Crow's Nest,
Queensland
15th. Nov. 1935.

Dear Archbold:

Herewith the remaining pages of my notes on the plants of the 1933-4 Expedition.

A few days ago I had from Father Dubuy, of Orange, specimens of another interesting tree. These, for want of suitable packing materials, I am unable to send from this bush township. Will forward them from Brisbane next week.

I have not been able to find a man suited to replace Adamson as ground transport man for the Fly River trip. But perhaps Dupain has succeeded in getting some one before this. It's a great pity Adamson is not coming along. He will be hard to replace.

With kind regards, & with best Christmas wishes.

Yours sincerely,

L. J. Brass

Following is the entire paper.

Contents

Contents

②

Journey to Mt Albert Edward. 25–48

③

INTRODUCTORY NOTE

The main object of the American Museum of Natural History 1933-4 New Guinea Expedition was to explore a section of the high mountains of Papua, formerly called British New Guinea, for mammals, birds, and plants. The party consisted of Richard Archbold, leader and mammalogist; A.L. Rand, ornithologist; and L.J. Brass as botanist. Transport arrangements for the high mountain trip were in the hands of C.J. Adamson.

The Expedition took the field in March of 1933, and terminated in April, 1934. Mount Albert Edward (m), first ascended in 1906 by a Government party led by C.A.W. Monckton, but unknown as regards fauna and flora, was chosen for investigation, and successfully ascended and explored. A visit was made to Rona (450 m) in the lower mountains behind Port Moresby, and two months spent on the lowlands of the Oriomo River in the far west of the Territory.

Knowledge of the Papuan highlands flora prior to the visit of the Expedition rested in the collections of Sir William MacGregor, made on his first ascent of Mount Victoria in 1889, and described by F. von Mueller in "Transactions of the Royal Society of Victoria," vol. I, pp. 1-45, 1889; the Mount Scratchley collections of Giulianetti, and those of A.C. English from the range between Mt. Scratchley and Mt. Victoria, made on behalf of Sir William MacGregor, and described by W.B. Hemsley in the "Kew Bulletin" for 1899, pp.95-126. At Rona territory was touched on which had previously been worked over by H.O. Forbes, in 1885, and later visited by C.T. White in 1918, and by L.J. Brass in 1925. The Oriomo, a little west of the Fly River, lies in regions from which botanical collections were made by ~~the Rev.~~ McFarlane in 1875, and D'Albertis in 1875-7, but these early explorers ? do not appear to have visited that particular river.

In the following brief account of the Expedition, and notes on

the flora and climate, the journeys undertaken are treated in chronological order, while the sections dealing with camp localities on the route to Mt. Albert Edward are arranged in altitudinal sequence.

PHYSIOGRAPHY AND CLIMATE

The Territory of Papua comprises the south-east portion of the mainland of New Guinea and the numerous outlying islands which terminate, in the Louisiade Archipelago, upwards of 250 miles from its easternmost extremity. Bounded politically by Dutch New Guinea on the West, and North-east New Guinea (Australian Mandate) on the north, it lies between the 141st. and 155th. degrees of east longitude and extremes of 5 and 12 degrees south latitude. The estimated total area is 90,540 square miles, of which 87,786 are on the mainland.

A large part of the land area is made up by mountains, which give rise to very numerous strong-flowing rivers of greater or less importance. The largest rivers, the Fly and Purari, in the west, take their source in the mountains of North-east New Guinea. By far the most important orographical feature, of Papua and the whole of New Guinea, is the massive central range which in the snow capped peaks of Dutch territory attains an elevation of over 4800 m, and rises in Papua, in Mts. Victoria and Albert Edward, to approximately 4000 m. Besides the Main Range, as this is generally called in Papua, in disregard to the distinguishing names that have been given to different sections, there are minor parallel ones, but most of the mountains belong to the one great system. East of about the 145th. meridian the mountains rise never far from the coast, and much of the country is exceedingly rugged and difficult; westwards the mountains recede from a swampy mangrove coast to positions near the northern boundary, and intervening is an immense low-lying tract

of which not much is known away from the riverbanks.

In moderately high temperatures subject to but slight diurnal and seasonal fluctuations, accompanied by high atmospheric humidity, most coastal districts conform to the generality of tropical insular climates. As temperatures fall and radiation increases with altitude, the thermometer shows a progessively greater daily range. At 1000 m the climate is sub-tropical. At high elevations, the only tropical character remaining to a climate essentially alpine, is the absence of a pronounced seasonal curve in temperatures, and above about 3000 m night frosts might be expected to occur throughout the year.

The seasons are marked by the duration of two great wind movements, the south-east trades in the so-called "cool months" which correspond with the southern winter, and the north-west monsoons in summer. Generally the trades commence late in April and blow strongly and steadily until October or November. During these months the sky is much of the time somewhat obscured by haze. The wind attains maximum strength during the heat of the day, and usually slackens to a soft breeze or ceases altogether at night, when a cool down-draught of air, the land-breeze of the coast, flows from the mountains. Upon meeting the obstruction of the land the trades rapidly lose force; only on the seaboard and high range crests in their full velocity experienced. Ushered in by thunderstorms in November and December, the monsoons last until late March or early April; a period of calms, light and variable winds, and sudden heavy squalls accompanied by much rain. Papua is not subject to the devastating cyclonic winds experienced in parts of the western Pacific during this season.

There is in most districts marked periodicity in the rains, and distribution for the Territory as a whole is very uneven; as will be seen from the following abstract of coast and inland rainfall means from the official handbook,[1] in which is incorporated,

---

1. Smith, Hon. Staniforth, Handbook of Territory of Papua, 1927 Edition.

Samarai, the records are therefore to be regarded as approximate.

The stations are in order of their position from west to east, then, from Samarai, north-west.

Means of Annual and Monthly Rainfall

			PERIOD (YEARS)	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	YEAR (INCHES)
Coast:																
Daru		S	15	15·77	9·78	13·25	12·67	10·88	4·39	2·61	3·16	2·02	2·51	4·73	7·98	90
Kikori		R	8	14·21	13·39	14·54	17·70	32·57	28·15	19·26	18·22	26·99	20·07	13·52	11·70	230
Kerema		R	13	9·43	9·84	8·95	9·97	15·99	12·36	8·82	11·38	10·65	11·11	8·13	7·06	123
Kairuku		M	5	12·04	12·34	7·43	5·64	2·74	·73	1·39	1·38	3·01	1·80	4·75	7·83	61
Galley Reach		R	5	10·70	12·35	7·95	7·07	4·47	4·73	·69	2·79	4·71	4·00	4·86	10·17	74
Port Moresby		S	15	8·07	8·05	6·30	3·42	1·96	·87	·27	·42	·71	1·41	2·17	4·35	38
Rigo		M	5	9·22	6·68	11·77	3·77	3·01	2·35	·57	1·33	1·77	1·33	2·24	4·21	48
Abau		R	5	10·81	11·93	12·98	5·18	8·63	5·61	3·96	2·75	3·51	2·81	1·90	5·41	75
Samarai		R	11	7·75	9·68	12·00	10·84	14·78	11·37	9·59	10·41	12·59	5·89	6·14	6·41	117
Cape Nelson (Tufi)		R	12	19·18	20·95	16·51	13·57	10·67	8·76	3·26	4·73	5·07	8·12	12·26	11·89	135
Buna		R	12	13·30	12·36	10·75	9·42	7·64	7·16	3·57	3·99	7·93	9·15	12·89	14·69	113
Inland:																
Lakekamu (Nepa)	240 m	R	11	16·76	15·79	20·43	22·56	22·57	13·21	11·90	11·65	18·33	14·99	15·65	13·28	197
Hombron Bluff	550 m	SR	6	16·61	11·13	9·37	6·85	4·51	1·48	·32	1·62	3·20	1·65	5·38	9·87	72
Sogeri	480 m	R	6	16·25	14·17	12·03	10·64	7·79	4·37	1·88	3·31	7·92	4·20	12·59	12·90	108
Efogi	1280 m	MM	2	19·25	14·26	16·05	13·99	3·75	5·60	3·30	7·63	7·45	12·49	15·00	13·39	132
Kokoda	368 m	R	12	14·52	13·86	13·46	13·79	8·20	8·09	5·82	7·05	9·94	8·43	14·85	12·82	131
Ioma	120 m	R	11	18·25	16·07	19·06	12·15	11·23	8·49	6·90	6·59	10·77	11·32	17·97	21·72	161

S indicates savannah as chief vegetation type; M = monsoon-forest;
R = rain-forest; MM = mid-mountain forest.

Over most of the Territory, the monsoons constitute the wet season, and bring ample rains in normal years. The south-east rains determine the climate; whether dry and semi-arid as at Port Moresby, which receives little rain during the trade-wind period and upon occasions none at all for weeks together, or phenomenally wet as at Kikori, which may, although it does not usually, average in this, the wettest season for much of the west, more than an inch a day for three or four months on end. In all but the very heavy rainfall districts, perhaps, there is an element of uncertainty in the seasons, and in dry districts, of which there are several on the coast, they tend to be erratic. Drought years are not unknown to high average rainfall areas, in the mountains as well as on the coast. In such years the partial failure of food gardens may be a very serious matter for native populations without natural reserves in the shape of swamp sago, for, apart from this useful palm, the forests contain little that is edible, and certainly nothing in bulk sufficient to sustain for long, on other than famine fare, large communities of people.

from later Government Gazettes, the fullest possible data available for the mountain station of Efogi. "Owing to the absence on duty of recording officers at certain stations, "says the handbook, "the daily rainfall has not been taken right throughout the year.....if the period of absence is short, the accumulated rainfall is measured, if the absence is of considerable duration, the rainfall has been estimated as the mean for that month during the whole period of existence of the station." Excepting perhaps Port Moresby and Samarai, the records are therefore to be regarded as approximate.

The stations are in order of their position from west to east, then, from Samarai, north-west.

Means of Annual and Monthly Rainfall

Coast:		
Daru		S
Kikori		R
Kerema		R
Kairuku		M
Galley Reach		R
Port Moresby		S
Rigo		M
Abau		R
Samarai		R
Cape Nelson (Tufi)		R
Buna		R
Inland:		
Lakekamu (Nepa)	240 m	R
Hombron Bluff	550 m	SR
Sogeri	480 m	R
Efogi	1280 m	MM
Kokoda	368 m	R
Ioma	120 m	R

S indicates savannah as chief vegetation type; M - monsoon-forest; R - rain-forest; MM - mid-mountain forest.

Over most of the Territory, the monsoons constitute the wet season, and bring ample rains in normal years. The south-east rains determine the climate; whether dry and semi-arid as at Port Moresby, which receives little rain during the trade-wind period and upon occasions none at

all for weeks together, or phenomenally wet as at Kikori, which may, although it does not usually, average in this, the wettest season for much of the west, more than an inch a day for three or four months on end. In all but the very heavy rainfall districts, perhaps, there is an element of uncertainty in the seasons, and in dry districts, of which there are several on the coast, they tend to be erratic. Drought years are not unknown to high average rainfall areas, in the mountains as well as on the coast. In such years the partial failure of food gardens may be a very serious matter for native populations without natural reserves in the shape of swamp sago, for, apart from this useful palm, the forests contain little that is edible, and certainly nothing in bulk sufficient to sustain for long, on other than famine fare, large communities of people.

It is said by residents of the country that boisterous trade-winds have the effect of lessening rainfall for the season, while light intermittent winds characterize unusually wet years; and, as has been pointed out by various writers, the position and trend of the coast in relation to prevailing winds, and the presence or absence of obstructing mountains, has an important bearing on rainfall. The few inland localities for which records exist, exhibit in every case a substantial advance in rainfall as compared with opposite points on the coast. From Port Moresby to Efogi, through Hombron Bluff and Sogeri, for example, the increase is from 38 to 132 inches in a distance of about 40 miles. Efogi is 1280 m above sea level, on the slopes of the Main Range. Records made by the missionaries there, in 1926-8, represent for the whole Territory the only meteorological data continuously recorded at altitudes above 550 m. It seems probable that, as Lane-Poole[1] suggests, rainfall increases with

---

[1] Lane-Poole, C.E., The Forest Resources of the Territories of Papua and New Guinea, p.3, 1925.

altitude to his appropriately named "mid-mountain forest" region, and then progressively diminishes to the summits of the high ranges. This line of supposed maximum rainfall lies in the lower parts of a great body of mist clouds which envelops the mountain slopes down to remarkably constant daily levels which are determined by local conditions. At high altitudes the mists and drizzling rains help to compensate rapid evaporation, and at intervals gales of wind and rain occur which thoroughly saturate the ground, making possible the growth of low forest up to an extreme elevation (on Mt. Albert Edward) of about 3850 m, where trees finally give way to alpine grass. We experienced between the south coast and Mt. Albert Edward, in the south-east season, regular afternoon mists as low as 500 m in the foothills, while in some high valleys they did not reach much below 2000 m. Whether or not these levels are maintained in the rather warmer and less prolonged north-west season, it is not possible to say with any degree of certainty. Clouds might be expected to form at lower levels, but, with the influence of regular winds removed, they probably form at irregular intervals of time and lack coherence. Judging by appearances from the coast the mountains, particularly the higher ones, enjoy a good deal of clear weather during the monsoons.

Below is a compilation, from Government Gazettes, of temperature, relative humidity, and further rainfall data in respect of Port Moresby, Samarai and Efogi, as representative of dry district savannah, rain-forest, and mid-mountain forest climates, respectively.

	Temperature F.		Rel.Humidity %.	Rainfall	
	Mean Maximum	Mean Maximum	9 a.m.	Amount (inches)	Days
Port Moresby					
January	89.4	75.7	72	4.90	14
February	87.2	75.6	71	4.80	10
March	87.9	76.2	72	5.52	11
April	87.1	76.6	68	4.14	9
May	82.4	78.0	74	2.69	3
June	82.7	74.6	77	2.57	6
July	81.2	73.2	77	.76	4
August	81.3	72.5	79	2.27	6
September	82.4	73.1	74	.76	3
October	85.2	74.1	79	3.22	4
November	87.5	75.0	73	1.34	5
December	89.4	75.5	72	6.90	10
5 yrs 1929-33	85.3	75.0	74	39.87	85
Samarai					
January	92.9	73.6	76	5.68	16
February	92.1	76.0	76	5.91	14
March	91.5	76.0	75	8.43	17
April	89.5	75.0	74	7.23	16
May	86.2	75.0	82	7.70	21
June	84.7	74.1	83	6.65	16
July	83.4	73.2	80	6.55	20
August	83.5	73.2	84	6.55	20
September	85.8	73.7	74	4.98	16
October	88.1	74.5	76	9.12	15
November	90.1	73.7	67	4.56	14
December	91.8	75.6	71	4.36	12
5 yrs I929-33	88.3	74.5	77	77.82	197
Efogi 1280 m					
January	76.8	62.0	84	14.99	23
February	74.8	64.2	75	13.21	21
March	74.9	62.0	62	12.78	23
April	77.4	59.3	79	12.93	23
May	75.6	55.4	75	2.56	8
June	75.2	56.5	72	4.57	10
July	76.0	56.1	79	3.20	11
August	71.5	51.3	67	8.60	15
September	71.5	51.3	79	5.10	11
October	74.1	59.0	65	13.42	19
November	78.6	59.8	80	10.69	16
December	77.2	61.0	89	12.60	19
1 yr 1927	75.3	58.2	76	144.65	199

The dissimilarity between Port Moresby monthly rainfall means in this and the previous table is in large measure due to abnormal south-east rains in one year of the later period, namely 1933, a year of light winds, when precipitations were 61.29 inches as compared with only 28.30 inches for 1932. Samarai experienced in the 1929-33 period a sequence of five light rainfall seasons, and excepting only Port Moresby, means relative humidity for the term was lower than that of any south coast station, of which alone the records have been compared in detail. Humidity readings are made once daily, at 9 a.m. Kikori stood out above the other stations with an 88% mean for the five years, two monthly means of 100%, and an average of 269 days on which rain fell. The lowest mean for one month fell to Kairuku, with an abnormal 57% for March in 1929. In 1933 average mean humidity for eight south coast stations was 81%; mean maximum temperature 86.3 F., mean minimum 73.9 F, highest monthly maximum 93.1 F. at Kairuku in April and November, and lowest minimum mean for one month 69.8 F. at Abau, in February.

Briefly, the records refer chiefly to the coast and foothill regions, and apart from isolated observations made by explorers, no quantitative data are available for altitudes exceeding 1280 m. Annual rainfall may be said to range from 38 inches in dry, to 230 inches in wet districts, and rainy days from 85 to 269. Temperature means for the south coast, on one year's figures, are 86.3 F. maximum, 73.9 F. minimum, and mean relative humidity 81 per cent. The north coast, which was not visited by the Expedition, appears a good deal wetter on the average, and slightly warmer than the south coast.

PLANT FORMATIONS

Over most of the country climate and soils are suitable for dense forest, but grasslands occur on the Main Range summit and on low rainfall areas fronting parts of the coast; and on some of the western rivers, especially, are large areas in which swamp grasses predominate. Lane-Poole (loc. cit.) has divided the vegetation into lowland region savannah and rain-forests, foothill forests, mid-mountain forests, mossy forests and high-mountain forests; and has rejected, as inapplicable to the treeless highlands of Papua and North-east New Guinea, the term alpine grassland. The condition ~~is~~ alpine grasslands are, he believes, except for marshlands, and slopes too steep for trees, in all cases a secondary ~~one~~ condition following the destruction of forests by fire. Hunter's fires have caused a great spread of grasses on the highlands visited by us, but the spread has been from areas undoubtedly climatic.

Examination of a representative section from coast to alpine regions, suggests the following classification of the major communities:

Savannah Grassland	Coast to 600 m
Monsoon Forest	" to 450 m
Rain-forest	" to 2400 m
Mid-mountain Forest	480 to 2380 m
Mossy-forest	1500 to 3200 m
Sub-alpine Forest	3200 to 3850 m
Alpine Grassland	2800 to m

mt. valley grasslands?

? — in [illegible] rainforest?

The altitudes given are the extreme, not the general, limits between which the formations were observed to occur. Primary alpine grassland is, for example, at elevations less than 3550 m reduced to outposts scattered in glades, depressions and streamways.

Savannahs and savannah forests cover three extensive dry areas; namely, the as yet little known low-hilly region between the Fly River and the Dutch boundary inclusive of Daru Island, probably not

less than 6-7,000 sq. miles in area, characterized (at the eastern end) by *Tristania* and *Melaleuca* as trees; the comparatively well known Central Division "dry belt" of probably 2,000 sq. miles, which stretches from Cape Possession approximately 150 miles east to Hood Point, includes Kairuku, Port Moresby and Rigo meteorological stations, and is characterized by *Eucalyptus* spp.; and a much smaller tract about Goodenough Bay and Cape Vogel on the north coast, concerning which few details are available, but on which the capsular Myrtaceae are said by Lane-Poole not to occur. The two south coast areas are typically Australian in flora and physiognomy; features accounted for by generally accepted former land connections between the two countries, in relation to which interesting views based on Wegener's continental drift hypothesis have recently been advanced by Lam.[1]

The occurrence of savannah, on the south coast at least, is correlated not so much with low average annual rainfall as pronounced inequality in seasonal distribution of the rains. Reference to the table on page 3 will show, for instance, that Daru (90 in.) receives considerably more rain in the year than the rain-forest districts of Abau (75 in.) and Galley Reach (74 in.). Galley Reach, it is interesting to note, is a small rain-forest district geographically within the Central Division dry belt. But in no case does a savannah district receive more than 22 per cent, and in no case does a rain-forest district receive less than 25 per cent of total annual rainfall in the driest (trade-wind) six months of the year. Further comparisons carried as far as the records and an incomplete knowledge of the country permit, seem to show that, irrespective of soil and annual rainfall, savannah grassland is completely eliminated by rain-forest when rainfall for the driest half-year rises to 24 or 25 per cent of the annual total.

---

[1] Lam, H.J., Blumea pp. 115-159. 1934.

In the driest districts rain-forest forms fringing strips along the streams; and light monsoon-forest appears in gullies and depressions at least, showing to best advantage and frequently supplanting the grasses on the seaward side of coastal lines of hills. The Kairuku and Rigo monsoon-forest meteorological stations lie close to extensive savannah areas.

The disposition of cloud masses on the mountains would seem a ~~most~~ very important, if not the decisive, climatic factor determining the vertical distribution of several plant formations. The clouds form in orderly manner definite belts or strata. Three such belts, or rather differentiations in the daily process of condensation and accumulation, can be defined for the mountain districts visited by the Expedition. (1) The cloud-cap of Mt. Albert Edward which, from about 8 or 9 a.m., enshrouds the peak from summit or thereabouts down to about 3400 m. A local condition due, apparently, to congestion and uplift or moisture-laden wind from the Chirima Valley, which lies directly under the mountain to the south-east, the accumulation and rapid advance of this cloud-body could be watched almost every morning as the wind rose. (2) The general upper belt, which, developing between about 10 a.m. and noon, blots out the mountain tops and extends in strips down the spur ridges to levels which vary considerably with topography, aspect, and trend of the ranges in relation to strike of the wind, but mark, whatever the altitude, the lower limits of the mossy-forest (*Xanthomyrtus*, *Phyllocladus*). The higher the mountains the more elevated the cloud-mass; a rule that holds for (3) the lower belt, which, as the air cools in the afternoon, between about 2 and 5 o'clock descends the spurs and mountain sides to levels which vary from about 1750 m in the upper Vanapa Valley, to as low as 480 m in the seaward end of the Dilava Valley. This is the region of mid-mountain Fagaceae, and *Araucaria*; below it are the rain-forests.

PORT MORESBY

The vegetation of Port Moresby is more or less typical of the coast between Redscar Head to the west and Rigo to the east, a 60 mile stretch of the Central Division dry belt in which no stream of consequence enters the sea. Running closely parallel or rising in low cliffs from the sea, and apparently unconnected with the not far distant mountains of the interior, is an irregular line of stony, barren-looking hills, attaining at most 300 m elevation round the harbour. E.R.Stanley[1] has described the rocks as highly silicified, crushed, and contorted sediments of uncertain, pre-miocene age. In the rear of the hills are extensive savannahs, and on their seaward side a patchwork of dark monsoon-forest relics and smooth treeless grassland on slopes the natural feature of which is sun-bleached natural grass dotted with stunted grey Eucalypts in every open formation.

Tardy powers of regeneration have failed to balance extensive disturbance by a heavy population dependent upon garden produce for the bulk of their food, and much of the original monsoon-forest, which provided humus-enriched soil for the cultivator, has passed to grass. Faced with the problem of an annual food shortage, and needing also canoe logs which their home forests could not supply, the natives have for generations organized hazardous trading expeditions along the western coast to barter earthernware pots for sago; a trade still in existence and maintained to some extent by an annual voyage of great composite sailing canoes. - called "Lakatoi"

Annual rainfall is 38 inches; of which 85 per cent falls during November-April period, and 15 per cent, principally showers, in the dry season.

---

[1] Stanley, Evan R., The Geology of Papua, p.48. 1923.

Littoral Communities: Protected from high seas by a barrier reef, a curving beach of coral sand on the ocean foreshore supports numerous wide-ranging strand plants. First *Ipomaea Pes-caprae* and other trailing sand-binders, with shrubby clumps of *Scaevola frutescens*, *Suriana maritima*, *Abutilon indicum*, *Dodonaea viscosa*; backed on stabilized low dunes by thickets containing *Acacia farnesiana*, *Premna integrifolia*, *Guettarda speciosa*, and, scattered on grassy stretches or mixed in the thickets *Casuarina equisetifolia*, *Terminalia Catappa*, *Pandanus* sp., *Hibiscus titiaceus*, *Cordia subcordata*, etc.

Within the harbour are narrow beaches of coarser coral debris, shells, and stones, with limited drifts of fine sand above tide-mark. Often screening these, a few yards off shore, are low *Rhizophora* spp., which straggle round rocky headlands in company with *Osbornia octodonta*, and form on flats at the entrance of small streams open stands dominated by *Avicennia marina* var. *Resinifera* and *Sonneratia alba*, 4-5 m high. Behind the mangroves, on inundated beach, common strand trees of small stature, with *Vitex negundo*, *Bauhinia binata*, and straggling *Clerodendron inerme*, *Capparis sepiaria*, *Jasminum aemulum*, etc., often take precedence over sand-trailers as first line of vegetation.

Monsoon-forest: Generally known as "coast brush", this forest of the dry tracts is in habitat requirements obviously intermediate between rain-forest and savannah, and as soil moisture increases it passes gradually into the former. It meets the grasses in park-like transition zones, and contributes to the savannahs a number of hardy trees (*Alstonia*, *Clerodendron*, *Antidesma*, *Desmodium*, etc.) conspicuous among the Eucalypts by reason of their darker foliage and different habits of growth. Most typically an open formation of mixed deciduous and evergreen thick-boled trees with large crowns, raised above a dense underbrush of minor tree species and scrambling shrubs, it is in

places stunted and scrubby, and on rocky points degenerates into low brushwood and shrubberies. The deciduous character is most evident in the larger trees, of which some are without leaves in the wet season. Partial bareness in the dry months is a common condition; but most of the components are sclerophyllous evergreens.

About Port Moresby *Gyrocarpus americanus*, *Bombax Ceiba*, *Alstonia scholaris* and *No.3674*, attaining sometimes 20 m, are characteristic and conspicuous big trees. *Cochlospermum Gillivraei* with large yellow flowers, *Lagerstroemia Archeriana*, *Jossinia desmantha*, *Maba* sp., figure in reduced areas on rocky slopes near the sea, with principally *Flueggia microcarpa* as undergrowth, *Abrus precatorius*, etc. Between the hills, on flats of alluvial soil and rubble, notable species include *Sarcocephalus cordatus* on banks of dry watercourses, *Syzygium Branderhorstii* with showy white flowers on trunk and branches, *Jambosa* sp. aff. *megalosperma*, *Semecarpus australis*, *Morinda citrifolia*, and ~~phyllodinous~~ *Acacia auriculiaeformis*.

In some of the deeper gullies an exceedingly poor and spindly type of transition rain-forest meets the savannah on characteristically sharp lines of demarcation.

Savannah: *Themeda triandra*, erect in clumps about 1 m high, is the chief savannah grass; scattered *Eucalyptus alba*, *papuana* and *clavigera*, 3-5 or rarely 10 m tall, the principal trees. The grasses form a somewhat irregular thick cover in which interspersed small forbs, woody annuals, and Leguminous undershrubs and grass-twiners abound; but shrubs are few. *Cycas media* is in places conspicuous, and in the hollows *Albizzia procera* (4-7 m) a common tree.

Among alien weeds which, in the wet season especially, flourish in great variety on vacant town lots and the outer roads, may be mentioned *Hyptis suaveolens*, *Ageratum conyzoides*, *Crotalaria striata*,

Poinsettia heterophylla, *Sida* spp., *Amaranthus viridis*, *Acanthospermum hispidum*, *Clitoria ternatea*, *Passiflora foetida*, *Jatropa gossypiaefolia*, and *Stylosanthes mucronata*, the latter a valuable fodder plant which might repay experimental introduction to dry district pastures. The troublesome "Seed-grass" (*Chrysopogon acicularis*), which is dispersed by an abundant production of fine, rough-awned seeds that penetrate the hardest cloth, work their way into the seams of boots and shoes, and even cling to the bare feet of natives in rainy weather, has gained a big hold all along the coast.

RONA CAMP

Rona is a mountain holiday resort on the Astrolabe Range, 24 miles inland by motor-road from Port Moresby, and 450 m above sea level at the upper end of a deep gorge cut by the Laloki River. A broad valley-like area of dry, red, gravelly ridges, about 10 miles across, intervenes between the coastal hills and the Astrolabe, which is a parallel foothill range of the central system. From this dry area the prevailing savannah mounts the range, meeting on its steep slopes first low monsoon-forest, then rain-forest, to which it finally gives way on a fertile, high-rainfall plateau on the summit. Para rubber and Robusta coffee are grown very successfully on plateau rain-forest soils, and brought down to Rona by pack-mules. On the lowlands the road passes abandoned copper mines, a deserted sisal-hemp plantation, and small areas under tobacco; and a few horses and cattle are grazed.

The gorge, cut in thick beds of volcanic agglomerate, is roughly five miles in length, a mile wide at the entrance, and more than 500 m deep. From the narrow river bottom, filled with loose boulders and rocks, precipitous slopes rise on both sides to a more or less well defined and approximately mid-slope benchline or terrace, marking perhaps the level of the old valley bed; above which more gently sloping but nevertheless steep parallel weathered spurs ascend to the base of perpendicular cliffs 50 to 100 m high, which form a broken rim to the plateau. At the head of the gorge, a little beyond Rona accomodation house, the river drops from its grassy upper valley in the magnificent falls from which the locality takes its name. The agglomerates weather into rich, red-coloured, gravelly soils; and on the slopes are many large rock fragments that have gravitated from the cliffs above.

Fringing rain-forest of lowland type persists along the river as far as there are alluvial soils. Under the cliffs, and filling the end of the gorge near the waterfall, is another rain-forest body, of considerable area, which contains a certain admixture of monsoon-forest species. This spreads over most of the south-facing slopes; the opposite slopes, which alone were worked over, being mostly savannah, with gully strips of poor monsoon-forest and intermediate rain-forest.

Rainfall at Rona is somewhere about 80 inches. On Hombron Bluff, across the gorge, with somewhat similar vegetation, it is 72 inches, and at Sogeri Plantation, 10-12 miles distant in rain-forest on the plateau, 108 inches; respective averages for the driest half-year being 18 and 27 per cent.

Savannah Grassland

Two types of Eucalyptus savannah are represented at Rona; a dry type in the gorge, similar in most respects to that of the Port Moresby lowlands, but lacking E. clavigera; and on the plateau,

under heavier rainfall, a very distinct savannah-forest containing *E. tereticornis*, a species not found at lower levels.

Savannah of the Gorge: Such are the disadvantages of slope in the gorge, that the benefits of a rainfall double that of the coast are lost, and any slight improvement there is in plant cover could well be attributed to more nutritious soil. The seasons work remarkable transformations in these drier type savannahs. When we saw them early in March the wet season flush of grasses, already drying out after seeding, stood almost everywhere waist-high over the slopes, and the Eucalypts, which would flower profusely in May, were fully leafed and in bud. There would follow months of slow desiccation, and piecemeal burning by native hunters would reduce the grasses to a monotonous waste of stubble; and under the combined effects of drought and fires the Eucalypts, particularly *E. clavigera*, would shed much of their foliage. There is always visible at close quarters a tint of green in the burnt grass and in old patches that escape the fires, and so rapid is the response of these arrested shoots to rain that a few days after the season breaks they colour the landscape, fresh green in the cool hours, a wilted grey in the heat of the day, and in about three months another growth cycle is completed.

