

MACROLICHENS OF SIKKIM



G. P. SINHA & K. P. SINGH

BOTANICAL SURVEY OF INDIA
Ministry of Environment & Forests

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FOREWORD


Lichens, the most remarkable and successful alliances in nature, are one of the important components of biological diversity. Lichens with cyanobacterial symbionts contribute significantly to nitrogen fixation. Besides their economic value as food, fodder, dyes, perfumes and medicine, lichens are also used as indicators of health of forest ecosystem, air pollution and in dating of rocks. To facilitate future researches in the field of lichen ecology, eco-physiology, pollution studies, conservation, etc., lichen taxonomy is identified as one of the thrust areas to work out in India. About 2180 species are known to be distributed on various substrata in different climatic regions of India. But state-wise statistics based on exhaustive explorations is not available.

Botanical Survey of India, the premier organization in the field of taxonomy and floristic studies, has taken a lead to explore and document the lichen diversity of the country. The Lichen Flora of Nagaland, published by same authors was the first major step in this direction. The present effort is a further contribution in this endeavour.

Macrolichens of Sikkim is an outcome of extensive collections of lichens and critical laboratory investigations on their taxonomy by the authors over a period of 9 years. The documentation of 320 species, distributed under 72 genera with many colour photographs from the state of Sikkim is a significant contribution to Indian lichenology.

It is hoped that the present contribution would adequately serve the need of researchers, academicians, bioresource managers as well as nature lovers.

I congratulate the authors for this successful endeavour.



(M. Sanjappa)
Director
Botanical Survey of India

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G.P. Sinha & K.P. Singh

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INTRODUCTION

Lichens are one of the most remarkable and successful alliances in nature represented by about 20,000 species in world and about 2180 species in India. In Indian context, the knowledge accumulated so far clearly shows that the 3 regions *viz.* Eastern Himalaya, Western Ghats and Western Himalaya have rich and luxuriant lichen flora. But, in comparison to the higher plants, the lichen flora of India in general and lichens of Eastern Himalaya including the North-Eastern states in particular remained the "Cinderella" group of flora by majority of professional botanists. Nonetheless, there has been a welcome awakening of interest in Indian lichens in preceding years. To facilitate future research in the field of ecology, ecophysiology, pollution studies, conservation, etc. lichen taxonomy is identified as one of the important areas to work out. Botanical Survey of India, the premier organization in the field of Taxonomy and Floristic studies, has taken up the task to explore the lichen flora of North-Eastern states. As a result of this, lichens of Manipur (K. Singh, 1981a, 1981b), Lichen Flora of Nagaland (K. Singh & Sinha, 1994) and innumerable papers comprising new species, new records for India, systematic accounts, etc. have already been published from the region.

Eastern Himalaya, one of the main centres of speciation is also a Hot Spot of Biodiversity. The flowering plants are well worked out while knowledge of non-flowering plants such as lichens is meager. To begin with, the Lichen Flora of Sikkim particularly macrolichens were chosen to work out first as these are easily eye-catching, dominant, in temperate and alpine regions and most of the nature lovers as well as professional botanists remain desirous to know about these plants. Awasthi (1988) reported 697 species of macrolichens from India and Nepal while K. Singh (1999) reported 386 species from Eastern Himalaya including North-Eastern States. The present account primarily based on one of the author's (GPS) own field work and supplemented by authentic published work, deals with 320 macrolichen species, distributed within 72 genera from the state of Sikkim, which forms about 45 % of Indian and about 82 % of Eastern Himalayan macrolichens. This number is a clear indication of rich macrolichen diversity in such a small geographical area of the country (0.21%).

Squamulose, foliose, subfruticose and fruticose taxa falling under macrolichens have been dealt in the present study. These are fairly conspicuous in habit and to a certain extent can be identified to generic level with the help of external appearance.

TOPOGRAPHY

The state of Sikkim situated between the latitudes 27° 4' and 28° 7' 48" N and longitudes 88° 58" and 88° 55' 25" with a geographical area of 7096 sq km

came into existence as 22nd Indian state on 16th May, 1975. It lies on the western flank of Eastern Himalaya, bounded by Nepal in the west, Bhutan in the south-east, Tibet in the north and north-east and the Darjeeling district of West Bengal in the south. The mountain chains run southwards from the main himalayan ranges form the natural boundaries of Sikkim. The snow clad peaks of Chola ranges with altitudes above 4000 m divide it from Tibet in north-east and Bhutan in the south-east. Likewise Singalela range separates the state from Nepal in the west with east west axis of the Great Himalaya forming the barrier between Sikkim and Tibet in the north. The mountain passes along these ranges over the years have sustained two ways traffic of traders, pilgrims and adventurers from Nepal, Tibet and Central Asia. The most renowned of these passes are Nathula (4392 m), Jelep La (4388 m), Donkia La (5520 m) and Kongra La (4809 m). Sikkim has quite varied topography with altitudes ranging from 250 to 8598 m, and almost no flat piece of land anywhere. Mt. Kanchendzonga (8598 m) in north west border of the state is the third highest mountain peak in the world. It is sacred to the people of Sikkim and considered as their guardian diety. The picturesque landscapes and snow clad mountain ranges in Sikkim and their scenic beauty along with cultural richness of the state allure nature lovers and tourists from near and distant places.

The state abounds in a number of high altitude perennial lakes, a large number of perennial and seasonal streams and mountain springs. Teesta and Ranjeet are the two main rivers which flow in the north to south direction and create in their wake the gorges and valleys. Ranjeet merges with Teesta at Melli, then Teesta flows down through Darjeeling district of West Bengal to finally drains to the mighty river Brahmaputra.

Administratively, Sikkim, with state capital at Gangtok, has been divided into four districts *viz.* East district with an area of 954 sq km, North district (4226 sq km South district (750 sq km) and West district (1166 sq km) with their headquarters at Gangtok, Mangan, Namchi and Geyzing respectively.

Forest is the main land use system in the state and nearly 40% of the total geographical area is under varying densities of forest cover. The available agricultural land to the local inhabitants *viz.* Lepcha, Bhutia and Nepali pepole is approximately 12% of the total geographical area and is usually confined to the altitudes below 2000 m. Terraced cultivated fields with interspersed nullahs, the bamboo clumps and tree groves are the traditional habitations along the hill slopes of Sikkim. The major agricultural crops are rice, maize and millet while major cash crops are large cardamom, ginger, oranges and potatoes.

GEOLOGY AND SOIL

Geologically, Sikkim encompasses the Lesser Himalaya, Central Himalaya and the Tethys Himalaya (Raina & Srivastava, 1981). Major portion of Sikkim is covered by precambrian rock and is much younger in age. The geological position is known as " Younger units of Paleozoic age." The southern area has sedimentary

and metasedimentary rocks. The physical configuration of Sikkim is partly due to its geographical structure. The north-eastern and western portions of the state are composed of hard massive gneiss rock capable of resisting denudation. The south and central region is chiefly formed of comparatively soft thin slates and half schistern rock which denudes very easily. The trends of mountain system as a whole is east-west direction. The boundary ridges, however, run in a more or less north-south direction, i.e. Singalila and Chola ridges and another north south ridge in the central portion *viz.* Tendong ridge, divides the Ranjeet from the Teesta valley.

