarks. Patwardhan & Nagarkar (1980) and Nagarkar *et al.* (1988) reported the species incorrectly as *Ocellularia pycnophragmia* (Nyl.) Zahlbr. from tropical rainforests of the Andaman and Nicobar Islands, and Assam and Meghalaya (Eastern Himalaya).

Specimen examined. **India:** *Tripura*: North Tripura District, Rowya Reserve Forest, Panisagar, *Rupam Debnath* 12–023193 (LWG).

Chapsa leprocarpa (Nyl.) Frisch

Biblioth. Lichenol. **92:** 108 (2006).

Thallus pale to dark olive-grey.

Ascomata large, chroodiscoid with a lobed and recurved margin; disc pale brown to blackish but heavily white pruinose; asci 1-spored; ascospores muriform.

Chemistry. No substances detected.

Remarks. Awasthi (1991) first recorded *C. leprocarpa* from the Andaman and Nicobar Islands incorrectly as *Thelotrema colobicum* Nyl. *Thelotrema poeltii* Patw. & C. R. Kulk., described from India, has been reduced to synonymy with *C. leprocarpa* by Rivas Plata *et al.* (2010*a*). *Chapsa leprocarpa* inhabits lowland and submontane regions in the Western Ghats and also occurs in the Andaman Islands and the Eastern Himalaya. *Chapsa patens* is similar but differs in producing slightly larger ascospores and a recurved ascomatal margin.

Specimens examined. **India:** *Andaman & Nicobar Islands*: South Andaman, Baratang Island, between Nilambur and Jarwa Creek, *A. Singh* 61–79724 (LWG). *Goa*: South Goa, Cotigao Wildlife Sanctuary, Paigar Sacred grove, Gaodong Village, elev. 300 m, *S. Nayaka et al.* 03–001619 (LWG). *Karnataka*: Chikmagalure District, Chamudi Ghat, Kuvettu, elev. 104 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19739R (LWG). *Kerala*: Idukki District, ICRI campus, Myladumpara, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi*

84–88 (LWG–LWU). *Maharashtra*: Pune District, near Lonavala, Tiger point, *D. D. Awasthi* 59–4076 (LWG–AWAS). *Mizorum*: Aizawl District, Sateek Village area, enroute to Lunglei, *A. R. Logesh & M. Chinlampianga* 14–019151 (LWG).

Chapsa leprocarpoides (Hale) Cáceres & Lücking

Libri Bot. **22:** 52 (2007).—*Thelotrema confertum* Nagarkar, Sethy & Patw., *Kavaka* **13:** 58 (1987) ["1985"]; type: India, Karnataka, South Canara District, Hebri, on bark, 30 January 1980, *P. G. Patwardhan & U. V. Makhija* 80–518 (AMH—holotype).

Thallus ecorticate, pale olive to fawn, reflecting the bark through the matted surface.

Ascomata immersed to semi-immersed, rounded to angular; disc flesh-coloured, pruinose with low jagged to lobed margins; proper exciple pale to brownish or hyaline, free; asci 8-spored; ascospores hyaline, muriform, ellipsoid to ovoid.

Chemistry. No substances detected.

Remarks. The examined type material of *Thelotrema confertum* Nagarkar *et al.* agrees with *C. leprocarpoides*, viz., an ecorticate thallus producing no secondary metabolites, aggregated ascomata with erect margins, thinly white pruinose, flesh-coloured disc, 4–6-spored asci and small, submuriform (3–6 × 0–2 septa), non-amyloid ascospores, 20–25(–30) × 9–12 µm. It was collected from evergreen tropical forests of the Western Ghats on rough tree barks at lower altitude.

Specimens examined. **India:** *Karnataka*: Shimoga District, Sagar to Talguppa, Ulanahalli, elev. 697 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19742E, 08–19742I (LWG). *Tamil Nadu*: Kambam, Meghamalai Wildlife Sanctuary, Mathuthulu, *S. Nayaka* 99–75948 (LWG).

Chapsa meghalayensis (Patw. & Nagarkar) Lumbsch & Divakar

Lichenologist **42:** 183 (2010).

Thallus ecorticate, granular.

Ascomata immersed, chroodiscoid with recurved margins; exciple lacerate; asci 2-spored, ascospores small, muriform, brown, 27–46 × 11–16 µm.

Chemistry. No substances detected.

Remarks. This species is endemic and described from evergreen forests of the Eastern Himalayan region. It was first described from Meghalaya by Patwardhan & Nagarkar (1980) as *Leptotrema meghalayense* Patw. & Nagarkar and later classified in *Myriotrema* by Awasthi (1991) but subsequently placed in *Chapsa* (Rivas Plata *et al.* 2010*a*).

Specimen examined. **India:** *Meghalaya*: 20 km from Shillong, in evergreen forest on roadside at Barapani, *P. G. Patwardhan & M. B. Nagarkar* 77–736 (AMH).

Chapsa patens (Nyl.) Frisch

Biblioth. Lichenol. **92:** 111 (2006).

Thallus ecorticate, dark olivaceous grey to dark grey or blackish.

Ascomata immersed, mostly rounded to slightly angular with raised, lobed and recurved margins; disc white pruinose; proper exciple hyaline to pale brown; asci 1-spored; ascospores hyaline, muriform, 80–125 × 20–35 µm.

Chemistry. No substances detected.

Remarks. This species has been reported from tropical rainforests of the Eastern Himalaya where it is common in open, old-growth forests with large tree trunks (Joshi *et al.* 2012*a*). *Chapsa leprocarpa*, which also lacks secondary metabolites, differs from *C. patens* in having a slightly lower hymenium and smaller ascospores, and growing at lower altitudes (1000–1200 m).

Specimen examined. **India:** *West Bengal*: Darjeeling District, Tiger Hill, north face of the hill, elev. *c.* 2500 m, *D. D. Awasthi & M. R. Agarwal* 67–21 (LWG–LWU).

Chroodiscus (Müll. Arg.) Müll. Arg.

Lichenes epiphylli novi: 18 (1890).

The genus currently includes 14 species worldwide (Rivas Plata *et al.* 2010*a*),

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including two species also reported from India. Comprehensive accounts of the genus have been provided by Frisch *et al.* (2006), Lücking *et al.* (2008), Papong *et al.* (2009) and Mangold *et al.* (2009). Currently, the genus includes only foliicolous species with chroodiscoid ascomata a hyaline proper exciple lacking lateral paraphyses, rather lax paraphyses and thin-walled, I− ascospores. Some taxa show facultative parasitism, mostly on *Porina* spp. (Lücking & Grube 2002). Awasthi (1991) reported *Chroodiscus coccineus* and *C. mirificus* from India and later Singh & Sinha (2010) catalogued three species of the genus, namely *C. mirificus*, *C. australiensis* and the recently described *C. himalayanus* Nayaka & Upreti, which has now been recombined and treated under the genus *Stictis* as *Stictis himalayanus* (Nayaka & Upreti) S. Joshi & Upreti (Joshi *et al.* 2010).

Key to species of the genus *Chroodiscus* from India

1 Ascomata brownish grey; disc-shaped isidia present; ascospores submuriform; stictic acid present . . . . . **C. mirificus**
Ascomata scarlet red; disc-shaped isidia absent; ascospores transversely 1-septate unknown anthraquinones present . . . . . **C. australiensis**

Chroodiscus australiensis Vězda & Lumbsch

Nova Hedwigia **50**: 246 (1990).

Thallus pale greenish, smooth to uneven.
Ascomata reddish orange; ascospores 1-septate, 7–10 × 2–3 µm.

Chemistry. Stictic acid chemosyndrome.

Remarks. In India, this species is recorded from the Andaman and Nicobar Islands, and Arunachal Pradesh and West Bengal in the Eastern Himalayan region (Singh & Sinha 2010).

Chroodiscus mirificus (Kremp.) R. Sant

Nova Hedwigia **50:** 249 (1990).

Thallus smooth, uneven, grey to whitish grey; isidia disc-shaped.
Ascospores submuriform, fusiform to oblong, 8–15 × 3–5 µm.

Chemistry. Stictic acid.

Remarks. This species occurs in tropical rainforests of the Andaman and Nicobar Islands, and Arunachal Pradesh in the Eastern Himalayan region (Singh & Sinha 2010).

Cruentotrema Rivas Plata *et al.*

Fungal Diversity **52:** 119 (2012).

Species in this genus were previously recognized as the "*Ocellularia*" cruentata group, with a carbonized proper exciple and fissured or cruentodiscoid ascomata (Rivas Plata *et al.* 2010*a*). Subsequently, this group, forming a separate phylogenetic clade in the subfamily *Fissurinoideae,* was segregated as a separate genus. The delimiting characters for the genus include ecolumellate ascomata with split margins, trypethelioid ascospores with diamond-shaped lumina and non-amyloid ascospores (Rivas Plata *et al.* 2012*a*). Of the four recognized species, two are known from India and represent new country records.

Key to species of the genus *Cruentotrema* from India

1 Ascomatal margins red-pigmented, K+ green; ascospores 23–26 × 9–12 µm. . . . . **C. cruentatum**
Ascomatal margins with white pruina, K−; ascospores 14–20 × 5–8 µm. . . . . **C. kurandense**

Cruentotrema cruentatum (Mont.) Rivas Plata *et al.*

Fungal Diversity **52:** 119 (2012).

Thallus yellowish brown to brown.

Ascomata aggregated, fused, appearing irregular in shape, chroodiscoid, with a layered thalline margin with red pigment turning K+ green; disc greyish brown; proper exciple pale brown to distinctly carbonized; epihymenium grey, crystalline, 15–20 µm high; hymenium clear, 170–200 µm high; asci 8-spored; ascospores submuriform, oblong to ellipsoid, 4–6 × 1–2 locular, 23–26 × 9–12 µm, non-amyloid, halonate.

Chemistry. No substances detected.

Remarks. The species is newly recorded from the Western Ghats, occurring in rainforests.

Specimen examined. **India:** *Karnataka*: Uttarakannada District, Kumta taluk, Vadgeri (Chandawar), *S. Duani* 14–024694 (LWG).

Cruentotrema kurandense (Mangold) Rivas Plata *et al.*

Fungal Diversity **52:** 119 (2012).

Thallus yellowish brown to pale brown.

Ascomata round to irregular, chroodiscoid with incurved, split and lobed margins with white pruina; disc blackish; proper exciple fused, 30–40 µm thick, yellowish brown to carbonized marginally; epihymenium crystalline greyish brown, 15–20 µm high; hymenium clear, 80–100 µm high; asci 8-spored; ascospores submuriform, ellipsoidal, fusiform, hyaline, 4–7 × 1–3 locular, 14–20 × 5–8 µm, non-amyloid, non-halonate.

Chemistry. No substances detected.

Remarks. This species is a new record for India. The closely related *C. cruentatum* differs in having pigmented ascomatal margins. It occurs in tropical rainforests and is known from the Western Ghats.

Specimen examined. **India:** *Karnataka*: Chickmaglore District, Chamudighat near Kotigchara, elev. 979 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19735R/A (LWG).

Diploschistes Norman

Nyt. Mag. Naturvidensk. **7:** 232 (1853).

This genus is one of few genera in *Graphidaceae* having *Trebouxia* as photobiont and growing mostly on soil and rock, with its centre of distribution in arid to semi-arid regions. The thallus is covered by an epinecral layer. The ascomata are perithecioid to urceolate, with a carbonized pseudoparenchymatous excipulum with lateral paraphyses, 1–8-spored asci, submuriform to muriform, usually brown ascospores and varied chemistry. *Diploschistes* comprises 43 species worldwide, growing on rock, soil, mosses and sometimes on other lichens (CABI Bioscience *et al.* 2010; Rivas Plata *et al.* 2010*a*; Fernández-Brime *et al.* 2013). In India, Awasthi (1991) recorded six species: *D. actinostoma*, *D. candidissimus*, *D. cinereocaesius*, *D. megalosporus*, *D. muscorum* and *D. scruposus*. Subsequently, Pant & Upreti (1993) added a new species, *D. awasthii*, and five new records, viz. *D. caesioplumbeus*, *D. diacapsis*, *D. euganeus*, *D. gypsaceus*, *D. rampoddensis*, and the two subspecies of *D. muscorum*. *Diploschistes nepalensis* Pant & Upreti, described from the Himalayas (Nepal), does not belong to the genus but is probably a species of *Gyalidea*. Currently, the genus is represented by a total of 13 taxa from India (Pant & Upreti 1993; Singh & Sinha 2010).

Key to species of the genus *Diploschistes* from India

1	Ascomata deeply urceolate, appearing perithecioid	2
	Ascomata flat to shallowly urceolate, apothecioid	7
2(1)	Thallus whitish pruinose, on calciferous rocks	**D candidissimus**
	Thallus epruinose, on siliceous rocks	3
3(2)	Thallus whitish grey, lacking depsides	**D. euganeus**
	Thallus colour variable, containing lecanoric acid	4
4(3)	Thallus pale grey to whitish grey; ascospores 16–32 × 10–20 µm	**D. actinostomus**
	Thallus bluish grey; ascospores 28–60 × 15–28 µm	5
5(4)	Ascospores distinctly amyloid, 45–60 × 15–21 µm	**D. megalosporus**
	Ascospores faintly amyloid to non-amyloid	6
6(5)	Ascospores 10–20 × 9–13 µm	**D. microsporus**
	Ascospores 28–42 × 15–28 µm	**D. caesioplumbeus**
7(1)	Thallus on siliceous or calciferous rocks	8
	Thallus on soil, mosses or lichens	10
8(7)	Thallus whitish pruinose, on calciferous rocks; asci 4-spored	**D. gypsaceus**
	Thallus on siliceous rocks; asci 6–8-spored	9
9(8)	Thallus greenish grey to grey; ascospores broadly ellipsoid, 21–45 × 9–21 µm	**D. scruposus**
	Thallus yellowish grey to orange-yellow; ascospores ellipsoid, 15–27 × 6–12 µm	**D. rampoddensis**
10(7)	Thallus at least initially parasitic on *Cladonia* spp	11
	Thallus not lichenicolous	12
11(10)	Asci 8-spored	**D. muscorum** ssp. **bartlettii**
	Asci 4-spored	**D. muscorum** ssp. **muscorum**
12(10)	Thallus whitish grey, heavily pruinose; asci 4–8-spored	**D. diacapsis**
	Thallus yellowish brown, epruinose; asci 8-spored	**D. cinereocaesius**

Diploschistes actinostoma (Pers. ex Ach.) Zahlbr.

Hedwigia **31:** 34 (1892).

Thallus areolate, shiny.

Ascomata perithecioid; asci 8-spored; ascospores small, 16–32 × 10–20 µm.

Chemistry. Lecanoric acid.

Remarks. It grows on siliceous rocks and is widely distributed in India, occurring in the Western and Eastern Himalayas, Central India and the Western Ghats.

Specimens examined. **India:** *Himachal Pradesh*: Chamba District, in and around Khajiar, elev. 2000 m, *D. K. Upreti & S. Nayaka* 01–75464 (LWG). *Jammu & Kashmir*: Srinagar District, Shankaracharya Hills, *D. D. Awasthi* 53–2650 (LWG–AWAS). *Karnataka*: Bellari

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District, Hampi, along riverside, *A. Singh, G. P. Sinha & S. Singh* 90–234 (LWG–NRLC). *Madhya Pradesh*: Anuppur District, Amarkantak, *A. Prajapati* 10–017129 (LWG). *Maharashtra*: Pune District, Pune City, Chandni Chowk, NDA road, Banjara Hill, elev. 580 m, *S. Nayaka* 06–005076, 06–005081 (LWG). *Meghalaya*: 7 km from Cherapunji, elev. *c.* 1000 m, *D. D. Awasthi* 75–7980 (LWG–AWAS). *Tamil Nadu*: Salem District, Yercaud, Shevaroy Hills, near Kiliur Falls, elev. 1350 m, *D. K. Upreti & G. N. Hariharan* 90–202155 (LWG). *Uttarakhand*: Pithoragarh Distict, en route to Milam Glacier, Munsiyari to Lilam, elev. 2250–1800 m, *Santosh Joshi* 07–010319, 07–010321 (LWG).

Diploschistes caesioplumbeus (Nyl.) Vain.

Bot. Mag. (*Tokyo*) **35:** 70 (1921).

Thallus areolate epruinose.
Ascomata perithecioid; ascospores 28–42 × 15–28 µm.

Chemistry. Lecanoric acid.

Remarks. This species differs from the closely related *D. actinostomus* and *D. candidissimus* by having larger ascospores, and from the latter also by the epruinose thallus growing on silicious rock. It has been recorded from the arid zone (north-west) and Central India (Madhya Pradesh) by Pant & Upreti (1993).

Specimen examined. **India:** *Rajasthan*: Sirohi District, Mount Abu, near Arbuda Devi temple, *A. Singh* 73–101312 (LWG).

Diploschistes candidissimus (Kremp.) Zahlbr.

Cat. Lich. Univ. **2:** 600 (1923).

Thallus calcicolous, areolate and pruinose.
Ascomata perithecioid; asci 4–8-spored; ascospores 18–38 × 15–21 µm.

Chemistry. Lecanoric acid as a major constituent.

Remarks. This species is known from the Eastern Himalaya, North and Central India, and the Eastern and Western Ghats.

Specimens examined. **India:** *Himachal Pradesh*: Bilaspur District, Namhol, Tepra, Bahadurpur, elev. 1500–2200 m, *D. K. Upreti* 03–001361, 03–001322A (LWG). *Jammu & Kashmir*: Srinagar District, Shankaracharya Hill, *D. D. Awasthi* s. n. (LWG–AWAS). *Karnataka*: Hassan District, Shravanabelagola, Chandragiri Hills, *A. Singh & G. P. Sinha* 90–220 (LWG). *Madhya Pradesh*: Hosangabad District, Pachmarhi, Rajat Pratap Falls, elev. 1060 m, *D. K. Upreti & U. C. Mishra* 80–75, 80–114 (LWG). *Orissa*: Ganjam District, Taptapani, 5 km Berhampur, *D. D. Awasthi* 86–062 (LWG–LWU). *Rajasthan*: Sirohi District, Mount Abu, near Arbuda Devi temple, *A. Singh* 73–101335, 73–101343 (LWG). *Tamil Nadu*: Nilgiri District, Nilgiri Hills, Upper Bhani road from Avalanche, on Lakribetta top, elev. *c.* 2400 m, *D. D. Awasthi & Kr. P. Singh* 71–732 (LWG–LWU). *Uttarakhand*: Bageshwar District, near Phurkia dakbanglow, elev. 3510 m, *D. D. Awasthi* 70–7732 (LWG–AWAS); Pithoragarh District, en route to Milam Glacier, Lilam to Bogudiyar (Rargari udiyar), elev. 2400 m, *Santosh Joshi* 07–010349 (LWG).

