

SOME FOLIOSE AND FRUTICOSE LICHENS FROM ASSAM AND NORTH-EAST FRONTIER AGENCY OF INDIA

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THE north-eastern mountainous region of India, due to its interesting geographic and climatic conditions, is able to support a variety of flora, comprising one of the most moist tropical forests on the one hand and temperate and alpine vegetation on the other. It had consequently attracted the plant explorers since almost the very inception of the modern botanical investigations in this country. As a result of this, though, the higher plants from this region are now considerably well known it is, however, not so as far as the lower plants and especially the lichens are concerned. There have been only sporadic collections of lichens from this region notable of which are those of Simons from Khasia hills and of G. Watt from Manipur while the greater part of this area remains yet unexplored in this respect.

A collection of foliose and fruticose lichens made by Mr. Rolla Seshagiri Rao and Dr. G. Panigrahi of the Botanical Survey of India from Assam and North-East Frontier Agency during the years 1956-58 was sent to me for determination. It comprised of 35 specimens from Assam and 110 specimens from North-East Frontier Agency and could be considered fairly comprehensive for the latter area. Majority of the specimens have now been identified up to the specific level and are found to belong to 72 species under 18 genera and 9 families.

In addition to the usual abbreviations for chemical reactions used in Lichenology the following have been used in the text:—

NEFA = North-East Frontier Agency.

RSR = Rolla Seshagiri Rao.

GP = G. Panigrahi.

The number of specimens within parenthesis pertains to the field number of the collectors. The specimens are preserved in the Shillong herbarium of the Botanical Survey of India.

Collemaceæ

Leptogium saturninum (Dicks.) Nyl.

On bark of Rhododendron; NEFA, Bumla-Tawang, alt. 12,000 ft., 1957, RSR (No. 7921).

Thallus foliaceous, with rounded sinuate lobes, olivaceous to dark lead-brown coloured, smooth to reticularly lacunose on the upper side and grey-brown, tomentose (rhizinose) on underside. Apothecia subpodicellate, up to 1.5 mm. in diameter, cupular, with thin margin; spores muriform colourless, ellipsoid, $20-26 \times 8-10 \mu$ in size.

Leptogium cf. *menziesii* (Sm.) Mont.

On Quercus; NEFA, Towang to Zarang, alt. ca. 8,500 ft., 1957, RSR (No. 7967); Assam, Mamlu forest, 1956, RSR (No. 2715). Specimens foliaceous, thin, bluish-grey-brown. Sterile.

Leptogium cf. *tremelloides* (L.) S. Grey.

On rock surface in water dripping place; NEFA, Tirap F.D., 1958, GP (No. 14758).

Thallus foliaceous, thin, membranous, glaucous-lead coloured, smooth on both the sides. Apothecia subpodicellate, disc reddish-brown with yellowish margin; spores muriform, colourless, ellipsoid, $20-24 \times 8-9 \mu$ in size.

Leptogium sp.

On stone; NEFA, Seargaon, 1958, GP (No. 15796).

Thallus grey-brown-black, foliaceous, margin undulate crispate; above smooth; below tomentose; apothecia submarginal, immature.

Pannariaceæ

Coccocarpia pellita (Ach.) Müll. Arg. (Plate III, Fig. 1)

Assam, Shillong, 1956, GP (No. 3825).

Thallus foliose, orbicular, arising as monophyllous but ultimately sub-polyphyllous due to overlapping of the lobes. Lobes thick, adnate; upper side marked with concentric shell-like conformations, smooth, grey-brown in colour; underside with thick black rhizinæ-like hyphæ. Thallus up to 120μ thick, plectenchymatously corticated on both the sides, cortices variable in thickness between $20-28 \mu$ on either side; algal zone $30-40 \mu$ thick with *Scytonema* alga; medulla of semi-vertical hyphæ. The rhizinæ-like processes on the underside as hyphal prolongations of the cortex, $5-7 \mu$

thick, thick-walled septate hyphæ. Apothecia dark-brown to black, adpressed on the thallus, up to 1.5 mm. in diameter and irregular in outline; spore colourless, one-celled, $11-12 \times 4 \mu$ in size.

Stictaceæ

Lobaria discolor (Bory) Hue

On dry boulders; NEFA, Rupa-Jabrang, alt. 5,150 ft., 1957, GP (No. 6606).

Thallus foliose, sinuate laciniate lobate; lobes broadly crenate, pale-glaucous to darkish glaucous above; pale to copper pale in marginal and dark-brown in central parts on the underside; elongated fibrils and brownish rhizinæ also present on the underside. Apothecia usually crowded in central part of the thallus, young almost closed and superficially subgranulate, mature elevated and subpodicellate; disc reddish-brown, 2.5 mm. in diameter, margin crenulate; spores colourless, 2-celled, $30 \times 7 \mu$ in size. Thallus K + yellowish, medulla K—, Pd—.

Lobaria retigera (Bory) Trevis.

On trees; NEFA; Bomdila, 1957, GP (No. 6837); Chakoo, alt. 8,086 ft., 1957, GP (No. 6283); above Nyukmadong, 1957, RSR (No. 7633); Sela to Senge Dzong, alt. 11,700 ft., 1957, RSR (No. 7760); Siang, F. D., Minguing-Takepoking, alt. 5,700 ft., 1958, RSR (No. 17,824).

Thallus large foliaceous, broadly laciniate lobate and irregularly pinnatifid, apices crenate; upper side pale-reddish to brownish-black, reticulate-foveolate and scrobiculate, surface smooth without soredia and isidia; underside with the corresponding reversed reticulations, the grooves with black rhizinæ and the bullate surface smooth to scarcely rhiznose. Thallus and medulla K—, Cl—, Pd—. Apothecia usually present, submarginal, superficial, up to 1.5 mm. in diameter, plane to convex, margin crenulate to almost appearing immarginate in mature condition; disc dark red-brown to brown-black; spores colourless, fusiform, $28-32 \times 8-9 \mu$ in size.

