

FLORISTIC ACCOUNT OF SOME FOREST TYPES OF
THE EASTERN HIMALAYAS

P. N. MEHRA, K. S. BAWA*, P. K. KHOSLA** AND A. S. HANS***

Department of Botany, Punjab University, Chandigarh

A B S T R A C T

Detailed floristics of some forest types broadly classified as, i) Moist Tropical, ii) Montane Subtropical and iii) Montane Wet Temperate, of a limited area in the Eastern Himalayas are described. Rainfall, temperature, altitude, and profile of the mountains are the determining factors governing the types of forests in the area.

Forests are the outcome of interaction of several factors which include climate, soil, geology, past history of the vegetation and forest biota. Generally the climate is the most important single factor in painting the vegetational picture of a region. However, in an ancient country like India, biotic and edaphic factors have had considerable part to play in determining the nature of vegetation and floristic composition of forests.

There is much polemic over the various criteria on which the classification of vegetation is based. No attempt is made here to resolve this disputed issue. Champion in 1936 brought out the first comprehensive classification of Indian vegetation, climatic features formed its main basis. Puri (1960) followed more or less the same pattern, although he made a strong plea for its revision. He considered some of the climatic climaxes of Champion as biotic or edaphic or both. Puri argued that the division of major types into Southern and Northern forms is hardly justified, since these differences may be attributed to biotic and edaphic influences. Changes in vegetation, according to Puri, were more prominent in East-West direction. Recently, Champion & Seth (1968) revised the classi-

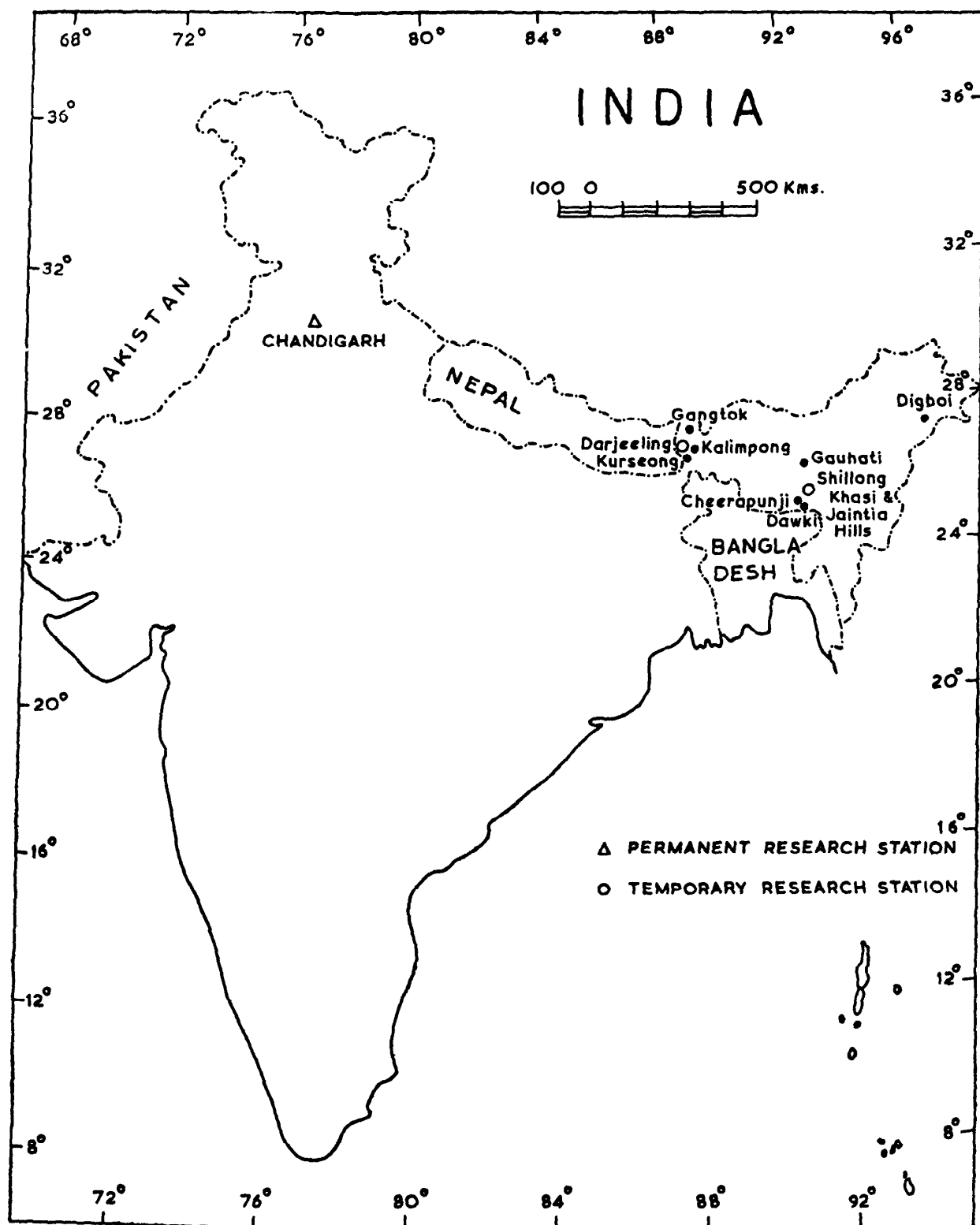
fication of Indian vegetation. However, Puri's suggestions were not acceptable to them. Thus, the original framework remained unaltered. Nevertheless, the role of biotic and edaphic features was re-examined and certain changes necessitated by these considerations were made. More factual data on climate and soil was incorporated. Recent nomenclatural changes were also taken into account.