Diploschistes cinereocaesius (Sw. ex Ach.) Vain.

Ann. Acad. Sci. Fenn., sér. A **15:** 172 (1921).

Thallus verrucose.
Asci 8-spored; ascospores 18–27 × 9–15 µm.

Chemistry. Lecanoric and diploschistesic acids.

Remarks. This is a terricolous species. The similar *D. rampoddensis* differs in lacking diploschistesic acid and occurs on siliceous rocks. In India *D. cinereocaesius* occurs in the Western and Eastern Himalayas, and the Western Ghats.

Specimens examined. **India:** *Kerala*: Idukki District, Munnar, Deviculam area, elev. *c.* 1500–1600 m, *D. D. Awasthi, R. Tewari & R. Mathur* 85–163 (LWG). *Meghalaya*: 3 km towards Mawsmai from Cherrapunji, elev. *c.* 1100 m, *D. D. Awasthi* 75–7932 (LWG–LWU). *Sikkim*: Gangtok District, Tashi viewpoint, elev. 1750 m, *S. Chatterjee & P. K. Divakar* 20–77187 (LWG). *Tamil Nadu*: Nilgiri District, Nilgiri Hills, Konada tea estate area, by roadside, *D. D. Awasthi & Kr. P. Singh* 71–13 (LWG–LWU); near Ooty, Emerald road, Fern Hill, *Kr. P. Singh* 73–499 (LWG–LWU).

Diploschistes diacapsis (Ach.) Lumbsch

Lichenologist **20:** 20 (1988).

Thallus whitish, pruinose.
Ascomata apothecioid; asci 8-spored; ascospores 21–33 × 12–18 µm.

Chemistry. Lecanoric and diploschistesic acids.

Remarks. This species was recorded from the Western Himalaya (Himachal Pradesh and Uttarakhand) by Pant & Upreti (1993) and Singh & Sinha (2010).

Diploschistes euganeus (A. Massal.) J. Steiner

Verhandl. Zool. Bot. Ges. Wien **69:** 96 (1919).

Thallus grey to greyish brown.
Ascomata perithecioid; asci 8-spored; ascospores 24–36 × 15–18 µm.

Chemistry. No substances detected.

Remarks. This saxicolous species was recorded from the Western Himalaya by Pant & Upreti (1993).

Specimen examined. **India:** *Uttarakhand*: Uttarkashi District, Hasil, on way to Gangotri, *A. Singh* 97254 (LWG).

Diploschistes gypsaceus (Ach.) Zahlbr.

Hedwigia **31:** 35 (1892).

Thallus whitish pruinose.
Asci 4-spored; ascospores 30–45 × 15–18 µm.

Chemistry. Lecanoric acid.

Remarks. In India, the species is reported from the Western Himalaya and Central India. *Diploschistes scruposus* differs in having an epruinose thallus and occurring in siliceous as opposed to calciferous rock habitats.

Specimens examined. **India:** *Himachal Pradesh*: Kinnaur District, Reckong Peo to Kalpa Village, elev. 2950 m, *D. K. Upreti, R. Srivastava & Prakash Singh Kunwar* 03–002664 (LWG). *Jammu & Kashmir*: Doda District, Badharwah, Ramkund, *Chandrashekhar* 10–012578 (LWG). *Uttarakhand*: Almora District, Karbala pine forest, elev. 1600 m, *D. K. Upreti, S. Chatterjee & J. Tandon* 97–L69753, 97–L69754 (LWG).

Diploschistes megalosporus Lumbsch & H. Mayrhofer

Mycotaxon **38:** 311 (1990).

Thallus areolate.
Ascomata perithecioid; asci 4–6-spored; ascospores 42–60 × 15–21 µm, I+ blue when young.

Chemistry. Lecanoric and diploschistesic acids.

Remarks. This species was described from the Western Ghats (Tamil Nadu) and is endemic to India. The morphologically close *D. actinostoma* and *D. caesioplumbeus* differ in having smaller, faintly to non-amyloid ascospores.

Diploschistes microsporus Lumbsch & Elix

Biblioth. Lichenol. **86:** 124 (2003).

Thallus smooth, rimose-areolate.
Ascomata perithecioid; asci 8-spored; ascospores non-amyloid, 10–20 × 9–13 µm.

Chemistry. Lecanoric and diploschistesic acids.

Remarks. This species is recorded from Meghalaya in the Eastern Himalayan region (Singh & Singh 2016). *Diploschistes caesioplumbeus* differs from this species in producing slightly larger ascospores.

Diploschistes muscorum subsp. bartlettii Lumbsch

Herzogia **7:** 602 (1987).

Thallus grey to whitish grey, rimose, areolate.
Ascomata immersed, urceolate.

Chemistry. Diploschistesic, lecanoric and orsellinic acids.

Remarks. This species is a juvenile parasite on *Cladonia* spp. Two subspecies are present in India, the 4-spored nominal subspecies and the 8-spored *D. muscorum* subsp. *bartlettii*. In India, the latter subspecies is reported from the Western Ghats, and the Western and Eastern Himalayas.

Specimens examined. **India:** *Himachal Pradesh*: Kinnaur District, Chitkul forest area, elev. 3900–4000 m, D. *K. Upreti, R. Srivastava & Prakash Singh Kunwar* 03–002749 (LWG). *Jammu & Kashmir*: Doda District, Bahadurpur, Kailash Kund, *Chandrashekhar* 10–012537 (LWG). *Karnataka*: Chikmagalure District, way to Kemmangundi, elev. *c.* 1400 m, *D. D. Awasthi, D. K. Upreti & U. C. Misra* 79–434 (LWG). *Kerala*: Wayanad

District, Chembra Hills, elev. 1050 m, *B. Haridas* 06–009647 (LWG). *Meghalaya*: Shillong District, *A. Singh, S. Chatterjee & S. Singh* 91–38 (LWG). *Mizoram*: Aizwal District, Chawn pui, elev. 1450 m, *M. Chinlampianga* 12–018692 (LWG). *Tamil Nadu*: Nilgiri District, Nilgiri Hills, Lovedale, *Kr. P. Singh* 73–507 (LWG–LWU). *Uttarakhand*: Almora District, elev. 2400 m, *D. D. Awasthi & A. M. Awasthi* 50–687 (LWG–AWAS). *West Bengal*: Darjeeling District, Kurseong, elev. 2400 m, *D. D. Awasthi & M. R. Agarwal* 66–321(LWG).

Diploschistes muscorum subsp. muscorum (Scop.) R. Sant.

Lichenologist **12:** 106 (1980).

This subspecies differs from *D. muscorum* subsp. *bartlettii* in having a smaller hymenium and 4-spored asci. In India, the taxon occurs in the Western and Eastern Himalayas and the Western Ghats.

Specimens examined. **India:** *Jammu & Kashmir*: Srinagar District, Shankaracharya Hill, *D. D. Awasthi* 53–2644 (AWAS). *Kerala*: Idukki District, Munnar, Rajamallay area, along border of tea plantation, elev. 1500–1600 m, *D. D. Awasthi, R. Tiwari & Mathur* 85–89 (LWG–LWU). *Uttarakhand*: Chamoli District, Badrinath, east of the temple, elev. *c.* 3250 m, *K. Dange* 76–838 (LWG–LWU).

Diploschistes rampoddensis (Nyl.) Zahlbr.

Cat. Lich. Univ. **2:** 665 (1924).

Thallus verrucose.

Ascomata apothecioid; asci 8-spored; ascospores 15–27 × 6–12 µm.

Chemistry. Lecanoric acid.

Remarks. The terricolous *D. cinereocaesius* has broader ascospores and those of *D. scruposus* are larger. Furthermore, both species produce diploschistesic acid as an additional thallus compound. *Diploschistes rampoddensis* occurs in the Western and Eastern Himalayas, Central India and the Western Ghats.

Specimens examined. **India:** *Himachal Pradesh*: Bilaspur District, Namhol, Tepra, Bahadurpur, elev. 1500–2200 m, *D. K. Upreti et al.* 03–001343 (LWG). *Madhya Pradesh*: Dindori District, Chauradader, elev. 1500 m, *D. K. Upreti, S. Nayaka & Satya* 05–005646A (LWG). *Maharashtra*: Satara District, Mahabaleshwar, Wilson Point, elev. 1470 m, *R. Bajpai* 10–013822 (LWG). *Tamil Nadu*: Palni Hills, Kodaikanal, Shembaganur near Silver Cascade, elev. *c.* 1800 m, *Kr. P. Singh* 70–1129 (LWG–LWU). *Uttarakhand*: Almora District, on way to Kasardevi, elev. 1650 m, *D. D. Awasthi* 56–3475 (AWAS).

Diploschistes scruposus (Schreb.) Norman

Nyt Mag. Naturvidensk. **7:** 232 (1853).—*Diploschistes awasthii* G. Pant & Upreti, *Lichenologist* **25:** 38 (1993); type: India, Uttarakhand, Bageshwar District, near Phurkia dakbunglow, elev. 3300 m, 10 June 1970, *D. D. Awasthi* 7662 (LWG-AWAS—holotype).

Thallus grey to greenish grey, rimose, areolate, verrucose.

Ascomata apothecioid; asci 4–8-spored; ascospores brown, 21–45 × 9–21 µm.

Chemistry. Lecanoric and diploschistesic acids.

Remarks. *Diploschistes scrupsosus* is widely distributed in the Western and Eastern Himalayas, Central India and the Western Ghats. It is both saxicolous and terricolous.

Specimens examined. **India:** *Arunachal Pradesh*: Kameng (west) District, labour camp, 3 km before Bomdila, *D. K. Upreti et al.* 08–009273 (LWG). *Himachal Pradesh*: Kinnaur District, Reckong Peo, in and around Kalpa, elev. 2950 m, *D. K. Upreti, R. Srivastava & Prakash Singh Kunwar* 03–002664 (LWG). *Jammu & Kashmir*: Anantnaag District, Pahalgam, north side, elev. 2280 m, *M. Sheikh* 05–006090 (LWG). *Karnataka*: Banglore District, Bannergatta Hazam Kalu, elev. 980 m, *D. D. Awasthi, D. K. Upreti & U. Misra* 79–237 (LWG). *Madhya Pradesh*: Raisen District, Bhimbetka, *D. K. Upreti* 04–003557 (LWG). *Meghalaya*: Shillong District, Elephant Falls, *A. Singh, S. Chatterjee & S. Singh* 91–24 (LWG). *Sikkim*: East Sikkim, Tsomgo Lake area, 3600 m, *S. Chatterjee & P. K. Divakar* 20–77153B (LWG). *Tamil Nadu*: Nilgiri District, Nilgiri Hills, Lovedale, *Kr. P. Singh* 73–518 (LWG). *Uttarakhand*: Pithoragarh District, en route to Milam Glacier, Munsyari to Lilam, *Santosh Joshi* 07–010316, 07–010317 (LWG). *West Bengal*: Darjeeling District, Kurseong, near Mahanadi towards north side, along tea garden, elev. 2400 m, *D. D. Awasthi & M. R. Agarwal* 66–291 (LWG–LWU).

Glaucotrema Rivas Plata *et al.*

Taxon **61:** 1174 (2012).

The genus was established to accommodate the *Myriotrema glaucophaenum*

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group, characterizing species with a dense, splitting thallus cortex, prominent ascomata with a hyaline proper exciple, often the presence of a pseudocolumella, transversely septate to submuriform, hyaline ascospores, and containing psoromic and sometimes hypoprotocetraric acids (Rivas Plata *et al.* 2012*b*). Of the four species known worldwide, a single species is reported from India.

Glaucotrema glaucophaenum (Kremp.) Rivas Plata & Lumbsch

Taxon **61:** 1175 (2012).

Thallus greenish to yellowish grey.

Ascomata emergent; pseudocolumella indistinct; proper exciple ± free; asci 8-spored; ascospores transversely 3–5-septate, hyaline, 10–20 × 5–8 µm.

Chemistry. Psoromic acid.

Remarks. Recent collections confirm the occurrence of this species in India in the Western Ghats and the Eastern Himalaya. The previous report of *Ocellularia glaucophaena* Patwardhan & Kulkarni (Patwardhan & Kulkarni 1977*a*) from Kerala has been included in *O. verrucoisidiata* (Frisch *et al.* 2006).

Specimens examined. **India:** *Kerala*: Idduki District, Kallar Munnar Hills, *A. Singh* 75–103067B (LWG). *Meghalaya*: Garo Hills, Thodlackein area, 2008, *D. K. Upreti* s. n. (LWG).

Leucodecton A. Massal.

Atti Reale Ist. Veneto Sci. Lett. Arti, sér. 3 **5:** 325 (1860).

Leucodecton, as currently circumscribed, includes several species previously placed in *Leptotrema*, *Myriotrema* and *Thelotrema*. *Leucodecton* is characterized by having usually small, apothecioid to perithecioid ascomata and a fused or free proper exciple of distinctly paraplectenchymatous hyphae lacking radially oriented tips, markedly interwoven and often scarcely branched paraphyses, an absence of periphysoids, ±muriform, usually non-amyloid, mostly brown ascospores, and the presence of stictic and norstictic acids (Frisch *et al.* 2006; Mangold *et al.* 2009; Rivas Plata *et al.* 2010*a*; Joshi *et al.* 2012*b*). The genus currently includes *c.* 19 species worldwide and nine species are known from India so far.

Key to species of the genus *Leucodecton* from India

1 Ascospores 10–50 µm long, (2–)4–8 per ascus 2
Ascospores >50 µm long, 1–4 per ascus 6

2(1) Norstictic acid present; ascomata lepadinoid with free exciple . . . . . **L. occultum**
Stictic acid present; ascomata variable 3

3(2) Ascomata often aggregated in whitish pseudostromata; thallus ecorticate, often hollow beneath . . . . . **L. glaucescens**
Ascomata solitary (sometimes numerous); thallus corticate (loose to irregular or prosoplectenchymatous) 4

4(3) Cortex dense, thallus shiny; ascospores 15–27(–33) µm long . . . . . **L. compunctum**
Cortex loose, thallus dull; ascospores 20–40 µm long 5

5(4) Ascomata lepadinoid, with free exciple . . . . . **L. subcompunctum**
Ascomata myriotremoid, with ±fused exciple . . . . . **L. fissurinum**

6(1) Ascospores remaining hyaline . . . . . **L. anamalaiense**
Ascospores brown at maturity 7

7(6) Ascomata myriotremoid to ocellularioid; thallus with irregular clusters of crystals . . . . . **L. tarmuguliense**
Ascomata porinoid to myriotremoid; thallus often with large columnar clusters of crystals 8

8(7) Ascomata porinoid (to indistinctly myriotremoid or lepadinoid with an apically free exciple), narrow pore surrounded by dark ring . . . . . **L. compunctellum**
Ascomata myriotremoid with narrow pore, thallus with small ±irregularly dispersed crystals, narrow pore surrounded by white ring. . . . . **L. nuwarense**

Leucodecton anamalaiense (Patw. & C. R. Kulk.) Rivas Plata & Lücking

Lichenologist **42:** 184 (2010).

Ascomata lepadinoid; exciple brownish, lacking lateral paraphyses; asci 2–4-spored; ascospores muriform, hyaline, 50–80 × 15–20 µm.

Chemistry. Stictic acid chemosyndrome.

Remarks. This species was described as *Thelotrema anamalaiense* Patw. & C. R. Kulk. from the Anamalai Hills in the Western Ghats by Patwardhan & Kulkarni (1977*b*) but was recently placed in *Leucodecton* due to the combination of characters described above. *Leucodecton nuwarense* is similar but differs in having smaller ascospores that turn brown in late maturity (Rivas Plata *et al.* 2010*a*).

Specimen examined. **India:** *Kerala*: Idduki District, Sholayar forest, in the ravine near dam, Anamalai Hills, *P. G. Patwardhan & A. V. Prabhu* 76–344 (AMH).

Leucodecton compunctellum (Nyl.) Frisch

Biblioth. Lichenol. **92:** 155 (2006).

Thallus pale yellowish grey to straw-coloured, finely rugose to verrucose surface with large columnar clusters of crystals.

Ascomata porinoid with very small pores (*c.* 0·05 mm); proper exciple fused; asci 1–4-spored; ascospores brown, ≥140 µm long.

Chemistry. Stictic acid.

Remarks. This species has been previously reported from India incorrectly as *Leptotrema elachistoteron* (Leight.) Patw. & C. R. Kulk., *L. microglaenoides* (Vain.) Zahlbr., *L. oligosporum* (Müll. Arg.) Patw. & Makhija, *Myriotrema elachistoteron* (Leight.) Hale and *M. reclusum* (Kremp.) Hale (Patwardhan & Makhija 1980; Nagarkar *et al.* 1986; Awasthi 1991; Mangold *et al.* 2009; Singh & Sinha 2010). It is known from the Andaman Islands and the Western Ghats.

Specimens examined. **India:** *Andaman & Nicobar Islands*: Unknown Island, near evergreen forest compound, *A. Singh* 61–79745 (LWG). *Kerala*: Idukki District, ICRI campus, Myladumpara, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi* 84–116 (LWG).

Leucodecton compunctum (Ach.) A. Massal.

Atti Inst. Veneto Sci. Lett., Arti, sér. 3 **5:** 325 (1860).

Thallus rather glossy, smooth to crystalline.

Ascomata immersed, perithecioid, with minute pores; ascospores brown, muriform.

Chemistry. Stictic acid.

Remarks. This species can be separated from *Sanguinotrema wightii* (Taylor) Lücking by the lack of red anthraquinone crystals and from *L. compunctellum* and *L. subcompunctum* by having smaller ascospores. Its distribution in India is restricted to tropical rainforests of the Western Ghats.

Specimen examined. **India:** *Kerala*: Kollam District, Rosemala, *B. Haridas* 06–009582 (LWG).

Leucodecton fissurinum (Hale) A. Frisch

Biblioth. Lichenol. **92:** 156 (2006).

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Thallus compact, regularly fissured, areolate thallus.

Ascomata myriotremoid; exciple fused to incompletely free, bordering ascoma with a rounded pore as brown ring; ascospores muriform (3–10 × 1–3 septate), 20–40 × 9–13 µm.

Chemistry. Stictic acid.

Remarks. Ascospore characters are the major characters distinguishing *L. fissurinum* from *L. subcompunctum*. In India this species was reported as *Myriotrema fissurinum* Hale (Awasthi 1991; Singh & Sinha 2010). It occurs in the Western Ghats and the Eastern Himalaya.

