

Flora of India
Series - 2

FLORA OF SIKKIM

Volume 1
(Monocotyledons)

Editors
P.K. HAJRA
D.M. VERMA

with assistance from
S. Bandyopadhaya



BOTANICAL SURVEY OF INDIA

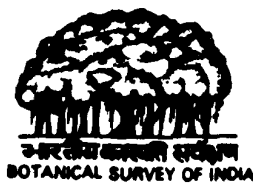
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Hedychium spicatum Buch. Ham. ex J.F. Smith



Pandanus nepalensis St. John



Maimaichu Lake (East Sikkim District)



Arisaema griffithii Schott.

INTRODUCTION

(R.C. Srivastava)

The State of Sikkim situated on the flanks of the Eastern Himalayas between 27°10' 28°5' N and 88°30' 89° E is 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 topography of this pretty Himalayan State is varied. The altitudes range from 244 m to over 8598 m. Most of the 7300 sq km area is interlaced with jungle-clad ridges and deep ravines created by, and through which, the raging torrents of the mountain rivers speed and emerald valleys alternating with their terraced hill-sides and dense forests ; a variety of plant beauties along with water-falls, rivulets, lakes and snow-capped mountains girdling the state in a protective embrace, embellish the land.

The climatic, edaphic, altitudinal and biotic variations with their complex inter-relationship and species composition have resulted in different kinds of vegetation cover in the area. The forests cover *ca* 42.8% (3124 sq. km) of the total geographic area, of which 2260 sq km are protected and reserve forests. The state is very rich in biological diversity. It is estimated that *ca* 5000 species of flowering plants, *ca* 350 pteridophytes and *ca* 15 species of Gymnosperms occur in this region. In addition to these a large number of non-flowering plants such as liver-worts, lichens, mosses, algae and fungi also occur.

CLIMATE : The abrupt variations in the altitude (elevations) have created diverse climatic conditions. The climate is warm and humid during summer and monsoon season (June Oct.) and moderately cold during winter (Dec. Feb.) at lower elevations. The winter months become more severe as one goes up. Places like Lachen, Lachung and Dzungri areas remain almost snow covered during most of the winter months. The perennial snow line however, begins from *ca* 4880 m only.

Most of the areas of the state are very wet during June to September, except the areas in North which are shielded from the monsoon clouds by the high embattlements of the Himalayas, or those areas where the monsoon loses its intensity. Average annual rainfall is *ca* 4000 mm and

average minimum/maximum temperature ranges between 4.2° 17.1° C/13.9° 23.9° C. Rainfall is usually very heavy during May Sept. being maximum in July.

Relative humidity is 70 80% throughout the year and at most of the places in Sikkim.

PEOPLE : Sikkim's population as per the 1991 census is 4,03,612 with a density of 57 per sq. km. However, the density varies district wise due to varied climatic conditions and topography. East district has the highest of 157, while it is 133 for South District, 83 for West District and only 7 for North District. Gangtok being the Capital is the most populated place in the State of which *ca* 83% is rural and consists mainly of Nepalese, Bhutia, Lepcha, Limbus (very few). In the township, service group and business people have come from the plains. But of these, Nepalese who themselves have a conglomeration of different ethnic types are at present largest in number. But the Lepchas (Rongkup-Children of Rong, Rongpa ravine dwellers) are the earliest settlers of Sikkim. They have an extremely well stocked vocabulary on plants. (Rip-flower; Kung-tree). Even today the old and rural folk can distinguish most of the species at a glance and tell their local uses (mostly medicinal/edible). Sir J.D. Hooker the world renowned explorer of the Sikkim Himalaya also mentioned in glorious terms about the Lepcha's wonderful knowledge of the Sikkim plants.

The state has been divided into four districts viz. East, North, South and West.

BOTANICAL EXPLORATIONS

Sikkim's botanical diversity has attracted a large number of plant collectors from different parts of the world since Griffith's visit in 1843. The famous botanist J.D. Hooker visited Sikkim during 1848-49 and the account published by him in 'Himalayan Journals' is still one of the most comprehensive description of the botanical splendour of this region.

Subsequently distinguished botanists such as Sir G. King, C.B. Clarke, G.H. Cave, W.W. Smith and J.M. Cowan visited the area during later part of the 19th century and early 20th century. In the post 1940 period, comparatively little collections were made except for K.P. Biswas, R.S. Rao, B.D. Sharma, B. Ghosh Hara *et al.* and A.R.K. Sastry & P.K. Hajra. But the exploration work gained momentum after the establishment of the Sikkim Himalayan Circle of the Botanical Survey of India at Gangtok in December 1979. In the post 1979 period, P.K. Hajra, P. Chakraborty, B. Krishna, A.K. Verma, D.C.S. Raju,

R.C. Srivastava, S. Kumar and N.R. Mandal, P. Basu, B. Mittal, S. Singh, M. Sanjappa, M. Ahmedullah, V. Sampat Kumar, K.D. Kumar, A.K. Raut, L.B. Chowdhury collected plants from different areas of the state including the areas like Sakyong Valley (Lepchas land). The Herbarium of this Circle until now houses *ca* 14000 specimens.

VEGETATION

Broadly Sikkim can be divided into three distinct botanical zones viz. Tropical, Temperate and Alpine, depending on the elevation and characteristics of the vegetation. The foothills of Sikkim are covered with forests consisting of the species of *Shorea*, *Adina*, *Dalbergia*, *Dillenia*, *Artocarpus*, *Ficus*, *Bauhinia*, *Litsea*, *Lagerstroemia*, *Terminalia* etc. In the lower hill ranges (600-1500m) the forests chiefly include the species of *Schima*, *Syzygium*, *Duabanga*, *Engelhardtia*, *Ficus*, *Castanopsis*, *Pandanus*, *Cyathia*, *Michelia*, *Quercus*, *Saurauia*, *Photinia*, *Juglans*, *Leucocephalum* etc.

The temperate vegetation comprises of forests consisting of the species of *Alnus*, *Acer*, *Betula*, *Magnolia*, *Rhododendron*, *Larix*, *Berberis*, *Salix*, *Cotoneaster*, *Vaccinium*, *Daphne*, *Sorbus*, *Rubus* and the herbaceous species of *Aconitum*, *Anemone*, *Potentilla* etc. *Abies densa*, *Larix griffithiana*, *Tsuga dumosa*, *Picea spinulosa* and *Taxus wallichiana* represent the coniferous belt in the altitudinal range of 2700-3900m. The Rhododendron-Conifer forests comprising of the several species of *Rhododendron*, *Daphne*, *Betula* etc. mark the timberline in the altitude of *ca* 4000m.

The alpine vegetation which occurs above 4500m and up to a limit of *ca* 5500m is confined to moorlands of coarse meadows with many stunted and dwarf shrubby species of *Rhododendron*, prostrate plants of *Juniperus squammata* and cushion-like herbaceous species of *Arenaria*, *Androsace*, *Aconitum*, *Cassiope*, *Saxifraga*, *Primula*, *Pinguicula*, *Sedum*, *Rheum*, *Saussurea*, *Gentiana*, *Kobresia*, *Carex* etc.

The vegetation in the area may be classified into the following categories :

i) *Low Hill Forests* (tropical to sub-tropical type, up to 900m) : From the base (244m) to 900m, the sub-mountainous tracts are inhabited by dense broad-leaved semi-evergreen forests with trees attaining 24-36 m height. The rainfall is heavy, even up to 500cm annually. Canes yams and other climbers are common. Epiphytes like orchids, aroids etc. are abundantly represented. The undergrowth is luxuriant and varied. *Shorea robusta* (sal) is very common, covering large tracts especially

along the Teesta and Rangit rivers. *Schima wallichii*, *Bauhinia purpurea*, *Cedrela toona*, *Stereospermum tetragonum*, *Bombax ceiba*, *Dillenia pentagyna*, *Lagerstroemia parviflora*, *Sterculia villosa*, *Terminalia myriocarpa*, *T. tomentosa* and *Albizia* spp. are prominent components of the forests. Other trees occasionally met with *Garuga pinnata*, *Cedrela microcarp*, *Amoora wallichii*, *A. rohituka*, *Chukrasi tabularis*, *Evodia mellaefolia*, *Ailanthus grandis*, *Duabanga grandiflora*, *Tetrameles nudiflora*, *Celtis tetrandra*, *Castanopsis indica*, *Syzygium formosa*, and *Michelia champaca* together with laurel like *Phoebe lanceolata*, *P. hainesiana*, *P. attenuata* *Litsea polyantha* and *Cinnammomum tamala*. Several species of *Artocarpus* such as *A. integrifolia*, *A. chaplasha* together with *Bischofia javanica* also occur. Large cultivated trees of *Ficus elastica* are often seen along banks of the river Teesta, along side Pakyong road, and near Dickchu. Occasionally interspersed in the forest are *Ficus semicordata* and *Pandanus nepalensis*. Tree-ferns are not uncommon in the low-land forests of Sikkim.

ii) *Middle Hill Forests* (subtropical type, 750-1500 m) : These are formed largely of evergreen species which are dominant. Deciduous trees may also occur. The trees are usually 20-30 m in height. Epiphytes and climbers occur in large numbers. The undergrowth is not usually dense and consists of numerous herbaceous and shrubby species. *Castanopsis tribuloides*, *C. indica*, *Schima wallichii* and *Phoebe hainesiana* are the commonest tree species between 750 and 1200m. *Michelia champaca* and *Stereospermum tetragonum* may also be occasionally met with. Other prominent components of the forests of this region are : *Drimycarpus racemosus*, *Juglans regia*, *Engelhardtia spicata*, *Spondias lutea*, *Exbucklandia populnea*, *Michelia cathcartii*, *Talauma hodgsonii*, *Saurauia nepalensis*, *Ficus oligodon*, *F. semicordata*, *Betula alnoides*, *Alnus nepalensis*, *Terminalia* spp., *Macaranga* sp., *Litsea polyantha*, *Phoebe lanceolata*, *P. attenuata*, and members of the family Meliaceae. Large evergreen trees of *Quercus glauca*, *Q. spicata*, *Q. serrata*, and *Q. griffithii* grow in dense formations between 1200 and 1600 m or above. Bamboos may also be found near habitations.

