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thesis
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Ranghel, Aparicio
The forests of columbia.

Forestry

Ranghel, Aparicio

THE FORESTS OF COLOMBIA, S. A.

By

Aparicio Rangel G.

University of Michigan

1947

THE FORESTS OF COLOMBIA, S. A.
AND SOME OF THEIR INDUSTRIAL POSSIBILITIES

- a) Division of the Forests
- b) Industrial Applications
- c) A New Diagram Log Rule

By

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(Agricultural Engineer)

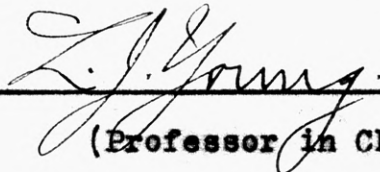
A Thesis submitted to the Faculty of the Forestry
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MASTER IN FORESTRY

Approved by:



Samuel T. Dana
(Dean of the Forestry School)



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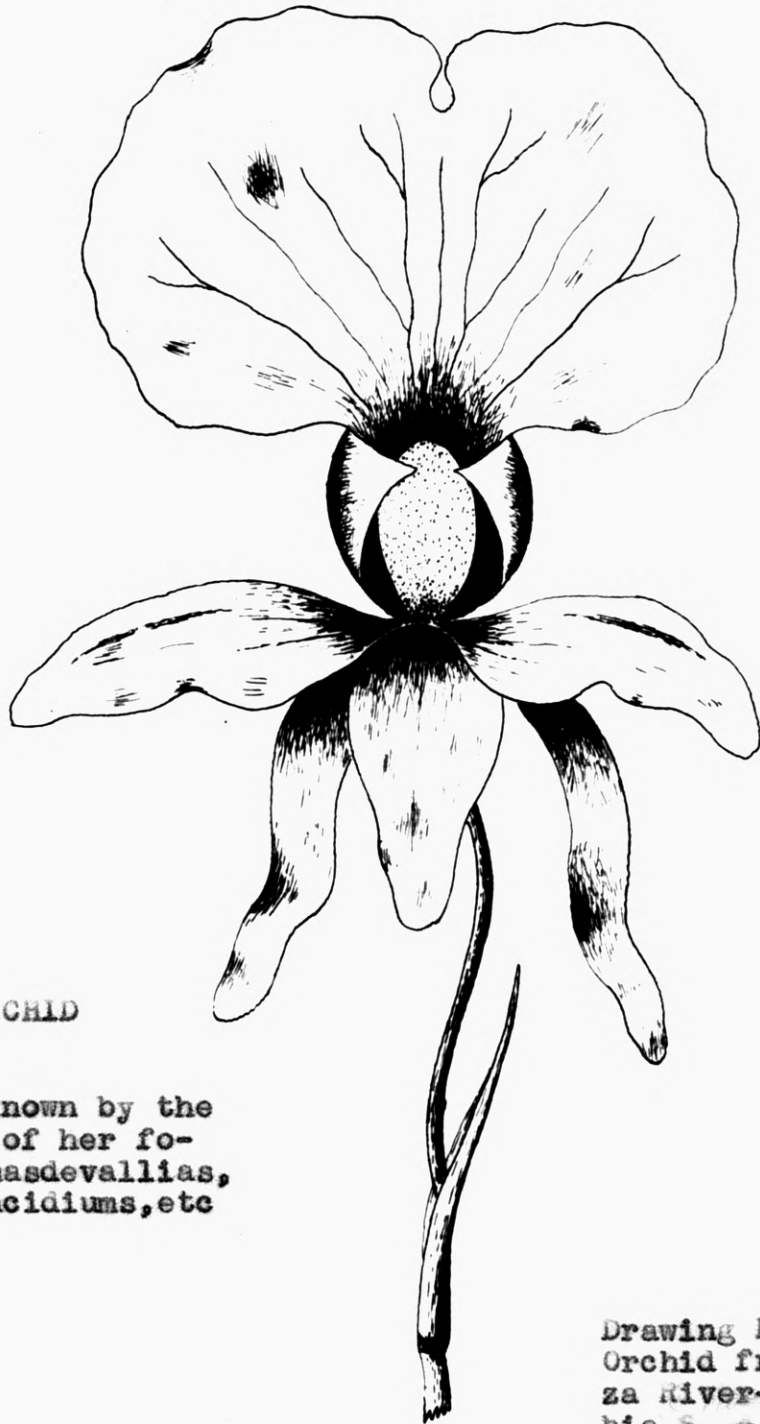
University of Michigan

January, 1947

To

Samuel T. Dana

Dean of the Forestry School
and sincere friend of Colom-
bia; this thesis is dedicated.



COLOMBIAN ORCHID

Colombia is well known by the beautiful orchids of her forests: cattleyas, masdevallias, odontoglossums, oncidiums, etc

Drawing No. 1
Orchid from the Ortega-za River-El Salado-Colombia S. a.

I N T R O D U C T I O N

The principal aim in writing this THESIS has been to study the commercial possibilities that the Colombian Forests may have in the light of analysis and facts, showing the industries that can be developed, the raw materials that can be extracted, the new plantations and factories that must be erected, whether by official action or by private enterprise.

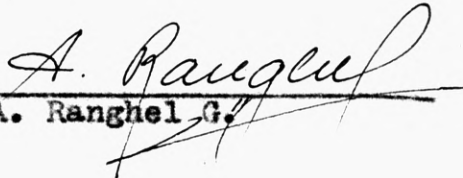
Since many years ago the scientists have studied those forests in a purely abstract way: the interesting point - for many a botanist - was to find a new species, to place a new Latin name: the practical application of the plant was of secondary importance. For the past, that was all right, but at present the economical viewpoint must not be overlooked. On the other hand, the Colombian people in general have considered the forests as a wasting asset and, sometimes, as a hindrance for the enlargement of their agricultural holdings. From this, a great destruction of wealth has resulted.

A close examination - "in situ" of the Colombian Forests shows that they are not only an excellent source of construction wood, but a reservoir of valuable fibers, osiers, dyes, fats, tanning materials, medicinal plants, vegetable oils, balsams, rubbers, precious woods, balatas, alcaloids, chicles, cinchonas, balsams, vegetable ivory, waxes, perfumes, rotenoids, etc. In the light of scientific knowledge, the exploitation of these forest resources; the development of new industries; the establishment of new

plantations; the building of paper, tanning and plywood factories; the achievement of the sustained yield will make of the Colombian forests real assets.

My task has been to present some of the principal spots of industrial interest of those stands in the light of the experience gained through five years of travelling in the forests, on account of the Colombian Government, for whom I worked in the Section of Forests, Ministry of National Economy at Bogota, between 1940 and 1945. The botanical specimens, the samples, the woods, the analyses, the monographs, the tapping apparatus and the photos of most of the plants that are mentioned here, are in the "Forestry Museum" at Bogota, an institution that practically the author of this Thesis founded and directed up to September 1945.

This Thesis is divided into three parts. In the work are included: two new apparatus and systems of tapping latex producing plants are presented; a new Log Rule with its corresponding graph is explained and the map of the Republic of Colombia is attached. The author apologizes for his intrusion in the English language.


A. Rangel G.

Ann Arbor, January 27, 1947

FORESTS OF COLOMBIA

(F i r s t P a r t)

We have attempted here to make an ecological classification of the Colombian Forests which will enable the investigator, the student, the tourist and investor to see some of the commercial possibilities of those regions.

The exploitation of new raw material, the development of new industries, the planning of new crops, the building of new factories, etc. are the possibilities open in these forests.

THE FORESTS OF COLOMBIA, S. A.
AND SOME OF THEIR INDUSTRIAL POSSIBILITIES

By

Aparicio RANGHEL Galindo
(Agricultural Engineer)

Generalities:

The country, which in the last century was called New Granada and now is named as C O L O M B I A, is situated in the northwestern corner of the South American continent, between the latitudes 12 degrees - 30' and 40'' north and 4 degrees - 13' and 5'' south, and between longitudes 0 degrees - 70' - 23.1" east; 66 degrees and 50' W. of the Greenwich meridian. Among the ten republics of that continent, Colombia occupies a very interesting position, having - from the geographical point of view - two long seashore lines on the Caribbean Sea and the Pacific Ocean. The Colombian system of mountains, rivers and cordilleras are the most diversified within the American tropical region.

The equatorial line crosses the territory in the southern part and, as the country is between the tropics of Cancer and Capricornio, the climate would be humid, torrid and warm if many geophysical factors did not influence the Flora and Fauna of this portion of the earth, making of the Colombian territory a masterpiece of beautiful scenery, striking contrasts,

variable climates, diversified habitats and a range of altitudes from the sea level up to the snow capped peaks of the eternal "nevados" or glaciers.

From the topographical point of view, the territory can be roughly divided into: a) ^eANDIAN UPLANDS integrated by the plateaus, slopes, ravines and river trains of the Cordillera de los Andes that start from the Tierra del Fuego in Chile and die in the frozen regions of Alaska; b) the ORIENTAL PLAINS, in the Amazonian Hyleae, that are covered with tall grasses in the "llanos" and stupendous and rich forest in the remaining portion; c) and finally, the RIVER VALLEY SYSTEM composed of the valleys of the large rivers that drain into the Pacific or Atlantic Ocean the waters of the Andes. More than half of the country is in the Oriental Plains. According to ZONE and Sparhawk, 150,000,000 acres are forests that will give a ratio of forest to total land area of 53.8% over the 1,139,155 square kilometers of surface. Here lives a population of nearly 10,000,000 inhabitants, which gives a forest area of 15 acres per inhabitant.

Of the (anterior) 35,000,000 acres or 23.3% of the total are temperate hardwoods and 115,000,000 acres or 76.7% are tropical hardwoods. 85% of all forests are in (the) public ownership. The annual growth and production of wood has been calculated as follows:

Total annual growth in M. Cu.ft.....	110,000	
Total annual growth per acre	0.70 M cu.	70 cu ft
	ft.	



COLOMBIAN
AMAZONIAN
HYLEAE

(Airview of
Subhygrophy-
tic Forests
near the
Caguan river
(Caquetá)
Colombia

Photo No. 1

COLOMBIA: THE COUNTRY OF RIVERS AND OCEANS

Colombia possesses a perimeter of 9,574 kilometers of which 34.15% are seashores, if we take into consideration that the boundaries over the Pacific Ocean are 1,470 kilometers and the coasts on the Caribbean Sea are 1,800 kilometers in longitude.

These 3,270 kilometers of maritime boundaries are the enormous door that gives to this nation access to world markets, an advantage that is supported by the proximity of Colombia to the Panama Canal Zone, which undoubtedly is the crossroad of the five continents. Among the independent South American nations, Colombia is the first in the extension of her seashores.^{no} If we ?

compare the total perimeter of some of the most advanced nations with their maritime coasts, the Colombian position is prominent. Here are some of those percentages:

England	100%	of seashores
Japan.....	100%	" "
United States.....	71%	" "
Spain	65%	" "
France	60%	" "
COLOMBIA	34.15%	" "
Germany	21%	" "
Poland	2%	" "

Due to her geographical position, Colombia can trade easily with all parts of the world. The North American continent is less than 10 hours of travel by airplane; the great ports of Europe can be reached with fast liners in less than a week; the ports of the Far East are almost at hand, without passing the Caps of Good Hope or Tierra del Fuego.

In addition to the above mentioned fact, it is necessary to have in mind that the Colombia territory is crossed in all directions by navigable rivers. To the East and South the Orinoco and Amazon rivers with ^{their} its enormous tributaries (The Caqueta, The putumayo, The Apoporis, The Rio Negro rivers); to the North the legendary Magdalena river, The Cauca, The Sinu; near the Isthmus of Panama, the Atrato River that can be plyed by ocean steamers and to the Pacific Ocean the San Juan, the Izcuané, the Patia and Mira rivers that made transportation for woods and forest raw materials easy and economical.



CONFLUENCE
BETWEEN
THE
CAQUETA
AND
CAGUAN
RIVERS

Photo No. 2

Here is a table of the principal Colombian rivers,
their total ^{length} longitude and sometimes the navigable portions:

<u>Name of River</u>	<u>Total Length</u>	<u>Navigable Length</u>	<u>Observations</u>
The Amazon	6,570 Ks.	4,000 Ks.	This river is the biggest and longest in the world - 116 ks. belong to Colombia. ?
Caqueta o Yapura	2,200 Ks.	1,200 Ks.	
Apoporis	1,500 "	50 "	
El Putumayo o Iza (1400 Ks. Coloms.)	1,600 "	1,200 "	
El Orinoco	2,400 "		
El Vichada	1,350 "	340 "	
El Meta	1,200 "	420 "	
El Arauca	1,000 "	90 "	
El Casanare	515 "	50 "	
El Cauca	1,350 "	340 "	
San Jorge	370	65 "	
El Magdalena (the 4th in importance in S. A.) ?	1,700 "	1,300 "	

<u>Name of River</u>	<u>Total Length</u>	<u>Navigable Length</u>	<u>Observations</u>
El Atrato	670 ks.	320 ks.	
Leon	100 "		
Sinu	460 "	120 "	
Tachira			
Zulia	250 "		
Pamplonita	120 "		
Catatumbo	440 "		
Mira	160 "	30 "	
Rio Patia	450 "	160	
" Iscuande	120		
(Naveg. en 45 Ks. por embar grandes, 120 " " " pequeñas) ?			
Rio Micay	140 "	10 "	
" San Juan (el tributario mas caudaloso del Oceano Pacifico	400 "	210 "	
" Baudo	160 "	70 "	
" Carare	200 "	70 "	
" Cesar	300 "		
" Guania	2,000 "	260 "	
" Lebrija	200 "		
" Sogamoso	500 "		
" Vichada	720 "	340 "	

AREA AND POPULATION:

Colombia ranges 4th in the South American continent due to her entire surface and is the 3rd in the amount of population. The territory has an area of 1,139,155 square kilometers (439,828 square miles), that is, more or less equal to the area of England, France and Germany combined. The population was estimated in 1941 as 9,167,800 inhabitants. At present, the population is about 10,000,000 people.

Of the total population, 96.6% is localized in two-fifths of the territory to the West, especially in the high plateaus, slopes and ranges of the Great Andean Cordillera; the

same Cordillera that, when arriving (through the Panama Isthmus) in the United States, received the name of "Rocky Mountains". With this fact in mind, we can assume that the relative density of the population in the inhabited portions is 19.5 inhabitants per Klm.2 (square kilometer). The remaining three-fifths of the Colombia area is uninhabited at present and those lands await the flow of energetic people, capital and machinery. Over there is an opportunity for many working and honest people who, in some parts of the world like Europe, do not find room to live and protection ^{for} of their enterprises.

Here is a table that shows the relative surface of COLOMBIA in relation to the continents:

By her ^{size} (extension), Colombia would fit in the European territory										9½ times.	
"	"	"	"	"	"	"	"	"	Asiatic	" 43	"
"	"	"	"	"	"	"	"	"	African	" 28½	"
"	"	"	"	"	"	"	"	"	American	" 40	"
"	"	"	"	"	"	"	"	"	Oceanic	" 8	"

By her population, Colombia would fit in Europe 55 times											
"	"	"	"	"	"	"	"	"	America	31	"
"	"	"	"	"	"	"	"	"	Asia	100	"
"	"	"	"	"	"	"	"	"	Africa	15	"

The Colombian population has increased in the following proportion:

In 1835	the population was	1,686,000	inhabitants
" 1843	"	"	1,955,000
" 1845	"	"	2,050,000
" 1846	"	"	2,091,000
" 1851	"	"	2,243,000
" 1871	"	"	2,951,000
" 1905	"	"	4,144,000
" 1912	"	"	5,072,000
" 1918	"	"	5,855,000
" 1928	"	"	7,851,000
" 1938	"	"	9,000,000
" 1941	"	"	9,167,800
" 1946	"	"	10,000,000

How The Forests Are Divided

Having in mind the altitude, topography, slope, soils, expositions and botanical species, the Colombian Forests can be divided into the following groups:

I. COLOMBIAN AMAZONIAN FORESTS: (Hygrophytic Forests)

The Hylaea amazonica or Amazon Valley is a huge area of over 2,000,000 square miles, lying in the tropical zone and including territory of Brazil, Bolivia, Peru, Ecuador, Venezuela and Colombia in the Northern portion.

East of the Eastern Cordillera and extending at the sides of the Putumayo, Caquetá, Caguan, Apoporis, Rionegro, Guainía and Orinoco rivers the Colombian Amazonian Forests extends as far as Letícia port in the South, Puerto Carreño, la Pedrera y Piedra del Cocuy in the East. It is well to remember that the Amazonian Hylae has the largest hardwood forests in the world and that the Amazon River System is, also, the largest in the world. In its basin the number of botanical species is estimated to be more than 2,500 sps. of trees. This will have in the future a tremendous influence upon the future civilization of those countries bordering the Amazon. The total area drained by this huge river comprises more than 2 and 2/3 millions of square miles, and a large part of it belongs to Colombia[?] between the Putumayo, Caquetá and Rionegro rivers.

The regions of Caquetá, Putumayo, Intendencia Amazonas, Vichada and Vaupés, in Colombia, are completely cov-

ered by rich and hygrophytic forests in which the families Bombaceae, Moraceae, Euphorbiaceae, Solanaceae, Sapotaceae, meliaceae and Pa'llionaceae are outstanding. Palms, laurels and myrtles are abundant. The Bignoniaceae family is the glory of those American tropics in the form of trees or vines, producing effective spots of colors in the wavy and green sea of the forest canopy. Beautiful Malpighiaceae vines, the Petreas, the Bouganvilleas, Calliandra, Triplaris and Erythrina ^{have} are showy flowers and useful woods.



AMAZONIAN
HYGROPHYTIC
FORESTS

(Shores of
the
Putumayo
river, Col-
ombia)

Photo No. 3

In the waters of the Amazon trapezoid, the largest flower on the earth, the "Victoria regia", and the beautiful water hyacinth are found.

In the "varzias" (territory between low and maximum

high water recorded over many years), we can find the wooded portions or "igapos" in which the Balsa Wood (*Ochroma* sp.), the cannon-ball tree, the Ceiba (*Bombax* sp.), the Hura crepitans, the *Guarea trichiliodes*, *Andripetalum* sp., *Ficus*, *Tessarias* and several kinds of Heveas are found.

In the higher ground, in hills and ridges, where the land is not flooded, are abundant the *Hevea brasiliensis*, the Seje Palm (*Jessenia polycarpa*), the Juansoco (*Couma macrocarpa* Barb), the Brazil nut and several rubiads.

In the Colombian Forests of the Amazon Valley, many important essences can be found. Here are some of them:

The expontaneous "Siringas" that produced the finest rubber

Hevea Brasiliensis
Hevea Benthamiana ?
Hevea Duckei ?

The "Balata Roja" (red gutapercha)

Manilkara bidentata
Chev

The "Balata Blanca" (white ")

Ecclinusa balata
Ducke

The "Juansoco" (Chicle)

Couma macrocarpa

The Piassaba

Leopoldinia piassaba
Wallace

The Seje palm

Jessenia polycarpa

The "Timbo"

Karts

Sps. Lonchocarpus

The "Sarrapio" (Tonka beans)

Coumarouna odorata

The "Castañadel Marañon" *Brazil Nut*

Bertholletia excelsa
H. B. K.

The Zarzaparrilas

Smilax officinalis L.

The Yaje

The Yoco

Paulinia Yoco

The "Palo de Tela"

Schulzei

Antiaris saccidora

The Canelo of Andaquios

Nectrandra cinnamomoides

The Anaya palm

Attalea sp.

The Rosewoods

Several botanical sps.

And hundreds of other medicinal, fibrous, amilaceous, alcaloidiferous and wood producing plants that make of this part of the world a real "paradise" for the botanists.



COUMA MACROCARPA
Barb. Rodr.

(The "Juansoco"
of Colombia)

Photo No. 4

II. THE GRASSLAND FORESTS:

Between the rivers Guaviare, Arauca and Meta exist enormous extensions of prairies or savannas in which the

vegetation is arrested in its growth in a certain part of the year due to the dry season. This is the region of the "llanos" of Casanare, Dan Martin y Meta. Many channels, rivers, swamps and lagoons are found in this area. Along the sides of the rivers and natural channels more or less broad belts of forests exist. Such forests are called "Gallery Forests".

Here it is possible to find valuable essences like:

Algarroba	<u>Hymenae curbarik</u>
Tonka beans or Sarrapia Real	<u>Dipterix odorata</u>
Palosanto	<u>Zygophyllum arboreum</u>
Carreto	<u>Genipa americana</u>
Palo tigre	<u>Guarea trichiliodes</u>
Granadillo	<u>Buëida capitata</u>

Upon inconsistent soil, marshy in character and treacherous on account of the soft substratum the "Morichales" (*Mauritia flexuosa*) form extensive groves.

Here this Grassland region is to Colombia what the "Prairies" are to the U. S.- the best place for a prosperous animal husbandry business. Raising of Spanish (almost wild) cattle is the principal occupation of the inhabitants of the "llanos".