For the most part leafy clump-forming or tufted tenacious perennials, of erect habit and hard of stem, the grasses include besides *Themeda triandra* (8-10 dm), the chief dominant, *Heteropogon contortus*, *Arundinella setosa*, *Andropogon serratus*, *A. micranthus*, *Ophiurus* 3586, and in damp hollows 2 m high clumps of irritant-hairy *Rottboellia 3617*. Small *Panicum coccospermum* and *Tripogon 3557*, with the sedges *Bulbostylis barbata* and *Cyperus* 3576 (15 cm), occur on scant soil over rocks. About sheltering rocks and forest borders are dense, rank growths of *Themeda gigantea* var. *3589* (3 m tall at times), *Pennisetum macrostachyum* and weak *Apluda mutica*; *Saccharum spontaneum* and *Panicum tuberculatum* occur as roadside strays from

the lowlands. *Rhizomatous Imperata arundinacea,* called "Kurukuru" in the police-Motu jargon of the country, favours the deeper bench soils and takes possession of the ground wherever it occurs. Besides being widely distributed on savannahs by wind carried seed, it overruns clearings in the forests from sea-level to 2000 m, and is one of the worst pests in plantations.

With "kurukuru", here as in most places in Papua, occurs the common tumeric (*Curcuma longa*), and, gregarious in forest shade, *Zingiber 3676,* a little ginger of strong flavour much relished by the natives. Other grass associates of diverse character, principally more or less woody annuals or undershrubs, and some rosette forbs, sporadic as a rule, shorter than the grasses and most plentiful where the grass cover thins out on shallow, stony soil, are *Spermacoce 3559*, *Mitracasme 3562*, *Polygala persicariaefolia*, *Knoxia corymbosa*, *Centranthera 3574*, *Crotalaria linifolia*, *Cassia mimosoides*, *Euphorbia serrulata*, *Dianella 3665*, *Osbeckia chinensis*, the little fern *Chielanthus tenuifolia*, *Uraria lagopoides*, *Indigofera trifoliata*, *Tephrosia vestita*, climbing *Desmodium microphyllum* and *Melothria 3695*, etc. The fleshy leaves of *Spathoglottis plicata*, a local rarity, were invariably cropped short by some grazing mammal.

Few in species and individuals, and seldom conspicuous, the shrubs are either many-stemmed plants with thickened woody stocks, e.g. *Grewia 3690*, and tangled clumps of *Nepenthes 3638*, the reddish pitchers of which contained small beetles, moths and ants drowned in watery fluid, or short lived and herbaceous in the branches, such as *Cantharospermum 3627*, *Desmodium gyroides* and *Abelmoschus 3661*, the last scarcely noticeable in the grass but for its large yellow-white flowers.

Eucalyptus clavigera with usually straight trunk and upright main branches, and *E. alba* of crooked, loose-branching habit-ever-green, and seldom more than 8-10 m high-are the distinguishing trees.

Widely spaced as a rule, they close in somewhat and are joined on the benches by *Albizzia procera*, smaller than on the coast, and sometimes dark foliaged *Timonius Rumphii*. Most *E. papuana* trees have rough dark bark at the butt, otherwise their bark is a smooth pale grey, and both have glaucous foliage to which is due the characteristic bluish-grey appearance of the savannahs at far sight.

Savannah of the Plateau: On the ridgy surface of the plateau savannah is soon in serious competition with tall rain-forest, but for several miles back from the rim the grasses retain supremacy. Improved conditions of climate, slope and soil are manifest in the vegetation immediately the gorge and coastal slopes are left behind. The river valley carries a heavy grass cover of kurukuru and *Themeda triandra*, seemingly not often burned, the former occupying, as usual, the best soils. *Eucalyptus papuana* persists as the distinguishing tree, better grown here, and with more varied intermittent associates, viz., *Melaleuca leucadendron*, the bark composed of thin, papery layers, and *Casuarina nodiflora*, up to 16-18 m tall; *Grevillea pinnatifida*, *G. 3684* and *Banksia integrifolia* of the Proteaceae, *Timonius Rumphii* and *Diplanthera tetraphylla*, of smaller stature. The rough bark and broad leaves of the latter make it a conspicuous tree, and it is the most frequent host of a striking group of fleshy epiphytes comprising *Myrmecodia* sp., *Hydnophytum* spp. including *camporum*, *Dischidia Rafflesiana*, and several hardy orchids (a *Cymbidium* was noticed in hollow trees on lowlands) and ferns.

On higher ground *Eucalyptus tereticornis* (16-18 m) forms with *E. papuana*, the *Casuarina* and *Melaleuca*, a savannah-forest in which the smaller trees listed above occur as a very scattered substage. In the thicker parts grasses develop poorly in the shade and are replaced to some extent by shrubs, such as *Melastoma 3666*, *Breynia 3656*, *Dalbergia densa*, *Grewia aspera* and *Nepenthes 3667.* Beneath the Casuarinas is a thin brown carpet of twig litter in which no vascular plant can grow.

The Astrolabe Range savannahs probably do not reach altitudes much exceeding 600 m. Farther east, on the Main Range slopes near Mount Obree, Lane-Poole (loc.cit. pp.2,5) found the E. tereticornis-C. nodiflora type to extend above 1500 m, where the Casuarina enters also adjoining rain-forest and forests of the mid-mountain mist belt, as it does the outer rain-forests of the Astrolabe. This species is extraordinarily versatile as to habitat, and has a wide, though localized, range in rain-forest from coast lowland to mid-mountain regions.

Rain-forest

We saw little of the plateau forests and those of the gorge could not be thoroughly examined. The former are, however, taller, incomparably richer, and more luxuriant true rain-forest, in large measure botanically different, and living under very different conditions.

In the gorge monsoon-forest species mix with the preponderating rain-forest elements in a diversified low forest poor in species, which attains maximum development under shading cliffs and especially the bottom of the gorge near the waterfall. Connecting the cliff-base and waterfall forests on the south side, where collections were made, is a greatly reduced area broken along the face by rough, rocky ground; the only place on that slope where forest is continuous from top to bottom. The rough tracts referred to carry xeric shrubs and small trees grouped amongst tall grasses and upon rocks, and an attractive community of lithophytes, which represent, perhaps, stages in succession. Grasslands subject to fires, i.e., the open savannahs, are met on a very sharp ecotone, a characteristic well illustrated at the resthouse, from which a clear-cut grassy lane mounts the slope between two dark forest bodies. Monsoon-forest species are most in

evidence in the narrow forest strips of dry gullies cut in the slopes, though perhaps all appear as well in some part of the main area. They are intimately mixed in the forests and could not be satisfactorily sorted out on slight acquaintance.

There is no general flowering season for rain-forest, or for that matter any Papuan forest except the sub-alpine, and the pure Eucalyptus communities of the drier savannahs. Out of 28 tree species (excluding Ficus) collected in the complex forests of Rona, in March, 61% bore fruit in forward stages of development, 29% were flowering, and 10% had both flowers and ripe fruit. Numbers were barren and the collection otherwise far from being complete. In this dry locality probably most trees bloom about December, or the beginning of the monsoons, followed by a fairly general flowering of lesser plants during the rains, and a common season for lianes in March.

Trees: The forests develop from slender polewoods to a dense low (14-15 m) canopy of well spaced, bushy-topped trees, very open underneath, which in favoured positions passes to an interrupted upper layer of uneven height growth (to 25 m) interspaced with subordinate species, which combine to form a thick canopy sheltering little undergrowth except along the riverbanks. At the lower levels occasional trees of outstanding size show well developed buttresses. Most larger species have richly branched crowns and dense foliage; the leaves small, glossy, frequently grey underneath, and in exceptional cases stiff and scabrous.

Characteristic upper layer species include Aleurites muluccana, briefly deciduous - first flowering then leafing-out in March, Terminalia 3642, Garuga floribunda, Alstonia villosa, Dysoxylum 3605, Horsfieldia 3607, Columbia 3615, Afzelia bijuga, Rhus 3674, Litsea sp., constricting Ficus subulata. Subordinates of diverse stature

and station comprise Mallotus 3646, Micromelum 3645, Gardenia 3678, G. 3679, Ficus 3572, Eugenia 3600, Antidesma 3677, Pittosporum 3552, No. 3671, No. 3566, No. 3587, Aglaia 3693, Aphananthe 3591, Boehmeria 3616, etc., and substage Pandanus 3650 (4-5 m) with prickly prop roots and long brown syncarps.

Undergrowth: Shading is very complete, soil moisture deficient over long periods, and both herbaceous and woody under growth consequently poorly developed. Progress through the forest is attended with some difficulty owing to lack of convenient vegetation to offer a handhold while negotiating steep slopes slippery with a loose covering of dry leaves. Leaf litter lies everywhere on the drier slopes several inches deep; a most unusual thing for rain-forest, where processes of decay are generally accelerated by the presence of abundant moisture. Psychotria 3585 and Codiaeum variegatum var. moluccanum are shade shrubs; Ervatamia pubescens var., No.3620, and Hyposetes 3670 shrubs of the borders. Herbaceous Oplismenus undulatifolius, Fleurya interrupta, and tall Amomum 3604 fairly common; as are Antrophyum reticulatum, Loxogramme 3673, Cheilanthus 3699 and Tectaria 3648, representing a scanty fern flora growing on rocks. Angiopteris evecta, the slight treefern Sphaerostephanos polycarpa, Heliconia sp., and one or two dwarf palms appear on moist soil near the river. At the foot of the waterfall the air is cool and misty with spray, and crowded on wet rocks is a luxuriant shade community of Elatostemma pachypoda, Syndrella nodiflora, Globba 3596, Curcuma 3597, Orthosiphon 3593; on the cliff-face grows Adiantum philippense, and higher up in crevices Begonia 3599 and Impatiens 3602 - both with pink flowers.

Lianes: Every climber observed was in flower. They are notably few in the body of the forest, though well represented by showy species

on the outskirts. Most prominent is *Bauhinia Williamsii*, with remarkably flattened, sinuous and spirally twisted stems, spreading a mantle of red flowers over patches of forest near the river; *Freycinetia stenophylla*, massed about tree-trunks, and a *Calamus* occur there also, and twining *No. 3608* in the undergrowth. Others, chiefly of sunny fringes, include *Ryssopterys 3672*, *Tetrastigma 3581*, *Mucuna 3582*, *Alsomitra 3606*, *Gouania 3609*, *Clematis 3611*, *Flagellaria indica* var. *minor*, *Oreocnide 3635*, *Strongylodon 3584*, *Gynura procumbens*; and sometimes advancing into contiguous grass *Ipomaea hederacea*, *Thunbergia fragrans*, and robust prostrate or scandent *Pueraria 3570.*

Epiphytes: Occasional ferns, orchids, Lycopodiaceae and mosses were noted on the trees, most often near the river. One large orchid, *Dendrobium 3583,* not infrequently flowers on exposed rocks outside the forest. In the drier parts parasitic Loranthaceae abound on the branches of individual trees, e.g., *Loranthus 3622*, *Viscum orientale*, *Notothixos 3681*.

Rock Communities: On the faces of cliffs and on top of rocks lying on the slopes, in positions exposed to strong sunlight, high temperatures, and recurring conditions of intense drought in the trade-wind season, is a xerophytic herbaceous community of mostly fleshy or grey-pubescent perennials, of which several possess bright blue or violet flowers. Colonization begins in small cavities on the agglomerate into which the rains wash disintegrated particles and a dry season dusting of soil from the savannah, or is initiated by *Drynaria quercifolia,* of "nest-epiphyte" habit, which retains behind a frill of upright fronds wind-blown leaves and other soil-forming matter. Characteristic species are *Aneilema 3564*, *Cyanotis 3562 and C.3696* in mats, *Boea 3560*, *Coleus scutellarioides*, *Peperomia 3561*, annual *Evolvulus alsinoides* and *Mollugo pentaphylla,*

the ferns Cyclophorus 3556 and Polypodium scolopendria, a few of which persist under closed canopy in the forest.

Following the herbs and rooting as well in cracks resulting from heat-splitting, is a woody community conspicuously perched about the summit of rocks; notably the shrub Mussaenda 3571, shrubby trees Macaranga 3633 and Fagraea 3634, and, sending down roots to the ground in the manner of some figs, a striking Araliaceous tree (6-8 m) with large rayed leaves, resembling the Australian Brassaia actinophylla.

Another small tree and shrub community inhabits flat, unelevated rock surfaces and soil pockets, and blends with fringing species of closed forest. This includes Wickstroemia 3577, Pipturus 3573, Fagraea 3634, Ficus 3569, F.3567, No.3566, usually grouped amongst tall grasses protected from fire, in thickets overrun by Dioscoraea bulbifera and Tetrastigma 3581.

Secondary Communities: Only a small amount of disturbance, incidental to road making, has taken place. There occur species of the usual softwood regrowth type that spring up so abundantly wherever rain-forest is disturbed and constitute the first stage of regenerative tree growth, e.g., Macaranga tanarius, M. quadriglandulosa, Homalanthus populifolius, Callicarpa 3675; much entangled underneath with Passiflora foetida.

Riverbank Community

Ficus 3588, Neonauclea Chalmersii, Jambosa naiadum and J.Sargentiana (2-5 m), of similar horizontal, low-branching habit, represent at Rona a group of small trees strictly confined to the banks of flowing streams. Widely distributed in the Central Division foothills, they border the rain-forest along the water's edge, and form fringing lines through the grasslands, for they follow the rivers through forest and savannah alike.

JOURNEY TO MOUNT ALBERT EDWARD

As viewed from a vessel passing westward to Yule Island, the grass patched hills of Port Moresby are succeeded in Redscar Bay by the Galley Reach and Aroa River rain-forests; then more dry, inhospitable low hills clothed in scrubby monsoon-forest, behind which savannah ridges stretch some miles inland to the foothills. Opposite Yule Island, which is itself monsoon-forest partly altered to grass, several miles of deltaic mangrove (Angabunga or St. Joseph, and Ethel Rivers) front the alluvial plains of the Mekeo, and a little farther on the savannah hills of Cape Possession mark, approximately, the western end of the Central Division dry belt.

From Kairuku government station, on Yule Island, commenced the journey in to Mt. Albert Edward; a matter of thirteen days actual travelling extended over a much longer period by difficulties of transport. Approach to our objective was, however, greatly facilitated by a pack road thrust far into the interior, through most difficult country, by the French Mission of the Sacred Heart, whose headquarters are on Yule Island. This road is carried to 2400 m elevation on Mt. Tafa Range, and terminates at Ononge, in the Vanapa Valley, 120 miles from the coast by road and 1875 m above sea level. Transport from Yule Island across Hall Sound to the mainland, and about ten miles up the Ethel River and its Bioto tributary, was by launch and canoe; thence to Ononge principally pack mules and horses; beyond Ononge, for the ascent of the Main Range, native carriers entirely, comprising relays of active local men bearing headloads, and a force of twenty indentured west coast men (1) carrying tandem fashion on poles the boxloads and most important baggage. Permanent carriers and camp retainers were supplied with flannel shirts and good blankets for use in the mountains.

Heights by boiling point test quoted in the following account were observed and calculated by Mr. Archbold; other altitudes given are route readings by aneroid.

The outer islands of the combined Angabunga and Ethel River deltas carry close-packed growths of low mangrove (*Aegiceras* sp.) which slope off to the sea and appear at a little distance like rounded ridges intensely green with fresh young grass. Within the Ethel, on more recent mudbanks near the main mouth, *Avicennia* sp. and *Sonneratia alba*, surrounded by numerous pheumatophores, form open stands which are succeeded on less saline reaches by dense *Rhizophora*-*Bruguiera*-*Ceriops* forests, 10-15 m high, rising like a wall from the sharp-cut edges of eroding banks in the bends, or fringed with *Sonneratia 5775* on points that are being raised by fresh deposits of silt. Next to assume prominence is *Nipa fruticans*, crowding the banks, and thereabouts, with the appearance of *Heritiera littoralis*, *Carapa mollucensis*, *Hibiscus tiliaceus*, begins transition to swampy inland forest. Characterized by a phyllodineous *Acacia*, *Sarcocephalus* and *Melaleuca leucadendron* on the inner edges, this forest soon gives way to tall Sirio-grass (*Saccharum spontaneum?*) on the fertile silt plains of the Mekeo.

The Mekeo plains occupy a large area, to some extent liable to inundation in the wet season, between the partly submerged coastal hills and the mountains. Partly covered with swamp grasses 2-3 m high, and part rain-forest, they support a heavy human population. The principal food crop is bananas, which grow to perfection on the rich soils, each bunch of fruit enclosed in a wrapping of the dry leaf-sheaths of the plant itself as a protection against nocturnal raids by fruit-bats. In addition, minor root crops and sugarcane are grown, and under Government supervision in recent years, increasing quantities of hill rice. About the villages, and bordering the

pathways, are haphazard plantings of coconuts, breadfruit, primitive mangoes, ornamental Eyrthrinas, and the aromatic Evodias and bright coloured Crotons and Hibiscus with which most natives of presentable age delight to adorn their person~~s~~.

At the eastern edge of the plain, about three miles from Bioto landing, are dry savannah hills. On the first elevation of ~~which~~ these hills, at the Baroka residence of Mr. C.J.Adamson, who supervised the Expedition transport, our coastal base was established. Baroka overlooks a mosquito infested Hanguas malayana swamp, several miles in circumference, and commands an imposing view of the mountainous hinterland. The savannahs are similar in character to those of the Port Moresby lowlands. Large tracts lying eastwards behind the coast would, in a pastoral country, be considered fair grazing land for cattle. Geologically, the hilly savannah area, or most of it, is included by Stanley (loc. cit.) in the south coast deposits of Pliomiocene fossiliferous mudstones, sandstones, and limestones.

The savannahs are interrupted by intrusive belts and isolated patches of rain-forest, to which the grasses and Eucalypts finally give way about six miles from Baroka on the inland track, at 130 m altitude. After several miles the forest, at first of poor quality, is enriched by numerous tall palms upon approach to the Kubuna River, on which, at 100 m elevation, a collecting camp was formed on the return journey. Some lofty stands of good volume occur along the river, but the climate is still influenced by conditions responsible for the coastal dry belt, and therefore inadequate for a rich development of forests of the type.

181 Kubuna

Some hundreds of acres have at different times been felled and planted to rice and native foodstuffs for the supply of a large mission establishment situated on the river. A sparse indigenous population, living in scattered small villages concealed in the forest, has done little to disturb the natural vegetation. These

people seem to subsist principally upon sweet-potatoes and inferior varieties of bananas, supplemented by taro and sugarcane. They manufacture in swamps in the forest, chiefly for trade to the coast, quantities of sago. ~~which~~ This may be seen stacked in bundles on stages near the villages, where, safe above the reach of wandering pigs, it is kept in the moist and sour-smelling condition considered desirable for its preservation.

The forests improve as one gradually ascends the foothill ridges to gain, at 380 m, the crest of the first mountain spur, and at 480 m elevation on the same spur, four hours from Kubuna, Dieni camp. *Freycinetia 3850*, a large *Pandanus* sp., and in lighted places varied Zingiberaceae, Araceae and Commelinaceae, appear as conspicuous forms in rain-forest considerably altered in composition and character as an outcome of climatic changes, and especially a rainfall increased in quantity and frequency. Chill mists cover the spur crest fairly regularly in late afternoon and, in accordance with the rule, mid-mountain oaks, in this locality *Quercus 3801* and *Q.3839*, appear along the cloudbank base in pure stands. On the more elevated opposite side of the Dilava Valley, which Dieni overlooks from a line of volcanic bluffs, the oak forests are continuous for miles, in a long regular line - clearly defined by the contrast their brownish foliage provides with the grey-brown greens of the rain-forest - which, at the level maintained by the clouds, dips with the slope of the mountain toward the coast.

The Dilava rises in Mt.Tafa Range (2800 m), about 20 miles distant, and lower down joins the Kubuna to form the Aroa. At the head of the valley, extensive grass slopes, and wisps of village smoke, indicate a numerous population. Mt. Tafa Range lies parallel to the Main Range, from which it is separated by the deep valley of the Vanapa and that of the co-terminous Auga tributary of the St.Joseph, as the Angabunga is called in the mountains. Our route, by a roundabout

course crossing from the Dilava back to the St. Joseph, thence up the Auga Valley, traversed on the fifth day from Dieni the top of Tafa Range, and thus passing round the Dilava headwaters,, descended to Ononge in the Vanapa Valley.

Past Fofofofo (680 m), where it leaves the Dilava, the road penetrates on the St. Joseph fall an exceedingly rugged and intricate region of volcanic peaks and crumbling slates, in which oak-forest on the spurs alternates with rain-forest in valleys and ravines; and crossing at 615 m the Iakaruma affluent, climbs round cultivated slopes to the Matsika villages (1000 m), which are reached in seven hours. In this region are the richest, and some of the tallest rain-forests seen on the route. But nowhere do they compare favourably with the forests of wet lowland districts. Increasing rainfall with altitude is offset by falling temperatures, and there is always the limiting factor of steep, for the most part rubbly, immature slopes.

The Matsika and neighbouring villages, perched in commanding positions round the sides of a secluded valley, constitute the chief centre of concentration of the Kuni tribe, a light-skinned Melanesian people whose territory we entered at Kubuna. The Kuni are inveterate chewers of betel-nut, and have an apparently well substantiated reputation as abortionists, the agents in use being species of *Zingiber*. They trade to the coast bird-of-paradise plumes and worked feather ornaments; and plaited armbands and belts made of brown material from the main rhachis of *Gleichenia 4960*, with inserted chevron designs in yellow from *No.4216* and other orchids, and silver from the weed grass *Eleusine indica*. Standing in the older villages, and marking the sites of others long since abandoned, are fine old tabu fig-trees (*Ficus 5433*), which formerly served as a repository for the bones of village notabilities, whose spirits, it is said, found in daylight

hours agreeable refuge in the thick foliage.

As indicated on page 9, the afternoon cloud masses and concomitant oak forests retreat to progressively higher levels as the mountains pile up to the central range. In the outer mountains they occupy the highest points, but as general elevation of the land increases, they tend to assume mid-slope positions which are, broadly speaking, maintained through all the higher valleys.

The road, intended to facilitate communication with the mountain people, keeps wherever possible this mid-slope level, for population follows the deep, red soils of the mid-mountain forest, and along their cloudline contact with the greyish soils of the rain-forest are concentrated, with few exceptions, the villages of the mountain tribes. The fact that many basal gullies head about this level, and topography is therefore less broken, probably has something to do with the choice of village sites, for, in the lower valleys, which are, however, the least heavily populated, most of the gardens are on rain-forest slopes below the houses.

Cultivation has not advanced beyond the primitive method of annually cutting down the burning fresh forest patches, and keeping them weeded until the crops are sufficiently advanced to take care of themselves. If reasonable intervals are allowed between crops, say 10, 12, or perhaps 15 years in the colder valleys, forest conditions will be maintained on the steepest rain-forest slopes by second-growth trees. Mid-mountain forest regeneration is by means of much less vigorous species which from the beginning seem unable to cope with aggressive, wind-dispersed grasses that follow the cultivator, and are later consolidated in their position by fires. This grass invasion presents a hopeless problem to the native~~s~~, who, being without digging tools, is compelled to advance his gardens always further into the upper (Fagaceae-other species) forests, which must, if population remains at the present level

and gardening methods are not improved, in some districts eventually disappear.

In the Kuni valleys we passed through, cultivation and grass (Imperata arundinacea) have not as yet spread far into the mid-mountains forests. The cloudline oaks at Matsika contain a curious admixture of trees, notably a Xanthomyrtus that has worked down from mossy-forested heights with a scrambling bamboo that overruns clearings, and, abundant and conspicuous on the crests of spurs, Casuarina nodiflora.

From Matsika the road swings out to the St. Joseph, and following the side of the gorge through which the river runs, a section dangerous in wet weather owing to frequent landslides, enters the Kea River side valley, in which are the Deva Deva villages and a resthouse at 770 m. This is a stage of four hours. On the following day about three hours' travel brings one to the Mafulu villages of the Fuyugi tribe, in the Auga Valley, near the first of which, a hamlet called Gala, at 1250 m altitude B.P.T., a collecting base was formed on our return.

Beyond the Kea the country alters. The hitherto confused mountains take definite shape, rising in long ridges whose lofty summits are most of the day concealed in mist, the nearer ones heavily capped with crystalline grey limestone resting on the slates. Across the river from Gala the Ambo spur range rises to 2500 m and more, so close that in the evening pig-feeding calls and shouting in villages half way up its sides can be clearly heard. Within shouting distance, too, Mt. Pitsoko (about 2000 m) rises to a sharp peak above extensive garden patchworks at the end of another high spur under which the river bends away south-east, and above which can be seen, in early morning, distant blue heights of the Main Divide. Near at hand forest regrowths and steep grass-slopes drop toward the river, which flows out of sight in a gorge,

too deep down to be heard unless in flood. Though not abundant, Araucaria Cunninghamii, some old trees 50-60 m tall, protruding in scattered lines along the spurs, is the most striking feature of the mid-mountain forest mass which covers the upper slopes, and it dominates on the grass spurs relic forest patches largely composed of Castanopsis 5216. In a rich fern and shrub undergrowth beneath the cloud-base oaks appears the first Rhododendron, the brilliant R.5305, with flowers 8 cm in diameter.

A population numbering some thousands of people has left undisturbed but fragments of the original rain-forest and lower mid-mountain forest between Gala and Mondo, six hours distant up the river. Beyond ~~which~~ Mondo the valley again assumes the character of a gorge, with sides too steep for occupation. Between these two points are the Mafulu, Kobu, Gaiva and Fani village groups, Mafulu and Fani missions, and at 1450 m near the Kobu villages, Bella Vista resthouse, where small collections were made.

A change soon apparent on the roadside upon entering this high valley, is the repression of the rank weeds and grass of more tropical levels, and their replacement by ferns and balsams (Impatiens 5335, I. 5417) in colours from white to henna shades and red. Balsams with beautifully variegated leaves are common as well in the mountains, but their recognised place is in the yam gardens, where large numbers are planted every year in the belief that the association is beneficial to the yams. Kaempferia rotunda has, in parts of the western country, more definite a similar reputation in banana culture.

The Fuyugi are a primitive, dark-skinned, so-called Papuan aboriginal tribe, distinct in appearance and customs from the Kuni.. They occupy, besides the Auga Valley, the upper Dilava and Vanapa, and on the northern side of the Main Range, the Chirima Valley.

In addition to sweet-potatoes, the staple crop of the tribe, we had from them while camped in the Auga Valley, supplies of yams, taro, bananas, sugarcane, breadfruit, a native cucumber called   , and also pumpkins, maize, manioc, pineapples, papaws (Carica papaya), beans, tomatoes, and eschalots introduced since their contact with government and mission.

In Papua the parts of the breadfruit (Artocarpus communis) eaten are the seeds, which are usually prepared by simply roasting on the coals. It does not occur naturally in the forests, though frequent as a stray on the banks of lowland streams, and as planted, untended trees in rain-forest regrowths. Seedless kinds introduced from Polynesia to parts of the coast in recent times, are not much grown. The seeds of indigenous A. 5184, a large hardwood tree of very different appearance, common in the Auga rain-forests and sometimes planted in clearings, are collected for food in times of scarcity. Another forest product, apparently a regular and much relished article of diet, is a repulsive-looking paste of the fermented seeds of Pangium edule, which are steeped in pits for two or three ? months to remove the toxic properties. A small Pandanus (P. 5463) called Onde in the Auga, Fea in the Kuni Valleys, is planted for its long red syncarps which, when boiled and mashed to a pulp to separate the tiny drupes, have an agreeable flavour not unlike that of caramel.

Until recently the Fuyugi, at least those of the Auga and Vanapa, had no betel-nut, nor had they tobacco or any other smoking plant. About 15 to 20 years ago, according to [redacted] Father Norin, of Mafulu Mission, the Auga people obtained from the Kuni a small betel-nut called Kasi, apparently Areca 2655; and during our visit to the Vanapa Valley, at the occasion of a big feast in celebration of the event, betel-nut of the same stock was first

planted at the Ononge villages. It is interesting to note that on the island of San Cristobal, in the Solomon Group, this species bears the almost identical name Takasi.

Tobacco arrived in the Auga, from two different sources, about the same time as betel-nut - *Nicotiana 5459* (Kuku) from the coast, and *N. tabacum 5460* (Misori) from the little known and as yet uncontrolled Tauwadi tribe of the mountains north of the Auga. The name Kuku suggests a tobacco of recent European introduction to the country. It is a Port Moresby word for excrement, originally applied in derision, that has spread with the tobaccos of the white man, whether manufactured or in the leaf, over wide areas of dissemination. Father Norin, who has studied the Tauwadi language, says tobacco has long been cultivated by that tribe; that it figures in tribal tradition; and that the name Misori is an indigenous Tauwadi word. The Fuyugi express a preference for the flavour of Misori, but pay more attention to the cultivation of Kuku, which yields a coarser leaf in greater bulk. Misori is a slender plant with narrow, sessile leaves, of which two varieties, distinguished by size of leaf alone, are recognised.

In the Fuyugi valleys are cultivated two magnificent species of *Pandanus*, known as Hina and Mondoa, which, in the domestic economy and folk-lore of the people fill a place comparable to that of the coconut on the coast. Trees superficially alike, about 30 m tall when fully grown, with long, fluted prop-roots, widely branched crowns and drooping, glaucous leaves, the fruit-heads of Hina are smaller and the individual fibrous drupes larger than those of Mondoa, and well marked differences are displayed in the seedling plants. The seeds of both are called Gatora. Cut from the trees

by climbers while still unripe, the fruit-heads are split with a sharp stick in longitudinal sections to facilitate separation of the fruits, which are then cracked open on a stone by a skillful blow with a smaller stone, and the highly nutritious, sweet, oily seed, in flavour not unlike a "green" coconut, eaten without any preliminary preparation; or, if intended for future use, and quantities are thus frugally preserved in the fruiting season, the split sections are cured by smoking over the household cooking fire and afterwards stored in the roof. The leaves, though stiff to work, furnish a most durable house thatch, in exclusive use wherever the trees will grow; and the prop-roots, hacked off in strips and smoothed of prickles, replace the split palm-trunks of lower altitudes as flooring material. There is, perhaps, no more impressive sight in the country than a mature grove of Hina or Mondoa. In comparison, the much vaunted coconut is a puny growth, and usually lacking ~~moreover~~ the clean vigorous appearance of these mountain giants. Each individual tree is said to bear a distinguishing name, and each a known history handed down by the owners from father to son. Essentially trees of the mist-belt, the lowest groves observed were in sheltered hollows near the Kobu villages at about 1500 m elevation. Others could be seen above the topmost gardens, in little clearings up to the edge of the mossy-forest. At villages higher than Kobu they succeed on the open ground of old garden clearings, and in the Vanapa Valley especially, very extensive groves are thus established.