Mehra et al (1971) in a previous communication gave floristic account of some of the forests in the Western Himalayas. The purpose here is to give a similar floristic account of the types of forests studied in the Eastern Himalayas, which in fact, is the outcome of a survey made during excursions in connection with the collection of material for cytological studies (cf. Mehra, 1976). The main stations in the neighbourhood of which the forests were studied are indicated in the Map and their geographical location given in the Table. Reference here may be made to the notable contributions of Cowan & Cowan (1927), Cowan (1929), Champion (1936), Bor (1938, 1942), Rowntree (1954), Chatterjee (1956), Schweinfurth (1957), Puri (1960), Rajkhwa (1961), Champion & Seth (l.c.).

* Gray Herbarium, Cambridge, Massachusetts 02138, U.S.A.

** Deptt. of Forestry, Himachal Agriculture University, Solan (Khaltu).

*** Tree Improvement Research Centre, P.O. Box 1210, Kitwe, Zambia.



Place	Table		Average altitude
	Latitude	Longitude	
Darjeeling, (Eastern Himalayas, Bengal)	27° 30'N	88° 18'E	2044 m
Shillong, (Khasia & Jaintia Hills)	25° 40'N	91° 55'E	1500 m
Digboi, (Upper Assam)	27° 15'N	95° 37'E	150 m

The style of description follows the pattern adopted by Champion & Seth. The species are listed in the order of frequency in which they are met with.

For an account of the Pteridophytic flora met with in such forests either as epiphytes or undergrowth, reference may be made to Mehra and Bir (1964).

I. MOIST TROPICAL FORESTS

Champion & Seth divided these forests into seven groups, out of which three i.e. Tropical wet evergreen, Tropical semi-evergreen and Tropical moist deciduous are represented in the areas presently surveyed.

A. Tropical wet evergreen forests

(a) Assam Valley tropical wet evergreen forest

Digboi forest division which comes under this category has a rainfall exceeding 2500 mm which is well distributed throughout the year. Maximum temperature is 35°C and the minimum 10°C. The altitude varies from 100 m to 480 m (Jeypore Reserve).

The soil is rich, vegetation luxuriant and the forests are generally damp. Stratification of vegetation into three storeys is the characteristic feature of the forest (Fig. 1). The lofty *Dipterocarpus macrocarpus* is the tree of top storey attaining a height of 40-45 m and has 30-35% distribution of the crop. The middle storey is dominated by

Mesua ferrea forming 20-30% of the vegetation. As one attains a higher altitude, *Dipterocarpus macrocarpus* is replaced by *Shorea assamica* and *Vatica lanceaefolia*. In low lying areas *Dipterocarpus macrocarpus* becomes rare and trees like *Terminalia myriocarpa*, *Bischofia javanica*, *Albizia lucida*, *Duabanga grandiflora* and *Sapium baccatum* become prominent. Besides the tall trees, one finds shrubs, herbs, woody lianas and large fern epiphytes. The dense undergrowth around the forest, where there is plenty of sunshine, makes the forests impenetrable.

Rowntree (1954) gives the name, *Dipterocarpus-Mesua-Michelia* association to these, so does Chatterjee (1956). Rajkhowa (1961) treats these under the evergreen *Mesua-Dipterocarp* formation. Richards (1954) describes such types under tropical rain forest.

Floristics : The upper storey is constituted by *Dipterocarpus macrocarpus* Vesque, *Amoora wallichii* King, *Artocarpus chaplasha* Roxb., *A. lakoocha* Roxb., *Shorea assamica* Dyer, *Michelia champaca* L., *Tetrameles nudiflora* R. Br., *Cinnamomum cecidodaphne* Meissn., *Endospermum chinense* Benth., *Duabanga grandiflora* (Roxb. ex DC.) Walp. and *Stereospermum personatum* Chatt.

The middle storey is composed of *Mesua ferrea* L., *Vatica lanceaefolia* Bl. (dominants), *Altingia excelsa* Noronha, *Dysoxylum procerum* Hiern, *Bischofia javanica* Bl., *Magnolia griffithii* Hook. f. & Th., *Dillenia indica* L., *Sapium baccatum* Roxb., *S. eugeniaefolium* Buch.-Ham., *Nyssa javanica* Wanger., *Cinnamomum obtusifolium* Nees, *Castanopsis tribuloides* A. DC., *Artocarpus gomeziana* Wall., *Eugenia jambolana* Lam., *Cryptocarya andersoni* King, *C. floribunda* Nees, *Eugenia praecox* Roxb., *Engelhardtia spicata* Lesch. ex Bl., *Alstonia scholaris* R. Br., *Terminalia chebula* Retz., *T. belerica* Roxb., *Michelia manii* King, *M. oblonga* Wall., *Machilus bombycina* King, *Myristica linifolia* Roxb., *Anthocephalus cadamba* Miq., *Litsea glabrata* Wall., *L. panamonja* Buch.-Ham., *Beilschmiedia fagifolia* Nees, *B. gammieana* King,



Fig. 1: Assam Valley tropical wet evergreen forest. Trees with light colored bark are *Dipterocarpus macrocarpus*. Digboi (Iekhapani, 200 m).

