Taiwania 62(1): 50–54, 2017
DOI: 10.6165/tai.2017.62.50

The lichen genera *Dictyomeridium* and *Polymeridium* (Trypetheliales: *Trypetheliaceae*) in India

Komal Kumar INGLE[1,2], Suman TRIVEDI[2], Sanjeeva NAYAKA[1] and Dalip Kumar UPRETI[1,*]

1. Lichenology Laboratory, CSIR-National Botanical Research Institute, Rana Pratap Marg, Lucknow-226001, India.
2. Department of Botany, Motilal Vigyan Mahavidyalaya, Bhopal-462026, India.
** Corresponding author tel.: +91-522-2297850; email: upretidk@rediffmail.com*

(Manuscript received 16 July 2016; accepted 7 January 2017; online published 20 February 2017)

ABSTRACT: Taxonomic account of *Dictyomeridium* and *Polymeridium* are presented from India. *Polymeridium cinereonigricans* (Vain.) R.C. Harris, *P. pleurothecium* R.C. Harris and *P. submuriforme* Aptroot are reported as new records for India. An artificial key to all the species known so far from India along with notes on their distribution and ecology is also presented.

KEY WORDS: *Dictyomeridium*, India, Lichen, *Polymeridium*, Taxonomy, *Trypetheliaceae*.

INTRODUCTION

The lichen genus *Polymeridium* (Müll. Arg.) R.C. Harris, belonging to the family *Trypetheliaceae*, was revived by Harris (in Tucker and Harris, 1980), who later recognized 19 species (Harris 1993). Aptroot and Cáceres (2014) studied the genus in Brazil, the centre of diversity for *Polymeridium*, and reported more than 30 species from the area. At present, the genus is represented by *c*. 50 species from all tropical regions in the world, with five species known from India. Recently (Lücking *et al.* 2016), some species were separated from the genus in the new genus *Dictyomeridium* Aptroot, M.P. Nelsen and Lücking, because they are not closely related to the remaining species of *Polymeridium*. The genus *Polymeridium* is characterized by black perithecioid ascomata, anastomosing interthecial filaments and trentepohlioid alga (Aptroot *et al.* 2013).

The species of lichen genus *Polymeridium* mostly have a corticolous habit and exhibit a wide distribution in tropical regions of the world. The species of *Polymeridium* known from India have a wide distribution in the Himalayas up to an altitude of 2000 m, together with tropical regions of Assam, Kerala, Manipur and West Bengal.

In the present study, three species of *Polymeridium*, *viz. P. cinereonigricans* (Vain.) R.C. Harris, *P. pleurothecium* R.C. Harris and *P. submuriforme* Aptroot, are reported as new records to the Indian lichen biota. A key and distribution map for all known species from India are also provided (Fig. 1).

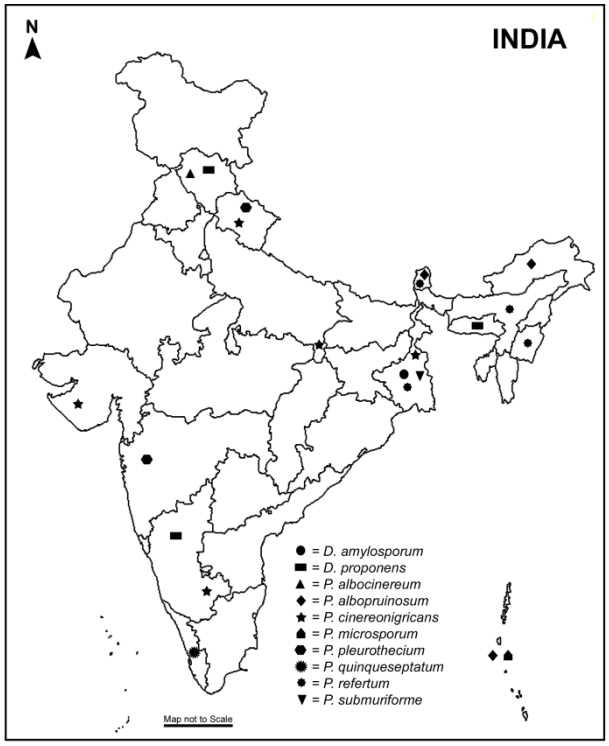


Fig. 1. Distribution of ***Dictyomeridium*** and ***Polymeridium*** spp. in India.