Most of the important forests species grow in black, red and lateritic soils. Black soil developed from ballistic rocks and cracks widely and deeply in dry season. It is neutral to alkaline, poor in Nitrogen and Phosphorus and good in lime and potash. The dark colour is due to mineral constituents and humus. The red soil is associated with granites, gneisses and ferrolitic nature. These are typically coarse, often with ferric concentrations, neutral to acidic with poor organic/ mineral nutrients. Lateritic soil is characteristic of the tropics with monsoon rainfall which tends to cap the hills in most part of peninsula. The soils are developed from basic rocks and these are acidic with poor mineral and low silica/oxide ratios.

CLIMATE

Sikkim has been known to be the most humid region in the whole range of Himalaya due to its direct exposure to the south - west monsoon from the Bay of Bengal. The rainfall varies from 2000-5000 mm in most of the inner valleys except for northern most region, *viz.* Llonakh valley and Cholamu plains where rainfall is scanty throughout the year. From June to September, the state experiences heavy rainfall. Lower hills and valleys enjoy a subtropical climate, warm in winter, hot and extremely humid in summer. Towards the interior and with rise in altitude, the climate becomes gradually more temperate with cool winters and hot summers and often there is a heavy rainfall. In the northern part of the state, summers are short and cool, while winters are with considerable snowfall and frost.

Climate and natural features of Llonakh valley are quite different from the rest of the places. There is no area in Sikkim which is quite parallel to Llonakh area (Smith & Cave, 1911). Llonakh valley constitutes flats and screes along the streams of Lungma chu and Naku chu, which join together and form Llonakh chu. Llonakh flats form a wonderful expanse of gently undulating ground amidst the highest peaks in the Himalaya. These are the level floor, formed by the action of some huge glaciers at the heads of all the valleys. On the flanks of this flat valley are huge moraines - accumulations of mighty boulders with a very limited plant life. Small lakes in the shallow basins are found regularly below the foot of each glacier.

LICHENOLOGICAL COLLECTIONS AND PUBLICATIONS IN SIKKIM

Sir J. D. Hooker and T. Thomson collected specimens of lichens during the famous botanical expedition from 1846 - 48. Later, these collections were studied, described and published in *Synopsis Methodica Lichenum* by W. Nylander (1860). Majority of the species reported were marolichens. A small collection by Stevens from Sikkim was also enumerated by Müll. Arg. (1895) in "Lichenes Sikkimensis", comprising 12 species of microlichens, but actually these were collected from Dajreeling hills of West Bengal and not from the present political boundary of Sikkim. In the late twenties, lichens from the Himalayan region were collected by Kashyap, Chaudhuri and Chopra. These were determined by A. L. Smith (1931) and apparently based on these determinations, Chopra (1934) published an account "Lichens of the Himalayas" comprising 75 species from Sikkim Himalaya (Darjeeling and East Sikkim up to Gangtok). Awasthi (1965, 1988, 1991), Asahina (1966), Sinha (1999), altogether enumerated 219 species including 162 macrolichens from Sikkim. Recently Upreti *et al.* (2003) reported 181 additional species including 56 macrolichens from the area. In sporadic publications, mainly in the form of new species and new records for India, Sinha and Chauhan (1996), Divakar *et al.* (2001a, 2001b, 2003), Ahti *et al.* (2002), Sinha (2003), Sinha and Elix (2003), Ahti and Upreti (2004) made some other significant contributions. Thus, a total number of lichens reported in these publications comes to 430 species, out of this 248 species were macrolichens.

MATERIAL AND METHODS

(A) Field work: During the period from 1994-2000, twelve intensive exploration trips were undertaken in tropical to alpine areas ranging from 500 to 5500 m altitude. While collecting specimens, special attention was paid to gather the data on habit, habitat, association with other species, ecological features and other interesting aspects. Attempts were also made to study the distribution pattern of each species in the state. As a result of these explorations, 1775 specimens were collected from various localities and their environs (see map).

The lichen samples, thus, collected were dried between blotting sheets, mounted on cards and made into suitable herbarium specimens. These specimens were carefully studied in respect of their morphology, anatomy and chemical colour reactions, microcrystallography and TLC wherever required following Culberson & Kristinsson (1970), Culberson (1972), Hale (1974) and White & James (1985). Anatomical details were studied with the help of a compound microscope.

The specimens thus studied were identified by comparing the descriptions available in the Floras and latest monographic work of various genera. Most of these taxa were authenticated in the lichen herbarium at National Botanical Research Institute, Lucknow (LWG) where vast collections of D. D. Awasthi and his associates are housed (Herb. AWAS, LWU in LWG) along with authenticated specimens of different renowned lichenologists. Besides these recent collections, the report of several taxa hitherto described or recorded from Sikkim by

MAP OF SIKKIM SHOWING IMPORTANT COLLECTION LOCALITIES



lichenologists viz. T. Ahti, Y. Asahina, D.D. Awasthi, G. Degelius, D. K. Upreti and his associates, etc. have also been incorporated in the present work. Apart from this, many specimens from the area were also identified by various specialist such as species of *Cladonia* by T. Ahti; species of genera *Heterodermia*, *Oropogon*, *Phaeophyscia* and *Physconia* by T. L. Esslinger; *Ramalina* by H. Kashiwadani; *Parmelia s.l.* by D. K. Upreti and J. A. Elix; *Cetraria s.l.* by D. D. Awasthi and J. A. Elix; *Stereocaulon* by D.K. Upreti. All the identified specimens are deposited in Cryptogamic herbarium, Botanical Survey of India, Sikkim Himalayan Circle, Gangtok (BSHC).

PRESENTATION

The account of macrolichen flora has been arranged according to the system of classification proposed by Tehler (1996). A generic key to all 72 genera is provided. Genera under each family and species under each genus are arranged alphabetically and numbered when they are more than one. Genus description provided in brief is mainly based on monographic treatment in order to facilitate the future researchers to develop overall concept of the genus. In treatment of species, the current valid name is followed by the citation of relevant literature, the basionym and synonyms, if any. The references cited in the text have been abbreviated according to usual convention. Each species is described briefly while generic characters have usually been omitted. Habitat and distribution in India as well as outside, as per available information for each species is provided. Colour photographs of habit and herbarium specimens of some selected species have been provided for easy identification. Majority of specimens cited are collected by G.P. Sinha, except for a few provided by others are abbreviated as Sinha. Unless otherwise stated, all the specimens are deposited in the herbarium of Sikkim Himalayan Circle, Botanical Survey of India, Gangtok (BSHC). Citation of specimens examined are arranged district wise and alphabetically. In few cases, where too many specimens examined, only selected representatives have been cited.

LICHEN VEGETATION

The state of Sikkim is frequently referred to as a botanist's paradise on account of its one third land area covered with dense forests which boast of providing suitable niche for the growth of commercially important plants *viz.* Sal, Teak, Bamboo and several species of Orchids on one hand while rich and diverse flora comprising an estimated number of 4500-5000 species of higher plants on the other hand. Tree trunks and branches of *Abies*, *Acer*, *Castanopsis*, *Cotoneaster*, *Juniperus*, *Larix*, *Michelia*, *Quercus*, *Rhododendron*, *Salix* show luxuriant growth of epiphytic lichens, mosses, pteridophytes, etc. This rich diversity of plant wealth is protected, particularly under Kanchendzonga Biosphere Reserve (North Sikkim and West Sikkim, 2619.92 sq km) and a number of Wild Life Sanctuaries *viz.* Singba Rhododendron Sanctuary (North Sikkim, 43 sq km), Varshey Rhododendron Sanctuary (West Sikkim, 104 sq km), Kyangnosla Alpine Sanctuary (East Sikkim, 31 sq km), Maenam Wildlife Sanctuary (South Sikkim, 35.34 sq km), Fambong Lho Wildlife Sanctuary (East Sikkim, 51.76 sq km).