Specimens examined. **India:** *Kerala*: Idukki District, ICRI campus, Myladumpara, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi* 84–103 (LWG–LWU). *Tamil Nadu*: Nilgiri District, Nilgiri Hills, Avalanche, Hatchery Shola, elev. *c.* 2100 m, *Kr. P. Singh* 71–564 (LWG–LWU). *West Bengal*: Darjeeling District, Rangit River valley, Rangit, near the bridge, elev. *c.* 600 m, *D. D. Awasthi & M. R. Agarwal* 67–185 (LWG–LWU).

Leucodecton glaucescens (Nyl.) Frisch

Biblioth. Lichenol. **92:** 164 (2006).

Thallus usually hollow beneath and very fragile.

Ascomata chroodiscoid-lepadinoid, aggregated in whitish pseudostromata; proper exciple ± free; asci 8-spored; ascospores small, brown, muriform, mostly under 20 × 10 µm.

Chemistry. Stictic acid.

Remarks. Awasthi (1991) reported the species as *Myriotrema glaucescens*. The closely related *L. phaeosporum*, *L. subcompunctum* and *L. fissurinum* have a loosely corticate thallus, mostly solitary ascomata and larger ascospores. *Leucodecton glaucescens* is restricted to tropical forests of the Western Ghats.

Specimens examined. **India:** *Kerala*: Idukki District, Munnar, Rajamallay area, along border of tea plantation, elev. *c.* 1500–1600 m, *D. D. Awasthi, R. Tewari & R. Mathur* 85–55 (LWG–LWU); on way from Myladumpara to Munnar, Chinnakanal area, elev. *c.* 1350 m, *D. D. Awasthi & G. Awasthi* 84–251 (LWG–LWU).

Leucodecton nuwarense (Hale) Frisch

Biblioth. Lichenol. **92:** 155 (2006).

Thallus pale greenish grey, unevenly cracked.

Ascomata numerous, immersed; proper exciple free; asci 2-spored; ascospores brown, muriform, 42–55 × 10–15 µm.

Chemistry. Stictic acid chemosyndrome.

Remarks. This taxon was originally recorded as *Leptotrema nuwarense* (Hale) Nagarkar *et al.* and *Myriotrema nuwarense* Hale from South Andaman (Nagarkar *et al.* 1986; Awasthi 1991). *Leucodecton nuwarense* is similar to *L. anamalaiense*, which is distinguished by the consistently hyaline and somewhat larger ascospores.

Leucodecton occultum (Eschw.) Frisch

Biblioth. Lichenol. **92:** 157 (2006).

Thallus ecorticate, fissured, yellowish grey to greenish grey.

Ascomata immersed to slightly emergent; proper exciple free; ascospores small, brown, submuriform or muriform, 5–9 × 1–5 septate, thick-walled, 20–40 × 10–17 µm.

Chemistry. Norstictic acid chemosyndrome.

Remarks. Patwardhan & Kulkarni (1977*a*) recognized *L. occultum* as *Leptotrema compunctum*, and Patwardhan & Nagarkar (1980) as *Leptotrema norstictideum* Patw. & Nagarkar. *Leucodecton occultum* occurs in the Andaman and Nicobar Islands, Central India, the Eastern Himalaya, and the Eastern and Western Ghats.

Specimens examined. **India:** *Andhra Pradesh*: Vishakhapatnam District, Simhachadam area in cashew plantation, *D. D. Awasthi et al.* 86–240, 86–248 (LWG–LWU). *Assam*: Gauhati to Shillong road, 10 km from Gauhati, Burnhatti, *P. G. Patwardhan & M. B. Nagarkar* 77–695 (AMH). *Kerala*: Trivandrum District, Botanical and Zoological Garden, *D. D. Awasthi, D. K. Upreti & U. Mishra* 79–898 (LWG–LWU). *Orissa*: Ganjam District, on way to Seranga, *D. D. Awasthi et al.* 86–128 (LWG–LWU). *West Bengal*: 24 Parganas District, Sunderban, Sajanakholi forest office, on bark, v 1975, *K. N. Roychowdhury* 75–3871 (LWG–CAL).

Leucodecton subcompunctum (Nyl.) Frisch

Biblioth. Lichenol. **92:** 162 (2006).

Thallus olive-grey to olive-brown, fissured to areolate, ±glossy, loose, irregularly corticate.

Ascomata immersed, round to angular; disc with wide opening, blackish but covered with white pruina; proper exciple free to partly fused; asci 8-spored; ascospores brown, muriform, 3–8 × 1–3 septate, 15–35 × 10–20 µm.

Chemistry. Stictic acid chemosyndrome.

Remarks. The compact, crystalline, irregularly fissured to areolate thallus and lepadinoid ascomata with free excipulum separate *L. subcompunctum* from *L. fissurinum*. *Leucodecton subcompunctum* occurs in tropical evergreen forests of the Western Ghats.

Specimens examined. **India:** *Kerala*: Idukki District, Kallar Munnar Hills, elev. 1140 m, *A. Singh & M. Ranjan* 75–103044 (LWG). *Tamil Nadu*: Nilgiri District, Nilgiri Hills, Kodanad, tea estate area, elev. *c.* 2019 m, *D. D. Awasthi & Kr. P. Singh* 70–1447, 70–1500 (LWG–LWU).

Leucodecton tarmuguliense (Sethy *et al.*) Frisch

Biblioth. Lichenol. **92:** 155 (2006).

Thallus yellowish grey to olivaceous.

Ascomata prominent; proper exciple fused; asci 2-spored; ascospores brown, muriform, 70–93 × 15–23 µm.

Chemistry. Stictic acid chemosyndrome.

Remarks. Sethy *et al.* (1987) described this species as *Leptotrema tarmuguliense* from South Andaman; later it was accommodated in *Myriotrema* (Awasthi 1991) until the recent re-evaluation of the thelotremoid group. *Leucodecton tarmuguliense* differs from the closely related *L. compunctellum* by its prominent (emergent) ascomata and irregular clusters of crystals. *Leucodecton tarmuguliense* is so far reported only from the Andaman and Nicobar Islands and is apparently endemic to India.

Specimen examined. **India:** *Andaman & Nicobar Islands*: South Andaman, near Wandoor, Tarmuguli Island, *M. B. Nagarkar & P. G. Patwardhan* 85–1862 (AMH).

Melanotrema A. Frisch

Biblioth. Lichenol. **92:** 382 (2006).

This group of species was recently segregated from *Ocellularia* s. l. (Frisch *et al.* 2006) to accommodate species having strong carbonization in the ascomata an *Ocellularia*-type proper exciple with a broad stump-shaped to reticulate columella without incorporation of calcium oxalate crystals, and an ecorticate thallus producing no lichen compounds, except lichexanthone. Twelve species are known worldwide, of which two are reported from India.

Key to species of the genus *Melanotrema* from India

1 Ascospores 3-septate; secondary metabolites absent . . . . . **M. submicrosporoides**
Ascospores 5–8-septate; lichexanthone present . . . . . **M. platystomum**

Melanotrema platystomum (Mont.) A. Frisch

Biblioth. Lichenol. **92:** 397 (2006).

Ascomata round to shortly lirellate, immersed to strongly emergent; proper exciple free; ascospores hyaline, transversely 5–8-septate, 16–26 × 6–8 µm.

Chemistry. Lichexanthone is an accessory compound.

Remarks. This species was recorded as *Thelotrema platystomum* Mont. from the Andaman Islands (Nagarkar *et al.* 1988). A recent collection also showed its occurrence in the Western Ghats.

Specimen examined. **India:** *Karnataka*: Shimoga District, near Hebri, elev. 107 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19733T/A (LWG).

Melanotrema submicrosporoides (Nagarkar, Sethy & Patw.) S. Joshi & Lücking comb. nov.

MycoBank No.: MB 826954

Leptotrema submicrosporoides Nagarkar *Biblioth. Lichenol.* **40:** 3 (1991); type: India, Andaman & Nicobar Islands, South Andaman, Tarmuguli Island, on bark, 19 December 1985, *P. K. Sethy & M. B. Nagarkar* 85–1975 (AMH—holotype).

Thallus pale to fawn-coloured, glossy, smooth.

Ascomata black-rimmed, immersed; proper exciple and columella distinctly carbonized; asci 8-spored; ascospores hyaline to brown, transversely 3-septate, amyloid (before initial pigmentation), 10–13 × 4–6 µm.

Chemistry. No substances detected.

Remarks. Upon re-examination the type of *L. submicrosporoides* was found to exhibit the above characters. This species was also reported as *Ocellularia submicrosporoides* (Nagarkar *et al*.) D. D. Awasthi in Awasthi (1991). *Melanotrema submicrosporoides* appears to be endemic and was described from the Andaman and Nicobar Islands. Superficially, it resembles a member of the non-lichenized family *Stictidaceae*.

Myriotrema Fée

Essai Crypt. Écorc. **1:** xlix, 103 (1825).

The diagnostic characters of the genus include an internally splitting prosoplectenchymatous cortex, small, myriotremoid ascomata immersed in the thallus and usually lacking periderm layers in the margin, a prosoplectenchymatous, uncarbonized proper exciple with radiating tips, an absence of periphysoids, and a thallus producing mostly psoromic or hypoprotocetraric acids or some unknown compounds. The genus was resurrected by Salisbury (1978) and Hale (1980, 1981) but its circumscription has changed and numerous taxa have been transferred to *Chapsa, Leucodecton*, *Ocellularia, Thelotrema* and *Wirthiotrema*. Currently, 50 species of *Myriotrema* are recognized worldwide (Lücking *et al*. 2016). Joshi *et al*. (2012*b*) reported nine species from India; however, the revised concept of the genus supported the placement of *M. masonhalei* and *M. pertusarioides* in *Ocellularia*, *M. glaucophaenum* in the newly established genus *Glaucotrema*, and *M. desquamans* in *Wirthiotrema* (Rivas Plata *et al*. 2010*a*; Lücking *et al*. 2016). Consequently, we recognize only five species strictly belonging to this genus in India.

Key to species of the genus *Myriotrema* from India

1 Ascospores submuriform to muriform 2
Ascospores transversely septate. 3

2(1) Secondary metabolites absent; ascospores 10–20 × 6–9 µm . . . . . **M. subconforme**
Psoromic acid present; ascospores 15–25 × 7–10 µm. . . . . **M. rugiferum**

3(1) Thallus containing olivaceic acid . . . . . **M. olivaceum**
Thallus containing psoromic acid 4

4(3) Thallus glossy, smooth to uneven, ±fused proper exciple; ascospores 10–20 × 6–8 µm . . . . . **M. clandestinum**
Thallus fissured, areolate, ±free proper exciple (double margins); ascospores 10–18 × 5–8 µm . . . . . **M. microporum**

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Myriotrema clandestinum (Fée) Hale

Mycotaxon **11:** 133 (1980).

Thallus pale greenish to olivaceous, continuous, glossy.

Ascomata immersed; proper exciple ± fused; ascospores small, hyaline, transversely 3-septate, 10–20 × 6–8 µm.

Chemistry. Psoromic acid.

Remarks. The similar *M. microporum* differs in having a fissured thallus and double margins. *Myriotrema clandestinum* occurs in the Andaman and Nicobar Islands, the Western Ghats and the Eastern Himalaya. This species was reported by Nagarkar *et al*. (1988) incorrectly as *Ocellularia terebratula* (Nyl.) Müll. Arg.

Specimens examined. **India:** *Karnataka*: Uttarakannada District, Kumta taluk, Vadgeri (Chandawar), *S. Dudani* 14–024494 (LWG). *Kerala*: Kollam District, Rosemala, *B. Haridas* 06–009585 (LWG). *Tamil Nadu*: Palni Hills, Perumal to Palni roadside, via short-cut road, elev. 1350–1500 m., *Kr. P. Singh* 70–984 (LWG).

Myriotrema microporum (Mont.) Hale

Mycotaxon **11:** 134 (1980).

Thallus thick, areolate, fissured, dark dull grey.

Ascomata small with double margins; asci 8-spored; ascospores transversely 3-septate, hyaline, 10–18 × 5–8 µm.

Chemistry. Psoromic acid chemosyndrome.

Remarks. This species was previously recognized as *O. micropora* (Mont.) Müll. Arg. (Nagarkar *et al*. 1988). It occurs in the Eastern Himalaya, and the Western and Eastern Ghats.

Specimens examined. **India:** *Assam*: North Cachar Hills District, Haflong, *D. K. Upreti & Jayshree Rout* 05–002992 (LWG). *Kerala*: Idukki District, ICRI campus, Myladumpara, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi* 84–118, 84–128, 84–148 (LWG–LWU). *Mizoram*: Champai District, Murlen National Park, elev. 2092 m, *A. R. Logesh & M. Chinlampianga* 14–031477 (LWG). *Orissa*: Ganjam District, on way to Seranga, *D. D. Awasthi et al.* 86–127 (LWG–LWU). *Tamil Nadu*: Palni Hills, Perumal to Palni roadside, via short-cut road, elev. 1350–1500 m, *Kr. P. Singh* 70–981 (LWG–LWU).

Myriotrema olivaceum Fée

Essai Crypt. Écorc. **1:** 103 (1825).

Thallus light greenish grey to ashy grey, smooth, fissured, areolate.

Ascomata with proper exciple free; asci 8-spored; ascospores small, 9–13 × 5–6 µm, transversely 3-septate.

Chemistry. Olivaceic with isonotatic and norisonotatic acids.

Remarks. This taxon was recorded by Nagarkar *et al*. (1986) as *Ocellularia olivacea* (Fée) Müll. Arg. from the Andaman and Nicobar Islands. It differs from the closely related *M. microporum* by producing olivaceic acid and related substances.

Myriotrema rugiferum (Harm.) Hale

Mycotaxon **11:** 135 (1980).

Thallus pale olive to greyish and greenish white, thick, corticate.

Ascomata small, immersed; proper exciple free; asci 4–8-spored; ascospores small, 15–25 × 7–10 µm, hyaline, submuriform, 3–6 × 0–3 septate.

Chemistry. Psoromic acid.

Remarks. The otherwise similar *M. subconforme* differs in lacking lichen compounds. *Myriotrema rugiferum* is confined to the tropical forests of the Western Ghats.

Specimens examined. **India:** *Kerala*: Idukki District, ICRI campus, Myladumpara, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi* 84–136, 84–73, 84–83 (LWG–LWU).

Myriotrema subconforme (Nyl.) Hale

Mycotaxon **11:** 135 (1980).

Thallus pale olive to greyish green or greenish grey, verruculose, corticate, with numerous crystals inclusions.

Proper exciple free; asci 8-spored; ascospores small, 10–20 × 6–9 µm, submuriform, 3–5 × 1–3 septate.

Remarks. *Myriotrema subconforme* is similar to *M. clandestinum* in lacking thallus compounds but differs in having transversely septate ascospores. Nagarkar *et al.* (1987) reported *M. subconforme* (as *Thelotrema subconforme*) from the Andaman and Nicobar Islands, and the Western Ghats.

Nadvornikia Tibell

Beih. Nova Hedwigia **79:** 672 (1984).

The genus currently contains four species worldwide, viz. the mazaediate *Nadvornikia hawaiensis* (Tuck.) Beih. and *N. sorediata* R. C. Harris, and two non-mazaediate species (Mangold *et al.* 2009; Medeiros *et al.* 2017). It was introduced by Tibell (1984) and has previously been placed in the family *Caliciaceae* accommodating only *N. hawaiensis*, but subsequent molecular studies showed that it belongs to *Graphidaceae* (Lumbsch *et al.* 2004; Mangold *et al.* 2008). *Nadvornikia* typically has mazaedioid ascomata with small, brown, bilocular ascospores. In India only one species is known.

Nadvornikia hawaiensis (Tuck.) Tibell

Beih. Nova Hedwigia **79:** 672 (1984).

Thallus lacks a true cortex, is verrucose, continuous, in shades of pale greenish to yellowish grey, bulging and flaking away from the substratum.

Ascomata mazaedioid, emergent, subglobose to urceolate; proper exciple fused to ±apically free; asci 8-spored; ascospores 2-locular, oblong to fusiform or subglobose, brown, non-amyloid, 6–10 × 4–6 µm, with thickened walls, septum with ornamentation (Mangold *et al.* 2009).

Chemistry. Stictic acid chemosyndrome.

Remarks. *Nadvornikia diplotylia* (Nyl.) G. Pant & D. D. Awasthi (Pant & Awasthi 1989) was reported from India but was later synonymized with *N. hawaiensis* (Mangold *et al.* 2009). *Nadvornikia hawaiensis* is known from the Andaman and Nicobar Islands and the Western Ghats (Singh & Sinha 2010).

Nitidochapsa Parnmen *et al.*

Bryologist **116:** 128 (2013).

The genus was described to accommodate species that are phylogenetically well separated from *Chapsa* s. str. and fall within the *Ocellulariae* tribe rather than the *Thelotremateae* tribe, and that share characters, viz., a nitidous, brown, corticate thallus, *Chapsa*-like ascomata with a wide open, grey-pruinose disc, lobulated to recurved, felty white margins, small brown ascospores, and a lack of secondary metabolites (Parnmen *et al.* 2013). Currently five species are accepted in the genus (Poengsungnoen *et al.* 2014), including one species also recorded from India.

Nitidochapsa leprieurii (Mont.) Parnmen *et al.*

Bryologist **116:** 131 (2013).

Thallus corticate, brown-olive, cartilaginous.

Ascomata Chapsa-like, rather small, rounded to slightly elongated or branched with lobate to recurved, felty white margins; disc grey-pruinose; asci 8-spored; ascospores transversely septate, brown, oblong to ellipsoidal or clavate, 12–16 × 5–6 µm.

Chemistry. No substances detected.

Remarks. *Nitidochapsa leprieurii* was previously recorded as *Thelotrema leprieurii* (Mont.) Hale and *Chapsa leprieurii* (Mont.) Frisch from Karnataka, Kerala and Tamil Nadu in the Western Ghats (Awasthi 1991; Singh & Sinha 2010; Joshi *et al.* 2012*a*).

Specimen examined. **India:** *Kerala*: Trivandrum, Palode, TBGRI campus, 2013, *A. R. Logesh* s. n. (LWG).

Ocellularia G. Mey.

Nebenst. Beschäft. Pflanzenk. **1:** 327 (1825).

