

STUDIES ON THE VASCULAR FLORA OF ANAIMUDI AND THE SURROUNDING REGIONS, KOTTAYAM* DISTRICT, KERALA

B. V. SHETTY AND K. VIVEKANANTHAN

Botanical Survey of India, Coimbatore

ABSTRACT

The paper deals with an account of the vegetation of Anaimudi (2,695 m)—the highest peak in the peninsular India—and the surrounding regions situated in the Kottayam District of Kerala. The above area has not received much attention in the detailed studies undertaken by various workers on the vegetation of the South Indian hill tops. Based on the explorations carried out by the authors during the years 1965-70, 317 taxa of vascular plants, under 233 genera and 101 families, are enumerated. An analysis of the distribution pattern of the shola and grassland species has shown that (1) the shola species are mainly of tropical stock, (2) quite a number of species on the shola fringes and the grassland are of temperate origin and (3) the temperate elements play a comparatively less important role in the composition of the vegetation at the higher altitudes (above 1,925 m), and that the predominant elements here are of tropical stock. The high incidence of endemic taxa in this region has been pointed out. Literature on the ecological status of the shola-grassland formation has been reviewed for a better understanding of the vegetation.

INTRODUCTION

Situated in the South Sahyadri (or Southern Ghats) and towering 2,695 m above m.s.l. from among the many smaller hills that constitute the High Range is Anaimudi, the highest peak in India south of the Himalayas. It is the nodal point from which three ranges radiate in three different directions: the Anaimalai in the north; the Palni in the north-east; and the Cardamom hills or the Elamalai in the south. The High Range is the name given to the plantation areas in the Devicolam Taluk of Kottayam District, Kerala, and with its deeply dissected valleys and massive peaks is "surpassingly grand, and incomparably beautiful" in the words of Hamilton (1892), one of the first visitors to this area in 1854. The valleys are now covered with tea plantations. About 10 km north-east of Anaimudi is Munnar, the central town in the High Range, and this enchanting valley which is 1,524 m above m.s.l., is aptly called the Little Tea Town of the South. Munnar in vernacular means three rivers, and it derives this name due to the fact that the three tributaries of the Muthirapuzha river, the source of power for a number of hydro-electric plants in Kerala, confluence in the vicinity of Munnar.

The High Range is also known as the Kanan Devan Hills. Kanan Thevar was the 19th century headman of the villages of the Anchanad, north of the High Range. It is said that the travellers from Madurai to west coast passed through his villages

and named these hills after him. This area attracted the attention of J. D. Munro, while on a hunting expedition in 1877 and he at once recognised the possibilities of raising plantation crops there. He bought from Pooniat Raja of Anchanad about 55,850 hectares of land on the Kanan Devan Hills and formed the North Travancore Land Plantation and Agriculture Society. Members of the society developed their own estates in various parts of the High Range and tried many crops such as coffee, cinchona, sisal and cardamom, before discovering in tea the best suited to the area (from K.D.H.P. Co.'s pamphlet). The pace of development had been rapid and the High Range today has about 35 tea estates, some of which situated at an elevation of over 2,135 m are said to be among the highest in the world.

Anaimudi lies within the boundaries of the Eravikulam Sanctuary, also known as the Hamilton Plateau, a private shooting reserve owned by the Kanan Devan Hill Produce Company. The game sanctuary extends from Eravikulam in the north to Rajamallay in the south-east. It is believed (Daniel, 1970) that this sanctuary holds not less than one third, but probably half the total world population of Nilgiri Tahr (*Hemitragus hylocrius* Ogilby), a species which is said to be in danger of extinction (Schaller, 1970). Another attractive feature of this sanctuary is trout fishing. Thanks to the efforts of the High Range Game Preservation Association, introduced trouts thrive well at these elevations.

*Now in the newly formed Iddiki district.

According to Schaller (*l.c.*) "the Eravikulam Reserve in the High Range is a magnificent piece of hill country, an area which in some future year would make an excellent national park for those who like to hike, fish and observe wild life". Bassett (1964) who visited this sanctuary for the purpose of seeing and photographing the Nilgiri Tahr was also struck by "the splendid scenery of this high untouched grassland" and suggested that "it deserves to be more widely known". For an account of the fauna of this region reference may be made to the article by Daniel (*l.c.*).

Munnar is about 160 km by road from both Cochin and Coimbatore. Anaimudi can be reached either from Upper Vagavurrai tea estates or from Rajamallay both of which are about 10 km from Munnar, but it is easier from the former place. The roads are wide enough for 4-wheeled vehicles till the highest level of tea at Upper Vagavurrai and up to the trout hatchery at Rajamallay. The area under study lies between $76^{\circ}57'-77^{\circ}$ East longitude and $10^{\circ}9'-10^{\circ}13'$ North latitude and extends over the range of altitude 1,700-2,695 m.

The mountainous configuration, the high altitude and the heavy rainfall due to its proximity to the west coast make this region one of the botanically interesting regions of peninsular India. No detailed study on the flora of this area has, however, been made. In the *Forest trees of Travancore* by Bourdillon (1908) and *Flowering plants of Travancore* by Rama Rao (1914) some of the species occurring on the High Range have been dealt with, but those from Anaimudi and adjoining regions are negligible. Viswanathan (1956), Iyppu (1960) and Chandrasekharan (1962) have dealt briefly with the forest types on the High Range. Sebastine and Vivekananthan (1968) have not covered Anaimudi and the surrounding regions in their enumeration of plants from Devicolam.

Barnes who made extensive collections on the High Range and considered it to be "one of the botanically richest areas of India south of the Himalayas" was the only Botanist to have made any appreciable collections from Anaimudi. He, however, published only an account of the Geraniaceae occurring on the High Range, including Anaimudi (Barnes, 1939). According to him (Barnes, *l.c.*) "there seems little doubt that in respect of species of balsams the High Range is the richest area in the Western Ghats, and consequently of the world". He recorded 12

species of *Impatiens* endemic to the High Range and found more than 30 species of them within a radius of 16 km of Munnar and most of them within a much smaller area. The botanical richness of this area is evident from the fact that based on the collections made by Barnes from Anaimudi alone seven species have been described, these being *Habenaria flabelliformis* Summerh., *Impatiens anaimudica* C. E. C. Fischer, *I. coelotropis* C. E. C. Fischer, *I. pandata* E. Barnes, *I. platyadena* C. E. C. Fischer, *Isachne fischeri* Bor and *Sonerila nemakadensis* C. E. C. Fischer.

There are only nine references to Anaimudi in the *Flora of the Presidency of Madras* by Gamble and Fischer (1915-36). Six of them are in relation to the above species (except *Impatiens pandata*), two others relate to *Andropogon lividus* Thw. and *Isachne bourneorum* C. E. C. Fischer which are also based on Barnes' collections and the remaining one is with regard to a collection of *Arundinaria densifolia* Munro made by Beddome. Based on the collections of Barnes from the other parts of the High Range, twelve other taxa have been described between the years 1936-40, after the publication of the *Flora of the Presidency of Madras*. They are *Anaphalis barnesii* C. E. C. Fischer, *Arisaema attenuatum* E. Barnes, *A. peltatum* C. E. C. Fischer, *A. psittacus* E. Barnes, *Begonia aliciae* C. E. C. Fischer, *Didymocarpus macrostachya* E. Barnes, *Impatiens chinensis* Linn. var. *brevicornis* E. Barnes, *I. johnii* E. Barnes, *I. munnarensis* E. Barnes, *Ophiorrhiza barnesii* C. E. C. Fischer, *O. caudata* C. E. C. Fischer and *O. munnarensis* C. E. C. Fischer. The explorations conducted by the present authors have yielded three taxa new to science, viz. *Hedyotis santapauli* Shetty & Vivek., *Leucas vestita* Benth. var. *devicolamensis* Shetty & Vivek. and *Vernonia anaimudica* Shetty & Vivek. and some rare and interesting species which are inadequately represented in our herbaria.

Many contributions have been made on the phytogeography and ecology of South Indian hill tops, but these studies are mainly confined to well known and easily accessible ones like the Nilgiris, Palnis, hills in Mysore and to some extent Anaimalais. Anaimudi range could yield interesting results, particularly due to the fact that the biotic interference with the vegetation is comparatively lesser. A detailed knowledge of the flora of the region is a prerequisite for such studies.

GEOLOGY AND SOIL

The underlying rock formation is of the archaic igneous origin consisting of granites and gneisses. The crystalline rocks consist mainly of the minerals silica, feldspars, muscovite and biotite with small amounts of the accessory ferromagnesian minerals (Koshy, 1970). The soil is acidic and is made up of sandy clay loam. Over the crest and along the slopes of the precipitous hills the soil is usually shallow with no tree growth, and outcrops of rocks can be seen in many places. Koshy (*l.c.*) who analysed the properties of the forest soil samples collected from different elevations on the High Range observed that in the soil samples collected from places lying between 1,800-2,100 m the sand fraction constitutes 30.5-37.5%, the silt 11.3-17.4%, the clay 47.9-49.3% and the organic matter 2.8-3.03%, the pH range being 5.4-5.7.

CLIMATE

The climate of the high plateaux of South India is often referred to as of temperate type on account of the relatively low temperature prevailing there during winter months. Theagarajan (unpub.) and Meher-Homji (1967), however, have shown that there are many differences here from the temperate climate. The above workers and Jayadev (1957) have also stressed on the wide diurnal range of tem-

perature, especially in winter months. Meher-Homji (*l.c.*) described the climate of these regions as tropical montane type.

No data on temperature are available for Anaimudi and the adjoining region. In the High Range in general (Viswanathan, 1956), however, the average temperature has been recorded to be about 24°C during the hottest months (March to May) and less than 7°C during the cold season (December to February). From November to February heavy frost occurs in Anaimudi and the surrounding areas.

The rainfall is heavy and the bulk of the annual rainfall is precipitated by the south-west monsoon, especially from June to August. During this season the whole area is generally swathed in dense fog and strong winds are usually prevalent. Considerable rain is received in October and November also, during the retreating south-west monsoon season, generally known as the north-east monsoon rains. Rainfall data for 5 years for Upper Vagavurrai and Rajamallay which are situated on the eastern and western sides of Anaimudi at an elevation of 1,930 m and 2,050 m, respectively are given in Table 1.

VEGETATION

The vegetation of Anaimudi and the adjoining regions like Umaiyamallay, Rajamallay, etc. consists of vast expanse of grassland interspersed with a

TABLE 1 : Rainfall record in millimetres

Locality: Upper Vagavurrai

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1961	106.93	—	—	59.69	489.20	1370.33	1864.36	925.58	219.96	246.13	270.76	109.73
1962	141.99	75.44	26.67	39.12	237.10	106.17	1658.11	903.99	419.61	381.76	57.66	7.39
1963	152.91	18.03	19.05	43.43	57.91	465.84	629.16	703.60	225.30	290.58	255.79	107.95
1964	—	—	61.72	29.46	93.73	239.03	767.08	1494.54	494.54	309.63	128.02	88.65
1965	1.02	6.86	15.75	115.06	32.51	283.21	769.37	216.15	121.67	117.60	110.24	311.40

Average annual rainfall: 3709.62 mm

Locality: Rajamallay

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1961	8.13	23.87	170.78	85.34	804.42	1887.22	2637.95	1338.58	607.31	333.50	59.44	3.05
1962	51.05	56.13	218.44	240.03	530.86	134.62	2498.85	996.95	836.57	357.12	48.77	55.37
1963	17.78	65.53	39.37	227.84	61.47	813.82	1369.82	1026.67	447.29	451.61	62.23	96.01
1964	—	26.67	36.32	9.14	190.01	582.58	1430.78	2418.84	790.96	461.26	144.78	88.90
1965	—	—	55.37	133.35	107.44	671.07	1117.09	519.18	352.30	209.30	40.89	5.84

Average annual rainfall: 5543.35 mm

number of isolated compact woods, locally known as sholas. These sholas are usually confined to sheltered valleys, glens, hollows and depressions where there is adequate moisture and good drainage. Roughly the grassland constitutes about 85% of the vegetation and the shola forests 15%. These two very contrasting physiognomic types which are in a state of equilibrium have been classified by Champion and Seth (1964) under the type Southern Montane Wet Temperate Forest (Sub Group 11A, type C 1) and Southern Montane Wet Grassland (Sub Group 11A, type DS 2), the latter being considered by them to be a degradation stage. Meher-Homji (1967), however, in his studies on the phytogeography of South Indian hill stations like Nilgiris, Kodaikanal, etc. where the vegetation is similar to that on Anaimudi and surrounding regions, recognises the following three physiognomic types: (1) shola, (2) tree and shrubby zone at the periphery of the shola and (3) shrub-savanna. Although types 1 and 2 are generally grouped together and considered as one type, namely sholas by most workers he is of the opinion that there is a distinct floristic difference between the two types, the species growing on the margins of sholas are light demanders and do not enter the forests. He considers what are generally referred to as grasslands to be shrub-savanna, since a number of herbaceous, under-shrubby and shrubby species are mixed with grasses.

Sholas: The trees comprising the sholas are all evergreen and mostly short-boled. The height of the trees is low, rarely exceeding 6 m and are clothed with lichens, mosses, ferns, orchids and other epiphytes. The crowns are usually dense and rounded. Marked differentiation of canopy layers is not present and there is a continuous series from undershrubs to shrubs, and larger shola trees. There is a considerable admixture of species, the principal tree species being *Actinodaphne bourdillonii*, *Elaeocarpus recurvatus*, *Ilex denticulata*, *I. wightiana*, *Ligustrum perrottetii*, *Litsea wightiana* var. *tomentosa*, *Michelia nilagirica*, *Microtropis ramiflora*, *Pithecellobium subcoriaceum*, *Pittosporum tetraspermum*, *Schefflera racemosa*, *S. rostrata*, *Symplocos pendula*, *Symplocos* sp. and *Syzygium arnotianum*. Trees found along the fringes of sholas are *Eurya nitida*, *Photinia notoniana*, *Rhododendron nilagiricum*, *Rhodomyrtus tomentosa*, *Symplocos laurina*, *Ternstroemia japonica* and *Turpinia cochinchinensis*. Shrubs and herbs confined to the mar-

gins of sholas are *Berberis tinctoria*, *Disporum leschenaultianum*, *Euphorbia laeta*, *Gaultheria fragrantissima*, *Hedyotis stylosa*, *Jasminum bignoniaceum*, *Leucas lanceaefolia*, *Moonia heterophylla*, *Smithia blanda* and *Valeriana arnottiana*.

The undergrowth in the shola is made up of species like *Abelmoschus angulosus*, *Arundinaria* sp., *Elatostema surculosum*, *Impatiens phoenicea*, *Psychotria congesta*, *Strobilanthes* spp., *Viola serpens* etc., the notable ferns being *Asplenium aethiopicum*, *A. laciniatum* and *Polystichum biaristatum*. Among the climbing plants in the sholas *Piper nigrum*, *P. schmidtii*, *Rubia cordifolia* and *Tylophora pauciflora* are the most frequent. Of epiphytic or lithophytic orchids there are *Aërides ringens*, *Coeogyne mossiae*, *C. nervosa*, *Dendrobium nanum*, *Eria dalzellii*, *E. pauciflora*, *Oberonia wightiana*, *Oberonia* sp. and *Schoenorchis filiformis*. *Helixanthera obtusata* and *Korthalsella japonica* are the two common parasites. Though not common, it is of interest to record the occurrence of two species of tree ferns, *Cyathea crinita* and *C. spinulosa*, particularly in Rajamallay which is on the eastern side of Anaimudi. The former, according to Beddome (1883), is "by far the most beautiful of all tree ferns."

