

LICHEN GENUS *CETRARIA* IN INDIA AND NEPAL

DHARANI DHAR AWASTHI

Lucknow University, Lucknow

ABSTRACT

The genus *Cetraria* Ach. has been found to be represented by twenty-four species distributed in the temperate and alpine Himalayas of India and Nepal. A detailed morpho-taxonomic study of the twenty-two species has been presented in the paper. *Cetraria endoxanthoides* Awas. is described as a new species and *C. endoxantha* (Hue) Awas., *C. isidioidea* (Räs.) Awas. and *C. nephromoides* (Nyl.) Awas. are new combinations. *Cetraria chlorophylla* (Willd.) Vain., *C. delavayi* (Hue) Sato, *C. laeteflava* Zahlbr., *C. rhytidocarpa* Mont. et v. d. Bosch and a taxon closely related to *C. potaninii* Oxner are reported from the area for the first time.

INTRODUCTION

The lichen genus *Cetraria* Ach., family Parmeliaceae, is widely distributed in the temperate, alpine, arctic and antarctic regions of the world. Regional or other accounts on *Cetraria* within the last fifty years include : of United States by Fink (1935), of Japan by Sato (1939), of central Europe by Hillmann (1936), of U.S.S.R. by Rassadina (1950), key to all the species from world by Räsänen (1952), key to European species by Poelt (1969) and a recent treatise on the brown fruticose species by Kärnefelt (1979). Certain species included within the genus *Cetraria* by Zahlbruckner (1930) have been transferred into the well accepted genera *Asahinea*, *Cetrelia* and *Platismatia* by Culberson and Culberson (1965, 1968) and *Masonhalea* by Kärnefelt (1977). Zahlbruckner (1926, 1930) and Räsänen (1952) treated *Nephromopsis* Müll.-Arg. as an independent genus, but Rassadina (1950) and Poelt (1969) considered *Nephromopsis* as a section of *Cetraria*. The delimitation and circumscription of *Cetraria* and allied genera since Linnaeus (1753) to 1979 have been illustrated by Kärnefelt (1979, pp. 34-35).

Though the taxa of the genus from the different regions of the world are fairly well known, there is no monographic treatment or a satisfactory delimitation on the world-wide basis. Consequently the generic position of some of the taxa is not clear. The heterogeneity is expected to be eliminated only when all the taxa of the world are studied together. I have followed the generic concept akin to that of Rassadina (1950) and Poelt (1969) in keeping the foliose taxa with nephromoid apothecia into the section *Nephromopsis* of the genus *Cetraria*. The scale in one division in all the photographs is equal to 1 mm.

Morphology of thallus and apothecia : Two distinct types of thalli with somewhat intermediate forms are discernible in the genus. In one of them the thallus is typically foliose, dorsiventral, horizontally spreading, more or less adpressed, somewhat orbicular to rosulate, usually with broad lobes, attached to the substratum by sparsely distributed rhizinae on the underside. The thallus is generally coriaceous, thin, smooth to thick and then variously lacunose rugose or scrobiculate and convoluted on one surface or on both the surfaces. Out

of the 14 species in this group, pseudocyphellae are present in 10 species either directly on the thallus surface or elevated on ridges or associated with special plug-like outgrowths. None of the species from the area is isidiate, but marginal soralia occur in the three species—*C. chlorophylla*, *C. laureri* and *C. pinastri*. In the second type, the thallus is generally laciniate lobate, sub-fruticose (fruticose sensu Kärnefelt, 1979), suberect to erect, with upper and lower surfaces distinctly different. The thallus is mostly thin, crisp, and may be smooth or slightly scrobiculate rugose on one or both the surfaces. In most of the species described here, the thallus lacinae or lobes are involute (concave to canaliculate on upper side), while in *C. everniella* the lacinae are revolute (convex on upper side and concave on lower side). In one form of *C. everniella* the thallus tends to be more or less fruticose with radial symmetry, and the algal cells are distributed all round the central medulla. In several species the thallus is attached to the substratum basally, where it also tends to die off. There are usually no rhizinae except in some cases when the thallus becomes ascendent on the small shrubs. Out of the ten species that belong to this group six species have pseudocyphellae on the lower surface, and none on the upper surface. None of the species is isidiate or sorediate.

The foliose and subfruticose types of thalli are not basically different. They both are dorsiventral, and have intermediate forms connecting the two groups. *Cetraria pinastri*, *C. chlorophylla*, *C. hepatizon* are typically parmelioid and may be confused for *Parmelia*. The thallus colour and nature of lobes of *C. rhytidocarpa* recalls subgenus *Amphigymnia* of *Parmelia*. The thallus in *C. endoxanthoides*, *C. delavayi*, *C. hypotrachyna*, *C. isidioidea*, *C. nephromoides*, *C. stracheyi* and *C. wallichiana* is thick coriaceous, scrobiculate, convolute, and

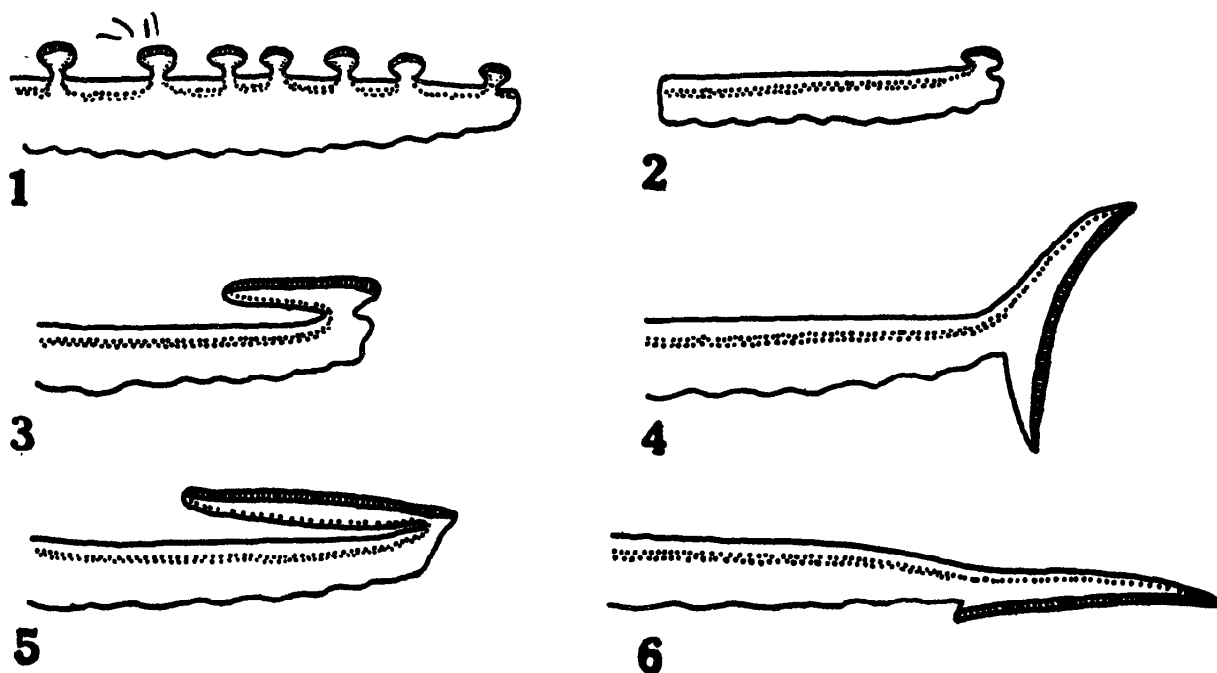
sometimes the margins of the lobes are suberect. A suberect condition with narrow lobes is exhibited by *C. laureri*, the central part is attached to the substratum by lower side. *C. ambigua* with narrow laciniate lobes is more prostrate than erect, *C. everniella* exhibits suberect to erect mode of development, *C. leucostigma* is partially prostrate and partially erect, whilst *C. nepalensis*, *C. melaloma*, *C. cucullata* and *C. islandica* are typically erect with far less distinction between upper and lower surfaces.

Irrespective of the type of thallus, the pycnidia wherever present are marginal, occurring either as minute black papillae or on apices of black, simple or rarely branched marginal fibrils. Pycnidia or pycnidial fibrils were not seen in *C. chlorophylla*, *C. cucullata*, *C. nephromoides*, *C. pallescens*, *C. pinastri*, *C. stracheyi* and *C. wallichiana*. Anatomical details of pycnidia or morphology of pycnoconidia was not studied.

Twelve species were found in fertile condition. In *C. wallichiana* the apothecia are typically laminal, very numerous and rather small (Figs. 1 & 23). Apothecia are submarginal and small in *C. ambigua* (Figs. 2 & 25). In the other taxa, the apothecial initials originate in the marginal position either near the upper cortex or between the upper and lower cortex. Probably, subsequent development decides the shape of the apothecium, and the mature apothecia are of the following types: (a) the apothecia are vertical on the margin or near the margin, are more or less rounded in outline, may have a short stalk and the receptacle is more or less entirely formed by the upper cortex tissues e.g. *C. pallescens* (Figs. 3, 17 & 18); (b) the apothecia are more or less peltate on the margin, the disc is also rounded, but the receptacle is partially formed by the extension of the tissues from upper cortex and partially from the lower cortex,

thus partially lecanorine, the position of the disc which apparently is lateral depends the way the specimen has been pressed and dried, i.e. the disc may face upwards or downwards (nephromoid), e.g. in *C. rhytidocarpa* and *C. leucostigma* (Fig. 4); (c) the apothecium is oblong or reniform, the receptacle is entirely formed by the extension of the tissues of upper cortex, but the disc may face upwards (Fig. 5) due to the apothecium having been reflexed back, or the disc may face downwards (nephromoid) in the normal prostrate habit of the thallus (Fig. 6). Both the conditions are present in taxa like *C. delavayi*, *C. nephromoides* and *C. stracheyi* (Figs. 7, 9, 14, 21 & 22). The typical nephromoid condition is more apparent when the thallus is foliose in nature, while the reflexed nephromoid condition of an erect thallus may appear laminal at the margin. Since the nephromoid condition is a developmental stage or result, such a condition hardly merits for a generic status for *Nephromopsis* Müll.-Arg.

Chemistry : The usefulness of lichen chemistry is too well known for the delimitation of the species. It had been emphasized by Dahl (1952) along with anatomical characters for the subdivision of the genus. The usual spot tests by solutions of KOH (K), bleaching powder (C), paraphenylenediamine (P) have been carried out. In addition, thin layer chromatography (TLC) has been done according to the methods suggested by Culberson and Kristinsson (1970) and Culberson (1972) on the silicagel glass plates prepared in the laboratory, by using the solvent BDA (Benzene, 1-4 dioxane, acetic acid). In addition Dr. P. W. James (BM) has kindly performed the TLC on the type specimens available to him at BM, as well as on small fragments of representative specimens sent by me, by using the two solvents TDA (toluene, 1-4 dioxane, acetic acid) and HEF (Hexane, ethyl ether, formic acid). The TLC observations given against each species are mostly based on information supplied by him (P. W. James) in



Figs. 1-6 : Diagrammatic representation of the different positions and nature of apothecia in *Cetraria* in section. 1. *C. wallichiana*, 2. *C. ambigua*, *C. potaninii*. 3. *C. pallescens*. 4. *C. leucostigma*, *C. rhytidocarpa*. 5. & 6. *C. nephromoides*, *C. stracheyi*, *C. delavayi*.

personal correspondence (in *litt.*) The table below provides a consolidated information of the lichen products present in the species treated here. Usnic acid, lichesterinic and protolichesterinic acids are invariably present. Fumarprotocetraric acid is present in five species, other lichen products are rather specific of the few species.