The colour and thickness of the thallus is variable in different specimens and is probably dependent on ecological and climatic conditions. It is usually thickish coriaceous with more prominent reticulations in specimens from higher altitudes which probably also brings about a greater darkening of the thallus as they are usually darker-brown to brown-black in high altitudes. Similar variations were also noticed in specimens collected by me

from East Nepal, where specimens above 10,000 ft. altitude are coriaceous darker-brown to brown-black while in lower temperate region they are thinner and reddish-brown.

Lobaria isidiosa (Müll. Arg.) Vain. var. *squamulifera* Awasthi var. nov.
(Plate III, Fig. 2)

A typo differt thallus angustiore, isidia late squamuliforma.

Assam, Jowai to Jorain, 23-1-1957, G. Panigrahi (No. 5083), Typus in Herbarium, Botanical Survey of India, Shillong and Isotype in herb. *meo*.

Thallus foliaceous, sinuate laciniate lobate; lobes furcate, about 1 cm. broad, 6 cm. long, scrobiculate, red-brown in colour; the ridges with dense isidiose flattened squamules which initially arise as minute cylindrical normal isidia-like but later gradually get flattened, dorsiventral and dense squamuliform. Medulla K—, Cl—, Pd—.

Lobaria sp.

On bark of trees; Bomdila, alt. 7,200 ft., 1957, GP (No. 6951).

Thallus foliose, large expanded, broadly laciniate lobate; above pale-greyish to glaucous (bluish-green when collected); below pale-greyish to pale, marginally pale-copper-coloured, concolorous rhizinæ in the central part only. Thallus sterile, K—, Cl—, Pd—.

Pseudocyphellaria aurata (Ach.) Vain.

On rock; NEFA, Siang, F. D., Tutting to Koppu, alt. 2,000–2,400 ft., 1958, RSR (No. 14739).

Specimens as two small fragments. Thallus foliose, laciniate lobate, lobes crisp, crenulate and undulate; upper side pale-glaucous-grey, smooth, margins bright-yellow sorediate; underside dark-brown, tomentose in central part and naked pale at the periphery; pseudocyphellæ on the underside pale-yellow and rounded. Thallus sterile, Cortex K—, Pd—; medulla K—, Pd +, deep yellow in algal zone only rest colourless.

Sticta henryana Müll. Arg.

On moist wood; NEFA, Parila, alt. 9,150 ft., 1957, GP (No. 6393 A).

Thallus small, sterile (initials of apothecia in submarginal region present).

Sticta platyphylloides Nyl.

On dead *Rhododendron* trunk and on *Quercus* trunk; NEFA, Sela to Senge Dzong, alt. 11,700 ft., 1957, RSR (No. 7759); Tawang

to Zang, alt. ca. 8,500 ft., 1957, RSR (No. 7966); Senge Dzong to Nyukmadong, alt. 9,500 ft., RSR (No. 8015).

Thallus rigid coriaceous, older parts more or less rugulose. Apothecia stipitate, up to 6 mm. in diameter, red to red-brown, margin crenulate dentate; spores elongate, fusiform, $45-58 \times 6-7 \mu$ in size.

***Sticta weigeli* Isert.**

On tree bark; Assam, Jowai to Jorain, 1957, GP (No. 5084).

Thallus lacinate lobate; lacinæ imbricated, margin undulated and granular isidiate. Thallus above dark pale to pale-brown; underside dark-brown tomentose. The marginal isidia are characteristic of the species. Thallus sterile. Thallus and medulla K—, Pd—.

***Sticta weigeli* var. *Beuvoisii* Del.**

On trees; NEFA, Jabrang, alt. 8,350 ft., 1957, GP (No. 6433).

Thallus lacinate lobate; lacinæ margin upturned and ultimately finely dissected and fimbriate and coralloid isidiate. Thallus above darkish pale with brownish apices; underside brown tomentose in central part and paler in periphery; cyphellæ on the underside, yellowish, 0.25–0.5 mm. in diameter. Apothecia in submarginal region, sessile, up to 3 mm. in diameter, disc red-brown; spores fusiform, 2–4-celled, colourless, $40-44 \times 7-8 \mu$ in size.

Peltigeraceæ

***Peltigera dolichorhiza* Nyl.**

Assam; Cherrapunji, 1956, GP (No. 3172); Shillong, Elephant Falls, 1958, GP (No. 3368); Nongstain village, 1958, GP (No. 16514); NEFA; Chakoo, alt. 8,200 ft., 1957, GP (No. 6364); Siang, F. D., Tuting to Kappu, alt. 2,000 ft., 1958, RSR (No. 17431), Tirap, F. D., Laju to Raho, 1958, GP (No. 14711).

Specimens in small fragments. Thallus foliose; upper side smooth, light brown in colour; underside with brown reticulated nerves in the peripheral parts while brown-black with dark rhizinæ in the central part. Apothecia marginal, red-brown, folded longitudinally; spores colourless, 6–8-celled, elongate fusiform, one end narrower than the other, $60-70 \times 4-5 \mu$ in size.

***Peltigera canina* (L.) Willd.**

NEFA; Jabrang, Parila, alt. 9,000 ft., 1957, RSR (No. 8183).

Only few fragmentary specimens showing the maximum resemblance to this species.

