Additions to the lichen flora of Himalaya from Darjeeling and Sikkim

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ABSTRACT

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The paper deals with the extended distribution of eighteen lichen species from Darjeeling and Sikkim areas in the Eastern Himalaya. This includes sixteen crustose and one each of foliose and fruticose growth forms recorded for the first time from Himalaya.

Key-words: Lichenized fungi, Ascomycota, Eastern Himalaya

INTRODUCTION

The state of Sikkim and the Darjeeling hills of West Bengal in Eastern Himalaya are well known for their floral wealth. Lichenological study from these areas was initiated by Nylander (1860). Subsequently, Müller Argoviensis (1895), Smith (1926), Chopra (1934), Asahina (1966), Kurokawa (1966), Awasthi and Agarwal (1968, 1969, 1970), Sinha (1999), Upreti et al. (2003) and Sinha and Singh (2005) made further significant contributions. Singh and Sinha (2010) listed over 370 and 500 species from Darjeeling and Sikkim, respectively. The investigations on the recently collected specimens from Darjeeling and Sikkim revealed the discovery of several new species and new records for India (Jagadeesh Ram et al. 2009, Jagadeesh Ram & Sinha 2009a, b, c, 2010a, b). During the course, 18 lichen species hitherto not known from Eastern Himalaya have also been found. The paper deals with the extended distribution of these which are also new records to Himalaya. All the species are enumerated with brief descriptions, distributional details along with habit photographs for ready reference.

MATERIAL AND METHOD

Specimens collected from Darjeeling and Sikkim, deposited in BSA herbarium, were investigated morphologically, anatomically and chemically. The external morphological features were observed with an Olympus SZ61 Stereo microscope. Thin hand-cut sections of thalli and ascomata were mounted in water, 10% KOH solution and Lugol's iodine solution and examined with a Leica DM 2500 compound microscope. The thallus colour reactions were carried out by 10% aqueous potassium hydroxide solution (K), aqueous calcium hypochlorite solution (C), Steiner's stable solution (P) and long wavelength UV. The lichen substances were identified by thin layer chromatography following Orange et al. (2001).

TAXONOMIC DESCRIPTION

Anisomeridium tamarindi (Fée) R. C. Harris (Monoblastiaceae)

Plate 1, figure 1

Description: Thallus crustose, corticolous, white to whitish grey, UV–; photobiont *Trentepohlia*. Perithecia 0.28–0.4 mm diam.; asci 8-spored; ascospores biseriate, hyaline, fusiform, 1-septate, 18–25 x 5–6.5 µm.

Distribution: India (Tamil Nadu and West Bengal – plains) and tropical regions of the world.

Specimen examined: West Bengal, Darjeeling district, Neora Valley National Park, Zero Point forest, alt. 2461 m, 15 May 2008, Jagadeesh 4285.

Arthopyrenia majuscula (Nyl.) Zahlbr. (Arthopyreniaceae)

Plate 1, figure 2

Description: Thallus crustose, corticolous, non-lichenized. Perithecia, 0.4–1 mm diam.; asci 8-spored; ascospores hyaline, ellipsoid to oblong-ellipsoid, 1-septate, becoming 3-septate, constricted at septum, 25–30 x 9–12 µm.

Distribution: India (West Bengal – Kolkata), Japan and U.S.A.

Specimen examined: West Bengal, Darjeeling district, Neora Valley National Park, Aloobari, alt. 2453 m, 15 May 2010, Jagadeesh 6127.

Arthothelium confertum (A.L. Sm.) Makhija & Patw. (Arthoniaceae)

Plate 1, figure 3

Description: Thallus crustose, corticolous, whitish grey; photobiont *Trentepohlia*; medulla white. Apothecia immersed, dark brown to black, rounded to irregular, 0.3–1.2 mm diam.; asci 8-spored; ascospores hyaline, ovoid, muriform, with 7–9 transverse and 1–3 longitudinal septa, 20–27 x 10–14 µm.