The genus *Ocellularia* is the largest genus of thelotremoid lichens in the family and was first revised by Frisch *et al.* (2006) who restricted the genus to species with a simple columella, a carbonized or hyaline proper

exciple and amyloid ascospores. The genus *Stegobolus* was reinstated in that study and the genera *Gyrotrema* Frisch, *Melanotrema* Frisch and *Redingeria* Frisch were described to accommodate species with complex columellar structures. Another genus, *Ampliotrema* Kalb, was described to accommodate a small homogeneous group of species lacking a columella but having a carbonized excipulum, an inspersed hymenium and protocetraric acid. Whereas initial molecular studies did not support the separation of *Ampliotrema* and *Stegobolus*, and both genera were included in *Ocellularia* (Mangold *et al*. 2009), subsequent phylogenetic studies further refined the generic delimitations in the tribe *Ocellularieae*, which includes the genus *Ocellularia* and relatives (Rivas Plata *et al*. 2012*b*; Kraichak *et al*. 2014*a*). Currently, the genera *Ocellularia* and *Myriotrema* are accepted together with the resurrected *Stegobolus* and *Rhabdodiscus* Vain., while the distinction of *Ampliotrema* and *Gyrotrema* remains unclear since they were found to be nested within *Ocellularia* s. lat.

Even in the restricted sense *Ocellularia* includes over 300 species worldwide (Rivas Plata *et al*. 2012*b*; Singh *et al*. 2013; Kraichak *et al*. 2014*a*; Lücking *et al*. 2016). The first comprehensive report on Indian *Ocellularia* species was provided by Patwardhan & Kulkarni (1977*a*, *b*). Subsequently, Nagarkar *et al*. (1988) discussed a total of 43 taxa including those previously placed under the genus *Thelotrema* (Nylander 1869, 1873) with four new species from south India. More recently, a small number of studies included Indian material of this genus (Frisch *et al*. 2006; Rivas Plata *et al*. 2010*a*; Kraichak *et al*. 2014*a*).

Species in the genus grow on bark in lowland to montane habitats but a few saxicolous species are also known. It occurs predominantly in undisturbed tropical rainforests (Rivas Plata *et al*. 2008; Kraichak *et al*. 2014*a*). *Ocellularia* species are more diverse on large tree trunks spreading up to 2000 m altitude and are good indicators of ecological continuity and forest health (Rivas Plata *et al*. 2008).

Typically, *Ocellularia* species mostly have a corticate, olive or grey thallus in greenish to yellowish or whitish shades; ±round, porinoid, solitary to strongly fused ascomata; usually a carbonized, brown or pale yellowish proper exciple lacking lateral paraphyses; a hyaline to brownish epihymenium; a non-amyloid, hyaline, clear or inspersed hymenium often with a columella; 1–8-spored, clavate, non-amyloid asci; transversely septate to submuriform or muriform, hyaline to brown ascospores; the presence or absence of a large number of secondary metabolites (orcinol depsidones) and unknown compounds (Mangold *et al*. 2009).

Here we report 34 species, 13 of which are potentially endemic (including the new taxon *Ocellularia upretii*), particularly in the Western Ghats of India. Owing to a narrowly defined species concept provided by Lücking (2014) for *O. perforata* and *O. papillata*, we cautiously excluded both these species from the present account, though listed in Singh & Sinha (2010).

Key to species of the genus *Ocellularia* from India

1	Columella present	2
	Columella absent or developed rarely	23
2(1)	Ascospores transversely septate	3
	Ascospores submuriform to muriform	16
3(2)	Isidioid structures present; ascospores 90–150 × 10–12 µm	**O. karnatakensis**
	Isidioid structures absent	4
4(3)	Ascospores small, 10–40 µm long	5
	Ascospores large, >40 µm long	13

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5(4) Secondary metabolites absent . . . . . **O. wandoorensis**
Secondary metabolites present 6

6(5) Psoromic acid present 7
Chemistry variable 8

7(6) Columella and proper exciple carbonized apically to upper half, pore surrounded by black, white pruinose rim; ascospores 15–25 × 5–7 µm . . . . . **O. garoana**
Columella and proper exciple carbonized fully, pore surrounded by yellowish rim; ascospores 15–30 × 7–10 µm . . . . . **O. terebrata**

8(6) Protocetraric acid present 9
Protocetraric acid absent 10

9(8) Proper exciple pale to dark brown lacking distinct carbonization, columella at least partly carbonized, surrounded by brown rim; ascospores 21–24 × 5–7 µm. . . . . **O. violacea**
Proper exciple and columella distinctly carbonized, pore surrounded by black rim; ascospores 21–27 × 6–7 µm . . . . . **O. subperforata**

10(8) Stictic acid present . . . . . **O. canara**
Hirtifructic acid and/or unknown chemistry present 11

11(10) Hirtifructic acid and cinchonarum unknown present; ascospores 15–40 × 6–9 µm . . . . . **O. diacida**
Hirtifructic acid absent, cinchonarum unknown or udupiensis unknown present 12

12(11) Cinchonarum unknown present; ascospores 10–20 × 3–5 µm . . . . . **O. xanthostromiza**
Udupiensis unknown present; ascospores 20–28 × 3–5 µm . . . . . **O. udupiensis**

13(4) Secondary metabolites absent 14
Secondary metabolites present 15

14(13) Asci 1-spored; ascospores 150–220 × 12–16 µm; thallus with notch-like depressions . . . . . **O. dolichotata**
Asci 4–8-spored; ascospores 110–125 × 15–20 µm; thallus smooth to slightly verruculose . . . . . **O. upretii**

15(13) Hypoprotocetraric acid present; ascospores 96–232 × 16–27 µm . . . . . **O. triglyphica**
Norisonotatic and norsubnotatic acids present; ascospores 50–200 × 10–18 µm. . . . . **O. allosporoides**

16(2) Ascospores small, ≤40 µm long 17
Ascospores large, >40 µm long 20

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17(16) Protocetraric acid present; ascospores 15–40 × 7–13 µm . . . . . **O. thelotremoides**
Psoromic acid present 18

18(17) Ascospores 20–40 × 8–11 µm . . . . . **O. conformis**
Ascospores ≤25 µm long 19

19(18) Ascomata semi-emergent to emergent; ascospores 15–25 × 7–12 µm . . . . . **O. urceolaris**
Ascomata immersed; ascospores 15–22 × 7–10 µm . . . . . **O. planaria**

20(16) Secondary metabolites absent 21
Secondary metabolites present 22

21(20) Ascospores hyaline; 150–232 × 30–47 µm . . . . . **O. neomasonhaleii**
Ascospores brown; 80–150 × 15–30 µm . . . . . **O. jamesii**

22(20) Salazinic acid present; ascospores 170–250 × 35–45 µm . . . . . **O. massalongoi**
Hypoprotocetraric acid present; ascospores 100–270 × 25–40 µm . . . . . **O. arecae**

23(1) Ascospores transversely septate 24
Ascospores submuriform to muriform 25

24(23) Norisonotatic and norsubnotatic acids present; ascospores 100–130 × 20–25 µm . . . . . **O. subgranulosa**
Hypoprotocetraric acid present; ascospores 80–200 × 10–20 µm . . . . . **O. neopertusariiformis**

25(23) Secondary metabolites absent 26
Secondary metabolites present 27

26(25) Ascomata emergent; ascospores hyaline, 100–210 × 25–45 µm . . . . . **O. keralensis**
Ascomata immersed to semi-emergent; ascospores hyaline to pale brown, 150–252 × 25–50 µm . . . . . **O. subkeralensis**

27(25) Ascospores small, ≤25 µm long 28
Ascospores large, 140–350 µm long 30

28(27) Psoromic acid present; ascospores hyaline to brown, 15–20 × 12–15 µm . . . . . **O. andamanica**
Protocetraric acid present 29

29(28) Ascospores hyaline, 15–25 × 10–13 µm . . . . . **O. bahiana**
Ascospores brown, 15–18 × 10–12 µm . . . . . **O. pertusarioides**

30(27) Psoromic acid present 31
Protocetraric or hypoprotocetraric acids present 33

31(30) Ascomata immersed; ascospores 140–255 × 24–55 µm . . . . . **O. masonhalei**
Ascomata emergent 32

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32(31) Ostiole immersed, flush with ascomata; ascospores 160–255 × 33–50 µm . . . . . **O. gibberulosa**
Ostiole funnel-shaped, raised; ascospores 200–350 × 45–55 µm long . . . . . **O. annuloelevata**

33(30) Protocetraric acid present; ascospores 140–250 × 30–40 µm . . . . . **O. khasiana**
Hypoprotocetraric acid present; ascospores 150–250 × 20–50 µm . . . . . **O. eumorpha**

Ocellularia allosporoides (Nyl.) Patw. & C. R. Kulk.

Kavaka **5:** 5 (1977).—*Ocellularia verrucomarginata* Patw. *et al.*, *Biovigyanam* **11:** 135 (1985); type: India, Karnataka, Chikmagalure District, South Canara District, Agumbe, on bark, 26 January 1980, *P. G. Patwardhan & M. B. Nagarkar* 80–109 (AMH—holotype).

Ocellularia canariana Patw., Sethy & Nagarkar, *Biovigyanam* **11:** 134 (1985); type: India, Karnataka, Chikmagalure District, North Canara District, Armol Ghat, 25 February 1977, *A. V. Prabhu & M. B. Nagarkar* 77–49 (AMH—holotype).

Thallus pale greenish to yellowish green or pale olive, glossy, smooth, continuous to ±verruculose.

Ascomata apothecioid; proper exciple mostly brown to indistinctly or sometimes strongly carbonized; columella entire, brown to carbonized; asci 4–8-spored; ascospores amyloid, oblong to fusiform, hyaline (becoming mottled in late maturity), transversely 10–20-septate, 50–130 × 10–18 µm.

Chemistry. Norisonotatic and norsubnotatic acids.

Remarks. Re-examination of the type materials of *O. verrucomarginata* and *O. canariana* confirmed similar anatomy and chemistry (originally reported as psoromic acid in the latter), except for the slightly immersed ascoma of *O. verrucomarginata*. *Ocellularia allosporoides* has a wide distribution in India and was recorded from the Andaman and Nicobar Islands, the Western Ghats and Eastern Himalaya.

Specimens examined. **India:** *Andaman & Nicobar Islands*: Middle Andaman, Parlob Jig, *A. Singh* 61–79802 (LWG); ≤30 m, *A. Singh* 61–79894, 61–79895, 61–79896 (LWG). *Karnataka*: Chikmagalure District, 2 km before Chamudi, way to Dharamstala, elev. 561 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19737D, 08–19737/J (LWG). *Kerala*: Ernakulam District, Thattekkad BS, elev. 400 m, *B. Haridas* 06–009581 (LWG).

Ocellularia andamanica (Nyl.) Tat. Matsumoto & Dequchi

Bryologist **102:** 89 (1999).

Thallus pale grey to pale yellowish or greenish grey, slightly glossy, smooth, continuous to markedly verruculose, non-rimose.

Ascomata inconspicuous, round, immersed to emergent; asci 4–8-spored; ascospores amyloid, submuriform, subglobose to ovoid, hyaline (brown at maturity), 2–6 × 1–4 locular, 15–20 × 12–15 µm.

Chemistry. Psoromic acid.

Remarks. This species is similar to *O. bahiana* which differs by the thallus containing protocetraric acid. It is known to occur in rainforests of the Andaman and Nicobar Islands and the Western Ghats (Singh & Sinha 2010).

Specimen examined. **India:** *Andaman & Nicobar Islands*: South Andaman, Wright Myo, elev. <30 m, *A. Singh* 61–88279 (LWG).

Ocellularia annuloelevata (Nagarkar, Sethy & Patw.) S. Joshi & Upreti comb. nov.

MycoBank No.: MB 822093

Thelotrema annuloelevatum Nagarkar *et al.*, *Kavaka* **13:** 57 (1987) ["1985"]; type: India, Tamil Nadu, Upper Kodayar, Agasthi Hills, on bark, 24 January 1983, *P. K. Sethy & M. B. Nagarkar* 83–325 (AMH—holotype).

Thallus olive-grey to greenish grey, dull, ± rimose (due to bark texture).

Ascomata emergent, ecolumellate opening by a slightly raised, funnel-shaped (raised) ostiole; proper exciple marginally carbonized; asci 1-spored; ascospores amyloid, muriform, hyaline, 200–350 × 45–55 µm.

Chemistry. Psoromic acid.

Remarks. The eastern palaeotropical *O. inturgescens* (Müll. Arg.) Mangold is similar but has uncarbonized ascomata. *Ocellularia annuloelevata* is known only from India and has been described from the Andaman and Nicobar Islands and the Western Ghats.

Ocellularia arecae (Vain.) Hale

Mycotaxon **11:** 136 (1980).

Thallus pale greenish grey.

Ascomata perithecioid to indistinctly apothecioid emergent; proper exciple fused, dark brown, mostly carbonized at margins and in the upper parts; columella carbonized; asci 1-spored; ascospores large, hyaline, muriform 100–270 × 25–40 µm.

Chemistry. Hypoprotocetraric acid chemosyndrome.

Remarks. In India, it is known from the Western Ghats to the Eastern Himalaya and the Andaman and Nicobar Islands.

Specimens examined. **India:** *Andaman & Nicobar Islands*: South Andaman, Port Blair, *A. Singh* 61–67607 (LWG). *Kerala*: Idukki District, ICRI campus, Myladumpara, elev. *c.* 200 m, *D. D. Awasthi & G. Awasthi* 84–77 (LWG–LWU).

Ocellularia bahiana (Ach.) Frisch

Biblioth. Lichenol. **92:** 503 (2006).

Thallus thick, bulging.

Ascomata immersed to emergent or hemispherical; columella absent; proper exciple mostly brown to reddish brown; ascospores brown, muriform, 3–5 × 1–2 septate, 18–24 × 12–13 µm.

Chemistry. Psoromic acid.

Remarks. This species is readily distinguished from *O. andamanica* in lacking a carbonized proper excipulum and by its chemistry. It is known from the Western Ghats.

Specimens examined. **India:** *Goa*: South Goa, Quepem-Rivona, Arecanut orchard, elev. 300–400 m, *S. Nayaka, Pathak & Samuel* 02–223413 (LWG); Margao-Rivona, 1962, *P. Chandra* s. n. (LWG).

Ocellularia canara Hale

Biovigyanam **66:** 9 (1980).

Thallus pale to yellowish or fawn-coloured, glossy, ±verrucose.

Ascospores amyloid, transversely 5-septate, hyaline, 17–20 × 5–7 µm.

Chemistry. Stictic acid chemosyndrome.

Remarks. This species is very close to *O. pyrenuloides* Zahlbr. which differs in its ascoma carbonization. *Ocellularia canara* is endemic to India and occurs in the Western Ghats.

Specimen examined. **India:** *Karnataka*: North Canara District, 6 km east of Yellapur, elev. *c.* 750 m, on remnants of evergreen forests, 28 ii 1978, *M. E. Hale* 78–50665 (AMH).

Ocellularia conformis (Fée) Hale

Mycotaxon **11:** 136 (1980).

Thallus whitish green to pale olive, glossy.

Proper exciple apically carbonized; columella carbonized; asci 8-spored; ascospores muriform, 8–11 × 1–3 septate, 24–40 × 8–11 µm (Awasthi 1991).

Chemistry. Psoromic acid.

Remarks. This species was previously recorded as *Thelotrema conforme* Fée by Patwardhan & Nagarkar (1980) and is known from the Eastern Himalaya (Assam).

Ocellularia diacida Hale

Mycotaxon **7:** 378 (1978).

Thallus greyish to greenish grey or pale olive, dull to glossy; whitish to pale orange medulla.

Ascomata ± rounded immersed to moderately emergent; asci 8-spored; ascospores amyloid, 15–40 × 6–9 µm, transversely septate.

Chemistry. Hirtifructic acid and cinchonarum unknown present.

Remarks. This species differs from *O. fumosa* in having a clear hymenium. *Ocellularia diacida* was described from the Western Ghats.

Specimen examined. **India:** *Karnataka*: Devimane Ghat on Kumtha-Sirsi road, elev. *c.* 100 m, *M. E. Hale* 77–47933 (AMH).

Ocellularia dolichotata (Nyl.) Zahlbr.

Cat. Lich. Univ. **2:** 589 (1923).

Thallus off-white to fawn, verruculose to finely rugulose with numerous depressed notch-like spots formed by eroded cortex over the surface.

Ascomata columellate, often with a verruculose pore; proper exciple carbonized; columella simple, carbonized; asci 1-spored; ascospores amyloid, 20–30-locular, 150–220 × 12–16 µm.

Chemistry. No substances detected.

Remarks. *Ocellularia allosporoides* is similar but differs from *O. dolichotata* in having a smooth thallus and comparatively smaller ascospores. *Ocellularia dolichotata* has been reported from the Andaman and Nicobar Islands and the Western Ghats (Singh & Sinha 2010).

Ocellularia eumorpha (Stirt.) Hale

Mycotaxon **11:** 136 (1980).

Thallus pale greenish grey to yellowish grey, ±glossy, ±verrucose.

Ascomata perithecioid, immersed to emergent; proper exciple fused, internally yellowish brown to rarely carbonized (at margins and in the upper parts); perithecia, ecolumellate; asci 1–2-spored; ascospores muriform, hyaline to pale brownish (in late maturity), large, amyloid, 150–250 × 20–50 µm.

Chemistry. Hypoprotocetraric and convirensic acids.

Remarks. The similar *O. arecae* differs in producing columellate ascomata. *Ocellularia eumorpha* is known from the Western Ghats.

Specimens examined. **India:** *Karnataka*: Chikmagalure District, Charmudi Ghat, Kuvettu, elev. 104 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19739G (LWG). *Kerala*: Idukki District, ICRI campus, Myladumpara, elev. 1200 m, *D. D. Awasthi & G. Awasthi* 84–77 (LWG–LWU). *Tamil Nadu*: Kanyakumari District, Mahendragiri Hills, elev. 1000–1200 m, *V. Sundareshan* 13–020488 (LWG).

Ocellularia garoana Patw. & Nagarkar

Biovigyanam **6:** 7 (1980).

Ascomata pores surrounded by black, whitish pruinose rims; proper exciple apically carbonized; columella carbonized; ascospores 5–9-septate, 15–25 × 5–7 µm.

Chemistry. Psoromic acid.

Remarks. This species was described from the Western Ghats by Patwardhan & Nagarkar (1980), and recorded recently from the Eastern Ghats and the Eastern Himalayan region. It appears to be endemic to India.

Specimens examined. **India:** *Assam*: Navgaon District, *A. Dey* 09–014936 (LWG). *Kerala*: Tivendrum District, Palode, TBGRI campus, 2013, *A. R. Logesh* s. n. (LWG). *Meghalaya*: Garo Hills, Ningwal Bibra, near coal mine, *M. B. Nagarkar* 78–290 (AMH). *Tamil Nadu*: Palni Hills, on way from Perumalmalai to Oothu, near Mulaiyar, elev. 1200 m, *Kr. P. Singh* 70–1192 (LWG).