Hina has been determined as P. 5461. Mondoa, seen fruiting in May, bore neither fruits nor flowers when specimens were sought in October, so its identity remains unknown. Their cultivation is

known to extend through the Tauwadi and Goilala country north-west to the Kunimaipa River; but Kuama villagers of the Chirima Valley, with whom we came in contact later, say they have no planted Pandanus, though a Fuyugi people in frequent communication with the Goilala and kinsfolk on the Vanapa. Mr.C.A.W. Monckton, who made from the north coast, in 1906, the first ascent of Mt. Albert Edward, mentions, however, in his book "Last Days in New Guinea" (p.43, 1922) Pandanus trees in the Chirima Valley bearing tabu marks of native ownership, and remarks that the leaves were used to thatch temporary shelters. Mr. Monckton also found tobacco in the villages, and "plants remarkable for the length and fineness of the leaves and peculiar fragrance," which he thought might be indigenous, growing in burnt forest on top of the Range. We saw none of this tobacco on our route, and none in the mountains or elsewhere in the country that could not definitely be described as cultivated or straying from cultivation. Nor did we find in the forests any one of the three Pandanus species observed in cultivation. A large species resembling Hina and Mondoa, not seen fertile, occurs in the lower mossy-forests of Murray Pass, but from the fact that native hunters of the Vanapa cut out and destroy on their own territory numbers of young plants to cover sleeping shelters, it might be inferred that the species possesses no higher value.

Officially termed a police camp, Mondo (1670 m) is a trim little hill station with well constructed buildings and fine food gardens, and ornamental gardens as well, containing roses and other temperate climate plants, and a splendid collection of native balsams. The valley is very narrow and the slopes tremendously steep, and the afternoon mists of density and eerie, sound-deadening qualities out of the ordinary. Work for the day ceases with the closing down of the mists, after which there is nothing to break

the silence excepting, perhaps, the roar of some distant landslide or muffled shouting from nearby villages. Accustomed as they are to yelling messages from spur to spur and across the valleys, these mountaineers, if at all excited - and they are an excitable people- put much unnecessary force into their speech when conversing at close quarters.

The road leaves the Auga at Mondo, and climbing above the last oak-forests and gardens, at about 1850 m, penetrates to the head of a rain-forested, hemmed-in side valley, from which it mounts the western end of Mt. Tafa Range, and enters at 2200 m the summit mossy-forests. For 3¼ hours it keeps the range top, crossing from side to side by saddles separating the razor-back summit ridges; all the way through low forest and climbing bamboo (No.5106) which hangs from the trees willow-like over the track and forces one into the slushy puddles formed by years of mission pack traffic. The forests, about 8-10 m high on the shady slope and 15 m on the eastern side, comprised principally of *Xanthomyrtus 4854* and *Phyllocladus 4034*, are blanketed in pale brown moss, mist-drenched and cold to the touch, and a thick yielding mass of moss and interwoven tree roots carpets the ground. Mosses and fruticose lichens, *Dawsonia superba* conspicuous among them, cover roadside soil exposures, with dwarfed *Dipteris conjugata*, a diminutive raspberry bush (*Rubus 4021*), and *Lycopodium 4994.* Under the base of Tafa Peak, 2400 m above sea level, by boiling point, is a mission resthouse and donkey pasture near which we subsequently formed a camp, and near it, in thick forest at the upper and lower ends of an ancient, arrested landslip, two small lakes. In the upper lake lives a snake, of imposing bulk and talkative disposition, it would seem, which has been known to call down, to terrify natives who venture to offend its privacy, sudden upon storms of thunder and hail. Whatever the cause, such storms are

not infrequent on the mountain. We experienced in August and September early morning temperatures as low as 7 deg. Centigrade, and cold afternoon rains added to the discomfort of almost constant mists.

As at the Mondo end of the range, rather mossy, stiff-foliaged rain-forest persists to high elevations in the heads of narrow valleys and ravines, and in the camp locality it makes contact with the mossy-forest at 2400 m. Croton 5081 and Elaeocarpus 4954, with scurfy grey leaves, dominate the canopy, in which climb Mussaenda 5040 and Freycinetia 4964. Notable substage species include Hibiscus? 4950 with broad red flowers, and the tall palm Ptychandra? montana.

The mid-mountain forests which in the broader valleys and indentations intervene between rain-forest and Mossy-forest, if present at all in ravines and narrow recesses in the ranges, occur as small patches isolated on the most prominent spurs. On the descent to Ononge, oak patches appear at 2350 m, and about a mile further on, at 2300 m, the road enters lofty forest of mid-mountain type, dominated by Fagus? 5057 (called Sama), which clothes the sides of long spurs running down towards the river. The sama forests are 40-45 m high; the timber a valuable hardwood. Their total area seems considerable, though already much reduced in this district by the advance of gardens from lower levels. Nemodi camp, at 2180 m B. P. T., stood in the sama forest, two hours from Tafa camp and half way down to Ononge, which is on a branch of the same spur.

About a mile from Nemodi the road leaves the forest, and passing first through sweet-potato crops on new, log-strewn land, then great groves of Hina and Mondoa, comes out on a long, uneven, grassy ridge on which are several hamlets and villages, and, out in the

middle of the valley, at 1875 m B.P.T., Ononge Mission. The villages are a long way from the principal gardens, and seem to occupy very old sites. Scavenging pigs wander through them at will and sleep in wallows under the eaves, and the houses, doubtless snug and weatherproof, if somewhat flea-infested, have an unprepossessing, squalid appearance. The people, however, are healthy and free from skin diseases, and the villages have a compensating feature in the well fenced and tended garden plots by which some are surrounded - ground reclaimed from grass with the aid of tools loaned by the mission, and planted in sweet-potatoes, taro and maize, as a handy supply for immediate needs.

The Vanapa, like the Auga, flows in a narrow gorge, but the valley proper is a broad one, and more continental in type. From near the river headwaters about 25 miles of its length has, to a width of 4 or 5 miles, undergone conversion to treeless grassland or open bush and small tree savannah, in which original forest survives only as island patches and gully strips, and above which the great forests of the ranges have receded on a clear-cut, irregular face to elevations averaging 1900-2000 m. For the most part too steep to plough, the deep, fertile soils of these grasslands are capable of supporting, with proper patch cultivation, a much larger population than the present one of about 8,000 people. The gorge, and the deeper side creeks and gullies were formerly rain-forested. In these sheltered, comparatively warm places the yams are grown, and down near the river a few bananas. As a gauge of the general climate of the valley, it may be mentioned that apples trees? grow and fruit at the mission.

Resting periods of 12-14 years are allowed between yam crops to ensure

reconditioning of the soil by successive growths of secondary forest (Alphitonia sp., Homalanthus populifolius, Sauraula 4820, Decaspermum 4822), which, instead of being clear felled in the usual way is killed by lopping, and the branches and cut underbrush then fired to clear the ground. Yams are said to be grown mostly for ceremonial consumption at feasts. A good deal of mystery and formalism attaches to their culture, which is the special prerogative of the men, who plant, weed, and dig the gardens, and carry the crop to the villages; while to the women falls most of the work of keeping up supplies of food for every-day use. It is necessary for all garden workers to abstain from pork and salt, and if one who has eaten these luxuries should as much as walk through a garden the crops will, it is affirmed, utterly fail, and rot in the ground. A white man is, of course, carefully escorted round the garden boundaries.

Grass follows inevitably the ~~first~~ felling of mid-mountain forest; not as in the lower valleys, Imperata arundinacea, but rampant, cane-like Miscanthus japonicus 4778, in closely spaced clumps 2-3 m tall; which is valuable in that it maintains for a long term of years conditions that allow the return of the ground to cultivation. With it at first appears a fallow scrub of small trees, bushes and treeferns, but these practically disappear after a few more clearings and burnings. Patches of pure grass are slashed down and further cropped, fires rage through it in dry spells of weather, and finally, retreating up the slopes after the forest, it gives way to another type of grass - a thick, fine coating of open ground species, less than 1 m high, derived from distant coastal savannahs. This interesting community includes, among grasses, Andropogon micranthus 4799, Hyparrhenia bracteata No.4817, Arthraxon hispidus No.4787, Setaria geniculata 4788, ~~Panicum~~ Sacciolepis indica 4789, also Imperata arundinacea, poorly developed and subordinate to the others, among forbs, Buchnera 4821, Lactuca laevigata 4816, Sopubia trifida, Blumea lacera 4818, woody Osbeckia chinensis, and Banksia 3568, dwarfed to 5-6 dm, Grewia 4748a, and Melastoma 4811 occur as low shrubs. Grewia,

the *Melastomaceae*, and most of the grasses probably owe their presence to carriage by birds, or some other animal agency: *Banksia*, *Imperata*, and some of the forbs haveseeds adapted for wind distribution. Natural grasslands of thetype from which they originate doubtfully occur nearer than 30 miles.

In crossing the grasslands frequent marshy hollows are met with in depressions between the ridges - narrow boggy strips up to about a quarter acre in area, fed by seepages, and seldom more than 1 or 2 dm deep in water. Surrounded as a rule by tall *Miscanthus* brakes, which help to dam up and retard the flow of water, these support massed herbaceous communities of open-marsh plants, up to 1 m high, comprising *Juncus 4804*, *Scirpus 4810*, *Fimbristylis 4805*, silver-grey *No.4802*, *Isachne 4807*, *Ischaemum 4808*, *Xyris 4803*, *Dysophylla 4809*, *Gonostegia 4824*, *Jussiaea 4823*, *Lindernia 4825*, etc., and on the margins *Hypericum* 4801, Viola 4800. Left bare andopen to invasion by removal of the forests, which would also have the effect of augmenting the seepages, stocking probably took place by a movement from the head of the valley, where swamps of considerable magnitude are known to exist; the probable distribution centre of Miscanthus 4778, as well.

The river, a fast flowing stream of no great width, was crossed at 1320 m, on sticks laid in pairs from rock to rock, and on the other side of the gorge the journey continued switchback fashion over transverse grass spurs, about four hours up valley to Urunu village, where we camped at 1900 m. Picturesque old Araucarias, solitary or in relic patches, and draped to the top in grey Usnea ~~usneous lichens~~, are a conspicuous feature of the valley. On ground recently cultivated, and not yet overrun with grass, *Ageratum conyzoides*, *Cynoglossum 4784*, *Polygonum 4785*, *Graptophyllum 4795*, *Emilia 4815*, *Erigeron 4786*, *Setaria geniculata*, *No.4783*, and *No.4782* wereobserved as weeds at Ununu.

About four miles further on a high Araucaria-clad spur called

[illegible]

and con [illegible]

[illegible]

Silisigoda projects from the range, and Ero Creek, descending in a ravine from the heights of Murray Pass, crosses the valley to join the Vanapa. Here we left the grasslands, and in secondary rain-forest near the creek above Uvulu village, the last settlement of the Urunu clan, formed a relay supply camp at which loads were rearranged in preparation for the ascent of the range.

A very old track, worn deep in the ground in places, leads up to an ill-defined spur from this point to hunting grounds on the high grasslands, and crosses the range through Murray Pass to Kuama village in the Chirima Valley. The climb, which takes about six hours with pole loads, begins at 1800 m in tall mid-mountain forest heavily shaded and open underneath, containing in admixture an oak, like Q.5289, frilled round the base with slender coppice shoots; and several Begonias in scant herbaceous undergrowth. A long, low camping shelter, covered with Araucaria bark bent to the ground across a ridgepole, and capable of accomodating a large party, is reached at 6726 ft. 2050 m. Here the real climb commences, still through tall forest, footholds cut in the track being necessary in parts to assist the carriers. At 7808 ft. 2380 m the track enters abruptly a smaller, flat-topped forest, 14-15 m high, the ground springy with moss and carrying a good deal of shrub and fern undergrowth, the trees principally Phyllocladus Hypophyllus, Xanthomyrtus spp. andCryptocarya 4741, with a leavening of Dacrydium? 4588 and Libocedrus 4579. Mossy forest prevails then to the top; sometimes 20 m tall in sheltered gullies in which, at 2500 m, Begonia, Freycinetia, and Melastomaceae appear to reach the limit of their range; in places choked with impenetrable scrambling bamboo; and on the edge of the ravine, as one ascends, shaggy with long moss and stunted through exposure to downdraughts from the Pass.

From a rest clearing at 8694 ft. Avios 2650 m the carriers, distressed by the climb, straggled on through low, weatherbeaten forest, gloomy in the mist, wet, and very mossy. At 2730 m we came at length to the open slopes of the [illegible] from the islands of Hawaii [illegible] in the grasslands [illegible]

[illegible] forest, [illegible] forest, [illegible]

[illegible]

Pass, and in the curious silence peculiar to high elevations when the mists are down, pitched camp amongst grass tussocks and squat, Cycas-like treeferns, ~~with crackling grasses underfoot~~. Visibility was limited to a few metres by drifting mists by this time (1 p.m.) turning to thin rain, in which the mountain carriers, naked but for perineal band and perhaps a turban of tapa-cloth, shivered wretchedly. Fire-killed trees from the forest edge provided, however, abundant fuel, and green treefern fronds piled up with a very inflammable shrub (Hypericum 4188) made bonfires which were ~~much~~ appreciated by all members of the party. At daylight next morning the thermometer stood at 44'F. (7'C.).

This camp stood on the right bank of the Ero Creek, at the lowest point reached by alpine grasses, and though still about two miles from the top of the Pass, and 300-400 m below it, situated on the edge of the summit plateau. Above it the Ero breaks through a gorge from a deep, circular basin about a mile in diameter, in the bottom of which, along the stream, are strips of apparently natural grassland. Glades in the forest and seepage areas along the range-top constitute other natural grass islands, from which an immense scope of forest land denuded by fire has been stocked with its present covering of grasses~~, forbs and treeferns~~. The grasslands owe their tussocky character to Deschampsia? 4624, somewhat widely spaced and 5-7 dm high. Styphelia 4575, Hypericum 4188, and Coprosma 4215 are common low shrub associates, while a curious savannah effect is provided by Cyathea 4595 and C. 4596, growing very abundantly, 1-2 m high. These treeferns do not occur in the forests. They are grassland species of the open ground, glades and forest margins, capable of enduring, though they frequently lose every frond in the process, periodical fires which kill out the grasses and leave the ground bare, or practically so, for years afterwards. Some months before our visit a patch of about 100 acres, not far from camp, had thus been denuded of ground cover by a burn that swept on into the forest as a top fire in the moss, and penetrating as far as 200 m in some gullies, killed all the trees,

[illegible]

[illegible]

[illegible] still out the expense and leave the [illegible] but left them standing and in most cases intact to the smallest branchlets The forests must have disappeared long ago if fires of the kind were common. This was, however, apart from very limited fringe strips, the only newly burnt mossy-forest seen on the range. Most grasslands in the region is an old condition, as evidenced by the treeferns and the absence of dead timber, and the forests have developed along their margins a distinct community of erect shrubs and small trees that present a solid face of foliage to the grasslands and afford some measure of protection against fire.

Regularly every year in the south-east season natives from both sides of the range visit the highlands to hunt, principally wallaby and wild pig on the grasslands, and cus-cus in the forests. Armed with bows and arrows, spears, and stone-headed clubs, they travel in bands and use dogs to locate the game. For night camps they build inside or at the edge of the forests permanent hip-roofed shelters of Libocedrus bark. To secure extra warmth these are covered over with Pandanus leaves if the camp is in mossy-forest, or a layer of grass if it is in sub-alpine forest. The hunters move about at a smart pace and make frequent stops to rest, for the prevailing temperatures are such as to encourage haste, while rarity of the air makes long sustained effort impossible. In unbroken forest clearings are made to serve as resting places, out on the grasslands they halt where fuel is to be had in places sheltered from wind, and wherever they stop they build fires. These fires, and burnings of grass to provide fresh young feed for game, have brought about the present vast spread of grasses at the expense of both mossy-forest and sub-alpine forest.

The Murray Pass mossy-forests are much more massive than those of Tafa Range, and proportionately better developed, and scattered Dacrydium? 4588 (which with Libocedrus 4578 belongs properly to the sub-alpine forest) rising as flat-topped darker trees above the general but have been burned and [illegible]

The forests had been exaggerated [illegible] of the kind were

common. This was, however, [illegible] important [illegible], the

only really burnt moss-forest [illegible] remain. [illegible] in

the region is an old condition, as [illegible]

absence of leaf litter, and the forests [illegible]

a distinct community [illegible]

case of falling [illegible] of protection

against fire.

Similarly, [illegible] in the [illegible]

sides of the range [illegible] principally [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

the present [illegible]

sub-alpine forest.

Barrington, like [illegible] more massive [illegible] of

Tara Range, and proportionally better developed, and contains

[illegible] with [illegible]

alpine forest [illegible]

canopy level, give them a somewhat different appearance from the outside. The fringe community effectively shuts out strong light from the grasslands, and a general absence of sharp surface irregularities in the area they cover makes for very complete canopy shading. Undergrowth is, in consequence, poorly developed, even for mossy-forest, and epiphytic ferns and orchids not so numerous as on the steep crests of Tafa Range. Red and pink Rhododendrons of several species figure in the fringe community, and others in shrubberies and epiphytic on the trunks of treeferns, make a brilliant display on the grasslands.

Crossing the Ero, the journey was continued past our later 9318' 2840 m camp site, approximately north-west along the range, the actual crest of which was reached at 10,072' 3070 m. From this position we had a fine, early morning view of Mt. Tafa; south-east beyond the Ero Basin the forests seemed to reach unbroken to Mt. Scratchely; while north-west on our route were fragmented forests and grasslands dotted with treeferns and low shrubs, such as we had traversed since leaving camp. Further on we had views of the Chirima Valley, which, shorter than the Vanapa Valley and not so wide, is completely forested; a circumstance which might point to comparatively recent human occupation, higher rainfall, or, most likely, the absence or poor representation of mid-mountain forest in the valley.

At the base of a dark forested height, which marks the junction of the short branch range that culminates, and ends, in Mt. Albert Edward, is a remarkable flat grassy depression, 4 or 5 square miles in area, (Neon Basin) having the appearance of a dried-up lake bed, in which Neon Creek, a tributary of the north-flowing Waria River, has its source. <u>Gahnia 4522</u>, in coarse yellow-brown tussocks, partly replaces the grasses on surrounding ridges; and we found at a bark shelter fresh signs of a Goilala hunting party.

On the branch range the vegetation takes on a different aspect. Mossy-forest species drop out one by one with increasing altitude, to be

[illegible]

during the approximate [illegible]

tributary of the north [illegible] river, and the [illegible]

in some [illegible]

[illegible]

[illegible]

entirely replaced, at about 3200 10,500' m, by Dacrydium?-Libocedrus coniferous forest, thinly mossed, and carrying a stiff underwood principally of Vaccinium macbainii 4293, 5-6 m high. Fires have in recent years played havoc with these lower sub-alpine forests. Apparently more inflammable than the mossy formation, they seem to have been consumed as they stood by fires affecting sometimes thousands of acres at one time. No regeneration of climax species was observed on open ground. Charred logs and stumps lie strewn about at intervals, and among dead conifers, and a few living ones, left standing on the slopes, thickets of Coprosma papuensis Oliver 4217, about 2 m high, are trying to re-establish forest conditions. In the many natural glades and treeless hollows between ridges, rigid short grasses form a close turf, as distinguished from the tussock cover of old burnt forest land, and a dense, sappy, herbaceous growth of silver-grey Potentilla papuana Focke 4230 and Epilobium 4289, Poa longiramea Hitch. 4195 and other annual grasses on areas more recently denuded. One peaty glade was full of potholes containing coffee-coloured water, and near it was adry swamp carpeted with grey lichens (Cladonia). Skirting sombre, wind-flattened forest, which caps the range in considerable bulk, after 6 1/2 hours of slow travel we again went into camp, at the upper end of a bleak depression littered with erratic boulders half buried in the ground, where, at 3430 m elevation, we found an unusually large bark shelter which showed signs of frequent occupation. Exhausted by the climb, and benumbed by the usual icy drizzle of early afternoon, the coast boys had difficulty in reaching camp, and all suffered the effects of altitude. In the morning the grass was white with frost, and trampled slush about camp half frozen.

The shelter at which we camped is used by the Kuama as a base for hunting operations on the big mountain, which rises above the forests close at hand. Flanking the mountain on the south-west and western sides, at an average elevation of about 3600 m, is an extensive, undulating, sloping plateau, at least five miles wide at the base, covered with short entirely prepared, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] with [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the south [illegible].

A chapter [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] martial operations [illegible] [illegible] [illegible] [illegible], which [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] extension, [illegible], [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] alpine grasses, and dotted with intensely blue small lakes. Fringed round the edges with dark forest, this drains east to the Chirima and west to the Giumu, which is an affluent of the Waria, and narrowing at the upper end, is produced into a rocky central spur which at approximately right angles connects with the lofty ridge, four or five miles in length, on which at the eastern end are the crowning peaks of the mountain, and at the western end another grass plateau, smaller than the first, but still of considerable extent. Garamu (Monckton's Main Peak), highest of the five principal peaks, rises to m (Archbold), 13,230 ft. (4032 m) according to Monckton. The quartz inpregnated grey schists which form the range, and outcrop rarely between Ero Gorge and the mountain, display marked stratification in the peaks, and a northerly dip from about 60 deg. to nearly vertical. On the lower plateau the rocks lie nearer the horizontal, have mostly a southerly dip, and form occasional fringing bluffs beneath with large blocks, detached by vertical fractures, litter the slopes. Landslides and screes do not occur. The plateaux are smoothed down and scoured out in depressions, in a manner suggesting glacial action (cf. Stanley op. cit. p.10). In these hollows, and on the shelves under the peaks, are the lakes, of which upwards of forty were counted on the mountain. Tree-line, at about 3850 m, is highest on the north slope, which falls away in steep timbered spurs to the Aikora River, as does the east side to the Chirima. At the present time, the south face and the windswept plateau lands are almost devoid of trees, and there is nothing to indicate the previous existence of forest other than in strips and patches under sheltering bluffs and on ridges with porous, stony or rocky soils. It seems safe to say that of existing grassland above 3550 m elevation, estimated at 50 square miles, fully two-thirds of the area is a natural condition, and would, under a more favorable climate, for the most part be capable of supporting forest. Treeferns were not observed above timberline on the peaks; but their

common tussock-grass associate of deforested areas and the warmer, probably post-climax natural grasslands of lower levels, ranges in reduced form to the summits. On the rocky top of Garamu, but a few square metres in area, the following flowering plants were found: Deschampsia? 4624, and four mat-forming grasses; Hypericum 4188, Drapetes 4223, Styphelia 4219, Coprosma 4215, and Diplycosia 4280 as small shrubs; Epilobium 4289, Anaphalis 4270, No.4307, No.4302, Gentiana 4269, Potentilla 4230 and P. 4308; besides No.4304 and two other ferns under slabs of rock.

The tents were pitched in a protected glade near timberline on the east or Chirima edge of the first plateau; and at this spot, called Gerenda by the Kuama, 3680 m above sea level, by boiling point, and about two miles from the peaks, we camped a month.

BAROKA CAMP

The elevation of this camp was 20 m. The dry, somewhat stony, irregular hills, which rise to about 100-150 m from a large permanent swamp at the edge of the Mekeo silt plains, are covered with savannah, broken here and there by rain forest patches, and fringed along the swamp margin by a narrow forest strip which extends some little distance up the gullies. Small collections of plants were made early in April, when most savannah plants, and a few forest species were in flower. Judging from the records of the nearest meteorological station - Kairuku (61 in.) - rainfall is probably about 60-70 inches.

Savannah Grasslands

The Baroka savannahs differ from those of the Port Moresby lowlands chiefly in Eucalyptus stocking, which on the outer hills is limited to E. alba (6-10 m) in quantity sufficient to give to the area a uniform grey appearance when viewed from a distance. E. clavigera appears farther in-

land, and with a phyllodineous *Acacia* enters the rain forests, where both trees attain their greatest dimensions. *Albizzia procera* occurs on moist flats, and rarely on the ridges, *Exocarpus latifolia*. A species of *Santalum* has been cut for export in the district.

Themeda triandra, the characteristic grass of the area, distinctly bunched or clumped, forms on the hilltops a shorter, thicker cover than is general on the slopes, except on the finer textured soils, where *Heteropogon contortus*, especially if grazed, may cover the ground fairly completely and be accompanied by small rosette plants such as *Ruellia 3750* and *Biophytum 3736*. The general run of stony or gravelly soils support a rather scattered growth of tall, hard stemmed grasses, e.g., yellowish *Themeda 3723*, glaucous *T. 3710*, *Andropogon 3713*, *Ophiurus 3724*, *Rottboellia 3702* (1-2.5 m), and in the wet season a wealth of interspaced more or less woody, often grey leaved annuals, of which more than half are legumes, e.g., *Desmodium heterocarpum*, *D. 3721*, *Indigofera trifoliata*, *I. linifolia*, *Tephrosia 3712*, *Evolvulus alsinoides*, *Anisomeles 3715*, *Psoralea 3707*, *Cassia mimosoides*, *Knoxia corymbosa*, trailing *Alysicarpus* 3718, and, entwining the grass culms *Cantharospermum scarabaeoides*, *Vigna 3700*, *Lepistemon 3709*. On flats between the ridges are grassless patches of hard, sandy, grey soil which in the wet season become thoroughly saturated and support a sparse ephemereal community of sedges and diminutive forbs, e.g., *Fimbristylis 3729* and *Pycreus 3731* (10-15 cm), *Mollugo pentaphylla*, *Mitreola 3737*, *Lindernia 3749*, *Bacopa floribunda*.

Leea 3697, *Grewia 3748a*, *Clerodendron 3781*, *Abelmoschus 3704*, and *Desmodium pulchellum* occur as shrubs scattered over the hillsides, and on moist flats and near forest borders (to which it properly belongs) *Securinega 3738* forms considerable shrubberies 1.5-2 m high.

Forests

Perhaps the forests are best described as a dry type of rain-forest on the higher ridges, very poor in herbaceous undergrowth, lianes and

epiphytes, from which there is a gradual transition through the gullies to monsoon-forest on dry points overlooking the swamp. *Gyrocarpus americanus*, which sheds its leaves and afterwards flowers in April, dominates not only the drier forest, but from a distance appears to be the constituent of striking pure stands of grey-boled trees, 20-25 m high, which on the far side of the swamp fringe the mixed forest and straggle out on to the grass plain.

Under the *Gyrocarpus*, and *Albizzia*, *No.3740*, etc., well spaced and 20-25 m high, and slender 10-15 m substage trees such as *Terminalia 3759*, *Randia 3744*, *Glycosmis 3745* and *Arytera littoralis*, smaller *Croton 3770* and *Breynia 3779*, in the forest near camp, mingle with a dense, tangled underbrush of semi-scandent shrubs characterized by *Harrisonia Brownei*, *Ehretia microphylla* and *Murraya exotica*, under which in places it is possible to walk erect, and in other parts with difficulty progress by crawling along the grownd. Shading is generally too intense for floor plants but in slight openings herbaceous *Pseuderanthemum 3747*, the fern *Microlepia speluncae*, and more commonly *Scleria lithosperma*, may be found growing in the thin layer of loose leaves that covers the ground. The borders in contact with grassland may be sharply defined, or, in the drier parts somewhat broken and produced into narrow shrubberies dominated by *Securinega 3738*, sometimes overrun by the "wild grape" *Columella 3761*, and containing semi-herbaceous *Fatoua pilosa* and abundant *Scleria lithosperma*.

The Swamp

Probably nowhere very deep, the swamp is roughly circular in shape, about a mile across, and but for a few central patches and narrow channels of open water leading to outlet creeks, crowded with a mass of *Hanguas malayana*, which roots in the mud and stands 2 m above the water, and in its leaf axils supports a scrambling Gleichenia and several flowering herbs. In marginal shallows which in the southeast season dry back to

the Hanguas body, is a very tall open stand of Phragmites 3777 (to 7 m), and floating amongst it brown patches of Azolla 3769, which is left stranded and roots in the mud as the water recedes. On the dry-land edge in an interrupted line of Polygonum 3764, Kyllinga 3746, Pouzolzia zeylanica, etc., and on the outer edge the reeds mingle with the tall Saccharum spontaneum? cover of the plain.

KUBUNA CAMP

Situated at 100 m elevation on the bank of the Kubuna River, in a ridgy country entirely rain-forested, this camp was occupied in late November and early December. Up to that time unsettled, hot, thundery weather had brought little rain to the lowlands, although rains in the mountains were responsible for a sharp rise in the river every night. Few trees were in flower. The soil of the river flats is a deep reddish-brown loam; that of the ridges a red clay loam containing waterworn boulders of hard, gabbro-like rock.

Generally, the forests, and especially the undergrowth, are poor in species. There are few plants with large leaves; few ferns, epiphytes and climbers. Handsome tall palms, which are abundant in some parts, tend to create an impression of tropical luxuriance, but the more exacting Pandanaceae, and herbaceous monocotyledons, appear to find the long dry season little to their

liking, and their scanty representation is a feature of the area.

The forests may be roughly divided into three main types, viz.:-

1. Forests of the Riverflats: This is a tall, heavily shaded forest of large trees set well apart, about 40 m high on the best soils, and often prominently plank-buttressed; e.g., Sterculia 3627, Pangium edule, Ganophyllum falcatum, Pterocarpus indica, on which Bauhinia Williamsii and a Calamus sp. were observed as canopy climbers. The clump-palm, No.5625 (8-12 m), particularly abundant near the river, figures in a high sapling substage, and young palms are the chief components of an exceedingly sparse undergrowth. Quantities of large woody fruits lie rotting beneath the trees, and there is an abundant production of seedlings, few of which survive as saplings. Small herbaceous floor plants occur rarely, and there is so little undergrowth of any kind that one could drive a motor-car through most of the forest. On the riverbanks, however, Selaginella 5618 and the fern Campium 5621 (15-30 cm) constitute a low ground community on surfaces washed clear of loose leaves; the bamboo Schizostachyum 5576 and Codiaeum 5685 appear as small shrubs; and under the break of the banks are the attractive clum-palms Actinophloeus macrospadix (4 m) and Leptophoenix Brassii (2-3 m) and large-leaved Saurauia 5624. Brassiophoenix drymophloeoides (6-7 m) is a slender palm of alluvial creekbanks.