III. MANGROVE SWAMP FOREST

An extended and narrow belt along the Pacific coast and in several places of the Caribbean sea shore are (^{occupied}integrated) by Mangrove Forests that are dependent not upon the natural precipitation but upon the salt water that continually floods and bathes their root system.

Here the mangle (*Rhizophora mangle* L.) forms dense and

almost pure stands that live in salt water continually immersed. The other kind of mangles, *Avicennia tomentosa*, *Laguncularia racemosa* and *Conocarpus erectus*, are able to live in dry and wet soil, sometimes in brackish swamps. Some firms are established already in this region extracting and exporting tanning materials.

From the mangles can be obtained a valuable tanning material in the form of extract or as powdered material. The wood of these species, principally of the *Rhizophora*, is valuable for construction under ground and water.

IV. THE XEROPHYTIC FORESTS:

In the more northern part of the country lies the Goajira peninsula, where the mean temperature is 29 degrees of centigrade Celsius; and the mean annual precipitation is only of 300 to 800 mm. distributed in 18 or 56 days.

Here the soil is sandy, arid in character, and bearing a vegetation of coarse grasses, brushy scrub or "deciduous thorn forest" (characterized integrated) by:

A. Along the water courses of the rainy period: the caracoli (*Rhinocarpus excelsa*)

B. In the extensive prairies: a thin grass
"Aristida sp."

C. In the marshy areas: the Sensitive Plant
(*Mimosa pudica*)

D. In drier regions the Cactaceae: as *Opuntia caribaeae*, *Cereus*, *Lemaireocereus*, *Pereskias*, y *Acanthocereus*.

E. In more moister places appear small stands of thorny trees like Mesquite (*Prosopis juliflora*), *Acacia* sp., *Pithecolobium*, *Jacquinas*. Among these may be found: *Aspidosperma Dugandii*, *Amyris* and *Bursera simaruba*.

F. Near the sea shore, more or less scattered in groups, is found the valuable *Dividive* (*caesalpinia coriaria*) that is exported in order to utilize the tanning material of its pods.

V. DECIDUOUS FORESTS:

In the great plains of the Caribbean Sea and including the lower portion of the Magdalena and Sinu rivers are found forests of great wealth, valuable species, deciduous trees in the dry season and with excellent sawtimber logs. These deciduous trees, during the dry season, assume a bare, arid appearance, but in the rainy season they are green and luxuriant. Some investigator called this type of vegetable formation "trophophilous forests". Here there is not an abundance of armed trees and ground ^{C. c.}caetaceae. Instead, the quantity of vines and climbing plants is increased. These deciduous forests possess a thin underbrush and circulation in many places is easy. Deciduous forests in Colombia are differentiated from the "Rain type of Forests" in the lessened vigor of vegetation and great number of deciduous species.

This region possesses great agricultural wealth and is divided at present into the cultivated portions, the "llanuras" or plains of the Departments of Atlántico, Bolívar and Magdalena

and the forested zones where exist forests of great commercial future, due to the value of the ^{products} (essences) for different purposes and the ease of communication by rivers and ocean to the markets of the world, especially the consuming centers of Europe and the United States. This zone of the "Deciduous Forests" includes the Lower Magdalena Valley and the plains bordering the Sinú, San Jorge, and Cesar y Valledupar Rivers.

Among numerous commercial species, we can find here:

The Tolú Balsamum
The Tamaca palm
The Noli palm or "American palmisto"
The Carreto
The Colombian Mahogany
The papayotes
The Almacigo
The tamboro
The Royal Colombian Mahogany
Etc., etc.

Toluifera officinalis
Acrocomia sp.
Corozo oleifera Bailey
Aspidosperma Digandii Standl.
Cariniana pyriformis Miers.
Cochlospermum Vitifolium
Bursera simarruba
Schizobium parahybum
Swietenia macrophylla King.



Photo No.5

"GUAYACAN HOBO" of
Colombia.

(A valuable species
for cabinet work
growing in the
Deciduous Forests)

VI. RAIN TYPE FOREST

This luxuriant type of forest can be found in those regions of Colombia where the habitat is hygrophytic in character; high temperature, high humidity and high precipitation. All this combined will give the optimum conditions for the vegetative development in the tropical conditions for the regions of Colombia. The more humid portions of the shore of Magdalena, Cauca, Atrato, San Juan, Cesar, San Jorge, Patía, Valledupar, Mira, Baudó and Isquandé rivers maintain this kind of forest growth which, among other places, can be found in the following regions:

A. The Forests of Baudó, Atrato, San Juan: this is an area where the most humid region of the tropical America can be found. Very frequently the explorer can find trees of elongated leaves; the families Rubiaceae, Melastomaceae and Lauraceae^a are abundant; the palms occur in profusion along the water course (of the river) and some can become of economic importance. Lianas, heavy and succulent Araceae, epiphytes and Bromeliaceae are common. The Heliconia, with their gaudy red bracts⁺ and yellow pedicels make a beautiful landscape among the green vegetation.

The Uraba Plains are situated around the Darien Gulf and they are (^{characterized} integrated) by the level and, for the most part, forested lands of the Atrato, Turbo, and León river basins. The forests of this region are almost unexplored. By the few data gathered by the author of this thesis in an expedition over

there in 1942, it can be ascertained that they possess invaluable wealth, not only in construction and cabinet timbers, but also in fibres, oils, fats, tanning and alkaloidiferous plants.

great potential

bearing

essences products

Among the most important forests are:

The "Pita Colombiana" -
produces one of the strongest
fibers used by men.

Aechmea Magdalenae
Andre

The "Mangle" (Mangrove tree)

Rhizophora mangle L.

The "Caucho Negro" -
During the World War II, big
quantities of this rubber were
exported to the Allies, after an
expedition of the author to those
regions in rubber exploration made
with the cooperation of the U. S.
Department of Agriculture.

Castilloa elastica
Cerv



Photo. No. 6

CASTILLOA ELASTICA Cerv.
(Caucho Negro" of Colom-
bia)

The "Macondo" -
which produces a wood
lighter than the Balsa wood.

Cavanillesia platani-
folia

The "Palo Campeche" (Logwood) -
This valuable tree produces
a beautiful cabinet wood and
a rare and very useful dye,
whose principal ingredient
is the "haematoxyline".

Haematoxylon Campechianum

The "Cativo" or "Amansamujer" that produces a resin that
industrially can be utilized in lacquers and varnish.

B. In the Magdalena River Margins and its
Tributaries - where the rain is abundant and

humidity (great, high)

Here in the forests of the Magdalena river and
its tributaries we have the inter-andian valleys that are
formed by the almost level portions of basins, of those currents
among the slopes and ravines at the foot of the three branches
into which the Andian Cordillera is divided over the Colombian
territory.

Of special importance are the valleys of the
middle Magdalena and Cauca Rivers:

1. The middle Magdalena valley can be considered
as beginning in Garzón and Pitalito (Huila) and forms the agri-
culturally rich "llanos" of plains of Tolima and gently merges
in the Banco with the Caribbean region. In this middle Magdalena
valley the precipitation goes from 1,600 to 6,000 millimeters
annually, distributed during 136 to 295 days in the year. The
most valuable forested regions of this area are situated in:
La Miel river, Puerto Wilches, Cimitarra, Carare, Tamalanque,

Zapatosa and Bosques del Cesar river.

Among other valuable essences of this zone, we can find here the following:

The "Dinde" that produces a very resistant to the decay-wood and gives a yellow dye which can be industrialized. The botanical species is Cholophora tinctoria Gaud

The "Diomate", sometimes called "vegetable steel" due to the fact that its heartwood is one of the strongest. - Astronium graveolens Jacq.

The Trebol or "macacauba" of the Brazilians produces a valuable wood for plywood making and is strongly resistant to decay on the soil. - Platimiscium polystachum.

The "Taparos", a kind of palm that produces more fat than the coconut palm. Here is a comparison of the percentage of fat between these two species:

COPRA: 63.10% of oil

Taparos (Attalea sps.): 65.76% of oil

The (corresponding) analysis ^{was} was made by The Laboratory of the Ministry of Mines and Petroleum in Bogota (Colombia)

The "Mamarrón" (Mamarrón palm) - Attalea cohune - whose seed, according to the above Laboratory, is ^(even) richer in fat than the Copra and Taparos. Mamarrón gave - 69.58% of oil by the Soxhlet system.

The "Palmas de Vine" (Wine palms) - Scheelea butyracea Are (essences) rich in fat and the stem produces an almost real wine.

2. The "Valle del Cauca" or Cauca Valley goes from the northern part of the Department (State) of Cauca and ends in the confluence with the Magdalena river. This zone includes one of the most fertile regions of Colombia, from the Agricultural point of view. Properly, the Cauca Valley is situated

at 1,000 meters above sea level, but in our division of the forest will include the plain land of the Cauca Department and the level and humid region of the southern part of the Department of Bolivar that is covered by extensive forests. Here we can find, among many other hundreds of useful species:

The "Comino crespo"

Aniba sp.

In the opinion of the author of this thesis, this is the most valuable and beautiful Colombian wood. This wood can be utilized for plywood, cabinet work of the most expensive type. The wood is yellow, iridescent, and with pretty designs.

The Ocobo (Primavera)

Tabebuia pentaphylla Nichols

Is a kind of wood that can be exported and the North American manufacturers are already acquainted with it.

The "Chicala" or "Flor amarillo"

Tabebuia spectabilis
Pl. et Lind.

Very valuable wood by its weight, hardness and resistance.

The Vegetable Ivory (Taguas)

Phytelephas Karstenii Cook

An abundant species whose fruits are real ivory utilized in the industry for buttons, toys, etc.

The "Perillo" or Chicle

Achras sp.

Since many years ago, this chicle has been exported to the U. S. by the Colombian merchants along the Cauca and Magdalena rivers.

C. The Catatumbo Forest: situated near Venezuela and is a "heavy tropical forest" in which the vegetation is profuse and gigantic. Here are abundant the trees of the genus Ficus, Cecropias and Lecythis and a kind of very useful caoba (Swietenia De Candollei), the Guaimaro (Brossimum columbiensis).

Here in these forests it is possible to find excellent hemostatics; also...

The gigantic "Caracoli" - Rhinocarpus excelsa

The wood of this rapid growing species can be utilized in craft making, like canoes, boats, and boxes and crates for shipments.

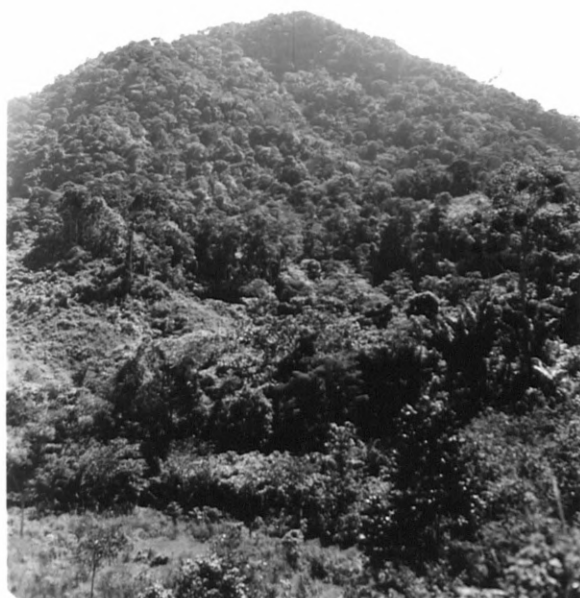
The Copaiba or "Canime" - Copaiva officinalis Jacq.

In the interior cavities of this tree, a kind of balsam or oil is formed and this oil can be utilized in industry and medicine for lacquers, varnishes, (anti-syphilitic remedies) etc.

VII. SUBTROPICAL ZONE FORESTS

[Subtropical Evergreen]

^{At} In the base of the Andes and Sierra Nevada de Santamarta, the high temperature is ^{reflected in ?} affected by the altitude of the forests as they are ascending (in) the slopes of the mountain. Here we have the torrid climates (Clima caliente) similar to the temperature of the contiguous areas of the big rivers like Magdalena and Cauca. For the purpose of this study, the author is considering as Subtropical Forest all those masses of vegetation situated between 0 meters and 400 meters above sea level. Average temperature is of 27 to 28 degrees C. The same kind of forest can be found ^{on} in all the slopes of the Andes where the altitude is of 400 meters to 1,000 meters but in which the climate on the average is 23 to 26 degrees C.



SUBTROPICAL ZONE
FOREST

(San Vicente del Ca-
guán (Caquetá)
Colombia

Photo No. 7

This subtropical Evergreen Forest is very similar in the kind of botanical sps. to the adjacent Rain Forest type of the low land; the difference consisting in aerial world of life formed by a wide variety of epiphytic ferns, mosses, bromeliaceaea, ^{Orchidaceae} orquidaceae, etc. Here, the occurrence of tree-ferns is more pronounced than in the rain-type of forests of the lowlands. In this Subtropical Zone Forest lianas and different kinds of palms are likely to occur but the density per acre of stand and the sps. are not the same, in comparison with the

plains. This habitat of subtropical conditions will show more flowering bloom and consequently more pollinating insects and birds.

This subtropical zone, at the base of the mountains, united with the Inter-andian Valleys and the coastal plains constitute what, in the common language, is called "The Tierras Calientes"; that is, the torrid climates with average temperature that ranges from:

23 to 26	degrees centigrade	in the subtropical zone
29 to 31	" "	" " Atrato river valley
31 - -	" "	" " Magdalena river valley
32 to 33	" "	" " Colombian Amazon valley

The "climas calientes" or torrid climates comprise 831,500 square kilometers and approximately 2½ millions of people are living there. The rest of the territory possesses mild temperate and cold temperate climates where the conditions are favorable to human life.

No seasons (in the sense understood by Europeans) occur in Colombia. Over there there is (an) eternal spring. The trees grow all the year round, if the humidity is favorable. The flowering season is not limited to April and May; some species or others are blooming at any time of the year. The rainy period the Colombians call WINTER and the dry season, SUMMER.

In the base and lower portions of the Andean slopes the naturalists will find: the resins, the rubbers, the balsams, the antidots, the valuable fibers, the antipiretic plants and the

alcaloids, according to the opinion of the greatest Colombian scientist, Francisco Jose de Caldas



Photo No. 8

CEDRELA ODORATA (Cedar from
Popayan (Colombia))

In the "Subtropical Zone Forests", among other valuable species the industrialist will find:

The Cedars (called in English "*spanish cedar*" "mahoganies") which produce one of the most highly appreciated woods for cabinet work, plywood, musical instruments etc. The corresponding botanical species are:

"Cedro bogotano"	<u>Cedrela bogotensis</u>
"Cedro cebollo"	<u>Cedrela mexicana Roemer</u>
"Cedro monde"	<u>Cedrela montana</u>
"Cedro jaspeado"	<u>Cedrela Fissilis Vell</u>

These cedars are fast growing species and can be utilized with great advantage in the reforestation and building up of artificial forests. *If you can get them to grow, not easy in Puerto Rico.*

VIII. MIDDLE CLIMATE EVERGREEN FORESTS

Comprise all masses of vegetation that are situated between 1,000 and 2,000 meters above sea level, with mean annual temperatures between 18 and 25 degrees of Celsius. More than 180,000 square kilometers are in this area, where 4,000,000 people live; the whole constituting the "Coffee Belt", one of the principal Colombian products for export. THE COLOMBIAN COFFEE IS THE BEST MILD COFFEE IN THE WHOLE WORLD. *g*

At the time of the Spanish conquest, the regions of this zone were covered by dense forests which the white men cut down to make room for his crops and pastures in many places. In spite of this fact, here and there remain, up to the present time, small or enormous extensions of lands where the forest is in its virgin condition.

Among the natives in the Plant Kingdom, we will find here:

The Cinchona tree (Quinas) - genus Cinchona sp.

This zone is the best as a natural habitat for the Cinchonas, especially the CINCHONA PUBESCENS Vahl and the Cinchona officinalis L from the 1,800 meters up.

During the First World War and especially in the Second one, the Cinchona tree of this Colombian zone gave to the Allies many hundreds of tons of bark that went to all parts of the world, saving the life of the armies against malarial fever.

The Wax Myrtles ("Laureles de cera") - Myrica pubescens
Myrica polycarpa

These valuable shrubs, which like to grow in poor and sandy soils, produce a kind of wax that is exported to different markets of the world. In certain regions of Colombia the cultivation of the Myrtle wax is already established, as in the "municipio" (county) of Tambo, (Department of Narino). The counties of the "Olive Zone in Colombia", as Leiva, Raquira, Tinjaca and Sutamarchan in Depto. of Boyaca, are very apt for this kind of cultivation.

The Guaduas - Guadua angustifolia

The Middle Climate Evergreen Forests Zone is also the natural habitat of the Guaduas (plants similar to the Asiatic bambu), which constitutes one of the most useful building material. This is a species of plant that can be easily cultivated, its natural rotation is very short and always there is a ready market for it.

The Erythrinas - Erythrina Umbrosa
Erythrina pisamo Willd.
Erythrina glauca
Erythrina corallodendron etc.

The above are some of the species of these trees that are very useful as shade for cocoa and coffee plantation

and produce a soft and useful wood that can be employed in the packing industry, match factories etc. *also good cattle forage*

IX. SUBALPINE EVERGREEN FORESTS

The zone in which are situated the fertile plateaus of the Bogotá Sabana, the valleys of Cerinza, Chiquinquirá, Sogamoso, Pamplona and Túquerres has a cool climate; a temperature between 10 and 18 degrees centigrade; the altitude is between 2,000 to 3,000 meters above sea level. It is a very healthy climate, free from insect pests (for human beings) and has an invigorating environment exceptionally adapted for intellectual studies. 10.5% of the Colombian area is situated in this climate, which is especially favorable for European immigration.

Here the forests are lower in height than in the "Middle Climate". The ^{appearance} views of the stands ^{is} are beautiful and luxuriant, the trees are more uniformly made and compactly branched with round tops and are park-like in formation in the upper regions near the "Bushland".

The forests in the limit (between the middle climates and the Subalpine Zone) and those of the Cool Temperate climates up to the 2,700 meters above sea level, grow in a humid atmosphere produced by the condensation of the moisture laden air currents which come up from the lower lands. Here the forests can be considered as "hygrophilous" and they are integrated by rustic trees, middle in size and growing in what we call in Spanish a dense "Sotobosque".

Here the orchids, the ephyphytes, the arborescent ferns and the graminaceous "chusques" (Chusquea scandens L) are abundant. Here is also the home of the graminaceous plants, the lichens and the criptogamous. *Cryptogams*

Near the upper level of these forests, the Russian Professor Bukasow and other investigators (including the author of this thesis) have found many of the ancestors and relatives (Solanum andigenum) of our cultivated potato (Solanum tuberosum).

Among many other plants that produce valuable woods, fibres, osiers, dyes, resins, waxes, etc. we can find in these forests the following:

The Colombian Pines ("Pinos Colombianos") - genus Podocarpus. With these names are known in Colombia all the members of the genus Podocarpus. They produce one of the best woods for cabinet work. The material is immune to the borers and is easy to work. These are the different species known in Colombia up to date:

"Pino Remeron"	<u>Podocarpus macrostachys</u> Parl
"Pino Colombiano"	<u>Podocarpus taxifolia</u>
"Pino Ayuelo"	<u>Podocarpus montanus var Communis</u>
"Chaquiro"	<u>Podocarpus taxifolia var.</u> <u>densifolia</u>
"Pino negro"	<u>Podocarpus taxifolia var.</u> <u>montana</u> Willd.

The Dividivi or Brasil - Coullteria tictoria H. B. K. - a resistant species that grows in poor and dry soils producing in the pods valuable ^{tanning materials} (tanoids) that the industry utilizes in the tanneries.

The "Encenillos" - Weinmania genus. This kind of

tree forms almost pure stands that produce a kind of wood useful for general construction including flooring and inside decoration. The bark is a tanning material that is at present actively exploited to supply the local factories.

The Cinchona "TUNA" - Cinchona officinalis L.

The tree constitutes the richest native species in alkaloids and has the advantage that its growing belt goes up to the 3,300 meter above sea level. With this Cinchona officinalis L. as a stock in the cool temperate climates and the Cinchona pytahayensis in the middle ones, Colombia is able to grow and cultivate the Cinchonas in a very wide range.

The Cedars and Walnuts - Among the precious woods, these are notable for the color, working qualities and quality of the:

"Cedro bogotano"	<u>Cedrela bogotensis</u>
"Cedro Nogal"	<u>Juglans columbina</u> var. <u>bogotensis</u>
"Cedro Negro"	<u>Juglans columbiana</u> Dode

The last two species are walnuts similar to the American ones, and from them can be obtained a precious wood for airplane, shipbuilding, cabinet and other works. The natural rotation of these walnuts does not exceed 30 to 40 years.

The "Esterilla" - Orthosanthus chimboracensis
(H. B. K.) Baker

Produces a fiber, known in the markets as "Maria, s fiber", that is employed after bleaching and pressing in the production of a certain kind of brushes. The roots are fiber.