Cladoniaceæ

***Cladonia mitis* Sandst.**

On moist moss-covered soil; NEFA, Senge Dzong to Sela, alt. 13,700 ft., 1957, RSR (No. 7726).

Podetia creamy-white, in small fragments only, yet quite typical, K—, Pd—.

***Cladonia impexa* Harm.**

On very moist moss-covered soil under *Rhododendron campanulatum*; NEFA, Senge Dzong to Sela, alt. 13,700 ft., 1957, RSR (No. 7767).

Podetia erect, sympodially branched with elongated perforations in the axils of the branches; usually 3 branches arising together (trichotomous). Podetia pale-grey to whitish-grey, subarachnoid, subpellucid, apices of the branches bent in all directions or almost straight. Podetia K—, Pd—.

***Cladonia aggregata* (Sw.) Ach.**

On soil over rock; Assam, Shillong near peak, 1956, GP (No. 3832); Shillong to Pynwasta Road, 1956, GP (No. 4733); NEFA, Siang, F. D., Minguing to Takepoking, alt. 3,800–5,700 ft., RSR (No. 17764).

Podetia typical, densely congested and with characteristic perforations, on the podetial wall, K—, Pd—.

***Cladonia furcata* (Huds.) Schrad. var. *pinnata* (Flk.) Vain.**

On dead log of wood; NEFA, Chakoo, alt. 8,250 ft., 1957, GP (No. 6333).

Podetia elongated congested, branches furcate and apically attenuated, axils of branches perforated. Podetia squamulose; squamules pale-glaucous-green above (bluish green at the time of collection) and white below, K—, Pd+ red.

***Cladonia gracilis* (L.) Willd. var. *elongata* (L.) Willd.**

On moist moss-covered soil under *Rhododendron*; NEFA, Senge Dzong to Sela Dzong, alt. 13,700 ft., 1957, RSR (No. 7768).

Podetia elongated, scarcely branched, grey-white to grey-brown, without perforations in the axils of the branches, squamules present on podetia, glaucous-green above and white below. Podetia K—, Pd + orange-red.

***Cladonia bellidioflora* (Arch.) Schaer.**

On moist moss-covered soil; NEFA, Senge Dzong to Sela Dzong, alt. 13,700 ft., 1957, RSR (No. 7737).

Podetia short cylindrical, scyphiferous, creamy to pale-grey; surface granular, larger squamules in basal part and smaller above. Podetia esorediate, subulate, K + yellowish, Pd—.

***Cladonia verticillata* Hoffm.**

Assam; Shillong near Nirala bungalow, 1956, GP (No. 3819);
On rocky boulders; Nongston village, 1958, GP (No. 16480).

Primary thallus squamulose well developed. Podetia vertically repeatedly centrally proliferated up to 4 tiers into one or more scyphiferous podetia; margin of the scyphus dentate, lobulate, often squamulose; the squamules also present on the podetial surface. No soredia. Podetia K— or + slightly yellowish, Pd + orange-red to red. Specimen No. 3819 is comparable to var. *evoluta* Th. Fr. and no. 16,480 to var. *subevoluta* Asah.

(In addition to the above-mentioned species of the genus *Cladonia* there are about a dozen more specimens of this genus in the collection which it has not been possible to determine for lack of either the authentic specimens for comparison or the specimens themselves were poor and hence have been left over from inclusion here.)

***Stereocaulon claviceps* Th. Fr.**

On moss-covered slope; NEFA, Zang to Senge Dzong, alt. 12,500 ft., 1957, RSR (No. 7995).

Pseudopodetia up to 6 cm. tall, branched, phylloclades well developed, cylindrical, tapering, simple or branched. Cephalodia sacculate type. Apothecia in juvenile condition, terminal in position.

***Stereocaulon nesæum* Nyl.**

On trees; NEFA, Siang, F. D., Minguing to Takepoking, alt. 5,700 ft., 1958, RSR (No. 17821).

Pseudopodetia ashy-grey, scarcely branched from the base but with short lateral branches in the upper part each terminated by juvenile apothecium.

Phylloclades well developed, cylindrical, branched and tapering. Apothecia juvenile, in early stage of development, pale-pink in colour.

***Stereocaulon* cf. *piluliferum* Th. Fr.**

Hanging on rock surface; NEFA, Siang, F. D., Geling to Kepangla, alt. 2,700–5,000 ft., 1958, RSR (No. 17562); Minguing to Takepoking, alt. 5,700 ft., 1958, RSR (No. 17826).

Pseudopodetia branched with unilateral, cylindrical, tapering, grey to ashy-green phylloclades; cephalodia sacculate type. Apothecia globular, terminal, in early stage of development, orange to pale-orange, usually many crowded together.

As in the typical mature *piluliferum* there are only few or a single apothecium in terminal position it is likely that out of the many apothecial initials seen in young condition only the few become fully mature and the others degenerate.

Umbilicariaceæ

***Umbilicaria yunnana* (Nyl.) Hue**

On dead wood; NEFA, Jabrang, alt. 8,750 ft., 1958, GP (No. 16059).

Thallus monophyllous, peltate, with somewhat undulating folds; upper side smooth, dull ashy-grey, under side brown-black with dense, branched, curved rhizinæ and with rounded, bullate convexities corresponding to the apothecia on the upper side. Apothecia up to 2 mm. in diameter, almost immersed in the thallus, rounded to oblong, black, concentrically gyrose; spores colourless, single-celled, oval ellipsoid, $20-25 \times 12-13 \mu$ in size. Thallus K—, Pd—.

Parmeliaceæ

***Parmelia pertusa* (Schrank.) Schaer.**

On twigs of trees; NEFA, Bomdila, alt. 8,600 ft., 1957, RSR (No. 7350).

