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 Their Importance For The Study Of The Regional Pathobiology)

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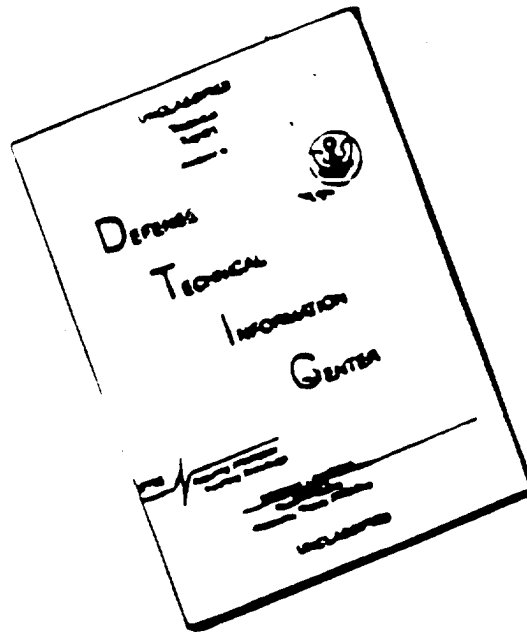
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ECONOMIC AND GEOGRAPHIC TRANSLATIONS  
ON LATIN AMERICA

No. 39

THE TROPICAL ENVIRONMENT-- BIO-REGIONS OF VENEZUELA AND THEIR  
IMPORTANCE FOR THE STUDY OF THE REGIONAL PATHO-  
BIOLOGY.

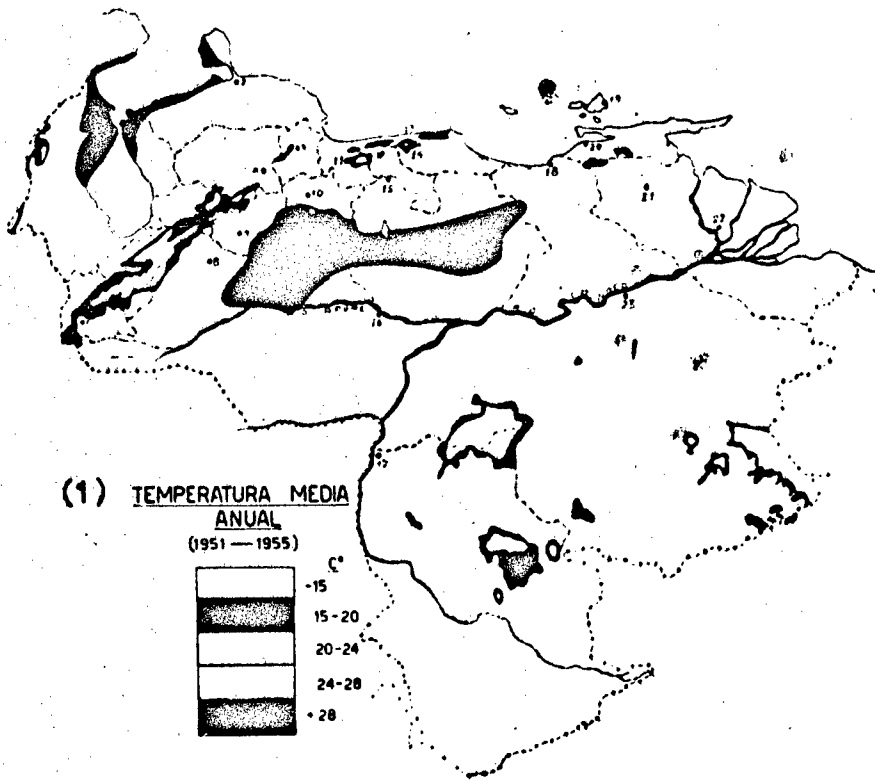
Following is a translation of an article by Dr. Felix Pifano C. in the Venezuelan Spanish-language journal Revista Venezolana de Geografía (Venezuelan Review of Geography), Caracas, Vol V, No 8, June 1964-June 1965, pp. 11-84.

ECOLOGICAL STUDY  
VEGETATION

Venezuela, located in the center of the neotropic region and in the northern part of South America, has an area of 912,050 square kilometers, with a northern coast of about 1,800 kilometers and an eastern coast of approximately 600 km. It lies between the latitudes of 0°45' and 12°26' North and the longitudes 59°35' and 27°20' West of Greenwich. Due to its intertropical location it is subject to the influence of the thermal Equator (isotherm of 28°) which passes through its territory. It has a population of 6,300,842 inhabitants according to the 1960 census. The rural population is of 2,286,094 inhabitants (36.28% of the country's total population), with 37,393 population centers of less than 200 inhabitants, which represents the scattered rural population. The indigenous population of about 150,000 inhabitants, is not included in the rural population.

From the geologic and physiographic point of view Venezuela consists of three sub-regions: 1) the Caribbean, 2) the Andean, 3) the Amazonian. ENP

The Caribbean sub-region comprises our Caribbean islands, the coastal belt running from the Goajira Peninsula to Paria



**PROVISIONAL CLIMATOLOGIC ATLAS**

(Ministry of Defense, Air Forces, Meteorological Service)

Key: 1) Average Annual Temperature.

Promontory and the Llanos plains which were marine beds in the Tertiary Period. The Andean sub-region includes the orographic system of the Andes cordillera and the coastal mountains, with their spurs and valleys and also the Lake Maracaibo basin. The Amazonian sub-region comprises the Amazonas Federal Territory, most of the State of Bolivar and the Orinoco Delta.

In these sub-regions there are various areas which can be distinguished individually as we shall see below by the characteristics of their relief in close connection with the bio-climatology and other local factors.

The seasons characteristic of temperate regions are not observed in Venezuela because of its location in the inter-tropical zone. The climatologic modalities of the country are basically determined by altitude, there being a succession of thermal levels ranging from the tropical or hot, the subtropical, the temperate and the cold. The tropical or hot level, which predominates in the lowlands subjected to the influence of the thermal equator, comprises about 40% of the nation's territory. The factor which gives rise to specific characteristics to the environmental differences in the country is rainfall, which in the neotropical zone is conditioned by the periodicity of the trade winds, the equatorial calms and orographic accidents.

The plains constitute a low pressure zone open in the east to the action of the trade winds coming in from the Atlantic which travel over their whole extent. The Caribbean coast is under the constant influence of the Northeast trades. The south of the country, particularly the Amazonian region is subjected to winds from the equatorial regions. All these winds, bearing moisture come from areas of high evaporation: the Atlantic ocean and the Amazon basin. When they meet the high orographic barriers of the national territory, they become condensed into large masses of clouds, which give rise to regimes of high rainfall. In the southwest of Lake Maracaibo where the hills belonging to the Andean mountain system are arranged in a horseshoe shape which halt and condense the trades, average annual precipitation is of 2,500 mm. At the foot of the mountains in the western plateau in the direction of the San Camilo forests, precipitation reaches the level of 3,000 mm.

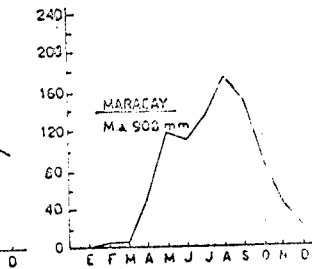
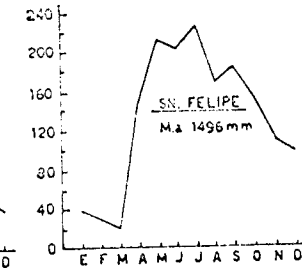
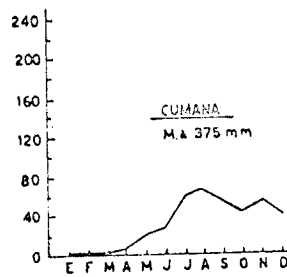
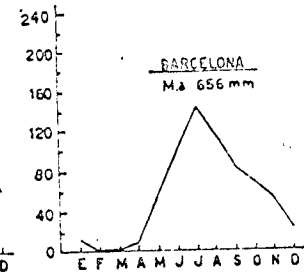
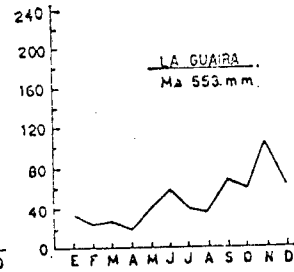
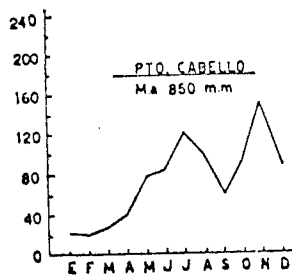
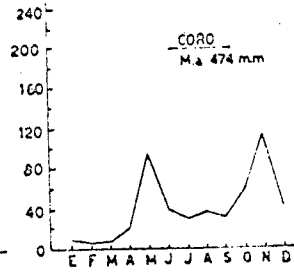
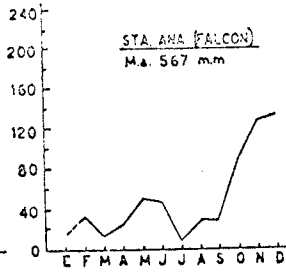
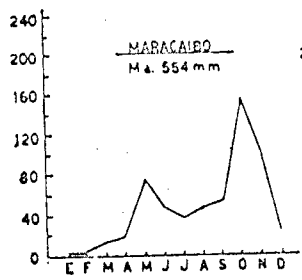
In Barlovento, which constitutes a funnel formed by the coastal hills and from the interior of the mountain system of the Costa opening eastward by the Unare depression, average annual precipitation reaches the level of 2,400 mm. The meeting in the Orinoco Delta of the Northeast trades with the southern winds from the Amazon basin explains the high precipitation of the delta zone and of the Guayana Shield. In the coastal zones with high pressure, the pre-

vailing climate is hot and dry because the moist winds from the sea meet no condensation surface and continue travelling toward the interior of the continent. The conditions are found in Goajira and the north of the Lake Maracaibo depression, on the Paraguana Peninsula and the eastern shore of Falcon, on the shores of the Unare depression and of Cariaco Gulf as well as the Araya Peninsula. In these areas precipitation is considerably smaller, with annual averages of 900 millimeters and even figures as low as 300 mm a year.

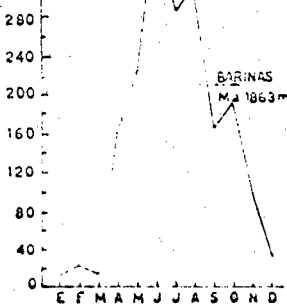
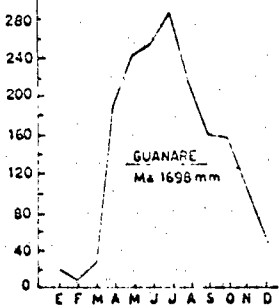
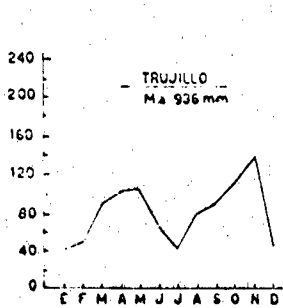
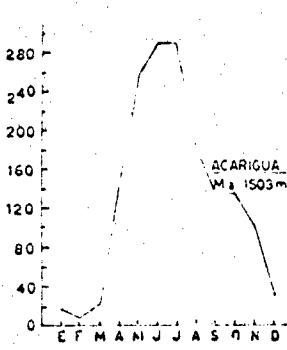
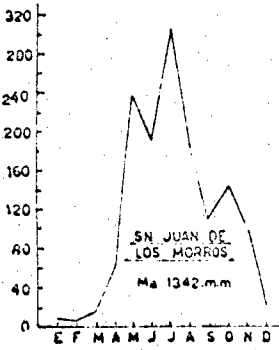
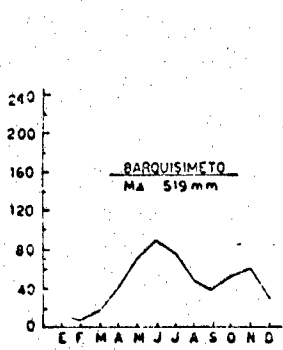
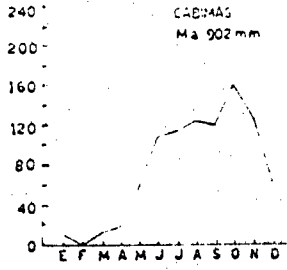
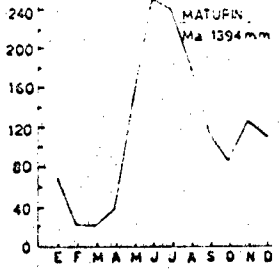
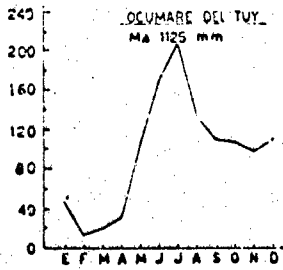
In most of Venezuela the rainy season begins around April and May and ends in October-November; the following months from November to April are dry or with moderate and irregular precipitation in some parts of the country. In the south of the Amazon area the rains fall the year round because of proximity to the equatorial zone. The areas north of the 11° parallel, particularly the mountainous areas on the coast have North Atlantic and not an inter-tropical pluvial regime, so that here the rainy season runs from October to February. Astronomic seasons have no influence on the climatic variations of Venezuela, due to the fact that its territory is subject to the influence of the thermal equator so that the climate of the lowlands and middle level areas belongs to the megathermic or intertropical group, with an average temperature of more than 22° C in the coldest month of the year. Only from December to February does the temperature decrease moderately in the northern parts of the country. In the lowlands average temperatures of 27° C and 28° C are recorded, while on the Andean peaks it falls below 0° C, with perennial snows and small glaciers in the Sierra Nevada de Merida.

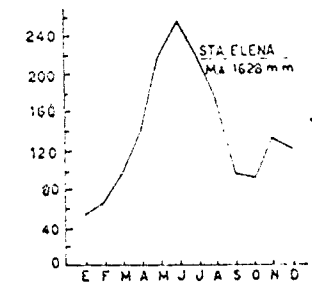
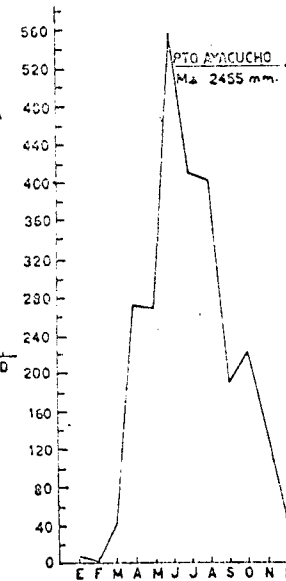
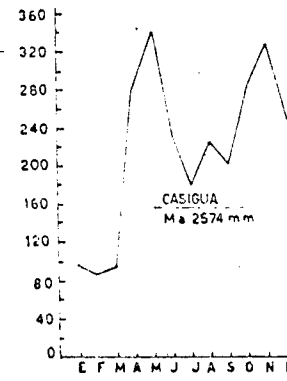
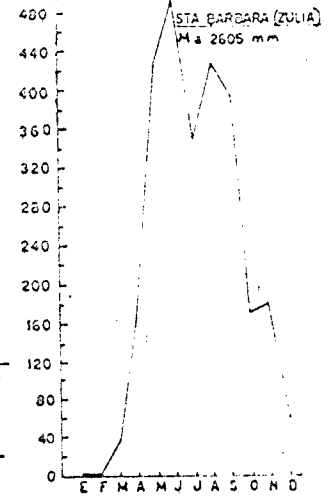
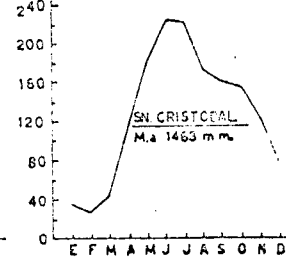
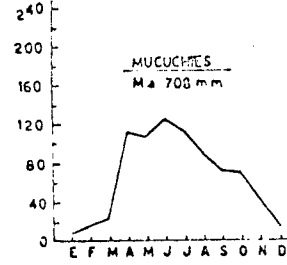
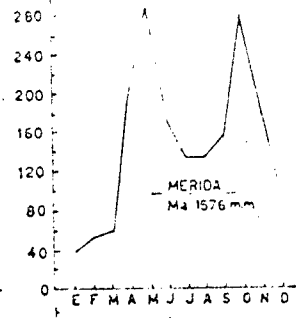
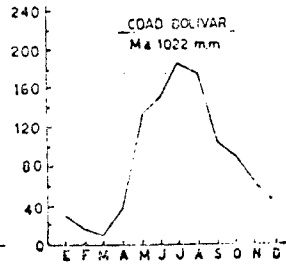
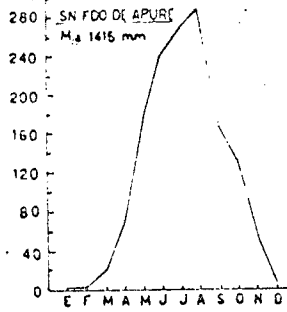
In undertaking a study of the bio-regions of Venezuela as a basis for the interpretation of some aspects of regional endemology, we will adopt in principle the climatologic classification by altitude levels of Koppen, with some modifications and additions applicable to our country mainly with respect to plant formations with regard to the features of the terrain, the temperature, rainfall and atmospheric humidity. Associating the relief features with the above-mentioned factors one will see more clearly the various ecologic niches which exist in the country. The concept of an ecologic niche in a very broad sense and in accordance with the definition originally formulated by naturalists will be used here to designate a bio-geographic unit occupied by groups of organisms which, due to the characteristics of the environment, constitutes a more or less distinct picture from that of the surrounding regions. Hesse in 1937, in his treatise Ecological Animal Geography defines an ecologic niche as a minimum primary unit to which different forms of life conditioned by the similarity of regional factors have uniformly adapted.