TABLE 1

<i>Cetraria</i> species	1	2	3	4	5	6	7	8	9	10	11	12	13
Subgenus PLATYSMARIA													
<i>C. chlorophylla</i>	—	+	—	—	—	—	—	—	—	—	—	—	—
<i>C. delavayi</i>	±	+	—	—	—	+	—	—	—	—	+	—	—
<i>C. endoxanthoides</i>	±	±	—	+	+	—	—	—	—	—	—	—	—
<i>C. hepaticum</i>	—	—	+	—	—	—	—	—	—	—	—	—	—
<i>C. hypotrachyna</i>	±	—	+	—	—	+	—	—	—	—	—	+	—
<i>C. isidioidea</i>	—	+	—	—	—	—	—	—	—	—	—	—	+
<i>C. laeteflava</i>	—	±	—	+	+	—	—	—	—	—	—	—	—
<i>C. laureri</i>	±	+	—	—	—	—	—	—	—	—	—	—	—
<i>C. nephromoides</i>	+	+	—	—	—	+	—	—	—	—	—	—	±
<i>C. pallens</i>	+	+	—	—	—	—	—	—	—	—	—	—	—
<i>C. pinastri</i>	+	—	—	—	—	—	+	+	—	—	—	—	—
<i>C. rhytidocarpa</i>	—	+	—	+	+	—	—	—	—	—	—	—	—
<i>C. stracheyi</i>	±	—	—	—	—	—	—	—	+	—	—	—	—
<i>C. wallichiana</i>	±	+	—	—	—	—	—	—	—	+	—	—	—
Subgenus CETRARIA													
<i>C. ambigua</i>	+	+	—	—	—	—	—	—	—	—	—	—	—
<i>C. cucullata</i>	+	+	—	—	—	—	—	—	—	—	—	—	—
<i>C. everniella</i>	+	+	—	—	—	—	—	—	—	—	—	—	+
<i>C. islandica</i>	—	+	—	+	+	—	—	—	—	—	—	—	—
<i>C. laevigata</i>	—	+	—	+	—	—	—	—	—	—	—	—	—
<i>C. leucostigma</i>	+	+	—	—	—	—	—	—	—	—	—	—	—
<i>C. melaloma</i>	+	+	±	—	—	—	—	—	—	—	—	—	—
<i>C. nepalensis</i>	—	+	—	—	—	—	—	—	—	—	—	—	—
<i>C. nigricans</i>	+	+	—	—	—	—	—	—	—	—	—	—	—
<i>C. cf. potaninii</i>	+	+	—	—	—	—	—	—	—	—	—	—	—

Reference : 1=Usnic acid ; 2=Lichesterinic and/or protolichesterinic acid ; 3=Stictic and/or norstictic acid ; 4=Fumarprotocetraric acid ; 5=Protocetraric acid ; 6=Caperatic acid ; 7=Vulpinic acid ; 8=Pinastric acid ; 9=Olivetoric acid ; 10=Alectoronic acid ; 11=Squamatic acid ; 12=Salacinic acid ; 13=Pigments.

Subdivisions of the genus Cetraria and their delimitation: Kärnefelt (1979) has made an informal proposal to treat the brown fruticose species of *Cetraria* under the subgenus *Cetraria*. Other fruticose (subfruticose) species of the genus could also conveniently be included under the same subgenus. The taxa that are basically foliose in nature need to be placed in a separate subgenus. Räsänen (1952) placed some of them under the subgenus *Platysma* (Hoffm.), and others in the genus *Nephromopsis* Müll.-Arg. Rassadina (1950) placed the foliose forms under the two sections *Platysma* and *Nephromopsis* of genus *Cetraria*. But, as pointed out by Santesson and Culberson (1966), the name *Platysma* (*Platysma*) Hoffm. is illegitimate and unusable. The use of the name *Nephromopsis* appears incongruous as all the species do not have nephromoid apothecia. It has therefore been proposed that the foliose forms be placed under the new subgenus *Platysmaria* Awas. The subdivisions of the genus are given below:

Genus *Cetraria* Ach.

Subgenus *PLATYSMARIA* Awas.

Section *Protocetraria* Awas.: *C. chlorophylla*, *C. hepatizon*, *C. hypotrachyna*, *C. isidioidea*, *C. laureri*, *C. pallescens*, *C. pinastri*, *C. wallichiana* and [*C. commixta*, *C. juniperina*, *C. oakesiana*, *C. saepincola*, *C. tilesii*, *C. teysmanni* (*C. citrina*)].

Section *Nephromopsis* (Müll.-Arg.) Rassad.: *C. delavayi*, *C. endoxanthoides*, *C. laeteflava*, *C. nephromoides*, *C. rhytidocarpha*, *C. stracheyi* and other species kept under the genus *Nephromopsis*.

Subgenus *CETRARIA*

Section *Flavidae* Räs.: *C. ambigua*, *C. cucullata*, *C. everniella*, *C. melaloma*, *C. potaninii* and (*C. denticulata*, *C. fahluensis*, *C. nivalis*).

Section *Cetraria*: *C. islandica*, *C. laevigata*, *C. leucostigma*, *C. nepalensis*, *C. nigricans*

and the species treated by Kärnefelt (1979).

TAXONOMIC ACCOUNT

Cetraria Ach. Meth. Lich. 292. 1803; Rassadina, Trav. Bot. Inst. Akad. Nauk SSSR Spov Rast. Ser. 2(5): 171-304. 1950. *Platysma* Hoffm., Nylander, Synop. Lich. 1: 310-315. 1860 pr. p. *Nephromopsis* Müll.-Arg. Flora 74: 374. 1891.

The genus *Cetraria* as understood here is characterised by a foliose, wide lobed more or less appressed to subfruticose (fruticose sensu Kärnefelt), suberect to erect thallus with a paraplectenchymatous cortex on both upper and lower surfaces; the pycnidia are marginal and these often occur on apices of black, marginal fibrils; the apothecia are rarely laminal to submarginal, generally marginal, lecanorine entirely or partially (in peltate apothecia), with disc directed upwards, laterally or downwards (nephromoid); the asci are unitunicate, 8 spored; the spores are simple, hyaline, thin walled, generally small, 6-10 × 3-6 μ m. Type species *Cetraria islandica* (L.) Ach.

Amongst the 24 species known from the area under reference, 8 species—*C. endoxanthoides*, *C. hypotrachyna*, *C. isidioidea*, *C. ambigua*, *C. everniella*, *C. leucostigma*, *C. melaloma* and *C. nepalensis* are endemic in the Himalayas. Another 8 species—*C. delavayi*, *C. laeteflava*, *C. nephromoides*, *C. pallescens*, *C. rhytidocarpha*, *C. stracheyi*, *C. wallichiana* and *C. potaninii* are distributed eastwards of the Himalayas in the eastern and south-eastern parts of Asia. The remainder 8 species are widely distributed in the temperate and alpine regions of the world.

For the taxonomic distinctions and delimitation of the species of *Cetraria* from India and Nepal, the general morphology of thallus, presence or absence of pseudocyphellae, presence or absence of black pycnidial

fibrils along the margin, the colour reactions by K, C, KC, P, inclusive of the lichen products present in the thallus as evidenced by TLC have been found diagnostic. The spores do not usually show much variation in their size, moreover several species are known in sterile condition. Only in *C. laeteflava* the spores are larger ($9-18 \times 5-8 \mu m$) than other taxa.

Key to the species of *Cetraria* from India and Nepal

- | | | | |
|---|-------------------------------|---|---------------------------------------|
| 1a. Thallus foliose, horizontally spreading, appressed to marginally ascending, widely lobate, and often with rhizinae on lower surface ... | 2 (subg. <i>Platysmaria</i>) | 12a. Apothecia laminal, dense, small, round ... | (14) <i>C. wallichiana</i> |
| 1b. Thallus subfruticose, suberect to erect, laciniate lobate, attached to substratum basally ... | 15 (subg. <i>Cetraria</i>) | 12b. Apothecia marginal, rarely sub-marginal ... | 13 |
| 2a. Thallus sorediate ... | 3 | 13a. Medulla G+red, KC+red (olivetric acid), apothecia large, nephromoid ... | (13) <i>C. stracheyi</i> |
| 2b. Thallus lacking soredia, also lacking isidia ... | 5 | 13b. Medulla G—, KC— ... | 14 |
| 3a. Thallus pseudocyphellate on lower surface ... | (8) <i>C. laureri</i> | 14a. Lower side of thallus ± markedly reticulate ridged, pseudocyphellae on ridges or on plug-like outgrowths, apothecia 1-3 mm diam., with short pedicel, disc facing upwards. ... | (10) <i>C. pallescens</i> |
| 3b. Thallus lacking pseudocyphellae ... | 4 | 14b. Lower side plane, smooth to slightly reticulate-lacunose, pseudocyphellae plane on the surface or slightly impressed, apothecia 4-7(9) mm diam., orbicular to semi-reniform, nephromoid, disc facing down or upwards ... | (9) <i>C. nephromoides</i> |
| 4a. Thallus yellow, usnic, pinastric and vulpinic acids present ... | (11) <i>C. pinastri</i> | 15a. Thallus pseudocyphellate ... | 16 |
| 4b. Thallus yellowish brown or brown, protolichesterinic acid present ... | (1) <i>C. chlorophylla</i> | 15b. Thallus lacking pseudocyphellae ... | 20 |
| 5a. Thallus brown to black, small, with minute, narrow appressed lobes or laciniae ... | (4) <i>C. hepatizon</i> | 16a. Medulla P+red (fumarprotocetraric acid) ... | 17 |
| 5b. Thallus yellowish grey to pale brown, with large rounded lobes ... | 6 | 16b. Medulla P— ... | 18 |
| 6a. Thallus pseudocyphellate ... | 7 | 17a. Pseudocyphellae laminal and sub-marginal, lobes flat to canalliculate, lower surface smooth to scrobiculate ... | (19) <i>C. islandica</i> |
| 6b. Thallus lacking pseudocyphellae ... | (5) <i>C. hypotrachyna</i> | 17b. Pseudocyphellae submarginal, forming a distinct continuous line, lobes 1-3 mm broad, canalliculate to subtubular ... | (20) <i>C. laevigata</i> |
| 7a. Pseudocyphellae on both surfaces ... | 8 | 18a. Marginal black fibrils absent, thallus yellow, canalliculate with connivent margin, pseudocyphellae minute (only distinct under lens) ... | (16) <i>C. cucullata</i> |
| 7b. Pseudocyphellae on the lower surface only ... | 10 | 18b. Marginal black fibrils present ... | 19 |
| 8a. Black fibrils arising from the rim of the pseudocyphellae, medulla white. ... | (12) <i>C. rhytidocarpa</i> | 19a. Thallus yellow with brown black margin or yellowish brown, lobes ± uniformly 2-6 mm wide ... | (22) <i>C. melaloma</i> |
| 8b. Black fibrils absent from the rim of the pseudocyphellae ... | 9 | 19b. Thallus yellowish brown to castaneous, lobes irregularly widened, up to 10 mm wide ... | (21) <i>C. leucostigma</i> |
| 9a. Medulla yellowish to pale croceus, spores $6-9.5 \mu m$ long ... | (3) <i>C. endoxanthoides</i> | 20a. Thallus brown to dark brown ... | 21 |
| 9b. Medulla white to slightly yellowish at places, spores $9-16(18) \mu m$ long ... | (7) <i>C. laeteflava</i> | 20b. Thallus yellow, yellowish brown or yellowish ochraceous ... | 22 |
| 10a. Thallus with laminal and/or marginal black fibrils ... | 11 | 21a. Margin with long ciliate (up to 2 mm) lobes $0.5-1.5 mm$ wide ... | (24) <i>C. nigricans</i> |
| 10b. Thallus lacking black fibrils on lamina and margin ... | 12 | 21b. Margin without cilia, marginal fibrils few, up to $0.5 mm$ long, lobes $2-3(4) mm$ wide ... | (23) <i>C. nepalensis</i> |
| 11a. Thallus reticulate scrobiculate on upper surface, black fibrils laminal and marginal, medulla yellow ... | (6) <i>C. isidioidea</i> | 22a. Medulla yellow ochraceous, with pigments ... | (17) <i>C. everniella</i> |
| 11b. Thallus ± smooth on upper surface, black fibrils marginal only, medulla white ... | (2) <i>C. delavayi</i> | 22b. Medulla white, rarely yellowish, lacking pigments ... | 23 |
| | | 23a. Thallus soft, plane to slightly concave on upper side, margin with sparse black papillae, rarely coriaceous, ascendent on small low alpine shrubs ... | (15) <i>C. ambigua</i> |
| | | 23b. Thallus crisp, involute-subcanalliculate, margin ± denticulate, with papillae or with dense black fibrils ... | (25) <i>C. sp. (cf. C. potaninii)</i> |

Subgenus *PLATYSMARIA* Awas. subgenus nov.

Thallus foliaceus, adpressus vel subascendentibus, coriaceus, late lobatus, inferne paucius rhizinosus.

1. *Cetraria chlorophylla* (Willd.) Vain.

Acta Soc. Faun. Fl. Fenn. 13: 7.1896. *Lichen chlorophyllus* Willd. in Humb. Fl.

Frib. Spec. p. 20. 1793. Type not seen.

Thallus foliose, appressed, 2-3 cm across, lobes radiating, 2-3 mm wide, $\pm$ concave with ascending margin; upper surface yellowish brown to brownish yellow, smooth; lower surface pale brown with short rhizinae; margin undulate, lacking black papillae or fibrils, soraliolate; soredia marginal, whitish farinose to grey granular. Isidia and pseudocyphellae absent. Thallus 200-350 μ m thick, medulla white. Apothecia absent in the specimens examined. Cortex and medulla K-, C-, KC-, P-. TLC: Protolichesterinic acid.

Cetraria chlorophylla is distinguished by the pale brown to brownish yellow, corticolous thallus with marginal soralia and absence of pseudocyphellae. It is distributed more in the southern temperate areas of S. America, New Zealand.

