AN OUTLINE OF THE VEGETATIONAL ACCOUNT OF
THE EASTERN HIMALAYAS AND ADJOINING HILLS

India's southern end (Cape Kumarin) is only 8°N of the Equator and the tropic of Cancer roughly cuts the country into two halves. The northern frontiers reach nearly to 37°NL, and thus although nearly half of India lies outside the tropics, it is customary to speak of India as a tropical country, mainly because the region is shielded off by the Himalayas in the north from the rest of Asia and has nearly the same general type of tropical monsoon climate almost throughout the land. Nevertheless, the variety in elevation and local climate are extremely remarkable and include transitions from the rainless deserts to the rainiest place, extremely hot conditions to alpine and arctic conditions on the Himalayas. India has thus an exceptionally rich and highly diversified flora.

The northern borders of India are flanked by the Himalayan system, which extends over 2400 km east-west and presents considerable variations in the altitude which have a pronounced effect on its climate. Miller (1950), while discussing the effect of altitude on climate, stated "height above sea level has a pronounced influence on climate, in many respects initiating the effects of increased latitudes". Because of a wide variety of climate and soil, the Himalayas support a remarkable assemblage of vegetation types.

The Himalayas have been divided into two distinct floristic regions, western and eastern, by various workers.
from time to time. The Eastern Himalayas differ from the Western Himalayas in receiving more rain but less snowfall. The vegetation of the Eastern Himalayas broadly differs from that of Western Himalayas in having more broad-leaved trees and less conifers. Incidentally, in the Eastern Himalayas, Malayan, Burmese and Chinese vegetation elements are more prominent, whereas in the Western Himalayas European elements are conspicuous.

Since the type of forests play an important role in the growth and distribution of the fungi, it would not be, therefore, out of place to discuss the vegetational account of the areas surveyed. Conveniently, the surveyed areas can be classified into the following two parts:

I. The Eastern Himalayas proper, which traverse Darjeeling (West Bengal), Sikkim and Arunachal Pradesh of the Indian territory, and the Royal Kingdoms of Bhutan and Nepal.

II. The Assam hills i.e. the hills of undivided Assam state (excluding Arunachal Pradesh).

I. THE EASTERN HIMALAYAS:

It is approximately 720 km long and comprises the portion between the Namche Barwa Peak (7,750 m), east of which the river Brahmaputra curves southward, and the river Teesta in the west. In this region, there is very little of the sub-Himalayan tract so that the Himalaya rises rather abruptly from the plain. The snowline in the region is at an elevation of 4,875 m, but glaciers come down to about 1,000 m below these limits.
rocks are of Pre-Cambrian age.

Following is the vegetational account of the areas visited in the Eastern Himalayas:

**Darjeeling**

Darjeeling region, during the monsoon season (June to September), receives average 2550 mm of the total 3065 mm of the average annual rainfall. Yearly, mean maximum temperature is 16.14°C and the minimum temperature is 10.22°C. Humidity is almost near the saturation point (90%) during the monsoon season.

Mehra and Bir (1964) classified the vegetation of this region into 5 categories:

1. **Low Hill Forests** (tropical type, up to 900 m)

From the base town Siliguri up to 900 m, the submontane tracts are inhabited by dense broad-leaved semi-evergreen forests. *Shorea robusta* is very common. Other prominent trees are: *Schima wallichii, Bauhinia purpurea, Cedrela toona, Salmalia malabarica, Lagerstroemia parviflora* and *Terminalia myriocarpa*. Other associated trees are: *Garuga pinnata, Cedrela microcarpa, Amoora wallichii, Evodia mellaefolia* and *Eugenia formosa*.