# Average Annual Precipitation of Various Localities of Venezuela









On the basis of the above, one can distinguish the following bio-regions in Venezuela.

## I.- BIO-REGIONS OF TROPICAL CLIMATE

Average annual temperature: 24° to 28° C; average temperature of the coldest month: over 22° C. Average annual rainfall more than 500 mm. Average relative humidity over 50%. In Venezuela these conditions are found in areas at altitudes between 0 and 800 meters above sea level. In this thermal level there are three well defined bio-regions.

### 1) Bio-regions of xerophilous climate

Average annual temperature of 28° C or more and average temperature of the coldest month above 22° C. Amplitude between the maximum daytime temperature and minimum night temperature of 10 to 12° C (amplitude of megathermal type). Specific correlation between rainfall and average annual temperature (high temperatures and low precipitation). Rainfall averaging about 500 millimeters annually. Average relative humidity of 50% or less (evaporation is greater than precipitation). Typical vegetal formation: thistle with areas of degradation, having a variable vegetation tending to disappear (hard pastures, sponge-tree, evergreen oak, etc). Typical area: Carora-Barquisimeto Depression.

### 2) Bio-regions of lowland tropical climate

Average temperature 26° C to 28° C depending on altitude. Amplitude of 6° C. (Macrothermal type of amplitude). Well defined seasons: the rainy season or winter, running from April to September; the dry season or summer, from January to April. Average annual precipitation of 1,200 to 1,800 millimeters. Average relative humidity from 50% to 75% or over during the rainy season. Typical flora formation: savannas, palm groves, the so-called mata woods and small gallery forests. Typical area: Ortiz (State of Guarico).

In these bio-regions are included the so-called deciduous forests (summer forests), made up of arboreal vegetation which is sometimes of great size, reaching its most luxuriant stage during the rainy season, in contrast with their appearance during the dry season. The presence of this kind of vegetation modifies to a greater or lesser extent the local climate. The flora formations constitute the transition between savanna and brush lowlands and the foothills, following the water courses which come down into the plains. The development of the vegetation depends on the fluvial network circulating in the area; the foliage disappears in those

areas where the rivers dry up in the summer.

3) Bio-regions of tropical forest climate (macrothermic forest, rain forest)

Average annual temperature more than 26° C. Uniformly hot climate, with macrothermic or megathermic amplitudes. Rainfall more or less evenly distributed throughout the year, with a very short summer. Average annual precipitation of more than 1,800 millimeters. Atmospheric humidity of over 75%. Typical flora formation: great forests, palm trees, grasses and shrubs in the clearings (heliophile vegetation) and trees with epiphytes and lianas. Typical area: Amazon Jungle (Amazonas Federal Territory).

II.- BIO-REGIONS OF SUB-TROPICAL CLIMATE (Inter-tropical of altitude):

Average temperature 19° to 22°C. Tropical or equatorial type of rainfall depending on latitude. Annual precipitation of 1,000 to 1,500 millimeters and atmospheric humidity above 75%. In the low valleys one finds a transition toward the summer type forest. In higher regions the flora formation comprises grasses, shrubs, tree ferns and trees with epiphytes and lianas. This is the thermal level of coffee plantations. These bio-regions are found in Venezuela between the altitudes of 800 and 1,500 meters above sea level. Typical area: Caribbean ( State of Monagas).

III.- BIO-REGIONS OF TEMPERATE CLIMATE (Clouded tropical forest):

Average temperature of 14° to 18° C, with the extremes of 5° C and 25° C. Variable rainfall depending on local conditions, decreasing progressively according to altitude. In the deep valleys located in areas of this climate there is a great deal of fog; Annual rainfall ranges from 900 to 1,800 millimeters depending on altitude (the greater the altitude the smaller the precipitation). Very high relative humidity, over 80%.

Typical flora formation: there are the following vegetation levels: a) mosses, lichens, fungi; b) grasses and ferns; c) shrubs and tree ferns; d) trees; e) epiphytes, orchids and bromeliaceae; f) lianas or vines. These bio-regions in Venezuela are found between 1,500 and 2,000 meters above sea level. Typical area: Colonia Tovar (Aragua State).

XEROPHILOUS REGIONS OF VENEZUELA  
(Shaded Areas in Maroon)

- (1) Península de la Goagira (2) Maracaibo (3) Depresión del lago de Maracaibo (4) Cordillera de los Andes (5) Sierra de Empalado (6) Quisiro (7) Capatárida (8) Punto Fijo (9) Los Taques (10) Pueblo Nuevo (11) Península de Paraguaná (13) Santa Ana (14) Coro (15) La Vela (16) Sierra de San Luis (17) Pedregal (18) Siquisique (19) Churuguara (20) Bobare (21) Depresión Carora-Barquisimeto (22) Carora (23) Barquisimeto (24) Yaritagua (25) Sarare (26) Quilbor (27) Sierra de las Misiones (28) Cúmarebo (29) San Juan de los Cayos (30) Valle de Aroa (31) Sierra de Aroa (32) Valle del Yaracuy (33) Sierra Santa María, en el tramo central de la Cordillera de la Costa (34) Puerto Cabeló (35) Valles de Carabobo (36) Cadena del litoral del Sistema montañoso de la Costa (37) Valles de Aragua (38) Cadena del interior del sistema montañoso de la Costa (39) Valles del Tuy (40) La Guayra (41) Valle de Caracas (42) Barlovento (43) Boca de Uchire (44) Depreción de Unare (45) Barcelona (46) Cumaná (47) Península de Araya (48) Isla de Margarita (49) Cardipano (50) Tramo Oriental del Sistema montañoso de la Costa (51) Río Caribo (52) Península de Parí (53) Delta del Orinoco.



#### IV.- BIO-REGIONS OF COLD CLIMATE

Average temperature of 5° to 10° C, with extremes of 5° to 25°C. Scanty rainfall, dry climate with atmospheric humidity less than 50%. Typical flora formation: brush in the lower parts (ferns, lycopods) while in the high portions the predominant vegetation is that characteristic of areas above the timber line, such as alpine mosses, growing in a xerophilous climate of altitude. In Venezuela these bio-regions are found at the altitude level between 2,000 and 3,500 meters above sea level. Typical Area: Paramo de Mucuchies (Merida)

Above 3,500 meters one enters the zone of eternal snows, whose extent is limited Andean mountain peaks and glaciers, with extremely scant vegetation represented by mosses and lichens.

We have described in general lines the main features of the bio-climate of the various altitude levels in Venezuela; one should note that in a given area one can find transitional variations which give rise to environmental conditions with special characteristics for certain regions.

Venezuela's tropical bio-regions are perhaps the areas where the greatest environmental variation is observed. Here we have xerophilous formations composed of thorny brush and low deciduous forests with terrestrial bromeliad plants on the floor; halophilous formations represented by the mangrove swamps; the great coastal valleys and depressions covered with macrothermic formations and the herbaceous cover of the plains where one finds gallery forests with various types of palm groves and wooded oasis called mata which are like islands of forest vegetation on the flatlands.

The xerophilous regions of Venezuela occupy a large portion of the country's territory along the coast and penetrating deep inland, from the shores of Falcon to the Lara depression, constituting what Prof. Tamayo calls the Falcon-Lara xerophytic pocket. Along the coast, these regions include the northern shores of the Paria promontory, the coasts of Araya, Cumana and Barcelona as far as the Unare depression, the shores of Cabo Blanco in the Federal District and those of the State of Falcon and the shoreline extending from West of the bar of Marcaibo to the peninsula of Goajira. In these regions are also included the coasts and lowlands of Margarita Island and the group of small islands of the Caribbean which are also federal dependencies. Toward the south of the Lara depression there is a flat arid zone which in some places is semi-desert and constitutes the large xerophilous zone of Barquisimeto-Carora. The Tocuyo Valley also has xerophilous features although they are not as pronounced as in the former.

The soils of these regions are highly calcareous and have a variable texture; they are very absorbent, without a humus cover and range in color from greyish-white to yellow, brown or purple. Rainfall is very scanty, ranging from 350 to 900 millimeters as a yearly average and decreasing from east to west as well as south to north. In the eastern portions the most abundant precipitation occurs in the months of June, July and August; toward the west, meanwhile, the greatest precipitation occurs in the last three months of the year. Due to these conditions, vegetation is sparse, limited to plants that are highly resistant to drought and require a minimum of moisture.

The phytogeography and particularly the plant associations of the xerophilous areas of Venezuela are well known from the works of Pittier and Tamayo. In 1957 Lasser and Vareschi published an interesting study on the bio-ecology and climate with respect to the vegetation of the dunes of Coro, Falcon State, where important data on the subject can be found. The endemic fauna, which is less well known, was partially studied by Marcuzzi and Racenis,

The most typical plants of the xerophile bio-regions of the country include: 1) seaside formations represented by mangroves (Laguncularia racemosa, Rhizophora mangle) and the beach grape (Coccoloba uvifera) and others; 2) thorny formations, typical of the dry coasts and of the Barquisimeto-Carora depression, where one finds different environments in various places. One also finds the typical desert environment with moving dunes, sands in constant movement and with no vegetation of its own; areas with very scanty herbaceous vegetation and some woody vegetation in neighboring areas, represented by the Cenchrus echinatus and the creeper Salicornia fruticosa. Intense solar radiation and the absence of water inhibits a less hardy vegetation. Typical areas of dunes are the Istmo de los Medanos in the Praguana Peninsula and the shore of Paraguaipoa on the Goajira Peninsula, where wind action keeps the sands thrown up by the sea in constant movement, preventing the development of plant associations. In stony and firmer soils of the coastal regions, the neighboring valleys and the Lara depression one finds another aspect: that of the thistle grown areas with associations of other thorny and woody plants. The species found here are mainly the Cactus caesioides, the Cereus and plants of the genus Opuntia. Over relatively large areas grows the Aristolochia ringens and terrestrial bromeliaceae. One also finds the Prosopis juliflora, the Croton glandulosus, the Cesalpinia coriaria, the Pereskia guamacho and the acacia Delonix regia. From this intermediate zone one passes into the deciduous forest of thorny plants, usually located at a higher altitude and composed of a larger number of species, among

the Bursera simarruba, the Pilocarpus, many species of Euphorbiaceae such as the Jatropha curcas and the Plumeria alba are the most important. In the prolongation of the maritime valleys inland, woody vegetation reaches greater development and great trees become mixed with the brush that constitutes the so-called xerophilous forest. Among these trees we have the Ceiba pentandra, the Hura crepitans, Bulnesia arborea, Pachira insignis, Tabebuia pentaphylla, Didymopanax morototoni and others. These deciduous forests are found mainly in the Lara depression, the interior valleys of Aragua State and in the north of the states of Anzoategui, Sucre and Monagas.

A brief description of the xerophilous environment as above leads to the supposition that in such desert, semi-desert and deciduous forest zones animal life may be practically impossible. The facts, however, do not bear this out. Conditioned by light and dryness a sui generis fauna has arisen here, consisting of species from other bio-regions but differing from them as to coloration and physiology. But there also is a typical endemic fauna of xerophilous regions which must be studied more carefully in Venezuela. According to Marcuzzi, certain species of coleoptera of the family of Tenebrionidae are typical of the xerophilous regions of the country. Some species acquired habits similar to those of the noctilopes, appearing only after sundown. Many species of mammals and reptiles, particularly rodents, have a coloration that mimics the colors of the ground. The great majority of insects have subterranean habits and others hide under stones, cavities in rocks or holes in trees and have a tendency to pseudo-albinism. During the rigorous summers the insects and some geohelminths go through a dormant period equivalent to the hibernation of some animals of temperate zones; but when the rains come the development of the insects' embryos and gonotrophic cycles is exacerbated. Everything is born, grows and mates at a vertiginous rate completing vital cycles that are adapted to the brief rainy season. As to the arthropods, to mention only two genera that are of interest to us: the Phlebotomus and the Gulicinus, they remain active after the rainy season until the environmental humidity decreases progressively to the point where they become dehydrated; despite this fact they survive for some time due to the characteristics of their exoskeleton which gives them a high degree of drought resistance. The Anopheles acuasalis breeds in the coastal areas and its larval stages have become adapted to briny water up to a content of 33 parts per thousand of sodium chloride. It is found in xerophilous zones and has been found to be the vector species of malaria in the eastern focus (bottom of the gulf of Paria and southern coast of the peninsula of the same name). The Phlebotomus panamensis



an important transmitter of *Leishmaniasis tegumentaria* in areas of luxuriant vegetation, has been found by Anduze and Ortiz in the xerophilous zones of the depression of Lake Maracaibo where this disease is also endemic. It has not been determined whether microclimates for this species of *Phlebotomus* exist in xerophilous zones or whether these are incursions of the insect from neighbouring areas with a similar vegetation and environmental humidity. During the rainy season various species of *Culex*, *Anopheles*, *Culicoides* and *Tabanus* are also abundant. Three vector species of the barber bug fever have been determined in the xerophilous zones of the country: *Rhodnius prolixus*, *Triatoma maculata* and *Panstrongylus geniculatus*. The *Rhodnius prolixus* has a very wide geographic distribution both in the coastal lowlands and in the plains and hill country. The *Triatoma maculata* is frequent in eastern coastal areas and of Falcon, on the Paraguana Peninsula, the island of Margarita and the Lara depression. It is found not only in houses but also in chicken and pigeons coops and under the bark of dead trees. We found them in cavities in the mud walls of huts in the Barquisimeto-Carora area under conditions of complete dryness and easily confused with the mud that was adhering closely to the exoskeleton. This is a species that is highly resistant to physical agents and can withstand high temperatures as well as very low hygro-tropic conditions. Although under natural conditions it is found infected by the *Schizotrypanum cruzi* it is considered as a secondary vector of this fever because of its feeding habits since it prefers fowl, feeding on man when its usual source of food fails. A better evaluation of the *Triatoma maculata* is needed from the epidemiologic point of view with respect to the barber bug fever in areas where the *Rhodnius prolixus* does not exist. The *Panstrongylus geniculatus* was found by us in the caves of xerophilous regions of the Lara depression, infected under natural conditions by the *Schizotrypanum cruzi*. We have confirmed this same infection in *Dassypus novencinctus* caught in the caves of this same region. Scorpions, particularly the *Rhopalurus laticauda* Thorell 1876 are abundant in the western xerophilous zone, in the Paraguana Peninsula and on the island of Margarita. According to Prof. Scorza, who made detailed studies on the scorpions of Venezuela, this species forms colonies of up to 50 individuals in subterranean galleries where it can be recognized by its muddy yellow color with the last segment of the tail being black. It is also found under the fallen trunks of thistles. According to Prof. Scorza this scorpion can be considered as typical of the xerophilous regions and it has not been found at altitudes above 556 meters above sea level. In these areas the millipedes of the genus *Scolopendra* are also abundant.

The Black Widow spider is abundant in the xerophilous coastal areas. It is a little over one centimeter long, it is black with a red spot like a sundial on the underside of the abdomen. This arachnid lives in dark cavities, under stones or abandoned pieces of wood. Its poison is highly neurotoxic and is responsible for the majority of serious accidents in America. In Venezuela, the spiders known by this name belong to the genus Latrodectus and up to know two species have been defined: Latrodectus curasavicus which occurs in the xerophilous areas of Zulia and Falcon, particularly on the Paraguana Peninsula; and the Latrodectus geometricus which is found in the state of Anzoategui. A species of "monkey spider" (hairy spider) with a histolytic and necrotizing poison, the Avicularia minatrix has been found in the xerophilous zone of the State of Lara. A kind of skin lesion, observed by Homez in Maracaibo in hundreds of cases and described by him quite precisely as a "lineal vesiculous dermatitis" is produced by the contact of the skin with a small coleopterus of the family Staphylinidae: the Pederus colombinus which is very abundant also in other areas of the country particularly during the summer. Lepidopteran dermatitis produced in epidemic form by contact of the skin with hairs from the butterfly Hylesia urticans which lives in mangrove swamps was observed in the eastern xerophilous zone.