It will not be out of place to mention that *Cryptomeria japonica* is being extensively cultivated. It covers large areas and forms dense forests between 1200 and 2400 m altitude. It thrives best in this climate but due to rapid growth the wood remains soft and thus loses much of its commercial values. The ground vegetation underneath these forests is scanty due to lack of sun light and unsuitable substratum. Only a few ferns grow on the fringes of such forests.

iii) *Upper Hill forests* (Warm or wet temperate type 1500 -2700 m) : The forests are evergreen with medium-sized trees, rarely over

24 m height. There are a number of deciduous tree species but these form only a small proportion. Oaks and laurels form large patches in otherwise mixed forests. The oaks have branched crowns and are abundantly covered with mosses and other epiphytes. The forests extremely thick and the requisite amount of moisture available for the ground growing as well as epiphytic vegetation. The shelter of trees provided shade and prevents rapid air movements to a considerable extent. This results in a prolific growth of small herbs, shrubs and ferns on the forest floor. Woody climbers are frequent but not conspicuous.

Several altitudinal zones may be distinguished by the preponderance of certain such as laurels between 1800 and 2100 m, *Quercus lamellosa* between 2100 and 2400 m and *Q. pachyphylla* between 2400 and 2700m, though freely overlapping. *Michelia cathcartii*, *Mangolia campbellii*, *Machilus edulis*, *Quercus fenestrata* and *Castanopsis hystrix* are quite common in all the forests up to 2100m. Between 2100 and 2400 m of altitudes *Quercus lamellosa*, *Castanopsis tribuloides*, *Acer campbellii*, *Michelia excelsa* and *M. cathcartii* are dominant. *Quercus lineata* *Betula alnoides* and *Symplocos theaeifolia* are also frequently met with the former being quite prominent. The oaks constitute the greater part of the trees of top canopy and Lauraceae is usually relegated to the second storey, though numerically predominant. Laurels like *Machilus grammiana* *M. gamblei* *M. edulis* *Litsea sericea*, *elongata* *L. kingii*, *L. zeylanica* and *Cinnamomum obtusifolium* are not uncommon. *Alnus nepalensis* grows mainly along water courses and is the chief colonizer of new landslip areas. *Michelia excelsa* is well known timber tree of this zone.

Still higher up, between 2400m and 2700m or so *Quercus lamellosa* *Q. pachyphylla*, *Castanopsis tribuloides* *Acer campbellii* *Magnolia campbellii* *Symploco theaeifolia* and *Taxus wallichiana* are the prominent elements of the forests. Above 2700m in this zone *Quercus pachyphylla* occurs in pure formations. Under the shade of these forest *Rhododendron griffithianum* finds a favourable place. Dwarf bamboos, *Arundinaria* spp. are not uncommon as undergrowth at higher altitudes.

iv) *Rhododendron-Conifer Zone* (cold temperate or sub-alpine, 2700m-3600m) : The forests of this zone are also evergreen, mainly composed of *Rhododendrons* and conifers. Quite often *Quercus pachyphylla* and *Q. lineata* formations extend above 2,700m altitude and *Acer combellu*, *A. caudatum* *Betula utilis* an *Magnolia campbellii* may also be met with though very infrequently. As one proceeds higher up, there is a gradual replacement of oak trees by *Rhododendron arboreum* *R. campanulatum* and *R. grande* and other species of the genus. *Betula utilis* is occasionally found in the high level *Rhododendron*

forest at the head of Lachen valley near or above Samdong (3300 m). *Taxus wallichiana* grows in the forests as one proceeds above Lachung. Interspersed with these are patches of *Tsuga wallichiana* and *Abies densa*. At about 2700-3000 m, in Lachen valley, *Tsuga dumosa* grows in abundance and is the dominant tree. It also grows at Chhoka in West Sikkim. *Picea spinulosa* grows abundantly on all the hills around Lachen intermixed with *Tsuga dumosa* but does not reach the heights above 3000 m. The bamboo, *Arundinaria aristata* forms dense undergrowth in silver fir forests, especially where fire has destroyed the tree canopy. *Abies densa* also occurs in almost pure formations between Karponang and Chhangu (East Sikkim), and Simdong to Thangu (North Sikkim) extending upto 3600 m or a little above. Few trees of *Salix wallichiana*, are also seen growing near Thangu along streams.

Rhododendron arboreum forms scrub on steeper slopes at about 3000 m. Above the tall tree line, the vegetation is a sort of mosaic of *Rhododendron campanulatum*, *R. wightii*, *R. thomsonii*, *R. cinnabarinum* and *R. decipens*. Lacaita scrub on slopes near Chhangu (3900 m) and near Thangu (3900 m). *Rhododendron anthopogon*, *R. setosum* and *R. barbatum* may also be occasionally met with. Grasslands are frequent at 2700 m altitude and above. *Arisaema* spp. may be found in open places. Various species of *Aconitum* grow abundantly on the forest floor underneath *Rhododendrons* at high altitudes especially around Thangu.

v) *Alpine Scrub and Grasslands* (3600-4300 m and above) : At the heights above 3600 m where the tree line ends, *Juniperus pseudo-sabina*, and *J. recurva* grow in bushy formations in North and East Sikkim especially on the exposed sunny hill slopes around Thangu (4200 m) and Chhangu (4300 m). *Ephedra gerardiana* covers vast areas tops of hills around Thangu (ca 4200). The species has not been seen flourishing anywhere else. The beautiful yellow-flowered *Rhododendron lepidotum* is another plant of high altitudes (3600 m or above) and grows in exposed rock crevices, hardly attaining 30 cm. In the open meadows on gentle mountain slopes a few species each of the genera like *Ranunculus*, *Anemone*, *Delphinium*, *Rhus*, *Potentilla*, *Primula*, *Fragaria*, *Cassiope*, *Allium* etc. are seen.

PHYTOGEOGRAPHICAL ASPECTS

Owing to the varied climatic and ecological conditions in its entire length and breadth, the Sikkim Himalayan region offers very suitable spots into which a variety of floristic elements have migrated from several near and far-off lands. Sino-Japanese elements (viz. species of *Quercus*, *Schima* etc.) are quite common in this region. The floristic

elements of Western China, which are distributed all along the Sikkim Himalayas are *Aletris pauciflora*, *Anemone rupicola*, *A. vitifolia* and others. *Primula sikkimensis* and *Magnolia campbellii* are also the species of Western China which extend from Yunnan in to the Eastern Himalaya. The European and Mediterranean elements are represented by the species of *Ranunculus*, *Gentiana*, *Swertia*, *Anemone*, *Tamarix*, *Allium*, *Artemisia*, etc. The American elements in Sikkim flora are exhibited generally by weeds of agricultural lands, open forest edges and waste places e.g. *Eupatorium adenophorum*, *E. odoratum*, *Parthenium hysterophorus*, *Mikania cordata* and *Lantana camara*. African elements such as the species of *Flacourtia*, *Grewia*, *Holarrhena*, *Alstonia* are represented in this region. The Siberian elements are exhibited in many predominantly temperate genera like *Potentilla*, *Pedicularis* and *Lonicera*. Tibetan elements like *Hippobhae*, *Prezwalakia* etc. are also found. An example of considerable phytogeographical significance is the occurrence of *Glaux maritima* (Primulaceae) in Leh area of Kashmir and Llonhak valley of Sikkim. This plant is distributed along the costal and inland salt marshes of northern temperate and arctic regions. In addition to such examples, there are very interesting areas that can be called 'Isolation belts' that have led to the isolation of certain species. *Meconopsis bella*, *Cathcartia lyrata*, *Senecio chola*, *Sausurea laneana*, *Geranium* spp., *Primula elwesiana*, *Primula wattii* and *Swertia burkilliana* serve as such examples in the Sikkim Himalayas.

Studies made by Janaki Ammal in genera viz. *Magnolia*, *Camellia*, *Lonicera*, *Rhododendron* and *Viburnum* represented by many species in this region revealed high polyploidy which led her to consider this region (Eastern Himalayas) as a region of active speciation. The occurrence of many families and genera of primitive flowering plants such as *Magnolia*, *Manglietia*, *Euptelea*, *Tetracentron*, *Pycnarrhena*, *Haematocarups*, *Aspidocarya*, *Holboellia*, *Exbucklandia*, *Houttuynia*, *Myrica*, *Alnus* and *Betula* has led Takatajan to consider this region (Eastern Himalaya) the cradle of flowering plants.

