The Forest Ecology of the Reventazón Valley

by

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Inter-American Institute of Agricultural Sciences

Turrialba, Costa Rica

March, 1952

The Forest Ecology of the Reventazón Valley

A Thesis

Submitted to the Faculty Committee in partial fulfillment of the requirements for the degree of

Magister Agriculturae

at

Inter-American Institute of Agricultural Sciences

APPROVED: L. R. Holdridge
Adviser

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Committee

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Biography

John B. Reark was born in Chicago, Ill., U.S.A. on August 1, 1923. He attended public schools in Miami, Florida, and graduated from Miami Edison High School in 1941. He attended The Georgia School of Technology for one year and spent the years 1942-1946 in the U.S. Army Air Force as a transport pilot, with two years in Europe. Following discharge from service he attended the University of Miami, receiving his B.S. in June, 1950. One year of post-graduate study at the University of Miami, and a similar period at the Inter-American Institute of Agricultural Sciences resulted in the completion of the present thesis.

He was married in September, 1950, and has no children.

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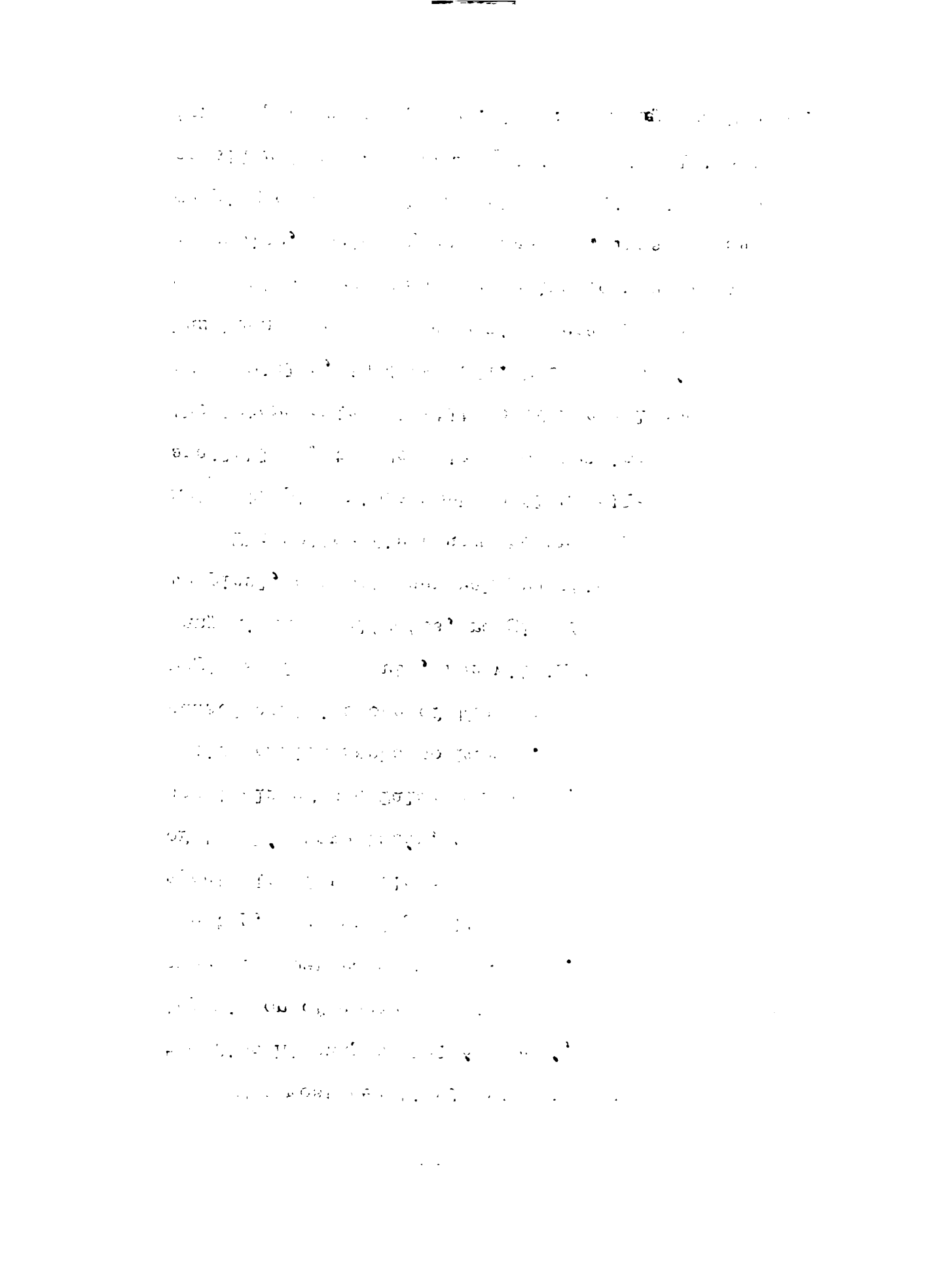
INTRODUCTION

The most beautiful drive in all Costa Rica is the fine highway to Volcán Irazú, a twisting, turning ribbon of concrete which climbs to a height of over 3400 meters above sea-level. As one approaches the top, a clear day will reveal the breath-taking spectacle of the slope down to the turbulent waters of the Río Reventazón, and the rise to the majestic sentinals of the Talamanca range, which stretch their serried ranks to Panama. The view thus encompassed contains one of the most interesting botanic regions of the earth, for within it are to be found many distinct climates, ranging from sub-alpine to tropical, and with several gradations in rainfall.

The writer first saw the area in I948, but did not attempt serious work until a fellowship was made available by the Technical Cooperation Program of the Interamerican Institute of Agricultural Sciences of Turrialba, in June I95I. The Reventazón Valley has been made a demonstration area by the Technical Cooperation Program for coordinated work in Agriculture, Education, Sociology and Forestry. Inasmuch as a mapping of areas of natural vegetation is generally considered to be a pre-requisite to intelligent forestry practise (Beard, L945; Standley and Record,



1936), the author was delegated to prepare such a study under the terms of the fellowship. Although Costa Rica has had a succession of distinguished native and foreign botanists, which are documented elsewhere, it was the rich flora which caused their interest, and not the ecology composition. Pittier, and later Standley (1937) were the first to attempt a floristic grouping of the species, Standley, who mentioned the complicated ecological structure, carried on the work of Pittier in classification of the altitudinal belts as "Tierra Caliente","Tierra Templada", and "Tierra Fría". It was not until Holdridge (1947) published his World Plant Formation Chart that a logical approach could be made to the problem, using temperature and rainfall as guides. The problem was also simplified by the decision to study only trees, which eliminates much of the difficulty caused by narrowly endemic species of Epiphytic and Herbaceous plants.

Mapping of forest associations requires both a knowledge of the flora and ability to traverse the area in question. The first was acquired by the making of botanical collections in every site visited, and the latter was accomplished by jeep, car, horseback, and on foot. Since most of the land is privately owned,

permission had to be obtained from the owners before collections could be made. Finca owners and managers were very generous in their treatment of requests, and many of them voluntarily furnished horses or meals. Aerial photographs were utilized whenever possible, for correlation on the site made mapping easier in the more inaccessible areas. Space is too limited to thank all who have been of help, but especial mention must be made of Ing. Mario Gutierrez J., whose aid in the procurement of transportation and proper introductions was invaluable. The help and guidance of Dr. L.R.Holdridge, under whose direction the study was accomplished, was also inestimable. Thanks are also due to: C.H.Muller, Santa Barbara Botanic Garden, for his help with the oaks; Jorge León, IICA Botanist; P.C.Standley, Escuela Agrícola Panamericana, for his very kind aid in identifying the largest part of the collection; F.L.Wellman and P.de Tarso Alvim, for their enthusiastic guidance; Elliot Coen and William Davis of the Servicio Meteorológico de Costa Rica; Alberto Torres and his staff of soils men at the Universidad de Costa Rica; J.P.Tosi, of the Technical Cooperation Program for his helpful criticism; and to my wife, Muriel, for her encouragements.

GEOGRAPHIC CONSIDERATIONS

1. Position and Physiography

Costa Rica is the next to southern most and the next to smallest of the Central American Republics. Its shores are washed on the East by the blue Caribbean, and on the West by the broad Pacific. Scarcely a hundred miles wide, its jagged mountains stretch from Nicaragua to Panama for over two hundred miles. It has been well named "The Switzerland of Central America", for nowhere in the country is one not conscious of the massive peaks and rough topography which dominate the landscape. Of the mighty valleys which carry the rushing waters to the sea, there are two that have been exploited most thoroughly to the benefit of man: the Meseta Central, of Pacific drainage, which contains the bulk of the present population; and the valley of the Reventazón, across the low continental divide, which, with its tributaries, occupies an area of about two thousand square miles in the center of the Atlantic slope.

From the southern rim of the crater of Irazú can be seen the entire area embraced by this study. The slopes fall off, steeply at first, then more gradually, to the gorge of the Reventazón. On the farther side, a tumbled succession of hills and mountains thrust them-

selves to the horizon. To the right, at the very foot of Irazú, is the low pass at El Alto with its railroad and highway to the Meseta Central. From El Alto to the west is a wide horseshoe of hills which, beginning with the small mountain La Carpintera and culminating with El Tablazo (2200 m), ring the broad Cartago Valley. From El Tablazo a rising succession of peaks stretch away to the southeast, the Cordillera de Talamanca, along whose crest runs the Pan American highway. From Irazú, the summits of Las Vueltas (3156 m), La Muerte (3540), Cuericí (3400 m) and the immense mass that is Chirripó Grande (3940 m) can easily be distinguished. Of these, only the former two are included in the study. Below the Talamanca peaks, the river system is very complicated, due to the chains of hills and mountains which here run parrellel and there perpendicular, to the main axis of the range. The Talamanca drainage is eventually centered in the long, steep-sided valleys of Orosi and Pejivalle, with several smaller valleys between. Near to the town of Orosi, the rivers of the Cartago and Orosi valleys merge to become the Reventazón, whose thundering course has cut a twisting canyon through the hills, and whose current is augmented by smaller streams until it is joined by the Pejivalle. To the east of Irazú, acros s a high ridge, the usually fog-shrouded cone of Turrialba Volcano reara itself to over 3400 meters, where it

towers over the Turrialba Valley and the river which flows to the Reventazón. Below Turrialba, the roaring gorge of the now large and uncontrollable river becomes lass precipitous, and the windings less abrupt, until it flows at last through the coastal flood plain to the Carribbean. The area of the study, however, descends no farther than the station of Paralta at 357 meters above sea- level, below which point there is little change in the forest until the mangroves of the coast are reached.

2. Geology and Soils

Costa Rica, Panama, and southern Nicaragua form a geologic unit, the Isthmian Region of Schuchert(1935). It is a young area, for as late as Cretaceous times the waters separated the Americas by a wide, deep sea. The Isthmus first appeared during the late Cretaceous and persisted as land until the Eocene, when shallow seas again connected the oceans. Parts of Costa Rica have been exposed as land, however, from the Cretaceous to the present. In the late Miocene and much of the Pliocene ages occured much volcanic activity, and the present mountain ranges were thrust up. According to Darrah(1945), the temperate floras of the high mountains are relict North American forms which migrated at the time of the orogeny or earlier. The entire isthmian region

has existed in much the same form since that time, although shallow seas have covered parts of the coastal plains.

The physiognomy of the Reventazón valley reveals a complex development. Both Irazú and Turrialba are quiescent volcanoes having ash cones. Obregón (1932) describes the craters in detail, giving maps and accounts of historical eruptions. Great lava flows, some of them fairly recent, can be traced on the slopes near the towns of Cartago, Cervantes, and Turrialba. Earthquakes are rather frequently centered in this area of volcanic activity. The La Carpintera range is of lower Miocene limestones, while that of El Tablazo is Oligocene shale and conglomerate. The Talamanca range is a much deformed intrusive mass of granite rocks overlain on the eastern slopes by sandstones and conglomerates, apparently of Pliocene age, and over Cerro de la Muerte and nearby peaks by basaltic rocks. Gabb spent sixteen months in The Talamancas, and reports (in Schuchert) that quarts-diorites and syenites are the most common rocks found. He also reports on the limestones of The Reventazón Valley, which are of Miocene age. The Reventazón watershed, therefore, is composed of early Tertiary sedimentary deposits, Tertiary granitic rocks, and recent volcanic ash and extrusions.

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The soils, as might be expected, vary considerably in composition and profile. Unfortunately little has been done in classification until recently, but there is now an active soil survey under the direction of Alberto Torres, which has classed the Coffee lands of the Reventazón. Most of the natural vegetation in land suitable for coffee has long since disappeared, so it is impossible to assess the vegetation as it is affected by soil factors with the information on hand. Only in cases of obviously poor drainage has this study been enable to distinguish edaphic associations; time did not permit a more complete comparison of species and soils. For this reason, the soils map (Fig. 1) is given on the basis of parent material, with only areas of markedly impeded drainage noted.

3. Climate

A. Introduction

Many systems have been set forth in attempts to classify plant formations according to climatic effect, and they have varied a great deal in terminology and methods. Schimper (1903) performed invaluable work with his physiological approach to the reaction of plants to climate. Wercklé (1909) and Pittier

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The first meteorological measurements were made in Costa Rica in the year 1866, consisting solely of pluviometric data. The modern Meteorological Service, a branch of the Ministry of Agriculture and Industry, has over eighty stations in operation, and records of

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over forty discontinued ones. The stations in the Reventazón Area are described in Table II; and stations from outside the Valley proper, but within associations found in the Valley which lack data, are given in Table III.

In addition to the above recordings, a few readings of temperature and relative humidity were taken on Irazú and Cerro de la Muerte, on both windward and leeward sides. Sample readings are given in Figure II, but these are merely an indication of climatic trend, and can in no sense be interpreted as anything but a random selection of a week's weather. All recordings were made at the end of the rainy season or during the dry season; unfortunately, no comparisons with other seasons were possible. The Meteorologic Service kindly furnished the hygrothermograph with which the high mountain readings were taken, and made records available from which the included graphs and tables were constructed.

B. Climatic Factors.

1. Temperature of the air is a function of altitude, the drop per hundred meter rise averaging about 0.7°C in Costa Rica, but that rate may vary between 0.4°C and 1.0°C depending upon atmospheric moisture and pressure.

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Epochs	Connection with N. Am.	Connection with S. Am.	
Recent	unbroken	unbroken	Continued Vulcanism - free migration of lowland forms.
Pleistocene	unbroken	unbroken	Continued Vulcanism - freemmigration of lowland forms.
Pliocene	broken	unbroken	Vulcanism and Orogeny - Talamanca Range formed.
Miocene	broken	broken	Orogeny late in epoch - Reventazón Valley and La Carpintera - Limestones formed early in epoch. Migration of temperate floras from North America.
Oligocene	none	broken	Formation of El Tablazo shales and conglomerates. Isthmian region a chain of islands.
Eocene	none	broken	Low relief, connected only with South America.
Cretaceous	unbroken	unbroken	Formation of Isthmian arch, North and South America joined for the first time.
Jurrasic and Earlier	none none	none none	A wide deep Portal separated the Americas.

Table I

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Table I

Station	Elevation	Location	Years of Record: Rainfall	Years of Record: Temperature	Climate Type
Cartago.	1436 M.	Foot of Irazu	1923-50	1945-51	Sub-Tropic Moist
El Yas	1205 M.	Reventazón Vy.	1944-50	---	Sub-Tropic Moist/Wet
Juan Viñas	990 M.	Reventazón Vy.	1901-03	---	Sub-Tropic Wet
			1924-50	---	
Orosí	1068 M.	Orosí Valley	1948-51	---	Sub-Tropic Wet
Pejivalle	630 M.	Pejivalle Vy.	1931-40	---	Sub-Tropic Wet
Peralta	357 M.	Reventazón Vy.	1931-50	---	Tropical Moist
Sanatorio Durán	2333 M.	Slopes of Irazú	1935-36	1935-36	Lower Montane Moist
			1942-50	1942-45	
Santiago		Reventazón Vy.	1901-09	---	Sub-Tropic Wet
Tapantí	1325 M.	Orosi Valley	1939-50	1941-44	Sub-Tropic Rain
Turrialba Centro	659 M.	Turrialba Vy.	1923-50	---	Sub-Tropic Wet
Turrialba IICA	602 M.	Reventazón Vy.	1941-50	1941-50	Sub-Tropic Wet

Table II. Weather Stations in the Reventazón Area.

El Alto	1543	M.	Foot of Irazú	1949-51	1950-51	Sub-Tropic Moist
El Cairo	94	M.	Coastal Plain	1942-50	1942-50	Tropical Moist
Las Nubes	2900	M.	Irazú	1941-46	---	Lower Montane Wet
San Isidro del Coronado	1420	M.	N.W. Slope Irazú	1941-42	1943-45	Sub-Tropic/Lower Montane/Wet
				1949-50	1950	
Villa Mills	2850	M.	Cerro de la Muerte	1944-50	1941-47	Montane Moist/Wet

Table III. **Stations outside of the Reventazón Valley**

Statistics outside of the Seventeen Valley

2. Rainfall may be due to orographic, conventional, or frontal causes. Since the study area is located in the trade wind belt, the orographic influence is felt on all mountain slopes; those facing the trades receiving abundant precipitation therefrom, and those to the leeward being in a rain shadow. Local conventional air currents are reponsible for much of the precipitation in rain shadows, and when these commonly interact with high rainfall orographic factors, a true rain climate results. Frontal conditions, "temporal" weather, can be either weak tropical cyclonic disturbances or air masses driven across the Gulf of Mexico during the northern winter. Unlike the rather hard rains of orographic and convectional showers, frontal precipitation is usually a drizzle produced by low hanging clouds, a condition which may persist for days at a time.

3. Wind is a decided factor in some associations. The very high mountains are clothed with a brushy growth, over which the winds are almost contantly blowing. This, coupled with the low average temperature, has a decided effect on the vegetation, for in sheltered sites a taller forest developes. The valley is out of

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hurricane paths thru the West Indies, but occasional wind storms bring large branches crashing to the earth. The valley acts as a funnel to the trade winds, which causes the farmers around Cartago and Paraiso to plant wind breaks, but whether the original forest there reacted to this element is unknown.

4. Humidity is usually rather high because of the moist winds which are constantly ascending the slopes. On some mountain sides an almost constant cloud formation gives relative humidities which are very nearly 100% the year round. Table IV contains all data available for valley stations.

5. Cloudiness can be important in reducing transpiration, so is considered an ecological factor. Although usually expressed as the opposite, hours of sunshine, it is probable that cloudiness is more important in the valley. There are no records of this type available for valley stations.

6. Seasons are represented by variations in rainfall and temperature. Severity and duration of the dry seasons have a marked effect upon vegetation. The Reventazón Area has two such dry times a year; one, the "verano" extending from January thru April, and the "veranillo de San Juan" coming in July and August.

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The "verano" may be of greater of lesser severity, the effect in rain shadow areas being especially well marked. "Temporal" conditions frequently interrupt the "verano". Davis (1951) has covered the "Veranillo de San Juan" as well as is possible with the short term records available. The "veranillo" may be more or less well marked, but is usually observable only in rain shadows and drier sections. The graphic rainfall charts (Figs. 4A, 4B, etc) show best the durations and intensities of the seasons.

C. Classification of Climates.

The climates represented in the Valley are: (a) Tropical Moist, (b) Sub-tropical Rain, (c) Sub-Tropical Wet, (d) Sub-Tropical Moist (e) Lower Montane Rain, (f) Lower Montane Wet, (g) Lower Montane Moist, (h) Montane Rain, (i) Montane Wet, and (j) Montane Moist. These are classfied according to the Holdridge plant formation chart, for other systems are based upon physical approaches and climatic extremes, which give little hint of the reaction of plants to climatic factors outside of the temperate zones. This system is obviously in synonomy with classfication of plant formations, but there can be no better indicator of climatic conditions

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Feb	91.3	84.2
Mar	91.5	85.2
Apr	91.1	83.7
May	89.7	82.9
Jun	91.9	85.8
Jul	93.4	86.2
Aug	91.7	86.2
Sep	90.9	86.5
Oct	90.8	86.5
Nov	94.5	87.1
Dec	95.5	88.6
Year	91.8	88.5

Table IV. Monthly and yearly average relative humidity recorded at two Reventazón valley stations.

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4. Human Factors

A. History and People

The history of the Reventazón Valley is inseparable from that of the country as a whole. Columbus discovered Costa Rica in 1502, but not until 1564 was a town established in the highlands: Cartago. Jones (1941) gives a very good account of the history of the country, and describes in detail the miserable standard of living throughout colonial days. Independence was gained on September 15, 1821, without a shot being fired. The present form of government is that of a republic.

The people are largely of Spanish decent, with slight admixture of Indian blood (Fernandez, 1927). Lowland banana operations have attracted large numbers of Jamaican laborers of the Negro race.

B. Transportation

The primitive mule-train and ox-cart civilization began to give way in 1872 with the construction of the Atlantic Railroad, whose roadbed follows along the north side of the Reventazón. With the expanding agriculture and increased utility of motor trucks, a

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net work of highways now extends thru much of the valley (See map, fig. 3). A system of secondary roads spreads out from these, but there are still large areas which can be reached only by cart road and mule trail. Indeed, there are many square miles to the south of the Reventazón without even hunting trails.

C. Exploitation

It is doubtful if the aborigines of the region were able to clear much of the forest, for when the Spanish arrived the land was still covered, as a rule, with virgin growth (Jones, Loc.Cit). Although there are vast areas of uncut timber, exploitation is proceeding at a steady rate. In 1909 the trail to Irazú passed thru many miles of oak forest (Calvert and Calvert, 1917), land which today is virtually all farmed.

The history of land exploitation begins in 1808, the year of the first coffee shipment. Before that date clearings had been made in a small way, chiefly about Cartago, with some cacao plantations in the Lower Reventázón; but coffee was the first successful money crop which Costa Rica had. Land suitable for coffee was rapidly cleared, and the expanding production brought undreamed of wealth into the country. In the

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last half-century there has occurred a diversification of agriculture, with lands unsuited to coffee being developed into dairy, meat, and staple-crop farming. There are no large banana plantations in the area, although much is raised for local consumption.

The forests are exploited as a virgin timber resource, with no thought of continuing yield, but rather as something to be gotten rid of so that farming may be carried on. Much land is cleared which proves unsuited to agriculture and which is allowed to come back into relatively worthless second growth. There are a very few managed wood lots, and rather more managed wind-breaks, but the volume of timber so produced is very small. Wasteful and primitive logging methods greatly decrease the yield of wood from virgin lands, but the industry supports agricultural expansion. Charcoaling is an occupation of note in certain areas, and much cord wood is cut for shipment to the Meseta Central.

Land use patterns have changed with the years because of varying economic pressures, but, in all cases of established agriculture, reflect the ecological status of the land. The Census of 1950 is the first in which agricultural information was broken down into useful statistical data, so there is no means of comparison

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Floristic Considerations

1. Botanic Collections

Anders Sandoe Oersted was the first botanist to visit Costa Rica. He arrived in 1848, and during his stay he collected for several months near Cartago and on the slopes of the volcanoes above that city. His route took him down the Reventazón Valley which enabled him to make collections near Juan Viñas and Turrialba.

Various collectors, most of them interested in horticultural material, had shipped living and pressed plants to Europe from the year 1848 onward, but the next important collections were made by Polakowsky, who botanized in the Meseta Central and Cartago regions, in 1873-77. The first plant list was published in 1888 by Prof. Anastasio Alfaro, Director of the National Museum. The collections of J.J.Cooper, made in the mountains to the south of Cartago, were studied by Captain John Donnell Smith, who described many new species therefrom.

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in the nation. Coming to the country from Switzerland in 1887, he remained until 1903, and during all of that time he labored incessantly to obtain a broader scientific knowledge of Costa Rica. Before he left, he had the satisfaction of knowing that the National Herbarium, composed not only of his collections but of those of Tonduz, Wercklé, Biolley, Brenes and Brade and Brade, was without equal in Latin America, consisting of over 18,000 numbers and over 5,000 species. Many botanists, native and foreign, have since collected the country, but the work of Paul C. Standley must stand out, for it resulted in the four volume "Flora of Costa Rica (1936-37) which enumerates over 6000 species in 1514 genera. More recently, with the foundation of the Inter-American Institute of Agricultural Sciences, a small herbarium has been built up of plants native to the Reventazón Valley, but to the Turrialba region in particular. The author made collections of trees wherever reasonable doubt existed as to exact identity, and a collection of some 800 numbers was thus made. Identifications were made by Mr. Jorge León, IICA botanist, Mr. P. C. Standley, botanist at the EAP, and oaks were determined by Prof C. E. Muller, botanist of Santa Barbara College, Sta. Barbara, Calif.

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2. Relationships of the flora

The Central American Isthmian region forms a meeting ground of the South and North American Floras. This does not imply that the flora is not distinctive, but rather that relationships exist both to the North and the South. Standley (loc.cit) cites that only 16 genera, largely Orchidaceae, are endemic; 107 characteristically South American genera find in Costa Rica a northern limit; and that 26 characteristically North and Central American genera find their southern limits in the country. This is not surprising in view of the relatively longer geologic time connection to South America.

The tropical moist forests of the lowlands differ very little in composition from those of neighboring lands, while many of the species are found over the whole Caribbean and farther. Again in the moist and wet sub-tropical areas, the floras have very close relationships with other near by places and many of the species are very wide ranging. In the sub-tropical rain forests the distinctive elements begin to be brought out, for climatic isolation has forced speciation and only very tolerant species are widely found. It

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3. Lists of tree species

Each association is followed by a listing of trees observed therein. A tree is defined as a woody plant, usually with a single main stem, which is over 15 feet in height. Exceptions, as noted, are woody or semi-woody plants in high mountain associations which are commonly of lower overall height than fifteen feet. Vulgar names are noted where known. Names are given together with authorities and families following Standley, Flora of Costa Rica (1936-37). Duplicate specimens of plants collected are at present under study at the Escuela Agrícola Panamericana by Dr. Standley, and as yet many of the specimens collected

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Formations and Associations

1. Plan

The formations are taken in natural sequence, beginning with the tropical and working to the montane. In all cases the formation description contains climatic limits, and reference to the area in which it is found. The Holdridge World Plant Formation Chart was used as a guide in mapping. A map (Fig. 3) shows the limits of each formation.

Association descriptions follow the respective formations in which they are found. The map (Fig. 6) delineates the areas of each association. Photographs and line transect drawings are included wherever possible. Line transects were made in every association in which virgin forest could be found, and consisted of enumeration of every tree over 15' whose canopy fell over the line. Ecological divisions of less rank than association are omitted because of lack of time, except for obvious facies which alone cover large areas.

2. Descriptions

A. Tropical Moist Formation

The tropical moist formation lies below the 550 meters contour line in central Costa Rica. The temperature range is higher than 24°C average, and the rainfall yearly

Formations and [illegible]

1. Plan

[illegible]

2. [illegible]

a. [illegible]

average is between 2 and 4 meters. Weather records are given for Peralta and El Cairo (Fig. 4-A), both of which are in the formation. In the Reventazón Valley, the formation is limited to a narrow strip in the river gorge from below Tucurrique, widening considerably to include slopes and hills near to Peralta. The tropical moist climate holds sway over most of the Caribbean coastal plain in Costa Rica.

The climate is warm, without marked extremes in temperature, 15º-18º C being the lowest and perhaps 30ºC being the highest of record. Rainfall is fairly well distributed thruout the year, but there is a marked dimunition from January thru April. Rain tends to fall in rather hard showers. Atmosphere humidity is nearly always high (Table IV), and night fogs are frequent. Morning sun is the rule, with clouds obscuring the sky before noon. There are probably many more days without sun than with sun the full day, but there is usually sufficient light for normal photosynthesis. Deciduousness may or may not be a character, depending upon the markedness of the dry season, but in general the dominants are briefly deciduous, with understory plants evergreen.

The forest is, in general, closed at the top, with

plants below the highest understory being irregularly spaced. Walking is usually unimpeded by ground cover except for falls in the canopy layers. The vegetation is arranged in five tiers, with the tallest over one hundred feet in height. The dominants have large trunk diameters, with moderate buttressing a feature, and usually a wide, spreading crown which touches those of similar sized trees in all directions. The tallest understory, which is about 75 to 80 feet high, is composed of straight trunked trees of moderate diameter (to 2½ feet), closely spaced, and with a very dense interlocking foliage level. There are broken layers of shade tolerant trees and palms at 30-45 feet, 10-20 feet, and a ground level to head high layer of scattered herbs and shrubs. Huge lianas are a significant feature of the vegetation; many of those festooning the dominants having woody stems larger in diameter than a man's body. Epiphytes are very common on the dominant trees, practically covering the horizontal branches; but only the very shade tolerant are found elsewhere. The strangling habit is exhibited by some of the larger growing epiphytes. Parasitism is well developed in various seed plants, and fungi are especially common. Insects are very numerous,

and include many forest tree enemies, as well as pollinators of most of the flowers.

A.1. The Anacardium excelsum, Luehea seemannii Association.

The A. excelsum - L. seemannii association is the only one represented in the tropical moist formation within the study area limits. The soils are well drained, even rocky in places, and in the more accessible places are virtually completely given over to cultivation or grazing.

The dominant trees are huge, many of them having well marked buttresses. The tallest trees grow at rather large distances from each other, touching only at the outermost branches. Save for Ceiba, the largest trees are usually confined to the strictly tropical climate. A. excelsum and L. seemannii seem best to typify the association, both growing to large size, with tall thick trunks and spreading crowns, and they are probably the most common.

The tallest understory is composed of trees which reach to about 75-80 feet, and include many, such as Bursera simaruba, which have trunk diameters of over one yard. The 35-50 foot broken layer which is present consists of various species of leguminous and other trees;

[illegible] as well as [illegible] mats [illegible] of [illegible].

a.1. The [illegible] ombrosum, [illegible] association.

The A. [illegible] - I. scoparium association is the only one [illegible] within [illegible] well-drained, ev[illegible] rocky [illegible] are virtually [illegible] over [illegible] or grazing.

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[illegible] understory [illegible] reach [illegible] as [illegible] Bromus [illegible] year. The [illegible] trees;

the concentration of which apparently depends in a large measure upon the elapsed time since the last fall in the dominant layer. The lowest layer consists of tall shrubs and small trees, such as Rheedia intermedia and various Rubiaceae. The ground cover consists of a great variety of ferns, small palms, grasses and other herbs, with frequent "pitales" of Aechmea magdalenae which are almost impenetrable. Rocks which extend above ground level are covered with aroids, ferns, mosses, and liverworts.

The association has suffered extensively from clearing operations, since many of the country's export crops, such as bananas, cacao, rubber, and abacá are partial to the climate. Sugar and cattle are also raised within the association limits, the year-round growth being an important factor. The included transec (Fig. 13) was taken in the only near virgin tract in the area, a small, inaccessible peninsula which is virtually surrounded by the Ríos Reventazón and Florencia near Turrialba. There the only falls are natural or those caused by orchid hunters.

The natural forest furnishes to man a great variety of products such as timber, firewood, fruits, fibers, and latexes, and, in addition, gives cover to

the concentration of wild species, especially cocoa, in a large measure upon the clearing of the first belt in the dominant layer. The next layer consists of tall arbors and small trees, such as Bombax intermedium and various Dombeyaceae. The third layer consists of a great variety of forms, small palms, vines and ferns, with frequent "buttresses" of Bombax mendalense and other species with irregular roots. Vines which extend above the general level are conspicuous, and consist of woody, fern, banana, and liverwort.

The vegetation has suffered greatly from clearing operations, since many of the country's export crops, such as bananas, cacao, rubber, and edible are also natural to the vegetation limit. Sugar and cattle are also raised within the vegetation limit, the pasture-ground growth being an important factor. The introduced grasses (Fig. 15) was seen in the only pasture visited in the area, a small, inaccessible peninsula which is vigorously overrun by the tall Pennisetum and Pteris aquilina. Where cattle are pastured on these areas the latter are kept down.

The [illegible] forest varies a good deal in variety of species and size, [illegible] wood, [illegible] fibers, vines, lianes, etc. In addition, [illegible] cover to

food birds and animals. Management of areas of natural forest can assure the perpetuity of these benefits, plus, of course, erosion and water control. Especially of use in the question of stream control is Pithecolobium longifolium, which grows naturally along river courses and is of great value in maintaining flood erosion control.

The forest, once cut, rapidly springs up to a moderately tall growth of weed species (Cecropia, Holodiscus, Inga, etc.) some of which have a definite timber value (Ochroma, Cordia). Reforestation would not be so necessary in the establishment of a woodlot as would selective weeding, since seeds of many of the desireable timber species become widely dessiminated by birds, animals, and the wind.

Dominants

Anacardium excelsum (Bert. & Balb.) Skeels, Anacardiaceae - "Espavel"

Cedrela Mexicana Roem.- Meliaceae - "Cedro amargo".

Ceiba pentandra (L.) Gaertn.- Bombacaceae - "Ceiba".