Gmelina arborea Roxb., and *Garcinia cowa* Roxb.

The lower storey is constituted by the following species :

Macaranga denticulata Muell. Arg., *Callicarpa tomentosa* Murr., *Croton roxburghianus* Bal., *Elaeocarpus floribundus* Bl., *Mallotus albus* Muell. Arg., *Litsea semicarpifolia* Wall., *L. lancifolia* Roxb. ex Wall., *Styrax serrulatum* Roxb.

The undergrowth consists of shrubs, bamboos and palms.

The common shrubs are : *Maesa indica* Wall., *Glerodendrum viscosum* Vent., *Litsea salicifolia* Roxb., *Glerodendrum bracteatum* Wall., *Melastoma malabathricum* L., *Croton caudatus* Geisel, *Alpinia speciosa* Schum., *A. allughas* Roscoe, *Saprosma ternatum* Hook. f., *Ixora acuminata* Roxb., *Callicarpa acumi-*

nata Roxb. and *Alchornea tiliacifolia* Muell. Arg.

Canes, bamboos and palms which are frequently met with are : *Calamus erectus* Roxb., *C. flagellum* Griff., *C. latifolius* Kurz, *C. leptospadix* Griff., *Dendrocalamus hamiltonii* Nees & Arn., *Dinochloa malellandii* Kurz, *Bambusa pallida* Munro, *B. tulda* Roxb., *Livistona jenkinsiana* Griff., *Pinanga gracilis* Bl.

The field layers harbour grasses like *Erianthus ravennae* Beauv., *Phragmites karka* Trin., *Saccharum* sp., many ferns, aroids and scitamineous species.

The lianas are : *Acacia pennata* Willd., *Dalbergia stipulacea* Roxb., *Delima sarmen-tosa* L., *Thunbergia grandiflora* Roxb., and *Vitis latifolia* Roxb.

R. Tropical semi-evergreen forests**(a) Sub-Himalayan tropical semi-evergreen forests**

The area surveyed was Samsing (Kalimpong forest division). The rainfall is from 2000 to 3000 mm, the number of rainy days are well distributed throughout the year. The precise mean maximum and minimum temperatures are not known but these are around 30°C and 5°C respectively.

The forests are semi-evergreen, deciduous elements also making up the dominants. The trees are not as tall as in the wet evergreen type. However, besides the upper storey there is well differentiated middle storey as well. The undergrowth is heavy and luxuriant.

Cowan (1929) recorded his observations of these forests under *Eugenia-Phoebe* hylum. *Eugenia formosa* Wall. and *Phoebe hainesiana* Brandis were mentioned to be the two dominants. However, present studies reveal that what was considered to be *Phoebe hainesiana* is in fact *Phoebe attenuata* Nees.

Floristics : *Eugenia formosa* Wall., and *Phoebe attenuata* Nees (not *Phoebe hainesiana* Brandis, as mentioned by Cowan, 1929) are the main species. *Ailanthus grandis* Prain, *Artocarpus fraxinifolius* Wight, *Alstonia scholaris* R. Br., *Castanopsis indica* A. DC., *Schima wallichii* Choisy, *Terminalia myriocarpa* Heurck. et Muell., *Cinnamomum cecidodaphne* Meissn., *Eugenia ramosissima* Wall., *Crataeva unilocularis* Buch.-Ham., *Gmelina arborea* Roxb., *Michelia champaca* L., *Phoebe hainesiana* Brandis, *Polyalthia simiarum* Benth. & Hook. f., *Castanopsis tribuloides* A. DC., *Tetrameles nudiflora* R. Br., *Litsea panamonia* Buch.-Ham. are the other common trees.

The trees of the second storey are : *Amoora wallichii* King, *Cinnamomum cecidodaphne* Meissn., *Styrax serrulatum* Roxb., *Gynocordia odorata* R. Br., *Turpinia pomifera* DC., *Actinodaphne obovata* Bl.

(b) K. & J. hills tropical semi-evergreen forests

The forests occurring on the southern slopes of K & J hills (Assam) are treated under this head (Fig. 2). Studies were made in Shella forest and adjoining areas. Rainfall is very high, from 4000-5000 mm, majority of it falling from June to September. The ground is plain or slopy, up to 500 m.

The trees are tall and scattered. Betel palm is the most common tree in the middle storey. A number of epiphytes cover the trunks of tree species. There is rich undergrowth.