The "Juncos y Espartes" - Juncus storae

Juncus andreanus
Weatherby
Juncus densiflorus
H. B. K.

These are plants of humid and wet soils, in marshes and lagoons, and they can be employed in numerous industrial products such as ropes, raw material for paper, baskets and furniture.

The "Calagualas" - Polypodium glaucophyllum Kze.
Polypodium percussum H.B.K.
Polypodium lanceolatum L.
Polypodium calaguala

These are species that possess antipiretic, astringent and anti-venereal qualities that pharmacy and medicine can utilize.

The Oaks - Quercus and Erythrobalanus ^{genera}

The Colombian oaks are close relatives of the American ones and they are situated, in general, in pure stands and grow at an altitude of 2,400 meters. These oaks produce a resistant, heavy and valuable wood which, aside from its qualities for general construction, give a charcoal of first quality.

Among the Ornamental species of these forests, the following are outstanding:

The "Mayos"	<u>Chaetogastra speciosa</u>
The "Sietecueros"	<u>Meriania nobilis</u>
The "San Juanito Morado"	<u>Tibouchina mollis</u>
The beautiful "Flor de Mayo"	<u>Tibouchina lepidota</u>
The "Raque"	<u>Vallea stipularis</u>
The "Alcaparros"	<u>Cassia tomentosa</u>
The "Bejuco clavellino"	<u>Mutisia clematis</u> Linn.
The "Amarraboyo"	<u>Chaetogastra macrophylla</u>
The "Coral"	<u>Loranthus americanus</u>
The "Rosario"	<u>Blokea andreana</u>



Photo No. 10

CHAETOGASTRA SPECIOSA

(One of the most beautiful ornamental
plants of the Subalpine Evergreen
Forests of Colombia.)

X. THE BUSHLAND FOREST

Somewhat similar to the American "Chaparral", there is a shrubby forest forming a transitory belt between the "Paramos or Andfan Meadows" (somebody called these formations "Alpine Meadows"), and the Sub-andfan Forests of the cool climates. Here the elevation may be approximately between 3,000

meters and 3,500 meters above the Besel, ^{Beisel} geoid; temperature may be between 5 and 10 degrees of Celsius. Here the plants are drought-resistant.

In this brushwood forest, the trees become more and more stunted, ending in being so low and spreading that sometimes it is possible to walk upon them. This is also the home of Weinmannias, Rubus, Berberis, Fuchsias, Clematis, Bomareas, Tagetes, Odontoglossums, Usneas, Salvias, Vacciniums, Hypericums, Gaultherias, etc. Depending upon the region and the ecological conditions above the 3200 meters above sea level are found the formation called "PARAMOS" or Andian Meadows, where the surface of the earth is covered by short grasses, shrubby bushes and where the "frailejón" (Speletia), "oche" (Stipa ichu) grass predominates.

Here the sheep industry can be developed on an ^{extensive} extraordinary scale, if care is taken to prevent pests and diseases. We are sure that "llamas", "alpacas", and vicunas can be acclimatized in these altitudes, that must be exploited in an economical way.

INFLUENCE AND INDISPENSABILITY OF THE FORESTS

All the above mentioned forests possess an extraordinary wealth that has influenced the past of the Colombian people and will provide in the future for many achievements in the road of progress and civilization. Among the innumerable influences, the Colombian forests:

1) Provided with food, shelter and dress the Pre-Colombian aborigines;

2) The same was done, and is continuing to be done, with the descendants of the Spanish conquerors and the present tribes that inhabit the vast forests and grassy plains of the Colombian Amazonian valley;

3) From the time of the Spanish conquest up to the present time the forest provided precious woods for cabinet making, house construction, boat building, ship construction, railroad ties, telephone poles etc.

4) The forests, with the powerful aid of climate, in general made our soils upon which we are cultivating and living.

5) Precious woods have been the object of exportation to Europe and the United States as a means of getting international currency, aside from coffee, platinum, emeralds, petroleum and gold.

6) The Colombian tanning materials are valuable in the markets abroad;

7) Oils and vegetable fats are always at high prices;

8) The "Golden Tree", as it is called, or Cinchona produces the Quinine that helped the Allies to win two wars;

9) Several times our rubber (Siringa and Caucho negro) has attained great demand in the markets abroad.

10) The vegetable fibers, like the Piassaba, Cumare and Chiguichigue are very well known;

11) Aromatic essences like tonka beans and vanilla are sent everywhere to foreign countries;

12) The latex of Coumas, Acfras, and Massarandubas is a continuous object of exportation for the chicle factories;

13) Logwood, Brasil and Fustete have produced beautiful colors and useful things, as varnishes, lacquers, dyes, shoe polishes and typing and printing inks;

14) Medicinal plants like Zarzaparrilla, Ipeca, etc. have helped many pains of humanity;

15) The Colombian ivory palm has buttoned up thousands of citizens of the world;

16) In 1923 Zoné and Sparhawk, in their book entitled "Forests Resources of the World", calculated that 5 towns with a population of 300,000 inhabitants consumed about 13 millions of board feet or 120 million board feet for the entire country; with the present population, the entire consumption of wood would be approximately from 300 to 360 million board feet in 1946. The anterior number is for sawlumber, hewlumber and railroad ties;

17) All wooden material needed for railroad constructions, bridges, ports, and mines has been supplied by the forests.

FORESTS OF COLOMBIA

(S E C O N D P A R T)

In order to give an idea of the commercial possibilities that can be developed from the ~~from~~ the Colombian Forests, we are going to describe some of the species that produce tanning materials, woods for exports, balsams, dyes, rubbers, fiber, fats, oils, resins, chicles, etc.

It is considered that more than 300,000 botanical species grow in the Colombian territory. Half of them are not even classified, since, in order to describe all the valuable species, it would require volumes.

In this "Second Part", and in the proper place, we present some new apparatus and systems to exploit those plants without injuring their productive capacity.

Finally, some suggestions are made as to how to preserve, study and industrialize the valuable forests of this nation.

B A L S A M S

Of the Colombian species that can be advantageously utilized as balsam-producing plants, we mention the following as an example:

- 1) "Balsamo del Tolu" in Colombia - Toluifera officinalis

This species has been called also "Palo de Balsamo" and "Arbol del Balsamo". This is a very valuable species for the balsam that it produces and its excellent wood.

In all parts of the tree a balsam or resin is found that, when extracted, is solid, sometimes viscous, of bitter taste, granulous structure, semi-transparent in nature and a reddish-yellow in color. This balsam has an extremely agreeable odor and the Roman Catholic Church employs it for administering the "Holy Chrism" and for incense in the religious ceremonies. This church went so far as to declare a sacrilege the cutting or injuring of the Balsamo. This "Balsamo del Tolu" has a definite and notable action on the respiratory system and has been employed to combat venereal diseases, asthma, rheumatism, stomach troubles, itch etc.

In the industry the "Balsamo del Tolu" (not Balsam of Peru) can be utilized in perfume manufacture, cosmetics, ointments, flavoring of beverages. The bark of the "Balsamo del Tolu" is employed in several parts of Colombia as an excellent cicatricial remedy for ulcers and wounds.

From a sample of "Balsamo Rosado" brought by the

author from the forest of Rio Orteguala (Caqueta), the following results were obtained:

Humidity	10.00%
Ashes	9.49%
Bencenis extract	1.84%
Alcoholic extract	9.07%

COLOMBIAN BALATAS

"Balata" is the name applied to all those trees that when their bark is wounded produce a white latex which, on coagulation, gives rise to a tenacious, hard and flexible polyterpene (C₅ H₈) x at room temperature. It is a kind of gutta-percha. When the balata is heated, it becomes soft, mellow and pasty. This balata gum is very valuable in the modern industry because it has the particularity that when subject^{ed} to high temperatures its behavior is similar to the other polyterpene RUBBER: and vice versa, a low temperature rubber behaves like balata. The combination of these properties renders these products more valuable, especially in the manufacturing of transmission bands, tanks for airplanes, catheters, etc. Several botanical species produced in Colombia balata on a commercial scale:

- 1) The "BALATA ROJA" - Manilkara bidentata Chev.

The Huitoto Indians name this species "fafacona" and in the Coreguaje language is called "tanqueojoguito".

This is the most valuable balata produced by the Colombian Amazonian region and has been in exploitation since

the last century. The trees produce the gum, an excellent timber, the latex is employed by the natives as food, and infusion of the leaves is employed against paralysis. This balata gum always brings a high price in the markets, in comparison with other forest products.



Photo No. 11

MANILKARA BIDENTATA Chev.

(The "Balata Roja" of Colombia, being tapped by a Huitoto Indian in the Putumayo forests)

In spite of the utility of this species, the "balateros" (balata gatherers) are employing a system of tapping V

incisions which girdle the trunk, killing the hen of the golden eggs. To prevent that the author of this thesis, in the above mentioned expedition, tried to develop a system or an apparatus which will preserve the life and productivity of the species. The apparatus that was invented is shown in the following photo, but its results need more tests and modifications, due to the fact that the bark of the "Balata Roja" is corky, fibrous and resistant to the penetration of cutting tools. See Drawing No. 2...

The wood of the "Balata Roja" is brownish-red in color, is of fine texture, straight grain, highly resistant to decay and can be used especially in durable construction like bridges, railway ties, poles, posts. Due to the coloration, this wood is called beefwood and horseflesh.

Awaiting to improve the apparatus here shown, the author of this thesis suggests the following system of tapping the Balatax trees, in order to avoid the wanton destruction that at present is taking place:

a) The "balatero", with climbing spurs, must begin carefully making incisions in the form of a V in one face only of the trunk; the inclination of these incisions must be 45 degrees and the width of them must not exceed 0.03m.; the distance between the V's is 0.40m.

b) It is necessary to teach the worker that the stroke must be of such gentle force that the edge of the machete will cut only four-fifths (4/5) of the total thickness of the

bark. This is not so difficult to accomplish if one remembers that the outside 4/5 of the balata bark are dark red in color and the Cambium layer, or vital zone, is of light pink and must not be touched with the machete. See Drawing No. ³...

Tapping with this system, we obtain 17 kilos of latex (12 to 13 kilos of dry gum) from a tree that was 24 meter height, and with d. b. h. of 1 meter. (Campament of Portales - Caguán River - Caquetá)

We found the "Balata Roja" in forests of Quebrada Tagua (Putumayo), in Portales (Caguán river), forests of "Quebradon de Huitoto" and in the region of San Vicente del Caguán and Puerto Rico (Caquetá). There is reliable information of the existence of this species of balata in :

Forests of Mesay, Papunauba, Cuemany, Cauinari, Cunare, Yari, and Guania rivers.

Analysis of the Balata Roja:

On a sample of "Balata Roja" gum brought by the author from the Caquetá region, the Nal. Lab. obtained the following:

Ashes	0.60%
Resin, soluble in acetone	45.55%
Gross rubber	54.44%

2) The "BALATA BLANCA" - Ecclinusa balata Ducke

This species is called by the Brazilians "Cuquirana" and produces a gum that is black outside and white when the cake is open. According to Dr. L. N. Norzaga^{ya}, the "Balata Blanca"

has a percentage of gutta of 36%; this species has been exploited in all the Colombian Amazonian region and has the advantage of its bark being soft, easy to cut and, similar to the "Juansoco" bark, it can be tapped with our Jebong modified knife.

We found the "Balata Blanca" in the forests of Pescado, Guecochará, Caguán and Jetuchá rivers.

3) The "BALATA CHINGONGO" - Probable Syderoxylon sp.

This is an abundant tree in the Colombian Amazonian region and has a latex that is much richer in resins than the two previously mentioned species. The reserves of this tree are almost untouched.



Photo No.12

The "BALATA CHINGONGO" of
Caqueta (Colombia)

4) The "MISPERILLO" of Colombia

Produces the balata that is exported from the forest of Magdalena and Cauca rivers and its tributaries.

We found this tree in the forest of Puerto Wilches, Aguas Claras and Bocas del Rosario (Santander).

5) "BALATILLA" of Caquetá - Probably a Manilkara sp.

Was found in the forest of Caquetá and Putumayo.

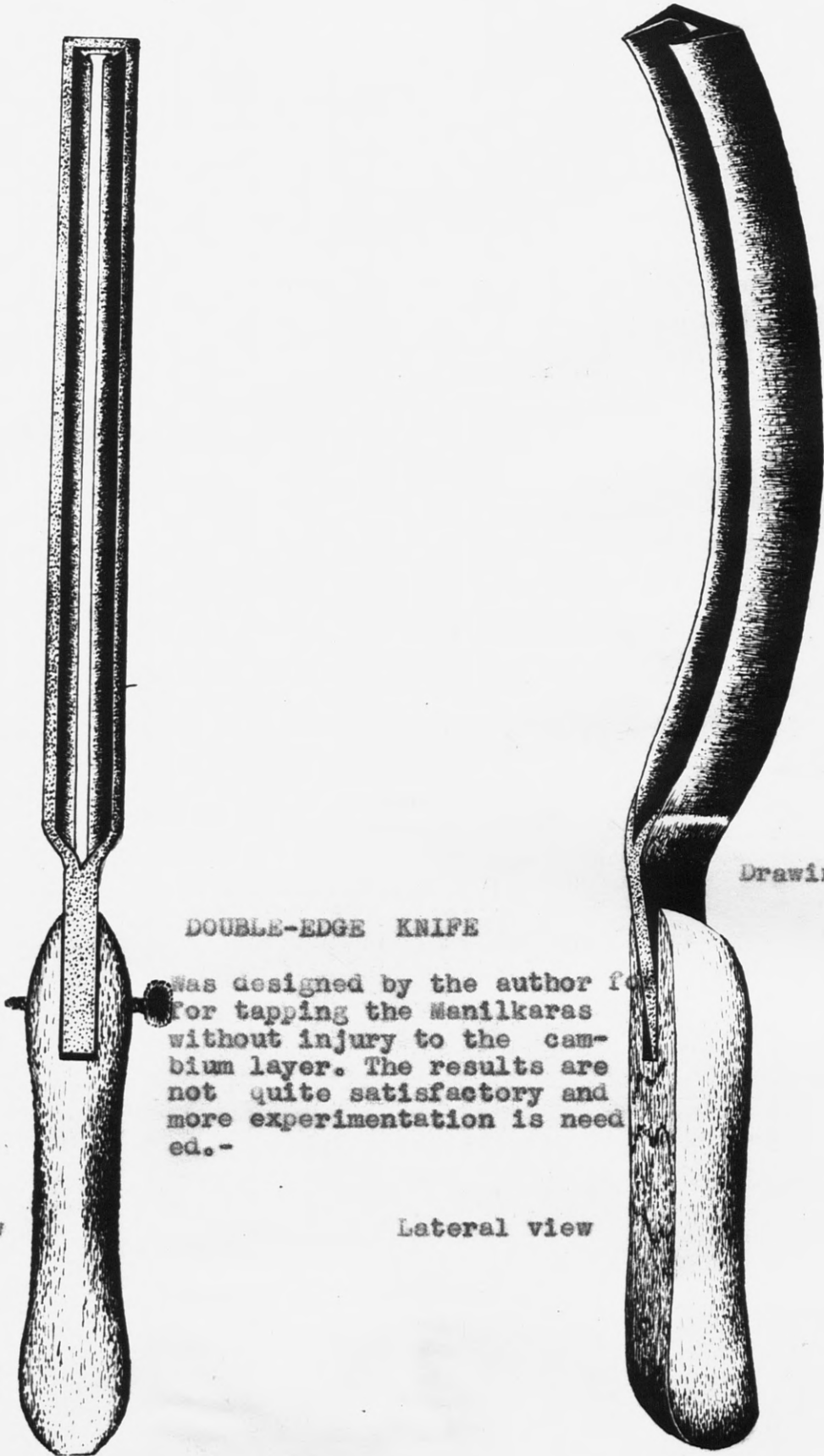
From samples of the latex brought to the Nal. Lab. by the author, the analysis gave:

(Humidity) Moisture	2.1%
Ashes	0.38%
Proteins	1.12%
Resins	45.58%
Volatile products at 18 degrees C.	18.32%
Balata	34.00%



Photo No. 9

Rubber of the "Mid-climate Evergreen Forests-"
Medellin-Colombia



Drawing No. 2-

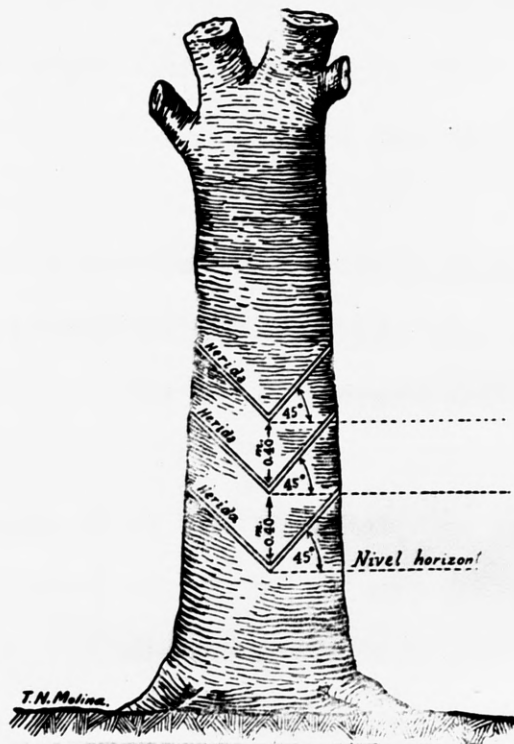
DOUBLE-EDGE KNIFE

was designed by the author for tapping the Manilkaras without injury to the cambium layer. The results are not quite satisfactory and more experimentation is needed.-

Back view

Lateral view

Drawing No. 3



How the "Balata Roja " must be tapped to obtain the maximum of latex, under sustained yield production.-

C O L O M B I A N R E S I N S

Among the numerous Colombian ^{products} (essences ^{species}) that can produce resins, we can mention the following:

- 1) "Algarrobo" of Colombia - Hymenaea curbarill

Produces the so called "South American Copal", a resin like gum ex/udated by the trunk that hardens in the ground into lumps in a quantity of 1 barrel per year and per tree of large size. From this copal varnishes are made, and the churches in Central America burned it as incense due to its agreeable odor.

Surrounding the seeds of this "Algarrobo", there is a white, sweet and edible substance that can be utilized for flavoring beverages, and, when it is fermented, gives a liquor similar to beer.

In a rustic way, the bark can be utilized as a canoe which sometimes can hold up to 30 men.

- 2) "Resbalamono" or "Indiodesnudo" of Colombia -
Elaphrium simaruba (L) Rose

This is the "Gumbolimbo" of North Americans and "jiote" of Guatemala. This tree produces in the liber secretory canals, which give origin to a resin called "CHIBU" and, in Central America, "copal". This last word is of Nahuatl, origin and is, at the present time, applied to all kinds of resin that come to the North American and European markets from Asia, Africa, and South America. The resin is gathered by notching the

trunk, received in gourds, is boiled and the resin skimmed off. The resina CHIBU of Colombia can be utilized as incense in the churches; varnishes and lacs can be made from it. This resin is a substitute for glue and sometimes is used for mending broken glass and chinaware. The "resina CHIBU" of the "Resbalamono" can be utilized for calking boats and canoes, having the advantage that it preserves the wood against the attacks of borers and termites. The Spaniards gave the name of "Goma Elemí" to the resin or copal, according to Standley and Steyermark.

The wood of "Resbalamono" is very perishable in contact with the ground or water; is medium to coarse in texture; very easy to work; resinous in nature; can be polished very fine; is light in weight and soft; and the coloration is white or brownish-white, sometimes with black spots due to defects in the seasoning. This wood, according to Dr. Armando Dugand (Director of the Colombian Institute of Natural Sciences), can be utilized as a source of pulpwood for paper making; it can be used with advantage also in the making of crates, boxes, fuel and charcoal.

The author of this thesis has found the "Resbalamono" in abundant quantities in the Colombian forests, corresponding to the DECIDUOUS and RAIN TYPE of forests of our classification. We have found the *Gumbolimbo* in the regions of: La Ceiba (Puerto Salgar), Campanito (San Carlos - Bolivar), Bocas del Rosario (Santander), San Vicente del Caguan and

Montañita (in Comisaria especial del Caquetá).

3) The "carano" of Colombia - Protium caranna March.

This species produces a wood that can be utilized for boats and canoe construction.

The "Carano's" bark and also the fruits produce a resin called "CARANA" and sometimes "Tacamaca". This resin is brownish, greenish yellow, solid at room temperature and it has a "sui-generis" smell, strong and agreeable.

This resin can be employed for preparing ointments and balsams; it has vulnerary and healing qualities for wounds and other skin troubles. It has been applied successfully to hernias and the people attributed to this resin anti-rheumatic, pectoral and analgesic qualities that it is necessary to prove with adequate tests.

The author has found this botanical species in the forests called in this work, DECIDUOUS, RAIN TYPE FOREST and sub-tropical Evergreen Forests; in particular San Vicente del Caguan (Comisaria del Caquetá); Guacamayas, Puerto Rico and Montañita of the same region.