Luehea seemannii Tr. & Pl. - Tiliaceae - "Guácimo"

Poulsenia armata (Miq.) Standl. - Moraceae - "Mastate"

Terminalia chiriquiensis Pitt. - Combretaceae - "Guayabón"

Tallest understory - 75-80 feet

Brosimum utile (HBK) Pitt. - Moraceae - "Mastate"

Bursera simaruba (L.) Sarg. - Burseraceae - "Indio desnudo"

Castilla costaricana Liebm. - Moraceae - "Hule"

Cecropia insignis Liebm. - Moraceae - "Guarumo"

Ce. mexicana Heinsl. - Moraceae - "Guarumo"

Cordia alliadora (R. & P.) Cham. - Boraginaceae - "Laurel"

Ficus tonduzii Standl. - Moraceae - "Higuerón"

Guarea turrialbana J. León - Meliaceae - "Cedro macho"

Heliocarpus appendiculatus Turcz. - Teliaceae - "Burío"

Hieronyma alchorneoides Alleao - Euphorbiaceae

Lafoensia punicafolia D.C. - Lythraceae - "Cortez amarillo"

Nectandra glabrescens Benth. - Lauraceae - "Quina"

N. globosa (Aubl.) Mez. - Lauraceae - "Quizarrá"

Ochroma lagopus Schn. - Bombaceae - "Balsa"

Ocotea ira Mez & Pitt. - Lauraceae - "Ira"

Pachira aguatica Aubl. - Bombaceae - "Ojoche"

Triplaris americana L. - Pelygonaceae - "Hormigo"

Theobroma simiarum D. Sm. - Sterculiaceae - "Cacao mico".

Middle understory 35-50 feet.

Albizzia adenocephala (D. Sm.) - Britt. & Rose - Mimosaceae

Alchornea latifolia Schn. - Euphorbiaceae

Anaxagora costaricensis. Fries. - Annonaceae

Apeiba aspera Aubl. (?) - Tiliaceae

Chrysophyllum panamense Pitt. - Sapotaceae

Croton gossypiifolius Vahl. - Euphorbiaceae - "Targuá"

Croton sp. undef. - Euphorbiaceae - "Targuá"

Cupania sp. undet. - Sapindaceae

Erythrina poeppigiana (Walp.) Cook. - Papilionaceae - "Poró gigante"

Eugenia sp. undet. - Myrtaceae

Euterpe longipetiolata Oerst. - Palmaceae

Ficus spp. undet. - Moraceae - "Higuerón"

Inga marginata Willd. - Mimosaceae - "Guaba"

Inga micheliana Harms. - Mimosaceae - "Guaba"

I. spp. undet. - Mimosaceae - "Guaba"

Nectandra sp. undet.- Lauraceae - "Quizarrá"

Ocotea dendrodaphne Mez. - Lauraceae - "Quizarrá"

O. tenera Mez & D. Sm. - Lauraceae - "Quizarrá"

Pithecolobium longifolium (H. & B.) Standl. - Mimosaceae - "Sotacaballo"

Sapium jamaicensis Schw. - Euphorbiaceae - "Yos"

Simaruba glauca D.C. - Simarubaceae

Symphonia globulifera L.F. - Guttiferae

Trichilia oerstediana C. DC. - Meliaceae

Zanthoxylem panamense P. Wilson - Rutaceae - "Lagarto"

Lower understory 10-25 feet - Partial listing

Chamaedorea sp. undet. - Palmaceae

Clusia sp. undet. - Guttiferae

Erythrina sp. undet. - Papilionaceae - "Poró"

Malpighia glabra L. - Malphighiaceae

Miconia sp. undet.- Melastomaceae

Mollenidia costaricensis D. Sm. - Monimiaceae

Oreopanax donnell-smithii Standl. - Araliaceae

Rheedia edulis (Seem.) Pl. & Tr. - Guttiferae

Rh. intermedia Pitt. - Guttiferae

Rondeletia buddlefoides Benth. - Rubiaceae

Vismia guianense (Aubl.) Pers. - Guttiferae

Many of the lower understory plants collected have not yet been identified.

B. Sub-tropical Rain Formation

The sub-tropical rain forest is found, in the Reventazón area, near Tapantí in the Orosi Valley and on the hill tops and windward slopes from Tucurrique to the Tuis district. The climatic limits are an annual average temperature of between 18° and 24°C, and average precipitation in excess of 4000mm per year. Weather records are available only for the station of Tapantí (Fig. 4-B), but these adequately show the climatic pattern. The rather warm climate is attended by almost daily rains and fog. The rainfall in the driest month is higher than that of the wettest month of at least one valley station, Cartago. Cloudiness is marked, but mornings are frequently clear.

The forest is moderately tall, but the dominants do not necessarily form a closed canopy. Usually the tallest understory forms a dense, unbroken layer. There is another understory composed of tall shrubs and small trees, but the form and concentration of individuals is irregular. Scattered ground cover is present. Deciduousness may be a character, but in those species which do lose their leaves, individuals may always be found in full leaf. Woody vines are present, but do not usually reach the sizes attained in the tropical forests. Epiphytes are very common on tall trees, but the gloom within the forest precludes their being abundant on lower limbs or short trees.

3. Sub-tropical Rain Formation

The sub-tropical rain forest is found, in the Reventazón area, near Tapantí in the Great Valley and on the hill tops and windward slopes from Tournefortia to the Tuis district. The climatic limits are an annual average temperature of between 18° and 21°C, and average precipitation in excess of 4000m per year. Weather records are available only for the station of Tapantí (fig. 4-3), but these adequately show the climatic pattern. The rainer warm climate is extended by almost daily rains and fog. The rainfall in the driest month is higher than that of the wettest month of at least one valley station, Cartago. Cloudiness is marked, but mornings are frequently clear.

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1. The Sideroxylon uniloculare - Pachira aquatica Association

A sub-tropical rain forest which is very rich in species, the Sideroxylon uniloculare - Pachira aquatica association occupies the ridges and slopes from above Tuis to Pejivalle and Tucurrique. The forests are difficult of access because there is usually an almost impenetrable band of second growth between cultivated lands and virgin timber; and collecting in the forest is doubly difficult because of the generally high level of foliage. Accordingly, although much time was spent in the forest, the collections are far from complete, and a great deal of the material is as yet unidentified.

Rainfall is general throughout the year, and much more frequent than that in the adjoining valleys. The soils are, for the most part, leached conglomerate clayey types, rather shallow in places.

Pachira aquatica, "ojoche", is a very frequent tree, although perhaps not so common as the tree tentatively identified as Sideroxylon uniloculare, called "sapote colorado" by the natives. Together with an unidentified lauraceous tree and Cedrela mexicana, the dominants are over one hundred feet in height. Unlike many of the forests, the tallest trees are rather widely spaced, and do not form an unbroken canopy except in rather flat places. There are

1. [illegible]

[illegible]

[illegible]

generally two understory tiers, the upper one presenting a dense canopy which is virtually unbroken at about 70 feet from the ground, and a rather ragged layer of many small trees which reaches up to about 20-40 feet. Trees in the former layer include Ficus, Cordia, an unidentified Sapotaceae, Ocotea, and Pithecolobium, among others. The lower understory presents a bewildering array of species, with Melastomes and Lauraceous trees being very prominent. Ground cover is spotty, and frequently consists of vinelike types such as Philodendron and Peperomia, with many Dieffenbachia, Begonia and other ornamental plants.

Due to the heavy rainfall there yet remains much of the original forest, although the comparatively drier valleys have been cleared and planted for many decades. Now, however, the axeman is moving farther and farther, clearing lands for sugar and pasture which will be unable to support a permanent agriculture without expensive fertilizers and weed controls. Most of the land should probably remain in managed timber as a continual source of firewood and saw logs. Much of the timber now being cut is permitted to rot where it is felled.

Dominants

Cedrela mexicana Roem. - Meliaceae - "cedro amargo"

Ocotea sp. undet. - Lauraceae - "ira" No specimen of the tree was obtainable, but it is probably

in this genus.

Pachira aquatica Aubl. - Bombaceae - "ojoche"

Sideroxylon uniloculare D. Sm. - Sapotaceae - "sapote colorado". This is a tentative determination.

Taller understory 70 feet

Cecropia mexicana Hemsl. - Moraceae - "guarumo"

Cordia alliodora (R.&P.) Cham. - Boraginaceae - "laurel"

Ficus tonduzii Standl. - Moraceae - "higueron"

Nectandra glabrescens Benth. - Lauraceae - "quiña"

Ocotea ira Mez. & P. H. - Lauraceae - "ira"

Pithecolobium racemiflorum D. Sm. - Mimosaceae

Sapotaceae, gen. & sp. undet. - "sapote"

Trichilia sp. undet. - Meliaceae

Several other trees in this size class were collected, and have not yet been determined.

Lower understory 20 - 40 feet

Bauhinia sp. undet. - Caesalpiniaceae

Blakea sp. undet. - Melastomaceae - "lengua de vaca"

Calocarpum viride Pitt. - Sapotaceae - "sapote"

Clusia sp. undet. - Guttiferae

Conostegia sp. undet. - Melastomaceae - "lengua de vaca"

Cyathea sp. - Cyatheaceae - "palma de helecho"

Guarea brevianthera C.DC. - Meliaceae - "cedro macho"

Inga marginata Willd. - Mimosaceae - "guaba"

Inga tonduzii D. Sm. - Mimosaceae

Micania sp. undet. - Melastomaceae

Ocotea dendrodaphne Mez. - Lauraceae - "aguacatillo"

Rheedia intermedia Pitt - Guttiferae

Rondeletia Guddleioides Benth. - Rubiaceae

Sapium sp. undet. - Eupherhiaceae

Simaruba glauca DC. - Simarubaceae

Trichilia sp. undet. - Meliaceae

Many of the tall shrubs and small trees are as yet undetermined as to genus, the number collected being near thirty.

2. The Quercus guglielmi-trelaeasi-Chaetoptelea mexicana Association

The rain forests near Tapantí have been largely destroyed below the 1500 meter contour, so the original composition of the sub-tropical portion is largely a matter of conjecture. Certainly two of the largest and most common of the trees are the black oak, Quercus guglielmi-treleasi, and the huge elm, Chaetoptelea (Ulmus) mexicana. Both of these forest giants grow to a height of over 100 feet, and specimens of the latter have been measured at 150 feet tall. Their large buttressed trunks are frequently as much as six to eight feet in diameter. The only other tree of similar stature which was observed is Cedrela mexicana.

Inga tonduzii D. Sm. - Mimosaceae

Licania sp. nuest. - Licaniaceae

Ocotea *cernodaphne* Mez. - Lauraceae - "aguacatillo"

Piresia interrupta Hitt - Gutiferae

Pondeletia *Pondeletides* Benth. - Rubiaceae

Sapium s. nudet. - Euphorbiaceae

Simaruba *glauca* DC. - Simaroubaceae

Trichilia sp. nuest. - Meliaceae

Many of the tall shrubs and small trees are as yet undetermined as to genus, the number collected being near thirty.

2. The *Quercus* *Copeliumi-trelassi-Dasetophiles* *mexicana* Association

The rain forests near Tapanti have been largely destroyed below the 1,500 meter contour, so the original composition of the sub-tropical portion is largely a matter of conjecture. Certainly two of the largest and most common of the trees are the black oak, *Quercus* *Copeliumi-trelassi*, and the ruge elm, *Dasetophiles* (*ulmus*) *mexicana*. Both of these forest giants grow to a height of over 100 feet, and specimens of the latter have been measured at 150 feet tall. Their large buttressed trunks are frequently as much as six to eight feet in diameter. The only other tree of similar stature which was observed is *Cedrela mexicana*.

Understory trees are listed of necessity in two size classes, which probably reflects the stratification which existed in the original forest.

Tapantí is located in a steep-sided valley, the flat floor of which supports pasture, the slopes being generally too steep to support tall forest. On those hill sides which are converted to pasture, many trees have been left. The alluvial soils in the valley are rather stony in places, and those on the steep hill sides tend to be shallow, for which reason it is doubtful if the area can support more agriculture than it now does. Exploitation of the remaining woodland is carried on a selective basis, with no attempt to control regeneration.

Dominants.

Cedrela-mexicana Room - Meliaceae - "cedro"

Chaetoptelea (Ulmus†) mexicanus Liebm. - Ulmaceae - "tirra"

Quercus guglielmi-treleasi Mull. - Fagaceae - "encino"

Tall understory 60-75 feet

Cordia alliodora (R.&P.) Cham. - Boraginaceae - "laurel"

Erythrina poeppigiana (Walp.) Cook.-Papilionaceae - "poro gigante"

Ficus spp. undet. - Moraceae-two large leafed species

Guarea sp. undet. - Meliaceae - "cedro macho"

Understory trees are listed or necessarily in two size classes, which probably reflects the stratification which exists in the original forest.

Tapant' is located in a steep-sided valley, the flat floor of which and parts pasture, the slopes being generally too steep to support tall forest. On those hill sides which are converted to pasture, many trees have been left. The alluvial soils in the valley are rather stony in places, and those on the steep hill sides tend to be shallow, for which reason it is doubtful if the area can support more agriculture than it now does. Exploitation of the remaining woodland is carried on a selective basis, with no attempt to control regeneration.

Dominants.

Cedrela-mexicana Roem - Meliaceae - "cedro"

Cheesopteres (Linn.) mexicanus Hiebm. - Linaceae - "tira"

Quercus Euglehmi-Trelease Mull. - Fagaceae - "encino"

Tall understory 60-75 feet

Cordia alliodora (R.&P.) Oken. - Boraginaceae - "laurel"

Brahmins bombycifera (Mart.) Cook.- sterculiaceae - "poro grande"

Ficus sp. undet. - Moraceae-two tall leafed species

Guarea sp. undet. - Meliaceae - "cedro macho"

Persea sp. undet. - Lauraceae - "aguatillo"

Quercus tomentocaulis Mull. - Fagaceae - "roble"

Lower understory 20-40 feet

Cassia fruticosa L. - Caesalpinnaceae

Erythrina sp. undet. - Papilionaceae - "poro de la montaña"

Eugenia sp. undet. - Myrtaceae

Inga edulis

Inga marginata Willd

Inga sp. undet.

Ladenbergia brenesii Standl.

Lauraceae gen. & spp. undet.

Piper auritum HBK - Piperaceae

Piper sp. undet. - Piperaceae

Psidium guajaba L. - Myrtaceae - "guayaba"

The larger part of collections made here are undetermined as yet.

Perseo sp. undet. - Lauraceae - "aguacatillo"

Amerous tonentosanlis Mull. -Euphorbiaceae -"roble"

Lower understory 20-40 feet

Garcia floribosa H. - Caesalpiniaceae

Erythrina sp. unset. - Papilionaceae - "palo de la pomarosa"

Inga sapida sp. undet. - Lyrsaceae

Inga edulis

Inga marginata Willd

Inga sp. undet.

Ladenbergia brenesii standl.

Lauraceae gen. spp. unset.

Piper aduncum HBK - Piperaceae

Piper sp. undet. - Piperaceae

Psidium guajaba L. - Myrtaceae - "guayaba"

The larger part of collections made here are undetermined as yet.

C. Sub-tropical Wet Formation

The sub-tropical wet forests cover a large area in the Reventazón drainage, occupying most of the belt between 600 and 1600 meters above sea-level. From Río Macho in the Orosi Valley, the Reventazón Valley itself, the Cachí valley and most of the lower Pejivalle, to the Turrialba and Tuis Valleys, tall forests once thrived, almost all of which have been cut and planted to coffee, sugar, or pasture. Stations in this climatic zone are Orosi, el Yas, Santiago, Juan Viñas, Turrialba centro and Turrialba IICA (Fig. 4-C). The mean annual climatic limits are 18º to 24º C. temperature, and 2000-4000 mm. rainfall. Although there is a marked decrease in rain during the verano, there is sufficient water present to maintain green fields the year round. Mornings are often sunny, but completely clear days are rare. Clouds frequently cover the slopes, while night fogs are common over the whole area.

The virgin growth, almost all of which has been cut, is over 100 feet tall, with occasional emergents to a much greater height. The dominant species are usually well spaced, with medium spreading crowns which touch to form a broken canopy. The highest understory likewise forms a broken canopy at 70 to 80 feet.

There is a lower understory at 30-45 feet which varies considerably in height and density; while there is yet another layer from 6 to 15 feet which is composed of shrubs and seedlings. Herbaceous ground cover is found only in those places where much light filters thru breaks in the canopy. Trunks may or may not be buttressed, while prop roots are rather common in understory trees. Woody vines, many of them several inches in diameter, are common, as are herbaceous c climbers. Epiphytic growth is heavy, with many showy species in evidence.

1. The Cedrela mexicana - Simaruba glauca sub-climax Association.

The greater part of the sub-tropical wet forest area is so cut-over that original forest trees scarcely remain. The virgin growth undoubtedly had large numbers of Cedrela and Simaruba in its composition, but it is doubtful if the latter was a dominant. Simaruba is a dominant in the second growth woodlots which have been visited, but in those the growth was hardly 70 feet tall.

Soils over the greater part of the area are volcanic or alluvial in origin, although much of the area to the south of the Reventazón has clays of

Oligocene conglomerate origin. Drainage problems exist in several sites, but in these there is no natural vegetation remaining. Since the climate is favorable for man and crops, most of the land will continue to be cultivated, and little in the way of forestry will be practiced save in scattered woodlots.

The plant lists are extensive and probably reflect the fact that more than one association may be involved, but this could not be confirmed. The trees remaining in the area about Turrialba and those about Cachí and Orosi show that the forest must have been a tall one, well over a hundred feet in height. Giants which have not been cut include Ceiba, Cedrela, Chaetoptelea, and Engelhardtia, any of which may have trunk diameters exceeding six feet. Trees which exceed sixty feet in height, and thus were probably in the taller understory, include Simaruba, Bursera, Cordia, and others, while many attain a lesser height of 40-50 feet, including some stragglers from the tropical forest which become much less tall here.

The borders of this and adjoining associations are probably the least well marked of any in the area. There are wide strips in which the species intermingle, including deminant species, and the mapping is further

complicated by man's interference with the natural vegetation, almost all of which has been cut heavily, if not destroyed outright. Thus, near Turrialba there is a larger proportion of tropical trees included, some of which may have been introduced by man, while the Orosi section has a larger proportion of lower montane types.

Dominants - 100 feet

Cedrela mexicana Roem.- Meliaceae - "Cedro amargo"

Ceiba pentandra (L.) Gaertn.- Bombacaceae - "Ceiba"

Chaetoptelea (Ulmus) mexicana - Ulmaceae - "Tirra"

Engelhardtia pterocarpa (Oerst.) Standl.- Juglandaceae

Quercus guglielmi-treleasi Mull.- Fagaceae - "Encino"

Q. tomentocaulis Mull.- Fagaceae - "Roble"

Sideroxylon capiri (A.DC.) Pitt.- Sapotaceae

Tall understory - 60-75 feet

Bursera simaruba (L.) Sarg.- Burseraceae - "Indio desnudo"

Cecropia insignis Liebm.- Moraceae - "Guarumo"

C. Mexicana Hemsl. - Moraceae - "Guarumo"

Cordia alliadora (R. & P.) Cham.- Boraginaceae - "Laurel"

con lleated in [illegible] with the material
veneration, allowed by [illegible] Mos Juan with [illegible].
it was destroyed under [illegible]. [illegible]
[illegible] a [illegible] [illegible] included [illegible],
some of which [illegible] [illegible], while
the Orosi section has a large [illegible] of lower
[illegible].

Dominguito - 100 feet

Cordell [illegible] Juan - [illegible] - "Dingo [illegible]"

Delfa [illegible] (L.) [illegible] - [illegible] -
"Delfa"

Drooping [illegible] - [illegible] - "Spra"

[illegible] [illegible] ([illegible]) stand -

Domingo [illegible]

Orozco [illegible] [illegible] - [illegible] -
"Encino"

Oil production - [illegible]

Silverthorn [illegible] (L.) Post - [illegible]

Tree [illegible] [illegible] - [illegible] -
"Tulip de [illegible]"

Fremont [illegible] [illegible] - [illegible] -
"[illegible]"

Dogwood [illegible] (L. [illegible]) Cusp - [illegible] -
"[illegible]"

Erythrina poeppigiana (Walp.) Cook.- Papilionaceae "Poró gigante"

Euterpe longipetiolata Oerst.- Palmaceae

Guarea brevianthera C. DC.- Meliaceae

Lafoensia punicafolia DC.- Lythraceae - "Cortez"

Nectandra glabrescens Benth.- Lauraceae - "Quina"

Pachira aquatica Aubl.- Bombacaceae - "Ojoche"

Simaruba glauca DC.- Simarubaceae - "Divo"

Talauma gloriensis Pitt.- Magnoliaceae

Trichilia oerstediana C. DC.- Meliaceae

Smaller trees - under 50 feet

Albizzia adenocephala (D. Sm.) Britt. & Rose - Mimosaceae

Alchornea latifolia Schw.- Euphorbiaceae

Allophyllus panamensis Radlk.- Sapindaceae

Byrsonima crassifolia (L.) DC.- Malpighiaceae - "Nance"

Calliandra similis Spr. & Riley - Mimosaceae - "Carboncillo"

C. Tetragona (Willd.) Benth.- Mimosaceae

Calocarpum viride Pitt.- Sapotaceae - "Sapote"

Clusia salvinii D. Sm.- Guttiferae - "Matapalo"

Cocoloba turckheimii - Polygonaceae

Comostegia xalapensis (Bonpl.) D. Don.- Melostomaceae

Croton gossypiifolius Vahl.- Euphorbiaceae - "Targuá"

Croton sp. undet.- Euphorbiaceae - "Balsa"

Eugenia sp. undet.- Myrtaceae

Ficus spp. undet.- Moraceae - Four and possibly five species.

Gommera grandis (Bartl.) Standl.

Hedyosmum calloso-serratum Oerst.- Chloranthaceae

Heliocarpus appendiculatus Turcz.- Tiliaceae - "Burío"

Inga edulis Mart.- Mimosaceae - "Guaba"

Inga marginata Willd.- Mimosaceae - "Guaba"

Inga micheliana Harms.- Mimosaceae - "Guaba"

Inga spp. undet.- At least ten Inga spp. have been collected in the region, but the botany of the genus is confused, and as yet several remain unidentified.

Mollenidia costaricensis D. Sm.- Monimaceae

Ochroma lagopus Schw.- Bombacaceae - "Balsa"

Ocotea dendrodaphne Mez.- Lauraceae

Pithecolobium longifolium (H. & B.) Standl. - Mimosaceae - "Sotacaballo"

Psidium guajava L.- Myrtaceae - "Guayaba"

Rheedia intermedia Pitt.- Guttiferae

Sapium sp. undet.- Euphorbiaceae

Symplocos martinicensis Jacq.- Symplocaceae

Theobroma simiarum D. Sm.- Sterculiaceae - "Cacao mico"

Vismia ferruginea - HBK - Guttiferae

Zanthoxylem panamense P. Wilson - Rutaceae - "Lagarto"

Z. sp. undet.- Rutaceae

These listings are incomplete as material still is awaiting determination.

2. The Cedrela tonduzii Association

On the slopes and ridges of Turrialba Volcano, at elevations of 1000-1500 meters, once existed a tall forest which must have been a virtually pure stand of the sweet cedar, Cedrela tonduzii. From the decayed stumps and the few living trees which remain, some idea may be had of the size of the dominant species; living trees which were measured being 120 feet tall and having trunk diameters in excess of nine feet twenty feet above the ground! Very few of these giants remain now, but several dozens may be found near to the town of Santa Cruz.

The soils are volcanic, of ash or extruded rock in origin, and apparently are free draining and deep.

The rainfall is probably more frequent, if not actually heavier, than that experienced at Turrialba. The land is utilized for coffee, sugar, and pastures, with the steeper slopes kept in inferior weeds by firewood hunters.

Aside from the cedar, the only other dominant sized tree observed was Sideroxylon capiri, but probably other trees were as tall. There were not found to be any lands which had more than poor second growth, so that a description of the association is an impossibility with information on hand. Trees are of necessity placed in one listing because many of them were not collected elsewhere, and, in view of the conditions of the woodlots, it was impossible to assess their mature sizes. More than any other place the lists are incomplete, and many of the trees collected have not yet been identified.

Dominants

Cedrela tonduzii C. DC.- Meliaceae - "Cedro dulce"

Sideroxylon capiri (C. DC.) Pitt.- Sapotaceae

Other trees

Anaxagorea sp. undet.- Annonaceae

Calliandra arborea Standl.- Mimosaceae

Casaeria sylvestris Sw.- Flacourtiaceae

The main [illegible] locally [illegible] plains. The land is utilized [illegible] rice, sugar, [illegible] tobacco, [illegible] steeper slopes [illegible] limestone mountains.

Besides [illegible] altitudes [illegible] a different [illegible] light, [illegible] [illegible] found to be any lands [illegible] north, so that a description of the [illegible] possibi-lity [illegible] placed [illegible] not collected [illegible], and, in view of the [illegible] of the specimens, it was [illegible] to assess their abund-ance. [illegible] any [illegible] the lists are incom-plete, and many of the trees collected have not yet been identified.

Dominants

[illegible] - "[illegible]"

[illegible] - [illegible]

Other trees

[illegible] sp. - [illegible]

[illegible] - [illegible]

[illegible] - [illegible]

Cecropia mexicana Hemsl.- Moraceae - "Guarumo"

Clethra lanata Mart. & Gal.- Clethraceae - "Nance"

Cocoloba sp. undet.- Polygonaceae

Croton gossypiifolius Vahl.- Euphorbiaceae - "Targuá"

Croton sp. undet.- Euphorbiaceae

Eugenia sp. undet.- Myrtaceae

Ficus spp. undet.- Moraceae - 2 species - "Higuerón"

Guarea brevianthera C. DC.- Meliaceae - "Cedro macho"

Hedyosmum calloso-serratum Oerst.- Chloranthaceae

Heliocarpus appendiculata Turcz.

Inga micheliana Harms.- Mimosaceae - "Guaba"

I. punctata Willd.- Mimosaceae - "Guaba"

I. spuria H. & B.- Mimosaceae

Ladenbergia brenesii Standl.- Rubiaceae

Mauria birringo Tul.- Anacardiaceae

Melastomaceae - 3 spp. of undet. genera

Meliosma glabrata(Liebm)- Urb.- Sabiaceae

Mollenidia costaricensis D. Sm.- Monimiaceae

Nectandra globosa (Aubl.) Mez.- Lauraceae

Ocotea austinii Allen.- Lauraceae - "Ira colorado"

Pachira aquatica Aubl.- Bombaceae - "Ojoche"

Persea sp. undet.- Lauraceae - "Aguacatillo"

Piper sp. undet.- Piperaceae

Rhus striata R. & P.- Anacardiaceae - "Hinchador"

Sapium sp. undet.- Euphorbiaceae

Trichilia sp. undet.- Meliaceae

Viburnum costaricanum (Oerst.) Hemsl.-
Caprifoliaceae.

D. Sub-Tropical Moist Formation

Within the Reventazón area the only region having a sub-tropical moist climate is the Cartago Valley. Stations given are Cartago, el Alto de Ochomogo, which is just outside the study area, and el Yas, which is on the border of the sub-tropical wet formation (Figs. 4-C, 4-D.) All land in this climate has been thoroughly de-forested, for man is best adapted to the temperature and there is sufficient rainfall for most crops. The temperature range is that of the other sub-tropical climates, 18°C to 24°C., annual average, which extends below the 1700m. contour in the rather high Cartago Valley. The lee side rain shadow of Irazú causes the reduction in rainfall to 1000 - 2000mm per year, with a very dry season of four months and a noticeable "veranillo" in July and August. The transition to other climates is rather sharp because the borders of the rain shadow are well defined. Rainfall is usually convectional, but frontal weather also is important. Cloudiness is much less than in other climates of the study area, the sun shining until afternoon as a rule, with many almost cloudless days, although "temporal" weather may cause low overcast of long duration. Night fogs are common .

D. Sub-Tropical Moist Formation

Within the Nevadensian area the only region having a sub-tropical moist climate is the Cartago Valley. Stations given are Cartago, el Alto de Ochomogo, which is just outside the study area, and el Yas, which is on the border of the sub-tropical wet formation (Figs. 4-C, 4-D.) All land in this climate has been thoroughly de-forested, for man is best adapted to the temperature and there is sufficient rainfall for most crops. The temperature range is that of the other sub-tropical climate, 10° to 22°C., annual average which extend below the 1500 m. contour in the rather high Cartago Valley. The lee side rain shadow of Irazú causes the reduction in rainfall to 1000 - 2000 mm per year, with a very dry season of four months and a noticeable "veranillo" in July and August. The transition to wetter climates is rather sharp because the borders of the rain shadow are well defined. Rainfall is mainly convectional, but frontal weather also is important. Cloudiness is much less than in other climates of the study area, the sun shining until afternoon as a rule, with many clear cloudless days, although "temporal" weather may cause low overcast on long duration. Night fogs are common.

The forests react principally to the climate, but the biotic human factor is most important in this formation. There does not now exist any virgin forest in the Cartago Valley; in fact, it exists only in small isolated areas in all of Costa Rica. Second growth woodland is common on poor soils, but, again, firewood hunters maintain it in worthless species by cutting out the others. The original forest probably was rather tall, 100ft. or so, with a composition of mixed hardwoods. Owing to the long dry season, deciduousness is the rule, which permits heavy understory development. Woody vines are common, and epiphytes conspicuous. The strangling habit is well developed in several genera which commence as epiphytes.

1. The Conostegia xalapensis - Zanthoxylem limoncello Sub-climax Association

The moist sub-tropical Cartago Valley is most intensively farmed, the land being generally of gentle slope, good drainage, and close to markets. In isolated pockets in the hills and mountain slopes, on patches of poor or rocky soil, and along drainage lines may be traced the remnants of the original forest. Perhaps two or more associations made up the original, but the broad valley, with its alluvial soils, is given over to coffee and cattle, and the better drained

The forests react principally to the climate, but the biotic human factor is most important in this formation. There does not now exist any virgin forest in the Carteço Valley; in fact, it exists only in small isolated areas in all of Portugal. Second growth woodland is common on poor soils, but, again, firewood hunters maintain it in worthless species by cutting out the others. The original forest probably was rather tall, leafy, or so, with a composition of mixed hardwoods. Owing to the long dry season, deciduousness is the rule, which permits heavy understory development. Woody vines are common, and epiphytes conspicuous. The alternating habit is well developed in several genera which commence as epiphytes.

1. The Convolvulo valdevarii - Quercetum lusitanicae Sub-climax Association

The moist sub-tropical Carteço Valley is most intensively farmed, the land being generally of gentle slope, good drainage, and close to markets. In isolated pockets in the hills and mountain slopes, on patches of poor or rocky soil, and along drainage lines may be traced the remnants of the original forest. Perhaps two or more associations made up the original, but over to coffee and cattle, and the better drained the broad valley, with its alluvial soils, is given

hillsides to pastures and cash crops. Only tenacious weed species are able to survive in either habitat. Soils are formed both from volcanic and sedimentary rocks.

Conostegia xalapensis and Zanthoxylem limoncello are small trees which seldom become more than twenty feet tall, but they may be found over the whole area, and a large proportion of the second growth woodland is composed of them. Quercus eugeniifolia, a black oak, is to be found in isolated pastures throughout the association, and there exists, on the slopes above Tobosi, a woodlot which is dominated by the tree. In places where the oak is dominant, the Conostegia, Zanthoxylem, and other weed trees show their original role in the forest: scattered individuals of many species as an understory. However, in most cases an almost impenetrable second growth about twenty feet tall takes possession of the land. The success of Conostegia and Zanthoxylem may in part be ascribed to their abundantly produced edible berries. Other very common woody weeds are Inga edulis, Calliandra similis, Croton gossypiifolius and Ficus padifolia. Forming a thorny tangle of undergrowth or impassible hedge rows are Rubus, Xylosma seemannii, and Randia Karstenii.

hillsides to pastures and open crops. Only temporary weed species are able to survive in either habitat. Soils are formed both from volcanic and sedimentary rocks.

Conostegia xalapensis and Xanthoxylum limoncello are small trees which seldom become more than twenty feet tall, but they may be found over the whole area, and a large proportion of the second growth woodland is composed of them. Pteropus antillarum, a black oak, is to be found in isolated pastures throughout the association, and there exists, on the slopes above Toposi, a woodlot which is dominated by the tree. In places where the oak is dominant, the Conostegia, Xanthoxylum, and other weed trees show their original role in the forest: scattered individuals of many species as an understory. However, in most cases an almost impenetrable second growth about twenty feet tall takes possession of the land. The success of Conostegia and Xanthoxylum may in part be ascribed to their abundantly produced edible berries. Other very common woody weeds are Inga edulis, Cailiandra siamis, Croton cascarilloides and Piper peltatum. Forming a thorny tangle of undergrowth or impassable hedge rows are Lupus, Mimosa scabrella, and Randia aculeata.

farmers are forced to wage a never ending fight against the woody weeds, for although mature trees are small, they are quick-growing and highly reproductive.

In areas which have been long in uncut second growth, the various longer lived and larger growing trees commence to crowd out the weed species. The former include Persea skutchii, Quercus eugeniifolia, and Chaetoptelea (Ulmus) mexicana among others, seedlings of trees which have remained in pastures. In time a condition approaching virgin growth could be attained, but the interspecific relationships have been deeply disturbed, and many kinds have been exterminated by the axe in four hundred years of cutting.

In spite of the fact that the weed species are inferior producers of wood, large amounts are cut and sold for fuel each year. As is usually the case, constant selective cutting lowers the valve of the stands. Such cord-wood is a valuable by-product on poor lands where a four or five year fallow period is employed.