2. Forests of the Ridges: On low, clayey ridges the trees are more compactly branched, not much more than 20 m tall, and the tall palms Orania disticha, with large orange-coloured fruits, No.5672 and Cyrtostachys Brassii, included in the canopy, or protruding slightly above it, are a prominent feature. On higher parts this passes into a type which carries much substage polewood, the canopy

Lindsay. [illegible] is a feature of the [illegible] roughly divided into three main types, [illegible]

1. *Forests of the Riverbanks*: This is a tall, fairly open forest of large trees set well apart, about 40 m high on the best soils, and often prominently plank-buttressed; e.g., *Sterculia* [illegible] *Terminalia edulis*, *Calophyllum* [illegible], *Pterocarpus indica*, on which [illegible] and a [illegible] sp., were observed as canopy [illegible] (25 ft) [illegible] near the edge, whereas it [illegible] other [illegible] are the [illegible] gradually [illegible]. [illegible] there is [illegible] small herbs and [illegible] plants occur rarely, and there is so little undergrowth of any kind that one could drive a motor-car through most of the forest. On the riverbanks, however, *Selaginella* [illegible] [illegible] [illegible] is [illegible] of alluvial riverbanks.

2. *Forests of the Ridges*: On low, clay ridges the trees are [illegible], not more than [illegible] tall [illegible] with [illegible] included in the canopy [illegible], are a prominent feature. In [illegible] this [illegible] into a type which [illegible]

trees 30-35 m high and usually spur-buttressed, and a characteristic of all the ridge forests is a thin undergrowth layer of slender trees and near-trees, 2-4 m high, of which *Chisochiton 5561*, *Barringtonia 5606*, *Phaleria 5657* and the palm *No.5622* are examples. Also present, in a sparse shrub layer 1-1.5 m high, are *No.5622*, with conspicuous yellow fruit exposing red seeds, *Anomopanax 5666*, *A.5602*, *Pleomele 5568* and acaulescent *Pandanus 5675*. *Eugenia 5573*, *Decaspermum 5601*, *Arytera 5560*, *Randia 5574*, *Drepananthus 5670*, *Dichapetalum 5577*, and *Horsfieldia 5668* are species of the substages; *Flindersia 5565* and *Wrightia 5570* trees of the canopy.

3. *Low Forest of Ridges*: This very distinctive forest, which covers a considerable gently sloping area near the camp, probably represents an old secondary condition following the clearing of the land for gardens. It differs from surrounding forest in tree composition (*Calophyllum 5654* and *Elaeocarpus 5640* are plentiful), the apparent even age of the trees, which are bushy-topped species 10-12 m high, arranged in a single layer, and in its well developed, even undergrowth stratum of harsh ferns, sedges and grasses, about 1 m high, comprising *Lophaterum gracile*, *Leptaspis urceolatus*, *Scleria 5563*, *Hypolytrum 5669*, *Tectaria 5572*, *Stenosemia 5651*, and especially *No.5571*.

Secondary Communities: Early stages in subseral development could be observed in the extensive river frontage clearings of the Mission establishment. Generally, cultivation is by native methods, which involve no labour in clearing beyond the felling and rough burning of the trees, and permit only a hasty cropping before vigorous ruderal and secondary communities gain possession of the ground. New areas are felled and burned each year in the dry season, and upland rice seeded-in with hoes amongst the stumps and logs after the rain commence. In the event of delayed germination rats destroy

[illegible]

of [illegible] forests in a thin undergrowth [illegible] [illegible]-[illegible]ed, 2-4 m high, of which *Chiesiella* [illegible] [illegible] [illegible] and the [illegible]. Also present, in a sparse shrub layer 1-1.5 m high, [illegible] with conspicuous yellow fruit appearing red [illegible] [illegible], *Dianella* 8865 and [illegible] [illegible] [illegible]

[illegible]

the land for gardens. It differs from surrounding [illegible] in composition (*Calophyllum* [illegible] and *Elaeocarpus* [illegible]) [illegible] the [illegible], which [illegible]

[illegible]

Secondary communities: [illegible] observed in the [illegible] river [illegible] clearings of the Mission establishment. [illegible], cultivation [illegible] which [illegible] no labour [illegible] clearing beyond [illegible] felling [illegible] of the trees, and [illegible] only [illegible] [illegible] and secondary communities [illegible] possession of the ground. New [illegible] are felled and [illegible] [illegible] also [illegible] the [illegible] after the [illegible]. In the [illegible] of [illegible] from

/

much of the seed, so that a second planting is necessary. The crop is harvested about May. A crop of sweet-potatoes follows, and as it develops so do the weeds. Passiflora foetida, Paspalum conjugatum, Panicum patens, etc., are well forward before the roots are ready to dig, and through their cover begins to appear Kurukuru-grass and seedlings of Macaranga 5636, M.5616, Pipturus 5615, Melanalepis multiglandulosa, cauliflorous Ficus 5606, and other fast-growing small softwood trees with usually pubescent, rather large pale leaves disposed at the periphery of the branches. Large Araceae and Zingiberaceae spring up with the woody plants in wet places, and thickets of Schizostachyum 5589 are characteristic of moist soils, particularly on riverbanks liable to flooding. On dry soils Kurukuru, assisted by fires, may delay for sometime the establishment of ligneous species. Finally, however, it gives way to the Macaranga community, and this to a group of small trees with harder wood and smaller leaves, such as Glochidion 5632, Antidesma 5633, Dalbergia 5598, No.5588 and No.5671, with which Nephrolepis 5684, in marginal masses 1 m high, and the climbing ferns Lygodium 5686 and L.circinnatum are commonly associated. The clearings were not old enough for further successional movements to be traced. Areas kept open for pastures are being overrun by scrubs of naturalized Psidium Guajava, the common yellow guava, which has been carried as far inland as Ononge by natives, and seems likely to become, on the lowlands, a serious pest.

Vegetation of Streams: In shaded, gravelly streams flowing through the forest are quantities of submerged Aponogeton 5567, and massed on the tops of boulders the semi-aquatic fern Phyllitis 5566. On the banks, and lining the river, which also has a gravel bottom, Neonauclea 5584, Eugenia 5583, E.5608 and Diospyros 5609, their lateral spread often exceeding their height of 2-5 m, represent the widespread waterside community of horizontally branched small trees

mentioned as occurring at Rona.

At normal level the river is flanked in many places by beds of gravel and coarse detritus which support a sparse pioneer vegetation comprised in part of coastal grassland species, and including Hygrophila 5629, Hemigraphis 5610, Aneilema 5673, Pollia 5582, Uraria lagopoides, the fern Odontosoria chinensis, the sedges Mariscus 5614 and Kyllinga 5687, and the tough shrubs **Phyllanthus 5612**.

DIENI CAMP

Situated in a small clearing at the lower edge of the afternoon cloud belt, at 480 m elevation, this camp in the outer mountains was occupied in the unsettled interval between the monsoon and trade-wind seasons, in late April and early May. Recorded temperatures ranged from 17 to 20 deg.C. at 6 a.m., and noon heat seldom exceeded 27 deg.C. The mornings were usually fine, but frequent rain after about 2 o'clock, mists, and occasional thunderstorms, kept the forests in an unpleasant, wet condition. The camp occupied an elevated position above a long line of vegetated volcanic bluffs; the only regular feature of an area of very steep, but not rocky, ridges cut up by headwater gullies of the Kubuna. Except for outpost patches of mid-mountain forest on the summits, the whole of the area is covered with rain-forest. Recent disturbance of the primary vegetation is restricted to the roadway and camp clearings. One very old village site was discovered in a plantation of bamboos, but the surrounding forest had developed to a stage not easily recognized as secondary. Most species of the undergrowth were found in flower; a condition not so general in large trees and lianes, though probably no better time could have been chosen for collecting in that particular region.

mentioned as distribution of [illegible].

At normal level the river is [illegible] by beds of gravel and coarse pebbles [illegible] vegetation submerged in [illegible], [illegible] *[illegible]* *[illegible]* [illegible] *[illegible]* the *Phyllanthus* 5611.

[illegible]

Situated in a small clearing [illegible] belt, at 400 m elevation. [illegible] was covered in the [illegible] in late April and early May. [illegible] from 17 to 22 deg. C. at 6 a.m., and noon heat seldom exceeded 27 deg.. The mornings were usually fine, but frequent rain after about 2 o'clock, mists, and occasional thunderstorms, kept the forests in an unpleasant, wet condition. [illegible] The [illegible], the whole of the [illegible] is covered with [illegible]. Recent disturbance of the primary vegetation is restricted to the roadway and camp clearing. The very old village site was discovered in a plantation of bamboos, but the surrounding forest had developed to a stage not easily recognized as secondary. Most species of the undergrowth were found in flower; a condition not so general in large trees and lianas, though probably no better time could have been chosen for collecting in that particular area.

The mid-mountain forest patches are comprised of pure stands of Quercus 3801 and Q.3839, 20-25 m high, open underneath and practically free of ground plants. Cryptocarya 3802 and Glochidion? 3799, their branches disfigured by parasitic brown clumps of Henslowia 3800, occur as slender subsidiary trees, supporting sometimes the small climber Tecoma? 3803, which bears, near the ground, beautiful pink and yellow flowers 10-11 cm long. Q.3839 also occurs scattered in rain-forest along the crests.

The rain-forests differ considerably in composition and general appearance from those of Kubuna, and the inner mountain forests of Mafulu, and they show a good deal of local variation in relation to soil moisture and exposure. Composition is extraordinarily diverse as compared one ridge or gully with the next, but considered in a general way, the forests of the gullies and more sheltered slopes are relatively tall and open as regards canopy and well supplied with substage, and an abundant, richly layered woody and herbaceous undergrowth, which thins out and practically disappears on the drier slopes, distinguishes them from the forests of the ridges.

Canopy Trees: The average height for canopy trees in the hollows is about 30 m, and on the ridges 20-25 m. Exceptionally large, usually plank-buttressed species may attain 40 m. The majority are furnished with short spur-buttressed supports, and nearly all have a close, grey bark. The following list of representative species, belonging to twenty? families, indicates to some extent the mixed nature of the forest: Elaeocarpus 3944 and Ficus 3857 (large plank-buttressed trees), Evodia 3915, No.3945, Endiandra 3813, Phoebe 3829, Parinarium corymbosum, No.3913, Canarium 3869, Vitex 3837, Commersonia bartramia, Barringtonia? 3855 with showy white flowers, Eugenia 3922 with bright brown, papery bark, Garcinia 3995, Podocarpus 5907 (the juveniles Agathis-like), P.neriifolius?;

and slender, though equally tall Myristica 3946, Pithecolobium 3932, P.3854, Pisonia 3912, Buchanania 3866, No.3805, Polyalthia 3852, Erythroxylum 3859.

Substage Trees: Mingling with the lower branches of the canopy layer, is a mixed substage of saplings and regular second storey trees, 8-15 m tall, which includes, on the drier ridges, Garcinia 3980, Ficus 3828, F.3832; on moist slopes Polyosma 3899, Ervatamia orientalis, Ardisia 3917, Psychotria 3921, Mallotus 3976, a splendid Pandanus with wide flung prop-roots, and smaller P.3851; and, along the streams, larger leaved Sterculia 3883, Artocarpus 3881, Randia 3887, and No.3984 with clustered, cauliflorous white flowers.

3rd Storey Trees: From 2 to 5 m high, and seldom dense enough to impede progress through the forest, this rich undergrowth layer (or layers) of the moister slopes - with the exception of Saurauia 3882, S.3886, Astronia 3888 and A.3889, which inhabit the gully-beds and are of more robust growth - is made up of slender, loosely branched small trees and tall shrubs, many of which have elongated leaves and attractive, racemose flowers. It includes the slight palms Areca rostrata and Leptophoenix microcarpa; rare examples of two small (barren) treeferns; Pandanus 3916, and numerous localized groups of trunkless P.3924, P.3948 and P.3955, with globose red or purple fruit heads. The chief components are Helicia 3981, Pisonia 3885, Eugenia 3936, E.3986, Dichapetalum 3834, Galearia 3878, Dysoxylum 3997, Ixora 3808, Chisochiton 3836, Ardisia 3841, A.3993, No. 3976, Antidesma 3937, No.3996, Mischocarpus 3994, Lasianthus 3861, Papualthia 3862, and Kibara spp. including 3798, 3938 and 3992.

Semecarpus gigantifolius with whorled leaves nearly a metre long, and Prunus 3978 with greenish flowers and fruit, are interesting rarities.

Low Undergrowth: A very distinct, crowded underlayer of small shrubs, dwarf palms, fleshy herbaceous phanerogams, and ferns, averaging rather less than 1 m, is developed beneath the small tree layer in moist places which receive a little extra light through the canopy, e.g. gullies, and small areas disturbed by the fall of some old tree, characteristic woody constituents being Psychotria 3827, Antidesma 3809, Ixora 3822, I.3941, Mycetia 3847, Cyrtandra 3797, No.3840, Lasianthus spp. including 3810, 3811, 3812, 3982, 3983 and 3984, Licuala linearis, No.3825 and Paralinospadix amischus; herbaceous species Elatostematoides 3795, No.3845, No.3846, No.3964; and ferns Athyrium 3848, A.3863, Tapeinidium 3821, Dryopteris 3849. Scattered over the forest floor, in deep shade, and characteristic more of the ridges, are the sedge Thoracostachyum 3931, orchids Nos. 3873 and 4002, the ferns Lindsaya 3979, Leucostegia 3919, No.3794 Angiopteris 3853, and, half concealed in rotting leaves, the tiny red saprophyte Sciaphila 3942. Trichomanes 3967 and Selaginella 3864, in association with mosses, cover wet rocks in the streams.

Costus 3907, C.3874, C.3893, Amomum 3830, Hornstedtia 3940, H.3951 (Zingiberaceae), Forrestia 3870 with showy purple flowers, Pollia 3786, P.3787 (Commelinaceae) and the anise-scented Homalomena 3949 (Araceae), from about 1 to 4 m high, figure in a group of robust, light-demanding, herbaceous undershrubs abundant on the banks of the larger streams and at the edge of clearings, but finding poor representation under the canopy. A magnificent Musa sp., 10 m tall, occurs at the heads of gullies, in wet positions open to strong light.

Epiphytes: With few exceptions, the epiphytes are xeric species of the canopy, often massed several together on the branches of aged trees, and bryophytes and small ferns forming mats on the bases of trees growing in moist situations. Henslowia 3920 and Notothixos 3910 are common branch parasites on exposed ridges. The canopy species collected, viz., Oleandra 3893, Davallia 3911, Polypodium 3868, Vittaria 3999, Lycopodium 3792, Medinilla 3895, Dendrobium 3939, D.3960 and Coelogyne 3792, doubtless form but a small part of a community difficult to discover without clear felling. The fern and moss mats are comprised of Hymenophyllum 3890 and Asplenium 3860, in association with Rhizogonium spiniforme, Chaeomitrium 3902, Trichostelium papuanum, No.3905, Neckera 3903, etc., most of which occur as well on logs and rotting wood, with the fungi Trametes persooni, No.3953, No.3981, No.4006, No.4007. Minute epiphyllous bryophytes, including Calymperes aeruginosum and No.3892, abound in the undergrowth layers.

Lianes: Large, spreading canopy climbers, though not particularly plentiful, occur all through the forest, e.g. Mussaenda 3947, Xanthoxylum 3833, Dioclea 3856 resplendent with large blue flowers, Erycibe 3917, Ardisia 3973, Calamus pseudozebrinus. On some of the drier ridges a scandent bamboo, Korthalsia 4000, and Flagellaria indica var. minor form a heavy entanglement sometimes borne down to the ground by its own weight. Among root-climbers, Epipremnum 3950, Ficus 3844 and F. 3929, massed about tree trunks, exhibit great luxuriance at the edge of forest clearings, as does Freycinetia 3850, Scrambling in the upper branches. Freycinetia 3838, flatly appressed to its support, and F.3908 are smaller representatives of this attractive genus, and Poikilospermum 3928 a rare scrambling shrub.

[illegible]: With [illegible], the [illegible] of the [illegible] the [illegible] breel. [illegible] and [illegible] they [illegible] of [illegible] under [illegible]. Virginia 2060 [illegible] 3512, the [illegible] [illegible] [illegible] [illegible] to discover [illegible] [illegible] [illegible] [illegible] in [illegible], shown in the [illegible] leaves.

[illegible] [illegible] [illegible] the [illegible] and [illegible], does [illegible] in the upper [illegible]. [illegible] to its [illegible], and [illegible] are smaller representatives of this [illegible], and [illegible] 2223 [illegible].

Vegetation of Clearings

Some evidence of the distinct successional relationships of rain-forest and oak-forest is to be seen in the vegetation on the road clearing, which follows for some distance the zone of contact of the two forests. Characteristic of the oak-forest patches is a very dense community dominated by erect ferns about 1.5 m high, e.g. *No.3794, Blechnum orientale*, *Tapeinidium 3821*, *Dryopteris 3806*, and *Athyrium 3807*, containing *Lycopodium cernuum* and much rambling *Gleichenia 3965*, a number of smaller ferns and herbs, and the shrubs *Otanthera 3782*, *Graptophyllum 3783*, *Boehmeria? 3789*, *Dichroa 3780*, *No.3791*, *Solanum 3814*, etc. There is, of course, a certain inter-change of species, and but for the annual or biennial slashing-down the rain-forest regrowth trees receive, they would, perhaps, overrun the fern communities as well as the roadway. As it is, repeated cutting of the trees (chiefly *Homalanthus populifolius* and *Macaranga* spp.) seems to have brought about a considerable replacement by impenetrable thickets of scrambling *Scaevola 3900* (2-3 m) and associated *Mussaenda 3896*, *Rubus moluccanus* and *Gleichenia 3965*.

Interesting plants of the camp clearing, which is covered with matted *Paspalum conjugatum*, are *Alocasia 3959*, clumps of *Piper 3796* (2 m), and two prominent second-growth species from higher altitudes - *Albizzia 5297* (30 m) and *Cyathea 5488*. Common "weeds" of the mountains, up to about 2000 m, include, besides the *Paspalum*, *Panicum 3820*, *Urena lobata* var. *scabriuscula*, *Polyscalis prostrata*, *Desmodium 3788*, and *Drymaria cordata*.

[illegible]

Some evidence of the distinctness of [illegible] forest was [illegible] in a [illegible] clearing, which follows the [illegible] the [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible] forms [illegible], and the [illegible] [illegible], etc. [illegible] species, and but for the [illegible] cannot outgrowth these species, they would, [illegible] [illegible] those [illegible] have brought about [illegible] of [illegible] [illegible].

Interesting [illegible] of the [illegible], which [illegible] [illegible], the [illegible] [illegible] [illegible] [illegible], besides [illegible] [illegible] [illegible].

MAFULU (GALA) CAMP

Elevation of camp 1250 m. Period of occupation 28th September to 20th November. The position of this camp has already been described on page It stood at the very clearly defined line of demarcation between the rain-forests of the lower slopes and the mid-mountain forests which clothe the upper slopes to near the summit of the range (1700 m), which is capped with a strip of mossy-forest. On page meteorological records are given for Efogi, a mountain station situated at approximately the same altitude about 60 miles to the south-east, and possessing, probably, a somewhat similar climate. Our arrival coincided with the ripening season for many trees with large fruits. Weather conditions were rather dry; the yam planting being delayed past the usual time for want of sufficient rain. Heavy thunderstorms commenced about the middle of October and by mid-November the ground was thoroughly soaked, the river constantly swollen, and landslides were beginning to occur on the mountain sides. In both rain-forest and mid-mountain forest a freer production of flowers followed the rains, first one canopy species then another breaking out in abundant bloom for periods of a few days; most of them scarcely noticeable at a little distance, and not a few would escape notice altogether but for the insects and birds that frequent them. Most of the species listed in the following account are from altitudes between 1000 and 1400 m.

Rain-forests

These, in the area under consideration, occupy the slopes from about the 1250 m level down to 580 m in the riverbed. They differ in composition from the forests of Dieni and are generally inferior in species and tree volume. The steep pitch of the slopes, and the

low water-retaining capacity of the rubbly grey soils, which are derived from slate, are adverse factors affecting tree growth and the development of undergrowth, and doubtless a further impoverishment has been brought about by the change to a more temperate climate, the addition of special mountain species failing to compensate the withdrawal of others whose habitat requirements approach the optimum for the formation. There is a corresponding alteration in subseral communities, which lack the vigour displayed at lower altitudes, and show reduced resistance to the competition of invading grasses. In the immediate camp locality only small areas of primary vegetation survive at the heads of gullies, but about a mile down the valley, beyond the populated zone, the forests are quite undisturbed except for damage caused by landslides.

The only practicable track to the river, 670 m below camp, passed through low second-growth forest down to the bottom of the gorge in which it flows, a rapid stream 30-40 m wide, impeded by bars of slate, large boulders, and blacks of limestone. Flat-branching *Ficus 5269* (15 m), fringing the banks, replaces the waterside small tree community of foothill streams, and on limited gravel beaches was found *Equisetum 5501*. On narrow terrances along the banks the small stinging-tree *Laportea 5490* was common undergrowth in the forest with rather a lowland facies; the grotesque epiphyte *Myrmecodia 5496* abundant on the trees, with *Antrophyum 5493*, *Dendrobium 5503*; and on shaded rocks were *Peperomia 5489*, coarse *Asplenium 5494*, *Cyclophorus 5492*, etc. A pocket of tall, upper-slope type forest, above flood level, carried a very distinctive stiff grass and fern undergrowth comprised of *Leptaspis 5541* and *Asplenium 5504*, and a few shrubs such as *Desmodium ormocarpoides* and *Pavetta indica*.

o/ ?

In general, the forests of the upper slopes, whether 15 m tall on sharp declivities or over 30 m tall on occasional benches or in gullies, are much alike in having little substage, and in the undergrowth being predominantly herbaceous. They are, in consequence, unusually open under the canopy. Undergrowth is reduced to a minimum on the drier sites, the trees shading practically bare, fine rubble; most varied in species in moist gullies, but most prominent, in an almost continuous stratum, on the gently sloping surfaces of benches. The tallest, **best developed forest located** in the area was on a bench at 1100 m altitude.

Trees: Common and characteristic large trees of the superior sites include Sloanea 5510, S.5210, S.5399, Microcos 5194, Pangium edule, Artocarpus 5184, Litsea 5378, Canarium 3869, Timonius 5340, Ficus 5398 and others, Dysoxylum 5426, and Terminalia spp. including 5431. Casuarina 5314 (30-35 m), rising above the general forest level, is very conspicuous in sheltered gullies near cloudline. Smaller species of the steep slopes, which constitute most of the area, are, to name the few examples found in flower or fruit, Alstonia macrophylla var. glabra (abundant), Pavetta 5143, Ficus 5326, F.5436, Pygeum 5292, Eugenia 5338, Ehretia 5404, and, confined to the gullies, Chisochiton 5367.

Slender Sterculia 5475, Ficus 5376, F.5227, Microcos 5373, and Timonius 5379, about 10-15 m tall, appear in a distinct, thin substage under the taller stands, in which the palm No.5489 is not uncommon, and Pandanus 5435, with soft red fruit-heads, also occurs. No.5440, from which "black palm" spears are made, is a rare species of the gullies.

Undergrowth: The abundant herbaceous ground cover of the bench forests is dominated in large part by No.5381 and Lepidagathis 5368 (Acanthaceae), rather less than 1 m high, and in parts by Bengonia 5508. Above this is produced a scattered shrub layer (1.5-2.5 m) comprising Elatostematoides 5370, Laportea 5375 and No.5380, and an intermittent small (3-5 m) tree layer of mostly Clerodendron 5199 and Psychotria 5188. Elatostemma 5374, E.5387, and E.5418 figure prominently in the complex communities of ravines, banks of streams, soak areas, etc., in which were found Pollia 5371, No.5432, No.5190, Hemigraphis 5384, Impatiens 5335, the orchids No.5400 and No.5509, the ferns Tectaria 5369, Asplenium 5194, Cyathea 5137 (a slight treefern), etc., and the shrubs Psychotria 5126, Pellionia 5149, Medinilla 5180.

Epiphytes: Low epiphytes comprise a few bryophytes and lichens attached to the butts of trees, between buttresses especially, and to the undergrowth in moist situations; and occasional clumps of Vittaria 5192, V.5424, and rarely Elaphoglossum 5484, within reach from the ground. Canopy species are anything but plentiful, but they include such striking forms as Myrmecodia 5401, hanging in scores from the branches of individual trees, the fern Dryostachuum 5425, and, derived from terrestrial stations in nearby oak-forest, Rhododendron 5305. Only one of the few orchids - Bulbophyllum 5505 - was found flowering.

Lianes: Large canopy climbers scattered over the area include Mucuna 5185, one of the magnificent red-flowering species known as "D'Albertis Creepers," Dioclea sp. (probably D.3856), Morinda 5187, Ficus 5428, No.5239, Strychnos 5252, Melodinus 5232, No.5427, Calamus 5422 and C. macrospadix. Stenochlaena 5195, with large radial fronds, is a trunk climber, and No.5507 a rare species of the substage.

Secondary Communities

As a result of clearing by natives, the primary vegetation has wholly disappeared from a large part of the Mafulu rain-forest area. Much of the land formerly cultivated, however, lies abandoned owing to a sharp decline in population in recent years. Trees are beginning to invade parts of the grass areas, which are considerable, and the secondary forests exhibit, indistinctly, more than one stage in reversion to the original type of vegetation. Although little disturbance has taken place in the main mid-mountain forest body, projecting strips which occupied the larger spurs down to about the 900 m level, have, for the most part, shared the fate of the rain-forest. It is on these spurs that the artificially-formed grasslands occur, but they are not confined to the mid-mountain forest soils. Similarly, there is an undoubted blending and overlapping of subseral communities along the contact of the two forests. An accurate delimitation of the respective rain-forest and mid-mountain communities being impossible under the circumstances, the species involved are grouped together in the following lists indicating the composition of (1) ruderal communities, (2) grass areas, (3) secondary forests, and (4) roadside and landslip vegetation.

1. Ruderals: The following examples of garden and roadside weeds include several naturalized species recently introduced from the coast: _Lepidagathis 5518_, _Ageratum conyzoides_, _Bidens pilosa_, _B.5524_, _Siegesbeckia orientalis_, _Emilia 5523_, _Crepis japonica_, _Euphorbia 5530_, _Oenanthe 5334_, _Triumfetta pilosa_, _Desmodium Scalpe_, _Urena lobata_ var. _scabriuscula_, _Physalis peruviana_, _Paspalum conjugatum_, _Digitaria 5522_, _Eleusine indica_, _Sporobolus longifolius_.

2. _Grasslands_: The prevailing, exclusive dominant over most of the grass spurs is _Imperata arundinacea._ There are, however, as in the Vanapa Valley, areas dominated by a very distinct community

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

of migrants from the coastal savannahs. These species, which occupy patches of dry, stony soil, include Ophiurus 5310, Setaria 5482, Sacciolepis indica ~~Panicum 5483~~, Apluda mutica; Carex 5318, Cyperus zollingeri, Fimbristylis 5480; Osbeckia chinensis, Desmodium microphyllum, Euphorbia serrulata, and the small forbs Dicrocephala 5319, Hypericum japonicum, Hedyotis 5315, Oldenlandia 5152, Lagenophora 5151. Melastoma 5248, also from the coast, occurs as a shrub. Common Imperata associates on old established grassland touching on oak-forest are Coleus 5311, Dianella 5224 and Spathiglottis 5340; and Vaccinium 5404, Schurmannsia 5291 occur as isolated small trees.

Pennisetum macrostachyum, Thysanolaena maxima, Ophiurus 5485 and Ischaemum 5432, rank grasses 1.5-2 m high, found on the moister soils and in gardens not long abandoned, are members of an initial community which in course of time yields either to Imperata or growths of secondary forest.

3. Secondary Forests: Among species which seem properly to belong to the mid-mountain forest, or at least are practically confined to the cloudline zone, may be mentioned Albizzia 5397 (20-25 m) and Cyathea 5488, the two most striking species in the whole area, Eurya 5341, Rhamnus 5416, Muehlenbeckia 5511 and Dodonaea viscosa. Small trees 5 to rarely 15 m tall, include Macararanga 5186, M.5297, Ficus 5260, F.5243, F.5412, Glochidion Ferdinandi var. supra-axillaris, G.5342, Saurauia 5414, S.5419, Evodia spp., Premna 5336, Piper 5396, Pittosporum 5136, Dysoxylum 5143, Callicarpa 5520, Grevillea 5264, Wendlandia 5406 and Decaspermum 5330, growing in dense formation, with shrubs such as Boehmeria 5539, Callicarpa 5520, Pipturus 5515, Mussaenda 5333, Solanum 5411, Acalypha Hellwigii, No.5218 common at the borders with rambling Rubus moluccanus and Gleichenia 5519, and containing a great many climbing or semi-scandent species, e.g. Scaevola 5246, S.5324, Uncaria 5258, Tournefortia 5514, Vernonia 5332, Microglossa volubilis, Securidacea 5331,

of Mikania [illegible] and [illegible] [illegible], [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] 1925 - [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible],

[illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible]. [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] of [illegible].

[illegible] [illegible], [illegible] [illegible] [illegible] [illegible]

and [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] and [illegible] [illegible] [illegible] [illegible]

[illegible] which have been on other plants [illegible] [illegible] [illegible]

of [illegible] [illegible].

[illegible] [illegible]: [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

and [illegible] [illegible], [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible],

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

Mucuna 5327, *Phylacium 5251*, *Hoya 5343*, *H.5392*, *H.5395*, *Lepistemon 5535*, *Clematis Pickeringii*, *Rhipogonum 5421*, *Buddleia asiatica*, *Campanumaea 5184*, *No.5257*, *No.5347*.

4. *Roadsides and Landslips*: Very similar conditions are produced by the displacement or removal of soil by landslips and in the making of roads, and in the Mafulu area the initial vegetation following these disturbances is much the same. Often the first colonists of raw soil surfaces are small mosses and fruticose lichens, especially *Cladonia gracilis*, preceeding a community of ferns and fern allies comprising tall *Dryopteris 5140*, *D.5144*, *D.5153*, *D.5197*, *D.5538* *Pteris 5321*, *Nephrolepis 5184*, *Polypodium 5271*, etc., occasionally *Dipteris conjugata*, and an abundance of *Gleichenis 5519* and *Lycopodium cernuum.* Characteristic flowering plants of moist sunny places include *Dichroa 5390* and *No.5382* as shrubs, *Elatostemma 5418*, and the showy balsams *Impatiens 5335* and *I.5417*.

Mid-mountain Forest

This forest of the lower mist zone occupies a broad belt of deep, red soil overlying, in the Mafulu area, either crystalline limestone or slate, and it is characterized throughout by the presence, and abundance, of Fagaceae in the tree flora. It blends in a transition zone with species of the mossy-forest, but at the lower edge its contact with rain-forest is very clearly defined as regards both soil and flora. It consists of two (perhaps more) associations very distinct in composition and appearance, i.e. a narrow lower strip of almost pure Fagaceous forest containing a remarkably rich, somewhat xeromorphic, undergrowth and abundant

Important

climbing Pandanaceae, and a wide upper belt of more composite taller forest carrying little undergrowth of any kind and few climbers and low epiphytes. Strips of mid-mountain forest extend down the spurs some distance below the main body, and it is in turn penetrated by rain-forest in ravines and gullies.