The lichen vegetation of Sikkim can be grouped into following four types.

1. Tropical lichens

These lichens are mainly confined in foot hills and lower hilly regions between 250 and 900 m altitude in Teesta and Ranjeet valleys bordering to the state of

West Bengal. The forests comprise three distinct sub types viz. Sal, dry mixed and wet mixed forests. At some places Pine forests are also found along with Sal forests. Dry mixed forests are mainly deciduous and occur on ridges and drier slopes. Wet mixed forests are mainly confined in deep valleys with high humid climate. The arboreal elements in this area comprise *Shorea robusta*, *Aglaia lawii*, *Alstonia neerifolia*, *A. scholaris*, *Bombax ceiba*, *Chukrasia tabularis*, *Bauhinia purpurea*, *Lagerstromia parviflora*, *Eugenia kurzii*, *Duabanga grandiflora*, *Terminalia alata*, *T. bellirica*, *T. chebula*, *T. myricarpa*, *Phyllanthus embilica*, *Ficus hirta*, *Albizia gamblei*, *A. odoratissima* and *A. procera*. The trunks of these trees barely support macrolichen taxa, though microlichen taxa (not dealt here) belonging to families Graphidaceae, Pyrenulaceae, Lecanoraceae, Caliciaceae, Pertusariaceae, Arthoniaceae are quite common. Wherever moist conditions due to streams, rivers and rivulets prevail a few macrolichen species of genera *Dirinaria*, *Pyxine*, *Parmotrema* and *Usnea* are found.

2. Subtropical lichens

The subtropical lichens are found between altitudes 900 and 1800 m in the vicinity of Bey, Chungthang, Mangan, Nampruk, Pentong, Sakyong, Singhik in North Sikkim district; Sumbuk - kartikey and Temi in South Sikkim district; lower ridges of Gangtok, Ranipul, Regu, Rumtek, etc. in East Sikkim district; Geyzing, Kacheopalri, Soreng, Tashiding, Narkhola, Yoksum, etc. in West Sikkim district. The arboreal elements are composed of *Alnus nepalensis*, *Alangium chinense*, *Bischofia javanica*, *Callicarpa arborea*, *Castanopsis indica*, *Eurya cerasifolia*, *Gynocordia odorata*, *Haldina cordifolia*, *Helicia nilagirica*, *Macaranga denticulata*, *Taluma hodgsonii*, *Michelia velutina*, *Mangifera sylvatica*, *Saurauja napaulensis*, *Erythrina arborescens*, *Ficus auriculata* and *F. semicordata*. These trees usually support a good number of epiphytic flora which include orchids, ferns, microlichens and a few macrolichen taxa. Amongst macrolichens, the foliose taxa viz. *Bulbothrix isidiza*, *Everniastrum nepalense*, *Heterodermia diademata*, *Parmelinella wallichiana*, *Myelochroa xantholepis*, *Parmotrema sanctae-angelii*, *P. tinctorum*, *Rimelia reticulata*, *Pseudocyphellaria aurata* are fairly common on trunks of these trees. In moist places *Leptogium burnetiae*, *L. denticulatum*, *Lobaria retigera*, *Peltigera dolichorrhiza* are more common. Besides, a few fruticose taxa viz. *Usnea baileyi* and *U. orientalis* grow on tree trunks while *Cladonia scabriuscula*, *Stereocaulon piluliferum*, *S. pomiferum* are usually found on mossy rocks.

3. Temperate lichens

These lichens occur between altitudes 1800 and 3600 m in the vicinity of Chhaten, Jakthang, Lachen, Lachung, Phuni, Thangu, Tholung, Yakche, Yumthang, etc. in North Sikkim district; Damthang, Mainam, Namchi, Rabangla, Tendong, etc. in South Sikkim district; Gangtok, Karponang, Penengla, Pangolakha, Phadamchen, Rechala, etc. in East Sikkim district and Bakhim, Karchi.

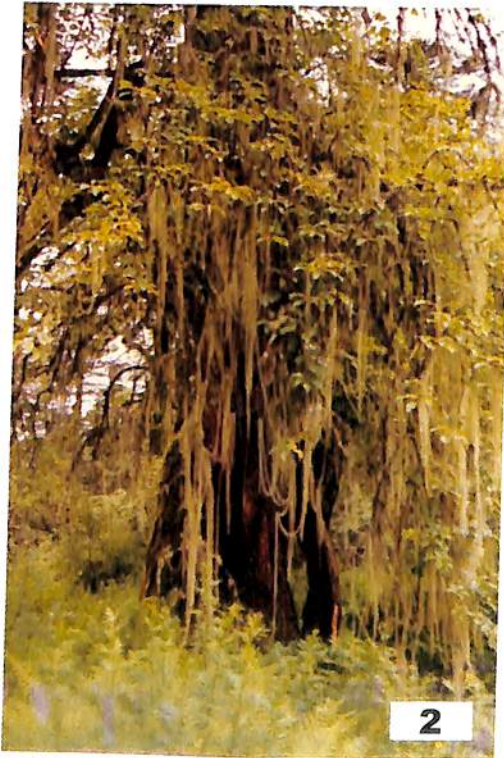


Fig. 1. Coniferous forest - a habitat of temperate lichens at Jakthang, North Sikkim.
Fig. 2. *Abies densa* Griff. ex Parker supporting luxuriant growth of *Usnea longissima* Ach. at Jakthang, North Sikkim.



Fig. 3. *Rhododendron* trees supporting luxuriant growth of *Bryoria* spp. at Dzungri, West Sikkim. Fig. 4. Alpine vegetation - Llonakh Valley, North Sikkim.

Kongri, Labdang, Pernayangtse, Phedang, Tsoka, etc. in West Sikkim district. The temperate climate offers the optimum conditions for luxuriant growth of macrolichens. The tree trunks of *Acer campbelli*, *Engelhardia spicata*, *Exbucklandia populnea*, *Juglans regia*, *Populus ciliata*, *Prunus nepalensis*, *Malus sikkimensis*, *Quercus glauca*, *Lithocarpus pachyphylla*, *Rhododendron* spp., *Viburnum* spp., etc. provide suitable habitat for growth of different foliose species like *Cetrelia braunsiana*, *Coccocarpia erythroxyli*, *Everniastrum cirrhatum*, *E. vexans*, *Heterodermia boryi*, *Lobaria kurokawae*, *Nephromopsis pallescens*, *Parmelaria thomsonii*, *Parmotrema nilgherrense*, *Platismatia erosa*, *Sticta nylanderiana* while fruticose taxa viz. *Bryoria himalayana*, *Sulcaria sulcata*, *Usnea himalayana*, *U. longissima*, *U. thomsonii* are usually seen pendent from tree twigs and trunks. The fruticose forms like *Baeomyces pachypus*, *Cladonia furcata*, *C. squamosa*, *Stereocaulon paradoxum*, *S. piluliferum*, *S. pomiferum*, etc. grow abundantly on the ground as well as on exposed boulders in moist shady places. In upper reaches beyond 3000 m altitude, most of the exposed boulders are, however, characteristically dominated by foliose *Umbilicaria indica*, *U. vellea* and *U. yunnana*. Similarly foliose taxa such as *Lobaria kurokawae*, *L. pseudopulmonaria*, *Peltigera canina*, *Sticta nylanderiana*, *S. weigelii* are well distributed and usually grow on dead wood as well as on the ground and over mosses in humid places.

