

# THE LICHEN GENUS *LEPTOGIUM* (SECTS. *LEPTOGIUM*, *LEPTOGIOPSIS* AND *HOMODIUM*) IN INDIA

DHARANI DHAR AWASTHI AND PARWEEN AKHTAR

*Department of Botany, Lucknow University, Lucknow*

## ABSTRACT

The paper records the occurrence in India of 24 species of *Leptogium* in the three sections mentioned. A key for the identification of all the taxa, and detailed description of 19 species, including *L. indicum* sp. nov., have been given.

## INTRODUCTION

The lichen genus *Leptogium* S. Gray, member of the family Collemataceae, is characterized by a generally foliose, soft gelatinous (when wet) thallus of lead grey, greenish brown or olivaceous colour. The presence of cellular cortices, mostly single layered on both the sides (rarely only on the upper side), distinguishes it from the genus *Collema*. The cortices are purely mycobiontic, while the inside tissue comprises the mycobiont and the phycobiont (*Nostoc*) in homoimerous condition. ZAHLBRUCKNER (1926) subdivided the genus into 7 sections, and the same delimitation has been followed by SIERK (1964) for the North American species of the genus. The taxa of the section *Mallotium* (Ach.) Vain. from India have already been dealt elsewhere (AWASTHI & AKHTAR, 1977). Out of the remaining six sections, taxa belonging to the sections *Hcmodium* (Nyl.) Zahlbr., *Leptogium*, and *Leptogiopsis* (Müll. Arg.) Vain. are treated in this paper, while the taxa of sections *Collemodium* Harm., *Diplohallus* Vain., and *Pseudoleptogium* Zahlbr. are yet unknown from India. The three sections dealt with are distinguished from the section *Mallotium* by the absence of a tomentum. The thallus in section *Homodium* is characterized by being paraplectenchymatous throughout, while in the sections *Leptogium* and *Leptogiopsis* the hyphae are irregularly to periclinally disposed within the two cortices. The nature of spores distinguishes the section *Leptogium* (spores muriform) from *Leptogiopsis* (spores transversely septate).

AWASTHI (1965) reported thirteen species, in the three sections, from India. The following account based on the investigations of lichens from different parts of the mainland of India also includes the previous reports. The formulation of the key for the identification of the species pertains to the 24 species thus known from India, but detailed descriptions have been given in respect of the 19 taxa, the specimens of which have been examined.

## MORPHOLOGY OF THE THALLUS AND APOTHECIUM

The nature and colour of thallus, presence or absence of the wrinkles on the surface, presence and position of the isidia, and general apothecial characters are useful in the delimitation of the taxa. Most of the specimens are corticolous, though saxicolous, muscicolous and terricolous conditions also occur. They often grow in moist shady places, and when corticolous mostly near the base of the tree trunk. The lobes are mostly orbicular to elongate with entire margin, though rarely the margin is irregularly dissected

(e.g. in *Leptogium sinuatum*). The presence and density of wrinkles, an important taxonomic character, sometimes tends to differ in dry and wet conditions, e.g. in *L. javanicum* and *L. indicum*, the wrinkles are prominent when wet but become inconspicuous when dry. The lower surface is mostly naked, but in some taxa (e.g. *L. javanicum*) there are single celled (non septate) tufts of hyphal hairs (Text-fig. 2) disposed here and there, and apparently fix the thallus to the substrate.

In general, the thickness of the thallus varies between 40 to 450  $\mu\text{m}$  when all the taxa are taken into consideration. A thin thallus below 100  $\mu\text{m}$  occurs in *L. azureum*, *L. javanicum*, *L. moluccanum*, *L. sinuatum* and *L. tremelloides*; thallus up to 150  $\mu\text{m}$  in *L. austroamericanum*, *L. cyanescens*, *L. denticulatum*, *L. indicum* and *L. ulvaceum*; and a thickest (up to 450  $\mu\text{m}$ ) in *L. corticola*, *L. phyllocarpum* and *L. platynum*. The cortical cells are generally uniformly thin walled, rounded, but may rarely be  $\pm$  rectangular and thick walled. The size of the cells in the two cortices is similar though variation occurs in some species. The phycobiont in all the species is a *Nostoc*, homoiomorous in distribution, but somewhat denser below the upper cortex. The cells of *Nostoc* vary between 2-10  $\mu\text{m}$  in size, and occasionally heterocysts are also present.

Isidia occur in 6 species. They are typically laminal, globular to cylindrical, simple to branched or rarely squamuliform. None of the species is sorediate.

The apothecia are generally laminal to submarginal. The disc is concave to plane, rarely convex, smooth, orange to red brown. The thalline exciple is well developed, it is smooth or periclinally to irregularly wrinkled or even minutely lobulate. The variations in the thalline exciple are useful taxonomic characters. In *L. cyanescens* and *L. marginellum* the thalline exciple bears isidia though the thallus in the latter species is non-isidiate. The cortex of the thalline exciple may consist of a single or more layer of cells, and this distinction is useful in delimiting otherwise closely allied taxa. The proper exciple is wholly or partially euparaplectenchymatous and this distinction is made use in delimitation of the species. Hypothecium and hymenium are colourless, the latter is I+ blue in all species. Epithecium is pale brown and 6-20  $\mu\text{m}$  thick; the asci are cylindrico-clavate, unitunicate and generally 8-spored. The spores are colourless, acicular to ellipsoid with pointed ends, and are either transversely septate or muriform. The size of the spores does not always seem to be a useful taxonomic character.

The chemical reactions by K, C, KC, & P are negative. The measurements have been taken with water as mounting medium. Personal herbarium of G. Degelius has been abbreviated to DEGEL and that of D. D. Awasthi to AWAS.

Key to the Indian species of genus *Leptogium* (sects. *Homodium*, *Leptogiopsis* and *Leptogium*).

- 1a. Thallus paraplectenchymatous throughout its thickness.....Sect. *Homodium*
- 2a. Thallus granular, apothecia with thick margin, spores 18-24  $\mu\text{m}$  long.....  
..... 1. *L. subtile*
- 2b. Thallus cushion shaped, with coralloid outgrowths, apothecia entire to lobulate,  
spores 17-37  $\mu\text{m}$  long.....2. *L. tenuissimum*
- 1b. Thallus not paraplectenchymatous throughout
- 3a. Spores transversely septate.....Sect. *Leptogiopsis*
- 4a. Spores acicular, 45-67  $\mu\text{m}$  long.....3. *L. adpressum*
- 4b. Spores generally fusiform to ellipsoid, 20-40  $\mu\text{m}$  long.....4. *L. brebissonii*
- 3b. Spores muriform ..... Sect. *Leptogium*
- 5a. Thallus and/or apothecia isidiate
- 6a. Isidia associated only with apothecia.....15. *L. marginellum*