Floristics : The principal tree species are: *Cedrela toona* Roxb., *Artocarpus heterophyllous* Lam., *Cinnamomum cecidodaphne* Meissn., *Artocarpus chaplasha* Roxb., *Diospyros binectariferum* Hook. f., *Stereospermum personatum* Chatt., *Areca catechu* L., *Spondias pinnata* Kurz, *Michelia champaca* L., *Mesua ferrea* L., *Castanopsis indica* A. DC., *Eugenia praecox* Roxb., *Vitex peduncularis* Wall., *Eugenia oblata* Roxb., *Sapium baccatum* Roxb., *Garuga gamblei* King, *Eugenia operculata* Roxb., *Duabanga grandiflora* (Roxb. ex DC.) Walp., *Garuga pinnata* Roxb., *Poupartia axillaris* King, *Zanthoxylum limonella* Alston, *Castanopsis tribuloides* A. DC., *Premna bengalensis* Clarke, *Terminalia belerica* Roxb., *Quercus serrata* Thunb., *Ehretia wallichiana* Hook. f. & Th., *Gmelina arborea* Roxb., *Ormosia robusta* Wight, *Trema amboinensis* Bl., *Celtis australis* L.

The smaller trees are : *Macaranga denticulata* Muell. Arg., *Leea sambucina* Willd., *Glochidion sphaerogynum* Kurz, *Securinega virosa* Baill., *Erioglossum rubiginosum* Bl., *Olex nana* Wall., *Croton roxburghianus* Bal., *Wrightia coccinea* Sims, *Ochna squarrosa* L., *Wrightia tomentosa* R. & S., *Citrus hystrix* DC., *Saraca indica* L., *Eugenia khasyana* Duthie, *Brucea mollis* Wall., *Melastoma normale* Don, *Randia fasciculata* DC., *Ixora acuminata* Roxb., *Mallotus albus* Muell. Arg.



Fig. 2: K. & J. hills tropical semi-evergreen forest (Shella, 300 m).

C. Tropical moist deciduous forests

(a) East Himalayan Sal Forests

Tista valley, Rungit valley and Sukna (Darjeeling hills) are typical localities. The mean annual temperature in these areas is around 23°C, and minimum and maximum temperatures near 14°C and 38°C respectively. The rainfall is 1500-2000 mm. The winter is cold; frost, however, is unknown. There is a definite dry period from November to March.

Shorea robusta which attains 25-40 m in height dominates these forests and forms 60-90% of the crop. The undergrowth is composed mainly of herbs and shrubs (Fig.

3). Climber species are few in number but sometimes dense in growth (Fig. 4) and the forest is almost completely devoid of bamboos. Cowan (1929) has dealt these under *Shorea-Terminalia-Garuga* hylum.

Floristics: The dominants are *Shorea robusta* Gaertn. f., *Terminalia belerica* Roxb., *Garuga pinnata* Roxb., *Schima wallichii* Choisy, *Lagerstroemia parviflora* Roxb., *Bauhinia purpurea* L., *Dillenia pentagyna* Roxb., *Chickrassia tabularis* A. Juss., *Bischofia javanica* Bl., *Sterculia villosa* Roxb., *Tetrameles nudiflora* R.Br., *Terminalia crenulata* Roth, *Cedrela toona* Roxb., *Ailanthus grandis* Prain, *Euodia meliaefolia* Benth., *Salmalia malabarica* Schott., *Alstonia scholaris*



Fig. 3: East Himalayan Sal forest. The conspicuous undergrowth is formed by *Hedyechium* species. Darjeeling (Sukna, 150 m).

R.Br., *Anthocephalus cadamba* Miq., *Terminalia myriocarpa* Heurck. et Muell., *Gmelina arborea* Roxb., *Terminalia chebula* Retz. and *Litsea monopetala* (Roxb.) Pers.

The medium-sized trees are: *Amoora wallichii* King, *Premna bengalensis* Clarke, *Dysoxylum hamiltonii* Hiern, *Turpinia pomifera* DC., *Careya arborea* Roxb., *Stereospermum personatum* Chatt., *Lannea corromandelica* Merr., *Cinnamomum cecidodaphne* Meissn., *C. obtusifolium* Nees., *Aphanomixis polystachya* Parker, *Dysoxylum binectariferum* Hook. f., *Rhus griffithii* Hook. f., *Premna mucronata* Clarke, *Mallostus philippinensis* Muell. Arg., *Cryptocarya amygdalina* Nees, *C. floribunda* Nees, *Ilex godajam* Colebr., *Olea dentata* Wall.,

Lophopetalum fimbriatum Wight, *Canarium sikkimense* King, *Grewia vestita* Wall., *Eugenia formosa* Wall., *Litsea glutinosa* (Lour.) C. B. Robin., *Machilus villosa* Hook. f., *Aglaia perviridis* Hiern, *Semecarpus anacardium* L., *Spondias pinnata* Kurz, *Machilus sericea* Bl., *Actinodaphne obovata* Bl., *Beilschmiedia roxburghiana* Nees.

The smaller trees are: *Holarrhena antidysenterica* Wall., *Crataeva unilocularis* Buch. -Ham., *Chisocheton paniculatus* Hiern, *Zanthoxylum limonella* Alston, *Heynea trijuga* Roxb., *Baccaurea sapida* Muell.Arg., *Wrightia tomentosa* R. & S., *Aporosa roxburghii* Baill., *Dysoxylum pallens* Hiern, *Phoebe lanceolata* Nees., *Ixora acuminata* Roxb., *Picrasma nepalensis* Benn., *P. quasoides* Bennet., *Meliosma pinnata* Roxb.