There are two perennial streams, one on either side of Anaimudi, one flowing through Umaiymallay and the other through Rajamallay. The fringing forests along these water courses are not dense and consist mostly of species that occur along the margins of sholas. Other characteristic trees here are *Rapanea capitellata* and *Vaccinium leschenaultii*. Growing from the clefts of rocks in these rapid streams is *Impatiens tangachee* with its attractive lilac flowers and by the side of streams *Osmunda regalis* is common. The rocks in the stream in Umaiymallay are clothed with *Zeylanidium olivaceum* during November to February.

Grasslands: The grasslands (shrub-savanna) are extensive and include a complex of grasses, herbs, undershrubs and a few shrubs. Of the many species of grasses in the grasslands the dominant ones are *Dichanthium polyptychum* var. *polyptychum* and *Eulalia phaeothrix*. The other common species are *Agrostis peninsularis*, *Andropogon lividus*, *Arundinella purpurea*, *A. vaginata*, *Bromus ramosus*, *Chrysopogon zeylanicus*, *Indochloa oligantha*, *Isachne bourneorum*, *Ischaemum indicum* and *Tripsogon bromoides*. Growing amidst these grasses are orchids like *Habenaria heyneana*, *H. perrottetiana*, *Malaxis densiflora*, *Satyrium nepalense* and *Spiranthes sinen-*

sis. There are several other herbs and ligneous elements of which the species of common occurrence are *Anaphalis bournei*, *A. meeboldii*, *A. subdecurrens*, *Bupleurum wightii*, *Centratherum rangacharii*, *Cnicus wallichii* var. *wightii*, *Cortalaria scabrella*, *Dichrocephala chrysanthemifolia*, *Drosera peltata*, *Gentiana quadrifaria* var. *zeylanica*, *Geranium nepalense*, *Hedyotis swertioides*, *Hypericum mysorensis*, *Impatiens tomentosa*, *Justicia* spp., *Leucas ternifolia*, *Neanotis indica* var. *affinis*, *Osbeckia leschenaultiana*, *Pedicularis zeylanica*, *Pimpinella candolleana*, *Polygala sibirica* var. *heyneana*, *Ranunculus reniformis*, *Senecio lavandulaefolius*, *Sopubia trifida*, *Swertia corymbosa* and *Wahlenbergia marginata*. In marshy places in the grasslands *Burmanna pusilla*, *Eriocaulon brownianum* var. *nilagirensis*, *E. collinum*, *Fimbristylis kingii*, *Lobelia zeylanica*, *Lysimachia deltoidea*, *Parnassia mysorensis*, *Rhynchospora rugosa*, *Scirpus fluitans*, *Utricularia graminifolia*, *U. roseo-purpurea* and *Xyris capensis* var. *schoenoides* are encountered. During the monsoon season *Brachycorythis iantha*, *B. splendida* and *Impatiens omissa* make their appearance, and on dripping rocks during this season are found *Impatiens modesta* and *I. pandata* growing in cushions of moss.

Extensive patches of *Phlebophyllum kunthianum* are present in certain places, particularly in Umaiymallay, extending up to an elevation of 2,100 m and the gregarious flowering of it occurred in November 1969, rendering a vivid bluish purple hue to the landscape. *Pteridium aquilinum* has made considerable inroads into the grasslands at several places, especially in areas adjoining tea estates. The other common ferns and fern allies in grasslands are *Botrychium lanuginosum*, *Lindsaya cultrata* and *Osmunda regalis*, the last species is generally found in clefts of rocks near streams. Scattered trees of *Rhododendron nilagiricum* are also often seen on grassy slopes.

The summit of Anaimudi peak is devoid of forests and the few isolated plants of *Gaultheria fragrantissima* and *Rhododendron nilagiricum* that are present are very stunted in growth on account of their exposure to strong winds. The reed bamboo, *Arundinaria* sp., occurs in small patches. Associated with the grasses which are abundant, there are in this region species like *Anaphalis bournei*, *A. meeboldii*, *Bupleurum wightii*, *Campanula alphonsii*, *Eriocaulon brownianum* var. *nilagirensis*, *Gentiana quadrifaria* var. *zeylanica*, *Hedyotis buxifolia*, *Leucas ternifolia*, *Micromeria biflora*, *Senecio lavandulae-*

folius and *Wahlenbergia marginata*. During the monsoon season a few plants of *Arisaema wightii* can also be seen growing on humus soil from the clefts of rocks.

Southern subtropical Hill Forests: Evergreen forests of the type classified by Champion and Seth (1964) under Southern subtropical Hill Forest (Type 8a/C₁) and by Chandrasekharan (1962) under Subtropical Wet Hill Forests are met with at lower elevations like Vagavurrai and parts of Umaiymallay which are situated at an elevation of 1,700-2,000 m. These "stunted rain forests" which are found in the transitional zone between the montane woodlands and the typical tropical wet evergreen type are not as luxuriant as the latter and the trees are smaller, ranging from 10 to 15 m. The flora here contains a mixture of species of tropical evergreen forest and that of montane temperate forest, the former element predominating. This zone has been considerably interfered with and some of these forests have been reduced to small patches due to the expansion of tea estates. The principal trees here are *Aporusa* sp., *Elaeocarpus oblongus*, *Eurya nitida*, *Garcinia cambogia* var. *papilla*, *Gomphandra coriacea* and *Mastixia arborea*.

The undergrowth includes an abundance of *Strobilanthes* spp., the other notable species being *Ardisia rhomboidea*, *Elatostema lineolatum*, *Heraclium pedatum*, *Impatiens fruticosa*, *Lasianthus acuminatus*, *Ophiorrhiza* sp., *Pilea kingii*, *P. trinervia*, *Plectronia rheedii*, *Pogostemon pubescens*, *Psychotria* sp., *Rauwolfia densiflora* and *Selaginella repanda*. In addition, terrestrial orchids like *Calanthe triplicata* and *Malaxis versicolor* and the tree fern *Cyathea spinulosa* are also common. *Cambellia cytinoides* with its bright red flowers is also commonly met with as a parasite on *Strobilanthes* sp. Among the climbers mention may be made of *Gardneria ovata*, *Piper mullesua*, *Senecio wightianus*, *Tetrastigma muricatum*, *Toddalia asiatica* var. *floribunda* and *Tylophora pauciflora*.

Near tea estates there are small patches of evergreen forests and in these highly disturbed patches *Maesa perrottetiana*, *Pilea trinervia*, *Polygala arillata*, *Rauwolfia densiflora*, *Rubus ellipticus* and *Trema orientalis* are common.

Some of the common weeds on road sides and in the tea estates are *Commelina clavata*, *Cyanotis pilosa*, *Dichrocephala integrifolia*, *Erigeron karvinskianus*, *Galinsoga parviflora*, *Oxalis corniculata*,

Picris hieracioides, *Polygonum chinense* and *P. nepalense*.

OBSERVATIONS ON GRASSLANDS

Some contributions have been made on the types of grasslands occurring at the higher altitudes of Nilgiris (Shankaranarayan, 1958; Agrawal *et al.*, 1961; Gupte and Rege, 1965; Gupte *et al.*, 1967), but, except for the work of Blasco (1970) who deals with parts of Nilgiris and Palnis, very little information is available on the type or types of grasslands situated on other South Indian hill tops. Shankaranarayan (*l.c.*) indicated the type of grasslands studied by him in some parts of Kundahs in Nilgiris as *Cymbopogon-Themeda cymbaria* type. Agrawal *et al.* (*l.c.*) found *Chrysopogon zeylanicus* to be the dominant grass in the Wenlock Downs of Nilgiris where the grasslands are generally in an overgrazed condition. Their studies on the succession stages in the grasslands, protected by fencing, indicated that the highest stage is represented by *Arundinella* species. According to Gupte *et al.* (*l.c.*), however, in these grasslands *Arundinella* species are very low in ecological succession.

Gupte and Rege (*l.c.*) and Gupte *et al.* (*l.c.*) have shown the existence of two major types of grasslands in the Nilgiri plateau, one dominated by *Chrysopogon zeylanicus* and the other by *Dichanthium polyptychum*. The former type is found in the Wenlock Downs where the grasslands are generally subjected to overgrazing and the latter type is found in the western and south-western parts of Nilgiris, near Avalanche and Upper Bhavani, where the grasslands are little subjected to biotic interference. According to them, *Eulalia* spp. contributes about 10% to 20% to the composition of the latter type of grassland. The grasslands dominated by *Dichanthium polyptychum*, in their opinion, are the oldest grasslands in the Nilgiris and the disappearance of this species from vast areas is attributed to biotic factors. They consider *Chrysopogon zeylanicus* to be an invader which has replaced *D. polyptychum* over large areas in Nilgiris. What appears as two distinct grassland types in Nilgiris are, according to them, "in fact two stages of only one type; *C. zeylanicus* representing its apparently stable stage in retrogressive succession on overgrazed and eroded areas".

The grassy plateau studied by the authors is comparable to those in Nilgiris, the dominant species of grasses being *Dichanthium polyptychum* var. *polyptychum* and *Eulalia phaeothrix*. The incidence of

grazing and fire is very much less here when compared to many parts of Nilgiris. In areas which are not much disturbed *D. polyptychum* var. *polyptychum* reaches a height of over a metre.

Many of the plants in the grasslands present characters which are clearly adaptations to tide over the adverse conditions prevailing there, namely, physiological drought, cold, high intensity of solar radiation, violence of the monsoon gales etc. Similar observation has been made by Pearson (1899) while dealing with the flora of the *patanas* of Ceylon and he found a predominance of plants with marked xerophytic characters. The present authors found a large number of the species in the grasslands to be perennials. Plants with underground tubers (like *Brachycorythis* spp., *Habenaria* spp., *Malaxis* sp., and *Drosera peltata*) and with gnarled woody body or with highly developed root system (like *Anaphalis bournei*, *A. meeboldii* and *Leucas ternifolia*) are common. Leaves are usually numerous and crowded, thus providing shade to the majority at the expense of the rest, mostly radical or rosulate and often densely woolly or hairy. Semi-erect position of the leaves is a common feature and many species with leaves showing sun movements are encountered e.g. *Smithia blanda*, some other species of Leguminosae and species of Oxalidaceae. Persistence of the remains of dead vegetative parts which help in retaining considerable amount of water is seen in the case of members of Eriocaulaceae and Gramineae. Species which do not show any of the above mentioned adaptations are usually the ephemerals which generally come up during the monsoon season.

DISTRIBUTION PATTERN OF THE SHOLA AND GRASSLAND SPECIES

Out of the 182 taxa of flowering plants collected from the higher altitudes, between 1,925 m to 2,695 m, 82 are found in the sholas, 6 are confined to the fringing forests along streams and the remaining are restricted to the grasslands. An analysis of the areas of distribution of the 17 taxa of trees in the sholas, excluding those that are found on the shola fringes (Table 2), has shown that 8 species are generally restricted in their distribution to the Western Ghats (chiefly at the higher altitudes) like the Nilgiris, Palnis, Anaimalais and the High Range, another 8 species are found in the above areas and Ceylon and the remaining species, *viz.* *Symplocos pendula* occurs from Ceylon and the Deccan Peninsula to the Pahang province of the Malay Peninsula in montane zone (van Steenis, 1948). At the generic

level most of the genera of the shola species are tropical (with a few extending into sub-tropical regions), the exceptions being *Euonymus* and *Ligustrum* which are chiefly temperate. *Ilex* and *Michelia* have their species distributed over both tropical and temperate regions.

TABLE 2: *Distribution pattern of the shola species—trees*

(a) Species generally restricted to the Western Ghats and mostly found at higher altitudes (No. 1 and 4 also extend to the adjacent Biligirirangan and Kollegal hills in Mysore).

1. *Actinodaphne bourdillonii* Gamble
2. *Elasocarpus recurvatus* Corner
3. *Euonymus crenulatus* Wall. ex Wt. & Arn.
4. *Ligustrum perrottetii* A. DC.
5. *Litsea wightiana* (Nees) Hook. f. var. *tomentosa* (Me. ssn.) Gamble
6. *Schefflera rostrata* (Wt.) Harms
7. *Symplocos anamllayana* Bedd.
8. *Syzygium arnottianum* Walp.

(b) Species generally restricted to the higher altitudes of the Western Ghats and Ceylon (No. 3 also extends to Biligirirangan and Kollegal hills in Mysore).

1. *Ilex denticulata* Wall. ex Wt.
2. *I. wightiana* Wall. ex Wt.
3. *Meliosma simplicifolia* (Roxb.) Walp. ssp. *pungens* (Walp.) Beus.
4. *Michelia nilagirica* Zenk.
5. *Microtropis ramiflora* Wt.
6. *Pithecellobium subcoriaceum* Thw.
7. *Pittosporum tetraspermum* Wt. & Arn.
8. *Schefflera racemosa* (Wt.) Harms

(c) Species distributed in the higher altitudes of the Western Ghats, Ceylon and Malay Peninsula.

1. *Symplocos pendula* Wt.

The other components of the sholas, namely, the shrubs, climbers, epiphytes and other herbs constitute about 29 species of which 15 are restricted in their distribution to the Western Ghats and the adjacent hills, 5 are generally restricted to the Western Ghats and Ceylon and 9 have their distribution range extending into the Himalayas and also to other countries (Table 3). Of the species with wider distribution *Carex filicina* is often seen in the grassland and the parasite *Korthalsella japonica* is sometimes found on the occasional trees in the grassland. At the generic level 18 genera are of tropical distribution (with a few extending into sub-tropical regions); the cosmopolitan ones with chiefly temperate distribution are *Carex*, *Circaea* and *Viola*, while *Asparagus*, *Korthalsella* and *Rubia* have their distribution in both tropical and temperate regions. The above facts show that the shola

species (excluding those on the periphery) are predominantly of tropical stock.

TABLE 3: *Distribution pattern of the shola species—shrubs, climbers, epiphytes and other herbs*

(a) Species generally restricted to the Western Ghats and mostly found at higher altitudes (No. 1, 3, 4, 5, 6, 7 and 11 also extend to Biligirirangan and Kollegal hills in Mysore).

1. *Aërides ringens* (Lindl.) C.E.C. Fischer
2. *Coelogyne mossiae* Rolfe
3. *C. nervosa* A. Rich.
4. *Dendrobium nanum* Hook. f.
5. *Eria dalzellii* Lindl.
6. *E. pauciflora* Wt.
7. *Helixanthera obtusata* (Schult.) Danser
- *8. *Impatiens coelotropis* C.E.C. Fischer
- **9. *I. leschenaultii* (DC.) Wall.
10. *I. phoenicea* Bedd.
11. *Piper schmidtii* Hook. f.
12. *Plectranthus stocksii* Hook. f.
13. *Pogostemon atropurpureus* Benth.
14. *Psychotria congesta* Hook. f.
- *15. *Vernonia anamallica* Bedd. ex Gamble

(b) Species generally restricted to the Western Ghats and Ceylon (No. 1 also extends to Biligirirangan hills in Mysore).