MATERIALS and METHODS

The study is based on the lichen material available in CSIR- National Botanical Research Institute herbarium, Lucknow (LWG). The external morphology of the specimens was studied with a Leica S8APO stereo-zoom microscope while anatomical characters of ascomata were observed under Leica DM500 compound microscope. Thin, hand cut sections of the ascomata were initially mounted in water to record the colour and measurements of various structures. For ascospore dimensions 10 measurements per specimen were recorded. The dimensions are presented as range from minimum to maximum value recorded. The sections were then observed after applying aqueous KOH solution and Lugol's solution (CDH, New Delhi)

臺灣大學學術期刊資訊網

used for iodine reactions. The colour tests were performed by using routine reagents; aqueous solution of KOH (K), calcium hypochlorite (C) and *para*-phenalene-diamine (Pd) and TLC was performed in solvent system A following Walker and James (1980).

TAXONOMIC TREATMENTS

Key to the Indian species of *Polymeridium* and *Dictyomeridium*

1. Ascospores muriform or submuriform 2
1. Ascospores transversely septate 5
2. Ascospores muriform 3
2. Ascospores submuriform 4
3. Thallus UV+ yellow, ascospores 36–55 × 14–21 µm ..... ***D. proponens***
3. Thallus UV- , ascospores 33–55 × 12–21 µm ..... ***D. amylosporum***
4. Hamathecium inspersed, ascospores 24–38 × 8–12 µm ..... ***P. submuriforme***
4. Hamathecium not inspersed, ascospores 28–36 × 9–11 µm ..... ***P. cinereonigricans***
5. Ostiole apical 6
5. Ostiole lateral 9
6. Hamathecium inspersed, ascospores 4–7 septate, 19–25 × 5–7 µm ..... ***P. quinqueseptatum***
6. Hamathecium not inspersed 7
7. Ascospores 7–11 septate, 30–64 × 6–12 µm ..... ***P. albocinereum***
7. Ascospores 3 –septate 8
8. Thallus UV+ yellow, ascospores 13–20 × 6–8 µm ..... ***P. albopruinosum***
8. Thallus UV-, ascospores 12–15 × 7 µm ..... ***P. microsporum***
9. Hamathecium inspersed, ascospores 3–6 septate, 22–26 × 7–9 µm ..... ***P. refertum***
9. Hamathecium not inspersed, ascospores 9–11 septate, 58–70 × 12–15 µm .....***P. pleurothecium***

Dictyomeridium amylosporum (Vain.) Aptroot, M.P. Nelsen and Lücking, in Aptroot and Lücking, *Lichenologist* 48(6): 923 (2016) - *Thelenella amylospora* Vain., Acta Soc. Fauna Flora Fenn. 7(2): 218 (1890)

Thallus crustose, ecorticate, white, smooth, UV-; photobiont *Trentepohlia*; ascomata perithecioid; ostiole lateral; hamathecium not inspersed; ascospores 8 per ascus, hyaline, IKI+ violet, muriform, 33–55 × 12–21 µm, with partly oblique septa, not ornamented, wall not thickened.

Remarks: This species is distributed in Australia, Brazil, Costa Rica, Fiji, Hawaii, Hong Kong, Mexico, New Caledonia, Papua New Guinea, Puerto Rico, Seychelles, South Africa and USA (Aptroot and Cáceres 2014). In India it is reported from West Bengal (Aptroot and Cáceres 2014).