Thallus small, adpressed, lacinia with characteristic perforations on the upper cortex and verrucose soredia; no rhizinæ. Thallus sterile.

***Parmelia cirrhata* Fr.**

There are a large number of specimens of this species in the collection, some of which are typical while others show certain minor variations as detailed below:—

On trees, wood and ground; Assam, Kynshi to Markassa, 1958, GP (No. 16375); NEFA, Sirsini, 1957, GP (No. 6238); Chakoo, alt. 8,086 ft. 1957, GP (No. 6350); near Jabrang, alt. 8,150 ft., 1957, RSR (No. 7233); Nyukmadong, alt. 7,750 ft., 1957, RSR (No. 7612)—Specimens typical.

NEFA, Parila, alt. 9,150 ft., 1957, GP (No. 6397)—Lacinæ narrow, elongated, grey-white, marginal black fibrils (rhizinæ) comparatively longer; underside black, rugulose, without rhizinæ.

NEFA, Jabrang-Theegni, alt. 6,250 ft., 1957, GP (No. 6494)—Lacinæ short, broad, congested and with numerous apothecia; underside with short densely congested rhizinæ.

NEFA, Bomdila, alt. 8,400 ft., 1957, RSR (7355); Nyukmadong, alt. 9,200 ft., 1957, RSR (No. 7638); Siang, F. D., Siang to Guizang, alt. 4,500–2,000 ft., 1958, RSR (No. 17918); Takepoking—Sirang, alt. 5,700–7,200 ft., 1958, RSR (No. 17890)—Lacinæ uniformly dichotomously branched, underside rhizinose, all the specimens sterile.

NEFA, Baha, 1958, GP (No. 15262)—Lacinæ narrow, usually 0.5 mm. broad, no apothecia.

***Parmelia ruderata* Vain.**

On Quercus; NEFA, Jabrang-Rupa, alt. 8,150 ft., 1957, RSR (No. 7236).

Thallus yellowish-grey, adpressed, lobes imbricate, densely isidiate; isidia branched and flattened; rhizinæ up to the margin. Medulla white, K—, Cl + red, Pd—, sterile.

***Parmelia reticulata* Tayl.**

On dry rock; Assam, Shillong, 1956, GP (No. 3822 and 3824); On twigs of trees, Assam, Kynshi, 1958, GP (No. 16322); NEFA, Seargaon, 1958, GP (No. 15799 A); Rahung, alt. 5,400 ft., 1957, RSR (No. 7505).

Thallus typical wide lacinate lobate, ashy-grey; upper side reticulately white maculate and minutely cracked; soralia globular, along the margin, separate or confluent. Medulla white, K+ blood-red.

***Parmelia lævigata* (Sm.) Ach. var. *exsecta* (Tayl.) Asah.**

On twigs; NEFA, Parila, alt. 9,150 ft., 1957, GP (No. 6395); Chakoo, alt. 8,086 ft., 1957, GP (No. 6350 B).

Thallus characteristically sinuate laciniate lobate; underside with thick dense black rhizinæ up to the margin. Apothecia large up to 1.4 cm. in diameter, cracked and lobed; spores single-celled, colourless, oval, $12-14 \times 8-9 \mu$ in size. Thallus K+ yellowish; medulla K-, Cl-.

***Parmelia sublævigata* Nyl.**

Assam, Jowai, 1956, GP (No. 4152); NEFA, Bomdila, alt. 8,600 ft., 1957, RSR (No. 7354); Paya to Shoeling, alt. 1,200 ft., 1957, RSR (No. 10885).

Thallus laciniate lobate, glaucous to pale-glaucous, no soredia and isidia. Medulla K+ red, Pd+ deep yellow to orange-red. Apothecia numerous, up to 5 mm. in size; spores single-celled, colourless, oval, $8-9 \times 6-7 \mu$ in size.

***Parmelia platyphyllina* Nyl.**

Assam, Shillong, 1958, GP (No. 3826).

Thallus wide lobate, glaucous-grey, smooth, non-isidiate in peripheral parts but characteristically granular isidiate in the central part. Medulla white, K+ red, Pd+ deep yellow to orange. Thallus sterile.

***Parmelia subcrinita* Nyl.**

On bark of tree; NEFA, Nara to Heyuliang, alt. 1,300-1,600 ft., 1957, RSR (No. 10738).

A small fragment mixed with *P. tinctorum*. Thallus pale to pale-grey; upper side isidiate, margin crenate and ciliate; underside copper-brown, rhizinæ few, not up to the margin; medulla K-, Cl+ red, K (Cl)+ red, Pd-.

***Parmelia tinctorum* Despr.**

On tree trunks; Assam, Shillong, 1956, GP (No. 3823); Nunai Kalamodi area, 1958, B. K. Nath (No. 13409); NEFA, Rahung to Kutana, alt. 5,500 ft., 1957, RSR (No. 7402); *Parmelia*, 1958, GP (No. 15134); Tirap. F. D., Waka, 1958, GP (No. 14921).

Thallus wide lobate, pale-grey to ashy-grey, with the characteristic isidia; rhizinæ few on the underside, not up to the margin; medulla Cl + red; Pd-, K-.

***Parmelia cristifera* Tayl. (Plate III, Fig. 7)**

On *Rhododendron arboreum*; NEFA, Rahung hill top, alt. 5,500 ft., 1957, RSR (No. 7502).

Thallus large foliaceous, orbicular, up to 15 cm. in size, laciniate lobate, margin of laciniae undulate, crispate, subascending and imbricate, lobes at periphery up to 1 cm. broad eciliate; margin of the laciniae in the central part of the thallus with globose elevated and often confluent soralia. Upper side pale-grey to whitish-grey, minutely somewhat cracked, otherwise smooth; underside smooth, brownish at periphery and black in central part, no rhizinae. Thallus K + yellowish; medulla K—, Cl—, K (Cl)—, Pd+ orange-red. Sterile.