The coniferous forests found between 2750 and 3350 m altitudes in temperate zone, often considered as subalpine forests, with *Abies densa*, *Larix griffithiana*, *Picea spinulosa*, *Tsuga dumosa* as the dominant tree species mixed with a number of *Rhododendron* spp., *Acer*, *Lonicera*, *Sorbus* spp. as the second tier tree species hosting a multitude of macrolichens in abundance. Some of the commonest lichen taxa of foliose forms are *Hypogymnia hypotrypa*, *Menegazzia terebrata*, *Melanelia stygia*, *Nephromopsis stracheyi*, *Parmelia adaugescens*, *Punctelia rudecta* while fruticose forms are represented by *Usnea longissima*, *U. montis-fuji*, *U. nepalensis*, *Sulcaria virnes*, etc.

4. Alpine lichens

These lichens usually grow at an altitude of 3600 m and above in the vicinities of Lasher, Lonakh valley, Sebu La, Thangu, Kareng, Yangdi, Gaigong, Chholamu, Theu La, most of the core areas of Kanchendzonga Biosphere Reserve and Yomesamdong in North Sikkim district; Chhangu, Jelep La, Nathula, Kupup and Tamsey in East Sikkim district and Dzongri, Thangsing and Samiti in West Sikkim district. A majority of alpine lichens are saxicolous or terricolous in habit as large trees are altogether absent in this region. However, the dwarf bushes of species of *Rhododendron*, *Cotoneaster*, *Salix*, *Juniperus*, *Myricaria*, *Berberis* are found laden with macrolichen genera like *Bryoria*, *Lethariella*, *Usnea* and *Nephroma*. Saxicolous microlichen taxa viz. yellow patches of *Rhizocarpon*; foliose *Xanthoria*; fruticose *Acrosyphus*, and terricolous white *Thamnolia* are the four characteristic lichens representing the alpine lichen vegetation. Besides, on

exposed boulders fruticose species like *Cladia aggregata*, *Cladonia rangiferina*, *Stereocaulon coniophyllum*, *S. massartianum*, *S. macrocephalum* and foliose species *Allocetraria stracheyi*, *C. islandica*, *C. melaloma*, *Lobaria pseudopulmonaria*, *Nephroma nakaoui*, *Nephromopsis leucostigma*, *Physcia caesia*, *P. dilatata*, *Umbilicaria* spp., etc. are fairly abundant in the area.

Uses

or

Lichens are well known for their various uses. As far as the uses of lichens of Sikkim area are concerned, a thorough study is required in this direction. However, some uses along with already recorded information (Saklani & Upreti, 1992; Sinha 2000) are enumerated below in tabular form.

Sl. No.	Name of the species	Vernacular names	Uses
1.	<i>Cladonia rangiferina</i> (L.) Wigg.	Lepcha- Anokbu-singlion	Dried thalli powder applied for curing of eczema and other skin diseases.
2.	<i>Everniastrum nepalense</i> (Fr.) Hale ex Sipman	Nepalese- Rukh ka jhau	Thalli boiled, fried and eaten as vegetables.
3.	<i>Heterodermia diademata</i> (Taylor) Awasthi	Nepalese- Dhungo ku seto jhau	Paste of thalli applied as plaster in cuts and injuries.
4.	<i>Lethariella cladonioides</i> (Nyl.) Krog	Bhutia- Chussa	Raw thalli mixed with garlic and chilly and eaten as pickle. Boiled thalli eaten as vegetables.
5.	<i>Peltigera polydactyla</i> (Neck.) Hoffm.	Nepalese- Jhau Lepcha- Phatdorbi	Paste of thalli applied on cut injury to stop bleeding.
6.	<i>Stereocaulon foliolosum</i> var. <i>strictum</i> (C. Bab.) Lamb	Lepcha- Longdorbi	Raw thalli after washing chewed to cure kidney stones.
7.	<i>S. himalayense</i> Awasthi & Lamb	Nepalese- Dhungo ku jhau	Decoction of pounded and boiled thalli taken orally to treat burning sensation during urination, in other urinary troubles and for the cure of blisters of tongue.
8.	<i>Sticta nylanderiana</i> Zahlbr.	Lepcha - Sangfon	Crushed thalli taken orally for relief in excessive cough.
9.	<i>Thamnolia vermicularis</i> (Swartz) Ach. ex Schaerer	Bhutia- Khange	Thalli as one of the ingredients in preparation of 'Dhoop'.
10.	<i>Umbilicaria indica</i> Frey	Bhutia- Sekdor	Washed thalli fried and consumed as vegetables.
11.	<i>Parmelaria thomsonii</i> (Stirton) Awasthi	Lepcha- Kungrif	Smoke of thalli for relief in eye pain.
12.	<i>Usnea longissima</i> Ach.	Lepcha- Gajetho	Thalli as one of the ingredients in preparation of 'Dhoop'. Also as fodder for yak.

DISCUSSION AND CONCLUSION

The present account of macrolichens of Sikkim is primarily based on specimens collected from different areas of Sikkim between the years 1994 and 2000. The state of Sikkim, situated in the lap of Eastern Himalaya, possesses rich and varied macrolichen flora on account of its geographical location, varied climatic conditions and altitudinal ranges. Through extensive explorations, 1775 specimens were collected from various localities at different altitudes from all the four districts of the state. Critical investigations of these specimens as well as published information from the area have resulted to a total number of 320 macrolichen species including 6 new records for India (*Bryoria nitidula* (Th.Fr.) Brodo & D. Hawksw., *Cetraria nigricans* Nyl., *Melanelia olivacea* (L.) Essl., *M. poeltii* Essl., *Tuckneraria ahtii* Randlane & Saag and *Usnea norkettii* G. Awasthi), disposed under 72 genera and 19 families.

Prior to this study, 248 macrolichen taxa were known from Sikkim. Present study has added 72 additional macrolichen species to Sikkim lichen flora. An analysis of the data thus accumulated shows that Parmeliaceae is the largest family, represented by 145 species. It is followed by Physciaceae (45 spp.), Cladoniaceae (32 spp.), Collemataceae (18 spp.), Lobariaceae (15 spp.), Stereocaulaceae and Peltigeraceae (12 spp. each) and Umbilicariaceae (10 spp.). Like wise in terms of number of species genus *Cladonia* is the largest with 30 species, followed by *Heterodermia* and *Usnea* (25 spp. each), *Hypotrachyna* (17 spp.), *Leptogium* (13 spp.), *Stereocaulon* (12 spp.) and *Peltigera* (10 spp.).

The macrolichens of Sikkim possess 7 interesting species as endemics. These are *Collema hookeri*, *Heterodermia togashii*, *Hypogymnia sikkimensis*, *H. thomsoniana*, *Hypotrachyna neosingularis* and *Nephroma sikkimense*. The species viz. *Anzia physoidea*, *Bryoria levis*, *Heterodermia indica*, *Hypotrachyna rigidula*, *Lethariella cladonioides*, *Nephromopsis isidioidea*, *N. leucostigma* endemic to Eastern Himalayan region and adjacent trans Himalayan areas of Tibet China and Nepal and the taxa viz. *Allocetraria ambigua*, *Leptogium askotense*, *Parmelaria subthomsonii*, *P. thomsonii* and *Usnea sordida* endemic in Himalayas as a whole are also present in the flora. One of the interesting features of Sikkim flora is the presence of some taxa viz. *Acroscyphus sphaerophoroides*, *Alectoria ochroleuca*, *Allocetraria flavonigrescens*, *Heterodermia chondroidea*, *Oropogon formasanus*, *Platismatia erosa*, etc. which are known only from Sikkim among Indian states but are not endemic.