1. *Asparagus gonocladus* Baker
2. *Boehmeria platyphylla* D. Don var. *longissima* Hook. f.
3. *Oberonia wightiana* Lindl.
4. *Schoenorchis filiformis* (Wt.) Schltr.
- *5. *Tylophora pauciflora* Wt. & Arn.

(c) Species with wide distribution and extending into the Himalayas and other countries.

1. *Abelmoschus angulosus* Wall. ex Wt. & Arn.
2. *Carex filicina* Nees
3. *Circaea alpina* Linn.
4. *Dumasia villosa* DC.
5. *Elatostema surculosum* Wt.
6. *Korthalsella japonica* Engler
7. *Piper nigrum* Linn.
8. *Rubia cordifolia* Linn.
9. *Viola serpens* Wall.

About 36 species have been noticed along the margins of the sholas of which 13 species are restricted in their distribution to the hill tops of southern India, 10 species are generally confined to South India and Ceylon (one species is found in Central India also) and the remaining 13 species have their distribution range extending into the Himalayas and often to other countries, particularly of higher latitudes like China and Japan (Table 4). At the generic level there are 14 temperate genera (sometimes extending into sub-tropical regions) and 17 tropical genera (sometimes extending into sub-tropical regions).

*These species are also found in the evergreen forests at lower altitudes.

**This species is also found in cleared areas.

TABLE 4: *Distribution pattern of the species on the shola fringes*

(a) Species generally restricted to the Western Ghats and mostly found at higher altitudes (No. 8 has also been reported from Shevaroy hills and No. 7 extends to Biligirirangan hills in Mysore).

1. *Anaphalis travancorica* W.W. Smith
2. *Hedyotis eualata* (Gamble) Henry & Subr.
3. *H. santapau* Shetty & Vivek.
4. *H. stylosa* R. Br.
- *5. *Jasminum bignoniaceum* Wall. ex G. Don
6. *Leucas lanceaefolia* Desf.
7. *Neanotis monosperma* (Wall. ex Wt. & Arn.) W.H. Lewis
8. *Plectranthus wightii* Benth.
- *9. *Rhododendron nilagiricum* Zenk.
10. *Rosa leschenaultiana* Wt. & Arn.
11. *Valeriana arnottiana* Wt.
- **12. *Vernonia anaimudica* Shetty & Vivek.
13. *V. bourneana* W.W. Smith

(b) Species generally restricted to South India and Ceylon (No. 4 has also been reported from Central India).

1. *Anaphalis marcescens* (Wt.) C.B. Clarke
2. *Desmodium rufescens* DC.
3. *Disporum leschenaultianum* D. Don
4. *Euphorbia laeta* Heyne ex Roth
5. *Helichrysum buddleioides* DC.
6. *H. hookerianum* Wt. & Arn.
7. *Lasiosiphon eriocephalus* Decne.
8. *Moonia heterophylla* (C.B. Clarke) Arn.
9. *Myriactis wightii* DC.
10. *Notonia walkeri* (Wt.) C.B. Clarke

(c) Species with wide distribution and extending into the Himalayas and often to other countries, particularly of higher latitude.

1. *Adenostemma reticulatum* DC.
2. *Berberis tinctoria* Lesch.
3. *Elaeagnus kolaga* Schlecht.
4. *Eurya nitida* Korth.
- *5. *Gaultheria fragrantissima* Wall.
- *6. *Mahonia leschenaultii* (Wall.) Takeda
7. *Photinia notoniana* Wt. & Arn.
8. *Rhodomyrtus tomentosa* Wt.
- **9. *Rubus fairholmanus* Gardn.
10. *Smithia blanda* Dalz.
- *11. *Symplocos laurina* Wall. ex Rehd. & Willd.
12. *Ternstroemia japonica* Linn.
13. *Turpintia cochinchinensis* (Lour.) Merr.

The fringing forests along streams not only contain the species that are usually found along the shola margins, but also 6 other species, the distribution pattern of which is as follows: 3 species are restricted to the Western Ghats and mostly found at higher altitudes, 2 species are restricted to Western Ghats and Ceylon and 1 species has a wider distribution and extends into Nepal, Bhutan, Khasia Mountains and Burma (Table 5).

*These species are often found in grasslands also.

**These species are often found in grasslands and in cleared areas.

TABLE 5: *Distribution pattern of species found only along streams*

(a) Species restricted to the Western Ghats and mostly found at higher altitudes.

1. *Impatiens tangachee* Bedd.
2. *Medinilla malabarica* Bedd.
3. *Sonerita grandiflora* Wall. ex Wt. & Arn.

(b) Species restricted to the Western Ghats and Ceylon.

1. *Vaccinium leschenaultii* Wt.
2. *Zeylanidium oliaceum* (Gardn.) Engl.

(c) Species with wide distribution and extending into Himalayas and other countries.

1. *Rapanea capitellata* (Wall.) Mez.

Of the 94 species encountered in the grassland, 45 have a restricted distribution and are confined to the montane zone of southern India, 18 species are restricted to South India (chiefly the Western Ghats) and Ceylon, two species are found in Burma also in addition to the Western Ghats and Ceylon and one species, viz. *Spilanthes paniculata* is a cosmopolitan weed. The remaining 28 taxa have their distribution extending into the Himalayas and often to other countries (Table 6). The distribution pattern of the 15 species of grasses collected is as follows: 7 are restricted to the high hills of southern India, two extend in their distribution into Ceylon, two to Ceylon and Burma and the remaining four to the temperate regions, including the mountains of western, central and south-eastern Asia. The species of the grassland belong to 73 genera of which 41 are mainly of tropical distribution, 18 are chiefly temperate and 14 are cosmopolitan.

TABLE 6: *Distribution pattern of the grassland species*

(a) Species generally restricted to the Western Ghats and mostly found at higher altitudes (No. 16, 25 and 35 have also been reported from Shevaroy hills; No. 42 has also been reported from Eastern Ghats).

1. *Agrostis peninsularis* Hook. f.
2. *Anaphalis bournei* Fyson
3. *A. meeboldii* W.W. Smith
4. *Arisaema wightii* Schott
5. *Arundinella purpurea* Hochst. ex Steud.
6. *A. vaginata* Bor
7. *Brachycorythis iantha* (Wt.) Summerh.
8. *B. splendida* Summerh.
9. *Campanula alphonsii* Wall.
10. *Centratherum rangacharii* Gamble
11. *Chlorophytum attenuatum* Baker
12. *Crotalaria fysonii* Dunn
13. *Eriocaulon brownianum* Mart. var. *nilagirensis* (Steud.) Fyson
14. *Exacum anamallayanum* Bedd.

15. *Fimbristylis kingii* C.B. Clarke
16. *Habenaria heyneana* Lindl.
17. *H. perrottetiana* A. Rich.
18. *Hedyotis articularis* R. Br. ex G. Don
19. *H. buxifolia* Bedd.
20. *H. swertioides* Hook. f.
21. *Impatiens modesta* Wt.
22. *I. omissa* Hook. f.
23. *I. pandata* E. Barnes
24. *I. tomentosa* Heyne ex Wt.
25. *Indigofera pedicellata* Wt. & Arn.
26. *Indochloa oligantha* (Hochst.) Bor
27. *Isachne bourneorum* C.E.C. Fischer
28. *I. fischeri* Bor
29. *Kalanchoe grandiflora* Wt. & Arn.
30. *Lucas ternifolia* Desf.
31. *L. vestita* Benth. var. *devicolamensis* Shetty & Vivek.
32. *Lysimachia deltoidea* Wt.
33. *Neanotis indica* (DC.) W.H. Lewis var. *affinis* (Hook. f.) W. H. Lewis
34. *Osbeckia leschenaultiana* DC.
35. *Phlebophyllum kunthianum* Nees
36. *Pimpinella candolleana* Wt. & Arn.
37. *Polygala sibirica* Linn. var. *heyneana* (Wall.) Benn.
38. *Ranunculus reniformis* Wall. ex Wt. & Arn.
39. *Senecio lavandulaefolius* DC.
40. *S. neelgherryanus* DC.
41. *Swertia corymbosa* Wt.
42. *Tripogon bromoides* Roem. & Schult.
43. *Utricularia uliginosa* Vahl
44. *Valeriana beddomei* C. B. Clarke
45. *Vernonia peninsularis* C.B. Clarke
5. *Calamintha umbrosa* Benth.
6. *Cheirostylis flabellata* (A. Rich.) Wt.
7. *Cnicus wallichii* Hook. f. var. *wightii* Hook. f.
8. *Curculigo orchioides* Gaertn.
9. *Dichrocephala chrysanthemifolia* (Bl.) DC.
10. *Drosera peltata* Sm.
11. *Eulalia phaeothrix* (Hack.) O. Kuntze
12. *Geranium nepalense* Sw.
13. *Helictotrichon asperum* (Munro) Bor
14. *Ischaemum indicum* (Houtt.) Merr.
15. *Justicia latispica* (C. B. Clarke) Gamble
16. *Knoxia sumatrensis* (Retz.) DC.
17. *Lactuca hastata* DC.
18. *Micromeria biflora* Benth.
19. *Parnassia mysorensis* Heyne ex Wt. & Arn.
20. *Parochetus communis* Hamilt.
21. *Rhynchospora rugosa* (Vahl) Gale
22. *Satyrium nepalense* D. Don
23. *Scirpus fluitans* Linn.
24. *Sopubia trifida* Ham.
25. *Spiranthes sinensis* (Pers.) Ames.
26. *Viola patrinii* Ging. ex DC.
27. *Wahlenbergia marginata* (Thunb.) A. DC.
28. *Xyris capensis* Thunb. var. *schoenoides* (Mart.) Nilsson

(b) Species generally restricted to the Western Ghats and Ceylon and mostly found at higher altitudes (No. 15 has also been reported from Shevaroy hills and No. 1 and 16 extend to Eastern Ghats also).

1. *Anaphalis subdecurrens* (DC.) Gamble
2. *Andropogon lividus* Thw.
3. *Bupleurum wightii* P. K. Mukh.
4. *Chrysopogon zeylanicus* (Nees) Thw.
5. *Crotalaria scabrella* Wt. & Arn.
6. *C. walkeri* Arn.
7. *Eriocaulon collinum* Hook. f.
8. *Gentiana quadrifaria* Bl. var. *zeylanica* Kusn.
9. *Hypericum mysorensis* Heyne ex Wt. & Arn.
10. *Lauremburgia hirsuta* Schindl.
11. *Lobelia leschenaultiana* (Presl.) Skottsb.
12. *L. zeylanica* Linn.
13. *Malaxis densiflora* (A. Rich.) O. Kuntze
14. *Osbeckia cupularis* D. Don ex Wt. & Arn.
15. *Pedicularis zeylanica* Benth.
16. *Pouzolzia bennettiana* Wt.
17. *Utricularia graminifolia* Vahl
18. *U. roseo-purpurea* Stapf ex Gamble

(c) Species distributed in the higher altitudes of the Western Ghats, Ceylon and Burma.

1. *Dichanthium polyptychum* (Steud.) A. Camus var. *polyptychum*
2. *Garnotia mutica* (Munro) Druce

(d) Cosmopolitan weed.

1. *Spilanthes paniculata* Wall. ex DC.

(e) Species with wide distribution and extending into Himalayas and often to other countries.

1. *Blumea hieraciifolia* (D. Don) DC.
2. *B. mollis* (D. Don) Merr.
3. *Bromus ramosus* Huds.
4. *Burmannia pusilla* (Wall. ex Miers.) Thw.

It may thus be seen that in contrast to the shola species which are predominantly of tropical stock quite a number of species on the shola fringes and in the grasslands are of temperate origin capable of tolerating the adverse condition prevailing in the open areas. It may also be pointed out that some of the species of the shola fringes often extend into the grasslands. Meher-Homji (1967) in his studies on the South Indian Hill Stations observed that the majority of the ligneous elements of the sholas are limited in their distribution to the tropical latitudes, while the ligneous elements of the shola fringes and the grasslands have their distribution range extending into the subtropical-temperate regions.

Hooker (1904), Fyson (1915) and Razi (1955 b) have observed a number of species common to the South Indian hill tops and the Himalayas, Khasias in particular. Gupta (1962 a) showed that the vegetation of the western Himalayas also shows similarity with the South Indian Hill stations like that reported earlier for eastern Himalayas. Fyson (*l.c.*) remarked that "we have on these mountain-tops relics of a vegetation which grew on the plains in the far distant past, when, as we have reason to believe from other evidence, the climate of the tropics was not so hot. The alternative explanation that seeds have been carried by birds across these long stretches, though possibly true to a certain extent, does not seem to afford complete explanation." Gupta (*l.c.*) pointed out that the hills of Bihar and Orissa played an important role in the migration of plants and served as channels of migration. Similar opinion had been expressed earlier by Anderson (1863), Clarke (1898), Haines (1925) and Razi (*l.c.*).

Different views put forward regarding the direction of migration of plants have been summarised by Razi (*l.c.*) and Gupta (*l.c.*). Blasco (*l.c.*) opines the floristic exchanges between the Himalayas and the Nilgiris to be recent or sub-contemporary brought about by the dispersal of seeds by wind, birds etc. and states that almost all plant species common to South India and Himalayas behave as vigorous pioneers, particularly apt to colonise the deforested lands of the montane domain.

Of the 182 taxa collected by the authors from above 1,975 m, 84 are confined to South India, 43 are confined to South India and Ceylon and the other 55 extend beyond these two areas. The last category includes species with wide distribution and extend into Himalayas and often to other countries of higher latitudes.

It is of interest to compare these figures with those reported for other South Indian hill tops, particularly the Nilgiris and the Palnis. Fyson (*l.c.*) has shown that "as much as 45 per cent, or nearly half, the truly wild and indigenous species of the flowering plants of these plateaus are confined to the mountains of South India and Ceylon. Another 17 per cent occur on the Khasi hills, 1,500 miles away, and about 12 per cent on the temperate parts of Himalayas. ... China and Japan appear to have 40 of our species". Blasco's (*l.c.*) analysis of the 380 species, also from the hill tops of Nilgiris and Palnis revealed that 275 species are localised in the hills of South India and Ceylon, 17 are also known in northern India, particularly in the Himalayas, whereas 36 extend to different countries of Asia.

All these studies go to prove that the temperate elements play a comparatively less important role in the composition of the vegetation of the high plateaus of South India and that the predominant elements are of tropical origin.

The abundance of endemic species on the southern Indian massifs has been pointed out by Razi (1955 a) and Blasco (*l.c.*). Blasco (*l.c.*) has shown that most of the 356 indigenous and spontaneous species found above an altitude of 1,700-1,900 m and which are not found at lower altitudes are endemic because "... 223 species are known only in the 'montane stage' of South India". He observed 82 species to be exclusively confined to the Nilgiris, 18 to the Palni hills and 13 to the Anaimalai hills and pointed out that "the Nilgiris appear as an important centre of speciation in South India, next only to Travan-

core and Tirunelveli". In this connection it is of interest to note that *Schefflera rostrata* and *Pavetta breviflora* var. *ciliolata* reported to be endemic to Nilgiris (Blasco, *l.c.*) have also been collected by the authors from Anaimudi.