Parmelia sp.

On dead wood, NEFA, Parila hill, alt. 9,150 ft., 1958. GP (No. 16079).

Thallus laciniate lobate, adpressed; lobes partly imbricate, whitish-grey; underside black, rhizinae up to the margin, no soredia and isidia. Medulla K+ red, K'(Cl) + red, Pd+ deep-yellow to orange-red. Apothecia numerous, small, 1-1.5 mm. in size, cup-shaped, asci immature.

Anzia physoidea A. L. Smith (Plate III, Fig. 3)

On twigs; NEFA, Parila, alt. 9150 ft., 1957, GP (No. 6398).

Thallus 4-5 cm. in size, laciniate; laciniae di- or trichotomously divided, about 2 mm. broad, apex rounded, crenate or retuse; upper side smooth, brownish-grey, without soredia and isidia; pycnidia prominent, dense, marginal to submarginal, black, ostiolar (under lens); underside brownish-black, composed of spongy coral-like thick-walled hyphae; haptera-like processes at intervals, which are thick, short and take their origin in the inner region of the upper cortex and then emerge out on the underside after traversing the medulla and the brown hyphal spongy tomentum, brown-black in colour and somewhat flattened pad-like at the end. Thallus K+ slightly yellow, Cl—, Pd—.

Apothecia scarce (only 2 seen in the specimen), subpodicellate, up to 4 mm. in diameter, disc concave, brown to olive-brown, shining, margin inflexed. Thecium 60μ thick, with its uppermost 20μ region brownish; hypothecium colourless. Asci few, oblong club-shaped, $40 \times 20\mu$ in size, multispored; spores colourless, single-celled, crescent-shaped, ends rounded, straight distance between the two ends $15-16\mu$, thickness of the spore near the middle 2μ .

The species was founded by Smith (1931) on a sterile material from Darjeeling (E. Himalayas) and was retained by her in the genus *Anzia*, pending the discovery of the fertile specimens. The present specimen happens

to be the first fertile specimen collected. It agrees well with the description of this species given by Smith and the spore characters justify its retention within the genus *Anzia* as correct.

***Cetraria leucostigma* Lév.**

On dead wood and also on ground ('probably collected fallen from the trees'); NEFA, Chakoo, alt. 8,086 ft., 1957, GP (No. 6349).

Thallus foliaceous, wide lobate, lobes rounded, often imbricated, smooth thin in marginal parts or in young conditions while minutely reticulate rugulose and thick coriaceous later or also in central parts; upper side pale-yellow to light-green-pale; underside pale-white to pale-grey, shining, rugulose wrinkled, with rounded pseudocyphellæ immersed in general undersurface (not elevated on plug-like growths), rhizinæ frequently present, short, branched and greyish. Medulla white, K—, Cl—, Pd—. Apothecia marginal, initiating their development in the subventral marginal part but mature constricted and curved backwards on the upper side and thus appearing dorsal, usually 2-3 mm. in diameter, sometimes up to 5 mm. in size, but mature asci with spores not seen in either.

***Cetraria Wallichiana* (Tahl.) Müll. Arg.**

On Twigs; NEFA, Jabrang, alt. 8,350 ft., 1957, GP (No. 6432); Jabrang to Rupa, alt. 8,150 ft., 1957, RSR (No. 7232).

Thallus widely lobate, lobes thick coriaceous, crisp and scrobiculate; upper side light-greenish to glaucous-pale or partially greyish-pale; underside much reticularly ridged, pale to deep pale yellow with minute, dense, plug-like protuberances tipped with white pseudocyphellæ; thick rhizinæ sometimes present. Medulla white, K (Cl)+ scarcely reddish, Pd—.

Apothecia in the peripheral lobes of the thallus, numerous and crowded, subpodicellate, up to 1 mm. in diameter, disc red-brown to dark-brown with thin margin; mature asci not seen.

***Cetraria thomsonii* (Strtn.) Müll Arg.**

On twigs; NEFA, Parila, alt. 9,150 ft., 1957, GP. (No. 6396 A and 8397 B).

Thallus lacinate lobate, ashy-grey, with prominent black pycnidia on the tips of the dichotomously dissected lobules; underside black with sparse black rhizinæ. Thallus K+ deep yellowish, Cl+ scarcely reddish. Apothecia subpodicellate, up to 1 cm. in diameter, perforated in the middle;

asci 8 spores; spores large, single-celled, thick-walled, oval ellipsoid, $28-36 \times 16-20 \mu$ in size.

Cetraria asahinæ Sato (Plate III, Fig. 5)

On wood and bark; NEFA, Parila, alt. 9,150 ft., 1957, GP (No. 6797 C); Kalaktang to Morsing, 1958, GP (No. 15707).

Thallus wide-lobate; lobes rounded crisp, undulate with black fibrils along the margin; upper side smooth, glaucous-pale to brownish, with occasional white pseudocyphellæ bordered with small black fibrils (sometimes only the black border is present, there are no black fibrils); underside with white pseudocyphellæ, surface pale-brown in marginal region and black in central part; medulla white or pale-yellow to ochraceous, K+ bright yellow, Pd+ orange-red to red. Apothecia marginal, mature nephroid; spores single-celled, colourless, $7-9 \times 3.5-4.5 \mu$ in size.

This Japanese species distributed in Keurile, Kores and Formosa is being reported from outside this region for the first time and forms a new report for the Himalayas.