PLANT RESOURCES

Germ Plasm

In Sikkim, the tribal populations have primitive but important germplasm of several crops. Still there is a tendency to preserve the local land races and varieties of crop plants which are the products of many years of natural selection and contain genetic treasures having natural resistance to pests and diseases and adaptability to stress conditions. Noteworthy among these is the prevailing enormous genetic diversity in Iskush, Maize, Wheat, Ginger, Cardamom, Mango, Banana, Orange,

Saccharum etc. The region is particularly important for crop plants such as brassicas, rice, cucumber, banana, mango, cardamom, *Dioscorea*, *Alocasia*, *Colocasia*, *Amorphophalus*, and horticultural significance like Orchids, Rhododendrons, Primulas, Pedicularis etc. Apart from these, several other elements in the flora which may not have an obvious economic value at present as the same has not been perceived as yet but in future may prove to be of much economic value in view of new vistas in plant research and changing patterns of our needs.

It is the sum total of such remarkable diversity which has made this state to be a 'Gene-bank' for a number of food crops, forest trees, medicinal plants, aromatic and highly ornamental plants etc.

Endangered plants

The flora of Sikkim is at present under great pressure due to biotic factors like various developmental projects viz. many Hydel power projects, road construction activities, heavy deforestation by burning and tree-felling for preparation of agricultural fields, intensive grazing, tourist-bungalows etc. These activities have destroyed many rich diversity centres on one side and on the other side have initiated several new land slides zones due to which a large number of precious rare plants are getting lost within a very short spell of time. These include : *Acer hookeri* var. *majus*, *Pimpinella tongloensis*, *P. wallichii*, *Pternopetalum radiatum*, *Lactuca cooperi*, *Arenerai thangoensis*, *Coelogyne treutleri*, *Cymbidium eburneum*, *C. hookerianum*, *C. whiteae*, *elegans*, *Cypripedium himalaicum*, *Didiciea cunninghamii*, *Diplomeris hirsuta*, *Paphipedilum venustum*, *Zeuxine pulchra*, *Aconitum ferox*, *Cotoneaster simonsii*, *Picrorrhiza kurrooa*, *Acronema pseudotonera*, *Angelica bulbigena*, *Ceropegia hookeri*, *C. lucida*, *Codonopsis affinis*, *Rhopalocnomis phalloides*, *Carex kingiana*, *Lloydia himalensis*, *Aphyllorchis parviflora*, *Calanthe alpina*, *Ophiorrhiza lucida*, *Nardostachys grandiflora*, *Dennataedtia elwesii*, *Mecodium levingei*, *Panax pseudoginseng*, *Calamus inermis*, *Livistonia jenkisiana*, *Begonia rupicola*, *B. satrapis*, *B. sanctata*, *Lagerstroemia minuticarpa*, *Vanda spectabilis*, *Cyclogramma squanaestipes*, *Oreopteris elwesii*, *Christiopteris tripicuspis*, *Rhynchospora sikkimensis*, etc.

Endemic plants

Endemics constitute another important element of biologically interesting plants. Being confined to narrow and restricted ecological niches, they are more prone to extinction due to adverse biotic or natural

factors. Sikkim as such has comparatively less number of endemics (which are confined to present political boundaries of Sikkim) because many of them range from Nepal to Bhutan. It is estimated that the total number of endemics truly confined to present Sikkim may be *ca* 2 percent of the total number in the flora elements. These include *Agrostis neodebilis*, *Calamagrostis tripilifera* var. *tripilifera*, *C. tripilifera* var. *cumminsit*, *Catabrosa aquatica*, *Cyathopus sikkimensis*, *Drepanostachyum intermedium*, *Poa gammieana*, *Trisetum sikkimense*, *Carex kingiana*, *Rhynchospora sikkimensis*, *Coelogyne treutleri*, *Anaphalis cavei*, *A. hookeri*, *A. subumbellata*, *Artemisia thellungiana*, *Blumea sikkimensis*, *Cremanthodium decaisnei* f. *clarkei*, *C. palmatum* ssp. *benthamii*, *Crepis atropappa*, *Gentiana glabriuscula*, *G. prainii*, *G. pluviarum*, *G. recurvata*, *Inula macrosperma*, *Jaeschkea microsperma*, *J. smithii*, *Ligularia dur*, *L. hookeri* ssp. *clarkei*, *L. pachycarpa*, *Saussurea forrestii*, *S. lineana*, *S. nimborum*, *S. obscura*, *S. pantlingiana*, *Swertia ramosa*, *S. rex*, etc. besides many more.

To conserve the depleting resources of this region, several attempts are being made. Kanchanjanga National Park, Fambongla Wildlife sanctuary and Kabi sacred groove are good examples where several endangered taxa are conserved. There are some botanical gardens viz. Jawaharlal Botanic Garden, Saramsta Botanic Garden and Orchid sanctuary, Rhododendron sanctuary near Yumthang, etc., wherein exist and insist conservation of many species is being attempted. Different sacred grooves situated in various parts of the state are playing a very positive role. But at present the main emphasis is to relocate or recollect the threatened taxa and attempts should be made for their *in-situ* conservation. However, in some cases the help of advance technologies viz. Tissue culture technique etc. can be used with advantage. In addition to this, the areas of diversity centre like Pangolekha range, Tendong ridge, Sakyong valley, Dongbong valley etc. should be brought under full protection.

Medicinal plants

Sikkim Himalayan region is the abode of a large variety of medicinal plants. *Prezwalskia tangutica*, *Nardostachys jatamansi*, *Picrorrhiza kurrooa*, *Aconitum luridum*, *Podophyllum hexandrum*, *Dactylorrhiza hatagirea*, *Taxus wallichiana*, *Ephedra gerardiana* and *Lycopodium clavatum* constitute the most important medicinal plants of the alpine zone. Several medicinal plants like *Dichroa febrifuga*, *Houttuynia cordata*, *Artemisia vulgaris*, *Rubia cordifolia*, *Panax pseudoginseng*, *Dioscorea deltoidea*, *Digitalis purpurea*, *Bergenia ciliata* are quite common in temperate and sub-temperate zones.

Tropical zone is also quite rich in the medicinal flora wherein plants viz. *Costus speciosus*, *Vitex negundo*, *Solanum viarum*, *Cissampelos pariera*, *Woodfordia fruticosa*, *Oroxylum indicum*, *Alstonia scholaris*, *Abroma augusta* and to some extent *Rauvolfia serpentina*, *Terminalia chebula*, *Hollarhena pubescens* etc. grow in good number.

Species of Horticultural importance

As the Flora of Sikkim includes plants of tropical, temperate and alpine characters in great diversity, a large number of plants found wild in this state (or the Eastern Himalayas as such), are of great horticultural importance. Many of them have been introduced into the European gardens. These include the species like : *Hedychium gardenerianum*, *Luculia gratissima*, *Allium wallichii*, *Acer oblongum*, *Anemone vitifolia*, *Arisaema griffithii*, *Berberis aristata*, *B. asiatica*, *B. sikkimensis*, *Bergina ciliata*, *Betula utilis*, *Boenninghausenia albiflora*, *Cautleya gracilis*, *C. spicata*, *Cymbidium cyperifolium*, *Daphne bholua*, *Juniperus recurva*, *Mahonia acanthifolia*, *Meconopsis bella*, *Meillia thyrsiflora*, *Paris polyphylla*, *Pleione praecox*, *Polygonatum oppositifolium*, *Prunus cerasoides*, *Rhododendron anthopogon*, *R. arboreum*, *R. barbatum*, *R. hodgsonii*, *R. nivale*, *Rosa macrophylla*, *R. sericea*, *Vandopsis undulata*, *Viburnum cordifolium*, *Primula* spp. and many others. But still several species of *Corydalis*, *Gentiana* and *Primula* being of interest and beauty, await introduction.

Food plants

There are over 350 species of flowering plants and Pteridophytes found wild in diverse localities of Sikkim which may serve as emergency life-saving food-products. These include : flowers of *Urtica dioica*, *U. parviflora* (Sisnoo-Nep.) ; rhizomes of *Dioscorea* species (Tarul-Nep.) ; fruits of *Aesandra butyracea* (Chiwari-Nep, Yelkung-Lep.) ; *Calamus erectus* (Betfal-Nep., Rue-Lep.) ; *Elaeagnus conferta* (Malindo-Nep.) ; *Heracleum lanatum* (Chimpin-Nep.) ; *Podophyllum hexandrum* (Papri-Nep.) ; *Machilus edulis* (Lepcha-Kawla, Phunchey-Nep., Phom-Kung-Lep.) ; *Melia eubia* (Lapsi-Nep., Silot-Kung-Lep.) ; *Morus australis* (Sanukimbu-Nep., Mekrape Kung-Lep.), *Terminalia chebula* (Hara-Nep., selim pot-Lep.), *Zanthoxylum acanthopodium* (Bogay Timur-Nep., Nangryupot-Lep.) ; leaves of *Phytolacca acinosa* (Jaringo-Nep.) ; young shoots of *Rheum nobile* (Tohuka-Nep.) *Diplazium esculentum*, sheath from young shoots of *Polygonum molle* and *Ficus virens*; tubers of *Satyrrium ciliatum* (Khiru-Tibetan) ; flower buds of *Bauhinia purpurea* ; inflorescence of *Tupistra natans* (Nakima-Nep.). Leaves of *Camellia*

kissii and bark of *Betula* spp. are used for making tea, white millet. *Rhododendron* (Flowers), Junipers, corn, East Himalayan cherry etc. are brewed as local wine which are named after the source plant viz. Guras wine, Cherry brandy, Juniper wine etc.