Seven species are endemic to Anaimudi and its adjoining regions and they are: *Habenaria flabelliformis*, *Impatiens anaimudica*, *I. coelotropis*, *I. pandata*, *I. platyadena*, *Isachne fischeri* and *Sonerila nemakadensis*. In addition to this the following taxa appear to be endemic to the High Range: *Anaphalis barnesii*, *Arisaema attenuatum*, *A. peltatum*, *A. psittacus*, *Begonia aliciae*, *Didymocarpus macrostachya*, *Impatiens aliciae*, *I. chinensis* var. *brevicornis*, *I. johnii*, *I. macrocarpa*, *I. munnarensis*, *I. pallidiflora*, *I. rivulicola*, *I. verecunda*, *Ophiorrhiza barnesii*, *O. caudata* and *O. munnarensis*. The high incidence of endemic species of *Impatiens* in the High Range—numbering about 12 taxa—is accounted for by Barnes (1939) to the feeble method of dispersal found in this genus.

ECOLOGICAL STATUS OF SHOLA—GRASSLAND FORMATION

The existence at the higher altitudes of some South Indian hills like the Nilgiris, Palnis, Anaimalais and the High Range of two fundamentally different types of vegetation, *viz.* evergreen shola forest and grassland, in close juxtaposition and apparent equilibrium has been acclaimed to be one of the most interesting ecological problems of India. The ecological status of this shola-grassland formation has been a subject of controversy over the years and many contributions have been made, the Nilgiris in particular receiving most of the attention. Opinions do not differ much regarding the ecological status of the shola forest; it is considered to be a climatic climax by most of the workers. The controversy mainly centres round the ecological status of the grassland that surrounds the sholas. Ranganathan (1938) is of the opinion that not only the shola but also the grassland is the climax over at least the greater part of the territory which it occupies at present in the Nilgiris. The relative distribution of the two climaxes is primarily governed, according to him, by the natural factor, frost than by the biotic factors of grazing and burning. The frost damage is considered to be due to physiological drought effect, the young plants with superficial root system being incapable of absorbing water from the soil frozen during night to counterbalance

the losses due to transpiration with the rising day temperature. Within the frost zone, therefore, the sholas are said to thrive in areas protected from the morning sun, thereby reducing the transpiration losses and occupy sites where the danger of wilting as an effect of frost is neutralised by the abundance of moving soil water. But the occurrence of a dual climax does not fit in with the clementsian concept of climax and Ranganathan's theory has, therefore, been considered untenable by Bor (1938). He believes that the shola forest is the relict of an evergreen forest climax which has been pushed back to its last strong hold by fire and grazing. He considers the grassland to be a "biotic complex" rendered stable by firing and grazing. In many parts of the world, including the higher altitudes in tropics, according to him, experience has shown that forest destroyed is replaced by grass and that the grassland can be maintained indefinitely through the agency of fire. Champion (1936) had earlier expressed the same opinion, namely, that the grassland is nowhere the climax formation and the past clearings coupled with periodic firing of grassland have been responsible for the extension of grassland, resulting in the restriction of forests to damper sites. Champion and Seth (1964) reaffirm what has been stated by Champion (*l.c.*) and view the grassland as a stable degradation stage, though over restricted areas they feel possible edaphic or physiographic climax status might be given. This view of Champion (*l.c.*) and Bor (*l.c.*) that the grassland is the 'sub-climax' has been accepted by Raghavan Nair (1957), Shankaranarayan (1958), Legris (1960), Gupta (1960, 1962 b), Gupta and Shankaranarayan (1962), Chandrasekharan (1962) and Noble (1967).

Jayadev (1957), however, is of the opinion that over considerable areas in the Nilgiri plateau where grassland had reigned for centuries, its ecological status is that of a pre-climax, mainly conditioned by a set of natural factors like the extent of moisture, exposure and wind which do not admit the easy passage towards the final climax. Factors like grazing and burning, according to him, can only degrade the forest climax almost to an inferior scrub, in view of the rainfall of the locality, and not permanently stabilise such a formation of grassland over extensive areas. The final stage of the plant succession under more favourable conditions prevailing in the plateau, he points out, had been reached in the formation of sholas in the sheltered, cooler, and moisture sites in the folds of the rolling hills.

Theagarajan (unpub.) in his recent revision of the Working Plan of Nilgiris does not consider the shola as a post-climax, since it cannot re-establish itself if destroyed. According to him, in the past climatic conditions over the Nilgiri Plateau were such that it supported a tropical evergreen forest which occurred extensively, and due to change in the climatic conditions these forests became gradually restricted in their extent till they came to occupy only the favourable locations in which they are found today. The shola is, thus, a relict vegetation. He classifies the grasslands under the following categories, namely, (1) Climax grassland, (2) Pre-climax grassland and (3) Sub-climax grassland. He recognises 2 sub-types in the sub-climax type of grassland.

Meher-Homji (1965, 1967, 1969) while accepting the adverse effect of fire on the distribution of shola, nevertheless feels that the explanation that the fire is the only agent limiting the spread of shola is inadequate. The establishment of the forest species in the open areas is prevented, according to him, by the effect of frost in winter on the seedlings of forest species, the damage being in the nature of a physiological drought effect. He has shown that the species of the sholas are of tropical stocks and that their seedlings are unable to bear the low temperature and ground frost prevailing in the open areas outside the forest cover. The ligneous species on the shola fringes and in the open grassland landscape, according to him, are largely of sub-tropical or temperate stock and are thus able to tolerate the conditions prevailing in the open areas, as they are cold resistant.

Puri (1960) has stated that in India the monoclinal theory of Clements holds good. The adaphic and bio-edaphic communities are recognised by him to be seral in nature.

In view of the similarity between the *patanas* in the higher parts of Ceylon and the high altitude grasslands of peninsular India reference may be made to the publications of Pearson (1899), Gleason (1916), de Rosayro (1945-46, 47) and Holmes (1951). They are all of the opinion that the *patanas* are of anthropogenous origin. Stomps (1925), however, put forward the view that the Ceylon *patanas* are due to special climatic conditions.

van Steenis (1961) in his paper on Axiomas and criteria of vegetatology with special reference to tropics cites a number of examples, including the

patanas of Ceylon, to demonstrate that the grasslands are caused by anthropogenous action (fire) during a very long period in the past. He has also explained (van Steenis, 1968) how deforestation leads to potential occurrence of frost.

Anaimudi and the surrounding regions, as already stated, are subjected to biotic interference to a lesser degree compared to the Nilgiri and Palni hills. This region which is in the Eravikulam Game Sanctuary has been protected from poachers and pastoralists since 1895 by the High Range Game Preserve Association and, hence, the incidence of fire and grazing, although present, is much less compared to the other plateaux of southern India. Thurston (1909) has given some information on the early inhabitants of the High Range. According to him, Muduvars who originally came from Madura occupied the area probably during the 14th Century. He assumes that when they arrived on the hills, they found a small tribe in possession with whom they subsequently intermarried. The Muduvars practise shifting cultivation and the majority of their villages are situated at an elevation of 1,220 m, although a few occur up to 1,830 m. The areas adjoining Anaimudi are not suitable for habitation or cultivation because of the cold and wind. To what extent the Muduvars interfered with the vegetation at these higher altitude is difficult to assess now. It is also of significance to point out that aliens like *Sarothamnus scoparius* (*Cytissus scoparius*) and *Ulex europaeus* which are a familiar sight in the grasslands of Nilgiris and Palnis are conspicuous by their absence.

COLLECTION

Four collection tours were undertaken, namely, in November 1965, April 1966, August 1967 and February 1970 and a total of 317 taxa spread over 101 families were collected. About 15 species are yet to be identified and are under critical study. All the specimens have been deposited in the herbarium of the Sourthern Circle, Botanical Survey of India, Coimbatore (MH). In the detailed enumeration, the classification of Copeland (1947) is followed in the arrangement of families of ferns; for Angiosperms the system of Bentham and Hooker with certain delimitations of families according to Hutchinson (1960) is followed. The taxa are arranged alphabetically under each family. The field numbers given after each taxon are those of B. V. Shetty.

ENUMERATION

FERNS AND FERN ALLIES

LYCOPODIACEAE

Lycopodium clavatum Linn.

Umairamallay, Anaimudi slopes, 2,125 m, common in grassland near stream, with strobili, 18-11-1965, 26492.

SELAGINELLACEAE

Selaginella repanda (Desv.) Spring

Umairamallay, 1,975 m, common in evergreen forests,* with strobili, 22-11-1965, 26616.

OPHIOGLOSSACEAE

Botrychium lanuginosum Wall. ex Hook. & Grev.

B. virginianum (Linn.) Sw. var. *lanuginosum* Bedd.
Umairamallay, Anaimudi slopes, 2,100 m, common in clefts of rocks in grassland, with sporangial pinnae, 20-11-1965, 26577.

OSMUNDACEAE

Osmunda regalis Linn.

Umairamallay, Anaimudi slopes, 2,000 m, common in clefts of rocks in grassland near stream, with sporangial pinnae, 27-4-1966, 27401.

PTERIDACEAE

Lindsaya cultrata (Willd.) Swartz

Umairamallay, Anaimudi slopes, 2,150 m, common in grassland in moist places, with sori, 3-2-1970, 33406.

Pteridium aquilinum (Linn.) Kuhn ex Decken

Pteris aquilina Linn.
Lower Vagavurrai, 1,700 m, abundant in cleared areas, with sori, 26-4-1966, 27392; also common in Umairamallay grassland upto 2,100 m.

Sphenomeris chinensis (Linn.) Maxon ex Maxon

Stenoloma chinensis (Linn.) Bedd.
Lower Vagavurrai, 1,700 m, common, with sori, 26-4-1966, 27396.

CYATHEACEAE

Cyathea crinita (Hook.) Copel.

Alsophila crinita Hook.
Rajamallay, 2,025 m, rare, with sori, 21-4-1966, 27353.

C. spinulosa Wall. ex Hook.

Umairamallay, Anaimudi slopes, 2,125 m, in sholas near stream, not common, with sori, 19-11-1965, 26521.

*The evergreen forests referred to here and elsewhere in the enumeration list are of the type Southern Subtropical Hill Forest (Champion and Seth, 1964).

ASPIDIACEAE

Arachnioides conifolia (Moore) Ching*Lastrea conifolia* Moore

Lower Vagavurrai, 1,700 m, not common, with sori, 26-4-1966, 27400.

Dryopteris atrata (Wall.) Ching*Lastrea hirtipes* Bedd.

Umaiyamallay, 1,975 m, common in evergreen forests, with sori, 22-11-1965, 26619.

Polystichum auriculatum (Linn.) Pr.

Upper Vagavurrai, 1,975 m, common in evergreen forests, with sori, 4-2-1970, 33417.

P. biaristatum (Bl.) Moore*P. aculeatum* Sw. var. *biaristatum* Bl.

Umaiyamallay, Anaimudi slopes, 2,100 m, common near stream in sholas, with sori, 20-11-1965, 26579.

ASPLENIACEAE

Asplenium aethiopicum (Burm.) Beck.*A. furcatum* Thunb.

Umaiyamallay, Anaimudi slopes, 2,100 m, common in clefts of rocks in sholas, with sori, 20-11-1965, 26575.

A. laciniatum D. Don

Umaiyamallay, Anaimudi slopes, 2,100 m, common in clefts of rocks in sholas, with sori, 20-11-1965, 26576.

A. unilaterale Lamk.

Rajamallay, 2,075 m, common in clefts of rocks, with sori, 21-11-1965, 26600.

POLYPODIACEAE

Lepisorus nudus (Hook.) Ching*Pleopeltis linearis* Bedd. (*pro parte*)

Umaiyamallay, 1,975 m, epiphyte, not common, with sori, 22-11-1965, 26613.

Paraleptochilus decurrens (Bl.) Copel.*Gymnopteris variabilis* Hook.

Rajamallay, 2,075 m, common in clefts of rocks, with sori, 21-11-1965, 26601.

Phymatodes hastata (Thunb.) Ching*Pleopeltis hastata* (Thunb.) Moore

Umaiyamallay, Anaimudi slopes, 2,150 m, epiphyte or lithophyte, common, with sori, 23-11-1965, 26634.

Pyrrosia mollis (Kze.) Ching*Niphobolus fissus* Bl.

Lower Vagavurrai, 1,700 m, epiphyte, common, with sori, 26-4-1966, 27391.

DICOTYLEDONS

RANUNCULACEAE

Clematis munroana Wt.

Umaiyamallay, 1,975 m, in evergreen forests, rare, flowering, 9-8-1967, 28343.

Ranunculus reniformis Wall. ex Wt. & Arn.

Anaimudi slopes, 2,575 m, in grassland, not common, flowering, 19-9-1965, 26527.

MAGNOLIACEAE

Michelia nilagirica Zenk.

Umaiyamallay, Anaimudi slopes, 2,200 m, in sholas, not common, flowering, 23-11-1965, 26641; Umaiyamallay, Anaimudi slopes, 2,125 m, in sholas, not common, fruiting, 19-4-1966, 27339.

MENISPERMACEAE

Stephania japonica (Thunb.) Miers

Upper Vagavurrai, 1,825 m, common, flowering and fruiting, 25-4-1966, 27383.

BERBERIDACEAE

Berberis tinctoria Lesch.

Anaimudi slopes, 2,425 m, on the fringes of sholas, not common, flowering, 22-4-1966, 27356.

Mahonia leschenaultii (Wall.) Takeda

Rajamallay, 2,025 m, common on the fringes of sholas and intruding into grassland, flowering and fruiting, 21-11-1965, 26604.

CRUCIFERAE

Cardamine trichocarpa Hochst. ex A. Rich.

Upper Vagavurrai, 1,930 m, common weed in tea estates, flowering and fruiting, 10-8-1967, 28364.

VIOLACEAE

Viola patrinii Ging. ex DC.

Rajamallay, 2,100 m, in grassland, not common, flowering, 6-2-1970, 33430.

V. serpens Wall.

Rajamallay, 2,025 m, common in sholas, flowering, 21-4-1966, 27348; Upper Vagavurrai, 2,050 m, common, flowering, 7-2-1970, 33440.

PITTIOSPORACEAE

Pittosporum tetraspermum Wt. & Arn.

Umaiyamallay, Anaimudi slopes, 2,075 m, common in sholas, flowering and fruiting, 17-11-1965, 26472; Umaiyamallay, 2,025 m, common in sholas, fruiting, 10-8-1967, 28362; Rajamallay, 1,950 m, common in sholas, flowering, 2-2-1970, 31782.

POLYGALACEAE

Polygala arillata Buch.-Ham. forma **chartacea** Mukerjee

Upper Vagavurrai, 1,930 m, common, flowering and fruiting, 16-11-1965, 26447.

Polygala sibirica Linn. var. **heyneana** (Wall.) Benn.

Umiamallay, Anaimudi slopes, 2,625 m, common in grassland, flowering, 18-11-1965, 26517.

HYPERICACEAE

Hypericum mysorens Heyne ex Wt. & Arn.

Rajamallay, 2,000 m, common in grassland, flowering, 19-11-1965, 26555.

GUTTIFERAE

Garcinia cambogia Desr. var. **papilla** (Wt.) T. And.

Umiamallay, 2,000 m, common, flowering, 18-4-1966, 27318; Rajamallay, 1,950 m, common, fruiting, 2-2-1970, 31795.

TERNSTROEMACEAE

Eurya nitida Korth.

E. japonica non Thunb.

Rajamallay, 2,000 m, common on the fringes of sholas and in evergreen forests, flowering and fruiting, 21-11-1965, 26580.