Reforestation will never be needed in large areas because of the intensive land use, but fence rows and wind breaks are being planted to Ciprés (Cupressus benthami). Perhaps wood lots can be improved by the selective cutting of poorer species, the improved stands being better producers. Stream control is at present gained to a degree by the use of the doubtfully native Salix chilensis.

farmers are forced to wage a never ending fight against the woody weeds, for although mature trees are small, they are quick-growing and highly reproductive.

In areas which have been long in true second growth, the various longer lived and larger growing trees commence to crowd out the weed species. The former include Persea skutchii, Quercus eugeniaefolia, and Chaetoptelea (Ulmus) mexicana among others, seedlings of trees which have remained in pastures. In time a condition approaching virgin growth could be attained, but the interspecific relationships have been deeply disturbed, and many kinds have been exterminated by the axe in four hundred years of cutting.

In spite of the fact that the weed species are inferior producers of wood, large amounts are cut and sold for fuel each year. As is usually the case, constant selective cutting lowers the value of such stands. Such cord-wood is a valuable by-product on poor lands where a four or five year fallow period is employed.

Reforestation will never be needed in large areas because of the intensive land use, but fence rows and wind breaks are being planted to Ciprés (Cupressus benthami). Perhaps wood lots can be improved by the selective cutting of poorer species, to improve stands for better producers. Erosion control is at present gained to a degree by the use of the [illegible] [illegible] native Salix chilensis.

Trees over 50 feet tall.

Cedrela mexicana Roem. - Meliaceae - "cedro"

Chaetoptelea (Ulmus) mexicana Liebm. - Ulmaceae - "tirra"

Persea skutchii Allen - Lauraceae - "aguacatillo"

Quercus eugeniifolia Liebm. - Fagaceae - "encino"

Q. tomento caulis Mull. - Fagaceae - "roble"

Salix chilensis Molina. - Salicaceae - "sauce"

Several of the plants listed below, as well as introduced trees, may be found taller than 50 feet, but are not normally permitted be grow so large.

Trees under 50 feet tall.

Acnistus arborescens (L.) Schl. - Solanaceae - "Güitite"

Annona reticulata L. - Annonaceae - "anón"

Ardisia compressa HBK. - Myrsinaceae

Bumelia austin-smithii Standl. - Sapotaceae

Calliandra portoricensis (Jacq) Benth. - Mimosaceae

Cal. similis Spr. & Riley - Mimosaceae - "carboncillo"

Cestrum aurantiacum Lindl. - Solanaceae

Conostegia oerstediana O. Berg ex Tr. - Melastomaceae

Con. xalapensis (Bonpl.) C.DC. - Melastomaceae

Croton gossypiifolia Vahl. - Euphorbiaceae - "targuá"

Trees over 30 feet tall.

Cedrela mexicana Roem. - Meliaceae - "cedro"

Chaetochloa (Thurb.) mexicana Hitchc. - Gramineae - "zacate"

Persea americana Miller - Lauraceae - "aguacatillo"

Quercus oleoides Schlecht. - Fa aceae - "encino"

*. tomentosa Cham. - Leguminosae - "roble"

Mimosa euryphylla Rose. - Leguminosae - "zarza"

Trees under 30 feet tall.

Acalypha arvensoides (L.) Scht. - Euphorbiaceae - "cuilito"

Amyris sylvatica L. - Rutaceae - "anón"

Argusia concinna I.M. - Boraginaceae

Bursera arborea Engl. - Burseraceae

Cathartocarpus pittieri (Hoehne) Britt. - Leguminosae - "cascabillo"

Cat. spinosa Spr. Miller - Leguminosae - "cambronillo"

Cestrum auriculatum Lindl. - Solanaceae

Comocladia cornifolia O. Ber. ex K. - Anacardiaceae

Cordia racemosa (Jacq.) G.D. - Boraginaceae

Croton reverchonii Vn . - Euphorbiaceae - "tar ra"

Cr. niveus Jacq. - Euphorbiaceae - "copalchí"

Cr. reflexifolius HBK. - Euphorbiaceae

Cupania glabra Schw. - Sapindaceae

Daphnopsis seibertii Standl. - Thymelaeaceae

Ehretia austin-smithii - Boraginaceae

Erythrina poeppigiana (Walp.) Cook. - Papilionaceae
"poro gigante"

Eugenia costaricensis Berg. - Myrtaceae

E. Lepidota Berg. - Myrtaceae

E. pittieri Standl. - Myrtaceae

Ficus padifolia HBK - Moraceae - "higueron"

Ficus sp. undet. - Moraceae - "higueron"

Hamelia patens Jacq. - Rubiaceae - "coralillo"

Inga edulis Mart. - Mimosaceae - "guaba"

Mauria glauca D. Sm. - Anacardiaceae

Myrcia oerstediana Berg - Myrtaceae

Myrica mexicana Willd. - Myricaceae

Ocotea tonduzii Standl. - Lauraceae - "ira"

Oreopanax xalapense (HBK) Dene. & Pl. - Araliaceae

Parathesis glabra D. Sm. - Myrsinaceae

Phoebe mexicana Meisn. - Lauraceae

Pierammia carpinterae Polak. - Simarubaceae

Psidium guajaba L. - Myrtaceae - "guayaba"

Ps. guineense Sa. - Myrtaceae

Rapanea ferruginea (R.&P.) Mez. - Myrsinaceae

Gr. wiyma ged. - Amorphaceae - "собачий"

Gr. vulgaris L. - Amygdalaceae

Gr. anga mara ogim. - Ja Indaceae

Dactylanthus aschersonii Bennet. - Cynomoriaceae

Dipterygium glaucum Decne. - Capparidaceae

Dolichos lablab L. (var.) Don. - Papilionaceae

"coro-coro"

Drymaria cordata Willd. - Caryophyllaceae

E. globulus Labill. - Myrtaceae

E. pilularis Smudd. - Myrtaceae

Echium pardoxum DC. - Boraceae - "Мигелон"

Elaeis sp. Indet. - Palmaceae - "Migueron"

Emmenia parens Good. - Euphorbiaceae - "cuallilo"

Ery ogonia Port. - Linaceae - "лен"

Eschscholtzia californica Cham. - Papaveraceae

Eucalyptus globulus Labill. - Myrtaceae

Euphorbia maculata L. - Euphorbiaceae

Fagara mantana St. Hil. - Anacardiaceae

Ficus carica L. - Moraceae - "инжир"

Fumaria parens Good. - Fumariaceae - "cuallilo"

Gilia sp. Indet. - Polemoniaceae - "Migueron"

Gilia pardoxa DC. - Boraceae - "Мигелон"

H. petiolaris Brandt. - Myrtaceae

H. sepiaria Jacq. - Myrtaceae

Hamelia patens constricta Ker. - Rubiaceae

"coro-coro"

Hyptis boechmeria (Willd.) Don. - Labiatae

Ilex aristata - Aquifoliaceae

Impatiens sp. - Balsaminaceae

Indigofera endecaphylla Jacq. - Papilionaceae

Ipomoea purpurea (L.) Roth - "собачий"

Rhamnus pubescens (R.&P.) Pl. & Tr. - Rhamnaceae

Sapium oligoneuron Schlum. & P.H. - Euphorbiaceae

Stemmadenia grandiflora (Jacq.) Miers. - Apocynaceae

Symplocos costaricensis Hemsl. - Symplocaceae

Trema micrantha (L.) Blume - Ulmaceae

Trichilia havanensis Jacq. - Meliaceae

Turpinia paniculata Vent. - Staphyliaceae

Viburnum stellato-tomentosum (Oerst.) Hemsl. - Caprifoliaceae

Vismia ferruginea HBK - Guttiferae

Zanthoxylem limoncello Pl. & Oerst. - Rutaceae - "limoncillo"

Ribamus sylvestris (L.) Lk. fr. - Ribesiaceae

Saprum oli oneuron Boltum. f. H. - Aphyllocaceae

Stereaceria tranditora (Lasch.) Fr. - Agaricaceae

Symbiocos cochlearensis Ferd. - Symplocaceae

Tremella mesenterica (L.) Retz. - Tremellaceae

Trichilia involucrata Lasch. - Meliaceae

Turpinia paniculata Vent. - Staphyliaceae

Viburnum erelato-dentatosum (Oerst.) Graebn. -

Caprifoliaceae

Vismia cayennensis Pers. - Guttiferae

Zamioculcas cf. "Lanceolio" Lk. & Otto. - Araceae -

"Lanceolio"

E. Lower Montane Rain Formation

The lower montane rain forests are characterized by cool, cloudy weather, with daily precipitation. There are no weather stations in this formation within the study area, but the annual average precipitation is high, over 4000 mm. estimated with an average temperature of 12º-18º C. The climate is found high (1500-3000 m.) on the east slopes of the Irazú-Turrialba volcanic mass, upon the windward slopes of the Talamanca range, and above Tapantí. Cloudiness is high, with sun only in the early morning hours except on rare days. This is one formation that could truly be termed a "cloud forest", for even when rain is not falling in clearings, the forest is almost constantly dripping from the moisture precipitated from the fogs by the foliage.

Within the forest the low quantity of illumination gives the impression of constant twilight. Although the clouds do cut down the light, the dense canopy formed by the dominants is practically unbroken. The forest is moderately tall, 80-100 feet, with one broken understory at three-quarters that height and a sparse understory at from 15-40 feet, composed of

16. Torpedo runs and communication

[illegible]

smaller trees. Virtually everything is a somber green, even bright colored flowers are not conspicuous. Vines, herbaceous and woody, are present but not common. Epiphytes are very common in the taller trees, but are not notably showy when in bloom, as are others in ~~similar~~ climates. Trees are evergreen, the larger ones with prominent trunk buttresses.

1. The Quercus corrugata - Quercus guglielmi-treleasi Association.

Above Tapantí, on the steep slopes which give adequate drainage, is a tall forest which has been very incompletely botanized. There are at least nine species of trees which are as tall as one hundred feet, but of these only four could be positively identified. Because of the steepness of the terrain and the high rainfall, the land should remain in forest, but to date no attempt has been made at management. The better species are being exploited as rapidly as is possible with the primitive equipment and the isolation from roads will permit. Soils are derived from sedimentary rocks.

Quercus corrugata has not been observed elsewhere in the valley, but Q. guglielmi-treleasi extends its dominance over the sub-tropical lands below. Both the

small to trees. Widespread, it is a common tree,
even beside the roads. Vines,
herbaceous annuals, are
Bul-
bytes are very common in the
not
noticably
clin tea. Trees are evergreen, the
with
numerous
small
leaves.

1. The Tropical Botanic - Florida Botanical
Association.

Above Ferrol, on the
eighteen miles, is a
impossibly beautiful
of trees with
Because it
reflect, the
date to
bathe
particularly
thing
willingly.

former, a white oak, and the latter, a black oak, are trees which may become 120 feet tall. There is also present another species of black oak, which, according to Dr. C. H. Muller, authority on the genus Quercus, represents a new species. This, too, is a very tall tree. The oaks have prominent buttresses, but some of the tremendous specimens of Q. corrugata have thrust out great planks from the trunks to a distance of ten feet. However, the oaks are not alone in their dominance, for equally large trees of several other genera share the upper canopy. These include Cedrela tonduzii, Ocotea austinii, a species of Guarea, a Eugenia, and two species of Lauraceous trees known to the natives as "ira rosa" and "quina". The four latter are awaiting identification. Each species of the dominant layer may have trunk diameters of six feet at breast height.

The understories present the same problem with regard to identifications. The taller understory, which may reach to 80 feet, is composed of many species, among which are Weinmannia pinnata and W. wercklei . Common names are all that are known of the identity of many of these too, "gavulín", "sangre de toro", "quizarrá amarillo", etc. There is another layer of vegetation at about 20-40 feet which is not consistent due to the

heavy shade and almost constant cloudiness to which it is subjected. In contrast to the canopy and upper story strata, these lower trees usually have poor form, weak wood, and thin foliage. There is often a low shrubby growth of aroids and Rubiaceaeous plants, but this ground cover is by no means universally present nor difficult to walk through. A transect is given in Fig. 15.

Dominants - 100 feet

Cedrela tonduzii C. DC.- Meliaceae - "Cedro"

Eugenia sp. undet.- Myrtaceae - "Guayabillo"

Guarea sp. undet.- Meliaceae - "Cedro macho"

Lauraceae - 2 species - "ira rosa" and "quina" or "ira quina"

Ocotea austinii Allen.- Lauraceae - "Ira colorado"

Quercus corrugata Hook.- Fagaceae - "Roble"

Q. guglielmi-trele asi Mull.- Fagaceae - "Encino"

Q. sp. nov. undet.- Fagaceae - "Encino"

Upper story - to 80 feet

Billia colombiana Pl. & Lind.- Hippocastanaceae

Cecropia mexicana

Lauraceae - 2 sp. unident.- "Quizarrá amarillo" and "aguacatillo"

Podocarpus deifolius Don.- Taxaceae - "Cipresillo"

Locogene Mudflats Mem.- Muddiness - "Silliness"

and "Mudflats"

Lacustrine - Lg. mud. - "Mire-like silliness"

Deposits resulting

Billie colourless Pl. & Diag.- Hippocentaurs

Upper story - To 60 feet

C. sp. Nov. Model.- Performance - "Problem"

S. Collier-Lapel Mod.- Performance - "Problem"

Syncrude & computer model.- Performance - "Double"

Double multiple films.- Increases - "La Silicon"

of "Los Grios"

Isolines - 2 Specks - "Los Rosa" and "Pink"

Lacuna sp. Nomet.- Pelle [illegible] - "Deep echo"

Burrie sp. Pellet.- Increase - "[illegible]"

Deposits - Pellet 0. Do.- Isolines - "Deep"

Low slope in mature to depths of Abscessous Flats, but this is used to the increasingly

[illegible] in all locals as well known. A to most is given in Fig. 15.

Dominate - 150 feet

heavy sludge mud is at certain closeness to which it is subjected. It is almost as [illegible] Upper story strata, and Lo es these initially to poor form, weak mud, as Lain definite. This is taken a low slope in mature to depths of Abscessous Flats, but this is used to the increasingly

Sapotaceae - 1 sp. unident.- "Sapote"

Weinmannia pinnata L.- Cunoniaceae

W. wercklei Standl.- Cunoniaceae

In addition, there are many plants awaiting identification from this size class, including those called "chilamate", "gavulín", and "sangre de toro" by the natives.

Lower story

Drimys winteri Forst.- Winteraceae

Eugenia sp. undet.- Myrtaceae

Gilibertia sp. undet.- Araliaceae

Inga tonduzii Standl.- Mimosaceae

Ladenbergia brenesii Standl.- Rubiaceae - "Cacho de venado"

Trichilia sp. undet.- Meliaceae

Wercklea insignis Pitt. & Standl.- Malvaceae

Among other understory plants which are as yet unnamed are to be included the small trees known as "azulillo", "Lechillo", "lengua de vaca" (3 spp. Melastomaceae), "ratón papa", and "sapotillo".

2. The "ira rosa" - "quina" fasciation

On the windward slopes of the Talamancas at elevations in excess of 2000 meters, the lower montane rainforest exists in much the same form as that

at Tapantí, but no oaks have been found there. The forest is easily reached by a short descent from the Panamerican Highway, in an easterly direction. The soils and topography are much the same as those above the Orosi Valley, but the nearness of the road has led to greater clearing of forest.

The dominant species are reduced to three species of the family Lauraceae, the as yet unidentified "ira rosa" and "quina", and "ira colorado" - Ocotea austinii. These maintain the same forest physiognomy as that found at lower elevations in the same formation. The tall understory is not noticeably different either, Clethra sp. and Alnus acuminata being the only observed additions to the previous list. About ten small trees are as yet unidentified from the lower understory. Tree ferns are somewhat more abundant at these higher elevations. No list is appended, as it would merely be repetitious.

3. The Ocotea austinii Association

"Ira colorado", Ocotea austinii, forms an almost pure stand of moderately tall timber over the slopes of Irazú and Turrialba volcanoes from the Río Birrís headwaters to the eastern limits of the study area and beyond, between the altitudes of 1500

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and 3000 meters. The soils are all volcanic in nature.

The forest is similar in structure to the other lower nontane rain forests, save for the complete dominance of the Ocotea. Although the dominant species is not so tall, being less than ninety feet, the trunks are thick, averaging three feet, and of excellent timber form. There is one tree, a species of Eugenia which is very nearly as tall as the Ocotea, but it is not nearly so abundant, and has a more slender trunk. Below the virtually solid canopy formed by the dominant trees, can be distinguished two understories, one at about 50-60 feet, the other much lower. The taller of the understories has a varied composition, Miconia, Viburnum, and Ilex among others, most of which have spreading crowns and low branching habit. The lower stratum consists of small trees, tall shrubs, and tree ferns, with a few scattered ground cover plants present.

Much of the area originally occupied by this association has been cleared for evergreen pasture, and most of the timber has been utilized as saw logs, although many trees remain in the fields. Forestry is practiced in a small way with Cryptomeria japonica and Alnus acuminata, the latter showing excellent promise, A transect of the forest near Celiblanco is given in Fig. 10.

Dominants

Eugenia sp. undet.- Myrtaceae - "Ira colorado"

Ocotea austinii Allen - Lauraceae - "Guayabillo"

Tall understory - 40-60 feet

Alnus acuminata HBK.- Betulaceae - "Jaúl"

Billia colombiana Pl. & Lind.- Hippocastaneaceae

Buddleja alpina Oerst.- Loganiaceae - "Salvia"

Clethra sp. undet.- Clethraceae

Didymopanax pittieri March - Araliaceae

Ilex vulcanicola Standl.- Aquifoliaceae

Miconia bipullifera Cogn.- Melastomaceae

Oreopanax xalapense (HBK.) Dcne. & Pl. -
Araliaceae

Viburnum costaricanum (Oerst.) Hemsl.-
Caprifoliaceae -

Weinmannia pinnata L.- Cunoniaceae

Unidentified plants include those known as "cari-blanco" and "salvia", the latter not being Buddleja.

Lower understory - 15-20 feet

None of the collected plants have been positively identified, but include a Cyathea and an Ardisia. The list is not extensive.

F. Lower Montane Wet Formation

The lower montane wet formation contains some of the most interesting and most impressive forests in Costa Rica. With an estimated annual temperature of between 12° and 18° C, and a rainfall of two to four meters average per year, the climate extends over the south slopes of Irazú, the summits of la Carpintera and el Tablazo, and a along the crest of much of the Talamanca Range. The altitudinal limits are from about 1600 to 2900-3000 meters. Cloudiness is common, but morning sun is frequent, with all day sunshine quite often during the dry season. Rains may be in showers or drizzles, with fogs commonly bathing the whole forest. There is no station in the study area, but the incomplete data from Las Nubes and San Isidro Coronado are given in Fig. 4-E

The forest is tall, to over 100 feet, with the dominants having a not quite closed canopy of medium density. There is a high understory at 75-80 feet, and another, of irregular height, at 20-45 feet. There is usually a ground cover present which may be as tall as ten feet. Lianas, while common, are not of large size. Epiphytes cover the trees, for this climate seemingly leads to their best development. Diciduousness is a character of many of the trees, including the dominants

7. Lower montane wet formation

The lower montane wet formation c
most interesting and most i
Mica. With an estimated annual
12° and 13° J, and a rainfall of two
age per year, the climate extends over
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and a along the crest of
The altitudinal limits are from about
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The forest is
dominance having
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ton feet.

characteristic of many of the trees, including
loads to thick bark development.
with
Mica.

but trees do not remain bare for long periods, nor are all trees of a given species defoliated at one time. Buttressing of the trunks of the larger trees is notable, many of the dominants having huge plank type supports. Good timber form is the rule, and large timber volumes are carried per acre.

1. The Quercus tomentocaulis - Cornus disciflora Association

Above the 1600 meter level on Irazú, la Carpintera, el Tablazo, and along the low peaks of the northern most Talamanca ridges, extending upwards to an elevation of 1900-2100 meters, stands the remains of the stately forest dominated by Quercus tomentocaulis and Cornus disciflora. A rather large plant list has accumulated because of intergradation with other associations and because of the mountain top isolation, which gives slightly different lists from different peaks. The soils may be formed of volcanic, limestone, or conglomerate rock origin, which fact alone might account for slightly different floral aspects on different peaks. The soils may be formed of volcanic, limestone, or conglomerate rock origin, which fact alone might account for slightly different floral aspects on different sites.

The dominant trees are large, many of them buttressed. Quercus tomentocaulis is a white oak which is

pre-need. Fossil communities in a white marl, for is different floras separate on different sites.

The different types are [illegible], e.g. or their different origin, which just might account for difficulty rock origin, which just might account for difficulty may be formed of volcanic, limestone, or conglomerate different floras separate on different levels. The soils rock origin, which just might account for difficulty may be formed of volcanic, limestone, or conglomerate significantly influence flora [illegible]. The soils because of its content in isolation, which gives peaks of [illegible] with open associations and diatoms. A rather large plant list [illegible] and forest dominated by trees temperature and humus 1500-2100 metres, showing the remains of the swamp Permanos ridge, extending [illegible] to an elevation of el Tablazo, and along the low lands of the northern most [illegible] open flat on [illegible], la cumbre, above the [illegible]

1. The Quebrada [illegible] - plants dissociations association

voltage are carried [illegible] or more.

Good timber [illegible] is the pine, and this is abundant. Good timber is the pine, many of the dominants having [illegible] a rank pine. Butt[illegible] of pine trunks of the larger trees is not-[illegible] of 3 [illegible] specimens deformed at the time. but trees do not remain [illegible] for [illegible] method, nor are

quite equal in stature to the other species of its kind. The more slender Cornus, while sharing its codominance with several other species, is probably the most abundant large tree in the association. Virgin forest of this association is not to be encountered within the study area, but from the remnants it is possible to reconstruct much of the original physiognomy. The dominants have open crowns which barely touch one another, leaving for the tall understory trees the unbroken canopy layer. This canopy is composed of a variety of species, including several black oaks ("encino"), Ocotea austinii, a Guarea, and Persea schiediana. The lower understory is made up of many small kinds of trees, with leguminous and Rubiaceous species well represented. Ground cover includes types such as Costus and Heliconia, which occurs as dwarf forms, ferns, and terrestrial orchids of temperate zone genera.

Evergreen pasture has claimed most of the association area, but little cutting is still taking place. There are several managed wood-lots of native trees remaining, and Alnus is being increasingly planted. Probably most of the land will eventually become a source of both pasture and timber, managed for continued yield.

of both pastures and timber, kept up for centuries yearly. Probably most of the land will eventually become a coarse tenanting, and Africa is being inexorably planned. There are several managed wood-lots of native trees tion area, but little cutting is still taking place.

Vegetation has changed most of the associa- temperate zone conifers.

as dwarf forms, ferns, and herbaceous growths of includes tuber such as Dombeya and Hetranthe, which occupy and subtropical species well represented. Ground cover is made up of many small kinds of trees, with leguminous a Guarea, and tropical epiphytes. The lower understory crowding several strata ("sections"), Cordia abyssinica, the tall understory trees the umbrella canopy layer. This canopy is composed of a variety of species, in- open crowns which barely touch one another, leaving for more of the original pulpiness. The remnants have area, but even de Bermuth it is possible to reconstruct association is not to be encountered within the study large tree in the association. Alnus forest or thus with several other species, is probably no more abundant quite equal in stature to the other species of the kind.

Dominants. 90-100 feet

Alfaroa costaricensis Standl. - Juglandaceae

Cedrela tonduzii C.DC. - Meliaceae - "cedro"

Cornus disciflora DC. - Cornaceae - "llorón"

Quercus tomento caulis Mull. - Fagaceae - "roble"

Sideroxylon capiri (A.DC.) Pitt. - Sapotaceae

Tall understory - 55-70 feet

Alnus acuminata HBK. - Betulaceae - "jaúl"

Billia colombiana Pl. & Lind. - Hippocastanaceae

Cecropia mexicana Hemsl. - Moraceae - "guarumo"

Eugenia sp. undet. - Myrtaceae - "guayabillo"

Ficus sp. undet. - Moraceae - "higuerón"

Guarea brevianthera C.DC. - Meliaceae - "cedro macho"

Magnolia poasana (P.H.) Dandy - Magnoliaceae

Nectandra sp. undet. - Lauraceae - "ira"

Ocotea austinii Allen. - Lauraceae - "Ira colorado"

Oreopanax xalapense (HBK) Dene. & Pl. - Araliaceae

Persea schiedeana Nees. - Lauraceae - "yas"

Quercus borucasana Trel. - Fagaceae - "encino"

Q. eugeniifolia Liebm. - Fagaceae - "encino"

Q. guglielmi - treleasi Mull. Fagaceae - "encino"

Q. seemanii Liebm. - Fagaceae - "encino

Talauma gloriensis P.H. - Magnoliaceae

Dominantes. 50-foot toes

Hatura cosmocorus stamot. - Hirudinacese

Decorah Shadrill C. K. - Hirudinacese - "cedro"

Torma disciformis Pl. - Cyclocoele - "florin"

Amoeba primeio cornea Mit. - Amoebaeacese - "polo"

Didemnum canini (Verr.) Hitc. - Didemnacese

Tail ornamony - 55-70 feet

Alma mammalis Linn. - Bolinacese - "jail"

Ir a procordata Ir. Huxl. - Amphioxacese

Oscorie non sens Orst. - Noracese - "murmur"

Amoeba sp. Hitc. - Urbacese - "pajarillo"

Tigra sf. Mitc. - Noracese - "Mexican"

Grave Brevia Shore C.C. - Helicese - "cedro

radio"

. amoria noctua (Verr.) Berry - Hirudinacea

Lecanura s . Mitc. - Marinacese - "rio"

Socles anglia Afon. - Manacese - "rio o lorado"

Cheumax pa . . o (Verr.) Jane. . - Hirudinacea

Ferean copion-ana lees. - Marinacese - "pas"

Marina polmosana Tre. - Pa nacea - "ancho"

E. carcharias Leach. - Marinacea - "ancho"

. Hirudinid - Hirudeal . Manacese - "ancho"

. agonanii Rio. - Marinacea - "ancho"

Ia ana Hirudomela I... - Hirudinacea

Lower understory 20-40 feet

Blakea tuberculata D. Sm. - Melastomaceae

Citharexylem donnell-smithii Greenway - Verbenaceae

Clethra lanata Mart.&Gal. - Clethraceae

Clusia rotundata Standl - Guttiferae - "mata palo"

Conostegia xalapensis (Bonpl.) D.Don. - Melastomaceae

Con. sp. undet. - Melastomaceae - "lengua de vaca"

Croton gossypiifolius Vahl. - Euphorbiaceae - "targuá"

Drimys winteri Forst. - Winteraceae

Eugenia lepidota Berg - Myrtaceae

Ficus cervantesiana Standl. & L.Wms. - Moraceae - "higuerón"

E. padifolia HBK. - Moraceae - "higuerón"

Gilibertia arborea (L.) March - Araliaceae

Guettarda crispiflora Vahl. - Rubiaceae

Hampea appendiculata (D.Sm.) Standl. - Bombacaceae

Heliocarpus appendiculatus Turcz. - Tiliaceae - "burió"

Hieronyma guatemalensis D.Sm. - Euphorbiaceae

Ilex pallida Standl. - Aquifoliaceae

Inga micheliana Harms. - Mimosaceae

Ladenbergia brenesii Standl.-Rubiaceae

Lippia myriocephala Schl.& Cham. - Verbenaceae

Mauria glauca D.Sm. - Anacardiaceae

Tower Mugeratory 23-ho Ieel

Blaxea tripercylata D. Sm. - Шелезнякова

Gibbaroxeum dolmeli-a kiihni Грозный - Четвертаков

Cleftia rawsa Lap.-Ll. - Отеплякова

Ctenia robusta Hamm - Крепкого - "Чего рад"

Conocephela xanthocnis (Dorn.) W. Don. - Желтоголова

Don. ep. Mugel. - Желтоголова - "Сердце де уаса"

Dreton rosmarinifolius Va.l. - Розмаринового -

"Загрязнение"

Ficus religiosa Stanz. n.Mss. - Голозад -

Gnidia melleri Gilg - Гридасова

Hyalopteris arborea Mugeran. - Мишкова

T. Phillipia Tim. - Хорошая - "Идиотия"

Ulmiphoria arborea (L.) arch - Ильмовая

Uterpanda oxio affora Va ... - Прилипала

Xanthea a rmeniaca (D.Sm.) Stand. - Зонтичная

Heliocarpus periconiana Lucas. - Мягкая - "Вред"

Hyeronima macrocarpa Beyrich D.Sm. - Сонцовая

Ilex pallida Standl. - Идиотская

Inga edulis Mart. - Ильмовая

Ixora coccinea L. - Цветковая - Чернокожая

Litsea triperulata D. Sm. - Шелезнякова

Tower Mugeratory 23-ho Ieel

Miconia sp. undet. - Melastomaceae

Morus insignis Bur. - Moraceae

Ocotea endresiana Mez. - Lauraceae - "aguacatillo"

Phoebe valeriana Standl. - Lauraceae

Picramnia quaternaria D!Sm. - Simarubaceae

Pithecolobium costaricensis (Britt. & Rose) Standl. - Mimosaceae

Rapanea ferruginea (R. & P.) Mez. - Myrsinaceae

Rhus striata R. & P. - Anacardiaceae - "hinchador"

Rondeletia amoena (Pl.)Hemsl. - Rubiaceae

Ron. buddleoides Benth. - Rubiaceae

Solanum copyanum Bitter - Solanaceae

Symplocos austin-smithii Standl. - Symplocaceae

Trichilia sp. undet. - Meliaceae

Virburnum costaricanum (Oerst.)Hemsl.-Caprifoliaceae

Vismia ferruginea HBK. - Guttiferae

Weinmannia pinnata L. - Cunoniaceae

Zanthoxylem panamense P.Wilson - Rutaceae

Rhamnus pubescens (R. & P.) Tr.& Pl. - Rhamnaceae

2. The Quercus copeyensis Association

The upper portion of the lower montane wet formation is largely covered by a tall forest completely dominated by the white oak, Quercus Copeyensis. The area covered,in the Reventazón

Miconia sp. undet. - Melastomaceae

Morus insignis Bur. - Moraceae

Oocoea endresiana Cn. - Lauraceae - "aguacatillo"

Phoebe valeriana Standl. - Lauraceae

Picramnia quatemalensis Dlcm. - Simaroubaceae

Pithecolobium costaricensis (Britt. & Rose)

Standl. - Mimosaceae

Rapanea ferruginea (. & P.) Mez. - Myrsinaceae

Rhus striata R. & P. - Anacardiaceae - "hincharador"

Rondeletia amoena (H.)emsl. - Rubiaceae

Ron. bruchloides Benth. - Rubiaceae

Solanum copyanum Bitter - Solanaceae

Symplocos arata-amblit Standl. - Symplocaceae

Trichilia sp. undet. - Meliaceae

Virburnum costaricanum (Oerst.)Hemsl.-Caprifoliaceae

Vismia ferruginea (.) . - Guttiferae

Weinmannia pinnata . - Cunoniaceae

Xanthoxylem panamense K.Wilson - Rutaceae

Rhamnus prinoides (. & P.) Te.& H. - Rhamnaceae

2. The Quercus copeyensis Association

The upper portion of the lower montane wet formation is largely covered by a tall forest completely dominated by the white oak, Quercus copeyensis. The area covered in the following

watershed, by the original forest was about 6400 acres on the south slope of Irazú, none of which remains virgin, and an approximately equal amount in the Talamanca Range, but the association covers many square miles on the Pacific side of the latter mountains. The area thus delimited lies between the 1900 meter and 28-2900 meter levels. Clouds bathe the forest at all seasons, and direct precipitation on the foliage, with the resultant drip, maintains soil moisture at a high year-round level. Soils may be volcanic in nature or may be weathered intrusive or sedimantary material.

The complete dominance of the single species of oak is not contested by any other tree except at the rather sharply defined borders of the associations. The Copey oak is a majestic evergreen tree, the erect, plank buttressed trunks averaging 30-36 inches in diameter above the buttresses, and usually one hundred or more feet tall. Individuals can be easily found which are 70 inches or more in diameter and 120 feet tall, which probably makes it "the largest oak in the world" (Merker, etal, 1945). The branches are festooned with a bewildering variety of mosses, orchids, aroids, bromeliads, and dicotyledonous epiphytes, which quite cover the bark (Fig. 17). The huge crowns touch on all sides, thus forming a high canopy. There is a rather open understory

watershed, by the original forest was about 6600 acres on the south slope of Irazú, none of which remains virgin, and an approximately equal amount in the Talamanca Range, but the association covers many square miles on the Pacific side of the latter mountains. The area thus delimited lies between the 1900- meter and 2500-2900- meter levels. Clouds bathe the forest at all seasons, and direct precipitation on the foliage, with the resultant drip, maintains soil moisture at a high year-round level. Soils may be volcanic in nature or may be weathered intrusive or sedimentary material.