Mafulu is not sufficiently elevated for the full development of this forest, especiallly the upper association, into which an infusion of rain-forest species seems to have taken place from the gullies.

Trees: Generally, the lower association consists of a well illuminated stand of *Quercus 5217*, about 25 m high. On the ridges, however, it contains *Engelhardtia 5201* (Juglandaceae) in some quantity, occasional examples of *No.5339* (Rutaceae) and *Michelia 5430* (Magnoliaceae), and at the lower margin a considerable admixture of *Castanopsis 5216*, which dominates the strip forests running down the spurs. *Araucaria Cunninghamii*, rising above the canopy to 50-60 m, the tallest tree in the mountains, though not plentiful at this altitude, is very conspicuous on the spurs from the lowermost limit of the *Castanopsis* strips up to the mossy-forest. There is no substage apart from saplings of the canopy species.

In the upper forest first *Quercus 5276*, surrounded at the base by coppice shoots, and at higher levels *Q.5289*, with acorns 4-5 m tall, ?? containing in parts abundant *Dillenia 5282*. Among species of lesser importance are *Elaeocarpus* spp. including *E.5228*. The trees are mostly of large size, clear boled, and though widely spaced form a close canopy, under which *Pandanus 5283* (10-12 m) occurs in a patchy sapling substage.

[illegible]

taller growth [illegible] the [illegible]

[illegible] of [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

condition of [illegible] on [illegible] the [illegible]

valleys.

[illegible] the lower [illegible]

[illegible]

[illegible]

[illegible]

[illegible] of the lower [illegible]

[illegible] of [illegible], which [illegible]

[illegible]

[illegible] tree in the [illegible]

[illegible] at [illegible] altitude, is [illegible] on the [illegible]

the [illegible] of the [illegible]

forest. [illegible]

[illegible]

In the [illegible]

[illegible]

[illegible]

importance are [illegible]

[illegible] of [illegible], and [illegible]

[illegible]

[illegible]

Undergrowth: The lower forest is provided with a thin undergrowth layer of usually very slender small trees and shrubs possessing points of resemblance with the small tree stratum of Dieni rainforests; comprising Ardisia 5147, No.5175, No.5215, Antidesma 5344, Eugenia 4146, No.5409, rarely Rhododendron 5305 with splendid yellow and red flowers, and the palms Leptophoenix macrocarpa, Calamus anomalus, about 1.5-4 m high. The mass of the undergrowth is constituted by ferns of varying size and habit, which form irregular, interrupted layers from 2 to 15 dm high, containing in admixture Plagiostachys 5410 (2 m), Languas 5173, L.5432, No.5256, Psychotria 5304, Cyrtandra 5249, Begonia 5429, Apostasia 5438, No.5174, Selaginella 5169; the orchids No.5400, No.5262 with large yellow blooms, shrubby No.5159, No.5166 and No.5261; Carex 5323, Scleria 5322 and Hypolytrum latifolium; the ferns being Oleandra 5150, O.5303, O.5309 (of stiff, shrubby habit), Microlepia 5295, Athyrium 5165, Asplenium macrophyllum, A.5263, Nephrolepis 5142, Lindsaya 5156, L.5168, Dryopteris 5155, D.5158, Trichomanes 5162, No.5163, Polystichum 5177, Dryopteris 5155, D.5158, Trichomanes 5162, No.5163, Polystichum 5177, P.5202, Pteris 5437, No.5255, No.5231, Polypodium 5204, P.5205. Slow to decay, the highly cutinized leaves of the oaks litter the ground in a loose layer that affords very precarious footing on the steeper slopes.

The upper forest is likewise well supplied with leafy ground cover, but undergrowth, such as there is of it, is almost totally different as regards species, and quite commonly consists of but a few Pandanus seedlings scattered here and there, with or without the acaulescent palm Heterospathe sphaerocarpa and odd shrubs. Other species include the palm Calyptrocalyx Archboldianus (4 m), a treefern, a few small tuft ferns, Begonia 5235, Curculigo 5234, and more commonly Elatostemma spp.

Lateritic. The lower forest [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of seedlings [illegible] small tree layer [illegible].

The upper [illegible] tree layer [illegible] [illegible] [illegible] [illegible] [illegible] cover, [illegible] undergrowth, [illegible] [illegible] [illegible] of it, [illegible] almost wholly different as regards species, and [illegible] [illegible] [illegible] [illegible] few Eugenia seedlings encountered here [illegible] [illegible] [illegible] [illegible] [illegible] the [illegible] palm [illegible] [illegible] [illegible] [illegible] [illegible]. Other species include the [illegible] Calyptocalyx [illegible] (4 n), a few small [illegible] ferns, [illegible] [illegible] [illegible] [illegible] and more commonly Elatostema sp.

Epiphytes: The abundant epiphytic flora which characterizes the lower forest is essentially one of ferns, with which are associated numbers of small, generally inconspicuous orchids, e.g. Dendrobium 5301, No.5312, No.5205, No.5206, No.5211, No.5214, Eria 5213 and Bulbophyllum 5212. The nest-epiphytes Asplenium nidus and A.5167, growing half-way up the trees, Ophioglossum pendulum, and large scandent Dryostachyum 5230 are most prominent among ferns, the majority of which are massed or tufted nearer the ground or attached to trees of the undergrowth; other, small species present being Polypodium 5157, P.5176, P.5236, Cyclophorus 5383, Davallia 5234, Vittaria 5161, V.5232, Antrophyum 5235, No.5388, Ophioglossum 5274 and Trichomanes 5160; and also Lycopodium 5156. Minute Monogramme 5233 occurs in bright green moss-mats at the base of aged trees.

Few, if any, of the above species penetrate far into the upper forest. Though often rough-barked, and living under mistier conditions, the trees support remarkably few epiphytes, even mosses, visible from the ground, and only Asplenium 5287, Hymenophyllum 5288, Eria 5352 and No.5284, were collected.

Lianes: The genus Freycinetia attains in the lower oak-forest, generally, its greatest development in the territory visited by the Expedition. At least five species occur in abundance at Mafulu, those fertile being F.5178, shortly scandent or rambling in the undergrowth, F.5300 and F.5302, all with narrow leaves. They are the characteristic climbers of the forest, the only additional a large species observed, and that rarely, being Agapetes 5207, which is probably a hemi-epiphyte of mossy-forest deviation. Ficus 5293 and Trichospermum 5139 occur as root-climbers, while Hoya 5172, Parsonsia curvisepala, Rhipogonum 5436, and Lygodium 5556 find support in the undergrowth.

Epiphytes: The abundant epiphytic flora [illegible] characteristic of the lower forest is essentially one of ferns, with which are [illegible] numbers of small, generally inconspicuous orchids, e.g. [illegible] 3001, [illegible] 5016, [illegible] 5000, [illegible] 5081, and 5316. [illegible] Dendrophylax 5318. The [illegible] the [illegible], growing half-way up the trunk, [illegible] and [illegible] abundant [illegible] 5080 are most prominent among ferns, [illegible] majority of which [illegible] tufted [illegible] the trunks of the [illegible] [illegible] 5585, [illegible] 5031, [illegible] 5257, [illegible] 5601, [illegible] 5604 and Trichomanes 5140; and also [illegible] [illegible] 5055 [illegible] trees.

Few, if any, of the above species [illegible] in the upper forest, [illegible] under [illegible] conditions, the trees [illegible] for epiphytes, [illegible] from the ground, [illegible] Peperomia [illegible] 5818 [illegible] were collected.

Lichens: [illegible] generally, [illegible] in the [illegible] of the Expedition. [illegible] in abundance [illegible] abundant [illegible] and [illegible], all with [illegible] leaves [illegible] the characteristic [illegible] the only [illegible] large species [illegible] 5300 [illegible] is [illegible] Trichomanes 5152 [illegible] while [illegible], Thuidium 5456, and [illegible] 5588 find [illegible] in the undergrowth.

Freycinetia, reduced in individuals and species, persists throughout the upper forest; a large climbing bamboo forms occasional thickets at the higher levels; and *Aristolochia 5229* was found in the undergrowth.

Mossy-forest

As in the case of mid-mountain forest, mossy-forest is represented by a modified type in our Mafulu area. The section of range-top examined, immediately above the camp, is in the nature of a small limestone plateau, uneven with sink-holes and outcropping rocks, and having an elevation of about 1700 m. The range is a spur ridge of Mt.Tafa, separating the waters of the Auga and Kea Rivers. Mossy-forest covers the plateau in a stand perhaps 20 m high, or 10-12 m in exposed positions, very lightly mossed in most parts, and dominated by characteristic trees of the *Myrtaceae*. Much of the area is choked with an almost impenetrable growth of young *Pandanus*, probably *P.5366*, which is common as a substage tree 10 m tall. A large palm with abruptly tapered upper stem, and a striking *Dacrydium?*, unfortunately barren at the time, are interesting species not encountered elsewhere. Another notable plant is *Agapetes 5350*, common as a robust scrambling climber, bearing numerous large red flowers on the old wood. Sundry species which were not observed to occur in the parent forests of Mt. Tafa include *Freycinetia 5364*, *Vaccinium 5365*, *Mucuna 5351* (a lowland type), and the slender ferns *Hymenophyllum 5356* and *Lindsays 5359*, as climbers; *Dichapetalum 5360* and *Medinilla 5363*, as shrubs; *Burmannia 5353* with purple-tipped

white flowers, *Trichomanes 5286* and *Dryopteris 5354*, as small ground plants; and terrestrial or epiphytic in moss, *Trichomanes 5355* and *Hymenophyllum 5357*.

BELLA VISTA (1450 m) A SUBSIDIARY CAMP

At Bella Vista, primary plant cover consists of rain-forest remnants in some of the steep hollows and gullies, rather larger patches of lower mid-mountain forest, and a broad mass of upper mid-mountain and mossy-forest extending over the range top about 500 m above the level of the road.

Climatic conditions, and slope, are more advantageous to mid-mountain forest than at Mafulu, and an increased number of associate trees occur with the controlling Fagaceae in the lower belt, which alone was examined. Among these are *Endiandra 5469*, *Gordonia 5447*, and a species each of *Podocarpus* and *Elaeocarpus*; and *No.5464* figures in a sparse substage on the ridges. *Chisochiton 5477*, *Medinilla 5478*, and *Anomopanax* 5*454*, appear as shrubs in the undergrowth, which includes *Oleandra* 5466, *Athyrium 5444* and *Dianella 5468*, besides many species common at Mafulu. *Lycopodium 5467*, *Asplenium 5451*, *Bulbophyllum 5454*, *Oberonia 5446* and *No. 5452*, occur as epiphytes of no great importance; while *Medinilla 5476*, a mass of pale pink bloom, *Freycinetia 5458*, *Ficus 5477*, and *Poikilospermum 5450* are notable large climbers.

Additional rain-forest species for the Auga Valley are the canopy trees *Sloanea 5456* and *Sterculia 5455*; *Epipremnum 5462*, a very conspicuous climber, and *Begonia 5470* from the banks of a stream. Also, *Ficus myriocarpa*, *Macaranga 5465*, *Clerodendron 5448*, *Sauraria 5472*, with the *Cucurbitaceous* vines *Melothria 5449* and *No.5448* from second-growth areas. Most noteworthy, however, is a tall pinnate palm called Balu (Gulubia Brassii), which survives in

numbers on deforested slopes and gives a very beautiful effect to the old garden lands.

NEMODI (EAST MT.TAFA 2190 m) CAMP

Tall forest so closely invested this camp that only the mid-day sun, when unobscured by mist, reached the small clearing in which it stood. Misty conditions were general from about noon or a little later, and heavy rains frequent in the afternoon. Maximum temperature observations taken in camp from 15th to 23rd May (Archbold), gave a mean of 19.5 deg.C. for the nine days, and six 6.45 - 7 a.m. air temperature and relative humidity readings (14-19th May) gave means of 13.5 deg.C. and   per cent, respectively.

Nemodi Spur descends from Mt.Tafa as a sharp, razor-back ridge depressed at intervals by gaps or saddles. On the flanks of the spur are heavy forests of upper mid-mountain type dominated by Sama (Fagus? 5057), and on its summit low mossy-forest, fragmented into reduced outposts, surrounded by Sama forest, below the 2200 m level. A few scattered garden clearings occur in the Sama forest, most of them planted with Pandanus and overrun with scrambling bamboo. The bulk of the plants collected in a short stay at Nemodi were from the mossy-forest, in which many species, particularly orchids, were then in flower. These collections were largely duplicated, or the species observed, higher on the mountain in August and September. Therefore, to save reiteration, all the Tafa mossy-forests have been treated as a single unit and described in the section dealing with the later (2400 m) camp, while the following notes have a broad application to the Sama forests, which constitute a large part of the mid-slope vegetation between the two camp positions.

number [illegible] the
the [illegible] layer.

[illegible]

[illegible] closely investigated this same [illegible], [illegible] that [illegible], noted the [illegible] above. [illegible] conditions were [illegible] from [illegible] less. [illegible] rains [illegible] in the [illegible], [illegible] observations taken in [illegible] to [illegible] of [illegible] for the [illegible], [illegible] and [illegible] respectively.

[illegible] Open [illegible] Tufa as [illegible] areas [illegible] at intervals by [illegible] or [illegible]. On the [illegible] upon the [illegible] of [illegible] were [illegible] the fern (*Pteridium* [illegible]), [illegible] surrounded by [illegible]. A few [illegible] of the same form [illegible] plants which [illegible] with [illegible]. [illegible] of the plants [illegible] short [illegible] the [illegible]-forest, in which many species, [illegible] orchids, were then in flower. These collections were largely [illegible], higher on the [illegible] in [illegible] and September. Therefore, to save [illegible], all the [illegible] have been treated as a single unit and described in the [illegible] with [illegible] (1960) [illegible] while the following [illegible] application to the [illegible], which constitute a large part of the mid-slope vegetation between the two open positions.

to be confirmed

From a timberman's point of view, the Sama forests of the Vanapa Valley are probably unsurpassed in any known part of Papua, and they are of especial interest botanically as the first beech forests to be discovered in New Guinea. They are typically a well spaced stand of bulky, rough-barked, spur-buttressed trees up to about 45 m high, with massive thick-foliaged crowns, and clear boles of great length. A measured unbuttressed specimen of not exceptional size, had a circumference of 6.7 m at a metre above the ground. Two varieties or closely related species, both called Sama by the natives, are recognizable by the colour of the wood, one being red, the other white. Both kinds have been used extensively by Rev. Father Dubuy, of Ononge, in the construction of his Mission buildings, by whom they are esteemed above all local timbers as general purpose hardwoods.

repeated?

Circumstances permitted only a cursory examination of these fine forests. They clothe the mountain slopes from about 2300 m elevation under Tafa Peak to probably less than 2100 m below Nemodi, improving at the lower levels to almost pure stands. The best stands encountered contain a rather sparse understorey composed principally of young canopy trees, and apart from tangled bamboo (No.5106) in parts illuminated from clearings, they do not contain much undergrowth. In the Nemodi area they have usurped most of the positions which would normally be occupied by the lower mid-mountain forest belt, and, apparently, their lower contact is with rain-forest. It is, however, not unusual to find isolated on some of the drier ridges strips of lower association oak-forest dominated by Q.4173 and containing *Araucaria Cunninghamii*, and on other ridges, higher on the mountain side, oaks are relegated to positions in a complex substage containing such undoubted mossy-forest trees as *Phyllocladus hypophyllus*,

That a different point of [illegible] the [illegible] from [illegible] the
[illegible] Valley and [illegible] dense [illegible] in [illegible],
and they are of [illegible] not botanically on the other hand,
forests to be [illegible]. [illegible]
of a kind of [illegible], [illegible]
[illegible], [illegible]
[illegible]. [illegible]
also, [illegible] groups.
varieties are closely related [illegible], [illegible]
[illegible], [illegible],
[illegible], [illegible].
[illegible], [illegible]
by [illegible] are [illegible] general
hardwoods.

[illegible] permitted [illegible] of [illegible] the
forests. [illegible]
under [illegible]
at the [illegible]. [illegible]
[illegible]
[illegible]
[illegible],
the [illegible]
[illegible], and,
apparently, [illegible]. [illegible],
not unusual to find [illegible] of the [illegible]
[illegible]
[illegible], [illegible]
[illegible], oaks and [illegible]
such undoubted natives of trees as [illegible].

Podocarpus 5107, *P.5118*, *Elaeocarpus 5058* and *No.5059*. In mossy-forest transition areas on broad slopes *Xanthomyrtus* and *Phyllocladus* meet the Sama forest on equal terms in a somewhat lowered canopy, where they develop into big trees 25-30 m tall, and might easily pass unrecognized as mossy-forest species. It is interesting to note the gradual stunting of these trees as they mount the exposed summits to be finally dwarfed, contorted, and wind-flattened to less than 10 m.

The characteristic **undergrowth** is supplied by herbaceous shade plants of rather extreme type, largely *Elatostemma* spp., slender undershrubs of the *Zingiberaceae* (*Languas 4152*, *L.4153*), ferns (*Marattia 4064*, *Dryopteris 4128*, *Trichomanes 4130*), and under intense shade the leafless root-parasites *No.4100* (yellow) and *No.4100a* (red). *No.4144* and *Boerlagiodendron 4096* are fairly common shrubs, and *Eugenia 4146*, with very large red flowers, a notable member of a mixed layer of small (3-5 m) trees and canopy juveniles that appears with better lighting. In these lighted places mosses abound on the undergrowth, the butts of trees, and on wood decaying on the ground, species collected being *Dicranolosma subnerve*, *No.4163*, *Mniodendron 4164*, *M.comatum*, *Brotherella 4165*, *Pogonatum cirratum*, *No.4027b*, *Rhapidostichum leptocarpum*, *Ectropothecium* cf. *elegantipinnatum*; besides *Dawsonia superba* (2-3 dm), gregarious in considerable patches on the forest floor, and in appearance much like seedling pine trees. Associated with the mosses are various epiphytic ferns, and small bright-flowering orchids, e.g. *Dendrobium 4149*, *D.4151*, *D.4167* and *Gestichis 4129*. The upper branches of the

[illegible]

[illegible] of small [illegible] lichens. [illegible] (1-3 dm) [illegible] forest floor, and in compact [illegible]

[illegible] The upper [illegible]

Sama are bearded with grey and green lichens, and often from their lower branches hang long weeping masses of pink-flowering Vaccinium? 5008, the characteristic climber of the forest; others of note being Freycinetia 4147 and F.4964, both handsome species and the latter of wide distribution in the mountains. Openings, such as the roadway, carry in the moister sites a lush woody and herbaceous growth in which large fleshy Cyrtandra spp. (including C.4065 and C.4148) and velvety-leaved Melastomaceae figure prominently with variegated balsams and begonias, such as Impatiens 5138, I.5139, Begonia 5136 and B.5137.

The relatively dry, well lighted, mixed ridge forests referred to carry a less mesic undergrowth of correspondingly mixed Sama - oak-mossy-forest derivation, containing in addition to abundant Elatostemma and small Zingiberaceae, the slender rattan Calamus Brassii, and yellow Rhododendron 4028, Elaeocarpus 5058, and aphyllous Muehlenbeckia 5014 as shrubs, the latter equally at home as an epiphyte with Polypodium 5010, Psilotum complanatum and parasitic Henslowia? 5013.

MOUNT TAFA (2400 m) CAMP

This camp was occupied from 21st August to 25th September; a period of abundant rains, intermittent strong south-east winds, and regular mists, which, gathering on the peak during the morning, closed down on camp about midday and continued into the evening, to be followed usuallly by clear crisp nights. Hail was experienced on two occasions. Eleven 6.30 a.m. temperature readings, made on consecutive days, gave a mean of 10 deg.C.; the highest record being 11.5 deg. and the lowest 7 deg.

The camp was placed on a range crest saddle from which Tafa Peak rises to 2800 m on the south-east end, and from which the range continues approximately north-west at an average elevation of about 2500 m, giving off long spurs alternating with deep ravines on both slopes. Under the saddle on the western side is the termination of the Dilava Valley, and on the eastern side the head of a short creek which falls to the Vanapa at an average of about 300 m to the mile. The topography is uncomfortably steep, and numerous landslides, some recent, others very old, disfigure the slopes. Coarse crystalline rocks and others of finer texture are exposed by the landslides, and hard rounded boulders found here and there on the slopes have the appearance of granite.

With the exception of the landslip faces and debris piles, a few native rest clearings scattered at vantage points along the crests, the strip cleared for the roadway at 2300-2400 m on the slopes, and bamboo-infested pasture clearings aggregating about four acres at the camp, the whole of the range is clothed in dense forest differentiated into (a) rain-forest in the ravines, (b) mid-mountain forest represented by small patches of oaks about the 2350 m level, and (c) the mossy-forests. Of rain-forest species not more than 20 per cent bore flowers or fruit, the oaks were barren, and the main flowering season for mossy-forest trees had taken place about a month earlier. Two definite periods of reproductive activity were noted in the mossy-forests, viz. a fairly general season for angiospermous trees in July and August, and a season for orchids in May. The Taxaceae, which comprise a third important group, were generally barren during our term in the high mountains from May to September, and of seven species observed on Mt. Tafa only one bore a few stray fruits. Probably these trees react to the influence of the monsoons.

Rain-forest

The suppression of mid-mountain forest in the upper parts of the Vanapa branch valley (see page 31) and that of the Dilava, brings the rain-forest and mossy-forest in direct contact at a level which corresponds, approximately, with the lower limit of the noon cloud mass. On the shaded west and south slopes the clouds descend much lower than on the eastern aspect. In the Dilava Valley mossy-forest types persist in an ecotone with rain-forest down to 2150 m on the slopes and perhaps lower still, whereas, on the Vanapa side unaltered rain-forest mounts to 2400 m and gains the top of the range at the saddle on which we camped. There is little air movement in this hemmed-in eastern valley and it is bathed in sunlight long after the mists close down on the heights to darken and chill the mossy-forests.

The rain-forest ranges in height from about 15 m at the upper edge to a maximum of 35 m on little flats on the basal slopes and in the bottom of the valley. The trees develop straight, usually spur-buttressed boles, and stiff open crowns of not very spreading branches carrying, on the upper slopes, numerous green cushions and brown blanketing masses of mosses and hepatics in which grow various xeric ferns and small orchids. The ground is not mossed, nor do the trees produce adventitious surface roots as in the mossy-forest. Mossy-forest climbing bamboo supplies a thick undergrowth at the upper levels, and veils the small trees and saplings which constitute on parts of the lower slopes a substage too dense to admit of much intruding woody or herbaceous undergrowth. The tallest slope-forest is open in character under the canopy and contains a luxuriant low undergrowth of the Elatostemma type, with a few large ferns and more or less fleshy shrubs. Most undergrowth species of the slopes may be found in rich admixture with distinctly

[illegible]

This [illegible] is a mixed-rain forest in the [illegible] [illegible] of the Terbga Creek will [illegible] [illegible] of the [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] a level. Which [illegible] [illegible], the lower part of the [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] forest [illegible] [illegible] slopes [illegible] [illegible] lower still, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], the [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] valley and [illegible] [illegible] [illegible] [illegible] [illegible] until the [illegible].

The rain-forest canopy [illegible] [illegible] [illegible] the upper edge [illegible] [illegible] [illegible] on the lower slopes and [illegible] the [illegible] of the valley. [illegible] [illegible] [illegible] [illegible], [illegible] forest canopy. [illegible] the [illegible], [illegible] and brown [illegible] mosses [illegible] and [illegible] various [illegible] ferns and [illegible]. The [illegible] [illegible] [illegible] [illegible] surface [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] of the [illegible], and [illegible] the small [illegible] [illegible] [illegible] of the lower slopes [illegible] [illegible] [illegible] woody or herbaceous [illegible]. The [illegible] forest is open in character [illegible] the canopy [illegible] [illegible] [illegible] of the *Philippine* type, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] tropical Araceae and large Zingiberaceae on the constantly moist banks of the little stream which drains the valley. Slight shrubs and seedling trees are plentiful there, and everything draped in a thin covering of moss, in which are conspicuous foliose and collemaceous lichens, delicate filmy ferns and slender climbing species with radial fronds standing out stiffly from the trees.

Trees: *Croton 5081* and *Elaeocarpus 4954*, with stiff scurfy scaly foliage, impart to these forests their characteristic grey appearance as viewed from above; in which they present a strong contrast with the dark glistening leafage of the mossy-forests, and the slightly brown smooth foliage of the Fagaceous forests. *Mallotus 5077*, *Elaeocarpus 4896* and *Meliosma 5024*, with scleric grey or brown pubescent leaves, come next in importance in the canopy layer; species less abundant being *No.4916*, *No.5003*, *Ficus 4948*, *F.5398* common in mountain rain-forests from Dieni upwards, *No.5046*, *Homalium 5045*, slender *Macaranga 5052* with very large brown leaves, and *Hibiscus?4950* with magnificent dark red flowers 12-14 cm in diameter. Fruits of a *Garcinia* were picked up by Dr. Rand, but the tree could not afterwards be located.

Associated with the canopy trees is a very fine *Pandanus*, apparently identical with a species scattered through the mossy-forest, and resembling *P.5366* from Mafulu. In *No.4974*, a tall palm of the substage, the family attains the vertical limit of its range in regions traversed by the Expedition. Trees of the substage, mostly from gullies, include *Eugenia 4910* with showy pink flowers, *Meliosma 5050*, *No.5043*, *Saurauia 4837*, *Psychotria 4838*, *P.4881* and *Evodia 4858*. The treefern *Cyathea 4971*, rising above the undergrowth bamboo, attains large size in places favourably lighted.

tropical [illegible] and large [illegible] the constantly moist banks of the little stream which drains the valley. Slight shrubs and seedling trees are plentiful there, and everything is clad in a thin covering of moss, in which are conspicuous foliose and [illegible] lichens, delicate filmy ferns and slender climbing species with aerial [illegible] standing out stiffly from the trees.

Trees [illegible] 5051 and Elaeocarpus 4956, with [illegible] [illegible], [illegible] to these forests their [illegible] [illegible] [illegible] from above; to which they present a striking contrast [illegible] the dark glistening leaves of [illegible], and the slightly [illegible] of the Elaeocarpus trees. [illegible] 5077, Elaeocarpus 4956 and [illegible] 5051, with [illegible] green or brown pubescent leaves, [illegible] in [illegible] in the canopy layer, [illegible] less [illegible] being No. [illegible]. [illegible] [illegible] 5108 common in mountain rain-forest [illegible] upright, [illegible], [illegible] 5043, slender [illegible] 5075 with large green leaves, and [illegible] with magnificent [illegible] and flowers [illegible]. [illegible] of a [illegible] by Mr. [illegible], [illegible].

Associated with the [illegible] trees is a [illegible] apparently identical with a species scattered through the [illegible] forests, and resembling [illegible] 5066 from [illegible]. [illegible] 5074, a tall [illegible] of the subcanopy, the family attains the vertical limit of its range in regions traversed by the Expedition. Trees of the [illegible], mainly from gullies, include [illegible] 4410 with showy white flowers, [illegible] 5006, [illegible] 5043, [illegible] 4879, [illegible] 4139, [illegible] and [illegible]. The treefern Cyathea 4571, rising above the undergrowth [illegible], attains large size in places favourably lighted.

Undergrowth: The mossy-forest bamboo, No.5106, of rambling habit where lighting is good or climbing as the forest thickens, inhabits most low undergrowth on the upper slopes. Under more favourable conditions Cyrtandra 5042, C.4984, No.4949, Psychotria 5102, Boerlagiodendron 4951, No.4949, No.5019, rare little Pleomele? 5111, and No.4998 are present as shrubs and bushes, the last with the small treeferns No.4990 and No,4991 also common in the mossy-forests. Herbaceous undergrowth includes Elatostemma 5000, E.4830, Pilea 4829, P.4831, P.4832, and Begonia 5109 in even strata, Peperomia 5101 in moss on decaying logs, P.5105 on the banks of a gully, and, on soak areas especially, Homalomena 5021 and very tall (to 3 m) clumps of No.5017 and No.5083. Among the ferns are Marattia 4064, Athyrium 4859, A.5044, Dryopteris 4873, Antrophyum 5103 from stones in a stream, and Trichomanes 4999. The leafless woody root-parasites No.4100 and No.4100a, like several other undergrowth species common as well in the Nemodi Sama forests, are scattered in damp places heavily shaded.

Climbers: These comprise Mussaenda 5040 and Psychotria 4857 as abundant large canopy lianes; Freycinetia 4961 and F.4964, the first appressed in dense masses to supporting trunks, the latter a magnificent species prominent in the treetops; a large Epipremnum like E.5462; and low on the trees Piper 4969, P.5113 and Stephania 5104.

Epiphytes: Rhododendron 4855 with carnation-scented pink flowers, equally at home in the tops of rain- and mossy-forest trees

or terrestrial on landslips, its fragrance heavy in the air when the mists are down, is the most notable epiphyte. *Schefflera 5018* forms a lanky bush in the middle of high trees, on which *Polypodium scolopendria* and other hardy ferns root in the canopy moss, and only *Gestichis 4908* and *No. 4856* of numerous orchids were seen in flower. *Lycopodium 4997*, *Asplenium 4839*, *A. 4840*, *A. 4980* with climbing rhizomes and flat fronds radially arranged, *Polypodium 4860* also scandent, *P. 4970*, *Hymenophyllum 4976*, *H.4979* *Adiantum 4967*, and *Lindsaya 5079* occupy low stations in moist shade, with the remarkable *Spiridens longifolius* (to 50 cm), standing out stiffly from the trees, and various smaller mosses. *Mniodendron palmaeum*, *Acanthorrhynchium 5048*, *Brotherella 5049*, *No. 5080*, *Sciadocladus 5100*, etc. are matted on rotting logs.