Ternstroemia japonica Linn.

Umiamallay, Anaimudi slopes, 2,100 m, common on the fringes of sholas, fruiting, 20-11-1965, 26569; Umiamallay, 2,000 m, common on the fringes of sholas, flowering and fruiting, 27-4-1966, 27402.

MALVACEAE

Abelmoschus angulosus Wall. ex Wt. & Arn.

Hibiscus setinervis Dunn

Umiamallay, Anaimudi slopes, 2,150 m, in sholas, not common, flowering, 23-11-1965, 26631.

ELAEOCARPACEAE

Elaeocarpus oblongus Gaertn.

Lower Vagavurrai, 1,800 m, in evergreen forests, rare, flowering, 25-4-1966, 27364.

E. recurvatus Corner

E. ferrugineus (Wt.) Steud.

Umiamallay, Anaimudi slopes, 2,075 m, common in sholas, flowering and fruiting, 17-11-1965, 26481; Umiamallay, 2,025 m, common in sholas, flowering and fruiting, 17-4-1966, 27315.

GERANIACEAE

Geranium nepalense Sweet

Umiamallay, Anaimudi slopes, 2,200 m, in grassland, not common, flowering and fruiting, 23-11-1965, 26639.

OXALIDACEAE

Oxalis corniculata Linn.

Upper Vagavurrai, 1,975 m, weed in tea estates, abundant, flowering and fruiting, 11-8-1967, 28374.

BALSAMINACEAE

Impatiens coelotropis C.E.C. Fischer

Umiamallay, Anaimudi slopes, 2,100 m, common in sholas, flowering, 20-11-1965, 26574; Upper Vagavurrai, 1,800 m, in evergreen forests, not common, flowering, 8-8-1967, 28338.

I. cordata Wt.

Umiamallay, 1,975 m, in evergreen forests, not common, flowering, 22-11-1965, 26617.

I. cuspidata Wt. & Arn.

Upper Vagavurrai, 1,930 m, common, flowering and fruiting, 16-11-1965, 26450; Lower Vagavurrai, 1,700 m, common, flowering, 26-4-1966, 27395.

I. fruticosa DC.

Upper Vagavurrai, 1,825 m, common, flowering, 25-4-1966, 27377.

I. jerdoniae Wt.

Umiamallay, 1,975 m, epiphyte, abundant, flowering, 22-11-1965, 26625.

I. leschenaultii (DC.) Wall.

Hill adjoining Anaimudi, 2,300 m, common, flowering and fruiting, 19-11-1965, 26549; Upper Vagavurrai, 2,075 m, abundant in cleared areas near tea estates, flowering, 7-2-1970, 33434.

I. modesta Wt.

Umiamallay, Anaimudi slopes, 2,025 m, common on wet rocks in grassland and growing in moss cushions or humus soil, flowering, 6-8-1967, 28324.

I. omissa Hook. f.

Anaimudi, 2,695 m, in moss cushions in clefts of rocks in grassland, not common, flowering and fruiting, 19-11-1965, 26530.

I. pandata Barnes

Umiamallay, Anaimudi slopes, 2,025 m, in grassland on wet rocks in cushions of moss, not common, flowering, 6-8-1967, 28319.

I. phoenicea Bedd.

Umiamallay, Anaimudi slopes, 2,150 m, in sholas, not common, flowering, 23-11-1965, 26632.

I. tangachee Bedd.

Umiamallay, Anaimudi slopes, 2,075 m, common in clefts of rocks in stream, flowering, 17-11-1965, 26483; Rajamallay, 1,950 m, common in clefts of rocks in stream, flowering and fruiting, 2-2-1970, 31789.

I. tomentosa Heyne ex Wt.

Upper Vagavurrai, 1,930 m, common near stream, flowering and fruiting, 16-11-1965, 26439; peak adjoining Anaimudi, 2,300 m, common, flowering and fruiting, 19-11-1965, 26552.

RUTACEAE

Evodia lunu-ankenda (Gaertn.) Merr.

Petimudi, 1,675 m, not common, fruiting, 8-2-1970, 33445.

Toddalia asiatica (Linn.) Lamk. var. **floribunda** Gamble

Upper Vagavurrai, 1,825 m, common, fruiting, 25-4-1966, 27373; Lower Vagavurrai, 1,700 m, common, fruiting, 5-2-1970, 33418.

MELIACEAE

***Aglaiia roxburghiana** (Wt. & Arn.) Miq. var. **courtallensis** Gamble

Umaiyamallay, 2,025 m, in evergreen forests, not common, flowering and fruiting, 18-4-1966, 27320; Umaiyamallay, 2,025 m, common in evergreen forests, flowering, 7-2-1970, 33432.

ICACINACEAE

Gomphandra coriacea Wt.

Upper Vagavurrai, 1,930 m, rare, flowering and fruiting, 16-11-1965, 26455; Umaiyamallay, 2,025 m, common in evergreen forests, flowering and fruiting, 18-4-1966, 27321; Lower Vagavurrai, 1,700 m, common, flowering, 26-4-1966, 27388.

Nothapodytes foetida (Wt.) Sleum.

Petimudi, 1,675 m, common, fruiting, 8-2-1970, 33442.

AQUIFOLIACEAE

Ilex denticulata Wall. ex Wt.

Umaiyamallay, Anaimudi slopes, 2,150 m, common in sholas, flowering, 19-4-1966, 27336; Umaiyamallay, 2,025 m, common in sholas, fruiting, 10-8-1967, 28359.

I. wightiana Wall. ex Wt.

Umaiyamallay, Anaimudi slopes, 1,975 m, common near stream in sholas, flowering and fruiting, 17-4-1966, 27303.

CELASTRACEAE

Euonymus crenulatus Wall. ex Wt. & Arn.

Umaiyamallay, Anaimudi slopes, 2,075 m, common in sholas, flowering and fruiting, 17-11-1965, 26474.

Microtropis ramiflora Wt.

Umaiyamallay, Anaimudi slopes, 2,100 m, common in sholas, with buds, 20-11-1965, 26578.

VITACEAE

Tetragium muricatum (Wall. ex Wt. & Arn.) Gamble

Umaiyamallay, 1,975 m, common, flowering, 22-11-1965, 26623; Upper Vagavurrai, 1,800 m, common, fruiting, 8-8-1967, 28334.

STAPHYLEACEAE

Turpinia cochinchinensis (Lour.) Merr.

T. nepalensis Wall. ex Wt. & Arn.

Rajamallay, 2,075 m, common on fringes of sholas, flowering and fruiting, 21-11-1965, 26595; Umaiyamallay, Anaimudi slopes, 2,175 m, common on fringes of sholas, 19-4-1966, 27328.

SAPINDACEAE

Dodonaea viscosa (Linn.) Jacq.

Upper Vagavurrai, 2,050 m, not common, fruiting, 7-2-1970, 33438.

SABIACEAE

Meliosma simplicifolia (Roxb.) Walp. ssp. **pungens** (Walp.) Beus.

M. wightii Planch. ex Brand.

Rajamallay, 2,025 m, in sholas, not common, flowering, 21-4-1966, 27352.

PAPILIONACEAE

Crotalaria fysonii Dunn

Rajamallay, 2,050 m, common in grassland, flowering and fruiting, 21-11-1965, 26586.

C. obtecta Grah. var. **glabrescens** Baker

Upper Vagavurrai, 1,930 m, common near stream, flowering and fruiting, 16-11-1965, 26435; Rajamallay, 2,075 m, common, flowering, 21-11-1965, 26591.

C. scabrella Wt. & Arn.

Umaiyamallay, Anaimudi slopes, 2,125 m, in grassland, not common, flowering and fruiting, 18-11-1965, 26498.

C. walkeri Arn.

Upper Vagavurrai, 1,930 m, common, flowering, 16-11-1965, 26444; hill adjoining Anaimudi, 2,300 m, common in grassland, flowering, 19-11-1965, 26551.

Derris brevipes Baker (*s.l.*)

Umaiyamallay, Anaimudi slopes, 2,025 m, common, flowering and fruiting, 17-4-1966, 27312; Umaiyamallay, 2,125 m, common, fruiting, 6-8-1967, 28326.

Desmodium rufescens DC.

Umaiyamallay, Anaimudi slopes, 2,025 m, common, flowering, 17-4-1966, 27308; Rajamallay, 1,950 m, common on the fringes of sholas and intruding into grassland, flowering and fruiting, 2-2-1970, 31779.

Dumasia villosa DC.

Rajamallay, 2,075 m, common in sholas, flowering, 21-11-1965, 26588.

*The correct name for *Aglaiia roxburghiana* (Wt. & Arn.) Miq. is *Aglaiia elaeagnoides* (Juss.) Benth. It is, however, not known whether the combination for the var. *courtallensis* under the latter name has been made.

ADDITIONS TO THE FLORA OF RAJPIPLA FOREST DIVISION, GUJARAT

G. L. SHAH, A. I. PATEL AND V. K. SINGH

Department of Botany, Sardar Patel University, Vallabh Vidyanagar, Gujarat

ABSTRACT

In this paper 202 more angiosperms are listed of which 118 are dicotyledons and 83 are monocotyledons, based on collections made between 1965 and 1971 from different areas of the Rajpipla forest division. Such additions are due to (1) intensive exploration in all seasons and (2) two distinct types of vegetations (a) the dry deciduous type in hilly regions and (b) the scrub forest type in the undulating plains.

INTRODUCTION

Cooke (1901-1908) has listed about 425 species occurring in Gujarat and most frequent localities cited for their distribution are Kathiawar, Rajkot, Veraval, Porbander etc. all now in Saurashtra, whereas casual ones are Ahmedabad, Panchmahals, Dakor, Godhra, Baroda, Broach collectorate, Surat, Dangs etc. It is, therefore, evident that Rajpipla locality is not cited even once in his flora indicating that Rajpipla Forest Ranges had not been touched at all by the botanists in the time of Cooke. It remained so even upto 1965 when one of us (Shah, 1967) gave a preliminary account of the flora of Rajpipla forests division based on plants collected from Dediapada, Kokam, Dumkhal and Ghantoli. Another paper was published on the flora of that forest division by Shah and Singh (1970) based on intensive study of the places mentioned above and Sagbara, Sajpur, Kakadpada, Selamba, Gora, Kevadia and Garudeshwar. Ahuja and Patasakar (1970) also published four species from this forest division. The total number of species listed for the forest division till that time was 572.

The authors have been studying the flora of Rajpipla forest division since 1965 in vicinity of the following areas (1) *Dediapada and Sagbara forest ranges*: Dediapada, Mosda, Kakadpada, Sagbara, Sajpur, Selamba; (2) *Gora forest range*: Dumkhal, Piplod, Kokam, Surpeneshwar, Kevadia, Kothi, Dhavdi, Garudeshwar, Indravarna, Piparia, Gora and Thevadia; (3) *Netrang range*: Jaghadia, Gumandev, Avidhya, Rajpardi, Netrang; (4) *Rajpipla range*: Rajpipla, Juna Raj, Poicha, Bhadam. Bhatt *et al.* (1971) published a list of plants from Gora range. Of the 460 species listed by them 393 are dicotyledons, 64 monocotyledons and 3 pteridophytes, based on botanical excursions in 1962-1964 and 1968 in vicinity of Gora, Dhirkhadi, Zarvani, Chopdi, Sulpan,

Mokhadi, Piplod, Samot, Singlagabha, Dumkhal and Kokam. The families Alismaceae, Araceae, Balanitaceae, Cruciferae, Flacourtiaceae, Hypoxidaceae, Potamogetonaceae and Najadaceae are not represented in their list. Thus though a fairly large number of plants are now known for the Rajpipla Forest Division, there are several plants in our collections (Singh 1970; Patel 1971) which have yet to be added to these lists to make the flora of this forest division complete as far as possible. With this end in view, the present paper is prepared. The additions are obvious on two counts: (1) The unexplored areas and those cursorily explored areas have been intensively studied in all seasons. (2) There is a diversity in vegetational aspects varying from *Acacia* scrub forests in plains to dry deciduous forests in hilly regions.

GEOGRAPHY AND TOPOGRAPHY

Rajpipla district is situated 21°23' and 21°59' N and 73°5' and 74°0' E on the south-east border of the Gujarat State, with Rajpipla as a taluka capital. The areas explored by us fall within this range.

Rajpipla is the terminus of Rajpipla-Ankleshwar narrow gauge railway line, the latter in turn being a junction on Bombay-Ahmedabad main line about 352 km north of Bombay. Gumandev, Jaghadia, Avidhya, Rajpardi are small railway stations on this narrow gauge line. Regular State Transport buses ply between Ankleshwar and Rajpipla touching these stations. Similarly State Transport buses ply between Netrang and Jaghadia, which are also connected by a narrow gauge railway line. Garudeshwar, Kevadia, Gora, Poicha and Vavadi are also connected with Rajpipla by State Transport buses in all seasons. Kothi, Piparia, Dhavdi etc. are small villages near Kevadia whereas Thevadia is about 8 km from Gora, all only to be explored on foot or by private

Sonerila sp.

Hill adjoining Anaimudi, 2,300 m, in clefts of rocks, rare, flowering and fruiting, 19-11-1965, 26548.

ONAGRACEAE

Circaea alpina Linn.

Rajamallay, 2,000 m, common in sholas, flowering and fruiting, 21-11-1965, 26584.

CUCURBITACEAE

Zehneria scabra (Linn. f.) Sond

Melothria perpusilla (Bl.) Cogn.

Upper Vagavurrai, 1,930 m, common, flowering, 18-11-1965, 26514; Upper Vagavurrai, 1,800 m, common, flowering, 8-8-1967, 28335.

BEGONIACEAE

Begonia malabarica Lamk.

Upper Vagavurrai, 1,825 m, common, flowering, 25-4-1966, 27374.

UMBELLIFERAE

Bupleurum wightii P. K. Mukh.

B. mucronatum Wt. & Arn.

Umaiymallay, Anaimudi slopes, in grassland, not common, flowering and fruiting, 17-11-1965, 26465.

Centella asiatica (Linn.) Urban.

Upper Vagavurrai, 1,975 m, common, flowering and fruiting, 11-8-1967, 28373.

Heracleum pedatum Wt.

Upper Vagavurrai, 1,930 m, common, flowering, 16-11-1965, 26454; Umaiymallay, 1,925 m, common in evergreen forests, flowering, 9-8-1967, 28349.

H. sprengelianum Wt. & Arn.

Upper Vagavurrai, 1,930 m, common, flowering and fruiting, 16-11-1965, 26445.

Pimpinella candolleana Wt. & Arn.

Umaiymallay, Anaimudi slopes, 2,025 m, common in grassland, flowering and fruiting, 17-11-1965, 26466.

ARALIACEAE

Polyscias acuminata (Wt.) Seem.

Upper Vagavurrai, 1,825 m, not common, flowering and fruiting, 25-4-1966, 27384.

Schefflera racemosa (Wt.) Harms

Rajamallay, 2,075 m, in sholas, not common, fruiting, 21-11-1965, 26597; Umaiymallay, Anaimudi slopes, 2,025 m, common in sholas, flowering, 10-8-1967, 28358.

S. rostrata (Wt.) Harms

Umaiymallay, Anaimudi slopes, 2,075 m, common in sholas, flowering, 17-11-1965, 26479.