- 6b. Isidia on thallus and apothecia, laminal and marginal
- 7a. Thallus surface smooth to rough, not wrinkled
- 8a. Isidia squamuliform, never cylindrical..... 10. *L. denticulatum*
- 8b. Isidia granular to cylindrical, occasionally squamuliform
- 9a. Thallus up to 130  $\mu\text{m}$  thick, isidia concolorous to thallus....9. *L. cyanescens*
- 9b. Thallus 150-250  $\mu\text{m}$  thick, isidia blackish.....20. *L. pichneum*
- 7b. Thallus surface wrinkled
- 10a. Isidia much branched, dense, wrinkles acutely raised.....  
..... 13. *L. isidiosellum*
- 10b. Isidia simple
- 11a. Thallus lead grey, lobes orbicular and distinct..5. *L. austro-americanum*
- 11b. Thallus brownish grey, lobes elongate and anastomosing.....  
..... 16. *L. milligranum*
- 5b. Thallus not isidiate
- 12a. Thallus lobes elongate and anastomosing
- 13a. Thallus lead grey, apothecia 2-4.5 mm in diam., thalline exciple lobulate ..... 19. *L. phyllocarpum*
- 13b. Thallus greenish grey to brownish, apothecia 0.5-1.5 mm in diam., thalline exciple not lobulate..... 7. *L. chloromelum*
- 12b. Thallus lobes not anastomosing, usually well fertile
- 14a. Thallus upper surface smooth to rough or wrinkles rarely present on lower side only when wet
- 15a. Proper exciple euparaplectenchymatous at the margin only
- 16a. Thallus smooth on both sides, apothecia sessile to stipitate
- 17a. Lobes 2-3.5 mm broad, 30-60  $\mu\text{m}$  thick.....  
.....17. *L. moluccanum*
- 17b. Lobes 5-10 mm broad, 50-100  $\mu\text{m}$  thick.....6. *L. azureum*
- 16b. Thallus wrinkled on lower side when wet, apothecia raised on tubular stalk, stalk as wide as disc.....12. *L. indicum*
- 15b. Proper exciple euparaplectenchymatous throughout
- 18a. Thallus 50-100  $\mu\text{m}$  thick
- 19a. Spores 14-33  $\times$  6-13  $\mu\text{m}$ , thallus horizontal.....  
.....23. *L. tremelloides*.....
- 19b. Spores 24-35  $\times$  16-18  $\mu\text{m}$ , lobes suberect.....22. *L. sinuatum*
- 18b. Thallus 80-170  $\mu\text{m}$  thick, spores 16-32  $\times$  10-13  $\mu\text{m}$ .....  
..... 14. *L. ulvaceum*
- 14b. Thallus surface wrinkled
- 20a. Apothecia with a single layer of cortical cells at the base
- 21a. Lobes tufted, erect, corniculate at apices, apothecia small, spores 30-56  $\times$  10-20  $\mu\text{m}$ ..... 18. *L. palmatum*
- 21b. Lobes not corniculate at apices, apothecia 0.1-0.5 mm in diam., spores 28-53  $\times$  9-16  $\mu\text{m}$ .....21. *L. platynum*
- 20b. Apothecia with multilayered cortex at the base
- 22a. Thallus dark, rugose, thalline exciple rugose, tuberculose to laciniate, spores 30-37  $\mu\text{m}$  long.....11. *L. fallax*
- 22b. Thallus lead grey, spores 16-33  $\mu\text{m}$ .
- 23a. Apothecia sessile, thalline exciple smooth, spores 16-33  $\mu\text{m}$   
..... 8. *L. corticola*

- 23b. Apothecia pedicellate on tubular stalk, stalk and thalline exciple vertically wrinkled to lobed, spores 16-30  $\mu\text{m}$ .....  
 .....14. *L. javanicum*.

Section HOMODIUM (Nyl.) Zahlbr.

1. *Leptogium subtile* Torss.

Enum. Lich. et Byssac. Scandin. 54. 1843; Zahlbr. Cat. Lich. Univ. 3 : 170. 1925.

The taxon was reported by QURAIISHI (1928) from Mussoorie. It is characterized by minutely squamulose thallus with  $\pm$  granular thick margin, apothecia 0.3-0.4 mm in diam., and spores 18-22  $\times$  8-10  $\mu\text{m}$ . No specimen conforming to this description has so far been collected by us.

2. *Leptogium tenuissimum* (Dicks.) Fr.

Corp. Fl. Prov. Succ. 1 : 293. 1935; Zahlbr. Cat. Lich. Univ. 3 : 184. 1925; Sierk, Bryologist, 67 : 275. 1964.—*Lichen tenuissimum* Dicks. Pl. Crypt. Brit. 1 : 12. 1785.

*Leptogium tenuissimum* is subsimilar to *L. minutissimum*, but differs in the presence of a cushion shaped thallus with coralloid outgrowths. The taxon was reported from Mussoorie by QURAIISHI (1928), though no Indian specimen conforming to its description has been examined by us.

It is likely that both the above taxa are incorrect identifications.

Section LEPTOGIOPSIS (Müll. Arg.) Vain.

3. *Leptogium adpressum* Nyl. (Plate 2, Fig. 5)

Syn. Lich. 1 : 131. 1860; Zahlbr. Cat. Lich. Univ. 3 : 126. 1925; Sierk, Bryologist, 67 : 277. 1964.

Thallus corticolous, foliose, 2-5 cm in size, closely adnate to substratum, dark grey when dry, ashy grey and swollen when wet; lobes irregularly divided and crumpled, 1-3 mm wide, flat to ascending, margin entire to wavy; upper and lower surfaces irregularly to periclinally wrinkled; isidia absent. Thallus 150-280  $\mu\text{m}$  thick. Apothecia marginal, sessile, 0.5-3 mm in diam., disc orange red to red brown, concave, plane to convex, smooth; thalline exciple irregularly to periclinally wrinkled; proper exciple euparaplectenchymatous, 70-90  $\mu\text{m}$  thick at the base, cells distinct only at margin. Spores acicular, transversely 13-18 septate, 45-67  $\times$  3-5  $\mu\text{m}$  (Text-fig. 4).

*Leptogium adpressum* resembles *L. phyllocarpum* in external appearance but is distinguished by crumpled lobes and transversely septate spores. It is known from West Indies and is here reported from India for the first time.

Specimens examined

Tamil Nadu—Palni hills, Kodaikanal, alt. ca. 216 m, on tree bark, Singh 70.769 (LWU); near Moir Point, in grove, on tree trunk, alt. ca. 180 m, Degelius As—282 (DEGEI), det. Sierk.

4. *Leptogium brebissonii* Mont. in Webb.

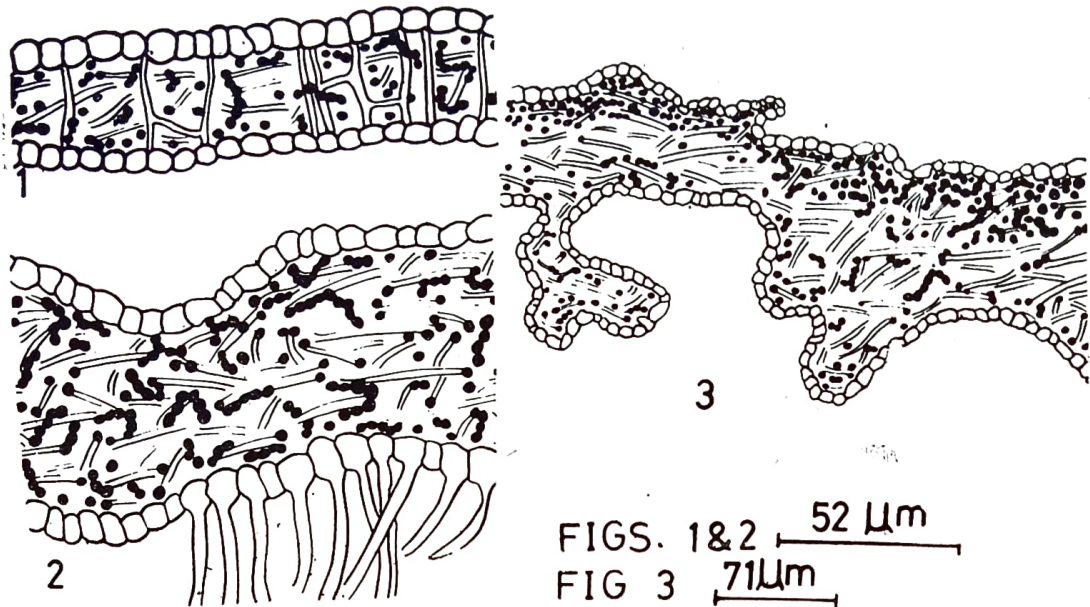
Hist. Nat. Iles. Canar. 3 : 130. 1840 et Mont. Sylloge Gener. Spec. Crypt. 378. 1856; Zahlbr. Cat. Lich. Univ. 3 : 126. 1925.

The taxon characterized by thin, reticulately wrinkled thallus, marginal apothecia and acicular spores with acute ends had been reported by MONTAGNE (1842) from Nilgiri hills. No specimen from India to conform to this species has been examined by us.