Cetraria straminea Vain. (Plate III, Fig. 4)

On dead wood; NEFA, Chakoo, alt. 8,086 ft., 1957, GP (No. 6349 B).

Thallus widely lobate; lobes rounded, scrobiculate or folded, irregularly cleft, thin, up to 1 cm. broad, subsascending and imbricate. Upper side smooth to sometimes imperceptibly minutely lacunose, straw-pale to straw-grey with a brownish line in the margin and often black blotched at places in the marginal or in the central part; pseudocyphellæ on both the sides, more or less rounded and white, about 0.5 mm. in diameter and black margined, no black fibrils along this margin of the pseudocyphellæ; underside pale-grey in peripheral parts and brown to black in the central parts, smooth to sometimes lacunose, short black rhizinæ sparsely dispersed in the central part.

Thallus $180-200 \mu$ thick; upper cortex yellowish, 20μ thick; algal stratum $20-25 \mu$ thick, lower cortex 16μ thick, medulla white to sometimes at places scarcely yellowish; hyphæ granular surfaced, 4μ thick. Upper cortex (in section) K+ deep yellow to reddish; the red colouration denser towards the algal zone and sometimes it diffuses out in subcortical region; medulla K—, Cl—, Pd+ orange-red,

Apothecia marginal, nephromoid, semilunar in outline, 1×0.4 cm. in size, disc smooth, brown, margin thin, receptacular surface lacunose and pseudocyphellate; young apothecia concave. Thecium $90-100 \mu$ thick, the exterior $9-10 \mu$ region \pm amorphous and brownish; hypothecium colourless, 20μ thick, algal cells present below the hypothecium. Asci 8-spored; spores uniseriate in the ascus, colourless, single-celled, thin-walled, elliptic (often one side more convex than the other) with pointed ends, $12-16$ (18) $\times 6-8 \mu$ in size.

This species was known so far from Formosa and Philippines in the sterile condition only. Its present find from the Himalayas is interesting in the fact that in addition to its being a new report for the area the specimens happen to be fertile. The surmise by Räsänen (1952, p. 50) based on the Pd—reaction on the thallus of the sterile specimens that *C. straminea* has very close affinity with *C. asahinæ* Sato (placed by him under genus *Nephromopsis*) and *Nephromopsis delavayi* Hue has thereby come to be correct. The Pd—reaction, the nephromoid nature of the apothecia is comparable to that of *asahinæ* and *delavayi* while the elliptic nature of the spores shows a close affinity to *Nephromopsis endocrocea* Asah.

***Cetraria stracheyi* Bab.**

NEFA; Bomdila to Rahung, alt. 8,200 ft., 1958, RSR (No. 7358); Seargaon, 1958, GP (No. 15798).

Thallus wide lobate, scrobiculate, thick, coriaceous; above smooth to lacunose, glaucous-pale to greyish; underside pale, pinkish-pale to greyish, pseudocyphellate and with dispersed thick rhizinæ. Medulla white, K—, Cl + red, Pd—.

Apothecia marginal, nephromoid, immature (spores not seen).

***Cetraria stracheyi* f. *ectocarpisma* (Hue) Sato**

On moss-covered bark; NEFA, Jabrang-Parila, alt. 9,000 ft., 1957, RSR (No. 8182); Siang, F. D., Minguing to Takepoking, alt. 3,800–5,700 ft., 1958, RSR (No. 17771).

Thallus morphologically subsimilar to the type. Distinguished by the negative Cl— reaction in medulla. Mature spores not seen though apothecia of different stages of development are present.

Usneaceæ

***Alectoria virens* Tayl.**

On trees; NEFA, Bomdila to Rahung, 1957, RSR (No. 7359),

Thallus fruticose, filamentous; filaments subdichotomously branched, subcylindrical, flexuose, grooved on the side, light-greenish-yellow in colour, apices brownish, Pd+ red. Sterile.

Alectoria sulcata (Lév.) Nyl.

On twigs; NEFA, Parila, alt. 9,150 ft., 1957, GP (No. 6396).

Thallus fruticose, divaricately branched, somewhat caespitose, filaments tapering, cylindrical and \pm furrowed on one side; cortex Pd-; medulla Pd+ reddish. Apothecia lateral up to 3 mm. in diameter, disc dark-brown, slightly pruinose; spore oblong ellipsoid, single-celled, colourless, $44-50 \times 11-15 \mu$ in size.

Alectoria cf. *bicolor* (Ehrht.) Nyl.

On twigs of the dead bark of *Rhododendron*; NEFA, Parila, alt. 9,150 ft., 1957, GP (No. 6397 A); near Senge Dzong Rest House, alt. 11,200 ft., 1957, RSR (No. 7672).

Thallus suberect, fruticose, fronds cylindrical, short, branched, dark-brown-black. Sterile.

Alectoria cf. *bicolor* f. *malaneira* (Ach.) Nyl.

On *Rhododendron thomsonii*; NEFA, Senge Dzong-Sela Dzong, alt. 12,300 ft., 1957, RSR (No. 7709).

Thallus more robust, larger, branches much entangled, apothecia lateral, sessile, brownish, convex; spores small, single-celled, colourless, oval, $5-6 \times 4-5 \mu$ in size.

Ramalina conduplicans Vain.

On trees; NEFA, Jabrang-Rupa, alt. 8,150 ft., 1957, RSR (No. 7231); Bomdila, alt. 8,600 ft., 1957, RSR (No. 7348); near Seargaon, 1958, GP (No. 15799 and 15802).

Thallus much similar to *R. complanata* Nyl., a species of very wide distribution in the Himalayas. *R. conduplicana* is distinguished by the positive reactions in the medulla which are K+ deep-yellow, Pd+ red, while there is a negative reaction in the case of *R. complanata*.