Habitat: On twigs of shrubs in alpine areas.

Specimens examined: INDIA: Uttar Pradesh, Uttarkashi district, Gomukh area, alt. ca. 3700 m, on twigs of *Juniperus*, Awasthi & Singh 8555 (Herb. Awasthi); West Bengal, Darjeeling district, Sandakhpoo, alt. ca. 3570 m, Awasthi & Agarwal 67. 381 (LWU).

2. *C. delavayi* (Hue) Sato, Nova Fl. Japonia, p. 48. 1939. *Nephromopsis delavayi* Hue, Nouv. Arch. Mus. Ser. 4, 1: 219. 1899, Plate 3, Fig. 2. Type collection: China, prov. Yunnan, Lopinchan, supra Lan-Kong, corticolum in sylvis faucium, alt. 3200 m, 31 July 1888. R. P. Delavay (Holotype: PC-not seen). (Figs. 7 & 9)

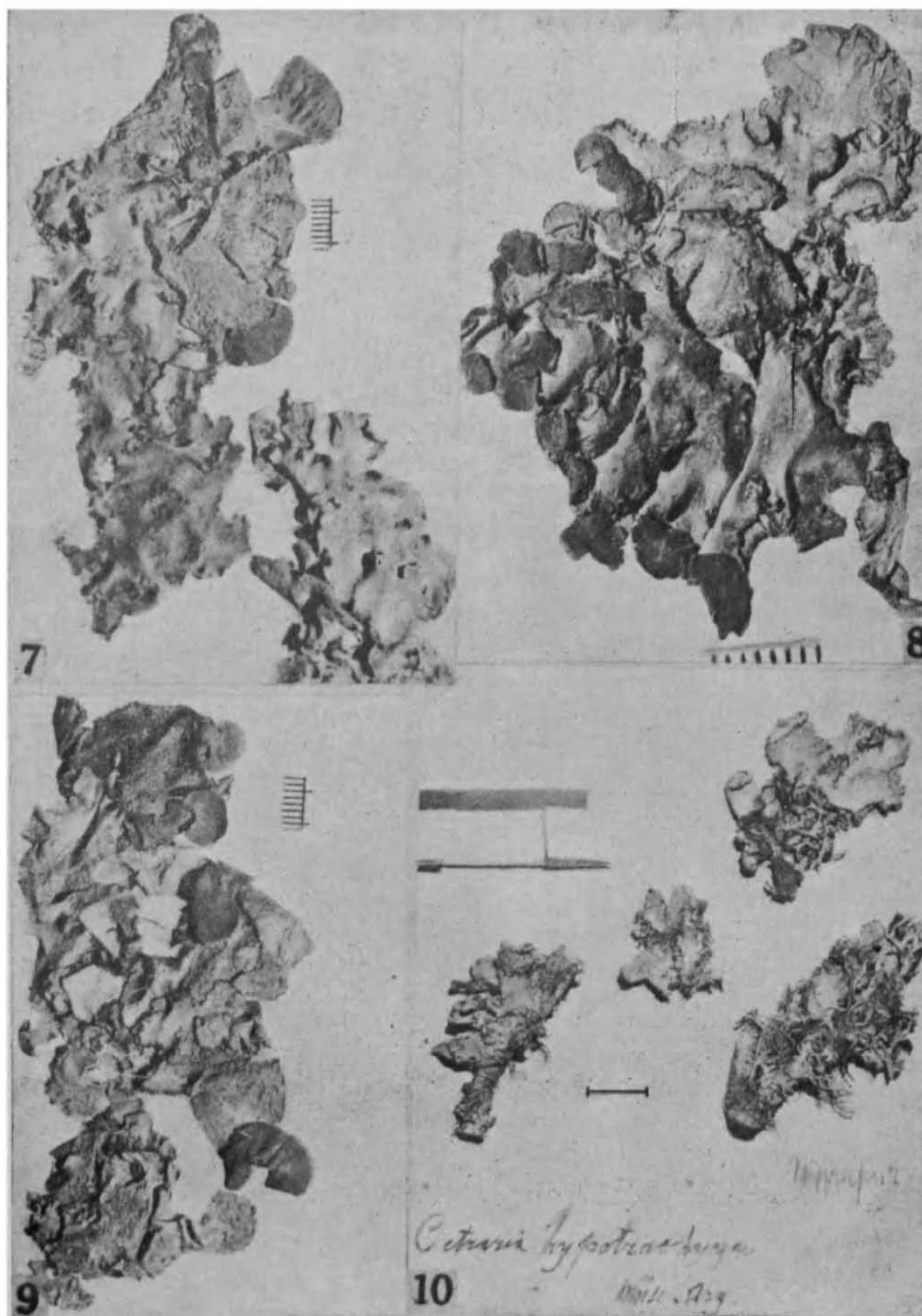
Thallus foliose, horizontally spreading, attached to substratum by rhizinae on lower-

side, thick coriaceous, up to 10 cm across; lobes rounded, irregularly divided and convolute, up to 2 cm wide; upperside smooth to faintly lacunose scrobiculate, yellowish grey to brownish yellow; margin with dense, black pycnidial fibrils; lowerside yellowish grey, brownish grey to darker brown in the central part, irregularly reticulately lamellate rugose, rarely smooth, pseudocyphellate; pseudocyphellae white, on general surface or on ridges of lamellae; rhizinae sparse, present in the central part of thallus, thick, branched and brown. Thallus 250-400 (500) μ m thick; medulla white. Apothecia marginal, nephromoid, oblong to reniform, up to 15 mm long and 5 mm wide; disc red brown to dark brown; receptacle scrobiculate rugose; spores $5-9 \times 3.5-5 \mu$ m. Cortex and medulla K-, C-, KC-, P-. TLC: Caperic acid (Herb. Awasthi No. 175), caperic acid and squamatic acid (Herb. Awasthi No. 2289), in some specimens also Usnic acid.

Cetraria delavayi is distinguished by the coriaceous thallus, lamellate, rugose lower surface with white pseudocyphellae, marginal black fibrils and nephromoid apothecia. It is close to *C. stracheyi* and *C. nephromoides* in the coriaceous thallus, presence of pseudocyphellae, but both of these taxa lack marginal black fibrils. The taxon originally described from China, is distributed in the eastern Himalayas.

Habitat: On tree trunks and branches (often found on ground having fallen from the tree canopy).

Specimens examined: INDIA: West Bengal, Darjeeling district, Batasi to Pal-majua, alt. ca. 2250 m, (collected fallen on ground), Awasthi 175 (Herb. Awasthi). Nepal, E. Nepal, Mewakhola valley, alt. ca. 3600 m, on *Rhododendron* tree trunk, Awasthi 2289 (Herb. Awasthi); ascent to Sandakhpoo (India) from eastern Nepal side, alt. ca. 3300 m, Awasthi 2476, 2476A (Herb. Awasthi), the latter specimen is much more yellowish and has usnic acid.



Figs. 7-10 : 7. *C. delavayi* (Hue) Sato, Awasthi 175. 8. *C. endoxanthoides* Awas., holotype, Awasthi 2477. 9. *C. delavayi* (Hue) Sato, Awasthi 2289. 10. *C. hypotrachyna* Müll.-Arg., holotype, Watt 6949 (BM).

3. *C. endoxanthoides* Awas. sp. nov. (Fig. 8)

Thallus foliaceus, membranaceus, opacus, ca. 4 cm latus, procumbens; supra viridiflavens, $\pm$ laevigatus, pseudocyphellatus; subtus ad centro nigrum, et ad peripheram pallido-brunneus; pseudocyphellatus; lobi 5-10 mm lati; rhizinis paucius; marginis papillatis vel spinulis ornatis. Medulla crocea. Apothecia 3-5(6) mm lata, marginalia, fere orbicularia; receptaculum reticulatim rugosum. Asci 8 spori; sporae hyalinae, simplices, ellipsoideae, $6-9.5 \times 4.5-6 \mu$ m. Medulla K+flavens, C-, KC-, P+aurantiacum (acidum fumarprotocetraricum et protocetraricum).

Type collection: Nepal, E. Nepal, Mewakhol valley, alt. ca. 2400-2700 m, on branch of tree, 28.5.1953, D.D. Awasthi 2477 (Holotype: Herb. Awasthi).

Thallus foliose, horizontally spreading, $\pm$ appressed, ca. 4 cm across, attached to substratum by rhizinae on lowerside; lobes rounded, 5-10 mm wide, somewhat imbricate; upperside greenish yellow, smooth to slightly lacunose, croceus pseudocyphellae in the central part; margin of lobes densely black papillate to fibrillate; lowerside yellowish brown in the peripheral region and brown black in the central part, minutely lacunose, $\pm$ shining, sparsely minutely pseudocyphellate; rhizinae in the central part of thallus, black, simple to branched. Isidia and soredia absent. Thallus 200-400 μ m thick, medulla pale croceus. Apothecia marginal, disc directed upwards, 3-5(6) mm in diam., $\pm$ rounded, slightly cracked lobate; disc dark brown, smooth; receptacle reticulately rugose. Asci 8 spored; spores colourless, simple, ellipsoid, $6-9.5 \times 4.5-6 \mu$ m. Upper cortex K-, C-, KC-, P-; medulla K+yellow, C-, KC-, P+orange. TLC: Fumarprotocetraric, protocetraric acids, unidentified substance charring deep orange, TDA 1-2, HEF 1-2, ? Trace of lich-esterinic and protolich-esterinic acids (fide P. W. James in litt.).

Cetraria endoxanthoides is subsimilar to *C. endoxantha* (Hue) Awas. Comb. Nov. (basonym: *Nephromopsis endoxantha* Hue, Nouv. Arch. Mus. Ser. 4, 1: 220. 1899), *Cetraria ornata* Müll.-Arg. and *C. endocrocea* (Asah.) Sato in the yellow to golden colour of the medulla, but is distinguished by the presence of pseudocyphellae on both the surfaces and the P+orange reaction of the medulla. The species is only known from the type collection.

4. *C. hepatizon* (Ach.) Vain. Lich. Cauc. Taur. p. 278: 1899. *Lichen hepátizon* Ach. Lich. Suec. Prodr. p. 110. 1798. Type not seen. (Fig. 11)

Thallus foliose, small, appressed to substratum, 1-1.5 cm across, lacinate lobate, lobes 1-3 mm wide, $\pm$ convex; upper surface dark brown to brown black, smooth; margin and lamina with short, black pycnidial papillae; lower surface black, with sparse, short, black rhizinae. Isidia, soredia and pseudocyphellae absent. Medulla white. Apothecia marginal, 0.7-1 mm in diam., disc dark brown, margin crenulate; spores $8-12 \times 5-7.5 \mu$ m. Medulla K-, C-, P+orange. TLC: Stictic and norstictic acids.

Cetraria hepatizon is distinguished by the brown-black parmelioid (*Melanoparmelia*-like) habit of thallus, P+orange medullary reaction, the crenulate margin of apothecia. The taxon is distributed in the dry temperate to alpine regions firmly attached to rocks and boulders.

Specimen examined: INDIA: Uttar Pradesh, Uttarkashi district, on way to Gomukh near Bhojbasa, alt. ca. 3600 m, on gravelly ground, Awasthi & Singh 8379 (Herb. Awasthi).

5. *C. hypotrachyna* Müll.-Arg. Flora 74: 373. 1891. Type collection: Manipur, on twigs, G. Watt 6949 (Holotype: BM!) —associated with *Parmelia* sp. and *Usnea* sp. (Fig. 10)

Thallus foliose, $\pm$ appressed, rigid, coriaceous, ca. 3 cm across, lobes rounded, up to 10 mm wide, margin irregular with 0.7×0.4 mm sized black pycnidial fibrils; upper surface yellowish grey to grey, scrobiculate rugose with dispersed, short, black fibrils in groups of 3 to 5; lower surface pale brown, dark brown to brown black, reticulately lamellate rugose; rhizinae black, sparse, simple to forked or branched. Isidia, soredia and pseudocyphellae absent. Thallus 300-500 μ m thick, medulla yellowish ochraceous. Apothecia marginal, 2-4 mm in diam., concave to plane, shortly pedicellate, not nephromoid; receptacle rugose with short, black fibrils along the margin; disc brown, smooth; hymenium ca. 50 μ m high; spores oval ellipsoid, $6-8 \times 4-5 \mu$ m. Medulla K+ yellowish brown, C-, P+orange. TLC: Norstictic, salacinic, caperatic and traces of usnic acids.

Cetraria hypotrachyna is distinguished by the scrobiculate, black fibrillate upper surface, the lamellate rugose lower surface and P+orange medulla. Müller Argoviensis (l.c.) considered the taxon as near to *C. rhytidocarpa*, but the latter has a smooth, thin thallus with pseudocyphellae on both the surfaces. *C. hypotrachyna* is somewhat close to *C. isidioidea* in the scrobiculate, fibrillate upper surface, the lamellate to scrobiculate-rugose lower surface, but the latter has pseudocyphellae on lower surface and its medulla is P-. The taxon is known from the type collection only.