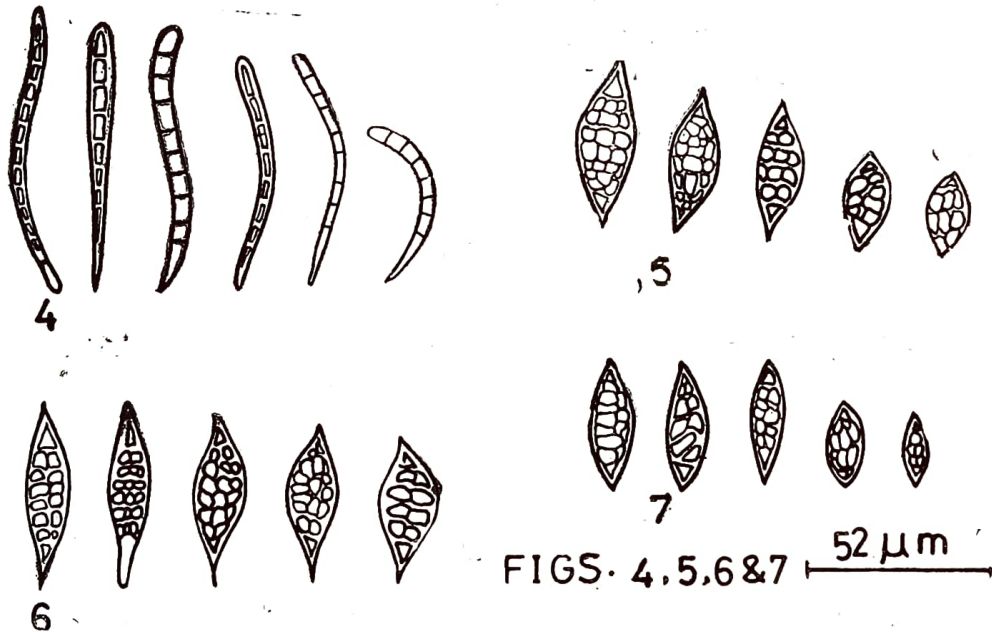
Section LEPTOGIUM

5. *Leptogium austro-americanum* (Malme) Dodge (Plate 2, Fig. 2)

Ann. Mo. Bot. Gard. 20 : 419. 1933; Zahlbr. Cat. Lich. Univ. 10 : 250. 1940; Sierk, Bryologist, 67. 1964.—*Leptogium cyanescens* var. *austroamericanum* Malme, Ark. Bot. 19 (8) : 11. 1924.



Text Figs. 1-3. V.S. through thallus of—1. *Leptogium azureum* (Sw.) Mont.; 2. *L. javanicum* Mont, and 3. *Leptogium chloromelum* (Sw.) Nyl.



Text Figs. 4-7. Spores of—4. *Leptogium adpressum* Nyl.; 5. *Leptogium chloromelum* (Sw.) Nyl.; 6. *L. platynum* (Tuck.) Herre.; and 7. *L. denticulatum* Nyl.

Thallus corticolous, foliose, 1.5-3 cm in size, loosely to closely attached to substratum, dark grey when dry, olive green, not much swollen when wet ; lobes spreading to suberect, orbicular, 1-3 mm wide in the older part, and 2-7 mm wide in peripheral region, discrete, margin entire, plane to wavy ; upper surface rough and wrinkled, wrinkles usually running length-wise to the thallus. Isidia present, laminal and sometimes marginal, simple, globular or rarely branched and squamuliform. Thallus 60-150  $\mu\text{m}$  thick. Apothecia lacking in the specimens examined.

*Leptogium austro-americanum* closely resembles *L. cyanescens* in colour of thallus and nature of isidia, but the latter has a smooth thallus. *L. isidiosellum* is also close, but it has acutely raised wrinkled thallus and much branched isidia. *Leptogium austro-americanum* is known from Europe, United States, and Central and South America. It is here reported from India for the first time.

## Specimens examined

*Kerala*—Quilon, on way to Aryan Kavu, on tree trunk, Singh 73.155 (LWU), on way to Endaman, on bark, Singh 73.196 (LWU).

*Uttar Pradesh*—Almora district, near Loharkhet, alt. ca. 1668 m, on tree trunk, Awasthi 75.26 (AWAS).

### 6. *Leptogium azureum* (Sw.) Mont. in Webb. & Berth (Plate 2, Fig. 4)

Hist. Nat. Canar. 3 : 129. 1840; Zahlbr. Cat. Lich. Univ. 3 : 159. 1925; Sierk, Bryologist, 67 : 304. 1964.—*Lichen azureus* Sw. in Ach. Lich. Succ. Prodr. 137. 1798.

Thallus corticolous or saxicolous, foliose, up to 5 cm in size, loosely to firmly attached to substratum, lead grey to dark grey when dry, dark olive green, slightly swollen when wet; lobes regular to irregular, orbicular to elongate, 0.5-1 cm wide; margin entire, plane to wavy, flat to ascending; upper surface smooth, rarely slightly rough; isidia lacking. Thallus 50-100  $\mu\text{m}$  thick, vertically disposed hyphae also sometimes seen in addition to the periclinal or irregular ones (Text-fig. 1). Apothecia laminal to submarginal, sessile to shortly stipitate and constricted at base, 0.5-2.5 mm in diam., disc orange red, smooth, concave to plane, rarely convex; thalline exciple entire, cream coloured to concolorous to thallus; proper exciple euparaplectenchymatous at marginal region, indistinct in the central part. Spores ellipsoid with beak like ends, muriform, transversely 3-5(6) septate, longitudinally 1-(2) septate, 15-25  $\times$  8-14  $\mu\text{m}$ .

*Leptogium azureum* resembles *L. moluccanum* in the colour of thallus and morphology of apothecia, but in the latter species, the thallus is thinner (30-60  $\mu\text{m}$ ), smaller and narrower lobed. *L. tremelloides* which shows some similarity is distinguished by the proper exciple distinctly cellular and larger spores. *L. ulvaceum* which also shows some resemblance to *L. azureum* has a thicker (80-170  $\mu\text{m}$ ) thallus. *L. azureum* is widely distributed in tropical and subtropical regions of the world.

## Specimens examined

*Meghalaya*—Mawsmai area of Cherrapunjee, alt. ca. 1100 m, on bark of twigs in shade along a stream, Awasthi 7945 (AWAS).

*Tamil Nadu*—Nilgiri hills, Kodanad, alt. 2166 m, on bark of tree, Singh 71.952 (LWU); Ootacamund, below Doddabetta peak, alt. ca. 2500 m, on bark of *Eucalyptus* tree near base, Awasthi & Singh 71.112 (LWU), Kodaikanal, Shembaganur, S. H. College, alt. 1800 m, Degelius As—239 (DEGEL), det. Sierk, 1969.

*Uttar Pradesh*—Almora district, Jageshwar, alt. 2000 m, on bark of *Quercus* tree, Awasthi 3508 (AWAS).

*West Bengal*—Darjeeling district, Kurseong, alt. ca. 1800 m, with mosses on bark of tree, Awasthi 3155 & 3935 (AWAS), over stones, Awasthi & Agarwal 66.169 (LWU); near Mahanadi over stones, Awasthi & Agarwal 66.298 (LWU); Tiger Hill, alt. ca 2800 m, on twigs of shrubs, Awasthi & Agarwal 67.66 (LWU).

### 7. *Leptogium chloromelum* (Sw.) Nyl. (Plate 1, Fig. 1)

Syn. Meth. Lich. 1 : 128. 1860; Zahlbr. Cat. Lich. Univ. 3 : 131. 1925; Sierk, Bryologist, 57 : 292. 1964.—*Lichen chloromelus* Sw. Fl. Ind. Occid. 3 : 1806. 1892.

Thallus corticolous, foliose, 1.5-3 cm in size, loosely adnate to substratum, grey to blackish grey when dry, olivaceous green, swollen semitransparent when wet; lobes anastomosing, 3-6 mm wide, contiguous in the older part, margins flat to wavy, irregular; upper surface rough to distinctly wrinkled, wrinkles running mostly along the length of thallus; isidia lacking; lower surface more strongly wrinkled than upper surface, slightly paler. (Text-fig. 3). Thallus 200-350  $\mu\text{m}$  thick. Apothecia common, submarginal to laminal, sessile, 0.5-1.5 mm in diam.; disc orange red, concave to plane, epruinose, thalline exciple concolorous to thallus, periclinally wrinkled, 93-100  $\mu\text{m}$  thick, with a single cell layered cortex at the base and margin of apothecium, cortical cells 8-10  $\mu\text{m}$ ; proper

exciple distinctly euparaplectenchymatous throughout, 8-10 cell layered, 80-124  $\mu\text{m}$  thick at the centre, and 3-4 cell layered, 25-35  $\mu\text{m}$  thick at margins. Spores muriform transversely 5-6 septate, longitudinally 1-septate, ellipsoid, 19-31  $\times$  10-13  $\mu\text{m}$  with acute ends (Text-fig. 5).