2. **Middle Hills (Forests)** subtropical type, 750-1500 m)

These are formed largely of evergreen species and the undergrowth is dense. *Castanopsis tribuloides, C. indica, Schima wallichii, Phoebe hainesiana* are commonest species
between 750-1200 m. Other associated species: *Drimycarpus racemusus, Juglans regia, Spondias lutea, Ficus cunia, Betula alnoides* etc. are also found. Large trees of *Quercus glauca*, *Q. spicata*, *Q. serrata* and *Q. griffithii* grow in dense formation between 1200-1600 m. Bamboos may also be found near habitations.

It would be pertinent to add here that most of the mountains, between 600 and 1200 m, have been cleared off the forests for tea plantation. Consequently, only a few thick forests are left around. *Cryptomeria japonica* which was introduced from Japan forms dense growth between 1200 and 2400 m.

3. Upper Hill Forests (warm or west temperate type, 1500-2700 m)

The forests are evergreen but the deciduous species also occur. Oaks and laurels predominate. The forests are thick, extremely wet and have dense ground vegetation. Between 1800 and 2100 m, common tree is *Quercus lamellosa*; between 2100 and 2400 m, common tree is *Q. pachyphylla*; between 2400 and 2700 m common trees are: *Michelia cathcartii, Magnolia campbellii, Quercus fenestrata* and *Castanopsis hystrix*. Between 2100 and 2400 m, *Q. lamellosa, Castanopsis tribuloides, Acer campbellii* and *Michelia excelsa* are dominant trees. Oaks constitute bulk of the forest in upper areas. At certain places, *Rhododendron griffithianum* grows luxuriantly.

4. Rhododendron-Conifer Zone (cold temperate to sub-alpine, 2700-3600 m).

In the lower part, often oaks and laurels are found but gradually upward *Rhododendron* takes the place of these broad-

leaved trees. The common species of Rhododendron are: R. arboreum, R. campanulatum and R. granda. Associated conifers are: Taxus baccata, Tsuga brunoniana and Abies dense. At 2700-3000 m, Tsuga brunoniana is dominant. Abies dense often forms pure formation at certain places.

5. *Alpine Scrubs* (3600-4300 m)

The tree line ends at 3600 m and the exposed hill sides are covered by Juniperus pseudo-sabina and J. recurva. The beautiful yellow flowered Rhododendron lepidotum is important plant of this region, which is hardly 30 cm in height.

Bhutan:

The territory of Bhutan includes many river valleys, the most important of them being the Manas Valley. The mountain ranges stretch mostly north-south. In general, it may be said that Bhutan forms a transition between the floras of Sikkim and West China. The forests of Bhutan can be classified into the following types:

1. Tropical and subtropical forests

   The outer spurs receive very heavy rainfall and are as a consequence densely forested with tropical and subtropical genera. The density of vegetation in the valleys, however, depends on the topography and the amount of rainfall received. The moisture-laden winds reach the interior of valleys, which are disposed in north-south direction and such valleys bear a luxuriant vegetation. The laterally disposed valleys, which

*Alpine zone was not visited during this study.*
receive comparatively less rainfall, have bare slopes and support moist deciduous forests. Shorea and Pinus may or may not be present. Shorea when present, dominates the vegetation and occurs along with Bauhenia, Careya arborea, Dillenia, Melastoma, Syzygium and others.

In the tropical evergreen forests along the river banks, the dominant genera are Dillenia, Duabenga, Hydnocarpus and Talauma, with numerous climbers, epiphytes and orchids. In the Quercus-Rhododendron-Schima forests, the dominant oak is Quercus griffithii associated with Castanopsis and Engelhardtia. Pinus roxburghii reaches a lower limit at about 600 m. On the dry slopes of the lower valley Euphorbia royleana is commonly met with.

2. Temperate forests

In the interior, wherever there is sufficient moisture, a temperate flora, in which Rhododendron, Acer and Betula are prominent, is developed. In some ranges, the forest is dominated by magnolias, oaks, Strobilanthes and others. In the inner valleys the inner valleys are also found the characteristic temperate conifer forests, consisting of Abies spectabilis (A. dense), Larix griffithiana, Picea spinulosa, Pinus spp. and Tsuga dumosa. Larix griffithiana may occur in association with an undergrowth of rhododendrons.