6. **C. isidioidea** (Räs.) Awasthi. Stat. et comb. nov. *Cetraria wallichiana* var. *isidioidea* Räs., Arch. Soc. Zool. Bot. Fenn. 'Vanamo' 5(1): 25. 1950. Type collection: E. Himalayas (West Bengal), Darjeeling district, Rimbick to Sandakhpoo, alt. ca. 2700 m (=9000 ft.), on dead tree stump, June 1948, D. D. Awasthi 179 (Holotype: H! isotype: Herb. Awasthi!). (Fig. 15) Thallus foliose, horizontally spreading, $\pm$ appressed, rigid coriaceous, ca. 5.5 cm

across; lobes somewhat imbricate, irregularly divided, 1-2 cm wide; upper surface grey to yellowish grey brown, irregularly reticulately scrobiculate, with numerous, simple to rarely forked, black fibrils on the ridges and along irregularly crenulate margin; lower surface brown black; lamellate to scrobiculate rugose with peg-like outgrowths; pseudocyphellae on ridges and peg-like outgrowths; rhizinae absent. Isidia, soredia absent. Thallus 300-500 μ m thick; medulla straw yellow to ochraceous. Apothecia not known. Upper cortex K-, C-, KC-, P-; medulla K+yellowish, C-, KC-, P-. TLC: Lichesterinic, protolichesterinic acids and two pigments (charring pale yellow-brown at TDA 4, HEF 2; and UV+orange at TDA 1, HEF 2)—fide P. W. James.

Remarks: Räsänen (1952) regarded his *C. wallichiana* var. *isidioidea* Räs. as a synonym of *C. hypotrachyna* apparently on superficial appearance, the colour of medulla, and the black fibrils on upper surface and margin. However, the two taxa differ significantly, as has been detailed above under *C. hypotrachyna*. The taxon lacks isidia, the specific epithet is thus misleading. The taxon is known from the type collection only.

7. **C. laeteflava** Zahlbr. Flecht. Ins. Form. 2: 60. 1933. Type presumably at Vienna (W)—not seen. *Cetraria straminea* Vain. Philipp. Journ. Sci. 4: 657. 1909, non *C. straminea* Krempelh. ex anno 1860, fide Sato (Lamb, 1963, p. 160).

Thallus foliose, horizontally spreading, attached to substratum by rhizinae on lower side, ca. 5 cm across; lobes ca. 10 mm wide, membranaceous; upper surface yellowish grey to pale grey, often with black blotched areas along the margin and in the central part; margin minutely black papillate; lower surface yellowish grey to black, shining, smooth to minutely lacunose rugose with sparse, short, black rhizinae. Thallus

pseudocyphellate on both the surfaces; pseudocyphellae white, ca. 0.5 mm across, brownish rimmed, lacking fibrils along the rim. Isidia and soredia absent. Thallus 200-300 μ m thick; medulla white, rarely yellowish at places. Apothecia marginal, nephromoid, reniform, 1 $\times$ 0.4 cm in size; disc brown, smooth; receptacle scrobiculate rugose and pseudocyphellate. Asci 8 spored; spores ellipsoid with pointed ends, one side more convex than the other, 9-16 (18) $\times$ 5.5-8 μ m. Upper cortex K+deep yellow, C-, P-; medulla K+yellow, C-, KC-, P+orange-red. TLC: Fumarprotocetraric and protocetraric acids, and traces of lichesterinic and protolichesterinic acids, (fide P. W. James in specimen Panigrahi 6349 B).

Cetraria laeteflava is characterized by the presence of pseudocyphellae on both surfaces, the absence of fibrils along their rim and characteristic spores. It is close to *C. rhytidocarpa* and *C. endoxanthoides* but is easily distinguished by the spores. *C. laeteflava* is known from S. E. Asia.

Specimen examined: INDIA: Arunachal Pradesh (N.E.F.A.), Chakoo, alt. 2425 m, on dead wood and also on ground (fallen?), Panigrahi 6349 B (Herb. Awasthi, and B.S.I. Herb. Shillong), reported as *C. straminea* Vain. by Awasthi (1961).

8. *C. laureri* Krempelh. Flora 34: 673. 1851; Hillmann in Rabenhorst, Kryptog. Fl. 9(5/3): 276. 1936. *Cetraria complicata* Laufer apud Fr., Lichenogr. Eur. p. 459. 1831—nomen nudum. Type not seen. (Fig. 12)

Thallus foliose, procumbent to subascending at periphery, ca. 5 cm across; irregularly to dichotomously divided and deeply lobed; lobes 2-6 mm wide, $\pm$ imbricate; upperside involute, smooth, yellowish brown; lower surface pale brown to darkish, slightly rugose and white pseudocyphellate; rhizinae sparse, concolorous with lower surface; margin of lobes inter-

mittently soraliolate; soredia farinose to granular; minute black fibrils in non-soraliolate part of margin. Medulla white. Apothecia absent in the specimens examined. Medulla K-, C-, KC-, P-. TLC: Lichesterinic, protolichesterinic and usnic acids in small quantities (fide P. W. James in specimen—Awasthi 7569).

Cetraria laureri is distinguished by deeply lobed, peripherally subascending thallus with narrower lobes, the marginal soralia and pseudocyphellae on lower surface. It somewhat resembles *C. chlorophylla* in the soraliolate habit, but that species lacks pseudocyphellae. The taxon is distributed in Europe.

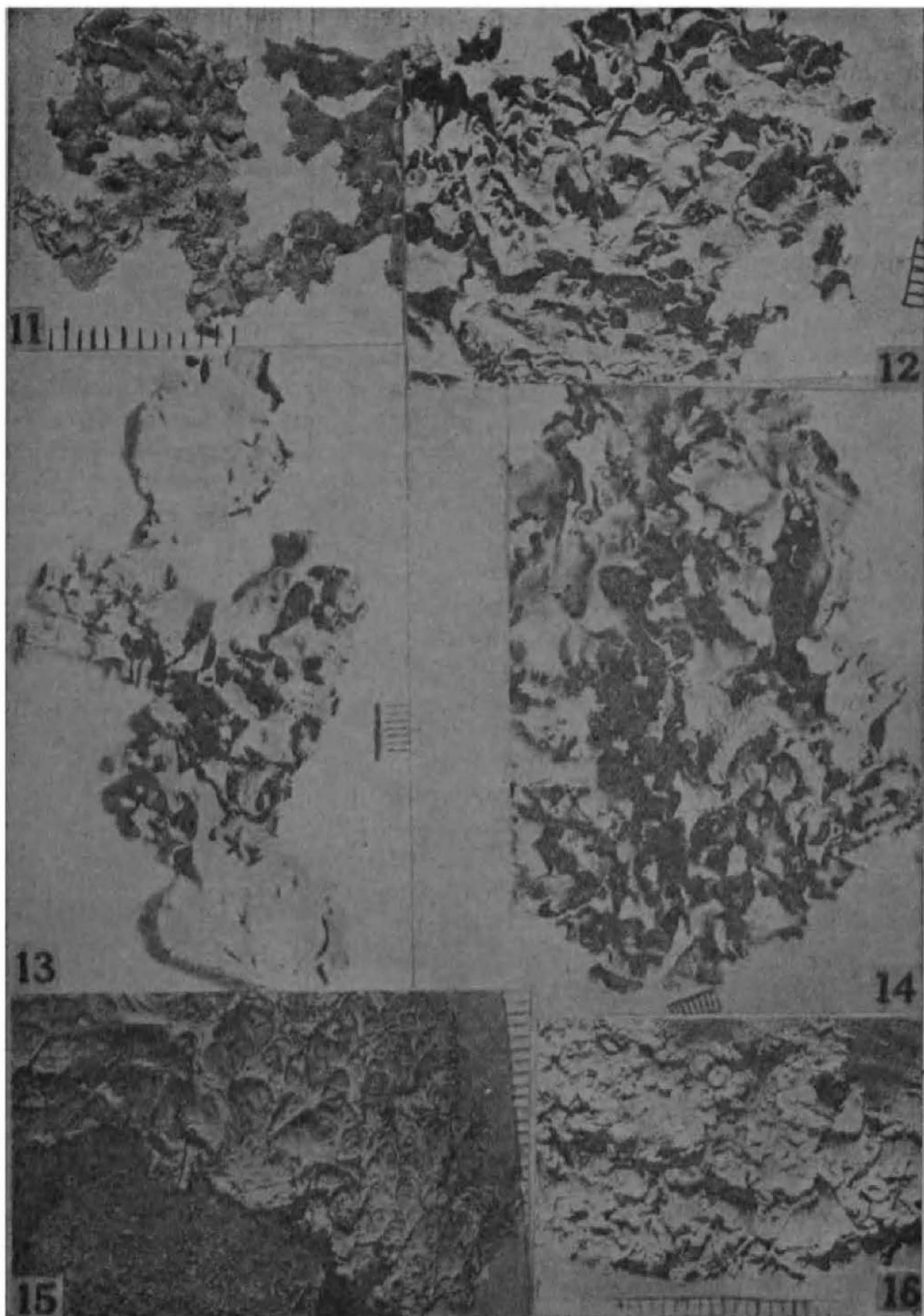
Habitat: On twigs and bark of *Rhododendron* tree.

Specimens examined: INDIA: Uttar Pradesh, Almora district, Dhakuri ridge, alt. ca. 2400 m, Awasthi 7569 (LWU, and Herb. Awasthi); Uttarkashi district, on way to Gomukh from Gangotri, alt. ca. 3300 m, Awasthi & Singh 8291 (Herb. Awasthi). Nepal, E. Nepal, Topkegola, Rupakhiola valley, alt. ca. 4000 m, Awasthi 2387 (Herb. Awasthi).

9. *C. nephromoides* (Nyl.) Awasthi, comb. nov. *Platysma nephromoides* Nyl., Flora 52: 442. 1869. Type collection: Herb. Ind. Or. Hook. fil & Thomson, No. 2080, Tonglo, Sikkim, 10,000 ft, col. J. D. Hooker (Lectotype: H-NYL 36068!; isolectotype: BM).

NB: Tonglo is now in West Bengal and not in Sikkim. In the type description the number is mentioned as 2020, apparently an error. *Nephromopsis stracheyi* f. *ectocarpisma* Hue, Nouv. Arch. Mus. Ser. 4, 1: 218. 1899. Type not indicated. (Figs. 13 & 14)

Thallus foliose, horizontally spreading, attached to substratum by rhizinae on lower side, thick, coriaceous, ca. 10-12 cm across, much convolute; lobes 1-2(4) cm wide, imbricate, undulate; upper surface green-



Figs. 11-16 : 11. *C. hepatizon* (Ach.) Vain., Awasthi & Singh 8379. 12. *C. laureri* Krempelh., Awasthi 7569. 13. *C. nephromoides* (Nyl.) Awas., lectotype, Hook. fil & Thomson 2080 (H-NYL 36068). 14. *C. nephromoides* (Nyl.) Awas., Awasthi & Awasthi 642B. 15. *C. isidioidea* (Räs.) Awas., isotype, Awasthi 179 —upper one shows upper surface, and lower one lower surface. 16. *C. pinastri* (Scop.) S. Gray, Awasthi & Singh 8554.

ish grey to glaucous yellow or grey, smooth to slightly scrobiculate lacunose; margin lacking black fibrils; lower surface yellow to yellow brown, sometimes tanned brown in lobe apices; finely irregularly lacunose rugose with white pseudocyphellae on general surface or in slight depressions; rhizinae short, stout. Isidia and soredia absent. Thallus 200-400 μ m thick; medulla white. Apothecia marginal, mature nephromoid, often reflexed exposing the disc upwards, up to 7(9) $\times$ 3-5 mm in size, semi-reniform; disc dark brown; receptacle scrobiculate rugose; spores ellipsoid, 7-9 $\times$ 3-5 μ m. Cortex and medulla K-, C-, KC-, P-. TLC: Usnic, lichesterinic, protolichesterinic and caperatic acids, and a pigment in some specimens (*vide* P. W. James).

Cetraria nephromoides is similar to *C. stracheyi* in general morphology of thallus except that it is slightly thinner and the apothecia are smaller; it is distinctly different in medulla being C-, KC- (lacking olivetoric acid). The taxon is distributed in the Himalayas and eastwards in Asia.

Habitat: On bark of trees.