Ocellularia gibberulosa (Müll. Arg.) Mangold

Fl. Australia **57:** 656 (2009).

Thallus greyish green, uneven, ±verrucose.

Ascomata emergent, crowded, ecolumellate; asci 1-spored; ascospores amyloid, large, muriform, 160–255 × 33–50 µm.

Chemistry. Psoromic acid.

Remarks. This species was previously described from the Western Ghats as *Thelotrema kalakkadense* Nagarkar *et al*. (Nagarkar *et al*. 1985).

Specimen examined. **India:** *Tamil Nadu*: Tirunelvelli District, Singhalamtheri, Kalakkadu primary rainforest, elev. *c.* 1200 m, *P. G. Patwardhan & P. K. Sethy* 84–57A (AMH).

Ocellularia jamesii (Patw. & C. R. Kulk.) D. D. Awasthi

Biblioth. Lichenol. **40:** 3 (1991).

Thallus pale olivaceous, fawn to citrine-green, dull, continuous, warty.

Ascomata emergent, crowded; proper exciple dark brown, carbonized at tips; columella developed ± apically, carbonized; asci 1-spored; ascospores amyloid (before initial pigmentation), hyaline to brown, muriform, 80–150 × 15–30 µm.

Chemistry. No substances detected.

Remarks. This species is unique in producing large brown ascospores; *O. kalbii* is similar but has even larger ascospores and well-developed columellar structures. *Ocellularia jamesii* was described from the Western Ghats as *Leptotrema jamesii* Patw. & C. R. Kulk. by Patwardhan & Kulkarni (1977*b*), and is endemic to India.

Specimen examined. **India:** *Karnataka*: South Canara District, Agumbe-Udupi road, *C. R. Kulkarni* 74–3080 (AMH).

Ocellularia karnatakensis Hale

Mycotaxon **7:** 378 (1978).

Thallus with isidioid verrucae (cylindrical verrucae) conspicuously developed on the thallus.

Ascomata flush to immersed; ascospores 90–150 × 10–12 µm.

Chemistry. Notatic acid.

Remarks. Other characters and chemistry appear similar to those in *O. allosporoides*, consequently it was previously considered conspecific (Mangold *et al*. 2009). *Ocellularia karnatakensis* was described from the Western Ghats and occurs only in India.

Specimen examined. **India:** *Karnataka*: Chikmagalure District, Liana, 5 km SE of Yellapur, elev. *c.* 600 m, *M. E. Hale* 77–46205 (AMH).

Ocellularia keralensis Patw. & C. R. Kulk. ex Hale

Bull. Br. Mus. Nat. Hist., Bot. **8:** 308 (1981).

Thallus pale green to yellowish green, uneven, ±verrucose.

Ascomata emergent, ecolumellate with a black rimmed ostiole; proper exciple apically carbonized; asci 1-spored; ascospores large, muriform, hyaline, 100–210 × 25–45 µm.

Chemistry. No substances detected.

Remarks. *Ocellularia eumorpha* is similar but differs in containing hypoprotocetraric acid. *Ocellularia keralensis* is known from the Western Ghats.

Specimens examined. **India:** *Karnataka*: Uttarakannada District, Sharavathi Ghat, near Gersoppa, elev. 718 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19745V (LWG). *Kerala*: Idukki District, Myladumpara, ICRI campus, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi* 84–145, 84–146 (LWG–LWU).

Ocellularia khasiana (Patw. & Nagarkar) Kraichak *et al*.

Phytotaxa **189:** 74 (2014).

Thallus dark olive-green to dark grey-green, smooth.

Ascomata strongly emergent, ecolumellate; proper exciple fused, apically carbonized; ascospores large, muriform, amyloid, 140–250 × 30–40 µm.

Chemistry. Protocetraric acid.

Remarks. This was described from the Eastern Himalaya as *Thelotrema khasianum* Patw. & Nagarkar and is endemic to India.

Specimen examined. **India:** *Meghalaya*: Khasi Hills, near Nongstoin, in evergreen forests, *M. B. Nagarkar* 78–482 (AMH).

Ocellularia masonhalei (Patw. & C. R. Kulk.) Lücking

Herzogia **29:** 507 (2016).

Thallus greenish grey to grey, glossy, wrinkled to warty.

Ascomata immersed, ecolumellate; proper exciple pale brown, fused; carbonized marginally or at apices; asci 1-spored; ascospores amyloid, oblong-ellipsoid, hyaline, muriform, large, 140–255 × 24–55 µm.

Chemistry. Psoromic acid.

Remarks. This species was described from Maharashtra as *Thelotrema masonhalei* Patw. & C. R. Kulk by Patwardhan & Kulkarni (1977*b*) and later recorded from Kerala and Karnataka in the Western Ghats (Singh & Sinha 2010). *Ocellularia annuloelevata* is distinguished in morphology and has larger ascospores.

Specimens examined. **India:** *Karnataka*: Shimoga District, Agumbe Ghat, elev. 600–700 m, *R. Shankar & S. Ganapathy* 09–016240 (LWG). *Kerala*: Idukki District, Myladumpara, ICRI campus, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi* 84–106, 84–114 (LWG–LWU). *Maharashtra*: Sindhudurg District, Amboli, sunset point, *A. V. Prabhu & M. B. Nagarkar* 74–2262 (AMH).

Ocellularia massalongoi (Mont.) Hale

Mycotaxon **11:** 137 (1980).

Thallus olive to pale brownish green, glossy, smooth.

Ascomata large, columellate, perithecioid with annulate pores; proper exciple dark brown to carbonized; columella dark brown to carbonized; asci 1–2-spored; ascospores muriform, oblong ellipsoidal, hyaline, distinctly amyloid, 170–250 × 35–45 µm.

Chemistry. Salazinic acid.

Remarks. This species is unusual in containing salazinic acid, which is rare in the genus. It occurs in evergreen forests of the Andaman and Nicobar Islands and the Western Ghats (Singh & Sinha 2010).

Specimens examined. **India:** *Andaman & Nicobar Islands*: Middle Andaman, Parloli Jig, elev. *c.* 30 m, *A. Singh* 79893 (LWG); South Andaman, Port Blair, *A. Singh* et al. 61–67607 (LWG).

Ocellularia neomasonhalei (Patw. *et al.*) D. D. Awasthi

Biblioth. Lichenol. **40:** 3 (1991).—*Ocellularia guptei* (Nagarkar, Sethy & Patw.) D. D. Awasthi, *Biblioth. Lichenol.* **40:** 3 (1991); type: India, Andaman & Nicobar Islands, South Andaman, Port Mount, 14 February 1985, *P. G. Patwardhan & M. B. Nagarkar* 85–21 (AMH—holotype).

Thallus glaucous green to greenish grey, smooth, continuous.

Ascomata columellate, open by raised ostioles with annulate rims; proper exciple apically carbonized; columella apically carbonized; asci 1–2-spored; ascospores hyaline, muriform, 150–232 × 30–47 µm.

Chemistry. No substances detected.

Remarks. The material examined did not contain secondary metabolites; Awasthi (1991) and Singh & Sinha (2010) erroneously reported psoromic acid. The taxon occurs in the Andaman and Nicobar Islands and the Western Ghats, and is known only from India.

Specimens examined. **India:** *Andaman & Nicobar Islands*: Andaman Islands, South Andaman, Port Blair, *A. Singh* 61–67614 (LWG). *Tamil Nadu*: Coimbatore District, Anamalai Hills, on way to Valparai, elev. *c.* 1000 m, *P. K. Sethy & M. B. Nagarkar* 82–268 (AMH).

Ocellularia neopertusariiformis Hale

Bull. Brit. Mus. (Nat. Hist.), Bot. **8:** 315 (1981).

Thallus corticolous, greenish grey, dull to glossy, smooth.

Ascomata solitary, sessile, constricted, perithecioid, ecolumellate; asci 6–8-spored; ascospores hyaline, transversely 24–37-septate, oblong-fusiform, 80–200 × 10–20 µm, amyloid, with acute or slightly appendiculate ends.

Chemistry. Hypoprotocetraric acid.

Remarks. This species has only recently been recorded from India (Singh *et al*. 2013). *Ocellularia pertusariiformis* (Leight.) Zahlbr. differs in having 10–11-septate, smaller ascospores and a thallus containing unknown secondary metabolites. It was recorded from Assam in the Eastern Himalayan region.

Ocellularia pertusarioides (Nagarkar *et al.*) Lücking

Herzogia **29:** 509 (2016).

Thallus pale to yellowish grey warty.

Ascomata numerous, emergent, basally constricted, ecolumellate; proper exciple fused reddish yellow; asci 8-spored; ascospores amyloid (when young), brown, muriform, 1–3 × 0–3 septate, 15–18 × 10–12 µm.

Chemistry. Protocetraric acid.

Remarks. Nagarkar *et al*. (1986) described the species as *Leptotrema pertusarioides* Nagarkar *et al*., while Awasthi (1991) reported the species as *Myriotrema pertusarioides* (Nagarkar *et al*.) D. D. Awasthi. It is known from the Andaman and Nicobar Islands, and is endemic to India.

Specimen examined. **India:** *Andaman & Nicobar Islands*: South Andaman, Wandoor, Alexandria Island, *M. B. Nagarkar & P. K. Sethy* 85–1115 (AMH).

Ocellularia planaria (Hale) Hale

Mycotaxon **11:** 137 (1980).

Thallus thick, grey to greenish grey, smooth, glossy, uneven (due to bark texture).

Ascomata immersed having a wide ostiole circumscribed by a pale brown to brown rim; proper exciple apically carbonized; columella (sometimes with 1–2 strands) developing apically; asci 8-spored; ascospores amyloid, hyaline, submuriform. 3–5 × 1 septate, 15–22 × 7–10 µm.

Chemistry. Psoromic acid.

Remarks. This species is endemic to India and was described as *Thelotrema planarium* (Hale 1978*a*) from the Western Ghats.

Specimen examined. **India:** *Kerala*: Gudampara, Cardamon Hills, elev. 1100 m, *M. E. Hale* 76–46427 (AMH).

Ocellularia subgranulosa (Homchant. & Coppins) Lumbsch & Papong

Lichenologist **42:** 133 (2010).

Thallus pale olive-brown to greyish brown, dull, areolate, verrucose to warty.

Ascomata semi-emergent, ecolumellate to weakly columellate, perithecioid; asci 2-spored; ascospores amyloid, hyaline, transversely 10–12-septate, 100–130 × 20–25 µm.

Chemistry. Norisonotatic and norsubnotatic acids.

Remarks. The chemically similar *O. chonestoma* (Leight.) Zahlbr. has smaller ascospores. This taxon was recently recorded from the Eastern Himalayan region (Arunachal Pradesh) by Singh *et al*. (2013).

Ocellularia subkeralensis (Nagarkar, Sethy & Patw.) S. Joshi & Upreti comb. nov.

MycoBank No.: MB 822095

Thelotrema subkeralense Nagarkar *et al*., *Kavaka* **13:** 60 (1987) ["1985"]; type: India, Tamil Nadu, Trunelvelli District, Singhalamtheri, Kalakkadu primary rainforest, elev. 1200 m, on bark, 1 February 1984, *P. G. Patwardhan & P. K. Sethy* 84–55A (AMH—holotype).

Thallus grey-brown to olive-brown, smooth to slightly verruculose, dull.

Ascomata immersed to semi-emergent, ecolumellate; proper exciple carbonized in the ostiole region; asci 1-spored; ascospores amyloid, hyaline to pale brown, muriform, 150–252 × 25–50 µm.

Chemistry. No substances detected.

Remarks. The similar *O. keralensis* differs in having emergent ascomata and hyaline ascospores. So far, *O. subkeralensis* is known only from the Western Ghats.

Ocellularia subperforata Nagarkar *et al*.

Biovigyanam **13:** 36 (1988).

Thallus with elongate verrucae.

Ascomata with 0·3–0·4 mm wide pores surrounded by blackish rim; excipulum fully carbonized; columella broad stump-shaped; ascospores 21–27 × 6–7 µm.

Chemistry. Protocetraric acid.

Remarks. This species was previously included in the synonymy of *O. perforata* (Leight.) Müll. Arg. by Frisch *et al*. (2006) but it has more distinct ascoma carbonization and elongate thallus verrucae (Lücking 2014). It was described from the Western Ghats (Nagarkar *et al*. 1988).

Specimens examined. **India:** *Karnataka*: South Canara District, Hiriyadka, Udupi to Hebri road, elev. 45 m, *P. G. Patwardhan* 78–52 (AMH). *Kerala*: Trivandrum District, Peppara Wildlife Sanctuary, *B. Haridas* 06–009592 (LWG).

Ocellularia terebrata (Ach.) Müll. Arg.

Flora **70:** 398 (1887).

Thallus light yellow-olive, uneven.

Ascomata pores surrounded by yellowish margins; proper exciple carbonized; columella indistinct when seen from above, carbonized; ascospores 5–7(–9)-septate, 15–30 × 7–10 µm (Lücking 2014).

Chemistry. Psoromic acid.

Remarks. *Ocellularia terebrata* is recorded from the Andaman and Nicobar Islands and the Western Ghats (Singh & Sinha 2010).

Ocellularia thelotremoides (Leight.) Zahlbr.

Cat. Lich. Univers. **2:** 603 (1925).—*Thelotrema mahabalei* Patw. & C. R. Kulk., *Norw. J. Bot.* **24:** 128 (1977); type: India, Kerala, Idukki District, Munnar-Kodaikanal road, below Yellapatti, elev. 450 m, on bark, 24 January 1976, *C. R. Kulkarni* 76–540 (AMH—holotype).

Thallus pale greenish grey to yellowish grey or olive, dull to glossy with a loosely developed cortex.

Ascomata immersed to strongly emergent; proper exciple slightly carbonized at apices and very rarely developed; columella carbonized confined apically in the centre of ascomata asci 8-spored; ascospores amyloid, 6–10 × 1–4 locular, muriform, 15–40 × 7–13 µm.

Chemistry. Protocetraric acid.

Remarks. This species is known in India from the Eastern Himalaya and the Western Ghats (Singh & Sinha 2010).

Specimens examined. **India:** *Kerala*: Idukki District, ICRI campus, Myladumpara, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi* 84–152 (LWG–LWU). *Tamil Nadu*: Nilgiri Hills, Avalanche, in Shola near forest rest house, elev. *c.* 2100 m, *D. D. Awasthi & Kr. P. Singh* 71–247 (LWG–LWU).

Ocellularia triglyphica (Kremp.) Overeem & D. Overeem

Bull. Jard. Bot. Buitenzorg, sér. 3 **4:** 119 (1922).

Thallus pale greenish grey.

Ascomata strongly emergent; proper exciple laterally carbonized; columella well-developed, carbonized; ascospores transversely 24–35-septate, 96–232 × 16–27 µm (18–20-septate ascospores, 70–150 × 10–15 µm; Awasthi 1991).

Chemistry. Hypoprotocetraric acid.

Remarks. This is a pantropical species and is known from Meghalaya in the Eastern Himalayan region (Singh & Sinha 2010).

Ocellularia udupiensis Patw. *et al.*

Biovigyanam **11:** 135 (1985).

Thallus thick, olive-green to greenish grey, ± smooth, continuous.

Ascomata immersed to moderately emergent; proper exciple apically carbonized; columella apically carbonized; asci 8-spored; ascospores amyloid, transversely 5–9-septate, hyaline, 20–28 × 4–8 µm.

Chemistry. Unknown greyish substance ("udupiensis" unknown at Rf value ≤ 0·5).

Remarks. This species is unique in producing "udupiensis" unknown. It was described from the Western Ghats and is endemic to India.

Specimen examined. **India:** *Karnataka*: South Canara District, Udupi to Hebri road, *P. G. Patwardhan* 78–42 (AMH).

Ocellularia upretii S. Joshi, Divakar, Lumbsch & Lücking sp. nov.

MycoBank No.: MB 822092

Differing from *Ocellularia allosporoides* in lacking secondary metabolites.

Type: India, Karnataka, Central Western Ghats, Shimoga District, 3 km before Agumbe Ghat, Kopra to Agumbe, on bark, 14 January 2008, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 19730C (LWG—holotype; F—isotype).

(Fig. 1A–C)

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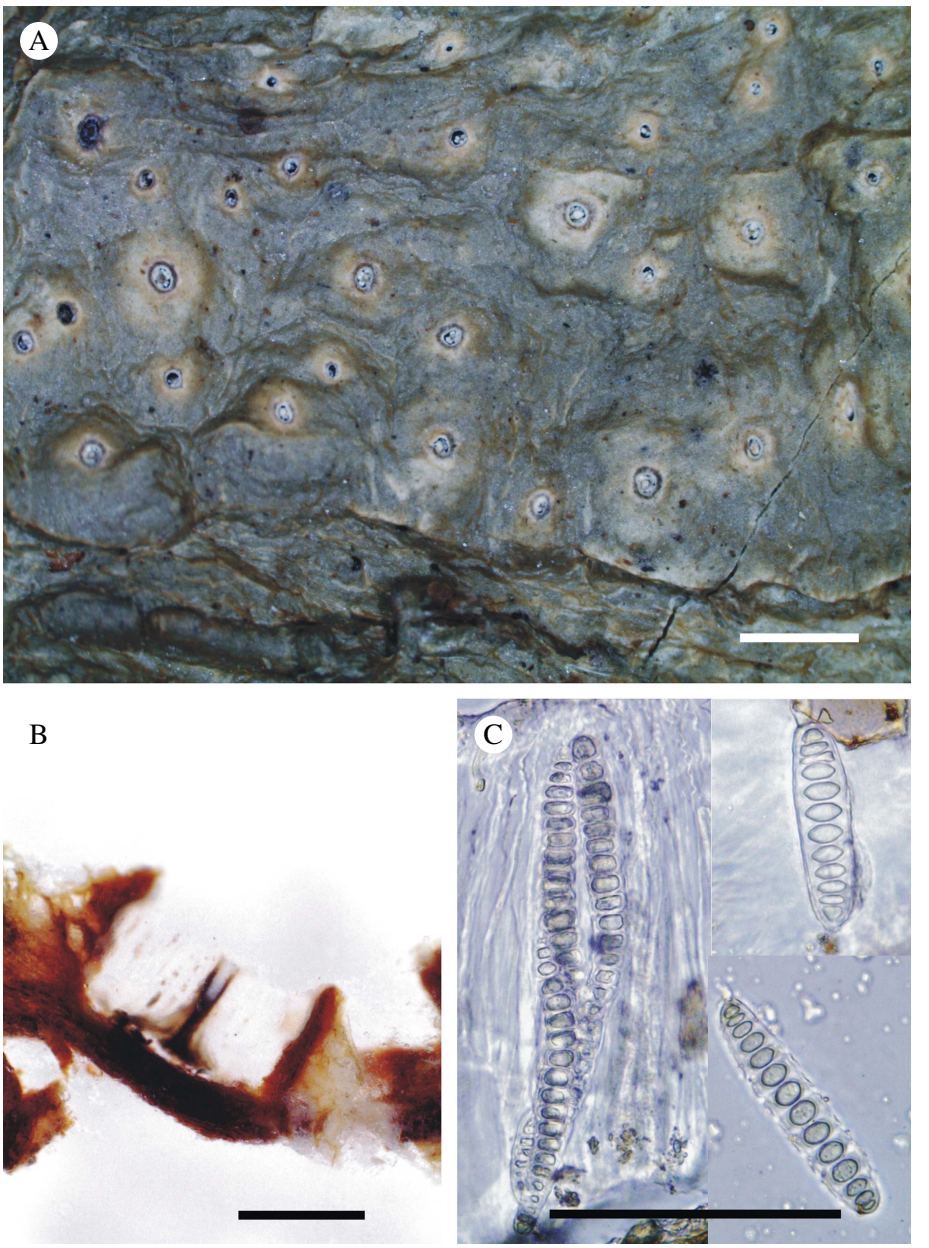

FIG. 1. *Ocellularia upretii* (holotype). A, habitus; B, ascoma (CS); C, ascus and ascospores. Scales: A = 1 mm; B & C = 100 µm. In colour online.