4) The "OTOBO" or "Otobero" of Colombia -

Dialyanthera otoba

H.B.K. Warbing

This extraordinary tree produces a resinous fat called "OTOBA" which is yellowish in color, with a peculiar odor, and employed by the Colombian people especially against dermatosis caused by the "Sarcoptes scabie" that produces itch or mange in men and animals. The result is excellent. By the

oral way, the "otoba" is taken as antisiphilitic. Several attempts have been realized to make soaps and candles and the result was good. The sour latex from the bark has been utilized against the aphthae.

The Agricultural Engineer, Luis A. Orozco, of Colombia, is making several experiments with this resinous fat to prove its properties and economical use as an insecticide against the aphids of cultivated plants. The wood is used for common construction work.

The otobo has been found especially in the Sub-tropical Evergreen forests described in this thesis, between the 300 to 1,000 meters above sea level. The author found the "Otobero" in the forests of Caqueta and Huila; there is reliable information that it exists in Guaduas (Cundinamarca), Honda (Tolima), Santander de Quilichao (Cauca), Casanare (Department of Boyaca) and Guadalajara river (Valle). The most abundance seems to exist, as far as it is known, in the neighborhood of Santander de Quilichao.

COLOMBIAN VEGETABLE WAXES

Several species in the Colombian forests produce waxes of commercial applications. We believe that it is possible to industrialize and cultivate some of them. Here we mention briefly the most important.

- 1) The "PALMAS DE CERA" or "Wax Palms" -

Ceroxylon ferrugineum

Ceroxylon Quindiense
Ceroxylon Schultzei

These are the Colombian species of palm-wax that produce a product that is exported every year to the markets abroad. These palms are found in Colombia in the "Middle Climate Evergreen Forests", especially in the Quindio region (Department of Caldas), in commercial concentration that can be cultivated, preserved and exploited with a more rational technique because, at present, the gathering of the wax in the trunks is laborious and wasteful. A further research must be done in this respect. The Ceroxylons are found also in the Huila Forests and the higher parts of Sierra Nevada de Santa Marta (Magdalena Department).

The Colombian palm-wax can be replaced in many instances for the Caunauba wax and the Candelilla wax in the manufacture of varnishes, floor waxes, candles, face-wax (Ceras mercolizadas), raincoats, linoleums, waxed cloth, plastics, phonograph records, ointments and shoe polishes. The Colombian palm-wax has a white-greenish color. It is brittle, porous and without odor or taste. According to Boussingault and Bonastre this forest-product is a mixture of resins with a crystalizable, waxy substance, whose composition is the following:

<u>Element</u>	<u>Analysis by Boussingault</u>	<u>Analysis by Teschmaker</u>
Carbon	80.28%	80.28%
Hydrogen	13.20%	13.20%
Oxygen	6.52%	6.52%

The combined quantities of palm-wax and myrtle-wax exported by Colombia can be evaluated by the following data, whose numbers were furnished by the Colombian "Contraloria de la Republica" from 1934 to 1940:

<u>Years</u>	<u>Kilos Exported</u>	<u>Value In Colombian \$</u>
1934	23,853	\$ 9,483
1935	24,548	10,581
1936	15,808	8,339
1937	26,619	6,707
1938	19,241	5,375
1939	78,175	52,917
1940	100,000	68,706

2) The "LAURELES DE CERA" - Myrica polycarpa
Myrica pubescens & others

The "Laureles de Cera" produce a berry-wax that can be employed, more or less, in the same industrial applications as the palm-wax. These shrubs are distributed in the slopes of the mountains, in the Middle Temperate to The Sub-Alpine Evergreen Forests of the country, especially in the Departments of Narino, Boyaca, Cundinamarca and Antioquia. The author has found abundance of these shrubs in Cerinza Valley (Boyaca), watersheds of Cali river, and in the olive-growing region of Raquira, Tinjaca, Sutamarchan, Sachica and Leiva (Boyaca). In the State of Narino many artificial plantations are made, and from the county of EL TAMBO a production of myrtle-wax is reported of 11,730 "arrobas" (an "arroba" is 25 metric pounds) for the year 1940 alone.

In the olive region of Boyaca, the yield in wax is the following:

From 10 metric pounds of "laurel" berries, the natives obtain 1 metric pound of wax; a shrub can produce 750 grams of dried berries and there are two crops in the year. The main crop occurs in the month of September, October and November, the secondary one in March, April and May.



Photo No. 13

THE "GUEGUERRE PALM"

(of the Atrato river,
Colombia)

CHICLE GUMS OF COLOMBIA

The U. S. consumes about 6,000 metric tons of chicle yearly. The chicle gums of Colombia are produced by different species and different genus of trees. Since many years ago, the gathering of the chicle-latex in different parts of the country has constituted a source of wealth for merchants, and destruction of trees. Here we mention some of the trees that produce a gum that is employed by the chiclets industry and used by everybody. A new apparatus and a new system of tapping is described in an attempt to preserve a natural resource.

A. The "JUANSOCO" of Colombia - Couma macrocarpa

"Juansoco" is the name of the tree in the Coreguaje language; "Iccuca" of Huitotos. This is the species that exist in abundance in certain regions of the Colombian Amazonian Forests, and produce a chicle-gum. It must be remembered that this product and the other chicles that come from the Colombian parts bear the name of "Goma Perillo".

The gum produced by the "Juansoco" comes from the bark of the tree that has a very white, sweet and nutritious latex. This latex is utilized by the natives for diarrhoeas. This latex, by evaporation, is concentrated in a form of cakes called "Marqueta" of 0.35 m to 0.30 m to 0.25 m. After several experiments in 1942, in the Caguan river, the author found that an average 86 metric pounds of fresh latex will give, after evaporation of water, 45 to 50 pounds of dry gum. Making a

machete incision in the form of a V all along the trunk of an average tree, we obtain 8 pounds of latex or approximately 4 pounds of dry chicle.

Barbarous System of Tapping

Without any scientific reason, the wealth represented by the chicles and "Juansocos" has been slowly destroyed, year after year, with the barbarous systems employed by the "Juansoqueros" (chicle gatherers) and the companies that sponsored them. Two systems are employed at present for tapping the "Juansoco":

- a) One is the complete cutting down of the trees, in which incisions are made in a circular way to bleed the trunk;
- b) Second, with apparatus for climbing the trees, the "juansoquero" begins making a machete incision on the trunk, from the lower portion up, in the form of a V and with an inclination of 45 degrees. The incisions practically girdle the tree, the depth of the wounds is not controlled, and the tree dies, undoubtedly, through faulty nutrition, pest and diseases.

A New System of Tapping "Juansoco"

After many trials and experiments made in the Putumayo and Caqueta forest by the author of this thesis in 1942, a new system of tapping "Juansoco" was developed. This system was intended to preserve the life of the tree, to extract the gum in a permanent way without affecting the health of the species. Detailed information on the experiments and conclusions can be found in our Report of August 1942 to the Ministry of National Economy - Bogota. The report is entitled: "LAS RIQUEZAS

FORESTALES DEL CAQUETA" (The Forest Wealth of the Caquetá region).

Modification of the Jebong Knife

During the already mentioned expedition to the Amazonian region, several apparatus were developed and tested for tapping "Juansoco". Some of them are shown by the pictures in this thesis. But of all, only a modification of the Jebong knife (used in Java to tap Hevea rubber) gave excellent results. Here is the Photo. of the new apparatus, whose original is in the "Museo Forestal" of the Forest Section of Ministry of National Economy - Bogotá:



Photo No. 14
MODIFIED JEBONG KNIFE

The dimensions of this apparatus are as follows:

Length of the knife	0.21 m.
Diameter of the socket	0.028m.
Width of the knife	0.03 m.
Thickness of the knife	0.003m.
Length of the incurvating knife	0.022m.
Maximum width of the cutting angle	0.011m.

A System To Insure Permanent Production:

In order to preserve the life of the chicle trees and insure their permanent productive power, the following rules must be followed:

1) The chicle gatherer (with climbing apparatus) with our knife must begin making, in one face of the trunk only, V incisions with an angle of 40 to 45 degrees;

2) The distance between each pair of incisions that form the V must be of 0.60 m. and they must be made with several careful strokes;

3) The bark of "Juansoco" is very easy work and the chicle gatherer must observe that the outer part of the bark is of a pink color that fades as soon as the incision approaches the Cambium layer, which is of a light pinkish tint. This layer must not be touched, because the success of the system lies in the prevention of doing any damage to this light pinkish cambium layer. The change of color with the depth of incisions is always so noticeable that no mistake is possible. With experience and care, the worker can do this operation fast and efficiently, as was tested with Indian and white workers in the Caqueta region.



Photo No. 15

TAPPING "JUANSOCO"

(The first two upper V incisions were made with our modified Jebong knife; the worker is showing that vertical or too wide incisions must not be made because they are difficult to heal)

(Florencia - Colombia)

4) This kind of incision is made ONLY in one face of the trunk, from the ground up to the first pair of branches. When the operation is well done, the wounds will heal in about 8 to 10 months. Then the operation can be done on the other side, alternating the faces.

B. The other species of chicle-producing trees in Colombia are:

1) The Nisperillo - Achras zapeta L

This is the Sapodilla tree of other regions, and we presume that our tapping system can be applied, ^{to it} after careful experiments. The Nispero is found in Colombia, especially in the Rain Type Forests of the Pacific Ocean and Magdalena river. The author found the Nisperillo in the Puerto Wilches region.

2) The "Caimo Perillo" - Several species of Chrysophyllum sp.



Photo No. 16

TAPPING APPARATUS

(This was designed by the author in an attempt to tap "Juansoco": The result was not satisfactory. During our expedition to the Colombian Amazonian region in 1942 more than 15 apparatus for tapping Castillas, Heveas and Coumas were designed or tested)



Photo No. 17

TAPPING APPARATUS

(Another apparatus designed for tapping chicles and rubbers: the results were not satisfactory.)

FIBER PRODUCING SPECIES

We mention here only some of the Colombian plants which, in the forests, produce fibers and real cloth:

- 1) "Damaguo" - Poulsenia armata (Miq) Standl

This tree produces a bark so fibrous that if it is

soaked in water and beaten out the rithidome, it gives a perfect cloth or fabric from which clothes, blankets and hammocks can be made. The author has slept in one of those hammocks in the Chichiburrú river in Intendencia Chocó.



Photo No. 18

DAMAGUO

(From its bark, a perfect cloth or fabric can be extracted and hammocks, blankets and clothes can be made from it.)

2) The "Pita Colombiana" - Aechmea magdalenae Andre

Of all the Colombian fiber producing plants, undoubtedly the "Pita" is the one that has more opportunity to be developed into a prosperous and permanent industry, if: the right system of extracting the fiber is found and technical management of the natural plantations is undertaken. (Father

Enrique Perez Arbelaez is the person who has devoted more time and study to the industrialization of the Colombian Pita, and he assures us that an economical system of extracting the fiber is already in existence.)

The "PITA" is a real natural wealth in the Colombian forests and produces one of the best kind of fibers in the world, due to its strength, its resistance to salt water, and its fineness. The pita fiber possesses great shearing strength; resistance to the diffusion of the external liquids into the leaf, and is very valuable for certain kinds of paper, artificial hides, army clothes, bank notes, transmission bands, impervious canvas and automobile tires. The analysis has demonstrated that the Colombian Pita possesses the following coefficients:

Extensibility	1.8% to 2.5%
Resistance to rupture	3.0 to 6.1 grams of "denier"
Cellulose content	75%
Weight	8.8 oz. per 2 yards of cloth
Resistance	207 metric pounds.

The "PITA" is found in Colombia, especially in the Rain type of forests from 0 to 1,000 meters above sea level; with average temperature of 25 degrees centigrade. In the Opopado and Salaquí region in Intendencia Chocó, the author of this thesis has found extensive, natural plantations (pitaes) of "Pita" from 5 to 50 and 80 meters above sea level, forming huge and impenetrable thickets. According to a study made by the Agr. Engineer, Pablo Bohorquez R., in 1941, the extension of the natural plantations of "PITA" explored in Colombia are near 80,653 Hectars distributed as follows:

Santander Sur Department	140	hectars
Magdalena	513	"
Antioquia	30,000	"
Intendencia Choco	50,000	"

According to the experience of "Maquinas Desfibradoras Colombia S. A. of Chocó, the natural plantations of "PITA" have an average of 3,000 plants per hectar, and they can produce 656,26 kilos of pure fiber, with a somewhat rudimentary system.

3) The "Nacuma" or Palmicho - Carludovica palmata
R. et P.

This species is called in English the hatpalm and it grows expontaneously in the Megatermic and Mesotermic climates of Colombia, from sea level to 2,000 meters in altitude, including the "Middle Climate Evergreen Forests". This palm produces a very strong and useful fiber that is utilized in Colombia for making men's and ladies' hats; the regions of Huila, Narino and Sapaoca (Santander) are especially noted for the perfect workmanship of the hats that, in the world markets, are known as Panama hats, but in reality are Colombian hats. In Colombia, these hats are known under the names of: "Sombrero de "JIPA" or "Jipijapas". The fiber used in making hats is produced by the leaves and is previously bleached and dyed, sometimes, with several colors; and the stems are flexible and fine furniture can be made of it.

4) The "Cumare" of Colombia - Astrocaryum vulgare

This palm is called by the Portuguese "Tucun"; the

Huitoto Indians called it "YUCAC" and in the coreguaje language, "Necuna". This palm produces in the young leaves a very strong fiber that is utilized in the Colombian Amazonian valley to make ropes, hammocks, casting nets, muzzles, etc. This interesting species must be studied and industrialized. To bleach this fiber, it is ^ocooked and then exposed to the open air.

5) The "Piassaba" or "Chiquichique" of Colombia
Leopoldinia piassaba Wallace.

This species is called "Malama" by the Colombian Indian in Vaupés region; it produces among the leaves an extraordinary fiber that sometimes attains a length of one and a half (1.5) meters with a diameter of 0.003 millimeters. The fiber is noted for its strength and flexibility. The Piassaba fiber is utilized for marine ropes, brooms of the best kind, brushes, cables that resist the action of salt water, etc. From the port of Manaos, more than a million (1,000,000) kilos of Piassaba is exported to the U. S. and other parts of the world; a considerable quantity of this output is of Colombian origin because the Piassaba is actually exploited also in the Colombian regions of:

- a) Region between the Sié river and Guainía river;
- b) San Martin plains and,
- c) Rionegro, Iraca and Domeni forests.

The fruits ("Corómbolos") of this palm produces, with the mesocarp, a kind of milky juice of nutritive value called "Leche de

Pliassaba".

Here is an analysis made by Ernesto Matz U. from the National Laboratory of Petroleum and Mines - Bogota on a sample of Pliassaba brought from the Inirida forests (Colombia):

Humidity	10.00%
Total cellulose	70.50%

FLAVORING AND AROMATIC SPECIES

There are many Colombian species that can give flavor and taste to foods, meats and beverages, etc.

Among other species for flavor, we can mention, as examples:

- 1) "Tamarindo" of Colombia - Tamarindus indica L

An Asiatic species that, since many years ago, has been acclimatized in all parts of the hot and mild temperate climates, giving now the impression that it is almost a native tree. In English it is called "Tamarind". The pods have their seed surrounded by a reddish, juicy and agreeable acidulous pulp that is utilized for flavoring iced drinks, sweetmeats, "horchatas", (edible) carbonated waters and are used also as antipir-
etic. The pods are sold in all the Colombian markets. According to analysis, this pulp contains: citric, tartaric and acetic acids united with sugars.

- 2) The "Paico" of Colombia - Chenopodium
ambrosioides L

This species is called in English, "Mexican worm-

seed" and is found in Colombia from sea level up to the 2,460 meter, especially in the Cerinza valley (Boyaca Department) where the peasants employ it for flavoring the children's food in case of indigestion. According to Standley and Steyermark in Guatemala these plants are supposed to have properties for expelling intestinal parasites. In that country the "Paico" is used for flavoring a dish made of beans, and there is also a popular belief that, placed under the pillows, it induces sleep.



Photo No. 19

Q U E R E M E
Thibaudia quereme
H. B. K.

(An extremely aromatic and rare plant that grows in the Salado valley (Cali) Colombia)

3) The species called in Colombia by the vernacular names of :

Sarrapia	Anisillo
Poleo	Bejuco Carare
Guarana	Canelo de los Andaquies
Vainilla	etc. etc.

are aromatic, and their flavoring properties can be utilized by the industry. Some of them are already utilized, as in the case of "Coumarouma odorata".

4) The "Canelo De Páramo" or "Palo aji" of Colombia
Drimys granadensis L.
Drimys Winteri Forst

Colombian species that produce what in the world trade is known as "Winter's bark" and Cortex Winteranus in the Pharmacopoiias. It has been used as an effective remedy against scurvy, and this pungent and aromatic bark has antiscorbutic properties. According to Standley and Steyermark, "In Costa Rica the bark is chewed to relieve toothache". In the Rio Cali basin, in Colombia, where the author found in 1945 this tree beginning at an altitude of 2,500 meters above sea level, the people employ the "Canelo de Páramo" or "Canelón" against rheumatic affections; the pungent bark crushed and placed in "Aguar diente" (a kind of rum derived from molasses). The lower side of the leaves of young trees are silvery in appearance.

FATS AND OILS PRODUCING PLANTS

Potentially, Colombia possesses a real wealth in her fats and oils producing plants that are so abundant in many parts

of the forests. The most promising of all are the species belonging to the Arecaceae family: the Palms:

1) The "Noli" or "Palmisto americano" -

Corozo oleifera Bailey

Botanically, the "NOLI" palm is closely related to the "Ovoira" or "African palm" (*Elaeis guinensis*) and we believe that the Colombian species can take the place in America that her African sister has in other lands. "NOLI" can produce two important products:

The Oil - "Aceite de Corozo" extracted from the pulp (mesocarp), and

The fat of kernel - "Manteca de pepita" extracted from the kernel.

Generally the "NOLI" fruits have the following content:

Percent of oil in the kernel	45.66%
Percent of oil in the pulp	32.84%

In expontaneous form and in great extension, under forests of Rain Type and in open lands, the "NOLI" palm is found in a density that sometimes is 50% of the arborescent vegetation. Excepting the Coco palm and the Ovoira, "NOLI" in Colombia is the ideal plant to cultivate and exploit for oil production, due to the nearness of the natural concentrations to the principal waterways and consuming centers (Bogotá, Medellín, Cali, Barranquilla, etc); for the absences of thorns in the leaves; the abundance of the fruits; its richness in oil and the low height of the palm (not more than 3 meters).

From the Colombian "NOLI" the following products

can be derived:

a) The oil extracted from the mesocarp can be used in the Marsella and resinous soaps;

b) The fat of the kernel ("manteca negrita") can be utilized as food, in the stearic industry, in margarine manufacture, soap industry, in tinware protection of metals, lubrication, etc;

c) The dry pulp and the fruit-bones are excellent fuel;

d) The pulp and the pressed kernel can be employed for feeding domestic animals;

e) The by-products can be utilized in agriculture as fertilizers;

f) From the endocarp (bone of the fruit) we can extract acetic acid, acetates, metanal or wood alcohol, etc;

g) From the same endocarp a useful coal can be derived and used in the war in anti-gal masks etc.;

h) From the oil, glycerine can be extracted for use in the industry and in the pharmacy, and

i) The fibers of the "NOLI" can be made into ropes.

The National Laboratory of Mines and Petroleum at Bogota obtained the following results with "NOLI" fruits from several parts of the country:

Noli fruits from Tolima	42.62%	of oil and fat
" " " Atlántico	41.62%	" " " "
" " " Rio de la Miel (Antioquia)	26.83%	" " " "
" " " Montería (Bolívar)	35.30%	" " " "
" " " Zona Bananera (Magdalena)	25.31%	" " " "
" " " Montería (Bolívar)	34.94%	" " " "

According to the Civil Engineer Gustavo Backman (Bogotá) the complete analysis of the "NOLI" fruits is as follows:

PULP

Water and volatile substances (up to 105 degrees C)	30.53%
Oil	32.84%
Saponification Index	200.00%
Residue (dry at 105 degrees C.)	36.05%

KERNEL

Humidity (temp. 105 degrees of C. during one hour)	11.3 %
Residue of the kernel, extracted with CS ₂	48.15%
Oil content (with carbon bisulfide)	38.24%
Oil content (with sulphuric ether)	45.6 %

We found the "NOLI" palm, in 1940, in the region of RIO DE LA MIEL (Caldas and Antioquia) in a quantity of about 25,000 individuals in bearing capacity, with a stocking of nearly 1,600 palms per square kilometer. Over there, an average, each palm produces three annual racemes; each raceme contains 149 secondary axis; and each secondary axis 20 fruits, giving a total of 2,500 to 3,000 fruits per raceme with a weight of 24 pounds, of which 16% (discounting some percentage for rubbish) is pure kernel. The Forests of Vesubio, Sonadora, Sietecerros, La Caridacita, al Agustina and Guatacas were the most abundant in "NOLI".