*Leptogium chloromelum* resembles *L. platynum* but can be distinguished by smaller spores and larger apothecia. It is distributed in S. E. United States. In India it is known from Tamil Nadu and N. W. Himalayas.

#### Specimens examined

*Tamil Nadu*—Nilgiri hills, Avalanche, near forest rest house, alt. ca. 2333 m, on bark of tree, Singh 71.772 (LWU), Power house area, E. B. deptt., alt. ca. 2333 m, on bark of *Rhododendron*, Singh 71.772 (LWU); Palni hills, Berijam, alt., ca. 2666 m, on ground and bark of tree, Awasthi & Singh 70.326A (LWU).

*Uttar Pradesh*—Almora district, on way to Kasardevi, alt. 1933 m, on *Cedrus deodara* bark, Awasthi 3482 (AWAS).

#### 8. *Leptogium corticola* (Tayl.) Tuck. (Plate 2, Fig. 3)

Cat. Pl. Cinc. 47. 1849; Zahlbr. Cat. Lich. Univ. 3 : 150. 1925; Sierk, Bryologist, 67 : 303. 1964.—*Collema corticola* Tayl., London J. Bot. 6 : 195. 1847.

Thallus corticolous, foliose, 2-5 cm in size, loosely attached to substratum, lead grey to dark grey when dry, dark olive green, glossy and swollen when wet, lobes orbicular, 0.5-1.2 cm wide, margin entire, rarely wavy, upturned; upper surface dull, faintly wrinkled; lower side distinctly wrinkled; isidia absent. Thallus 120-250  $\mu\text{m}$  thick. Apothecia laminal to submarginal, sessile, constricted at base, wrinkled in the region of constriction, 0.5-2 mm in diam.; disc reddish brown, smooth, concave to plane or rarely convex; thalline exciple entire, smooth, cortex 9-11 cell layered at the base; proper exciple euparaplectenchymatous, distinctly cellular throughout, 55-65  $\mu\text{m}$  thick in the central part. Spores ellipsoid, muriform, transversely 4-5 septate, longitudinally 1-septate, 16-23  $\times$  9-13  $\mu\text{m}$  with acute ends.

In general, *Leptogium corticola* is characterized by lead grey, thick, wrinkled thallus. It is distributed in Western Europe and North America, and is here reported for the first time from India.

#### Specimens examined

*Tamil Nadu*—Palni hills, Pillar Rocks area, alt. ca. 2500 m, on bark, Singh 70.660 (LWU).

#### 9. *Leptogium cyanescens* (Ach.) Körb. (Plate 2, Fig. 7)

Syst. Lich. 420. 1855; Zahlbr. Cat. Lich. Univ. 3 : 130. 1925; Sierk, Bryologist, 67.300. 1964.—*Collema tremelloides* var. *cyanescens* Ach. Syn. Meth. Lich. 326. 1814.

Thallus corticolous, saxicolous, terricolous or muscicolous, loosely to closely attached to substratum, 1-6 cm in size, foliose, usually lead grey when dry, olivaceous ashy green, glossy and swollen when wet; lobes orbicular, 2-13 mm wide in peripheral region, somewhat broader in central part, margin entire to isidiate and rarely lobulate; upper surface smooth, sparsely to densely isidiate; isidia cylindrical up to 1 mm long, rarely squamuliform and 2 mm wide; lower surface smooth. Thallus (38) 55-130  $\mu\text{m}$  thick. Thallus rarely fertile, apothecia uncommon, laminal, sessile, up to 1.5 mm in diam., disc concave, reddish brown, smooth; thalline exciple entire, isidiate, 6-9 cell layered cortex at base and 2-3 cell layered at margin; proper exciple euparaplectenchymatous at the margin, indistinct at the centre. Spores ellipsoid, muriform, transversely 2-4 (5) septate, longitudinally 1-septate, 9-20  $\times$  5-9  $\mu\text{m}$ .

*Leptogium cyanescens* is distinguished by a thin lead grey thallus with cylindrical isidia. It resembles *L. denticulatum* but in that species the isidia are always squamuliform. It is widely distributed in tropical to temperate regions of the world.

#### Specimens examined

Thallus sterile unless otherwise stated.

*Himachal Pradesh*—Parbati river valley, near Pulga, alt. ca. 2500 m, over boulders, Awasthi & Dange 75.217 & 75132 (fertile) (LWU).

*Maharashtra*—Pratapgarh fort, on twigs of shrubs, Awasthi 4049 (AWAS).

*Tamil Nadu*—Nilgiri hills, Avalanche, Hatchery Shola, alt. 2300 m, on bark of tree, Singh 71.663 A (LWU). Emerald Beat, Nilgiri peak, alt. 2500 m, on bark of tree, Singh 71.758 (LWU), Palni hills, Schembaganur, Perumal coffee plantation, alt. ca. 1900 m, at the base of *Eucalyptus* tree trunk, on decaying bark, Awasthi 4361 (AWAS); below Silver Cascade towards Tiger Shola, alt. 1800 m, on ground by road side, and on tree trunk, Awasthi & Singh 70.80 & 70.91 (LWU); Oothu area, alt. 1300 m, on bark of *Gnetum scandens* Awasthi & Singh (LWU); Perumal to Palni Road side, alt. 1600 m, on tree bark, Singh 70.976 (LWU).

*Uttar Pradesh*—Almora district, alt. ca. 1600 m, on bark of tree, Awasthi 75.26 A (AWAS).

*West Bengal*—Darjeeling district, above Sukna, alt. ca. 500 m, on bark of tree, Awasthi & Agarwal 66.74 (LWU); near first railway loop, on bark of tree, Awasthi & Agarwal 66.95 (LWU), near Mahanadi, alt. 1400 m, over soil with mosses, Awasthi & Agarwal 66.283, 66.286 (LWU); Kurseong, alt. ca. 1700 m, over stones and bark of tree, Awasthi & Agarwal 66.332 (fertile), 66.346 (LWU).

#### 10. *Leptogium denticulatum* Nyl. (Plate 2, Fig. 6)

Ann. Sci. Nat. Bot. 5 ser. 7 : 302. 1867; Zahlbr. Cat. Lich. Univ. 3 : 136. 1925; Sierk, Bryologist, 67: 298. 1964.

Thallus corticolous, saxicolous, terricolous or muscicolous, usually up to 3.5 cm in size, foliose, loosely to closely adnate to substratum, lead grey to dark grey when dry, olivaceous green, slightly swollen when wet; lobes 2-10 mm wide, usually younger lobes superposing the older ones, slightly suberect, discrete, margin entire to lobulate or isidiate lobulate; upper surface smooth, isidiate; isidia soon squamuliform, 2 mm wide, dense, concolorous or darker than thallus; lower surface smooth. Thallus 30-105  $\mu\text{m}$  thick. Thallus rarely fertile, apothecia rare, laminal, sessile or shortly stipitate, 0.5-1 mm in diam., disc reddish brown, concave, smooth; thalline exciple concolorous to thallus or pale, entire, smooth, cortex of thalline exciple 6-8 cell layered at base, cortical cells 9-16  $\mu\text{m}$  in size; proper exciple euparaplectenchymatous, at the margin, indistinct at the centre. Spores ellipsoid, muriform, transversely 3-5 septate, longitudinally 1-(2) septate, 15-28  $\times$  6-12  $\mu\text{m}$  with slightly acute ends (Text-fig. 7).

*Leptogium denticulatum* is distinguished by lead grey thallus and squamuliform (never cylindrical) isidia. It shows resemblance to *L. cyanescens* in the colour of thallus, but differs in the nature of isidia. The taxon is primarily a New World species, though widely distributed in India.

#### Specimens examined

Thallus sterile unless otherwise stated.

*Kerala*—Quilon, Tanmalai area, on bark of tree, Singh 73.167 (LWU).

*Tamil Nadu*—Nilgiri hills, Avalanche, alt. ca. 2300 m, on bark of tree, Singh 70.345 (LWU), Hatchery Sholar alt. 2300 m, on bark of tree, Singh 71.557 A, 71.663, & 71.676 (LWU), Avalanche, Power house area on tree trunk, near lake, Singh 71.774 (LWU); Mettupalayam in Adderly Shola, on bark of tree, Singh 71.826 (LWU); Doddabetta, alt. ca. 2000 m, on bark, Singh 73.451 (LWU), Gudalur road near Naduvattam, on *Cinchona* tree bark, Singh 73.587 (LWU), Palni hills, Kodaikanal to Berijam road, near moir Point, on low trees near grove, alt. ca. 1800 m, Degelius As—301 (DEGEL), det. Sierk, 1969; on Berijam road, alt. ca. 2500 m, on tree trunk, Foreau & Awasthi 4218 (AWAS), Shembaganur, near college, alt. 2000 m, on tree twigs, Awasthi 4244 (AWAS); Kodaikanal, near levings Path, on ground with mosses, Foreau & Awasthi 4200 (AWAS); Silver Cascade towards Tiger Shola, alt. ca. 1800 m, Awasthi & Singh 70.93 (LWU).