Thallus corticolous, greyish green, olivaceous green, smooth to uneven or verruculose, glossy, hard, continuous, <400 µm thick, corticate; cortex well developed, continuous, 40–50 µm thick; algal layer trentepohlioid, 50–70 µm thick; medulla white, crystalline, 120–150 µm thick.

Ascomata numerous, dispersed, porinoid, immersed to prominent, round to slightly angular, 0·1–0·8(–1.5) mm diam.; pore

https://doi.org/10.1017/S0024282918000439 Published online by Cambridge University Press

rounded to oval, surrounded by mottled or pale-coloured thalline margin, 0·2–0·3 mm diam.; proper exciple entire, brownish to reddish brown, (50–)100–185 µm thick; epihymenium greyish, granular, crystalline, 10–15 µm high; hymenium hyaline, clear, 200–220 µm high; columella simple, entire, conical, entirely carbonized, apically pruinose, protruding out of the pore, (50–)120–225 µm thick; asci 4–8-spored; ascospores hyaline, fusiform, transversely 10–20-septate, with thick septa and lens-shaped lumina, 100–125 × 15–25 µm, strongly amyloid (I+ blue-violet).

Chemistry. K−, PD−, C−; no substances detected by TLC.

Etymology. The new species is named in honour of the prominent Indian lichenologist Dr Dalip K. Upreti on the occasion of his retirement.

Ecology and distribution. The new taxon has a wide distribution in evergreen forests of the Western Ghats in south India and tropical rainforests of the Andaman and Nicobar Islands and the Eastern Himalaya. It was usually found growing in association with members of *Graphidaceae*, *Porinaceae* and *Trypetheliaceae*.

Remarks. This new taxon is characterized by a reddish brown proper exciple, simple carbonized columella, transversely septate ascospores and the absence of secondary compounds. The material belonging to this taxon can be superficially confused with, but is phylogenetically separated from, *Ocellularia allosporoides* (Kraichak *et al.* 2014*a*). It agrees in all aspects with *Ocellularia allosporoides* except the latter contains norisonotatic and norsubnotatic acids in the thallus. *Ocellularia dolichotata* is similar to the new species but produces single-spored asci with larger ascospores (150–220 × 12–16 µm).

Additional specimens examined. **India:** *Andaman & Nicobar Islands*: Middle Andaman, Parlob Jig, elev. ≤30 m, *A. Singh* 61–79802, 61–79823, 61–79830 (LWG). *Assam*: Cachar District, Bontarapur, xii 2009, *A. Dey* 09–014934, 09–014915 (LWG). *Karnataka*: Chikmagalure District, Charmudi Ghat, near Kotigehara, elev. 929 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19735V/A (LWG); Koppa, elev. 770 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19729B (LWG); Koppa to Agumbe, 08–19730C (LWG); North Kannada District, forest near PWD Guest House, elev. 1700 m, *A. Singh & D. K. Upreti* 83–11541(LWG); Shimoga District, Sharavati River Basin, Sagar taluk, elev. 594 m, *S. Nayaka* 01–222717, 01–10232 (LWG); elev. 623 m, *S. Nayaka* 01–222773 (LWG); elev. 594 m, *S. Nayaka* 01–222750 (LWG); Negiloni, elev. 710 m, *S. Nayaka* 01–107244 (LWG); forest near Jog Falls, *A. Singh & D. K. Upreti* 83–L11528/A, 83–L11528/B, 83–L11529 (LWG); Uttarakannada District, Sharavati Ghat, near Gersoppa, elev. 718 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19742I, 08–19744E, 08–19744H, 08–19745K, 08–19745N, 08–19745O, 08–19745S, 08–19744A–2, 08–19744G (LWG); Sirsi taluk, near Vibhooti Falls, *S. Dudani* 14–024480 (LWG); Agumbe Ghat, elev. 600–700 m, *Ravishankar & S. Ganapathy* 09–016238, 09–016252 (LWG). *Kerala*: Ernakulam District, Thattekkad, elev. 320 m, *B. Haridas* 06–009651 (LWG); Mallapuram District, Wayanad area, Thakarpadi, elev. 450 m, *A. Singh & M. Ranjan* 75–102215, 75–102216, 75–102204, 75–102204A, 75–102218 (LWG); Thirunelli, Begur Range, elev. 900 m, *B. Haridas* 06–009584 (LWG); Kollam District, Rosemala, *B. Haridas* 06–009576, 01–009593 (LWG); Palghat District, Silent Valley National Park, *B. Haridas* 06–009649 (LWG); MCL mines area, Walayar Forest, elev. *c.* 300 m, *D. D. Awasthi, R. Tewari & R. Mathur* 85–25, 85–22, 85–11, 85–16, 85–2, 85–4, 85–6 (LWG–LWU); Thrissur District, Vazhachal Range, elev. 300 m, *B. Haridas* 06–009589 (LWG); Anakkayam Range, *B. Haridas* 06–009577 (LWG); Trivandrum District, Braemore, elev. 520 m, *B. Haridas* 06–009629 (LWG).

Ocellularia urceolaris Ach.

Syst. Orb. Veg. (Lundae) **4:** 242 (1927).

Thallus whitish green to pale olive, shiny.

Ascomata semi-emergent to emergent; proper exciple carbonized; columella carbonized; ascospores 3 × 1 septate, hyaline, 15–25 × 7–12 µm.

Chemistry. Psoromic acid.

Remarks. This taxon was reported previously as *O. leucina* (Müll. Arg.) Hale from the tropical rainforests of Kerala and Tamil Nadu in the Western Ghats (Singh & Sinha 2010) but that name is considered a synonym of *O. urceolaris* (Buaruang *et al.* 2017).

Ocellularia violacea Räsänen

Suom. Elain-ja Kasvit. Seuran Van. Tiendon. Pöytäkirjat **3:** 184 (1949).

Thallus pale greenish grey to pale olive, ±glossy, smooth to slightly verruculose.

Ascomata mostly immersed to slightly emergent; proper exciple pale brown to brownish, dark brown, scarcely marginally carbonized; columella, often filling the pores, well-developed, carbonized, apically white pruinose; asci 8-spored; ascospores amyloid, small, hyaline, transversely 4–7-septate, oblong to fusiform or ellipsoid, amyloid, 21–24 × 5–7 µm.

Chemistry. Protocetraric acid.

Remarks. This species is a new record for India and herbarium specimens have previously been misidentified as *O. papillata* (Leight.) Zahlbr. *Ocellularia violacea* was earlier included in the synonymy of *O. perforata*, but following the narrowly defined species concept for *Ocellularia* by Lücking (2014), *O. violacea* was reinstated. It occurs in the Western Ghats.

Specimens examined. **India:** *Karnataka*: Shimoga District, Sharavati River Basin, Sagar taluk, elev. 594 m, *S. Nayaka* 01–222751–8 (LWG). *Kerala*: Thrissur District, Vazhachal, Peringalkuthu, elev. 400 m, *B. Haridas* 06–009623 (LWG).

Ocellularia wandoorensis Nagarkar *et al.*

Mycotaxon **27:** 78 (1986).

Thallus greenish grey, ±warty.

Ascomata semi-emergent to emergent; proper exciple weakly carbonized; columella entire to irregularly reticulate, carbonized; hymenium inspersed; asci 8-spored; ascospores amyloid, fusiform, hyaline, transversely 3-septate, 8–10 × 3–5 µm.

Chemistry. No substances detected.

Remarks. It has been collected in the Andaman Islands and is endemic to India.

Specimen examined. **India:** *Andaman & Nicobar Islands*: South Andaman, Wandoor, Alexandria Island, *P. K. Sethy & M. B. Nagarkar* 85–1103 (AMH).

Ocellularia xanthostromiza (Nyl.) Zahlbr.

Cat. Lich. Univ. **2:** 604 (1923).

Thallus greyish green to grey, verrucose, glossy.

Ascomata semi-emergent; proper exciple carbonized; columella carbonized; ascospores hyaline, transversely 2–5-septate, 10–20 × 3–5 µm.

Chemistry. Cinchonarum unknowns chemosyndrome.

Remarks. This species was included in the synonymy of *O. cavata* (Ach.) Müll. Arg. by Mangold *et al.* (2009) but later reinstated by Kraichak *et al.* (2014*a*). It is known in India from the Andaman and Nicobar Islands (Singh & Sinha 2010).

Pseudochapsa Parnmen *et al.*

PLoS ONE **7:** e51392, 10 (2012).

This new genus was described to accommodate species phylogenetically well separated from *Chapsa* s. str. and characterized by an ecorticate or loosely corticate thallus lacking secondary metabolites or containing stictic acid and relatives, ascomata with exposed disc and fissured to lobate margins, a brown exciple and transversely septate or muriform, colourless or occasionally brown, distoseptate, amyloid ascospores (Parnmen *et al.* 2012). The genus comprises 16 species worldwide with a single species from India.

Pseudochapsa pseudoexanthismocarpa (Patw. & C. R. Kulk.) Parnmen *et al.*

PLoS ONE **7:** e51392, 10 (2012).

Thallus pale yellowish to greenish brown or pale olive, verrucose.

Ascomata rounded to somewhat irregular and sometimes perithecioid, erumpent, immerged to semi-emergent with lacerate margins; asci 4–8-spored; ascospores hyaline, fusiform, trans-septate, 100–200 × 10–20 µm.

Chemistry. No substances detected.

Remarks. Patwardhan & Kulkarni (1977*b*) described the species from Kerala as an *Ocellularia*, but it was later recognized under *Chapsa* owing to the scabioid ascomata and

lacerate exciple (Rivas Plata *et al.* 2010*a*; Joshi *et al.* 2012*a*). Its distribution is in the Western Ghats.

Specimen examined. **India:** *Kerala*: Idukki District, Vazhachal, Anamalai Hills, *M. B. Nagarkar & K. D. Gole* 76–308 (AMH).

Pseudotopeliopsis Parnmen *et al.*

PLoS ONE **7:** e51392, 10 (2012).

This genus was recently segregated from *Chapsa* s. l. to accommodate a small group of species having a densely corticate thallus lacking secondary metabolites, *Topeliopsis*-like ascomata with a striate excipulum (covering the disc), hyaline or brown excipulum, and colourless to brown, trans-septate to muriform, subdistoseptate, non-amyloid ascospores (Parnmen *et al.* 2012). Six species are currently accepted worldwide, including *Pseudotopeliopsis laceratula* from India.

Pseudotopeliopsis laceratula (Müll. Arg.) Parnmen *et al.*

PLoS ONE **7:** e51392, 11 (2012).

Thallus pale to dark olive-green to olive-brown, corticate.

Ascomata round to irregular, perithecioid to apothecioid with lacerate margins; asci 1–2 (–4)-spored; ascospores hyaline, fusiform, muriform, 70–170 µm long.

Chemistry. No substances detected.

Remarks. This species was recorded previously as *Thelotrema laceratulum* Müll. Arg. and *Chapsa laceratula* (Müll. Arg.) Rivas Plata & Mangold (Patwardhan & Kulkarni 1977*a*; Rivas Plata *et al.* 2010*a*). It occurs at lower elevations in evergreen forests of the Western Ghats (Karnataka, Kerala, Maharashtra and Tamil Nadu). Material included previously under the name *Chapsa laceratula* by Joshi *et al.* (2012*a*) has now been identified as *Thelotrema adjectum*.

Pycnotrema Rivas Plata & Lücking

Fungal Diversity **52:** 120 (2012).

This monospecific genus was described to accommodate a species with no well-defined diagnostic characters that separate it from *Ocellularia* s. l. and *Mytriotrema* s. l. but was phylogenetically distantly classified from them and placed in the subfamily *Fissurinoideae* (Rivas Plata *et al.* 2012*a*).

Pycnotrema pycnoporellum Nyl.

Fungal Diversity **52:** 120 (2012).

Thallus thick, greenish grey, warty.

Ascomata aggregated, immersed, with a black annulate rim around the ostiolar region; exciple fused; asci 8-spored; ascospores amyloid, hyaline muriform, 20–25 × 5–7 µm.

Chemistry. No substances detected.

Remarks. This species was collected in Karnataka in the Western Ghats as *Thelotrema pycnoporellum* Nyl. (Singh & Sinha 2010).

Reimnitzia Kalb

Mycotaxon **79:** 325 (2001).

The genus *Reimnitzia* is monospecific and delimited from the closely related *Chapsa* and *Thelotrema* based on characters such as an isidiate thallus, deep photobiont layer with inclusions of large columns of calcium oxalate crystals responsible for the warty appearance of the thallus, thick-walled, non-halonate, immature ascospores, and lax and comparatively less distinct paraphyses. Worldwide only a single species, *Reimnitzia santensis*, is currently known.

Reimnitzia santensis (Tuck.) Kalb

Mycotaxon **79:** 325 (2001).

Thallus greenish glaucous to pale glaucous blue, ecorticate, farinose, thick, isidiate.

Ascomata large, chroodiscoid with wide open disc; proper exciple fused; ascospores small, brown, submuriform with irregular locular arrangement.

Chemistry. No substances detected.

Remarks. This species was recorded as *Leptotrema santense* (Tuck.) Zahlbr. from Kerala and Tamil Nadu in the Western Ghats by Patwardhan & Kulkarni (1977*a*).

Specimen examined. **India:** *Tamil Nadu*: Coimbatore District, Siruvani Waterfall, elev. 1440 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19706B (LWG).

Rhabdodiscus Vain.

Ann. Sci. Acad. Fenn., sér. A **15:** 184 (1921).

The genus was recently resurrected by Rivas Plata *et al.* (2012*b*) and includes species that are morphologically and phylogenetically well separated from the columellate genera (*Ocellularia* and *Stegobolus*). It differs from *Ocellularia* in having a reticulate columella, and from *Stegobolus* in the distinctly carbonized ascomata with thin margins lacking felty pruina, and columella penetrating the hymenium completely. Additionally, it produces prominent ascomata, mostly chroodiscoid, and hyaline or brown ascospores. Currently, more than 40 species are known globally, of which seven (two endemic) are known from India.

Key to species of the genus *Rhabdodiscus* from India

1 Ascospores transversely septate. 2
Ascospores muriform 4

2(1) Ascospores brown . . . . . **R. auberianus**
Ascospores hyaline 3

3(2) Psoromic acid; thallus with isidia . . . . . **R. verrucoisidiatus**
Cinchonarum unknowns; thallus lacking isidia . . . . . **R. indicus**

4(1) Ascospores hyaline . . . . . **R. asiaticus**
Ascospores brown 5

5(4) Columella remaining more or less entire, broad stump-shaped . . . . . **R. epitrypus**
Columella becoming dissected 6

6(5) Columella forming 3–5 teeth; thallus with columnar crystals and minutely rugulose surface . . . . . **R. marivelensis**
Columella forming irregularly radiating strands; thallus with irregular crystals and smooth to uneven surface . . . . . **R. fissus**

Rhabdodiscus asiaticus (Vain.) Rivas Plata *et al.*

Taxon **61:** 1175 (2012).

Thallus greyish to pale greenish or yellowish grey to olive, ±glossy, smooth to verruculose.

Ascomata semi-emergent; proper exciple thick, brownish to distinctly carbonized; columella well-developed, entire to distinctly complex and carbonized; asci 8-spored; ascospores amyloid, transversely septate to indistinctly submuriform, mostly fusiform, hyaline to occasionally pale brownish, 10–40 × 7–12 µm.

Chemistry. Psoromic acid syndrome.

Remarks. This species resembles *R. fissus*, which differs in having smaller brown ascospores that are submuriform. *Rhabdodiscus asiaticus* is known from the Andaman and Nicobar Islands and the Western Ghats.

Specimens examined. **India:** *Kerala*: Idukki District, Myladumpara, *B. Haridas* 06–009573 (LWG); ICRI campus, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi* 84–158, 84–84 (LWG–LWU).

Rhabdodiscus auberianus (Mont.) Vain.

Ann. Acad. Sci. Fenn., sér. A **15:** 184 (1921).

Ascomata rounded to shortly lirellate; columella broad stump-shaped to reticulate, carbonized; proper exciple strongly carbonized; asci 4–8-spored; ascospores brown, transversely 3–7-septate 10–27 × 5–8 µm.

Chemistry. Psoromic acid.

Remarks. This species has been reported from Tamil Nadu in the Western Ghats (Singh & Sinha 2010).

Rhabdodiscus epitrypus (Nyl.) Vain.

Ann. Acad. Sci. Fenn., sér. A **15:** 184 (1921).

Thallus greenish grey.

Ascomata emergent; columella carbonized, 3–4-stranded; proper exciple carbonized; asci 8-spored; ascospores submuriform, hyaline to brown, 2–3 × 1 septate, 10–15 × 8–10 µm.

Chemistry. Psoromic acid.

Remarks. This species was previously recorded as *Ocellularia epitrypa* (Nyl.) Hale (Awasthi 1991) and later synonymized under *Ocellularia fissa* (Müll. Arg.) Hale (Mangold *et al*. 2009). In a subsequent study, Rivas Plata *et al*. (2012*b*) reinstated the species. In India it occurs in the Andaman and Nicobar Islands and the Western Ghats (Kerala and Tamil Nadu) (Singh & Sinha 2010).