Specimens examined: INDIA: Arunachal Pradesh (N.E.F.A.), Chakoo, alt. ca. 2400 m, Panigrahi 6349 (B.S.I. Herb. Shillong, Herb. Awasthi); Jabrang to Pumila, alt. ca. 2700 m, Rao 8182 (B.S.I. Herb. Shillong, Herb. Awasthi); Takepoking, Rao 17771 (B.S.I. Herb. Shillong, Herb. Awasthi). Uttar Pradesh, Almora district, Loharkhet-Dhakuri, alt. ca. 2500 m, Awasthi & Awasthi 624, 624B (Herb. Awasthi). West Bengal, Darjeeling district, Tongloo, alt. 10,000 ft. (=3000 m) Hook. fil & Thomson No. 2080 (BM, H-NYL 36068); Sandakhpoo to Phalut, alt. ca. 3600 m, Awasthi & Agarwal 67 442 (LWU); Rimbick to Sandakhpoo, alt. 2700' m, Awasthi 188 (Herb. Awasthi); Batasi to Palmajua, alt. 2800 m, Bose 60.65, 60.151 (Herb. Awasthi); Nepal, E. Nepal, ascent to Sandakhpoo (India) from Nepal

side, near ridge, alt. ca. 3600 m, Awasthi 2470 B, Rakshe to Ethung, alt. 2700 m, Awasthi 2128 A (both Herb. Awasthi).

10. *C. pallescens* Schaer. apud Moritzi, Syst. Verz. p. 129. 1845-46. Type collection: Java, presumably at G, not seen. (Figs. 17 & 18).

Thallus foliose, horizontally spreading, up to 12 cm across, coriaceous, attached to substratum by rhizinae in the central part on lower surface; lobes rounded, up to 10 mm wide, somewhat ascendent and rosulate marginally, irregularly divided, slightly convolute undulate; upper surface glaucous yellow to yellowish grey or green, smooth to slightly scrobiculate lacunose; margin lacking black fibrils; lower surface greyish yellow to light castaneous yellow in wide lobes, densely reticulately lamellate rugose, lamellae not high, and with plug-like outgrowths; pseudocyphellae on ridges of lamellae and on plug-like outgrowths; rhizinae sparse, short, brown. Isidia and soredia absent. Thallus 300-400 (500) μ m thick, medulla white. Apothecia typically marginal, disc facing upwards, shortly pedicellate to somewhat reflexed, 1-2 (3) mm in diam., generally rounded to ellipsoid oblong; disc plane to slightly convex, dark brown; margin thin, smooth to crenulate; asci rarely mature, 8 spored; spores oval ellipsoid 5-6.5 (9) $\times$ 2.5-4.5 μ m. Medulla K-, C-, KC-, P-. TLC: Lichesterinic, protolichesterinic and usnic acids (*vide* P. W. James in specimen Awasthi 7593).

Cetraria pallescens closely resembles *C. nephromoides* in the form of the thallus, the marginal apothecia, and the medullary reaction by K, C and P. The two are separated by the lamellate-rugose surface of the under side with special plug-like pseudocyphellae on ridges of lamellae and the smaller apothecia (1-3 mm) in *C. pallescens*, while in *C. nephromoides* the lower surface is usually smooth to slightly rugose with pseudocyphellae level with the surface

or in depressions and the larger apothecia. Final decision can be possible after examination of the type of this taxon.

Habitat: On tree trunk and branches.

Specimens examined: INDIA: Sikkim, near Karponang, Awasthi 173, 174 (Herb. Awasthi); Jongri, Bose 60.130 (Herb. Awasthi); Uttar Pradesh, Almora district, Dhakuri ridge, alt. 2700 m, on *Rhododendron* and *Quercus* trees (often also found fallen on the ground from the trees), Awasthi & Awasthi 625, 641 (Herb. Awasthi), Awasthi 1768, 7593 (LWU, Herb. Awasthi); near Phurkia, alt. 3000 m, Awasthi & Awasthi 729 (Herb. Awasthi); Chamoli district, Mandakini river valley, Gaurikund, alt. 2800 m, Dange 76.137 (LWU); Dehradun district, Chakrata, alt. 2700 m, Awasthi 960 (Herb. Awasthi); West Bengal, Darjeeling district, Batasi-Palmajua, Bose 60.62, 60.63 (Herb. Awasthi). Nepal, E. Nepal, ascent to Sandakhpoo (India) from Nepal side, alt. ca. 3300 m, Awasthi 2468 A, 2469 (Herb. Awasthi); Mewakhola valley, alt. 2400 m, Awasthi 2237 B (Herb. Awasthi); no precise locality, Banerjee 1411 A (Herb. Awasthi).

11. **C. pinastri** (Scop.) S. Gray. Natur. Arrangem. Brit. Pl. 1: 432. 1821. *Lichen pinastri* Scop., Fl. Carniol. ed. 2, 2: 382. 1772. Type not seen. (Fig. 16)

Thallus foliose, appressed or adnate to substratum, up to 3 cm across; lobes compact, $\pm$ imbricate, 2-3 mm wide; upper-side yellow to deep yellow, smooth to lacunose; lowerside light yellow, reticulately lacunose with sparse, short, concolorous to brown rhizinae; margin of lobes undulate, soraliolate; soredia yellow, granular. Medulla yellow. Isidia, pseudocyphellae and marginal fibrils absent. Apothecia absent in the specimens examined. Cortex and medulla K-, C-, KC-, P-. TLC: Usnic, vulpinic and pinastric acids.

Cetraria pinastri is distinguished by the appressed yellow thallus with marginal yellow soralia. In general external appearance

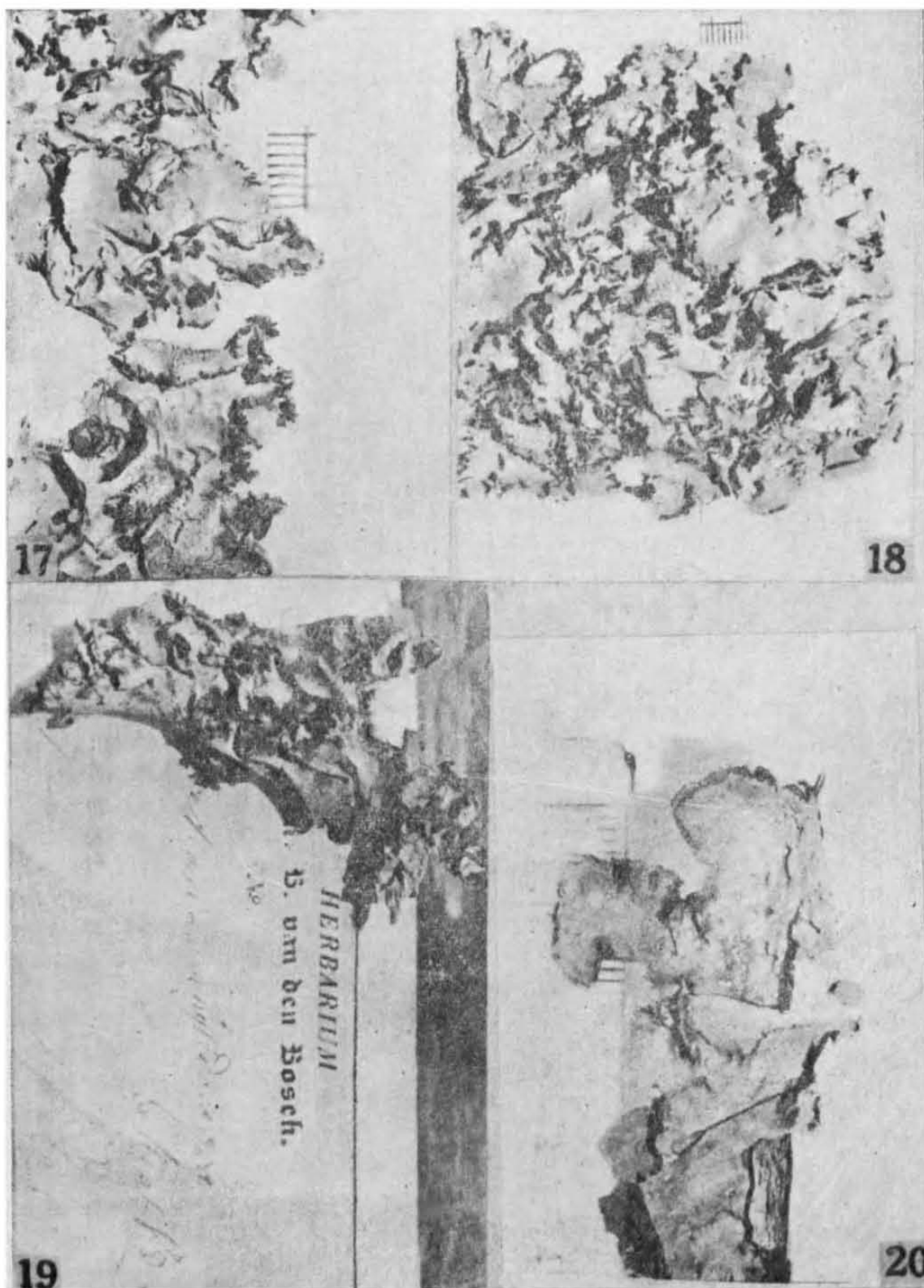
it resembles *Parmelia ulophylloides* but in the latter the medulla is C+red (gyrophoric acid).

Habitat: On bark of coniferous trees.

Specimens examined: Uttar Pradesh, Uttarkashi district, Gangotri to Gomukh area, alt. ca. 3300-3600 m, Awasthi & Singh 8285, 8327, 8360, 8554, 8597 (Herb. Awasthi); N. W. Himalayas, Chini, Skoliezka 345 (CAL, H-NYL 36203).

12. **C. rhytidocarpa** Mont. et v. d. Bosch apud Jungh. Plant. Junghuhn, fasc. 4: 430. 1855. Type collection: Java, Junghuhn s. n. (Lectotype: PC). *Nephromopsis rhytidocarpa* (Mont. et v. d. Bosch) Zahlbr. Ann. Cryptog. Exot. 1(2): 208. 1928. (Figs. 19 & 20).

Thallus foliose, partially appressed and attached to substratum by rhizinae on lower-side, ca. 8 cm across; lobes up to 15 mm wide, irregularly undulate, lobulate and imbricate; upper surface yellowish grey to glaucous yellow, somewhat blackening along the margin, smooth to lacunose rugose; lowerside black in the central part and yellowish brown in the marginal area; pseudocyphellae present on both the surfaces, brown black rimmed or not, often with black, short fibrils along the rim of the pseudocyphellae; margin of lobes with dense, simple to furcate, black pycnidial fibrils; rhizinae short, black, dispersed in groups. Isidia and soredia absent. Thallus 200-300 (400) μ m thick; medulla white. Apothecia marginal, rounded, up to 10 mm in diam., $\pm$ peltate, concave to cup-shaped, to slightly nephromoid in some cases; margin crenulate; disc dark brown, smooth; receptacle rugose, pseudocyphellate; asci 8 spored; spores oval ellipsoid, 5-8(9) $\times$ 3-5(7) μ m. Medulla K+yellowish red, C-, P+orange red. TLC: Fumarprotocetraric, protocetraric acids. Trace of lichesterinic and protolichesterinic acid, and an unidentified substance charring deep orange, TDA 1-2,



Figs. 17-20 : 17. *C. pallescens* Schaer., Awasthi 641. 18. *C. pallescens* Schaer., Awasthi 7593. 19. *C. rhytidocarpa* Mont. et v.d. Bosch, lectotype, Junghuhn (PC). 20. *C. rhytidocarpa* Mont. et v.d. Bosch, Bosc 60.138—the pseudocyphellae with black fibrils are distinct.

HEF 1-2 (*vide* P. W. James in specimen, Panigrahi 15707).

Cetraria rhytidocarpa has distinctive black fibrillate pseudocyphellae on both the sides of the thallus, as well as containing fumarprotocetraric acid (medulla P+red). The lobes and habit recall the *Parmelia* (*Amphigymnia*) thallus. The taxon is apparently close to *C. asahinae* Sato, which is also reported to have fibrillate pseudocyphellae and the medulla which is P+red. However I have not examined the type specimen of *C. asahinae* Sato. Specimen collected and determined as *C. asahinae* by Kurokawa (No. 57167), is yellowish brown to brown, more thick and coriaceous with narrower lobes, more cetrarioid than parmelioid in colour, medulla is P+orange-red.

Habitat: On twigs of trees or on dead wood.

Specimens examined: INDIA: Arunachal Pradesh (N.E.F.A.), Kalaktang to Morsing, on dead wood, Panigrahi 15707 (Herb. B.S.I. Shillong, Herb. Awasthi); Parila, alt. ca. 2745 m, Panigrahi 6397 C (Herb. B.S.I., Shillong, Herb. Awasthi), both the specimens were reported as *C. asahinae* by Awasthi (1961); West Bengal, Darjeeling district, Batasi-Palmajua, alt. ca. 2400 m, Awasthi 396 (Herb. Awasthi); Sandakhpoo to Phalut, alt. ca. 3600 m, Bose 60.138 (Herb. Awasthi). Nepal, E. Nepal, Mewakhola valley, alt. ca. 2400 m, Awasthi 2227 (Herb. Awasthi). Java, no precise locality, Jung-huhn s. n. (PC); Java (H—NYL 36082), may be isotype material, annotated as *Platysma rhytidocarpa* (Mont.) Nyl. in Nylander's handwriting.