In the coastal area of the country including Catia la Mar and Caraballeda we have xerophilous formations where the Australorbis glabratus has become well adapted; it is the intermediate host of the Schistosoma mansoni and is abundant in the streams and rivers flowing into the Caribbean. On the rocky coasts and in slow fresh water currents of the Lara depression there are molluscs in which develop trematodes of fish and aquatic birds whose cercariae produce dermatitis in persons who come into contact with these waters. Also abundant are rattlesnakes (Crotallus terrificus) and poisonous coral snakes in these xerophilous regions. The Bothrops lansbergii has been found in the xerophilous areas of the east, in the Lara depression and the Maracaibo depression.

The pathobiology of the xerophilous regions of Venezuela is not as restricted as one might think on the basis of the environmental conditions. There is a focus of malaria in the xerophilous areas of the eastern part of the country where the vector, as we saw, is the Anopheles aquasalis. The barber bug fever is frequent in these areas in places where there are houses infested with Rhodnius prolixus. Cases have also been confirmed of Leishmaniasis tegumentaria and visceral Leishmaniasis or Kala-azar which make it necessary to conduct research relating to the Phlebotomus in these areas. In the xerophilous parts of the Lara depression, of the southwest sector of the Yaracuy valley and the depression of Lake Mara-

caibo cromomycosis is frequent. The Barquisimeto-Carora depression is a focus of coccidioidomycosis, a disease of arid and dusty places. In these areas another frequent disease is histoplasmosis; the Histoplasma capsulatum has been isolated from soil samples taken from a cave in the vicinity of Sarare (Campins). The large numbers of flies that appear at the start of the rainy season is an important factor in the high incidence of intestinal amoebiasis, frequently complicated by very severe hepatic localizations, particularly in children (amoebian hepatic abscess). Intestinal parasitoses are quite common, particularly ascariidiosis, due to the great resistance of the eggs of this worm to desiccation. The characteristics of the soil, intense insolation and low humidity are not favorable to the maintenance of anchilostomiasis with a prevalence comparable to that of other bio-regions of the country which have a tropical ecology. The coastal areas of Zulia, Falcon, Anzoategui and Sucre as well as the Lara depression have the lowest incidence of parasites of this type, with indices of 20 to 25% and only 1% of infections with 100 worms or more. It should be noted that despite the low incidence of intense infections, one observes here pictures of severe anemia among those suffering from these parasites due to conditions of nutritional deficiency because of the poor nutritional resources of these areas because of the xerophilous nature of the environment. Clinical observations show that viral hepatitis is very severe in rural communities of the xerophilous regions which is frequently complicated by post-necrotic fibrosis. Important factors which contribute to the situation are pre-existent conditions of nutritional deficiencies and possibly an increase in the virulent potential of the causal agent in the vector elements, particularly flies, as a result of the high temperatures. The same nutritional deficiencies explain the frequency of hepatic estheatorsis both in children and adults in these areas, which constitute the basis for the progressive development of hepatic cirrhosis.

Below are mentioned some of the communities which are located in these areas of xerophilous characteristics. The data on average annual temperature and average annual precipitation have been calculated according to the provisional climatologic Atlas of the Meteorological Service of the Air Forces of the Ministry of Defense (1951-1955). Some data have been taken from Climatologia de Venezuela (The Climatology of Venezuela) by Epifanio Gonzalez. Marco Aurelio Villa's Regiones naturales de Venezuela (The Natural Regions of Venezuela) was very useful in dealing with physiographic aspects.

Very careful research on the pathobiology of Venezuela's xerophilous regions is necessary, particularly with regard to the existence of microclimates and other environmental factors and bio-ecologic factors conditioning the existence of various diseases in these areas of the country.

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
La Asunción	10 m.	27° C	700 mm.
Río Caribe	3 m.	27° C	800 mm.
Carúpano	15 m.	26.5° C	800 mm.
Cumaná	3 m.	27° C	400 mm.
Píritu	100 m.	27° C	500 mm.
Barcelona	5 m.	27° C	650 mm.
La Guaira	5 m.	27° C	550 mm.
San Juan de los Cayos	5 m.	28° C	700 mm.
Puerto Cumarebo	5 m.	27° C	500 mm.
La Vela	5 m.	28° C	450 mm.
Coro	15 m.	28° C	450 mm.
Santa Ana	100 m.	28° C	600 mm.
Pueblo Nuevo	80 m.	28° C	550 mm.
Adicora	5 m.	28° C	400 mm.
Los Taques	5 m.	28° C	400 mm.
Punta Cardón	5 m.	28° C	400 mm.
Capatárída	10 m.	28.5° C	400 mm.
Quisiro	15 m.	28° C	500 mm.
Maracaibo	6 m.	28.8° C	575 mm.
Barquisimeto	556 m.	25° C	500 mm.
Bobare	654 m.	24.25° C	500 mm.
Santa Rosa	500 m.	26.50° C	650 mm.
Siquisique	290 m.	26° C	600 mm.
Carora	425 m.	28° C	600 mm.
Quíbor	450 m.	27° C	500 mm.

Key: 1) Locality 2) Altitude above sea level 3) Average annual temperature 4) Average annual precipitation.

Continuing our study of the country's tropical region's, we will now give a detailed description of the principal depressions, valleys and extensive flatlands with different bio-ecologic environments, which are of interest in an examination of the prevalence of endemic regional diseases in rural Venezuela.

The depression of Lake Maracaibo is perhaps the one with the biggest environmental variations: there is a gradual succession from north to south of xerophilous formations, savannas with large areas covered by deciduous forest and dense humid macrotermic jungles (rain forests).

From the point of view of the political division, this depression is almost entirely located within the State of Zulia and it is surrounded by the Andean Cordillera and its dependencies: the Perija and Montes de Oca mountains to the west which run into the lowlands at Paraguaipoa; the Jirajara mountains (also called Siruma and Empalado) to the east on the border with the States of Lara and Falcon; the Andes themselves to the south which enclose it like a horseshoe. In this depression lies Lake Maracaibo with an area of about 14,500 square kilometers and a much larger surrounding territory lying between sea level and an altitude level of 500 meters. Despite the low elevation of this area, local climate conditions are very varied, ranging from the wind whipped dunes of Paraguaipoa and the mangrove swamps of Sinamaica to the dense rain forests to the south of the lake.

The distance between the lake and the surrounding mountains is very variable with the maximum extent being in the south, where it ranges up to 100 kilometers.

The numerous rivers having their headwaters in the mountain system surrounding this area flow down the slopes and along the flatlands into the lake, which is fed by this rich fluvial network; the main rivers here are the Motatan, the Zulia, the Escalante, the Catatumbo and the Limon. To the north of the lake the coast is characterized by the presence of mangrove swamps. Here we have the lagoon of Sinamaica, fed by the Limon river which comes down the mountains and empties in the Bay of Tablazo at the entrance of the Bar of Maracaibo. Farther south the land is higher and drier, constituting a plain that runs as far as Maracaibo. Following the lake shore to the mouth of the Palmar River, the landscape grows richer in vegetation but the ground remains dry and with a scanty river network. From the Palmar River to the river of Santa Ana there are more rivers and more vegetation. To the west and toward the Perija mountains the ground becomes higher; this area is inhabited by Indian tribes of Caribbean origin, with two main ethnic branches: the Goajira and the Mutilon and there are groups of these Indians in the areas of Apon and Aponcito, the Rio Negro river and the

Tucucos zone as well as in Agua Blanca and Araguasi. From the Santa Ana River, which comes down the Mene mountains with the name of Lora River, to the Chama River there is a broad area running from the lake to the foothills which has numerous rivers, the most important being the Zulia, the Escalante and the Chama. This is a rather flat area, interrupted by irregular hills toward the southwest and the last Andean foothills as well. This is the area of swamps, many of which are quite large and linked by a dense fluvial network. There is the swamp of Morotuto with an area of about 20 x 30 kilometers, made up of numerous rivers coming down the Andes of Tachira and Merida and which constitutes the source of the Escalante river; the swamp of Onia and Laguneta de Zulia, covered by Eichornias (water lilies), various reeds and Cyperaceae, with an area of about 20 x 6 kilometers; the swamp of Chama, where the river of the same name empties; that of Aguas Negras, of Juan Manuel, Motilones, Boyera, Valderamas, Mariana, Lagunillas, Mene and many others, which are formed along the rivers and low lying areas. This is a lush region where there is a dense tropical forest. From the Chama River to the mouth of the Motatan on the eastern shores of the lake, the area is fertile and wooded and is watered by numerous rivers flowing down the Andes. The greater slope of the ground here makes it less subject to flooding and there are few swamps, except in the rainy season. From the Motatan River to the Oribono Point, which is the junction point with the Caribbean coast, the lake receives the rivers originating in the Jirajara mountains; they are less numerous and have a smaller water volume than those mentioned above. The eastern flatlands running toward the northern dry areas are called El Cenizo plains and belong to the State of Trujillo. Farther north one begins to note the same transformation observed on the opposite bank of the channel linking the lake with the gulf: the ground becomes drier and the vegetation decreases until one reaches the area of Santa Rita and Altigracia with its dry and hot climate.

To the north of the Limon River is the Goajira with dunes running parallel to the coast. These are low sand hills either isolated or grouped into small mountain chains. The largest dunes area lies between the vicinity of Sinamaica and Paraguaipoa, gradually phasing out in the direction of the extremity of Goajira Peninsula. This area is inhabited by the Goajira Indians, nomadic tribes with a tendency to migrating toward Maracaibo.

The temperature in the depression is generally high. In the northern parts the annual average reaches 28° C in a belt running from the shores of the lake and the gulf to about 40 kilometers inland. Toward the south, the average temperature is about 27° C. In the Andean foothills average

temperatures of 26° and 25° C are recorded and on the heights of the Perija mountains the temperature goes down to 12° C. Maximum temperatures have been recorded in the Lagunillas area (40° C), while the highest minimum temperatures have been recorded in Maracaibo (20.2° C) because this city is located far from orographic formations and is surrounded by terrain with extremely scarce vegetation.

Rainfall in the southern and northern portions of this area varies. In the north the rainy season runs from April to October or November, with precipitations of up to 570 millimeters. In the south and particularly in the region of Cataumbo, there is rainfall the year round, with precipitation of up to 4,500 millimeters. Atmospheric humidity is relatively low in the northern parts of the depression while it is very high in the south due to high evaporation from the lake and the numerous swamps, rivers and lush vegetation.

The Lake Maracaibo region is subject to steady winds from the north and northeast; there are also periodic winds blowing from the south and southeast from May to November. There are strong breezes during November and December and winds of lesser intensity during February and March. The intensity of the rains in the south and west of the lake is explained by the fact that the northeastern winds, saturated with moisture, condense in the hills southwest of the lake; while in the eastern part the Jirajara mountains prevent the passage of these winds into the lake basin, which release a large quantity of moisture during their passage over the Lara-Falcon formation.

According to the above two types of sub-regions can be distinguished in the Lake Maracaibo depression: the dry one with xerophilous and savanna formations, which are very hot and with average annual precipitation below 750 millimeters; and the humid regions with jungle and rain forest formations, which are also hot but have high pluviosity and a very high atmospheric humidity.

In the dry sub-region we have the following localities:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Maracaibo	6 m.	28.8° C	573 mm.
Chiquinquirá	65 m.	28° C	700 mm.
Santa Cruz de Mara	5 m.	28° C	750 mm.
Paraguaiipoa	5 m.	28° C	500 mm.
Sinamaica	10 m.	28° C	600 mm.
Cabimas	5 m.	28° C	750 mm.
Altagracia	5 m.	28° C	500 mm.
Quisiro	15 m.	28° C	450 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.

In the humid sub-region, among others, we have the following communities:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Machiques	150 m.	26.8° C	1.600 mm.
Encontrados	10 m.	27° C	2.000 mm.
Bobures	5 m.	27° C	1.600 mm.
El Vigía	90 m.	27° C	2.000 mm.
Santa Bárbara	10 m.	27° C	1.600 mm.
Casigua	50 m.	27° C	2.500 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.

To the north of the Lake Maracaibo depression, endemic diseases include the group which makes up the pathobiology of xerophilous regions, while to the south frequent diseases are Leishmaniasis tegumentaria americana, barber bug fever, Trypanosomiasis rangeli, amoebiasis, anchilostomiasis and other intestinal parasitoses as well as superficial, intermediate and systemic mycoses. Visceral Leishmaniasis (Kalaazar) has been confirmed in this region. Nutritional deficiencies in children are prevalent in this region just as in the rest of the country.

In the Perija mountains carate and leishmaniasis tegumentaria americana have an endemic character. To the south of the lake, in the forest areas with settlements built on stilts in flooded and swampy areas, there is a focus of malaria transmitted by the Anopheles nunez-tovari. The rain forest to the south of the depression is a severe focus of Leishmaniasis tegumentaria americana and jungle yellow fever. In the forest areas the Bothrops atrox is abundant, known by the name of Guayacan; accidents produced by the bite of this fearsome ophidian are frequent among the peasants of this area. The Bothrops lansbergii has been found in Perija and here also it is suspected that the Bothrops xanthogramma exists; it is known in the neighboring mountainous areas of Colombia by the name of boquidorada (golden mouth) because of the golden yellow color of the supralabial plaques. The Crotalus terrificus is found in the xerophilous areas of the depression.

The endemic fauna of the Lake Maracaibo depression, particularly that which is noxious to man, needs further study; more research is also needed on the pathobiology of the various ecologic niches particularly in the partially explored big jungle areas.



Embedded in the foothills of the coastal range is the Yaracuy depression. It is an large region bounded on the north by the Sierra de Aroa and the central portion of the Cordillera de la Costa range in the south. In the west it is linked with the Lara depression and in the east its continuation constitutes the maritime valleys that run from Puerto Cabello to Tocuyo de la Costa. Its area is of about 5,000 square kilometers and comprises a large part of the state of Yaracuy and small portions of the states of Carabobo, Lara and Falcon. The depression runs from northeast to southwest, and its topography, which is relatively regular, has a slope ranging from an altitude of 500 meters in the Yaracuy-Lara border area down to sea level in the northeast. The characteristics of this landscape permit considering this depression as an extensive valley originally covered with dense forests. Since the time when the indians populated this area and colonists from Europe came to occupy it, the forests were cut down and burned slowly, being replaced by areas with a natural secondary vegetation cover, represented by large zones of herbaceous formations and brushland. This process of slash and burn has been going on continually over the years until now, for the purpose of establishing small farms and plantations in the areas thus opened, which explains why the main activity in the Yaracuy valley is farming. Nevertheless, most of the valley is still covered with deciduous forests, particularly in the foothills. Toward the north of the Yaracuy Valley, separated by the Aroa Mountains, there is the Aroa Valley running from east to west and with an area of about 300 square kilometers. The Bobare Mountains separate it from the Lara depression. This is an alluvial valley with dense rain forests, which runs into the maritime valleys by joining that of the Yaracuy.

The soils of the valley are very fertile because these are alluvial deposits very rich in organic matter. Experts regard this as one of the best agricultural lands in the nation. This is an essentially agricultural area, where bananas, sugar cane, root crops, corn, carrots, rice, tomatoes, onions, potatoes, garden vegetables, citrus, cotton and other crops are grown. In addition to population centers there is a very numerous scattered population concentrated in small groupings at the foot of the hills, depending on the crops grown. Coffee and cocoa growing, which flourished in the past have decreased significantly. The agricultural future of the Yaracuy valley depends on irrigation; without it it will not be possible to develop all the potential wealth of its soils and there will be no revival among its rural population.

In some regions there are small savannas with flora formations very similar to those of the Barinas and Portuguesa plains which will be described later. There are also areas

of definite xerophilous type, with thorny vegetation and xerophilous deciduous woodlands in the Caribbean coastal lowlands and in the southwest of the valley, running toward the Lara depression. At this level, the valley comes into contact with the Portuguesa plains through the Cabudare gorge.

In the basins of the Yaracuy and Aroa rivers there are different species of palm trees represented by the Roystonea venezuelana, the Attalea sp. or water palm and the round palm or Sabal mauritiaeformis. Scattered over the valley there are small lakes covered with tiny aquatic plants and floating plants (Lemnaceae) while in some places water lilies (Eichhornia crassipes) and reeds (Cyperus articulatus) also grow.