Maharashtra—Panchgani, on tree trunk, Awasthi 4064 (AWAS).

West Bengal—Darjeeling district, Kurseong, alt. ca. 1700 m, over stones, Awasthi & Agarwal 66.354 (fertile) (LWU); Dow hills, on bark of tree, Awasthi & Agarwal 66.262 (LWU).

11. *Leptogium fallax* Müll. Arg.

Flora, 65 : 292. 1882; Zahlbr. Cat. Lich. Univ. 3 : 134. 1925.

The taxon has been reported by JATTA (1902, 1911) from Mussoorie, in N. W. Himalayas and Malabar but in our collection no specimen has been found to conform to the description given by Müll. Arg. (*l. c.*). The taxon is distinguished by a dark rugose thallus; margin of lobes ascending and undulate; apothecia 2.5-4 mm in diam., thalline exciple rugose tuberculose to laciniate; spores  $30-37 \times 12-15 \mu\text{m}$ .

12. *Leptogium indicum* sp. nov. (Plate 2, Fig. 1)

Thallus foliaceus, plumbeus vel fuscenti-plumbeus, irregulariter, lobatus, lobi orbiculate; marginibus ascendentibus, superne laevigatus; inferne laevigatus vel rugulosus, etomentosus. Isidiis destitutus. Apothecia tubulosa pedicellata, 0.5-2.5 mm lata, disco rufescente aut fusco. Excipulum proprium partis marginalis euparaplectenchymaticum, partis centralis stratum non euparaplectenchymaticum, cortex partis prope basium pluribus seriebus cellularum, partis marginalis simplice vel duabus seriebus cellularum. Asci 8 spori. Sporae hyalinae, murales, ellipsoideo fusiformes, apices vulgo acutae,  $19-27 \times 9-13 \mu\text{m}$ . Corticola.

Thallus corticolous, foliose, 3-6 cm in size, light to dark lead grey when dry, olive green, swollen when wet, irregularly lobate, lobes orbicular, 4-9 mm wide, ascending along the margin, margin wavy, often with apothecial initials; upper surface smooth to rough; lower surface rough, etomentose, irregularly wrinkled when wet. Thallus 78-100 (120)  $\mu\text{m}$  thick, corticated on both sides, cortex single cell layered, cells 2-6  $\mu\text{m}$  thick, isodiametric; alga *Nostoc* with sphaerical (5-6  $\mu\text{m}$ ) to oval (6-7  $\mu\text{m}$ ) cells, denser below the upper cortex; hyphae irregularly distributed, 3  $\mu\text{m}$  thick.

Apothecia common, dense, laminal to submarginal, pedicellate, stalk uniformly tubular and almost as wide as the disc, 0.5-1.5 mm long; disc 0.5-2.5 mm in diam, concave to plane, eventually convex, epruinose, red brown; thalline exciple rough to faintly periclinally to sometimes longitudinally wrinkled. Epithecium 9-13  $\mu\text{m}$  thick, pale brown, hymenium 100-150  $\mu\text{m}$  high, I+blue; hypothecium 40-45  $\mu\text{m}$  thick; cortex of thalline exciple 1-4 cell layered at the margin and 7-11 cell layered at the base, cells up to 9  $\mu\text{m}$  in size; proper exciple distinctly euparaplectenchymatous, 4-5 cell layered, 30  $\mu\text{m}$  thick at the margin, centrally indistinguishable from the hypothecium. Asci cylindrico-clavate, 8-spored,  $80-130 \times 14-19 \mu\text{m}$ . Spores colourless, muriform, with 3-5 transverse septa and 0-1 longitudinal septum, ellipsoid fusiform with acute apices,  $19-27 \times 9-13 \mu\text{m}$ ; paraphyses simple.

The taxon *Leptogium indicum* shows affinity to *L. azureum* and *L. tremelloides* but differs from both in the tubular-pedicellate apothecia and colour of thallus. The apothecia of *L. azureum* are sessile to constricted at base and have pale yellow thalline margin. The absence of cellular condition at the central part of proper exciple is similar in the two. *L. tremelloides* shows some resemblance in colour but in that the apothecia are sessile to constricted, the proper exciple is distinctly cellular throughout. In addition, *L. indicum* has thicker thallus with ascending margins, smaller sized cortical cells, sphaerical to oval algal cells, higher hymenium and periclinally wrinkled thalline exciple.

## Specimens examined

*Maharashtra*—Khandala near Boma Hills, alt. ca. 540 m, on bark of *Erythrina indica*, Aug. 1, 1971, P. G. Patwardhan s.n. (Holotype : LWU; Isotype : AWAS); *Rajasthan*, district Sirohi, Mt. Abu, alt. 1350 m, on bark of *Euphorbia royleana* S. R. Singh, 78.157 (Paratype : LWU).

### 13. *Leptogium isidiosellum* (Ridd.) Sierk (Plate 1, Fig. 2)

Bryologist, 67 : 282. 1964.—*Leptogium marginellum* var. *isidiosellum* Ridd. Brooklyn Bot. Gard. Mem. 1 : 115. 1918.

Thallus corticolous, foliose, up to 5 cm in size, usually closely adnate to substratum, flat to crumpled, grey to greenish grey when dry, olivaceous green, semitransparent and swollen, glossy when wet; lobes irregularly divided, orbicular, 2-5 mm wide, discrete; margin entire to isidiate, flat to undulate; upper surface wrinkled, wrinkles acutely raised mostly running along the length of thallus, isidia laminal to marginal, dense, simple to coralloid branched, occasionally lobulate; lower surface wrinkled, wrinkles less prominent than on the upper surface. Thallus 55-200  $\mu\text{m}$  thick. Apothecia absent in the specimens examined.

*Leptogium isidiosellum* is distinguished by heavily wrinkled thallus (wrinkles acutely raised) and dense coralloid branched isidia. It is distributed in American tropics, extending into the United States to Florida. In India it is known from South India.

## Specimens examined

*Tamil Nadu*—Nilgiri hills, Kodanad, alt. ca. 2240 m, on bark of tree, Awasthi & Singh 70.1483 (LWU); Ootacamund, on way to Doddabetta peak, in *Eucalyptus* grove, alt. ca. 2500 m, Awasthi & Singh 71.94 (LWU); Pykara forest range, near Pykara, alt. 2330 m, on bark of tree, Awasthi & Singh 71.198 (LWU), Emerald road, near Muthora, on bark of tree, Singh 73.477 (LWU); Palni hills, Shembaganur, alt. 2000 m, on bark of tree, Foreau 4150 (AWAS).

### 14. *Leptogium javanicum* Mont. (Plate 1, Fig. 3)

Sylloge Gener. Spec. Crypt. 379. 1856; Zahlbr. Cat. Lich. Univ. 3 : 135. 1925; Vain. Ann. Acad. Sci. Fenn. Ser. A, 15 (6) : 42. 1923.

Thallus corticolous or saxicolous, foliose, up to 5 cm in size, loosely to closely adnate to substratum, lead grey, dark lead grey to blackish grey when dry, olivaceous green, semi-transparent, swollen, non glossy when wet; lobes orbicular, 2-10 mm wide, margins entire, plane to wavy; upper surface rough to irregularly wrinkled when wet; lower surface with more prominent wrinkles than the upper surface, tufts of unicellular hairs at places and attaching the thallus to the substrate (Text-fig. 2). Isidia absent. Thallus 37-80  $\mu\text{m}$  thick. Apothecia common, laminal to submarginal, raised on tubular stalk in young condition, 0.5-2 mm long, distinctly wrinkled, disc red brown, concave to plane; thalline exciple prominently vertically wrinkled, sometimes with small lobules in old condition, cortex 6-9 cell layered at the margin, proper exciple euparaplectenchymatous at the margin, and indistinct at the centre. Spores muriform, transversely 3-5 septate, longitudinally 1-septate, ellipsoid, 16-30  $\times$  9-13  $\mu\text{m}$ .