Ramalina sinensis Jatta

On twigs; NEFA, Jabrang-Rupa, alt. 8,150 ft., 1957, RSR (No. 7230); Jabrang hills, alt. 8,750 ft., 1958, GP (No. 16060). Specimens small, fertile and typical.

***Usnea cladonioides* (Nyl.) Du R.**

Epiphytic, forming clump-like mass; NEFA, Tungri village, Jabrang camp, 1957, GP (No. 6965).

Thallus fruticose, erect to procumbent, caespitose; filaments flexuose, subdichotomously branched, apically tapering and much interlocked, pale-orange in colour, tip brownish-black; surface smooth to indistinctly longitudinally rimulose, soredia present, pale-orange in colour. Thallus K + intense red.

***Usnea implicita* (Strtn.) A. Zahlbr.**

On trees; NEFA, Tirap, F. D., Khonsakheli, 1958, GP (No. 14521); Rusa, 1958, GP (No. 16784); Lonju hills, alt. 5,250 ft., 1958, GP (No. 14699); Boha to Kalaktang, 1958, GP (No. 15367).

Thallus fruticose, up to 12 cm. long, pendulous, laxly branched basally up to 1 mm. thick, pale-grey to dark-grey, tomentose-sorediose and isidiöse; central chondroid axis hollow in the middle; medulla reddish, K—.

***Usnea rubicunda* Strtn.**

On tree trunk; NEFA, near Bomdila, alt. 8,600 ft., 1957, RSR (No. 7349 B).

Thallus fruticose, suberect to pendulous, branched, rigid, reddish in colour; surface with white maculate soralia which later turn isidiöse; medulla K+ yellowish.

***Usnea pectinata* Tayl.**

Common on trees; NEFA, Jabrang-Parila, alt. 9,150 ft., 1957, GP (No. 6413) Bomdila to Wangbost, alt. 7,200 ft., 1957, GP (No. 6949).

Thallus fruticose, filaments very long, thread-like, cylindrical, less than 1 mm. thick, cortex evanescent, lateral branches perpendicular to the main axes, pale-glaucous-grey; central chondroid axis I—. Apothecia scarcely present; spores single-celled, colourless, oval, $7-9 \times 4-6 \mu$ in size.

***Usnea longissima* Ach.**

On Rhododendron, Quercus, etc., trees; NEFA, Tawang-Bum La alt. 12,000 ft., 1957, RSR (No. 7919).

Thallus subsimilar to *U. pectinata* but differing in the lateral branches which are somewhat apically directed, colour greenish pale and the central chondroid axis I+ intense blue.

***Usnea asahinai* Mot. (Plate III, Fig. 6)**

Habitat (?); Assam, Shillong, Elephant Falls, 1956, GP (No. 3764).

Thallus fruticose, filamentous, filaments in the specimens 30 cm. long (collector's note reads "profusely branched, elongated to 3 ft., greyish yellow"), main axes about 1 mm. thick, longitudinally subangulate, often cracked, pale-grey in colour, lateral branches smooth, cylindrical, pale-yellow in colour; basal ends of the main axes dark-reddish for about 1 cm. length; medulla K+ rubescens. The reddish colouration to the basal ends is comparable to the K- reaction in medulla and the red-coloured basal ends may be the result of the action of the substrate on the thallus a phenomenon often witnessed in many more lichens.

The species reported so far from Japan forms a new report for the Himalayas.

***Usnea undulata* Strtn.**

On *Pinus Khasia* bark; Assam, Shillong, 1956, GP (No. 3827).

Thallus fruticose, caespitose, pale-grey, sorediose; soralia isidiose-fur-furaceous; medulla K-. Sterile.

***Usnea luridorufa* Strtn.**

Assam, Nongstoni, 1958, GP (No. 16604).

A small piece only. Thallus fruticose, sympodially branched, pale-reddish-brown, medulla K+ red.

***Usnea spinosula* Strtn.**

On trees; NEFA, Parila, alt. 8,000 ft., 1957, GP (No. 6351 and 6394); Bomdila, alt. 8,600 ft., 1957, RSR (No. 7349); Siang, F. D., Minguing to Takepoking, alt. 3,800-5,700 ft., RSR (No. 17762).

Thallus fruticulose, subdichotomously or sympodially branched, branches divergent and curved, surface spinulose and papillate; pale-grey-brown; medulla arachnoid, K-. Apothecia small, pale-brown, pruinose, with marginal cilia; spores single-celled, colourless, oval, $10-11 \times 7-8 \mu$ in size.

***Usnea subsordida* Strtn.**

On dead wood; Assam, Cherrapunji, on way to Monchema Falls, alt. 4,600 ft., 1956, GP (No. 4855).

Small pieces, thallus dark-glaucous in colour; medulla K+ red.

Usnea dendritica Strtn.

On tree bark; NEFA, Nyukmadong, alt. 7,750 ft., 1957, RSR (No. 7611).

Thallus large fruticose, sympodially branched, sordid dark-brown, lateral branchlets paler brown; surface tuberculate papillate and scarcely white maculate; medulla K—; central chondroid axis thick, dilacerated. Apothecia large, up to 2 cm. in diameter; spores single-celled, colourless, $10-12 \times 8 \mu$ in size.

Usnea cineraria Mot.

On trees; NEFA, Jabrang-Rupa, alt. 8,150 ft., 1957, RSR (No. 7229).

Thallus fruticose, subsimilar to *U. dendritica* but branches divergent, white maculate, central chondroid axis solid, medulla K—; apothecia smaller up to 1.2 cm. in diameter, faveolate lacunose; spores smaller, $8-9 \times 6-7 \mu$ in size.