Mid-mountain Forest

The oaks in a few patches on exposed points of spurs were ~~unfortunately not fertile~~ not in flower or fruit. They resemble, however, *Quercus 5276* in appearance. Landslips on these points are of interest in that they support in association with wide-ranging *Dodonaea viscosa*, *Trema 4927*, Kurukuru grass, and tangles of *Gleichenia 4922* on dry earthy screes, *Gleichenia 4924*, *G. 4929* (both erect palmate species), *Odontosoria chinensis*, the herbs *Dianella 5120*, *Crepis japonica*, *Scutellaria 4023*, *No.4024*, *Gentiana 4928*, the pink orchid *No. 5055*, and on the rock faces *Bryum argenteum*, plants which were not found elsewhere on the mountain. The gentian and the orchid establish a connection with the high grasslands of the Main Range, which lie at a distance of less than 20 miles across the Vanapa Valley, and on which the first named plant is of common distribution. The orchid, however, was only observed to occur in Murray Pass, where it grew in abundance over a limited area at 2840 m, and there, curiously enough, in close proximity at the forest edge and apparently not long established after a fire, was found Polygonum 4968, a rambling species plentiful in clearings on Mt. Tafa, and, like the orchid, encountered nowhere else. Murray Pass, the

involved

[illegible]

[illegible]

[illegible]

[illegible] Panama Canal, and on [illegible] the [illegible]

[illegible]

lowest part of the Main Range for many miles, is approximately opposite Mt. Tafa north-east across the valley and therefore not in the direction, either way, of prevailing strong (south-east) winds which might assist the dispersal of the orchid, but which would not in any case avail in transportation of seeds of the Polygonum. They could with difficulty be regarded as dispersed by man, the journey between the two points being a matter of at least two days. Circumstances seem to point with more probability to an interchange by means of birds passing to and fro in high flight across the valley. There is on Mt. Tafa abundant evidence of recent migration of other Main Range plants of the open ground and forest margins and their establishment on disturbed sites such as landslips and clearings in the mossy-forests; and it is on such places, and in the epiphytic flora, that the majority of species occuring on the two range summits are found, the composition of the forest masses being in large measure at least specifically different as regards trees.

in this vol? (apparently represented [illegible]).

Mossy-forest

Very distinct in appearance, floristic composition, and systematic relationships, this forest of the upper regions of clouds and mist is characteristic of all but the most elevated positions on the lofty ranges of the interior. It is not necessarily low and stunted, nor is it always conspicuously mossy. Tree stature and degree of mossiness are matters largely determined by the measure of exposure to prevailing winds; the more stunted the forest the heavier the coating of moss on trees and ground. On Mt. Tafa it clothes the crest and upper slopes of the range from end to end and descends in strips down the principal spur ridges to probably 2000 m in the Vanapa Valley and under 1500 m on the western watershed. The range itself is produced into a narrow culminating ridge which trends approximately south-east and north-west and thus offers in spite of its superior elevation, less obstruction to the trade-winds than

some of the diverging spurs. The forest is, in consequence, taller and better grown at 2700 m near the top of the main peak than at 2300 m on the spur that descends across the path of the wind to Nemodi Camp.

It is most typically a forest of rather thick-boled shortened trees with rough bark, wide richly branched twiggy crowns, and small glossy leaves, interspersed with species of slighter stature; the general canopy level being about 10 m. The heavier trees develop massive ascending branches, often from a short trunk divided into two or three divergent stems close to the ground. Though much stunted, contorted, and wind-clipped in exposed positions, the trees were not in any place observed to adopt prostrate, or, as a body, even sharply inclined habits of growth. The forest floor is springy with dull green moss permeated by a mass of tree roots spreading over the ground, littered with dry leaves and twigs, and easily penetrable with a stick to about 3 dm between trees or nearly a metre in the mounds which commonly form about their bases. Beneath a thin layer of peat is a stiff clay soil in which the trees root shallowly. Delicate, fuzzy mosses and hepatics encase the trees, spread along the limbs in soft tufts and patches, and interlace the terminal twigs. In the upper branches grey foliose lichens abound, and in exposed sites the tops of the trees are draped with streaming Usnea? and beards of bright brown moss. Though normally turgid and soggy with moisture, the mosses soon dry out. After a few hours of sunshine and wind they may be stripped from the trees and, with a little judicious blowing and fanning, used for lighting fires. Moisture is, however, more effectively retained by the ground mosses, and on that account the forests were always more or less damp, and at no time in a condition sufficiently dry to carry fire, during our stay of over three months at high altitudes. A rich, but for the most part inconspicuous, flora of epiphytic ferns and orchids characterizes this forest. There is little undergrowth apart from seedlings of the dominant trees, which are in places numerous, and few climbers.

[illegible]

[illegible] chambers [illegible]

[illegible] and small, glossy

leaves, [illegible]

[illegible]

[illegible] which commonly [illegible]

[illegible]

Under less rigorous conditions below the crests the forest takes on a different character. Mosses thin out on trees and ground, epiphytic and undergrowth species decrease in number and abundance, and additional tree species appear in the canopy. This is the zone of dense climbing bamboo undergrowth, particularly on the warmer and better lighted slopes, where *Podocarpus* spp. are well represented in a forest scarcely mossy and approaching 20 m in height in Mt. Tafa camp locality. There is little bamboo undergrowth in undisturbed forest on poorly insolated slopes, and there shade-tolerant *Xanthomyrtus* spp., widely spaced, attain large dimensions.

Trees: Tree species, considering the extent and vertical range of the forest, are few in number. *Xanthomyrtus 4854* (=*No. 4040?*) and *Phyllocladus hypophyllus*, occuring in varying quantities throughout, constitute the mass of the Mt. Tafa forests, although they may be almost entirely replaced in some parts by slender *Podocarpus imbricatus* and *P. 5118*. *Podocarpus 4962*, differing from other local members of the genus in its minute glaucous leaves and superior stature, and of localized distribution, is another important tree. *Decaspermum 4836*, *Xanthomyrtus 4982*, *X. 4036*, X. 4039, *Elaeocarpus 5002*, and *No.4888* are crest trees of secondary importance, and *Helicia 5063*, *Fagraea 4084*, *Timonius? 4077* and *Arthrophyllum 4062*, the latter an araliad with large rayed leaves, associates of very rare occurence. Characteristic more of the slopes, where they are mixed with most of the foregoing species, are *Astronia 4953*, *Ilex 4897*, *Eurya 5073*, *Decaspermum 4836*, *Elaeocarpus 4102*, *E. 5058* and *E. 5004*, the latter with large bluish fruits 5 cm in length. Another araliad, Schefflera 4889, forming a small substage tree or more often climbing or hemi-epiphytic, is common. There is, as a rule, no substage, and apart from this notable species and small *Podocarpus 4034*, only Eugenia? 4101, No.4119, and Vaccinium? 4037, in unusually stunted and

wind-beaten forest on Nemodi Spur, were met with in that rôle. Rising conspicuously above the forest, and by far the tallest trees, are odd specimens of *Libocedrus papuanus*, an immigrant conifer from high altitudes on the Main Range. A large glaucous *Pandanus*, incongruous in surroundings of moss and mist, and probably owing its presence to cassowaries, birds active in the dissemination of many plants with large fruits, though common enough as a seedling, seldom reaches maturity on the crests, and was not seen fertile.

Undergrowth: On Mt. Tafa, the characteristic climbing or scrambling bamboo undergrowth of this forest, which provides one of the greatest obstacles to mountain travel, is supplied by irritant-hairy No.5106, which, though troublesome only on the slopes, is present as an attenuated rambler on the most exposed crests. The most important of its few associates in crowded areas is *No.4998*, an attractive little shrub with glossy leaves and fleshy blue flowers. The sparse woody undergrowth on crests is comprised of *Drimys 4124*, *D. 4046*, *Discocalyx 4907*, aromatic *D. 4958* and *D. 4959*, as broad-leaved shrubs or small trees of about 2 m; slender semi-scandent *Alyxia 4117*, *Dichapetalum 5060*, *Piper 4120*, and *Agapetes 4109*; and less commonly *Elaeocarpus 4069*, *Vaccinium? 4031*, *Muehlenbeckia 4113*. Stiff *Lycopodium 4994*, *Gleichenia 4960* in reduced form, and G. 4847 form thin tangles about the trunks of trees and spread over shrubs of the undergrowth. Delicate *Hymenophyllum 5033* and the remarkable *Dawsonia superba* are everywhere plentiful on the ground moss; Trichomanes 4116 with stiff curly fronds a rare associate; and scattered throughout with the slender herbaceous undershrubs *Languas 5025*, *No.5074* and No.5082 (occasionally epiphytic), are the larger ferns *Plagiogyria 5031*, *Dryopteris 5032*, *D. 4104* and *No.4115* (3-6 dm). As small treeferns, up to 1.5 m high, *No.4990* and *No.4991* occur most frequently on shaded slopes, and enter the rain forests.

Epiphytes: Most of the bryophytes and lichens collected on Mt. Tafa

were unaccountably lost on the coast, and with them a number from Murray Pass. *Spiridens longifolius* and *Pterobryella papuensis*, standing out stiffly on slender *Podocarpus* spp., with one or more cushion-forming species, are most conspicuous and least common among epiphytic mosses. The soft coverings of ground and lower tree trunks are very similar in composition, and the commonest associated small fern, *Hymenophyllum 5033*, is equally abundant terrestrial or as a low epiphyte with mats of grey *Trichomanes 4890*, *T. 4891* and *T. 4114*, creeping *Humata 5117*, *Polypodium 4052* and *P. 4053*. Higher on the trees are *Prosaptia 5026*, *P. 5034* and *Asplenium 5027*, with pendent fronds almost a metre long, *A. 4058*, *Polypodium 4903*, *P. 5028*, *P. 5039*, *Vittaria 5035*, *Hymenophyllum 5030*, *Hymenolepis 4973*, *H. 5038*, *Elaphoglossum 4112*, *Lindsaya 5112*, *Lycopodium 4121*, *L. 4122*, etc., in varying quantities with a host of small orchids, including *Dendrobium 4043*, *D. 4123*, *D. 4904*, *D. 4983*, *D. 4988*, *D. 4988a*, all colourful, attractive species; *No.4050* and *No.4051* with pure white flowers; *Nos.4042*, *4044*, *4048*, *4049*, *4056*, *4087*, *4088*, *4089*, *4090*, *4092*, *4092a*, *4107*, *4108*, *4126*, *4843*, *4892*, *5036*, *5037*, *Agrostophyllum 4045*, and *Bulbophyllum 4070*.

Seemingly confined to the rough branches and branch axils of *Xanthomyrtus 4854* are the shrubs *Rhododendron 4855* with pink and *R. 4094* with red flowers, *Vaccinium 4032* and *V. 4893*, the two last of infrequent occurrence and inconspicuous. One of the most interesting denizens of the mossy-forest, and an unexpected find at high altitudes, is *Hydnophytum 4093*, the swollen tuberose stock, 15-20 cm in diameter, hollowed out in galleries containing water and often tenented by a small species of frog which breeds inside the plant, but none of the numerous specimens cut open showed any sign of occupation by ants. Parasitic mistletoes are represented by *Loranthus 4125*, of climbing habit, L. 4095 and L. 4972, all three with red flowers.

Climbers: Fairly common on the crests, climbing by means of stem

roots buried in the moss, are *Piper 4047*, *P. 5029* and *P. 5116*; and Trichosporum 4981, of similar habit, is found on sunny slopes. Very rare species of diverse habit include *Tecoma? 4103* with large pink flowers, first met with in oak-forest at Dieni (480 m), *No.4105*, an extremely slender *Freycintia* sp., and robust *F. 5001*. Most characteristic and abundant, however, is *Vaccinium 4038*, a mass of waxy pink bloom in May, and without exception the showiest plant in all the mossy-forest. Like its local congener *V. 4845*, a green-flowered species of which but a solitary specimen was found, it develops a compact bushy top of almost tree-like proportions, and is probably hemi-epiphytic in habit.

Native Rest clearings in Mossy-forest

These little clearings along the hunting paths and lines of inter-village communication are located with nice discrimination to catch the maximum warmth of the morning sun, and at the same time command the most magnificent views of the surrounding country. Inhabiting them is a distinctive community of light-demanding plants which shows strong affinities with the grassland bordering communities of the Main Range mossy-forests. On the peaty, burnt over soil are close mats of the moss *Macromitrium 4159*, prostrate and creeping *Lycopodium 4850*, *L. 4851* and *Vaccinium 4848*, low clumps of *Languas 4079*, *L. 4080* and *L. 4081*, species most variable as to station; herbaceous *Scutellaria 4900* and red patches of *Hedyotis 4067*; dwarfed *Dipteris 4071* and the small bushes *Gaultheria 4066*, *Rhododendron 4074*, *R. 4175*; surrounded at the edges with scrambling *Gleichenia 4847*, *G. 4960* and *Pteridium 4634*, and as shrubs of about 2 m *Rhododendron 4894*, *R. 4083*, *Rhodomyrtus 4895*, and *Eleaeocarpus 4078*. On
To be confirmed { the largest clearing was found among tussocks of *Carex 4068* a solitary example of *Cyathea 4063*, and one of the grassland treeferns of the Main Range. The standing forest as a rule is fringed with a thick, graduated young tree growth of *Xanthomyrtus 4854*, *X. 4853* and *Phyllocladus hypophyl-*

lus; while on ground cleared but afterwards left undisturbed, occur the small sub-seral trees or shrubs *Alphitonia 4082a* with large truncate fruit, *Trema 4082*, No.4852, *Dodonaea viscosa* and the arborescent composite Olearia *Vernonia 4073*.

Landslips

Generally, the vegetation of landslip faces and spoil piles is very different from that of other disturbed areas and suggest again some derivation from the Main Range; some epiphytic Polypodiums, for instance, being identical with species found at 3680 m on Mt. Albert Edward. A noteworthy feature is the adoption of terrestrial stations by *Rhododendron 4855* and a number of orchids common as epiphytes in surrounding forest, especially rain-forest. The majority of landslips commence on mossy-forest slopes and end far below in the inaccessible depths of rain-forest ravines, and nearly all are on the Vanapa side of the range.

To be confirmed

Most important in point of size, and diversity of vegetation, is the great arrested slip near camp (page 31), which was already very old and the subject of native tradition when the pioneer missionaries entered the district 20 years ago. Held in check by the narrowing sides of a gully which it fills, and still imperceptibly moving, the spoil deposit of churned up earth and small bits of weathered rock is some 500 m long from top to bottom, and at the road crossing half-way down about 80 m in width. It is more than twice as wide at the upper end, where a piled up ridge of earth, connecting the points of the semi-circular slipface, forms a basin in which is a deep secluded lake, about 80 m long and 50 wide, fringed on one side with beds of bur-reed (*Sparganium 4886*), and without any surface outlet. Drainage from the lake issues in a little seepage stream which, disappearing at times in surface cracks and irregularities, finally enters a smaller lake at the lower end of the slip. At the upper end of the spoil deposit, where the soil has undergone little alteration in struc

ture, the covering vegetation to the water's edge is a dense young forest of rain-forest regrowth type, containing a good deal of climbing bamboo and comprised, in part, of Alphitonia sp., Macaranga 4862, Saurauia 4878, S. 4963, No.4870 and Evodia 4883, concealing many old logs and sheltering a few luxuriant clumps of Alpinia? 5083 and Amomum 5099, 2-3 m high. In contact with this on the western side of the lake is a patch of intermediate mossy-forest growing in upright position as lodged with the supporting soil from above. A few trees similarly transplanted stand in water along the shores, either dead or still living, and supporting numerous epiphytes, such as Oleandra 4880, Polypodium scolopendria, P. 5089, slender sub-alpine P. 5090, P. 5093, P. 5094 and P. 5095, Dendrobium 5084, No. 5078, No.5085, all rooted in moss. On the eastern shore and slipface is low sub-seral mossy-forest composed almost entirely of large-leaved Saurauia 4872 with a slight admixture of No.4863 and Venonia 4877, the trunks bristling with Spiridens longifolius, and the ground patched with moss mats in which grows prostrate Selaginella 5087. The rocky surface of the southern slipface, which rises directly from the lake to 30-40 m, is sparsely vegetated. Sole occupant of loose talus heaps, the moss Polytrichum 4887, with Cladonia spp., Baeomyces 5071, B. 5072 and other lichens, invades the weathering rock surfaces; followed by a mixed community of Polypodium 5092, Carex 5088, very stunted Imperata arundinacea, Lycopodium 4850, Vaccinium 4848, Languas 5082, Cyrtandra 4010, stunted Agapetes 4867, Rhododendron 4866, etc. Conspicuous on the forest front above, and forming thickets narrowly fringing the lake, is the beautiful treefern Cyathea 4966, and this rising above a wild tangle of raspberries and bamboo in a mixed community of rain-forest and mossy-forest subseral trees, edges an extensive low shrubbery which extends from this young rain-forest at the lake down to the road crossing. The shrubbery contains No. 4936, Pygeum 4884, No. 5064, Medinilla 5114, M. 4018, Agapetes 4867, No. 5064, Ficus 5098, Piper 4011, Cyrtandra 4010, No.4019, Begonia 4017, Languas 5082, Elatos-

[illegible]

an exception, in part at least, [illegible]

[illegible] of Virginia [illegible]

[illegible] on the western side of the [illegible]

[illegible]

temma 4020, Pilea 4016, Rubus 4012, R. 4932, R. 4933, Blumea 4930, B.4931, from about .5 to 2 m high, besides No.4920, No. 5065, No.5066 and other orchids normally epiphytic. Lower down, on inhospitable, denatured soil, hard set though porous, very uneven of surface and appearing as if deposited in a puddled state, fruticose lichens and Lycopodium 4850 supply an incomplete ground cover, Imperata arundinacea, of starved appearance, attains some prominence, and the hard-leaved Ericaceae Rhododendron 4866 (flowering at 1m or growing to a slender tree), R. 4855, Vaccinium 4869 and Agapetes 4867, with No.4861 and Geniostoma 4995, form an open shrubbery in which Dipteris conjugata, Dryopteris 4937 and Gunnera 4879, the latter also abundant on wet ground, are common. Dryopteris 4937, the grasses Isachne 4871 and No.4874, small ground orchids Pterostylis? 4875, No.4876 and No.5123, were found along the seepage stream more or less hidden by shrubs. The lower lake, unlike the upper one, is subject to fluctuations with the rains, and during our visit was but half full, leaving exposed a shelving muddy bottom over which Polygonum 4975 spread in a partly submerged mat flowering only in the shallows; while coarse Carex 4865, considerably overrun with scrambling Rubus 4932 and woody Polygonum 4013, constitutes on dry ground a tussock community abutting upon the rain-forest.

Road and Roadside Clearings

The pack road keeps close to the summit, wherever possible on the sunny aspect of the range, passing alternately through mossy-forest and intermediate rain-forest in the heads of ravines. A strip of forest cut on the lower side admits wind and sun to dry the surface and makes it a very good road indeed, where not damaged by landslips. The clearing is everywhere choked with No.5016 interlocked in a dense thicket over stumps and logs and climbing in the forest edges, and common along the open track are scrambling Gleichenia 4922, Lycopodium 4994, Polygonum 4968 and P.4013,

Dipteris 4071, D. 4844 and Carex 4842, shrubby Pilea 4016, Elastotemma 4020, Rubus 4940 and No.4019; and particularly abundant in moist shade, Dawsonia superba, Marchantia 4906, and various fruticose lichens. Associated with bamboo and young subseral trees on rain-forest soils are the climbers Tetrastigma? 4868, Parsonia Brassii, Rhipogonum? 5119 and Gynura procumbens; while Hydrocotyle 4898, Nertera 5020, and Selaginella 4956 appear as low ground herbs.

Cut in intermediate rain-mossy forest, and originally planted with Paspalum dilitatum for a donkey pasture, the clearing in which we camped was for the most part covered with an impenetrable woody growth, 2-4 m high, dominated by the usual bamboo, and made more impassable by a top layer of Rubus 4932, and Hypolepis 4970 spread over such small trees and shrubs as Alphitonia 4935, Pipturus 4846, Dodonaea viscosa and Solanum 4936. No.5070 with large pinnate leaves, a tree 10 m high when fully grown, is a conspicuous feature, as is Cyathea 4971, much slenderer than in adjoining rain-forest.

— alt!

MURRAY PASS (TOTORESI) CAMP

9318 ft

Situated at 2840 m altitude on the western edge of the plateau-like summit of the Main (Wharton) Range (see p.36), this camp was occupied from 13th July to 17th August. Alyhough mild in comparison with that of Mt. Albert Edward, which we had just left, the climate was still unpleasantly cold; fires being essential for comfort in the tents. Occasional days of sunshine were experienced, but almost constant mists and showery conditions were the rule, with frequent afternoon rains continuing after nightfall, and a great deal of south-east wind blowing down the pass. Temperatures

t/

occasionally recorded in camp ranged between 5.5 and 9 deg. C. before sunrise; and from 13 to 15 deg. in the shade, or up to 20 deg. in the sun, at noon. A 2 p.m. sun temperature of 10 deg. C. was observed after a heavy gale of wind and rain which confined us to our holed ? and torn tents for three days, and lasted in all nearly a week. Apparently a common feature of the Main Range climate, these storms are greatly feared by the natives who hunt the high grasslands and forests for game, and their suddenness and severity may be gauged by the fact that, weatherwise as the natives doubtless are, their expeditions not infrequently end in disaster. We were informed of a party of five who, caught in such a storm, met their death from exposure some time prior to our visit, and one member of another party perished in similar circumstances shortly after we left the Range.

In their pristine state the mossy-forests clothing the range at Murray Pass would appear to have been broken only by *Sphagnum* hollows and glades, and perhaps narrow strips of natural grass along the banks of Ero Creek; a condition long since altered by grass and treefern invasion of very extensive, constantly increasing tracts denuded by man-made fires. The rigours of the climate are reflected to some extent in the close-packed character and rigidity of the tree tops which, when violently assailed by wind, yield in short, springy movement without hurt to branches or foliage. The forests of such an extensive ridgy terrain naturally present many minor variations in type. They are, however, characterized throughout by the inclusion of scattered sub-alpine *Dacrydium*? 4688 and *Libocedrus papuanus*, especially the former, which rise above the general forest level and show a tendency to congregate on hilltops in pure, well lighted stands carrying much bamboo undergrowth. Such is the forest a mile or so from Totoresi on the slopes of Mt. Silisigoda, where associated *Elaeocarpus* 4540,

growing to 15 m, almost equals the conifers in height. In the opposite direction, roughly southeast along the range towards Mt. Scratchley, after crossing about a mile of grassland on the Ero slopes, forest of considerable timber volume is entered in which the conifers are associated with *Cryptocarya* 4741, *Elaeocarpus* 4537, E. 4742 and No. Schizomeria parvifolia 4576, 12-15 m. tall, many of the trees raised about a metre from the ground on arched prop-roots, the ground very deeply mossed and supporting a meagre undergrowth of small treeferns and abundant *Dawsonia grandis*. Surrounding depressed *Sphagnum* glades on a broad summit farther on. Libocedrus up to 20 m. tall and .5 m trunk diameter, forms with *Dacrydium*? and No. 4576 in very open order a distinctive bog succession forest with strong sub-alpine affinities, containing *Vaccinium* 4658, *Vernonia* 4179, and *Dedea* 4602 as low substage trees, but filled most frequently with tangled *Gleichenia* 4633 and *Rubus* 4712 or *Agapetes* sp. undergrowth, in which *Blechnum* 4590 and No. 4618, rooted in thin forest moss and humus, constitute a scattered ground layer. In a sheltered basin beneath this summit *Cryptocarya* 4741 attains large dimensions in tall forest (20 m) lightly mossed on trees and ground and furnished with an abundant shrubby undergrowth characterized by *Crytandra* 4693, No. 4615 and No. 4715, 2-2.5 m high; an unusual type somewhat resembling rain-forest in structure and appearance. Most typical of the whole, however, are the forests lying adjacent to the camp position. This is a very mixed low stand dominated by *Phyllocladus* 4584 and *Xanthomyrtus* 4573, bulking about 8-10 m in height, with shrub, treefern, and bamboo undergrowth just sufficient to be troublesome in walking through, the tree trunks and main branches thickly padded in moss, and the ground overspread with a soft carpet of moss and hidden roots sprinkled with leaves and twigs and the shining brown phyllodes of the co-dominant taxad.

Though generally richer in species than the mossy-forests of Mt. Tafa, taxads, ferns and orchids are not so well represented, and few of the latter were found in bloom. We were fortunate in finding in flower most of the trees and lesser ligneous species.

Trees: Next in size to overtopping Dacrydium 4688 and less frequent Libocedrus papuanus, are Cryptocarya 4741, Elaeocarpus 4742 with large fruit erect on the terminal branchlets, E. 4540 and No. 4576, which dominate the forest in some sheltered positions. Phyllocladus 4584, attaining sometimes 15 m, is a handsome symmetrical tree with rounded crown yellowish in young growth, comprising with a common uncollected Podocarpus with long lanceolate leaves, P. imbricatus found only as a seedling, and nondescript P. 4605, the taxad group. Xanthomyrtus Myrtus brassii 4573 bearing a profusion of yellow flowers, co-dominant X. 4514 with white flowers, X.4521 papuana, X.4523, X.4541 [illegible], Decaspermum 4543, etc., which comprise the Mrytaceous element, are compact low trees similar in appearance, and indistinguishable at a short distance from Elaeocarpus 4501, E.4504, E.4505, E.4537, E.4559 and E.4665, all common species. Abundant also are more slender, erect branching Vaccinium 4538 and V. 4548, with bluish leaves and large pink flowers; very distinct from uncommon V. 4658 with bright red juvenile foliage, and from V. 4666, a sub-alpine forest dominant practically confined to the fringes of this forest. Other trees, of minor importance and diverse appearance, include Ilex 4601, Dedea 4719, Helicia 4534 with showy red racemes and large follicles, and very rarely Macaranga? 4560, Cephaloschefflera 4568, Schurmannsia 4706, Timonius 4705. On sheltered western slopes is a splendid Pandanus not unlike the species planted for their edible seeds in the Vanapa and Auga Valleys. (see p.30).

34

Found generally [illegible]

[illegible]

Rhododendron 4517 with conspicuous red flowers, No. 4525, No.4630 and Symplocos 4659, with Cyathea? 4551, 3-4 m tall, may constitute some semblance of a substage in the better lighted parts of the prevailing low forest.

Undergrowth: Rambling or climbing bamboo undergrowth is made up of a slender species, like No. 5106 of Mt. Tafa, of general distribution through the forest, and a larger one (No. 4747) occurring in belts and patches of relatively small area; neither of which was seen in flower. Whole patches of the larger species are killed by a gall-forming insect which attacks the lateral vegetative shoots and is doubtless a contributory factor in the piecemeal destruction of the forests, for, to a native, the temptation to set alight such readily inflammable material would be irresistible. Shrubby undergrowth is supplied by Nos. 4614, 4615 and 4715, forming attractive horizontally branched bushes, Drimys 4506, No. 4607, Cyrtandra 4693, Agapetes 4566, A. 4566a, Symplocos 4612, No. 4752 and rarely Piper 4512, with the little treeferns Cyathea 4549 and C.4550, 1 to 1.5 m high, in places abundant. A poorly developed herbaceous undergrowth includes fleshy Pilea 4608, P.4511 and Elatostemma 4609, most plentiful in hollows at the lower elevations, Languas? 4604, L.4714 and L. 4722, 4-10 dm high, and growing in the ground moss, delicate Polypodium 4563, Hymenophyllum sp. and Dawsonia grandis.

Epiphytes: Of the numerous mosses and hepatics, conspicuous brown Frullaria 4771 from tree-tops; cushion forming Dicranum 4646; Rhodobryum giganteum, No. 4687, Dicranoloma blumii, and from rotting logs Mniodendron palmaeum, were collected. Small ferns on moss-grown trees, seldom out of reach from the ground, include fragile Hymenophyllum 4611, H. 4664, H. 4684, H. 4685 and Trichomanes 4683 in spreading masses; tufted Hymenophyllum 4773, always of curled and withered appearance, Calymodon 4662, C. 4663, C. 4686, C. 4581, Humata 4653,

Prosaptia 4610, Polypodium 4556, P.4558, P.4631, P.4654, No.4580, Asplenium 4555, A.4557, Elaphoglossum 4772 and Vittaria 4694, with which are associated Lycopodium 4628 (rare), and, among others, the small orchids Dendrobium 4508, D. 4632 and D. 4180, with very beautiful green, orange-red, and pink flowers respectively, Nos. 4506a, 4507, 4509, 4562, 4561, 4579, 4582, 4583 and 4692. Dendrobium 4588 is a large species of lower altitude type common in forest margins. Branches of Hydnophytum 4589 bearing flowers and fruit were brought in by a native. Loranthus 4564, L. 4564a and Henslowia 4587, the latter very abundant in rounded brown clumps on fringe trees, occur as branch parasites.

Climbers: These comprise Rubus 4712, looped between the trees in the manner of some rain-forest lianes; Agapetes? 4586 with showy red and white flowers, scrambling in tree-tops; and pink Vaccinium 4750, like a species abundant on Mt. Tafa and more in the nature of a hemi-epiphyte; all large species, and none of them common.

Forest Fringe Community

Shutting out from the forest the strong light and drying winds of the grasslands, and forming a living firebreak, is a compact wall of upright small trees and shrubs, which requires to be forcibly parted or cut through to effect a passage to the forest interior. The community originates from the edges of natural glades. Few components extend within the forest, and not any to the open grasslands. A number show affinities with the higher mountain flora, while arborescent Vaccinium 4666, which occurs sparingly within the forest as well, Dedea 4602, and Pittosporum 4668 are actual species of the timberline forests on Mt. Albert Edward.

Characteristic small trees attaining 3-5 m are Eurya 4660, E.4744, E. 4575, Acronychia 4516, Drimys 4519, No.4520, No.4554,

Vaccinium 4516, Polysoma 4524, No.4661 and Vernonia 4542, the latter, with the sub-alpine species, showy in flower. Species up to about 2 m high include Elaeocarpus 4510, E. 4545, Rapanea 4546, Geniostoma 4522, Xanthomyrtus 4515 with decurrent branches and solitary green flowers, Vaccinium 4613, Rhododendron 4557 with diminutive red flowers, R. 4713, R. 4716 Symplocos 4638 and S. 4669; with which are associated semi-scandent Maesa 4639, No.4544, No.4667, very prickly Rubus 4565 with large red flowers, and Gleichenia 4633.

Agapetes 4622 is a stiff little shrub with green flowers, massed around the base of old trees standing in fringe vegetation; Gaultheria 4621 a low, strongly aromatic shrub growing in or about Sphagnum mounds with Veronica? 4620, the white flowered herb No.4618, Blechnum 4590 and Plagiogyria 4746. Gunnera 4532, most frequent along the banks of flowing streams, occurs also on wet soil in this community.

Sphagnum Areas

In some parts of the forest, Sphagnum is killing out the trees by waterlogging the ground, and initiating conditions favourable for the invasion of grassland plants, while in other parts it is active in the reclamation of natural swamp areas upon which forest is gradually becoming established. Sphagnum junghuhnianum is instrumental in the first process, which is operative in the fringe community and within the forest as well, as exemplified by occasional narrow, crooked lanes, lined with trees standind dead in the moss, on which Blechnum 4590, with Gahnia 4552, grow as grassland pioneers, followed as the ground dries by treeferns, grasses, forbs and shrubs. The natives fire, as a matter of course, anything that will burn on these small openings, and some, widened for the purpose by cutting, are in regular use as rest clearings. Peculiar to these clearings are Dodonaea viscosa, Gleichenia 4718 and

[illegible]

[illegible]

In some parts of the forest, [illegible]

[illegible]

No.4709, in association with *Languas 4722* and species of the fringe and grassland communites. Pot-holed peat accumulations covering extensive wet depressions (pp.77-78), the open ground populated with grassland plants, illustrate the opposite effects induced by the activities of *Sphagnum*.