We have identified our specimens on the basis of the description of VAINIO (1923). There appears an ambiguity with regard to the actual identity of *L. vesiculosum* (Sw.) Malme, *L. stipitatum* Vain. and *L. javanicum* Mont. as outlined by SIERK (1964). The type of *L. vesiculosum* was not available for examination to SIERK and we have not tried to locate it either. The apothecia in *L. stipitatum* are very prominent on hollow lobes looking like a vesicle, and it is likely that *L. stipitatum* is conspecific to *L. vesiculosum*, while apothecia in *L. javanicum* though with prominent wrinkles are not by themselves so pronounced as to be called vesicular in appearance.

In the specimens examined, the specimens from W. Himalayas possess a darker and thicker thallus, tufts of hyphal hairs on the lower side, and the apothecia are shorter stalked in comparison to the specimens from E. Himalayas. *L. javanicum* is distinguished by the prominently wrinkled apothecia. It is distributed in the Himalayas and elsewhere in Asia.

#### Specimens examined

*Uttar Pradesh*—Nainital district, near Tanakpur on way to Poornagiri, alt. 500 m, on bark of tree, Awasthi 3365 (AWAS); Almora district, on way from Kapkote to Loharkhet, alt. 1300 m, on shrubs in shade, Awasthi 7508 (AWAS); Pithoragrh district, alt. 1500 m, on shrubs and trees, Awasthi 197 (AWAS); Askote, near village Naret, alt. 1600 m, on bark of *Sapoum insigne*, Awasthi 2668, 2677, 2693, 2704, 3314, 6428, 642B, 6430A (AWAS).

*West Bengal*—Darjeeling district, Tiger Hills, alt. ca. 2800 m, on twigs of shrubs, Awasthi & Agarwal 67.41 & 67.67 (LWU).

#### 15. *Leptogium marginellum* (Sw.) S. Gray (Plate 1, Fig. 4)

Nat. Amer. Brit. Pl. 1 : 401. 1821; Zahlbr. Cat. Lich. Univ. 3 : 1925; Sierk, Bryologist, 67 : 281. 1964.—*Lichen marginellum* Sw. Nova. Gen. et Sp. Pl. 147. 1788.

Thallus corticolous, foliose, up to 5 cm in size, loosely to closely adnate to substratum, grey to ashy or brownish grey when dry, olivaceous green to ashy green, semitransparent and not much swollen when wet; lobes orbicular, 1-5 mm wide, discrete; margin plane to undulate, with swellings here and there; upper surface faintly to distinctly wrinkled, wrinkles mostly longitudinal; isidia absent. Thallus 40-190  $\mu$ m thick. Apothecia marginal, 0.2-1 mm in diam., immature; thalline exciple with numerous squamuliform isidia, dense at the rim, isidia 0.1-3 mm wide.

*Leptogium marginellum* is distinguished by wrinkled thallus and marginal apothecia bearing squamuliform isidia on thalline exciple. It is distributed in American tropics, Philippines, Australia and United States. In India it is so far known from Palni hills.

#### Specimens examined

*Tamil Nadu*—Palni hills, Machur, alt. 1200 m, on tree trunk, Degelius As—230, 320, 368 (DEGEL, AWAS), det. Sierk; Oothu area, 1166—1333 m, on *Artocarpus integrifolia*, Awasthi & Singh 70.385 (LWU); Perumal to Palni road side, alt. 1600 m, on bark, Singh 70.949 (LWU); Kodaikanal road, Temtamparai about 1 km from Nandaparai, alt. 800 m, on bark of tree, Singh 70.1251 (LWU).

#### 16. *Leptogium milligranum* Sierk

Bryologist, 67 : 291. 1964.

Thallus corticolous, foliose, 2-3 cm in size, loosely adnate to substratum, olivaceous grey when dry, olivaceous green, semi-transparent and much swollen, glossy when wet; lobes orbicular, anastomosing, 2-4 mm wide, margins isidiate, rarely entire; upper surface distinctly and heavily wrinkled, wrinkles mostly longitudinal; isidia present, globular, rarely cylindrical, up to 200  $\mu$ m long, 75  $\mu$ m thick; lower surface distinctly wrinkled and rough. Thallus 60-280  $\mu$ m thick. Apothecia absent in the specimens examined.

*L. milligranum* is distinguished by radiating, irregularly anastomosing lobes and brownish thallus. It is distributed in North America. In India it is here reported for the first time from Palni hills and Nilgiri hills.

#### Specimens examined

*Tamil Nadu*—Palni hills, Kodaikanal, Shembaganur, below Silver Cascade, alt. ca. 2000 m, Awasthi & Singh 70.80 (LWU); Nilgiri hills, Ootacamund, Doddabetta peak, alt. 2666-3866 m, on bark of tree, Awasthi & Singh 71.178 (LWU).

17. *Leptogium moluccanum* (Pers.) Vain.

Étud. Lich. Bresil. 1 : 223. 1890. Zahlbr. Cat. Lich. Univ. 3 : 145, 1925; Malme, Ark. Bot. 19 (8) : 23. 1924—*Collema moluccanum* Pers. in Gaud. Voy. Uran. Bot., 203. 1826.

Thallus corticolous, or terricolous, foliose, up to 4 cm in size, loosely to closely adnate to substratum, grey to lead grey when dry, olive green, semitransparent not much swollen when wet ; lobes orbicular, 5-10 mm wide, discrete, margin entire ; upper surface smooth ; lower surface smooth, paler than the upper ; isidia absent. Thallus 40-60  $\mu\text{m}$  thick. Apothecia common, submarginal, sessile, to rarely shortly stipitate, constricted at base, 0.5-1.2 mm in diam., disc red brown, concave to plane, smooth ; thalline exciple smooth, cream coloured, cortical cells 5-11 layered at base, cells 9-13  $\mu\text{m}$  in size ; proper exciple euparaplectenchymatous, 20-30  $\mu\text{m}$  thick at margin, indistinct at the centre. Spores muriform, transversely 3-5 septate, longitudinally 1-septate, ellipsoid, 16-25  $\times$  6-13  $\mu\text{m}$ .

*Leptogium moluccanum* is distinguished by lead grey, smooth, distinctly lobed thallus. It resembles *L. tremelloides* but the latter has broader lobes and cellular proper exciple throughout. It is distributed in the tropical regions of the world. In India it occurs in Eastern Himalayas and Tamil Nadu.

Specimens examined

Tamil Nadu—Palni hills, Oothu area, alt. ca. 1100 m, on bark of *Gnetum* sp., Awasthi & Singh 70.350 (LWU); Kodaikanal, near La Providence, on shady rocks, alt. ca. 2100 m, Degelius As—253 (DEGEL); Bombay Shola, on shady trees, Degelius As—273 (DEGEL).

West Bengal—Darjeeling district, near Kurseong, alt. ca. 2000 m, on soil with mosses, Awasthi & Agarwal 66.211 (LWU).

18. *Leptogium palmatum* (Huds.) Mont.

Nat. Canar. 3 (2) 128. 1840; Zahlbr. Cat. Lich. Univ. 3 : 147. 1925; Sierk, Bryologist, 67 : 285. 1964.—*Lichen palmatus* Huds. Fl. Angl. ed. 2 : 535. 1778.

The taxon has been reported from Darjeeling by SMITH (1931) and CHOPRA (1934), but we have not come across any specimen conforming to the description of this species. It is distinguished by tufted and erect lobes with corniculate tips, and sometimes with tufted hyphal hairs on the lower side. Apothecia are small (up to 0.6 mm) and spores 30-56  $\times$  10-20  $\mu\text{m}$ .

19. *Leptogium phyllocarpum* (Pers.) Mont. (Plate 1, Fig. 5)

Ann. Sci. Nat. Bot. 3 : 10. 1848; Zahlbr. Cat. Lich. Univ. 3 : 149. 1925; Sierk, Bryologist, 67 : 1964.—*Collem phyllocarpum* Pers. in Gaud. Voy. Uran. Bot. 204. 1826.