Besides these interesting features, as expected, a number of cosmopolitan taxa viz. *Candelaria concolor*, *Cladonia amaurocraea*, *C. pyxidata*, *C. ramulosa*, *Coccocarpia erythroxyli*, *Peltigera polydactyla*, *P. rufescens*, *Pseudocyphellaria aurata*, *Punctelia borreri*, *Solorina crocea*, *Thamnolia vermicularis*, *Umbilicaria vellea*, etc. on one side and a few circumpolar taxa viz. *Cladonia borealis*, *C. coccifera*, *Melanelia hepatizon*, *Stereocaulon glareosum*, etc. on the other side are also present in the flora. The macrolichen flora exhibits some

striking resemblance with the flora of distant and neighbouring regions. There are over 160 species of Sikkim macrolichens common with neighbouring Darjeeling district of West Bengal. Some of these are *Anzia physioidea*, *Bryoria bicolor*, *Bulbothrix meizospora*, *Cetraria melaloma*, *Cetrelia cetrarioides*, *Cladonia chlorophaea*, *Erioderma meiocarpum*, *Everniastrum cirrhatum*, *Gymnoderma coccocarpum*, *Heterodermia albidiflava*, *Hypogymnia pseudohypotrypa*, *Hypotrachyna exsecta.*, *Lobaria isidiosa*, *Melanelia stygia*, *Parmelia sulcata*, *Pyxine soredata*, *Ramalina himalayensis*, *Stereocaulon himalayense*, *Usnea montis-fuji*, etc. Similarly over 70 species are common with Arunachal Pradesh macrolichens (as per present record) viz. *Bryoria confusa*, *Bulbothrix setschwanensis*, *Cetreliaopsis rhytidocarpa*, *Cladia aggregata*, *Cladonia luteoalba*, *C. singhii*, *Heterodermia lutescens*, *Hypotrachyna infirma*, *Lobaria retigera*, *Myelochroa aurulenta*, *Peltigera dolichorrhiza*, *Ramalina conduplicans*, *Stereocaulon macrocephalum*, *Sulcaria virens*, *Usnea pectinata*, etc. Interestingly, macrolichens of Sikkim also share about 174 species common with Western Himalayan lichens such as *Allocetraria strachevi*, *Bryoria implexa*, *Canomaculina subtinctoria*, *Cetraria islandica*, *Cladonia mongolica*, *Flavopunctelia flaventior*, *Heterodermia awasthii*, *Hypogymnia alpina*, *Hypotrachyna crenata*, *Nephroma isidiosum*, *Parmelaria subthomsonii*, *Parmelia saxatilis*, *Parmelina tiliacea*, *Parmotrema rampoddense*, *Phyllopsora corallina*, *Physcia dimidiata*, *Physconia detersa*, *P. muscigena*, *Ramalina roesleri*, *Stereocaulon myriocarpum*, *Umbilicaria virginis*, *Usnea pangiana*, *Vulpicidia pinastri*, *Xanthoparmelia tinctoria*, *Xanthoria soredata*, etc. The macrolichen flora of Sikkim, owing to its unique geographical position, shows resemblance with neighbouring countries like Bhutan, Nepal and China. An analysis of available data shows that there are 55 species common between Sikkim and Bhutan such as *Cladonia coccifera*, *Coccocarpia palmicola*, *Everniastrum cirrhatum*, *E. nepalense*, *Cetreliaopsis rhytidocarpa*, *Hypogymnia physodes*, *H. vittata*, *Heterodermia boryi*, *H. tremulans*, *Parmotrema praesorediosum*, *Rimelia reticulata*, *Sulcaria sulcata*, *Tuckneraria laureri*, *Usnea longissima*, *U. subfloridiana*, etc.; about 110 species common with Nepal viz. *Cetrelia braunsiana*, *C. olivetorum*, *Everniastrum nepalense*, *Flavocetraria cucullata*, *Hypogymnia hypotrypa*, *Hypotrachyna crenata*, *Leprocaulon arbuscula*, *Lobaria retigera*, *Myelochroa irrugans*, *Nephroma nakaoi*, *Nephromopsis leucostigma*, *Parmelaria thomsonii*, *Parmelia meiophora*, *Phaeophyscia pyrrophora*, *Siphula ceratites*, *Sticta praetextata*, *Umbilicaria nanella*, *Usnea norkettii*, *U. robusta*, etc.; about 61 species common with China viz. *Acroscyphus sphaerophoroides*, *Bryoria perspinosa*, *Bulbothrix setschwanensis*, *Cetrelia collata*, *Cladonia yunnana*, *Everniastrum vexans*, *Gymnoderma coccocarpum*, *Heterodermia firmula*, *Lobaria kurokawae*, *Lethariella cladonioides*, *Oropogon formasanus*, *Platismatia erosa*, *Ramalina sinensis*, *Sulcaria virens*, *Umbilicaria virginis*, *U. yunnana*, *Usnea eumitrioides*, etc. This similarity extends up to far east in Japan. Over 68 species are common with Japan flora viz.

Alectoria ochroleuca, *Cetrelia sanguinea*, *Collema japonicum*, *Heterodermia pseudospeciosa*, *Hypotrachyna koyaensis*, *Leptogium pedicellatum*, *Myelochroa metarevoluta*, *Parmelia squarrosa*, *Peltigera membranacea*, *Ramalina shinanoana*, *Stereocaulon coniophyllum*, *Tuckermannopsis sepincola*, *Usnea aciculifera*, *U. bismolliuscula*, etc. Further, the high altitude macrolichens of Sikkim resemble with the flora of Europe as shown by the species like occurrence of *Alectoria ochroleuca*, *Bryoria implexa*, *Cladonia arbuscula*, *C. subulata*, *Cetraria islandica*, *Heterodermia speciosa*, *Lobaria isidiosa*, *Phaeophyscia decolor*, *Physcia caesia*, *P. dimidiata*, *Rhizoplaca chrysoleuca*, *Tuckneraria laureri*, *Umbilicaria cylindrica*, *Usnea subfloridiana*, *Xanthoria soredata* in both the areas and North America as exemplified by the occurrence of *Acrosyphus sphaerophoroides*, *Arctoparmelia subcentrifuga*, *Bryoria tenuis*, *Cladonia kanewskii*, *Collema flaccidum*, *Heterodermia podocarpa*, *Hypogymnia enteromorpha*, *Lasallia pustulata*, *Leprocaulon arbuscula*, *Lobaria pseudopulmonaria*, *Melanelia stygia*, *Peltigera horizontalis*, *Stereocaulon alpinum* and *Vulpicidia pinastri* in both the areas.

Like other states, there has been a great deal of damage to the richness of the biodiversity of Sikkim Himalaya. The forests have been denuded by the large scale felling of trees for timber, through unmanaged grazing, road construction activities, etc. However, there has been a welcome awakening with regard to Biodiversity conservation in this small Himalayan state in recent past. Presently, the rich diversity of plant wealth including lichens are protected under Kanchendzonga Biosphere Reserve and a number of Wild Life Sanctuaries viz. Singbha Rhododendron Sanctuary, Varshey Rhododendron Sanctuary, Kyangnosla Alpine Sanctuary, Maenam Wild Life sanctuary and Fambong Lho Wild Life Sanctuary. If these areas are protected with care, the lichens would need no special conservation measures separately.