In the open lands and pastures in Montería and Cereté (Bolívar), the "NOLI" is cultivated, several mills for the extraction of the fats are working, and about (\$10,000) Colombian pesos enters into the income of the people of Cereté annually for the products of the NOLI palm.

In the forests of Territorio Vazquez, Rionegro river (Cundinamarca state), Barrancabermeja, Cimitarra river (Magdalena), Sogamoso river (Santander), Cano de Mojana, Pivijay and Fundacion, the Noli palm is found.

2) The "SEJE PALM" or "Milpesos" of Colombia -

Jessenia polycarpa Karts

This palm is called "CONSA" by the Coreguaje Indians; is the "JOMANA" of the Huitoto Indians and the "PATABA" of the Portuguese. From this "MILPESOS" palm, the industry can derive the following products:

a) The Seje oil - which can be used for food purposes; in medicine against the lung tuberculosis, quirurgic tuberculosis and osteatric tuberculosis, osteomielitis, Pott disease, and Lupus vulgaris. The Colombian physicians; Carlos J. Cuartas - Bogota, 1938; Roberto Penuela del Castillo - Bogota, 1925 and Ramon Cabrales Pacheco - Ocaña, 1935, after research and experiments, presented their thesis advising the use of the "MILPESOS OIL" against the above mentioned diseases. The last investigator advanced the interesting suggestion that it is very probable that the Seje oil can be employed in the treatment of Leprosy.

b) The natives of the Colombian Amazon region obtain, with the mesocarp of the fruits of the "MILPESOS" palm, a milky liquid of pinkish coloration that is very agreeable and nutritious.



Photo No. 20

THE SEJE PALM

Jessenia polycarpa Karst

(This plant produces the famous seje oil that can be utilized in the treatment of several kinds of tuberculosis)

The Analysis of the Seje Oil:

The "MILPESOS" oil is an oleaginous, transparent and beautiful golden liquid, similar to the olive oil, which it may replace. L. Bacarach, in 1918, obtained the following coefficients for our Seje oil:

Sp. gravity at 15 degrees C.	0.9161
Saponification value	188.5 to 190.5
Iodine No. (Wijs)	75.3 to 74.8
Acid value	3.8 to 4

Distribution and Density

The *Jessenia polycarpa* Karts can be found in densities that range from 3 to 40 individuals per hectare in the following forests:

- a) Forests of the Apoporis river
- b) " " " Maticurú "
- c) San Matin's plains (Int. Nal. Meta)
- d) Forests between San Vicente del Caguan and Florencia (Caquetá)

Aside from the *Jessenia polycarpa* Karts, we have found in Colombia the following palms called "MILPESOS" and whose products are similar:

- a) The "MILPESOS" from the Porce river (Antioquia)
- b) The "Palma lechera" in the forest of Aguas Claras and Puerto Wilches (Santander) and,
- c) The "Milpesos" of Baudó (Chocó)



Photo No. 21

MILPESOS of Porce
(Jessenia sp)

(One of the Palms that
produce the Seje oil.
Porce (Antioquia)
Colombia)

3) The "PALMAS DE VINO" of Colombia - With this name found found in Colombia, among others, the following species:

Scheelea Dryanderæ - of the Cauca Valley, in open land and pastures;

Scheelea regia - of the open lands and Deciduous forest of the lower Magdalena river;

Scheelea butyraceæ - of the open lands and Rain Type forests of the upper Magdalena river, including the Tolima plains;

.....- "Palma Real" or "puac" of the Indians of the Coreguaje tribe in the Caquetá.

All these species give the following products which industry can utilize, after solving the mechanical problem of cracking the nuts:

a) The stems give a sweet liquid which can be fermented, making a delicious drink;

b) The nuts contain big kernels, very rich in fat, whose analysis never gives less than 50% of fats and oils.

These fats and oils can have, in industry, the same application we explained for the "NOLÍ" palm.

Extensive concentrations, in many parts of the country, are reported, especially in the Pivijay and Fundación forests (Magdalena state).

In an analysis made by the above mentioned Laboratory with fruits from Pivijay (Magdalena), the following result was obtained:

Fats extracted by the Soxhlet method
and with petroleum ether 53.61%

In an analysis made by Dr. Nicolás Hojos Becerra

of the National Lab. of Mines and Petroleums, on a sample brought by the author of this thesis, in 1941, the result was:

Fruits of Scheelea butyraceae 52.26%

4) Other Arecaceae, whose industrialization can be undertaken:

a) The "MAMARRÓN" of Colombia - Attalea cohune

The "Mamarron" is a very promising palm, due to the fact that its kernels are very rich in oils, up to the extreme of exceeding the Coconut in the percentage of fat. For comparison, we place here the analysis together:

COPRA from the Loricica region
(Bolívar)

63.10% of fats

MAMARRÓN from la Agustina (Buenavista - Caldas)

66.42% of fats
and oils

MAMARRÓN from La Dorada

69.58% of fats
and oils

We found in the Buenavista forests, alone, more than 15,000 of these palms, and it is reported that this phoenicace is found also in the Rionegro and Rionegríto (Cundinamarca) rivers. Several attempts have been made to solve the mechanical problem involved in the breaking down of the endocarp. It must be remembered here that the "Mamarrón" palm is richer in fats and oils than the famous Elaeis guinensis, or African palm.



Photo No. 22

MAMARRON PALM
Attalea cohune

(The fruits of this palm are richer in oil than the *Elaeis guinensis* and *Copra*)

Cocos nucifera

b) The "TAMACA" of Colombia - Acrocomia sp.

In the open lands and Deciduous Forests of the lower Magdalena river, especially in the Zona Bananera and Valledupar, this palm exists. An analysis made by the above mentioned official Laboratory gave:

Total fats, by the Soxhlet method	24.76%
Acidity in miligrams of Na OH	5.8

The fat of this species is very similar to the fat of the coconut, according to Dr. Nicolás Hoyos B., chemist in charge.

- c) The "MOVIL" of Colombia - Probable Astrocaryum malybo Karst

We found this palm in the Rio de la Miel forest in 1940, and its fruits sent to the Lab. gave:

Total fats	25.32%
Acidity in miligrams of KOH	2.00

- d) The "MANGUE" of Colombia - Attalea sp. A.
Nucifera Dugand

This was found by the author of this thesis in the forests (Rain Type forests) of Aguas Claras (Puerto Wilches); its fruit sent to the Nat. Lab. gave:

Fats extracted by Soxhlet system - 41.86%

- e) The "GUAJO" or "Marifa" - is a palm of the Colombian Amazonian region that is called also:

"Juio Ere" of the Coreguaje Indians
"Dore" of the Huitoto Indians

From the fruits of this beautiful and useful palm, it is possible to derive: a) oil and a kind of butter; b) the sweet mesocarp will produce a fermented drink; c) the exterior bark is burned and the ashes are utilized by the native Indians as salt for the foods and also for the "mambeo" (chewing of the coca leaves). The fruits of Guajo brought by the author to the Nat. Lab. gave:

Oil extracted with petroleum ether	60.76%
Acidity in miligrams of K OH	2.30



Photo No. 23

GUAJO

or

"Marifa" Palm

(Its fruits produce
60.76% of fats and
oils)

f) The "TAPAROS" of Colombia - sps. of Attalea

Under the name of "Taparos", several species of palms are known. They are characterized by the big racemes and the high content of fats and oils. Here is an analysis of the Nal. Lab. for fruits sent from the forest of Antioquia department:

Total fats, extracted with Soxhlet and petroleum ether	65.76%
--	--------

These "Taparos" are found in the forests of Antioquia and Choco.

g) With the vernacular names of: Minche, Nena, Moriche, Crespa, Chuchana, Corunta, cachuda, etc., there are many kinds of Colombian palms whose studies and analyses are to be made in order to know their economical values.

5) Other species which, in the Colombian territory, produce industrial^{oleaginous} products, among many others:



Photo No. 24

COROZO PALM

Probable Aiphanes caryo-
tefolia

(From the Porce region -
Colombia)

a) The "MUELLE" of Boyacá - Schinus molle L.

This valuable species produces an oil which can be utilized in the industry, in veterinary science as well as in human medicine. Here is an analysis made by Fritche Brothers Inc. of New York on Muelle oil, from Boyacá:

Specific gravity	0.831
Optical rotation	plus 56 degrees and 10 minutes
Refractive Index at 20 degrees	1.4720
Number of saponification	9.96
Solubility at 20 degrees	Turbid in 90% alcohol

b) The "PALO DE CAPARRAPI" - Oreodaphne caparrapi

Produces inside the trunk a precious oil that is utilized as alexipharmic. This species was found by the author in the forest of Teherán, on the shore of the Rionegro (Puerto Salgar).

Note: For the sake of brevity, we omit dozens of other fat and oil producing species.

LATEX AND RUBBER PRODUCING SPECIES

Among the numerous Colombian species that produce rubber, here we only mention some of the outstanding one:

- 1) "PALO DE VACA" or "cow's tree" of Colombia -
Galactodendron utile H. B. K.

This is called also "Sande" and is a natural curiosity, due to the fact that the bark produces a latex that resembles cow's milk, not only in color and consistency, but in real taste. The milk of "Vaco" is watery in nature and flows freely when the trunk is cut with the machete. In the Caqueta forests, the author observed that previous incisions made on this tree healed in perfect condition, and we believe that a technique can be developed for tapping a tree without injuring the cambium layer. It is possible, in this respect, that the

apparatus invented in our expedition of 1942 to the Amazon region (See figure ..) can be applied to the tapping of this extraordinary tree. That this latex is edible is not doubtful to us, because in one time we took near 450 grams of "Leche de Vaco" without feeling any inconvenience.



Photo No. 25

CAUCHO MANTEQUILLO
Ficus sp.

(the abundant latex of this tree has a real butter taste and nutritive value.)

The natives of the Caqueta and Putumayo region extract the milk of this tree, making incisions with a machete in the form of V and at an approximate angle of 45 degrees. This species can be found in the Rain Type - Catumbo Forest; in the Putumayo, Caqueta, Apoporis regions. Generally it can be said

that the "SANDE" or "Vaco" is a tree of the hot climates (Tierras calientes) of Colombia.

The wood is whitish in color with some stripes artistically arranged; the weight and strength are moderate; it can be used in the containers industry, having in mind that it is subject to the attacks of borers.

2) The "CAUCHO NEGRO" of Colombia - Castilla or Castilloa genus

As far as we know, Colombia possesses two kinds of "Caucho Negro":

a) Castilloa elastica Cervantes - common "Caucho negro" of Chocó, Pacific coast and other regions;

b) Castilloa ulei Warb - called "Caucho negro papayuelo". The Huitoto Indians called it "JICTUNA" and in the Coreguaje language it is named "chiquito". In the foregoing markets it has been called "Caucho do Pará". The "Caucho Negro Papayuelo" is found in the forests of the Colombian Amazonian region, especially Caqueta and Putumayo.

The Castilloa ulei Warb seems to grow at altitudes not exceeding 700 meters above sea level and prefers for its "habitat" the drained soils of the watersheds ("cabeceras") of small rivers and in association with the "Cachuda" palm.



Photo No. 26

CASTILLA ELASTICA Verv

(A commercial species of rubber, very abundant in the Choco region - Colombia, S. A.)

Economic Importance

The "Caucho negro", especially of the Choco' region, was exploited intensively during the last century, when the rubber price was high and the competition of the siringa of the Netherland Dutch East Indies was not yet established. So alluring were the prices that in the beginning of this century General Rafael Reyes stimulated the rubber plantations, especially in the Baudo' river, where 500,000 castilloas were luxuriously growing when in 1941 the author of this thesis visited Choco' in cooperation with the U. S. Dept. of Agriculture. Considerable

Considerable amounts of rubber have been extracted from the CASTILLA genus in Colombia in the last two world wars.

The genus *Castilloa* (Caucho negro and Caucho negro Papayuelo) produces a kind of rubber (C 5 H 8)x that is only second to the product of *Hevea brasiliensis* or *Siringa* and in time of emergency almost no distinction is drawn in the utilization. Here is an analysis by Mr. Ernesto Matiz U. in the official Laboratory of Mines and Petroleum - Bogota', with a sample brought by the author from the forest of La Tagua (Caqueta):

Technical name *Castilloa ulei* Warb.

Analysis made in November, '43

Total rubber	98.26%
Resins soluble in acetone	1.73%
Ashes	0.94%

Preservation of a Natural Wealth

The *Castilloa* trees in Colombia began the production of commercial latex at the age of 7 years, and their maximum production is attained at the age of 25 to 30 years. Tapped with a system developed by the author, the life of the tree can be lengthened to 40 or 50 years, producing on the average every six (6) months ~~to~~ 5 kilos of latex, that is, 6 metric pounds of dried rubber for a tree of average height and age.

The system of exploitation of the "Caucho negro" trees in the last century as well as at present, consists of cutting down the trees and tapping it in branches, trunk and roots. This is a wasteful and barbarous destruction of wealth.



Photo No. 27

UNECONOMICAL SYSTEM OF
EXPLOITATION OF
CASTILLOA

(With this system, the
trees are cut down
and a valuable wealth
is destroyed forever.)

The New Apparatus for Tapping Castilloa

Since the year 1911 the magazine "India Rubber World" of New York offers a reward for a system that would enable us to tap the Castilloa trees without affecting the vitality of the tree. Due to the fact that the Castilla bark is fibrous, somewhat brittle and of difficult cicatrization to vertical or diagonal wounds, it is not possible to employ with these trees the same system of tapping the Hevea rubber.

After numerous tests and calculations with trees of different ages, sizes and thickness of bark (the whole procedure

is described in our Report of August 15, 1942 to the Ministry of National Economy - Bogotá entitled, "Forestry Wealth of the Caquetá Region"), the author of this thesis developed an apparatus for tapping Castilleos that has the following advantages:

a) Easy to handle by any kind of worker

b) Simple in construction

c) Not expensive

d) Instead of being a new tool, it is a device added to the common machete (cutlass) of the rubber gatherer.

e) Our apparatus produces a wound that does not injure the cambium layer, and, as a result, the vitality of the tree

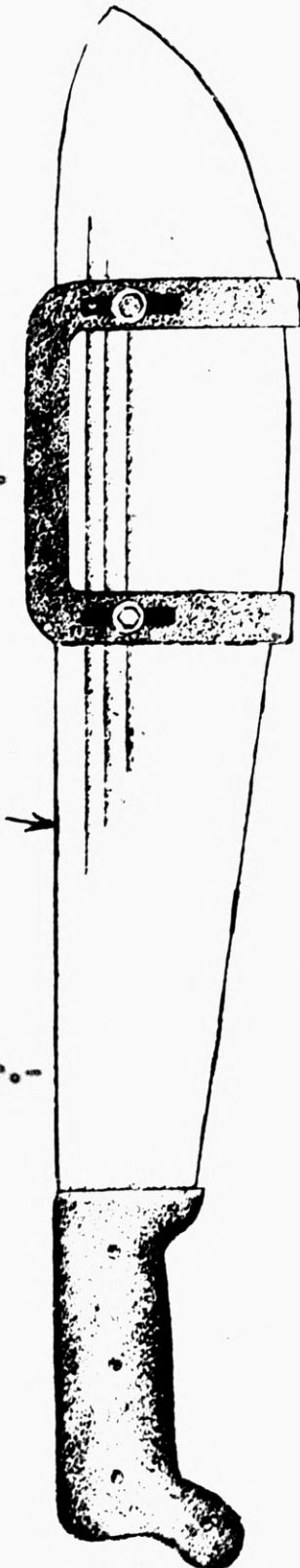
f) The incision produced makes it easy to collect the latex of the tree.

(See Drawing No. 4...)

The whole apparatus (see the corresponding drawing) consists of a machete of "18", with edge an back almost straight, that carries superposed the "AMORTIGUADOR DE PINZAS" (shock absorber). The dimensions of the machete must be:

Length	0.45 meters
Maximum width	0.075 "
Diameter of perforation to place the holding screws	0.007
Distance between the handle of the machete to the first perforation	0.20 "
Distance of the handle to the second perforation	0.34 "
Distance between the perforation and back of machete	0.02 "

Shock absorber....



NEW APPARATUS for tapping
Castilla rubber, without
injuring the cambium layer.-

Drawing No. 4

Distance between the holes	0.14 meters
Weight of the machete alone	1 kilo
The shock absorber ("Amortiguador de pinzas")	

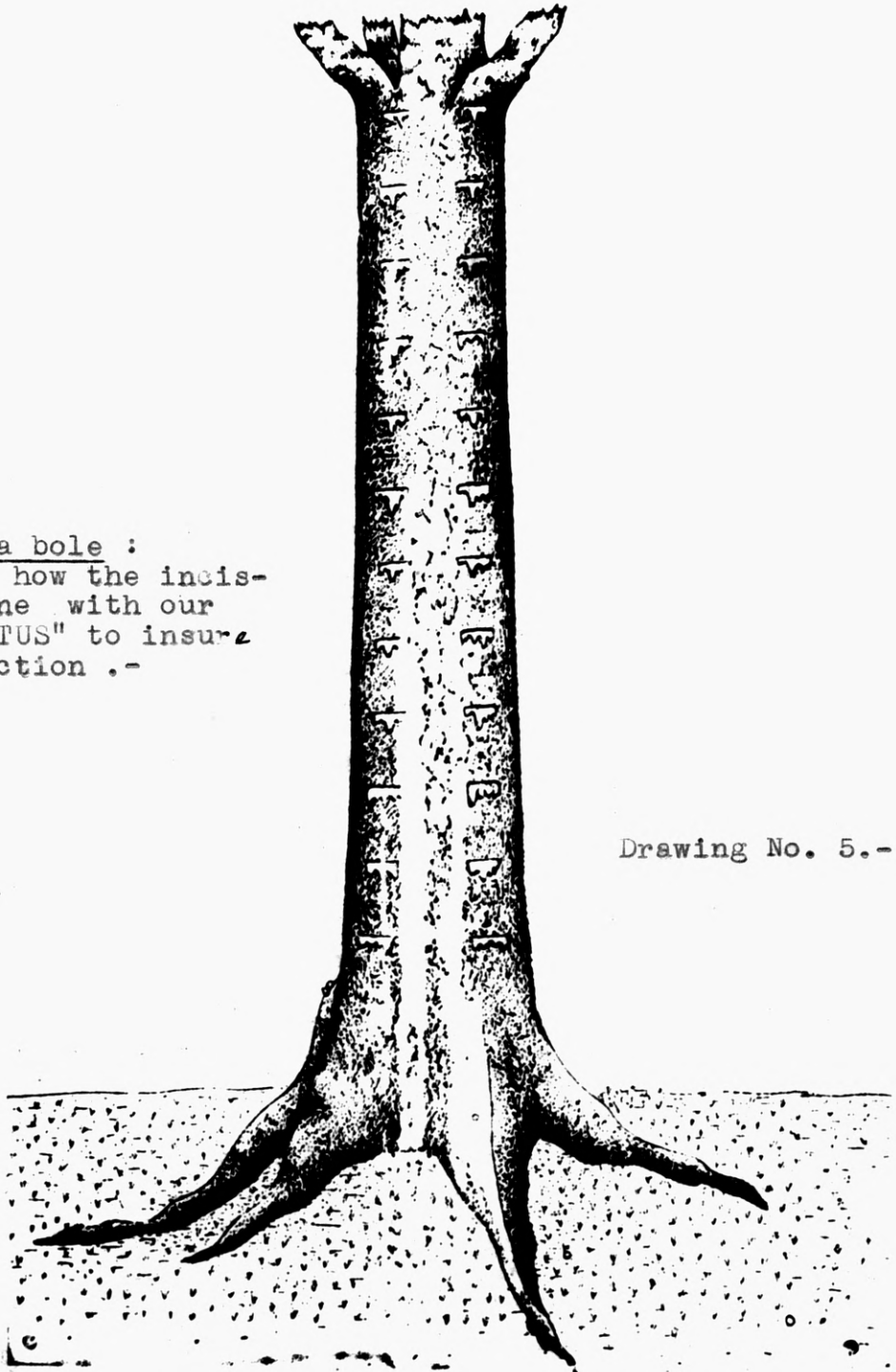
is a double metallic carpenter's square whose ends are somewhat thin to facilitate the penetration into the Castilla bark. The shock absorber carries a groove or slot to hold the screws and allow the graduation of the apparatus according to the thickness of the bark. Here are the dimensions of the shock absorber:

Length	163 millimeters
Length of the pincers or forceps	80 "
Width of the shock absorber	25 "
Thickness	6 "
Length of the slots	31 "
Width of the slots	8 "
Length of pincers, from the slot to the extreme	45 "
Total weight of the machete with the shock absorber	1.045 grams

The New System of Tapping:

In order to tap the Castilla trees with the new apparatus, the following instruction must be followed. (See drawing No. 5 .) The "Caucho Negro" trees must be tapped, not on a rainy day, by making, with the apparatus, a series of incisions in one face of the trunk only from the ground up to the first pair of branches in the crown. The rubber gatherer must begin from the ground up giving to the tree blows with regular strength that will produce on the bark horizontal wounds at the same level. In an average tree (35 years of age and 28 meters in height, and 0.80 m. diameter) generally it is possible to place

Castilloa bole :
showing the way how the incision must be done with our
"TAPPING APARATUS" to insure
sustained production .-



Drawing No. 5.-

three (3) horizontal incisions separated, one from another 0.03m, 0.04m, 0.05m . The vertical distance between the horizontal rows of wounds must be 0.15 m to 0.20 meters.