Thallus corticolous, foliose, 2-4 cm in size, loosely adnate to substratum, dark grey when dry, olive ashy green, semitransparent, much swollen when wet ; lobes elongate anastomosing, irregularly divided and crumpled, 2-3 mm wide, contiguous in the central part, margin entire, plane to wavy ; upper surface heavily wrinkled, wrinkles acute, mostly longitudinally directed ; lower surface paler, bluish grey and irregularly wrinkled, wrinkles less prominent than the upper surface, irregular. Isidia absent. Thallus 270-450  $\mu\text{m}$  thick. Apothecia common, submarginal to laminal, sessile, disc orange red to reddish brown, concave to plane, 2-4.5 mm in diam., smooth ; thalline exciple lobulate and heavily wrinkled, cortex of single layer of cells at the base and margin ; proper exciple distinctly euparaplectenchymatous throughout, 6-9 cell layered, 100-140  $\mu\text{m}$  thick at the centre, 75-93  $\mu\text{m}$  at the margin. Spores muriform, transversely 4-5 septate, longitudinally 1-septate, ellipsoid, 21-30  $\times$  9-13  $\mu\text{m}$ .

*Leptogium phyllocarpum* is distinguished by elongate, irregularly branched, anastomosing wrinkled thallus and by presence of lobulate thalline exciple. It is distributed in the tropical regions of the world. In India it is so far known from Nilgiri hills.

#### Specimens examined

Tamil Nadu—Nilgiri hills, Ootacamund, below Doddabetta peak, in *Eucalyptus* plantation, alt. ca. 2500 m, on bark of *Eucalyptus* at base, Awasthi & Singh 71.111 (LWU), on bark of tree at Doddabetta peak, Awasthi & Singh 73.366 (LWU).

#### 20. *Leptogium pichneum* (Ach.) Malme (Plate 1, Fig. 6)

Ark. Bot. 19 (8) : 20. 1924; Zahlbr. Cat. Lich. Univ. 8 : 131. 1932.—*Collema tremelloides* var. *pichneum* Ach. Syn. Lich. 243. 1814.

Thallus corticolous or saxicolous, foliose, up to 3.5 cm in size, loosely to closely adnate to substratum, lead grey to dark grey when dry, olivaceous green, semi-transparent and swollen when wet; lobes discrete to contiguous, 3-10 mm wide, margin entire to isidiate, plane to wavy; upper surface smooth to slightly rough; isidia laminal to marginal, cylindrical to branched and squamuliform; lower surface smooth. Thallus 100-230  $\mu\text{m}$  thick. Apothecia not present in the specimens examined.

*Leptogium pichneum* resembles *L. cyanescens* in the isidiate condition but is differentiated by the thicker thallus and darker isidia. It is now known from Nilgiri and Palni hills in Tamil Nadu, and is here reported for the first time from India.

#### Specimens examined

Tamil Nadu—Nilgiri hills, Kodanad, alt. ca. 2100 m, on bark of tree, Singh, 71.1005 (LWU); Palni hills, on way to Thandikuddi from Panniakuddi, alt. ca. 1500m, over stones, Awasthi & Singh 70.478A (LWU).

#### 21. *Leptogium platynum* (Tuck.) Herre

Proc. Wash. Acad. Sci. 12 : 144. 1910; Zahlbr. Cat. Lich. Univ. 3 : 150. 1925; Sierk, Bryologist, 67 : 283. 1964.—*Leptogium californicum*. var. *platynum* Tuck. Syn. N. Amer. Lich. 1 : 159. 1882.

Thallus terricolous, foliose, flat, spreading, 1-3 cm in size, loosely adnate to substratum, dark grey to blackish brown in dry condition, dark olivaceous green, semitransparent and swollen and glossy when wet; lobes 4-6 mm wide, irregular in growth, orbicular, margins entire to wavy, or sometimes fringed, flat, rarely ascending; upper surface dull, distinctly and heavily wrinkled; wrinkles running length wise or irregular, acutely raised; lower surface slightly paler than upper, bluish grey in colour, wrinkles irregular but less distinct than upper surface; isidia absent. Thallus 270-450  $\mu\text{m}$  thick. Apothecia common, submarginal to laminal, adnate, 0.3-1.8 mm in diam., disc of apothecium reddish brown, smooth, concave, rarely convex or plane; thalline exciple irregularly to periclinally wrinkled, concolorous to thallus, with 1-2 cell layered cortex at the base and at the margin; proper exciple distinctly euparaplectenchymatous throughout. Spores muriform, ellipsoid, transversely 6-8 septate and longitudinally 1-2 septate, 28-53  $\times$  9-16  $\mu\text{m}$  with acute ends (Text-fig. 6).

*Leptogium platynum* resembles *L. corticola* but can be easily distinguished by its crumpled lobes, larger spores and smaller apothecia. It is distributed in West Coast of North America and Texas. In India it is now reported for the first time from Plani Hills, Tamil Nadu.

#### Specimens examined

Tamil Nadu—Palni hills, Kodaikanal, Shembaganur, Tiger Shola, alt. 1833 m, on ground, 1970, Awasthi & Singh 70.176 (LWU); Berijam, alt. ca. 2666 m, on ground, Awasthi & Singh 70.326 B (LWU).

22. *Leptogium sinuatum* (Huds.) Mass.

Mem. Lichenogr. 88. 1853; Zahlbr. Cat. Lich. Univ. 3 : 154. 1925; Sierk, Bryologist, 67 : 285. 1964.—*Lichen sinuatus* Huds. Fl. Angl. ed. 2, 2 : 535. 1778.

Thallus corticolous or saxicolous, foliose, cushion shaped, up to 6 cm in size, loosely attached to substratum, dark grey to bluish grey when dry, olivaceous green, swollen when wet : lobes elongate to orbicular, 2-5 mm wide, overlapping and suberect; discrete, margin entire to lobulate, plane to folded ; upper surface rough, occasionally irregularly wrinkled, lower surface smooth to rough. Isidia absent. Thallus 46-100  $\mu\text{m}$  thick. Apothecia common, submarginal to laminal, found on both the surfaces of thallus, sessile, constricted at base, 0.1-1 mm in diam., disc reddish brown, smooth, concave to plane ; thalline exciple entire, periclinally wrinkled, cortex single cell layered throughout ; proper exciple distinctly euparaplectenchymatous throughout, 40-60  $\mu\text{m}$  thick at centre. Spores muriform, transversely 5-7 septate, longitudinally 1-2 septate, ellipsoid, apices pointed, 24-35  $\times$  16-18  $\mu\text{m}$ . In sterile specimens pycnidia are seen embedded in the marginal and sub-marginal part of the lobes, 140-180  $\mu\text{m}$  in diam., pycnoconidia 3.5-7.5  $\times$  1-2  $\mu\text{m}$ .

*Leptogium sinuatum* resembles *L. platynum*, but is distinguished by the presence of apothecia on both sides of thallus, and smaller sized spores. In general it is distinguished by cushion shaped thallus, rough to wrinkled lobes in its sterile condition. It is distributed in America, Europe and Asia. It is now reported for the first time from India, distributed in southern part of the country and Eastern Himalayas.

Specimens examined

Kerala—Quilon, near Tanmalai, over stones, Singh 73.107 (LWU).

Tamil Nadu—Palni hills, Berijam, alt. ca. 2666 m, on ground and bark, Awasthi & Singh 70.326 C (LWU).

West Bengal—Darjeeling district, Kalimpong, alt. ca. 1500 m, on bark of tree, Awasthi & Singh 67.319 (LWU).

23. *Leptogium tremelloides* (L. f.) S. Gray.

Nat. Ark. Brit. Fl. 1 : 400. 1821; Malme, Ark. Bot. 19 (8) : 22. 1924; Zahlbr. Cat. Lich. Univ. 3 : 155. 1925.—*Lichen tremelloides* L. f. Suppl. Pl. 450. 1781.

Thallus corticolous, terricolous or muscicolous, foliose, 2-5 cm in size, loosely to closely adnate to substratum, lead grey when dry, olivaceous green, slightly swollen, glossy when wet ; lobes orbicular, 4-10 (13) mm wide, discrete, margin entire, plane to wavy, upper and lower surfaces smooth to rough. Isidia absent. Thallus 50-90  $\mu\text{m}$  thick. Apothecia common, laminal to submarginal, sessile, constricted at base to shortly stipitate, 0.5-2 mm in diam., disc concave to plane, reddish brown ; thalline exciple concolorous to thallus to cream coloured, entire, smooth, 30-90  $\mu\text{m}$  thick, with 5-10 cell layered cortex at the base, and 1-3 cell layered cortex at the margin ; proper exciple euparaplectenchymatous throughout, distinctly 6-12 cell layered and ca. 90  $\mu\text{m}$  thick at the centre, and 3-4 cell layered, ca. 25  $\mu\text{m}$  thick at the margin. Spores muriform, transversely 3-5 septate, longitudinally 1-2 septate, ellipsoid, 14-33  $\times$  6-13  $\mu\text{m}$ .