Rhabdodiscus fissus (Nyl.) Vain.

Ann. Acad. Sci. Fenn., sér. A **15:** 184 (1921).

Thallus pale greenish grey or olivaceous, continuous, in a shade of yellow, ±glossy.

Ascomata emergent; proper exciple brownish to carbonized; columella well-developed, entire to complex, carbonized; asci 8-spored; ascospores ±submuriform, 2–5 × 1–2 septate, pale to brown (at maturity), 8–22 × 6–12 µm.

Chemistry. Psoromic acid chemosyndrome.

Remarks. In India this species is known from the Andaman and Nicobar Islands, the Eastern Himalaya and the Western Ghats.

Specimen examined. **India:** *Assam*: Nagaon District, Chapanala Village, *A. Dey* 12–020495 (LWG).

Rhabdodiscus indicus Pushpi Singh & Kr. P. Singh

Taiwania **58:** 246 (2013).

Thallus isidiate, pale yellowish, rugose.

Ascomata rounded to irregular; disc white pruinose; columella reticulate; exciple brown; ascospores hyaline, transversely 3-septate, 10–13 × 5–6 µm.

Chemistry. Cinchonarum unknown present.

Remarks. *Rhabdodiscus isidiifer* (Hale) Rivas Plata *et al*. is similar but contains psoromic acid. *Rhabdodiscus indicus* has recently been described from Arunachal Pradesh in the Eastern Himalaya (Singh *et al*. 2013) and is so far known only from India.

Rhabdodiscus marivelensis (Vain.) Rivas Plata *et al*.

Taxon **61:** 1176 (2012).

Thallus yellowish grey, ±glossy, ±verruculose.

Ascomata emergent; proper exciple brown to carbonized; columella well-developed; asci 8-spored; ascospores submuriform to muriform, 3–9 × 0–5 septate, hyaline to brownish (in late maturity), large, 10–30 × 7–15 µm.

Chemistry. Psoromic acid chemosyndrome.

Remarks. This species was previously recorded as *Ocellularia marivelensis* (Vain.) Hale and *O. confluens* (Kremp.) Zahlbr. (Hale 1980; Mangold *et al*. 2009). *Rhabdodiscus marivelensis* is similar to *R. fissus* but

differs in having slightly larger ascospores. It is recorded from the Western Ghats.

Specimens examined. **India:** *Kerala*: Idukki District, ICRI campus, Myladumpara, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi* 84–57, 84–76, 84–78, 84–143 (LWG–LWU).

Rhabdodiscus verrucoisidiatus (Nagarkar, Sethy & Patw.) S. Joshi, Upreti & Lücking comb. nov.

MycoBank No.: MB 822096

Ocellularia verrucoisidiata Nagarkar *et al.*, *Biovigyanam* **14:** 39 (1988); type: India, Kerala, Cardamom Hills, Devicolam-Kumily road, near Kumily, on bark, 25 January 1976, *C. R. Kulkarni* 76–836 (AMH—holotype).

Thallus pale greenish grey, thick, uneven, with globose or verrucose structures (isidioid verrucae).

Ascomata semi-emergent; columella carbonized, broad, fills ascoma (sometimes with 2–3 strands); ostiole, irregular, widely open with raised margins; proper exciple carbonized; asci 8-spored; ascospores large, transversely 5–7-septate, hyaline, 15–20 × 5–8 µm.

Chemistry. Psoromic acid.

Remarks. This species was recorded from Kerala in the Western Ghats and is endemic to India.

Sanguinotrema Lücking

Bot. J. Linn. Soc. **179:** 441 (2015).

This monospecific genus was introduced to accommodate *Sanguinotrema wightii*, previously known in the genus *Leptotrema* as *L. wightii* (Taylor) Müll. Arg. Subsequent molecular studies revealed that the generic delimitations of *Leptotrema* were well represented by *L. zollingeri* Mont. & Bosch, long considered in the synonymy of *Leptorema wightii*. Consequently, the latter species has been placed in the newly established genus *Sanguinotrema* and the tribe *Sanguinotremateae* (Lücking *et al.* 2015).

Sanguinotrema wightii (Tayl.) Lücking

Bot. J. Linn. Soc. **179:** 441 (2015).

Thallus hollow, fragile, with a gall-like appearance, with columnar clusters of calcium oxalate crystals, pale greenish grey, photobiont and medulla with blood-red crystals.

Ascomata myriotremoid; asci uniformly thinned; ascospores thick-walled (young), 10–30 × 8–15 µm.

Chemistry. No substances detected.

Remarks. *Sanguinotrema wightii* is known from Central India and the Western Ghats (Singh & Sinha 2010).

Specimen examined. **India:** *Goa*: Goa University area, Bamboli, *D. K. Upreti, S. Chatterjee & P. K. Divakar* 04–004377 (LWG).

Stegobolus Mont.

London J. Bot. **4:** 4 (1845).

The genus was reinstated by Frisch *et al.* (2006) including two major groups: the *S. berkeleyanus* group and the *S. auberianus* group. These groups were shown to represent two monophyletic clades. Consequently, the *S. auberianus* group is now being considered as the separate genus *Rhabdodiscus*, whereas *Stegobolus* is restricted to the *S. berkleyanus* group. *Stegobolus* s. str. includes species with complex, weakly to uncarbonized pseudocolumellar structures, ±sessile ascomata small, hyaline, transversely septate to submuriform ascospores and commonly the presence of psoromic acid (Rivas Plata *et al.* 2012*b*). Although molecular phylogeny showed that *Rhabdodiscus* and *Stegobolus* s. str. are not closely related, some studies still treated *Stegobolus* in a wide sense and included species of *Rhabdodiscus* within *Stegobolus* s. l. (Sipman *et al.* 2012).

Stegobolus berkeleyanus Mont.

London J. Bot. **4:** 4 (1845).

Thallus olive-green, schizodiscs present.

Asci 8-spored; ascospores amyloid, hyaline, transversely 3-septate, 10–15 × 3–6 µm.

Chemistry. Psoromic acid.

Remarks. This species is known from the Andaman and Nicobar Islands and the Western Ghats.

Specimens examined. **India:** *Andaman & Nicobar Islands*: South Andaman, Baratang Island, Nilambur (Oralkachha), elev. < 30 m, *A. Singh* 61–79719 (LWG). *Kerala*: Trivandrum District, Ponmudi, 10th HP Curve, elev. 700 m, *B. Haridas* 06–009613 (LWG).

Thelotrema Ach.

Meth. Lich.: 130 (1803).

Following the concept of Hale (1974*a*, *b*, 1978*a*, *b*, 1981), the original circumscription of *Thelotrema* was greatly modified by Frisch *et al*. (2006), Mangold *et al*. (2009) and Rivas Plata *et al*. (2010*b*). Several species previously recorded in *Thelotrema* have now been transferred to numerous genera including *Asteristion*, *Astrochapsa*, *Chapsa*, *Myriotrema*, *Ocellularia*, *Reimnitzia*, *Topeliopsis* and *Wirthiotrema* following phylogenetic studies (Frisch *et al*. 2006; Mangold *et al*. 2009; Rivas Plata *et al*. 2010*a*; Parnmen *et al*. 2012; Medeiros *et al*. 2017). *Thelotrema* presently forms the largest genus in the tribe *Thelotremateae* and includes more than 100 species worldwide (Mangold *et al*. 2009; Rivas Plata *et al*. 2010*a*; Singh & Sinha 2010). Forty-three species were recorded for the genus by Singh & Sinha (2010); some had not been collected for a long time, while others needed thorough revision. Singh & Sinha (2010) accepted 16 species of the genus endemic to India from rainforests of the Western Ghats, Andaman Islands and the Eastern Himalaya. In the current circumscription, 18 species are included from India three of which are known only from India.

Thelotrema is characterized by a weakly corticate to ecorticate, immersed to superficial, greyish to greenish or olivaceous thallus in shades of yellow, brown or white, ± round to slightly irregular, lepadinoid, ± indistinctly chroodiscoid ascomata mostly with double margin, a ± free, rarely fused pale brown to hyaline proper exciple with lateral paraphyses (periphysoids), a hyaline, greyish to brownish epihymenium, hyaline, clear or inspersed hymenium lacking columellar structures, 1–8-spored, clavate, non-amyloid asci, transversely septate to muriform, hyaline to yellowish or brown, non-amyloid to distinctly amyloid, non-halonate to ± distinctly halonate

Key to species of the genus *Thelotrema* from India

1 Ascospores transversely septate 2
Ascospores muriform 8

2(1) Ascospores hyaline, >100 µm long 3
Ascospores pale brown to brown 7

3(2) Thallus producing secondary metabolites 4
Thallus lacking secondary metabolites 6

4(3) Unknown compounds present; ascospores 2–4 per ascus . . . . . **T. kamatii**
Chemistry variable; ascospores 1–8 per ascus 5

5(4) Norstictic acid present; ascospores 1–2 per ascus; ascomata with minute pores and discs concealed; thallus verrucose . . . . . **T. patwardhanii**
Stictic acid present; ascospores 8 per ascus; ascomata with wider pores and discs partially visible; thallus smooth to uneven . . . . . **T. porinoides**

6(3) Ascomata >1 mm in diam.; ascospores 2–4 per ascus, up to 220 × 12 µm . . . . . **T. nureliyum**
Ascomata <1 mm in diam.; ascospores 4–8 per ascus, up to 110 × 12 µm . . . . . **T. diplotrema**

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7(2) Thallus ecorticate; ascospores 35–75 µm long . . . . . **T. pachysporum**
Thallus corticate; ascospores 60–150 µm long . . . . . **T. lacteum**

8(1) Ascospores hyaline 9
Ascospores brown 17

9(8) Ascospores >60 µm long 10
Ascospores <60 µm long 14

10(9) Ascospores 4–8 per ascus, 40–80 µm long . . . . . **T. adjectum**
Ascospores 1–4 per ascus 11

11(10) Ascospores 1–2 per ascus, up to 220 × 45 µm 12
Ascospores 1–4 per ascus, up to 120 × 25 µm 13

12(11) Thallus verrucose; ascomata erumpent . . . . . **T. rugulatum**
Thallus smooth to uneven; ascomata immersed . . . . . **T. armellense**

13(11) Ascospores thick walled; ascomata prominent . . . . . **T. lepadinum**
Ascospores thin walled becoming grey-brown in maturity; ascomata immersed . . . . . **T. lepademersum**

14(9) Secondary metabolites present 15
Secondary metabolites absent 16

15(14) Norstictic acid present . . . . . **T. canarense**
Stictic acid present . . . . . **T. cyphelloides**

16(14) Ascospores 10–22 × 4–8 µm . . . . . **T. kalarense**
Ascospores 17–25 × 8–10 µm . . . . . **T. polythecium**

17(8) Thallus with loose cortex; ascomata immersed to erumpent, distinctly lepadinoid; ascospores becoming pale brown in late maturity . . . . . **T. lepademersum**
Thallus ecorticate; ascomata erumpent to prominent 18

18(17) Asci 2–8-spored, ascospores ±amyloid, becoming brown in late maturity. . . . . **T. lepadodes**
Asci 1–4-spored, ascospores non-amyloid, soon becoming brown . . . . . **T. monosporum**

ascospores, and the presence or absence of β-orcinol depsidones.

Thelotrema adjectum Nyl.

Flora **49:** 290 (1866).

Thallus green to olive-green, mostly dull, continuous.

Ascomata immersed to semi-emergent, with wide ostiole, partly exposed flesh-coloured disc, ±layered margins; proper exciple free, hyaline to pale brown; asci 4–8-spored; ascospores non-amyloid to weakly amyloid, muriform, 11–17 × 0–5 septate, 40–80 × 8–25 µm.

Chemistry. No substances detected.

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Remarks. This taxon is a new record for India. It is somewhat similar to *Chapsa laceratula* but differs in having mostly ecorticate to loosely corticate thalli. It occurs in different parts of the Western Ghats.

Specimens examined. **India:** *Goa*: South Goa, Cotigao Wildlife Sanctuary, Gaodanger Village, elev. 300 m, *S. Nayaka* 03–001605C (LWG). *Karnataka*: Chikmagalure District, Chamudi Ghat, Kuvettu, elev. 104 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19739S (LWG). *Maharashtra*: Kolhapur District, Dajipur, Radha Nagari, Ugavai, Sacred Grove, elev. 700 m, *S. Nayaka* 99–75973/A (LWG). *Tamil Nadu*: Nilgiri District, Nilgiri Hills, Gudalur Way, after Naoluvattum, *Kr. P. Singh* 73–620, 73–635 (LWG–LWU).

Thelotrema armellense Patw. *et al.*

Biovigyanam **11:** 136 (1985).

Thallus smooth to uneven.

Ascomata immersed to slightly raised; open by wide ostiole; disc brown epruinose; proper exciple colourless, mostly fused to free, internally lined (at apices) by periphysoids; asci 1–2-spored; ascospores weakly amyloid, large 130–220 × 25–45 µm, becoming mottled in late maturity.

Chemistry. No substances detected.

Remarks. This species seems close to the *T. monosporum* complex and resembles *T. lepademersum* which is distinct in its morphology, producing a double margin around the ascomata. *Thelotrema armellense* was described from Karnataka in the Western Ghats by Patwardhan *et al.* (1985) and is endemic to India.

Specimens examined. **India:** *Karnataka*: North Canara District, Armol Ghat, Yellapur to Ankola road, *P. G. Patwardhan* 78–10 (AMH). *Maharastra*: Pune District, Thamini, elev. 600 m, *S. Nayaka* 99–86222B (LWG).

Thelotrema canarense Patw. & C. R. Kulk.

Norw. J. Bot. **24:** 128 (1977).

Thallus pale brown, honey brown, fawn-coloured, glossy, thin, smooth, continuous, evanescent reflecting bark.

Ascomata immersed, solitary, lepadinoid; asci 8-spored; ascospores non-amyloid, hyaline, submuriform, 5–7 × 1–2 septate, 20–25 × 9–10 µm.

Chemistry. Norstictic acid.

Remarks. Another norstictic acid-containing species is *T. patwardhanii* (Hale) Rivas Plata & Mangold, which differs in having a verrucose thallus, 1–2-spored asci and transversely septate, larger ascospores. *Thelotrema canarense* was described from Karnataka in the Western Ghats by Patwardhan & Kulkarni (1977*b*) and also occurs in the Western and Eastern Himalayas.

Specimens examined. **India:** *Karnataka*: South Canara District, at Manjeshwar, near Mangalore, *P. G. Patwardhan & A. V. Prabhu* 76–1201 (AMH). *Uttarakhand*: Pithoragarh District, Kali River valley, on way to Punyagiri from Tanakpur, elev. 300 m, (55–56)–3187, (55–56)–3377 (LWG–AWAS). *West Bengal*: Darjeeling District, Kurseong, near 1st loop, elev. 30–60 m, *D. D. Awasthi & M. R. Agarwal* 66–98 (LWG–LWU).

Thelotrema cyphelloides Müll. Arg.

Bull. Herb. Boissier **3:** 314 (1895).

Thallus grey to greenish grey, smooth, prosoplectenchymatous cortex.

Ascomata numerous, erumpent; asci 8-spored; ascospores non-amyloid small, hyaline, 6–10 × 1–2 septate, 20–27 × 4–8 µm.

Chemistry. Stictic acid chemosyndrome.

Remarks. This muriform species in India was described as *T. subexpallescens* Nagarkar *et al.* from the Andaman and Nicobar Islands by Nagarkar *et al.* (1987).

Specimen examined. **India:** *Andaman & Nicobar Islands*: Middle Andaman, Long Island range, Parlobjig Island, *M. B. Nagarkar & P. K. Sethy* 85–2258 (AMH).

Thelotrema diplotrema Nyl.

Ann. Sci. Nat., Bot., sér. 4 **11:** 258 (1859).

Thallus mostly ecorticate, uneven, pale greenish grey to pale olive.

Ascomata immersed, lepadinoid; asci 4–8-spored; ascospores amyloid, hyaline, transversely 10–20-septate, 50–110 × 8–12 µm.

Chemistry. No substances detected.

Remarks. Thelotrema nureliyum is comparable to *T. diplotrema* in lacking lichen compounds but differs in having larger ascomata and ascospores. *Thelotrema diplotrema* was reported from the Andaman and Nicobar Islands by Nagarkar *et al.* (1987) as *Ocellularia turgidula* Müll. Arg.

Thelotrema kalarense Sethy *et al.*

Mycotaxon **28:** 194 (1987).

Thallus glaucous grey to silver-grey, smooth, glossy ecorticate.

Ascomata immersed to semi-emergent, lepadinoid; asci 8-spored; ascospores weakly amyloid, hyaline, muriform, sometimes I+ violet-blue, 4–5 × 1–2 septate, small, 10–22 × 4–8 µm.

Chemistry. No substances detected.

Remarks. This species was described by Sethy *et al.* (1987) from evergreen forests of the Andaman and Nicobar Islands and is endemic to India.

Specimen examined. **India:** *Andaman & Nicobar Islands*: North Andaman, Kalara, Diglipur range, in evergreen forest, *P. G. Patwardhan & M. B. Nagarkar* 86–460 (AMH).

Thelotrema kamatii (Patw. & C. R. Kulk.) Hale

Mycotaxon **6:** 8 (1980).

Thallus corticate, olive-green, smooth, continuous.

Ascomata immersed to semi-emergent, lepadinoid; asci 4–8-spored; ascospores non-amyloid, hyaline, transversely 15–21-septate, 90–110 × 8–10 µm.

Chemistry. Unknown compounds present (yellow spots at Rf value 4 and 5).

Remarks. Thelotrema kamatii was described from Karnataka by Patwardhan & Kulkarni (1977*b*) as *Ocellularia kamatii* Patw. & C. R. Kulk. It is also known from the Andaman and Nicobar Islands, and Kerala in the Western Ghats.

Specimen examined. **India:** *Karnataka*: Chikmagalure District, Kalmaggi, in Charmudi Ghat, *M. B. Nagarkar & K. D. Gole* 76–1061 (AMH).

Thelotrema lacteum Kremp.

Flora **47:** 269 (1867).

Thallus ± corticate, different shades of pale and greenish grey.

Ascomata prominent, lepadioid with pruinose disc; ascospores brown, transversely 17–27-septate, thick-walled ≤ 150 µm long.

Chemistry. No substances detected.