Dictyomeridium proponens (Nyl.) Aptroot, M.P. Nelsen and Lücking, in Lücking *et al.*, *Lichenologist* 48(6): 757 (2016) - *Verrucaria proponens* Nyl., Bull. Soc. Linn. Normandie, Sér. 2 2: 130 (1868)

Thallus crustose, ecorticate, white, smooth, UV+ yellow (lichexanthone); photobiont *Trentepohlia*; ascomata perithecioid; ostiole lateral; hamathecium not inspersed; ascospores 8 per ascus, hyaline, IKI-, muriform, 36–55 × 14–21 µm.

Remarks: This species is known from Australia, Brazil, Canary Islands, Costa Rica, Guyana, Hawaii, Mexico, Papua New Guinea, Puerto Rico, USA and Venezuela (Aptroot and Cáceres 2014). In India it is reported from Himachal Pradesh, Karnataka and Meghalaya (Singh and Sinha 2010). Earlier report of this species from West Bengal, India (Jagadeesh Ram *et al.* 2005) pertains to *Polymeridium amylosporum* (Vain.) Aptroot (Aptroot and Cáceres 2014).

Polymeridium albocinereum (Kremp.) R.C. Harris, Bolm Mus. Paraense 'Emílio Goeldi', Sér. Bot. 7(2): 625 (1993) [1991]; Upreti and Nayaka, Lichenologist 38(3): 233. 2006 - *Verrucaria albocinerea* Kremp., Flora 59: 524. 1876. **Figs. 2A, B & C**

Thallus crustose, ecorticate, white, smooth; photobiont *Trentepohlia*; ascomata perithecioid, solitary, 0.1–0.4 mm diam., black; ostiole apical; hamathecium not inspersed; ascospores 8 per ascus, hyaline, IKI-, 7–11 septate, 30–64 × 6–12 µm, not constricted. Thallus UV-, K-, C-, KC-, Pd-; no substance detected in TLC.

Remarks: Upreti and Nayaka (2006) reported this species from temperate Himalayan region of Himachal Pradesh between altitudes of 1400–2000 m. In ascospore septation and size, the species closely resembles with *Polymeridium pleurothecium* R.C. Harris, but the latter differs in having eccentric ostiole, pointing in various directions. This species is known from Brazil, Colombia, Madagascar, Tanzania, Thailand and The Philippines (Aptroot and Lücking 2016).

Specimens examined: **INDIA**: Himachal Pradesh, Kangra district, Palampur, Bagh Nalla, alt. 1400–2000 m, on bark, 1994, *D.K. Upreti, 213654* (LWG).

Polymeridium albopruinosum (Makhija and Patw.) Aptroot, Nova Hedwigia 98: 8 (2014) - *Trypethelium albopruinosum* Makhija and Patw., J. Hattori Bot. Lab. 73: 193 (1993)

Thallus crustose, ecorticate, yellowish-white, UV+ bright yellow (lichexanthone); ascomata perithecioid, completely immersed to naked; osiole apical; hamathecium not inspersed; ascospores 8 per ascus, 3-septate, 13–20 × 6–8 µm.

Remarks: The species is distributed in Brazil and Tanzania (Aptroot and Cáceres 2014). In India it is reported from Andaman and Nicobar Islands, Arunachal Pradesh and Sikkim (Singh and Sinha 2010).

Polymeridium cinereonigricans (Vain.) R.C. Harris, Bolm Mus. Paraense 'Emílio Goeldi', Sér. Bot. 7(2): 631 (1993) [1991] - *Thelenella cinereonigricans* Vain., Acta Soc. Fauna Flora Fenn. 7(no. 2): 216 (1890).