In the basin of the Aroa River there is an extensive rain forest with a great variety of usable hardwoods, only a few of which, namely the caoba and cedar have been exploited. The richness of the soil in humus, the topography of the terrain and abundant annual precipitation have created in the Aroa valley specially favorable conditions for the formation of a rain forest very rich in palm species. The trees attain gigantic proportions, many of them being over 30 meters in height, covered with Bromeliaceae and epiphytic orchids. The extensive tree tops and their height stop sunlight from reaching the forest floor so that the vegetation develops vertically, there being numerous climbing vines and lianas that climb up the trunks and spread over the tree tops thus contributing even more to the darkness below. The climatologic conditions of the forest regions, which are uniform almost throughout the entire year are favorable to the development of a very varied entomo-fauna of great medical importance. The abundance of stagnant waters and of epiphytes with big axillary spaces in their leaves where water gets collected and the numerous micro-aquariums formed by the inflorescences of the Heliconia favor the growth of ciliated protozoa, flagellates and micro-crustaceans which serve as food for the larvae of the mosquitoes which transmit Leishmaniasis (Phlebotomus) and jungle yellow fever (forest Hemagogus and Aedinos). Similarly the waterfalls of permanent flow and in the marshy areas harbor an abundance of Simuliids and Culicoids whose role in the transmission of Oncocercosis, Mansonella Ozzardi, Dipetalonema perstans and the filaria of monkeys in this region has not been studied. This jungle area is very rich in birds and mammals, particularly various species of monkeys which must be studied in connection with encephalitis and yellow fever. There is a great abundance of Megalomorphous spiders of the genera Ischnothele, Thalérothelè, Metriopelma and Avicularia; scorpions of the genera Chactas, Centruroides, Tityus and Rhopalurus; poisonous ophidians such as the Bothrops atrox, the Micrurus lemniscatus, the Microrus bipartitus and the Micrurus coralinus riisei. The Crotalus terrificus is

found in savannas with stony areas in the vicinity of the foothills of the Aroa Mountains in the central portion of the valley (Sabana de Cascavel [Rattlesnake Savanna] to the north of the town of San Felipe) and in the west of the depression (the Yaritagua xerophilous zone).

The whole Yaracuy depression is subject to the effect of the northeast trades; the moisture they carry is condensed over the mountains which surround it in the north and south, giving rise to tropical cloudy forests above the 1,000 meters mark above sea level in the Aroa and the Santa Maria mountains. These winds travel over the entire extent of the valley being warmed up and lose their moisture as they travel without obstacles toward the Lara depression. They usually blow in the afternoon, being more intense from November to February. These phenomena determine some environmental features in various parts of the valley, particularly those relating to temperature and rainfall. Temperature is uniformly high over the whole valley, with variations depending on latitude and also altitude. In Yumare, in the eastern part of the depression, with an altitude of 60 meters above sea level, the average annual temperature is of 28° C while in San Felipe, in the central part of the valley and with an altitude of 225 meters, the average annual temperature is 26.5° C. In Yaritagua in the west of the depression and with an altitude of 390 meters the average annual temperature is 25.6° C.

The rainy seasons runs from April to October, sometimes running into November. In December and January drizzle is observed in the direction of the Aroa valley. The months of February and March are dry. Average annual precipitation varies in different parts of the valley, decreasing from east to west. In the tropical forest of Yumare to the northeast, the maximum rainfall is 1,600 millimeters a year, while in the xerophilous area of Yaritagua in the west the precipitation is 850 millimeters. Between these extremes we have the Marin region in the central sector of the depression, with 1,500 millimeters; in Chivacoa in the west the precipitation is of 1,300 millimeters. The former tends toward the pluvial regime of the rain forest while the latter has a regime corresponding to that of xerophilous areas. Atmospheric humidity in the depression ranges from 70% to 100%, also decreasing from west to east. The mountains limiting the valley have altitudes reaching 1,600 meters above sea level, there being a succession of climatic levels represented by subtropical and temperate climate zones (tropical cloudy forest) with the characteristic flora formations of these bio-regions.

Among the population centers of the Yaracuy depression with a tropical climate we have the following:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
San Felipe	225 m.	26.5° C	1.400 mm.
Cocorote	400 m.	24.6° C	1.300 mm.
Guama	420 m.	25.8° C	1.200 mm.
Boraure	190 m.	26.5° C	1.200 mm.
San Pablo	340 m.	25.8° C	1.200 mm.
Chivacoa	300 m.	26° C	1.130 mm.
Campo Elías	500 m.	24° C	1.250 mm.
Urachiche	381 m.	25° C	1.000 mm.
Yaitagua	390 m.	24.6° C	850 mm.
Los Rastrojos	450 m.	25.8° C	900 mm.
Sararé	320 m.	26° C	900 mm.
Cabudare	440 m.	25.8° C	900 mm.
Aroa	250 m.	25.6° C	1.300 mm.
Yumare	60 m.	27° C	1.600 mm.
Marín	112 m.	26.4° C	1.500 mm.
Farriar	50 m.	27° C	1.450 mm.
Urama	55 m.	26.5° C	1.300 mm.
Morón	20 m.	27° C	1.300 mm.

In the maritime valleys which prolong the depression eastward and in the vicinity of the forested areas of San Esteban there is the town of Puerto Cabello, at an altitude of 5 meters above sea level and an average annual temperature of 26.7° C. This is an important port and in this area there are mangrove swamps to the east and semi-xerophilous terrain to the west.

To the south of the Yaracuy depression and in the central portion of the Cordillera de la Costa there are small valleys nestling among the hills with the following main population centers, which also have a tropical climate:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Nirgua	798 m.	22.5° C	1.200 mm.
Salom	768 m.	22.6° C	1.200 mm.
Temerla	750 m.	23.4° C	1.000 mm.
Miranda	625 m.	23.4° C	1.000 mm.
Montalbán	675 m.	23° C	1.200 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.

To the west of the Yaracuy depression and separated from it by small hills which run from the Aroa Mountains in a north-south direction toward the central portion of the Cordillera de la Costa, there is the Lara depression which comprises most of the State of the same name and the southern part of the State of Falcon. Its limits are the San Luis Mountains in the north, the Portuguesa and Barbacoa mountains in the south, and the Siruma and Emplado mountains in the west. The gorges of Santa Rosa and Cabudare in the northeast connect this depression with that of Yaracuy and with the Portuguesa plains respectively. In the Lara depression there is the Barquisimeto-Carora xerophilous zone which has already been described. There also are extensive areas of irregular topography with valleys at variable altitudes, covered with herbaceous formations similar to those of the Portuguesa plains, intermixed with xerophilous vegetation, brushland and woodlands that follow the course of the rivers and foothills of the mountains slopes. In this region the temperature is high but more moist than in the xerophilous region, for here, precipitation exceeds 750 millimeters as an annual average due to the condensation of the trade winds on the neighbouring mountains. Among the communities in this portion of the Lara depression we have the following:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Duaca	275 m.	24.5° C	800 mm.
El Tocuyo	620 m.	24° C	900 mm.
Curarigua	600 m.	24° C	800 mm.
San Francisco	600 m.	24° C	800 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.

To the west of the Lara depression are the Portuguesa and Barbacoas Mountains, which run into the Andes. These mountains which are geologically regarded as belonging to the same formation harbor depressions and extensive valleys at varying altitudes where there are numerous population centers. We shall mention here only those which are comprised in altitude levels with the bio-climatic characteristics of the tropical environment.

The following are the principal communities located in this area:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Biscucuy	600 m.	23.5° C	1.000 mm.
Trujillo	790 m.	23.5° C	950 mm.
Valera	550 m.	25.5° C	900 mm.
Pampán	500 m.	25.5° C	1.400 mm.
Pampanito	380 m.	25.7° C	1.400 mm.
Betijoque	560 m.	24.5° C	1.000 mm.
Isnotú	725 m.	23° C	1.200 mm.
Motatán	350 m.	25.5° C	950 mm.
Santa Cruz de Mora	622 m.	23.5° C	1.000 mm.

Significant because of its extent and the relationships it sets up with neighbouring areas is the Tachira depression, which lies between the eastern part of the Andes Cordillera (beginning of the Perija Mountains) to the west and the Merida Mountains in the east. In the north it extends toward the southwestern part of the Maracaibo depression and in the south it is linked to the Barinas plains. The following localities with a tropical climate are found in this depression:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
San Cristóbal	820 m.	22.5° C	1.400 mm.
San Antonio del Táchira	438 m.	26° C	800 mm.
Ureña	300 m.	26° C	1.000 mm.

Between the coastal chain and the interior cordillera of the Costa mountain system are the valleys of the central-coastal part of the country, represented principally by the big valleys of the Carabobo and Aragua; farther to the east are the valleys of Caracas and of Tuy and Barlovento.

The valley of Carabobo runs from the Trincheras gorge in the west to the lake of Valencia where it continues along the valley of the Aragua. The Puerto Cabello slopes limit it in the north and the Aguacate and Teipa mountains in the south. This valley continues in the southwest into the plains of Tinaco, which is the northern entrance to the central plains. The following are the main localities of the Carabobo valley:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Valencia	480 m.	24.6° C	1.200 mm.
Los Guayos	441 m.	25° C	1.200 mm.
Naguanagua	490 m.	24.5° C	1.200 mm.
Tocuyito	450 m.	25° C	1.200 mm.
Guacara	438 m.	25° C	1.200 mm.
San Joaquín	435 m.	24.8° C	1.200 mm.
Güigüe	453 m.	24° C	1.000 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.

The Aragua Valley also lies between the coastal and inland portion of the Cordillera de la Costa mountain system and runs from the lake of Valencia to Guayas in the foothills separating it from the Tuy valley. The following are the main localities in this valley:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Maracay	445 m.	26° C	900 mm.
Turmero	490 m.	25.5° C	1.000 mm.
La Victoria	550 m.	25° C	1.200 mm.
San Mateo	480 m.	25.5° C	1.000 mm.
El Consejo	500 m.	24° C	1.000 mm.
Tejerías	550 m.	24° C	1.200 mm.
Cagua	460 m.	25.5° C	1.000 mm.
Villa de Cura	556 m.	25° C	1.100 mm.

The interior range of the Cordillera de la Costa mountain system to the south of the Aragua valley presents a depression which establishes direct access to the plains. Here is the locality of Villa de Cura on the banks of the Tucutunemo river, just at the spot where the river changes direction abruptly leaving the valley and running into the plain. Here begins the plain extending south from the locality and becoming gradually narrower toward Bocachica, spreading out again in the Puerta region. Here is a narrow gorge running through the San Jose chain establishing a link between this region and the valley of San Juan de los Morros. All this area (the valleys of Villa de Cura, Bocachica, la Puerta and San Juan) constitute part of the extensive basin of the Guarico River, which has its upper course in the Belen region west of Villa de Cura, soon entering the plains. In small valleys lying in the mountains of the interior in this system of the coastal area with the valley of Aragua constituting the limits in the south, we have, among others, the following localities:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Belén	700 m.	23° C	1.500 mm.
San Sebastián	350 m.	25° C	1.000 mm.
San Casimiro	480 m.	24.5° C	1.100 mm.
Valle Morín	600 m.	23.5° C	1.100 mm.
Camatagua	250 m.	25.5° C	1.150 mm.

Key: 1) Locality; (2) Altitude above sea level;  
3) Average annual temperature; 4) Average annual precipitation.

In the mountains enclosing the valley to the north, there are gorges giving access to the humid and forested coastal valleys where we have the localities of Ocumare de la Costa at an altitude of 10 meters above sea level, average annual temperature of 27° C and annual precipitation of 1,000 millimeters; and Choroni, at 50 meters of altitude, average annual temperature of 27° C and annual precipitation of 1,200 millimeters.

The climate of the Carabobo and Aragua valleys is hot, with the humidity conditioned by the rainy season. This is due to the fact that the trade winds blowing in from the sea and bearing moisture encounter a mountainous barrier of more than 1,000 meters of altitude, which prevent their access to these valleys. This is partly compensated for by the evaporation of the waters of lake Valencia and the moist winds blowing from the east which penetrate by the gorge where the river Tuy flows and which links the valley of the same name with that of the Aragua. The Carabobo valley, particularly in the southern section is very similar to the Cojedes plain. There are large herbaceous formations and brushland, with some areas of xerophilous vegetation, deciduous forests, flat farmland and pastures.

The Caracas valley is a depression in the Costa mountain system. It is the bottom of an ancient lake, lying between the coastal range of this system and the Maestra mountains which runs north from the Cadena del Interior separating the Aragua valley from that of Tuy. This is an alluvial valley, with an altitude ranging from 900 to 1,000 meters above sea level, surrounded by mountains, with opening toward the east in the direction of the Tuy valley and in the west (the gorge of Tacagua) opening toward the coastal areas of the Caribbean. In this valley we have the city of Caracas, capital of the Republic. The average temperature is 22° C, with extreme maximum of 33° C and extreme minimum of 8° C. The average annual rainfall is of 805 millimeters, with a maximum of 1,250 millimeters and a minimum of 500 millimeters. The prevailing winds are from the southeast.

Between the mountains of Codera cape on the north and the interior chain of the Cordillera de la Costa system on the south, before opening on the Unare depression, we have the broad valley of the Tuy, which runs eastward into the humid region of Barlovento, which is regarded as an ancient gulf filled in with alluvial deposits. This is a depression in the shape of a funnel with the opening toward the maritime valleys (Boca de Uchire) and which runs far inland into the foothills of the surrounding mountains.

The altitude of this valley does not surpass 200 meters. It is a humid and fertile region due to the numerous rivers flowing here and the lush vegetation which covers it, consist-



ing of an intermixture of herbaceous formations with rain-forests.

In the Tuy valley the following are the main localities:

Locality	Altitude above sea level	Average Annual Temperature	Average Annual Precipitation
Santa Teresa	150 m.	27° C	1.500 mm.
Santa Lucía	170 m.	26.5° C	1.200 mm.
Ocumare del Tuy	200 m.	26.5° C	1.500 mm.
San Francisco de Yare	160 m.	26.5° C	1.200 mm.
Cúa	250 m.	26° C	1.000 mm.

In the Barlovento region we have the following population centers:

Locality	Altitude above sea level	Average Annual Temp.	Average Annual Precipitation
Caucagua	60 m.	27° C	1.500 mm.
Panaquire	25 m.	27° C	3.000 mm.
Capaya	60 m.	26.5° C	2.400 mm.
Tapipa	30 m.	26.8° C	2.500 mm.
Aragüita	75 m.	26.8° C	
El Clavo	30 m.	26.8° C	3.000 mm.
Higuerote	5 m.	27° C	2.500 mm.
Tacarigua	20 m.	27° C	3.000 mm.
Curiepe	10 m.	27° C	2.500 mm.
Río Chico	5 m.	27° C	1.300 mm.
El Guapo	50 m.	26.8° C	2.700 mm.
Cúpira	10 m.	27° C	2.500 mm.
San José de Río Chico	10 m.	27° C	2.500 mm.
Boca de Uchire	5 m.	27° C	750 mm.

The climate of these areas is hot and humid. The trade winds blow from the sea and are charged with moisture and they encounter no obstacles in penetrating the maritime valleys of Barlovento, following the funnel to the end of the Tuy valley. These winds condense on the mountains surrounding the depression and are responsible for a high pluviosity with areas subject to flooding and swamplands covered with extensive woodlands and humid macrotermic forests. In the coastal area, in the regions of Tacarigua, Boca de Uchire and Unare, various rivers flow into the sea (the Tuy, Guapo, Uchire, Unare) forming lagoons separated from the sea by mangrove swamps that constitute islands of vegetation in a continuous line parallel

to the coast which serve to fix the alluvial materials brought by the rivers from the mainland.

To the east of the Barlovento region and following the Caribbean coastal zone the Cordillera de la Costa mountain system gradually disappears giving way to a broad depression extending from Boca de Uchire to Puerto La Cruz, penetrating deep into the Mesas region of the eastern plains. This is the Unare depression, through which flows the river of the same name which starts at the foot of the Mesa de Guanipa, near Pariaguan and which flows into the sea after a course of about 150 kilometers, forming the Unare lagoon. In the east it is limited by the first foothills of the eastern section of the Cordillera de la Costa, which emerges behind the depression constituting the mountainous shield of the peninsulas of Araya and Paria and the mountain which run to the north of the States of Anzoategui, Sucre and Monagas, and is a counterpart to the interior chain of the same system. From the point of view of political boundaries, the Unare depression includes the northern portions of the States of Anzoategui and Guarico. The relief of the depression presents the features of a plain with shallow valleys of variable width that follow the courses of rivers. In the northern parts near the coast the vegetation is xerophilous but as one goes southward the savannas and brushland appear with isolated woodland formations in the vicinity of rivers and lakes.