Fig. 4: East Himalayan Sal forest showing dense growth of lianas. Darjeeling (Sukna, 150 m).

The common shrubs are: *Leea sambucina* Willd., *Micromelum integerrimum* Wight & Arn., *Murraya paniculata* Jack., *M. koenigii* Spreng., *Clerodendrum squamatum* Vahl, *Indigofera pulchella* Roxb., *Leea alata* Edg., *L. trifoliata* Laws., *Paramignya monophylla* Wight.

In the Rungit valley at some places along with Sal is seen *Pinus roxburghii* Sargent (Fig. 5).

(b) *East Himalayan moist mixed deciduous forests*

This type includes deciduous forests which occur on the slopes of the Eastern Himalayas up to 600 m in the outer ranges, which are characterised by heavy precipitation. The trees are generally tall, the undergrowth

heavy and composed of shrubs. Bamboos are absent.

Field studies were carried around Rongtong (Darjeeling hills). The rainfall is slightly heavier than for the previous type, usually approaching 5000 m. There is a definite dry period from November to February.

Floristics: *Tetrameles nudiflora* R. Br., *Duabanga grandiflora* Walp., *Terminalia belerica* Roxb., *Salmalia malabarica* Schott, *Schima wallichii* Choisy, *Lagerstroemia parviflora* Roxb., *Sterculia villosa* Roxb. are the dominant species.

The other trees are: *Shorea robusta* Gaertn. f., *Albizia procera* Benth., *Trewia nudiflora* L., *Ailanthus grandis* Prain, *Anthocephalus cadamba* Miq., *Eugenia ramosissima* Wall., *Holarrhena antidysenterica* Wall., *Wrightia tomentosa* R. & S., *Hymenodictyon*



Fig. 5: East Himalayan forest *Pinus roxburghii* forms light colored areas on the ridges. Darjeeling (Manjitar, 300 m).

excelsum Wall., *Careya arborea* Roxb., *Cinnamomum cecidodaphne* Meissn., *Chisoche-ton paniculatus* Hiern and *Wendlandia puberula* DC.

(c) *Savannah type of vegetation observed in K & J hills*

These forests have not been described before. Savannah effect is *biotic due to grazing or fire*. The trees, about 15-18 m in height, are scattered in the grass which is 1-1.5 m in height (Fig. 6). Only a few species are commonly met with. No shrubs are noticed.

The observations are recorded from the areas around Garampani (K & J hills), where there is high rainfall (4,000-5,000 mm); temperature data is not available. Altitude is 500-700 m.

Floristics: The common trees are: *Bischofia javanica* Bl., *Careya arborea* Roxb., *Gmelina arborea* Roxb., *Stereospermum personatum* Chatt., *Ehretia wallichiana* Hook. f. & Th., *Glochidion sphaerogynum* Kurz, *Cordia dichotoma* Frost. f., *Spondias pinnata* Kurz, *Lannea corromandelica* Merr., *Garuga pinnata* Roxb., *Eugenia operculata* Roxb., and *Melia toosendan* Seib. & Zucc.

II. MONTANE SUBTROPICAL FORESTS

These may be considered under two groups: (A) Subtropical broad-leaved hill forests and (B) Subtropical pine forests.

A. Subtropical broad-leaved hill forests

(a) *Subtropical wet hill forests*

Mahanadi and Lopchu (Darjeeling hills)