Finally, in the light of above discussion it can be concluded that due to unique geographical position, snow capped peaks and presence of cold desert areas in North Sikkim district adjacent to Nepal and Tibet area of China, the macrolichens of Sikkim show general affinity to Eastern Himalayan and South East Asian lichen flora.

TAXONOMIC TREATMENT

Artificial key to the Macrolichen genera

- 1a. Thallus foliose 2
- 1b. Thallus subfruticose or fruticose 67
- 2a. Thallus bright yellow to orange 3
- 2b. Thallus otherwise 4
- 3a. Thallus K+ purple-red; parietin present **Xanthoria**
- 3b. Thallus K-; parietin absent **Candelaria**
- 4a. Thallus umbilicate 5
- 4b. Thallus non umbilicate 7
- 5a. Thallus brown black to black; cortex with necral layer; apothecia usually gyrose, lecideine 6
- 5b. Thallus yellowish grey to grey; cortex lacking necral layer; apothecia not gyrose, lecanorine **Rhizoplaca**
- 6a. Thallus pustulate; asci 1-2 spored; spores brown, muriform **Lasallia**
- 6b. Thallus lacking pustules; asci 8-spored; spores colourless to brown, simple to muriform **Umbilicaria**
- 7a. Thallus underside with well developed rhizines, lacking distinct vein like markings from which rhizines arise 8
- 7b. Thallus underside apparently devoid of rhizines or sparsely rhizinate at margins only, or tomentose, or on a spongy indumentum or prothallus, sometimes cyphellae, pseudocyphellae or with distinct vein like markings from which rhizines arise 50
- 8a. Lobes marginally ciliate 9
- 8b. Lobes marginally eciliate 23
- 9a. Cilia bulbate **Bulbothrix**
- 9b. Cilia not bulbate 10
- 10a. Pycnidia marginal, either emergent or on projections, if laminal, present only on projections 11
- 10b. Pycnidia laminal, immersed 13
- 11a. Apothecia marginal, nephromoid 12

- 11b. Apothecia laminal **Parmelaria**
- 12a. Upper surface yellowish grey or yellowish
green; usnic acid present; pseudocyphellae present
on lower surface **Tuckneraria**
- 12b. Upper surface pale olive grey to olive
brown; atranorin present; pseudocyphellae absent
on either surfaces **Tuckermannopsis**
- 13a. Cilia sharply tapered, often forked **Canomaculina**
- 13b. Cilia not markedly tapered, rarely forked 14
- 14a. Spores transversely 2-celled; lobes up to 2 mm wide 15
- 14b. Spores simple; lobes usually more than 2 mm wide 16
- 15a. Thallus K+ yellow; atranorin present **Heterodermia**
- 15b. Thallus K-; atranorin absent **Phaeophyscia**
- 16a. Lobes broader, more than 5 mm wide 17
- 16b. Lobes narrower, less than 5 mm wide 19
- 17a. Upper surface emaculate, or if maculate,
maculae not forming reticulate cracks; rhizines simple
or rarely branched, not squarrose or dimorphous 18
- 17b. Upper surface with reticulate maculae, forming
cracks; rhizines squarrose or simple or dimorphous **Rimelia**
- 18a. Lobe tips broadly rotund, with a broad naked
marginal zone below **Parmotrema**
- 18b. Lobe tips narrow, truncate to subrotund, without
naked marginal zone below **Parmelinella**
- 19a. Rhizines dichotomously branched **Hypotrachyna**
- 19b. Rhizines simple or squarrosely branched 20
- 20a. Lobes canaliculate **Everniastrum**
- 20b. Lobes flat 21
- 21a. Medulla yellow to orange, at least in part, C- or
C+ more intensely yellow; containing terpenes and
secalonic acids **Myelochroa**
- 21b. Medulla white, or if partly yellow C+ rose or red;
lacking terpenes and secalonic acids 22

- 22a. Lobe apices truncate, cilia evenly dispersed **Parmelinopsis**
- 22b. Lobe apices subrotund, cilia mainly in lobe axils **Parmelina**
- 23a. Apothecia present on lower surface of lobe
apices, nephromoid 24
- 23b. Apothecia present on upper surface of lobes, not
nephromoid 26
- 24a. Thallus greenish-brown to brown; lower surface
pubescent or tomentose; spores transverse
3-septate **Nephroma**
- 24b. Thallus yellow-green or grey; lower surface lacking
tomentum; spores simple 25
- 25a. Pseudocyphellae present on both surfaces **Cetrelia**
- 25b. Pseudocyphellae present only on lower surface **Nephromopsis**
- 26a. Thallus brown or olive 27
- 26b. Thallus white, grey, straw yellow to yellow green 30
- 27a. Photobiont a blue green alga; upper cortex tomentose **Erioderma**
- 27b. Photobiont a green alga; upper cortex etomentose 28
- 28a. Upper cortex pseudocyphellate; spores colourless,
simple **Melanelia**
- 28b. Upper cortex lacking pseudocyphellae; spores brown,
2-celled 29
- 29a. Lobes whitish pruinose; lower cortex
prosoplectenchymatous; rhizines squarrose **Physconia**
- 29b. Lobes epruinose; lower cortex paraplectenchymatous;
rhizines simple **Phaeophyscia**
- 30a. Thallus straw yellow to yellow green or yellowish
brown 31
- 30b. Thallus white or whitish grey to grey 37
- 31a. Pycnidia marginal on projections 32
- 31b. Pycnidia laminal, not on projections 34
- 32a. Pseudocyphellae present; vulpinic acid absent 33
- 32b. Pseudocyphellae absent; vulpinic acid present **Vulpicidia**

- 33a. Pseudocyphellae present on lower surface; apothecia both laminal and marginal, not nephroid **Allocetraria**
- 33b. Both upper and lower surfaces pseudocyphellate; apothecia only marginal, nephroid **Cetrellopsis**
- 34a. Upper surface pseudocyphellate **Flavopunctelia**
- 34b. Lower and upper surfaces not pseudocyphellate 35
- 35a. Lower surface velvety **Arctoparmelia**
- 35b. Lower surface not velvety 36
- 36a. Lobes narrow, truncate; usnic acid present in cortex, atranorin absent **Xanthoparmelia**
- 36b. Lobes subrotund; usnic acid and traces of atranorin present in cortex **Flavoparmelia**
- 37a. Photobiont blue green; upper surface with concentric rings **Coccocarpia**
- 37b. Photobiont green 38
- 38a. Upper surface pseudocyphellate 39
- 38b. Upper surface non pseudocyphellate 43
- 39a. Spores brown, transversely 2-celled; lobes usually less than 2 mm wide **Pyxine**
- 39b. Spores colourless, simple, lobes usually more than 2 mm wide 40
- 40a. Pycnidia marginal, immersed 41
- 40b. Pycnidia laminal, immersed 42
- 41a. Upper surface reticulately ridged; apothecia (absent in Sikkim specimens) eperforate; spores ellipsoid to subspherical, 5-8 x 3-5 μm **Platismatia**
- 41b. Upper surface not reticulately ridged; apothecia perforate; spores ellipsoid, 11-22 x 6-12 μm **Cetrelia**
- 42a. Upper surface with linear or reticulate pseudocyphellae; lower surface black; some rhizines squarrose; conidia cylindrical or weakly bifusiform **Parmelia**
- 42b. Upper surface with punctiform pseudocyphellae; lower surface jet black; all rhizines simple; conidia unconfined to filiform **Punctelia**