The following localities are in this depression:

Locality	Altitude Above sea level	Average Annual	
		Temp.	Precipitation
El Hatillo	5 m.	27° C	570 mm.
Puerto Píritu	5 m.	27° C	570 mm.
Píritu	100 m.	26.8°C	590 mm.
Barcelona	5 m.	27° C	650 mm.
Puerto La Cruz	10 m.	27° C	900 mm.
Guanape	150 m.	26.5°C	800 mm.
Clarines	25 m.	26.8°C	600 mm.
Guaribe	70 m.	26.5°C	600 mm.
Caigua	20 m.	27° C	550 mm.
El Pilar	150 m.	26.5°C	700 mm.
Guaratapiche	30 m.	27° C	1,000 mm.
San Mateo	100 m.	26.5°C	750 mm.
Quiamare	30 m.	27° C	900 mm.
La Margarita	50 m.	27° C	600 mm.
El Socorro	150 m.	27° C	1,000 mm.
Tucupido	130 m.	28° C	1,200 mm.
San José de Unare	50 m.	26.8°C	1,000 mm.
Zaraza	60 m.	28° C	1,150 mm.
Aragua de Barcelona	100 m.	26.5°C	1,000 mm.

The climate of the depression is hot and dry. The trade winds find no barrier and blow freely determining a pluvial regime of increasing rainfall in the north-to-south direction, with xerophilous type rainfall in the north and tropical rains in the south, with a very pronounced dry season and low environmental humidity in the first three months of the year, there existing areas where not a single drop of rain falls during the summer months.

In the eastern part of the Cordillera de la Costà system, there are numerous depressions with valleys of varying extent and altitude, some of which follow the course of important rivers such as the Neveri, the Manzanares, the Grande, the Caripe and Guarapiche. The last foothills in the direction of the coast are continued by low hills and coastal lowlands which become broader at the head of the gulf of Paria where there are maritime valleys that are continued by the Monagas plains. Toward the north the Cordillera is prolonged by the Paria formation and when it blends into the lowlands, it is followed by extensive coastal flats bordering all this formation from the gulf of Gariaco to the Gulf of Paria.

The following localities are in the coastal zone, the valleys and depressions of the eastern Cordillera of the coastal mountain system:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Cumaná	10 m.	27° C	500 mm.
Mariguaitar	5 m.	27° C	500 mm.
Cariaco	5 m.	27° C	1.000 mm.
Carúpano	10 m.	27° C	900 mm.
Río Caribe	5 m.	27° C	850 mm.
Güiria	10 m.	27° C	1.500 mm.
Irapa	5 m.	27° C	1.500 mm.
Yaguaraparo	25 m.	27° C	1.500 mm.
Casenai	5 m.	27° C	1.200 mm.
Guarahunos	80 m.	27° C	1.800 mm.
Las Vegas	50 m.	27° C	750 mm.
Naricual	100 m.	26.5° C	750 mm.
Tunapui	200 m.	26° C	1.200 mm.
Guanaguana	700 m.	23° C	1.200 mm.
Cumanacoa	250 m.	25° C	1.500 mm.
Aricagua	320 m.	25.5° C	1.300 mm.
San Antonio	600 m.	24° C	1.400 mm.
San Francisco	500 m.	24.5° C	1.400 mm.
Aragua de Maturín	250 m.	26° C	1.200 mm.
Santa Cruz	455 m.	25° C	1.300 mm.
Santa María	500 m.	24.5° C	1.200 mm.
Bergantín	300 m.	25.5° C	1.000 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.

The prevailing winds in this region are the northwest trades which, upon penetrating the gulf of Paria, condense on the nearby mountains causing high pluviosity, with extensive jungles which extend as far as the southeast of the State of Monagas. The northern coastal areas are arid because there are no mountain barriers to condense the moisture out of the trade winds, so that rainfall is scanty, not going above 500 millimeters of average annual precipitation. This explains the difference in the two environments as to vegetation, which is typically xerophilous along the coast of the Araya and Paria peninsulas while there are herbaceous, woodland and great macrotermic jungle formations both in the low mountain valleys as well as in the immediate vicinity of the mountain systems.

In the depressions and valleys of the mountain systems of the Andes and of the Cordillera de la Costa, which lie at the level of tropical climate, the following diseases are endemic: barber bug fever, *Tripanosomiasis rangeli*, *Leishmaniasis tegumentaria americana*, amoebiasis, anchilostomiasis and other intestinal parasitoses as well as superficial, intermediate and systematic mycoses. There is an abundant fauna which is harmful to man in these regions, represented by poisonous ophidians, scorpions and arachnids. Cases of visceral Leishmaniasis (Kala-azar) have been confirmed in the Lara depression, the Yaracuy depression, the valleys of Carabobo and Aragua as well as those of Tuy, Cumanacoa and in the east of the country.

In some Andean regions the recurring spirochetetic fever is endemic which is transmitted by *Ornithodoros venezuelensis*. *Oncocercosis* occurs frequently at the foot of the mountains and in flatlands with herbaceous formations and coppices in the valleys in the central and eastern parts of the country. In the Puerto Cabello region in the maritime valleys which prolongue the Yaracuy depression toward the northeast, there is an important focus of Bancroft's Filariasis. In some regions of the Carabobo valley and that of Aragua as well as in the valleys of Caracas and Tuy the *Schistosomiasis mansoni* is endemic and its occurrence extends southward up to Villa de Cura, San Juan de los Morros and San Casimiro. In some areas of the Lara depression (Sarare), in the border area Yaracuy-Lara-Cojedes and the Aragua valley (El Consejo) there are foci of Carate. In the Yaracuy depression, the Carabobo and Tuy valleys and in some Andean regions cases of bubonic plague are found. In the central coastal area of the country there exists the only known focus of the plague so far identified in Venezuela, which comprises the area of Tejerias and de-

pressions and small valleys in the mountains of the interior chain of the Cordillera de la Costa system in the sector corresponding to the Maestra range, between the altitudes of 400 and 1,600 meters above sea level, separating the valleys of the Aragua from that of the Tuy. In these interior mountains, in the immediate vicinity of the localities of San Casimiro and San Sebastian as well as in the jungle regions of the states of Anzoategui, Sucre and Monagas there are foci of yellow fever. Conditions due to nutritional deficiencies, particularly the multi-deficiency syndrome in children are very common among the rural population of these areas.

The most important halophilous region of Venezuela is located in the eastern part of the country and comprises the portion of the State of Sucre bordering on the Triste gulf and practically the entire zone of the Orinoco Delta. This is a vast territory cut by a network of channels by which the Orinoco River flows into the Atlantic. Its entire area is included in the Delta Amacuro Federal Territory. The Eastern limit of the Delta is the ocean, constituting a coastline of 300 kilometers, running from the south of the Gulf of Paria to the border between Venezuela and British Guayana. Inland, the region extends over 150 kilometers, extending in the south as far as the Imataca jungles and in the west as far as the Monagas plains into which it gradually runs. The Orinoco Delta is actually a enormous swamp made of an intricate network of navigable canals which border on numerous valleys and islands, where the Guarahunos Indians, descendants of Caribbean tribes live in a savage state inhabiting huts on stilts. In this almost impenetrable swamp there is a dense jungle subject to flooding where alluvial deposits brought by the river become fixed. The houses of the Indians living in this region are always standing separately from those of their neighbours, sometimes being at great distances from one another. The streets of the settlements are the canals of the area and dugout canoes are the sole transportation; paddles as well as poles are used in propelling them. They live almost exclusively from fishing, although they also use the fruits and other products of the surrounding vegetation and cultivate small fields of root crops and grow bananas. Despite their restricted diet and the multitude of insects which attack them, the inhabitants of this region have a strong constitution; they are of almost completely pure Indian blood. They come to civilized settlement only to sell the products of their activities (dugouts, fishing nets, pets they have tamed) and to buy products indispensable to them such as salt, tobacco, fabrics, fish-hooks and some tools.

Temperatures over the entire Delta region reach quite high readings, averaging 28° C. Maximum temperatures go up to 37° C and at night there is a considerable drop, which can read as low as 20° C. (megathermic type amplitudes), so that the Indians keep fires going in their homes on stilts so as to keep warm. The drop in the nighttime temperature is due to the high atmospheric humidity of more than 80%. The rainy season begins in May and runs without interruptions to October. From November to January there are the "northerlies" which can reach great intensities. During the dry season there are regular violent cloudbursts, so that the rainy season is actually defined by the greater abundance and frequency of rainfall, with averages of 2,000 millimeters or more a year. The cause of the high level of precipitation in this zone of the delta is the intense evaporation and the moist winds blowing from the sea (trades) from the northeast and the east. The region is also subject to westerly winds coming from the plains which blow along the Orinoco valley. These are dry and hot winds as compared with those from the sea.

Among the localities in the Orinoco Delta zone there are the following: Tucupita, capital of the Delta Macuro Federal Territory on the banks of the Manamo channel, at an altitude of 15 meters above sea level, average annual temperature of 27.8° C and average annual precipitation of about 2,000 millimeters. Curiapo, far to the east, located in front of Boca Grande channel, is a small river and coastal shipping port, with the housing built mostly on stilts. It is situated at sea level, with an average annual temperature of 27.5° C and average annual precipitation of 2,000 millimeters. In the northeastern part of the Delta there is the settlement of Pedernales, a port located in front of the Cotorra island at sea level, with average annual temperature of 27.6° C and approximate average annual precipitation of 2,000 millimeters. Other communities are the ports of Coporito on the Mariamo channel; and la Horqueta at the junction of the Capure and Cocuima channels.

The vegetation of the region is variable. There are large areas covered with monospecific trees with the so-called white mangrove being predominant while in other places the red mangrove predominates; the latter is exploited for its bark which is used in tanning while the branches are used in housing construction. Between the zones of actual mangroves there are large areas covered with palm trees, particularly the species Manicaria saccifera, the fronds of which are used by the Indians as well as the more civilized inhabitants in the construction of their housing. In association with this one, one finds the species of big palm trees called Roystonea regia

which is soon replaced by Maurita setigera, the tree of life, a palm which provides the Guarao Indians with food, wine, shelter and clothing. In these vast palm groves, where the roots of the trees becomes fixed in the delta alluvium, there extensive flatlands of moving terrain and others with firmer ground are covered with grass. More to the west the ground rises gently and is covered with very dense forests of impressive height with apamate trees and carapo trees from the fruit of which the Indians extract a bitter tasting oil. Almost imperceptibly one passes from the halophilous zone to the tropical jungle with its macrotermic climate.

The area of the Orinoco Delta is one of the large regions of the country which is of great interest because of its flora and fauna. Its high humidity lends itself to the almost uninterrupted maintenance of biotic cycles. The entomofauna is extraordinarily rich and very important from the point of view of tropical medicine. Among the elements of greatest interest from this point of view we have the Phlebotomus, transmitters of Leishmaniasis tegumentaria and also Kala-azar; the Simuliids which transmit Oncocercosis; the Culicoids which transmit the filarias Mansonella ozzardi and Dipetalonema perstans which are endemic among the Indians of this region and also vectors of monkeys' filarias; and the Anopheles mosquitoes, particularly Anopheles acuasalis which is very abundant and transmits malaria in the eastern part of the country. Many of the region's insects and vertebrates exhibit varying degrees of melanism, which are reflections of the environmental ecologic niches; their colors are mostly black, sepia and dark green. Even the waters are dark and the sky is almost always covered with dark clouds due to the intense evaporation. In these regions and as far as the banks of the channels, one finds large bands of two types of Cebus monkeys. In the north one finds the darker Cebus nigrivittatus is the predominant type, while in the south the predominant breed are the Cebus apella. These monkeys are always migrating within their common habitat and they also invade the zone of great forests where the Alouata seniculus is abundant. These monkeys are the hosts and principal victims of yellow fever which is endemic in the region and this is part of the eastern focus of this disease.

The culicoid population of Haemagogus and Aedes of the sub-genera Howardina, Soperia and Finlaya, which are the species incriminated as being the vectors of the yellow fever virus breed in holes in the trees in these tangled jungles and in the Bromeliaceae which are the parasites of these trees. Very rare is the tree growing in the vicinity of the great mangrove swamps which is not covered with these plants, particularly the big Erythrina.

Within the mountainous arc made up by the system of the Andes and that of the Cordillera de la Costa in the north and going down toward the banks of the Orinoco in the south there is a vast territorial expanse of some 300,000 square kilometers constituting the Llanos plains, so-called because of the absence of mountains and apparent horizontality of the terrain. Toward the east these areas are continued by the Orinoco Delta; while in the west they run into the Llanos of Colombia, which constitute a much larger territory. The Llanos of Venezuela constitute the most uniform physiographic feature of the country. This enormous plain, regarded by geologists as the bed of an ancient sea has slight undulations over its extent and is cut by numerous rivers flowing into the Orinoco or its tributaries. The majority of these rivers run low during the local summer, while during the rainy season large areas of the plains are flooded.

The main plant formations in the varied topography of the Llanos are the savannas, the gallery forests, moriche palm groves, the forests and the mesas plateau formations.

The savannas are flat formations with very young soils which are only 20 centimeters deep. The coarse grained nature of the soil and high concentration of hematite and bauxite which give it a reddish-yellow color only permits the development of a herbaceous vegetation dominated by gramineous species, constituting a prairie with scattered leguminous shrubs (Cassia occidentalis), compositae with small leaves and yellow flowers (Eupatorium sp.) and various genera of Cyperaceae which become confused with the gramineae because of their appearance. Every once in while one finds Hypoxis suaveolens, as well as other Labiatae and Malvaceae (Sida rhombifolia, Hibiscus sulfurens). The flatness of the prairie is broken up by clumps of thistles and scrub oak growing around the sombrero palm (Copernicia tectorum). The gallery forests are areas of jungle vegetation following the course of the rivers or taking advantage of the elevation of the freatic level. Very characteristic trees constitute this formation: Mimosa cabrera, Jugastrum christii, Lycaea pyrifolia, Caesalpinia coriaria; less abundant and less developed are the Bowdichia virgiloides and the Calliandra affinis as well as other species.

The palm groves of the plains are an indication of the presence of springs; the prevalent species is the Mauritia minor, which starts a population at the source of the stream and follows its course, constituting extensive colonies which, in conjunction with other species make up dense bush, often impenetrable due to the presence of Bactris sp., a kind of palm with very sharp slender thorns. Among the species growing on the moist sands of the palm groves there are grasses such as Axonopus anceps, the Panicum stenoides, Cyperus haspans and Scleria hirtella, as well as various shrubs (Platylepis



brasiliensis and Jussieu repens).

The coppices are well-defined woodlands composed of tall trees usually producing hardwoods or wild fruits which are edible: the locust tree (Hymenaea courbaril), the guasimo (Guazuma ulmifolia) the papaya (Melicocca bijuga) and the paraparo (Sapindus saponaria) while human influence is responsible for the presence of mangoes, guavas and even oranges. The presence of this shade-giving vegetation always constitutes the starting point for a ranch or hamlet, and even towns. Many are the plains communities which at first were only coppices with indigenous or saints' names.

Despite the physiographic unity of the plains, the differences in environmental features permit dividing them into three sub-regions: the eastern Llanos, the western Llanos and the central Llanos.

### The Eastern Llanos

The eastern plains also known as Monagas plains comprise level land to the southeast of the Mesas and the eastern Cordillera of the Costa mountain system. The Orinoco river constitutes the southern limit and in the east the plains extend to the shores of the gulf of Paria and the Orinoco Delta zone. The area of the eastern plains is of about 20,000 square kilometers, lying mainly in the state of Monagas, the south of the State of Sucre and the southwest of the State of Anzoategui. The terrain is level with practically no elevations except in the state of Sucre and in some parts of Anzoategui and Monagas. Among the main rivers of the region are the following: the San Juan whose source is in the eastern cordillera and which flows into the gulf of Paria; the Guarapiche, which also starts in the eastern mountains, passes Maturin and flows into the San Juan; the Guanipa with its source in the Mesa of the same name and flows into the sea near the island of Cotorra which is of alluvial formation. At the foot of the Mesas starts also the Morichal Largo, which is a tributary of the Tigre; as well as the Uracoa, which flows into the Cano Manamo after running through extensive swamplands. In the vicinity of the mouths of these rivers there are numerous lakes and swamps. The sea coast of the eastern plains includes the gulf of Paria from the Boca de Ajies to Barra de Maturin. These are level coasts, cut by numerous river arms which make the terrain wet and swampy, which has already been described as a halophilous zone. The northeastern section of the eastern plains is covered with a big rain forest, which is a continuation of that of the Orinoco Delta area. The rest of this zone is covered with grasslands and

brush, with tropophile forests around rivers and lakes. Small areas of xerophilous vegetation exist in some places near the coast.

To the northwest of the eastern plains there is a region equally large consisting of a series of plateaux at altitudes between 200 and 500 meters above sea level called Mesas; these go down in steps in a southeasterly direction until they become connected with the plains. Westward they are continued by the central plains and the Unare depression; in the north they end in the cliffs bordering on the eastern Cordillera. A large number of rivers have their source at the foot of the mesas and they flow into the Caribbean through the Unare depression. Others flow into the Atlantic either directly or by way of the Orinoco. The region of the Mesas occupies part of the states of Guarico, Anzoategui and Monagas. The most important of the Mesas is that of Guanipa with the localities of Pariaguan, at 240 meters above sea level, average annual temperature of 27° C and average annual precipitation of approximately 1,500 millimeters; and El Tigre, at 225 meters above sea level, average temperature of 26.7° C and average annual precipitation of 1,200 millimeters.