13. *C. stracheyi* Bab. Hook. Journ. Bot. 4: 245. 1852. Type collection: Himalayas, Kumaon, Kathi, alt. 7200 ft. (=ca. 2160 m), (R. Strachey & J. E. Winterbottom No. 11) (Holotype: BM; isotypes: BM, H—NYL 36138!). *Nephromopsis* (*stracheyi*

(Bab.) Müll.-Arg. Flora 74: 374. 1891. (Figs. 21 & 22.)

Thallus foliose, attached to substratum by rhizinae near the central part of thallus on lowerside, horizontally spreading, thick coriaceous, 15-20 (or more) cm across, much convolute; lobes imbricate, variable in width, sterile lobes wider than the fertile and then 3-4 cm wide; upperside glaucous yellow to yellowish grey or slightly brownish, smooth to slightly scrobiculate lacunose-rugose; margin rounded, entire, lacking black fibrils; lowerside yellow to yellow-brown, reticulately nervose rugose, marginal area of some lobes brownish; pseudocyphellae on the plane surface or raised on ridges; rhizinae short, sparse, concolorous with lower surface. Isidia and soredia absent. Thallus 300-500 (600) μ m thick; medulla white. Apothecia marginal, nephromoid, sometimes reflexed upwards, oblong to reniform, up to 15 $\times$ 10 mm in size; disc red brown to dark brown, smooth; receptacle smooth to lacunose rugose; margin thin, smooth to crenulate. Asci rarely with mature spores; spores ellipsoid, 5-7(9) $\times$ 3.5 μ m. Upper cortex K—, C—, KC—, P—; medulla K—, C+red, KC+red, P—. TLC: Olivetoric acid, usnic acid (present or absent), an unknown substance at TDA 2. The type also has a trace of anziac acid and an unknown fatty acid. As a rule this species lacks protolichesterinic and lichesterinic acids (*vide* P. W. James).

Remarks: I have been able to examine the isotype material only. The specific epithet on the sheet is spelled 'stracheii', but since the published epithet is *stracheyi* Bab., after Strachey, the same has been accepted here. The name of the collector of the specimen is not mentioned on the sheet; the specimens had been collected by Strachey and Winterbottom. The details from the holotype material at BM have been added by Dr. James. The locality Kathi could be Khati in Almora district,

which is on the way to Pindari Glacier from which area Strachey and Winterbottom had made their collections of plants. Specimens collected by me from Khati are very similar to the isotype material.

Cetraria stracheyi is distinguished by the large coriaceous thallus with large nephromoid apothecia and the C+red, KC+red reactions of the medulla. Thallus with small immature apothecia can be confused with *C. nephromoides* and *C. pallescens*, the medulla in both these taxa is C-, KC-. The taxon frequent in the Himalayas extends to eastern Asia.

Habitat: On branches and trunks of trees, often found fallen on ground from trees.

Specimens examined: INDIA: Arunachal Pradesh (N.E.F.A.), Bomdila to Ralang, alt. 2460 m, Rao 7358, Seargaon, Panigrahi 15798 (Herb. B.S.I. Shillong, Herb. Awasthi); Sikkim, Thomson 270 (H-NYL p.m. 1474 pr. p.); Uttar Pradesh, Almora district, Dhakuri ridge, alt. ca. 2800 m, Awasthi & Awasthi 642, Khati to Dwali, alt. ca. 2400 m, Awasthi & Awasthi 712 (Herb. Awasthi), both the specimens are very much similar to the isotype. Himalayas, Kumaon, Kathi, alt. 7200 ft (=2160 m, Strachey and Winterbottom) (H-NYL 36138); Uttarkashi district, near Jamnotri, alt. ca. 3450 m, Awasthi 910 (Herb. Awasthi); West Bengal, Darjeeling district, alt. 2300 m, Awasthi 176, 177 (Herb. Awasthi); Tiger hill, alt. 2500 m, Awasthi 3877, Bose 60.33, 60.139 (Herb. Awasthi). Nepal, E. Nepal, Rakshe to Ethung, alt. 2700 m, Awasthi 2128 B, ascent to Sandakhpoo (India) from Nepal side, alt. ca. 3300 m, on dead wood stump of conifer tree, Awasthi 2470 A (both in Herb. Awasthi).

14. *C. wallichiana* (Tayl.) Müll.-Arg. Flora 71: 139. 1888. *Sticta wallichiana* Tayl., Hook. Journ. Bot. 6: 177. 1847. *Type collection*: Nepal, Wallich (possibly No.

5) (Holotype: FH!, isotypes: BM). (Fig. 23.)

Thallus foliose, horizontally spreading, attached to substratum by rhizinae on lower side, 8-15 cm across, thick coriaceous, irregularly convolute; lobes imbricate, up to 2 cm wide, irregularly divided; upper side glaucous green to yellow green to grey, $\pm$ smooth to reticulately scrobiculate rugose; margin smooth, lacking black fibrils; lower side yellow to brownish yellow, reticulately densely lamellate rugose, pseudocyphellate; pseudocyphellae on ridges, and also on plug-like outgrowths; rhizinae sparse, in groups, short, grey to brown black. Isidia and soredia absent. Thallus 200-400 (500) μ m thick, medulla white. Apothecia laminal, extending up to the submarginal or marginal region, dense, sessile to substipitate, 0.5-1(2) mm in diam., plane to convex; disc pale brown to dark brown, margin thin, entire, often excluded. Asci rarely mature; spores ellipsoid, 8-10 $\times$ 3.5-5 μ m. Medulla K-, C-, KC+red or reddish, P-. TLC: Alectoronic acid, usnic acid (present or absent), lichesterinic and protolichesterinic acids and α -collatolic acid ($\pm$) (*fide* P. W. James in isotype material)

Cetraria wallichiana is distinctive in the foliose, coriaceous thallus with laminal, dense, small apothecia and the KC+reddish reaction of the medulla. It resembles no other species in the form and nature of apothecia. The lower surfaces of *C. wallichiana* and *C. pallescens* are very similar, but the latter has marginal apothecia and medulla is KC-. The taxon is distributed in the Himalayas and extends eastwards in Asia.

Habitat: On branches of trees, often found fallen on ground from trees.

Specimens examined: INDIA: Arunachal Pradesh (N.E.E.A.), Jabrang, alt. 2405 m, Panigrahi 6432, down Jabrang, near Rupa, alt. 2445 m, Rao 7232 (Herb. B.S.I., Shillong, Herb. Awasthi); Sikkim, Jongri, alt.



Figs. 21-23 : 21. *C. stracheyi* Bab., isotype, Strachey & Winterbottom (H—NYL 36138). 22. *C. stracheyi* Bab., Awasthi 2470A. 23. *C. wallichiana* (Tayl.) Müll.-Arg., Awasthi & Joshi 76.83.

3900 m, Bose 60.131 (Herb. Awasthi). Uttar Pradesh, Almora district, Dhakuri, alt. 2550 m, on *Quercus* tree. Awasthi & Awasthi 623, 626, 640 (Herb. Awasthi), same locality Awasthi 7592, 7619 (LWU, Herb. Awasthi); Dehradun district, Chakrata, Deoban, alt. 2700 m, Awasthi 961 (Herb. Awasthi); same locality Awasthi & Joshi 76.83, 76.151 (LWU); Manipur, Watt (BM *fide* P. W. James); West Bengal, Darjeeling district, Batasi-Palmajua, alt. 2150 m, Awasthi 180 (Herb. Awasthi), Tonglo (Sikkim), 10,000 ft (=3000 m), Hooker 2081 (BM *fide* P. W. James), Nepal, no precise locality, Wallich (FH); Mewakhola valley, alt. 2400 m, Awasthi 2237 A, ascent to Sandakhpoo (India) from Nepal side, alt. 3000 m, Awasthi 2468 (Herb. Awasthi).

Subgenus *CETRARIA*

Thallus suberect to erect, subfruticose, laciniate lobate, attached to substratum basally, rhizinae absent or rare.

15. *C. ambigua* Bab. Hook. Journ. Bot. 4: 244. 1852. Type collection: (India) Garhwal, Bompras, alt. 16000 ft. (=4800 m) on wood and mosses, R. Strachey and J. E. Winterbottom 6, Himalayan herbarium (Holotype and isotype: BM!) (Fig. 24)

Thallus prostrate to suberect, subdichotomously divided, laciniae $\pm$ compact, soft, up to 3 cm long, (1) 2-3 mm wide; upper-side yellow to ochraceous, plane to concave, smooth to faintly lacunose; margin undulate, smooth, sparsely minutely black papillate; lowerside deeper yellow to orange-yellow, $\pm$ longitudinally to reticulately lacunose-scrobiculate. Isidia, soredia and pseudocyphellae absent. Thallus 200-300 μ m thick; medulla white. Apothecia absent in the type specimen. In a specimen from Sikkim (BM) $\pm$ corresponding to the type: apothecia marginal to submarginal, up to 4 mm diam., disc $\pm$ concave, brown; recep-

tacle slightly lacunose; hymenium *ca.* 40 μ m high, asci 22-30 $\times$ 6-8 μ m in size; spores immature. (Nylander 1860, p. 311: "spores 7-9 $\times$ 4 μ m". Cortex and medulla K-, C-, KC-, P-. TLC: Usnic, licheterinic and protolicheterinic acids (also *fide* P. W. James).

To some extent, *C. ambigua* resembles *C. nivalis*, but the laciniae of the thallus in the latter are wider, thicker and distinctly scrobiculate. *C. ambigua* also shows some resemblance to *C. everniella* particularly in the width of laciniae and black papillae along margin, but the latter has yellow to ochraceous medulla, having 2-3 pigments. *C. ambigua* is endemic to the alpine areas of the Himalayas above 3700 m.

Habitat: On ground, rocks, on mosses and twigs.

Specimens examined: INDIA: Sikkim, *ca.* 4200 m, on twigs, Hooker 2061 (BM)—fertile; Uttar Pradesh, Garhwal, Bompras, alt. *ca.* 4800 m, Strachey & Winterbottom 6 (BM); Uttarkashi district, Gomukh area, alt. *ca.* 3700 m, on ground over mosses, Awasthi & Singh 8521 (Herb. Awasthi), reported as *C. nivalis* by Awasthi & Singh (1978). Nepal, E. Nepal, Topkegola, ridge between Rupapokhari and Sajupokhari, alt. *ca.* 4500 m, Awasthi 2407 (Herb. Awasthi), fertile with *ca.* 10 mm diam. apothecia, spores 7-8 $\times$ 5-6 μ m, with similar lichen products as *C. ambigua* has been considered cf. to *C. ambigua* as the thallus is $\pm$ coriaceous. (Fig. 29)

16. *C. cucullata* (Bell.) Ach. Meth. Lich. p. 293. 1803. *Lichen cucullatus* Bell. Observ. Bot. p. 54. 1788. Type not seen. (Fig. 26)

Thallus suberect to erect, 2-3 cm tall, subdichotomously divided, (1) 2-4 mm wide, laciniae canaliculate by connivent margins; upper surface pale straw to yellow, smooth, basally brown black; margin smooth to slightly wavy, lacking black fibrils or papillae; lowerside smooth, concolo-

rous with upperside or paler, minutely pseudocyphellate or cracked pseudocyphellate (pseudocyphellae distinct only under lens). Isidia and soredia absent. Thallus 140-250 μ m thick, medulla white. Apothecia absent in the specimens examined. Cortex and medulla K—, C—, KC—, P—. TLC: Usnic and protolichesterinic acids.

Cetraria cucullata is distinguished by involute, canaliculate, pale yellow to yellow, thin thallus. In Indian specimens the marginal papillae (fibrils) are absent, though they have been reported in the European specimens. The taxon is widely distributed in the temperate alpine regions of the world. In Himalayas it is not common, and has been found in associations with *C. everniella*.

Habitat: On ground amongst mosses, and low alpine vegetation.

Specimens examined: INDIA: Uttar Pradesh, Uttarkashi district, Gomukh area, Alt. ca. 4200 m, Awasthi & Singh 8493 B; Almora district, Phurkia near Pindari glacier, alt. ca. 3850 m, Awasthi & Awasthi 781A (both Herb. Awasthi).