Chemistry: Barbatic acid present.

Distribution: India (Assam).

Specimens examined: Sikkim, Gangtok: Hanuman tok, alt. ca 2000 m, 24 Nov. 2006, G. P. Sinha 3725; Gangtok, Baluakhani, BSI-SHRC campus, alt. 1724 m on *Cryptomeria japonica*, 19 Mar. 2007, Jagadeesh 4167, 4168; ibid., on *Alnus nepalensis*, 20 May 2010, Jagadeesh 6196; Namthang, alt. 1523 m, 26 Nov. 2006, G. P. Sinha 3821.

Arthothelium consociatum Makhija & Patw. (Arthoniaceae)

Plate 1, figure 4

Description: Thallus crustose, corticolous, whitish grey; photobiont *Trentepohlia*; medulla white. Apothecia immersed, dark brown to black, rounded to irregular, 0.3–1 mm diam.; asci 8-spored; ascospores hyaline, ellipsoid to ovoid, muriform, with 9–15 transverse and 2–6 longitudinal septa, 36–58 x 17–26 µm.

Chemistry: Barbatic acid present.

Distribution: India (Meghalaya).

Specimens examined: Sikkim, Gangtok: Dikchu-Singtam Road, alt. 725 m, 21 Nov. 2006, G. P. Sinha 3641; Rumtek-Sang, alt. 1450 m, 25 Nov. 2006, G. P. Sinha 3771. West Bengal, Darjeeling district, Lava, Kolakham, 1660 m, 12 May 2010, Jagadeesh 6018.

Bunodophoron diplotypum (Vain.) Wedin (Sphaerophoraceae)

Plate 1, figure 5

Description: Thallus fruticose, erect, hollow. Fertile branches up to 3 cm tall, 1.5–2.5 mm wide, irregularly to almost isotomic-dichotomously branched; shorter lateral branches scattered along the margins; upper surface greyish green. Apothecia terminal, 1–2 mm wide; mazaedia ventrally exposed, not enclosed by thalline receptacle, black; ascospores simple, globose, brown, 5.5–7.5 µm diam.

Chemistry: Sphaerophorin, stictic acid, constictic acid and norstictic acid present.

Distribution: India (Karnataka and Kerala), Madagascar, Africa, Australia and South East Asia.

Specimen examined: West Bengal, Darjeeling district, Neora Valley National Park, PHE Source – Aloobari way, alt. ca 2300 m, 11 Mar. 2007, Jagadeesh 4056.

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Plate 1

1. *Anisomeridium tamarindi* (Jagadeesh 4285). 2. *Arthopyrenia majuscula* (Jagadeesh 6127). 3. *Arthothelium confertum* (G. P. Sinha 3821). 4. *A. consociatum* (G. P. Sinha 3641). 5. *Bunodophoron diplotypum* (Jagadeesh 4056). 6. *Catillaria leptocheiloides* (Jagadeesh 3960). 7. *Cryptothecia scripta* (G. P. Sinha 3654). 8. *Diorygma hieroglyphicum* (Jagadeesh 3895). 9. *D. tuberculosum* (Jagadeesh 4061). Scale = 1 mm.