The complete dominance of the single species of oak is not contested by any other tree except at the rather sharply defined borders of the associations. The Copey oak is a majestic evergreen tree, the erect, plank buttresses of which average 30-35 inches in diameter above the buttresses, and usually one hundred or more feet tall. Individuals can be easily found which are 70 inches or more in diameter and 120 feet tall, which probably makes it "the largest oak in the world" (Dwyer, 1944). The branches are festooned with a bewildering variety of mosses, orchids, aroids, bromeliads, and dicotyledonous epiphytes, which quite cover the bark (Fig. 17). The huge crowns touch on all sides, thus forming a high canopy. There is a rather open understory

at from 40-60 or more feet high, composed principally of Magnolia poasana, Ilex lamprophylla, Weinmannia pinnata and various Lauraceae. A lower understory of Drimys winteri, Miconia sp., and various other small trees and tall shrubs is 15-25 feet tall. Ground cover is 4-6 feet high, and is largely limited to a rather dense growth of bamboo, with tree seedlings and occasional small palms and tree ferns. A transect of the association is given in fig. 8 .

Because of the year round precipitation, all parts of the association are within potential dairy farming areas as sites of evergreen pasture. The generally low temperatures lessen the value for crops, but some potatoes and kitchen gardens are cultivated. It is probable that most of the area will be given over to agriculture as roads are extended and population pressures increase, but the generally poor soils of the Talamancas will produce many problems to long term development. Another problem to agriculture is the under growth bamboo, which, when the forest is cut, quickly takes possession of the land if not checked.

Cutting of remaining timber on Irazú is proceeding at a slow rate, and many trees yet remain in the pastures and gullies. The easily reached forest along the Carretera Interamericana, on the other hand, is being

at from 40-50 or more feet high, composed principally of Lagunia rosana, Ilex lamprophylla, Weinmannia pinnata and various Lauraceae. A lower understory of Drimys winteri, Escallonia sp., and various other small trees and tall shrubs is 15-25 feet tall. Trees cover is 4-6 feet high, and is largely limited to a rather dense growth of bamboo, with tree ferns and occasional small palms and tree ferns. A transect of the association is given in Fig. 8 .

Because of the year round precipitation, silt peats of the association are within economical reach for cultivation as sites of overmoss pasture. The generally low temperatures reduce the value for crops, but some potatoes and kitchen gardens are cultivated. It is probable that most of the area will be given over to agricultural use as roads are extended and population increases, and the generally poor soils of the Lauraceae will produce many problems to long term development. Another problem to anticipate is the under drained bamboo, which, when the forest is cut, quickly takes possession of the land if not checked.

Cutting of remaining timber on Isla is proceeding at a slow rate, and many trees lay rotting in the pastures and gullies. The easily reached forest along the Estero Tortuga, on the other hand, is being

rapidly cleared by primitive and wasteful methods to make way for the agricultural expansion. Woods not removed as saw-logs, as well as waste from the larger trees, are made into cord wood and charcoal. Much of the wood is permitted to rot where it is felled, however. Perhaps world wood shortages and the high timber volume will justify modern logging methods as new areas are opened up.

Natural regeneration of oak is abundant in virgin stands, trees of all size classes growing together, but rate of growth is probably slow. Squirrels and peccaries have been observed eating, and probably disseminating, the acorns. Other trees in the association also have edible fruits. Pollination may be accomplished by wind, insects, or humming birds, depending upon the flower structure of the various species.

Ridges, gullies, and steep slopes should be maintained in forest. Attempts should be made to determine whether the growth rate of the oak is sufficiently high to justify its use in managed woodlots. There are many trees which will make satisfactory growth within the limits of the association, such as Jaúl (Alnus acuminata), Ciprés (Cupressus benthami), Ciprés Japonesa (Cryptomeria japonica), and various other conifers.

rapidly cleared of timber and weeds and so make way for the agriculturist eventually. Woods not be saved as saw-logs, as wood as waste from the larger trees, are made into cord wood and charcoal. Much of the wood is permitted to rot where it is felled, however. Perhaps finally modern forestry methods as new areas are opened up.

Mature reforestation of oak is subsequent in virgin stands, trees of all size classes growing together, but rate of growth is probably slow. Squirrels and boxcaries have been observed eating, and probably digsearching, for acorns. Other trees in the association also have edible fruits. Fertilization may be accomplished by wind, insects, or humming birds, depending upon the flower structure of the various species.

Ridges, gullies, and steep slopes should be maintained in forest. Attempts should be made to determine whether the poorer rate of oak reproduction is sufficiently high to justify its use in managed woodlots. Where are many trees which will make satisfactory growth within the limits of the association, such as Ash (Fraxinus acuminata), Cherry (Cupressus benthamii), Chêres Taxodium (Cryptomeria japonica), and various other conifers.

Dominant

Quercus copeyensis Mull. - Fagaceae - "roble"

Tall understory

Ilex lamprophylla Standl. Aquifoliaceae

Magnolia poasana (P.H.) Dandy - Magnoliaceae

Nectandra sp? - Lauraceae - "ira rosa"

Ocotea austinii Allen - Lauraceae - "ira colorado"

Oreopanax pycnocarpum D.Sm. - Araliaceae

Or. xalopense (HBK) Dcne. & Pl.) Araliaceae

Quercus seemannii Liebm. - Fagaceae - "encino"

Talauma gloriensis Htt. - Magnoliaceae

Viburnum costaricanum (Oerst.) Hemsl. - Caprifoliaceae

Weinmannia pinnata L. - Cunoniaceae

Lower understory

Alnus acuminata HBK - Betulaceae "Jaúl"

Ardisia irazuensis Oerst. - Myrsinacere

Brunellia costaricensis Standl. - Brunelliaceae

Clethra sp. nov. undet. - Cletraceae

Clusia alata Pl. & Tr. - Guttiferae "matapalo"

Cyathea sp? - Cyatheaceae - "palma de helecho"

Didymopanax pittieri March - Araliaceae

Drimys winteri Forst. - Winteraceae

Fuchsia arborescens Sims - Onagraceae - "achiotillo"

Miconia sp. undet. - Melastomaceae

Portugal

Aferição confrontação f. lit. - confrontação - "mobile"

Bal. mundschatz

Ilex ver.ro. Ilex paraguariensis. Aquifoliaceae

Jacquinia aculeata (L.) Mill. - Jacquiniaceae

Nectandra sp? - Lauraceae - "lire rosa"

Coleo antrirhi Lindl. - Lauraceae - "ari colorado"

Cheiranthus cheiri L. - Cruciferae

Op. xylocarpa (Klotzsch) Done. & Wr.) Apocynaceae

Cheiria neesiana Gleb. - Ka ao se - "aeolo"

Cha'a Cleome rosea Vahl. - Capparidaceae

Allamanda cathartica (Jacq.) Mart. - Apocynaceae-

Apocynaceae

Veiranthus cheiri L. - Cruciferae

Power Amerikaans

Micania scandens Willd - Compositae "aapi"

Mimosa scabrella Benth. - Leguminosae

Ilex theezans Mart. - Aquifoliaceae

Ocotea sp. Aubl. - Lauraceae

Nectandra megapotamica Mez. - Lauraceae - "canela"

Ilex dumosa Reiss. Aquifoliaceae

Cha'a Mysine coriacea (L.) R. Br. - Myrsinaceae - "Rapoli"

Myrica pubescens Willd. - Myricaceae

Neea sp. undet. - Nyctaginaceae

Persea schiedeana Nees - Lauraceae - "yas"

Phoebe mollicella Blake - Lauraceae

Rapanea ferruginea (R.&P.) Mex. - Myrsinaceae

Rhamnus pubescens (R.&R.) Tr. & Pl. - Rhamnaceae

Styrax irazuensis Standl. - Styraceae

St. warscewiczii Perk - Styraceae

Zanthoxylem melanostichtum Schl. & Cham. - Rutaceae

Much of the ground cover is represented by the bamboo, Chusquea sp. undet.

The Podocarpus oleifolius - Weinmannia Wercklei Fasciation

In areas surrounding the Puya - Lomaria type bogs and in other places of poor drainage, a fasciation of the Copey oak association of quite different physiognomy grows. It is characterized by Podocarpus oleifolius and Weinmannia wercklei, the lower general canopy height (60-80 feet). and poorer form of the trunks giving a different aspect to the forest than that in the Copey oak adjoining. Many more species reach the dominant layer, species which are rare or non-existant in the taller forest. There is a very dense canopy, and for this

Myrica pubescens Willd. - Myricaceae

Nyssa sp. unlet. - Nyssaceae

Persea caroliniana Mees - Lauraceae - "Bay"

Rhoeo spathacea Stapf - Lauraceae

Sabrea ferruginea (D. C.) Gr. - Myrsinaceae

Symplocos cubescens (D. Don) Benth. - Symplocaceae

Styrax japonica Lindl. - Styracaceae

St. Vincentia Griff. - Styracaceae

Tamilcylon membranifolium Boerl. & Diar. -

Ebenaceae

Much of the young cover is represented by the bamboo, Chusquea sp. unlet.

The Podocarpus oreiloides - Weinmannia hercinii

Association

In areas surrounding the Mya - Lomaria type both and in other places of poor drainage, a variation of the Copey can occur which is dominated almost physiognomy by Podocarpus oreiloides and Weinmannia hercinii. The lower terrain canopy height (20-30 feet). and lower face of the trunks giving a different aspect to the forest than that in the "open oak adjoining. Many more species reach the dominant layer, forest. Vines in a very dense canopy, are for this

reason there is but one understory at about 20-30 feet, and a quite distinct ground cover layer (Fig.20). A transect from the Puya - Lomaria Bog, thru this swamp forest fasciation, to Quercus copeyensis tall forest is given in Fig. 7 . The forest furnishes timber of rather short lengths to man, and should be kept as forest unless drainage is carried out.

Dominants

Alnus acuminata HBK. - Betulaceae - "jaúl"

Magnolia poasana (Pitt.) Dandy - Magnoliaceae

Podocarpus oleifolius Don. - Taxaceae "cipresillo"

Quercus aaata Mull. - Fagaceae - "roble"

Q. copeyensis Mull. - Fagaceae - "roble"

Q. seemannii Liebm. - Fagaceae - "encino"

Weinmannia pinnata L. - Cunoniaceae

W. wercklei Standl. - Cunoniaceae

Understory

Ardisia irazuensis Oerst. - Myrsinaceae

Brunellia costaricensis Standl. - Brunelliaceae

Clusia alata Pl. & Tr. - Guttiferae

Cyathea sp. undet. - Cyatheaceae - "palma de helecho"

Didymopanax pittieri March - Araliaceae

Drimys winteri Forst. - Winteraceae

Eugenia sp. undet. - Myrtaceae

reason there is but one understory at about 25-30 feet, and a quite distinct ground cover layer (Fig.20). A transect from the Tuya - Esmeralda No), thru this swamp forest formation, on Moreira conglomerate talus slopes is given in Fig. 7 . The forest inventory[illegible] timber of rather short height to man, and should be kept as forest unless drainage is carried out.

Dominants

Acacia acuminata Benth. - Leguminosae - "jarra"

Eucalyptus rostrata (Schl.) Dandy - Myrtaceae

Jacaranda oleifolia Hook. - Bignoniaceae "carpesillo"

Myrcia salicifolia Berg. - Myrtaceae - "roble"

Q. conglomerata Trel. - Fagaceae - "roble"

Q. sessilifl Liebm. - Fagaceae - "encino"

Weinmannia pinnata L. - Cunoniaceae

W. vercrucis Standl. - Cunoniaceae

Understory

Azorella trifoliata Cham. - Umbelliferae

Drymaria cordatifolia Standl. - Plumbaginaceae

Clusia alata Pl. & T. - Guttiferae

Dyckia sp. nov. - Bromeliaceae - "palma de roseco"

Hedyosmum trilineatum Lorch - Aristaceae

Juncus wimbeyi Coss. - Juncaceae

Miconia sp. nuev. - Melastomaceae

Ilex lamprophylla Standl. - Aquifoliaceae

Miconia sp. undet. - Melastomaceae

Myrtus oerstedii Mez. - Myrtaceae

Phoebe mollicella Blake - Lauraceae

Podocarpus standleyi Bucholtz. - Taxaceae

Rhamnus pubescens (R.&P.) Tr. & Pl. - Rhamnaceae

Styrax warscewiceii Perx. Styraceae

Vaccinium consanguineum Kltzsch. - Ericaceae

Zanthoxylem melanostichtum Schl. & Cham.

The ground cover is principally composed of Chamaedorea parvifolia Burret; Carludovica irazuensis Cuf.; Anthurium sp?; Greigia sylvicola Standl.; and an undetermined grass. There are only a few dicotyledonous plants visible in the cover, mostly tree seedlings.

Ilex [illegible] Hook. - Aquifoliaceae

Ficaria ca. Mnch. - Ranunculaceae

Pyrus communis Linn. - Rosaceae

Prunus mollucella Hasskarl - Rosaceae

Rodocarpus oleifolius Hook. f. - Podocarpaceae

Thuja orientalis (Linn.) Fr. et L. - Taxaceae

Taxus wallichiana Zucc. Pl. Jap. - Taxaceae

Vaccinium oxycoccus Linn. - Ericaceae

Xanthoxylum [illegible] Linn. f. Hook.

The ground cover is principally composed of Ranunculus cantoniensis Bunge; rare below Ranunculus Ficaria; and unidentified moss. There are only a few dicotyledonous plants visible in the cover, mostly tree seedlings.

G. Lower Montane Moist Formation

The lower montane moist formation is restricted, in the study area, to that portion of the Irazú rain shadow between 1600 and 2700 meters elevation. The climate is cool, and the rainfall plentiful, but not excessive. The limits are 12°-18°C for temperature, and a rainfall of 1-2 meters annual average. The station for climatic data is Sanatorio Durán, (Fig. 4-F), where records are short term and of broken time, but which show a higher rainfall than that expected. The irregularly may be explained on the basis of the statistically too short time of record, and the long dry season, which no doubt has a strong effect in the free draining volcanic type soils. Sunny morning are usual, with much afternoon cloudiness. Much of the rain falls in sharp showers, which may be long continued, Sanatorio Durán reporting over 400 mm in a 5 hour period during October 11th, 1951. Clouds do not usually touch the tree-tops.

The forest is moderately tall, about 100' average. There is a high understory at 60-70 feet, another at 20-40, and the lowest from 5 to 15 feet tall. Scattered herbs grow in the abundant leaf mold. None of the vegetation has a dense crown, and the forest appears much like a North American warm temperate

C. Lower Montane Moist Formation

The lower montane moist formation is restricted, in the study area, to that portion of the Naranjo drainage between 1600 and 2700 meters elevation. The climate is cool, and the rainfall plentiful, but not excessive. The limits are 12°-17° for temperature, and a rainfall of 1-2 meters annual average. The station for climatic data is Santorio Duran, (Fig. 4-E), where records are short term and of broken time, but which show a higher rainfall than that expected. The irregularity may be explained on the basis of the statistically too short time of record, and the long dry season, which no doubt has a strong effect in the free draining volcanic type soils. Sunny morning are usual, with much afternoon cloudiness. Much of the rain falls in sharp showers, which may be long continued, Santorio Duran reporting over 400 mm in a 2 hour period during October 1949, 1951. Clouds do not usually touch the tree-tops.

The forest is moderately tall, about 100' average. There is a high understory at 40-70 feet, another at 20-40', and the lowest from 5 to 15 feet tall. Scattered herbs grow in the abundant leaf mold. Some of the vegetation has a dense crown, and the forest appears much like a North American warm temperate

hardwood stand. Thin woody and herbaceous vines are present, while the few epiphytes are almost all cryptogamic. Deciduousness is the rule in this forest, with large trees being slightly buttressed. The strangling habit is developed in one tree in the study area, and the larger trees are almost without exception parasitized by mistletoes.

The Quercus aáata - Quercus yoroensis Association

Behind the Sanatorio Durán ther is preserved a wonderful woods which covers about ten manzanas, all that is left of the oak forests which once covered the middle portion of the Irazú rain shadow. Great oaks, of several species, are the only trees of dominant height, but the under - stories are more varied. The areas about streams show the influence of moisture, many species from the wetter associations being found there.

The white oak, Quercus aáata, and the black oak, Q. yoroensis are most frequently encountered, but the list includes several other species, several of which are difficult to identify. The oaks become one hundred feet tall, with trunks four to six in diameter. Timber form is good to fair, branching being lower than that in other oak forests, with spreading, thin crowns. A

second layer of foliage, at 60-70 feet, is composed of trees with straight trunks of small diameter and thin, spreading foliage, such as Eurya, Rhamnus, and Rapanea. The lower undestory, which is broken in form, consists of a thin shrubby growth which varies from head high to twenty feet. The very heavy carpet of leaves and lead mold is virtually the only ground cover, occasional ferns, violets, or orchids of the genus Malaxis representing the herbaceous layer. Clusia and Oreopanax, which may commence life as epiphytes, are the trees which here take the place of the strangling figs (Ficus) of lower elevations.

Virtually every oak is infected with parasites of the mistletoe family, one, Psittacanthus schiedeanus, having large showy blooms of an orange-red color. Another common parasite is Conophilus americanus, which infests oak roots, sending only its columnar yellowish inflorescences above ground.

In valley bottoms certain of the wet forest types are encountered. Alnus, Cornus, Chusquea, and the Copey oak, which plants also mix at the lateral boundaries of the association. Considerable mixing of floras also occurs at the upper boundary, where montaine types descend below the regular habitat.

second layer of foliage, at 10-15 feet, is composed of trees with straight trunks of small diameter and thin, spreading foliage, such as Musa, Rhamnus, and Pagenae. The lower understory, which is broken in form, consists of a thin shrubby growth which varies from head high to twenty feet. The very heavy carpet of leaves and load mold is virtually the only ground cover, occasional ferns, violets, or orchids or the genus Malaxis represent the herbaceous layer: Cimicifuga and Oreopanax, which may commence life as epiphytes, are the trees which here take the place of the strangling figs (Ficus) of lower elevations.

Virtually every oak is infected with parasites of the mistletoe family, one, Dendrophthora colubrina, having large showy forms of an orange-red color. Another common parasite is Gaiadendron punctatum, which infests oaks mostly, seldom only the columnar yellowish inflorescences above pruning.

In valley bottoms certain of the wet forest types are encountered. Pinus, Quercus, Pinaceae, and the Cupey oak, which climbs also up the lateral boundaries of the associated m. Commensurable rainfall of flora also occurs at the up or boundary, where montane types succeed below the regular habitat.

The lower borders of the association are almost lost, however, owing to the intensive cultivation of the land, only the deeper quebradas and scattered pasture shade trees permitting the tracing of the association line. Fallow land is usually quickly occupied by Rubus species unless controls are instituted.

Although the land has too high a value for extensive reforestation, the very steep hillsides and quebradas could produce enough firewood and lumber for the region by use of species such as Alnus, Eucalyptus globulus, and Mexican cypress.

Dominants - 100 feet

Quercus aáata Mull. - Fagaceae - "roble"

Q. borucasana Trel. - Fagaceae - "encino"

Q. copeyensis Mull. - Fagaceae - "roble"

Q. costaricensis Liebm. - Fagaceae - "encino"

Q. eugeniifolia liebm. - Fagaceae - "encino"

Q. seemannii Liebm. - Fagaceae - "encino"

Q. yoroensis Trel. - Fagaceae - "encino"

Tall understory - 50-60 feet.

Alnus acuminata HBK. - Betulaceae - "jaul"

Cedrela tonduzii C.DC. - Meliaceae - "cedro"

Clusia flava Jacq. - Guttiferae

Cornus disciflora DC. - Cornaceae

Croton gossypiifolius Vahl - Euphorbiaceae

The lower borders of the association are almost bare, however, owing to the intensive elevation of the land, only the deciduous and scattered pasd be shade trees permitting the tracing of the association line.

Fallow land is usually quickly occupied by Pinus species unless controls are instituted.

Although the land has too high a value for extensive reforestation, the very steep hillsides and draperies could produce enough firewood and timber for the region by use of species such as Pinus, Eucalyptus globulus, and Leptospermum cau cypress.

Dominants - 100 feet

Quercus agrifolia Nutt. - Fagaceae - "oak"

2. Pinus radiata D. Don. - Pinaceae - "pine"

3. Cupressus macrocarpa Hartw. - Pinaceae - "cypress"

4. Eucalyptus globulus Labill. - Myrtaceae - "eucalyptus"

5. Eucalyptus viminalis Labill. - Myrtaceae - "eucalyptus"

6. Eucalyptus rudis Endl. - Myrtaceae - "eucalyptus"

7. Eucalyptus cornuta Labill. - Myrtaceae - "eucalyptus"

Tall understory - 50-60 feet.

Arbutus menziesii Pursh. - Ericaceae - "madrone"

Heteromeles arbutifolia M. Roem. - Rosaceae - "toyon"

Quercus agrifolia Nee - Fagaceae

Quercus kelloggii Newb. - Fagaceae

Umbellularia californica (Hook. & Arn.) Nutt. - Lauraceae

Aesculus californica (Spach) Nutt. - Hippocastanaceae

Eurya theoides (Sw.) Blume - Theaceae

Ilex pallida Standl. - Aquifoliaceae

Oreopanax pycnocarpum D.Sm. - Araliaceae

O. xalapense. (HBK.) Dcne. & Pl. - Araliaceae

Persea americana Mill - Lauraceae - "aguacate"

Per. sp. undet. - Lauraceae

Phoebe complifolia Mez. & D.Sm - Lauraceae

Rapanea pellucido-punctata (Oerst.) Mez - Myrsinacea

Rhamnus pubescens (R.&P.) Pl.&Tr. - Rhamnaceae

Lower understory.

Ardisia glanduloso-marginata Oerst. - Myrsinaceae

Cestrum aurantiacum Lindl. - Solanaceae

Citharexylem lankesteri Moldenke - Verbenaceae

Compositae - genus and sp. undet.

Fuchsia arborescens Sims - Onagraceae - "achiotillo"

Morus insignis Bur. - Moraceae

Phoebe mollicella Blake - Lauraceae

Rhacoma tonduzii (Loes.) Standl. & Steyern. ex Juss. - Celastraceae

Styrax warscewiczii Perk. - Styracaceae

Urera caracasana (Jacq.) Griseb. - Urticaceae

Zanthoxylem melanostichtum Schlect. & Chain. - Rutaceae

Lower undergrowth.

Rhamnus frangula (N.Gr.) Faulbr. - Faulbaum

Ga area per cubic-meter (Germ.) Ies - Ästigkeit

Fuego combustible Es. C.R. - Raumgehalt

Fer. sp. Prod. - Raumgehalt

Person qualified Ill - Eignung - "Tauglichkeit"

O. xalapensis (Mex.) Acre. Fr. - Mexikanische

Organum mensurae D.Sp. - Messinstrument

Ilex paraguariensis Bras. - Mateblattbaum

Ilex theezans (Sw.) Blume - Teebaum

Tsuga tongrenii (Engl.) Stapf. & Steyerm. ex Bas. -

Tsugabaumart

Fuego y Fuerza Cuba - Reinigung

Horma Port Mie Ger. - Normung

Arbeit erforderliche Zeit - Ausführung - "Arbeitszeit"

Composite - Kern und Sp. Amer.

Attraction Anziehung Indien - Verbindung

Gestion Verwaltung Ind. - Bewirtschaftung

Arabia Kaffeebaum-Kaffeebohne Egypt. - Kaffeebaum

Lower undergrowth.

H. Montane Wet Formation

The montane wet formation is found high on the windward slopes and peaks of the taller mountains, at altitudes in excess of 2800 meters. The only station in the climate is Villa Mills (Fig. 4-G), which is just outside of the study area. The climate is generally too cool for human comfort, the average temperature being 6°-12°C. annually, with fogs, drizzles, andstrong winds common. Although the mornings are often clear, the clouds and fog form early, and usually a part of each day is wet. In the dry season, there is a definite drop in rainfall, but there is always sufficient water to maintain growth of plants. Frost and ice are frequent in the dry season.

The plant formation may take two forms: forest or bush. The limiting factor is apparently exposure, for in sheltered places the forest developes. The forest tends to be low, less than 80 feet average height, and open. The dominants have thin crowns which rarely touch those of other trees. There is an irregular understory to 35 feet, and a brushy lower understory or ground cover which may become taller than head high. The few vines are mostly herbaceous, while epiphytic growth, of few species, may cover virtually all exposed bark. Mistletoes are conspicuous on many

1. Montane wet formation

The montane wet formation is found high on the windward slopes and peaks of the taller mountains, at altitudes in excess of 5000 metres. The only station in the climate is Villa Mills (fig. 4-c), which is just outside of the study area. The climate is generally too cool for human comfort, the average temperature being 6°-12°C. annually, with fogs, drizzles, and strong winds common. Although the mornings are often clear, the clouds and fog form early, and usually a part of each day is wet. In the dry season, there is a definite drop in rainfall, but there is always sufficient water to maintain growth of plants. Frost and ice are frequent in the dry season.

The plant formation may take two forms: forest or bush. The limiting factor is apparently exposure, for in sheltered places the forest develops. The forest tends to be low, less than 60 feet average height, and open. The dominants have thin crowns which rarely touch those of other trees. There is an irregular or broken cover which may become taller in head high. The few vines are mostly herbaceous, while epiphytic growth, of few species, may cover virtually all exposed bark. Epiphytes are conspicuous on many

of the trees. The larger trees may have slight trunk buttresses, and stems are seldom of good form. Deciduousness is not usually a character.

The montane bush is sometimes called "páramo", but is unlike the true páramos of South America. It is a dwarf open forest, which, while including many of the species of the mantane forest, has several shrubs peculiar to the site. The small trees and shrubs have a spreading habit, usually with rounded crowns. They vary from shoulder high to 30 feet tall. Small meadows are scattered about, which may contain woody or herbaceous grasses and sedges. Leaves are usually microphyllous and leathery, with a thick cuticle. There is no real stratification, although the ground may be covered by an herbaceous growth. Vines and scrambling climbers are present, as are epiphytic lichens. Sample hydrothermographs are given in Fig. 5.

Included among the association descriptions is the edaphic Puya dasylirioides - Lomaria wercklei bog. Although there is little change in its composition from the high peaks to the 2300 meter lower limit of its area, the essentially montane species list should warrant its inclusion in this formation.

I. The Buddleja alpina - Escallonia poasana Association

The montane wet slopes of Irazú and Turrialba

The montane wet slopes of Iraz and Turrialba

I. The Buddleja alpina - Escallonia pterocarpa association

The montane dwarf forest, which, while including many of the species of the montane forest, has several shrubs peculiar to the site. The small trees and shrubs have a spreading habit, usually with rounded crowns. They vary from shoulder high to 20 feet tall. Small meadows are scattered about, which may contain woody or herbaceous grasses and sedges. Leaves are usually microphyllous and leathery, with a thick cuticle. There is no real stratification, although the ground may be covered by an herbaceous growth. Vines and scrambling climbers are present, as are epiphytic lichens. Sample hygrotherographs are given in Fig. 3.

Included among the association descriptions is the edaphic Pinus daphniphoides - Lomatia weberbaueri bog. Although there is little change in its composition from the high peaks to the 2900 meter lower limit of its area, the essentially montane species list should warrant its inclusion in this formation.

The montane moist slopes of Irazú and Turrialba

volcanoes are separated by several miles of elevations lower than 2900 meters, but the plant growth is strikingly similar. Quercus costaricensis is the only common large tree not observed in both forests. Buddleja and Escallonia are rather small trees, neither exceeding fifty feet in height, but together they compose about fifty percent of the stand. Since there is hardly any virgin growth in existance within the limits of the association, it is considered that the two trees which are to be found in all its parts best characterize the forest. Other trees of like size share the dominant layer, which, except in favorable places, hardly exceeds forty feet. There is a shrubby understory and scattered ground cover.

Virtually all of the original area of the association is utilized for grazing, the volcanic soils and misty climate supporting a fine evergreen pasture for pure-bred dairy herds. The land is good and reforestation should never be necessary.

Buddleja alpina Oerst. - Loganaceae - "salvia"

Escallonia poasana D.Sm. - Saxafragaceae

Lippia sp. undet. - Verbenaceae - "salvia"

Oreopanax xalapense (HBK) Dcne.& Pl. - Araliaceae

Quercus costaricensis Liebm. - Fagaceae - "encino"

volcanoes are so [illegible] vast and
lower than [illegible]
[illegible]
[illegible] large trees [illegible]
[illegible]
Fifty feet [illegible]
fifty percent [illegible]
[illegible]
as columns, it is [illegible]
[illegible]
[illegible]
[illegible] forty feet. There is [illegible]
toned ground cover.

Virtually all of [illegible]
ation is utilized for [illegible] the volcanic soil [illegible]
[illegible] climate [illegible] evergreen pasture for
pure-bred dairy herds. [illegible] land is good [illegible]
than she had never [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Weinmannia pinnata L. - Cunoniaceae

Understory trees, less than 40 feet.

Didymopanax pittieri March. - Araliaceae

Garrya lavrifolia Hartweg. - Garryaceae

Holodiscus argenteus (L.F.)Maxim - Rosaceae

Ilex vulcanicola Standl. - Aquifoliaceae

Miconia bipullifera Cogn. - Melastomaceae

Myrica pubescens Willd. - Myricaceae

Myrtus oerstedii(Berg) Hemsl. - Myrtaceae

Rapanea pittieri Mez - Myrsinaceae

Vaccinium consanguineum Klotzsch. - Ericaceae

2. The Weinmannia pinnata - Quercus costaricensis Association

On the high windward slopes of Cerro las Vueltas and Cerro de la Muerte, as well as on the crest of the ridge which connects them, is the montane wet forest which is deminated by Weinmannia pinnata and Quercus costaricensis. Areas in which there are virtually pure stands of Weinmannia alternate with places in which oak is completely dominant, but over most of the association there is a mixture of the two. It is the most open of the Reventazon area forests, the trees hardly touching one another. In favorable sites the forest may be 80 feet tall, but is usually less. There are several trees which share the dominant layer with Weinmannia and

Weinmannia pinnata L. - Cunoniaceae

Understory trees, less than 40 feet.

Didymopanax pittieri March. - Araliaceae

Cestrum lanatifolia Hartweg. - Solanaceae

Miconia argentea (L.f.) Naxim - Rosaceae

Ilex vulcanicola Steyerl. - Aquifoliaceae

Miconia diphyllifera Cogn. - Melastomaceae

Myrica pubescens Willd. - Myricaceae

Myrtus oerstedii(Berg) Kausel. - Myrtaceae

Rapanea pittieri Mez - Myrsinaceae

Vaccinium consanguineum Klotzsch. - Ericaceae

2. The Weinmannia pinnata - Juercus costaricensis Association

On the high windward slopes of Cerro las Vueltas and Cerro de la Muerte, as well as on the crest of the ridge which connects them, is the montane wet forest which is dominated by Weinmannia pinnata and Juercus costaricensis. Areas in which there are virtually pure stands of Weinmannia alternate with places in which oak is completely dominant, but over most of the association there is a mixture of the two. It is the most open of the Nevontazon area forests, the trees hardly touching one another. In favorable sites the forest may be 80 feet tall, but is usually less. There are several trees which share the dominant layer with Weinmannia and

Quercus. There is an understory of varying height which is nowhere uniform, some of the species being those of the montane forests of the volcanic mountains to the north. The ground cover is almost exclusively the bamboo, Chusquea.

The exploitation of this association dates from the building of the Panamerican Highway during World War II. To date it has furnished only wood to man, for the land supports but inferior pasture, and it is difficult to keep the bamboo under control after the forest is cut. It should be maintained in forest; if the native Podocarpus is not used for reforestation, other conifers should be attempted. The oak is at present serving as a source of charcoal, but probably grows too slowly for profitable reforestation work.

Dominants - 60 - 80 feet

Drimys winteri Forst. - Winteraceae

Podocarpus oleifolius Don. - Taxaceae - "cipresillo"

Podocappus standleyi Bucholtz - Taxaceae-"cipresillo"

Quercus costaricensis Liebm.-Fagaceae- "encina"

Weinmannia pinnata L.-? Cunoniaceae

Understory trees 20-40 feet

Buddleja alpina Oerst. - Loganaceae - "salvia"

Clusia sp. undet. - Guttiferae

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Quercus costaricensis Liebm.-Fagaceae- "encino"

Weinmannia pinnata L.-: Cunoniaceae

Understory trees 20-40 feet

Clusia sp. nudet. - Guttiferae

Rapanea alpina Mez. - Myrsinaceae - "salvia"

Cyathea sp. undet. - Cyatheaceae - "palma de helecho"

Didymopanax pittieri March - Araliaceae

Ilex pallida Standl. - Aquifoliaceae

Ocotea fuluescens Standl. & L. Wms. - Lauraceae

Oreopanax pycnocarpum D.Sm. - Araliaceae

Vaccinium consanguineum Klotzsch. - Ericaceae

Zanthoxylum chiriquinum Standl. - Rutaceae

3. The Chusquea subtessellata Association

The shrubby association which is found on Volcán Turrialba, Cerro las Vueltas, and the Cerro de la Muerte peaks, at elevations in excess of 3000 meters, is dominated by the shrubby bamboo, Chusquea subtessellata. Although the volcano and the Talamanca peaks are widely separated, the floras are remarkably similar, all but four of the commonest shrubs being found on both sites, namely: Monnina xalapensis, on Turrialba only, and a Vaccinium and two composites which are only on the southern mountains. The relative abundance of the various plants varies more than the floral composition, but Chusquea covers over fifty percen of the area on all three peaks. Other common shrubs are Vaccinium consanguineum, Myrtus oerstedii, and Pernettya coriacea.