Figs. 2D, E, F & G

Thallus crustose, ecorticate, smooth; photobiont *Trentepohlia*; ascomata perithecioid, solitary, 0.1–0.4 mm diam.; ostiole apical; hamathecium not inspersed;

臺灣大學學術期刊資料庫

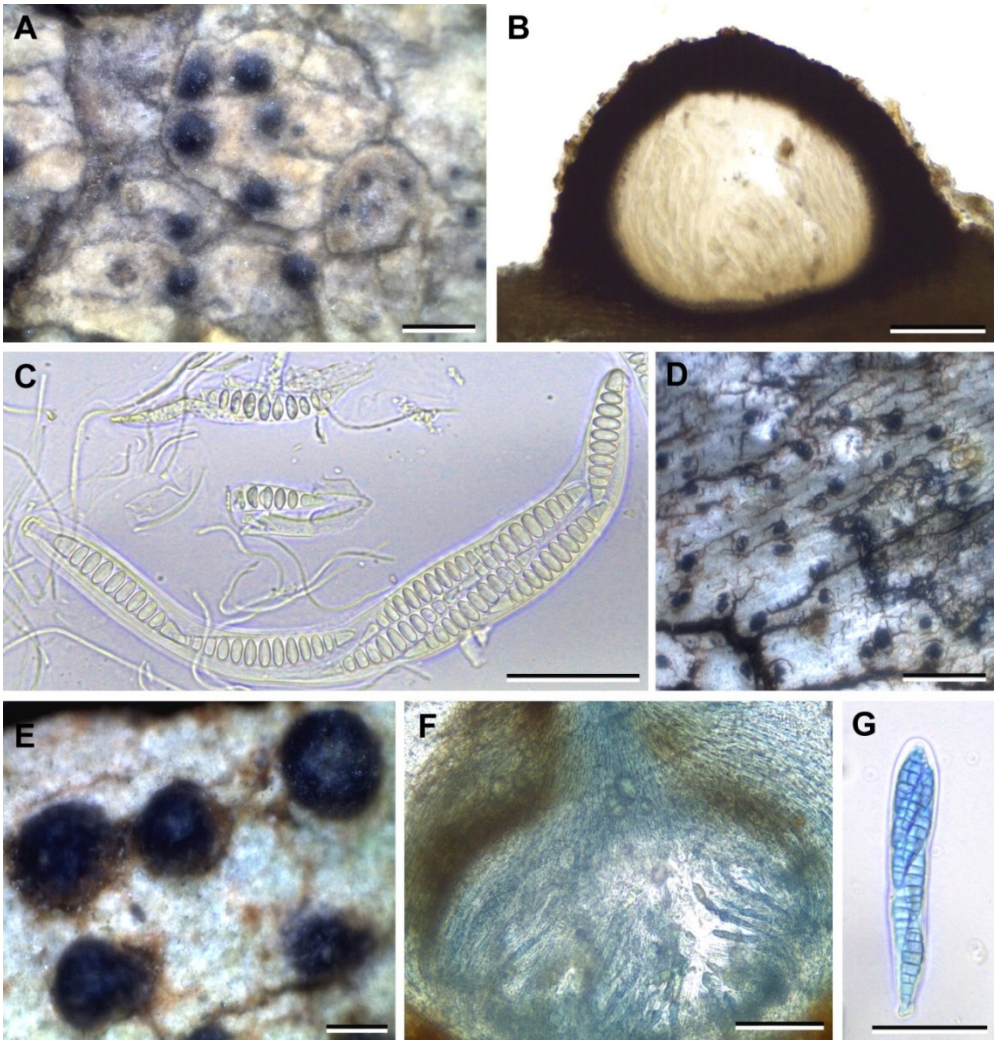


Fig. 2. A–C. ***Polymeridium albocinereum***. **A**: Habitus. **B**: Section through ascomata. **C**: Asci with ascospores. **D–G**. ***Polymeridium cinereonigricans***. **D** and **E**: Habitus. **F**: Section through ascomata (treated with Lactophenol cotton blue). **G**: Asci with ascospores (treated with Lactophenol cotton blue). Scale bars: **A** = 1 mm. **B** = 200 µm. **C, F** and **G** = 50 µm. **D** = 2 mm. **E** = 0.2 mm.

ascospores 8 per ascus, hyaline, IKI-, submuriform, 7–10 × 1–2 septate, 28–36 × 9–11 µm. Thallus UV-, K-, C-, KC-, Pd-; no substance detected in TLC.