CORNACEAE

Mastixia arborea (Wt.) C. B. Clarke

Lower Vagavurrai, 1,800 m, in evergreen forests, rare, fruiting, 25-4-1966, 27365; Upper Vagavurrai, 1,825 m, rare, flowering, 25-4-1966, 27372.

CAPRIFOLIACEAE

Viburnum coriaceum Bl.

Upper Vagavurrai, 1,975 m, not common, flowering and fruiting, 11-8-1967, 28370.

RUBIACEAE

Galium mollugo Linn. subsp. **asperifolium** (Wall.)

Kitamura

G. asperifolium Wall.

Upper Vagavurrai, 1,930 m, common, flowering, 16-11-1965, 26453.

Hedyotis articularis R. Br. ex G. Don

Oldenlandia articularis (R. Br.) Gamble

Umaiymallay, Anaimudi slopes, 2,125 m, in grassland along the margins of stream, not common, flowering and fruiting, 6-8-1967, 28329.

H. buxifolia Bedd.

Oldenlandia buxifolia (Bedd.) O. Kuntze

Anaimudi slopes, 2,425 m, in grassland, not common, flowering, 22-4-1966, 27357; Rajamallay, 2,025 m, common in grassland, flowering, 21-4-1966, 27347.

H. eualata (Gamble) Henry & Subr.

Oldenlandia eualata Gamble

Rajamallay, 2,000 m, common on the fringes of sholas, flowering and fruiting, 21-11-1965, 26582; Rajamallay, 1,950 m, common on the fringes of sholas, flowering, 2-2-1970, 31783.

H. santapau Shetty & Vivek.

Umaiymallay, Anaimudi slopes, 2,075 m, common, flowering and fruiting, 17-11-1965, 26471.

H. stylosa R. Br.

Oldenlandia stylosa O. Kuntze

Umaiymallay, Anaimudi slopes, 2,025 m, common on the fringes of sholas, flowering and fruiting, 17-4-1966, 27311; Umaiymallay, 2,025 m, abundant on the fringes of sholas, flowering, 6-8-1967, 28322.

H. swertioides Hook. f.

Oldenlandia swertioides O. Kuntze

Umaiymallay, Anaimudi slopes, 2,475 m, common in grassland, flowering and fruiting, 18-11-1965, 26505.

Ixora notoniana Wall.

Lower Vagavurrai, 1,800 m, rare, flowering, 25-4-1966, 27366.

Knoxia sumatrensis (Retz.) DC.

K. corymbosa Willd.

Umaiymallay, Anaimudi slopes, 2,125 m, in grass-

land, not common, flowering and fruiting, 18-11-1965, 26496.

Lasianthus acuminatus Wt.

Upper Vagavurrai, 1,930 m, rare, flowering and fruiting, 16-11-1965, 26451.

Mussaenda hirsutissima (Hook. f.) Hutch. ex Gamble
Lower Vagavurrai, 1,700 m, common, flowering, 26-4-1966, 27393.

Neanotis indica (DC.) W. H. Lewis var. **affinis** (Hook. f.) W. H. Lewis

Anotis leschenaultiana (Wall. ex Wt. & Arn.)
Hook. f. var. **affinis** Hook. f.

Umaiyamallay, Anaimudi slopes, 2,325 m, common in grassland, flowering, 18-11-1965, 26504.

N. monosperma (Wall. ex Wt. & Arn.) W. H. Lewis
Anotis monosperma (Wall. ex Wt. & Arn.) Hook. f.

Umaiyamallay, Anaimudi slopes, 2,150 m, common on the fringes of sholas, flowering and fruiting, 23-11-1965, 26636; Umaiyamallay, 1,625 m, common in evergreen forests, flowering, 9-8-1967, 28345.

Ophiorrhiza sp.

Umaiyamallay, Anaimudi slopes, 1,975 m, common in evergreen forests, fruiting, 22-11-1965, 26620; Umaiyamallay, 1,975 m, common in evergreen forests, flowering, 9-8-1967, 28342.

Pavetta breviflora DC. var. **ciliolata** Gamble ex Brem.

Lower Vagavurrai, 1,700 m, not common, flowering, 26-4-1966, 27390.

Plectronia rheedii Bedd.

Lower Vagavurrai, 1,700 m, common, flowering and fruiting, 25-4-1966, 27367; Upper Vagavurrai, 1,775 m, common, fruiting, 8-8-1967, 28333.

Psychotria congesta Hook. f.

Rajamallay, 2,075 m, common near stream in sholas, flowering and fruiting, 21-11-1965, 26599.

Rubia cordifolia Linn.

Umaiyamallay, Anaimudi slopes, 2,125 m, common in sholas, flowering, 19-11-1965, 26522; Umaiyamallay, 2,150 m, common in sholas, flowering and fruiting, 19-4-1966, 27337.

VALERIANACEAE

Valeriana arnottiana Wt.

Anaimudi slopes, 2,250 m, on the fringes of sholas, not common, flowering, 19-11-1965, 26525.

V. beddomei C. B. Clarke

Anaimudi slopes, 2,425 m, in grassland, not common, flowering, 22-4-1966, 27354.

COMPOSITAE

Adenostemma reticulatum DC.

Umaiyamallay, Anaimudi slopes, 2,200 m, common, flowering and fruiting, 23-11-1965, 26640.

Anaphalis bournei Fyson

Anaimudi slopes, 2,475 m, abundant in clefts of rocks in grassland, flowering, 19-11-1965, 26526.

A. marcescens (Wt.) C. B. Clarke

Umaiyamallay, Anaimudi slopes, 2,125 m, common on the fringes of sholas, flowering, 18-11-1965, 26501.

A. meeboldii W. W. Smith

Umaiyamallay, Anaimudi slopes, 2,075 m, common in clefts of rocks in grassland, flowering, 17-11-1965, 26473; Anaimudi slopes, 2,350 m, common in grassland, flowering, 4-2-1970, 33411.

A. subdecurrens (DC.) Gamble

Umaiyamallay, Anaimudi slopes, 2,125 m, common in grassland, flowering, 18-11-1965, 26491.

A. travancorica W. W. Smith

Umaiyamallay, Anaimudi slopes, 2,525 m, common on the fringes of sholas, 18-11-1965, 26509.

Artemisia nilagirica (C. B. Clarke) Pamp.

A. vulgaris auct. non Linn.

Upper Vagavurrai, 1,975 m, common, flowering, 22-11-1965, 26608.

Blumea hieraciifolia (D. Don) DC.

Rajamallay, 2,025 m, common in grassland, flowering, 21-4-1966, 27346.

B. mollis (D. Don) Merr.

B. neilgherrensis Hook. f.

Rajamallay, 2,075 m, in grassland, not common, flowering, 21-11-1965, 26587.

Centratherum rangacharii Gamble

Umaiyamallay, Anaimudi slopes, 2,125 m, abundant in grassland, flowering, 18-11-1965, 26497; Upper Vagavurrai, 1,975 m, common, flowering, 11-8-1867, 28371.

***Cnicus wallichii** Hook. f. var. **wightii** Hook. f.

Umaiyamallay, Anaimudi slopes, 2,250 m, in grassland, not common, flowering, 18-11-1965, 26518.

Crassocephalum crepidioides (Benth.) S. Moore

Upper Vagavurrai, 1,975 m, common weed in tea estates, flowering and fruiting, 26607.

Dichrocephala chrysanthemifolia (Bl.) DC.

Umaiyamallay, Anaimudi slopes, 2,150 m, common in grasslands, flowering, 23-11-1965, 26638.

D. integrifolia (Linn. f.) O. Kuntze

D. latifolia DC.

Upper Vagavurrai, 1,930 m, common weed in tea estates, flowering, 10-8-1967, 28365.

*The correct name for *Cnicus wallichii* Hook. f. is *Cirsium wallichii* DC. It is, however, not known whether the combination for the var. *wightii* under the latter name has been made.

Emilia sp.

Umiamallay, Anaimudi slopes, 2,250 m, in grassland, not common, flowering, 18-11-1965, 26515.

Erigeron karvinskianus DC.

E. mucronatus DC.

Upper Vagavurrai, 1,930 m, weed in tea estates, abundant flowering, 10-8-1967, 28366.

Erigeron sp.

Upper Vagavurrai, 1,075 m, common weed in tea estates, flowering, 9-8-1967, 28554.

Eupatorium glandulosum H. B. K.

Umiamallay, Anaimudi slopes, 2,125 m, common, flowering, 18-11-1965, 26502.

Galinsoga parviflora Cav.

Upper Vagavurrai, 1,975 m, common weed in tea estates, flowering, 9-8-1967, 28353.

Helichrysum buddleioides DC.

Rajamallay, 2,100 m, common on the fringes of sholas, flowering, 6-2-1970, 33431.

H. hookerianum Wt. & Arn.

Umiamallay, Anaimudi slopes, 2,125 m, on the fringes of sholas, rare, flowering, 19-11-1969, 26523; Umiamallay, 2,150 m, on the fringes of sholas, rare, flowering, 3-2-1970, 33409.

Hypochoeris glabra Linn.

Umiamallay, 1,975 m, common, flowering and fruiting, 22-11-1965, 26629.

Lactuca hastata DC.

Umiamallay, Anaimudi slopes, 2,625 m, common in grassland, flowering, 18-11-1965, 26512.

Moonia heterophylla (C. B. Clarke) Arn.

Umiamallay, Anaimudi slopes, 2,125 m, common on the fringes of sholas, flowering, 18-11-1965, 26494.

Myriactis wightii DC.

Rajamallay, 2,075 m, common on the fringes of sholas, flowering, 21-11-1965, 26593.

Notonia walkeri (Wt.) C. B. Clarke

Umiamallay, Anaimudi slopes, 2,100 m, on the fringes of sholas, rare, with buds, 20-11-1965, 26571.

Picris hieracioides Linn.

Upper Vagavurrai, 1,975 m, common weed in tea estates, flowering, 9-8-1967, 28355.

Senecio lavandulaefolius DC.

Anaimudi slopes, 2,475 m, common in grassland, flowering, 18-11-1965, 26519; Rajamallay, 1,950 m, common in grassland, flowering and fruiting, 2-2-1970, 31790.

S. neelgherryanus DC.

Umiamallay, Anaimudi slopes, 2,325 m, common in grassland, flowering, 18-11-1965, 26503.

S. wightianus DC.

Lower Vagavurrai, 1,700 m, common, flowering, 26-4-1966, 27394.

Spilanthes paniculata Wall. ex DC.

S. acmella auct. non Murr.

Umiamallay, Anaimudi slopes, 2,150 m, common in grassland, flowering, 23-11-1965, 26635.

Vernonia anaimudica Shetty & Vivek.

Hill adjoining Anaimudi, 2,300 m, common, flowering and fruiting, 19-11-1965, 26550; Western slopes of Anaimudi, 2,300 m, common, flowering and fruiting, 19-11-1965, 26546; Rajamallay, 1,950 m, common, flowering and fruiting, 2-2-1970, 31786.

V. anamallica Bedd. ex Gamble

Rajamallay, 2,075 m, not common, flowering and fruiting, 21-11-1965, 26598; Petimudi, 1,675 m, not common, flowering and fruiting, 8-2-1970, 33450.

V. bourneana W. W. Smith

Rajamallay, 1,950 m, on the fringes of sholas, abundant, flowering and fruiting, 2-2-1970, 31781.

V. monosis (Wt.) C. B. Clarke

Lower Vagavurrai, 1,700 m, rare, flowering, 26-4-1966, 27387.

V. peninsularis C. B. Clarke

Hill adjoining Anaimudi, 2,300 m, in grassland, not common, flowering and fruiting, 19-11-1965, 26553.

Youngia japonica (Linn.) DC.

Crepis japonica (Linn.) Benth.

Umiamallay, 1,975 m, common, flowering, 9-8-1967, 28344.

CAMPANULACEAE

Campanula alphonisii Wall.

Anaimudi peak, 2,695 m, in grassland, not common, flowering, 19-11-1965, 26529; Anaimudi peak, 2,650 m, in grassland, not common, flowering, 4-2-1970, 33413.

Lobelia leschenaultiana (Presl.) Skottsb.

L. excelsa Lesch.

Rajamallay, 1,950 m, common in grassland, flowering, 2-2-1970, 31791.

L. zeylanica Linn.

Rajamallay, 1,950 m, common in grassland in moist places, flowering, 2-2-1970, 31793; Umiamallay, Anaimudi slopes, 2,150 m, common, flowering and fruiting, 19-4-1966, 27332.

Walhenbergia marginata (Thunb.) A. DC.

W. gracilis Schrad.

Umiamallay, Anaimudi slopes, 2,475 m, common in grassland, flowering, 18-11-1965, 26506.

VACCINIACEAE

Vaccinium leschenaultii Wt.

Umaiymallay, Anaimudi slopes, 2,250 m, common on the fringes of sholas, flowering, 19-11-1965, 26524; Umaiymallay, 2,025 m, common near stream, fruiting, 17-4-1966, 27306; Rajamallay, 2,000 m, common along the margins of stream, flowering and fruiting, 6-2-1970, 33424.

ERICACEAE

Gaultheria fragrantissima Wall.

Rajamallay, 2,075 m, common on the fringes of sholas and intruding into grassland, flowering, 21-11-1965, 26589.

Rhododendron nilagiricum Zenk.

Umaiymallay, Anaimudi slopes, 2,625 m, common on the fringes of sholas and sometimes intruding into grassland, flowering, 18-11-1965, 26511; Umaiymallay, 2,050 m, common on fringes of sholas and near stream, fruiting, 6-8-1967, 28321.

PRIMULACEAE

Lysimachia deltoidea Wt.

Anaimudi slopes, 2,425 m, in grassland in moist places, not common, flowering, 22-4-1966, 27359.

MYRSINACEAE

Ardisia rhomboidea Wt.

Umaiymallay, Anaimudi slopes, 2,100 m, in sholas, rare, with buds, 20-11-1965, 26572; Umaiymallay, 1,975 m, common in evergreen forests, flowering and fruiting, 20-4-1966, 27340.

Embelia ribes Burm. f.

Lower Vagavurrai, 1,700 m, common, flowering, 26-4-1966, 27386.

Maesa perrottetiana A. DC.

Upper Vagavurrai, 1,930 m, common, flowering, 16-11-1965, 26448; Rajamallay, 2,025 m, common, fruiting, 21-4-1966, 27351.

Rapanea capitellata (Wall.) Mez.

Umaiymallay, Anaimudi slopes, 2,150 m, common along the margins of stream, fruiting, 23-11-1965, 26633; Umaiymallay, 2,025 m, common along the margins of stream, flowering, 10-8-1967, 28351; Umaiymallay, 2,150 m, common along the margins of stream, flowering and fruiting, 3-2-1970, 33402.

SAPOTACEAE

Isonandra perrottetiana DC.

Umaiymallay, 2,000 m, in evergreen forests, rare, flowering and fruiting, 18-4-1966, 27319.

SYMPLOCACEAE

Symplocos anamallayana Bedd.

Western slopes of Anaimudi, 2,500 m, in sholas, rare, flowering, 23-4-1966, 27363.

S. laurina Wall. ex Rehd. & Wills.

Umaiymallay, Anaimudi slopes, 2,075 m, common on the fringes of sholas, flowering and fruiting, 17-11-1965, 26478; Rajamallay, 2,000 m, common on the fringes of sholas, fruiting, 21-11-1965, 26585; Umaiymallay, 2,025 m, common on the fringes of sholas, flowering, 17-4-1966, 27310.