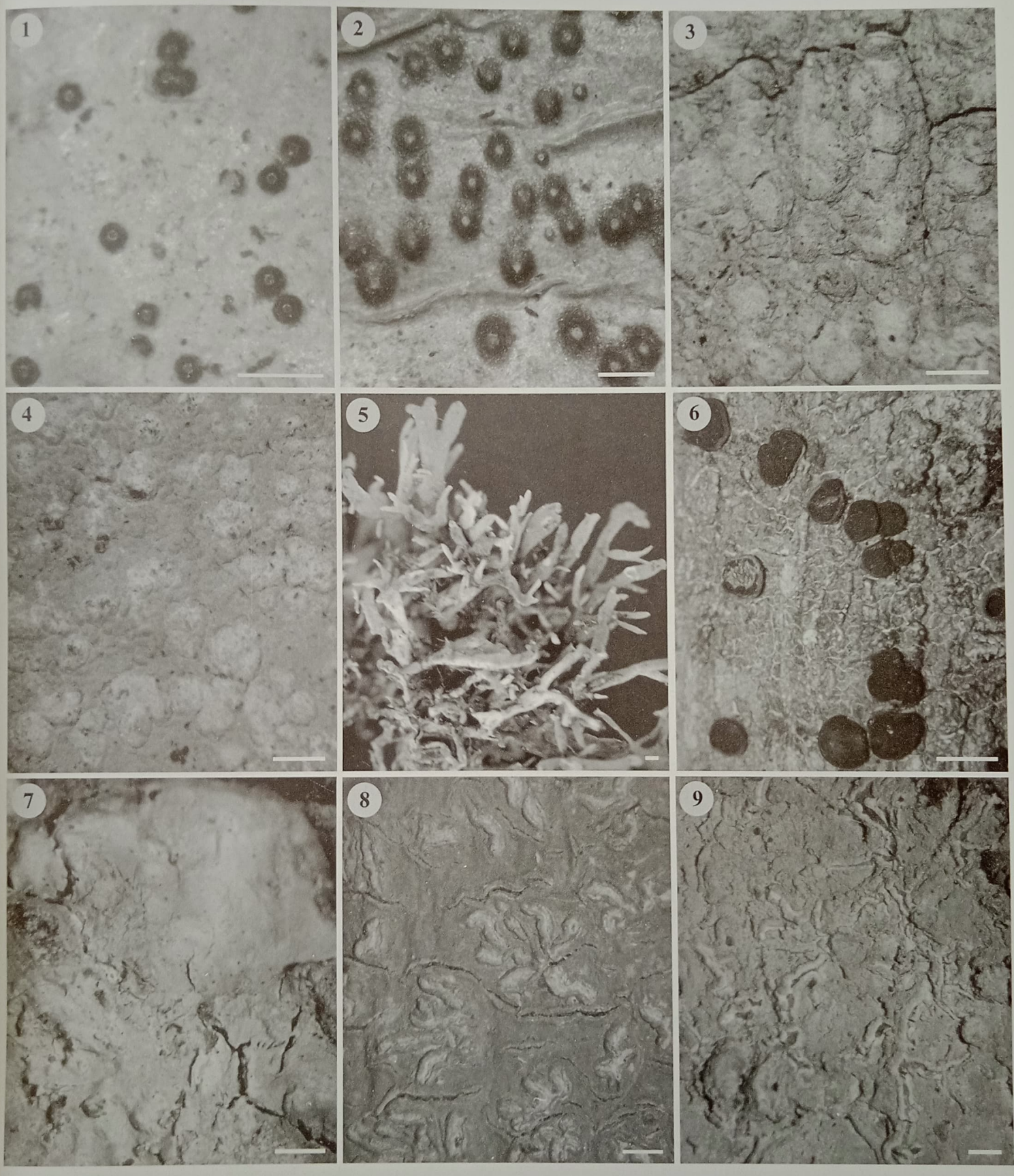

Plate 1

Catillaria leptocheiloides (Nyl.) Zahlbr. (Catillariaceae)

Plate 1, figure 6

Description: Thallus crustose, corticolous, greyish; photobiont *Trebouxia*. Apothecia lecideine, sessile, rounded, black, up to 1.3 mm diam.; asci 8-spored; ascospores hyaline, 1-septate, ellipsoid to fusiform, not halonate, 14–20 x 4.5–6 µm.

Chemistry: Atranorin and zeorin present.

Distribution: India (Goa, Karnataka, Kerala, Manipur and Tamil Nadu) and Tahiti.