On the grasslands, *Sphagnum junghuhnianum* spreads in a hummocky, quaking mass over seepages, and fills wet hollows between the ridges, speical associates being *No.4599* and *Veronica? 4620* as dwarf shrubs, *Scirpus 4644* (about 2 dm), *Viola 4656*, tiny *No.4546*, *No.4704* and *Haloragis 4645*; besides quantities of *Gleichenia 4591* and *G. 4314*, erect bifid gregarious ferns of about 3 dm, the first very abundant as well on steep, dry slopes, where it displaces the grasses over considerable areas, the other ranging to high altitudes on wet, peaty ground.

Grassland Community

The copious rains during our stay had no stimulating effect upon the grasses, which were ripening seed and already far enough advanced in the resting stage to warrant precautionary measures to safeguard the camp against fire; but dampness from rains and mist limited to small patches the burns were effected by each visiting band of natives. The rythm of growth, for grasses at least, is apparently the same here as upon the coastal savannahs, though possibly slightly increased average temperature rather than higher rainfall is the chief factor determining the monsoonal months as the maximum period. This, and the xerophytic character of the component species, are about the only points of resemblance between the alpine and lowland grasslands. So far as our observations and collections show, only a solitary species, the forb *Wahlenbergia gracilis*, occurs in both formations, and they possess but few genera in common.

Everything points to the trade-wind months being the driest season,

and the time of the fierce fires which occur at intervals of years, laying waste the grasslands and destroying each time a little more of the forest. During the season prior to our visit such a fire passed over a portion of the Ero country (p.36). After the lapse of the greatest part of a year, including a monsoon, there was still no sign of the reappearance of grasses over most of the affected area, and on the blackened ridges, dotted with treeferns, many of them despoiled of their fronds and just breaking into new growth, very scattered small *Carex 4623*, the flat growing forbs No.4178 and No.4691, with occasional shrubs sprouting from underground stocks (*Coprosma 4215*), alone relieved the bareness of the ground. From this it would appear that the alpine grasses and associated forbs are lacking in the fire resistant qualities and extraordinary tenacity of life which are such notable attributes of the lowland savannah plants. It might be supposed, however, that such destructive fires are only possible with the drying out of the ground in abnormally dry seasons, and that the usual burn is a surface affair, harmless to the x roots of perennial species, which are merely checked in growth, and after missing one reproductive season again seed abundantly.

In addition to the characteristic tussock-grass, *Descampsia? 4624* (5-7 dm), which dominates over most of the area, *No.4191* and *No.4194*, of similar habit and appearance, occur as localized co-dominants. *Imperata cylindrica*, forming a pure short cover on some steep hillsides, is a most distinctive species. Rather slender, apparently annual tuft-forming species, growing among the tussocks, include *Poa 4195* (one of the first to appear on burnt ground), Nos.4570, 4571, 4572, 4649, 4650, 4651, 4732, 4192 and 4916, from about 2 to 10 dm high. *Isachne 4642* and *No.4674*, found near native paths, were observed also in the Vanapa Valley, the possible source of *No.4723* (1 m) and *Miscanthus 4528* (to 2 m), incongruous clump-forming species of rare occurence. The few Cyperaceae include *Gahnia 4552* (6-8 dm), a social tussock species in complete possession of

[illegible]

[illegible] rare of genera and species, which are [illegible]

[illegible]

[illegible] from about [illegible] to 10 am [illegible] other native palms, were observed [illegible] considerable patches of slope, and usually discoverable along forest margins; Carex 4676, C. 4697, C. 4672, and C. 4623 of secondary importance and varying habit and station.

Associated forbs ~~and~~ are fewer in number and species and less dwarfed than at greater elevations on the range. They include Potentilla 4635, P. 4636, Antennaria 4200, Didiscus? 4177, D.4671, Epilobium 4179, No.4196, Gentiana 4641, Anaphalis 4643, No.4533, No.4179, and less commonly Epilobium 4547, No.4597, No.4598, No.4198, Wahlenbergia gracilis, No.4646, Lactuca 4648, L. 4652, Ranunculus 4647, Hydrocotyle 4670, No.4673, No. 4707, No.4737, Galium 4745, G. 4746, and the pink flowering orchid No.4682; many of them rosette perennials and the tallest not more than about 3 dm high.

Besides many of the foregoing forbs, the narrow flood banks and sandy beaches of Ero Creek yielded from amongst the grass tussocks Juncus 4699, Rumex 4700, Galium 4730, G.4736, No.4755, Veronica 4971, Selaginella 4739, cushion-forming No.4738, and from saturated low banks diminutive Scirpus 4725, No.4737, Pilea 4724, No.4702 and Marchantia 4368, while the submerged aquatic No.4774 rooted in grass-like masses in the fast waters of the stream. Growing in niches on the sides of the creek gorge were tiny Satureia 4942, Argostemma 4943, No.4728 and Polypodium 4726, Blechnum 4733 with flat-spreading fronds, and numerous juveniles of the open ground treeferns.

As compact low shrubs Styphelia 4199, Hypericum 4188, Eurya 4185, Coprosma 4215, and Diplycosia 4745 occur scattered through the grass or form mixed shrubberies on the drier ridges. Rhododendron 4553 with red flowers, up to 2 m high, forms splendid thickets in broad peaty glades, ranges in reduced form over the grasslands, and constitutes with R. 4530 and other species, mixed shrubberies on the more sheltered slopes. In addition, the sub-alpine forest composite No.4593, normally a tree, and Styphelia? 4675, a fringe shrub of the same forest, occur as rare shrubs

of about 1-1.5 m.

Though few in species the ferns are of particular interest, for they include, besides the characteristic treeferns *Cyathea? 4595* and *C?. 4596* P. 36), the two important *Gleichenia* spp. which have received mention on page 82. *Pteridium 4634* is a common bracken in situations sheltered by forest, and *Polystichum 4690* forms stiff low clumps out on the open ground. Prostrate *Lycopodium 4528* is in places abundant, as is also the handsome brown moss *Funaria* *Hygrometrica*.

On the trunks of treeferns, above the level of the grasses, are a number of ornamental small shrubs and herbaceous species, of which *Agapetes 4622*, *Dendrobium 4503*, *Humata 4592*, *Asplenium 4689*, *No.4727* and the hepatic *Frullaria 4771* originate from neighboring forest, *Oxalis 4703* *Geranium 4637* and *Lycopodium 4729* occur sometimes in grassland ground cover, while *Rhododendron 4536*, *R. 4531*, *R. 4536*, *No.4183*, *No.4186*, and *Bulbophyllum 4527* seem to be limited to this epiphytic station. The majority explore with their roots the matted integumentary rootlets of their hosts, and obtain there the supplies of moisture and nutrients necessary for growth.

Extra-montane Communities

Homalanthus 4619, a tree of 4-5 m, the nettle *No.4534* and *Solanum 4539* as shrubs, herbaceous *Coleus? 4710* and *Selaginella 4708*, peculiar to recently burned forest borders, come under this heading as alien elements of distictly lower altitude type, perhaps owing to their presence to occasional dispersal by birds crossing over the Pass or venturing upon the heights from their homes in the valleys. Never more than a few plants gathered here and there, they flower and mature fruit in the forest shelter, but fail to survive the advance of grassland species and the establishment of regular fringe community shrubs and trees.

GERENDA (3680) CAMP, MT. ALBERT EDWARD

Established on the 14th of June and vacated on 13th July, Gerenda Camp was situated in a narrow glade near timberline on the south-west slope of the mountain. Maximum shade temperature readings for seven consecutive days (3rd-9th July) gave a mean of 13 deg., with extremes of 11 deg. and 14.5 deg. Centrigade (Archbold). Thirteen early morning readings made with a Fahrenheit thermometer before sunrise, gave a mean of 34 deg., the lowest record being 29 deg. and the highest 40 deg. On clear mornings, which were altogether too infrequent, the grass was covered with frost and shallow ponds sometimes frozen over. Such mornings would occasionally be followed by a sarm, sunny day without much wind, the temperature rising as high as 73 deg. F. in the sun at noon. But as a rule the mountain was enshrouded from early morning until after nightfall in cold, penetrating, driving mists carried on the south-east trade-wind, accompanied usually by thin rain commencing between about 8 a.m. and noon and lasting until the wind died down in the evening, when the stars would show out clear and cold. One heavy gale, which extended through a night and most of the following forenoon, was experiencedl In all, eleven frosts were recorded during our stay; four days were without mist or rain, six days wholly wet and misty, and eighteen days, including three of high wind, more or less inclement.

The soil of the mountain, as of the Main Range summit generally, is a gritty grey loam derived from quartz-impregnated schist. The main topographic features, and types of vegetation, viz. sub-alpine forest and alpine grassland, have been indicated on pages 38-40. In addition to the grassland lakes, numbering over forty, which have been mentioned, there are many shallow ponds surrounded as a rule by <u>Sphagnum</u> marshes, and in exposed positions temporary rain pools which seem to have been excavated by wind erosion of the soil. Few of the lakes would much exceed 100 m

in diameter. Fed, most of them, by extensive seepage slopes, they are subject to but slight fluctuation in level, and their outlet streams, and a few rills draining Sphagnum marshes, are the only wateercourses on the mountain; circumstances which point to gentle precipitation in frequent light rains.

Sub-alpine Forest

The transition from mossy-forest takes place at about 3200 m on the summit of the range. Above that elevation not a single mossy-forest tree was observed, and of sub-alpine species, apart from Podocarpus compactus ~~Dacrydium~~? 4284 and Libocedrus papuanus, only Vaccinium amplifolium 4666, V. acutissimum 4324, Pittosporum pullifolium 4222, ~~Dedea~~? Syzygium costatum 4221, No.4304?, and the fringe shrub Styphelia 4220 were met with in the mossy-forest region, where they occupy for the most part positions in the fringes, cold peaty soil, or occur as stunted shrubs on the grasslands. At the lower levels the forest which has been called sub-alpine is dominated by Dacrydium? and to a lesser extent Libocedrus, about 12-14 m tall on an average, and contains a very distinct substage or underwood of stiff angiospermous trees, principally Vaccinium macbainii 4293, some 5-6 m high. With increasing altitude the conifer stand thins out and lower layer trees increase in species and individuals until, on Mt. Albert Edward, they dominate the forest, that is, their tops form the canopy of the stand; Libocedrus practically disappears from exposed slopes, and Dacrydium?, still very abundant, its crown and upper trunk extruded above the general canppy, constitutes an incomplete superficial layer, as it does in some degree in the mossy-forest. Competition between the two strata of trees is apparently negligible, and in the adult stage, at least, an independant existence is possible to both. Vaccinium and associated trees thrive equally well regardless of the presence or absence of Dacrydium, which, owing to height disparity and wide spacing, seldom deprives them ~~from~~ of

[illegible]

[illegible]

[illegible]

any appreciable amount of light; and the Dacrydium, in turn, by long survival under grassland conditions after the removal of forest by fire, frequently demonstrates its independence of the ground-sheltering lower stratum species.

Occupying, as it does, the greatest elevations possible for tree growth in South-east New Guinea, this rigid, wind-blasted forest, seldom more than 7-8 m high, and reduced in parts to a scrub of half that height, exhibits a not unexpected paucity of species. A few major dominants comprise most of the stocking, and the forest is unique in that all the components conform to a general flowering season, which falls in the southern-winter months of June and July. The time of our visit was thus most opportune for collecting. The forest gatherings, though comprising only vascular plants, include every species encountered. But as nearly all of these grew within a mile or so of camp, the limit of effective collecting range in the bad weather prevailing at the time, and numbers of species were observed to be very localized in distribution, producing at short distances decided changes in forest composition, it is more than probable that material additions to the list could be made from unvisited sections of the mountain. The forest of the Giumu headwaters were found to differ substantially from those of the camp locality, and more than half the circumference of the mountain, including all of the northerly slopes, could not be worked over at all. Sub-alpine forest conditions hold in the sheltered Chirima Valley as far down as 3480 m, the lowest point visited, but with the addition of an abundant, somewhat fleshy undergrowth of shrubs with a distictly mossy-forest facies, and other extraneous elements in the shape of ferns, orchids, etc. (e.g. Gleichenia 4387, Polypodium 4384, No.4383, Loranthus 4387).

The principal trees develop from a short, heavy, divided or undivided trunk, a stiff crown of upright branches, open and leafless within, bearing

on very numerous, thickened terminal branchlets a dense foliage which casts an even shade over the ground. Generally, the leaves are erect upon the branchlets, smooth, much thickened, and tinged with red as if by frost. Some secrete oils, others are mucilaginous, and in the case of the Compositae the edges are rolled and the underside densely hairy. The springy ground covering of moss and roots, characteristic of the mossy forest, is undeveloped here. The forest interior presents a dim monotony of low tree trunks shaggy with pale brown mosses and hepatics, but slightly relieved by a few small epiphytic ferns, and still fewer terrestrial ferns and shrubs. There is a total absence of climbing plants. However, poor in species it may be in comparison with lower altitude forests, the sublapine forest connot fail to impress with the incomparable profusion of pink, yellow, and white bloom produced by the trees in the flowering season.

Trees: Of the gymnosperms, Dacrydium? 4284 Podocarpus compactus has a rough scaly bark, istorted, deliquescent crown of irregularly layered crooked branches, and dark close-packed foliage; Libocedrus papuanus is an excurrent tree with down-bent branches, greyish foliage and fibrous, fissured bark; and Podocarpus 4395 brassii, seemingly restricted to the giumu slopes, a handsome species with brown fibrous bark and compact crown, of brownish aspect owing to the coloration of the branchlets. Vaccinium 4293 and V. 4242 both macbainii (and varieties?), with heavy low-spreading main branches and waxy flowers pale pink to almos red, of general distribution and unquestioned dominants in the camp locality, yield supremacy on the comparatively sheltered Giumu slopes to No.4398 Melicope parvifolia, a compact, shapely species with aromatic leaves, and in the Chirima Valley, localized Agapetes 4380 alberti-edwardii, with rather weak branches and large red and green flowers, forms a large part of the stocking. Secondarily important, often slender trees, are Pittosporum 4222 pullifolium with large yellow and P. 4399 berberidifolium with purple flowers, Symplocos 4283, often in gradated by [illegible] costs as [illegible] ons on one [illegible] Terai. [illegible] [illegible].

[illegible] with many low-spread [illegible] alone [illegible] locality, [illegible] both, important, [illegible] willow and [illegible] thickets and little more than a shrub in stature, *S. 4397*, *S. 4448*, *Dedea? 4221*, a mass of pure white flowers, *Vaccinium 4324*, bright red in young leaf, profuse flowering Vernonia? 4305 with white and yellow florets, *Rapanea 4241*, *R. 4281*, *R. 4349*, *No.4282*, *Drimys 4239*, *D. 4322* and *Eurya 4265*; while *Evodia? 4341*, *No.4371*, *Rhododendron 4311* with splendid red blooms, rare *Aster Kernotti?* (4338) and *Daphniphyllum 4374* are small sub-stage or shade requiring species of scattered occurrence.

Undergrowth: Shrubby undergrowth is entirely lacking from closed forest at the upper levels, very few tree seedlings are to be seen, and small *Polypodium 4256*, *P. 4258*, *Trichomanes 4263* and slender *Carex 4415*, scattered over a thin soil cover of dry leaves and moss, alone seem able to endure the low light intensity. With slight thinning of the canopy, such as occurs at the ends of grassy glades and over subsidence hollows marking vertical fractures of the rock underground, *Luzula 4228*, *No.4224*, the weak grass *No.4238*, and the more robust ferns *No.4389*, *Pteris? 4291*, *Histiopteris 4233*, *Cyathea? 4351* and *Paesia 4235*, appear in limited numbers; and in such places Cyathea? 4351 (2-3 m), probably a rare shade form of the open ground treefern *C.? 4285*, may be found a few paces within the forest. Of very different appearance is *Cyathea 4375* (2 m), a true species of the forest interior, common below 3600 m. Gregarious *Polyosma 4310* in rare patches 5 dm high, *Styphelia 4424* (1-2 m) and trailing, tenacious *Rubus 4337*, with *Agapetes 4320* (2-4 dm), a common gregarious species terrestrial or epiphytic near the ground, supply what little ligneous undergrowth there is above 3550 m, and only the first inhabits dense shade. Lower down, in the Chirima Valley, a thick shrubby layer is formed by the mossy-forest derivatives *No.4372* and *No.4373*, growing about breast high and interlaced with *Rubus*, to which are added, on approach to the river bottom, *No.4379* and much *Elatostemma? 4376* fleshy shrubs under

1 m high.

Epiphytes: Slender, elongated, pale brown bryophytes, and other of fuzzy appearance, almost constantly saturated with moisture and benumbing to bare hands, envelop the trees; interrupted, and to a great extent displaced on the branches by grey crustose lichens, and, in the canopy, foliose species. Of the numerous mosses and hepatics, highly pigmented reddish-brown Schlotheimia pilosa and Macromitrium 4440, abundant on the branches of Dacrydium, and Bartramia halleriana, No.4429, Myuriopsis papuensis, Nardia 4432, Zygodon anomalus, Leucodon 4434, L. 4441, Macrohymenium strictum, Daltonia 4436, Glastobyrum 4437, Holodontium 4442, H. 4451, Ceratodon stenocarpus, from the forest interior, were found in fruit and collected; and among lichens Alectoria bicolor, No.4453, Sticta 4458, S. 4460 and golden fringed S. 4457. Associated with the lower bryophytes, and with them in some instances attached to the walls of chasms and to rocks lying about in the forest, are the filmy ferns Hymenophyllum 4261, H. 4262 and H. 4313; Polypodium 4254, P. 4255, P. 4257, P. 4259, P. 4260, P. 4236, Hymenolepis 4243, Calymodon 4253, C. 4413 and Humata 4333, mostly insignificant tufted species, Lycopodium 4249 and L. 4252. Dwarf Pelea 4232 occurs in the margins, where stiff Polypodium 4201 and Asplenium 4237 are commonly massed on trees and rocks. Disposed above these, on exposed branches in the canopy, are the very xeric small orchids No.4250, fragrant No.4331, No.4334, No.4426, and, high in the overtopping Taxads, orange-red Dendrobium 4294 makes a brilliant display; No.4445, found on a grassland rock, was probably wind-borne from lower altitude forests. Henslowia 4240, of straggling habit, is abundant throughout as a shrubby branch parasite on angiospermous trees.

Forest fringe community

The fringe, or grassland ecotone, community is similar in character

[illegible]

[illegible] found on a gravel [illegible] Menidia [illegible]

[illegible]

[illegible]

to that of the mossy-forest, i.e. a narrow body of shrubs 1-3 m high and not more than 2 m through, growing densely, but in this case without continuity and composed of but two species, *Styphelia 4220* of compact erect habit, and thinly foliages almost arborescent *Coprosma 4217*, with twiggy, interlocking, supple branches, to which are superadded many treeferns of the glades and open grasslands (*Cyathea? 4285*). A frequent associate is *Diplycosia 4213* (5-7 dm), in stiff low thickets, but like the treefern, it is as much a grassland as a fringe plant. The Iridaceous herb *No.4224*, with white flowers, is abundant, and the ferns *Plagiogyria 4317* and *Blachnum 4318*, erect to about 1 m, present in limited numbers.

In some parts *Sphagnum Junghuhnianum* forms a marginal bed of peat, dried out and showing signs of fire on the outer edge, slowly advancing and killing out fringe shrubs and trees in the forest. At this elevation climatic conditions probably exert a retarding influence on its spread, but considered in the aggregate, over long periods of time, it must be an important contributaory factor in the destruction of sub-alpine forest.

Alpine Grassland

Here, again, we were fortunate in the time of our visit, for with few exceptions the grassland plants were flowering or with seed. While the collections cannot be considered exhaustive, it is unlikely that furter search woul result in any large additions, unless from seasonal forms appearing earlier or later in the year.

The grasses which characterize the community fall into two main groups, (1) short growing species, about 2-10 cm (1-4 inches) high, which form a rigid closely tufted or matted sward and inhabit principally bleak uplands, depressions, seepage slopes, and the larger forest glades, and (2) the long tuft or tussock grasses, about 2 to rarely 10 dm high, of the deeper and warmer soils; each with its quota of distinctive forbs, and each em-

bracing several more of less distinct minor habitat communities. The Mt. Albert Edward grasslands are less luxuriant but much more varied than those of the burnt-over forest lands lower down on the range summit. In mossy-forest regions, both communities contribute to a mixed covering dominated by the long grasses, the least important community of the parent grasslands at high elevations, notwithstanding a large spread to denuded sub alpine forest lands at the present time.

Ages of weathering have produced over practically the whole of the mountain deposits of soil sufficient to support m~~i~~acroscopic plants, and in few places is the surface so barren and inhospitable as to preclude the growth of dwarf perennial forbs and grasses. A patchy lichen carpet comprised principally of grey *Cladonia 4452* and *C. 4456*, with red *C. 4466*, brown *No.4461*, *C. verticillata*, *C. 4468*, *C. Pyxidata* and *Parmelia 4454*, is, however, developed on very shallow soils and on the tops of disintegrating rocks scattered singly or in groups over the plateaux. *No.4464* covers dry peaty soil, Sphagnum-killed forest borders, for instance, and *Cladonia 4455*, in great abundance on wet ground, imparts a tinge of grey to some of the seepage slopes and peat swamps.

The mat-forming moss *Bryum argenteum* is a common short grass associate on soils of average moisture content; *Tetraplodon bryoides* grows erect from loose peaty bodies, a few centimetres in diameter, lying strewn over the grass as if thrown there; and *Bartramia 4450* occurs with the thallose hepatic *Marchantia 4368* on wet banks of streams. On the marshier seepage slopes, and in shallow swamps in which long, bleached grasses (especially *No.4446*) are an accompaniment of hummocky conditions, *Sphagnum junghuhnianum*, and other bog-mosses, are present in quantity.

Sphagnum 4473, abundant about lake edges, or submerged in up to 3 dm of water, has sometimes associated with it *Isoetes 4366*, tufted over shallow stony bottoms, and in one of the highest lakes, entirely submerged in deeper water, were grasslike masses of slender *No.4300*.

Short-grass Community: Both the short- and long-grass communities, especially the former, cover extensive areas exclusively, but a good deal of intermixture naturally takes place where topographic irregularities upset the uniformity of conditions which govern their distribution. The immediate camp locality, a rocky slope partly denuded (and standing) forest and partly natural grassland, with soils of all depths and degrees of moisture content, was an area of great confusion. There is evidence to show that, after a considerable lapse of time, long grasses are to some extent displaced byshort grasses on deforested grounds.

Following the moss-lichen stage on primary areas, and preceeding the short grasses, are communities in which dwarf perennial forbs predominate. On very wet, cold, boggy seepage slopes the principal species are No.4363 in grey cushion-like masses, and squelching light-packed mats of Eriocaulon 4365 and E. 4367 (3 cm); succeeded by Potentilla 4419, No.4422, No.4344, Ranunculus 4266, No.4271, No.4471, Veronica 4403, grasslike No.4299, etc., amd the mat grass No.4470. On very shallow dry soils Potentilla 4308, No.4247, Gentiana 4270, No.4245, and Pilea 4279 are among the pioneers.

The community is richest in both grassed and forbs on somewhat sheltered slopes of good average moisture content, the usual habitat of Potentilla 4229, P. 4231, Gentiana 4269, Lactuca 4356, L. 4357, Plantago 4352, No.4278, Lagenophora 4268, No.4309, No.4345, No.4298, No.4302, No.4303, Didiscus? 4358, No.4361, No.4401, No.4417, prostrate Lycopodium 4301, erect L. 4362 (rarely), Ranunculus 4267, R. 4354 and R. 4355, up to about 10-12 cm high, with Ranunculus 4353 and Oxalis 4359 restricted to the wet banks of streams. Though many of these small plants produce attractive yellow and blue flowers, they are seldom visible at anything but short distances, and make no appreciable difference to the general coloration of the community. A few social species occur in limited pat-

4211 Monostachya oreoboloides

Aulacolepis epileuca

ches, but most are sprinkled over a close sward comprised of No.4210, No.4209 =4210 and No.4208 Poa callosa, very densely tufted on contiguous mats, with the occasional addition of small glaucous tufts of No.4275 =4210 and NO.4469 Poa crassicaulis. The sedges Carex perciliata 4274, C. trichotoma 4316, Scirpus merrillii 4364 (abundant on ground rooted over by wild pigs), and S. subcapitulata 4315, though common in parts, are of little importance.

The final short grass phase, perhaps the climax of the formation, occurs under drier and more uniform conditions on the broad open plateaux. A great reduction in forbs is at once apparent, characteristic species being No.4306 in vivid green cushions, and almost grasslike No.4307. Carex 4418 is abundant on stony ground. Probably some of the grasses are distinct, but they had already finished their short season when we ascended the mountain, and fertile specimens were unobtainable.

Long-grass Community: As typically represented on the more porous, warmer soils, this community is probably postclimax in relation to the short grasses. The chief dominants are tussock-forming No.4288 of general distribution, and No.4202 in very sheltered places. Tufted species include Bromus 4204, No.4203, No.4326, Poa 4393, No.4400, No.4412, No.4206, and No.4207. No.4411 sometimes fills very narrow, warm glades, and No.4406 occurs in clefts on the faces of cliffs. The associated sedges, Carex 4386 in large tussocks, C. 4391, C. 4407 and Cladium? 4447, are merely incidental.

The characteristic forbs are few, but they include silver-grey Potentilla 4230, most abundant and adaptable of a genus pre-eminent among the forbs on these grasslands, and Epilobium 4289, equally common and almost as variable as to habitat. Less important ones are Antennaria 4248, Stellaria 4402, Potentilla 4229, No.4404, the white "everlasting" Anaphalis 4290, abundant and very conspicuous about rocks, and, on wet ground in the comparative warmth of the Chirima Valley, No.4381, No.4385

and Cardamine 4382. Growing under the most favorable conditions of shelter provided by rocks, but thriving best as invaders of denuded forest soils, are No.4342, No.4244, Lagenophora 4226, No.4330, and rarely Geranium 4227.

As true ferns of the open ground, Gleichenia 4314 dominates over acres of wet seepage slopes at elevations not exceeding 3600 m; while No. 4304 (2-3 dm), with remarkable curled stiff fronds, is found in occasional clumps a metre or so across amongst grass on the slopes and under rocks to the summit of the peaks. Other species crowded under sheltering rocks or hidden in the recesses of broken cliffs, include Plagiogyria 4286, Polystichum 4350, Athyrium 4392, Dryopteris 4409, No.4329, and associated with lichens on exposed surfaces, small Hymenalepis 4477.

The list of shrubs is an imposing one, but only Hypericum 4277, Styphelia 4219, Coprosma 4215, Diplycosia 4280, Drapetes 4223 and Eurya 4499 (2-5 dm high), in about the order given, are in numbers sufficient to be important. Their distribution is practically that of the long grasses, although the first, showy with yellow flowers, is by no means uncommon on bleak short grass uplands, and the Drapetes, stunted to under 1 dm, is to be found in the dwarf herbaceous cover of marshy seepage slopes, with Styphelia? 4405 prostrate in the moss underneath. Styphelia 4327 and S. 4425 much resemble the common S. 4219, with which they grow, and with the attractive red Rhododendrons, R. 4292 and R. 4346 (2-3 dm), are extremely rare. Gaultheria 4323 is a variable species prostrate in mats about rocks and forest borders. There are, besides, Veronica? 4295 and V.4296, from the margins of a lake at 3810 m, and V. 4297 from the slopes round about, the two last not seen below that altitude.

With the long grasses, the treeferns Cyathea? 4265 and C. 4285 have have considerably extended their territory since the natural balance between grassland and forest has been disturbed by fires. They are, however, not nearly so abundant here as on deforested ground at lower,

warmer levels, nor do they grow so large. *C. 4265*, the smaller of the two, is generally about 1.5 m high overall, with a squat trunk of 1 m thickened upwards to over 2 dm diameter under the stiff crown, which contains about 50 very brittle, scurfy, flat fronds 1 m in length. Under natural conditions it occurs most typically in the middle of glades, and as an associate of tussock grasses and low shrubs out on the ridges. The upper limit of its range on the Mountain is about 2700 m. *C. 4285* is a slenderer species, generally about 2 m tall, with about 30 more spreading, tougher, less paleaceous fronds arranged in vertical rows in the crown, persistent, and either hanging down or standing out stiffly from the trunk when dry. Characteristic of forest borders, but not confined thereto, it ranges to treeline on the peaks (3850 m), and though for preference a plant of sheltered places, survives the burning of protecting forest and lives on and multiplies (if somewhat sparingly) under conditions intolerable to its normally more or less open grassland inhabiting relative. Treeferns are of very rare occurence on the open windswept plateaux, apart from rather stunted examples growing about scattered outcrops of the underlying rock. A third, very distinct species (*Cyathea 4410*), to all appearances a new addition to the grassland flora, bearing the stamp of its forest origin, is localized in some abundance on a warm deforested slope in the Chirima Valley.

Dendrobium 4294, *Agapetes 4320*, and *Lycopodium 4287*, infrequent strays from the forest, occur epiphytic on the treeferns. The epiphytic Rhododendrons, which brighten the grasslands of the mossy-forest region, do not reach these altitudes.

VISIT TO THE WESTERN DIVISION

From the western end of Yule Island to Cape Possession, and along the shores of the Gulf of Papua some few miles to the neighborhood of Jokea village, the coast is hilly, and covered with thinly timbered Eucalyptus savannah and patches of poor quality rain-forest or monsoon-forest. At this point the Central Division dry belt ends, the coast flattens out, and for approximately 100 miles to the Alele Mouth of the Purari River, presents a series of shallow sweeping bays with clean beaches of dark grey sand, broken by rocky headlands at Kerema. Rainfall at Kerema is 123 inches. At Nepa, in the interior, it is 197 inches. The tremendous run-off is carried by four large rivers, the Biaru, Lakekamu, Tauri and Vailala, which flow from the Main Range through low hills and flat swampy country and enter the sea on this stretch of coast. The rivers and numerous smaller streams are obstructed by sandbars at their mouths, and behind the raised beach-line, which has been likened to a retaining wall, form small deltas and spread out along the seaboard in swamps in which are the sago forests that supply the natives with their chief articles of food. The coast is rich in coconuts and betel-nut and supports a heavy population centred in large villages on the beach.