With this system, it is possible to tap (collect the rubber) the Castilloas every 4 months, alternating the faces of the trunk subject to treatment. The author gathered reliable data in the forest of Baudó (Intendencia Chocó) that this kind of wounds in the Castilloa trees heal with no difficulty, if the Cambium layer is not injured.

To avoid any possible injury to the Cambium Layer of the bark, the following rules were developed, and they are subject to revision according to the circumstances under which the tapping of this kind of rubber is done:

FIRST - For Castilloas of 25 years and up, with a diameter b. h. between 0.40 m and 0.65 m up in which the bark has a thickness of 0.18 m, the pincers of the apparatus must be graduated so that they exceed TEN MILLIMETERS outside of the machete edge;

SECOND - For Castilloas of d. b. h. between 0.25 and 40 m. and with a bark thickness of 0.016 m. the pincers must exceed ONE CENTIMETER;

THIRD - For trees with d. b. h. not exceeding above 0.25 meters and a bark thickness of 0.014 m., the pincers must exceed TWELVE MILLIMETERS and the blow must be given with the forward part of the machete in such a way that the front pincers will be the center of the wound; and

FOURTH - For Castilloa trees with a bark thickness

less than fourteen (0.014 m) millimeters, the pincers must exceed ONE CENTIMETER AND A HALF giving the blow to the trunk with the forward pincer.

Where The Castilloas Are Found

If Colombia is going to plant rubber, that must be of the *Hevea Brasiliensis* genus; but it seems logical that the present stands of "Caucho Negro" (*Castilla elastica* Cerv. and *Castilloa Ule* Warb) must be preserved for future use.

In Colombia these *Castilla* trees are found:

- a) Plantations made in the shores of the Atrato river;
- b) In the forests of Opogado, Truando, Salaquí, Munguido, Suruco, Tangui, Arquia, Amparraida, Berreberre, Chichiburu, rivers of Chocó Intendency;
- c) In general, in all the forests of Uraba and Chocó, the Castilloas are found;
- d) Excepting the Mangrove forests, the "Caucho negro" is found in the forests of the Pacific Forest, especially around Tumaco port;
- e) In the forests situated in the shores and between the Caqueta, Putumayo, Apoporis, Cuemany, Ajaju, Peneya, Caguan, Yari, Guayas, Orteguaza, Sinu, Consaya and Losada rivers, the Caucho Negro is found.

The wood produced by this kind of trees is creamy white, relatively soft, with fair strength, easy to work, somewhat coarse and may be utilized for containers. But it must be remembered that it is not durable.



Photo No. 28

Tapping System recommended by the North American rubber technician Marshall Carlton^{nologist}. Generally the Castilla trees do not heal such wounds.

Photo taken in Baudo (Choco), Colombia, S.A.

3) The Heveas in Colombia

Among the dozens of trees that, in the Colombian territory, produce rubber, the most important in the world trade are the plants of the genus HEVEA. It seems that the natural habitat and place of origin of the HEVEA genus is located in the forests of Vaupes, Vichada, Rionegro and Guainia, because in that section of the country it is possible to find at least ten different species of HEVEA rubber. Here are some of them:

a) Hevea brasiliensis Muell et Arg. -

- called "Siringa rubber"

-called "Gague jict" by the
Huitoto Indians

-called "Guecochitaguito" by the
Coreguaje Indians

-called "Seringueira" by Brazilians

Colombia has this Siringa rubber in the forests of Caqueta, Putumayo, Isana, Vaupés, Guainía, Ixé, Guaviare, Vichada, and Orinoco rivers. It produces the best kind of rubber in the world. Extensive plantations of this species has been made by the Colombian Government in the Uraba region, in cooperation with the U. S. Department of Agriculture.



Photo No. 29

HEVEA BRASILIENSIS
Muell et Arg.

(With the technical cooperation of the U. S. Dept. of Agriculture, the Colombian Government has made extensive plantations of this kind of rubber in the Uraba region.)

We believe that a cooperative policy can be accomplished between the different nations of the Western Hemisphere in order to produce what the continent needs, without depending on outside sources of raw materials which many times are out of control, as has been the case with the rubber, fibers and strategic minerals of the Phillipines and the Netherland East Indies.

Personally, we found the *Hevea brasiliensis* or *Siringa* in the Forests of Venecia, Montañita, Puerto Rico, San Vicente del Caguan, Puerto Huitoto and Pescado river in the Caqueta region. Our modified Jebong knife (developed to tap "Juansoco") was applied to this *Hevea* with excellent results.

b) *Hevea discolor* - native *siringa* of the upper parts of the Amazon basin and is a tree that produces a good quantity of rubber, but not equal in quality to the *Hevea brasiliensis*.

c) *Hevea Guayanensis* - "*Siringa mangle*" - native of Guayana. Colombia possesses this species in the Ixe, Iza, Yapura, Isana, Vaupes and Vichada river forests.

d) *Hevea cuneata* - "*Caucho Rojo*" which we found in the forest between the Caguan and Peneya rivers.

e) *Hevea lutea* - This species is found in Colombia only in the forests of the Igaraparana and Toalla rivers, tributaries of the Putumayo.

f) *Hevea Benthamiana* - is a native *siringa* of the Colombian Vaupes territory.

g) Hevea rigidifolia - Native rubber of the Rio-negro region.

h) Hevea pauciflora - Native of the Vaupes river forests. It can be found also in the Colombian rivers called Igaraparana and Toalla.

i) Hevea membranacea - Native rubber of the Colombian Vaupes.



Photo No. 30

When the U. S. entered World War II, this expedition of a North American rubber technologist and several Colombian agricultural Engineers was sent to the Choco region to study and start the exploitation of the "Caucho Negro."

During the last world war, many tons of these rubbers, especially *Hevea Brasiliensis* and *Castilloas*, went to the Allies helping in winning the war. It seems, naturally, that if at any

time the rubber needed by the American industry is going to be raised in this continent, the most appropriate place for its development must be the native habitat (the Vaupés region) and Urabá Gulf, where, aside from other advantages of low wages, protection to the capital, etc., there is easy water transportation to Europe and to the United States of North America. To obtain the maximum yield from cultivated *Hevea brasiliensis*, aside from selected clones, it is necessary to have the following requirements:

- A) The plantations must be at an elevation not exceeding 500 m. above sea level;
- B) The climate must be an ^{humid} (hygrophytic) one in which the average temperature is between 24 and 30 degrees centigrade;
- C) The ^{rainfall} (pluviometry) must not be less than 2 meters per year; ?
- D) Deep, clay-sandy soils of virgin forest;
- E) Must be a gentle slope of the region, to provide for drainage and avoid floodings. ?

4) Some trees of the genus *FICUS* have been exploited in Colombia commercially under the following names:

a) "Caucho Rosado" that we found in Puerto Rico (Caquetá) and has been reported by the Agricultural Engineer Francisco Zapata from Villavicencio and Meta region. The analysis of this rubber, made in the official Laboratory of Mines and Petroleum at Bogotá, gave the following results:

Ashe's	12%
Proteins	4.07%

Resins	1.08%
Rubber	81.82%

b) "Caucho Colorado" of the same forests of Caqueta produces a very elastic rubber and has been cultivated in that region to some extent.

NOTE: We tried our "Modified Jebong Knife" for tapping these trees of the genus FICUS, and the result is practical, especially if it is taken into consideration that these species heal the horizontal wounds in no more than one year. There is a handicap with these Ficus rubber; this is the small quantities of latex yielded by an individual tree.

5) In the Colombian territory there are other species of trees that yield rubber, of more or less commercial importance, under the names of Caucho Mantequillo, Caucho Blanco, Rack, Caucho gris, Caucho bejuco, Bejuco lechero, etc. These species belong undoubtedly to the general Symphonia, Ficus, Sapium, etc. In our opinion, the only important ones are the "SIRINGA" (*Hevea brasiliensis* Muell et Arg) and the "CAUCHO NEGRO" (*Castilla* genus).

(See Photo No. 31)



Photo No. 31

HEVEA BRASILIENSIS Muel
et Arg.

(The photo shows the
"ARRUCHO" system of
tapping rubber em-
ployed by the abori-
gines of Vaupes re-
gion, Colombia, S.A.
The man on the right
has our "Modified
Jebong Knife".

Very wasteful

MEDICINAL PLANTS OF COLOMBIA

The medicinal plants of Colombia are so numerous that to mention all would occupy a whole volume. We are going to enumerate only a few:

- 1) "Palo Santo" or "Guayacan" of Colombia -
Guaiacum sanctum L

Not only the "Palo Santo" is a very valuable wood for industry, but it has been also used extensively in medicine for the following ailments: Syphilis, menstrual pains, pulmonary

affections, gout, paralysis, leprosy, epilepsy, hydropsy, and scrofula. The "Palo Santo" has been applied for those ailments in the form of tincture, powder, infusions, extracts, etc.

The U. S. Pharmacopoeia agrees that the extract of Lignum-vitae has diaphoretic and stimulant properties. By means of analysis, the acids, Guayacetic, Guayaconic and Guayacic, have been found in addition to Guayacine.

(See Woods for Turnery Articles)

2) "Cuassia" of Colombia - Picramnia gracilis Tul.

This is one of the Cuassias of the country. The bark of this tree has tonic and bitter properties. It has been used in alterations caused by syphilis and as a tonic in the gastro-intestinal organs and for intermittent fevers.

The bark and Cuassia wood ^{have} been exported because they contain a bitter substance called "CUASSINA" that is soluble in alcohol. From the flowers of the Cuassia, a kind of tonic wine is prepared. In moderate doses the Cuassina stimulates a great deal the liver action, the salivary glands, and the kidneys are also affected.

In Colombia, this species is found in the forest of the lower Magdalena river; THE DECIDUOUS FORESTS of this thesis.

(See Photo No. 32)

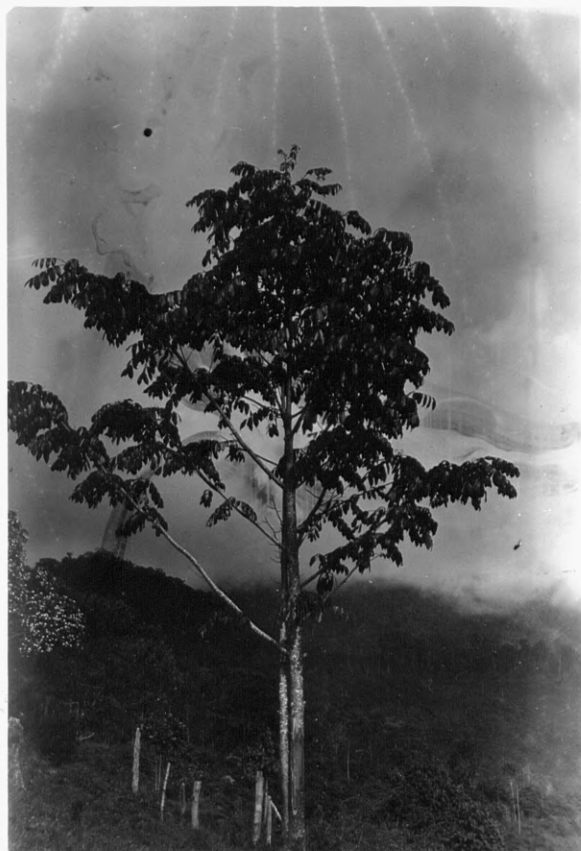


Photo No. 32

CUASSIA

Picramnia gracilis Tul

(A valuable medicinal plant that has been exported from Colombia.)

3) The list and description of the Colombian medicinal plants will occupy a volume; we need to stress here that the territory of that nation is the natural habitat of the well-known:

Zarzaparrilla
Ipecacuanha

The Guaco
The Copaiba
The famous Cinchonas
 "Quina tunita"
 "Quina Roja"

The Palo María
 Etc. etc.

Smilax officinalis L
Cephaelis ipecacuanha
 (Brot.) Ric
Aristolochia
Copaiva officinalis Jacq.

Cinchona officinalis L.
Cinchona pubescens
Calophyllum Mariae Pl.et Tr.

RAW MATERIALS FOR TANNING

Several are the species that in the Colombian territory give tanning materials, which are so useful in industry. In our opinion, three of them are especially of economic importance; the Mangroves, the Dividivis and "Encenillos".

- 1) The "Mangle Colorado" of Colombia - Rhizophora mangle L
The "Mangle blanca" - Avicennia tomentosa
The "Mangle salado" - Avicennia nitida Jacq.

Those are the botanical species that are known as "mangles" or mangroves in the Atlantic coast, where they form more dense stand or scattered group. Of economical importance are the concentrations of "Mangle colorado" between Cartagena and Uraba Gulf.

With the vernacular names of: Mangle colorado
Mangle injerto
Mangle concha de caiman
Mangle pecho-pava
Mangle caballero, etc.

are the mangroves that in the Colombian Pacific coast form dense stands all along the sea shore between the boundaries with Ecuador and the Isthmus of Panama on the north side; with densities that vary between 100 to 200 individuals per ha. Here great reserves of tanning materials are awaiting a technical exploitation that enables them to be on a sustained yield production. From the "Mangle" it is possible to obtain: a) an excellent charcoal; b) from the shoots a red dye is obtained; c) according to Paul C. Standley, treating the "Mangle" bark with salts of copper and iron, the industry can obtain olive, brown and slate

dyes; d) the wood is dark reddish in color, very hard and heavy, resistant to water, texture fine, difficult to cut and good for piling, railroad and tramway ties, construction in contact with the ground, etc.

e) The principal products is the bark of the "Mangle" that contains between 20% to 30% of tannin; in the Darien Gulf and in Buenaventura there are some mills that export not only the ground bark, but also the extract.

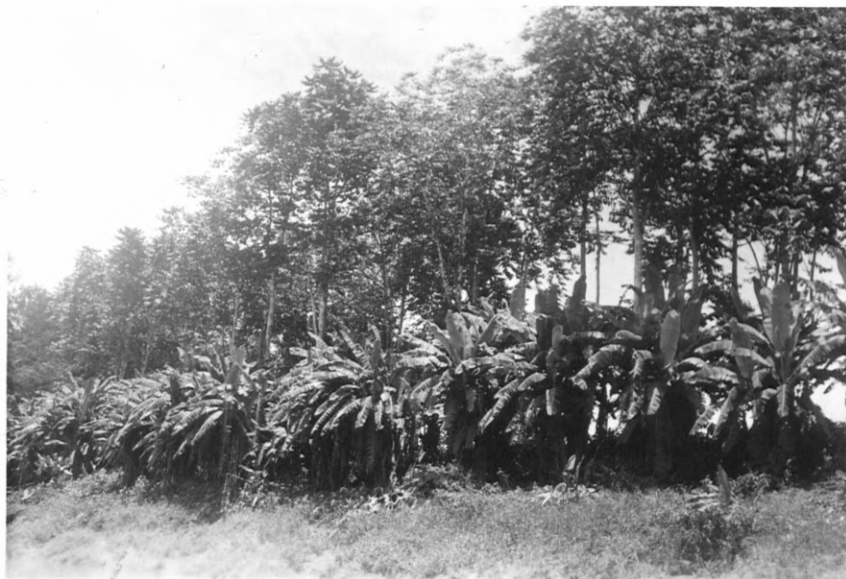


Photo No. 33

CASTILLOA ELASTICA Cerv. *with banana trees in the foreground*

(Dubasa River (Chocó) - All along the rivers of Chocó (Colombia) it is possible to find planted "Caucho Negro" in commercial concentrations)

2) The "Dividivi Colombiano" - Libidivia coriaria
(Jacq) Schlk

This species is distributed in Colombia in the

Department of Magdalena and the Goajira peninsula, where since many years ago it constituted a source of wealth especially for the inhabitants of the Goajira peninsula. From this species the following products can be obtained: a) the heartwood is exceedingly hard, with great strength and resistance; it is not affected by borers and its coloration is black; this wood has been used for outside covering of the cartwheel to prevent abrasion, instead of iron; b) from the wood itself, it is possible to obtain a red dye; and c) the principal product of the DIVI-DIVI COLOMBIANA is the S-shaped pod that contains about 50% of Tannin; on the average, a full grown tree can produce about 100 grams of pods (S. Record).

3) The "Dividivi" of Boyaca (Colombia) - Coullteria tinctoria H.B.K.

This species receives the vernacular names of:

Guarango	-	Department of Antioquia
Brasil	-	" " Cauca (Popayan)

This kind of "DIVIDIVI" only grows in the open lands and Subalpine Evergreen Forests of the so-called "Climas frios" of Colombia, where the altitude is between the 2,000 and 3,000 meters above sea level.

This species has a beautiful red pod that is rich in tanning materials, as well as the bark of the tree. The pods are extensively used in the tanneries and dye industries. This is a very drought-resistant species and in the Olive-region of Boyaca, it can produce on the average 2 or 3 "arrobas" (an arroba is 25 metric pounds) in each one of two annual crops.

4) The "Encenillos" of Colombia belong to the genus
Weinmania

These species are called "Queleg" by the Guambias Indians of Silvia (Cauca). These useful trees grow in the Sub-alpine Evergreen and Bushland forests of this thesis; that is, in the cold climates, and they attain altitudes up to 3,400 meters above sea level, almost in the limit of the arboreous vegetation. All the Colombian forests of the higher portion of the Andes, with temperatures below 16 degrees Centigrade, contain the Encenillos, sometimes almost in pure stands.

From the "Encenillos" the following industrial products can be obtained: a) The Weinmannias possess hemostatic, antidiarrheic and astringent properties. The bark and leaves crushed can produce a "peinalizo" (liquid to smooth out the hair); b) The wood is dark red or reddish, fine grain, good luster, takes high polish and can be employed in cabinet-work, furniture, bridges, parts of machinery etc.; and c) the principal product of these poor soil growing species is the bark that contains a good amount of tanning material that is extensively used in the local industry, especially in the Departments of Cundinamarca and Boyaca.

According to the tests of the Robledo brothers, already mentioned, one of those "Encenillos" possesses the following mechanical properties:

Weinmannia heterophylla

Rupture module	684
Elasticity module	122.113

Density	.66
Humidity	17.4

5) The species known by the vernacular names of Nato, Aliso, Flamboyan, Aromo, Ojito de Nena and many others also produce tanning material in the Colombian territory.

SPECIES FOR PAPER MANUFACTURING

Capital interested in the paper business will find in South America, and especially in Colombia, an excellent opportunity, due to the lack of internal competition, relatively low wages, state protection and political stability. Many are the Colombian trees that ^{may} possess the quality of producing pulpwood. Analysis, experiments and tests must be carefully carried on before any species is definitely accepted for producing a certain kind of paper.

Among other species, the following Colombian plants can be tentatively utilized for paper making:

- 1) "TAMBORO" of Colombia - Schizolobium parahybum (Vell)

The "Tamboro" of Honduras and "Gavilan" of Nicaragua-Blake produces a kind of wood that is spongy but tough; perishable in contact with the ground; light in weight, white in color and soft. This tree grows with great rapidity and appears in its range in second growth forest with a handsome appearance due to the fact that in the blooming time it becomes a solid mass of yellow color.

The result of experiments on paper making made by

the Imperial Institute in British Honduras on "TAMBORO"
(*Schizolabium parahybum*) called, in English, Quamwood, are
the following:

Average length of fiber	1.2 ?
Moisture	10.8 ?
Ashes	1.0 ?
Cellulose content on dry wood	58.7 ?

The trials of paper making made with "Tamboro"
using caustic soda demonstrate that from this species a pulp of
good strength and quality can be obtained.

2) "GUARUMO NEGRO" of Colombia - *Cecropia arachnoides*

This species is called in English, Trumpet Tree and
Tree-weed; is an intolerant plant that appears profusely in the
second growth and after burning or cutting down of the forests
in the Deciduous, Rain Type, subtropical and middle climate
Evergreen forests- regions of this thesis. Its cultivation is
easy and it can be industrialized especially for paper making.
The wood is light, soft, coarse in texture and perishable.

The "Guarumo" contains small amounts of rubber;
the trunks can be utilized for canoes, rustic aqueducts, trum-
pets etc; the bark can give fibers with which are made ropes,
cloths and mats; the dry wood, by friction, can produce fire
easily, after the Indian custom; the young buds of "Guaruma"
possess tonic and pectoral properties which are utilized in the
preparation of "Anacahuita pectoral" expended in pharmacies;
it has been used against the Saint Vitus' dance and heart
affections.