Remarks: *Polymeridium cinereonigricans* (Vain.) R.C. Harris is similar to *P. submuriforme* Aptroot in having ecorticate UV- thallus, apical ostiole and submuriform ascospores with similar size and septation but the latter differs in having inspersed hamathecium. This species is distributed in Hawaii and Brazil (Aptroot and Cáceres 2014). It is a new record for India and is reported from the states of Gujarat, Karnataka, Uttarakhand, Uttar Pradesh and West Bengal. The species was found growing on tree bark between altitude of 18–290 m in dry and moist deciduous forest regions.

Specimens examined: **INDIA**: Gujarat, Junagadh district, Sasan Gir, Gir Wildlife Sanctuary, N 21°13′21.0″ E 70°33′56.6″, alt. 188 m, on bark, 21 Feb. 2015, *Komal K. Ingle 15-025556* (LWG). Karnataka, Bangalore city, IISc Campus, alt. 900 m, on bark of *Ficus benjamina* tree, 16.Sep.2007, *S. Nayaka 07-012993/A* (LWG). Uttarakhand, USN, Sitarganj, Khatima road, on bark, 02.09.2015, *S. Mishra and G.K. Mishra 15-027778, 15-027778/A* (LWG). Uttar Pradesh, Sonbhadra district, Hathinala, alt. 934 ft., on bark, 28 Jun. 2008, *Santosh Joshi 08-015764/A* (LWG). West Bengal, Farakka, near barrage Gandhi ghat, N 24°48′19.2″ E 87°55′11.2″, alt. 18 m, on bark, 10 Jul. 2015, *S. Nayaka 15-031981* (LWG).

Polymeridium microsporum (Makhija and Patw.) Aptroot, Nova Hedwigia 98: 18 (2014) - *Trypethelium microsporum* Makhija and Patw., J. Hattori Bot. Lab. 73: 201 (1993).

Thallus crustose, ecorticate, yellow to yellowish-brown, K+ yellow, UV-; ascomata perithecioid, subglobose; osiole apical; hamathecium not inspersed; ascospores 8 per ascus, 3 -septate, 12–15 × 7 µm.

Remarks: It is distributed in Fiji, Hawaii and Papua New Guinea (Aptroot and Cáceres 2014). In India it is reported from mixed deciduous and evergreen forest regions of Andaman and Nicobar Islands (Makhija and Patwardhan 1993).

臺灣大學學術期刊資訊網

Polymeridium pleurothecium R.C. Harris, Bolm Mus. Paraense 'Emílio Goeldi', Sér. Bot. 7(2): 636 (1993) [1991] **Figs. 3A, B, C & D**

Thallus crustose, ecorticate, yellowish-white; photobiont *Trentepohlia*; ascomata perithecioid, solitary, 0.4–0.7 mm diam.; ostiole lateral; hamathecium not inspersed; ascospores 8 per ascus, hyaline, IKI-, 9–11 septate, 58–70 × 12–15 µm. Thallus UV-, K-, C-, KC-, Pd-; no substance detected in TLC.

Remarks: *Polymeridium pleurothecium* R.C. Harris is close to *Polymeridium albocinereum* (Kremp.) R.C. Harris in size and septation of ascospores, but the latter differs in having an apical ostiole. It is also close to *P. refertum* (Stirt.) Aptroot in having an ecorticate, UV- thallus and an eccentric ostiole, but in the latter the hamathecium is inspersed and the ascospores are shorter (22–26 × 7–9 µm) and less septate (3–6).