Specimens examined: West Bengal, Darjeeling district, Neora Valley National Park, PHE Source-Doley way, alt. ca 2150 m, 10 Mar. 2007, Jagadeesh 3960; Neora river bank, near PHE camp, alt. ca 2200 m, 11 Mar. 2007, Jagadeesh 4009; Rechilla, alt. ca 2500 m, 15 Mar. 2007, Jagadeesh 4147.

Cryptothecia scripta G. Thor (Arthoniaceae)

Plate 1, figure 7

Description: Thallus crustose, corticolous, greyish white to glaucous grey, with 0.1 mm diam. whitish globose isidia-like structures, ecorticate; prothallus whitish with a brownish tinge, byssoid, 1–2 mm wide; photobiont *Trentepohlia*; medulla white. Ascigerous parts indistinct; asci 1-spored; ascospores hyaline, muriform, ovoid to ellipsoid, 48–70 x 20–35 µm.

Chemistry: Gyrophoric acid present.

Distribution: India (Andaman Islands, Karnataka, Tamil Nadu and West Bengal – plains), Papua New Guinea, Thailand and Australia.

Specimens examined: Sikkim, Ranipool, Souremi village area, 20 Nov. 2006, G. P. Sinha 3608. West Bengal, Darjeeling district: Simulbari, Simulbari T. E., on shade tree, 12 May 2005, V. N. Singh 2115; Neora Valley National Park, Aloobari – Chaudaphery way, alt. 2500 m, 16 May 2010, Jagadeesh 6187.

Diorygma hieroglyphicum (Pers.) Staiger & Kalb (Graphidaceae)

Plate 1, figure 8

Description: Thallus crustose, corticolous, pale grey; photobiont *Trentepohlia*. Ascomata lirellate, simple to irregularly branched, 1–2.5 mm long, 0.6–1 mm wide; asci 1–2-spored; ascospores hyaline, ellipsoid-oblong, muriform, 20–32 x 4–8 locular, with ± equal locules, 80–132 × 28–45 µm, I+ blue-violet.

Chemistry: Stictic, hypostictic, constictic, cryptostictic and norstictic acids present.

Distribution: India (Andaman and Nicobar Islands, Kerala and Maharashtra) and tropical regions of the world.

Specimens examined: West Bengal, Darjeeling district, Neora Valley National Park, Chaudapheri-Zero Point way, alt. ca 2300 m, 8 Mar. 2007, Jagadeesh 3895; PHE Source-Doley way, alt. ca 2150 m, 10 Mar. 2007, Jagadeesh 3967.

Diorygma tuberculosum (Stirt.) Kalb, Staiger & Elix (Graphidaceae)

Plate 1, figure 9

Description: Thallus crustose, corticolous, whitish grey; photobiont *Trentepohlia*. Ascomata lirellate, simple to branched, 1–8 mm long, 0.4–0.8 mm wide; asci 1-spored; ascospores hyaline, muriform, with smaller peripheral locules, 100–140 x 40–50 µm, I+ weakly violet.

Chemistry: Norstictic and connorstictic acids present.

Distribution: India (Tamil Nadu – Nilgiri hill).

Specimen examined: West Bengal, Darjeeling district, Neora Valley National Park, PHE Source-Aloobari way, alt. ca 2300 m, 11 Mar. 2007, Jagadeesh 4061.

Graphis albidofarinacea Adaw. & Makhija (Graphidaceae)

Plate 2, figure 1

Description: Thallus crustose, corticolous, whitish, granulose to verruculose; photobiont *Trentepohlia*. Ascomata lirellate, immersed, simple to branched, 2–8 mm long, 0.4–0.7 mm wide; asci 8-spored; ascospores hyaline, oblong-ellipsoid, not halonate, 12–18 locular, 43–60 x 8–10.5 µm, I+ blue-violet.

Chemistry: Norstictic acid (major) and connorstictic acid (minor) present.