It is unlikely that the association will ever be of great benefit to man, for although pastures can be

Gyrianea [illegible] - [illegible]aceae - "[illegible] de [illegible]"

[illegible] [illegible] [illegible] - [illegible]aceae

Ilex pallida Standl. - Aquifoliaceae

[illegible] [illegible] [illegible] - [illegible]aceae

[illegible] [illegible] [illegible] - [illegible]aceae

Vaccinium consanguineum Klotzsch. - Ericaceae

[illegible] [illegible] Standl. - [illegible]aceae

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It is unlikely that the association will ever be of great benefit to man, for since its pastures can be

established, they will never support large herds of animals. Forest trees from similar sites might make a satisfactory growth, but this must be tried before conclusions can be drawn. Maintenance of the present vegetation has a certain value for erosion and water control.

Dominant shrub

Chusquea subtessellata Hitch. - Graminae

Other shrubs

Buddleja alpina Oerst. - Loganaceae

Compositae, 2 gen.&sp. undet.

Escallonia poasana D. Sm. - Sakifragaceae

Eupatorium sp. undet. - Compositae

Hesperaomeles obovata (Pitt.) Standl. - Rosaceae

Hypericum silenoides Juss. - Guttiferae

Monnina xalapense HBK. - Polygalaceae

Myrica pubescens Willd. - Myricaceae

Myrtus oerstedii (Berg.) Hemsl. - Myrtaceae

Pernettya coriaceae Klotzsch. - Ericaceae

Vaccinium consanguineum Klotzsch. - Ericaceae

Vac. sp. undet.

1. The Puya dasylirioides - Lomaria wercklei Association

The Puya - Lomaria association is an edaphic one, occurring in bogs in at least two climatic belts, at

occultism in Java in the fourteenth century' as

que l'Y - Turning association in an era like one'

1. the rite des Pythagoras - Trinity Knowledge association

Ego. e . . et.

Vaccinal extent Trinity Concern. - to case e

Knowledge continue mineral. - Microcosm

Turning consciousness (con.) in ur. - Symbiose

Cipher Unbecoming wing. - Symbiosis

Formula only ends Ill. - Polyandrous

Trinity ecological fine. - Political

Real Knowledge objects (ref.) Young. - Jesus is

Virgin rule . Ine . - Polygamy

Beautiful Trinity r. ur. - Pythian Gods

Ideal", " e . a . m ct.

Buddhist writing (ers). - To arouse

Pythagoras Angeles at. -ot. - Feminine

Other sorts

Dominant cult

Trinity Knowledge is a point's value for occult and water control.

consciousness can be Fawn. Illumination of the Present satisfaction. Power, but this must be right notice animate. Power Gods from sufficient close life's Unite a establish. Ego will Power or Self Jane Gods of

altitudes varying from 2300 to 3400 meters. The basic habitat is a filled lake, and the association is part of the hydroseric succession. The Panamerican Highway passes close by several of the bogs, which dot the Talamanca Range. There is no comparable habitat on the volcanic mountains to the north. Three of the bogs are to be found within the limits of Vicente Lachner Park, a ten hectare plot which will be preserved in natural vegetation.

The association is supported on a soggy mat of Sphagnum mosses into which one slowly sinks if standing still. The vegetation is largely herbaceous, and is generally less than knee high (Fig.). The most striking common plants are Puya dasylirioides and Lomaria wercklei. The former is a terrestrial bromeliad not unlike a pineapple; the inflorescence, in shape like a mullein stalk, rising to over eight feet in some specimens. Puya flowers once, then dies. Lomaria is an arborescent fern to eight feet tall, which is so similar in form to cycads as to cause botanists to marvel (Stanley, 1936). The small bamboo Chusquea subtessellata is the only other common plant over three feet high. Among the lower growth may be found various herbs and shrubs, as Xyris mexicana, Hypericum strictum, Carex purdeyi, and Pernettya coriacea. Around the borders of the association may be found such montane shrubs and

of the association may be formed from mere shrubs and
Juncus, and *Leucothoë* seedlings. Around the borders
shrubs, as *Myrica* seedlings, *Myrsine africana*, *Osmanthus*
among the lower growth may be found various herbs and
is the only common plant over three feet high.
(Stanley, 1932). The small bamboo *Arundinaria subspathulata*
in form to evade as to cause botanists to marvel
arborescent fern to eight feet tall, which is so similar
specimens. *Lycopodium* flowers once, then dies. *Dicranopteris*
million stalk, rising to over eight feet in some
like a pinnapple; the inflorescence, in shape like a
wercklei. The former is a xerophytic bromeliad not un-
ing common plants are *Lycopodium* and *Dicranopteris*
generally less than knee high (Fig.). The most strik-
Sphagnum masses into which one slowly sinks if standing
still. The vegetation is largely herbaceous, and is
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small trees as Escallonia poasana, Hesperomeles obovata, Myrtus oerstedii, Hypericum silenoides, and Vaceinium consanguineum, from which there is an abrupt transition to tall forest. On the eastern side of the higher mountains of the Talamanca Range the association grows on slopes, which, however, have excessive surface water. In the higher meadows the addition of shrubby compositae is notable. The sites are unproductive to man, but drainage might convert the land to pasture.

Dominants

Lomaria wercklei Christ. - Polypodiaceae

Puya dasylirioides Standl. - Bromeliaceae

Other shrubs

Chusquea subtessellata Hitche. - Graminae "canuela"

Escallonia poasana D.Sm. - Saxafraceae

Hesperomeles obovata (Pitt.)Standl. - Rosaceae

Hypericum silenoides Juss. - Guttiferae

Hyp. strictum HBK. - Guttiferae

Myrtus oerstedii Mee - Myrtaceae

Pernettya coriacea Klotzgch Ericaceae

Vaccinium consanguineum Klotzsch. - Ericaceae

Unidentified Compositae (2 species)

small trees as Vaccinium vacillans, Leucothoe editorum, Myrica cerifera, Hypericum aethiopicum, and Vaccinium corymbosum, from which there is an abrupt transition to tall forest. On the eastern side of the higher mountains of the Catawba and the association grows on slopes, which, however, have excessive surface water. In the higher meadows the addition of simply composites is notable. The sites are unproductive to man, but drainage might convert the land to pasture.

Dominants

Lomaria werckloi Christ. - Polypodiaceae

Pinus caryiniotes Beauv. - Pinaceae

Minor shrubs

Chrysoma subsessiliflora Nuttall. - Vernonia "camosa"

Vaccinium vacillans T.Sm. - Ericaceae

Leucothoe editorum (Nuttall). - Ericaceae

Myrica aethiopica Linn. - Myricaceae

Hypericum aethiopicum Linn. - Guttiferae

Pernettya coriacea Klotzsch Ericaceae

Pinus caryiniotes Loe - Pinaceae

Vaccinium corymbulosum Klotzsch. - Ericaceae

Unidentified Composita (2 species)

1. Montane Moist Formation

The montane moist formation occupies only a small area on the south west slope of Volcan Iraźu, in the upper portion of the rain shadow. There is no weather station in the climate, but readings are given of a week's weather on Iraźu and on the west slope of Cerro de la Muerte, which point is outside of the study area (Fig. 5). Cool, with an annual average temperature of between 6° and 12° C., and generally cloudy, the climate is rather unpleasant to man. Rainfall averages between 500 and 1000 mm. per year, with a well marked dry season and veranillo. The rain often falls in torents, but the number of rainy days is not too large. Fog is frequent, especially in the upper portions of the formation. Frost and ice are of common occurance.

The montane moist, like its wet counterpart, takes two forms, bush and forest, with exposure being the separation factor. The forest is one of medium height, 70 to 90 feet being the usual canopy layer. There are two understories, one at 35-45 feet, and a lower one at 5-15 feet. Herbaceous ground cover is rare. The dominants have spreading crowns which touch, but light freely penetrates the canopy. Trunks are not buttressed and of fair to poor form. Mistle-

1. Montane moist formation

The montane moist formation occupies only a small area on the south west slope of Volcan Irazú, in the upper portion of the rain shadow. There is no weather station in the climate, but readings are given of a week's weather on Irazú and on the west slope of Cerro de la Muerte, which point is outside of the study area (Fig. 5). Cool, with an annual average temperature of between 6° and 12° C., and generally cloudy, the climate is rather unpleasant to man. Rainfall averages between 500 and 1000 mm. per year, with a well marked dry season and veranillo. The rain often falls in torrents, but the number of rainy days is not too large. Fog is frequent, especially in the upper portions of the formation. Frost and ice are of common occurrence.

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toes are present, but not vines or vascular epiphytes.

The montane moist bush varies from thick scrub over thirty feet high down to head high in exposed situations. Meadows may be interspersed according to topography. Individual plants are woody, with few to many twisted stems and microphyllous foliage. Semi-woody or herbaceous vines may be present, but epiphytes are limited to mosses and lichens. Herbaceous plants cover the ground between the more or less widely spaced woody plants, but there is no true stratification.

1. The Quercus costaricensis Association

The forests which exist in the upper portion of the Irazu rain shadow, from the 2700 meter contour to just below the highest volcanic ridges, are completely dominated by the black oak, Quercus costaricensis. The forests are now largely destroyed, but many trees remain in the pastures, and there is a 200 manzana reserve, owned by the city of Cartago, which is set aside as a water catchment basin.

The forest is moderately tall, from 60 to 90 feet; and the dominants form a virtually continuous canopy, but much light strikes through the foliage. A sparse understory, composed of a small number of trees and shrubs, is nowhere uniform, and may be completely ab-

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cover the ground between the more or less widely spaced
woody plants, but there is no true stratification.

1. The Lucrous costaricensis association

The forests which exist in the upper portion of
the Irazú rain shadow, from the 2,500 meter contour to
just below the highest volcanic ridges, are completely
dominated by the black oak, Quercus costaricensis. The
forests are now largely destroyed, but many trees re-
main in the pastures, and there is a 500 hectare re-
serve, owned by the city of Cartago, which is set a-
side as a water catchment basin.

The forest is moderately tall, from 60 to 90 feet;
but much lit bit strikes through the foliage. A sparse
and the dominants form a virtually continuous canopy,
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side as a water catchment basin.

The forest is moderately tall, from 60 to 90 feet;

sent in places. Stream beds have a more dense, shrubby growth lining their banks. The flora is richest at the borders of the association, but, even so, is poor in species. Little ground cover is present. A transect is given in Fig. 11.

Dairy pasture is virtually the only farming practised, although some attempt is made to grow potatoes. The rigor of the dry season forces the use of inferior grasses and sedges as pasture, and it is probable that irrigation will be used in the future. Much of the area at the headwaters of the Rió Reventado should be reforested in order to prevent repetitions of the Cartagó Flood of 1951, for overcutting of timber has created a water control problem. Native hardwood, such as "jaúl"(Alnus acuminata), or an imported conifer, such as the Guatemalan Pinus ayacahuite, could be employed for the purpose.

Dominant 60-90 feet

Quercus costaricensis Liebm. - Fagaceae "encino"

Understory 15-30 feet

Buddleja alpina Oerst. - Loganiaceae "salvia"

Eurya seemanniana Pittier - Theaceae

Garrya lauriflora Hartweg - Garryaceae

Hesperomeles obovata (Pitt.)St andl. - Rosaceae

Hesperomeles obovata (Pitt.)Lt amat. - Rosaceae

Garrya laurifolia Hartweg - Garryaceae

Rubus ecomamiana Pittier - Rosaceae

Buddleja alpina Cerat. - Loganiaceae "salvia"

Understory 15-20 feet

Quercus costaricensis Liebm. - Fagaceae "encino"

Dominant 60-90 feet

such as the Guatemalan Pinus oocarpa, could be employed for the purpose.

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sent in places. Stream beds have a more dense, shrubby

Mahonia paniculata Oerst. - Berberidaceae

"San Juan"

Miconia bipulliferg Cogn. - Melastomaceae

My rica pubescen s Willd; - Myricaceae

Myrtus oerstedii (Berg.)Hemsl. - Myrtaceae

Oreopanax xalapense (HBK)Dene. & Pl. - Araliaceae

Rapanea pittieri Mez - Myrsinaceae

Vaccinium consanguineum Klotzsch. - Ericaceae

Weinmannia pinnata L. - Cunoniaceae

2. The Arctostaphylos costaricensis - Vaccinium consanguineum Association

At the summit of Iraźu, and extending to outflung exposed ridges to the southwest and west of the crater rim, exists a low forest which is best typified by Arctostaphylos costaricensis and Vaccinium consanguineum. The soils are sandy or rocky ones of recent volcanic origin, with very rapid drainage. This excessive runoff is combined with the dessicating effects of wind and low atmospheric pressure to produce a physiologically dry habitat. The exposure factors become very pronounced on the crater rim and nearby ridges, where the vegetation is frequently lower than head high, with natural meadow areas interspersing the brush. (Figs. 12a & 12b).

Mahonia pamiculata Oerst. - Berberidaceae

"San Juan"

Miconia bipulliifera Cogn. - Melastomaceae

My rica phaseoen a Willd; - Myricaceae

Myrtus oerstedii (berg.)Hemsl. - Myrtaceae

Oreopanax xalapense (H.B.K.)Decne. & Pl. - Araliaceae

Rapanea pittieri Mez - Myrsinaceae

Vaccinium consanguineum Klotzsch. - Ericaceae

Weinmannia pinnata L. - Cunoniaceae

2. The Arctostaphylos costaricensis - Vaccinium consanguineum Association

At the summit of Irazú, and extending to outflung exposed ridges to the southwest and west of the crater rim, exists a low forest which is best typified by Arctostaphylos costaricensis and Vaccinium consanguineum. The soils are sandy or rocky ones of recent volcanic origin, with very rapid drainage. This excessive runoff is combined with the desiccating effects of wind and low atmospheric pressure to produce a physiologically dry habitat. The exposure factors become very pronounced on the crater rim and nearby ridges, where the vegetation is frequently lower than head high, with natural meadow areas interspersing the brush. (Tiep. 102 & Tab).

The greater part of the association lies above the 3300 meter contour, although it decends to 3000 meters on certain exposed ridges. Im 1941, large portions of the area were swept by fire, which has left the dead, whitened, gnarled trunks of Arctostaphylos above the now returning vegetation. The association extends to within the main crater, but that volcanic activity has killed the crater vegetation in the past is attested to by the whitened tree skeletons which remain. The association's lower border is a well marked tree line which defines the limits of this and the Quercus costaricensis Association, but the demarkation with the neighboring montane associations is not so clear.

The family Ericaceae is dominant in the association, A. costaricensis, V. consanguineum, Pernettya coriacea, and Gaultheria glandulifera all being abundant. Arctostaphylos is a squat, spreading tree with one to several stems which may attain a height of 25 feet and a trunk diameter of more than eighteen inches. The Vaccinium may become as tall, but is more slender and shrub-like. Timber classes of both are very poor; the stems being crooked and gnarled. The Gaultheria and Pernettya shrubs are seldom waist high, and are

The greater part of the association lies above the 3500 meter contour, although it descends to 3000 meters on certain exposed ridges. In 1911, large portions of the area were swept by fire, which has left the dead, whitened, gnarled trunks of Arctostaphylos above the now returning vegetation. The association extends to within the main crater, but that volcanic activity has killed the crater vegetation in the past is attested to by the whitened tree skeletons which remain. The association's lower border is a well marked tree line which defines the limits of this and the Quercus costaricensis Association, but the demarkation with the neighboring montane associations is not so clear.

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usually much less. Other shrubs, of several families; are common, but none attains a height much greater than six to ten feet, even in protected places. Grasses are everywhere, the most striking of which is the bamboo, Chusquea subtesselIata, which forms clumps several feet in diameter, with individual canes becoming twelve feet tall. Other herbaceous or semi-woody growth consists to a large degree of composites and European weeds which were introduced in seed lots of pasture grasses.

The association furnishes little of direct value to man, since the nature of the trees precludes a large wood crop, and edaphic factors prevent utilization as pasture. The upper slopes should be kept in a wooded state as a wise conservation measure, and, since the crater of Irazu is a popular attraction, the woods are valuable from a recreational standpoint. If wood needs in the area become acute, doubtless the more sheltered sites would support conifers from similar habitats in Guatemala and Mexico.

Dominants

Arctostaphylos costaricensis Oerst. - Ericaceae

Vaccinium consanguineum Klotzsch - Ericaceae

Lower shrubs

Lower shrubs

Vaccinium consanguineum Klotzsch - Ericaceae

Arctostaphylos confertiflora Gerst. - Ericaceae

Dominants

habitats in Guatemala and Mexico.

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than six to ten feet, even in protected places. Grasses

are common, but more attains a height much greater

usually much less. Other shrubs, of several families;

Arc ytophyllum lavarum Schum. - Rubiaceae

Buddleja alpina Oerst. - Loganiaceae

Coriaria thymifolia H.& B.ɬ Coriariaceae

Chusquea subtessellata Hitchc. - Graminae

Eupatorium subcordatum Benth. - Compositae

Gaultheria glandulifera Sm. - Ericaceae

Hesperomeles obovata (Pitt.)Standl. - Rosaceae

Holodiscus argenteus (L.F.)Maxim - Rosaceae

Myrtus oerstedii (Berg.)Hemsl. - Myrtaceae

Pernettya coriacea Klotzsch. - Ericaceae

Rapanea pittieri Mez. - Myrsinaceae

These shrubs go by the general term "arrayan".

These shrubs do by the General Lora 'Strahan'.

Rapanea pittieri Mez. - Myrsinaceae

Fernettya corymbosa Klotzsch. - Ericaceae

Myrtus cornetdii (Berg.)Herel. - Myrtaceae

Melodinus angentens (...)Henk. - Rosaceae

Heaperomeles obovata (Pitt.)Urandl. - Rosaceae

Gaultheria clarkmilleri Dm. - Ericaceae

Eupatorium subcordatum Benth. - Compositae

Cyrtandra subtessellata Hitchc. - Gesneriaceae

Dorstenia thymifolia ...+ Moraceae

Muehlenbeckia platina (Endl.) - Polygonaceae

Ate Xtephanium laevum Bohm. - Rubiaceae

Summary

The Reventazón Valley, because of it's topographical features, has varied climates. On the basis of the Holdridge World Plant Formation Chart these are: Tropical Moist, Subtropical Rain, Subtropical Wet, Subtropical Moist, Lower Montane Rain, Lower Montane Wet, Lower Montane Moist, Montane Wet, and Montane Moist. The climate lines are the plant formation lines. The formations are subdivided into seventeen associations which are described, including plant lists, and mapped.

Sumario

La cuenca del río Reventazón, debido a la topografía, tiene climas variados. Con base en la Carta Mundial de Formaciones Vegetales de Holdridge éstos son: Tropical Húmedo, Subtropical Pluvial, Subtropical Muy Húmedo, Subtropical Húmedo. Montano Bajo Pluvial, Montano Bajo Muy Húmedo, Montano Bajo Húmedo, Montano Muy Húmedo, y Montano Húmedo. Los bordes climáticos son los mismos de las formaciones vegetales. Las formaciones se subdividen en diecisiete asociaciones, las cuales se describen, con listas de plantas, y se incluye en un mapa.

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Summario

La cuenca del río Reventazón, debido a la topografía, tiene climas variados. Con base en la Carta Mundial de Formaciones Vegetales de Holdridge éstos son: Tropical Húmedo, Subtropical Pluvial, Subtropical Muy Húmedo, Subtropical Húmedo, Montano Bajo Pluvial, Montano Bajo Muy Húmedo, Montano Bajo Húmedo, Montano Muy Húmedo, y Montano Húmedo. Los bordes climáticos son los mismos de las formaciones vegetales. Las formaciones se subdividen en dieciciete associaciones, las cuales se describen, con listas de plantas, y se incluye en un mapa.

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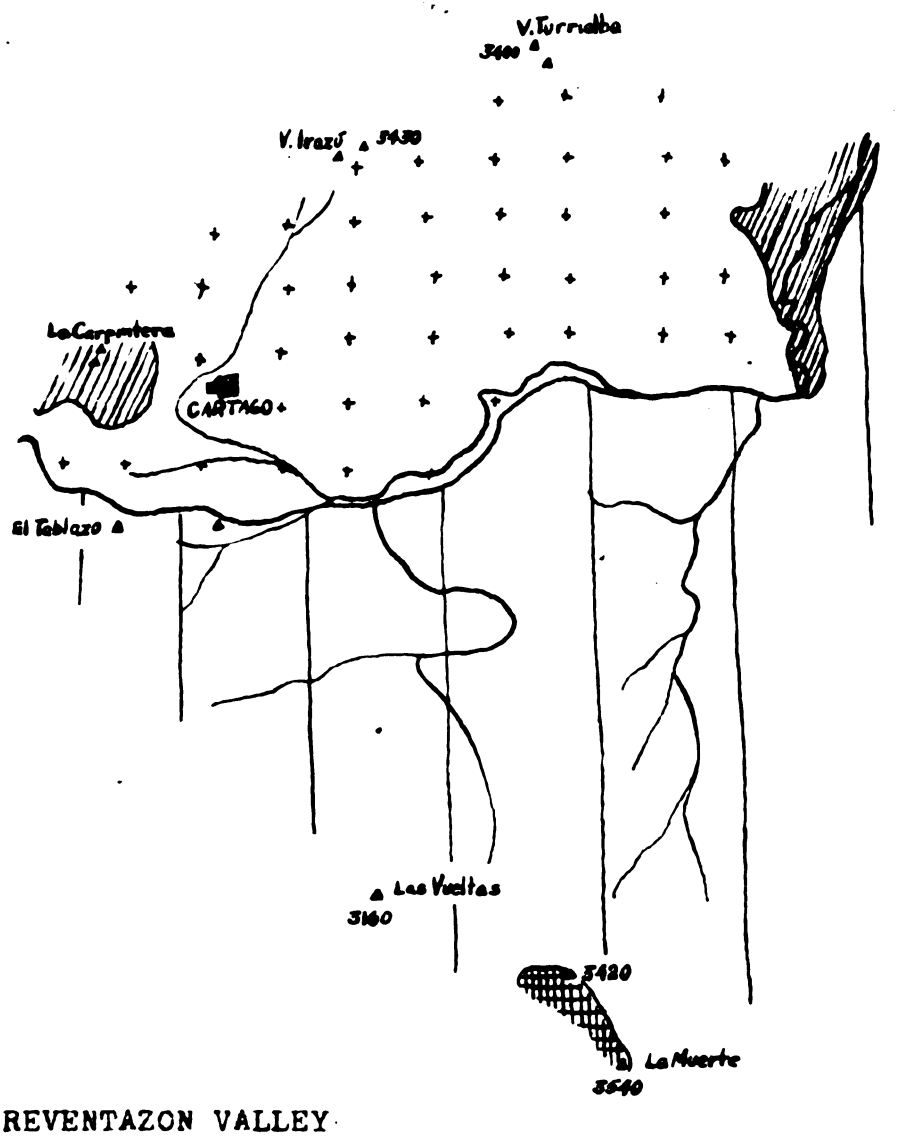
APPENDIX

APPENDIX.



REVENTAZON VALLEY
GEOLOGY AND SOIL ORIGIN MAP

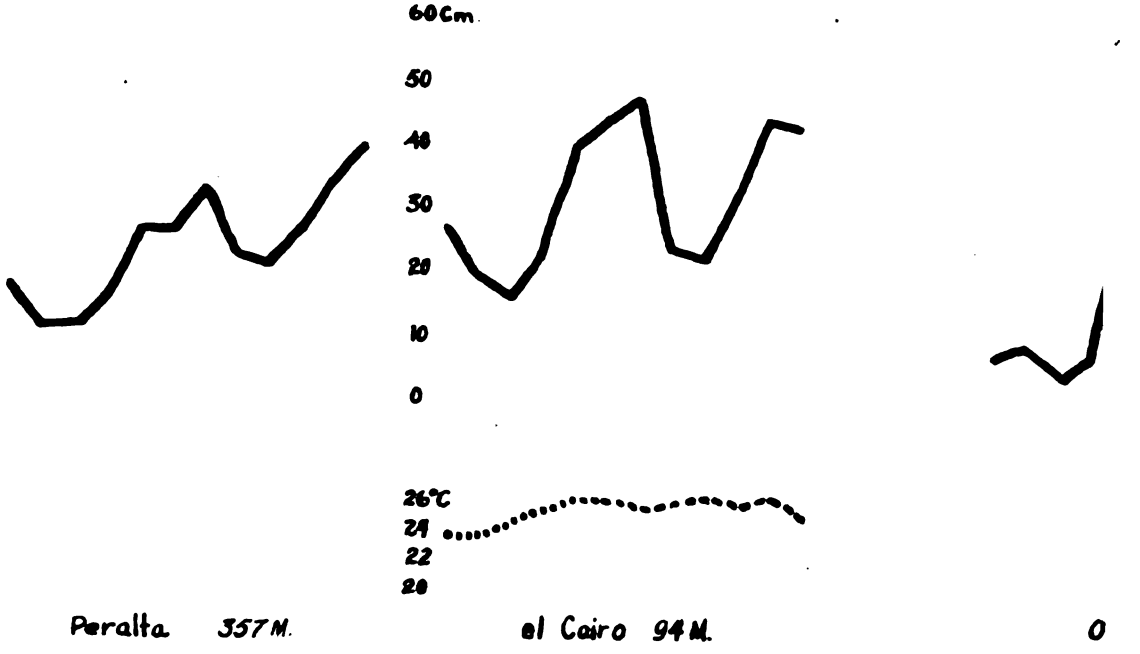
Recent volcanic soils and rocks

Oligocene conglomerate soils and rocks

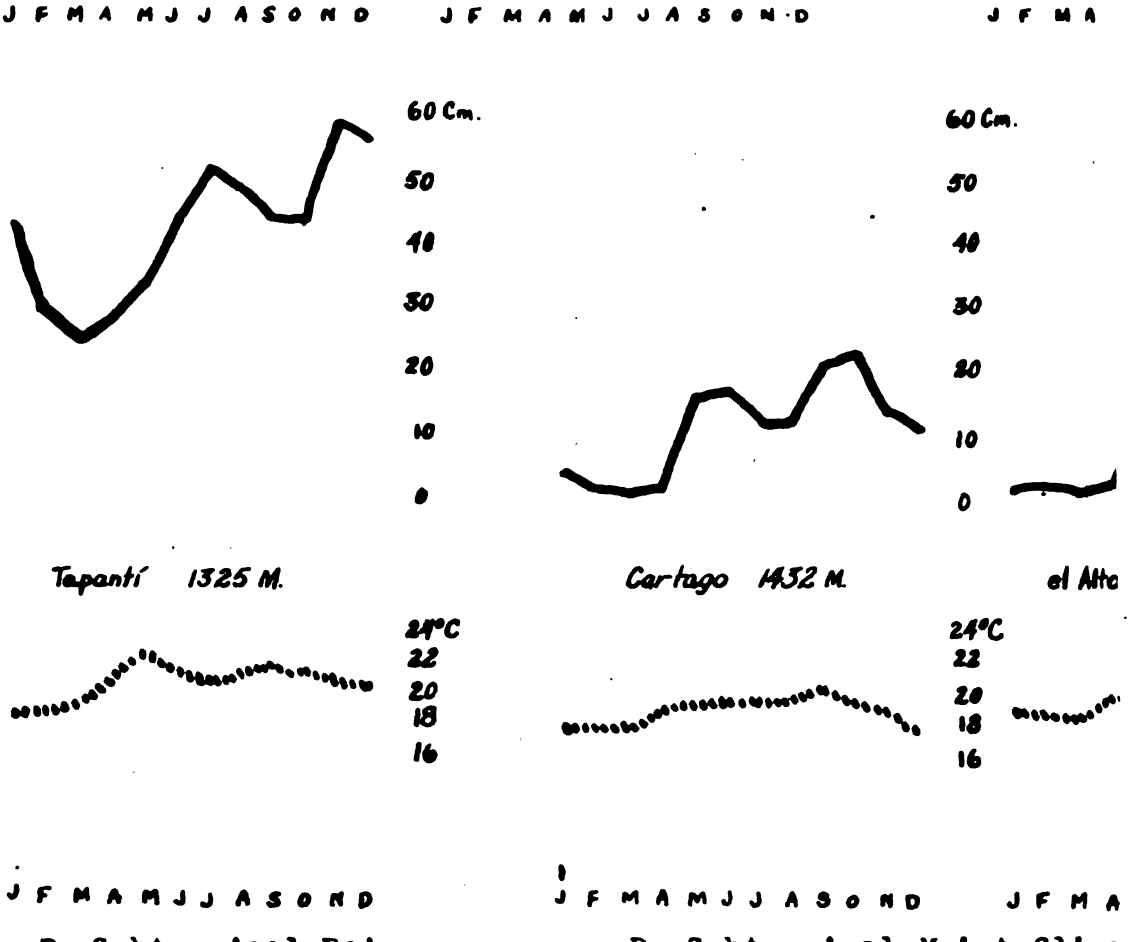
Intrusive basalts, schists, etc.

Miocene limestones soils and rocks

Fig. 1, Generalized geologic map.



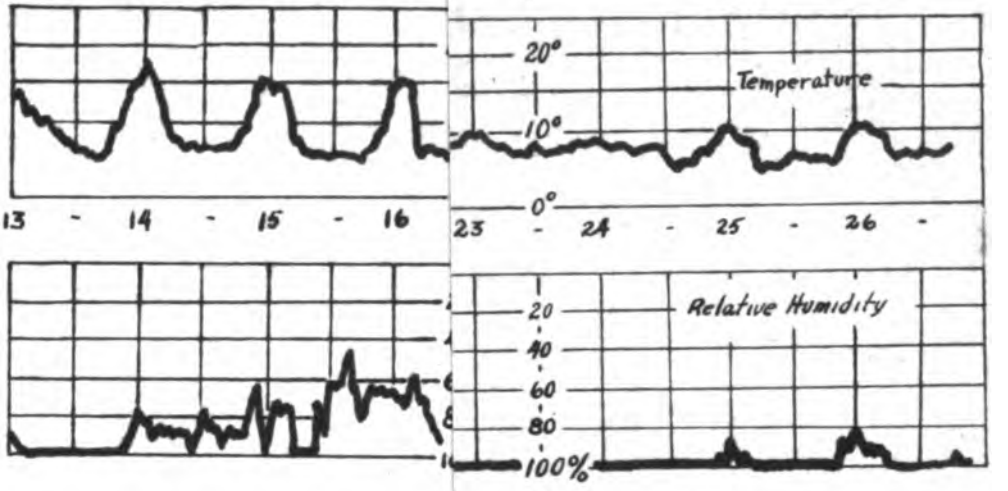
A. Tropical Moist Climate.



B. Subtropical Rain Climate

D. Subtropical Moist Clima

Fig.

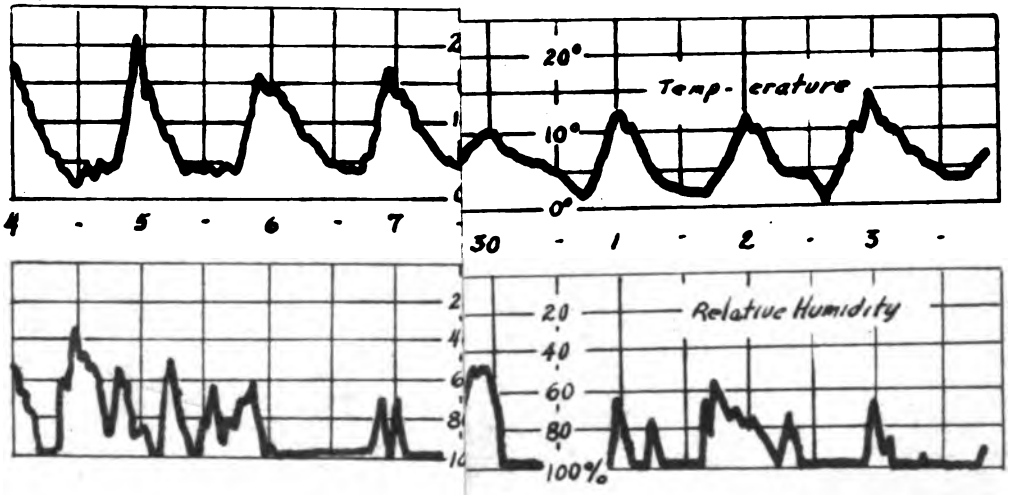


1951, NOV.

Above: SW slope of Irazú Irazú, 3400 M.

Below: West slope of Cer Cerro de la Muerte, 350 M.

Leeward Slopes d Slopes



1951, DEC.

Figure.

San José.