This species is known from Australia, Costa Rica, Guyana, Papua New Guinea and Venezuela (Aptroot and Cáceres 2014). It is a new record for India and is reported from the states of Uttarakhand and Maharashtra. The species was found growing on twigs and *Betula* tree trunk between altitude of 969–1650 m in the tropical moist deciduous forest regions of Western Ghats and Western Himalayas.

Specimens examined: **INDIA**: Uttarakhand, Chamoli district, Gwaldam, alt. 1650 m, on *Betula* tree trunk, 04 May 2015, *S. Rawat 15-019929* (LWG). Maharashtra, Pune district, Bhimashankar Wildlife Sanctuary, enroute to Manchar, 2 Km from temple, N 19º04′ 39.5″ E 73º 32′13.8″, alt. 969 m, on twigs, 19.10.2015, *R. Bajpai and party 15-027618* (LWG).

Polymeridium quinqueseptatum (Nyl.) R.C. Harris, in Tucker and Harris, Bryologist 83(1): 12 (1980) - *Verrucaria quinqueseptata* Nyl., Expos. Synopt. Pyrenocarp.: 58 (1858) **Figs. 3E and F**

Thallus crustose, ecorticate, yellowish-white, photobiont *Trentepohlia*; ascomata perithecioid, solitary, 0.1–0.4 mm diam.; ostiole lateral; hamathecium inspersed; ascospores 8 per ascus, hyaline, IKI-, 4–7 septate, 19–25 × 5–7 µm. Thallus UV-, K-, C-, KC-, Pd-; no substance detected in TLC.

Remarks: This species is similar to *Polymeridium refertum* (Stirt.) Aptroot in hamathecium inspersion, ascospore size and septation, but the latter differs in having eccentric ostiole. This species is known from Australia, Brazil, Costa Rica, Cuba, Jamaica, Mozambique, Netherlands Antilles, Phillippines, Seychelles, Thailand, U.S.A. and Venezuela (Aptroot and Cáceres 2014). In India the species is known from Assam and Kerala. The species was found growing on tree bark at an altitude of 1200 m in tropical evergreen forest region of Western Ghats.

Specimen examined: **INDIA**: Kerala, Idukki district, Santhampara, alt. 1200 m, on bark, 2 Mar. 1984, *D.K. Upreti L87181* (LWG).

Polymeridium refertum (Stirt.) Aptroot, Nova Hedwigia 98: 24 (2014) - *Trypethelium refertum* Stirt., Proc. Roy. Phil. Soc. Glasgow 11: 321 (1879) [1878]

Thallus crustose, ecorticate, white, UV-; photobiont *Trentepohlia*; ascomata perithecioid, solitary; ostiole lateral; hamathecium inspersed; ascospores 8 per ascus, hyaline, 3–6 septate, 22–26 × 7–9 µm.

Remarks: Stirton (1879) described the species as *Trypethelium refertum*, its type locality is Nilgiris, where it was collected by G. Watt (in 1814). Singh and Sinha (2010) mentioned the distribution of this species in Assam, Manipur, Sikkim and West Bengal based on the specimens annotated as *Plagiotrema refertum* (Stirt.) Makhija and Patw. (Makhija and Patwardhan 1993).

Polymeridium submuriforme Aptroot, Nova Hedwigia 98: 25 (2014). **Figs. 3G, H & I**

Thallus crustose, ecorticate, white, photobiont *Trentepohlia*; ascomata perithecioid, erumpent, solitary, conical with round top, 0.3–0.5 mm diam.; ostiole lateral; hamathecium inspersed; ascospores 8 per ascus, hyaline, IKI-, submuriform, 5–8 × 0–1 septate, 24–38 × 8–12 µm. Thallus UV-, K-, C-, KC-, Pd-; no substance detected in TLC.

Remarks: The Indian specimen exhibit a close resemblance to *P. submuriforme* in thallus colour, structure and anatomical characters. However, the ascospore size mentioned by Aptroot and Cáceres (2014) of the type specimen of *P. submuriforme* from The Philippines is smaller (18– 20 × 6–7.5 µm).