Distribution: India (Tamil Nadu – Palni hill).

Specimen examined: West Bengal, Darjeeling district, Kalimpong, Divisional Forest Manager Office campus, on dry bark of *Pinus*, alt. ca 1206 m, 6 Mar. 2007, Jagadeesh 3884.

Graphis handelii Zahlbr. (Graphidaceae)

Plate 2, figure 2

Description: Thallus crustose, corticolous, whitish grey, ecorticate; photobiont *Trentepohlia*. Ascomata lirellate, partly immersed to emergent, simple to furcate, 1–2.5 mm long, 0.15–0.3 mm wide; asci 8-spored; ascospores hyaline, oblong to oblong-ovoid, 8–10 locular, 23–36 x 6–9 µm, I+ blue-violet.

Chemistry: Norstictic acid present.

Distribution: India (West Bengal – plains), New Caledonia, Hawaii, Australia and South America.

Specimen examined: West Bengal, Darjeeling district, Neora Valley National Park, Aloobari, near watch tower, alt. ca 2441 m, 20 May 2008, Jagadeesh 4413.

Graphis semirigida (Müll. Arg.) Lücking (Graphidaceae)

Plate 2, figure 3

Description: Thallus crustose, corticolous, grey to greyish brown, ecorticate; photobiont *Trentepohlia*. Ascomata lirellate, simple to branched, 1–3 mm long, 0.25–0.35 mm wide; asci 1-spored; ascospores hyaline, oblong, muriform, 18–22 x 4–8 locular, 83–110 × 23–34 µm, I+ blue-violet.

Chemistry: Norstictic acid present.

Distribution: India (Manipur).

Specimen examined: West Bengal, Darjeeling district, Neora Valley National Park, PHE Source-Doley way, alt. ca 2150 m, 10 Mar. 2007, Jagadeesh 3963.

Hemithecium nagalandicum (Kr. P. Singh & G. P. Sinha) Adaw. & Makhija (Graphidaceae)

Plate 2, figure 4

Description: Thallus crustose, corticolous, greenish grey, ecorticate; photobiont *Trentepohlia*. Ascomata lirellate, immersed to emergent, simple to branched, up to 20 mm long, 0.4–0.6 mm wide; asci 8-spored; ascospores hyaline, oblong, 6–8 locular, 21–30 x 7–8 µm, I+ blue-violet.

Chemistry: Stictic (major), constictic (major), norstictic (minor) and hypostictic (trace) acids present.

Distribution: India (Nagaland).

Specimen examined: West Bengal, Darjeeling district, Neora Valley National Park, Bhotekharka, alt. ca 1600 m, 16 Mar. 2007, Jagadeesh 4151.

Herpothallon philippinum (Vain.) Aptroot & Lücking (Arthoniaceae)

Plate 2, figure 5

Description: Thallus crustose, corticolous, loosely attached, minutely felty, mineral green to grey; hypothallus whitish; prothallus whitish, up to 1 mm wide, byssoid; pseudosidia numerous, cylindrical, simple or rarely branched, up to 1 x 0.1 mm; photobiont *Trentepohia*. Ascomata not seen.

Chemistry: Gyrophoric acid present.

Distribution: India (Assam – Cachar hills), Costa Rica, Ecuador, Indonesia, Malawi, Philippines, Seychelles, Taiwan, Thailand, Vanuatu and Venezuela.

Specimens examined: Sikkim, Gangtok, Baluakhani, BSI – SHRC campus, on *Alnus nepalensis*, 1724 m, 20 May 2010, Jagadeesh 6199.