Remarks. Thelotrema pachysporum and *T. diplotrema* can be confused with *T. lacteum* but differ in having shorter ascospores and persistently hyaline ascospores, respectively. Earlier, Hale (1981) treated *T. pachysporum* and *T. lacteum* as conspecific but subsequently both taxa were accepted as distinct by Frisch *et al.* (2006). In India the species has been reported from the Andaman and Nicobar Islands and the Eastern Himalaya (Assam) by Nagarkar *et al.* (1986) as *Phaeotrema lacteum* (Kremp.) Müll. Arg.

Thelotrema lepademersum Nagarkar *et al.*

Kavaka **13:** 59 (1985).

Thallus grey-green, green, greenish grey, smooth to uneven, verrucose; cortex irregular, loose.

Proper exciple colourless; asci 1–4-spored; ascospores hyaline, grey in older stage, muriform.

Chemistry. No substances detected.

Remarks. This species was described from Karnataka by Nagarkar *et al.* (1985). It is recorded from the Western Ghats and the Eastern Himalaya. The species shows a close resemblance to *T. lepadinum*, which differs in having prominent ascomata and persistently hyaline ascospores.

Specimens examined. **India:** *Assam*: Nagaon District, Salna Village, *A. Dey* 12–020497 (LWG). *Karnataka*: North Canara District, on the way to Jog Falls, *P. G. Patwardhan & U. V. Makhija* 81–633 (AMH).

Thelotrema lepadinum (Ach.) Ach.

Meth. Lich.: 132 (1803).

Thallus different shades of pale and yellow-green.

Ascomata emergent, lepadinoid, proper exciple hyaline; asci 1–4-spored; ascospores hyaline, muriform, 100–120 × 20–25 µm.

Chemistry. No substances detected. However, Singh & Sinha (2010) mentioned an infrequent occurrence of yellow pigment.

Remarks. Morphologically, many species resemble *T. lepadinum* but differ in ascospore size and septation. The closely related *T. lepademersum* differs in producing immersed ascomata and thin-walled ascospores which are not persistently hyaline. *Thelotrema lepadinum* has its distribution mainly in the Western Ghats, and in some parts of the Eastern Himalaya.

Specimens examined. **India:** *Karnataka*: Uttarakannada District, Kumta taluk, Sampegadde, *S. Dudani* 13–024452 (LWG). *Kerala*: Idukki District, ICRI campus, Myladumpara, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi* 84–78 (LWG–LWU). *Tamil Nadu*: Nilgiri District, Nilgiri Hills, way to Doddabetta Peak, elev. 2500–2633 m, *G. Awasthi* 82–4D (LWG–LWU).

Thelotrema lepadodes Tuck.

Proc. Amer. Acad. Arts Sci. **5:** 405 (1862).

Thallus pale grey to yellowish grey.

Ascomata ±emergent; asci 2–8-spored; ascospores moderately large, brown, non-amyloid to weakly amyloid, muriform, 60–120 µm long.

Chemistry. No substances detected.

Remarks. This species had previously been considered under the synonymy of *T. monosporum* by Frisch *et al.* (2006) but recently was accepted under its current name (Mangold *et al.* 2009; Rivas Plata *et al.* 2010*a*). *Thelotrema lepadodes* differs from the closely related *T. monosporum* in having 2–8-spored asci and fusiform ascospores with ±subacute ends, ascospore septation, time of maturity (browning) and amyloidity. *Thelotrema lepadodes* has been reported as *Leptotrema lepadodes* (Tuck.) Zahlbr. by Patwardhan & Kulkarni (1977*a*) from Tamil Nadu. In addition, it occurs in the Andaman and Nicobar Islands, the Eastern Himalaya, and the Eastern and Western Ghats.

Specimens examined. **India:** *Assam*: Nagaon District, Lumding forest, *A. Dey* 09–19055 (LWG). *Karnataka*: Uttarakannada District, Honnavar taluk, Karikan sacred grove, *S. Dudani* 12–016872 (LWG). *Orissa*: Berhampur District, Taptapani, elev. *c.* 750 m, *D. D. Awasthi* 45–204 (LWG–AWAS). *Tamil Nadu*: Nilgiri District, Nilgiri Hills, Kodanad, near tea estate, in the Shola, elev. *c.* 2000 m, *D. D. Awasthi & Kr. P. Singh* 70–1482 (LWG–LWU).

Thelotrema monosporum Nyl.

Ann. Sci. Nat., Bot., sér. 4 **15:** 46 (1860).

Thallus ecorticate.

Ascomata emergent; asci 1–4-spored; ascospores large, < 100 µm long, brown, muriform.

Chemistry. No substances detected.

Remarks. Thelotrema monosporum is formally recognized as a separate species from the closely related *T. lepadodes* on the basis of longitudinal septation, darkening and amyloidity of ascospores and the number of spores per ascus. It was recorded from the Andaman and Nicobar Islands (Awasthi 1991) and also occurs in the Western Ghats (including Karnataka, Kerala and Maharashtra) and the Western Himalaya.

Specimens examined. **India:** *Andaman & Nicobar Islands*: South Andaman, unnamed island, near Baratang Island, *A. Singh* 61–79745 (LWG). *Kerala*: Idukki District, ICRI campus, Myladumpara, elev. *c.* 1200 m, *D. D. Awasthi & G. Awasthi* 84–119 (LWG–LWU). *Tamil Nadu*: Nilgiri District, Nilgiri Hills, on way to Doddabetta, elev. *c.* 1800 m, *Kr. P. Singh* 73–417 (LWG–LWU). *Uttarakhand*: Pithoragarh District, Ginny Band, *D. K. Upreti et al.* 09–012104 (LWG).

Thelotrema nureliyum Hale

Bull. Br. Mus. (Nat. Hist.), Bot. **8:** 261 (1981).

Thallus pale greenish grey to olive or yellowish grey, strongly rimose, verrucose.

Ascomata > 1 mm in diam.; asci 2–4-spored; ascospores large, up to 220 × 20 µm, transversely septate.

Chemistry. No substances detected.

Remarks. Patwardhan *et al.* (1985) recorded the species from the Western Ghats (Tamil Nadu) as *Ocellularia nureliya* (Hale) Patw. *et al.*

Thelotrema pachysporum Nyl.

Bull. Soc. Linn. Normandie, sér. 2 **2:** 72 (1868).

Thallus pale grey to pale yellowish grey, thin, ecorticate.

Ascomata large, proper exciple free; ascospores moderately large, transversely septate, thick-walled, brown.

Chemistry. No substances detected.

Remarks. This species was earlier considered conspecific with *T. lacteum* (Hale 1981) but recently (Mangold *et al.* 2009) it has been treated as a different species with smaller ascospores of 35–75 µm compared to the 60–150 µm long ascospores of *T. lacteum*. Samples from India with brown ascospores were misidentified previously as *T. subtile* Tuck., which differs in producing consistently hyaline ascospores (Sipman *et al.* 2012). The species was first collected in 1879 from the Eastern Himalaya (Assam) as *T. exalbidum* by A. Watt, and has been reported from Karnataka and Maharastra in the Western Ghats by Patwardhan & Kulkarni (1977*a*) and Nagarkar *et al.* (1988) as *Ocellularia subtilis* (Tuck.) Riddle. It is also known to occur in the Andaman Islands, the Gangetic Plains and the Eastern Himalaya.

Specimens examined. **India:** *Andaman & Nicobar Islands*: Middle Andaman, Bajalungta, <60 m, *A. Singh* 61–52913 (LWG). *Assam*: Nagaon District, Jugijan Village, *A. Dey* 10–019001 (LWG). *Karnataka*: Hassan District, near Sakleshpur, Sambhalli, *D. D. Awasthi, D. K. Upreti & U. Misra* 79–315 (LWG). *Tamil Nadu*: Tirunelveli District, Pothigai Hills, Papanasum, near upper Tamra barni Dam, elev. 1000–1200 m, *Upreti & G. N. Hariharan* 90–202296 (LWG). *Uttar Pradesh*: Behraich District, Katarniaghat Wildlife Sanctuary, near Bicchiya, elev. 120 m, *D. K. Upreti, S. Nayaka & J. Tandon* 07–008540 (LWG).

Thelotrema patwardhanii (Hale) Rivas Plata & Mangold

Lichenologist **42:** 184 (2010).

Thallus green to olive-green or pale green, verrucose, continuous.

Ascomata inconspicuous, perithecioid; asci 1–2-spored; ascospores muriform, ≤ 200 µm long.

Chemistry. Norstictic acid.

Remarks. The type material examined was rather poor and could not be studied for ascomatal anatomical characters. It was previously described as *Ocellularia patwardhanii* Hale from Karnataka and Kerala in the Western Ghats and has so far been recorded only from India.

Specimen examined. **India:** *Karnataka*: South Canara District, Agumbe, *P. G. Patwardhan* 77–426 (AMH).

Thelotrema polythecium Sethy *et al.*

Mycotaxon **28:** 195 (1987).

Thallus ecorticate, translucent pseudocortex present, off-white to smoke grey, brown, smooth.

Ascomata immersed to slightly raised, with lacerate margins; asci 8-spored, ascospores non-amyloid, small, hyaline, muriform to submuriform, 5–6 × 1–2 septate, 17–25 × 8–10 µm.

Chemistry. No substances detected.

Remarks. Thelotrema kalarense is similar but has smaller ascospores with fewer septa. *Thelotrema polythecium* was described from the Andaman and Nicobar Islands by Sethy *et al.* (1987).

Specimen examined. **India:** *Andaman & Nicobar Islands*: North Andaman, Mayabandar Range, Kaichi Nala, *M. B. Nagarkar & P. G. Patwardhan* 85–2793 (LWG).

Thelotrema porinoides Mont. & Bosch

Pl. Jungh. **4:** 484 (1855).

Thallus greyish green.

Ascomata ± conspicuous, emergent; asci 8-spored; ascospores amyloid, transversely septate, hyaline, 40–170 × 15–22 µm.

Chemistry. Stictic acid chemosyndrome.

Remarks. The morphologically similar *T. nureliyum* does not contain secondary compounds. *Ocellularia agasthiensis* Nagarkar *et al.*, *O. albidiformis* (Leight.) Zahlbr. and *O. exanthismocarpa* (Leight.) Zahlbr., treated previously as separate species (Patwardhan & Kulkarni 1977*a*; Nagarkar *et al.* 1988), have subsequently been synonymized with *T. porinoides* (Rivas Plata *et al.* 2010*a*; Singh & Sinha 2010). This taxon is known from the Andaman and Nicobar Islands and the Western Ghats.

Specimens examined. **India:** *Andaman & Nicobar Islands*: South Andaman, Mount Harriat, elev. *c.* 360 m, *A. Singh* 61–67629 (LWG). *Tamil Nadu*: Manjolai Upper Kodayar, Agasthi Hills, *P. K. Sethy & M. B. Nagarkar* 83–188B (AMH).

Thelotrema rugatulum Nyl.

Bull. Soc. Linn. Normandie, sér. 2 **7:** 168 (1873).—*Thelotrema verrucorugosum* Nagarkar *et al.*, *Kavaka* **13:** 60 (1987) ["1985"]; type: India, Karnataka, South Canara District, Ganga Mulla to Nagatritha, on the way to Kudremkha, on bark, 1 January 1981, *P. G. Patwardhan & D. Rane* 81–13 (AMH—holotype).

Thallus off-white, smooth.

Ascomata numerous, erumpent, with a depressed indistinct to distinct ostiole; proper exciple indistinctly free; asci 1(–2)-spored; ascospores non-amyloid, hyaline, muriform, large, 150–200 × 20–30 µm.

Chemistry. No substances detected.

Remarks. Nagarkar *et al.* (1987) recorded *T. rugatulum* from the Andaman and Nicobar Islands.

Topeliopsis Kantvilas & Vězda

Lichenologist **32:** 347 (2000).

The genus *Topeliopsis* was introduced to accommodate species having a thick, slightly pale proper exciple lined by indistinctly separated periphysoids and straight, parallel to slightly interwoven paraphyses that never have strongly thickened tips. A total of *c.* 19 species of the genus are known worldwide. Only two species are known in India: *T. muscigena* and *T. tuberculifera*. *Topeliopsis pseudoexanthismocarpa* (Mont. & Bosch) Mangold, placed in the genus earlier, was later treated under *Chapsa pseudoexanthismocarpa* and thereafter accommodated in *Pseudochapsa* as *P. pseudoexanthismocarpa*. The genus differs from the closely related *Thelotrema* by the fused proper exciple and arrangement of paraphyses and periphysoids (Mangold *et al.* 2009). The other common diagnostic characters of the genus include 1–8-spored asci, and transversely septate to muriform, usually hyaline, rarely yellowish to brown, thin- to thick-walled, mostly I+ violet ascospores, halonate or not.

Key to species of the genus *Topeliopsis* from India

1 Thallus verrucose; ascomata with entire margins; ascospores lacking ascoconidia . . . . . **T. tuberculifera**

Thallus smooth; ascomata with lobed or denticulate margins; ascospores producing ascoconidia. . . . . **T. muscigena**

Topeliopsis muscigena (Stizenb.) Kalb

Mycotaxon **79:** 322 (2001).

Thallus grey to olive-grey or pale yellowish grey, smooth, ecorticate.

Ascomata urceolate, sessile to shortly stipitate, margin exfoliating; corticate, smooth, cylindrical, reddish brown ascomatal base; proper exciple fused with periphysoids; asci 1(–2)-spored; ascospores amyloid,

muriform, thin-walled, hyaline to brownish, large, 100–210 × 20–55 µm, may generate ascoconidia.

Chemistry. No substances detected.

Remarks. This species is mostly muscicolous (rarely corticolous). It differs from *T. tuberculifera* in having a smooth thallus and fissured to denticulate or lobulate ascomatal margins. *Topeliopsis muscigena* was previously recognized as *T. indicum* Hale by Hale (1975) and is currently known from the Western Ghats.

Specimens examined. **India:** *Tamil Nadu*: Nilgiri District, Nilgiri Hills, along road to Doddabetta, elev. 2600 m, *M. E. Hale & P. G. Patwardhan* 73–40185 (AMH); Doddabetta, elev. 2619 m, 2012, *A. R. Logesh, P. Shukla & K. K. Ingle* s. n. (LWG).

Topeliopsis tuberculifera (Vain.) Rivas Plata & Mangold

Lichenologist **42:** 185 (2010).

Thallus pale olivaceous to greenish, glaucous, warty.

Ascomata numerous, ± emergent; proper exciple brown, fused; asci 1-spored; ascospores amyloid, larger, muriform, 130–150 × 25–50 µm.

Chemistry. No substances detected.

Remarks. The species was earlier recorded as *Thelotrema tuberculiferum* Vain. from Karnataka and Kerala (Patwardhan & Kulkarni 1977*a*), and occurs in the Western Ghats.

Wirthiotrema Rivas Plata *et al.*

Lichenologist **42:** 198 (2010).

The recently introduced genus *Wirthiotrema* contains five species worldwide (Rivas Plata *et al.* 2010*b*; Sipman *et al.* 2012), including three found in India: *W. desquamans*, *W. trypaneoides* and *W. glaucopallens*. The genus differs from the allied genera *Myriotrema*, by its paraplectenchymatous excipulum, *Leucodecton*, in having thick-walled, non-amyloid ascospores, and *Thelotrema*, in having myriotremoid ascomata. Other characters of *Wirthiotrema* are a compact, glossy, prosoplectenchymatous cortex, immersed to erumpent, round to angular ascomata a brownish proper exciple, non-amyloid, muriform ascospores and the presence of stictic acid and satellite substances.

Key to species of the genus *Wirthiotrema* from India

1 Hymenium inspersed; ascospores brown, 25–40 × 8–15 µm . . . . **W. trypaneoides**
Hymenium clear; ascospores hyaline or brown 2

2(1) Ascospores brown, 20–35 × 8–18 µm . . . . . **W. desquamans**
Ascospores hyaline, 20–28 × 9–13 µm . . . . . **W. glaucopallens**

Wirthiotrema desquamans (Müll. Arg.) Lücking

Phytotaxa **55:** 200 (2012).

Thallus glossy, corticate.

Ascomata small-pored, immersed; perithecioid; proper exciple fused; ascospores brown, muriform, 5–11 × 1–6-septate.

Chemistry. Stictic acid.

Remarks. This species was misidentified as *Leptotrema irosinum* (Vain.) Zahlbr. by Patwardhan & Kulkarni (1977*a*) and recognized as *L. desquamans* (Müll. Arg.) Patw. & Makhija by Patwardhan & Makhija (1980). Joshi *et al.* (2012*b*) accepted the species as *Myriotrema desquamans* (Müll. Arg.) Hale. It is similar to *Wirthiotrema trypaneoides* (Nyl.) Rivas Plata & Lücking (Rivas Plata *et al.* 2010*b*), which has a densely inspersed hymenium. In India, the species occurs in the Andaman and Nicobar Islands and the Western Ghats (Singh & Sinha 2010).

Wirthiotrema glaucopallens (Nyl.) Rivas Plata & Kalb

Lichenologist **42:** 201 (2010).

Thallus glossy, smooth; different shades of olive.

Ascomata myriotremoid, level with the thallus; ascospores oblong to ellipsoidal, hyaline, submuriform to muriform, 5–9 × 1–2 septate.

Chemistry. Stictic acid chemosyndrome.

Remarks. This species was previously collected from the Andaman and Nicobar Islands and the Western Ghats as *Thelotrema glaucopallens* Nyl. (Patwardhan & Kulkarni 1977*a*; Awasthi 1991).

Specimens examined. **India:** *Karnataka*: Shimoga District, Agumbe Ghat, elev. 199 m, *H. T. Lumbsch, D. K. Upreti & P. K. Divakar* 08–19732A (LWG). *Kerala*: Kollam District, Rosemala, *B. Haridas 06*–009627 (LWG); Palghat District, MCL mines area, Walayar Forest, elev. *c.* 300 m, *D. D. Awasthi, R. Tewari & R. Mathur* 85–8 (LWG–LWU).

Wirthiotrema trypaneoides (Nyl.) Rivas Plata & Lücking

Lichenologist **42:** 201 (2010).

Thallus thick, glossy, corticate.

Ascomata immersed to slightly emergent, perithecioid, with minute pores; proper exciple dark; hymenium inspersed; ascospores brown, muriform, 5–11 × 0–5 septate.

Chemistry. Stictic acid chemosyndrome.

Remarks. This species was recorded in India as *Leptotrema trypaneoides* (Nyl.) Riddle by Nagarkar & Kulkarni (1977*a*) and as *Myriotrema trypaneoides* (Nyl.) Hale by Awasthi (1991) from Karnataka, Tamil Nadu and Kerala in the Western Ghats.

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