Usnea thomsonii Strtn. subsp. *arborea* (Strtn.) Mot.

On trees; NEFA, Jabrang-Parila, alt. 9,000 ft., 1957, RSR (No. 8184).

Thallus fruticose, divergently branched, pale sordid-grey, surface papillate, white maculate; medulla arachnoid, white or reddish, K+ reddish.

Usnea sp.

NEFA, Siang, F. D., Sirang-Guizing, 1958, RSR (No. 17929) and Takepoking, Sirang, 1958, RSR (No. 17894).
Specimens in small fragments.

Teloschistaceæ

Xanthoria sp.

On moss over rock; NEFA, Sela-Senge Dzong, alt. 12,750 ft., 1957, RSR (No. 7754).

Thallus foliose, lacinia narrow, small, orange-yellow, marginally isidiate. Sterile.

Physciaceæ

Pyxine sp.

On bark, NEFA, Bomdila, 1957, RSR (No. 7354 B).

Two small fragmentary pieces. Thallus glaucous-ashy-grey, laciniaë smooth, without soredia and isidia. Apothecia present, black lecideine, spores brown, 2-celled, ellipsoid, $18-21 \times 6-7 \mu$ in size.

Thallus K—, Pd—.

***Physcia aspera* H. Magn.**

On rocky boulders; thallus separating out in flakes; NEFA, Parmelia, 1958, GP (No. 15135).

Thallus ashy-grey with characteristic granular soredia. Thallus sterile.

***Physcia picta* (Sw.) Nyl.**

On the betel-nut tree trunk: Assam, Silghat, Sunary village, 1957, GP (No. 5,400).

Thallus subsimilar to *Ph. aspera* but easily distinguished from it by the globose farinose soredia. Thallus sterile.

***Anaptychia firmula* (Nyl.) Dodge et Awasthi**

On rock; Assam, Shillong, Nirala Bunglow, 1956, GP (No. 3828).

Few fragmentary pieces with immature apothecia.

***Anaptychia esorediata* (Vain.) Dur. et Lyng.**

On rock; NEFA, Nyukmadong, alt. 7,750 ft., 1957, RSR (No. 7610); Baha, 1958, GP (No. 15261); Bomdila, alt. 8,200 ft. 1957, RSR (No. 7357); Tirap, F. D., Laju-Raho, GP (No. 14762); Assam Motharguri, 1957, RSR (No. 10030);—the last in a decaying condition.

In all the specimens the thallus is well developed and the apothecia are present. The specimens are quite characteristic though in some cases the margin of the laciniaë in peripheral part is reddish-orange.

***Anaptychia esorediata* f. *rubescens* (Räs.) Awasthi**

Assam, Mamlu forest, 1956, RSR (No. 2714).

***Anaptychia pellucida* Awasthi**

NEFA, Parila, alt. 9,150 ft., 1957, GP (No. 6397 E).

Spores more than 60μ long, but not distinctly pellucid.

***Anaptychia incana* (Strtn.) A. Zahlbr.**

On rock; Assam, Pynusla-Shillong, 1956, GP (No. 4538).

Two small pieces; marginal fibrils branched, brown-black, medulla K—; apothecia present, margin crenate lobulate with fibrils; spores 2-celled, brown, oval ellipsoid, $40-44 \times 20-24 \mu$ in size, thick-walled, lumen of the cells \pm elongated.

Anaptychia cf. *podocarpa* (Bél.) Mass.

NEFA, Sissui camp, 1957, GP (No. 6043).

Thallus rather thin translucent, when viewed against light dispersed darker areas of algal groups well demarcated; thallus foliose, laciniate; laciniae imbricated, subascending, pale-greenish, smooth, marginal fibrils apically brownish. Thallus K—, Cl—, Pd—. Apothecia few, superficial to submarginal, podicellate, pruinose, with marginal crenate lobules; spores brown, 2-celled, ellipsoid, $44-52 \times 20 \mu$ in size, lumen of cells elongated.

SUMMARY

The paper deals with a collection of foliose and fruticose lichens collected by Mr. R. S. Rao and Dr. G. Panigrahi from Assam and North-East Frontier Agency of India. The total number as determined is 72 species under 18 genera and 9 families in a collection of about 145 specimens. Notable aspects of the investigations are the new reports from this region of the species—*Cetraria asahinæ*, *C. straminea* and *Usnea asahinæ*—and the discovery of the fertile state of the specimens *Anzia physoidea* and *Cetraria straminea* which were so far known in the sterile condition only.

ACKNOWLEDGEMENTS

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EXPLANATION OF PLATE

- FIG. 1. *Coccocarpia pellita* (Ach.) Müll Arg.; G. Panigrahi (No. 3825), $\times ca. 1$.
- FIG. 2. *Lobaria isidiosa* var. *squamulifera* Awasthi var. Nov.; G. Panigrahi (No. 5083), $\times ca. 1$.
- FIG. 3. *Anzia physodea* A. L. Smith; G. Panigrahi (No. 6398), $\times ca. 1$.
- FIG. 4. *Cetraria straminea* Vain.; G. Panigrahi No. 6349 B), $\times ca. 5/6$.
- FIG. 5. *Cetraria asahinæ* Sato.; G. Panigrahi (No. 15707), $\times ca. 5/6$.
- FIG. 6. *Usnea asahinai*, Mot.; G. Panigrahi (No. 3764), $\times ca., \frac{3}{4}$.
- FIG. 7. *Parmelia cristifera* Tayl.,; Rolla S. Rao (No. 7502), $\times ca. 5/6$.