- 43a. Rhizines dichotomously branched, usually projecting beyond margins 44
- 43b. Rhizines simple, squarrose, usually not projecting beyond margins 45
- 44a. Upper cortex palisade plectenchymatous; spores colourless, simple **Hypotrachyna**
- 44b. Upper cortex composed of longitudinally disposed hyphae; spores brown, transversely 2-celled **Heterodermia**
- 45a. Spores colourless, simple; thallus usually loosely attached on substratum; lobes rotund to subrotund, more than 3 mm wide 46
- 45b. Spores brown, transversely 2-celled; thallus usually closely appressed on substratum; lobes otherwise, less than 3 mm wide 47
- 46a. Rhizines restricted to the centre leaving a bare, more than 2 mm wide marginal zone **Parmotrema**
- 46b. Rhizines up to margin but leaving a small, less than 2 mm wide erhizinate or papillate marginal zone **Canoparmelia**
- 47a. Thallus UV+ yellow; lichexanthone present **Pyxine**
- 47b. Thallus UV-; lichexanthone absent 48
- 48a. Lobes plicate, coalescing laterally **Dirinaria**
- 48b. Lobes discrete, neither plicate not coalescing laterally ... 49
- 49a. Lobes sublinear, closely appressed, usually marginally pseudocyphellate; apothecia lecideine **Pyxine**
- 49b. Lobes irregular with subrotund apices, marginal pseudocyphellae absent; apothecia lecanorine **Physcia**
- 50a. Lower surface cyphellate or pseudocyphellate or with vein like markings which bear rhizines 51
- 50b. Lower surface lacking cyphellae, pseudocyphellae or vein like markings 54
- 51a. Lower surface vein like 52
- 51b. Lower surface cyphellate or pseudocyphellate 53
- 52a. Apothecia terminal on digitate lobes **Peltigera**

- 52b. Apothecia sunken on the thallus **Solorina**
- 53a. Lower surface cyphellate **Sticta**
- 53b. Lower surface pseudocyphellate **Pseudocyphellaria**
- 54a. Rhizines sparse, restricted to margin or constrictions
in thallus 55
- 54b. Rhizines absent 56
- 55a. Lower surface with brown-black
spongiostratum layer; lobes articulated **Anzia**
- 55b. Lower surface lacking such layer; lobes
not articulated **Heterodermia**
- 56a. Photobiont a blue green alga 57
- 56b. Photobiont a green alga 60
- 57a. Thallus homoiomerous (not zoned in sections) 58
- 57b. Thallus heteromerous (zoned in sections) 59
- 58a. Thallus blue grey, brown or grey black; upper cortex
single layered of well defined cells **Leptogium**
- 58b. Thallus brown or green black, without a cellular
upper cortex **Collema**
- 59a. Upper surface with stiff prominent hairs;
lower surface with yellow tomentum **Erioderma**
- 59b. Upper surface usually scrobiculate, lacking
stiff prominent hairs; lower surface usually bullate with
rhizines in convexities, lacking yellow tomentum **Lobaria**
- 60a. Thallus inflated and hollow, or medulla more
than twice as thick as upper cortex and often loose
and cobweb like 61
- 60b. Thallus not inflated, solid, medulla less than twice as thick
as upper cortex 62
- 61a. Upper cortex pierced by holes **Menegazzia**
- 61b. Lower cortex pierced by holes at margins or at
branching axis **Hypogymnia**
- 62a. Thallus corticated only on upper surface 63
- 62b. Thallus corticated both on upper and lower surfaces 64

- 63a. Thallus squamulose to foliose on hypothallus; apothecia laminal, sessile **Phyllopsora**
- 63b. Thallus foliose, lobate, not on hypothallus; apothecia marginal, stalked **Gymnoderma**
- 64a. Lobes plicate and coalescing laterally **Dirinaria**
- 64b. Lobes discrete, neither plicate or coalescing laterally 65
- 65a. Upper surface usually scrobiculate or thick and rugose; spores transversely septate; lower surface bullate or with diffuse tomentum **Lobaria**
- 65b. Upper surface \pm smooth; spores simple; lower surface etomentose 66
- 66a. Thallus erect; lobes strongly canaliculated or subtubular, once or twice dichotomously branched, yellowish; pseudocyphellate on lower surface; usnic acid present **Flavocetraria**
- 66b. Thallus dorsiventral; lobes linear elongate repeatedly dichotomously branched, lacking pseudocyphellae on both surfaces; usnic acid absent **Everniastrum**
- 67a. Thallus dimorphic, primary thallus crustose, leprose or squamulose; secondary thallus erect, arising from primary thallus with or without apothecia 68
- 67b. Thallus not as above 72
- 68a. Primary thallus leprose; secondary thallus of erect, short white podetia with a continuous sorediate crust; apothecia not known **Leprocaulon**
- 68b. Primary thallus crustose, granular or squamulose 69
- 69a. Primary thallus at least crustose in central part; peripheral margin foliose or not; apothecial stalk small .. 70
- 69b. Primary thallus granular or squamulose 71
- 70a. Primary thallus crustose throughout; apothecial disc pinkish **Dibaeis**
- 70b. Primary thallus lobate along peripheral margin; apothecial disc black **Baeomyces**
- 71a. Podetia hollow, usually with apical cups and squamules; phyllocladia and cephalodia absent; spores simple **Cladonia**

- 71b. Pseudopodetia solid with granular peltate or finger like phyllocladia, lacking apical cups and squamules, usually with pale brown to blackish cephalodia; spores transversally septate **Stereocaulon**
- 72a. Thallus flattened, strap -shaped, dorsiventral (with a distinct, differently coloured upper and lower surfaces); algae concentrated near the upper surface only 73
- 72b. Thallus not flattened, terete or, if flattened, algae distributed on both lower and upper sides 78
- 73a. Marginal cilia present; thallus usually subpendulous on cliffs **Heterodermia**
- 73b. Marginal cilia absent; thallus usually in tufts (except a few *Ramalina*) 74
- 74a. Pycnidia emergent; spores simple 75
- 74b. Pycnidia immersed or absent; spores transversely 1 -septate 77
- 75a. Apothecia nephromoid 76
- 75b. Apothecia not nephromoid **Cetraria**
- 76a. Lower surface pseudocyphellate; spores ellipsoid; usnic acid usually present **Nephromopsis**
- 76b. Pseudocyphellae absent on both surfaces; spores subspherical; usnic acid absent **Tuckermannopsis**
- 77a. Thallus soft, shrubby foliose; lobes dorsiventral with paler lower surface, photobiont cells mainly confined to upper side **Evernia**
- 77b. Thallus cartilaginous, shrubby, often tufted; branches generally markedly compressed or strap -shaped, rarely rounded, not dorsiventral, of uniform colour on all sides **Ramalina**
- 78a. Thallus, podetia or pseudopodetia solid 79
- 78b. Thallus or podetia hollow in the centre 87
- 79a. Spores in mazaedium; thallus saxicolous in alpine himalaya **Acroschyphus**
- 79b. Spores not in mazaedium 80