3. Alpine forests

In the alpine zone, the vegetation varies between the moist alpine type on the south and the dry steppe type on the
northern aspects. *Primula sikkimensis* is abundant in moist alpine zone.

Kameng (Arunachal Pradesh)

The vegetation of Kameng can be described under the following heads:

1. **Tropical forests**

   In the tropical zone, at elevations of about 900 m, are seen the evergreen and semi-evergreen forests, in which species of *Ficus*, *Sterculia*, *Syzygium*, *Terminalia*, along with *Dubanga grandiflora*, are the main tree elements. The palm *Caryota* and the screw-pine *Pandanus* may also occur in the forests of this zone.

2. **Subtropical forests**

   In the subtropical zone are found mixed forests of *Ficus-Castanopsis-Callicarpa* on the lower ridges and *Schima-Castanopsis Engelhardtia-Soursuja* association on the higher ridges, *Rhododendron-Lyonie* forests occur on the drier aspects of hills, and in the deep river valleys *Albizia*, *Morus* and some bamboos are seen.

3. **Temperate forests**

   In the temperate region, mixed forests of *Acer*, *Betula*, *Juglans*, *Magnolia*, *Michelia*, *Quercus*, *Rhododendron* and others with bamboos characterise the hill tops and valleys. At higher altitudes, the temperate forests have a different composition, with dominance attained by *Rhododendron*, *Pyrus*, and *Tsuga* among the trees. The temperate conifer forests are
mostly of *Pinus wallichiana* associated with *Rhododendron*, *Quercus* spp. and *Lyonia*. Epiphytes, particularly orchids are very conspicuous in this zone.

4. **Subalpine to alpine forests**

The subalpine vegetation includes the trees of *Abies spectabilis*, with shrubby and bushy rhododendrons, junipers, *Berberis*, *Cotoneaster*, *Salix* and others. The alpine zone is devoid of any trees.

II. **THE ASSAM HILLS**

These hills are much broken up into serrated ridges and deep valleys so that most of the region south of the Eastern Himalayas proper appears to be an undulating land. The area receives 2480.55 mm average annual rainfall, of which as much as 65.8% (1632.20 mm) is received during the monsoon months (June to September). It may be here mentioned that though most text-books report that Cherrapunji, with an annual mean rainfall of 1250 cm, is the rainiest spot in the world, recent records show, however, that this honour goes to Mawsynram, on the same hills, which has annual mean rainfall of 1750 cm. The mean daily minimum and maximum temperature in centigrade during monsoon months is:

<table>
<thead>
<tr>
<th>Month</th>
<th>Minimum</th>
<th>Maximum</th>
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</thead>
<tbody>
<tr>
<td>June</td>
<td>25.0</td>
<td>31.1</td>
</tr>
<tr>
<td>July</td>
<td>25.0</td>
<td>31.6</td>
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<tr>
<td>August</td>
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<td>31.6</td>
</tr>
<tr>
<td>September</td>
<td>24.4</td>
<td>31.1</td>
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The rocks of these hills, especially of the Shillong Plateau, are probably mainly of Middle and Upper Pre-Cambrian age.

The Garo, Khasi and Jaintia hills form the Western part of this range of hills (also called Assam Range). In the south, these rise rather abruptly from the level plain and slope somewhat gradually in the north by a succession of low hills. The southern and the central parts of the area constitute a wide plateau, the Shillong Plateau, about 1200-1930 m above mean sea level. The highest point is Shillong Peak (1930 m). The Shillong Plateau is also known as Meghalaya (the abode of clouds). The Cachar, Tripura, Manipur and Naga are the other main hills under this division.

The vegetation of all these hills may be broadly classified into the following types:

1. **The tropical vegetation**:

   It typically covers areas up to elevations of 900 m and embraces evergreen and semi-evergreen forests, deciduous forests (dry and moist) and grasslands.