S. pendula Wt.

Umaiymallay, Anaimudi slopes, 2,075 m, common in sholas, fruiting, 17-11-1965, 26475; Umaiymallay, 2,075 m, common in sholas, fruiting, 19-4-1966, 27326; Umaiymallay, 2,100 m, common in sholas, flowering, 10-8-1967, 28361.

S. rosea Bedd.

Umaiymallay, 1,975 m, in evergreen forests, rare, flowering and fruiting, 20-4-1966, 27342.

Symplocos sp.

Umaiymallay, Anaimudi slopes, in sholas, not common, fruiting, 20-11-1965, 26559; Umaiymallay, 2,025 m, in sholas, not common, flowering, 17-4-1966, 27316; Umaiymallay, 2,025 m, not common, flowering and fruiting, 10-8-1967, 28360.

Symplocos sp.

Lower Vagavurrai, 1,875 m, not common, flowering, 5-2-1970, 33423.

OLEACEAE

Jasminum bignoniaceum Wall. ex G. Don

Anaimudi slopes, 2,300 m, common on the fringes of sholas and intruding into grassland, fruiting, 19-11-1965, 26545; Umaiymallay, Anaimudi slopes, 2,025 m, common on the fringes of sholas, flowering and fruiting, 17-4-1966, 27309.

Ligustrum perrottetii A. DC.

Umaiymallay, Anaimudi slopes, 2,025 m, in sholas, not common, fruiting, 6-8-1967, 28316.

Linociera macrophylla Wall. ex G. Don

Umaiymallay, 2,025 m, in evergreen forests, rare, flowering and fruiting, 18-4-1966, 27322.

APOCYNACEAE

Rauvolfia densiflora (Wall.) Benth. ex Hook. f.

Upper Vagavurrai, 1,930 m, not common, flowering and fruiting, 16-11-1965, 26449; Lower Vagavurrai, 1,800 m, common, flowering, 25-4-1966, 27369.

ASCLEPIADACEAE

Ceropegia thwaitesii Hook.

Umaiymallay, 2,000 m, in evergreen forests, not common, flowering, 20-4-1966, 27345.

Gymnema hirsutum Wt. & Arn.

Lower Vagavurrai, 1,800 m, common, flowering, 25-4-1966, 27371.

Tylophora pauciflora Wt. & Arn.

Umaiyamallay, Anaimudi slopes, 2,100 m, common in sholas, fruiting, 20-11-1965, 26573; Umaiyamallay, Anaimudi slopes, 2,025 m, common in sholas, flowering, 17-4-1966, 27314.

T. subramanii Henry

Petimudi, 1,675 m, not common, flowering, 8-2-1970, 33446.

LOGANIACEAE

Gardneria ovata Wall.

Upper Vagavurrai, 1,930 m, rare, fruiting, 16-11-1965, 26458; Umaiyamallay, 1,975 m, common in evergreen forests, flowering, 20-4-1966, 27341; Upper Vagavurrai, 2,075 m, flowering, not common, 7-2-1970, 33437.

GENTIANACEAE

Exacum anamallayanum Bedd.

Umaiyamallay, Anaimudi slopes, 2,025 m, common in grassland, flowering, 17-4-1966, 27307.

E. wightianum Arn.

Upper Vagavurrai, 1,930 m, common, flowering, 16-11-1965, 26438.

Gentiana quadrifaria Bl. var. **zeylanica** Kusn.

Anaimudi peak, 2,695 m, in grassland, not common, flowering, 19-11-1965, 26531; Umaiyamallay, Anaimudi slopes, 2,200 m, common in grassland, flowering, 23-11-1965, 26643.

Swertia corymbosa Wt.

Umaiyamallay, Anaimudi slopes, 2,025 m, common in grassland, flowering, 17-11-1965, 26437.

BORAGINACEAE

Cynoglossum furcatum Wall.

Lower Vagavurrai, 2,025 m, not common, flowering, 20-11-1965, 26557.

CONVOLVULACEAE

Cuscuta reflexa Roxb.

Umaiyamallay, 1,975 m, common parasite on *Strobilanthes* sp. in evergreen forests, flowering and fruiting, 22-11-1965, 26618.

SOLANACEAE

Lycianthes bigeminata (Nees) Bitter

Solanum laeve non Dunal

Upper Vagavurrai, 1,930 m, common, flowering and fruiting, 16-11-1965, 26452.

Physalis peruviana Linn.

Upper Vagavurrai, 1,825 m, common, flowering and fruiting, 25-4-1966, 27376; Upper Vagavurrai, 2,075 m, common, flowering and fruiting, 7-2-1970, 33435.

Solanum giganteum Jacq.

Upper Vagavurrai, 1,825 m, common, flowering and fruiting, 25-4-1966, 27379; Upper Vagavurrai, 2,075 m, common, flowering and fruiting, 7-2-1970, 33436.

S. indicum Linn. var. **multiflora** C. B. Clarke

Upper Vagavurrai, 1,930 m, common, flowering and fruiting, 16-11-1965, 26461.

SCROPHULARIACEAE

Pedicularis zeylanica Benth.

Umaiyamallay, Anaimudi slopes, 2,625 m, common in grassland, 18-11-1965, 26510.

Sopubia trifida Ham.

Umaiyamallay, Anaimudi slopes, 2,475 m, common in grassland, flowering and fruiting, 18-11-1965, 26507; Anaimudi slopes, 2,600 m, in grassland, not common, flowering, 4-2-1970, 33414.

Torenia courtallensis Gamble

Upper Vagavurrai, 1,900 m, common, flowering, 11-8-1967, 28369.

OROBANCHACEAE

Campbellia cytinoides Wt.

Umaiyamallay, 1,975 m, common parasite on *Arundinaria* sp. and *Strobilanthes* sp. in evergreen forests, flowering, 22-11-1965, 26628.

LENTIBULARIACEAE

Utricularia graminifolia Vahl

Umaiyamallay, Anaimudi slopes, 2,200 m, in marshy places in grassland associated with *Eriocaulon* sp., rare, flowering, 23-11-1965, 26442.

U. roseo-purpurea Stapf ex Gamble

Umaiyamallay, Anaimudi slopes, 2,075 m, common on moist rocks growing along with moss, grass and *Eriocaulon* sp., flowering, 17-11-1965, 26486.

U. uliginosa Vahl

Rajamallay, 1,950 m, in grassland, not common, flowering, 2-2-1970, 31797.

GESNERIACEAE

Aeschynanthus perrottetii A. DC.

Umaiyamallay, 1,975 m, common epiphyte, flowering and fruiting, 22-11-1965, 26615.

ACANTHACEAE

Andrographis neesiana Wt.

Upper Vagavurrai, 1,930 m, abundant near stream, flowering and fruiting, 16-11-1965, 26436.

Phlebophyllum kunthianum Nees

Strobilanthes kunthianus (Nees) T. And. ex Benth.

Umaiyamallay, Anaimudi slopes, 2,250 m, common in grassland, stray plants were flowering, 18-11-1965, 26516; Umaiyamallay, Anaimudi slopes,

2,075 m, common in grassland, stray plants were flowering, 3-2-1970, 31798.

Justicia latispica (C. B. Clarke) Gamble

Umiamallay, Anaimudi slopes, 2,125 m, in grassland, not common, flowering, 18-11-1965, 26499; hill adjoining Anaimudi, 2,300 m, common in grassland, flowering, 19-11-1965, 26554.

Justicia sp.

Petimudi, 1,675 m, common, flowering, 8-2-1970, 33444.

Rungia laeta C. B. Clarke

Umiamallay, 2,000 m, in evergreen forests, not common, flowering, 20-4-1966, 27344; Umiamallay, 2,025 m, in evergreen forests, not common, flowering, 7-2-1970, 33433.

LABIATAE

Calamintha umbrosa Benth.

Umiamallay, Anaimudi slopes, 1,975 m, common in grassland, flowering, 22-11-1965, 26610.

Leucas angularis Benth.

Petimudi, 1,675 m, not common, flowering, 8-2-1970, 33437.

L. lanceifolia Desf.

Umiamallay, Anaimudi slopes, 2,075 m, on the fringes of sholas, not common, flowering, 17-11-1965, 26489.

L. ternifolia Desf.

Umiamallay, Anaimudi slopes, 2,075 m, in clefts of rocks in grassland, not common, flowering, 17-11-1965, 26469.

L. vestita Benth.

Petimudi, 1,675 m, common, flowering, 8-2-1970, 33451.

L. vestita Benth. var. **devicolamensis** Shetty & Vivek.

Upper Vagavurrai, 1,975 m, common along the water courses, flowering and fruiting, 11-8-1967, 28372; Upper Vagavurrai, 1,930 m, common, flowering and fruiting, 16-11-1965, 26441; Rajamallay, Anaimudi slopes, 2,400 m, in clefts of rocks in grassland, not common, fruiting, 6-2-1970, 33427.

Micromeria biflora Benth.

Anaimudi peak, 2,575 m, common in grassland, flowering, 23-4-1966, 27362.

Plectranthus stocksii Hook. f.

Umiamallay, Anaimudi slopes, 2,100 m, common in sholas, flowering, 20-11-1965, 26570.

P. wightii Benth.

Umiamallay, Anaimudi slopes, 2,525 m, common on the fringes of sholas, 18-11-1965, 26508.

Pogostemon atropurpureus Benth.

Umiamallay, Anaimudi slopes, 2,175 m, in

sholas, rare, flowering, 19-4-1966, 27329; Rajamallay, Anaimudi slopes, 2,200 m, in clefts of rocks, not common, flowering, 6-2-1970, 33425.

P. pubescens Benth.

Lower Vagavurrai, 1,700 m, common, flowering, 26-4-1966, 27389.

P. wightii Benth.

Petimudi, 1,675 m, common, flowering, 8-2-1970, 33431.

Pogostemon sp.

Lower Vagavurrai, 1,800 m, rare, flowering and fruiting, 25-4-1966, 27370; Lower Vagavurrai, 1,875 m, not common, flowering and fruiting 5-2-1970, 33420.

Scutellaria sp.

Umiamallay, Anaimudi slopes, 2,075 m, common, flowering, 19-4-1966, 27327.

PLANTAGINACEAE

Plantago asiatica Linn.

Upper Vagavurrai, 1,825 m, common, flowering, 25-4-1966, 27378.

AMARANTHACEAE

Indobanalia thyrsiflora (Moq.) Henry & Roy

Banalia thyrsiflora Moq.

Lower Vagavurrai, 1,700 m, not common, flowering, 26-4-1966, 27399.

POLYGONACEAE

Polygonum chinense Linn.

Umiamallay, Anaimudi slopes, 2,150 m, common, flowering, 19-4-1966, 27334.

P. nepalense Meissn.

P. punctatum Buch.-Ham.

Upper Vagavurrai, 1,975 m, weed in tea estates, abundant, flowering, 9-8-1967, 28352.

PODOSTEMACEAE

Zeylanidium olivaceum (Gard.) Engl.

Hydrobryum olivaceum Tul.

Umiamallay, Anaimudi slopes, 2,025 m, abundant on rocks in stream, flowering and fruiting, 17-11-1965, 26467; Umiamallay, 2,150 m, abundant on rocks in stream, flowering, 3-2-1970, 33401.

PIPERACEAE

Peperomia tetraphylla (G. Forst.) Hook. & Arn.

P. reflexa (Linn. f.) A. Dietr.

Upper Vagavurrai, 1,930 m, epiphyte growing amidst moss, abundant, flowering, 16-11-1965, 26456.

Piper mullesua Buch.-Ham. ex D. Don

P. brachystachyum Wall. ex Hook. f.

Upper Vagavurrai, 1,825 m, common, flowering, 25-4-1966, 27381.

Piper nigrum Linn.

Umiamallay, Anaimudi slopes, 2,075 m, in sholas, not common, flowering and fruiting, 17-11-1965, 26490; Umiamallay, 2,000 m, in sholas, not common, flowering, 20-4-1966, 27343.

P. schmidtii Hook. f.

Umiamallay, Anaimudi slopes, 2,075 m, in sholas, not common, flowering and fruiting, 17-11-1965, 26482.

LAURACEAE

Actinodaphne bourdillonii Gamble

Umiamallay, Anaimudi slopes, 2,175 m, common in sholas, fruiting, 19-4-1966, 27330.

Apollonias arnottii Nees

Upper Vagavurrai, 1,930 m, rare, flowering, 16-11-1965, 26457; Umiamallay, 1,975 m, not common, flowering and fruiting, 22-11-1965, 26622; lower Vagavurrai, 1,875 m, not common, flowering, 5-2-1970, 33419.

Litsea wightiana (Nees) Hook. f. var. **tomentosa** (Meissn.) Gamble

Rajamallay, 2,075 m, in sholas, not common, flowering, 21-11-1965, 26592; Umiamallay, Anaimudi slopes, 2,150 m, in sholas, rare, fruiting, 19-4-1966, 27333; upper Vagavurrai, 1,975 m, rare, fruiting, 4-2-1970, 33415.

THYMELAEACEAE

Lasiosiphon eriocephalus Decne.

Rajamallay, 2,025 m, on the fringes of sholas and in cleared areas, abundant, flowering, 21-11-1965, 26606; lower Vagavurrai, 1,875 m, not common, flowering, 5-2-1970, 33422.

ELAEAGNACEAE

Elaeagnus kologa Schlecht.

Umiamallay, Anaimudi slopes, 2,150 m, in sholas, not common, fruiting, 3-2-1970, 33403.

LORANTHACEAE

Helixanthera obtusata (Schult.) Danser

Loranthus obtusatus Wall.

Anaimudi slopes, 2,425 m, parasite on *Rhododendron nilagiricum* Zenk., not common, flowering and fruiting, 22-4-1966, 27358.

Korthalsella japonica Engler

Umiamallay, Anaimudi slopes, 2,125 m, parasite on *Rhododendron nilagiricum* Zenk. and *Ilex denticulata* Wall. ex Wt., not common, 18-11-1965, 26493.

Macrosolen parasiticus (Linn.) Danser

Elytranthe loniceroides Engler

Upper Vagavurrai, 2,050 m, parasite, not common, fruiting, 7-2-1970, 33439.

BUXACEAE

Sarcococca brevifolia Stapf ex Gamble

Lower Vagavurrai, 1,700 m, not common, flowering and fruiting, 26-4-1966, 27398.

S. trinervia Wt.

Petimudi, 1,675 m, common, flowering, 8-2-1970, 33443.

EUPHORBIACEAE

Aporusa sp.

Umiamallay, 2,025 m, in evergreen forests, not common, flowering, 18-4-1966, 27323 (♀); Umiamallay, 2,025 m, in evergreen forests, not common, flowering, 18-4-1966, 27325 (♂).

Euphorbia laeta Heyne ex Roth

E. rothiana Spr.

Umiamallay, Anaimudi slopes, 2,125 m, on the fringes of sholas, not common, flowering, 18-11-1965, 26495; Rajamallay, 1,950 m, common, flowering, 2-2-1970, 31792.

Glochidion sp.

Umiamallay, Anaimudi slopes, 2,025 m, in sholas, not common, flowering, 17-4-1966, 27313.

Phyllanthus debilis Ham.

Upper Vagavurrai, 1,930 m, common, in clefts of rocks, flowering, 16-11-1965, 26440.