This species was earlier only known from Philippines. It is a new record for India and is reported from the mango orchards in Gangetic plains, where it was found growing on bark of *Mangifera indica* tree at an altitude of 18 m.

Specimen examined: **INDIA**: West Bengal, Murshidabad, Jagtai Nimtita, Samserganj block, N 24º37′58.2″ E 88º01′32.6″, alt. 18 m, on *Mangifera indica*, 9Jul. 2015, *S. Nayaka 15-031928* (LWG).

ACKNOWLEDGEMENTS

We are grateful to the Director, CSIR-National Botanical Research Institute, Lucknow for proving laboratory facilities and financial assistance under in house project (OLP-83). Some of the specimens utilized in the study were collected under funds provided by Ministry of Environment, Forest and Climate Change, New Delhi (mangrove lichen project) and Ministry of Water Resources, River Development and Ganga Rejuvenation, New Delhi (NMCG Project).

LITERATURE CITED

Aptroot, A. and M.E.S. Cáceres. 2014. A refined species concept in the tropical lichen genus *Polymeridium* (Trypetheliaceae) doubles the number of known species, with a worldwide key to the species. Nova Hedwigia **98(1):** 1–29.

臺灣大學學術期刊資料庫

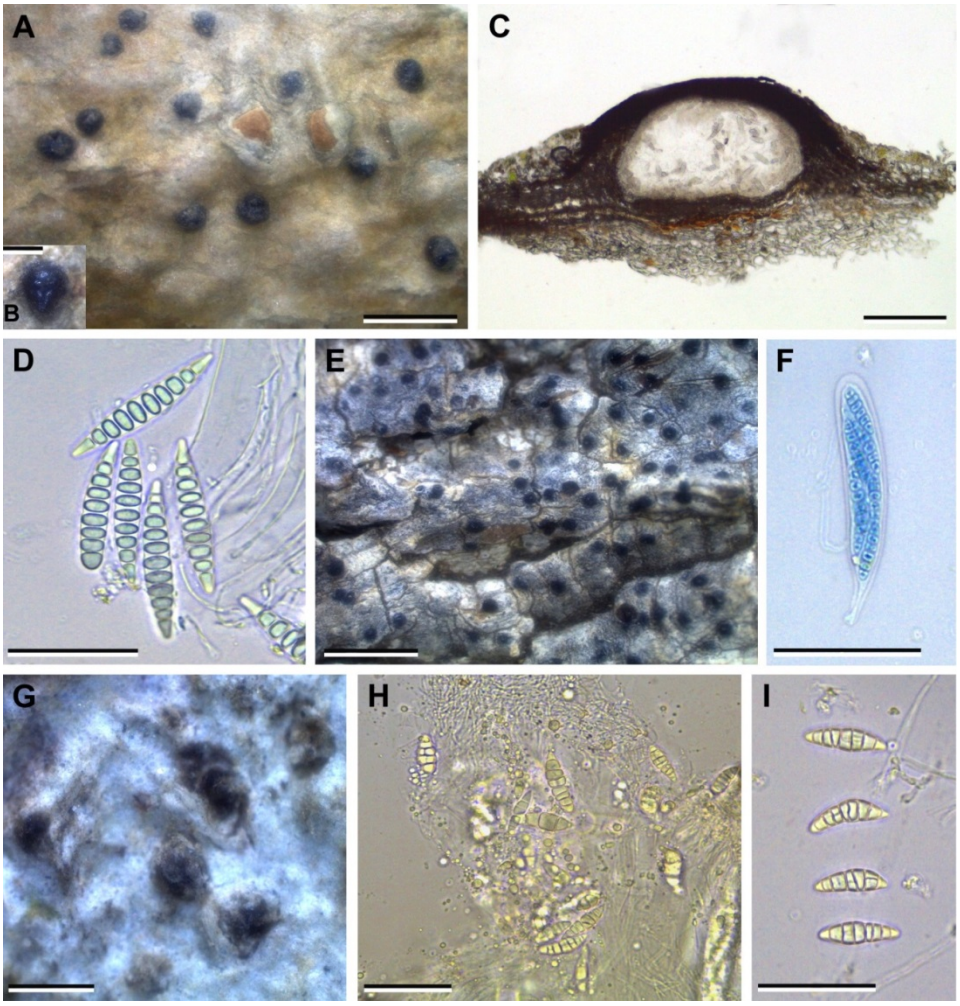


Fig. 3. A–D. ***Polymeridium pleurothecium***. **A**: Habitus. **B**. Enlarged ascomata. **C**: Section through ascomata. **D**: Ascospores (treated with Lactophenol cotton blue). **E–F**. ***Polymeridium quinqueseptatum***. **E**: Habitus. **F**: Asci with ascospores (treated with Lactophenol cotton blue). **G–I**. ***Polymeridium submuriforme***. **G**: Habitus. **H**: Hamathecium showing oil droplets. **I**: Ascospores. Scale bars: A and E = 2 mm. B and G = 0.5 mm. C = 200 µm. D, F, H and I = 50 µm

Aptroot, A. and R. Lücking. 2016. A revisionary synopsis of the Trypetheliaceae. (Ascomycota: Trypetheliales). Lichenologist **48(6):** 763–982.