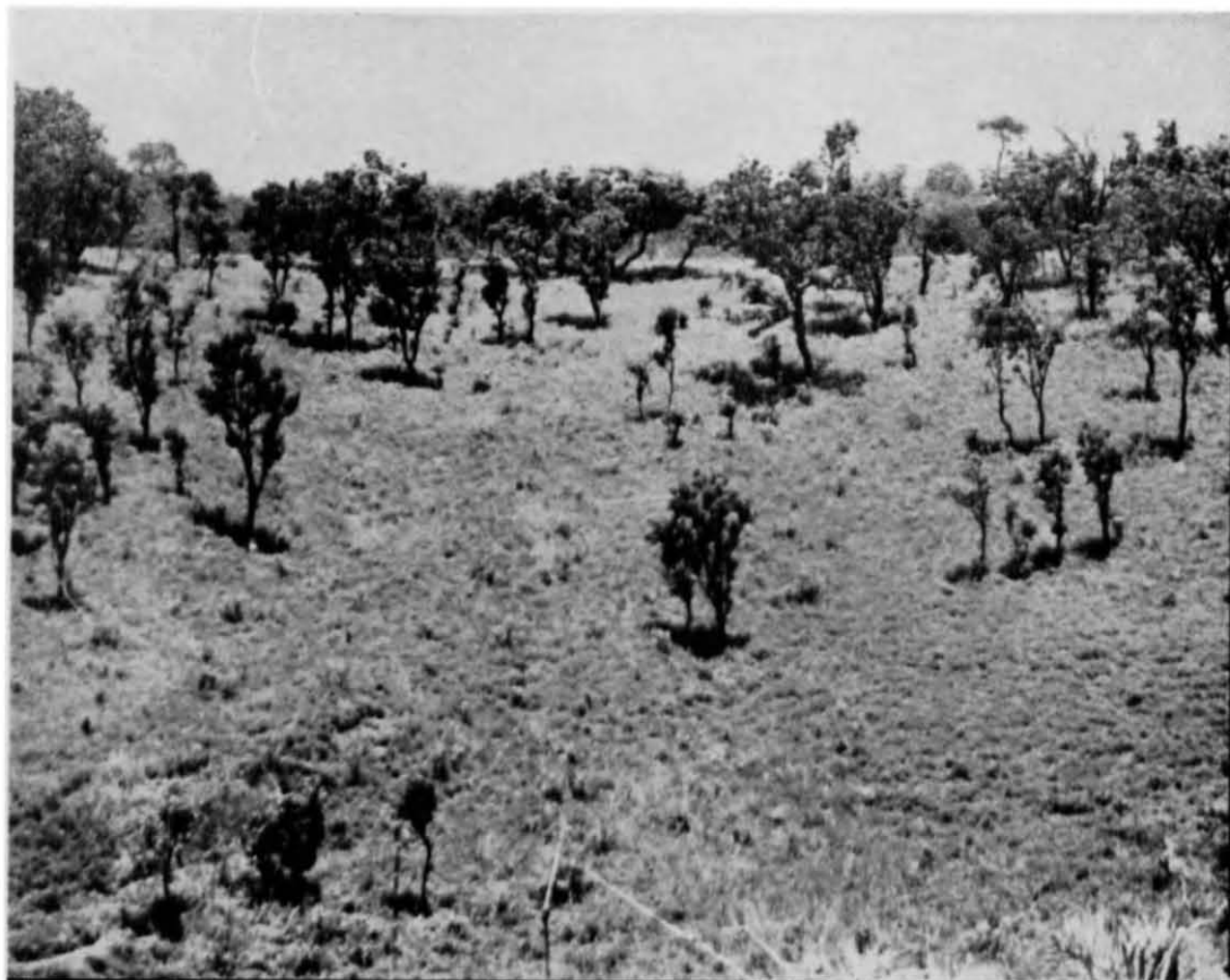


Fig. 6: Savannah type of vegetation in K. & J. hills. (Garampani, 750 m.)

come under this category. The mean annual temperature is 15-20°C. The minimum temperature is 7°C and the maximum 23°C. The rainfall varies from 2000-3500 mm. Altitude is between 1200-1600 m.

The tall trees are 25-30 m in height, the forest is generally dense. Two storeys can be distinguished. The undergrowth is constituted by shrubs. The grass is almost absent. Epiphytes are common. Fig. 7 gives a general view of these forests.

Floristics: Mahanadi Forest: The dominants are: *Engelhardtia spicata* Lesch. ex Bl., *Castanopsis indica* A. DC., *Quercus spicata* Smith, *Schima wallichii* Choisy. The other trees in the top canopy are: *Acer thomsoni* Miq., *Cedrela microcarpa* DC.,

Ailanthus grandis Prain, *Eugenia kurzii* Duthie, *Albizzia chinensis* Merr., *Terminalia myriocarpa* Heurck. et Muell., *Cinnamomum glanduliferum* Meissn., *Melia composita* Willd.

The trees of the second storey are *Aglaia perviridis* Hiern, *Macaranga pustulata* King, *Ostodes paniculata* Bl., *Albizzia odoratissima* Benth., *Poupartia axillaris* King, *Machilus parviflora* Meissn., *Rhus insignis* Hook. f., *R. semialata* Murr., *Dysoxylum procerum* Hiern and *Chisocheton paniculatus* Hiern.

The common shrubs are *Maesa indica* Wall., *Leucospectrum* sp. The herbaceous element is represented by *Strobilanthes* sps., *Arisaema* sps., and *Globba* sps.



Fig. 7: East Himalayan subtropical wet hill forest. Darjeeling (Mahanadi, 1400 m).

Lopchu Forest: This forest differs from the above in the absence of *Quercus spicata* Smith, and presence of *Betula cylindrostachys* Gamble and *Pasania fenestrata* Chatt. in almost pure patches.

(b) *K & J hills subtropical wet hill forests*

The floristics described below pertain to Riat Khwan forest below Shillong Plateau. Rainfall is 1500-2000 mm. Temperature data is not available. Altitude varies from 1000-1400 m.

There are evergreen trees 15-20 m in height. Not distinguished into two storeys. The undergrowth is heavy in moist shady places but scant where forest is open.

Floristics: The common trees are: *Schima wallichii* Choisy, *Cedrela toona* var. *pillistaminea* C. DC., *Euodia fraxinifolia* Hook. f.,

Castanopsis indica A. DC., *Betula alnoides* Ham., *Bischofia javanica* Bl., *Cryptocarya amygdalina* Nees, *Rhus succedanea* L., *Meliosma arnottiana* Wight, *Ostodes paniculata* Bl., *Chisocheton paniculatus* Hiern, *Machilus odoratissima* Nees, *Erythrina fusca* Lour., *Eugenia praecox* Roxb., *Castanopsis tribuloides* A. DC., *Artocarpus lakoocha* Roxb., *Xerospermum noronhianum* Bl., *Itea chinensis* Hook. & Arn., *Picrasma javanica* Bl., *Itea macrophylla* Wall., *Wendlandia exerta* DC., *Styrax serrulatum* Roxb., *Litsea umbrosa* Nees, *Engelhardtia spicata* Lesch. ex Bl., *Litsea khasiana* Meissn., *Alangium chinense* (Lour.) Harms., *Ixora nigricans* Bl., *Saurauja napaulensis* DC. and *Dysoxylum binectariferum* Hook. f.