3) The "BALSO" of Colombia - *Ochroma obtusa* Rowlee

This kind of balsawood grows in the megathermic climates (climas calientes) in the Deciduous, Rain Type, and Subtropical Forests. This must not be confused with the other Colombian species of Balsa wood (*Ochroma lagopus*) that grows from the 1,200 meter and up above sea level. The *Ochroma obtusa* grows in sandy and poor soil, its growth is very rapid because the utilization can be done from the 5 to 7 years of age.

The "BALSO" produces one of the lightest woods in the world, with notable flexibility, and its ^{heat}conductibility to heat is of 0.9, almost as good as cork; the color is pale white, very soft and easy to reduce to paper pulp. The balsawood is one of the most useful in refrigeration, road construction, airplane, sound isolation, toys, war mines, aeromodelims and containers industries. The mechanical properties of the balsawood from Colombia are the following, according to the studies of Robledo brothers, already mentioned:

Rupture coefficient	499
Elasticity module	85.923
Density	.50 ?
Humidity	26.8
Normal compression to fiber	23

Facilities for Paper Production in Colombia

We believe that after careful tests and trials with the possible paper-producing species, a prosperous paper industry can be developed (as it is already started) due to the following factors:

- 1) The mill factory can be established in any one of

the shores along the Magdalena, Cauca, San Juan, Atrato and other rivers of the lowlands, near the sea coast, where the transport of the raw materials and the products is economical and the supply of at least 40,000 gallons of water per hour can be obtained throughout the year;

2) Coal, petroleum or wood can be obtained in any amount for fuel purposes;

3) Limestone quarries are found not very far away and it must be remembered that the amount of Ca CO₃ needed in the paper industry is not so great as it is the requirements for fuel and raw material;

4) We are sure that the following requirements for a minimum paper unit with an output of 10,000 tons annually can be met under the Colombian conditions: (Requirements established by Mr. W. Raith of the Forest Research Institute of Dehra in India)

25,000	tons	per	annum	of	dry	raw	material	
45,000	"	"	"	"	fuel	wood		
15,000	"	"	"	"	coal			
6,000	"	"	"	"	calcium	carbonate	(limestone)	

4) The "PAPAYOTES" of Colombia - Cochlospermum
vitifolium

This species is also called "Jurubay". This essence is found in lowland forests of Magdalena, Cauca, Sinú and other rivers. It produces a very light wood; of short fibers, coarse in nature and somewhat brittle. It can be utilized for paper manufacture.

5) Other species that can be tested in Colombia for production of paper are:

Resbalamono

The "Algodon" tree of Choco

The so-called: Barril, Majaguo, Agustino, Curabubas etc. of the Forest of LA CRIBA in Puerto Salgar (Cundinamarca)

Bursera simarruba

We know that many other plants can be utilized and tested for pulpwood production, but we have omitted mentioning them for the sake of brevity for this thesis.

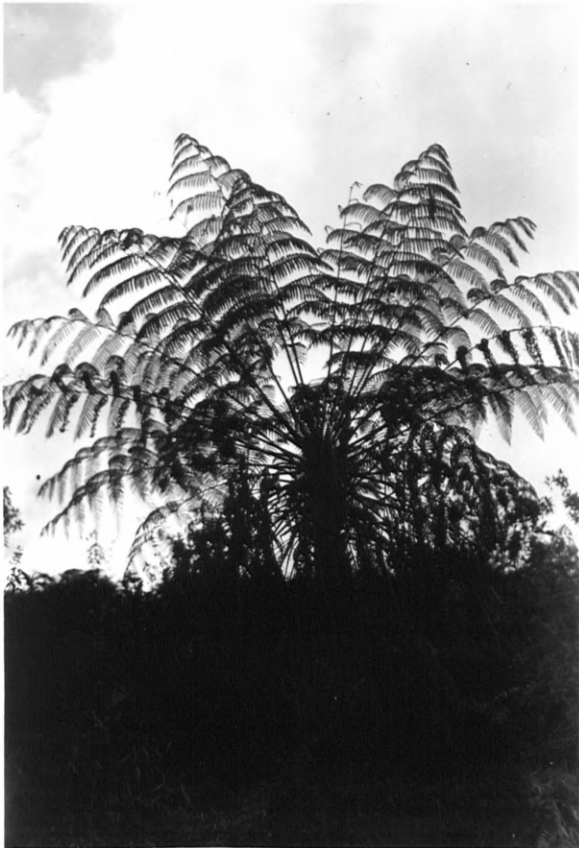


Photo No. 34

CYATHEA INCANA

(Beautiful fern of the Cali river basin-Colombia, S. A.)

WOODS FOR TOOL HANDLES

To maketool handles, certain requirements must be met; the wood for this purpose must be hard and heavy, fine and uniform in texture, very durable, that turns out readily; and it is very desirable that it contain oils which will tend to water-proof the wood, make it easy to polish and is very little affected by the repeated immersion in hot water, as it is in the case of the wood employed in the cutlery trade.

Among the Colombian trees that can produce wood fitted for tool handles and cutlery, we mention the following as examples:

1) "Trebol" of Colombia - Platymiscium pinnatum

This species is also called "Trebol Negro". It produces a very hard wood, somewhat difficult to work, very resistant, and proper for all constructions in the earth; it has a mahogany coloration streaked with darker veins.

In our opinion this wood of "Trebol Negro" can be successfully employed in making tool handles, pieces of machinery, backs of brushes, handles of heavy hammers, musical instruments, scientific ones, tools for carpentry work like planes, jack planes and long planes, jewelry boxes, rosary beads, billiard cue butts and keys of marimbas.

The author of this work has found the "Trebol Negro" in: Department of Santander del Sur, counties of Puerto Wilches, Aguas Clara, in some forests of Antioquia, especially the Nare

region; forests near the Ciénaga de Paturia and Quebrada Cayumba in the vicinity of Puerto Wilches.



Photo No. 35

PRIMITIVE MILL

(A Mill for sawing lumber. LA CEIBA forests (Puerto Salgar) Colombia. Here the sawing is made by hand and the standard is "RASTRA".

2) The "Guaimaro" of Colombia - Brossimum colombianum
Blake

This species produce a kind of wood that is light yellow in color, speckled or variegated in curved veins; the wood is heavy and its strength fair. This wood can be utilized in industry for certain kinds of tool handles and for common work in carpentry. When it must be subject to deteriorating conditions, immunization is advisable. The natives utilized

the "Guaimaro" fruits for feeding pigs.

This species can be found in the megatermic and mesotermic climates of Colombia where our Deciduous, Rain Type, subtropical and Middle Climates Evergreen forests of this thesis are situated. The forests of Santanderes and Cauquillo (Caldas) are reported to have an abundance of this species.

Note: Dozens of other trees can be found which would produce wood for tool handles.

WOODS FOR TURNERY ARTICLES

We must mention, among the several trees that produce wood fitted for turnery articles, the following species; as one example:

- 1) "Palo Santo" of Colombia - Guaiacum sanctum L.

This species is known in the world trade as "LIGNUM-VITAE" and has been utilized for its extraordinary wood and its medicinal properties. This species is found in the hot climates ("tierras calientes" of Colombia, especially in the Caribbean plains, in somewhat rocky hillsides and at an altitude not exceeding 300 meters.

The wood of Palo Santo or Lignum-vitae possesses great tenacity and strength combined with self-oiling properties due to its natural oils; it is a very durable wood, medium in weight, pleasantly scented, fine-grained and with an olive-brown to nearly black coloration. This wood can be employed for elegant cabinet making, furniture, expensive interior decorations,

brush backs, caster wheels, mallets, pulley sheaves, bowling balls, stencil and chisel blocks, bows, etc. The principal utility of this wood consists of its being self-lubricating with a natural resin, and in addition, it has strength combined with tenacity and easy turning qualities, in such a way that several articles of turnery can be made, especially bearings for under-water work, for the linings of stern tubes of propeller shafts of steamships. In addition, cups, dishes etc can be made.

WOODS FOR EXPORT

As the time goes on, the forest resources of the world and especially of the more industrialized countries are shrinking in such a way that in the future a great percentage of the Colombian wood will find a place in the markets abroad. Among the woods already exported to foreign countries, we can remember the following; as an example:

- 1) "Algarrobo" of Colombia - Hymenaea Curbaril L.

Produces a wood fairly durable; not easy to work but it takes polish very well; strong and of medium texture and the heartwood is dark brown or orange in color.

The wood is utilized for cabinet-work, sugar mill machinery, boat constructions, ball and wheel of ox-carts.

- 2) The Caoba" of Colombia - Swietenia macrophylla King
(See "Woods for Cabinet-making")

3) The "Ceiba Blanca" of Colombia - Hura crepitans

This is a species of very rapid growth and must be cultivated in the megatermic climates. The "Ceiba Blanca" or "Ceiba lechosa" produces a wood of yellowish-white color, of medium hardness, easy to work and taking a high polish. It can be utilized in the industry of containers and general construction. Before World War II this wood was exported in appreciable quantities to Europe. The "Ceiba Blanca" of Colombia is the "Sand-box" tree and in the U. S. markets, it is found as possum wood or hura wood. This tree can attain in the Deciduous and Rain Type forests of the Magdalena river valley 100 feet in elevation and can produce 2,000 board feet. According to S. Recors, this wood can be used for cabinet-work, interior trim, plywood, and corestock etc.

Specifically, the author found this species in the shores of the Sogamoso and Santos Gutierrez rivers; it has been reported also in the vicinities of Puerto Salgar (LA CEIBA), Cienaga de Zapatosa, La Gloria and Isla de Papayal.

4) The "Abarco" or Colombian mahogany - Cariniana pyriformis Miers.

One of the trees with more future in the Colombian forests; produces a very straight log of about 80 feet on the average, with a kind of wood that resembles real mahogany (*Swietenia* sp.); it is reddish-mahogany in color, with lines of darker shade; it takes a high polish; the strength, weight and density are excellent. According to Gilbert R. King of

London, the "ABARCO" wood can replace in many uses the American Black Walnut. Here are the mechanical properties derived by the Robledo brothers:

Rupture coefficient	972
Elasticity module	151.824
Density	.73
Humidity	18.0
Normal compression to the fiber	75



fine grain, easy to work,

The Deciduous and Rain Forests of Colombia and Territories

Photo No. 36

CARINIANA PYRIFORMIS Miers.

("Colombian Mahogany" or "ABARCO" of Colombia: a promising species for export. The photo illustrates the first log of this tree that can give merchantable boles 80 ft. in height.)

Before the World War II via to the European ports, swing, according to the

tests of the Robledo brothers:

The "ABARCO" lives in the Deciduous and Rain Type forests, of this thesis, especially in the Atrato, Cauca and Magdalena river valleys. The author has found this tree in Buenavista (Caldas), Puerto Nino (Boyaca state) La Ceiba (Puerto

Salgar) and in the forests of Choco where it is called "Chibuga".

5) The "CARRETO" of Colombia - Aspidosperma Dugandii
Standl.

This is a very valuable species because its wood can be utilized with excellent results in turnery work (as is done now); can be used for ties; backs of cliches; engineering instruments; posts and works where strength is needed as bridges, beams, etc. The wood is of very fine grain, easy to work, takes high polish and its weight is medium.

The Carreto is found in the Deciduous and Rain Type forests; especially in the Zona Bananera and Territorio Vazquez.

6) The "Caracoli" of Colombia - Anacardium excelsum
Bert. et Balb.

This is a tree relatively abundant and is a giant in the Colombian forests. It grows even in poor soils and can attain 30 meter in height with a d, b, h, of 2 meters; it produces a yellow wood with some shades of pink, is light in weight, relatively soft, taking a high natural finish. It can be employed in boat construction, containers especially for tobacco; kitchen utensils; canoes; etc. Before the World War II the "Caracoli" was exported from Colombia to the European ports. Its mechanical properties are the following, according to the tests of the Robledo brothers:

Rupture coefficient	509
Elasticity module	98.274
Density	.48
Humidity	16.9
Normal compression to the fiber	32

The "CARACOLI" grows in Colombia in the Deciduous, Rain Type subtropical forest, up to the elevation of 1,000 meters above sea level, and especially the author has found this tree in La Ceiba (Puerto Salgar), Monteria (Bolívar), forests of Antioquia, forests of La Miel river and in the regions of Santos Gutierrez, Aguas Claras, Sogamosos river, near Puerto Wilches. We have also found this species in Choco, Caqueta and Putumayo. In the region of Rio de Oro (Santander) the tobacco growers made cultivation of Caracoli to obtain its wood for containers.



Photo No.37

ABARCO

Cariniana pyriformis
Miers

(The photo illustrates
the top of this val-
uable species.)

7) The "Cedro Trompillo" or "Bilivil" of Colombia -
Guarea Guara (Jacq.)

This species produces a wood that, in some respects, is similar to the Swietenia sp. (Caoba): it is a durable wood, strong, heavy and hard. The coloration of the heartwood is dark reddish. It can be utilized with advantage in the construction of wagons, tram ways, and truck bodies, aside from many other uses in carpentry.

The bark gives a viscous latex to which toxic and emethocartartic properties are attributed by the people and need scientific investigation.

This essence is abundant in the Rain Type and subtropical Evergreen Forest of the Cauca Valley; it has been found also in the Caqueta region. This species likes especially those altitudes between 500 to 1,000 meters above sea level.

NOTE: Many other species of valuable trees are fitted for export.

WOODS FOR CABINET WORK

The Colombian woods that are fitted for cabinet work are very numerous and as soon as the studies in the industrialization of the forests are advancing, it is possible to find new species that, in the past have been regarded as of no value. It has been the case in the U. S. when at the end of the last century the markets only paid attention to the Pinus strobus. When this species became scarce, the once forgotten Hemlock and Jack pines came into outstanding position; here are some

of the woods for cabinet work:

1) "Balsamo del Tolu" - Toluifera officinalis

The wood of this species is one of the best produced in the country; its hardness, fine grain, and strength are remarkable; it takes a very good polish, has numerous fine lines; it has a dark red or red-brown coloration in the heart-wood.

Herein the United States, this wood of "Balsamo del Tolu" has been appreciated for cabinet work; it can be used also for railroad ties, fence posts, inlaying work, piling in common water, machinery for the sugar mills, house posts etc.

In the Colombian Amazonian territory, the aborigines used the heart wood for dying.

2) The "Caoba Colombiana" (True Mahogany) -

Swietenia macrophylla King

This species is exactly the same quality (for practical purposes) as the Central America and West Indies Mahogany, and produces one of the most useful and esteemed wood for cabinet making and plywood of the "face veneer type", due to the fact that in this mahogany the tangential shrinkage is very little greater than the radial and surface shrinkage, giving as a result no distortion. THIS IS THE REASON WHY MAHOGANY IS THE STANDARD FOR COMPARISON OF OTHER WOODS.

This "Caoba Colombiana" can be employed not only in plywood and face veneer, but also in engravings, shipbuilding, mosquito-planes, boat construction, musical instruments, etc.

Before the World War II the board foot of "Caoba Colombian" was paid for export at \$0.08 (Colombian currency).

In forestry surveys, the author found this valuable species in the forests of Puerto Wilches, Aguas Claras, Bocas del Rosario and Rio Payoa. There is reliable information of its existence on a commercial scale in the regions of Ayapel (Department of Bolivar), Robles and Valledupar (In Magdalena State).

Colombia possesses two other kinds of valuable mahoganies:

- a) "Caoba del Catatumbo" - Swietenia candollei
Pittier

It is found in the Rain Type Forest - Catatumbo Forest zone of this thesis.

- b) The "Aguano" - Swietenia sp.

The "Caoba Colombiana" is one of the species which must be cultivated because its price is very high at all times; its planting is easy and the natural rotation is calculated to be not more than 40 years.

- 3) The "Cedros" of Colombia - Cedrela genus

These species belong to the Meliaceae family and are in general called "Spanish Cedars" in English, to distinguish them from the coniferous cedars of North America (Incense cedar, Northern White Cedar, Western Red Cedars and Atlantic White Cedars).

The "CEDROS" of Colombia produces, in general, a

very highly appreciated wood for "face veneer" plywood, fine cabinet making, musical instruments, and house building. They grow in Colombia almost from the sea shore up to Sabana de Bogota, at an altitude of 2,460 meters above sea level.

In this country is possible to find the following species:

- a) The "Cedro Bogotano" or "Cedro Rosado" -
Cedrela bogotensis Triana
et Planchon

Ubiquitous species of the hot, temperate and cold climates.

- b) The "Cedro Cebollo" of Colombia - Cedrela Mexicana Roemer

This species possesses an alliaceous odor and can be found in the Deciduous, Rain Type and Subtropical Evergreen forests of this thesis.

- c) The "Cedro Jaspeado" of Colombia - Cedrela fissilis Vell

This mahogany (it must be remembered that in the international wood trade the name mahogany is also applied to the Cedrelas) produces, as well as the other, a kind of wood that is immune to the attack of xilofagous insects, takes a high polish, is light in weight and easy to work, and is for these reasons the ideal wood for turnery, ornamental works, pencils and fine furniture. This species is found also in the same region - forest of the Cedrela mexicana Roemer.

- d) The "Cedro Blanco" - Cedrela odorata L

Claimed to be native of Colombia: the author

only found this species cultivated in Popayan (Cauca Department)

3) The "Cedro Monde" of Colombia - Cedrela montana Turcz

This mahogany is called also "Cedro Caoba" and produces a kind of wood that is very much appreciated for plywood, cabinet work, expensive furnitures, musical instruments. (Note: See photo 39, ahead)

This heartwood of this species is sometimes very beautiful because it shows a curly appearance; the color is dark reddish or brownish-reddish; the mechanical properties of this species are the following, according to the tests performed by the Robledo brothers, already mentioned:

Humidity	12.30
Rupture coefficient	842
Density	0.510
Elasticity module	95.882
Compression normal to fibers	75

This species of cedar is found in the three branches in which the Andean Cordillera is divided in Colombia; it occurs in the MILD TEMPERATE FOREST of this thesis; specifically, it has been reported also from the forest in the Nima river (Palmira-Valle) basin.

4) The "Dinde" or "Palo Mora" of Colombia - Chlorophora tinctoria (L) Gaud.

This species gives a tough, durable and strong wood. This wood is one of the most valuable of the country, because it can be employed in railroad ties, tramway ties (durmientes), fence posts, cartwheels, interior decoration, parts of machinery, fine furniture, mine works, wooden balls, house posts, etc. The

color of this wood is bright yellow or reddish. The bark contains tannoids that are utilized in the tanneries.



Photo No. 38

COLOMBIAN BASBASCO

(This is one of the Rotenone producing plants in which the Colombian territory is very rich. The well known "TIMBOS" (Lonchocarpus Nicou and Lonchocarpus urucu) are found in the Colombian Amazonian region.)

5) For the sake of brevity, we omit the mention here of such valuable species for cabinet work and fine furniture as:

The "Comino crespo" - Ocotea sp.

The "Cedro nogal" - Juglans nigra var. Bogotensis

The "Pinos Colombianos" - Podocarpus genus

The "Ceiba Tolua" - Bombacopsis quinatum (Jacq.)
Dugand

The "Guayacan Hobo" - Centrolobium sp.

The "Ocobo" - Tabebuia pentaphylla L.

VEGETABLE DYE STUFFS

Among numerous Colombian plants that produce valuable and beautiful dyes, we can mention briefly the following:

- 1) "Anil" - Indigofera suffruticosa Mill.

In the last century some regions of Colombia, especially the Santanderes, devoted many capitals and efforts to the indigo industry whose product was exported aside from the intensive use made of it in the domestic market for giving indigo hues to the domestic-made clothes and for whitening collars, shirts and under clothes.

The development of synthetic dyes gave a complete blow to the indigo industry, which now is utilized in a very small scale. The author remembers that up to the year 1930 indigo or "Anil" was carried in wooden boxes lined with banana leaves, to the markets of the Santa Rosa de Viterbo, Cerinza and Belen, in the Department (State) of Boyacá. There it was sold by pounds and "Arrobas" (25 metric pounds). We believe that this industry can be revived by raising the customs tariffs and finding more efficient ways of cultivation and manufacturing of indigo.

- 2) The "Dinde" or "Pale Mora" of Colombia - Chlorophora tinctoria (L) Gaud.

This species is known in the world markets as "Fustete" and "Fustic". This is one of the most industrializable species of the Colombian forests due to the fact that the wood

and leaves contain a substance soluble in alcalis that is the base of the "Fustic dyewood" of commerce with which it is possible to give green, brown, yellow and olivaceous coloration to khakis, hides, wools and clothes. The substance responsible for this valuable action is the "Maclurine" which not only dyes cotton and wool, but also silk and, in combination with other dyes, will give a permanent black and other colours.



Photo No. 39

CEDRELA MONTANA Turcz

(The Colombian "Cedro
Monde" that produces
a fine wood similar
to the West Indies
Mahagony.
La Ceiba Forests -
Puerto Salgar, Colom-
bia, S. A.)

The fruits of the "Dinde" and the resin of the bark are odontalgic and they can help the atonic affection of the mouth and sometimes pyorrhoea.