THE REVENTAZON VA

Highway

2 1 0 2

PLANT ASSOCI

Anacardium e
seemannii

Sideroxylon
Pachira a

Quercus gugl
Chaetopte

Cedrela mexi
sub-clima

Cedrela Tond

Conostegia x
Ilmoncello

Quercus corr
Guglielmi

51

THE REVE
DEMONST

PRINCIPAL HIGHWA

2 1 0 2

'PLANT

TROPICAL

premontan
SUBTROPI

SUBTROPI

SUBTROP

LOWER M

beis

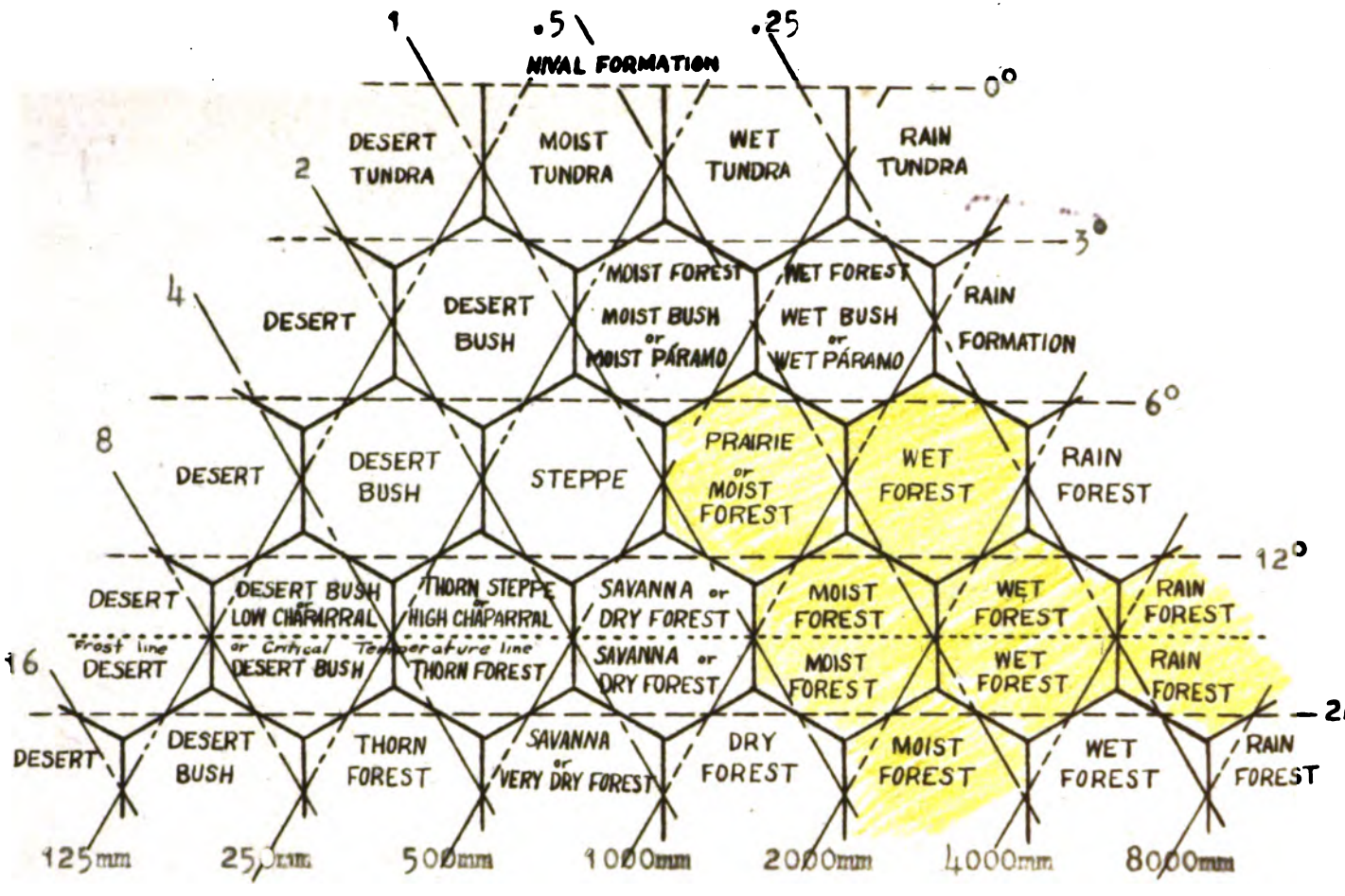
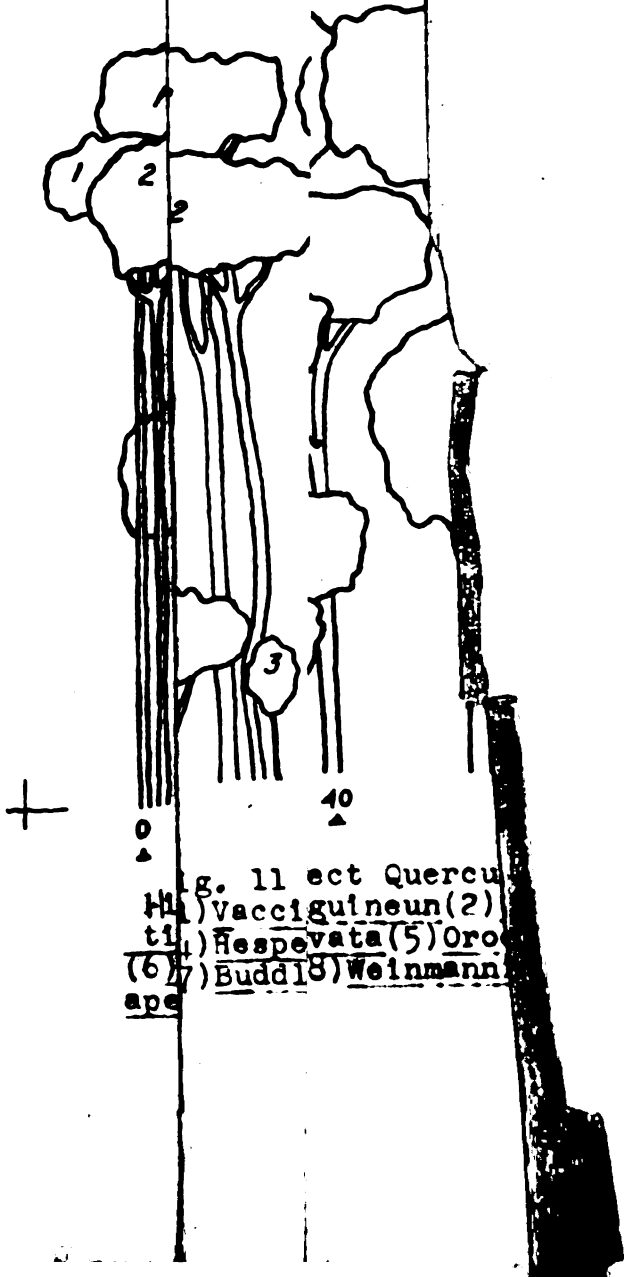


Fig.2. The Holdridge World Plant Formation Chart. Shading shows Reventazón Valley Climates.

essellata,
(8) Miconia sp?,
(14) Phoebe
lata,



g. 11 ect Quercu
1)Vacciguineun(2)
ti4)Aespevata(5)Oro
(6)7)Buddl8)Weinmann
ape

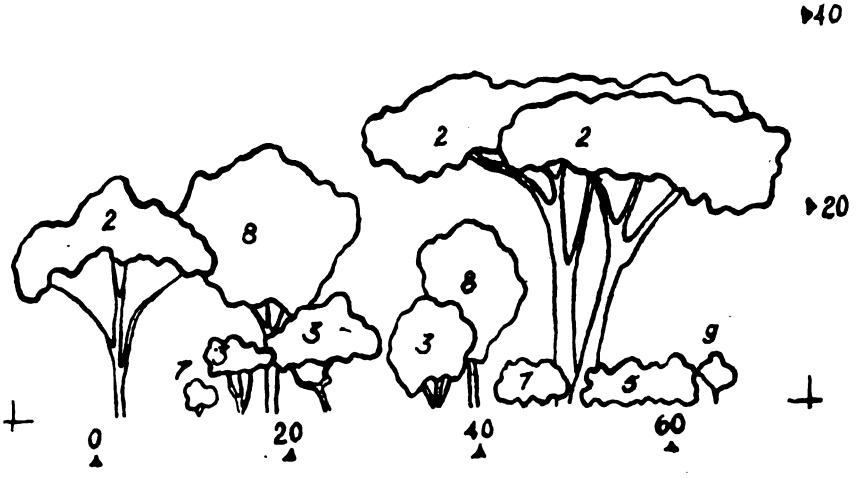


Fig. 12a Line transect Arctostaphylos-Vaccinium, montane moistbrush, Cartago Municipal Forest Reserve, Irazú

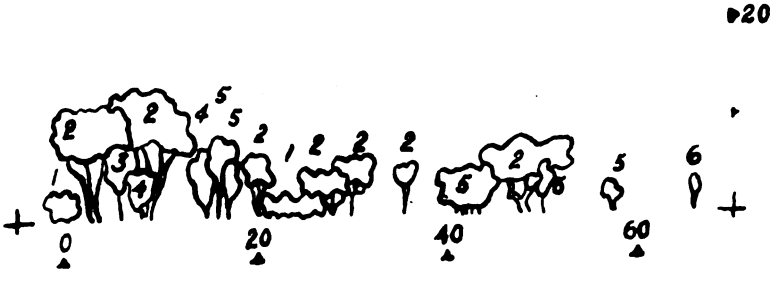


Fig. 12b Line transect montane moist brush, Irazú Volcano (1)Pernettya coriacea(2)Arctostaphylos costaricensis(3)Hesperomeles obovata (4)Hohodiscus argentia(5)Vaccinium consanguineum (6)Coriaria thymofolia(7)Bacharis sp.(8)Buddleja alpina(9)Eupatorium subcordatum

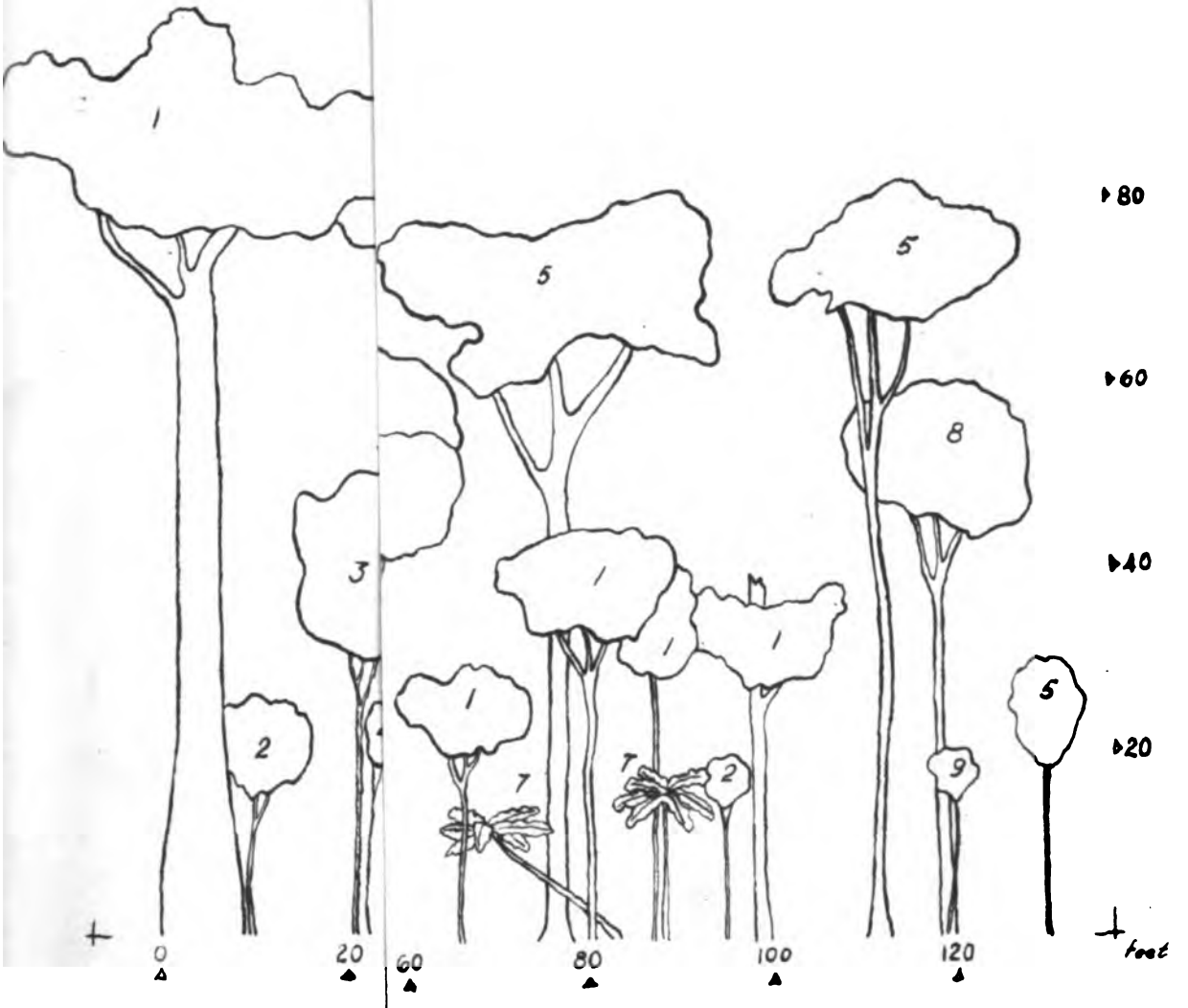


Fig. 13. Lin wet forest, Cerro Las Vueltas. (1) Anacardium ex um chiriquinum (3) Didymopanax pittieri (4) Trichilia rcus costaricensis (6) Vaccinium consang- tandra glabre interi (9) Clusia sp. Eugenia sp. (1 chiriquiensis intermedia (17

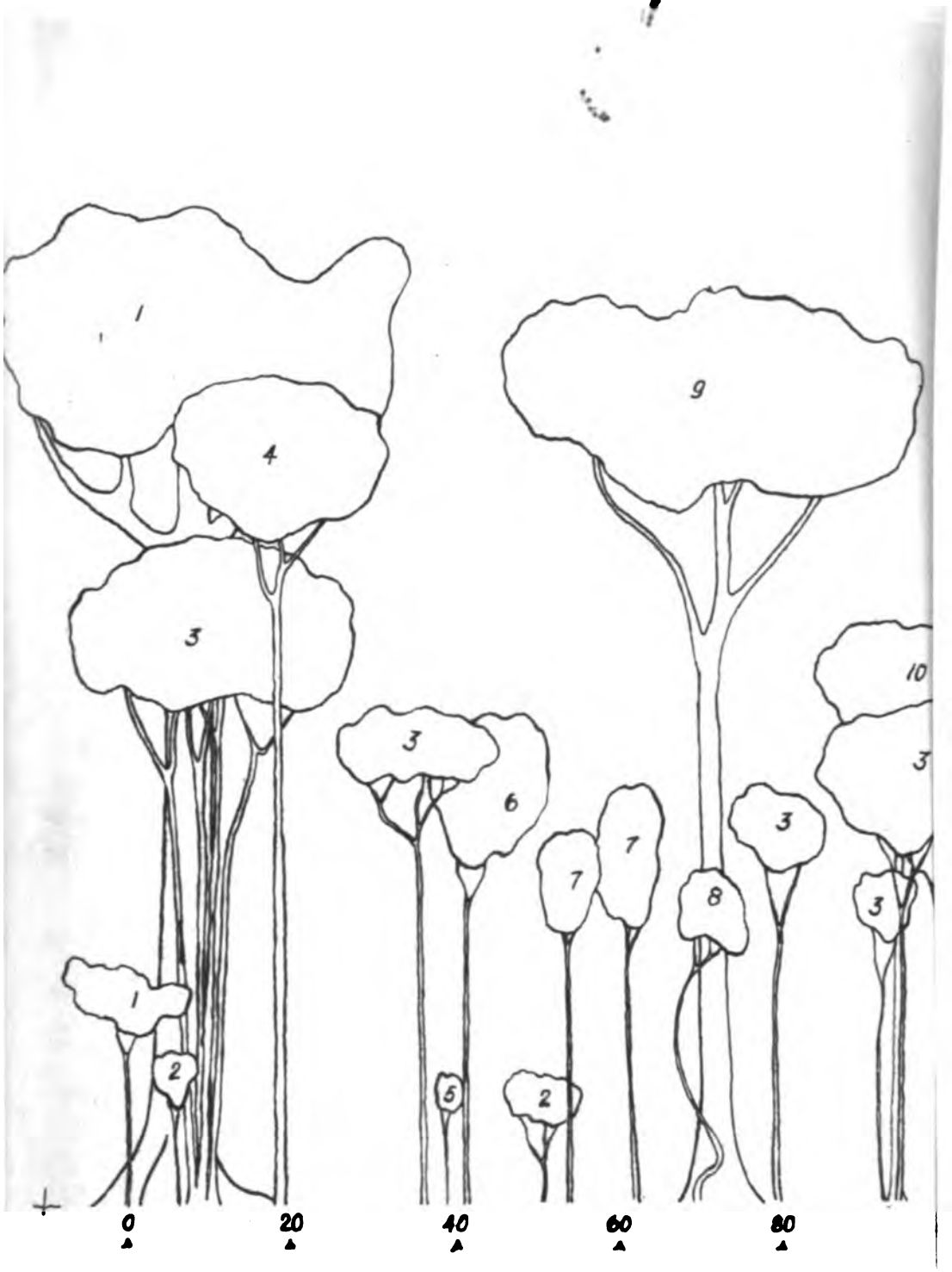


Fig. 15. Lower montane rain forest, Quercus corru
treleasi Association; transect above Tapanti. (1)
sp.(3)undet."gavulin"(4)Ocotea austinii(5)Inga tor
aceae"ira rosa"(7)undet. "lechillo"(8)Eugenia sp.
leasi(10)Eugenia sp."guayabillo"(11)undet. Laurace
(12)undet. "ratón papo"(13)"sangre toro", undet.
"ira quina".

Left: Lower montane rain forest, Ocotea austinii Association. The omniprocent clouds obscure the tops of the dominant Ocotea.

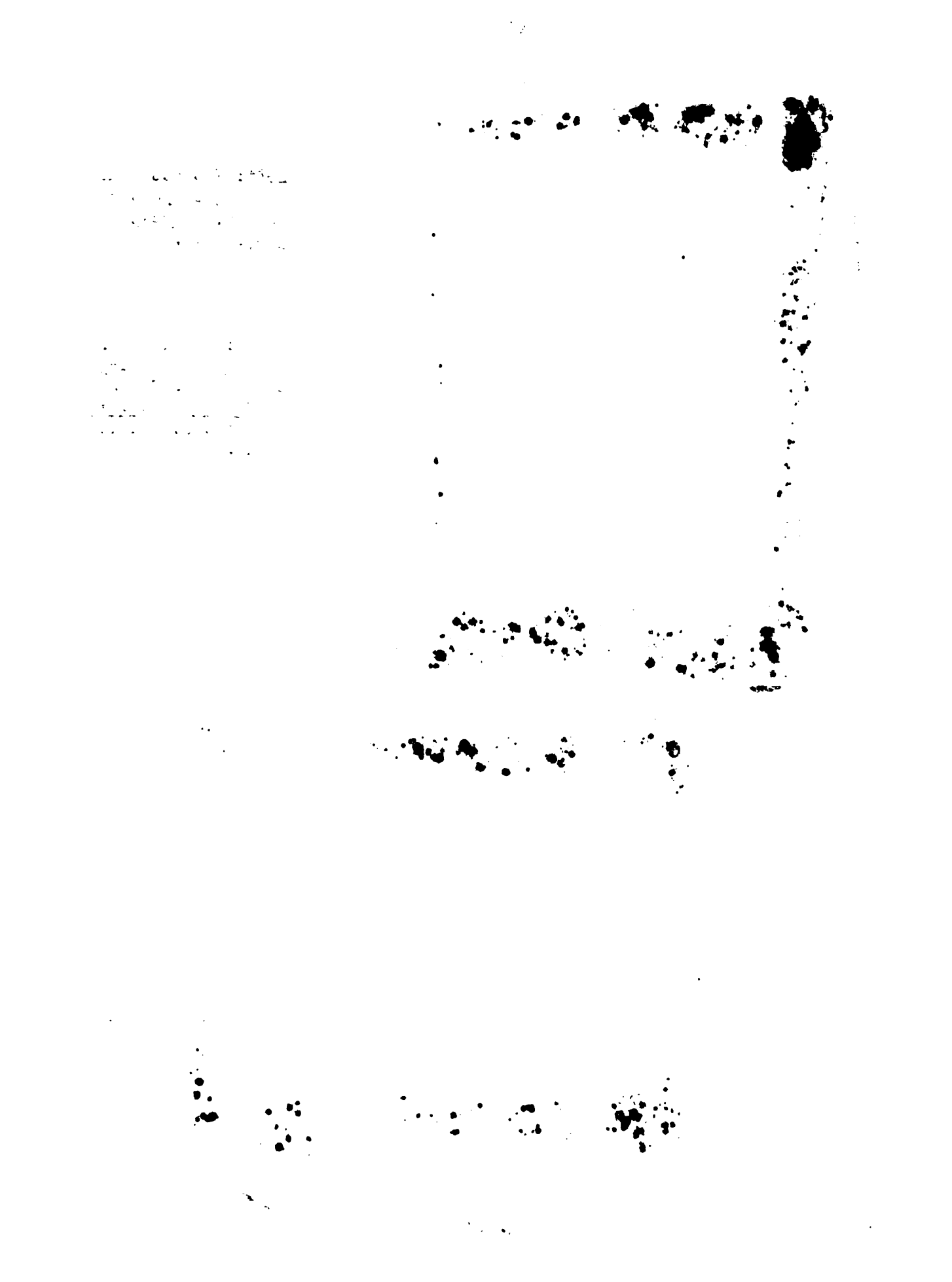
Right: Lower montane wet forest, Quercus tomentocaulis-Cornus disciflora Association. The tallest tree is Sideroxylon Capiri.

Fig. 16

Left: Isolated oaks showing epiphytic growth, Quercus copeyensis.

Below: Trunk of Q. copeyensis showing buttresses. The bamboo is Chusquea Tenduzii, the most common undershrub.

Fig. 17



Left: View of forest from pasture, Quercus adata-Q. yoroensis association, Eurya theoides in foreground, oaks in rear.

Below: View inside the same forest, (Left) Q. yoroensis, (Right) Fuchsia arborescens. The open character of the forest shows to advantage in this and in figure 19 (below).

Fig. 18

Left: Upper branches of Q. adsta showing absence of epiphytes.

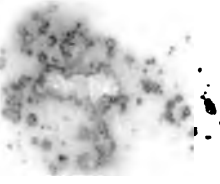
Right: Trunk of Q. adsta

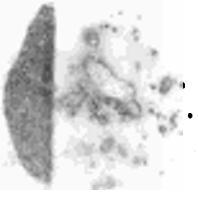
Fig. 19

Above: Interior of Podocarpus oleifolius-Weinmannia wercklei swamp forest, showing typical ground cover layer and spacing of trees.

Left: Lomaria wercklei

Fig. 20





Above: Puya-Lomaria bog, Parque Vicente Lachner. Puya dasylirioides in foreground, swamp forest in background.

Above: Chusquea subtessellata on Cerro de la Muerte.

Fig. 21

Above: _Ma-_ma-_ma-_ma_, _ma_ a _ma_-_ma_ _ma_, _ma_ a _ma_-_ma_ _ma_-
_ma_. _Ma_ a _ma_ _ma_ _ma_ _ma_ in _ma_-_ma_-_ma_, _ma_ _ma_
_ma_ in _ma_-_ma_-_ma_.

Above: Enhanced <u>subscripting</u> on terms in a
formula.

Appendix II

During the course of the investigation, a botanical collection of some 760 numbers was made. The specimens were taken in triplicate and sets are deposited in the herbaria of the I.I.C.A., Turrialba, Costa Rica; Escuela Agricola Panamericana, Zamorano, Honduras; and the University of Miami, Miami, Florida. Additional specimens of the genus Quercus are in the herbarium of the Santa Barbara Botanic Garden, Santa Barbara, California. The following represents the identified species in the collection. In the case of blank numbers, the material remains unidentified.

1.	Mollenidia costaricensis D.Sm.	I.I.C.A.	600m.
2.	Coriaria thymifolia H&B	Volcán Irazú	3400m.
3.	Arcytophyllum lavarum Schum.	"	"
4.	Myrtus Oerstedii (Berg) Hemsl.	"	"
5.	Eupatorium subcordatum Benth.	"	"
6.	Pernettia coriacea Kl.	"	"
7.	Rapanea Pittierii Mez	"	"
8.			
9.	Hypericum silenoides Juss.	"	"
10.	Trifolium dubium Sibth.	"	"
11.	Pernettia coriacea Kl.	"	"
12.	Vaccinium consanguineum Kl.	"	"
13.			
14.	Holodiscus argenteus (LF)Maxim	"	"
15.	Smilacina paniculata Mart. & Gal.	"	"
16.	Bomarea acutifolia (L&D) Herb.	"	"
17.	Arctostaphylos costaricensis (Sm)	"	"
18.	Castilleja irasuensis Oerst.	"	"
19.	Halenia rhyacophila Allen	"	"
20.	Rapanea ferruginea (R&P) Mez	Hedge rows a-	
21.	Cestrum aurantiacum Lindl.	bove Cartago	1600m.
22.	Malvaviscus arboreus	"	"
23.	Randia karstenii Polak.	"	"
24.	Eugenia lepidota f. corymbosa Berg.	"	"
25.	Aegiphila species	"	"
26.	Jussiaea peruviana L.	"	"
27.	Ficus padifolia HBK	"	"
28..	Sapium oligoneurum Schum & Pitt.	"	"
29.	Croton - probably a new species	"	"
30.	Psidium guajava L.	"	"
30a.	Acnistus arborescens (L) Schlecht.	"	"
31.	Cissus sicyoides L.	"	"
32.	Psidium guinense Swartz	"	"
33.	Lobelia laxiflora HBK	Sanatorio Durán	2300m.
34.			
35.	Leandra costaricensis Cogn.	"	"
36.	Monochaetum intermedium Gleason	"	"
37.	Rapanea pellucido-punctata (Oerst.) Mez	"	"
38.	Alnus acuminata HBK	"	"
39.	Malaxis	"	"
40.	Ardisia glandulosomarginata Oerst.	"	"
41.	Fuchsia arborescens Sims		

During the course of the investigation, a botanical collection of some 760 numbers was made. The specimens were taken in triplicate and sets are deposited in the herbaria of the I.I.C.A., Turrialba, Costa Rica; Escuela Agricola Panamericana, Zamorano, Honduras; and the University of Miami, Miami, Florida. Additional specimens of the genus Quercus are in the herbarium of the Santa Barbara Botanic Garden, Santa Barbara, California. The following represents the identified species in the collection. In the case of blank numbers, the material remains unidentified.

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4.	Myrtus Oerstedii (Berg) Hemsl.	"	"
5.	Eupatorium subcordatum Benth.	"	"
6.	Pernettia coriacea Kl.	"	"
7.	Jaqpanea Pittieri Mez	"	"
8.			
9.	Hypericum silenoides Juss.	"	"
10.	Trifolium dubium Sibth.	"	"
11.	Pernettia coriacea Kl.	"	"
12.	Vaccinium consanguineum Kl.	"	"
13.			
14.	Hoiodiscus argentea (LF)Maxim	"	"
15.	Smilacina paniculata Mert. & Gal.	"	"
16.	Bomarea acutifolia (Link) Herb.	"	"
17.	Arctostaphylos costaricensis (Sm)	"	"
18.	Castilleja irazuensis Oerst.	"	"
19.	Halenia rhyacophila Allen	"	"
20.	Rapanea ferruginea (R&P) Mez	Hedge rows a-	
21.	Cestrum aurantiacum Lindl.	bove Cartago	1600m.
22.	Malvaviscus Sporena	"	"
23.	Xandia karstenii Polak.	"	"
24.	Eugenia lepidota f. corymbosa Berg.	"	"
25.	Aegiphila species	"	"
26.	Juanlosa peruviana L.	"	"
27.	Ficus padifolia HBK	"	"
28.	Sapium oligonerum Schum & Pitt.	"	"
29.	Croton - probably a new species	"	"
30.	Paidium guajava L.	"	"
30a.	Aeniatus arboreacens (L) Schlecht.	"	"
31.	Cissus sicyoides L.	"	"
32.	Paidium guineense Swartz	"	"
33.	Lobelia laxiflora HBK	Sanatorio Durán	2300m.
34.			
35.	Leandra costaricensis Cogn.	"	"
36.	Monochaetum intermedium Gleason	"	"
37.	Rapanea pellucido-punctata (Oerst.) Mez	"	"
38.	Alnus acuminata HBK	"	"
39.	Melastomataceae	"	"
40.	Ardisia glandulosomarginata Oerst.	"	"
41.	Miconia arboreacens Sims	"	

43.	Peperomia cartagoana Trel.	"	"
44.	Rhamnus pubescens (R&P) Tr.& Pl.	"	"
45.	Ilex pallida Standl.	"	"
46.	Viola Mannei Polak.	"	"
47.	Eurya theoides (Sw) Blume	"	"
48.	Fuchsia microphylla HBK	"	"
49.	Botrychium	"	"
50.	Quercus adata Mull.	"	"
51.	Phoebe molleifolia Blake	"	"
52.			
53.	Cestrum dumetorum Schlecht.	"	"
54.	Rhacoma Tonduzii (Loes) Standl. & Steyerm.	"	"
55.	Oreopanax pychocarpum B.Sm.	"	"
56.	Pithecolebium costaricense (Britt & Rose) Standl.	Pacayas	1500m.
57.	Heliconia	"	"
58.	Zanthoxylem panamense P.Wilson	"	"
59.			
60.			
61.	Besleria solanoides HBK	"	"
62.	Besleria princeps Hemst	"	"
63.			
64.			
65.			
66.			
67.	Vismia ferruginea HBK	"	"
68.	Psychotria	"	"
69.	Psychotria cartaginensis Jacq.	"	"
70.			
71.			
72.			
73.	Conopholis americana (L) Wall	Sanatorio Durán	2300m.
74.	Vincetoxicum edule (Hemsl) Standl.	La Carpintera	1600m.
75.	Vincetoxicum rothschuhii (Schlt.) Standl.	"	"
76.			
77.	Peperomia	"	"
78.	Peperomia	"	"
79.	Peperomia	"	"
80.			
81.	Plurothallis	"	"
82.			
83.	Quercus copeyensis Mull.	La Chonta	2230m.
84.	Disterigma humboldtii (Klotz) Niedenzu	"	"
85.	Drimys winterii Forst.	"	"
86.			
87.	Psychotria Goldmannii Standl.	"	"
88.			
89.			
90.	Vaccinium consanguineum Kletzsch	"	"
91.	Zanthoxylum melanostictum Schl.& Cham.	"	"
92.	Peperomia	"	"
93.	Oxalis	"	"
94.	Palicourea hoffmami K.Schum.	"	"
95.	Quercus copeyensis Mull.	"	"
96.			
97.	Chusquea serrulata Pilger	"	"
98.	Styrax Warscewiczii Perkins	"	"
99.	Epidendrum	"	"
00.	Styrax Warscewiczii Perkins	"	"

	Sanatorio Durán	2300m.
Peperomia cartagoana Trel.	"	"
Rhamnus pubescens (R&P) Tr.& Pl.	"	"
Ilex pallida Standl.	"	"
Viola Nannei Polak.	"	"
Eurya theoides (Sw) Blume	"	"
Fuchsia microphylla HBK	"	"
Botrychium	"	"
Quercus ahata Mull.	"	"
Phoebe mollicella Blake	"	"
Cestrum dumetorum Schlecht.	"	"
Rhacoma Tonduzii (Loes) Standl. & Steyerm.	"	"
Oreopanax pycnocarpum D.Sm.	"	"
Pithecolobium costaricense (Britt & Rose) Standl.	Pacayas	1500m.
Heliconia	"	"
Zanthoxylum panamense P.Wilson	"	"
Besleria solanoides HBK	"	"
Besleria princeps Hanst	"	"
Vismia ferruginea HBK	"	"
Psychotria	"	"
Psychotria cartaginensis Sm.	"	"
Tournefortia [illegible] (L) [illegible]	Sanatorio Durán	2300m.
Vincetoxicum edule (Hemsl) Standl.	La Carpintera	1500m.
Vincetoxicum Rothschuhii (Schltr.) Standl.	"	"
Peperomia	"	"
Peperomia	"	"
Peperomia	"	"
Pleurothallis	"	"
Quercus copeyensis Mull.	La Chonta	2250m.
Disterigma humboldtii (Klotz) Niedenzu	"	"
Drimys winteri Forst.	"	"
Psychotria Goldmanii Standl.	"	"
Vaccinium consanguineum Klotzsch	"	"
Zanthoxylum melanostictum Schl.& Cham.	"	"
Peperomia	"	"
Oxalis	"	"
Palicourea Lehmanni K.Schum.	"	"
Quercus copeyensis Mull.	"	"
Chusquea [illegible] Pilger	"	"
Styrax Warscewiczii Perkins	"	"
Epidendrum	"	
Styrax Warscewiczii Perkins	"	

102.	Rhamnus pubescens (RAP) Tr.& Pl.	La Chonta	2230m.
103.	Smilacina paniculata Mart.& Gal.	"	"
104.			
105.	Weinmannia pinnata L.	"	"
106.	Viburnum costaricanum (Oerst.) Hemsl.	"	"
107.	Satyria Warscewiczii Klotzsch	"	"
108.	Ardisia iramuensis Oerst.	"	"
109.	Palicourea vestita Standl.	"	"
110.			
111.	Phoebe mollicella Blake	"	"
112.	Myrica pubescens Willd.	"	"
113.			
114.	Bomarea	"	"
115.	Brunellia costaricensis Standl.	"	"
116.	Vaccinium consanguineum Klotzsch	"	"
117.	Persea schiedeana Nees	"	"
118.	Symbolanthus pulcherrimus Gilg.	"	"
119.	Monnina sylvatica Schl.& Cham.	"	"
120.	Clusia Salvinii D.Sm.	Parque National	2100m.
121.	Quercus eugeniifolia Liebm.	"	"
122.	Vaccinium consanguineum Klotzsch	"	"
123.	" " "	"	"
124.	Pernettia coriacea Klotzsch	"	"
125.	Hesperomeles obovata (Pitt.) Standl.	"	"
126.	Bomarea	"	"
127.	Burmeistera obtusifolia Wimmer	"	"
128.			
129.	Clusia alata Planch.& Tr.	"	"
130.	Quercus (sterile)	"	"
131.	Hesperomeles obovata (Pitt) Standl.	"	"
132.			
133.	Fuchsia microphylla HBK	"	"
134.	Fuchsia arborescens Sims	"	"
135.	Cornus disciflora DC.	Sanatorio Durán	2330m.
136.	Quercus copeyensis Mull.	"	"
137.	Zanthoxylum melanostictum Schl.& Cham.	"	"
138.	Clusia	"	"
139.	Nectandra reticulata Standl.	"	"
140.	Viburnum costaricanum (Oerst.) Hemsl.	"	"
141.	Citharoxylem lankesteri Moldenke	"	"
142.	Quercus copeyensis Mull.	"	"
143.	bombee - unident.	"	"
144.	Styrax polyanthus Perkins	"	"
145.	Piper pellitiacule Trel.	"	"
146.	Styrax Warscewiczii Perkins	"	"
147.	Phoebe Pittieri Mez	"	"
148.	Erythrina rubrinervia HBK	"	"
149.	Psittacanthus schiedeanus (Schlect.& Cham.) Blume	"	"
150.			
151.	Salix chilensis Molina	"	"
152.	Persea americana Mill.	"	"
153.	Urera caracasana (Jacq.) Griseb.	"	"
154.	Oreopanax xalapensis (HBK)Done.& Pl.	"	"
155.		El Alto	1540m.
156.			
157.			
158.	Quercus tomentocaulis Mull.	"	"
159.	Quercus guglielmi-treleasei Mull.	-	-
160.			