The shrubs which are frequently met with are: *Zanthoxylum scandens* Bl., *Clerodendrum viscosum* Vent., *Micromelum integr-*

rimum Wight & Arn., *Rubus ellipticus* Smith, *Morinda angustifolia* Roxb., *Maesa indica* Wall., *Phyllanthus glaucus* Wall., *Toddalia asiatica* Lam., *Breynia patens* Benth. and *Debregeasia velutina* Gaud.

B. Assam subtropical pine forests

Field studies were undertaken on Shillong Plateau. The area is hilly, slopes gentle, at a few places deep gorges are present, the maximum height attained is 1800 m. The climate is equitable. Strong winds prevail during March-April. Rainfall is moderately high, about 2500 mm. Maximum temperature is 25°C and minimum 4°C.

Floristics: *Pinus insularis* Endl. occurs in pure patches with the broad-leaved species confined as undergrowth. The pine attains its best development from 300-1700 m; at

higher altitudes it is generally stunted. When it occurs in cooler places, evergreens, mainly *Pasania dealbata* (Hook. f. & Th.) Chatt., *Machilus duthiei* King, *Quercus griffithii* Hook. f. Th., *Schima khasiana* Dyer also appear.

The undergrowth comprises species of *Viburnum*, *Daphne cannabina* Wall., *Rubus ellipticus* Smith, *Myrsine semiserrata* Wall., *Lyonia ovalifolia* (Wall.) Drude., *Cassia laevigata* Willd., *Indigofera* species and ferns. The species of *Indigofera* with grass form the ground cover.

III. MONTANE WET TEMPERATE FORESTS

Evergreen forests with high density (Figs. 8-13). The height of trees does not exceed 25 m. The trunks are covered with mosses, ferns and other epiphytic growth. The dominant species are oaks and laurels.



Fig. 8: East Himalayan Montane wet temperate forest. Trees in the upper storey are *Machilus gammieana*, Darjeeling (Sanchal, 2200 m).

Darjeeling and Shillong montane wet temperate forests were visited several times. The mean maximum temperature and mean minimum temperatures for Darjeeling are 16.14°C and 10.22°C respectively. The rainfall is around 3060 mm and the number of cloudy days exceeds 200 in a year. The climatic factors for Shillong have already been referred to earlier.

It is pertinent to point out here that in K & J hills, "Sub-tropical vegetation" and "temperate vegetation" sometimes appear side by side under apparently similar environmental conditions. Thus sub-tropical Pine forests replace the temperate Oak-Laurel association on the ridges on the same mountain. This is in strong contrast to the vegetation encountered in Darjeeling hills where sub-tropical and temperate zones are

well defined. The latter begins above 1600 m. The occurrence of temperate type of vegetation at lower altitudes in K & J hills may be attributed to the fact that climatic factors with regard to altitude vary from one mountain to the other (cf. Richards, 1954, p. 347). It has also been pointed out by Richards, that altitudinal limits of vegetational zones are lower on smaller mountains than on extensive ranges.

A. *Darjeeling montane wet temperate forests*

These may be treated under three heads.

- (i) *Lauraceous forest (1700-2200 m)*: (*Machilus-Michelia hylium* of Cowan (1929): The dominant trees are *Machilus edulis* King, *Machilus gammieana* King, *Castanopsis hystrix* A.DC., *Machilus gamblei* King, *Pasania*



Fig. 9: East Himalayan Montane wet temperate forest showing abundant epiphytes as well as thick undergrowth, Darjeeling (Sanchal, 2200 m).

fenestrata (Roxb.) Chatt., *Alcimandra cathartii* Dandy, *Acer campbellii* Hook. f. & Th., *Nyssa javanica* Wanger., *Meliosma wallichii* Planch., *Cinnamomum impressinervium* Meissn. The other trees are *Symingtonia populnea* van Steen., *Alnus nepalensis*

D. Don, *Quercus lineata* Bl., *Acer laevigatum* Wall., *Eriobotrya bengalensis* Hook. f., *Euodia fraxinifolia* Hook. f., *Betula alnoides* Buch. Ham., *Eurya acuminata* DC., *Acer oblongum* Wall., *Itea macrophylla* Wall., *Machilus odoratissima* Nees, *Viburnum*



Fig. 10: East Himalayan Montane wet temperate forest. The Buk Oak forest merges imperceptibly into high level Oak forest. West Sikkim (Bakkim, 2700 m).

coriaceum Bl., *Glochidion acuminatum* Muell. Arg.

(ii) *Buk oak forest* (2000-2500 m) (Fig. 8, 9): The dominants are: *Quercus lamellosa* Sm., *Castanopsis tribuloides* A. DC., *Machilus gammieana* King, *Acer campbellii* Hook. f. & Th., *Castanopsis hystrix* A. DC. The other trees are: *Magnolia campbellii* Hook. f. & Th., *Meliosma wallichii* Planch., *Litsea sericea* Wall., *Symplocos theaefolia* Buch. Ham., *Acer laevigatum* Wall., *Rhus succedanea* L., *Cinnamomum impressinervium*

Meissn., *Ilex insignis* Hook., *Acer hookeri* Miq., *A. sikkimense* Miq., *Zanthoxylum acanthopodium* DC., *Z. oxyphyllum* Edgew., *Styrax hookeri* Clarke, *Viburnum erubescens* Wall., *Acer osmastonii* Gamble.