17. *C. everniella* (Nyl.) Krempelh. Verhandl. Zool. Bot. Gesellsch. Wien 18: 315. 1868. *Platysma everniellum* Nyl. Synop. Lich. 1: 311. 1860, nom. nov. for *Evernia stracheyi* Bab. in Hook. Journ. Bot. 4: 244. 1852. Type collection: (India) Kumaon, Gori river, alt. 4700 ft (erroneous, probably 11700 ft), among mosses and dead leaves, R. Strachey & J. E. Winterbottom (Lectotype: H—NYL 36055!; isolectotype: BM). (Figs. 27 & 28)

Thallus suberect to erect, caespitose, 2-4 cm tall, subdichotomously branched, laciniae irregularly (1) 2-3 mm wide, slightly revolute, sometimes laciniae narrow, $\pm$ radially symmetrical with slight lacunose condition on all sides; upperside yellow grey to brownish yellow often tending to be brown in herbarium with passage of time, smooth,

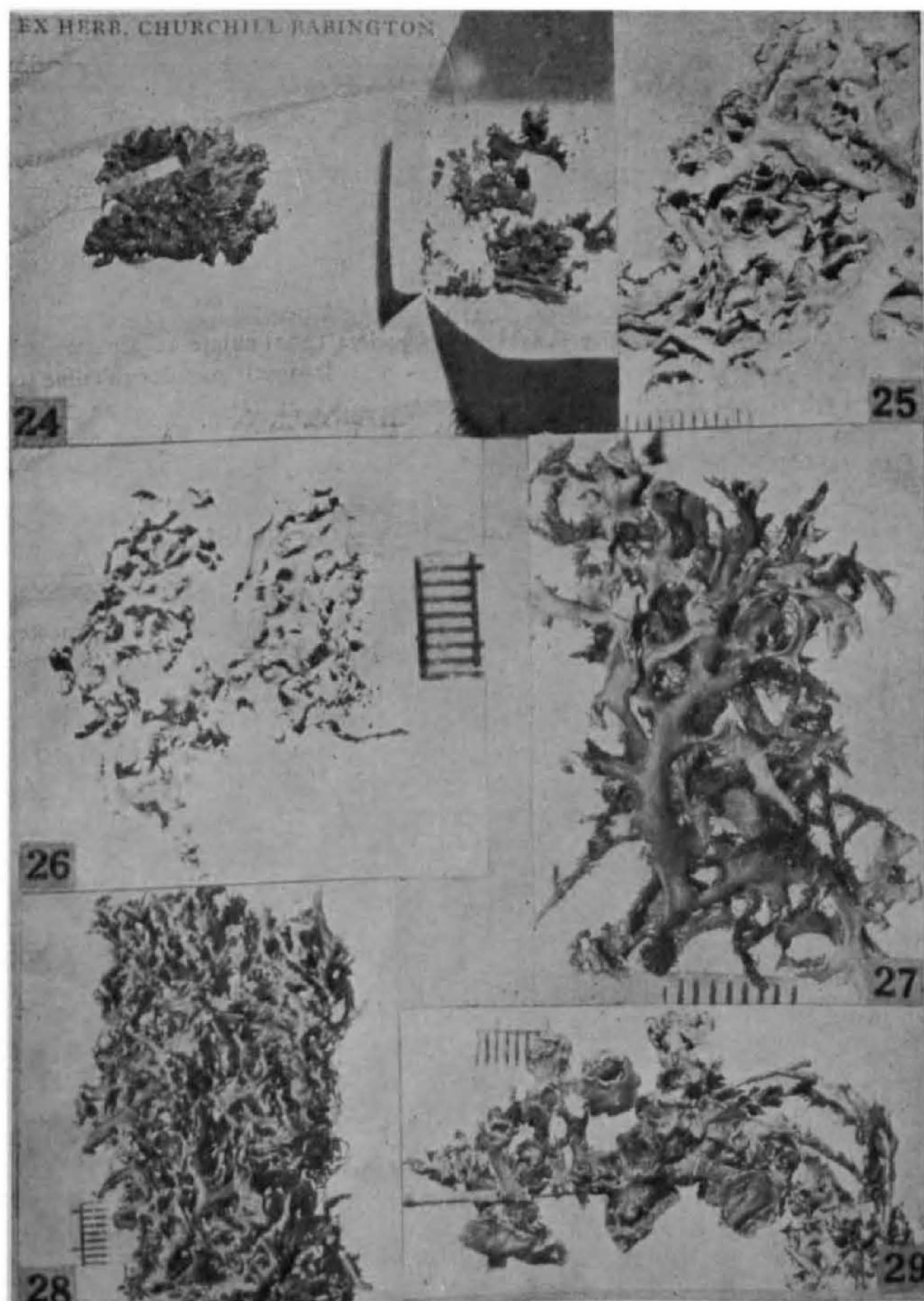
convex; margin with black pycnidial papillae, which often get broken leaving scars or exposed medulla and thus may appear as pseudocyphellae; lowerside deep yellow to reddish brown, concave, slightly reticulately lacunose or scrobiculate. Isidia, soredia and pseudocyphellae absent. Thallus 300-500 (600) μ m thick, medulla yellowish to ochraceous in the central part. Apothecia absent in the specimens examined. Cortex and medulla K—, C—, KC—, P—. TLC: Usnic, protolichesterinic, lichesterinic acids, and 3 pigments: (A) charring rose-pink at TDA 4 HEF 5; (B) charring pale yellow-brown at TDA 4 HEF 2; (C) UV+ orange at TDA 1 HEF 2. Sometimes only 2 pigments and two fatty acids (*fide* P. W. James in type and other material).

Remarks: The altitude of the type material (at BM & H) is given as '4700 ft' corresponding to subtropical conditions. This must be an error, as *C. everniella* is typically an alpine species (i.e. above about 11,000 ft). Gori river originates in Kumaon from the Milam glacier at an altitude of about 12,000 ft., and it is likely that the specimen may have been collected near its origin, and the altitude could be 11700 ft. There may have been a slip in the handwriting of Churchill Babington and the '4' may be a compact '11'. The specimens cited below have been collected above 11000 ft.

Cetraria everniella is a distinct species with narrow, 2-3 mm wide laciniae, convex and smooth on upperside, and a concave lacunose-rugose lower side, as well as an ochraceous medulla. The specimens with narrower and subcylindrical (almost radially symmetrical) laciniae have been referred to form a *subteres* Asah. by Asahina (1955). *C. everniella* shows some similarity with *C. ambigua*, but that species has somewhat thinner thallus and white medulla.

Habitat: On ground, among mosses etc.

Specimens examined: INDIA: Sikkim, Mornay, alt. 15,500 ft (=ca. 4650 m), J. D.



Figs. 24-29 : 24. *C. ambigua* Bab., holotype, Strachey & Winterböttöm 6 (BM). 25. *C. cf. potaninii* Oxner, Rao 13758. 26. *C. cucullata* (Bell.) Ach., Awasthi & Singh 8493B. 27. *C. everniella* (Nyl.) Krempelh., Awasthi 2744. 28. *C. everniella* (Nyl.) Krempelh., Awasthi 7683. 29. *C. cf. ambigua* Bab., Awasthi 2407.

Hooker 1746 (BM, H—NYL 36054); Wallanchoon, alt. 12,000 ft (=3600 m), J. D. Hooker 2062 (BM, H—NYL 36056); Himalayas, no precise locality, leg.? (H—NYL p.m. 1483); Uttar Pradesh, Almora district, Phurkia-Mirtoli near Pindari glacier, alt. ca. 3600 m, Awasthi & Awasthi 781 (Herb. Awasthi); same locality, Awasthi 7683, 7690, 7744 (LWU, Herb. Awasthi); Kumaon, Gori river (in Pithoragarh district), alt. 4700 ft. (?), Strachey & Winterbottom (H—NYL 36055, BM—; *fide* James), Uttarkashi district, Gomukh area, alt. ca. 3780 m, Awasthi & Singh 8527 (Herb. Awasthi). Nepal, E. Nepal, Chupkula to Laboji, alt. 4998 m, Rao 13786 (Herb. B.S.I., Shillong, Herb. Awasthi).

18. **C. islandica** (L.) Ach. Meth. Lich. p. 293. 1803. *Lichen islandicus* L. Sp. Pl. p. 1145. 1753. Type in Herb. LINN seen by P. W. James, in litt. (Fig. 30)

Thallus suberect to erect, densely divaricately branched, coriaceous, 2.5–3.5 (5) cm tall, laciniae 2–3 (5) mm wide, major part of laciniae involute subcanaliculate, much polymorphic in size, involuteness, and branching of thallus lobes; upperside light brown to dark chestnut brown, smooth; margin densely beset with brown to brown-black pycnidial fibrils; lowerside yellowish brown to brown, smooth to scrobiculate, shining, pseudocyphellate; pseudocyphellae whitish, laminal rounded to irregular, submarginal $\pm$ continuous and linear-elongate basal part of laciniae brown black. Isidia and soredia absent. Thallus 200–350 μ m thick, medulla white. Apothecia absent in specimens examined. Cortex K–, C–, P–; medulla K–, C–, KC–, P+red. TLC: Fumarprotocetraric, protocetraric and protolichesterinic acids.

Cetraria islandica, a polymorphic species, is separated by the brown chestnut colour of thallus, subcanaliculate laciniae with marginal fibrils, pseudocyphellae in submarginal area and lower lamina of thallus, and

P+red reaction of the medulla. The Himalayan material has shorter and narrower laciniae in comparison to the Scandinavian and European material. Kärnefelt (1979) has pointed out that *C. islandica* ssp. *islandica* “does not seem to reach the Himalayas”. The Himalayan material subsimilar to *C. islandica* has been stated to be *C. laevigata*. The two taxa differ in the “Lobes canaliculate to subtubular, laminal pseudocyphellae rare and indistinct” in *C. laevigata*, and “Lobes less canaliculate to almost flat, marginal and laminal pseudocyphellae usually present” in *C. islandica*. The Himalayan specimens examined by me show variation in being flat to canaliculate, but possess both laminal and submarginal pseudocyphellae. The narrower the thallus, the more canaliculate the laciniae are. I have not seen any typical *C. laevigata*.

Habitat: On ground with mosses and grasses, often associated with *C. everniella* and *Thamnolia* sp.

Specimens examined: INDIA: Uttar Pradesh, Almora district, Phurkia near Pindari glacier, alt. ca. 3450–3600 m, Awasthi & Awasthi 781B (Herb. Awasthi); same locality Awasthi 7682, 7792 (LWU, Herb. Awasthi); Uttarkashi district, Gomukh area, alt. ca. 3500 m, Awasthi & Singh 8458 (Herb. Awasthi). Nepal, E. Nepal, Topkegola, Rupapokhari and Sajupokhari area, alt. ca. 4500 m, Awasthi 2395, 2411 (Herb. Awasthi).

19. **C. laevigata** Rassad., Kärnefelt, Opera Bot. 46: 111 117. 1979.

The taxon is characterised by a usually 3–6 cm tall lacinate thallus, strongly canaliculate to subtubular with marginal (submarginal) pseudocyphellae in distinct continuous line, other characters $\pm$ similar to *C. islandica*.

I have not come across the typical specimens of this taxon.

20. **C. leucostigma** Lév. in Jacquemont Voyag. dans l'Inde Bot. p. 180. Tab.

180, fig. 4. 1841-44. Type Collection: India Orientalis, ad *Quercum truncos* (type not seen, location of type not known). Neotype proposed: India Orientalis, dédit Lévillé (H-NYL 36083!), annotated as *Platysma leucostigma* (Lév.) in Nylander's handwriting. *Cetraria sikkimensis* Räs. Arch. Soc. Zool. Bot. 'Vanamo' 5(1)25. 1950. Type collection: Sikkim, Chhangu, alt. ca. 3900 m, on branches of *Rhododendron* shrub, May 1947, D. D. Awasthi 355 (Holotype: H—sterile; isotype: Herb. Awasthi—fertile!). (Figs. 31, 32 & 33)

Thallus suberect to erect, 3-5 (8) cm tall, irregularly to subdichotomously branched, widest part 5-7 (10) mm; lobes usually 5 mm wide, plane to involute subcanaliculate towards apices, undulate along margin; upperside yellow brown to pale brown, smooth; margin irregular with black, 0.2-0.4 mm long sparse to dense pycnidial fibrils; lowerside pale brown, light brown to chestnut brown, smooth to slightly lacunose rugose, pseudocyphellate; pseudocyphellae white, $\pm$ depressed, 0.1-0.2 (0.5) mm across, with or without brown rim; sometimes thick, black rhizinae present in groups. Isidia and soredia absent. Thallus 180-280 μ m thick, medulla white. Apothecia rare (only two seen, one in isotype of *C. sikkimensis*, and one in Awasthi 2409 from Nepal), marginal, subnephromoid, $\pm$ peltate on the margin, round to oblong, 10 $\times$ 6 mm in size; disc concave to plane, brown, smooth; receptacle scrobiculate rugose; asci 8 spored; spores simple, hyaline, oval, 8-9 $\times$ 6 μ m; paraphyses ca. 3 μ m thick, capitate brownish at apices. Cortex and medulla K—, C—, KC—, P—. TLC: Lichesterinic, protolichesterinic and usnic acids (*fide* P. W. James in isotype of *C. sikkimensis*).