The temperature of the Monagas plains varies from north to south. In the areas near the mountains the average temperature is 25° C and goes up to 28° C as one goes southward. The rainy season runs from May to October, with maximum precipitation in July. The remaining months of the year are dry, though there can be some irregular rainfall. When the rainy season begins the temperature drops, with minimum average temperatures being registered in the months of December and January due to the effect of the trade winds from the northeast. From these months onward the heat grows more intense

reaching a maximum of 36° C due to the high number of hours of insolation. Precipitation reaches the level of 2,000 millimeters a year. Relative atmospheric humidity is high, ranging from 80 to 90%. The prevailing winds throughout the year are the trades blowing from the northeast which penetrate by way of the gulf of Paria and the Orinoco Delta.

Among the localities of the eastern Llanos, we may mention Maturin, capital of the State of Monagas, located in the north of this region, at an altitude of 75 meters above sea level, with an average annual temperature of 26.5° C and average annual precipitation of 1,250 millimeters; Barrancas, in the vicinity of the Orinoco Delta, at an altitude of 7 meters above sea level, average annual temperature of 27.7° C and average annual precipitation of approximately 1,200 millimeters; Uracoa, near the river of the same name, at an altitude of 10 meters, average temperature of 27° C and average annual precipitation of approximately 1,200 millimeters; Caripito, important petroleum center, at an altitude of 50 m

average temperature of 26.5° C and average annual precipitation of 1,750 millimeters; Quiriquire, also an oil center, at an altitude of 90 meters, average temperature of 27° C and average annual precipitation of 1,200 millimeters.

In the Mesas region the average temperature is 26° C. In the hottest months of the dry season maximum temperatures of 35° C are recorded, with minimum of 24° C. In the rainy season and in the months of December and January the temperature goes down to 25° C. The rainy season runs from May to October, with average precipitation ranging from 1,000 millimeters to 1,500 millimeters. Atmospheric humidity is not very high, because the winds of the region are continuous and also because of the high permeability of the soil of the mesas. The prevailing winds are the northeast trades. When these winds penetrate the plains region they are fairly cool because they are loaded with moisture from the ocean. The Monagas and Anzoategui Mesas border partly on the Unare depression and in the west there is another smaller mesa known as the Sierra Andaluz. Among the localities in this Mesa and nearby areas we have Santa Maria de Ipire at 220 meters of altitude, average temperature of 26° C and average annual precipitation of 1,000 millimeters. The southern edge of the mesa borders on the plains that extend to the Orinoco; the main communities here are San Diego de Cabrutica, at 165 meters of altitude, average temperature of 26.5° C and average annual precipitation of 1,600 millimeters; Santa Clara, at 160 meters of altitude, average temperature of 26.6° C and average annual precipitation of 1,400 millimeters; Pariaguan, on the Mesa de Guanipa at 240 meters of altitude, average temperature of 26.3° C and average annual precipitation of 1,429 millimeters; El Pao, at 180 meters, average temperature of 27° C and average annual precipitation of 1,400 millimeters; Cachipo, a petroleum center, at 220 meters above sea level, average temperature of 26.5° C and average annual precipitation of 1,200 millimeters. Urica, at 250 meters, average temperature of 25.5° C and average annual precipitation of 1,100 millimeters and Cantaura, on the Mondoaga Mesa, at 220 meters, average temperature of 26.5° C and average annual precipitation of 1,895 millimeters.

### The Central Llanos Plains

The central plains are limited on the north by the interior chain of the Cordillera de la Costa; on the west by the San Carlos River which separates it from the western plains; on the east by the Unare depression and the Mesas region and on the south by the Orinoco and its tributary the Meta, separating this zone with that of Guayana and the Co-

lombian plains, respectively.

The central plains have about 180,000 square kilometers and comprise parts of the states of Anzoategui, Guarico, Cojedes, Barinas, Portuguesa and Apure. In the northern part, up to an imaginary line running through the community of Ortiz, the terrain is rolling and irregular, with elevations running parallel to the Cordillera de la Costa and which go down from north to south. These orographic formations are called Galeras or Pretiles, the most important being the Galeras de El Pao, in the north of the State of Cojedes; and the Galeras de Ortiz and those of Parapara in the state of Guarico. The southern sector is almost entirely level and constitutes the plains properly speaking, with abundant grassland and archipelagoes of woodland called Mata.

The 100 meters altitude curve running north of Achaguas, San Fernando de Apure, Camaguan, Cazorla and Soledad divides the central plains into two great sectors: the higher Alto llano and the lower Bajo llano.

In the Alto llano the slope of the terrain in the north to south direction is fairly pronounced and there is little flooding during the rainy season by the rivers flowing here. Among these rivers are the Guarico with its numerous tributaries, flowing through the entire extent of the plains from San Juan de los Morros to the point where it joins the Apure; the San Carlos, with its tributary, the Tinaco; and the Santo Domingo, the Pao and the Chirgua, which are tributaries of the Portuguesa.

The Bajo llano or Llanos de Apure is quite level there being no irregularities in the terrain and for this reason it becomes flooded in the rainy season with the formation of big lakes and swamplands which persist during the dry season constituting the so-called "esteros". To the north of Cabruta there are large ponds in the rainy season. The Apure, Apurito, Portuguesa, Guarico, Caracol rivers and the Falcon canal constitute a huge winter lake called Estero de Camaguan with a considerable area, which decreases, without drying out completely during the summer. Among the many rivers of the lower plain we can mention the Apure and its main tributary, the Portuguesa; the Guarico, the Meta, the Capanaparo and the Arauca which are tributaries of the Orinoco; the Manapipe, which has its source in the Cordillera del Interior and flows through the Tamanaco forest; and the Suata which comes down from the area of the Mesa Andaluz.

The flora formations of the central plains consist of great savannas of natural pastureland, composed mainly of the genera Diectomys, Eragrostis, Paspalum, Porophyllum and rounded forest formations standing isolated, sometimes with a spring in the midst of it as well as gallery forests of deciduous trees: Guazuma, Hymenaea, Centrolobium, Tecoma,

Andira, and others as well as moriche palm groves along the rivers and canals. The *Acrocomia scherocarpa*, brush of *Byrsonima* and groves of moriche palm (*Mauritia flexuosa*) constitute a very characteristic vegetation of these plains. In the summer all this herbaceous vegetation disappears due to fires in the savannas which destroy large areas of pastureland and woodland.

The average temperature of the central plains ranges from 26° to 28° C. The minimum temperatures occur in December, January and February, dropping down to 18° C in San Fernando de Apure. The maximum temperatures are registered in March and April, rising to 38° C in the same town. The coming of the rains cools things off and at night the temperature falls, difference of up to 8° C with respect to average daytime temperatures being registered. The seasons are well defined: the rainy season runs from May to October, the remaining months being of complete drought. Precipitation attains an average of 1,200 to 1,800 millimeters, with average atmospheric humidity of 75% or more; The prevailing winds in this region and the trades blowing from the east, which penetrate up the Orinoco Delta, and the northeast trades, coming by way of the Unare depression; there are also cool winds blowing down the Cordillera de la Costa. In the Bajo llano there are westerly winds during the rainy season called "Barines" which we will discuss later in connection with the western plains.

Among the main population centers of the central plains we can mention the following:

In the Alto llano: San Carlos, capital of the State of Cojedes, at 150 meters above sea level, average temperature of 27° C and average annual precipitation of 1,600 millimeters; Tinaco, at 143 meters above sea level, average temperature of 27° C and average approximate annual precipitation of 1,500 millimeters; el Pao, at 130 meters of altitude, average temperature of 27.3° C and approximate average annual precipitation of 1,200 millimeters; Ortiz, at 168 meters, average temperature of 27.5° C and approximate annual precipitation of 1,200 millimeters; El Sombrero at 160 meters, average temperature of 27° C and approximate average annual precipitation of 1,200 millimeters; Calabozo, at 160 meters above sea level, average temperature of 28° C and average annual precipitation of 1,250 millimeters; Caguarhamas at 170 meters average temperature of 28° C and average annual precipitation of 1,260 millimeters; Valle de la Pascua, at 195 meters of altitude, average temperature of 27° C and average annual precipitation of 1,200 millimeters. In the Alto llano are also included the localities of the Distrito Zaraza and of the Distrito Monagas of the State of Guarico.

In the Bajo llano we have: San Fernando de Apure, capital of the State of Apure, at 70 meters above sea level, average temperature of 28° C and average annual precipitation of 1,400 millimeters; Bruzual, at 90 meters of altitude, average temperature of 28° C and average annual precipitation of 1,700 millimeters; Puerto Nutrias, on the bank of the Apure river, at 80 meters above sea level, average temperature of 28° C and average annual precipitation of 1,600 millimeters; Achaguas, at 60 meters above sea level, average temperature of 27° C and average annual precipitation of 1,800 millimeters; Guanarito, at 90 meters of altitude, average temperature of 28° C and average annual precipitation of 1,400 millimeters; El Baul at 102 meters of altitude, average temperature of 28° C and average annual precipitation of 1,800 millimeters; Arismendi at 85 meters, average temperature of 28° C and average annual precipitation of 1,800 millimeters; Guayabal at 50 meters of altitude, average temperature of 27° C and average annual precipitation of 1,400 millimeters; and Casorla at 50 meters above sea level, average temperature of 27° C and average annual precipitation of 1,350 millimeters.

### The Western Plains

The western plains are limited on the north by the interior chain of the Cordillera de la Costa mountain system, and by the San Carlos River which separates it from the Alto llano region; on the south, by the Meta River separating them from the Colombian plains and on the west by the Andes. In the Andean foothills are the big Ticoporo forests to the northeast and of San Camilo to the southwest which is limited by the Caura river on the south. In an eastward direction these western plains gradually run into the Bajo llano of the central plains. They have an approximate area of 100,000 square kilometers, and comprise the States of Cojedes, Portuguesa, Barinas and Apure.

The western plains begin in the foothills of the Andes and the Cordillera de la Costa, with a slight declivity toward the Apure and the Orinoco. Numerous rivers flowing down the mountains cut the region: the San Carlos, the Cojedes, the Cano Turen, the Portuguesa and its tributaries, the Masparrito, the Paguey, the Canagua, the Uribante and the Sarare. In the rainy season these rivers overflow their banks, flooding huge areas particularly in the south, where they give rise to lakes and swamps, many of which retain water during the dry season.

As to plant formation, there are great savannas with grasslands of the same gramineous species already mentioned,

with brushland, palm groves, bush areas and gallery forests in the vicinity of rivers and streams. In the foothills of the above-mentioned mountain systems there are big forest formations with the same common plains flora but interspersed with such species as the cedar, the caobo, and others, of the transition zone.

The average temperature of the western plains ranges from 26° to 27° C, due to the absence of high vegetation and the length of insolation time. On the other hand, the trade winds penetrating by way of the Orinoco Delta and the Unare depression and the broad eastern and central plains of Venezuela, have already lost their coolness by the time they reach the western plains, which they had gathered in the Atlantic and Caribbean. The rainy season begins in May and ends in October, with average annual precipitation of 1,200 to 1,600 millimeters, being greater in the west and northwest of the region than in the center. Besides the east and northeast trades, there are northwest winds that blow over the Yaracuy depression and penetrate by way of the Cabudare gorge which links the Yaracuy depression with the western plains. These moisture-bearing winds condense on the Sierra Portuguesa range, which is the last chain of mountain of the Andean system in the direction of the plains; here are extensive forests which are sources of valuable hardwoods. Here we also have the wind called "Barines" formed when masses of hot air of the Llanos Bajos rise while cool winds from the nearby mountains tend to go down occupying the space vacated by the warm current in their rise. Thus there is another type of wind which blows over the rest of the plains from west to east reaching Ciudad Bolivar, where it blows mainly during the rainy season.

Among the localities in the western plains we have: Acarigua, at 190 meters of altitude, average temperature of 27° C and average annual precipitation of 1,500 millimeters; Guanare, capital of Portuguesa State, at 180 meters, average temperature 27° C and average annual precipitation 1,700 millimeters; Barinas, capital of Barinas State, at 215 meters, average temperature 27° C and average annual precipitation 1,800 millimeters; Firitu, at 160 meters, average temperature 26° C and average annual precipitation of approximately 1,300 millimeters; Villa Bruzual, at 140 meters, average temperature 27° C and average annual precipitation 1,500 millimeters; Guasdalito, at 142 meters, average temperature 26.5° C and average annual precipitation 1,500 millimeters.

The great tropical endemic diseases of the plains and areas with similar vegetation are represented mainly by the barber bug fever, anchilostomiasis and other intestinal parasitoses, amoebiasis and nutritional deficiencies, particularly the multi-deficiency syndrome.

The barber bug fever is intimately connected with the ranch, of which there are a great many in the region. Among the elements of epidemiologic importance in the prevalence of ranches infected by the Rhodnius prolixus one should mention the interesting discovery made by the Division of Rural Endemic Diseases of the Department of Malaria Studies of the Ministry of Health and Social Welfare, in confirming the presence of this triatomide in various species of palms, with no connection to human habitation and also in the nests of various kinds of birds as well as of migratory birds such as the Mycteria americana, which can carry these insects from one place to another.

In the forested areas of the plains (gallery forests) Leishmaniasis tegumentaria americana is frequent; in some towns and villages of the central plains, particularly in the States of Guarico and Portuguesa cases of Kala-azar have been confirmed as well as the occurrence of dogs naturally infected with Leishmania donovani. The area of San Juan de los Morros and the basin of the river of the same name in the northern part of the central plains is a focus of an endemic character of Schistosomiasis mansoni. In the foothills of the Cordillera de la Costa there are foci of Oncocercosis. Amoebiasis is both very frequent and very serious; one finds not only the dysenteric forms but also visceral localizations, particularly the hepatic abscess. The superficial mycoses, particularly Pytiriasis are frequent; sporadically one can also observe Cromomycosis, Paracoccidiomycosis and related diseases. The Crotalus terrificus is frequent in the savannas, particularly in dry and stony ground. In the forests and the bush the Bothrops atrox is prevalent.

The plains of Monagas and of the Orinoco Delta are continued southward by the valleys of the lower Orinoco and the Venezuelan Guayana region. This huge area extends to the Paracaima mountains on the border with Brazil. The basin of the Caroni in the west separates it from the Amazon region. To the northeast and along the right bank of the Orinoco is the Imataca range with a structure of iron-bearing quartzites and these are the most important iron ore deposits of the country. The right bank of the lower Orinoco is covered by a dense jungle with a high level of humidity rendering the area practically uninhabitable; there only are some small isolated savannas where sugar cane and maize are grown. The average temperature is 28° C with a minimum of 21° C. At about 100 kilometers from the river the forest disappears, giving way to the typical savannas of Guayana which greatly resemble the plains by their vegetation and general aspect, differing because of the presence of low rolling hills. The



landscape seems deserted and arid with a short and coarse herbaceous vegetation associated to palm groves in the vicinity of streams.

The fluvial valleys of the lower Orinoco begin in the delta area and extend westward as far as the rapids of Atures, in the Federal Territory of Amazonas. Here are numerous localities using the river as the principal means of communication.

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Ciudad Bolívar	30 m.	27.5° C	1.200 mm.
Paruey	50 m.	26.8° C	1.600 mm.
Caicara de Orinoco	60 m.	26.6° C	1.400 mm.
Las Bonitas	60 m.	27° C	1.500 mm.
Soledad	50 m.	27° C	1.200 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.

To the east of the Guayana region is the broad valley of the Yuruari, limited on the west by the Caroni River and the Imaraca mountains in the northeast. This is a mining, crop and livestock growing area, with plains formations and great jungle areas, with the following communities:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
El Callao	80 m.	26.5° C	1.400 mm.
San Félix	20 m.	27° C	1.000 mm.
Guasipati	350 m.	25° C	1.500 mm.
Tumeremo	180 m.	25.° C	1.400 mm.
El Dorado	40 m.	26.8° C	2.500 mm.
Upata	340 m.	25.5° C	1.000 mm.
El Manteco	110 m.	26.5° C	1.200 mm.