- 80a. Thallus with a central chondroid axis within medulla 81
- 80b. Thallus lacking central chondroid axis 82
- 81a. Thallus orange to orange grey with dense longitudinal wrinkles and grooves on surface; usnic acid absent **Lethariella**
- 81b. Thallus yellowish grey to grey, lacking longitudinal wrinkles and grooves on surface; usnic acid usually present **Usnea**
- 82a. Thallus chalk white, on acidic soil and peat; a few mm tall **Siphula**
- 82b. Thallus neither chalk white nor grow on acidic soil or peats; usually larger, filamentous, caespitose 83
- 83a. Thallus brown, dark brown to black; spores colourless simple **Bryoria**
- 83b. Thallus yellow, yellowish grey; spores colourless or brown at maturity 84
- 84a. Thallus sulcate pseudocyphellate throughout its length **Sulcaria**
- 84b. Thallus otherwise 85
- 85a. Branches entirely flattened; spores transversely 1-septate, ellipsoid or kidney-shaped **Ramalina**
- 85b. Branches filamentous, not flattened; spores simple, colourless or brown 86
- 86a. Thallus yellow with brown black apices; papillae and tubercles absent; spores (absent in Sikkim specimens) brown at maturity **Alectoria**
- 86b. Thallus yellowish grey or with brownish tinge; papillae and tubercles usually present; spores colourless **Usnea**
- 87a. Thallus hollow within the central chondroid axis **Usnea**
- 87b. Thallus lacking central chondroid axis 88
- 88a. Thallus podetial in nature, with or without squamules 89
- 88b. Thallus otherwise, lacking squamules 92
- 89a. Podetia frequently present with squamules, cups or soredia **Cladonia**

- 89b. Podetia or pseudopodetia lacking squamules,
cups or soredia 90
- 90a. Podetia simple to furcated, tapering, vermiform, milky
white to grey **Thamnotia**
- 90b. Podetia profusely branched 91
- 91a. Podetial surface with elliptic perforations in cortex **Cladia**
- 91b. Podetial surface lacking perforations in cortex; primary
thallus crustose of diffuse verrucae becoming
evanescent later **Cladonia**
- 92a. Thallus usually in tufts; branches entirely flattened;
asci 8-spored; spores colourless, transversely
1-septate, ellipsoid or kidney-shaped **Ramalina**
- 92b. Thallus caespitose; branches filamentous, rounded;
asci 1-spored; spores brown, muriform **Oropogon**

CALICIACEAE

Acroscyphus Lév.

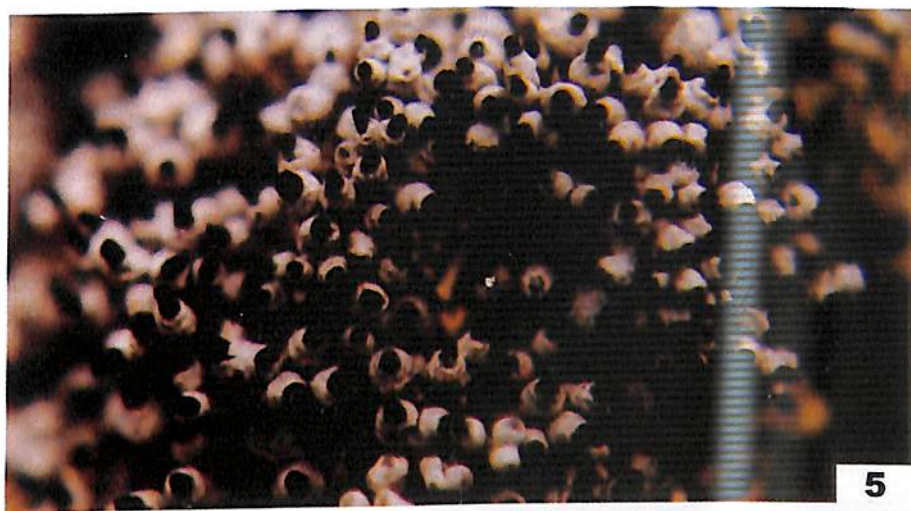
Thallus dwarf fruticose, erect, solid, firmly attached to the substratum. Podetia arising from verruculose mass, numerous, irregularly thickened; medulla solid, yellow at first, thereafter chondroid cartilaginous. Apothecia black, clavate to subglobose, mazaedium on podetial tips; spores transversely bicelled, constricted in the middle.

A monotypic genus distributed in high montane regions of Asia and America. In India, it is known only from Sikkim by the following species.

Acroscyphus sphaerophoroides Lév., Ann. Sci. Nat. Bot., ser. 3, 5: 262. 1846; Zahlbr., Cat. lich. univ. 1:681. 1922; G. Pant & D. Awasthi, Biovigyanam 15(1):4. 1989. (Figs. 5, 6)

Thallus yellowish grey to grey, irregularly thickened, rigid, occurring in large irregular patches. Podetia crowded, cylindrical to clavate, repeatedly dichotomously branched, up to 4.5 - 5 cm tall, 1-2 mm diam.; podetial surface verrucose. Apothecia sunken, globose, 0.5 - 3 mm diam., blackish; spores dark greyish, 20 - 30 x 10 - 13 μ m. Chemistry: Cortex K-; medulla K-, C-, KC-, P+ red; calycin, gyrophoric acid and two unknown substances present.

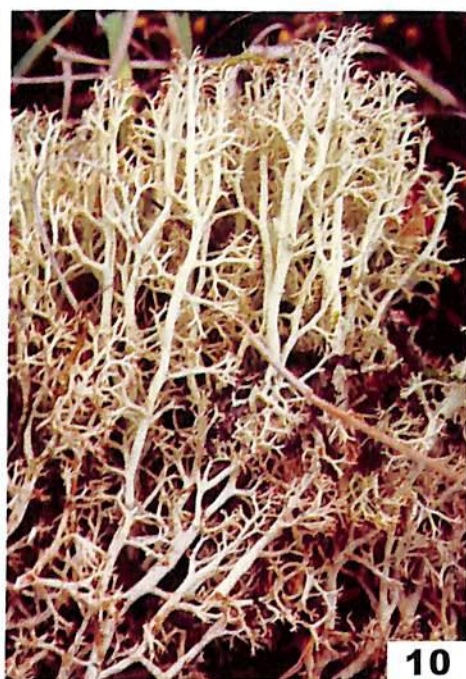
It is abundant in alpine areas and grows on bare boulders in association with species of *Cetraria*.



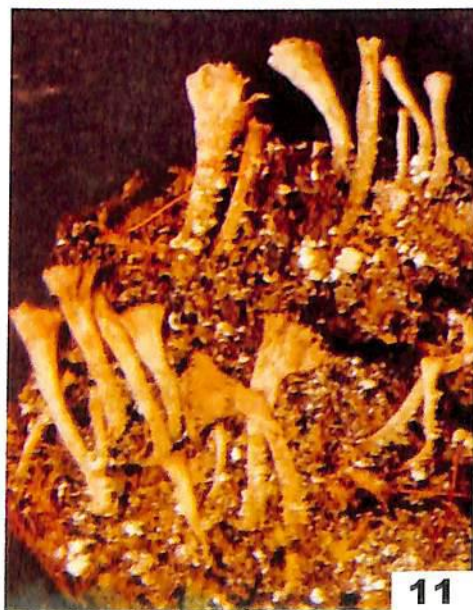
Figs. 5-6. *Acrosyphus sphaerophorioides*. **Fig. 7.** *Baeomyces pachypus*.
Fig. 8. *Cladia aggregata*.



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Fig. 9. *Cladonia amourocreaea*. Fig. 10. *C. arbuscula*. Fig. 11. *C. chlorophaea*.
Fig. 12. *C. fenestralis*.