Fire-wood yielding species

Due to the total dependence of the rural folk on fire wood for cooking and warming of the houses, any woody plant is cut and used as a fire wood ; yet some important firewood yielding species include : *Alnus nepalensis* (Utis-Nep.), *Betula cylindrostachys* (Saur-Nep.) *Castanopsis indica*, *Engelhardtia spicata* (Mauwa-Nep.), *Toona ciliata* (Tooni-Nep.), *Cryptomeria japonica* (Dhupi-Nep.), *Acer campbellii* (Kapasey-Nep.), *Schima wallichii* (Chilaune-Nep.), etc. At higher elevations even the plants like *Abies densa*, *Tsuga dumosa*, *Picea smithiana*, *Rhododendron* spp. *Larix griffithiana* are also used.

Timber yielding species

Most important timber yielding species of the State include *Shorea robusta*, *Tectona grandis*, *Juglans regia*, *Castanopsis indica*, *Quercus lamellosa*, *Toona ciliata*, *Cryptomeria japonica* and *Terminalia myriocarpa*.

Dye yielding plants

Most important plants used on commercial scale include : roots of *Rumex nepalensis* (Halhale-Nep.), stem of *Ruia manjith* (Majitho-Nep.); bark of *Mahonia nepalensis* (Kerapsing-Bhutia) ; fruits of *Dichroa febrifuja* (Basak-Nep., Gebokhamok-Lep.); leaves of *Symplocos glomerata* (Sungi-Nep.) ; bark of *Juglans regia* (Okhar-Nep.) etc. In addition to these several other dye yielding plants viz. *Byxa orellena*, *Mallotus philippensis*, several spp. of *Indigofera* etc. occur wild in the state.

Fodder yielding species

Although a large number of species are employed for feeding the livestock, yet the preferred ones include *Ficus auriculata*, *F. oligiodon*, *F. hirta*, *F. hispida*, *F. virens*, *F. clavata*, *F. nemoralis*, *Sauria nepalensis*, *Morus alba*, *Brasssiopsis mitis*, *Artocarpus lakoocha*, *Grewia oppositifolio*, *Litsea polyantha* etc.

Botanical curiosities

Several examples of biologically very interesting plants in Sikkim Flora include the insectivorous plants like *Drosera burmanii*, *Pinguicula alpina*, *Utricularia* spp. (*Lentibulariaceae*), beautiful parasites like *Aeginetia indica* (*Orobanchaceae*) etc. Several plants, which grow especially in the high alpine meadows, survive extreme adverse ecological conditions by special adaptations; e.g. woolly species of *Saussurea* (*S. gassypiphora*) or cushion like or bushy habit (species of *Arenaria*, *Festuca*, *Juniperus*, *Gaultheria*, *Saxifraga* etc.). Some of the very ancient living angiosperms viz. *Magnolia pterocarpa* (*Magnoliaceae*), *Tetracentron sinense* var. *himalayana* (*Tetracentraceae*), *Talauma hodgsonii* (*Magnoliaceae*) occur in this state. Several medicinal plants like *Podophyllum hexandrum*, *Panax pseudoginseng*, *Dactylorrhiza hatagirea*, *Picrorrhiza kurrooa*, *Nardostachys grandiflora*, *Berberis aristata*, *B. asiatica*, *Valeriana wallichii*, *Ephedra gerardiana* var. *sikkimensis*, *Taxus wallichiana*, *Mandragora caulescense*, *Aconitum ferox*, *A. spicatum*, *Dioscorea deltoidea*, *Rauwolfia serpentina* etc. which created sensational news are natural components of Sikkim Flora.

A large number of epiphytes such as foliose lichen; a variety of mosses and ferns cover available space on the bark of the roots suspended in the air with the ability to absorb moisture from the mist and the clouds. Some species of *Rhododendron*, *Impatiens* (1 sp.) *Aeschenanthus*, *Polygonatum*, *Cautleya*, *Hedychium*, *Gonatanthus* and many orchids and aroids are epiphytic in these forests.

Sacred groves

Sacred groves are playing important role in 'in-situ' conservation of the indigenous elements of the Flora and Fauna of Sikkim. Most of these are the place of worship and have Monastery at the summit. A few like Kabi-sacred grove being the place of union of Lepchas and Bhutias, are of historical importance. Many of them are declared as 'rearserve forests' and are well protected from the biotic pressure. Khetchipuri Sacred-grove in West district, Mt. Mainam, Rabong, Tendong Sacred groves in South district, Churten Sacred grove in East district and Kabi Sacred-grove in North district are a few good examples where a variety of precious elements of Flora and Fauna are well protected. *Cyathea spinulosa* and *C. gigantea* the tree-ferns which are under threat due to demand of their trunks in orchid-culture and trade, are well protected in Churten Sacred-grove. *Camellia kissi* the wild-tea is common in the protected woods around Khetchipheri lake. 'Red-Panda' (*Ailurus fulgens*) the State-Animal of Sikkim-finds the dense

thickets of Kabi Sacred-grove quite suitable for its inhabitation. *Dendrobium nobile* the State-Flower of Sikkim is also quite common here.

Conservation aspects

Vavilov (1951) was very correct in saying that “many of the areas of centre of origin of crop plants are the areas where the tribal people live, and sooner or later the Governments of these regions, are bound to uplift them socially and economically. Once these communities are in different socio-economic milieu, the working of thousands of years of natural selection will be lost because the people would like to go in for high out-put agriculture.” This statement is very true in case of Sikkim.

During the recent past a great deal of damage has been done to the richness of the biodiversity of Sikkim Himalayas. The forests have been denuded by the haphazard felling of trees for timber, through unmanaged grazing, road-construction activities etc. Rural folk of Sikkim still depend totally on firewood for cooking and also for warming their houses. Frequent landslides resulting from deforestation are swallowing several habitats of many biologically and economically important plants even before they or their utility is known to the society.

Not only deforestation, but even afforestation programmes are also responsible to a greater extent for the loss of biodiversity of Sikkim Flora. Plantation of exotic trees like *Cryptomeria japonica*, *Pinus patula* etc. may have added to the glamorous green-cover but the fact is that because of its impact on soil, several precious elements of the ground flora are getting lost. Actually the indigenous species like *Alnus nepalensis*, *Duabanga grandiflora*, *Terminalia myriocarpa* etc. should be included in afforestation programme. Now a days great emphasis is being paid on promotion of Tourism in the State which is showing a disruptive influence on local traditional and social mores by introducing new and not necessary desirable life-styles, and has destructive effect on biodiversity as well.

Because of large scale cultivation of large-cardamom which is a major revenue yielding crop of the State, several precious elements of ground Flora (e.g. *Paphiopedilum venustum*-the lady's slipper orchid) are getting lost.

Another major threat to the floristic diversity is the mushroom growth of small and large scale Hydel-power projects. These are causing an irreparable damage to Flora of the State.

Being the border line state defence set-ups in Sikkim cannot be avoided. But it has definitely resulted in a large scale deforestation and soil erosion because the impact of army activities on the fragile ecosystem and geological aspects have not been taken into consideration.

Although several botanical expeditions have been made to Sikkim since 1843, yet even today any serious botanical exploration yields a number of novelties such as new taxa, new records, and many interesting plants, some of which are of great economic and botanical importance. Therefore, our present knowledge about the plant resources of Sikkim is not the last word on the real situation in this region. Still much is to be done and much is to be known about the hidden 'Green-Gold' treasure of the State.

The strategy of utilization of plant resources of the Sikkim Himalayas is to be drawn after taking into consideration all the factors and to ensure that the large variety of flora of this region not only continues to survive but maintains conditions for the evolution of the flora i.e. for speciation or origin of new taxa.

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PLAN OF ENUMERATION

The families are arranged in the sequence of Bentham & Hooker's *Genera Plantarum* (1862 - 63) which was adopted in J.D. Hooker's *Flora of British India* (1872 - 97), but their delimitations have sometimes been amended in accordance with later concepts. For example Scitamineae of *Flora of British India* (FBI) is here divided into Zingiberaceae, Cannaceae, Marantaceae and Musaceae. Genera and species are listed alphabetically. A good number of exotic taxa have been included, especially those which have become or are becoming naturalised or have become prominent feature of the general vegetation. For each species, the accepted correct name with its place and date of publication, basionym, if any, and a few synonyms relevant to nomenclature or to earlier important regional publications are given. The local names are given in capital letters followed by the name of the languages in brackets. The local language are abbreviated as Lep. (Lepcha), Nep. (Nepali), and Bhut. (Bhutia), Tib. (Tibetan). Other abbreviations used in literature citations are listed separately.

Only brief distinguishing characters are mentioned. The information about the distribution within Sikkim is provided. The localities of recorded occurrence are followed by the altitudes of occurrence. The period of flowering/fruiting is also provided in most of the cases. Additional information regarding economic importance or any other peculiarity is sometimes given under notes.

BURMANNIACEAE

(R.C. Srivastava)

BURMANNIA L.