Rhamnus purpurea (Rafn) Tr.& Pl.		La Conita 2230m.
Salicina pentandra Mert.& Zol.	"	"
Melampyrum pratense L.	"	"
Viburnum opulus (Oerst.) Hensl.	"	"
Satyria Parowskii Klotzsch	"	"
Ardisia crenulata Oerst.	"	"
Palicourea vestita Standl.	"	"
Thoebe mollicella Blake	"	"
Myrica pubescens Willd.	"	"
Rosaceae	"	"
Prunella corymbosa Standl.	"	"
Vaccinium consanguineum Klotzsch	"	"
Persea schiedeana Nees	"	"
Symplocarpus pulcherrimus Gilg.	"	"
Monnina sylvatica Schl.& Cham.	"	"
Clusia Salvinii D.Sm.		Parque Nacional 2100m.
Quercus cuspidifolia Liebm.	"	"
Vaccinium consanguineum Klotzsch	"	"
" " "	"	"
Pernettia corimbosa Klotzsch	"	"
Hesperomeles obovata (Pitt.) Standl.	"	"
Rosaceae	"	"
Pyrenaistera obtusifolia Wimmer	"	"
Clusia alata Planch.& Tr.	"	"
Quercus (sterile)	"	"
Hesperomeles obovata (Pitt) Standl.	"	"
Ficonia microphylla HBK	"	"
Tachia arborescens Sims	"	"
Cornus disciflora DC.		Sanatorio Durán 2330m.
Quercus copeyensis Muell.	"	"
Xanthoxylum melanostictum Schl.& Cham.	"	"
Clusia	"	"
Nectandra ramonensis Standl.	"	"
Viburnum costaricanum (Oerst.) Hemsl.	"	"
Citharexylum lankesteri Moldenke	"	"
Quercus copeyensis Muell.	"	"
bamboo - unident.	"	"
Styrax polyanthus Perkins	"	"
Piper pellitiacuio Trel.	"	"
Styrax Warscewiczii Perkins	"	"
Phoebe Pittieri Mez	"	"
Erythrina rubinervia HBK	"	"
Psittacanthus cochleocarpus (Schlecht.& Cham.) Blume	"	"
Salix chilensis Molina	"	"
Persea americana Mill.	"	"
Urera caracasana (Jacq.) Griseb.	"	"
Oreopanax xalapensis (HBK)Decne.& Pl.	"	"
		El Alto 1940m.
Quercus tomentocarpa Muell.	"	"
Quercus Pittieri-tolimensis Muell.	"	"

162.	Calliandra similis Sprague & Riley	El Alto	1540m.
163.	Annona cherimola Mill.	"	"
164.	Ficus	"	"
165.	Ardisia compressa HBK	"	"
166.	Psidium	"	"
167.	Zanthoxylum limoncello PL.& Oerst.	"	"
168.	Eugenia Pittieri Standl.	"	"
169.	Croton reflexifolius HBK	"	"
170.	Bumelia austin-smithii Standl.	"	"
171.	Eugenia costaricensis Berg.	"	"
172.	Phoebe mexicana Meish.	"	"
173.	Persea skutchii Allen	"	"
174.	Conostegia salapensis (Bompl.) Don	"	"
175.	Mimosa	"	"
176.	Hamelia patens Jacq.	"	"
177.	Quercus eugeniifolia Liebm.	"	"
178.	Trichilia havanensis Jacq.	"	"
179.	Hamelia	"	"
180.	Malaxis	"	"
181.	Croton	"	"
182.	Cupressus lusitanica Mill.	"	"
183.	Malpighia	"	"
184.		Parque National Vic.	2200m.
185.		Lachner	
186.	Rapanea ferruginea (R&P) Mez	"	"
187.	Quercus copeyonsis Mull.	"	"
188.	Quercus eugeniifolia Liebm.	"	"
189.	Myrtus oerstii (Berg) Hemsl.	"	"
190.	Hypericum	"	"
191.	Hypericum	"	"
192.			
193.	Escallonia poasana D.Sm.	"	"
194.	Styrax Warscewiczii Perkins	"	"
195.	Chusquea serrulata Pilger	"	"
196.	Hesperomeles obovata (Pittier) Standl.	"	"
197.	Carex purdiei Boott.	"	"
198.			
199.	Xyris mexicana Wats.	"	"
200.	Magnolia poasana (Pitt.) Dandy	"	"
201.			
202.	Lomaria werckiei Christ.	"	"
203.	Chamaedorea parvifolia Burret.	"	"
204.	Viburnum costaricanum (Oerst.) Hemsl.	"	"
205.	Podocarpus oleifolius Don	"	"
206.	Zinowiewia costaricensis Lundell	"	"
207.	Weinmannia werckiei Standl.	"	"
208.	Begonia luxii C.DC.	"	"
209.	Begonia		
210.	Podocarpus Standleyi Buchholtz	"	"
211.	Quercus alata Mull.	"	"
212.	orchid	"	"
213.	orchid - Masdavallia	"	"
214.			
215.	Carludovica iraxuensis Cuf.	"	"
216.			
217.			
218.	Ardisia minor Standl.	"	"
219.	Quercus eugeniafolia Liebm.		"

162.	Calliandra similis Sprague & Riley	Mt Alto	1540m
163.	Annona cherimolia Mill.	"	"
164.	Ficus	"	"
165.	Ardisia compressa HBK	"	"
166.	Psidium	"	"
167.	Zanthoxylum limoncello Pl.& Oerst.	"	"
168.	Eugenia pittieri Standl.	"	"
169.	Croton reflexifolius HBK	"	"
170.	Bumelia austin-smithii Standl.	"	"
171.	Eugenia costaricensis Berg.	"	"
172.	Phoebe mexicana Meisn.	"	"
173.	Persea skutchii Allen	"	"
174.	Conostegia salpensis (Bonpl.) Don	"	"
175.	Mimosa	"	"
176.	Hamelia patens Jacq.	"	"
177.	Quercus oxyphylla Liebm.	"	"
178.	Trichilia havanensis Jacq.	"	"
179.	Hamelia	"	"
180.	Malaxis	"	"
181.	Croton	"	"
182.	Cupressus lusitanica Mill.	"	"
183.	Malpighia	"	"
184.		Parque National Vic.	2200m.
185.		Lachner	
186.	Rapanea ferruginea (Ruiz & Pav.) Mez	"	"
187.	Quercus copeyensis Mull.	"	"
188.	Quercus oxyphylla Liebm.	"	"
189.	Myrtus cerasifolia (Berg) Hemsl.	"	"
190.	Hypericum	"	"
191.	Hypericum	"	"
192.			
193.	Escallonia poeppigiana D.Don.	"	"
194.	Styrax warscewiczii Perkins	"	"
195.	Quercus corrugata Hooker	"	"
196.	Hesperomeles obovata (Pittier) Standl.	"	"
197.	Carex purdiei Boott.	"	"
198.			
199.	Xyris mexicana Wats.	"	"
200.	Magnolia poeppigii (Pitt.) Dandy	"	"
201.			
202.	Lomaria werckleana Christ.	"	"
203.	Chamaedorea pinnatifolia Burret.	"	"
204.	Viburnum costaricanum (Oerst.) Hemsl.	"	"
205.	Podocarpus oleifolius Don	"	"
206.	Zinowiewia costaricensis Lundell	"	"
207.	Weinmannia werckleana Standl.	"	"
208.	Begonia luxii C.DC.	"	"
209.	Begonia	"	"
210.	Podocarpus standleyi Buchholtz	"	"
211.	Quercus sapotifolia Liebm.	"	"
212.	orchid	"	"
213.	orchid - Masdevallia	"	"
214.			
215.	Carludovica drudei Mast.	"	"
216.			
217.			
218.	Ardisia minor Standl.	"	"
219.	Quercus oxyphylla Liebm.	"	"
220.	Sobralia cattleya		

221.	Columnea hirta Kl.& Hanst.	La Lucha	1900m.
222.	Clidemia costaricensis Cogn.& Gleason	"	"
223.	Hillia Valerii Standl.	"	"
224.	Magnolia poasana (Pittier) Dandy	"	"
225.			
226.			
227.			
228.			
229.	Lauraceae (sterile)	"	"
230.	Melastome	"	"
231.	Lauraceae	"	"
232.	Melastome	"	"
233.	Clusia sp.	"	"
234.	Psychotria sp.(sterile)	"	"
235.			
236.	sterile bamboo	"	"
237.			
238.			
239.	Alnus acuminata HBK	"	"
240.	Miconia sp. (sterile)	"	"
241.			
242.	Lycopodium	"	"
243.			
244.		finca Llano Grande	2100m.
245.	Phoebe complifolia Mez & D.Sm.	"	"
246.			
247.	Croton xalapensis HBK	"	"
248.	Morus insignis Bureau	"	"
249.			
250.	Meliosma irazuensis Standl.	"	"
251.	Conostegia macrantha Berg.	"	"
252.	Rhamnus pubescens (R&P) Tr.& Pl.	"	"
253.	Perrottetia longistylis Rose	"	"
254.	Cedrela Tonduzii C.DC.	"	"
255.	Citharexylum	"	"
256.	Garrya laurifolia Hartw.	"	"
257.	Quercus semanii Liebm.	"	"
258.	Meliosma irazuensis Standl.	"	"
259.	Nectandra ramonensis Standl.	"	"
260.	Clethra panamensis Standl.& L.Wms.	"	"
261.	Nectandra Woodsoniana Allen	"	"
262.	Billia columbiana Planch.& Linden	finca Hnos. Cruz	2600m.
263.	Ilex lamprophylla Standl.	"	"
264.	Eupatorium araliaefolium Less.	"	"
265.	Buddleia sp. nov.	"	"
266.	Columnea hirta Kl.& Hanst.	"	"
267.			
268.			
269.			
270.	Lycopodium	"	"
271.	Cornus disciflora DC.	"	"
272.	Drimys winteri Forst.	"	"
273.			
274.	Viburnum costaricanum (Oerst.) Hemsl.	"	"
275.	Perrottetia longistylis Rose	"	"
276.	Morus insignis Bureau	"	"
277.			
278.	Magnolia poasana (Pitt.) Dandy	"	"
279.	Hieronyma guatemalensis D.Sm.		

221.	Columnea hirta K1.& Hanst.	La Lucha	1900m.
222.	Clidemia costaricensis Cogn.& Gleason	"	"
223.	Hillia Valerii Standl.	"	"
224.	Magnolia poasana (Pittier) Dandy	"	"
225.			
226.			
227.			
228.			
229.	Lauraceae (sterile)	"	"
230.	Melastome	"	"
231.	Lauraceae	"	"
232.	Melastome	"	"
233.	Clusia sp.	"	"
234.	Psychotria sp.(sterile)	"	"
235.			
236.	sterile bamboo	"	"
237.			
238.			
239.	Alnus acuminata HBK	"	"
240.	Miconia sp. (sterile)	"	"
241.			
242.	Lycopodium	"	"
243.			
244.		finca Llano Grande 2100m.	
245.	Phoebe cumpliifolia Mez & D.Sm.	"	"
246.			
247.	Croton xalapensis HBK	"	"
248.	Morus insignis Bureau	"	"
249.			
250.	Meliosma irazuensis Standl.	"	"
251.	Conostegia macrantha Berg.	"	"
252.	Rhamnus pubescens (R&P) Tr.& Pl.	"	"
253.	Perrottetia longistylis Rose	"	"
254.	Cedrela Tonduzii C.DC.	"	"
255.	Citharexylum	"	"
256.	Garrya laurifolia Hartw.	"	"
257.	Quercus seemanii Liebm.	"	"
258.	Meliosma irazuensis Standl.	"	"
259.	Nectandra ramonensis Standl.	"	"
260.	Clethra paramensis Standl.& L.Wms.	"	"
261.	Nectandra Woodsoniana Allen	"	"
262.	Billia columbiana Planch.& Linden	finca Hnos. Cruz	2600m.
263.	Ilex lamprophylla Standl.	"	"
264.	Eupatorium arellanoi Loes.	"	"
265.	Buddleia sp. nov.	"	"
266.	Columnea hirta K1.& Hanst.	"	"
267.			
268.			
269.			
270.	Lycopodium	"	"
271.	Cornus disciflora DC.	"	"
272.	Drimys winteri Forst.	"	"
273.			
274.	Viburnum costaricanum (Oerst.) Hemsl.	"	"
275.	Perrottetia longistylis Rose	"	"
276.	Morus insignis Bureau	"	"
277.			
278.	Magnolia poasana (Pitt.) Dandy	"	"
279.	Hieronyma quatemalensis D.Sm.	"	"

280.	Guarea breviantherа C.DC.	finca Hnos. Cruz	2600m.
281.	Eugenia Sterkii Standl.	"	"
282.	Clusia retundata Standl.	"	"
283.			
284.	Hieronyma guatemalensis D.Sm.	"	"
285.	Nectandra sp.	"	"
286.	Calyptranthes Pittieri Standl.	"	"
287.	Parathesis ?	"	"
288.	Brunellia costaricensis Standl.	"	"
289.			
290.			
291.			
292.	Buddleia alpina Oerst.	east slope V. Irazú	3000m.
293.	Solanum Sterkii Standl.	"	"
294.			
295.			
296.	sterile bamboo	"	"
297.	Melastome	"	"
298.	Vaccinium poasanum D.Sm.	"	"
299.	Miconia biperulifera Cogn.	"	"
300.	Ardisia pleurobotrya D.Sm.	"	"
301.			
302.	Gerrya laurifolia Hartw.	"	"
303.	Solanum irazuense Standl.& L.Wms. - sp. nov.	"	"
304.	Clethra Rearkii Standl.& L. Wms. - sp. nov.	"	"
305.			
306.	Ocotea Austinii Allen	"	"
307.	Quercus copeyensis Mull.	"	"
308.	Oreopanax	"	"
309.			
310.			
311.			
312.	Viburnum costaricanum (Oerst.) Hemsl.	"	"
313.	Adiantum	"	"
314.	Chusquea subtessellata Hitchc.	"	"
315.	Chusquea serrulata Pilger	"	"
316.	Viburnum costaricanum (Oerst.) Hemsl.	Quebrada Honda	1750m.
317.	Conostegia macrantha Berg.	"	"
318.	Billia columbiana Pl.& Linden	"	"
319.	Quercus tomentocaulis Mull.	"	"
320.	Citharexylum recurvatum Greenm.	"	"
321.	Pouteria chiricana (Standl.) Baehni ?	"	"
322.	Alfaroa costaricensis Standl.	"	"
323.	Pouteria chiricana (Standl.) Baehni ?	"	"
324.	Panopsis costaricensis Standl.	"	"
325.	Alchornea latifolia Swartz	"	"
326.	Rondeletia amoena (Planch.) Hemsl.	"	"
327.	Rondeletia buddleoides Benth.	"	"
328.	Clethra lanata Mart.& Gal.	"	"
329.	Hieronyma guatemalensis D.Sm.	"	"
330.	Ladenbergia brenesii Standl.	"	"
331.	Rhus striata R.& P.	"	"
332.	Rapanea ferruginea (R&P) Mez	"	"
333.	Inga - (sterile)	"	"
334.	Picramnia quaternaria D.Sm.	"	"
335.	Citronella costaricensis (D.Sm.) Howard	"	"
336.	Trichilia sp.	"	"
337.	Ilex sp. ?	"	"
338.	Eugenia sp. ?	"	"

280.	Guarea brevianthera C.DC.	"	Finca Hnos. Cruz 2600m.
281.	Eugenia Storkii Standl.	"	"
282.	Clusia rotundata Standl.	"	"
283.			
284.	Hieronyma guatemalensis D.Sm.	"	"
285.	Nectandra sp.	"	"
286.	Calyptranthes Pittieri Standl.	"	"
287.	Parathesis ?	"	"
288.	Prunellia costaricensis Standl.	"	"
289.			
290.			
291.			
292.	Buddleia alpina Oerst.	east slope V. Irazú 3000m.	
293.	Solanum Storkii Standl.	"	"
294.			
295.			
296.	sterile bamboo	"	"
297.	Melastome	"	"
298.	Vaccinium poasanum D.Sm.	"	"
299.	Miconia biperulifera Cogn.	"	"
300.	Ardisia plumbeifolia D.Sm.	"	"
301.			
302.	Garrya laurifolia Hartw.	"	"
303.	Solanum irazuense Standl.& L.Wms. - sp. nov.	"	"
304.	Clethra Pearcii Standl.& L. Wms. - sp. nov.	"	"
305.			
306.	Ocotea Austinii Allen	"	"
307.	Quercus copeyensis Mull.	"	"
308.	Oreopanax	"	"
309.			
310.			
311.			
312.	Viburnum costaricanum (Oerst.) Hemsl.	"	"
313.	Adiantum	"	"
314.	Cnemidaria subteserifolia Hitchc.	"	"
315.	Cnemidaria serrulata Pilger	"	"
316.	Viburnum costaricanum (Oerst.) Hemsl.	Quebrada Honda 1750m.	
317.	Conostegia macrantha Berg.	"	"
318.	Billia columbiana Pl.& Linden	"	"
319.	Quercus tomentocaulis Mull.	"	"
320.	Citharexylum recurvatum Greenm.	"	"
321.	Fouteria obtriciana (Standl.) Baehni ?	"	"
322.	Alfaroa costaricensis Standl.	"	"
323.	Fouteria obtriciana (Standl.) Baehni ?	"	"
324.	Panopsis costaricensis Standl.	"	"
325.	Alchornea latifolia Swartz	"	"
326.	Rondeletia amoena (Planch.) Hemsl.	"	"
327.	Rondeletia buddleoides Benth.	"	"
328.	Clethra lanata Mart.& Gal.	"	"
329.	Hieronyma guatemalensis D.Sm.	"	"
330.	Ladenbergia brenesii Standl.	"	"
331.	Rhus striata R.& P.	"	"
332.	Rapanea ferruginea (R&P) Mez	"	"
333.	Inga - (sterile)	"	"
334.	Picramnia quaternaria D.Sm.	"	"
335.	Citronella costaricensis (D.Sm.) Howard	"	"
336.	Trichilia sp.	"	"
337.	Ilex sp. ?	"	
338.	Eugenia sp. ?	"	

340.	Lippia Myrio cephala Schl. & Cham.	Quebrada Honda	1700m.
341.	Dendropanax arboreus (L.) Dcne.& Pl.	"	"
342.	Eugenia Storkii Standl.	S. slope V.Irazú	3000m.
343.	Ilex pallida Standl.	"	"
344.	Miconia bipedilifera Cogn.	"	"
345.			
346.	Vaccinium consanguineum Klotzsch	"	"
347.	Quercus costaricensis Liebm.	"	"
348.	" " "	"	"
349.	Weinmannia pinnata L.	"	"
350.	Holodiscus fissus (Lindl) Schneid.	"	"
351.	Quercus costaricensis Liebm.	"	"
352.	" " "	"	"
353.	Monnina xalapensis HBK	"	"
354.	Phoebe Pittieri Mez	"	"
355.	" " "	"	"
356.	Maytenus blepharoides (Pittier)	"	"
357.	Quercus costaricensis Liebm.	"	"
358.			
359.	Ardisia pleurobotrya D.Sm.	"	"
360.			
361.	Symplocos irazuensis Cufodontis	"	"
362.	Ocotea Austinii Allen	"	"
363.	Quercus copeyensis Muell.	"	"
364.	" " "	"	"
365.	" " "	"	"
366.	" " "	"	"
367.	" " "	"	"
368.	" " "	"	"
369.	" " "	"	"
370.	" " "	"	"
371.	Sideroxylon Capiri (A.DC.) Pittier	Cervantes	1600m.
372.	Achimines longiflora DC.	baseba Carpintera	1460m.
373.	Rhychanthera paludicola (D.S.) Gleason	Cervantes	1600m.
374.	Phoradendron piperoides (HBK) Trel.	"	"
375.	Phoradendron robustissimum Eichler	"	"
376.	Eugenia sp.	"	"
377.	Viburnum costaricam (Oerst.) Hemsl.	"	"
378.	Clusia flava Jacq.	"	"
379.	Lippia myriocephala Schl. & Cham.	"	"
380.	Nectandra globosa (Aubl.) Mez	"	"
381.	Lauraceae sp. (sterile)	"	"
382.	Solanum nudum L.	"	"
383.	Picramnia quaternaria D.Sm.	"	"
384.	Inga	"	"
385.	Ocotea endresiana Mez	"	"
386.	Guettarda crispiflora Vahl.	"	"
387.	Hampea appendiculata (D.Sm.) Standl.	"	"
388.	Rondeletia buddleoides Benth.	"	"
389.	Ficus padifolia HBK	"	"
390.			
391.	Psychotria carthaginensis Jacq.	"	"
392.	Miconia hyperprasina Naud.	"	"
393.	Phoebe mexicana Meissn.	"	"
394.	Ficus cervantesiana Standl.&L.Wms. sp. nov.	"	"
395.	Laplacea grandis Brandeg.	"	"
396.	Tonomitopsis nicaraguensis (Oerst.) Tr.& Pl.	"	"
397.	Quercus costariconsis Liebm.	S. slope V. Irazú	3000m.
398.	Miakea tuberculata D.Sm.	Quebrada Honda	1700m.

340.	Lippia Myrio cephala Schl. & Cham.	Quebrada Honda	1700m.
341.	Dendropanax arboreus (L.) Dene.& Pl.	"	"
342.	Eugenia Storkii Standl.	S. slope V.Irazú	3000m.
343.	Ilex pallida Standl.	"	"
344.	Miconia bipennifera Cogn.	"	"
345.			
346.	Vaccinium consanguineum Klotzsch	"	"
347.	Quercus costaricensis Liebm.	"	"
348.	" " "	"	"
349.	Weinmannia pinnata L.	"	"
350.	Holodiscus fissus (Lindl) Schneid.	"	"
351.	Quercus costaricensis Liebm.	"	"
352.	" " "	"	"
353.	Monnina xalapensis HBK	"	"
354.	Phoebe Pittieri Mez	"	"
355.	" " "	"	"
356.	Maytenus Gaspariodes (Pittier)	"	"
357.	Quercus costaricensis Liebm.	"	"
358.			
359.	Ardisia pleurobotrya D.Sm.	"	"
360.			
361.	Symplocos tremuenais Cordonis	"	"
362.	Oreopanax Austinii Allen	"	"
363.	Quercus copeyensis Mull.	"	"
364.	" " "	"	"
365.	" " "	"	"
366.	" " "	"	"
367.	" " "	"	"
368.	" " "	"	"
369.	" " "	"	"
370.	" " "	"	"
371.	Sideroxylon Capiri (A.DC.) Pittier	Cervantes	1600m.
372.	Achimines longiflora DC.	basela Garpinteros	1400m.
373.	Rhychanthera paludicola (D.S.) Gleason	Cervantes	1600m.
374.	Phoradendron piperoides (HBK) Trel.	"	"
375.	Phoradendron rosmatissimum Kichler	"	"
376.	Eugenia sp.	"	"
377.	Viburnum costaricen (Oerst.) Hemsl.	"	"
378.	Clusia flava Jacq.	"	"
379.	Lippia myriocephala Schl. & Cham.	"	"
380.	Nectandra globosa (Aubl.) Mez	"	"
381.	Lauraceae sp. (sterile)	"	"
382.	Solanum nudum L.	"	"
383.	Piteramis quaternaris D.Sm.	"	"
384.	Inga	"	"
385.	Cecropia andreaiana Mez	"	"
386.	Guettarda crispiflora Vahl.	"	"
387.	Hampea appendiculata (D.Sm.) Standl.	"	"
388.	Rondeletia buddleoides Benth.	"	"
389.	Ficus paulifolia HBK	"	"
390.			
391.	Psychotria carthagenensis Jacq.	"	"
392.	Miconia hyperpraeina Naud.	"	"
393.	Phoebe mexicana Meisen.	"	"
394.	Ficus cervantesiana Standl.fl.Wma. sp. nov.	"	"
395.	Lapiacea grandis Brandeg.	"	"
396.	Tomomitopsis microphyllaria (Oerst.) Tr.& Pl.	"	"
397.	Quercus costaricensis Liebm.	S. slope V. Irazú	3000m.
398.	Blakea tuberculata D.Sm.	Quebrada Honda	1700m.

399.		S. slope V.Irazú	3000m.
400.	Stemmadenia glabra Benth. ?	Cartago	1400m.
401.	Bomarea acutifolia (L.& O.) Herb.	Sanatorio Durán	2330m.
402.	Puya dasylirioides Standl.	Parque National	2100m.
403.	Urera caracasana Jacq.	Sanatorio Durán	2330m.
404.	Quercus semannii Liebm. = *see mannii*	Tablón	1500m.
405.	Rhamnus pubescens (R.& P.) Tr.& Pl.	"	"
406.	Chaetoptelea mexicana Liebm.	"	"
407.	Eupatorium ligustrinum DC.	"	"
408.	Citharexylum Donnell-Smithii Greenm.	"	"
409.	Clethra salvadorensis Britton	"	"
410.	Palicourea angustifolia HBK	"	"
411.	Ficus padifolia HBK	"	"
412.	Phoebe Valeriana Standl.	"	1900m.
413.	Saurauia psuedopittieri Besc.	"	"
414.	Panopsis costaricensis Standl.	"	"
415.	Symplocos Austin-Smithii Standl.	"	"
416.	Aiouea costaricensis (Mez) Kosterm.	"	"
417.	Hedyosmum callososerratum Oerst.	"	"
418.	Quercus semanii Mull. = *see mannii*	"	"
419.	Baccharis trinervis (Lam.) Pers.	Panam. Hwy.	1500m.
420.	Lippia myriocephala Schl.& Cham.	"	"
421.	Heliocarpus appendiculatus Turcz.	"	"
422.	Quercus sapotaefolia Liebm.	"	1800m.
423.	Alfaroa costaricensis Standl.	"	"
424.	Banara costaricensis (Standl.) Sleumer	"	"
425.	Lauraceae - not yet placed	"	"
426.	Miconia dodecandra Cogn.	"	"
427.	Piper vemulosum Trel.	"	"
428.	Pouteria Austin-Smithii (Standl.) Cronquist	"	"
429.	Zinowiewia Costaricensis Lundell	"	"
430.	Lauraceae (sterile)	"	"
431.	Ladenbergia Brenesii Standl.	"	"
432.	Quercus acuta Mull.	"	2000m.
433.	Persea	El Cañon	2600m.
434.	Ocotea Austinii Allen	"	"
435.	Styrax Warcewiczii Perkins	"	"
436.	Nectandra reticulata (R.& P.) Mez	"	"
437.	Chusquea Tonduzii Hack. ?	"	"
438.	Senecio andicola Turcz.	C.de La Muerte	3400m.
439.	Quercus costaricensis Liebm.	"	"
440.	Desfontainea spinosa R.& P.	Las Vueltas	3000m.
441.	Senecio Oertsedianus Benth.	C.de La Muerte	3400m.
442.	Hypericum silenoides Juss.	"	"
443.	Solanum Storkii Standl.	"	"
444.	Hypericum strictum HBK	"	"
445.	Lycopodium	"	"
446.	Vaccinium consanguineum Kl.	"	"
447.	Myrtus Oerstedii (Berg.) Hemsl.	"	"
448.	Pernettia prostrata (Cav.) Sleumer	"	"
449.	Pernettia coriacea Kl.	"	"
450.	Pernettia coriacea Kl.	"	"
451.	Dilpostephium costaricanum Blake	"	"
452.	" " "	"	"
453.	Senecio firmipes Greenm.	"	"
454.	Chusquea subtessellata Hitchc.	"	"
455.	Ficus Georgii Standl.& L.Wms.	Pres	1800m
456.	Byrsonima crassifolia (L.) DC.	"	"
457.	Quercus corrensis Trel.	V. Irazú	3000m.

429.		S. slope V.Irazú	3000m.
430.	Stemmadenia glabra Benth. !	Cartago	1400m.
431.	Bomarea acutifolia (L.f 0.) Herb.	Sanatorio Durán	2350m.
432.	Piya dasylirioides Standl.	Parque Nacional	2100m.
433.	Vitex cartaginensis Jacq.	Sanatorio Durán	2330m.
434.	Quercus sanmartii Liebm.	Tablón	1500m.
435.	Rhamnus pubescens (R.& P.) Tr.& Pl.	"	"
436.	Chaetopteles mexicana Liebm.	"	"
437.	Zuparoria lignatrinum DC.	"	"
438.	Ctenarexylum Donnell-Smithii Greenm.	"	"
439.	Clethra salvadorensis Britton	"	"
440.	Palicourea angustifolia HBK	"	"
441.	Ficus padifolia HBK	"	"
442.	Rhoebo Valerianus Standl.	"	1900m.
443.	Saurauia pseudopittieri Pesc.	"	"
444.	Panopsis costaricensis Standl.	"	"
445.	Symplocos Austin-Smithii Standl.	"	"
446.	Alnus costaricensis (Mez) Koeterm.	"	"
447.	Hedyosmum callososerratum Oerst.	"	"
448.	Quercus sanmartii Mull.	"	"
449.	Bacchaeris trinervis (Lam.) Pers.	Param. Hwy.	1500m.
450.	Lippia myriocephala Schl.& Cham.	"	"
451.	Helicarpus appendiculatus Turcz.	"	1800m.
452.	Quercus aspotaefolia Liebm.	"	"
453.	Alfaroa costaricensis Standl.	"	"
454.	Banara costaricensis (Standl.) Sleumer	"	"
455.	Lauraceae - not yet placed	"	"
456.	Miconia dodecandra Cogn.	"	"
457.	Piper vemuloum Trel.	"	"
458.	Peutoria Austin-Smithii (Standl.) Cronquist	"	"
459.	Zinowiewia Costaricensis Lundell	"	"
460.	Lauraceae (sterile)	"	"
461.	Ladenbergia Brenesii Standl.	"	"
462.	Quercus sapata Mull.	"	2000m.
463.	Persea	El Cañon	2600m.
464.	Ocotea Austinii Allen	"	"
465.	Styrax Warcewiczii Perkins	"	"
466.	Nectandra reticulata (R.& P.) Mez	"	"
467.	Cinnamum Tondusii Huck. !	"	"
468.	Senecio andicola Turcz.	C.de La Muerte	3400m.
469.	Quercus costaricensis Liebm.	"	"
470.	Baccharis glutinosa (R.& P.) Pers.	Las Vueltas	3000m.
471.	Hypericum silenoides Juss.	C.de La Muerte	3400m.
472.	Solanum Storkii Standl.	"	"
473.	Hypericum strictum HBK	"	"
474.	Lycopodium	"	"
475.	Vaccinium consanguineum Kl.	"	"
476.	Myrtus Oerstedii (Berg.) Hemsl.	"	"
477.	Pernettia prostrata (Cav.) Sleumer	"	"
478.	Pernettia coriacea Kl.	"	"
479.	Pernettia coriacea Kl.	"	"
480.	Diplostephium costaricanum Blake	"	"
481.	" " "	"	"
482.	Senecio firmipes Greenm.	"	"
483.	Cinnamum subtenuifolium Lindo.	"	"
484.	Ficus Georgii Standl.& L. Wms.	"	"
485.	Byronima crassifolia (L.) DC.	"	"
486.	Quercus veroensis Trel.	V. Irazú	3000m.