Remarks: The type specimen could not be examined as its location is not known. The neotype here proposed is dédit by Lévillé, and it is likely that it may be a

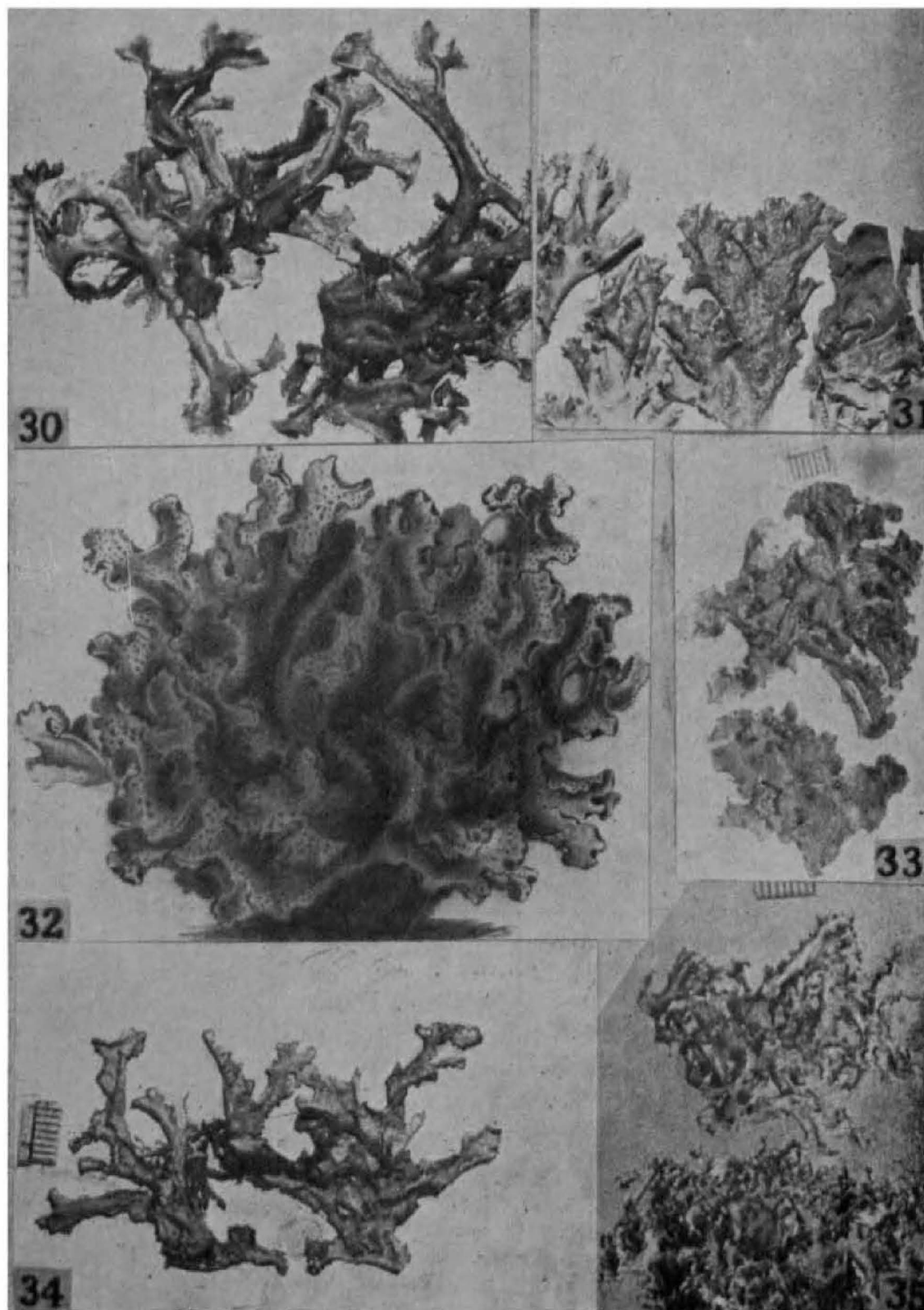
part of the type; but since the annotation is that of Nylander rather than of Lévillé, it has been considered more correct to consider the collection as a neotype rather than an isotype. The type description "Thallo foliaceo, membranaceo adscendentes luteo subtus punctato, lobis rotundatis undulatis, margine aculeatis" as well as the figure (Tab. 180, fig. 4), reproduced here as Fig. 32 corresponds to the neotype, as well as to the type material of *C. sikkimensis*. Räsänen (1952) considered *C. sikkimensis* a synonym of *Nephromopsis rhytidocarpa* (= *C. rhytidocarpa*), but as indicated here this taxon is quite distinct and is unrelated to *C. sikkimensis*.

Cetraria leucostigma is closed to *C. melaloma* in the thallus habit and presence of pseudocyphellae on the lower surface, but the latter has a yellow to brownish yellow thallus and narrower laciniae. The taxon is only known from the Himalayas.

Habitat: On ground or on twigs of low, small shrubs.

Specimens examined: INDIA ORIENTALIS: precise locality not given, dédit Lévillé (H—NYL 36083). Sikkim, Chhangu, alt. ca. 3900 m, on twigs of low shrubby *Rhododendron*, Awasthi 355 (H, Herb. Awasthi), type of *C. sikkimensis*. Nepal, E. Nepal, Topkegola, ridge between Rupapokhari and Sajupokhari, alt. ca. 4500 m, Awasthi 2409 (Herb. Awasthi).

21. *C. melaloma* (Nyl.) Krempelh. Verhandl. Zool. Bot. Gesellsch. Wien, 18: 315. 1868. *Platysma melalomum* Nyl. Synop. Lich. 1: 303. 1860. Type collection: (India), Sikkim, Jongri, regione alpina, supra mare, alt. 13000 ft, inter Cladonias et muscos, J. D. Hooker 2065 (Lectotype: BM!; isotype H—NYL 36072!) in the isotype sheet Hooker no. is inscribed '2665', apparently an error and should be corrected to 2065. *Cetraria pallida* Awas., Proc. Indian Acad. Sci. 45B: 130. 1957, Plate 10, Fig. 1. Type collection: Nepal,



Figs. 30-35 : 30. *C. islandica* (L.) Ach., Awasthi 2411. 31. *C. leucostigma* Lév., Awasthi 355 (isotype of *C. sikkimensis* Räs.). 32. *C. leucostigma* Lév., photograph of the fig. in Jacquemont, Voyag. Ind. Bot., Table 180, fig. 4. 1841-44. 33. *C. leucostigma* Lév., dédit Lévaille (H—NYL 36083)—neotype proposed. 34. *C. melaloma* (Nyl.) Krempelh., Lectotype, Hooker 2065 (BM). 35. *C. cf. potaninii* Oxner, Awasthi 8473.

E. Nepal, Topkegola, Thaglabhanjyang, alt. ca. 4200 m, 29.5.1953, D. D. Awasthi 2347 (Holotype: Herb. Awasthi!). (Fig. 34.)

Thallus suberect to erect, 2-3.5 cm tall, irregularly to dichotomously branched, laciniae 2-6 mm wide, plane to involute, subcanaliculate with undulate margins; upper surface yellow to yellowish grey to mottled brown at the base, smooth to faintly lacunose, rarely pseudocyphellate; margin brown lined, with 0.1-0.2 mm long black fibrils; lower surface paler than the upper, pseudocyphellate; pseudocyphellae brown-black rimmed, round, 0.5 mm across to linear or irregular in outline. Isidia and soredia absent. Thallus ca 250 μ m thick, medulla white. Apothecia not known. Cortex and medulla K-, C-, KC-, P-. TLC: Lichesterinic and protolichesterinic acids (*vide* Kärnefelt, l.c.).

Cetraria melaloma is distinctive in yellowish, suberect to erect, narrowly laciniate thallus with pseudocyphellae on lower surface. It is similar to *C. leucostigma*, but the latter has comparatively taller and wider lobes or laciniae and is also darker in colour. *C. melaloma* is restricted in the alpine Himalayas.

Habitat: On ground with mosses.

Specimens examined: INDIA: Sikkim, reg. alpine, Jongri, Hooker 2065 (BM, H); Hooker 2063, 2066 (BM); same locality, Bose 60.132 (Herb. Awasthi); Wallanchoon, Hooker 2067 (BM), thallus prostrate to suberect among mosses. Type collection: Nepal, E. Nepal, Thaglabhanjyang, Awasthi 2347 (Herb. Awasthi) type of *C. pallida*.

22. *C. nepalensis* Awasthi. Proc. Indian Acad. Sci. 45B: 130. 1957, Plate 10, fig. 2; Kärnefelt, Opera Bot. 46: 117. 1979, Fig. 64. Type collection: Nepal, E. Nepal, Topkegola, Thaglabhanjyang, alt. ca. 4300 m, on ground among mosses, 29.5.1953, D.

D. Awasthi 2373 (Holotype: Herb. Awasthi!).

Thallus 2-4 cm tall, subdichotomously divided, laciniae 2-3(4) mm wide, plane to involute subcanaliculate; upperside smooth, chestnut brown, shining, margin undulate, with 0.25 mm long black fibrils; lowerside concolorous with upperside or paler brown, basal decaying parts of thallus yellowish. Isidia, soredia and pseudocyphellae absent. Thallus 160-200 μ m thick, medulla white. Apothecia not known. Cortex and medulla K-, C-, KC-, P-. TLC: Lichesterinic and protolichesterinic acids (*vide* Kärnefelt, l.c.).

The taxon does not show any resemblance to any other species of *Cetraria*. It is only known from the type collection.

23. *C. nigricans* Nyl., Kärnefelt, Opera Bot. 46: 117-121, 1979.

The taxon is characterised by a small 0.5-1.5(3) cm tall thallus, with 0.5-1.5(3) mm wide lobes, brown or pale brown in colour, pseudocyphellae almost indistinguishable, marginal cilia up to 2 mm long, lacking fumarprotocetraric acid (medulla P-). *C. nigricans* var. *himalayana* Asah. described from Nepal has been considered by Kärnefelt as a synonym of the taxon. There is no other record of the taxon from the Himalayas, and I have not seen or examined any.

24. *Cetraria* sp. (cf. *C. potaninii* Oxner, Sp. Lich. nov. As. p. 168. 1933). (Figs. 25 & 35)

Thallus suberect to erect, up to 2.5 cm tall, crisp, $\pm$ caespitose; laciniae subdichotomously divided, 1-3 mm wide, involute, subcanaliculate, upperside yellowish grey to yellow, smooth to faintly lacunose; margin crenate, with small black papillae or with minute brown black fibrils; lowerside yellow to deeper yellow, often lacunose rugose, the lacunose scrobiculate condition more pronounced in older parts of laciniae. Isidia, soredia and pseudocyphellae absent. Apothecia marginal, up to 3 mm in diam., disc

concave, brown, margin crenulate. Asci not mature. Cortex and medulla K—, C—, KC—, P—. TLC: Usnic, lichesterinic and protolichesterinic acids.

The specimens cited below show some similarity with *C. potaninii* Oxner in the involute subcanaliculate laciniae, forming tussocks, but they could not be confirmed.

Habitat: On ground.

Specimens examined: INDIA: Uttar Pradesh, Uttarkashi district, Gomukh area, alt. ca. 3600 m, Awasthi & Singh 8473, 8493 A (Herb. Awasthi), reported as *C. nivalis* by Awasthi & Singh (1978). Nepal, E. Nepal, Pambochi to Mingbo, alt. 4480 m, Rao 13758 (Herb. B.S.I. Shillong, Herb. Awasthi).

EXCLUDED TAXA

The following taxa have been reported to occur in India by several workers (see Awasthi, 1965). Of these, the specimens of the following were not available for study, as there were none in our collection:

Cetraria fahluensis (L.) Schaer. and *C. saepincola* (Ehrh.) Ach.

Others have been transferred as follows:

Cetraria crispa var. *japonica* = *C. laevigata* Räsäd.

C. nigricans var. *himalayana* Asah. = *C. nigricans* Nyl.

Cetraria glauca (L.) Ach = *Platismatia glauca* (L.) Culb. & Culb.

Cetraria sanguinea Schaer. = *Cetrelia sanguinea* (Schaer.) Culb. & Culb.

Cetraria megaleia (Nyl.) Räs. = *Cetrelia sanguinea* (Schaer.) Culb. & Culb.

Cetraria thomsonii (Stirt.) Müll.-Arg. = *Parmelia thomsonii* (Stirt.) Culb. & Culb.

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