Hypotrachyna revoluta (Flörke) Hale (Parmeliaceae)

Plate 2, figure 6

Description: Thallus foliose, corticolous, loosely adnate, up to 6 cm across, dichotomously lobate; lobes

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Plate 2

1. *Graphis albidofarinacea* (Jagadeesh 3884); 2. *G. handelii* (Jagadeesh 4413); 3. *G. semirigida* (Jagadeesh 3963); 4. *Hemithecium nagalandicum* (Jagadeesh 4151); 5. *Herpothallon philippinum* (Jagadeesh 6199); 6. *Hypotrachyna revoluta* (Jagadeesh 4446B); 7. *Mycomicrothelia conothelena* (Jagadeesh 4343); 8. *Pyrenula subelliptica* (G. P. Sinha 3831A); 9. *Trypethelium ochroleucum* (Jagadeesh 4012). Scale = 1 mm.

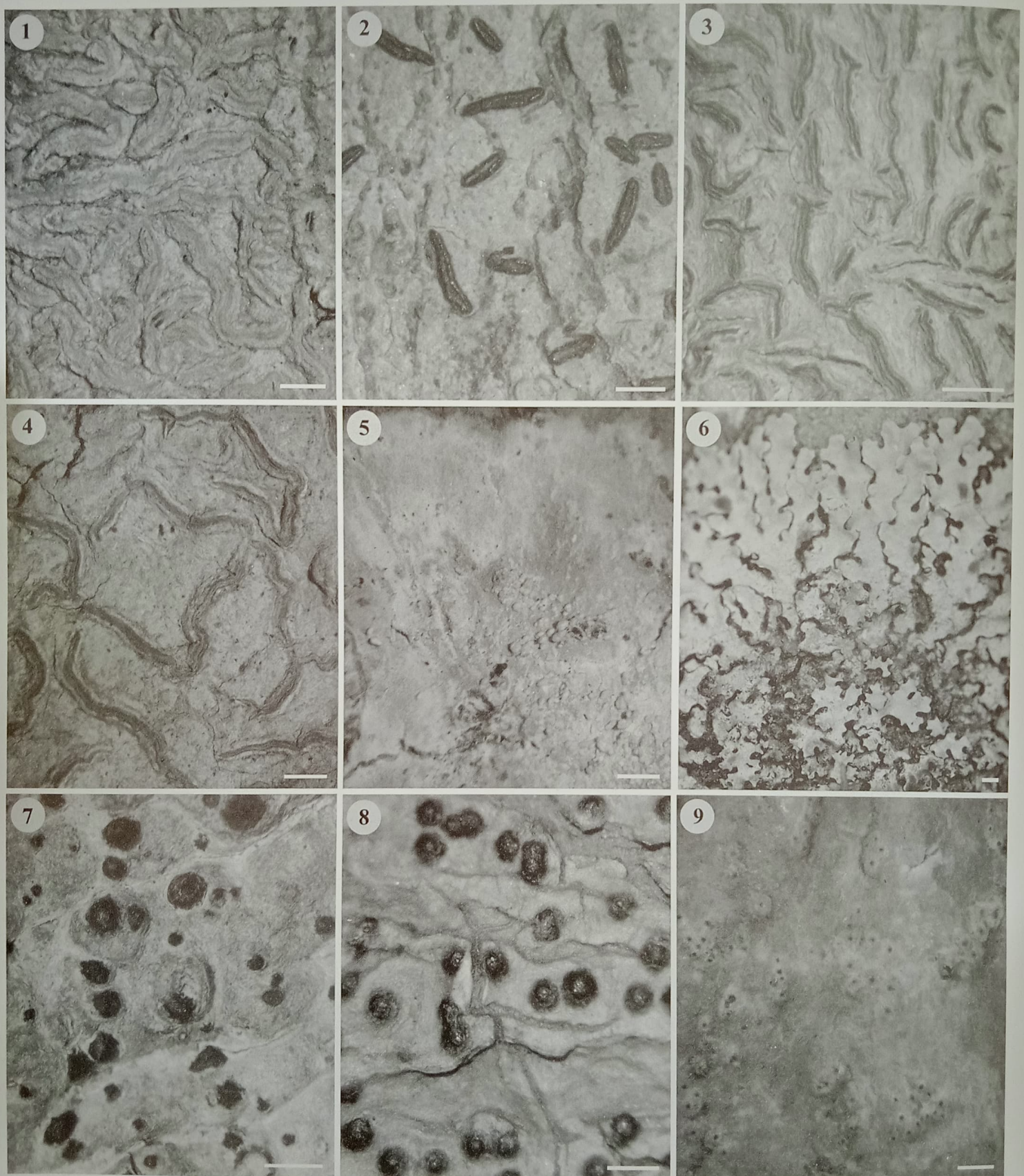

Plate 2

sublinear, up to 2 mm wide; upper surface grey to mineral grey, subapically pustulate sorediate; soredia granular; lower surface black with brown marginal zone, with short, sparse dichotomously branched rhizines; medulla white. Ascomata not seen.

Chemistry: Atranorin (major), gyrophoric acid (major) present.

Distribution: India (Tamil Nadu – Nilgiri and Palni hills), Australia, China, Japan, Indonesia and Nepal; Africa, Europe, North, Central and South America.

Specimen examined: West Bengal, Darjeeling district, Neora Valley National Park, Aloobari, Lat. 27°07'27.5"N: Long. 88°43'05.5"N, alt. 2441 m, 20 May 2008, Jagadeesh 4446B.

Mycomicrothelia conothelena (Nyl.) D. Hawksw. (Arthopyreniaceae)

Plate 2, figure 7

Description: Thallus crustose, pale brown, non-lichenized. Perithecia conical, 0.3–0.7 mm diam.; asci 8-spored; ascospores brown, soleiform, 1-septate, constricted at septum, with larger and broader upper locule, 21–27 x 9–12 µm.

Chemistry: Lichexanthone present.