This region is continued southward by extensive humid tropical forests along the basins of the big rivers, from the Caura to the Cuyuni and from the Orinoco river valleys to the Amazon forest in the south, ending in the escarpments of the Lema mountains. These escarpments mark the beginning of the Gran Sabana savanna, a plateau of about 35,000 square kilometers, limited by escarpments of high mesas, dotted by numerous hills and with level areas of gentle declivity covered with herbaceous formations with palm groves, very similar to those of the big plains, but without the brushland and at elevations ranging from 900 to 1,400 meters above sea level. The natural boundaries of the Gran Sabana are as follows: in the north the Lema mountains and the valley of the

Carrao River up to the point where it flows into the Caroni; in the south, the Paracaima mountains, which constitute the border between Brazil and Venezuela and the Caroni River; in the east with the Roraima Irutepui system up to the source of the Venamo River following the border with British Guayana; and in the west, by the Caroni River where it turns northward, between the mouths of the Uriman and the Carrao. The Kamarata plateau is part of this physiographic region; its dimensions are about 100 kilometers from east to west by about 160 from north to south. In the Gran Sabana stand the big massifs which, because of their geologic formation are almost all truncated, forming isolated mesas, covered with some small sized vegetation and others which are completely bare at the top. In the savannas one often finds big lakes of crystalline waters.

The first indigenous inhabitants of the Gran Sabana are believed to have belonged to the Guaharibos tribes, who were conquered before the period of colonization by the Arekuna Indians of the big Caribbean tribe. At present there are isolated groups of descendants of the original Guaharibos, represented by the Taurepanes and the Kamarakotos, belonging to the Arekuna tribe.

The Gran Sabana has a moderate tropical climate which varies from region to region depending on altitude and topography. It is subject to the action of the moisture-bearing northeast trades. The climate is cool in the northern parts in the vicinity of the Luepa mountains at an altitude of 1,300 meters, with an average annual temperature of 21.8° C. More to the south the plateau clearly slopes down, so that the altitude decreases and there are climatologic changes with sub-tropical and tropical characteristics.

In the Gran Sabana plateau we have the following localities:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Luepa	1.296 m.	21.8° C	2.000 mm.
Santa Elena	907 m.	24° C	2.000 mm.
Uon-ken	850 m.	24.5° C	1.800 mm.
Uruyen (Kamarata)	450 m.	24.8° C	1.500 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.

To the south of the Gran Sabana there are great rain forests covering the depressions and slopes of the Paracaima mountains with altitudes of more than 1,000 meters above sea level.

Much remains to be discovered about the tropical pathobiology of the Venezuelan Guayana. Although there are works on the physiography, climatology and the composition of the flora and fauna of some parts of this immense area, a better definition of the ecologic niches in relation to the biotopes determining the existence of endemic diseases in their natural nests. In regions covered with forests Leishmaniasis tegumentaria americana is endemic and the fact that one acquires the disease upon penetrating these areas indicates the presence of natural nests of this protozooosis which must be investigated. The magnificent work done in 1941 by Anduze shows the importance of the Guayanan entomofauna and the necessity of continuing work in this field. South of the Orinoco the Phlebotomus anduzei is abundant and this species is suspected of being the vector of the disease in the endemic areas. Kala-azar certainly exists in the region in view of the components of panoramic epidemiology here. The first focus of yellow fever known in Venezuela was found in Guayana with rural repercussions of the disease in some communities of the Yuruari valley. Today we know that this focus includes the forest regions south of the lower Orinoco, extending to the Gran Sabana and the Oaracaima mountains. Exantematic typhus is endemic among the population of the Yuruari valley (prolongues fevers of the Yuruari) and for a long time it was confused with pyrexias of different etiology. The problem of amoebiasis is important, both because of the greater incidence and severity of the dysenteric forms as well as the frequency and severity of hepatic localizations (amoebian hepatic abscess). Anchilostomiasis and other intestinal parasitoses have a broad distribution, associated with nutritional deficiency conditions, particularly among children. The bacterial dysenteric syndrome among adults and enterocolitis and gastroenteritis among children have the same incidence and gravity as elsewhere in the country. Systemic mycoses, particularly Histoplasmosis and its ecologic niches must be investigated. Studies are needed on the epidemiologic aspects of Mansonella ozzardi and Dipetalonema perstans in the populations of the lower Orinoco basin, particularly in the Delta, where a significant percentage of the indigenous population of the area are parasited by these filaria. Oncocercosis also must be investigated, choosing population centers in the vicinity of water falls and rivers of fast current, which are so abundant in the region and where certainly Simuliids must be abundant. Cases of ophidic poisoning caused by the Bothrops atrox and the Crotalus terrificus are common. But we don't know what other species of poisonous snakes exist in the region and there also are scorpions, spiders and centipedes which remain to be classified. A species of poisonous snake new to science, the Bothrops

lichenosa, was described by Dr. J.A. Rose in 1958 on the basis of a specimen captured by Steyermark and Wurdick of the Botanical Expedition of the Museum of Natural History of Chicago in Chimanta-Tapui in the west of the Gran Sabana, along the Tirica river on the summit of the central part of a rocky savanna. No systematic studies have been conducted on the barber bug fever and trypanosomiasis rangeli. The Rhodnius prolixus has had its presence confirmed in some population centers located along both banks of the lower Orinoco, particularly in the municipalities Ciudad Bolivar (localities of Buenos Aires, Calzada Paez, Canagua, Hacienda La Auxiliadora, Ojo de Agua and San Antonio), Ascencion FARRERAS, Caicara, El Palmar, La Urbana and Moitaco. The Triatoma maculata has been found in Ciudad Bolivar, Upata and some of the other population centers mentioned above. It is in these localities that it is necessary to conduct detailed research on the trypanosomiasis of man by a study of the trypanosomatic formula of the vector and an examination of representative samples of the population, with clinical and electrocardiographic exploration, complemented by the xenodiagnosis and the fixation reaction of the complement. Of great importance is the investigation in this region of the extradomestic intermediary epidemiologic chain of the barber bug fever, by searching out the Rhodnius prolixus and other triatomids in palm trees, the nests of birds and the lairs of animals in both rural and forest areas, as well as the existence of extra-human reservoirs of a vertebrate nature (domestic, peridomestic and wild) of the Schizotrypanum cruzi in nature. Potentially barber bug fever can exist in various animals associated with human habitation and may become adapted to man with the introduction and projection of the vector in human habitation. One should not wait for the arrival of the human material in the hospital in order to make an evaluation of this disease in the areas where the presence of the vector has been confirmed. It is necessary to bring research equipment to the rural areas, with well planned work programs. It would be advisable to make a thorough investigation of the transmitters of the disease in the whole Guayana zone, with a study of the possible factors that might interfere with its endemism in the localities where its existence has not been demonstrated. The Chair of Tropical Medicine of the School of Medicine of the University of Oriente in Ciudad Bolivar should undertake extensive research programs connected with this area.

To the south of Puerto Ayacucho is the huge jungle region of the Amazon, between the Orinoco, the Atabapo, the Guainia and the Negro Rivers which limit it to the west; the mountain ranges of Unturan, Parima and Maigualida in the south and east. This area is cut by the most abundant river

network in the country. From the point of view of political division, this area belongs to the Federal Territory of Amazonas and it has been the object of numerous scientific expeditions conducted by Europeans, Americans and Venezuelans so that there is partial knowledge of its physiography, climate, geology, hydrology, botany, zoology and endemology.

In its course from the Parima mountains where it has its headwaters, to the rapids of Atures and Maipures near Puerto Ayacucho, the Orinoco River receives many tributaries coming from the plains and the Guayana shield. Important basins are those of the Vichada, Mataveni, Guaviare and Atabapo on the left bank; the Sipapo, Ventuari, Cunucunuma, Matacuni and Ocamo on the right bank. To the west of Esmeralda is the Casiquiare with its tributaries: Curamuni, Siapa and Pacimoni, linked to the Orinoco by the Negro river, which, after receiving the Guainia runs southward and then flows into the Amazon.

From the rapids of Atures and Maipures, where the Venezuelan Amazon region begins, there are extensive gallery forests with clearings covered with gramineous plants running along the banks of the Orinoco and its tributaries, where alluvial material carried by floodwaters is deposited. In some places, such as Esmeralda, to the south of Duida at an altitude of 2,475 meters above sea level, there are extensive savannas. The gallery forests gradually become larger becoming the macrotermic rainforest of the upper Orinoco. The floor of these forests, in addition to the humus which covers ground that is very rich in quartzes, has living layers of superficial roots of palms and ferns, abundant piperaceous plants and other flora. The trees are gigantic, attaining heights of up to 50 meters, with large quantities of bromeliaceae, epiphytes and orchids. The tangled vegetation where the sun hardly penetrates, the ground always moist with pools of water and streams and the existence of micro-aquariums in cavities in the trees and bromeliaceae and the axillae of leaves where ciliated protozoa, flagellates and microcrustaceans breed serving as food to the larval stages of mosquitoes, constitute the most varied ecologic niches for the breeding and survival of an important entomofauna from the medical point of view. Breeding places for *Haemagogus*, which are vectors of yellow fever; of simuliids and culicoids, which transmit filariasis to man and monkeys; and the phlebotomus that are vectors of visceral and tegumentary Leishmaniasis, are extremely abundant in these dense forests. From the family of Triatomidae the only ones found were the *Rhodnius brethesi* in the San Fernando de Atabapo region; the *Panstrongyllus geniculatus* in the vicinity of Puerto Ayacucho. There also exists the *Paederus colombinus*, which is responsible for lineal vesiculous dermatitis, observed among the settlers of the area.

Also abundant are monkey spiders (*Avicularia*), scorpions, and centipedes, as well as poisonous ophidians, represented by the *Bothrops atrox*, the *Bothrops neglecta* and the *Lachesis muta*. The *Crotalus terrificus* is found in the savannas near Puerto Ayacucho. The *Temblador* is found in the Orinoco as well as ray fish which remain sedentary in the backwaters and swampy lowlands of the basin of this river and its tributaries. Among the jungle mammals special mention is deserved by some primates which are carriers of the virus of yellow fever, particularly the *Atheles belzebuth*, the *Cebus nigrivittatus* and the *Saimiri* and *Aotus* monkeys; the latter is very small and of nocturnal habits, having some similarities with the lemuridae. Also abundant in this region are wild rodents, particularly *Proechymis guayanensis*, which is a possible carrier of *Leishmania brasiliensis* in the natural state.

The climate of the Amazon region is hot and humid, with the characteristics of the climate of rainy tropical forests. The temperature attains quite high levels, with an annual average of 28° C, Maximum temperatures reach up to 37° C, there being a considerable drop during the night, as low as 20° C (megathermic type of amplitude). The drop in temperature is due to the high atmospheric humidity which is of over 80%. The rains are continuous, though more intense from April to September, and a drop from January to March. Rainfall is of over 2,500 millimeters as an annual average, reaching 3,336 millimeters in the region of Casiquiare. The pluvial regime results from the presence of equatorial calms due to the low latitude of these regions and the evaporation from the Orinoco and its numerous tributaries, with a thick forest cover which interferes with solar radiation.

The following population centers are in the Venezuelan Amazon region:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Puerto Ayacucho	120 m.	28° C	2.500 mm.
San Fernando de Atabapo	125 m.	27° C	2.800 mm.
Maroa	127 m.	28° C	3.200 mm.
San Carlos de Río Negro	100 m.	26.8° C	3.336 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.

Along the Orinoco basin and that of its tributaries there are other small settlements, Indian missions and Indian settlements represented by groups of huts to which a name has been given. Some of these persist, others are abandoned because of the nomadic nature of the population. The tribes of the Amazon region belong to the Piaroa, Marikitare, Wahabio, Piapoko, Guaharibo (Schiriana) and Waika groups. These Indians are primitive in the vast majority of cases, with villages in the midst of the forest and are not reached by civilization; they live from hunting and fishing and they complement their diet with small plantations of bananas and roots crops as well as wild fruit. The yare, which is prepared from cooked manioc is their staple.

The jungle pathology of the Amazon region is mainly represented by yellow fever, Leishmaniasis tegumentaria americana and carate. Pteriasis is very frequent among the Indians. Cases of poisoning due mainly to the Bothrops atrox are quite common. The Bothrops neglecta and Lachesis muta also exist in this region. The Crotallus terrificus is found in the savannas south of Puerto Ayacucho. A considerable percentage of the indigenous population is parasited by the Mansonella ozzardi but it is well known that this filaria lacks pathogenic characteristics. In Puerto Ayacucho and San Fernandode Atabapo anchilostomiasis and other intestinal parasitoses, as well as amoebiasis are quite frequent.

The natural features of the Upper Orinoco, with a detailed description of the environment, the floral and fauna composition and the ecology of the Indian population have been dealt with by Anduze in his excellent book Shilili-ko (Descubrimiento de las fuentes del Orinoco) /The Discovery of the Headwaters of the Orinoco/ which constitutes quite profitable reading.

We have described in broad strokes the principal environments of the tropical bio-regions of Venezuela limited by the altitude curve of 800 meters as a matter of convention, with the temperature of the coldest month of the year above 22°C. From this altitude level on there is a succession of climatic levels including the sub-tropical, the temperate and the cold zone.

In the sub-tropical regions of the country the conditions during the dry season (local summer) are very similar to those prevailing in the hot areas, having the same pathology but with lesser prevalence and in some places, a pathology restricted to only some endemic diseases. However, in the sub-tropical level there are some areas of niches with very well defined permanent tropical characteristics due to the disappearance of the typical vegetation formations, parti-

cularly forests of altitude due to deforestation and fire which led to erosion with the resulting changes in climate and plant and animal ecology of the zones which were originally occupied with dense forests with low temperature and high environmental humidity. In the temperate regions of the country tropical endemic diseases are even more restricted and disappear after the altitude level of 2,500 meters.

The sub-tropical and temperate regions of Venezuela are found in the mountain system of the Andes (the ranges of Perija, Empalado, Montes de Oca, Portuguesa and Barbacoas) the Sierra de San Luis de Falcon, some places in the Cordillera de la Costa and the Guayana Shield. The plant formations of the sub-tropical level are represented by forests of large trees and broad tree tops which are quite tangled and are populated with epiphytes and vines, preventing totally the penetration of sunlight, which favors the implantation of a herbaceous vegetations as well as shrubs and tree ferns. The soil is rich in humus, very moist, with a cover of mosses and ferns along the course of streams. Along the low valleys between the mountains there is a transition toward the summer type of forest. During the dry season the vegetation of this forest loses most of its foliage which presents a greyish green color with abundant growths on the floor, changing to deep green when the first rains come. The average annual temperature is from 19° to 22° C with temperatures in the summer months going up to 24° C on the average. The trade winds are condensed on the mountains of these regions giving rise to pluvial regimes of increasing precipitation up to the level of 1,500 meters above sea level, where it becomes stabilized, giving rise to the clouded forest. Rainfall here varies according to local conditions, ranging from 800 to 1,500 millimeters of annual average precipitation. The following population centers are located in regions of sub-tropical climate:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Palmira	1.200 m.	19° C	1.000 mm.
Torondoy	1.100 m.	22° C	1.150 mm.
Pregonero	1.260 m.	20° C	1.400 mm.
Tovar	950 m.	21.5° C	1.300 mm.
Zea	900 m.	21.5° C	1.300 mm.
Egido	1.150 m.	22° C	1.000 mm.
Chiguará	927 m.	22° C	900 mm.
Escuque	1.030 m.	22.2° C	900 mm.
Monte Carmelo	1.000 m.	22° C	1.000 mm.
Boconó	1.200 m.	21.2° C	900 mm.
Chegendé	1.040 m.	22° C	900 mm.
Carache	1.200 m.	21° C	800 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.



### Sierras of Portuguesa and Barbacoas

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Chabasquén	970 m.	22° C	1.700 mm.
Guarico	1.040 m.	21° C	1.200 mm.
Humocaro Alto	1.090 m.	22° C	1.000 mm.
Humocaro Bajo	1.120 m.	22° C	1.000 mm.
Sanare	1.358 m.	19° C	950 mm.

### Sierra of San Luis de Falcon

Población	Altura sobre el nivel del mar	Temperatura media anual	Precipitación media anual
Churuguara	900 m.	22° C	1.800 mm.

### Valleys of the Central Coastal Region

Población	Altura sobre el nivel del mar	Temperatura media anual	Precipitación media anual
Los Teques	1.170 m.	20° C	1.120 mm.
San Diego	1.200 m.	20° C	1.200 mm.
San Antonio	1.200 m.	20° C	1.200 mm.
Carrizal	1.200 m.	20° C	1.200 mm.

### Guayana Massif

Población	Altura sobre el nivel del mar	Temperatura media anual	Precipitación media anual
Luepa	1.296 m.	21.8° C	2.000 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.