Aptroot, A., A.A. Menezes, A.B. Xavier-Leite and M.E.S. Cáceres. 2013. New species of *Polymeridium* from Brazil expand the range of known morphological variation within the genus. The Lichenologist **45(4):**545-552.

Harris, R.C. (1993) [‘1991’]. A revision of Polymeridium (Muell. Arg.) R. C. Harris (Trypetheliaceae). Boletim do Museu Paraense Emílio Goeldi, Série Botânica **7:** 619–644.

Jagadeesh Ram, T.A.M., A. Aptroot, G.P. Sinha and K.P. Singh. 2005. New species and new records of lichenized and non-lichenized pyrenocarpous ascomycetes from the Sundarbans BiosphereReserve, India. Mycotaxon **91:** 455–459.

Lücking, R., M.P. Nelsen, A. Aptroot, R. Barillas de Klee, P.A. Bawingan, M.N. Benatti, F. Bungartz, M.E.S. Cáceres, L. da Silva Canêz, J.-L. Chaves, D. Ertz, R.E. Esquivel, L.I. Ferraro, A. Grijalva, C. Gueidan, J.E. Hernández M., A. Knight, H.T. Lumbsch, M.P. Marcelli, J. Mercado-Díaz, B. Moncada, E.A. Morales, T. Orozco, S. Parnmen, E. Rivas Plata, N. Salazar-Allen, A. Spielmann and N. Ventura. 2016. A phylogenetic framework for reassessing generic concepts and species delimitation in the lichenized family Trypetheliaceae (Ascomycota: Dothideomycetes). Lichenologist **48(6):** 739–762.

Makhija, U. and P.G. Patwardhan. 1993. A contribution to our knowledge of the lichen genus *Trypethelium* (family Trypetheliaceae). J. Hattori Bot. Lab. **73:**183-219.

Singh, K.P. and G.P. Sinha. 2010. Indian Lichens: An Annotated Checklist. Botanical Survey of India. 571pp.

Tucker, S. and R.C. Harris. 1980. New and noteworthy pyrenocarpous lichens from Lousiana and Florida. The Bryologist **83(1):** 1-20.

Upreti, D.K. and S. Nayaka. 2006. *Anisomeridium calcicolum* sp. nov. and further new records of pyrenocarpous lichens from India. Lichenologist **38(3):** 231–233.

Walker, F.J. and P.W. James. 1980. A revised guide to microchemical techniques for the identification of lichen products. British Lichen Society Bulletin **46:** 13–29. (Supplement).

臺灣大學學術期刊資料庫