Burmannia coelestis D. Don, Prodr. Fl. Nep. 44. 1825; Hook. f., F.B.I. 5: 665. 1888 ; Hajra in Fasc. Fl. India 19 : 9. 1988.

Herbs, up to 20 cm tall. Leaves linear-lanceolate, acute or acuminate. Flowers blue or purplish with yellow lobes.

Sikkim, *s. l.* ; up to 1500 m.

Fl. & Fr. : June - Nov. In marshy habitats.

B. disticha L., Sp. Pl. 1 : 287. 1753; Hook. f., F.B.I. 5 : 644. 1888 ; Hajra, *l. c.* 11.

Herbs, up to 50 cm tall. Leaves linear or lanceolate, 2 - 12 x 0.5 - 1.5 cm, acute or acuminate at apices. Flowers blue or purple with yellow tipped greenish lobes.

Sikkim, *s.l.* ; 1000 - 1500 m.

Fl. & Fr. : June - Sept. In paddy fields.

B. nepalensis (Miers) Hook. *f.*, F.B. I. 5 : 666. 1888 ; Hajra, *l.c.* 12. *Gonyanthes nepalensis* Miers in Trans. Linn. Soc. London 18 : 537. t. 38. f. 1. 1841.

Herbs, up to 15 cm tall. Leaves reduced to scales, appressed to stem, elliptic. Flowers white with yellow tinge.

Sikkim, *s.l.* ; 1000 - 1500 m.

Fl. : July - Sept. In moist habitats.

ORCHIDACEAE

(R.C. Srivastava)

ACAMPE Lindl.

Acampe ochracea (Lindl.) Hochr. in Bull. New York Bot. Gard. 6 : 270. 1910. *Saccolabium ochraceum* Lindl. in Edw., Bot. Reg. Misc. 2. 1842 ; Hook. *f.*, F.B.I. 6 : 62. 1890.

Epiphytes. Leaves oblong. Flowers yellow, *ca* 10 mm across, borne on leaf-opposed 2 - 6-flowered panicles.

In valleys.

Fl. : Nov. - Dec.

A. papillosa (Lindl.) Lindl., Fol. Orchid. 2. 1853. *Saccolabium papillosum* Lindl. in Bot. Reg. t. 1552. 1841 ; Hook. *f.*, F.B.I. 6 : 63. 1890.

Epiphytes. Leaves coriaceous, curved, conduplicate, apically truncate or obliquely notched. Flowers yellow with brown base, *ca* 8 mm across.

Found at lower elevations.

Fl. : Oct. - Jan.

Notes : Roots tonic; said to have cooling effect, useful in rheumatism.

A. rigida (Buch. - Ham. ex J.E. Sm.) Hunt in Kew Bull. 24 : 98. 1970. *Aerides rigida* Buch. Ham. ex J.E. Sm. in Rees, Cyclop. 39, *Aerides* n. 12. 1819. *Saccolabium longifolium* (Lindl.) Hook. f., F.B.I. 6 : 62. 1890 ; King & Pantl. in Ann. Roy. Bot. Gard. Calc. 8 : 220. t. 292. 1898. *Acampe longifolia* (Lindl.) Lindl., Fol. Orch. *Acampe* 1. 1853. *Vanda longifolia* Lindl., Gen. & Sp. Orchid. 215. 1833.

Epiphytes. Leaves oblong, coriaceous. Inflorescence leaf opposed, much shorter than the leaves.

Found in tropical valleys ; up to 1500 m.

Fl. : June.

ACANTHEPHIPIUM Bl.

Acanthephippium striatum Lindl. in Bot. Reg. 241. 45. 1838 ; Hook. f., F.B.I. 5 : 816. 1890.

Terrestrial herbs with ovoid pseudobulbs. Leaves subcoriaceous, plicate, elliptic. Flowers dull white, suffused and blotched with yellow, the apices of sepals and petals purplish.

Sikkim, *s.l.* 600 1200 m.

Fl. & *Fr.*: April May.

A. sylhetense Lindl., Gen. & Sp. Orchid. 117. 1833 ; Hook. f., F.B.I. 5 : 815. 1890.

Terrestrial herbs with elongate - obpyriform pseudobulbs. Leaves elliptic. Flowers pale pink with bold red lines ; lip yellow tinged.

Sikkim, *s. l.* ; 540 900 m.

Fl. : July Aug.

ACRIOPSIS Reinw. ex Bl.

Acriopsis javanica Reinw. ex Bl., Bijdr. 377. 1825 ; Hook f., F.B.I. 6 : 79. 1890. *Acriopsis harai* Tuyama in J. Jap. Bot. 39 : 129. 1964 ; Pradhan, Ind. Orch. 2 : 717. 1979.

Sympodial epiphytes. Rhizomes creeping. Pseudobulbs crowded. Flowers 2 - 40 mm apart, 8 14 mm across, lip 3 lobed.

In the vicinity of Gangtok ; *ca* 1000 m.

Fl.: April.

ACROCHAENE Lindl.

Acrochaene punctata Lindl., Fol. Orchid. 1. 1853 ; Hook f., F. B.I. 5 : 783. 1890.

Epiphytic herbs with ovoid pseudobulbs. Leaf solitary, oblong, petiolate. Flowers pale yellowish green, dotted and streaked with purplish brown.

Sikkim, *s.l.* ; 1500 1800 m.

Fl. : Oct. Nov.

AERIDES Lour.

Aerides multiflora Roxb., Pl. Corom. 3 : 68. t. 271. 1820 ; Hook. f., F.B.I. 6 : 44. 1890.

Epiphytic herbs with stout stem. Leaves narrowly oblong. Flowers white, marked with pink or purple.

In tropical valleys ; up to 1100 m.

Fl. : April.

A. odorata Lour., Fl. Cochinch., 2 : 528. 1790 ; Hook. f., F. B.I. 6 : 47. 1890.

Epiphytic herbs. Stems stout. Leaves flat, keeled oblong, unequally lobed at apex. Flowers white, spotted with pink.

Sikkim *s. l.* ; *ca* 1200 m.

Fl. : May June.

AGROSTOPHYLLUM Bl.

Agrostophyllum brevipes King & Pantl. in Ann. Roy. Bot. Gard. Calc. 8 : 156. t. 213. 1898.

Epiphytic herbs. Rhizomes narrow, covered with spreading subulate scales. Leaves linear-oblong, membranous. Flowers white, column and anther red.

Sikkim, *s.l.* ; *ca* 600 m.

Fl. : July.

A. callosum Reichb. f. in Sem. Fl. Vit. 296. 1868 ; Hook. f., F.B.I. 5 : 824. 1890.

Epiphytic herbs. Rhizomes stout, branched, clothed with triangular scales. Leaves sessile, linear-oblong. Flowers reddish, borne in heads.

Sikkim, *s.l.* ; *ca* 1800 m.

Fl. : June July.

A. khasianum Griff. in Calc. J. Nat. Hist. 4 : 378. t. 19. 1844 ;
Hook. *f.*, F.B.I. 5 : 824. 1890.

Epiphytic herbs with tufted double fusiform compressed, sheathed stem. Leaves narrowly oblong, subcoriaceous. Flowers white with pale yellow patches.

In tropical valleys.

Fl. : Aug.

A. myrianthum King & Pantl. in Ann. Roy. Bot. Gard. Calc. 8 :
155. t. 211. 1898.

Epiphytic herbs. Rhizomes stout, clothed with adpressed lanceolate scales. Leaves linear-oblong, sub-coriaceous. Flowers yellow.

Teesta valley ; *ca* 3600 m.

Fl. : Aug.

AMITOSTIGMA Schltr.

Amitostigma puberula (King & Pantl.) Schltr. in Fedde Repert.
4 : 92. 1919. *Orchis puberula* King & Pantl. in Ann. Roy. Bot. Gard.
Calc. 8 : 304. 1898.

Terrestrial herbs, less than 15 cm tall. Leaf solitary, linear.
Flowers white.

Lachung valley ; *ca* 3000 m.

Fl. : July.

ANOECTOCHILUS Bl.

Anoectochilus crispus Lindl. in J. Linn. Soc. 1 : 180. 1857.
Odontochilus crispus (Lindl.) Hook. *f.*, F.B.I. 6 : 99. 1890.

Terrestrial herbs, up to 20 cm tall. Leaves ovate, acute. Sepals
green ; petals and lip white with yellow tinges on sac.

Mahalderam Peak (?) ; *ca* 1800 m.

Fl. : Sept.

A. elwesii (Clarke *ex* Hook. *f.*) King & Pantl. in Ann. Roy. Bot.
Gard. Calc. 8 : 296. t. 394. 1898. *Odontochilus elwesii* Clarke *ex* Hook.
f., F.B.I. 6 : 100. 1890.

Terrestrial herbs, up to 25 cm tall. Leaves ovate. Sepals green with white mid-ribs and brown tips. Petals white with brown tips. Lip white, teeth of claw brown, basal sac green.

Chungthang, Tendong ; 900 1800 m.

Fl. & Fr. July-Aug.

A. grandiflorus Lindl. in J. Linn. Soc. 1 : 179. 1857. *Odontochilus grandiflorus* (Lindl.) Benth. in Gen. Pl. 2 : 598. 1883 ; Hook. *f.*, F.B.I. 6 : 100. 1890.