458.	Quercus berucasana Trel.	V. Irazú	3000m.
459.	Acaena elongata L.	"	"
460.	Garrya laurifolia Hartw.	"	"
461.	Chuequea subtessellata Hitchc.	Sanatorio Durán	3100m.
462.	Quercus guilielmi-trelleasei Mull.	"	"
463.		V. Irazú	2900m.
464.			
465.	Mahonia paniculata Oerst.	Coliblanco	2600m.
466.	Cestrum irazuense Kuntze	"	"
467.	Oreopanax Liebmanni March.	"	"
468.	Symplocos irazuensis Cuf.	"	"
469.	Miconia biperulifera Cogn.	"	"
470.	Hydrangea Oerstedii Briq.	"	"
471.	Hedyosmum callososerratum Oerst.	"	"
472.	Viburnum costaricanum (Oerst.) Hemsl.	"	"
473.	Verbesina Oerstediana Benth.	"	"
474.	Ocotea Austinii Allen	"	"
475.	Quercus eugeniifolia Liebm.	Panam. Hwy.	2800m.
476.	Stevia lucida Lag.	"	"
477.	Citharexylum recurvatum Greenm.	"	"
478.	Vaccinium consanguineum Kl.	"	"
479.	Gaiadendron peasense D.Sm.	"	"
480.			
481.	Rhamnus Humboldtiana R.& S.	"	"
482.	Viburnum conspectum Morton	"	"
483.	Virburnum costaricanum (Oerst.) Hemsl.	"	"
484.			
485.	Podocarpus Standleyi Buchholtz	"	"
486.			
487.	Miconia globuliflora (Rich.) Cham.	"	"
488.	Ilex pallida Standl.	"	"
489.	Zanthoxylum chiriquinum Standl.	"	"
490.	Rapanea Pittieri Mez	"	"
491.	Vaccinium consanguineum Kl.	"	"
492.	Clusia sp.	"	"
493.	Ocotea fulvescens Standl.& P.Wms.	"	"
494.	Castilleja irazuensis Oerst.	C.de La Muerte	3500m.
495.	Ocotea sp.	Orosi	1200m.
496.	Ardisia pleistantha Standl.& L.Wms.	"	"
497.	Persea pallida Mez & Pittier	"	"
498.	Ficus crassiuscula Warb.	"	"
499.	Inga punctata Willd.	Tapantí	1400m.
500.	Lycopodium	"	"
501.	Clidemia sp.	"	"
502.	Inga sp.	"	"
503.	Saurauia yasicae Loes.	"	"
504.	Inga multijuga Benth.	"	"
504.	Wercklea insignis Pitt.& Standl.	"	"
506.	Alchornea latifolia Swartz	"	"
507.	Persea sp.	"	"
508.	Oreopanax capitatus (Jacq.) Dene & Pl.	"	"
509.	Dussia macroprophyllata (D.Sm.) Harms	"	"
510.	Quercus guglielmi-trelleasei Mull.	"	"
511.	Casearia arborea (Rich.) Urban	"	"
512.	Cassia fruticosa L.	"	"
513.	Zinowiewia costaricensis Lundell	"	"
514.	Posoqueria latifolia (Rudge) R.& S.	"	"
515.	Quarea sp.	"	"
516.	Styrax glabrescens Benth.	"	"

458.	Quercus borucasana Trel.	V. Irazú	3000m.
459.	Acaena elongata L.	"	"
460.	Garrya laurifolia Hartw.	"	"
461.	Cinchona subsessilis Pitchc.	Santa Elena	1200m.
462.	Quercus Guilelmi-treubeana Mull.	"	"
463.		V. Irazú	2900m.
464.			
465.	Rubus pauciflorus Cham. & Schl.	Colombia	2600m.
466.	Coccoloba caracasana Meisn.	"	"
467.	Oreopanax Liebmannii March.	"	"
468.	Symplocos tremulifolia Humb.	"	"
469.	Miconia biperulifera Cogn.	"	"
470.	Hydrangea Seemannii Riley	"	"
471.	Hedyosmum callososerratum Oerst.	"	"
472.	Viburnum costaricanum (Oerst.) Hemsl.	"	"
473.	Verbesina Oerstediana Benth.	"	"
474.	Cocoloba Manthii Allen	"	"
475.	Quercus eugenifolia Liebm.	Panam. Hwy.	2400m.
476.	Stevia lucida Lag.	"	"
477.	Citharoxylum tricarpum Greenm.	"	"
478.	Vaccinium consanguineum Kl.	"	"
479.	Guadendron poasanae D.Sm.	"	"
480.			
481.	Rhamnus Humboldtiana F.& S.	"	"
482.	Viburnum conspectum Morton	"	"
483.	Viburnum costaricanum (Oerst.) Hemsl.	"	"
484.			
485.	Podocarpus Standleyi Buchholtz	"	"
486.			
487.	Miconia globuliflora (Rich.) Cham.	"	"
488.	Ilex pallida Standl.	"	"
489.	Zanthoxylum chiriquinum Standl.	"	"
490.	Rapanea Pittieri Mez	"	"
491.	Vaccinium consanguineum Kl.	"	"
492.	Clusia sp.	"	"
493.	Cocoloba tuivaecana Standl.& P.Wms.	"	"
494.	Castilleja fraseriana Oerst.	C.de la Muerte	3000m.
495.	Cocoloba sp.	Orosi	1200m.
496.	Ardisia pleiantha Standl.& L.Wms.	"	"
497.	Perrea pallida Lor & Pittier	"	"
498.	Ficus crassinervia Warb.	"	"
499.	Inga punctata Willd.	Tapantí	1400m.
500.	Lycopodium	"	"
501.	Clidemia sp.	"	"
502.	Inga sp.	"	"
503.	Saurauia pauciflora Loes.	"	"
504.	Inga multijuga Benth.	"	"
505.	Wercklea insignis Pitt.& Standl.	"	"
506.	Alchornea latifolia Swartz	"	"
507.	Perrea sp.	"	"
508.	Oreopanax capitatus (Jacq.) Done & Pl.	"	"
509.	Ousaia macrophylla (D.Sm.) Harms	"	"
510.	Quercus Guilelmi-treubeana Mull.	"	"
511.	Casearia arborea (Rich.) Urban	"	"
512.	Casaia fruticosa L.	"	"
513.	Cinnowiwia costaricensis Lundell	"	"
514.	Poecilanthe latifolia (Lunge) R.& S.	"	"
515.	Guarea sp.	"	"
516.	Styrax glaberrimus Benth.	"	"

517.	Aphelandra	Tapanti	1400m.
518.	Weinmannia Wercklei Standl.	"	"
519.	Clusia pithecolobiana Standl.& L.Wms.	"	"
520.	Billia columbiana PL.& Tr.	"	"
521.	Quercus corrugata Hook.	"	"
522.	Inga punctata Willd.	I.I.C.A.,	590m.
523.	Croton glabellus L.	Turrialba	"
524.	Croton Hoffmanni M. Arg.	"	"
525.	Manilkara Chicle (Pitt.) Gilly	"	"
526.	Compsoneura Sprucei (A.DC.) Warb.	"	"
527.	Piper pergeniculatum Trel.	"	"
528.	Trichilia sp. (sterile)	"	"
529.	Inga sp. (sterile)	"	"
530.	Ocotea tenera Mez & D. Sm.	"	"
531.	Luehea Seemannii Tr.& Pl.	"	"
532.	Inga leptoloba Schlect ?	"	"
533.	Pithecolobium longifolium (F.& B.) Standl.	"	"
534.	Eugenia sp. (sterile)	"	"
535.	Meliosma glabrata (Liebm.) Urban	"	"
536.	Ocotea Ira Mez & Pittier ?	"	"
537.	Tapirira Brenesii Standl.	"	"
538.	Banara guianensis Aubl.	"	"
539.	Guarea turrialbana J.Leon	"	"
540.	Castilla elastica Cerv.	"	"
541.	Simaruba glauca DC.	"	"
542.	Zanthoxylum elephantiasis Macfad.	"	"
543.			
544.			
545.	Lafoensia punicifolia DC.	"	"
546.	Piper pergeniculatum Trel.	"	"
547.	Acalypha villosa Jacq.	"	"
548.	Zexmenia frutescens (Mill.) Blake	"	"
549.	Rondeletia buddleoides Benth.	"	"
550.	Theobroma simiarum D. Sm.	"	"
551.	Virola Koschnyi Warb.	"	"
552.	Neea amplifolia D.Sm.	"	"
553.	Inga marginata Willd.	"	"
554.	Inga Micholiana Harms	"	"
555.	Stemmadenia Donnell-Smithii (Rose) Woodson	"	"
556.			
557.	Malphigia glabra L.	"	"
558.	Malortiea gracilis Wendl.	"	"
559.	Rubiaceae (sterile)	"	"
560.	Lafoensia punicifolia DC.	"	"
561.	Rubiaceae (sterile)	"	"
562.	Coutarea hexandra (Jacq.) Schum.	"	"
563.	Ouratea costaricensis Standl.	"	"
564.	Poulsenia armata (Miq.) Standl.	"	"
565.	Cordia alliodora (R.& P.) Cham.	"	"
566.	Coussapoa Donnell-Smithii Mildbr.	"	"
567.	Cupania cinerea Poepp.& Endl.	"	"
568.	Cecropia insignis Liebm.	"	"
569.	Conostegia subcrustulata (Beurl.) Triana	"	"
570.	Anacardium excelsum (Bert.& Balb,) Skeels	"	"
571.	Ficus Jimenezii Standl.	"	"
572.	Dialyanthera acuminata Standl.	"	"
573.	Jacaratia costaricensis I.M.Johnston	"	"
574.	Castilla costaricensis Liebm.	"	"
575.	Anacardium excelsum (Bert.& Balb.) Skeels	"	"
576.	Eugenia Donnellsmithii Standl.	"	"

[illegible]	Lophelandra	Tapanti	[illegible]
[illegible]	Heisseania Werckli (Standl.)	"	"
[illegible]	Miconia pithecocteinia Standl. & L.Wms.	"	"
[illegible]	Sipilia colmuiana Pe.& Tr.	"	"
[illegible]	Quercus corrugata Hook.	"	"
[illegible]	Inga punctata Willd.	I.N.B.A.	[illegible]
[illegible]	Croton glabellus L.	Turrialba	"
[illegible]	Croton lobianus [illegible] Muell. Arg.	"	"
[illegible]	Xanthium Chinense (Pitt.) Britt.	"	"
[illegible]	Compsoneura Sprucei (A. DC.) Warb.	"	"
47.	Piper peregrinulatum Trel.	"	"
[illegible]	Trichilia sp. (acerifolia)	"	"
[illegible]	Inga sp. (acerifolia)	"	"
[illegible]	Cestea tenera Mez & Pi. Sm.	"	"
[illegible]	Licania Seemannii Pr.& Pl.	"	"
[illegible]	Inga leptoloba Schlecht.	"	"
[illegible]	Pithecolobium longifolium (C.& S.) Standl.	"	"
[illegible]	Eugenia sp. (acerifolia)	"	"
[illegible]	Malleanthera glabrata (Blanco) Fries	"	"
[illegible]	Cestea lra Mez & Pittier !	"	"
[illegible]	Tapirira Pruinosa Standl.	"	"
[illegible]	Zanona Guianensis Aubl.	"	"
[illegible]	Guarea Surinamensis Lanjon	"	"
60.	Casilla elastica Cerv.	"	"
61.	Simarouba glauca DC.	"	"
[illegible]	Zanthoxylum oleaginatis Macbr.	"	"
[illegible]			
[illegible]			
[illegible]	Laplonia punicifolia DC.	"	"
[illegible]	Piper peregrinulatum Trel.	"	"
67.	Acalypha villosa Jacq.	"	"
[illegible]	Zanthoxylum Juniperinum (Willd.) Engl.	"	"
[illegible]	Mordelatia buchtienii Donn.	"	"
[illegible]	Theobroma glaucum H. Cm.	"	"
[illegible]	Virola koschnyi Warb.	"	"
[illegible]	Ideo amplifolia P.Sm.	"	"
[illegible]	Inga marginata Willd.	"	"
[illegible]	Inga Michelianu Harms	"	"
[illegible]	Stemmadenia Donnell-Smithii (Rose) Woodson	"	"
[illegible]			
[illegible]	Xylopsia glabra L.	"	"
[illegible]	Meliortea grandis Standl.	"	"
[illegible]	Rubiacea (estéril)	"	"
[illegible]	Laplonia punicifolia DC.	"	"
[illegible]	Rubiacea (estéril)	"	"
[illegible]	Couterea hexandra (Jacq.) Schum.	"	"
[illegible]	Cinchona costaricensis Standl.	"	"
[illegible]	Foulsonia armata (Vid.) Standl.	"	"
[illegible]	Cordia alliodora (R.& P.) Oken.	"	"
[illegible]	Conostegia subcrustulata (Cogn.) Triana	"	"
[illegible]	Anacardium excelsum (Bert.& Balb.) Skeels	"	"
[illegible]	Ficus Insipida Willd.	"	"
[illegible]	Dialyanthera costaricana Standl.	"	"
[illegible]	Iacaranda copaiaeifolia D.Don.	"	"
[illegible]	Casilla costaricensis Pitt.	"	"
[illegible]	Anacardium excelsum (Bert.& Balb.) Skeels	"	"
[illegible]	Pithecolobium Saman (Jacq.) Benth.	"	"

577.	Rheedia edulis (Seem.) Tr.& Pl.	I.I.C.A.	550m.
578.	Ceiba pentandra (L.) Gaertn.	"	"
579.	(Oerst.)		
580.	Viburnum costaricanum (Klotz.) Hemsl.	Cachi	1450m.
581.	Hampea appendiculata (D.Sm.) Standl.	"	"
582.	Quercus tomentocaulis Mull.	"	"
583.	" " "	"	"
584.	Ardisia pleisthantha Standl.& L.Wms. sp. nov.	"	"
585.	Chione costaricensis Standl.	"	"
586.	Phenax mexicanus Wedd.	"	"
587.	Lonchocarpus sp. (sterile)	"	"
588.	Nectandra reticulata (R.& P.) Mez	"	"
589.		C.de La Muerte	3500m.
590.			
591.	Coussapoa panamensis Pittier	Ujarraz	1006m.
592.	Nectandra panamensis Standl.	"	"
593.	Ficus Georgii Standl.& L. Wms.	"	"
594.	Ficus costaricana (Liebm.) Miq.	"	"
595.	Nectandra globosa (Aubl.) Mez	"	"
596.	Zexmenia frutescens (Mill.) Blake	Agua Caliente	1600m.
597.	Calliandra tetragona (Willd.) Benth.	"	"
598.	Guarea Caoba C.DC.	"	"
599.	Miconia pteropoda Benth.	"	"
600.	Quercus Rearki Mull. sp. nov.	"	"
601.	PerseaSkutchii Allen ?	"	"
602.	Styrax Warscewiczii Perkins	"	"
603.	Symplocos costanicana Hemsl.	"	"
604.	Eugenia cartagensis Berg.	"	"
605.	Clusia modesta Standl.& L.Wms. sp. nov.	"	"
606.	Myrica cerifera L.	"	"
607.	Clusia alata Pl.& Tr.	"	"
608.	Hedyosmum callososerratum Oerst.	Turrialba	800m.
609.	Dussia macrophyllata (D.Sm.) Harms	"	"
610.	Cornutia grandifolia (S.& C.) Schauer	"	"
611.	Ocotea Endresiana Mez	"	"
612.	Myrcia costaricensis Berg	"	"
613.	Nectandra reticulata (R.& P.) Mez	"	"
614.	Tetrorchidium euryphyllum Standl.	"	"
615.	Ficus sp. (possibly new)	"	"
616.	Psidium Guajava L.	"	"
617.	Conostegia xalapensis (Bonpl.) Don	"	"
618.	" " " "	"	"
619.	Chusquea subtessellata Hitchc.	C.de La Muerte	3500m.
620.	Diplostephium costaricense Blake	"	"
621.	Eupatorium Kupperi Suesseng.	"	"
622.	Eupatorium subcordatum Benth.	"	"
623.	Vaccinium consanguineum Kl.	"	"
625.	Croton sp. probably new	E. of Rio Macho	1400m.
626.	Banara costaricensis (Standl.) Sleumer	"	"
627.	Lauraceae	"	"
628.	Desmopsis panamensis (Rob.) Safford	"	"
629.	Clethra panamensis Standl.& L.Wms.	"	"
630.	Ladenbergia Brenesii Standl.	"	"
631.	Ardisia (sterile)	"	"
632.	Psidium	"	"
633.	Trichilia havanensis Jacq.	"	"
634.	" " "	"	"
635.	Trophis chorizantha Standl.	"	"
636.	Piper venulosum Trel.	"	"
637.	Trichilia [illegible]	"	"

577.	Rhoedia edulis (Seem.) Tr.& Pl.	I.I.C.A.	Seem.
578.	Cecina pennandra (L.) Baerth.	"	"
579.	(Desrt.)		
580.	Viburnum costaricanum (Kl.&Gl.) Hemsl.	Costa	Hemsl.
581.	Harpea oppendiculata (P.Br.) Standl.	"	"
582.	Guarea tomentosanlis Pitt.	"	"
583.	" " "	"	"
584.	Ardisia pleistantha Standl.& L.Wms. sp. nov.	"	"
585.	Chione costaricensis Standl.	"	"
586.	Phenax mexicanus Wedd.	"	"
587.	Lonchocarpus sp. (sterile)	"	"
588.	Hectandra reticulata (R.& P.) Mez	"	"
589.			C.de la Muerte 3500m.
590.			
591.	Conostegia pennervenis Pittier	Ujarras	1000m.
592.	Nectandra pannervenis Standl.	"	"
593.	Ficus Seorgii Standl.& L. sp.	"	"
594.	Ficus costaricana (Liebm.) Mig.	"	"
595.	Nectandra globosa (Mart.) Mez	"	"
596.	Zexmenia frutescens (Mill.) Blake	Loma Salitre	1600m.
597.	Calliandra tetragona (Willd.) Benth.	"	"
598.	Guarea Cooba C.DC.	"	"
599.	Miconia pteropoda Benth.	"	"
600.	Guarea Pittieri Mull. sp. nov.	"	"
601.	Personskytchii Alton ?	"	"
602.	Styrax Turcozwiczii Perkins	"	"
603.	Symplocos costaricana Hemsl.	"	"
604.	Eugenia costaricensis Berg.	"	"
605.	Clusia modesta Standl.& L.Wms. sp. nov.	"	"
606.	Myrica cerifera L.	"	"
607.	Clusia alata Pl.& Tr.	"	"
608.	Hedyosmum callicoma Cuatr.	Turrialba	Bucn.
609.	Guatteria macrophylla (Sm.) Gmelina	"	"
610.	Cornutia grandifolia (S.& L.) Schauer	"	"
611.	Cestrum Turrialbae Mez	"	"
612.	Myrcia costaricensis Berg	"	"
613.	Nectandra reticulata (R.& P.) Mez	"	"
614.	Tetrorchidium euphylum Standl.	"	"
615.	Ficus sp. (possibly new)	"	"
616.	Psidium Guajava L.	"	"
617.	Conostegia xalapensis (Bonpl.) Don	"	"
618.	" " " "	"	"
619.	Cinchona subsessilifolia Hitchc.	C.de la Muerte	3000m.
620.	Diplostephium costaricense Blake	"	"
621.	Eupatorium Rupestre Greenm.	"	"
622.	Eupatorium subcordatum Benth.	"	"
623.	Vaccinium consanguineum Kl.	"	"
624.	Croton sp. probably new	R. de Rio Macho	140m.
625.	Guarea costaricensis (Standl.) Pennell	"	"
626.	Lauraceae	"	"
627.	Dennophis pannervenis (Rob.) Safford	"	"
628.	Cleyera pannervenis Standl.& L.Wms.	"	"
629.	Ladenbergia Tonduzii Standl.	"	"
630.	Ardisia (sterile)	"	"
631.	Psidium	"	"
632.	Trichilia pannervenis Jacq.	"	"
633.	" " "	"	"
634.	Trophis Stapeliarioides Standl.	"	"
635.	Piper ramulosum Trel.	"	"
636.	Trichilia pannervenis Jacq.	"	"

638.	Quercus Rearki Mull. sp. nov.	E. of Rio Macho	1400m.
639.	Panopsis costaricensis Standl.	"	"
640.	Erythrina gibbosa Cuf.	"	"
641.	Citharexylum costaricense Mold.	"	"
642.	Inga Tonduzii D.Sm.	"	"
643.	Lauraceae	"	"
644.	Hieronyma guatemalensis D.Sm.	"	"
645.	Beilschmiedea ovalis (Blake) Allen	"	"
646.	Persea	"	"
647.	Nectandra reticulata (R.& P.) Mez	Tapanti	1200m.
648.	Cornutia grandifolia (S.& C.) Schauer	"	"
649.	Miconia caudata (Bonpl.) DC.	"	"
650.	Sommera grandis (Bartl) Standl.	"	"
651.	Dobdropanax ~~arboreascens~~ Arboreus (L.)Dcne.& Pl.	"	"
652.	Piper auritum HBK	"	"
653.	Trophis macrostachya D.Sm.	"	"
654.	Ficus Torresiana Standl.	"	"
655.	Piper rufescens C.DC.	"	"
656.	Ficus Torresiana Standl.	"	"
657.	Ficus	"	"
658.	Alchornea latifolia Swartz	"	"
659.	Weinmannia Wercklei Standl.	La Sierra"	2205m.
660/	Billia colombiana PL.& Tr.	"	"
661.	Ocotea ?	"	"
662.	Inga sp. (sterile)	"	"
663.	Tovomitopsis nicaraguensis (Oerst.) Tr.& Pl.	"	"
664.	Phoebe Valeriana Standl.	"	"
665.	Beilschmiedea ovalis (Blake) Allen	"	"
666.	Lauraceae	"	"
667.	Nectandra sp. (sterile)	"	"
668.	Begonia alnifolia A. DC.	Santa Cruz	1400m.
669.	Besleria triflora (Oerst.) Hemsl.	"	"
670.	Oreopanax Oerstedianus Marsh.	"	"
671.	Dialyanthera acuminata Standl.	Atirro	550m.
672.	Ocotea Dendrodaphne Mez	"	"
673.	Trichilia sp. (sterile)	"	"
674.	Ouratea costaricensis Stamdl.	"	"
675.	Pouteria ?	"	"
675A.	Virola Koschnyi Warb.	"	"
676.	Rondeletia buddleoides Benth.	"	"
677.		"	"
678.	Synechanthus Warscewiczianus Wendl.	"	"
679.		"	"
680.	Garrya laurifolia Hartweg	V. Turrialba	3400m.
681.	Ilex vulcanicola Standl.	"	"
682.	Myrica pubescens Willd.	"	"
683.	Alchornea costaricensis Pax & Hoffm.	La Florencia	600m.
684.	Psychotria chiapensis Standl.	"	"
685.	Nectandra globosa (Aubl.) Mez	"	"
686.	Eupatorium hylonomum Rob.	"	"
687.	Dussia macroprophyllata (D.Sm.) Harms ?	"	"
688.	Ocotea Dendrodaphne Mez	"	"
689.	Rheedia intermedia Pittier ?	"	"
690.			
691.	Trichilia ~~sp. nov.~~ Oerstèdiana C.DC.		
692.	CCasearia sylvestris Swartz	Tuis	800m.
693.	Trichilia sp. nov.?	"	"
694.	Moraceae	"	"
695.	Castilla elastica Cerv. ?	"	"

638.	Quercus Garryi Nutt.	C. Nev.	
639.	Lampsana communis Gaertn.	"	"
640.	Erythraea pulchella Fr.	"	"
641.	Cichorium Intybus L.	"	"
642.	Ilex Cassine L.	"	"
643.	Juncaceae	"	"
644.	Hieronyma alchorneoides Fr.	"	"
645.	Sailcornia ambigua (Mich.) Allen	"	"
646.	Poaceae	"	"
647.	Rhoetanthera reticulata (P. & L.) Mez	Tapanahoni	
648.	Tournefortia gnaphalodes (L.) R. Br.	"	"
649.	Nicotiana quadrivalvis (Pursh) Merr.	"	"
650.	Sommera grandis (Nutt.) Steud.	"	"
651.	Oenothera rosea L'Her.	"	"
652.	Piper aduncum L.	"	"
653.	Tropaeolum majus L.	"	"
654.	Ficus Perrottetiana Steud.	"	"
655.	Piper pulcherrimum C. DC.	"	"
656.	Ficus Perrottetii Miq.	"	"
657.	Ficus	"	"
658.	Alchornea latifolia Swartz	"	"
659.	Heimannia Wrightii (Gray) Fr.	La Pierre	
660.	Tillia colombiana H. & Tr.	"	"
661.	Cocoes ?	"	"
662.	Inga sp. (sterile)	"	"
663.	Tovomitopsis microphylla (Cuatr.) Tr. & Pl.	"	"
664.	Ipomoea Batatas (Lam.)	"	"
665.	Peltandra ovalis (Rohr) Allen	"	"
666.	Cyperaceae	"	"
667.	Hedyotis sp. (sterile)	"	"
668.	Pogonia ophioglossoides L.	Savanna Path	
669.	Rhexia virginica L.	"	"
670.	Cryptopus Gentianoides Pers.	"	"
671.	Dialypetalum arnottianum Benth.	Litoro	
672.	Cocoes Xanthosoma sp.	"	"
673.	Trichilia sp. (sterile)	"	"
674.	Curatella americana L.	"	"
675.	Paullinia ?	"	"
675A.	Virola Kosanyi Sprg.	"	"
676.	Pandaceae Microstylis Griseb.	"	"
677.		"	"
678.	Synechanthus warscewiczianus Wendl.	"	"
679.		"	"
680.	Cecropia Leucoma Miq.	V. Turiscba	
681.	Ilex paraguariensis St. Hil.	"	"
682.	Myrica pubescens Willd.	"	"
683.	Alcornea costaricensis Lex & Hoffm.	La Florencia	
684.	Polygalaria oligophylla Trail.	"	"
685.	Thecacoris Blepharis (Mart.) Esp.	"	"
686.	Piper trichostachyum Trel.	"	"
687.	Dracaena reflexa Lam.	"	"
688.	Ocotea cymbarum H.B.K.	"	"
689.	Rhoetia laborandia Miquel ?	"	"
690.			
691.	Trichilia pl. Poep. & Endl.		
692.	Paspalum plicatulum Michx.	Tuis	
693.	Trichilia sp. nov.?	"	"
694.	Morocoto	"	"
695.	Castilla elastica Cerv. ?	"	"

696.	Casearia sylvestris Swartz	Tuis	800m.
697.	Ficus Georgii Standl.& L.Wms.	"	"
698.	Cordia alliodora (R.& P.) Cham.	"	"
699.	Hirtella triandra Swartz	"	"
700.	Guarea brevianthera C.DC.	"	"
701.	Pouteria lucentifolia (Standl.) Baehni ?	"	"
702.	Inga sp. nov.	"	"
703.	Pachira aquatica Aubl.?	"	"
704.	Ficus sp. nov.	"	"
705.	Phoebe mexicana Meissn.	"	"
706.	Miconia argentea (Sw.) DC.	"	"
707.			
708.	Myrica plicatocostata Berg	"	"
709.	Guarea excelsa HBK	"	"
710.	Ladenbergia Boenesii Standl.?	"	"
711.	Cecropia sp. nov.	"	"
712.	Meliosma glabrata (Liebm.) Urban ?	"	"
713.	Ardisia - probably new	"	"
714.	Swartzia panamensis Benth.	"	"
715.	Alchornea latifolia Swartz	"	"
716.	Dendropanax arboreus (L.)Dene.& Planch.	Atirro	600m.
717.	Croton guatemalensis Lotsy	"	"
718.	Calocarpum viride Pittier	"	"
719.	Persea Skutchii Allen	"	"
720.	Nectandra ?	La Florencia	600m.
721.	Inga leptoloba Schlecht.?	"	"
722.	Guarea Caoba C.DC.?	"	"
723.	Croton glabellus L.	"	"
724.	Croton Tonduzii Pax ?	"	"
725.	Allophylus panamensis Radlk.	"	"
726.	Trichilia	Turrialba	850m.
727.	Persea Skutchii Allen	"	"
728.	Sommera grandis (Bartl.) Standl.	"	"
729.	Mimosa Bracaatinga Hoehne	"	"
730.	Calliandra arborea Standl.	San Antonio	1100m.
731.	Miconia dodecandra Cogn.	"	"
732.	Miconia glaberrima (Schl.) Naud.	"	"
733.	Guatteria amplifolia Tr.& Pl.	"	"
734.	Oreopanax Oerstedianus March.	"	"
735.			
736.	Conostegia Oerstediana Berg	"	"
737.	Sapium jamaicense Swartz ?	"	"
738.	Guarea brevianthera C.DC. ?	"	"
739.	Tabernaemontana aphlebia Standl.	"	"
740.			
741.	Pseudolmedia oxyphyllaria D.Sm.	"	"
742.	Myrsine costaricensis Berg	"	"
743.	Mollinedia costaricensis D.Sm.	"	"
744.	Nectandra globosa (Aubl.) Mez	"	"
745.	Meliosma glabrata (Liebm.) Urban	"	"
746.	Pachira aquatica Aubl.	"	"
747.	Coccoloba nematostachya (Griseb.) Lindau	"	"
748.	Croton gossypiifolius Vahl	"	"
749.	Mauria Birringo Tulasne	"	"
750.			
751.	Guarea brevianthera C.DC.	"	"
752.	Miconia scorpioides (S.& C.) Naud.	"	"
753.	Alchornea latifolia Swartz	"	"
754.			

1.	Dasserie olivacella Mart.	Wld.	
2.	Chore Georgii Staud.& T. Mm.	"	"
3.	Cuscuta alliacea (Lor. i.) Chmss.	"	"
4.	Dianthella tricuspa Guerin	"	"
5.	Cirsea Prestandera S.Bc.	"	"
6.	Lonicera Periclymenum (Scand.) Honkeni f	"	"
7.	Lupa sp. nov.	"	"
8.	Isoetes aquatica Mill.!	"	"
9.	Picea sp. nov.	"	"
10.	Pinus montana Mutsan.	"	"
11.	Silene argentea (Sw.) Ait.	"	"
12.			
13.	Agrion platycnemis Burm	"	"
14.	Quercus excelsa Ltt.	"	"
15.	Dalechampia Bronconii Chmss.!	"	"
16.	Ocer tia sp. nov.	"	"
17.	Valkamia glabrata (Lam.) Vahl ?	"	"
18.	Arabis - probably new	"	"
19.	Avenaria pauciflora Host.	"	"
20.	Alcantrae latifolia Mart.	"	"
21.	Cardiospermum arboreum (L.) Pres. ilia ...	Adirp	30 Mt.
22.	Crocus pratomalensis Jordy	"	"
23.	Calocoryum variae Littl.	"	"
24.	Forbes Bentonii Miers	"	"
25.	Hedysarum !	ba Florenola	0 Cc.
26.	Sium latifolia Schkuhr.!	"	"
27.	Carex Gmelin S.Gc.!	"	"
28.	Cirsium Pseudis L.	"	"
29.	Orobus tuberosus !	"	"
30.	Arabis pauciflora Grab.	"	"
31.	Trifolia	Tarrilla	Cm.
32.		"	"
33.		"	"
34.	Lam. pra Ercadia (Lam. Chaub.	"	"
35.	Linum Pseudo ga Gussino	"	"
36.	Trifolium arborea Stand.	Ian Pino Io	Ilc.
37.		"	"
38.	Micania scandens Spr.	"	"
39.	Micania glycerrhiza (Schl.) Tul.	"	"
40.	Narcissus x pilosi Tr.& Fl.	"	"
41.	Cruciata Gerardiana Mutsan.	"	"
42.			
43.	Cornus le Cerer Ilan ncre	"	"
44.	Spinum jacobaea Wulfe ?	"	"
45.	Quercus brevipes cua S.Mc. ?	"	"
46.	Tephrosemon ... cyanobra Wendl.	"	"
47.			
48.	Teucrium scorodonia subsp. la D.Sm.	"	"
49.	Pyrus sylvestris Mill.	"	"
50.	Hollandia ... Tr.Pm.	"	"
51.	Rosmarinus officinalis (Willd.) Mor	"	"
52.	Melicoma pyrifera (Lieb.) Urban	"	"
53.	Ipomoea ... Wbl.	"	"
54.	Eucalyptus ... (Cunn.) Miers	"	"
55.	Cruciata pyrifolia Ehrh.	"	"
56.	Ulmaria Ilr... Tilcra	"	"
57.			
58.	Quercus ... Sc.	"	"
59.	Micania ... (Sw.) Wrb.	"	"
60.	"Ic'ura ... Ly	"	"
61.			

755.	Hieronyma guatemalensis D.Sm.	San Antonio	110
756.	Inga Barbourii Standl. ex descr.	"	"
757.	Casearia sylvestris Swartz	"	"
758.	Ficus Brenesii Standl.	"	"
759.	Lauraceae	"	
760.	Dussia macroprophyllata (D.Sm.) Harms.	"	"

[illegible].	Hieronyma [illegible].	San Antonio	[illegible]
[illegible].	Inga Barbourii Donnell. ex Rose.	"	"
[illegible].	Mascagnia sylvestris sandwith	"	"
[illegible].	Ficus Pringlei Standl.	"	"
[illegible].	Euphorbiaceae	"	"
[illegible].	Dussia macrophyllata (Donn. Sm.) Harms.	"	"