This species is found in Colombia in the megatermic climates and in the regions where the Deciduous, hygrophytic, Rain Type and Subtropical forests predominate. The author has found the "Palo Mora" in forests of La Ceiba (Puerto Salgar), Paldas de Loba (Bolívar), forests of La Dorada and El Banco, Caquetá, etc. There is reliable information of its existence in the forests of Guaduas (according to Pablo Bohorquez R., Agricultural Engineer); forests of Cauca, Sinu, La Vieja, Risaralda, San Juan and some regions of Antioquia and Caldas.

3) For lack of time, we are unable to describe here such valuable species for the dyeing industry as:

The "Palo Brasil" or "Campeche" - Haematoxylon campechianum L.

The "Brasil" of Santa Marta - Faramea cestroides

The "Brasil" of Sinu river - Poinciana insignis

The "Brasilete" - Haematoxylon brasiletto Karst

The "Palo Brasil" - Caesalpinia echinata Uribe



Photo No. 40

Forests of "LA CEI-
BA (Puerto Salgar)
Colombia.-where the
new Diagram Log Rule
was originated.-

THE FORESTS OF COLOMBIA, S. A.
AND SOME OF THEIR INDUSTRIAL POSSIBILITIES

T H I R D P A R T

"The New Diagram Log Rule"

As a practical device that can save time and money for the people of the lumbering region of the Magdalena River (Deciduous and Rain Type Forests), Colombia, S. A., we present here a "NEW DIAGRAM LOG RULE" developed by the author in the year 1944.

A NEW DIAGRAM LOG RULE

The Need for a Log Rule

In the year 1944, the author of this thesis needed to make a timber survey and volume evaluation of some 20,000 Hectars in the "Subtropical Evergreen Forests" situated in the "LA CEIBA", municipality of Puerto Salgar (Cundinamarca Department), Colombia, S. A. Up to that time, no record was made of any Log Rule, in that country.

The Standard

In the above mentioned forest and in some forested sections of the Magdalena river, the sawyer, wood merchants and lumber-jacks use to evaluate the cubic content of the standing timber and of the lumber itself a standard measure which they called:

"R A S T R A"

Definition

"Rastra" is a piece, or pieces, of sawlumber having:

Total length 3 meters (approx. 10 feet)
Total area on the base,
or one of the cross-
sectional ends 96 square inches

Generally on the Colombian wood markets, the standard of dressed wood is:

Length: $3\frac{1}{4}$ "varas", or 2.80 meters, or 9.33 feet;
the exceeding 0.20 meters (8") are left in the "Rastra" to
allow for the damage and wear in the transportation of lumber by

mules. The name of "Rastra" (sled) of this standard was due to the fact that an average mule, in these forests travelling 8 hours a day, is only able to carry two pieces of fresh-sawed lumber (Cedrela montana, Centrolobium sp.) having a total length of 3 meters and 48 square inches on the cross-sectional end or "punta". One of these wood pieces is placed on each side of the mule, making a total of 96 square inches: the "Rastra".

How the Lumbermen Used This Standard

Over there the lumbermen used this standard by guessing how many of these "Rastras" will a standing tree contain, or in the sawlumber by actual measuring of the cross-sectional end in square inches and then dividing by the 96 square inches of the "Rastra".

The New Diagram Log Rule

Having the duty to evaluate in "Rastras" the total volume of the standing timber in 20,000 hectares and being obliged (by force of custom) to use the metric system in the measuring, the author of this thesis decided to make a DIAGRAM LOG RULE for the "Rastras".

NOTE: Only to prevent any misunderstanding, we must point out that in that time (1944) the author had not studied any Forestry and ignored the existence of any Log Rule, having to depend on common reasoning. With the present thesis is presented the original manuscript written in March, 1944.

The Procedure

I observed that the sawyers and lumberjacks in the

forests, after dividing the bole of the tree in logs of ten (10') feet in length and splitting them longitudinally in half, began dividing each portion in a variable number of parts - in the cross-sectional end - starting from a minimum of 2" by 1" up to 48 square inches. (Here it is necessary to remember that the mules will only carry 96 square inches.)

So I started drawing on cardboards a range of circles from 0.20 (8") to 2 meters (80"); assuming that the circles were the cross-sectional small ends of the boles of 3 meters in length. I drew on them the different parts that it was possible to saw according to the prevailing practice. One eighth (1/8) of an inch was allowed for the sawkerf.

I took, for instance, a cross-section of 0.50 meters (20") in diameter and from it I obtained:

A piece of 1" by 5"	equal	5 square inches
" " " 4" " 6"	"	24 " "
" " " 1" " 3"	"	3 " "
" " " 9" " 7"	"	63 " "
" " " 1" " 3"	"	3 " "
" " " 4" " 6"	"	24 " "
" " " 1" " 4"	"	<u>4</u> " "

Total in square in: 125 in half the cross-sectional portion of the bole.

The other half has 125 square inches also

Total in the bole: 250 square inches

Scaling of Different Logs:

In the same way I obtained the following figures for different diameters:

Top Diameter in Meters	Top Diameter in Inches	Pieces of the Following Dimension in Inches	Total in Sq. Inches	
			Partial	Total
<u>0.25m</u>	10"	3" x 1"	3	
		5" x 4"	20	
		3" x 1"	3	<u>26 x 2</u> : 52
<u>0.30m</u>	12"	3" x 1"	3	
		8" x 4"	32	
		1" x 6"	6	
		3" x 1"	3	<u>44 x 2</u> : 88
<u>0.35m</u>	14"	3" x 1"	3	
		9" x 5"	45	
		1" x 6"	6	
		3" x 1"	3	<u>57 x 2</u> : 114
<u>0.40</u>	16"	3" x 1"	3	
		4" x 4"	16	
		2" x 3"	6	
		4" x 7"	28	
		2" x 3"	6	
		4" x 4"	16	
		3" x 1"	3	<u>78 x 2</u> : 156
<u>0.45</u>	18"	4" x 1"	4	
		4" x 5"	20	
		2" x 3"	6	
		8" x 5"	40	
		4" x 1"	4	
		4" x 5"	20	
		2" x 3"	6	<u>100 x 2</u> : 200
<u>0.50</u>	20"	1" x 5"	5	
		4" x 6"	24	
		1" x 3"	3	
		9" x 7"	63	
		1" x 3"	3	
		4" x 6"	24	
		1" x 4"	4	<u>Approx. 125 x 2</u> : 250

Top Diameter in Meters	Top Diameter in Inches	Pieces of the Following Dimension in Inches	Total in Sq. Inches	
			Partial	Total
<u>0.55</u>	22	5 x 1	5	
		4 x 7	28	
		2 x 2	4	
		9 x 10	90	
		2 x 2	4	
		4 x 7	28	
		5 x 1	5	<u>164 x 2 : 328</u>
<u>0.60</u>	24	4 x 7	28	
		4 x 6	24	
		2 x 2	4	
		11 x 10	110	
		1 x 7	7	
		4 x 1	4	
		4 x 6	24	
		2 x 2	4	<u>181 x 2 : 362</u>
<u>0.65</u>	26	5 x 1	5	
		4 x 7	28	
		2 x 2	4	
		12 x 11	132	
		1 x 8	8	
		1 x 11	11	
		5 x 1	5	
		4 x 7	28	
		2 x 2	4	<u>225 x 2 : 450</u>
<u>0.70</u>	28	5 x 1	5	
		4 x 7	28	
		3 x 2	6	
		12 x 11	132	
		2 x 6	12	
		3 x 11	33	
		2 x 1	2	
		5 x 1	5	
		4 x 7	28	
3 x 2	6	<u>257 x 2 : 514</u>		

Top Diameter in Meters	Top Diameter in Inches	Pieces of the Following Dimensions in Inches	Total in Sq. Inches	
			Partial	Total
<u>0.75</u>	30	5 x 1	5	
		4 x 7	28	
		2 x 3	6	
		12 x 12	144	
		2 x 8	16	
		1 x 2	2	
		5 x 1	5	
		4 x 7	28	
		2 x 3	6	
		5 x 12	60	
		1 x 3	3	
				<u>303</u> x 2 : 606
<u>0.80</u>	32	5 x 1	5	
		7 x 4	28	
		2 x 3	6	
		12 x 12	144	
		3 x 7	21	
		2 x 2	4	
		5 x 1	5	
		7 x 4	28	
		2 x 3	6	
		7 x 12	84	
		2 x 4	8	
		<u>339</u> x 2 : 678		
<u>0.85</u>	34	5 x 1	5	
		8 x 4	32	
		2 x 3	6	
		10 x 13	130	
		3 x 2	6	
		10 x 13	130	
		3 x 5	15	
		3 x 2	6	
		5 x 1	5	
		8 x 4	32	
		2 x 3	6	
		1 x 16	16	
		1 x 16	16	
		<u>388</u> x 2 ³² : 808		

Top Diameter in Meters	Top Diameter in Inches	Pieces of the Following Dimensions in Inches	Total in Sq. Inches	
			Partial	Total
<u>0.90</u>	36	1 x 5	5	
		4 x 8	32	
		2 x 3	6	
		12 x 12	144	
		7 x 4	28	
		1 x 5	5	
		3 x 3	9	
		2 x 1	2	
		12 x 12	144	
		7 x 4	28	
		1 x 5	5	
		3 x 3	9	
		2 x 1	2	
		1 x 5	5	
		4 x 8	32	
		2 x 3	6	<u>462 x 2 : 924</u>
<u>0.95</u>	38	1 x 5	5	
		4 x 8	32	
		2 x 3	6	
		1 x 5	5	
		4 x 8	32	
		2 x 3	6	
		12 x 12	144	
		5 x 7	35	
		3 x 3	9	
		4 x 1	4	
		12 x 12	144	
		5 x 7	35	
		3 x 3	9	
		4 x 1	4	
		1 x 18	18	<u>488 x 2 : 976</u>
		<u>1.00</u>	40	5 x 1
12 x 10	120			
7 x 5	35			
3 x 2	6			
4 x 2	8			
12 x 5	60			
7 x 5	35			<u>269 x 4 : 1,076</u>

Top Diameter in Meters	Top Diameter in Inches	Pieces of the Following Dimensions In Inches	Total in Sq. Inches	
			Partial	Total
<u>1.10</u>	44	6 x 1	6	
		12 x 10	120	
		8 x 5	40	
		2 x 2	4	
		4 x 3	12	
		12 x 7	84	
		8 x 7	56	
		4 x 1	4	
				<u>4 326 x 4 : 1,304</u>
<u>1.20</u>	48	6 x 1	6	
		12 x 10	120	
		9 x 5	45	
		2 x 2	4	
		6 x 3	18	
		3 x 2	6	
		12 x 9	108	
		9 x 10	90	
		4 x 1	4	
		<u>4 401 x 4 : 1,604</u>		
<u>1.35</u>	54	6 x 1	6	
		12 x 11	132	
		9 x 5	45	
		2 x 2	4	
		5 x 4	20	
		3 x 2	6	
		12 x 12	144	
		12 x 12	144	
		7 x 2	14	
		<u>14 515 x 4 : 2,060</u>		
<u>1.50</u>	60	6 x 1	6	
		12 x 11	132	
		8 x 7	56	
		2 x 2	4	
		5 x 3	15	
		2 x 2	4	
		12 x 12	144	
		12 x 12	144	
		9 x 3	27	
		4 x 1	4	
		12 x 3	36	
		12 x 3	36	
5 x 3	15			
		<u>15 623 x 4 : 2,492</u>		

Top Diameter in Meters	Top Diameter in Inches	Pieces of the Following Dimensions In Inches	Total in Sq. Inches	
			Partial	Total
<u>1.70</u>	68	1 x 7	7	
		12 x 12	144	
		8 x 8	64	
		5 x 2	10	
		5 x 3	15	
		2 x 2	4	
		12 x 12	144	
		12 x 12	144	
		12 x 4	48	
		7 x 3	21	
		12 x 6	72	
		12 x 6	72	
		9 x 6	54	799 x 4 : 3,196
		<u>1.80</u>	72	7 x 1
12 x 12	144			
8 x 8	64			
2 x 4	8			
5 x 3	15			
12 x 12	144			
12 x 12	144			
12 x 4	48			
3 x 7	21			
2 x 2	4			
12 x 9	108			
12 x 9	108			
10 x 9	90			911 x 4 : 3,644
<u>1.90</u>	76			1 x 7
		12 x 12	144	
		10 x 7	70	
		5 x 3	15	
		4 x 4	16	
		2 x 2	4	
		12 x 12	144	
		12 x 12	144	
		11 x 6	66	
		7 x 3	21	
		2 x 2	4	
		12 x 11	132	
		12 x 11	132	
		12 x 11	132	1031 x 4 : 4,124

Top Diameter in Meters	Top Diameter in Inches	Pieces of the Following Dimensions In Inches	Total in Sq. Inches	
			Partial	Total
<u>2.00</u>	80	1 x 7	7	
		12 x 12	144	
		9 x 8	72	
		5 x 2	10	
		4 x 5	20	
		2 x 2	4	
		12 x 12	144	
		12 x 12	144	
		12 x 12	144	
		12 x 12	144	
		12 x 12	144	
		12 x 6	72	
		7 x 4	28	
		3 x 2	6	
		2 x 2	4	
7 x 1	7	1094 x 4 :4,376		

As a result of the above calculation from the Diagrams, checked by some actual sawing in the forests, the following was obtained:

ACTUAL VOLUME TABLE
(In cross-sectional square inches)

Top Dia. inside bark in centimeters	Top Dia. inside bark in inches	Actual Square Inches
0.20	8	
0.25	10	52
0.30	12	88
0.35	14	114
0.40	16	156
0.45	18	200
0.50	20	250
0.55	22	328
0.60	24	362
0.65	26	450
0.70	28	514
0.75	30	606
0.80	32	678
0.85	34	808
0.90	36	924

New Diagram Rule

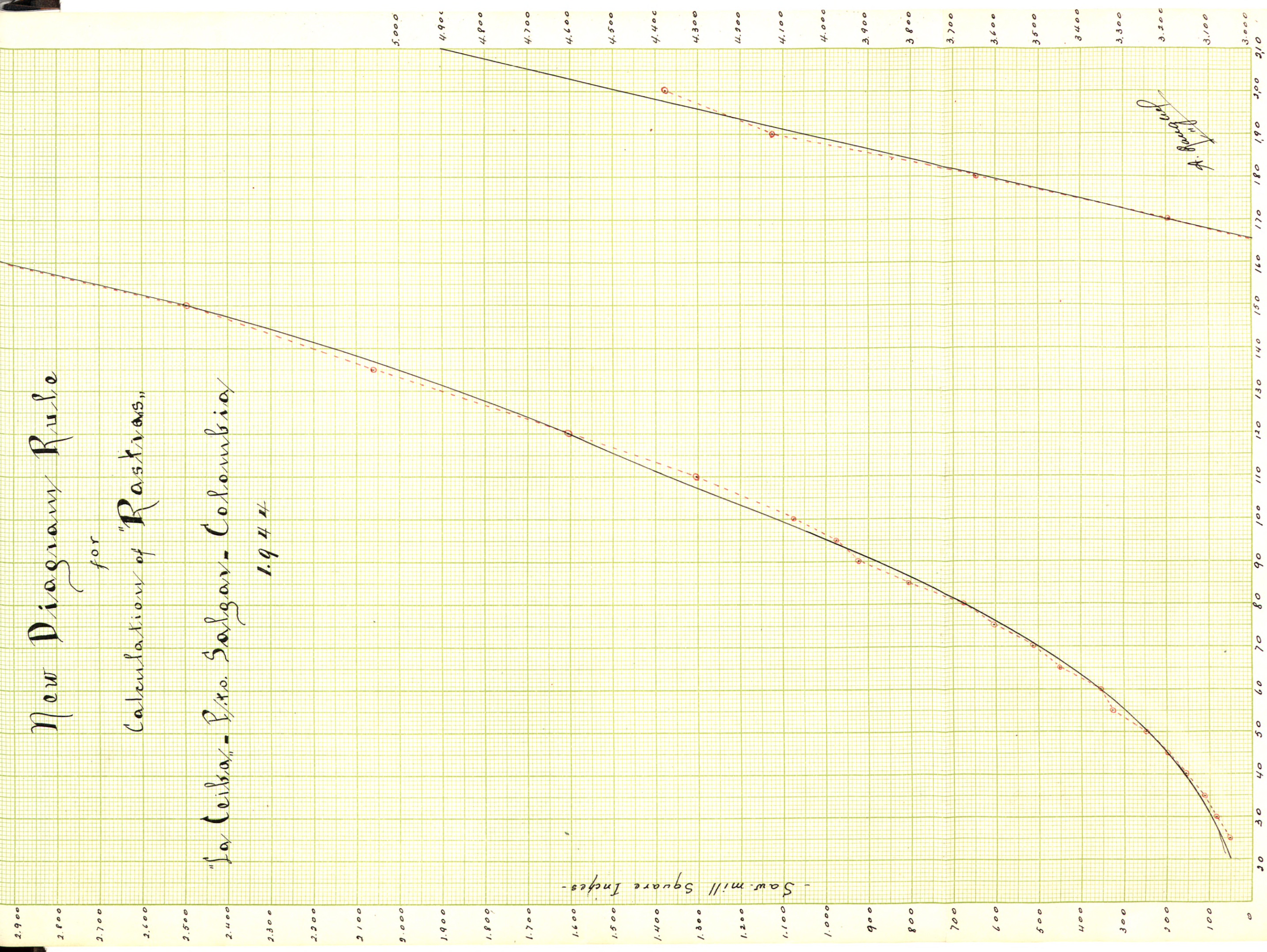
for

Calculation of "Rastras"

"La Ceiba" - Pto. Salgar - Colombia

1944

Saw-mill Square Inches -



A. B. B. B.

ACTUAL VOLUME TABLE
(continued)

<u>Top Dia. inside bark in centimeters</u>	<u>Top Dia. inside bark in inches</u>	<u>Actual Square Inches</u>
0.95	38	976
1.00	40	1,076
1.10	44	1,304
1.20	48	1,604
1.35	54	2,060
1.50	60	2,496
1.70	68	3,196
1.80	72	3,644
1.90	76	4,124
2.00	80	4,376
2.25	90	6,157

THE GRAPH

In order to smooth out the roughness of the data, a graph was constructed in which the "Saw-mill square inches" were placed in the ordinates from 0 to 5,000 and the top diameter in centimeters in the abscissas from 20 to 210. The Curve was balanced with:

Plusses	20
Minuses	24
Balance	4

The accompanying graph called "NEW DIAGRAM RULE" for calculation of "RASTRAS" gives the Saw-mill square inches that correspond to a log of certain top diameter inside bark; the result must be divided by 96 in order to obtain the number of "RASTRAS" that the bole contains.

With the above procedure, a final volume table was obtained which gives the number of rastras of a given log whose top diameter inside bark has been measured in centimeters or

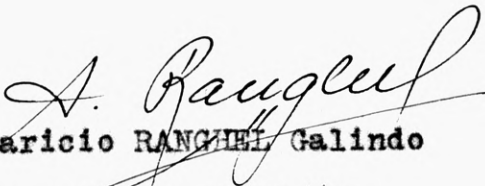
inches. The logs, as already explained, must be three (3m.) meters in length, or 120 inches. The "RASTRA" has 11,520 cubic inches or 80 board feet.

VOLUME TABLE IN "RASTRAS"

<u>Top Diameter inside bark in centimeters</u>	<u>Top diameter inside bark in inches</u>	<u>Saw-mill sq. inches</u>	<u>"RASTRAS"</u>
20	8	50	0.52
25	10	70	0.73
30	12	95	0.99
35	14	125	1.30
40	16	160	1.67
45	18	200	2.08
50	20	250	2.60
55	22	300	3.12
60	24	355	3.69
65	26	425	4.43
70	28	500	5.20
75	30	580	6.04
80	32	670	6.98
85	34	770	8.00
90	36	880	9.16
95	38	990	10.31
100	40	1,115	11.61
105	42	1,240	12.91
110	44	1,365	14.16
115	46	1,490	15.52
120	48	1,600	16.67
125	50	1,725	17.98
130	52	1,860	19.37
135	54	2,000	20.83
140	56	2,150	22.40
145	58	2,310	24.06
150	60	2,500	26.04
155	62	2,700	28.12
160	64	2,915	30.36
165	66	3,000	31.25
170	68	3,200	33.33
175	70	3,400	35.42
180	72	3,625	37.76
185	74	3,830	39.90
190	76	4,045	42.15
195	78	4,255	44.32
200	80	4,470	46.56
205	82	4,680	48.34
210	84	4,900	51.00

NOTE: As a rough approximation, until experimental work is done on the subject, it will be advisable to discount five per cent (5%) of the total, to allow for shrinkage of wood in drying, when measuring with this "New Diagram Rule" Mahogany, Spanish Cedars, Walnuts, Colombian Mahogany, etc.

A further development of this LOG RULE will be the use of the rule in the form of a ruler or lath which can be employed for measuring the Top Diameter inside bark of the logs, and it has printed in one of the surfaces the corresponding "RASTRAS" for the given diameter in centimeters or inches.


Aparicio RANGEL Galindo
Ann Arbor, 1/25/47

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