Terrestrial herbs, up to 45 cm tall. Leaves elliptic. Flowers green, mottled with white and tipped with pink.

Tendong ; 1200 1800 m.

Fl. : July.

A. lanceolatus Lindl., Gen. & Sp. Orchid. 499. 1840. *Odontochilus lanceolatus* (Lindl.) Bl., Orchid. Arch. Ind. 81 1858 ; Hook. *f.*, F.B. I. 6 : 101. 1890.

Terrestrial herbs, up to 30 cm tall. Leaves ovate-lanceolate. Flowers pale green ; dorsal sepal brown-tinged ; lip bright yellow : anthers pink.

Yoksum ; 1500 2100 m.

Fl. : July Sept.

A. roxburghii (Wall.) Lindl. in Royle, Illustr. Bot. Himal. 368. 1839 & Gen. & Sp. Orchid. 499. 1840 ; Hook. *f.*, F.B.I. 6 : 95. 1890. *Chrysobaphus roxburghii* Wall., Tent. Fl. Nep. 37, t. 27. 1826.

Plants including inflorescence less than 30 cm tall. Leaves ovate or ovate-oblong, velvety, purplish red with golden reticulations. Flowers white.

In tropical valleys.

Fl. : Nov.

A. sikkimensis King & Pantl. in J. Asiat. Soc. Beng. 65 : 124. 1896.

Plants less than 23 cm tall. Leaves elliptic ovate, velvety, dark red, with golden yellow veins on upper surface, dull red beneath. Flowers olive green and white.

Sikkim, *s.l.*; 900 1500 m.

Fl. : Sept.

ANTHOGONIUM Wall. ex Lindl.

Anthogonium gracile Wall. ex Lindl., Gen. & Sp. Orchid. 426. 1840 ; Hook. f., F.B.I. 5 : 822. 1890.

Terrestrial herbs with small ovoid pseudobulbs. Leaves 2-5, linear, plicate, sessile, sheathing. Flowers white or rose coloured ; lip white with dark purple spots ; anthers bright yellow.

On way to Lachen ; 1200 2100 m.

Fl. : Sept.

APHYLLORCHIS Bl.

Aphyllorchis alpina King & Pantl. in Ann. Roy. Bot. Gard. Calc. 8 : 26. t. 347. 1898.

Terrestrial herbs up to 75 cm tall. Stems sheathed. Flowers yellowish red.

Singale La, Mon Lepcha (?) ; *ca* 4200 m.

Fl. : July Aug.

A. montana (Thw.) Reichb. f. in Linnaea 41 : 57. 1876 ; Hook. f., F.B.I. 6 : 116. 1890. *Apturia montana* Thw., Enum. Zeyl. 301. 1861. *Aphyllorchis prainii* Hook f., F.B.I. 6 : 117. 1890.

Terrestrial herbs, 60 cm tall. Whole plant pale brown except yellow pollinia.

Sikkim, *s.l.* ; *ca* 600 m.

Fl. Aug.

A. pantlingii W.W. Smith in Rec. B.S.I. 4 : 243. 1911. *A. parviflora* King & Pantl. in J. Asiat. Soc. Beng. 65 (2) : 128. 1896 *et* in Ann. Roy. Bot. Gard. Calc. 8 : 262. t. 348. 1898.

Terrestrial herbs, *ca* 35 cm tall. Almost all parts pale brown except white anthers and yellow pollinia.

Lachung ; *ca* 3000 m.

Fl. : July.

APOSTASIA Bl.

Apostasia wallichii R. Br. in Wall., Pl. Asiat. Rar. 1 : 75. t. 84. (*A. odorata*) 1830 ; Hook. f. F.B.I., 6 : 175. 1890.

Terrestrial herbs, 30-60 cm tall. Leaves linear, lanceolate. Flowers yellow.

Sikkim, *s. l.*; (*cf.* Hara *et al.* 1978).

APPENDICULA B1.

Appendicula cornuta Bl., Bijdr. 7 : 302. 1825. *A. bifaria* Lindl. in Hook. *f.*, F.B.I. 6 : 84. 1890.

Herbs with tufted, slender, leafy, often compressed stem. Leaves many, lanceolate. Flowers white, flushed with yellow.

In tropical valleys.

Fl. : Aug.

ARACHNIS B1.

Arachnis cathcartii (Lindl.) J.J. Smith in Naturw. Tijdrachr. Nederl. Ind. 72 : 75. 1912. *Vanda cathcartii* Lindl., Fol. Orchid. Vanda. 8 : 1853. *Arachnanthe cathcartii* (Lindl.) Benth. in Benth. & Hook. *f.*, Gen. Pl. 3 : 573. 1883 ; Hook. *f.*, F.B.I. 6 : 27. 1890.

Epiphytic herbs. Stems stout, pendulous. Leaves sessile, oblong, unequally and obliquely bifid at apex. Flowers brown-yellow on upper surface.

Sikkim, *s.l.* ; 900 1800 m.

Fl. : March April.

ARUNDINA B1.

Arundina graminifolia (D. Don) Hochr. in Bull. New York Bot. Gard. 6 : 270. 1910. *Bletia graminifolia* D. Don., Prodr. Fl. Nep. 29. 1829. *Arundina chinensis* Bl., Bijdr. 8 : 502. 1825 ; Hook. *f.*, F.B.I. 5 : 857. 1890. *A. bambusifolia* Lindl., Gen. & Sp. Orchid. 125. 1830 ; Hook. *f.*, *l.c.*

Terrestrial herbs. Stems reed-like, up to 2 m tall. Leaves narrowly oblong-lanceolate. Flowers pinkishpurple.

Gangtok, Jorethang-Namchi, Teesta valley. Rangeet valley ; *ca* 1750 m.

Fl. & Fr. : April Sept.

ASCOCENTRUM Schltr.

Ascocentrum ampullaceum (Roxb.) Schltr. in Fedde Repert. 1 : 975. 1913. *Aerides ampullaceum* Roxb., Fl. Ind. 3 : 476. 1832.

Saccolabium ampullaceum (Roxb.) Lindl., Sert. Orchid. t. 17. 1838 ;
Hook. f., F.B.I. 6 : 64. 1890.

Epiphytic herbs without pseudobulbs. Leaves narrowly oblong, keeled, coriaceous, mottled with brown. Flowers pink, except deep purple pollinia.

Sikkim, *s.l.* ; 300 1000 m.

Fl. : March April.

BIERMANNIA King & Pantl.

Biermannia bimaculata (King & Pantl.) King & Pantl. in Ann. Roy. Bot. Gard. Calc. 8 : 200. t. 267. 1898. *Sarcochilus bimaculatus* King & Pantl. in J. Asiat. Soc. Beng. 44 : 340. 1875.

Epiphytes. Leaves linear - oblong. Flowers white, with 2 brown blotches on the calli or lip.

Teesta valley ; *ca* 450 m.

Fl. : July.

BRACHYCORYTHIS Lindl.

Brachycorythis obcordata (Buch. - Ham. *ex* D. Don) Summerh. in Kew Bull. 243. 1955. *Orchis obcordata* Buch. - Ham. *ex* D. Don, Prodr. Fl. Nep. 23 : 1825, *non* Willem. 1796. *Habendria galeandra auct. non* Benth : Hook. f., F.B.I. 6 : 163. 1890.

Terrestrial herbs, with globose or oblong tubers. Leaves oblong. Flowers pale purple.

Sikkim, *s.l.* ; 1000 2000 m.

BULBOPHYLLUM Du. Petit Thouars.

Bulbophyllum affine Lindl., Gen. & Sp. Orchid. 48. 1830 ; Hook. f., F.B.I. 5 : 756. 1890 ; King & Pantl., Ann. Roy. Bot. Gard. Calc. 8 : 67. t. 91. 1898.

Epiphytes. Pseudobulbs cylindrical, *ca* 7.5 mm apart. Leaves narrowly oblong, obtuse at apex. Flowers pale green with purple nerves.

Teesta valley, Zemu, Tadong Rumtek ; 600 1000 m.

Fl. : June Sept.

B. andersonii (Hook. f.) J.J. Smith in Bull. Jard. Bot. Buitenz. 2, 8 : 22. 1912. *Cirrhopetalum andersonii* Hook. f., F.B.I. 5 : 777. 1890.

Epiphytes. Pseudobulbs elliptic-ovoid, fibrous at base. Leaf oblong, subacute. Flowers pink with minute dark spots.

Teesta valley ; *ca* 450 m.

Fl. : Oct.

B. bisetum Lindl. in Ann. Nat. Hist. 10 : 186. 1842 ; Hook. *f.*, F.B.I. 5 : 767. 1890.

Epiphytes. Pseudobulbs ovoid conic, with a fibrous sheath at base. Leaves narrowly oblong lanceolate, acuminate and obliquely bifid at apex. Flowers purplish.

Sikkim, *s.l.* ; 1500 1800 m.

Fl. Sept.

Notes : Flowers are remarkable for the spurs which run parallel to the dorsal sepal and the petals.

B. bootanense (Griff.) Par. & Reichb. *f.* in Trans. Linn. Soc. 30 : 153. t. 32. f. 2. 1874. *Cirrhopetalum bootanense* Griff., Notul. 3 : 297. 1851. & Ic. Pl. Asiat. t. 299. 1851 ; Hook. *f.*, F.B.I. 5 : 775. 1890.