   Tropical evergreen forests are found in the Assam Valley, in the lower parts of Naga, Manipur and Tripura hills. The tallest trees are: *Dipterocarpus turbinatus*, *Canarium resiniferum*, *Artocarpus cheplase*, *Ailanthus grandis*, *Euphorbe longana*, *Keyea assamica*, *Terminalia chebula*, *Phoebe goalparensis*, *Toona ciliata*, *Dyssoxylum binectariferum*, *Dillenia indica* and *Dubanga grandiflora*. Other lower trees are *Amoora wellichii*, *Ficus rumphii*, *Lagerstroemia parviflora* and *Terminalia*...
myriocarpa. Another conspicuous element is the large bamboo Dendrocalamus sp. and Bambusa sp. often crowded in clumps. The forest floor is dense with herbs and ferns are also profuse, the most conspicuous and elegant being the tree fern Cyathea sp.

The deciduous forests include Shorea (the sal) forests, with Shorea robusta dominating. Such forests were visited in the lower slopes of Khasi and Garo hills of the Shillong Plateau and in some parts of North-Cachar hills. The associated species of trees are Careya arborea, Kydia calycina, Sterculia villosa, Bombax ceiba, Terminalia spp., Bauhinia spp., Acacia spp., Albizia spp., Adina cordifolia, and Gmelina arborea. The herbaceous vegetation and ferns are less profuse.

2. The subtropical vegetation

These occur in the areas reaching up to 1500 m above mean sea level and include associations of Castanopsis, Schima, Engelhardtia, Terminalia, Ficus, Michelia and Albizia.

3. The temperate vegetation

It occurs at elevations from about 1300 m to 2500 m. In several suitable localities there is a mixed temperate vegetation with subtropical vegetation. Albizia, Acer, Juglans, Quercus, Magnolia and Michelia with Rhododendron, Rubus and sprinkling of Arundinaria are present.

The temperate vegetation in the Khasi and Jaintia hills of the Shillong Plateau, especially of the 'sacred forests' at Shillong Peak, Mawphlang, Mowsmai and some other places, was originally studied by Hooker (1854) and more recently by
Bor (1942) and Rao (1969). These represent relicts, amidst a much disturbed and altered vegetation, due to the devastating practice of JHUMING, a kind of primitive agricultural practice, involving a large scale cutting down and burning of trees before cultivation. The small pockets of 'sacred forests' left untouched due to religious beliefs, afford us a glimpse of the original forest that must have once clothed these hills in the pre-historic times. They are present in saucer-shaped depressions, amidst rolling grassland, and often have a little mountain stream meandering through them. Fagaceae with Quercus spp., and Castanopsis spp., Rosaceae with Rosa, Photinia, Eriobotrya, Pyrus, Prunus, Sorbus and several other shrubby and herbaceous species, Carylopsis, Albizia, Manglieta, Acer occur in them. The forest floor has a dense carpet of herbaceous vegetation. A comparable kind of temperate vegetation occurs at compatible altitudes of the Naga hills (Bor, 1938).

An important result of human influence from pre-historic times in these hills, is the intrusion and spread of Pinus insularis. In the Khasi and Jaintia hills of the Shillong Plateau this pine makes its appearance at about 900 m and forms extensive pure groves at higher altitudes, giving the landscape a parkland appearance, with the interspersed rolling grasslands. These pine-woods may contain sometimes a sprinkling of Symlocos, Schima wallichii and Schima khasiana. The floor underneath is thick with a carpet of pine needles, and as may be
expected, is devoid of any vegetation, but rich in fungal growth.

4. The subalpine vegetation

It occurs at altitudes of 3000 to 4500 m in the Naga and Manipur hills. The dominant trees are Abies, Tsuga, and Picea with a dense bushy zone of Rhododendron, Juniperus recurva, Berberis, Salix, and Rubus.