There are present numerous epiphytes and thick undergrowth of shrubs and herbs. This forest passes imperceptibly into high level oak forest (Fig. 10).

(iii) *High level oak forest* (2500-2800 m) The dominants are: *Pasania pachyphylla* (Kurz) Schott, *Machilus gammieana* King



Fig. 11: K. & J. hills montane wet temperate forest.

Quercus lamellosa Sm. The other trees are: *Acer campbellii* Hook. f. & Th., *Rhododendron arboreum* Sm., *Magnolia campbellii* Hook. f. & Th., *Ilex fragilis* L., *Euodia fraxinifolia* Hook., *Acer pectinatum* Wall., *Litsea oreophila* Hook. f., *Viburnum erubescens* Wall., *Acer sikkimense* Miq., *A. hookeri* Miq., *Skimmia laureola* Hook. f., *Hydrangia vestita* Wall., *Lindera heterophylla* Meissn.

The ground growing ferns and fern allies are: *Diplazium stoliczkae* Bedd., *Pteris wallichiana* Ag., *Lycopodium clavatum* L. and the epiphytes and lithophytes are: *Oleandra wallichii* (Hook.) Presl. *Pleopeltis kashyapii* Mehra, *Hymenophyllum simosianum* Hook., *Asplenium ensiformae* Wall. and *Phymatodes malacodon* (Hook.) Ching.

B. K & J hills montane wet temperate forests: Cherrapunji which experiences the maximum amount of rainfall in the area and Mawnsyrnum were explored. These forests (Figs. 11-13) differ from those on Darjeeling hills in several respects. The dominant species are oaks and laurels. Magnolias and maples which along with oaks and laurels dominate the vegetation in Darjeeling hills are missing. Finally, sub-tropical species occur side by side with the temperate ones. The main tree species are: *Pasania dealbata* (Hook. f. & Th.) Chatt., *Machilus duthei* King, *M. gamblei* King, *Schima khasiana* Dyer, *Quercus lineata* var. *lobbii* Wenzig., *Pasania spicata* (Smith) Chatt., *Machilus odoratissima* Nees, *Quercus glauca* Thunb., *Prunus puddum* Roxb., *Elaeocarpus bracea-*

nus Watt., *Symingtonia populnea* van Steen., *Cinnamomum obtusifolium* Nees, *Garcinia anomala* Planch. & Trian., *Beilschmiedia gammieana* King, *Ilex excelsa* Wall., *Manglietia insignis* Bl., *Acer laevigatum* Wall., *Syzigium tetragonum* Kurz, *Rhododendron arbo-*

reum Smith, *Machilus kingii* Hook. f., *Ficus nemoralis* Wall.

The small trees are: *Ilex venulosa* Hook., *Helicia erratica* Hook. f., *Eurya acuminata* DC., *Lindera assamica* Kurz, *Euonymus grandiflorus* Wall., *Glochidion acuminatum*



Fig. 12: K. & J. hills montane wet temperate forest. K. & J. hills (Cherrapunji, 1300 m).

Muell. Arg., *Viburnum odoratissimum* Ker, *Ligustrum robustum* Bl., *Ehretia acuminata* Bedd., *Ilex griffithii* Hook. f., *I. khasiana* Purk., *I. theaeifolia* Hook. f., *Viburnum simonsii* Hook. f. & Th., *Lyonia ovalifolia* Drude., *Erythroxylon kunthianum* Wall., *Zanthoxylum ovalifolium* Wight.

The shrubs are: *Ardisia undulata* Clarke, *Berberis wallichiana* DC., *Clerodendrum nutans* Wall., *Daphne canabina* Wall., *Desmodium floribundum* G. Don, *D. griffithianum* Benth., *D. racemosum* DC., *Elaeagnus*

latifolia L., *Euonymus grandiflorus* Wall., *Gaultheria fragrantissima* Wall., *Luculia pinceana* Hook., *Maesa indica* Wall., *Rauwolfia densiflora* Benth., *Viburnum foetidum* Wall., *Psychotria adenophylla* Wall., *Coffea jenkinsii* Hook. f., *Euonymus bullatus* Wall., *Gymnosporia acuminata* Hook., *Schoefia fragrans* Wall.

CONCLUSION

The above account is based on an intensive



Fig. 13: K. & J. hills montane wet temperate forest. K. & J. hills (Mawnsyrnum, 1300 m).

study of some forest types in a limited area of the Eastern Himalayas. It is suggested that similar studies should be carried out in the adjacent regions to comprehend how the various factors, climatic, edaphic, as well as the mountain profiles bring about alteration in the type and composition of the forests in the area. Eastern Himalayas harbour exceedingly rich vegetation and some of the primeval forest pockets, undisturbed by mankind, are discernible here, especially in the Arunachal Pradesh.

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