Epiphytes. Pseudobulbs narrowly ovoid. Leaves fleshy, narrowly elliptic, obtuse or subacute. Flowers red with dark red spots.

Sikkim. *s.l.* ; tropical valleys.

Fl. : April.

B. careyanum (Hook.) Spr., Syst. Veg. 3 : 732. 1826 ; Hook. *f.*, F.B.I. 5 : 760. 1890. *Anisopetalon careyanum* Hook., Fl. Exot. 2 : t. 149. 1825.

Epiphytes. Pseudobulbs ovoid-subsessile. Flowers brownish.

Sikkim, *s.l.* ; 450 1200 m.

Fl. Oct. Dec.

B. caudatum Lindl., Gen. & Sp. Orchid. 56. 1830 ; Hook. *f.*, F.B.I. 5 : 759. 1890.

Epiphytes. Pseudobulbs ovoid, compressed, furrowed. Leaves ovate-lanceolate, acute, coriaceous. Flowers white.

Gangtok ; *ca* 1800 m.

Fl. : April July.

B. cauliform Hook. *f.* in Hook., *l.c.* Pl. t. 2036. 1890 & F.B.I. 5 : 758. 1890.

Epiphytes. Pseudobulbs cylindric-elliptic. Leaves oblong, obtuse. Flowers green, flushed with brown.

Sikkim, *s.l.* ; 1500 1800 m.

Fl. : July.

B. clarkeanum King & Pantl. in *J. Asiat. Soc. Beng.* 64 : 333. 1895.

Epiphytes. Pseudobulbs cylindric or ovoid. Leaves narrowly elliptic-oblong, notched at apices. Flowers white with orange-red tips.

Sikkim, *s.l.* ; 450 m.

Fl. : June.

B. cornu-cervi King & Pantl. in *J. Asiat. Soc. Beng.* 64 : 332. 1895.

Epiphytes without rhizomes. Pseudobulbs minute, 2 3 mm, crowded, globular. Leaves ovate - elliptic, sessile or subsessile. Flowers green with reddish brown margins ; lip yellow inside, reddish brown outside.

Sikkim, *s.l.* ; *ca* 759 m.

Fl. : July.

B. cylindraceum Lindl., *Gen. & Sp. Orchid.* 53 : 1830 ; King & Pantl., *l.c.* 70 : t. 96. 1898.

Epiphytes without pseudobulbs. Leaves oblong-elliptic, acute. Flowers blackish purple.

Sikkim, *s.l.* ; 1600 2400 m.

Fl. : Oct. Jan.

B. ebulbum King & Pantl. in *J. Asiat. Soc. Beng.* 64 : 334. 1895.

Epiphytes without pseudobulbs. Leaves solitary, oblong-lanceolate. Flowers pale green.

Sikkim, *s.l.*

B. eublepharum Reichb. *f.* in *Walp. Ann.* 6 : 252. 1861 ; Hook. *f.*, F.B.I. 5 : 746. 1890.

Epiphytes. Rhizomes lacking. Pseudobulbs cylindric, closely placed. Leaf oblong. Flowers green.

Sikkim, *s.l.* ; 1800 2100 m.

Fl. : Aug.

B. elatum (Hook. *f.*). J.J. Sm. in Bull. Jard. Bot. Buitenz. 3, 3 : 23. 1912. *Cirrhopetalum elatum* Hook. *f.*, F.B.I. 5 : 775. 1890.

Epiphytic caespitose herbs. Pseudobulbs cylindric. Leaves narrowly oblong, obtuse. Flowers dull yellow spotted.

Sikkim, *s.l.* ; 1500 -1800 m.

Fl. : May.

B. gamblei (Hook. *f.*) Hook. *f.* in Hook. Ic. Pl. 3. t. 2039. 1890 & F.B.I. 6 : 188. 1890. *B. leptanthum* Hook. *f.* var. *gamblii* Hook. *f.*, *l.c.* 5 : 759.

Epiphytes. Pseudobulbs narrowly obpyriform or subcylindric. Leaves oblong-lanceolate, apically notched.

Sikkim, *s.l.* ; 1500 -2100 m.

Fl. : July Aug.

B. griffithii (Lindl.) Reichb. *f.* in Walp. Ann. 6 : 247. 1881 ; Hook. *f.*, F.B.I. 756. 1890. *Sacropodius griffithii* Lindl., Fol. Orchid 6. 1855.

Epiphytes. Pseudobulbs caespitose, narrowly ovoid. Leaves sessile, narrowly oblong. Inflorescence 1 - flowered. Flowers yellowish with red brown spots.

Lachung ; *ca* 2700 m.

Fl. : Aug.

B. guttulatum Wall. *ex* Hook. *f.*, F.B.I. 5 : 776. 1890. *Cirrhopetalum guttulatum* Hook. *f.*, *l.c.* *B. umbellatum* in Edw., Bot. Reg. 30. t. 44. 1844, *non* Lindl. 1830.

Epiphytes. Pseudobulbs caespitose, crowded, ovoid. Leaves elliptic-oblong, subacute. Flowers pale yellow, purple spotted.

Sikkim *s.l.* ; 600 1500 m.

Fl. : July Sept.

B. gymnopus Hook. *f.* in Hook. *f.*, Ic. Pl. 3, t. 2040. 1890 & F.B.I. 5 : 764. 1890.

Epiphytes. Pseudobulbs ovoid, sheathed at base. Leaves narrowly oblong, notched at apices. Flowers white.

Sikkim, *s.l.*

Fl. & Fr. : Nov. Dec.

B. helenae (O. Ktze.) J.J. Sm. in Bull. Bot. Gard. Buitenz. 2, 8 : 24. 1912. *Phyllorchis helenae* O Ktze., Rev. Gen. Pl. 2 : 676 1891. *Cirrhopetalum cornutum* Lindl. in Edw., Bot. Reg. 24 : Misc. 75. 1838 ; Hook. *f.*, F.B.I. 5 : 774. 1890.

Epiphytes. Pseudobulbs narrowly ovoid, compressed. Leaf narrowly oblong, obliquely notched. Flowers reddish brown.

Sikkim, *s.l.*

Fl. : May June.

B. hirtum (J. E. Sm.) Lindl., Gen. & Sp. Orchid. 51 : 1830 ; Hook. *f.*, F.B.I. 5 : 672. 1890. *Stelis hirta* J.E. Sm. in Res. Cyclop. 34. 1816.

Epiphytes. Pseudobulbs closely placed, ovoid oblong, terete with a scarious terminal collar, oblong oblanceolate, flaccid, absent during flowering time. Flowers yellow, green outside, white inside.

Sikkim, *s. l.* ; 900 1800 m.

Fl. : Oct. Jan.

B. hymenanthum Hook. *f.* in Hook., Ic. Pl. 3 : t. 2046. 1890 ; Hook. *f.*, F.B.I. 5 : 767. 1890.

Epiphytic herbs with thread like rhizomes. Pseudobulbs lacking. Leaves sessile, ovate - elliptic. Flowers yellowish, streaked with purple.

Lachung valley, Yoksum ; 1700 2400 m.

Fl. : May.

B. leopardianum (Wall.) Lindl., Gen. & Sp. Orchid. 48. 1830 ; Hook *f.*, F.B.I. 7 : 756. 1890. *Dendrobium leopardianum* Wall., Tent. Fl. Nepal 39 : t. 1826.

Epiphytes. Pseudobulbs obpyriform, crowded. Leaves elliptic-oblong. Flowers whitish or pale ochraceous, spotted with crimson.

Sikkim, *s.l.* ; 1700 2200 m.

Fl. : Oct. Nov.

B. leptanthum Hook. *f.*, F.B.I. 5 : 759. 1890.

Epiphytes. Pseudobulbs cylindric. Leaves narrowly oblong. Flowers yellowish green.

Sikkim, *s.l.* ; 900 m.

Fl. : July.

B. listeri King & Pantl. in J. Asiat. Soc. Beng. 64 : 34. 1895.

Epiphytes without rhizomes. Pseudobulbs narrowly ovoid, compressed. Leaves linear-oblong, tapering at both ends.

Ratong Chu ; 900 2100 m.

Fl. : May Sept.

B. odoratissimum (J.E. Sm.) Lindl., Gen. & Sp. Orchid. 55. 1830 ; Hook. *f.*, F.B.I. 5 : 758. 1890. *Stelis odoratissima* J.E. Sm. in Rees, Cyclop. 34 : Stelis no. 12. 1816.

Epiphytes. Pseudobulbs subcylindric. Leaves oblong-lanceolate, slightly notched at apex. Flowers white with yellow tinge.

Ratong Chu ; *ca* 100 m.

Fl. : May.

B. ornatissimum (Reichb. *f.*) J.J. Sm. in Bull. Jard. Bot. Buitenz. 2, 8 : 26. 1912. *Cirrhopetalum ornatissimum* Reichb. *f.* in Gard. Chron. 2 : 424. 1882 ; Hook. *f.*, F.B.I. 5 : 773. 1890.

Epiphytes. Pseudobulbs narrowly ellipsoid. Leaves oblong-obtuse and slightly notched at apices. Flowers yellowish green with purple markings.

Sikkim, *s.l.*

Fl. : Oct. Nov.