ULMACEAE

Celtis cinnamomea Lindl.

Upper Vagavurrai, 1,800 m, not common, fruiting, 8-8-1967, 28340.

Trema orientalis (Linn.) Bl.

Lower Vagavurrai, 1,800 m, common, flowering, 25-4-1966, 27368.

MORACEAE

Dorstenia indica Wt.

Umiamallay, 1,925 m, common in evergreen forests, flowering, 9-8-1967, 28348.

Ficus guttata Kurz

Lower Vagavurrai, 1,875 m, not common, with syconia, 5-2-1970, 33421.

URTICACEAE

Boehmeria platyphylla D. Don

Upper Vagavurrai, 1,930 m, common, flowering, 18-11-1965, 26520; upper Vagavurrai, 1,825 m, common, flowering, 25-4-1966, 27382.

B. platyphylla D. Don var. **longissima** Hook. f.

Rajamallay, 2,075 m, common in sholas, flowering, 21-11-1965, 26602.

Debregeasia longifolia (Burm. f.) Wedd.

D. velutina Gaud.

Upper Vagavurrai, 1,975 m, flowering and fruiting, 22-11-1965, 26609.

Elatostema lineolatum Wt.

Umaiyamallay, 1,975 m, common in evergreen forests, flowering, 22-11-1965, 26627; upper Vagavurrai, 1,825 m, common in shady places near stream, flowering, 25-4-1966, 27380.

E. surculosum Wt.

Rajamallay, 2,000 m, common in sholas, flowering, 21-11-1965, 26583.

Pilea kingii C. E. C. Fischer

Umaiyamallay, 1,975 m, common in evergreen forests, flowering, 22-11-1965, 26612.

P. trinervia Wt.

Upper Vagavurrai, 1,930 m, common, flowering, 16-11-1965, 26460.

Pouzolzia bennettiana Wt.

Upper Vagavurrai, 1,930 m, common, flowering, 16-11-1965, 26437; Umaiyamallay, Anaimudi slopes, 2,025 m, in clefts of rocks in grassland, not common, flowering, 17-4-1966, 27305.

P. bennettiana Wt. var. **ovalifolia** (Wt.) Hook. f.

Upper Vagavurrai, 1,930 m, common near stream, flowering, 16-11-1965, 26442.

MONOCOTYLEDONS

BURMANNIACEAE

Burmannia pusilla (Wall. ex Miers) Thw.

B. coelestis C. E. C. Fischer non D. Don

Umaiyamallay, Anaimudi slopes, 2,025 m, in grassland, not common, flowering, 3-2-1970, 31779.

ORCHIDACEAE

Aërides ringens (Lindl.) C. E. C. Fischer

Umaiyamallay, Anaimudi slopes, 1,975 m, common in sholas, flowering and fruiting, 17-4-1966, 27301; also noted at Anaimudi up to 2,425 m.

Anoectochilus elatior Lindl.

Umaiyamallay, 1,975 m, common in evergreen forests, with buds, 22-11-1965, 26624.

Brachycorythis iantha (Wt.) Summerh.

Phyllomphax obcordata (D. Don) Schltr.

Umaiyamallay, Anaimudi slopes, 2,025 m, common in grassland, flowering, 6-8-1967, 28317.

B. splendida Summerh.

Phyllomphax obcordata (D. Don) Schltr. var. *iantha* (Hook. f.) C. E. C. Fischer

Umaiyamallay, Anaimudi slopes, 2,025 m, common in grassland, flowering, 6-8-1967, 28318.

Calanthe triplicata (Willem.) Ames

C. veratrifolia (Willd.) R. Br.

Umaiyamallay, 1,975 m, common in evergreen forests, flowering, 22-11-1965, 26614.

Cheirostylis flabellata (A. Rich.) Wt.

Rajamallay, 1,950 m, in clefts of rocks on humus soil, not common, flowering, 2-2-1970, 31785.

Cirrhopetalum gamblei Hook. f.

Umaiyamallay, 2,025 m, epiphyte in evergreen forests, rare, flowering, 18-4-1966, 27324.

Coelogyne mossiae Rolfe

Rajamallay, 1,950 m, common epiphyte or lithophyte in sholas, flowering, 2-2-1970, 31780.

C. nervosa A. Rich.

Anaimudi slopes, 2,350 m, common epiphyte in sholas, fruiting, 23-4-1966, 27361.

Dendrobium nanum Hook. f.

Umaiyamallay, Anaimudi slopes, 1,975 m, epiphyte in sholas, abundant, flowering and fruiting, 17-4-1966, 27302; Rajamallay, 1,950 m, common epiphyte in sholas, flowering and fruiting, 2-2-1970, 31796.

Disperis sp.

Umaiyamallay, 1,925 m, in evergreen forests growing on humus soil, rare, flowering, 9-8-1967, 28346.

Eria dalzellii Lindl.

Umaiyamallay, Anaimudi slopes, 2,075 m, common epiphyte or lithophyte in sholas, flowering, 17-11-1965, 26485.

E. pauciflora Wt.

Umaiyamallay, Anaimudi slopes, 2,075 m, common epiphyte in sholas, flowering, 17-11-1965, 26476.

Habenaria heyneana Lindl.

Umaiyamallay, Anaimudi slopes, 2,025 m, in grassland, not common, flowering, 6-8-1967, 28320.

H. perrottetiana A. Rich.

Umaiyamallay, Anaimudi slopes, 2,125 m, in grassland, rare, flowering, 19-11-1965, 26538.

Liparis walkeriae Grah.

Umaiyamallay, 1,925 m, in evergreen forests, not common, flowering, 9-8-1967, 28351.

L. wightiana Thw.

Upper Vagavurrai, 1,800 m, not common, flowering, 8-8-1967, 28341.

Liparis sp.

Umaiyamallay, Anaimudi slopes, 2,100 m, in sholas, not common, fruiting, 20-11-1965, 26567.

Malaxis densiflora (A. Rich.) O. Kuntze

Microstylis densiflora (A. Rich.) C. E. C. Fischer
Anaimudi slopes, 2,400 m, in grassland, not common, flowering, 7-8-1967, 28331.

M. versicolor (Lindl.) Abeywickr.

Microstylis versicolor Lindl.

Umaiyamallay, 1,975 m, in evergreen forests, not

common, fruiting, 22-11-1965, 26626; Umaiyamallay, 1,975 m, common in evergreen forests, flowering, 9-8-1967, 28347.

Oberonia wightiana Lindl.

Umaiyamallay, Anaimudi slopes, 2,025 m, common epiphyte in sholas, flowering, 17-11-1965, 26468; Rajamallay, Anaimudi slopes, 2,200 m, common epiphyte in sholas, fruiting, 6-2-1970, 33426.

Oberonia sp.

Umaiyamallay, Anaimudi slopes, 2,075 m, common epiphyte in sholas, flowering and fruiting, 17-11-1965, 26480; Rajamallay, 1,950 m, common epiphyte in sholas, fruiting, 2-2-1970, 31784; Umaiyamallay, Anaimudi slopes, 2,150 m, common epiphyte in sholas, fruiting, 3-2-1970, 33404.

Peristylus aristatus Lindl.

Umaiyamallay, 1,925 m, in evergreen forests, rare, flowering, 9-8-1967, 28350.

Satyrrium nepalense D. Don

Rajamallay, Anaimudi slopes, 2,000 m, common in grassland, fruiting, 19-11-1965, 26556; Umaiyamallay, Anaimudi slopes, 2,025 m, common in grassland, flowering, 10-8-1967, 28363.

Schoenorchis filiformis (Wt.) Schltr.

Saccolabium filiforme (Wt.) Lindl.

Umaiyamallay, Anaimudi slopes, 2,100 m, epiphyte in sholas, not common, flowering, 6-8-1967, 28325.

Spiranthes sinensis (Pers.) Ames.

Umaiyamallay, Anaimudi slopes, 2,125 m, common in grassland, flowering and fruiting, 19-4-1966, 27338.

HAEMODORACEAE

Ophiopogon intermedius D. Don

Upper Vagavurrai, 1,930 m, common, flowering, 16-11-1965, 26459.

HYPOXIDACEAE

Curculigo orchioides Gaertn.

Anaimudi slopes, 2,425 m, common in grassland, flowering, 22-4-1966, 27355.

LILIACEAE

Asparagus gonoclados Baker

Umaiyamallay, Anaimudi slopes, 2,075 m, common in sholas, flowering and fruiting, 17-11-1965, 26488.

Chlorophytum attenuatum Baker

Western slopes of Anaimudi, 2,300 m, common in the clefts of rocks in grassland, flowering, 19-11-1965, 26547.

Disporum leschenaultianum D. Don

Umaiyamallay, Anaimudi slopes, 2,150 m, on the

fringes of sholas, rare, flowering, 19-4-1966, 27335; Anaimudi slopes, 2,300 m, common on the fringes of sholas, fruiting, 7-8-1967, 28380.

XYRIDACEAE

Xyris capensis Thunb. var. **schoenoides** (Mart.) Nilsson

X. schoenoides Mart.

Umaiyamallay, Anaimudi slopes, 2,150 m, in marshy places in grassland, not common, flowering, 23-11-1965, 26630.

COMMELINACEAE

Commelina clavata C. B. Clarke

Upper Vagavurrai, 1,930 m, common weed in tea estates, flowering, 10-8-1967, 28367.

Cyanotis pilosa Schult. f.

Upper Vagavurrai, 1,930 m, weed in tea estates, abundant, flowering, 10-8-1967, 28368.

JUNCACEAE

Juncus effusus Linn.

Upper Vagavurrai, 1,930 m, common, flowering, 16-11-1965, 26446 B; upper Vagavurrai, 1,825 m, not common, flowering, 25-4-1966, 27385.

J. prismatocarpus R. Br.

Upper Vagavurrai, 1,930 m, common, flowering, 16-11-1965, 26446 A.

PALMAE

Calamus gamblei Becc.

Upper Vagavurrai, 1,825 m, common, flowering and fruiting, 25-4-1966, 27375.

ARACEAE

Arisaema wightii Schott

Anaimudi, 2,695 m, rare, growing on humus soil in clefts of rocks, flowering, 7-8-1967, 28332.

ERIOCAULACEAE

Eriocaulon brownianum Mart. var. **nilagirensis** (Steud.) Fyson

Anaimudi, 2,575 m, common in marshy places in grassland, flowering, 19-11-1965, 26528.

E. collinum Hook. f.

Umaiyamallay, Anaimudi slopes, 2,000 m, common in marshy places in grassland, flowering, 27-4-1966, 27403; Umaiyamallay, Anaimudi slopes, 2,075 m, in marshy places in grassland, rare, flowering, 17-11-1965, 26484.

CYPERACEAE

Carex filicina Nees

Rajamallay, 2,075 m, common in sholas and intruding into grassland, 21-11-1965, 26603.

C. phacota Spreng.

Petimudi, 1,675 m, common in marshy places, 8-2-1970, 33448.

Fimbristylis kingii C. B. Clarke (*s.l.*)

Anaimudi slopes, 2,575 m, in marshy places in grassland, not common, 19-11-1965, 26534; Umaiya-mallay, Anaimudi slopes, 2,200 m, common in marshy places in grassland, 23-11-1965, 26645.

Rhynchospora rugosa (Vahl) Gale

R. glauca Vahl

Umaiya-mallay, Anaimudi slopes, 2,025 m, common in marshy places in grassland, 3-2-1970, 31800.

Scirpus fluitans Linn.

Umaiya-mallay, Anaimudi slopes, 2,200 m, in marshy places in grassland, not common, 23-11-1965, 26644.

GRAMINEAE

Agrostis peninsularis Hook. f.

Umaiya-mallay, Anaimudi slopes, 2,100 m, abundant in grassland, 20-11-1965, 26562.

Andropogon lividus Thw.

Umaiya-mallay, Anaimudi slopes, 2,100 m, abundant in grassland, 20-11-1965, 26561; Umaiya-mallay, Anaimudi slopes, 2,100 m, abundant in grassland, 20-11-1965, 26568; Umaiya-mallay, Anaimudi slopes, 2,000 m, common in grassland, 4-2-1970, 33412.

Arundinella purpurea Hochst. ex Steud.

A. fuscata Hook. f.

Western slopes of Anaimudi, 2,500 m, common in grassland, 19-11-1965, 26541; Rajamallay, 2,075 m, common in grassland, 27-11-1965, 26596.

A. vaginata Bor

Western slopes of Anaimudi, 2,500 m, common in grassland, 19-11-1965, 26539.

Bromus ramosus Huds.

B. asper Murray

Western slopes of Anaimudi, 2,500 m, common in grassland, 19-11-1965, 26542; Umaiya-mallay, Anaimudi slopes, 2,100 m, abundant in grassland, 20-11-1965, 26563.

Chrysopogon zeylanicus (Nees) Thw.

Anaimudi slopes, 2,575 m, common in grassland, 19-11-1965, 26535.

Dichanthium polyptychum (Steud.) A. Camus var. **polyptychum**

Andropogon polyptychus Steud. var. *polyptychus*

Anaimudi slopes, 2,575 m, common in grassland, 19-11-1965, 26536, 26537; Umaiya-mallay, Anaimudi slopes, 2,150 m, common in grassland, 3-2-1970, 33408; Rajamallay, 1,950 m, common in grassland, 2-2-1970, 31794.

Eragrostis nigra Nees ex Steud.

Upper Vagavurrai, 1,800 m, common along the margins of tea estates and streams, 8-8-1967, 28337.

E. unioloides (Retz.) Nees ex Steud.

Upper Vagavurrai, 1,800 m, common along the margins of tea estates and streams, 8-8-1967, 28336.

Eulalia phaeothrix (Hack.) O. Kuntze

Umaiya-mallay, Anaimudi slopes, 2,100 m, abundant in grassland, 20-11-1965, 26564.

Garnotia mutica (Munro) Druce

G. tectorum Hook. f.

Umaiya-mallay, Anaimudi slopes, 2,125 m, in grassland, not common, 6-8-1967, 28328.

Helictotrichon asperum (Munro) Bor

Avenastrum asperum (Munro) Vierh.

Umaiya-mallay, Anaimudi slopes, 2,100 m, in grassland, not common, 20-11-1965, 26565.

Indochloa oligantha (Hochst.) Bor

Heteropogon oliganthus (Hochst.) Blatt. & McCann

Anaimudi, 2,695 m, common in grassland, 19-11-1965, 26532; Anaimudi slopes, 2,500 m, common in grassland, 19-11-1965, 26543.

Isachne bourneorum C. E. C. Fischer

Umaiya-mallay, 1,975 m, abundant, 22-11-1965, 26611; Umaiya-mallay, Anaimudi slopes, 2,025 m, common in grassland, 10-8-1967, 28357.

I. fischeri Bor

I. kunthiana Wt. & Arn. var. *nana* C. E. C. Fischer

Anaimudi slopes, 2,575 m, in grassland, not common, 19-11-1965, 26533.

Ischaemum indicum (Houtt.) Merr.

Umaiya-mallay, Anaimudi slopes, 2,100 m, abundant in grassland, 20-1-1965, 26566.

Panicum gardneri Thw.

Umaiya-mallay, 1,975 m, common in evergreen forests, 22-11-1965, 26621.

Tripogon bromoides Roem. & Schult.

Anaimudi slopes, 2,500 m, common in grassland, 19-11-1965, 26544.

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