The Alele marks the beginning of a low muddy mangrove coast, and gives acces to the combined delta system of the Purari, Kikori, and several lesser rivers. Through this vast area of swampy silt islands and intricate tidal waterways it is possible to take a launch from the Alele entrance to Kikori government station, a distance of 75 miles as measured on the map, without going out to sea, and from there another 100 miles of back creeks afford a smooth passage for canoes as far as the Fly. The outer delta islands carry tall mangrove forests, 16-18 m high, rising for miles in clear cut faces along the sea front, which is exposed to the erosive action of a heavy ocean swell in the tradewind season. In the

rear of these are nipa swamps, sago swamps, and various transitions from mangrove to intermediate littoral swamp forests rich in palms and pandans and luxuriant rain-forest on dry land. This region, too, supports a numerous population of sago-eating peoples. Kikori, with a rain-fall of 230 inches, has the distinction of being the wettest station in the Territory. A sawmilling enterprise has mills working at Kikori and on the Wane River, where principally Okaka (Terminalia catappoides) is cut ~~fx~~ for domestic internal use in the country and for export in small quantities to Australia. The wealth of the littoral forests is as yet unexploited.

From the delta south-west past the Bamu and Fly River estuaries, the foreshores continue low and swampy. The climate, however, becomes progressively drier, until, south of the Fly, a savannah grassland type of vegetation again prevails on a very large tract of low ridgy country inland from the littoral and riverine fringes. European settlement in the Western Division is limited to one or two coconut and rubber plantations on the lower Fly, and the township of Daru, situated on an island of that name about two miles off the mainland and opposite the mouth of the Oriomo River. Daru is the only locality for which rainfall records are available. These, as tabulated in the Official Handbook published in 1927, indicate December-May wet season average of 70.33 inches, a June-November dry season average of 19-42 inches, and an annual mean of 89.75 inches over a term of 15 years.

The geographical limits of the western savannahs can not be set out with any certainty. A good deal of exploration remains to be done between the Delta and the Fly and from there on to the border of Dutch New Guinea. Mr. Woodward, Resident Magistrate of the Western Division, states that Melaleuca savannah occurs between the north bank of the Fly and the Aramia River, and our native carriers recruited from the Bamu River were familia with, and had names for, a number of dry type savannah

plants. From this it would appear that the high rainfall area of the Gulf of Papua, and the continuous rain-forests of that region, do not reach as far south as the Fly. Various explorations, carried out principally along the rivers, have proved the existence of savannahs extending to a depth of perhaps 50-60 miles behind the coast from the Fly westwards over the political boundary to positions near Merauke in Dutch territory. The Papuan portion of this area might be very roughly estimated at 6-7000 sq. miles.

In general appearance, not so much in the grasses as in the trees which give them character, the savannahs visited by the Expedition in the west differ from those of the Central Division. This is due mainly to the almost complete suppression of *Eucalyptus* over much of the area by species of the related genera *Tristania* and *Melaleuca*, and to a dissimilar specific representation of the genus *Eucalyptus* on the restricted area on which it is abundant. The north Australian term, "sour teatree (*Melaleuca*) ridges", could very well be applied to much of the country seen. Trees are more numerous, larger, and in greater variety than in the drier Central Division, and sedges such as *Rhynchospora rubra* figure prominently in a less varied ground cover.

Daru Island has a circumference of about 10 miles round the mangrove fringe, and rises on one side about 40 m above the sea. It is generally low-lying, heavily grassed, swampy in the wet season, and nowhere very fertile. Narrow strips of light rain-forest touching on the mangrove formation contain little of special botanical interest. The island flora is remarkable chiefly for the prominence assumed by *Eucalyptus 6408* (Bloodwood) and *E 5947* (Blue-gum) in the prevailing savannah forest, in association with *Melaleuca 6041* and *M. 6036* (Teatrees), and for the presence of odd examples of *Eucalyptus 6054*, a common Central Division species encountered nowhere else in the west. *E. alba* and *E. papuana*, the usual

associates of *E. 6054*, were not met with at all on Daru or the mainland opposite, while *E. 6048* would seem not to extend east to the Central Division savannahs.

On the mainland, a little north of the mouth of the Oriomo, and not far removed from a somewhat muddy beach on which *Galophyllum inophyllum* and *Ipomoea Pes-capraea* characterize the shore vegetation, is an open swamp a mile or more in length which, though filled with fresh water and frequented by numerous ducks and other waterfowl during the rains, is said to evaporate to a low level and become brackish in the dry part of the year. It is approached from the beach through a dark, evil smelling swamp forest of rain-forest type in which great quantities of the stiff climbing fern, *Blechnum serrulatum*, occur massed about the tree trunks, and fringing it is a brushy growth of *Excaecaria* sp., *Clerodendron inerme* and stunted *Melaleuca leucadendron*, which stood in water several decimetre deep when we visited the place in wet season. Within an outer zone of *Phragmites 6066*, *Diphlachne 6065* and *Alternanthera sessilis*, the cantral portion of the swamp is filled with an even pure stand of rushes (*Eleocharis 6064*) about 2 m tall. The duckweed *Wolffia 6063* occurs plentifully on small patches of open water, and dainty blue flowering *Nymphaea 6061* attracts attention as a floating plant amongst the grasses which occupy the marginal shallows.

After a reconnaissance of the Binaturi River, sixteen miles down the coast from Daru, we proceeded up the Oriomo and there established camp. The Binaturi, for a distance of about four miles from the sea - which as far as we went - is a muddy mangrove creek on the banks of which we saw no inducement for landing, excepting at the mouth, where there is a village of some 200 odd houses on the west side, and a track leading through fringing mangrove and *Pluchea indica* flats to a far-reaching grassy silt plain on which, in a patch of rain-forest 1 1/2 miles out, is the large

village of Mawatta. Tall growing savannah species (*Ischaemum 6040*, etc.) comprise the grass cover, and there is a good deal of scattered teatree, *Sarcocephalus cordatus*, *Pandanus* sp., *Barringtonia 5915*, etc., and belts of swampy forest. Much water lay on the plains, but most of this would disappear in the tradwind season, leaving the surface dry. Haliphilous vegetation on the banks of little creeks and flat watercourses indicate tidal flooding in the dry months. The Mawatta cultivate in an efficient manner extensive gardens of bananas, a glaucous plantain and taro, more or less mixed together, with *Tacca pinnatifida* in between as a side crop. Neat fences of split bamboo surround the gardens, and an elaborate system of shallow drains divides them into raised rectangular plots a few metres square in area.

Oriomo River

In January and February, 1934, collections were made at Wuroi landing, 40 miles by river from the coast, and at Dagwa subsidiary camp, situated six miles out from the river in a souterly direction, on the edge of the Binaturi watershed. Wuroi camp was 20 m and Dagwa 40 m above sea level, with undulating ridges rising round about to approximately 40 m and 75 m respectively. We found the climate extremely hot and humid, though cool at night on the open savannahs, and leeches, infesting both forests and savannahs, did much to add to the discomforts of the region.

The Oriomo is a deep turbid stream perhaps 200 m wide at the mouth and 50 m across at Wuroi. The bordering mangrove swamps of the lower reaches acquire, as the water loses its salinity, a dense fringe of nipa palm, and with the first appreciable rise in the muddy banks, about nine miles from the coast, rain-forest appears and is the principal frontage vegetation therafter. Sago swamps and swamps of teatree and tall grass are glimpsed here and there, and at intervals of miles, scattered singly

or in small village groups, are the houses of a wretched people by whom the riverbanks are occupied. These river folk brought to our camp for barter abundant supplies of bananas; also sago, taro, sweet-potatoes, pumpkins, sugarcane, papaws, pineapples, cocnuts, and bundles of Derris-root (probably D. 5768), called "Sadi", with which they poison fish. From another clan, scarsely less miserable and degraded, living in scattered communities on the savannahs, similar foodstuffs were obtained. The savannah people live largely on taro. Contrary to the usual custom, they lay out their garden in ovals, and each planted bed amongst the network of drains that served to prevent undue waterlogging of the surgace soil in the wet season, is roughly oval in shape.

Representatives of the estuarine freshwater mangrove communities persist along the banks to the limit of tidal influence, about four miles above Wuroi. Most important is Bruguiera 5836, a scaly barked tree of 25-30 m, which forms with Myristica 5765 limited to pure stands on sites subject to inundation, at leat by abnormal tides, and in some low situations occasional flooding for days on end in the wet season. The nutmeg, the commonest riverbank tree, develops on poorly aerated soil wide-flung aerial roots like those of a Rhizophera; great numbers of pneumatophores are produced by the Bruguiera, and, as is often the case where inundation is frequent and the substratum soft mud, the lower parts of the tree trunks are enveloped in radial masses of climbing Phyllitis 5778 and Arthropteris 5715, or support epiphytic patches of Cyclophorous 5779 and C. 5780, the inside of these miniature mangrove forests present a most fantastic appearance.

Sonneratia 5775, called "firefly mangrove" from the swarms of insects that illuminate individual trees at night, and odd clumps of Nipa fruticans occur on marginal mudbanks. With them are large groups of Pandanus 5791, a widespread species with prickly yellow fruit-heads. On more elevated banks, growing tangled together and partially submerged by the or in [illegible] groups, and the [illegible]

[illegible]

[illegible] that is, [illegible]

[illegible]

[illegible] subject to inundation, at least [illegible] the occasional flooding [illegible] the commonest [illegible] aerial roots like [illegible]

[illegible]

tides, and co-mingling above the rain-forest types in unbroken walls of foliage lining the river, are robust scrambling or scandent *Derris 5768*, *Caesalpinia nuga*, *Gnetum latifolium* var., *Blumei*, *Flagellaria 5835* and *Strychnos 5890*, the large shrubs *Couthovia 5815* and *Polyosma 5767*; and *No. 5834*, a tree with low spreading branches and large pinnate leaves. *Barringtonia 5776*, a small tree always having the appearance of being borne down to the water by the weight of vegetation overhead, is common all along the banks, and its caducous white flowers conspicuous objects in the river drift. *Mucuna 5774* (D'Albertis Creeper) and *Entada scandens*, festooned and hanging in leafy curtains between rain-forest fringe trees, heavy-trunked sago palms surrounded by vigorous young sucker growths, and the remarkable tall and slender palm, No.5887, towering over all, combine to create an impression of tropical richness which an interior view of the forest soon dispels.

The aquatic fern *Ceratopteris 5818* grows commonly on river mud exposed by the tidal reflux, and submerged in the shallows are *Hydrilla 5882* and *Myriophyllum 5883*. A pink water-lily, *Nymphaea 5842*, with *Azolla 5843* floating among the serrate leaves, was found in the quiet waters of a tidal pool connected with the river and encompassed by forest in which was a secluded swamp filled with *Hanguas malayana*.

The inland vegetation is comprised of (1) rain-forest, (2) *Melaleuca-Tristania* savannah-forest, (3) open palm-Pandanus savannah (at Dagwa), and (4) a distict typy of gallery forest peculiar to streams flowing through No.3.

1 Rain-forests

These are generally of poor quality and volume, and their total area, as compared with savannah, insignificant. Distribution is in strips following the river and its larger affluent creeks, small outpost patches and clumps flanking these bodies and, at Dagwa, rather larger patches

isolated in sinkholes in the limestone which seems to underlie the whole district. They contain, as do all lowland rain-forests, numbers of wide ranging species, among them *Podocarpus 5878*, as a young tree often mistaken for an *Agathis*, and of special interest on that account. The presence, and actual dominance, of a *Dacrydium* (*D. 5875*) in dry back areas along the river, is a notable feature, as is an extraordinary interpenetration of savannah and rain-forest types. It is not, for example, unusual to find in the drier rain-forest areas such savannah trees as *Melaleuca leucadendron*, *M. 5680*, *Tristania 5900*, *Acacia 5696*, and *Careya 5663* dominant in the canopy above a normal substage and undergrowth. Savannah grasses and ground plants do not, however, penetrate the rain-forests, and although canopy trees like *Evodia 5851* and *Alsonia angustifolia* are commonly sporadic in the savannahs and savannah-forests, a free dipersal of inferior trees and shrubs of the rain-forests by frugiferous birds is ineffectual, unless the propagules chance to lodge beneath heavily foliaged trees such as *Wormia 5713* and *Careya 5663*, where, under conditions of shade inimical to grasses and therefore immune from fire, they initiate forest conditions and constitute the nucleus of a rain-forest patch. Of factors controlling the distribution of rain-forest and savannah, within the broad climatic ones, probably fire is most important, and in the dry areas of Papua, as in tropical Australia, lightning in "dry storms" preceeding the monsoonal rains may be a causative agent of no mean significance.

Trees: In the river frontage forests, which vary at Wuroi from a few paces to half a mile in width, *Eugenia 5816*, *Ficus* spp., and *Parinarium 5874*, attaining 30-35 m, figure among the larger trees; but, with *Pometia 5879*, *Podocarpus 5878*, *Gnetum gnemon* var. *domesticum* and *No.6016*, they are restricted to narrow strips of alluvium along the stream. Out from the riverbanks the forest becomes progressively drier, savannah species migle in the canopy with *Gordonia 5721*, *No.5699*, *Podocarpus 5907*, [illegible] in the iris. [illegible]

[illegible]

Evodia 5851, etc., and eventually it degenerates to little better than a pole-wood in which Dacrydium 5875, 20-25 m high, forms sometimes nearly pure stands.

Slender species of forest borders, and forest patch pioneers, include Alstonia angustifolia, Elaeocarpus 5802, No.5803, No.5804 and No.5755, with which Exocarpus latifolia, often of shrubby habit, is abundant.

as substage species ranging to 15 m tall, Gymnacranthera 5903, Eugenia 5772 with bright brown bark, Dysoxylum 5904, Sideroxylon 5905, Sterculia 5785, No.5838, Ficus 5881, F. 5771, F. 5773, Vatica 5884, Decaspermum 5769, and anise-scented Evodia 5719 were collected, mostly from near the river, where the palm No.5790 and Pandanus 5893 occur on swampy ground, and magnificent P. 5847, raised on columnar stilt-roots, is a very conspicuous tree.

Undergrowth: A slender sapling substage of considerable density characterizes the margins and back areas, but woody undergrowth species come into their own as the thickening canopy discourages tree regeneration. Such species are, howerer, not present in great force, the moister, more heavily shaded forests being very open underneath, excepting in places inclined to swampiness in the wet season, where young Pandanus and a prickly young (?) palm occur in quantity. Herbaceous undergrowth and ferns are lacking altogether in parts, and of these Trichomanes 5717 and Schizaea 5716 of the forest floor, Phrynium 5786, No.5787 and No.5788 of sago-swamp margins, alone deserve special mention. Among shrubs are Psychotria 5899, P. 5720, Randia 5718, Casearia 5898, No.6071, Canthium 5837, the clump palm No.5839, Anomopanax 5757 and No.5756.

Peculiar to marginal stations touching on savannah, and very abundant round the edges of isolated forest patches, is the glaucous shrub Heydotis 5691, in association with Gleichenia 5812, Blechnum orientale, Nephrolepis 5809, Lycopodium cernum and Zingiber 5691 (over 1 m high),

all more or less gregarious, in tall grass, or sheltering small Zingiber 5951, Apostasia 6077, Schizaea 5728, etc., where the grass is short.

Climbers and Epiphytes: Within the forest, these are conspicuous by their absence, though plentiful enough along the river frontage. Calamus spp. and a few large lianes are present in the richer areas: Alyxia acuminata var. lancifolia, Freycinetia 5994, and rarely No.5877 (an orchid) in back area forest; Cissampelos pareira, an uncollected Nepenthes sp., etc., in the borders. Lycopodium 5783, Dendrobium 5764, Bulbophyllum 5781 with foetid large blooms, B. 5777, B. 6022, and Vittaria 6021 were collected as epiphytes, all but the latter two from the river-bank trees on which parasitic Loranthus 5782 is common, also that striking fern Platycerium grande, which ranges through the forest canopy to the closer savannahs.

2. Melaleuca-Tristania Savannah-forest

This ranges up and down the river on the southern side in a belt some five or six miles in width between the river frontage rain-forest at Wuroi, and open palm-Pandanus savannah on the Binaturi headwaters at Dagwa. It covers smooth undulating ridges, with streamless hollows in between, or drained by small creeks fed by gullies which dry out after the rains. The chief soil types are an acid grey loam, and a heavier red soil containing quantities of lateritic pebbles. Peaty areas, timbered with very stunted Melaleuca and Banksia, are said to occur towards the Fly, but these we had not the opportunity to view, nor any grassland north of the river. An approach to such conditions was observed at Dagwa, where a concentrated though limited occurrence of Restio 5912 and Drosera 5962, and patches of low Banksia forest, convey some impression of a peat flora.

Trees: The two soil types have each their characteristic trees and ground cover, but the distinctions are not widely maintained, the general-

ity of soils being intermediate grey pebbly loams which are a mixing ground for most species found on the area, trees of the grey soil category assuming there substage positions in relation to the taller *Melaleuca 5690*, *M. leucadendron* varieties, *Acacia 5696*, *A. 6017*, and especially *Tristania 5900*, typical of red soil ridges. These larger trees are usually 20-25 m tall, and well spaced to form a very thin, somewhat interrupted canopy over the grasses. Under exceptional circumstances some may attain 30 m and a girth of 3 m.

Melaleuca leucadendron var. *5695*, with broad thick leaves and racemous red flowers, a distorted low tree of 6-8 m average height, prevails in close formation and is the characteristic dominant on sour grey soil, with often much *Banksia 5742*. *Grevillea 5711* is a rare associate, while *Glochidion 5701* (3-5 m) tends to gather in dark foliaged scrubs.

Other important species, characteristic more of the grey pebbly soils, and of intermediate stature, are *Xanthostemon 5932*, *No.5754* and *Tristania? 5805*, to which may be added *Wormia 5713* and *Careya 5763*, very conspicuous shady trees of sporadic occurrence, with large yellow and white flowers, respectively. *Eucalyptus 5947* is most versatile as to station, but localized in distribution, and *E. 5970* a rarity. *Melaleuca leucadendron* var. *5814*, most abundant in swamps, seasonal or permanent, was the only tall form of this variable species seen in flower. A third *Acacia*, slender, profuse flowering *A. 5698* (4-6 m), forms thick "wattle" scrubs of limited extent about rain-forest borders. In addition, there are several small species of outside (probably monsoon-forest) origin, which have become thoroughly accomodated to savannah conditions, e.g. *Antidesma ghaesembilla*, *No.5753*, *Fagraea 6019*, *Barringtonia 6050* and *Rhodamnia 5806*.

Ground cover: Considering the extent of the area of which the Oriomo savannahs and savannah-forests form a part, and the close proximity of the Australian continent, grass species are few in number, and the same may be said of associated forbe. Massed *Imperata arundinacea*, with the [illegible] soils [illegible] intermediate grey podzols, [illegible]

[illegible]

[illegible]

shady [illegible] of [illegible], [illegible] yellow [illegible]

[illegible]

alnoides, [illegible] flowering [illegible] [illegible]

[illegible] not [illegible] mid-forest [illegible]. In addition, there are

several small species of outside (probably monsoon-forest) origin, which

have become thoroughly acclimatized in [illegible], e.g. [illegible]

[illegible] [illegible] and [illegible]

[illegible]. Considering the extent of the area of which the

[illegible] [illegible]-forests form [illegible], and the [illegible]

[illegible]

Andropogon 5725, *No.5726* and *Scleria 5808*, 2 m tall, grow rankly on deep red soil, in positions adjacent to rain-forest, especially. Out on the ridges tuft- or clump-forming species, with a Cyperaceous element varying in accordance with soil acidity, form a mixed covering of good body but irregular height growth. Growth generally is somewhat modified by frequent burnings, and severe patch grazing by amazing numbers of big brown wallabies, the result being an increase in low leafage at the expense of reproductive parts. *Pollinia 5926*, *P. 5710*, *P. 5733*, *Themeda 5927*, *Rottboellia 5735*, *Andropogon 5895* and *Ischaemum 5928*, up to 1 m or more, are among the larger and more important species on red and intermediate soils. Others include *Setaria geniculata*, *Heteropogon 5727*, *Eremochloa 5743*, *Alloteropsis 5745*, *Eriachne 5736*, *E. 5929*, *E. 5964*, *No.5911*, *Dimeria ornithopoda*, *Andropogon 5985*, *Panicum 5744* and *P. 5960*. The principal sedges, *Fimbristylis 5750*, *F. 5706*, *F. 5734*, *Rhynchospora 5709*, and particularly *R. rubra* (4-5 dm), may be abundant enough to dominate over considerable areas the aspect of the ground cover. *Scleria 6012* and *S. 5996* also occur.

On very sour grey soil, indicated by pure stands of *Melaleuca leucadendron* var. *5695* (Broad-leaved Teatree), the few characteristic grasses (e.g. *No.5910*, *No.6014* and *No.6015*) yield almost complete control to a dense short cover of soft sedges, especially *Scleria 5868*, in which occur the slight forbs *Goodenia? 5796*, *Mitracasme 5797*, *Salomonia 5867*, *Polygala 5869*, *P. 5870*, *No.5901*, *Drosera 6076* and *Calogyne 5995*.

On patches of hardpan, destitude of ordinary plant cover, which are not infrquent, small *Eragrostis 5829*, *Panicum indicum*, *No.5828*, and *Fimbristylis 5817*, with the forbs *Stylidium 5820*, *Mitracasme 5819*, *Lindernia 5821*, *Vernonia 5823*, *Centipeda minima*, *No.5832*, *Phyllanthus 5824*, *Dantella 5825*, *Heydotis 5830*, *H. 5831*, *Hypericum 5833*, *Pseuderanthemum 5822*, etc., mostly minute ephemeral species, constitute a wet season aspect of short duration.

[illegible] 1922, [illegible] (1911), are parasitic on [illegible] thurians. In addition [illegible] adjustment to endoparasitism, [illegible] [illegible] -forming [illegible] [illegible] in accordance with [illegible] mobility, [illegible]

[illegible]

[illegible] also occur.

[illegible]

[illegible] aspect of [illegible] adaptation.

Yellow *Utricularia bifida* (6 cm) and blue *U. 5853* (15 cm) were prominent in another special habitat community, found on an open seepage-patch of rich black muck, which held, in addition, small *Isachne 5854*, *Halorhagis 5855*, *No.5856*, and a few taller plants of *Xyris 5799*.

Points of interest which arise in a consideration of the remaining forbs, for the most part sporadic species ranging throughout, are the paucity of woody legumes, especially grass climbers, which abound on the stonier soils of the Central Division savannahs, and the occurrence of the orchids *Habenaria 5702*, *H. 5913*, *No.5914*, *No.5945*, *No.5955*, *No.6034*, *No.6035* and *Eulophia 5747*, which, excepting the two first and the last, are seemingly very localized, and all but the two first named, rare. Outstanding by reason of their size and form are *Crinum 5762*, in widely separated groups, and the very common tumeric (*Curcuma 5858*) of thinly timbered areas. Mostly slender erect, or rosette types, the species include *Centranthera 5703*, the yellow "everlasting" *Helichrysum 5704*, *No. 5692*, *No.5737*, *Curculigo 5741*, *No.5798*, *Stackhousia 5760*, *Aeginelia indica*, *No.5861*, *Phyllantus 5865*, *P. 5866*, *Euphorbis serrulata*, *Eriosema chinense*, *Knoxia corymbosa*, *Thysanotus 5961*, *No.5931*, *No.6007*, *Aneilema 5936*, *Dicrocephala 5759*, *No.5738*, the little ferns *Cheilanthus tenuifolia* and *Schizoloma 6027*, twining *Vigna 5763*, trailing or prostrate *Desmodium heterophyllum* and *Pyncospora nervosa*, and the larger woody annuals, undershrubs or near-shrubs *Pimelea 5708*, *Osbeckia chinensis*, *Cassia mimosoides*, *Abelmoschus 5764*, *Tephrosia 5752*, *Desmodium heterocarpum*, *Psoralea 5909*.

Shrubs: Though some are common enough, the following shrubs, .5-1.5 m high, are scattered and not of much consequence: *Melastoma 5693*, *Leea 5700*, *L. 5807*, *Nepenthes 5749* in low tangled clumps, *Breynia 5897* and *Clerodendron 6025*, the last discovered in but a single example.

Epiphytes: Succulence, yellow coloration, high cutinization and other xerophytic characters are exhibited in *Myrmecodia 5848*, *No.5849*, *Dischidia*

5896, the ferns *Polypodium 5712*, *Drynaria 5731*, *Cyclophorus 5800*, and the other orchids *Bulbophyllum 5793* and *Dendrobium 5794*, which many old trees support in large quantities on the upper trunk and branches. Yellow flowering *Loranthus 6023*, of shortly scandent habit, was the only parasite observed.

3. Palm-Pandanus Savannahs of Dagwa

The change to this type of savannah, an open landscape of rolling ridges dotted with fan-palms, Pandanus, and compact small trees, is an abrupt one, coinciding, and perhaps in some way connected with, the occurrence of much obscured, weathered outcroppings of a pale brown cavernous limestone, about five or six miles out from the Oriomo. Dark rain-forest patches, growing in sink-holes in the limestone, provide a striking contrast with the open grassland vegetation, and winding through the ridges are flat-flowing creeks shaded by rain-forest strips and a distinct type of low gallery forest. A thick, waving body of grass, principally *Themeda* ~~5729~~ 5927, rising about 1 m above the surface of the ground, contains nothing in the way of plants which can definitely be said not to occur in the *Melaleuca-Tristania* savannah-forests, excepting perhaps *Tacca 5954*, and the shrubs *Xylosma 5943* and *Helicteres 5975*. It is in tree stocking that great differences arise. The characteristic palm, *Livistona Brassii*, attaining rarely 10 m, is not nearly so abundant as Pandanus 5933, a freely branched species of 4-5 m, scattered, grouped, or gregarious in fairly extensive pure forest stands on the slopes. These species occur, it is true, as occasional strays in the savannah-forests, from which a few species, notably *Banksia 5724*, *Grevillea 5711* and *Glochidion 5756*, spread to the open ground. Also present are the trees previously referred to as outside elements in the savannah-forest, and *Albizzia 5858* (6-7 m), a feature of open patches in the forest, is very common. Apparently distinctive small trees of 3-5 m include *Macaranga 6008*, *Breynia 5978* and *Trema 5983*; but most abundant and characteristic, next to the palm and Pandanus, are *Parinarium 5997* and *Symplocos* ~~5799~~ 5977, picturesque thick-foliaged trees of 5-6 m, which, from their appearance, might be taken as belonging to the peculiar flora from which

5. [illegible]

[illegible] on the [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] cut from the interior. [illegible] [illegible] in the literature, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] which, [illegible] [illegible] [illegible] [illegible], rising about 1 m from [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] forms, occurring [illegible] [illegible] [illegible] [illegible] [illegible] Helicteres [illegible]. [illegible] [illegible] [illegible] [illegible] different [illegible]. The characteristic [illegible], [illegible], attaining rarely 1 m, [illegible] [illegible] [illegible] [illegible], a few [illegible] species of 2-5 m, scattered, [illegible], [illegible] [illegible] [illegible] [illegible]. These species [illegible] [illegible] occasional [illegible] in the [illegible], [illegible] [illegible] notably [illegible] [illegible] [illegible] [illegible] [illegible]. Also [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] (2-5 m), a feature of open glades in the forest, is very common. [illegible] [illegible] small trees of 2-5 m include [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]; but most abundant and characteristic, next to the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] picturesque [illegible] [illegible] [illegible] of 2-5 m, which, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the gallery forests are derived.

4. Gallery Forests of Dagwa

Characteristic of these are Barringtonia 5915, Symplocos 5939, Endiandra 5940, No.5989, Randia 5993, Fagraea 5941, and the scrambling shrub Tetracera 5938. It is a low, close-packed, sclerophyllous community of 6-8 m average height, as compared with 12-15 m for rain-forest fringing strips in the same locality. Both types occur on the same streams, rain-forest usually along the upper parts and within savannah-forests, the other lower down on open savannah, where there are indications of the water being permanent at all seasons. The more aggressive rain-forest, which seems always engaged in deadly struggle with the grasses, widens out where the banks are low and spreads over narrow bends formed by meanderings of the streams. Shade-giving component trees make this spread possible, and at the same time give shelter to a tall bordering growth of coarse grasses. The hardier gallery types give and require no shade and there is no fringe growth whatever. They root in muddy soil along the edge of the deep, narrow streams, which flow sluggishly as in a tunnel underneath. It is necessary to peer over the banks to see their short trunks, and clean grass slopes reach to the screening wall of foliage as if ending against a half-sunken hedgerow. The distinguishing trees occur nowhere in the Oriomo rain-forests. The only local affinities of the gallery-forest community would seem to lie in the tree flora of the surrounding savannahs. The constituent species of both communities are, in all probability, from a downstream (Binaturi River) source, and members of a special flora inhabiting the large swampy plains known to occur on the western rivers, of which we saw a little at the Binaturi mouth.

5 Grassland Hydrophytes

Barringtonia 5915 of the gallery forests, a thinly foliaged low tree of about 4-7 m, with spreading branches, red flowers and small winged fruit, is equally at home in periodic swamps and around the edges of deep permanent ponds on open savannah, but , so far as our observations go, it is absent from similar sites within the savannah-forests. In the shallow margins of a lagoon near Dagwa camp it endures complete submersion of the roots and lower trunk for months together in the wet season, and bears on its branches very numerous epiphytic orchids, viz. *Luisia 5925*, *Dendrobium 5948*, and especially *D.5925*.

A seasonal community of herbaceous amphibious plants, variously represented in shallow bodies of water, and lagoon and pond margins from which the waters recede in the dry season, includes *Melochia supina*, *Philydrum languinosum*, *Polanisia 6026*, *Polygonum 5916*, *Limnophila 5872*, *L.5919*, *Hygrophila 5999*, *Dysophylla 5917*, *Ilysanthes 5918*, *Oldenlandia 6000*, *Eriocaulon 5751*, *E.5752*; the sedges *Fuirena umbellata*, *Eleocharis 6010*, tall *Mariscus 5921* and *No.5920* (1-1.5 m); and the grasses *Panicum 5923*, *No.6001*, *Paspalum 5922*. In one deep pond, inside a fringing sedge community of *Scleria oryzoides* 2.5 m high, *Nymphaea 5949* made a beautiful showing with its large upraised blue flowers; and in smaller ponds were found *Limnanthemum 5871* with orange-yellow, and *L.5974* with white fringed flowers.

[illegible]

[illegible] occasionally [illegible].

[illegible] represented in shallow bodies of water [illegible] from which the waters recede in the dry season, [illegible] Lycopodium 521, [illegible]; the sedges [illegible]

[illegible]