B. pantlingii Lucksom in J. Bombay Nat. Hist. Soc. 90 (3) : 551. 1993. *B. flavidum (flavida)* Lucksom *Ibid* 90 (1) : 71. 1993, *non* Lindl. 1840.

Epilithic herbs. Pseudobulbs ovoid, broadly ridged. Leaves 2, oblong-oblongate, flaccid. Inflorescence solitary, from the base of pseudobulbs. Flowers orange yellow.

Phyangla R.F., Lachung valley R.F. ; 1000 2135 m.

Fl. & Fr. : July Dec.

B. parvulum Hook. *f.*, F.B.I. 5 : 778. 1890.

Epiphytes. Pseudobulbs ovoid. Leaves narrowly elliptic, subacute, sessile. Flowers drooping.

Sikkim, *s.l.* ; 2100 2700 m.

Fl. : Aug.

B. piluliferum King & Pantl. in Ann. Roy. Bot. Gard. Calc. 8 : 76. t. 104. 1898.

Epiphytes. Pseudobulbs caespitose, globose or depressed globose. Leaf fleshy, linear-oblong, obtuse. Flowers pale reddish brown with streaks of darker shade.

Sikkim, *s.l.* ; *ca* 300 m.

Fl. : May.

B. polyrhizum Lindl., Gen. & Sp. Orchid. 53. 1830 ; Hook. *f.*, F.B.I. 5 : 767. 1890.

Epiphytes. Pseudobulbs globular or ovoid. Leaves narrowly oblong, sessile. Flowers yellowish.

Teesta valley ; *ca* 450 m.

Fl. : April.

B. protractum Hook. *f.*, F.B.I. 5 : 758. 1890.

Epiphytes. Pseudobulbs cylindric. Leaves oblong, acute. Flowers pale yellow ; sepals orange in upper half.

Sikkim, *s.l.* ; 450 600 m.

Fl. : July.

B. reptans (Lindl.) Lindl., Gen. & Sp. Orchid. 51. 1830 ; Hook. *f.*, F.B.I. 5 : 768. 1890. *Tribrachia reptans* Lindl., Col. Bot. t. 41. a. 1825.

var. *reptans*

Epiphytes with thin, wiry branching rhizomes. Pseudobulbs obovate. Leaves linear-oblong. Flowers yellowish with purple spots.

Sikkim, *s.l.* ; 400 - 2400 m.

Fl.: Oct. Nov.

var. **sub-racemosa** Hook. *f.*, F.B.I. 6: 769. 1890.

Sepals buff coloured, flushed with brown and spickled slightly with red ; petals coloured; lip yellow at tip.

Sikkim, s.l.

Fl.: Oct. Dec.

B. retusiusculum Reichb. *f.* in Gard. Chron. 1182. 1869. *Cirrhopetalum wallichii* Lindl., Gen. & Sp. Orchid. 59. 1830 ; Hook.*f.*, F.B.I. 5: 776. 1890.

Epiphytes. Pseudobulbs ovoid. Leaves narrowly oblong, subacute, obliquely notched. Flowers deep violet, with darker spots.

Sikkim, *s.l.*; 1800 2250 m.

Fl.: July Aug.

B. rigidum King & Pantl. in Ann. Roy. Bot. Gard. Calc. 8 : 69. t. 94. 1898.

Epiphytes. Pseudobulbs lacking. Leaves rising direct from rhizome, each with a whorl of fibres at base. Flowers brownish yellow flushed with green, nerves purplish.

Sikkim, *s.l.* ;1800 m.

Fl. : May June.

B. rolfei (O.Ktze.) Seid. in Dansk. Bot. Ark. 33: 149. 1979. *Phyllorchis rolfei* O. Ktze., Rev. Gen. Pl. 677. 1891. *Cirrhopetalum parvulum* Hook. *f.*, F.B.I. 5: 778. 1890.

Epiphytes. Pseudobulbs ovoid. Leaf narrowly elliptic, sub-acute. Flowers drooping.

Sikkim, *s.l.* ; 2100- 2700 m.

Fl.: Aug.

B. sarcophyllum (King & Pantl.) J.J. Sm. in Bull. Jard. Bot. Buitenz. 2, 8: 27. 1912. *Cirrhopetalum sarcophyllum* King & Pantl. in J. Asiat. Soc. Beng. 64 : 335. 1895.

Epiphytes. Pseudobulbs discoid. Leaves pendulous, fleshy, oblong, subfalcate, acute at apices. Flowers reddish brown, much mottled ; lip purple with dark purple blotches.

Sikkim, *s.l.* ; 900 1500 m.

Fl. : June Sept.

B. scabratum Reichb. *f.* in Walp. Ann. 6: 259. 1861 ; Seid. in Dansk. Bot. Ark. 29: 67. t. 24. 1973. *Cirrhopetalum caespitosum* Wall.

ex Lindl. in Edw. Bot. Reg. 24: Misc. 35. 1830 ; Hook. f., F.B.I. 5 : 775
1890. *B. confertum* Hook.f., F.B.I. l.c. 757.

Epiphytic, caespitose herbs. Pseudobulbs much crowded, ovoid.
Leaves linear-lanceolate, acute. Flowers ochraceous yellow.

Sikkim, *s.l.* ; 1200 m.

Fl. : April.

B. secundum Hook. f., F.B.I. 5: 764. 1890.

Epiphytes. Pseudobulbs crowded, turbinate, *ca* 7 mm in diam.
Leaves narrowly oblong. Flowers pale purple with dark nerves.

Chungthang, Tendong ; 1800 2100 m.

Fl. : June July.

B. sikkimense (King & Pantl.) J.J. Sm. in Bull. Jard. Bot. Buitenz.
2, 8: 12. 1912. *Cirrhopetalum sikkimensis* King & Pantl. in Ann. Roy.
Bot. Gard. Calc. 8: 90. t. 125. 1898.

Epiphytes. Pseudobulbs ovoid-globose. Leaves oblanceolate, obtuse,
obliquely notched, fleshy. Dorsal sepal greenish with few brownish red
markings, lateral sepals ochraceous, minutely spotted with reddish
brown. Petals ochraceous with three broad reddish brown nerves and
purplish marginal cilia.

Sikkim, *s.l.*

Fl. : May.

B. striatum (Griff.) Reichb. f. in Walp. Ann. 6: 257. 1861. ;
Hook. f., F.B.I. 5: 775. 1890. *Dendrobium striatum* Griff., Notul. 3:
318. 1851.

Epiphytes. Pseudobulbs obpyriform. Leaf elliptic, retuse at apex,
coriaceous. Flowers yellowish green with purple strips.

Sikkim, *s.l.* ; 2100 m.

Fl. : Oct.

B. thomsonii Hook.f., F.B.I. 5 : 764. 1890.

Epiphytes. Pseudobulbs subdiscoid. Leaf narrowly oblong, acute.
Flowers yellowish white.

Sikkim, *s.l.* ; 1200 m.

Fl. : Sept.

B. triste Reichb. f. in Walp. Ann. 6: 253. 1861; Hook.f., F.B.I. 5: 768. 1890. *B. micranthum* Hook. f. l.c. ; S. Misra in Bull. Bot. Surv. India 22: 152. (1980) 1982. *B. alopecurum* Reichb. f. Gard. Chron. 2: 70. 1880; Hook.f., l.c. 770.

Epiphytes. Pseudobulbs turbinate with umbonate apices, closely placed or 1.2–2.5 cm apart; leafless during flowering. Leaves 2, from each pseudobulb, narrowly oblong, acute at apex. Flowers purplish, except for a yellow line on the edges of the lip and ovary.

Teesta valley; ca 450 m.

Fl. : March.

B. viridiflorum (Hook.f.) Schltr. in Orchids 4: 108. 1910. *Cirrhopetalum viridiflorum* Hook. f., F.B.I. 5 : 779. 1890.

Epiphytic, caespitose herbs. Pseudobulbs ovoid. Leaf in pairs on young pseudobulbs, narrowly oblong or oblong lanceolate, Flowers yellowish green turning to pale brown.

Sikkim, s.l ; 1500–2100 m.

Fl. : Oct–Nov.

B. umbellatum Lindl., Gen. & Sp. Orchid. 56. 1830. *Cirrhopetalum maculosum* Lindl., Edw. Bot. Reg. 27. Misc. 81. 1841 : Hook. f., F.B.I. 5 : 776. 1890.

Epiphytes. Pseudobulbs ovoid, only when dried. Leaf narrowly oblong, obtuse and notched at apex. Flowers cream coloured.

Tendong ; ca 1500 m.

Fl. : May.

B. wallichii Reichb.f. in Walp. Ann. 6: 259. 1861 ; Seid. in Dansk. Bot. Ark. 29: 234. t. 127. 1973. *Cirrhopetalum refractum sensu* Hook. f., F.B.I. 5: 779. 1890, *non* (Reichb. f.) Zoll. 1847.

Epiphytic, caespitose herbs. Pseudobulbs concial, wrinkled during flowering, crowded. Leaves 2, narrowly oblong, acute. Flowers pale green, turning pale brown.

Sikkim, s.l. ; 1200–1800 m.

Fl. : Oct.–Nov.

B. yoksunense J.E. Sm. in Bull. Bot. Jard. Buitenz. 2, 8 : 29. 1912. *Cirrhopetalum brevipes* Hook.f., F.B.I. 5 : 777. 1890, *non* *B. brevipes* Ridl. 1903.