The temperate regions of Venezuela are characterized by the presence of the clouded forest. The trade winds, warmed up and saturated with moisture, condense it when they come near the slopes between altitudes ranging from 1,200 meters and 1,500 meters above sea level, becoming transformed into thick fog of very little mobility which persists almost throughout the entire year and becomes more intense toward evening. Frequently condensation is more pronounced in limited areas, giving rise to light rainfall which adds to the high humidity of the soil. The presence of fog prevents the direct incidence of sunlight, creating numerous dark niches with a very varied fauna. The average temperature of the temperate areas of Venezuela ranges from 14° to 18° C, with extremes of 5° to 26° C. Rainfall varies according to local conditions, decreasing progressively with altitude. In the deep mountain valleys at altitudes ranging from 1,200 to 1,500 meters thick blankets of fog predominate. Rainfall has an annual average ranging from 900 to 1,800 millimeters, according to altitude (the greater the altitude the lower the precipitation), with very high atmospheric humidity, which is above 80%.

The vegetation of these levels is as varied as the zones are extensive and is partly conditioned by latitude and partly by the chemical and structural features of the soil. Above the 800 meters level one begins to observe a transitional flora featuring composites and a great variety of mosses and tree ferns (Pteridium). Here one finds a larger number of Piperaceous and Rubiacous plants as well as great quantities of Araceae. Among the great trees of these mesothermic forests one finds the Gyneranthera caribensis, the biggest of our trees and great quantities of palms, laurels and moraceous plants. This level is sometimes eroded by water with no vegetation or covered with a secondary heliophile vegetation resulting from deforestation. But in the areas where the original vegetation has been preserved, there is a thick layer of humus, and roots of the low vegetation with cover of Calladium in the more humid places. The fauna of the sub-tropical and temperate levels is no less interesting. One finds here also the simians of the genera Alouatta and Cebus; marsupials abound, particularly the genera Philander, Caluromys and Marmosa. Many rodents have their habitat exclusively here. The avi-fauna is particularly rich and the entomo-fauna is very abundant.

Among the population centers located in these regions we may mention the following:

(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Mérida	1.640 m.	19° C	1.600 mm.
El Cobre	1.925 m.	17.5° C	900 mm.
Bailadores	1.750 m.	18.5° C	900 mm.
Timotes	1.600 m.	16.5° C	1.000 mm.
Santo Domingo	2.170 m.	16.5° C	1.100 mm.
Jajó	1.790 m.	17° C	1.000 mm.
La Mesa	1.750 m.	17° C	1.000 mm.
Niquitao	1.937 m.	17° C	1.800 mm.
La Puerta	1.758 m.	17.5° C	1.000 mm.
Libertad	1.495 m.	19° C	1.000 mm.
La Grita	1.437 m.	19° C	900 mm.
Cubiro	1.500 m.	18.5° C	1.000 mm.
Barbacoa	1.400 m.	20° C	1.000 mm.
San Pedro	2.000 m.	16.5° C	1.200 mm.

Key: 1) Locality; 2) Altitude above sea level;  
3) Average annual temperature; 4) Average annual precipitation.

Thorough research is needed on the pathobiology of the temperate regions of Venezuela, conducted in loco, with the aim of determining the natural foci of diseases that can be transmitted to man. We have found autochthonous cases of Leishmaniasis tegumentaria, with mucous lesions in the area of Niquitao at 1937 meters of altitude, but we don't know the species of Phlebotomus existing there, the micro-climates of their breeding places and the nests of zoonosis connected with this disease, where wild rodents are abundant and may be the carriers of Leishmania brasiliensis under natural conditions. The arborviroses must be carefully studied particularly with respect to carriers of the virus of yellow fever and the ecologic nests of Haemagogus. We have seen that the species of monkeys that are abundant in these regions are the same as those that were found to be infected in the known foci of yellow fever in the county, which can migrate from one thermal level to another. The richness of the avifauna offers excellent material for an investigation of the virus of encephalitis. We don't know anything about the existence of zoonosis nests in connection with wild Rickettsiosis at these altitudes. The so-called Guacarapa fever, observed up to 1924 among peasants working in coffee harvesting on the plantation of that name in the sub-tropical forests on the mountains to the northeast of Guarenas, State of Miranda, most probably corresponds to Rocky Mountains spotty fever of the United States to judge by a careful analysis of the publications of the period and on the basis of conversations which we had with physicians who attended the patients. We

know that the causing agent of this serious illness (*Rickettsia rickettsi*) circulates constantly among certain wild animals, being transmitted among them by ticks which are also of the forest type. Similar considerations apply to plague and tularemia. The endemic zone of the plague at present known in Venezuela consists of a relatively restricted area (1,000 square kilometers) in valleys and mountains in the center of the country, but it includes tropical, sub-tropical and temperate climate levels. Research is also needed on some mycoses of the temperate regions, particularly sporotrichosis and histoplasmosis, particularly with regard to the sources of infection of these diseases. Although barber bug fever and trypanosomiasis *rangeli* are prevalent in the tropical bio-regions, we have confirmed the existence of *Rhodnius prolixus* infected under natural conditions by the *Schizotrypanum cruzi* and the *Trypanosoma rangeli* in the housing of Andean regions located at an altitude of 1,300 meters. The *Erathyrus cuspidatus*, a triatomide of forest ecology which is attracted to houses by light has been found in the same region at an altitude of 1,800 meters. In the area of Pregonero, at 1,260 meters there is the *Triatoma nigromaculata*; we captured it under wild conditions and with a natural infection by the *Schizotrypanum cruzi* in the Sierra de Aroa at an altitude of 1,200 meters. In the same region of Pregonero, as well as in Tovar, Santa Cruz de Mora and other Andean localities, spirochetic recurrent fever is endemic; it is produced by the *Borrellia venezuelensis* and is transmitted by the *Ornithodoros venezuelensis*. We don't know anything about the vertebrate carriers of this spirochetid in nature where the infection is maintained without affecting man, constituting natural foci of the disease. Arachnids, scorpions, millipedes and poisonous ophidians are frequent in the sub-tropical regions and the temperate ones as well; however, systematic studies on their ecology are still needed.

The beauty of the landscape at these altitudes should not be a veil for ignoring what is hiding behind it with regard to the biologic and pathologic phenomena which occur here and whose actual significance and effects on man we ignore. Nature offers the Chair of Tropical Medicine of the Faculty of Medicine of the University of the Andes broad scope for studies on the pathobiology of the tropical, sub-tropical and temperate regions of the mountains, starting with the depression of Lake Maracaibo and going up the various altitude levels of the Andes up to the valleys and slopes of the temperate zone, passing by the Merida plateau and adjacent areas.

Lastly, we have to describe the altitude levels represented by the cold zone above the timber line, at altitudes ranging from 2,500 and 3,500 above sea level. The lowering of the atmospheric pressure, violent gales and low temperatures of these regions deprive the ground of any existing moisture which is only received in the form of very fine snow, which is used by some plants by means of a very complex system of roots. Vegetation is adapted to these conditions and tends to be stunted, growing almost flush with the ground and the arboreal species grow stunted and twisted trunks bent in the direction of the wind. The leaves have reduced surfaces and become minute, coriaceous and rigid. The superficial roots and very reduced trunks and branches and the foliage spread almost flush with the ground gives the plants a cushiony appearance. Under these organic matter accumulates permitting the dispersion of the vegetation and facilitating the development of the rare insects and a whole predatory fauna which is dependent on them. In the depressions, the valleys and the slopes a profusion of geraniums and gencians grow. The *Aciachne pulvinata*, extremely hard grass of these altitudes, constitutes small meadows where one notes the most typical plants of these regions, the *Espeletia* sp. with tall stems with white or yellowish heads. There is an exuberant variety of polichrome lichens, covering trunks and rocks.

In the cold highland regions of Venezuela we have the following Andean localities:

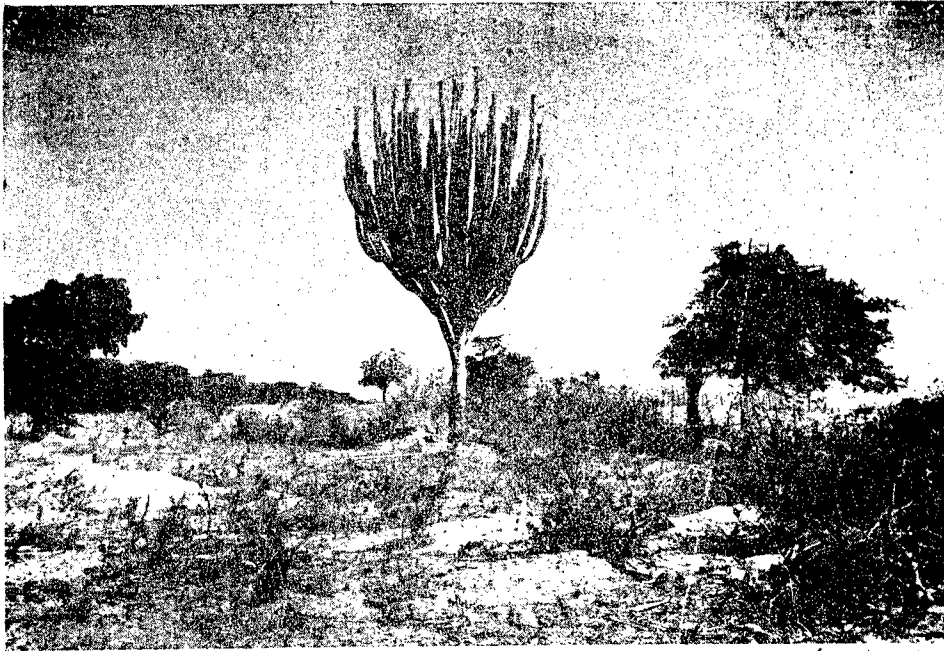
(1) Población	(2) Altura sobre el nivel del mar	(3) Temperatura media anual	(4) Precipitación media anual
Mucurubá	2.500 m.	14.5° C	900 mm.
Chachopo	2.600 m.	13.5° C	900 mm.
Mucuchíes	3.000 m.	10° C	800 mm.

Key: 1) Locality; 2) Altitude above sea level; 3) Average annual temperature; 4) Average annual precipitation.

In this environment the fauna is very poor but no less important. Here are two unique species, the marsupial *Caenolestes* and the mammal *Cryptotis meridensis* which feed exclusively on insects. In this region the only Venezuelan bear, the *Tremartus* has his natural habitat. The birds are also rather specialized; the fauna here is rich in tricholidae, particularly the lovely *Hydropsalis lira*. At the lower level there is an abundance of insects, but they grow scarce as one goes up. Arachnids persists, having their habitat in the spaces between rocks with which they built their homes. In Peru Herrer has found the *Phlebotomus verrucarum* and the *Phlebotomus noguchi* in a similar habitat of endemic areas of Leishmaniasis tegumentaria Uta, at 2,500 meters above sea level. No observations in this respect have been made in this

country, but it is very possible that the species of Phlebotomus living at high altitudes will be found here as well as other mosquitoes. Flees, lice and flies of the Hyppoboscidae family are abundant.

After the level of 3,500 meters above sea level, one enters the frigid zone of Venezuela, which is restricted to Andean mountain peaks and glaciers, with extremely sparse vegetation represented only by mosses and lichens, which disappear in the places covered with snow.



Xerophilous Landscape in the Falcon-Lara Depression (Near Coro)



Thorny Formation in the Lara Depression (Near Bobare)

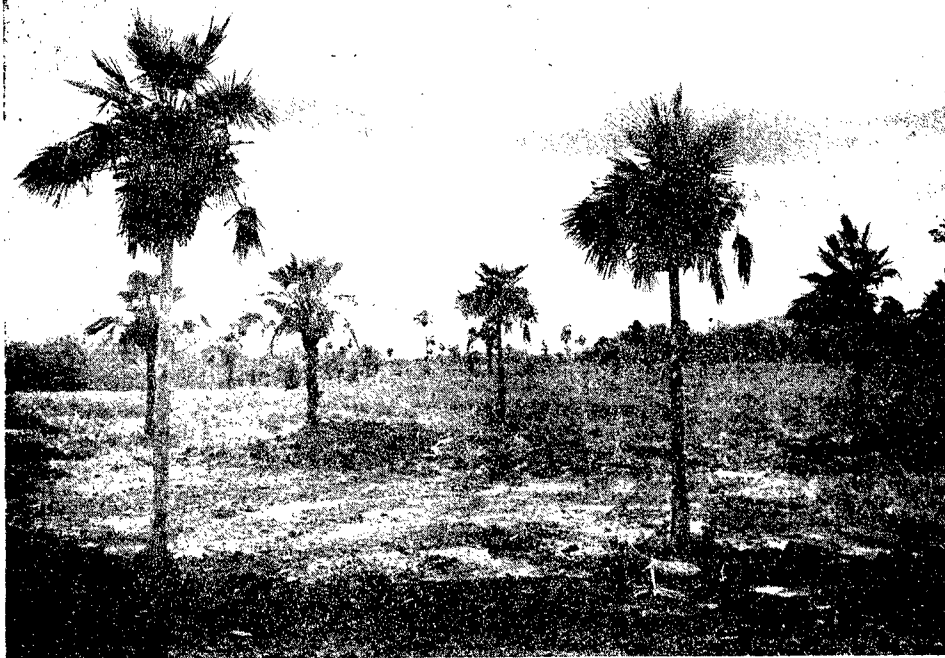


Xerophilous Area of the Barquisimeto-Carora Region



Lara Depression  
(Xerophilous Region in the Vicinity of Bobare)





Palm Grove in the Central Plains  
(Courtesy of the Ministry of Agriculture)



Lara Depression (Sisal Fields)



A View of the Eastern Plains (Mesas Regions)



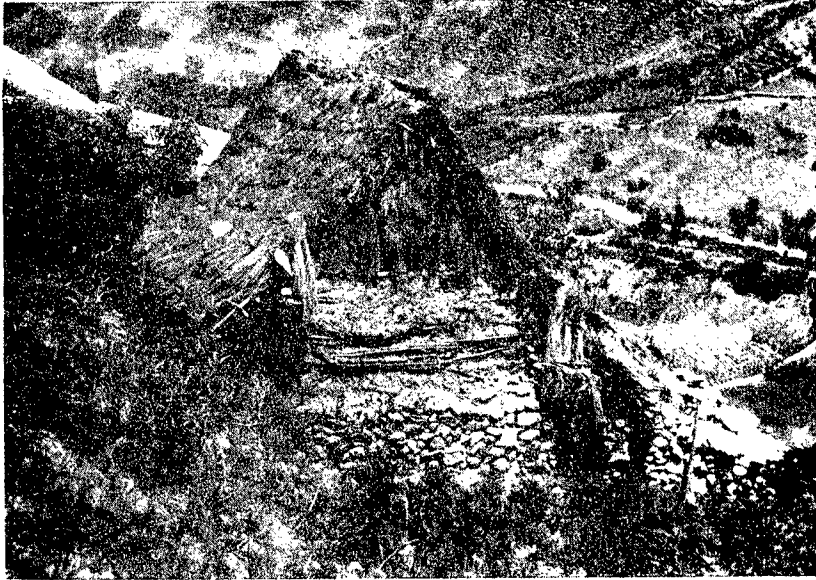
Gallery Forest  
(Courtesy of don Alfredo Boulton)



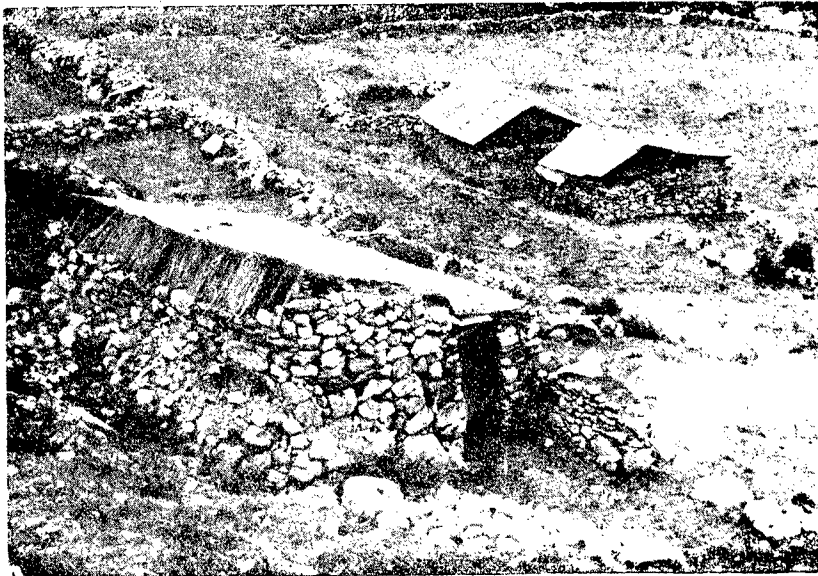
Flood Plain of Camaguan (Central Plains, Bajo Llano)  
(Courtesy of don Alfredo Boulton)



A Palm Grove in Central Plains  
(Courtesy of don Alfredo Boulton)



A View of Ranches in the Cold Regions of Venezuela  
(Micuchies, system of the Andes Mountains)



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