Distribution: India (Andaman Islands).

Specimen examined: West Bengal, Darjeeling district, Neora Valley National Park, Neora river bank, Lat. 27°06'18.4"N: Long. 88°43'10.1"E, alt. 2208 m, 17 May 2008, Jagadeesh 4343.

Pyrenula subelliptica (Tuck.) R. C. Harris (Pyrenulaceae)

Plate 2, figure 8

Description: Thallus crustose, corticolous, yellow-brown; photobiont *Trentepohlia*. Perithecia semi-immersed, subglobose, 0.4–0.8 mm diam.; asci 8-spored; ascospores brown, ellipsoid, usually 3-septate, occasionally submuriform with 4–5 x 1 septa, distoseptate, sometimes with 3-eusepta, median lumina longitudinally elongated, 26–33 x 10–15 µm.

Chemistry: Lichexanthone present.

Distribution: India (Assam and West Bengal-plains), Georgia, Iran and North America.

Specimen examined: Sikkim, Tarku, alt. ca 643 m, 26 Nov. 2006, G. P. Sinha 3771A; Majitar, Rangpo, alt. 355 m, 27 Nov. 2006, G. P. Sinha 3831A.

Trypethelium ochroleucum (Eschw.) Nyl. (Trypetheliaceae)

Plate 2, figure 9

Description: Thallus crustose, corticolous, yellowish green; photobiont *Trentepohlia*. Pseudostromata immersed to semi-immersed, white pruinose. Perithecia immersed, 0.25-0.35 mm diam.; asci 8-spored; ascospores hyaline, oblong, 4-locular, with rounded to lentiform locules, 18–23 x 7–9 µm.

Chemistry: Lichexanthone present.

Distribution: India (Andaman and Nicobar Islands, Kerala and West Bengal-plains), Brazil, China, Costa Rica, Cuba, Indonesia, Mexico, the Philippines, Sri Lanka and Africa.

Specimen examined: West Bengal, Darjeeling district, Neora Valley National Park, Neora river bank, Lat. 27°06'18.4"N: Long. 88°43'10.1"E, alt. 2208 m, 17 May 2008, Jagadeesh 4012.

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