*Leptogium tremelloides* closely resembles *L. azureum* but is distinguished by the distinct cellular proper exciple throughout. It is widely distributed in the world. In India it is known from Tamil Nadu and Eastern Himalayas.

Specimens examined

Tamil Nadu—Nilgiri hills, on way to Kodanad from Kilkotagiri, alt. ca. 2000 m, on bark of tree, Awasthi & Singh 71.68 (LWU); Hatchery Shola, alt. 2333 m, on bark of tree, Singh, 71.633 (LWU);

Ootacamund, Kilkotagiri road, alt. ca. 2300 m, on bark of tree, Singh 71.116 (LWU); Kodanad, by road side, alt. ca. 2300 m, on bark of tree, Awasthi & Singh 70.1510 (LWU); Palni hill, Madurai district Shola, near 9th mile Kodaikanal Berijam-road, alt. 2500 m, on tree trunk, Foreau & Awasthi 4210 (LWU); Pambar Shola, alt. 2333 m, Foreau 3757 AWAS; Croakers Walk, on way to Pambampuram, alt. ca. 12333 m, on tree trunk, Singh 70.489 (LWU).

West Bengal—Darjeeling district, Oodlabari, alt. 333 m, on bark of tree, Awasthi & Agarwal 66.15 (LWU); Tiger hill, alt. 2800m, on twigs of shrubs, Awasthi & Agarwal 67.36 (LWU); above Sukna, alt. ca. 500 m, on bark, Awasthi & Agarwal 66.94 (LWU); Chhunabhati, alt. 733 m, Awasthi & Agarwal 66.107 (LWU); Between Chhunabhati and Tindharia, alt. ca. 767 m-800 m, on bark of tree, Awasthi & Agarwal 66.133 (LWU).

#### 24. *Leptogium ulvaceum* (Pers.) Vain.

Ann. Acad. Sci. Fenn. Ser. A, 15 (6) : 38. 1921; Malmé, Ark. Bot. 19 (8) : 19. 1924; Zahlbr. Cat. Lich. Univ. 3 : 160.1925.—*Collema ulvaceum* Pers. Gaud. Voy. Uran. Bot. 203.1826.

Thallus corticolous, foliose, up to 4 cm in size, loosely adnate to substratum, dark grey when dry, olivaceous green, swollen, glossy when wet, lobes broad orbicular, rarely elongate, up to 15 mm in size discrete, margin entire, plane to wavy; upper surface smooth to rough; lower surface smooth, isidia absent. Thallus 80-170  $\mu\text{m}$  thick. Apothecia common, laminal to submarginal, sessile to shortly stipitate, 0.5-2 mm in diam., disc red brown, smooth, concave to plane; thalline exciple entire, concolorous to thallus to cream coloured, smooth, 60-80  $\mu\text{m}$  thick, with 6-8 cell layered cortex at the base and 1-3 cell layered cortex at the margin; proper exciple euparaplectenchymatous, distinctly 6-8 cell layered, 80-150  $\mu\text{m}$  thick at the centre and 3-5 cell layered at the margin. Spores muriform, transversely 4-8 septate, longitudinally 1-2 septate, ellipsoid, 16-32  $\times$  10-13  $\mu\text{m}$ .

*Leptogium ulvaceum* is distinguished by dark grey smooth to rough thallus. It is distributed in S. E. Asia. It is here reported for the first time from India.

#### Specimens examined

Tamil Nadu—Nilgiri Hills, Avalanche, Hatchery Shola, alt. 2330 m, on bark of tree, Singh 71.678 (LWU); Palni hills, Kodaikanal, lake side, on tree, alt. 2100 m, Degelius As. 881 (DEGEL)—det. Sierk.

#### ACKNOWLEDGEMENTS

Most of the *Leptogium* specimens in the herbarium of Botany Department, Lucknow University (LWU) have been collected during the course of research projects under the supervision of senior author and, financed by Council of Scientific and Industrial Research, New Delhi. We also extend our sincere thanks to Dr. G. Degelius (Sweden) for the loan of the specimens collected by him from India.

#### REFERENCES

- AWASTHI, D. D. (1965). Catalogue of the lichens from India, Nepal, Pakistan and Ceylon. *Beih. Nova. Hed.* **17** : 1-137.
- AWASTHI, D. D. & AKHTAR, P. (1977). The genus *Leptogium* (Sec. Mallotium) in India. *Norw. J. Bot.* **24** : 59-71.
- CHOPRA, G. L. (1934). Lichens of the Himalayas, pt. 1. Lichens of Darjeeling and Sikkim Himalayas. 134. Punjab University, Lahore.
- JATTA, A. (1902). Licheni esotici dell' Erbario Levier raccolti nell' Asia Meridionale e nell' Oceania. *Malpighia* **19** : 163-185.
- JATTA, A. (1911). Lichens Asia meridionalis lect. a rev. B. Luthi in Malabar et a E. Long et W. Gollan in Himalaya. *Bull. Orto Bot. d. R. Univ. Napoli.* **3** : 309-312.
- MONTAGNE, C. (1842). Cryptogamae Nilgherienses seu Plantarum in montibus peninsulae indicae Neelgherries dictis a cl. Perrottet collectarum enumeratio. *Ann. Sci. Nat. Bot.* **2**, **17** : 17-21. (Lichens).
- QUARAIISHI, A. A. (1928). Lichens of Western Himalayas. *Proc. 15th Indian Sci. Congr. Abstracts* : 228.

- SIERK, H. A. (1964). The genus *Leptogium* in North America, north of Mexico. *Bryologist* **67** : 145-317.
- SMITH, A. L. (1931). Lichens from Northern India. *Trans. Bri. mycol. Soc.* **16** : 128-132.
- VAINIO, E. A. (1920). Lichenes Insularum Philippinarum. *Ann. Acad. Sci. Fenn. Ser. A.*, 15 nr. **6** : 1-368 (1921).
- ZAHLEBRÜCKNER, A. (1926). Flechten (Lichen) B. Spezieller Teil. In Engler & Prantl. *Die natürlichen Pflanzenfamilien*, 2 ed., Band B, Leipzig.

#### PLATE I

Figs. 1-6. (each division of scale=1 mm).

- Fig. 1. *Leptogium chloromelum* (Sw.) Nyl.—Photo of a part of thallus (Awasthi 3482).
- Fig. 2. *Leptogium isidiosellum* (Ridd.) Sierk—Photo of a part of thallus (Awasthi and Singh 71.94).
- Fig. 3. *Leptogium javanicum* Mont.—Photo of a part of thallus (Awasthi 2704).
- Fig. 4. *Leptogium marginellum* (Sw.) S. Grey—Photo of a part of thallus (G. Daegelius As—320).
- Fig. 5. *Leptogium phyllocarpum* (Pers.) Mont.—Photo of a part of thallus (Singh 73.366).
- Fig. 6. *Leptogium pichneum* (Ach.) Malme—Photo of a part of thallus (Awasthi & Singh 70.478).

#### PLATE II

Figs. 1-7. (each division of scale=1 mm).

- Fig. 1. *Leptogium indicum* Awasthi & Akhtar—Photo of a part of thallus (Patwardhan, s. n.).
- Fig. 2. *Leptogium austro-americanum* (Malme) Dodge—Photo of a part of thallus (Singh 73.155).
- Fig. 3. *Leptogium corticola* (Tayl.) Nyl.—Photo of a part of thallus (Singh 70.660).
- Fig. 4. *Leptogium azureum* (Sw.) Mont.—Photo of a part of thallus (Awasthi 3935).
- Fig. 5. *Leptogium adpressum* Nyl.—Photo of a part of thallus (Singh 70.769).
- Fig. 6. *Leptogium denticulatum* Nyl.—Photo of a part of thallus (Awasthi 4244).
- Fig. 7. *Leptogium cyanescens* (Ach.) Körb.—Photo of a part of thallus (Awasthi & Agarwal 66.332).



